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This document last compiled : 2016/01/31 14:20:41 from http://www.freebasic.net/wiki/
Welcome to FreeBASIC

Welcome to our world! This page is an overview of our online warehouse of knowledge. Enjoy your surfing and we hope this will be the first of many visits.

Introduction
FreeBASIC is a free 32-bit compiler for the BASIC language. It is open source and licensed under the GPL. It is designed to be syntax compatible with QuickBASIC, while expanding on the language and capabilities. It can create programs for MS-Windows, DOS and Linux, and is being ported to other platforms. See About FreeBASIC and Main Features.

Latest Version
FreeBASIC is a beta release compiler and development is ongoing. With each full update, many features are added, and bugs from previous releases are fixed. To see the latest version available, visit http://sourceforge.net/projects/fbc on SourceForge, or http://www.freebasic.net/index.php/download on FreeBASIC's official website.

Requirements and Installation
Minimum hardware is listed on the Requirements page. Visit our Installation page for setting up FreeBASIC on your computer.

Running
FreeBASIC is a compiler and as such is not packaged with an IDE (Integrated Development Editor), although there are a few IDE's available. For information on using FreeBASIC without an IDE, see Running.

Compatibility with QuickBASIC
FreeBASIC is designed to be syntax compatible with QuickBASIC. For best code-compatibility with QuickBASIC, the QB dialect can be used when compiling source code. See FreeBASIC Dialects and Differences from QB.
Documentation
All official documentation can be found online in the wiki at http://www.freebasic.net/wiki. The online documentation is the most up-to-date resource available. In all cases it can be regarded as the correct version. The downloadable versions of the manual are snapshots of the documentation available at a particular time and should be mostly correct for a specific released version of the compiler. However, we do not maintain multiple versions of the documentation so there may be some discrepancies.

Starting points in the Manual
- Table of Contents
- Getting Help with FreeBASIC
- Programmer's Guide

Starting points on the Web
- Official Website at http://www.freebasic.net
- Official Forums at http://www.freebasic.net/forum
- Official Archive at http://www.freebasic.net/arch

Thank you for using FreeBASIC. Happy coding!
Getting help with FreeBASIC

There are several options available for getting help with FreeBASIC.

The Manual
This huge user's manual is full of information that can help you learn to write programs using FreeBASIC.

The manual is available online at http://www.freebasic.net/wiki. There is a search box at the bottom of every page to help you find what you're looking for.

If you are unfamiliar with FreeBASIC or the documentation, you may find these pages a good place to start:
  - Table of Contents
  - Programmer's Guide
  - Library Headers Index
  - Glossary
  - Compiler FAQ
  - Graphics Library FAQ
  - Runtime Library FAQ

A downloadable manual (in CHM format) is available from the sourceforge project page at http://sourceforge.net/projects/fbc which features a full table of contents, searching capabilities, an index, plus all the same content as the online version.

Searching the manual on or offline is an excellent place to start finding help about how to write and use FreeBASIC programs.

Examples and Source Code
In the ./examples directory located where FreeBASIC was installed on your system are hundreds of examples to be compiled and run. Most of the external library examples will need additional libraries to be downloaded to allow them to work. See Library Headers Index for a full list.
FreeBASIC's official code archive is located at http://www.freebasic.net/arch. This archive hosts user contributed libraries and tools and has links to source code located on other websites.

**Tutorials**
Community created tutorials about FreeBASIC can be found at CommunityTutorials. Some selected tutorials are included in this manual.

**FreeBASIC Forum**
An active community forum can be found at http://www.freebasic.net/forum with several sub-forums. The forum has a search feature that can help you find answers to questions or problems that may have already been asked and solved. First do a search for your problem, if you can't find the answer then post a message in one of the sub-forums.

**Chat**
IRC or Internet Relay Chat is a great way to chat with the developers and other users, some of whom are very knowledgeable. There are several ways to connect to IRC, if you know what you're doing simply join #freebasic on FreeNode.

If you haven't the foggiest what IRC is and you have Java installed, you can simply go [here](http://www.freebasic.net/arch).

If you're trying to get help, the most important thing is to be patient. Sometimes you won't get a reply right away. Stick around or check back and the Community will try and assist you.
### Alphabetical Keywords List

Alphabetical listing of keywords, macros and procedures.

#### Operators

- __DATE__  
- __Date_Iso__  
- __Fb_64Bit__  
- __FB_ARGC__  
- __FB_ARGV__  
- __Fb_Arm__  
- __Fb_Asm__  
- __Fb_Backend__  
- __FB_BIGENDIAN__  
- __FB_BUILD_DATE__  
- __FB_CYGWIN__  
- __FB_DARWIN__  
- __FB_DEBUG__  
- __FB_DOS__  
- __FB_ERR__  
- __Fb_Fpmode__  
- __Fb_Fpu__  
- __FB_FREEBSD__  
- __Fb_Gcc__  
- __FB_LANG__

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- ByVal
- C
  - Call
  - CAllocate
  - Case
  - Cast
  - Cbool
  - CByte
  - CDbl
  - cdecl
  - Chain
  - ChDir
  - Chr
  - CInt
  - Circle
  - Class
  - Clear
  - CLng
  - CLngInt
  - Close
  - Cls
  - Color
  - Command
  - Common
  - CondBroadcast
  - CondCreate
  - CondDestroy
  - CondSignal
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  - Const
  - Const (Member)
- Public
- Public: (Access Control)
- Put (Graphics)
- Put # (File I/O)
- R
  - Random
  - Randomize
  - Read
  - Read (File Access)
  - Read Write (File Access)
  - Reallocate
  - ReDim
  - Rem
  - Reset
  - Restore
  - Resume
  - Resume Next
  - Return
  - RGB
  - RGBA
  - Right
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  - Screen
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- Deallocate
- Declare
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- DefDb1
- defined
- DefInt
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- DefShort
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- Defulongint
- DefUShort
- Delete
- Destructor
- Destructor (Module)
- Dim
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| Get (Graphics) | View Print       |
| Get # (File I/O) | View (Graphics) |
| GetJoystick | Virtual (Member) |
| GetKey |                 |
| GetMouse |                 |
| GoSub |                 |
| Goto |                 |

| Hex | View Print |
| HiByte | View (Graphics) |
| HiWord | Virtual (Member) |
| Hour |                 |

| If...Then | View Print |
| If | View (Graphics) |
| ImageConvertRow | Virtual (Member) |
| ImageCreate |                 |
| ImageDestroy |                 |
| ImgInfo |                 |

| WHex | View Print |
| Width | View (Graphics) |
| Window | Virtual (Member) |
| WindowTitle |                 |
| WInput |                 |
| With |                 |
| WOct |                 |
| Write |                 |
| Write # |                 |
| Write (File Access) |                 |
| WSpace |                 |
| WStr |                 |
| WString (Data Type) |                 |
| WString (Function) |                 |
| Xor | View Print |
| Xor (Graphics Put) | View (Graphics) |
| Year | Virtual (Member) |
- Imp
- Implements
- Import
- Inkey
- Inp
- Input (Statement)
- Input (File I/O)
- Input #
- Input$
- InStr
- InStrRev
- Int
- Integer
- Is (Select Case)
- Is (Run-Time Type Information Operator)
- IsDate
- Isredirected
- ZString
... (Ellipsis)

Used in place of procedure parameter to pass a variable number of arguments, or as the upper bound in an array declaration to denote that the number of elements will be determined by the initializer.

**Syntax**

```pseudo
Declare { Sub | Function } proc_name cdecl ( param_list, ... ) {
  Dim array_symbol ([lbound To] ...) [As datatype] => { expression_list
  #define identifier( [ parameters, ] variadic_parameter... ) body
```

**Description**

The ellipsis (three dots, ...) is used in procedure declarations and definitions to indicate a variable argument list. A first argument (at least) must always be specified, and the procedure must be called with the C calling convention `cdecl`. In the procedure body, `va_next` is used to handle the variable arguments.

Only numeric types and pointers are supported as variable arguments. Passed on variable arguments are implicitly converted to integers, all single numbers passed on variable arguments are implicitly converted to doubles. Strings can be a `ZString Ptr` to the string data is taken.

A variadic procedure name can never be overloaded.

Using an ellipsis in place of the upper bound in an array declaration causes the upper bound to be set according to the data that appears in the `expression_list`. When used in this manner, an initializer must appear, and cannot be `Any`.

Using an ellipsis behind the last parameter in a `#define` or `#macro` declaration allows to create a variadic macro. This means it is possible to pass any number of arguments, `varadic_parameter`, which can be used in the `body` as if it was a normal macro. The `varadic_parameter` will expand to the full list of arguments passed, including commas, and can also be completely empty.

**Example**

```pseudo
Declare Function foo cdecl ( x As Integer, ... ) As
```
Dim As Integer myarray(0 To ...) = {0, 1, 2, 3}
Print LBound(myarray), UBound(myarray)  '' 0, 3

'' Using a variadic macro to wrap a variadic function
#include "crt.bi"
#define eprintf(Format, args...) fprintf(stderr, Format, args)
eprintf(!"Hello from printf: %i %s %i\n", 5, "test")

'' LISP-like accessors allowing to modify comma-separated lists
#define car(a, b...) a
#define cdr(a, b...) b

Differences from QB
- New to FreeBASIC

See also
- cdecl
- va_arg
- va_first
- va_next
- Dim
- Static
- #define
__DATE__

Intrinsic define (macro value) set by the compiler

**Syntax**

`__DATE__`

**Description**

Substitutes the compiler date in a literal string ("mm-dd-yyyy" format) where used.

**Example**

```basic
Print "Compile Date: " & __DATE__
```

Compile Date: 09-29-2011

**Differences from QB**

- New to FreeBASIC

**See also**

- `__Date_Iso__`
- `__TIME__`
- `Date`
Intrinsic define (macro value) set by the compiler

**Syntax**

`__DATE_ISO__`

**Description**

Substitutes the compiler date in a literal string ("yyyy-mm-dd" format) where used. This format is in line with ISO 8601 and can be used for lexicographical date comparisons.

**Example**

```vbnet
Print "Compile Date: " & __DATE_ISO__

If __DATE_ISO__ < "2011-12-25" Then
    Print "Compiled before Christmas day 2011"
Else
    Print "Compiled after Christmas day 2011"
End If
```

Compile Date: 2011-09-29
Compiled before Christmas day 2011

**Differences from QB**

- New to FreeBASIC

**See also**

- `__DATE__`
Intrinsic define set by the compiler

**Syntax**

```
__FB_64BIT__
```

**Description**

Define created at compile time if the compilation target is 64bit, otherwise undefined.

**Example**

```
#ifdef __FB_64BIT__
   '...instructions for 64bit OSes...
#else
   '...instructions for other OSes
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_LINUX__`
- `__FB_FREEBSD__`
- `__FB_OPENBSD__`
- `__FB_NETBSD__`
- `__FB_CYGWIN__`
- `__FB_DARWIN__`
- `__Fb_Pcos__`
- **Compiler Option: -target**
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_ARGC__

**Description**

Substituted with the number of arguments passed in on the command line.

__FB_ARGC__ is the name of a parameter passed to the program's implicit main function, and therefore is only defined in the module level code of the main module for an application.

**Example**

```plaintext
Dim i As Integer
For i = 0 To __FB_ARGC__ - 1
    Print "arg "; i; " = "; Command(i); ""
Next i
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_ARGV__
- Command
**__FB_ARGV__**

Intrinsic define (macro value) set by the compiler

**Syntax**

```plaintext
__FB_ARGV__
```

**Description**

Substituted with a pointer to a list of pointers to the zero terminated command line arguments passed in on the command line.

`__FB_ARGV__` is the name of a parameter passed to the program's implicit main function, and therefore is only defined in the module level code of the main module for an application.

**Example**

```plaintext
Declare Function main _
( _
    ByVal argc As Integer, _
    ByVal argv As ZString Ptr Ptr _
) As Integer

    End main( __FB_ARGC__, __FB_ARGV__ )

Private Function main _
( _
    ByVal argc As Integer, _
    ByVal argv As ZString Ptr Ptr _
) As Integer

    Dim i As Integer
    For i = 0 To argc - 1
        Print "arg "; i; " = "; argv[i]; ""
    Next i
```
Return 0
End Function

Differences from QB

- New to FreeBASIC

See also

- __FB_ARGC__
- Command
**__Fb_Arm__**

Intrinsic define set by the compiler

**Syntax**

```c
__FB_ARM__
```

**Description**

Define created at compile time if the compilation target uses the ARM CPU architecture, otherwise undefined.

**Example**

```c
#ifdef __FB_ARM__
    '...instructions for ARM OSes...
#else
    '...instructions for other OSes
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_FREEBSD__
- __FB_OPENBSD__
- __FB_NETBSD__
- __FB_CYGWIN__
- __FB_DARWIN__
- __Fb_Pcos__
- Compiler Option: -target
Intrinsic define set by the compiler

**Syntax**

`__FB_ASM__`

**Description**

`__FB_ASM__` returns a string equal to "intel" or "att" depending on whether inline assembly blocks should use the Intel format or the GCC/AT&T; format.

**Example**

```basic
Dim a As Long
#if __FB_ASM__ = "intel"
    Asm
        inc dword.Ptr[a]
    End Asm
#else
    Asm
        "incl %0\n" : "+m" (a) : :
    End Asm
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Compiler Option: -asm
Intrinsic define set by the compiler

**Syntax**

```__FB_BACKEND__```

**Description**

Defined to either "gas" or "gcc", depending on which backend was specified via `-gen`.

**Differences from QB**

- Did not exist in QB
**__FB_BIGENDIAN__**

Intrinsic define set by the compiler

**Syntax**

```
__FB_BIGENDIAN__
```

**Description**

Define without a value created at compile time if compiling for a big endian target.

It can be used to compile parts of the program only if the target is big endian.

**Example**

```
#ifdef __FB_BIGENDIAN__
  "...instructions only for big endian machines"
#else
  "...instructions only for little endian machines"
#endif
```

**Differences from QB**

- Did not exist in QB
**__FB_BUILD_DATE__**

Intrinsic define (macro string) set by the compiler

**Syntax**

__FB_BUILD_DATE__

**Description**

Substituted with the quoted string containing the date (MM-DD-YYYY) the compiler was built on.

**Example**

```
Print "This program compiled with a compiler built on " & __FB_BUILD_DATE__
```

**Differences from QB**

- New to FreeBASIC
Intrinsic define set by the compiler

**Syntax**
```
__FB_CYGWIN__
```

**Description**
Define without a value created at compile time in the Cygwin version of the compiler, or when the `-target cygwin` command line option is used. It can be used to compile parts of the program only if the target is Cygwin.

**Example**
```
#ifdef __FB_CYGWIN__
  "...instructions only for Cygwin..."
#else
  "...instructions not for Cygwin..."
#endif
```

**Differences from QB**
- New to FreeBASIC

**See also**
- __FB_LINUX__
- __Fb_Win32__
- __Fb_Unix__
- Compiler Option: -target
Intrinsic define set by the compiler

**Syntax**

`__FB_DARWIN__`

**Description**

Define without a value created at compile time in the Darwin version of the compiler, or when the `-target darwin` command line option is used. It can be used to compile parts of the program only if the target is Darwin.

**Example**

```c
#ifdef __FB_DARWIN__
  /* instructions only for Darwin... */
#else
  /* instructions not for Darwin... */
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_LINUX__`
- `__FB_WIN32__`
- `__Fb_Unix__`
- Compiler Option: `-target`
Intrinsic define (macro value) set by the compiler

**Syntax**

```
__FB_DEBUG__
```

**Description**

`__FB_DEBUG__` indicates if the generate debug information option `-g` was specified on the command line at the time of compilation.

Returns non-zero (-1) if the option was specified. Returns zero (0) otherwise.

**Example**

```
#if __FB_DEBUG__ <> 0
    #print Debug mode
#else
    #print Release mode
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_ERR__`
- `__FB_MT__`
- Compiler Option: `-g`
Intrinsic define set by the compiler

**Syntax**

__FB_DOS__

**Description**

Define without a value created at compile time if compiling for the DOS target. Default in the DOS hosted version, or active when the `-target dos` command line option is used. It can be used to compile parts of the program only if the target is DOS. Note: the DOS hosted version cannot compile to other targets than DOS by now.

**Example**

```plaintext
#ifdef __FB_DOS__
  ' ... instructions only for DOS ...
  ' ... INT 0x31
#else
  ' ... instructions not for DOS ...
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_WIN32__
- __Fb_Pcos__
- DOS related FAQ
- Compiler Option: -target
Intrinsic define (macro value) set by the compiler

**Syntax**

```
__FB_ERR__
```

**Description**

`__FB_ERR__` indicates if `-e`, `-ex`, or `-exx` was specified on the compiler command line at the time of compilation of a module.

Returns one of the following values:

<table>
<thead>
<tr>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><code>-e</code>, <code>-ex</code>, <code>-exx</code> not specified</td>
</tr>
<tr>
<td>1</td>
<td><code>-e</code> was specified</td>
</tr>
<tr>
<td>3</td>
<td><code>-ex</code> was specified</td>
</tr>
<tr>
<td>7</td>
<td><code>-exx</code> was specified</td>
</tr>
</tbody>
</table>

`__FB_ERR__` is always defined.

**Example**

```vbnet
'Example code to demonstrate a use of __FB_ERR__
Dim err_command_line As UByte
err_command_line = __FB_ERR__
Select Case err_command_line
Case 0
    Print "No Error Checking enabled on the Command Line!"
Case 1
    Print "Some Error Checking enabled on the Command Line!"
Case 3
    Print "QBASIC style Error Checking enabled on the Command Line!"
Case 7
    Print "Extreme Error Checking enabled on the Command Line!"
```
```
Case Else
Print "Some Unknown Error level has been set!"
End Select

Differences from QB
- New to FreeBASIC

See also
- __FB_MT__
- __FB_DEBUG__
- Compiler Option: -e
- Compiler Option: -ex
- Compiler Option: -exx
- Error Handling
Intrinsic define set by the compiler

Syntax

__FB_FPMODE__

Description

Defined as "fast" if SSE fast arithmetics is enabled, or "precise" otherwise.

Example

```bash
#if __FB_FPMODE__ = "fast"
  ' ... instructions for using fast-mode math ...
#else
  ' ... instructions for using normal math ...
#endif
```

Differences from QB

- New to FreeBASIC

See also

- Compiler Option: -fpmode
Intrinsic define set by the compiler

**Syntax**

__FB_FPU__

**Description**

Defined as "sse" if SSE floating point arithmetics is enabled, or "x87" otherwise.

**Example**

```plaintext
#if __FB_FPU__ = "sse"
  ' ... instructions only for SSE ...
#else
  ' ... instructions not for SSE ...
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_SSE__
- Compiler Option: -fpu
Intrinsic define set by the compiler

**Syntax**

__FB_FREEBSD__

**Description**

Define without a value created at compile time in the FreeBSD version of the compiler, or when the `-target freebsd` command line option is used. It can be used to compile parts of the program only if the target is FreeBSD.

**Example**

```c
#ifdef __FB_FREEBSD__
  "...instructions only for FreeBSD..."
#else
  "...instructions not for FreeBSD..."
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_WIN32__
- __FB_UNIX__
- **Compiler Option: -target**
__Fb_Gcc__

Intrinsic define set by the compiler

**Syntax**

__FB_GCC__

**Description**

Defined to true (-1) if `-gen gcc` is used, or false (0) otherwise.

**Differences from QB**

- Did not exist in QB
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_LANG__

**Description**

__FB_LANG__ indicates which language compatibility option was set at the time of compilation of a module. By default __FB_LANG__ will be set to "fb". The language compatibility option can be changed using one (or more) of the following methods:

- **-lang** command line option
- **-forcelang** command line option
- **#lang** directive
- **$Lang** metacommand

Returns a lower case string with one of the following values:

<table>
<thead>
<tr>
<th>value</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;fb&quot;</td>
<td>FreeBASIC compatibility (default)</td>
</tr>
<tr>
<td>&quot;qb&quot;</td>
<td>QBASIC compatibility</td>
</tr>
<tr>
<td>&quot;fblite&quot;</td>
<td>FreeBASIC language compatibility, with a more QBASIC-compatible coding style</td>
</tr>
<tr>
<td>&quot;deprecated&quot;</td>
<td>FBC version 0.16 compatibility</td>
</tr>
</tbody>
</table>

__FB_LANG__ is always defined.

**Example**

```
' Set option explicit always on

#ifdef __FB_LANG__
#ifdef __FB_LANG__ <> "fb"
```
Differences from QB

- New to FreeBASIC

See also

- __FB_VERSION__
- #lang
- Compiler Option: -lang
- Compiler Option: -forcelang
- Compiler Dialects
Intrinsic define set by the compiler

**Syntax**

```plaintext
__FB_LINUX__
```

**Description**

Define without a value created at compile time when compiling to the Linux target. Default in the Linux hosted version of the compiler, or active when the `-target linux` command line option is used. It can be used to compile parts of the program only if the target is Linux.

**Example**

```plaintext
#ifdef __FB_LINUX__
  ' ... instructions only for Linux ...
  ' ... #libpath "/usr/X11/lib"
#else
  ' ... instructions not for Linux ...
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_DOS__
- __FB_WIN32__
- __Fb_Unix__
- Compiler Option: -target
__FB_MAIN__

Intrinsic define set by the compiler

**Syntax**

__FB_MAIN__

**Description**

__FB_MAIN__ is defined in the main module and not defined in other modules.

The main module is determined by the compiler as either the first source file listed on the command line or explicitly named using the -n option on the command line.

**Example**

```plaintext
#ifdef __FB_MAIN__
    #print Compiling the main module
#else
    #print Compiling an additional module
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Compiler Option: -m
- #ifdef
- ifndef
__FB_MIN_VERSION__

Macro function to test minimum compiler version

**Syntax**

```c
#define __FB_MIN_VERSION__( major, minor, patch ) _
((__FB_VER_MAJOR__ > major) or _
((__FB_VER_MAJOR__ = major) and ((__FB_VER_MINOR__ > minor) or _
((__FB_VER_MINOR__ = minor and __FB_VER_PATCH__ >= patch_level)))))
```

**Usage**

```c
__FB_MIN_VERSION__( major, minor, patch )
```

**Parameters**

- **major**
  - minimum major version to test
- **minor**
  - minimum minor version to test
- **patch**
  - minimum patch version to test

**Return Value**

Returns zero (0) if the compiler version is less than the specified version, or non-zero (-1) if the compiler version is greater than or equal to specified version

**Description**

__FB_MIN_VERSION__ tests for a minimum version of the compiler.

**Example**

```c
#if Not __FB_MIN_VERSION__(0, 18, 2)
    #error fbc must be at least version 0.18.2 To
#endif
```
Differences from QB

- New to FreeBASIC

See also

- #if
Intrinsic define (macro value) set by the compiler

**Syntax**

```
__FB_MT__
```

**Description**

`__FB_MT__` indicates if the the multithreaded option `-mt` was specified on the command line at the time of compilation.

Returns non-zero (-1) if the option was specified. Returns zero (0) otherwise.

**Example**

```
#if __FB_MT__
    #print Using multi-threaded library
#else
    #print Using single-threaded library
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_DEBUG__`
- **Compiler Option: -mt**
Intrinsic define set by the compiler

**Syntax**

```
__FB_NETBSD__
```

**Description**

Define without a value created at compile time in the NetBSD version of the compiler, or when the `-target netbsd` command line option is used. It can be used to compile parts of the program only if the target is NetBSD.

**Example**

```
#define __FB_NETBSD__

  "...instructions only for NetBSD...
#define __FB_NETBSD__

  "...instructions not for NetBSD...
#undef __FB_NETBSD__
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_WIN32__
- __Fb_Unix__
- Compiler Option: `-target`
Intrinsic define set by the compiler

**Syntax**

__FB_OPENBSD__

**Description**

Define without a value created at compile time in the OpenBSD version of the compiler, or when the `-target openbsd` command line option is used. It can be used to compile parts of the program only if the target is OpenBSD.

**Example**

```plaintext
#ifdef __FB_OPENBSD__
  /*instructions only for OpenBSD*/
#else
  /*instructions not for OpenBSD*/
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_WIN32__
- __Fb_Unix__
- Compiler Option: `-target`
**Intrinsic define (macro value) set by the compiler**

**Syntax**

```
__FB_OPTION_BYVAL__
```

**Description**

Indicates if parameters to a `Function` or `Sub` are passed by reference or by value as with `ByVal` by default when the by value / by reference specifier is not explicitly stated.

`__FB_OPTION_BYVAL__` is set to non-zero (-1) if by default parameters are passed by value, and zero (0) if by default parameters are passed by reference.

The default for passing parameters by reference or by value is determined by the `lang` command line option used during compilation or usage of `Option` source file.

**Example**

```
#if( __FB_OPTION_BYVAL__ <> 0 )
    #error Option ByVal must Not be used With This source File
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `ByVal`
- `ByRef`
- `Option ByVal`
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_OPTION_DYNAMIC__

**Description**

__FB_OPTION_DYNAMIC__ is defined as true (negative one (-1)) if a recent `Option Dynamic` statement or `$Dynamic` meta-command was issued. Otherwise, it is defined as zero (0).

**Example**

```
#if __FB_OPTION_DYNAMIC__ <> 0
#error This module must Not use Option Dynamic
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `Option Dynamic`
- `Option Static`
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_OPTION_ESCAPE__

**Description**

Indicates if by default, string literals are processed for escape characters when not explicitly prefixed with the $ Operator for non-escaped strings, or the ! Operator for escaped strings.

The default method for processing string literals is set by usage of the option during compilation or usage of Option Escape in the source file.

__FB_OPTION_ESCAPE__ returns zero (0) if the option has not been set. It returns a non-zero (-1) if the option has been set.

**Example**

```c
#if(__FB_OPTION_ESCAPE__ <> 0 )
#error Option Escape must Not be used With This #endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Option Escape
Intrinsic define (macro value) set by the compiler

**Syntax**

`__FB_OPTION_EXPLICIT__`

**Description**

`__FB_OPTION_EXPLICIT__` indicates if `Option Explicit` has been used in the source.

Returns zero (0) if the option has not been set. Returns non-zero (-1) option has been set.

**Example**

```c
#if( __FB_OPTION_EXPLICIT__ = 0 )
    #error Option Explicit must used With This module
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `Dim`
- `Option Explicit`
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_OPTION_GOSUB__

**Description**

Indicates how _GoSub_ and _Return_ will be handled at compile time. If the option is set (-1) then _GoSub_ is allowed and _Return_ is recognized as return-from-gosub only. If the option is not set (0) then _GoSub_ is not allowed and _Return_ is recognized as return-from-procedure only.

This macro value can be changed at compile time. _Option Gosub_ will set the option (enable gosub support) and _Option Nogosub_ will clear the option (disable gosub support).

__FB_OPTION_GOSUB__ returns zero (0) if the option has not been set. Returns non-zero (-1) if the option has been set.

**Example**

```
#if( __FB_OPTION_GOSUB__ <> 0 )
   '' turn off gosub support
   Option nogosub
#endif
```

**Dialect Differences**

- Defaults to -1 in the `-lang qb` dialect and 0 in all other dialects.

**Differences from QB**

- New to FreeBASIC
See also

- Option Gosub
- Option Nogosub
Intrinsic define (macro value) set by the compiler

**Syntax**

`__FB_OPTION_PRIVATE__`

**Description**

Indicates if by default `Function's` and `Sub's` have module scope or global scope when not explicitly specified with `Private` or `Public`.

The default scope specifier for functions and subs is set by usage of the command line option during compilation or usage of `Option Private` in:

```
__FB_OPTION_PRIVATE__ returns zero (0) if the option has not been set.
zero (-1) if the option has been set.
```

**Example**

```
#if( __FB_OPTION_PRIVATE__ <> 0 )
    #error Option Private must Not be used With This
#else
    #endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `Option Private`
- `Private`
- `Public`
__FB_OUT_DLL__

Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_OUT_DLL__

**Description**

__FB_OUT_DLL__ indicates that the specified output file type on the compiler command line at the time of compilation is a shared library.

Returns non-zero (-1) if the output is a shared library. Returns zero (0)

Only one of __FB_OUT_DLL__, __FB_OUT_EXE__, __FB_OUT_LIB__, or __FB_OUT_OBJ__ (-1). All others will evaluate to zero (0).

**Example**

```
#if __FB_OUT_DLL__
  '... specific instructions when making a shared library
#else
  '... specific instructions when not making a shared library
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_OUT_EXE__
- __FB_OUT_LIB__
- __FB_OUT_OBJ__
- **Compiler Option: -dll**
__FB_OUT_EXE__

Intrinsic define (macro value) set by the compiler

**Syntax**

___FB_OUT_EXE___

**Description**

___FB_OUT_EXE___ indicates that the specified output file type on the compiler command line at the time of compilation is an executable.

Returns non-zero (-1) if the output is an executable. Returns zero (0) otherwise.

Only one of ___FB_OUT_DLL___, ___FB_OUT_EXE___, ___FB_OUT_LIB___, or ___FB_OUT_OBJ___ non-zero (-1). All others will evaluate to zero (0).

**Example**

```plaintext
#if ___FB_OUT_EXE___
    '
#else
    '
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- ___FB_OUT_DLL___
- ___FB_OUT_LIB___
- ___FB_OUT_OBJ___
Intrinsic define (macro value) set by the compiler

Syntax
__FB_OUT_LIB__

Description
__FB_OUT_LIB__ indicates that the specified output file type on the compiler command line at the time of compilation is a static library.

Returns non-zero (-1) if the output is a static library. Returns zero (0) otherwise.

Only one of __FB_OUT_DLL__, __FB_OUT_EXE__, __FB_OUT_LIB__, or __FB_OUT_OBJ__ returns zero (-1). All others will evaluate to zero (0).

Example

```plaintext
#if __FB_OUT_LIB__
    '... specific instructions when making a static library
#else
    '... specific instructions when not making a static library
#endif
```

Differences from QB
- New to FreeBASIC

See also
- __FB_OUT_EXE__
- __FB_OUT_DLL__
- __FB_OUT_OBJ__
- Compiler Option: -lib
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_OUT_OBJ__

**Description**

__FB_OUT_OBJ__ indicates that the specified output file type on the compiler command line at the time of compilation is an object module.

Returns non-zero (-1) if the output is an object module. Returns zero (0) otherwise.

Only one of __FB_OUT_DLL__, __FB_OUT_EXE__, __FB_OUT_LIB__, or __FB_OUT_OBJ__ will evaluate to non-zero (1). All others will evaluate to zero (0).

**Example**

```basic
#if __FB_OUT_OBJ__
    '... specific instructions when compiling to an object file only
#else
    '... specific instructions when not compiling to an object file only
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_OUT_EXE__
- __FB_OUT_DLL__
- __FB_OUT_LIB__
**__Fb_Pcos__**

Intrinsic define set by the compiler

**Syntax**

```
__FB_PCOS__
```

**Description**

Define created at compile time if the OS has filesystem behavior style like common PC OSes, e.g. DOS, Windows, OS/2, Symbian OS, possibly others. Drive letters, backslashes, that stuff, otherwise undefined.

**Example**

```c
#ifdef __FB_PCOS__
  "...instructions for PC-ish OSes..."
#else
  "...instructions for other OSes"
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_WIN32__
- __FB_DOS__
- __FB_XBOX__
- __Fb_Unix__
- Compiler Option: -target
**Syntax**

`__FB_SIGNATURE__`

**Description**

Substituted by a signature of the compiler where used.

**Example**

```plaintext
Print __FB_SIGNATURE__
```

FreeBASIC 0.21.1

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_VERSION__`
- `__FB_WIN32__`
- `__FB_LINUX__`
- `__FB_DOS__`
Intrinsic define set by the compiler

**Syntax**

__FB_SSE__

**Description**

Define without a value created at compile time if SSE floating point arithmetics is enabled.

**Example**

```plaintext
#ifdef __FB_SSE__
    ' ... instructions only for SSE ...
#else
    ' ... instructions not for SSE ...
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __Fb_Fpu__
- Compiler Option: -fpu
Intrinsic define set by the compiler

**Syntax**

__FB_UNIX__

**Description**

Define created at compile time if the OS is reasonably enough like UNIX that you can call it UNIX, otherwise undefined.

**Example**

```c
#ifdef __FB_UNIX__
    "...instructions for UNIX-family OSes..."
#else
    "...instructions for other OSes"
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_FREEBSD__
- __FB_OPENBSD__
- __FB_NETBSD__
- __FB_CYGWIN__
- __FB_DARWIN__
- __Fb_Pcos__
- **Compiler Option: -target**
__Fb_Vectorize__

Intrinsic define set by the compiler

**Syntax**

__FB_VECTORIZE__

**Description**

Defined as the vectorisation level number set by the `-vec` command-line option.

**Example**

```plaintext
#if __FB_VECTORIZE__ = 2
  ' ... instructions only for vectorization level
#else
  ' ...
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Compiler Option: `-vec`
Intrinsic define (macro value) set by the compiler

**Syntax**

```__FB_VER_MAJOR__```

**Description**

`__FB_VER_MAJOR__` will return the major version of FreeBASIC currently 0.90, and will remain 0 until FreeBASIC version 1.0 is released.

**Example**

```Dim fbMajorVersion As Integer
Dim fbMinorVersion As Integer
Dim fbPatchVersion As Integer

fbMajorVersion = __FB_VER_MAJOR__
fbMinorVersion = __FB_VER_MINOR__
fbPatchVersion = __FB_VER_PATCH__

Print "Welcome to FreeBASIC " & fbMajorVersion & ""
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_VER_MINOR__`
- `__FB_VER_PATCH__`
Intrinsic define (macro value) set by the compiler

**Syntax**

`__FB_VER_MINOR__`

**Description**

`__FB_VER_MINOR__` will return the minor version of FreeBASIC currently being used. For FreeBASIC version 0.90.1, for example, the minor version number is 90.

**Example**

```basic
Dim fbMajorVersion As Integer
Dim fbMinorVersion As Integer
Dim fbPatchVersion As Integer

fbMajorVersion = __FB_VER_MAJOR__
fbMinorVersion = __FB_VER_MINOR__
fbPatchVersion = __FB_VER_PATCH__

Print "Welcome to FreeBASIC " & fbMajorVersion & ""
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FB_VER_MAJOR__`
- `__FB_VER_PATCH__`
Intrinsic define (macro value) set by the compiler

**Syntax**

__FB_VER_PATCH__

**Description**

__FB_VER_PATCH__ will return the patch/subversion/revision number the version of FreeBASIC currently being used. For FreeBASIC 0.18, for example, there were subversions 1, 2, 3, 4, 5 and 6, resulting in versions 0.18.1 through 0.18.6.

**Example**

```basic
Dim fbMajorVersion As Integer
Dim fbMinorVersion As Integer
Dim fbPatchVersion As Integer

fbMajorVersion = __FB_VER_MAJOR__
fbMinorVersion = __FB_VER_MINOR__
fbPatchVersion = __FB_VER_PATCH__

Print "Welcome to FreeBASIC " & fbMajorVersion & ""
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_VER_MAJOR__
- __FB_VER_MINOR__
Intrinsic define (macro string) set by the compiler

**Syntax**

`__FB_VERSION__`

**Description**

Substituted by the version number of the compiler where used.

**Example**

```c
#if __FB_VERSION__ < "0.18"
#error Please compile With FB version 0.18 Or above
#endif
```

This will stop the compilation if the compiler version is below 0.18

**Differences from QB**

- Did not exist in QB

**See also**

- `__FB_SIGNATURE__`
- `__FB_WIN32__`
- `__FB_LINUX__`
- `__FB_DOS__`
Intrinsic define set by the compiler

**Syntax**

```plaintext
__FB_WIN32__
```

**Description**

Define without a value created at compile time if compiling to the Win32 target. Default in Win32 hosted version, or active if the `-target win32` command line option is used. It can be used to compile parts of the program only if the target is Win32.

**Example**

```plaintext
#ifdef __FB_WIN32__
  ' ... instructions only for Win32 ... 
  ' ... GetProcAddress ... 
#else
  ' ... instructions not for Win32 ... 
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_DOS__
- __FB_LINUX__
- __Fb_Pcos__
- Compiler Option: -target
Intrinsic define set by the compiler

**Syntax**

__FB_XBOX__

**Description**

Define without a value created at compile time when the `-target xbox` command line option is used. It can be used to compile parts of the program only if the target is Xbox.

**Example**

```plaintext
#ifndef __FB_XBOX__
  "...instructions only for Xbox..."
#else
  "...instructions not for Xbox..."
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- __FB_LINUX__
- __FB_WIN32__
- Compiler Option: `-target`
Intrinsic define (macro string) set by the compiler

**Syntax**

```__FILE__```

**Description**

Substituted with the quoted source file name where used.

An example of normal use is to report wrong values in debugging.

**Example**

```Dim a As Integer
If a<0 Then
    Print "Error: a = " & a & " in " & __FILE__
End If```

Error: a = -32767 in test.bas (MAIN) line 47

**Differences from QB**

- Did not exist in QB

**See also**

- `__FILE_NQ__`
- `__FUNCTION__`
- `__LINE__`
Intrinsic define (macro string) set by the compiler

Syntax

__FILE_NQ__

Description
Substituted with the non-quoted source file name where used.

Example

#print __FILE_NQ__

Differences from QB

- New to FreeBASIC

See also

- __FILE__
- __FUNCTION_NQ__
- __LINE__
**__FUNCTION__**

Intrinsic define (macro string) set by the compiler

**Syntax**

```
__FUNCTION__
```

**Description**

Substituted with the quoted name of the current function block where used. Its normal use is to report wrong values in debugging.

If `__FUNCTION__` is used at the module level, the function name given will be `"__FB_MODLEVELPROC__"` for a different module.

**Example**

```vbnet
Dim a As Integer
'
...
If a < 0 Then ' this shouldn't happen
    Print "Error: a = " & a & " in " & __FILE__ & 
End If
```

```
Error: a = -32767 in test.bas (__FB_MAINPROC__) line 47
```

**Differences from QB**

- Did not exist in QB

**See also**
__FILE__
__FUNCTION__
__LINE__
Intrinsic define (macro string) set by the compiler

**Syntax**

__FUNCTION_NQ__

**Description**

Substituted with the non-quoted name of the current function block where used.

If __FUNCTION_NQ__ is used at the module level, the function name given will be __FB_MAINPROC__ for the main module, or __FB_MODLEVELPROC__ for a different module. This is not the actual function name though, so it's not as useful there.

**Example**

```basic
Sub MySub
    Print "Address of " + __FUNCTION__ + " is ";
    Print Hex( @__FUNCTION_NQ__ )
End Sub

MySub

Address of MYSUB is 4012D0
```

**Differences from QB**

- Did not exist in QB

**See also**
Intrinsic define (macro value) set by the compiler

**Syntax**

__LINE__

**Description**

Substituted with the current line number of the source file where used.

Its normal use is to report wrong values in debugging.

**Example**

```basic
Dim a As Integer

If a < 0 Then
    Print "Error: a = " & a & " in " & __FILE__ & 
End If
```

Error: a = -32767 in test.bas (MAIN) line 47

**Differences from QB**

- Did not exist in QB

**See also**

- __FILE__
- __FUNCTION__
Intrinsic define (macro string) set by the compiler

**Syntax**

`__PATH__`

**Description**

Set to the quoted absolute path of the source file at the time of compilation.

**Example**

```
' Tell the compiler to search the source file's directory for libraries

#libpath __PATH__
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `__FILE__`
Intrinsic define (macro value) set by the compiler

**Syntax**

__TIME__

**Description**

Substitutes the compiler time in a literal string (24 clock, "hh:mm:ss" format) where used.

**Example**

```vbnet
Print "Compile Time: " & __TIME__
```

Compile Time: 13:42:57

**Differences from QB**

- New to FreeBASIC

**See also**

- __DATE__
- __Date_Iso__
- Time
Preprocessor conditional directive

**Syntax**

```
#assert condition
```

**Parameters**

`condition`

A conditional expression that is assumed to be true

**Description**

Asserts the truth of a conditional expression at compile time. If `condition` is false, compilation will stop with an error.

This statement differs from the `Assert` macro in that `#assert` is evaluated at compile-time and `Assert` is evaluated at run-time.

**Example**

```basic
Const MIN = 5, MAX = 10
#assert MAX > MIN '' cause a compile-time error if MAX <= MIN
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `Assert`
- `#if`
- `#error`
#define
Preprocessor directive to define a macro

**Syntax**

```
#define identifier body
#define identifier( [ parameters ] ) body
#define identifier( [ parameters, ] Variadic_Parameter... ) body
```

**Description**

#define allows to declare text-based preprocessor macros. Once the compiler sees a #define, it will start replacing further occurrences of `identifier` with `body`. The expansion is done recursively, until there is nothing more to expand and the compiler can continue analyzing the resulting code. #undef can be used to make the #define.

**Parameters** turn a define into a function-like macro, allowing text arguments to be passed to the macro. Any occurrences of the parameter names in the `body` will be replaced by the given argument text during expansion. The `# Stringize` operator can be used to turn them into string literals, and the `## Concatenate` operator can be used to merge tokens together.

Note: In the function-like macro declaration, the `identifier` should be followed by the opening parentheses (`) immediately without any white-space in between, otherwise the compiler will treat it as part of the `body`.

Defines are scoped; they are only visible in the scope they were defined in. At module level, the define is visible throughout the module. If the `identifier` is defined within a statement having scope (Sub, For..Next, While..Wend, Do..Loop, Scope..End Scope) `identifier` define is only visible within that scope. Namespaces on the other hand do not have any effect on the visibility of a define.

Identifiers can be checked for with `#ifdef` and others, which can be used to hide parts of code from the compiler (conditional compiling).

The result of macro expansion can be checked by using the `-pp` compiler option.
#defines are often used to declare constants. The Const statement is a type-safe alternative.

Example

```
'' Definition and check
#define DEBUGGING
#ifdef DEBUGGING
  ' ... statements
#endif

'' Simple definition/text replacement
#define FALSE 0
#define TRUE (Not FALSE)

'' Function-like definition
#define MyRGB(R,G,B) (((R)Shl 16) Or ((G)Shl 8) Or (B))
Print Hex( MyRGB(&hff, &h00, &hff) )

'' Line continuation and statements in a definition
#define printval(bar) _
  Print #bar; " ="; bar

'' #defines are visible only in the scope where they are defined
Scope
  #define LOCALDEF 1
End Scope

#ifndef LOCALDEF
#  Print LOCALDEF Is Not defined
#endif

'' namespaces have no effect on the visibility of a define
Namespace foo
#  define NSDEF
End Namespace

#ifndef NSDEF
#  Print NSDEF Is Not defined
```
Differences from QB

- New to FreeBASIC

See also

- #macro
- # Preprocessor Stringize
- ## Preprocessor Concatenate
- #ifdef
- #undef
- Const
- ...

#endif
Preprocessor conditional directive

**Syntax**

```
#if (expression)
  ' Conditionally included statements if expression is True
#else
  ' Conditionally included statements if expression is False
#endif
```

**Description**

`#else` can be added to an `#if`, `#ifdef`, or `#ifndef` block to provide an alternate result to the conditional expression.

**Example**

```basic
#define MODULE_VERSION 1
Dim a As String
#if (MODULE_VERSION > 0)
  a = "Release"
#else
  a = "Beta"
#endif
Print "Program is "; a
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#define`
- `#macro`
- `#if`
- #elseif
- #endif
- #ifdef
- #ifndef
- #ifdef
- #ifndef
- #undef
- defined
#elseif

Preprocessor conditional directive

**Syntax**

```
#if (expression1)
    ' Conditionally included statements if expression1 is True
#elseif (expression2)
    ' Conditionally included statements if expression2 is True
#else
    ' Conditionally included statements if both
    ' expression1 and expression2 are False
#endif
```

**Description**

#elseif can be added to an #if block to provide an additional conditions.

**Example**

```
#define WORDSIZE 16
#if (WORDSIZE = 16)
    ' Do some some 16 bit stuff
#elseif (WORDSIZE = 32)
    ' Do some some 32 bit stuff
#else
    #error WORDSIZE must be set To 16 Or 32
#endif
```

**Differences from QB**

- New to Freebasic

**See also**

- #define
- #macro
- #if
- #else
- #endif
- #ifdef
- #ifndef
- #undef
- defined
Preprocessor conditional directive

**Syntax**

`#endif`

**Description**

Ends a group of conditional directives

See `#if`, `#ifdef`, or `#ifndef` for examples of usage.

**Example**

```basic
#define DEBUG_LEVEL 1
#if (DEBUG_LEVEL = 1)
  'Conditional statements
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#define`
- `#macro`
- `#if`
- `#else`
- `#elseif`
- `#ifdef`
- `#ifndef`
- `#undef`
- defined
Preprocessor directive to define a multiline macro

**Syntax**

```
#macro identifier( [ parameters ] )
body
#endmacro
```

```
#macro identifier( [ parameters, ] Variadic_Parameter... )
body
#endmacro
```

**Description**

`#macro` is the multi-line version of `#define`.

**Example**

```
'' macro as an expression value
#macro Print1( a, b )
a + b
#endmacro

Print Print1( "Hello", "World" )

'' Output :
'' Hello World!
```

```
'' macro as multiple statements
#macro Print2( a, b )
    Print a;
    Print " ";
    Print b;
    Print "!"
#endmacro
```
Print2( "Hello", "World" )

'' Output :
'' Hello World!

Differences from QB

- New to FreeBASIC

See also

- #define
- #ifdef
- #undef
Preprocessor diagnostic directive

**Syntax**

`#error error_text`

**Parameters**

`error_text`

The display message

**Description**

`#error` stops compiling and displays `error_text` when compiler finds it.

This keyword must be surrounded by an `#if <condition> ...#endif`, so the compiler can reach `#error` only if `<condition>` is met.

**Example**

```
#define c 1

#if c = 1
    #error Bad value of c
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#if`
- `#print`
- #Assert
Preprocessor conditional directive

**Syntax**

```plaintext
#define DEBUG_LEVEL 1
#if (DEBUG_LEVEL >= 2)
  ' This line is not compiled since the expression is False
  Print "Starting application"
#endif
```

**Description**

Conditionally includes statements at compile time.

Statements contained within the `#if / #endif` block are included if `expression` is True (non-zero) and excluded (ignored) if `expression` evaluates to False.

This conditional directive differs from the `If` conditional statement in that at compile-time and `If` is evaluated at run-time.

**Example**

**Differences from QB**

- New to FreeBASIC

**See also**

- `#define`
- `#macro`
- #else
- #elseif
- #endif
- #ifdef
- #ifndef
- #undef
- defined
- #Assert
Preprocessor conditional directive

Syntax

```c
#ifdef symbol
  ' Conditionally included statements
#endif
```

Description

Conditionally includes statements at compile time.

Statements within the `#ifdef...#endif` block are included if `symbol` is defined and excluded (ignored) if `symbol` is not defined.

`#ifdef symbol` is equivalent to `#if defined (symbol)`

Example

```c
#define _DEBUG
#ifdef _DEBUG
  ' Special statements for debugging
#endif
```

Differences from QB

- New to Freebasic

See also

- `#define`
- `#macro`
- `#if`
- `#else`
- #elsenf
- #endif
- #ifndef
- #ifndef
- #undef
- defined
#ifndef

Preprocessor conditional directive

**Syntax**

```
#ifndef symbol
' Conditionally included statements
#endif
```

**Description**

Conditionally includes statements at compile time.

Statements within the `#ifndef ... #endif` block are included if `symbol` is not defined and excluded (ignored) if `symbol` is defined.

`#ifndef symbol` is equivalent to `#if Not defined(symbol)`

**Example**

```
#ifndef __MYFILE_BI__
#define __MYFILE_BI__
' __MYFILE_BI__
' Declarations
#endif
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#define`
- `#macro`
- `#if`
- `#else`
- #elseif
- #endif
- #ifdef
- #ifndef
- #undef
- defined
#inclib

Preprocessor directive

**Syntax**

#inclib "libname"

**Description**

Includes a library in the linking process as if the user specified `-l libname` command line.

**Example**

```
'' incomplete code snippet

'' this will include libmystuff.a in the link process
#inclib "mystuff"
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#include`
- **Compiler Option: -l**
- **Compiler Option: -p**
Preprocessor statement to include contents of another source file

**Syntax**

```
#include [once] "file"
```

**Description**

`#include` inserts source code from another file at the point where the `#include` directive appears. This has the effect of compiling the source code from the include file as though it were part of the source file that includes it. Once the compiler has reached the end of the include file, the original source file continues to be compiled.

This is useful to remove code from a file and separate it into more files. It is useful to have a single file with declarations in a program formed by several modules. You may include files within an include file, although avoid including the original file into itself, this will not produce valid results. Typically, include files will have an extension of `.bi` and are mainly used for declaring subs/functions/variables of a library, but any valid source code may be present in an include file.

The `once` specifier tells the compiler to include the file only once even it is included several times by the source code.

`$Include` is an alternative form of `include`, existing only for compatibility with QuickBASIC. It is recommended to use `#include` instead.

The compiler will automatically convert path separator characters (`'/'` and `'\'`) as needed to properly load the file. The filename name may be an absolute or relative path.

For relative paths, or where no path is given at all, the include file is search for in the following order:

- Relative from the directory of the source file
- Relative from the current working directory
- Relative from addition directories specified with the `-i` command line option
- The include folder of the FreeBASIC installation (`FreeBASIC\inc` where `FreeBASIC` is the folder where the `fbc` executable is located)

**Example**

```bas
' header.bi file
Type FooType
   Bar As Byte
   Barbeque As Byte
End Type
```

```bas
' main.bas file
#include "header.bi"

Dim Foo As FooType

Foo.Bar = 1
Foo.Barbeque = 2
```

**Differences from QB**
- New to FreeBASIC

**See also**
- `#define`
- `#inclib`
- **Compiler Option: -i**
- **Compiler Option: -include**
Preprocessor statement to set the compiler dialect.

**Syntax**

```
#lang "lang"
```

**Parameters**

"lang"

The dialect to set, enclosed in double quotes, and must be one of "fb", "fblite", "qb", or "deprecated".

**Description**

If the `-forcelang` option was not given on the command line, `#lang` can be used to set the dialect for the source module in which it appears. At most two passes will be made on the source module. On the first pass, if the specified dialect is anything other than the default dialect (chose with `-lang`, or "fb" by default), the compiler will reset the parser for another pass and restart compilation at the beginning of the source module. If this directive is encountered again on the second pass, and the specified dialect does not match the new current dialect, a warning is issued and compilation continues. If any errors were encountered on the first pass, the compiler will not attempt a second pass.

`#lang` may not be used in any compound statement, scope, or subroutine. However, it may be nested in module level preprocessor statements or used in an include file.

There is currently no restriction on where this directive may be placed in a source module. In future this may change, therefore best practice would be to use this directive before the first declaration, definition, or executable statement in the source.

This directive overrides the `-lang` option if it was given on the command line. However, if the `-forcelang` option was given on the command line, this directive will have no effect. A warning is issued,
the directive is ignored, and compilation will continue. This allows the user to explicitly override #lang directives.

Example

```plaintext
#lang "fblite"
```

Differences from QB

- New to FreeBASIC

See also

- $Lang
- __FB_LANG__
- Compiler Option: -lang
- Compiler Option: -forcelang
- FreeBASIC Dialects
Preprocessor statement to add a search path for libraries

**Syntax**

```
#libpath "path"
```

**Description**

Adds a library search path to the linker's list of search paths as if it had been specified on the command line with the `-p` option.

Paths are relative to the working directory where `fbc` was invoked and relative to the directory of the source file.

No error is generated if the path does not exist and compilation and linking will continue.

**Example**

```
' search the lib directory for external libraries
#libpath "lib"
```

**Differences from QB**

- New to FreeBASIC

**See also**

- `#inlib`
- `#include`
- **Compiler Option: -p**
Preprocessor directive to set the current line number and file name

**Syntax**
```
#line number [ "name" ]
```

**Parameters**
- `number`: new line number
- "name": new file name (optional)

**Description**
Informs the compiler of a change in line number and file name and updates the `__LINE__` macro values accordingly.

Both compile time messages and run-time messages are affected by this directive.

This directive allows other programs to generate source code for the FreeBASIC compiler and have it return warning and/or error messages that refer to the original source file.

**Example**
```
#line 155 "outside.src"

Error 1000

'' Output is:
'' Aborting due to runtime error 1000 at line 157
```

**Differences from QB**
- New to FreeBASIC

See also

- __FILE__
- __LINE__
#pragma

Preprocessor directive

**Syntax**

```
#pragma option [ = value ]
Or
#pragma push ( option [, value ] )
Or
#pragma pop ( option )
```

**Parameters**

Possible values for `option` and related `values`:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>msbitfields</td>
<td>0</td>
<td>Use bitfields compatible with gcc (default)</td>
</tr>
<tr>
<td></td>
<td>-1 (or any other non-zero value)</td>
<td>Use bitfields compatible with those used in Microsoft</td>
</tr>
<tr>
<td>once</td>
<td>N/A</td>
<td>cause the source file in which the pragma appears to include once ...</td>
</tr>
</tbody>
</table>

If `value` is not given, the compiler assumes `-1 (TRUE)`.

**Description**

Allows the setting of compiler options inside the source code.

**Push** saves the current value of the `option` onto a stack, then assigns restores the `option` to its previous value, and removes it from the stack. This mechanism allows options to be changed for a certain part of source code, regardless of context, which is especially useful inside `#include` header files.

**Example**

```
' ' MSVC-
```
compatible bitfields: save the current setting and
#pragma push(msbitfields)

' ' do something that requires MS-compatible bitfields

' ' restore original setting
#pragma pop(msbitfields)

Differences from QB

- New to FreeBASIC

See also

- #include
#print

Preprocessor diagnostic directive

**Syntax**
```
#print text
```

**Description**
Causes compiler to output `text` to screen during compilation.

**Example**
```
#print Now compiling module foo
```

**Differences from QB**
- New to FreeBASIC

**See also**
- `#error`
Preprocessor directive to undefine a macro

**Syntax**

```plaintext
#define symbol
```

**Description**

Undefines a symbol previously defined with `#define`.

Can be used to ensure that a macro or symbol has a limited lifespan and does not conflict with a similar macro definition that may be defined later in the source code.

(Note: `#undef` should not be used to undefine variable or function names used in the current function scope. The names are needed internally by the compiler and removing them can cause strange and unexpected results.)

**Example**

```plaintext
#define ADD2(a_, b_) ((a_) + (b_))
Print ADD2(1, 2)
' Macro no longer needed so get rid of it ...
#undef ADD2
```

**Differences from QB**

- New to Freebasic

**See also**

- `#define`
- `#macro`
- #if
- #else
- #elseif
- #endif
- #ifdef
- #ifndef
- #ifndef
- defined
$Dynamic

Metacommmand to change the way arrays are allocated

Syntax

'$Dynamic
or
Rem $Dynamic

Description

'$Dynamic is a metacommand that specifies that any following array declarations are variable-length, whether they are declared with constant subscript ranges or not. This remains in effect for the rest of the module in which '$Dynamic is used, and can be overridden with '$Static. It is equivalent to the Option Dynamic statement.

Example

' compile with -lang fblite or qb

#lang "fblite"

'$DYNAMIC
Dim a(100)
'......
ReDim a(200)

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.

Differences from QB

- When used inside comments it must be the first token
See also

- $Static
- Dim
- ReDim
- Erase
- Option Dynamic
$Include

Metacommand statement to include contents of another source file

**Syntax**

```
'$Include [once]: 'file'
or
Rem $Include [once]: 'file'
```

**Description**

$Include inserts source code from another file at the point where the $Include metacommand appears. This has the effect of compiling the source code from the include file as though it were part of the source file that includes it. Once the compiler has reached the end of the include file, the original source file continues to be compiled.

The once specifier tells the compiler to include the file only once even it is included several times by the source code.

'$Include: exists for compatibility with QuickBASIC. It is recommended to use #include instead.

**Example**

```basic
' header.bi file
Type FooType
  Bar As Byte
  Barbeque As Byte
End Type
Dim Foo As FooType

'' compile with -lang fblite or qb
#lang "fblite"
```
Dialect Differences

- Only available in the `-lang fblite` and `-lang qb` dialects.

Differences from QB

- None

See also

- `#include`
$Static

Metacommmand to change the way arrays are allocated

**Syntax**

```plaintext
'SStatic
or
Rem $Static
```

**Description**

'SStatic is a metacommmand that overrides the behavior of $Dynamic, that is, arrays declared with constant subscript ranges are fixed-length. This remains in effect for the rest of the module in which 'SStatic is used, and can be overridden with $Dynamic. It is equivalent to the Option Static statement.

**Example**

```plaintext
' compile with -lang fblite or qb

#lang "fblite"

'$dynamic
Dim a(100)   '<<this array will be variable-length
'$static
Dim b(100)   '<<this array will be fixed-length
```

**Dialect Differences**

- Only available in the -lang fblite and -lang qb dialects.

**Differences from QB**

- When used inside comments it must be the first token
See also

- $Dynamic
- Dim
- Erase
- ReDim
- Option Dynamic
- Option Static
$Lang

Metacommend statement to set the compiler dialect.

**Syntax**

'\$lang: "lang"

or

Rem $lang: "lang"

**Parameters**

"lang"
The dialect to set, enclosed in double quotes, and must be one of "fb" "fblite", "qb", or "deprecated".

**Description**

If the **-forcelang** option was not given on the command line, $Lang can be used to set the dialect for the source module in which it appears. At most two passes will be made on the source module. On the first pass, if the specified dialect is anything other than the default dialect (chosen with -lang, or "fb" by default), the compiler will reset the parser for another pass and restart compilation at the beginning of the source module. If this metacommand is encountered again on the second pass, and the specified dialect does not match the new current dialect a warning is issued and compilation continues. If any errors were encountered on the first pass, the compiler will not attempt a second pass.

$Lang may not be used in any compound statement, scope, or subroutine. However, it may be nested in module level preprocessor statements or used in an include file.

There is currently no restriction on where this directive may be placed in a source module. In future this may change, therefore best practice would be to use this directive before the first declaration, definition, or executable statement in the source.

This directive overrides the **-lang** option if it was given on the
command line. However, if the -forcelang option was given on the command line, this directive will have no effect. A warning is issued, the directive is ignored, and compilation will continue. This allows the user to explicitly override $Lang metacommands.

This metacommand was introduced in FreeBASIC version 0.20.0. Older versions of FB, and QuickBASIC, will treat it as a comment and silently ignore it.

**Example**

```
'$lang: "qb"
```

**Differences from QB**

- New to FreeBASIC
- QB handles '$lang: as a normal comment

**See also**

- #lang
- __FB_LANG__
- Compiler Option: -lang
- Compiler Option: -forcelang
- FreeBASIC Dialects
Abs

Calculates the absolute value of a number

Syntax

```
Declare Function Abs ( ByVal number As Long ) As Long
Declare Function Abs ( ByVal number As Ulong ) As Ulong
Declare Function Abs ( ByVal number As LongInt ) As LongInt
Declare Function Abs ( ByVal number As ULongInt ) As ULongInt
 Declare Function Abs ( ByVal number As Double ) As Double
```

Usage

```
result = Abs( number )
```

Parameters

- **number**
  
  Value to find the absolute value of.

Return Value

The absolute value of **number**.

Description

The absolute value of a number is its positive magnitude. If a number is negative, its value will be negated and the positive result returned. For example, `Abs(-1)` and `Abs(1)` both return 1. The required **number** argument can be any valid numeric expression. Unsigned numbers will be treated as if they were signed, i.e. if the highest bit is set the number will be treated as negative, and its value negated.

The value returned will be greater than or equal to 0, with the exceptic of signed integers containing the lowest possible negative value that can be stored in its type, in which case negating it will overflow the result.

The **Abs** unary **Operator** can be overloaded with user defined types.
Example

```vbnet
Dim n As Integer

Print Abs( -1 )
Print Abs( -3.1415 )
Print Abs( 42 )
Print Abs( n )

n = -69

Print Abs( n )
```

Output:

1
3.1415
42
0
69

Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- Sgn
- Operator
Abstract

Declare abstract methods

Syntax

\[
\text{Type typename Extends base_typename} \\
\text{Declare Abstract Sub|Function|Property|Operator ...} \\
\text{End Type}
\]

Description

Abstract is a special form of \texttt{Virtual}. The difference is that abstract methods do not have a body, but just the declaration. Essentially this allows the declaration of an interface which can be implemented by various derived types.

In order to call an abstract method, it must have been overridden and implemented by a derived data type, or else the program will abort. As a result, only types that implement all the abstract methods are allowed to create objects. For the same reason, a constructor should not call an unimplemented method.

\texttt{Constructors} cannot be abstract, since they cannot be virtual. In addition, abstract \texttt{Destructors} are not supported either, because a destructor body (no matter whether implicit or explicit) is needed in order to call base and field destructors.

Abstracts are called "pure virtual" in C++ (unlike FreeBASIC, C++ allows pure virtuals to have a body, but accessible only statically).

\textbf{Note}: In a multi-level inheritance, a same named method (same identifier and signature) can be declared \texttt{Abstract, Virtual} or normal (without specifier) at each inheritance hierarchy level. When there is mixing of specifiers, the usual order is abstract -> virtual -> normal, from top to bottom of the inheritance hierarchy. The access control (Public/Protected/Private) of an overriding method is not taken into account by the internal polymorphism process, but only for the initial call at compile-time.
A derived static method cannot override a base virtual/abstract method, but can shadow any base method (including virtual/abstract).

Example

```plaintext
Type Hello extends object
    Declare abstract Sub hi( )
End Type

Type HelloEnglish extends Hello
    Declare Sub hi( )
End Type

Type HelloFrench extends Hello
    Declare Sub hi( )
End Type

Type HelloGerman extends Hello
    Declare Sub hi( )
End Type

Sub HelloEnglish.hi( )
    Print "hello!"
End Sub

Sub HelloFrench.hi( )
    Print "Salut!"
End Sub

Sub HelloGerman.hi( )
    Print "Hallo!"
End Sub

Randomize( Timer( ) )

Dim As Hello Ptr h
```
For i As Integer = 0 To 9
    Select Case( Int( Rnd( ) * 3 ) + 1 )
        Case 1
            h = New HelloFrench
        Case 2
            h = New HelloGerman
        Case Else
            h = New HelloEnglish
    End Select

    h->hi( )
    Delete h
Next

**Dialect Differences**
- Only available in the `-lang fb` dialect.

**Differences from QB**
- New to FreeBASIC

**See also**
- `Virtual`
- `Type`
- `Extends`
- `Object`
Access

Clause of the **open** statement to specify requested privileges

**Syntax**

```
Open filename for Binary Access {Read | Write | Read Write} as [#]
```

**Usage**

```
open filename for binary Access Read as #filenum
open filename for binary Access Write as #filenum
open filename for binary Access Read Write as #filenum
```

**Parameters**

**Read**
- Open the file with only read privileges.

**Write**
- Open the file with only write privileges.

**Read Write**
- Open the file with read and write privileges.

**Description**

**Access** is used with the **open** statement to request read, write, or read and write access. If the **Access** clause is not specified, Read Write is assumed.

**Example**

This example shows how to open the file "data.raw" with Read access, and then "data.out" with access in Binary mode, in an open file number returned by **FreeFile**.

```
Dim As Integer o

' get an open file number.
o = FreeFile

' open file for read-only access.
Open "data.raw" For Binary Access Read As #o
```
'' make a buffer in memory thats the entire size of the file
Dim As UByte file_char( LOF( o ) - 1 )

'' get the file into the buffer.
Get #o, , file_char()
Close

'' get another open file number.
o = FreeFile

'' open file for write-only access.
Open "data.out" For Binary Access Write As #o

'' put the buffer into the new file.
Put #o, , file_char()
Close

Print "Copied file ""data.raw"" to file ""data.out"

Sleep

Differences from QB
- None known.

See also
- Open
- Read
- Write
Acos

Finds the arccosine of an angle

Syntax

 Declare Function Acos ( ByVal number As Double ) As Double

Usage

 result = Acos( number )

Parameters

 number

 A cosine value in the range [-1..1].

Return Value

 The arccosine of number, in radians, in the range [0..Pi].

Description

 Acos returns the arccosine of the argument number as a Double within the inverse of the Cos function. The returned angle is measured in rad.

Example

 Dim h As Double
 Dim a As Double
 Input "Please enter the length of the hypotenuse of a triangle: "; h
 Input "Please enter the length of the adjacent side: "; a
 Print ""
 Print "The angle between the sides is"; Acos ( a / h )
 Sleep

The output would look like:

 Please enter the length of the hypotenuse of a triangle: 5
Please enter the length of the adjacent side of the triangle: 4

The angle between the sides is 0.6435011087932843

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- Cos
- *A Brief Introduction To Trigonometry*
**Add**

Parameter to the *Put* graphics statement which selects addition as the blitting method.

**Syntax**

\[
\text{Put} \quad [ \quad \text{target}, \quad ] \quad [ \quad \text{STEP} \quad ] \quad ( \quad x,y \quad ), \quad \text{source} \quad [ \quad ,\quad ( \quad x1,y1 \quad )-( \quad x2,y2 \quad ) \quad ,\quad \text{multiplier} \quad ]
\]

**Parameters**

- **Add**
  - **Required.**
  - **multiplier**
    - Optional value between 0 and 255. The source pixels are premultiplied \((\text{multiplier} \div 256)\) before being added. If omitted, this value defaults to 255.

**Description**

*Add* selects addition as the method for blitting an image buffer. For each target pixel, the values of each respective component are added together to produce the result. The addition is saturated - i.e. if the sum of the two values is 256 or more, it will be cropped down to 255.

This method will work in all color modes. Mask colors (color 0 for indexed images, magenta \((\text{RGB}(255, 0, 255))\) for full color images) will be skipped, though values of 0 \((\text{RGBA}(0, 0, 0, 0))\) will have also have no effect.

**Example**

```basic
'\'open a graphics window
ScreenRes 320, 200, 16

'\'create a sprite containing a circle
Const As Integer r = 32
Dim c As Any Ptr = ImageCreate(r * 2 + 1, r * 2 + 1, r, RGB(255, 255, 192), , , 1, f
Circle c, (r, r), r, RGB(255, 255, 192), , , 1, f
```
'put the sprite at three different multiplier
'levels, overlapping each other in the middle
Put (146 - r, 108 - r), c, add, 64
Put (174 - r, 108 - r), c, add, 128
Put (160 - r, 84 - r), c, add, 192

'free the memory used by the sprite
ImageDestroy  c

'pause the program before closing
Sleep

Differences from QB
- New to FreeBASIC

See also
- Trans
- Alpha
- Custom
- Put (Graphics)
Alias

Clause of the Sub and Function statements that provides an alternate int...

Syntax

[Declare] { Sub | Function } usablename Alias "alternatename" ( ... )

Usage

declare sub usablename Alias "alternatename" ( ... )
or
declare function usablename Alias "alternatename" ( ... )
or
sub usablename Alias "alternatename" ( ... )
...
end sub
or
function usablename Alias "alternatename" ( ... )
...
end function

Description

Alias gives an alternate name to a procedure. This alternate name cannot (if the function is not private) to the linker when linking with code written

Alias is commonly used for procedures in libraries written in other languages but invalid in BASIC. When using Alias with Declare, only the alternate

Differently from normal procedure names, Alias does not change the case of an exported function with a particular name or with a particular case.

Example

If there is a sub called xClearScreen in an external library and you want to do so:

Declare Sub ClearVideoScreen Alias "xClearScreen" ( ... )
A procedure meant to be used by external C code, exported as `MyExportedProc`.

```plaintext
Function MultiplyByFive cdecl Alias "MyExportedProc"
    Return Parameter * 5
End Function
```

**Differences from QB**

- In QB, `Alias` only worked with `Declare`.

**See also**

- `Declare`
- `Export`
Allocate

Allocates a block of memory from the free store

Syntax

Declare Function Allocate cdecl ( ByVal count As UInteger ) As A

Usage

result = Allocate( count )

Parameters

count

The size, in bytes, of the block of memory to allocate.

Return Value

If successful, the address of the start of the allocated memory is returned.

If allocated, or if count < 0, then the null pointer (0) is returned.

Description

Attempts to allocate, or reserve, count number of bytes from the free store.

As the initial value of newly allocated memory is unspecified, Allocate string, because the string descriptor being not cleared (containing random data) to write to a random place in memory or trying to deallocate a random containing string) to use Calllocate (clearing memory), or New (calling constructor) explicitly clear the descriptor (setting to 0) before the first string use.

The pointer that is returned is an Any Ptr and points to the start of the allocated memory.

Allocated memory must be deallocated, or returned back to the free store.

Example
This program uses the ALLOCATE(...) function to create a buffer of 15 integers that is then filled with the first 15 numbers of the Fibonacci sequence, then output to the screen. Note the call to DEALLOCATE(...) at the end.

```
Const integerCount As Integer = 15

' Try allocating memory for a number of integers
Dim buffer As Integer Ptr
buffer = Allocate(integerCount * SizeOf(Integer))

If (0 = buffer) Then
    Print "Error: unable to allocate memory, quitting."
End If

' Prime and fill the memory with the fibonacci sequence
buffer[0] = 0
buffer[1] = 1
For i As Integer = 2 To integerCount - 1
    buffer[i] = buffer[i - 1] + buffer[i - 2]
Next

' Display the sequence.
For i As Integer = 0 To integerCount - 1
    Print buffer[i];
Next

Deallocate(buffer)
End 0
```

Output is:

```
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377
```
It is important to free allocated memory if it's not going to be used any more, and if the address of that memory is somehow overwritten or forgotten, known as a memory leak, and should be avoided at all costs. Note that if the application terminates, either by an "ordinary" exit or crash, so the leak disappears, nevertheless it's a good habit to free any allocated memory inside your function with a memory leak, where the address of allocated memory is somehow lost and can't be freed anymore. If such a function is called frequently, the total amount of memory wasted can add up quickly.

```
'' Bad example of Allocate usage, causing memory leak

Sub BadAllocateExample()
    Dim p As Byte Ptr
    p = Allocate(420)  ' assign pointer to new memory
    p = Allocate(420)  ' reassign same pointer to different memory,
                      ' old address is lost and that memory is leaked
    Deallocate(p)
End Sub

'' Main
BadAllocateExample() ' Create a memory leak
Print "Memory leak!"
BadAllocateExample() ' ... and another
Print "Memory leak!"
End
```

**Platform Differences**

- This procedure is not guaranteed to be thread-safe.

**Dialect Differences**
- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**
- New to FreeBASIC

**See also**
- CAllocate
- Reallocate
- Deallocate
Alpha

Parameter to the Put graphics statement which selects alpha blending as the method for putting an image. If the Alpha parameter is not specified, Alpha will only work in 32-bit color depth, and pixels using the mask color will be treated as normal, and drawn with their given alpha value.

Description

Alpha selects alpha blending as the method for putting an image. If the Alpha parameter is not specified, Alpha will only work in 32-bit color depth, and pixels using the mask color will be treated as normal, and drawn with their given alpha value.

If alphaval is not specified, Alpha will only work in 32-bit color depth, and pixels using the mask color will be treated as normal, and drawn with their given alpha value.

Alpha also has another mode which allows an 8-bit image to be put on top of a 32-bit image by using the alpha channel of the 32-bit image with the contents of the 8-bit image.

Alpha values range between 0 and 255. An alpha value of 0 will not draw the image at all, and an alpha value of 255 will render the image as if it were being drawn using the Transblitting mode. All other alpha values intermediate between these two extremes blend the image.

Example

This example compares the two different Alpha modes, including how they react to the mask color.

```
'' Set up a 32-bit screen
ScreenRes 320, 200, 32

'' Draw checkered background
```
For y As Integer = 0 To 199
   For x As Integer = 0 To 319
      PSet (x, y), IIf((x Shr 2 Xor y Shr 2) And
   Next x
Next y
' Make image sprite for Putting
Dim img As Any Ptr = ImageCreate(32, 32, RGBA(0, 0, 0, 0))
For y As Single = -15.5 To 15.5
   For x As Single = -15.5 To 15.5
      Dim As Integer r, g, b, a
      If y <= 0 Then
         If x <= 0 Then
            r = 255: g = 0: b = 0   ' red
         Else
            r = 0: g = 0: b = 255   ' blue
         End If
      Else
         If x <= 0 Then
            r = 0: g = 255: b = 0   ' green
         Else
            r = 255: g = 0: b = 255 ' magenta
         End If
      End If
      a = 255 - (x ^ 2 + y ^ 2)
      If a < 0 Then a = 0   ' r = 255: g = 0: b =
      PSet img, (15.5 + x, 15.5 - y), RGBA(r, g,
   Next x
Next y
' Put with single Alpha value, Trans for comparison
Draw String (32, 10), "Single alpha"
Put (80 - 16, 50 - 16), img, Alpha, 64
Put (80 - 16, 100 - 16), img, Alpha, 192
Put (80 - 16, 150 - 16), img, Trans
' Put with full Alpha channel
Draw String (200, 10), "Full alpha"
Put (240 - 16, 100 - 16), img, Alpha
This example shows the special method for setting a 32-bit alpha channel using an 8-bit image.

Dim As Any Ptr img8, img32
Dim As Integer x, y, i

' ' Set up an 8-bit graphics screen
ScreenRes 320, 200, 8
For i = 0 To 255
    Palette i, i, i, i
Next i
Color 255, 0

' ' Create an 8-bit image
img8 = ImageCreate(64, 64, 0, 8)
For y = 0 To 63
    For x = 0 To 63
        Dim As Single x2 = x - 31.5, y2 = y - 31.5
        Dim As Single t = Sqr(x2 ^ 2 + y2 ^ 2) / 5
        PSet img8, (x, y), Sin(t) ^ 2 * 255
    Next x
Next y

Draw String (16, 4), "8-bit Alpha sprite"
Put (16, 16), img8
Sleep
' Set up a 32-bit graphics screen
ScreenRes 320, 200, 32
For y = 0 To 199
    For x = 0 To 319
        PSet (x, y), IIf(x - y And 3, RGB(160, 160, 160), RGB(0, 0, 0))
    Next x
Next y

' Create a 32-bit, fully opaque sprite
img32 = ImageCreate(64, 64, 0, 32)
For y = 0 To 63
    For x = 0 To 63
        PSet img32, (x, y), RGB(x * 4, y * 4, 128)
    Next x
Next y

Draw String (16, 4), "Original Alpha channel"
Put (16, 16), img32, Alpha

' Put a new alpha channel using the 8-bit image
Put img32, (0, 0), img8, Alpha

Draw String (16, 104), "New Alpha channel"
Put (16, 116), img32, Alpha

' Free the memory for the two images
ImageDestroy img8
ImageDestroy img32

Sleep
Differences from QB

- New to FreeBASIC

See also

- Put (Graphics)
- Trans
- Custom
Operator And (Conjunction)

Returns the bitwise-and (conjunction) of two numeric values

Syntax

Declare Operator And ( ByRef lhs As T1, ByRef rhs As T2 ) As Ret

Usage

result = lhs And rhs

Parameters

lhs
The left-hand side expression.
T1
Any numeric or boolean type.
rhs
The right-hand side expression.
T2
Any numeric or boolean type.
Ret
A numeric or boolean type (varies with T1 and T2).

Return Value

Returns the bitwise-and (conjunction) of the two operands.

Description

This operator returns the bitwise-and of its operands, a logical operation on operands (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value).

The truth table below demonstrates all combinations of a boolean-and:

<table>
<thead>
<tr>
<th>Lhs Bit</th>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
No short-circuiting is performed - both expressions are always evaluated.

The return type depends on the types of values passed. `Byte`, `UByte` and right-hand side types differ only in signedness, then the return type is the two types is returned. Only if the left and right-hand side types are the same, this operator can be overloaded for user-defined types.

**Example**

```vbnet
' Using the AND operator on two numeric values
Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 15 '00001111
numeric_value2 = 30 '00011110

'Result = 14 = 00001110
Print numeric_value1 And numeric_value2
Sleep

' Using the AND operator on two conditional expressions
Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 15
numeric_value2 = 25
If numeric_value1 > 10 And numeric_value1 < 20 Then
    If numeric_value2 > 10 And numeric_value2 < 20 Then
        Sleep
    End If
End If

' This will output "Numeric_Value1 is between 10 and 20" because both conditions of the IF statement is true
' It will not output the result of the second IF statement because the first condition is true and the second is false.
```
Dialect Differences

- In the *-lang qb* dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- AndAlso
- Operator Truth Tables
Operator Andalso (Short Circuit Conjunction)

Returns the short circuit-and (conjunction) of two numeric values

Syntax

Declare Operator AndAlso ( ByRef lhs As T1, ByRef rhs As T2 ) As

Usage

result = lhs AndAlso rhs

Parameters

lhs
The left-hand side expression.
T1
Any numeric or boolean type.
rhs
The right-hand side expression.
T2
Any numeric or boolean type.
Ret
A numeric or boolean type (varies with T1 and T2).

Return Value

Returns the short circuit-and (conjunction) of the two operands.

Description

This operator evaluates the left hand side expression. If the result is zero immediately returned. If the result is nonzero then the right hand side the logical result from that is returned.
(for conversion of a boolean to an integer, false or true boolean value integer value)

The truth table below demonstrates all combinations of a short circuit-
'-' denotes that the operand is not evaluated.
<table>
<thead>
<tr>
<th>Lhs Value</th>
<th>Rhs Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>nonzero</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>nonzero</td>
<td>nonzero</td>
<td>-1</td>
</tr>
</tbody>
</table>

Short-circuiting is performed - only expressions needed to calculate the result are evaluated.

The return type is almost always an `Integer`, of the value 0 or -1, denoting false and true respectively. Except if the left and right-hand side types are both `Boolean` type is also `Boolean`.

This operator cannot be overloaded for user-defined types.

**Example**

```
'' Using the ANDALSO operator to guard against array access when the index is out of range

Dim As Integer isPrime(1 To 10) = { _
    ' 1 2 3 4 5 6 7 8 9 10
    0, 1, 1, 0, 1, 0, 1, 0, 0, 0 _
}

Dim As Integer n
Input "Enter a number between 1 and 10: ", n

'' isPrime() array will only be accessed if n is in range
If (n >= 1 And n <= 10) AndAlso isPrime(n) Then
    Print "n is prime"
Else
    Print "n is not prime, or out of range"
End If
```
Differences from QB

- This operator was not available in QB.

See also

- OrElse
- And
- Operator Truth Tables
Parameter to the **Put** graphics statement which uses a bit-wise **And** as the blitting method.

**Syntax**

```
Put [ target, ] [ STEP ] ( x, y ), source [ , ( x1, y1 )-( x2, y2 ) ]
```

**Parameters**

- **And**
- Required.

**Description**

The **And** method combines each source pixel with the corresponding destination pixel using the bit-wise **And** function. The result of this is output as the destination pixel. This method works in all graphics modes. There is no mask color, although color values with all bits set (255 for 8-bit palette modes, or RGBA(255, 255, 255, 255) in full-color modes) will have no effect, because of the behavior of **And**.

In full-color modes, each component (red, green, blue and alpha) is kept in a discrete set of bits, so the operation can be made to only affect some of the channels, by setting the values of the other channels to 255.

**Example**

```
'open a graphics window
ScreenRes 320, 200, 16
Line (0, 0)-(319, 199), RGB(255, 255, 255), bf

'create 3 sprites containing cyan, magenta and yellow circles
Const As Integer r = 32
Dim As Any Ptr cc, cm, cy
cc = ImageCreate(r * 2 + 1, r * 2 + 1, RGBA(255, 255, 255, 255))
cm = ImageCreate(r * 2 + 1, r * 2 + 1, RGBA(255, 255, 255, 255))
cy = ImageCreate(r * 2 + 1, r * 2 + 1, RGBA(255, 255, 255, 255))
Circle cc, (r, r), r, RGB(0, 255, 255), , , 1, f
Circle cm, (r, r), r, RGB(255, 0, 255), , , 1, f
```
Circle cy, (r, r), r, RGB(255, 255, 0), , , 1, f

''put the three sprites, overlapping each other in
Put (146 - r, 108 - r), cc, And
Put (174 - r, 108 - r), cm, And
Put (160 - r, 84 - r), cy, And

''free the memory used by the sprites
ImageDestroy cc
ImageDestroy cm
ImageDestroy cy

''pause the program before closing
Sleep

Differences from QB

- None

See also

- And
- Put (Graphics)
Any is used as a placeholder for a type or value in various ways.

**Syntax**

```
Dim identifier As Any Pointer|Ptr
Or
Declare Sub|Function identifier ( ByVal identifier As Any [ , , .. )
Or
Dim identifier(Any [, Any...]) As DataType
Or
[ Declare ] { Sub | Function } proc_name ( param(Any [, Any...])
Or
Dim identifier As DataType = Any
Or
New DataType ( Any )
Or
New(Address) DataType [count] { Any }
Or
Instr|InstrRev ( string, Any substring )
```

**Description**

- **Pointers:**
  A special pointer type called the Any Pointer (or "Any Pointer") allows pointing to any variable type. Pointer arithmetic is allowed on an Any Ptr. A pure Any Ptr has no type checking by the compiler. It can be implicitly converted to and from other pointer types through assignment or parameter passing. Any on its own is not a valid data type for a variable. Also, it is illegal to dereference an Any.

- **Byref parameters:**
  Any can be used in procedure prototypes (in a Declare statement) with deprecated and it only exists for compatibility with QB.

- **Array dimensions:**
  In array declarations, Any can be specified in place of the array bound of AnyS specified (use the syntax with Any is mandatory when declaring...
In parameter declarations, Any can be also specified instead of empty parenthesis.

Initialization:
Any can be used as a fake initializer to disable the default initialization of variables to fill the variables with meaningful data before reading.

Comparison to C/C++: This matches the behavior of a variable declaration without an initialization value.

Similar to Any initializers for variables, Any can also be used with the New operator for objects that do not have constructors.

Instr/InstrRev:
Any can be used with InStr or InStrRev as a qualifier for the substring.

**Example**

```vba
Declare Sub echo(ByVal x As Any Ptr) '' echo will accept any pointer type

Dim As Integer a(0 To 9) = Any '' this variable is not initialized
Dim As Double d(0 To 4)

Dim p As Any Ptr

Dim pa As Integer Ptr = @a(0)
Print "Not initialized ";
echo pa '' pass to echo a pointer to integer

Dim pd As Double Ptr = @d(0)
Print "Initialized ";
echo pd '' pass to echo a pointer to double

p = pa '' assign to p a pointer to integer
p = pd '' assign to p a pointer to double

Sleep

Sub echo (ByVal x As Any Ptr)
Dim As Integer i
For i = 0 To 39
```


'echo interprets the data in the pointer as bytes
Print Cast(UByte Ptr, x)[i] & " ";
   Next
   Print
End Sub

'Example of ANY disabling the variable type checking
Declare Sub echo (ByRef a As Any) '' ANY disables

Dim x As Single
x = -15
echo x                '' Passing a single to a function that expects an integer.
Sleep

Sub echo (ByRef a As Integer)
   Print Hex(a)
End Sub

Dim a(Any) As Integer ' 1-dimensional dynamic array
Dim b(Any, Any) As Integer ' 2-dimensional dynamic array
Dim c(Any, Any, Any) As Integer ' 3-dimensional dynamic array ' etc.

' Further Redims or array accesses must have a matching size.
ReDim a(0 To 1) As Integer
ReDim b(1 To 10, 2 To 5) As Integer
ReDim c(0 To 9, 0 To 5, 0 To 1) As Integer

Dialect Differences

- Not available in the -lang qb dialect.
Differences from QB

- Pointers and initializers are new to FreeBASIC.

See also

- Dim
- Declare
Append

Specifies text file to be opened for append mode

Syntax

```
Open filename for Append [Encoding encoding_type] [Lock lock_type] as [#]filenum
```

Parameters

- `filename`
  file name to open for append
- `encoding_type`
  indicates encoding type for the file
- `lock_type`
  locking to be used while the file is open
- `filenum`
  unused file number to associate with the open file

Description

A file mode used with `Open` to open a text file for writing.

This mode is used to add text to an existing file with `Print #`, or comma separated values with `Write#`.

Text files can’t be simultaneously read and written in FreeBASIC, so if both functions are required on the same file, it must be opened twice.

`filename` must be a string expression resulting in a legal file name in the target OS, without wildcards. The file will be sought for in the present directory, unless the `filename` contains a path. If the file does not exist, it is created. The pointer is set after the last character of the file.

`Encoding_type` indicates the Unicode `Encoding` of the file, so characters are correctly read. If omitted, "ascii" encoding is defaulted. Only little endian character encodings are supported at the moment.

- "utf8"
- "utf16"
- "utf32"
- "ascii" (the default)

*Lock_type* indicates the way the file is locked for other processes, it is one of:

- **Read** - the file can be opened simultaneously by other processes, but not for reading
- **Write** - the file can be opened simultaneously by other processes, but not for writing
- **Read Write** - the file cannot be opened simultaneously by other processes (the default)

*filenum* Is a valid FreeBASIC file number (in the range 1..255) not being used for any other file presently open. The file number identifies the file for the rest of file operations. A free file number can be found using the *FreeFile* function.

**Example**

```basic
Dim i As Integer
For i = 1 To 10
    Open "test.txt" For Append As #1
    Print #1, "extending test.txt"
    Close #1
Next
```

**Differences from QB**

- None

**See also**

- *Input (File Mode)*
- *Open*
- Output
- `(Print | ?)` #
- `Write` #
Optional part of a declaration which specifies a data type, or part of the Open statement which specifies a file handle.

**Syntax**

```
symbolname As datatype
```

```
Open ... As #filenumber
```

```
Type ... As datatype
```

**Description**

As is used to declare the type of variables, fields or arguments and is also used in the statement to determine the file handle. As is also used with the `Type (Alias)` to C's `typedef` statement.

**Example**

```
' don't try to compile this code, the examples are
Declare Sub mySub (X As Integer, Y As Single, Z As String)
'...

Dim X As Integer
'...

Type myType
  X As Integer
  Y As Single
  Z As String
End Type
'...

Type TheNewType As myType
'...

Open "test" For Input As #1
'...
```
Differences from QB

- The **Type (Alias)** syntax was not supported in QB.

See also

- Declare
- Dim
- Type
- Open
**Assert**

Debugging macro that halts program execution if an expression is evaluated to 0.

**Syntax**

```c
#define Assert(expression) If (expression) = 0 Then : fb_Assert(#expression) : End If
```

**Usage**

```c
Assert( expression )
```

**Parameters**

- `expression`

Any valid conditional/numeric expression. If `expression` evaluates to 0, then it stops the program execution.

**Description**

The `Assert` macro is intended for use in debugging and works only if the `-g` command line is passed to `fbc`. In this case, it prints an error message and stops the program execution if the expression evaluates to 0.

Its normal use is to check the correct value of the variables during debugging.

If `-g` is not passed to `fbc`, the macro does not generate any code, and

Note: If an `Assert` fails while the program is in a graphics `Screen`, the error message will not be printed to the graphics screen, which will be closed immediately after.

**Example**

```c
Sub foo
    Dim a As Integer
    a=0
    Assert(a=1)
End Sub
```
foo

'' If -g is used this code stops with: test.bas(3): assertion failed at FOO: a=1

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- #Assert
- AssertWarn
**AssertWarn**

Debugging macro that prints a warning if an expression evaluates to 0.

**Syntax**

```c
#define AssertWarn(expression) If (expression) = 0 Then : fb_Ass __FUNCTION__, #expression ) : End If
```

**Usage**

```c
AssertWarn( expression )
```

**Parameters**

- `expression`
  - Any valid expression. If `expression` evaluates to 0, a warning message is printed to stdout (console).

**Description**

The `AssertWarn` macro is intended for use in debugging and works only on the FBC command line. In this case it prints a warning message if `expression` evaluates to 0, the program execution like `Assert` does.

Its normal use is to check the correct value of the variables during debugging.

If `-g` is not passed to `fbc`, the macro does not generate any code.

**Example**

```basic
Sub foo
    Dim a As Integer
    a=0
    AssertWarn(a=1)
End Sub

foo
'' If -
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Assert
Returns the corresponding ASCII or Unicode integer representation of a character

**Syntax**

```
Declare Function Asc ( ByVal str As Const String, ByVal position As Integer = 1 ) As Ulong
Declare Function Asc ( ByVal str As Const ZString Ptr, ByVal position As Integer = 1 ) As Ulong
Declare Function Asc ( ByVal str As Const WString Ptr, ByVal position As Integer = 1 ) As Ulong
```

**Usage**

```
result = Asc( str [, position ] )
```

**Parameters**

*str*

The source string.

*position*

The position in the string of a character.

**Return Value**

The raw character value stored at *position* in *str*.

**Description**

If *str* is a *String* or a *ZString*, the *UByte* value at that *position* is returned. This will be a 7-bit ASCII code, or even an 8-bit character value from some code-page, depending on the string data stored in *str*.

If *str* is a *WString*, the *UShort* (Windows) or *Ulong* (Linux) value at that *position* is returned. This will be a 16-bit value on Windows (WStrings UTF16 there), or a 32-bit value on Linux (WStrings use UTF32 there).

The function returns zero (0) if the string is a zero length string, *position* less than one (1), or *position* is greater than the number of characters.
str.

**Chr** performs the opposite function for ASCII strings, while **wChr** is the opposite for Unicode strings, returning a string containing the character represented by the code passed as an argument.

**Example**

```basic
Print "the ascii code of 'a' is:"; Asc("a")
Print "the ascii code of 'b' is:"; Asc("abc", 2)
```

will produce the output:

```
the ascii code of 'a' is: 97
the ascii code of 'b' is: 98
```

Unicode example (Note to documentation editors: don’t put inside %%% (qbasic) markers or the Russian text will disappear!)

```basic
dim a as wstring * 11
a = "Привет, мир"
print "the Unicode of the second char of " & a & " is: " & asc(a)
```

will produce the output:

```
the Unicode of the second char of Привет, мир is: 1088
```

**Platform Differences**

- DOS does not support the wide-character string version of **Asc**.

**Differences from QB**

- The optional *position* argument is new to FreeBASIC.
QB does not support the wide-character string version of Asc

See also

- ASCII Character Codes
- Chr
- Str
- Val
**Asin**

Finds the arcsine of a number

**Syntax**

```vbscript
Declare Function Asin ( ByVal number As Double ) As Double
```

**Usage**

```vbscript
result = Asin( number )
```

**Parameters**

- `number`
  
  Sine value in the range [-1..1].

**Return Value**

The arcsine of `number`, in radians, in the range [-Pi/2..Pi/2].

**Description**

`Asin` returns the arcsine of the argument `number` as a `Double` within the inverse of the `sin` function. The returned angle is measured in radians.

**Example**

```vbscript
Dim h As Double
Dim o As Double
Input "Please enter the length of the hypotenuse of the triangle:"
Input "Please enter the length of the opposite side:"
Print ""
Print "The angle between the sides is"; Asin ( o / h )
Sleep
```

The output would look like:
Please enter the length of the hypotenuse of a triangle: 5
Please enter the length of the opposite side of the triangle: 3
The angle between the sides is 0.6435011087932844

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Sin
- A Brief Introduction To Trigonometry
Code block that allows the use of architecture-specific instructions.

**Syntax**

```asm
architecture-dependent instructions
End Asm
```

Or

```asm
architecture-dependent instructions
```

**Description**

The _Asm_ block is used to insert specific machine-code instructions in a program operations that cannot be carried out using the features of the language or to hand-optimize performance-sensitive sections of code.

The current FreeBASIC compiler currently only produces code for Intel x86; however, in the future, the compiler might be ported to a platform which does not support the same instruction set. Therefore, _Asm_ blocks should only be used when necessary, and an alternative should be provided if possible.

The return value of a function may be set by using the `Function` keyword, as shown in the example below:

```asm
```

Asm block comments have the same syntax as usual FreeBASIC `Comments` comments, not `;` as usual in assembly code.

**x86 Specific:**

**Syntax**

The syntax of the inline assembler is a simplified form of Intel syntax. In the majority of x86 assemblers, such as MASM, TASM, NASM, YASM and FASM, the destination of an instruction is placed first, followed by the source. Variables defined by a program may be referenced in an _Asm_ block. The assembler used by FreeBASIC is GAS, using the `.intel_syntax noprefix` directive, and _Asm_ blocks are passed through unmodified, except for the substitution of local variable names for stack frame references, and comments.
Instruction syntax is mostly the same as FASM uses, one important difference is that GAS requires size settings to be followed by the word "ptr".

```plaintext
' Assuming "n" is a FB global or local ULONG variable
mov  eax, [n]      ' OK: size is apparent from eax
inc  [n]           ' Not OK: size is not given
inc  dword [n]     ' Not OK: size given, but still
inc  dword Ptr [n] ' OK: "ptr" is needed by GAS here
```

Register Preservation
When an `asm` block is opened, the registers ebx, esi, and edi are pushed to the stack, when the block is closed, these registers are popped back from the stack. This is because these registers are required to be preserved by most or all OS's using the x86 CPU. You can therefore explicitly preserving them yourself. You should not change esp and ebp, as these are usually used to address local variables.

Register Names
The names of the registers for the x86 architecture are written as follows:
- 4-byte integer registers: eax, ebx, ecx, edx, ebp, esp
- 2-byte integer registers: ax, bx, cx, dx, bp, sp, di, si (register)
- 1-byte integer registers: al, ah, bl, bh, cl, ch, d1, dl, dh (registers)
- Floating-point registers: st(0), st(1), st(2), st(3),...
- MMX registers (aliased onto floating-point registers: mm6, mm7
- SSE registers: xmm0, xmm1, xmm2, xmm3, xmm4, xmm5, xmm6

Instruction Set
See these external references:
- Original Intel 80386 manual from 1986
- Latest Intel Pentium 4 manuals
- NASM x86 Instruction Reference (Please note that NASM is not the assembler
Unsafe instructions
Note that the FreeBASIC compiler produces 32-bit protected-mode code in an unprivileged user level; therefore, privileged and sensitive instructions possibly won't work correctly or cause a runtime "General Protection Fault" or SIGILL error. The following are the privileged and sensitive instructions on Xeon:

- cli *1
- clts
- hlt
- in *1
- ins *1
- int *1
- into *1
- invd
- invlpg
- lgdt
- lidt
- lidt
- lldt
- lmsw
- ltr
- mov to/from CRn, DRn, TRn
- out *1
- outs *1
- rdmsr
- rdpmc *2
- rdtsc *2
- sti *1
- str
- wbinvd
- wrmsr
- all SSE2 and higher instructions *2
The privileged instructions will work "correctly" in DOS when running on (non-default) Ring 0 version of CWSDPMI, WDOSX or D3X, nevertheless useful and dangerous when executed from DPMI code. RDTSC (Read Time Stamp Counter) has been shown to be allowed by most, or all OS'es.

However the usefulness of RDTSC has been diminished with the advent of CPUs. SSE2 and higher instructions are disabled "by default" after CPU initialization, Windows and Linux usually do enable them, in DOS it is business of the DPMI host: HDPMI32 will enable them, CWSDPMI won't. The INT instruction is usable in the DOS version/target differently from real-mode DOS, see also FaqDOS.

The segment registers (cs, ds, es, fs, gs) should not be changed from any cases with the DOS port (note that they do NOT work the same way as in real-mode DOS, see also FaqDOS). The operating system or DPMI host is responsible for memory management; the meaning of segments (selectors) in protected mode is very different from real-mode.

Note that those "unsafe" instructions are not guaranteed to raise a "visible" error when insufficient privilege - the OS or DPMI host can decide to "emulate" them, for example some CRx works under HDPMI32), or "dummy" (nothing happens, like a NOP).

**Example**

```
' This is an example for the x86 architecture.
Function AddFive(ByVal num As Long) As Long
    Asm
        mov eax, [num]
        add eax, 5
        mov [Function], eax
    End Asm
End Function

Dim i As Long = 4

Print "4 + 5 ="; AddFive(i)
```
FreeBASIC's Assembler is AS / GAS, the assembler of GCC, so an external program is needed. Some quirks apply:

- The error lines returned by FBC for `Asm` blocks are not related to the FB source file. FBC simply displays the errors returned by AS, the lines are related to the assembly file. To make FreeBASIC preserve them, the compiler must be invoked with the `--delete ASM files` option.
- The label names are case sensitive inside `Asm` blocks.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the `@` directive.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Function`
- `Naked`
Atan2

Returns the arctangent of a ratio

Syntax

Declare Function Atan2 ( ByVal y As Double, ByVal x As Double )

Usage

result = ATan2( y, x )

Parameters

y
Vertical component of the ratio.

x
Horizontal component of the ratio.

Return Value

The angle whose tangent is y/x, in radians, in the range [-Pi..Pi].

Description

ATan2 returns the arctangent of the ratio y/x as a Double within the range of -Pi to Pi.

Arctangent is the inverse of the Tan function. The returned angle is measured in radians.

Example

Print Atan2 ( 4, 5 ) 'this is the same as PRIN

The output would be:

0.674740942235527
Differences from QB

- New to FreeBASIC

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

See also

- Tan
- Atn
- A Brief Introduction To Trigonometry
**Atn**

Returns the arctangent of a number

**Syntax**

```
Declare Function Atn ( ByVal number As Double ) As Double
```

**Usage**

```
result = Atn( number )
```

**Parameters**

- `number`  
  A number.

**Return Value**

The angle, in radians, whose tangent is `number`, in the range [-Pi/2..Pi/2].

**Description**

`Atn` returns the arctangent of the argument `number` as a `Double` within the range of -Pi/2 to Pi/2. The arctangent is the inverse of the `Tan` function. The returned angle is measured in `radians` (not `degrees`).

**Example**

```
Print "Pi ="; Atn ( 1.0 ) * 4
Print Atn ( 4 / 5 )
```

The output would be:

```
Pi = 3.141592653589793
0.6747409422235527
```
Differences from QB

- None

See also

- Tan
- Atan2
- A Brief Introduction To Trigonometry
Base (Initializer)

Specifies an initializer for the base UDT in derived Udt constructors

Syntax

Base ( constructor-parameters... )
or:
Base UDT-initializer

Description

The Base initializer can be used at the top of constructors of derived UDTs. It allows to specify an explicit constructor call or UDT initializer to be used to initialize the base object. It will replace the implicit default initialization, and must appear above any other statements in the constructor it is used in.

Note: Unlike "Base( )", a "Base.Constructor( )" statement does not replace the implicit default initialization done by the constructor of a derived UDT. It can usually not be used legally, because it would result in two constructor calls for the base object.

Example

Type SimpleParent
  As Integer a, b, c
End Type

Type Child extends SimpleParent
  Declare Constructor( )
End Type

Constructor Child( )
  '' Simple UDT initializer
  Base( 1, 2, 3 )
End Constructor
**Type ComplexParent**

```
As Integer i
Declare Constructor( ByVal As Integer = 0 )
End Type
```

**Constructor ComplexParent**

```
ByVal i As Integer = 0
this.i = i
End Constructor
```

**Type Child** extends ComplexParent

```
Declare Constructor( )
Declare Constructor( ByRef As Child )
End Type
```

**Constructor Child**

```
'' Base UDT constructor call
Base( 1 )
End Constructor
```

**Constructor Child**

```
'' Base UDT constructor call
Base( rhs.i )
End Constructor
```

---

**Dialect Differences**

- Methods are only supported in the `-lang fb` dialect, hence `Base` function in other dialects.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Base (Member Access)`
- `This`
- Type
- Extends
- Option Base
Base (Member Access)

Provides explicit access to base type members in non-static methods of

**Syntax**

```
Base.member
Base [ .Base ... ] .member
```

**Description**

*Base* provides a way to explicitly access members of a specific base type of a user-defined type derived from another type using *Extends*.

By using *Base* repeatedly, as in `base.base.base.member`, it is possible to there are multiple levels of inheritance.

*Base* is especially useful when a base type's member is shadowed by type using the same identifier. *Base* then allows unambiguous access.

For virtual methods, `base.method()` always calls the base method and

**Example**

```basic
Type Parent
    As Integer a
    Declare Constructor(ByVal As Integer = 0)
    Declare Sub show()
End Type

Constructor Parent(ByVal a As Integer = 0)
    This.a = a
End Constructor

Sub Parent.show()
    Print "parent", a
End Sub

Type Child extends Parent
```
As Integer a
Declare Constructor(ByVal As Integer = 0)
Declare Sub show()
End Type

Constructor Child(ByVal a As Integer = 0)
'' Call base type's constructor
Base(a * 3)
This.a = a
End Constructor

Sub Child.show()
'' Call base type's show() method, not ours
Base.show()

'' Show both a fields, the base type's and ours
Print "child", Base.a, a
End Sub

Type GrandChild extends Child
As Integer a
Declare Constructor(ByVal As Integer = 0)
Declare Sub show()
End Type

Constructor GrandChild(ByVal a As Integer = 0)
'' Call base type's constructor
Base(a * 2)
This.a = a
End Constructor

Sub GrandChild.show()
'' Call base type's show() method, not ours
Base.show()

'' Show both a fields, the base.Base type's, the base type's and ours
Print "grandchild", Base.Base.a, Base.a, a
End Sub
Dim As GrandChild x = GrandChild(3)
x.show()
Beep

Produces a beep sound.

**Syntax**

```vbnet
Declare Sub Beep()
```

**Usage**

```vbnet
Beep
```

**Description**

Beep tells the system to sound a beep noise. Note that this might not work on some platforms. Since this command is not reliable and there is no way to specify the frequency and duration, you might want to avoid it in favor of other / better solutions, for example: http://www.freebasic.net/forum/viewtopic.php?p=20441#20441 by yetifoot.

**Example**

```vbnet
Beep
```

**Differences from QB**

- In QB, this was a single tone noise generated through the PC speaker. Now this might not be the case.

**See also**

- `out` - producing sound using CPU ports
Bin

Returns a binary (base 2) string representation of an integer

**Syntax**

```vba
Declare Function Bin ( ByVal number As UByte ) As String
Declare Function Bin ( ByVal number As UShort ) As String
Declare Function Bin ( ByVal number As Ulong ) As String
Declare Function Bin ( ByVal number As ULongInt ) As String
Declare Function Bin ( ByVal number As Const Any Ptr ) As String
Declare Function Bin ( ByVal number As UByte, ByVal digits As Long ) As String
Declare Function Bin ( ByVal number As UShort, ByVal digits As Long ) As String
Declare Function Bin ( ByVal number As Ulong, ByVal digits As Long ) As String
Declare Function Bin ( ByVal number As ULongInt, ByVal digits As Long ) As String
Declare Function Bin ( ByVal number As Const Any Ptr, ByVal digits As Long ) As String
```

**Usage**

```vba
result = Bin[$]( number [, digits ] )
```

**Parameters**

- `number`
  A number or expression evaluating to a number. A floating-point number will be converted to a `LongInt`.

- `digits`
  Desired number of digits in the returned string.

**Return Value**

A string containing the unsigned binary representation of `number`.

**Description**

Returns a string representing the unsigned binary value of the integer `number`. Binary digits range from 0 to 1.
If you specify digits > 0, the result string will be exactly that length. It will be truncated or padded with zeros on the left, if necessary.

The length of the string will not go longer than the maximum number of digits required for the type of number (32 for a Long, 64 for a LongInt).

If you want to do the opposite, i.e. convert an binary string back into a number, the easiest way to do it is to prepend the string with "&B;", and convert it to an integer type, using a function like CInt, similarly to a normal numeric string. E.g. CInt("&B101;")

**Example**

```plaintext
Print Bin(54321)
Print Bin(54321, 5)
Print Bin(54321, 20)
```

will produce the output:

```
1101010000110001
10001
00001101010000110001
```

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the alias __Bin.

**Differences from QB**

- New to FreeBASIC

**See also**

- Oct
- Hex
- ValInt
- ValLng
**Binary**

Specifies file or device to be opened for binary mode

**Syntax**

```plaintext
Open filename for Binary [Access access_type] [Lock lock_type] a
```

**Parameters**

- `filename` file name to open
- `access_type` indicates whether the file may be read from, written to or both
- `lock_type` locking to be used while the file is open
- `filenum` unused file number to associate with the open file

**Description**

Opens a file or device for reading and/or writing binary data in the file. If the file does not exist, a new file will be created. The file pointer is initialized by `Get #` and `Put #` file operations move the file pointer according to the size of the data in the file.

The data existing in the file is preserved by `Open`. This file mode can use any buffer variable to read/write data in the file. The data is saved in binary mode, in the same internal format FreeBASIC uses.

`filename` must be a string expression resulting in a legal file name in the current directory, unless a path is given.

**Access_type** By default Binary mode allows to both read and write the file. It can be one of:

- **Read** - the file is opened for input only
- **Write** - the file is opened for output only
- **Read Write** - the file is opened for input and output (the default)

**Lock_type** indicates the way the file is locked for other processes (users or threads), it is one of:

- **Shared** - The file can be freely accessed by other processes
- **Lock Read** - The file can't be opened simultaneously for reading.
- **Lock Write** - The file can't be opened simultaneously for writing.
- **Lock Read Write** - The file cannot be opened simultaneously by other processes.

If no lock type is stated, the file will be **Shared** for other threads of the program.

**Lock** and **Unlock** can be used to restrict temporally access to parts of a file.

`filenum` is a valid file number (in the range 1..255) not being used for other files, which identifies the file for the rest of file operations. A free file number can be found using the `filenum` function.

### Example

```
' Create a binary data file with one number in it
Dim x As Single = 17.164

Open "MyFile.Dat" For Binary As #1
' put without a position setting will put from
' in this case, the very beginning of the file.
Put #1, , x
Close #1

' Now read the number from the file
Dim x As Single = 0

Open "MyFile.Dat" For Binary As #1
  Get #1, , x
Close #1

Print x
```

```
' Read entire contents of a file to a string
Dim txt As String
```
Open "myfile.txt" For Binary Access Read As #1
If LOF(1) > 0 Then
    " our string has as many characters as the file
    txt = String(LOF(1), 0)
    " size of txt is known. entire string filled
    Get #1, , txt
End If
Close #1

Print txt

Differences from QB
- None

See also
- Open
- Put #
- Get #
- Random
- Append
- Append
- Output
- Input
**Bit**

Gets the state of an individual bit in an integer value.

**Syntax**

```c
#define Bit( value, bit_number ) (((value) And (Cast(TypeOf(value), 1) Shl (bit_number))) <> 0)
```

**Usage**

```c
result = Bit( value, bit_number )
```

**Parameters**

- **value**
  The integer value.
- **bit_number**
  The index of the bit.

**Return Value**

Returns an `Integer` value of `-1` if the bit is set, or `0` if the bit is cleared.

**Description**

This macro expands to an integer value indicating whether or not the bit specified by `bit_number` is set in the integer `value`. Behaves as ``(value And 1 Shl bit_number) <> 0``.

**Example**

```c
Print Bit(4,2)
Print Bit(5,1)
Print Bit(&H8000000000000000ULL, 63)
```

will produce the output:
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Bit`.

Differences from QB

- New to FreeBASIC

See also

- `BitSet`
- `BitReset`
**BitReset**

Gets the value of an integer with a specified bit cleared.

**Syntax**

```c
#define BitReset( value, bit_number ) (((value) And Not (Cast(TypeOf(Value), 1) Shl (bit_number))))
```

**Usage**

```c
result = BitReset( value, bit_number )
```

**Parameters**

- `value`
  The integer value.
- `bit_number`
  The index of the bit to clear.

**Return Value**

Returns the integer value with the specified bit cleared.

**Description**

This macro expands to a copy of the integer `value` with the specified `bit_number` cleared (to off, or `0`). Behaves as `value And Not (1 Shl bit_number)`.

The valid range of values for `bit_number` depends on the size, in bits, of `TypeOf(value)`, which is `0` through `SizeOf(value) * 8 - 1`. See [Standard Datatype Limits](#) for a table of the standard datatypes and their sizes.

**Example**

```c
Print BitReset(5, 0)
Print Hex(BitReset(&h800000000000001, 63))
```
will produce the output:

```
4
1
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Bitreset`.

**Differences from QB**

- New to FreeBASIC.

**See also**

- `Bit`
- `BitSet`
**BitSet**

Gets the value of an integer with a specified bit set.

**Syntax**

```cpp
#define BitSet( value, bit_number ) ( (value) Or ( Cast(TypeOf(Value), 1) Shl (bit_number)))
```

**Usage**

```cpp
result = BitSet( value, bit_number )
```

**Parameters**

- `value`
  The integer value.
- `bit_number`
  The index of the bit to set.

**Return Value**

Returns the integer value with the specified bit set.

**Description**

This macro expands to a copy of the integer `value` with the specified `bit_number` set (to on, or `1`). Behaves as `value Or (1 Shl bit_number)`.

The valid range of values for `bit_number` depends on the size, in bits, of `TypeOf(value)`, which is `0` through `SizeOf(value) * 8 - 1`. See [Standard Datatype Limits](#) for a table of the standard datatypes and their sizes.

**Example**

```cpp
Print BitSet(4, 0)
Print Hex(BitSet(1ull, 63))
```
will produce the output:

```
5
8000000000000001
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__bitset`.

**Differences from QB**

- New to FreeBASIC.

**See also**

- `Bit`
- `BitReset`
**BLoad**

Loads arbitrary data from a file created with **BSave**, or a compatible BMP file.

**Syntax**

```vba
Declare Function BLoad ( ByRef filename As Const String, ByVal dest As Long ) As Long
```

**Usage**

```vba
result = BLoad( filename [, [ dest ] [, pal ] ] )
```

**Parameters**

- **filename**
  the name of the file to load the image from; can include a file path
- **dest**
  the memory location to load the image to, or null (0) to copy the image to the current graphics screen work page.
- **pal**
  the memory location to load the palette to, or null (0) to change the current graphics screen palette, if it uses one.

**Return Value**

Returns zero (0) if successful, or a non-zero error code to indicate a failure.

**Description**

**BLoad** can be used to load image data or any other data from a file created with **BSave** or paste it to the screen. If **dest** is absent or null (0), the image data is pasted to the current graphics screen work page. Otherwise it is loaded as image data to the address given by **dest**.

**BLoad** can load 3 different types of files:

- Old QB-like data files, saved with **BSave** from QB code, or code with **BSave**, or created / saved in a compatible format using a graphics editor / converter. QB-like data files and BMP files are converted to an FB-compatible image format when opened.
- New FB-like data files, saved with **BSave** from FB code, or code with **BSave**, or created / saved in a compatible format using a graphics editor / converter. There is no 64 KiB limit with this format.
- BMP image files, supports a subset of valid ("Windows") code with **BSave**, or created / saved in a compatible format using a graphics editor / converter.
Image files with 8-bit per pixel resolution or lower contain a palette that is not null (0), the palette is copied to memory starting at the address specified. If a graphics screen uses a palette then its palette is changed to match that of the image file.

When using one of the 2 "non-BMP" file formats to save images, the image file must be saved with the same graphics screen mode as it is being loaded into. When using the BMP file format, this restriction does not apply.

When loading a BMP file using **BLoad**, the images must be true-color (16, 24, or 32 bits per pixel) or palettized/indexed (8-bit or lower). The image data will be converted to the current color depth, except that true-color can't be reduced to a palettized image. BMP compression or other image file types (PNG, JPG, GIF, ...). **BLoad** will load 32-bit BMP files with **BITMAPV4HEADER** or **BITMAPV5HEADER** file headers.

### Runtime errors:

**BLoad** throws one of the following **runtime errors**:

1. **Illegal function call**
   - `dest` was not specified or was null (0), and no graphics screen was set.
   - The Bitmap uses an unsupported BMP file compression type.
   - The Bitmap is true-color (16, 24, or 32 bits per pixel) and the current graphics screen uses a palette (8 bits per pixel or lower).

2. **File not found**
   - The file `filename` could not be found.

3. **File I/O error**
   - The file doesn't have any of the supported types.
   - A general read error occurred.

**Note:** When you use **BLoad** to load a BMP file into an image buffer, the original dimensions of the image are not changed. If you want the image buffer to have the same dimensions as the BMP file beforehand, and create an image of the right size yourself, **please read below how to do this**.

**Example**

```
'Load a graphic to current work page
```
Screen 18, 32
Cls
BLoad "picture.bmp"
Sleep

'Load a 48x48 bitmap into an image
ScreenRes 320, 200, 32
Dim myImage As Any Ptr = ImageCreate( 48, 48 )
BLoad "picture.bmp", myImage
Put (10,10), myImage
ImageDestroy( myImage )
Sleep

ScreenRes 640, 480, 8 '' 8-bit palette graphics mode
Dim pal(0 To 256-1) As Integer '' 32-bit integer array

'' load bitmap to screen, put palette into pal() array
BLoad "picture.bmp", , @pal(0)

WindowTitle "Old palette"
Sleep

'' set new palette from pal() array
Palette Using pal(0)

WindowTitle "New palette"
Sleep

'' A function that creates an image buffer with the dimensions as a BMP image, and loads a file into
Const NULL As Any Ptr = 0

Function bmp_load( ByRef filename As Const String

    Dim As Long filenum, bmpwidth, bmpheight
    Dim As Any Ptr img

    '' open BMP file
    filenum = FreeFile()
    If Open( filename For Binary Access Read As #filenum Then

        '' retrieve BMP dimensions
        Get #filenum, 19, bmpwidth
        Get #filenum, 23, bmpheight

        Close #filenum

        '' create image with BMP dimensions
        img = ImageCreate( bmpwidth, Abs(bmpheight) )

        If img = NULL Then Return NULL

        '' load BMP file into image buffer
        If BLoad( filename, img ) <> 0 Then ImageDestroy

        Return img

End Function

Dim As Any Ptr img

ScreenRes 640, 480, 32

img = bmp_load( "picture.bmp" )

If img = NULL Then
Print "bmp_load failed"

Else

    Put (10, 10), img

    ImageDestroy(img)

End If

Sleep

**Differences from QB**

- Support for loading BMP files is new to FreeBASIC.
- Support for retrieving the palette from BMP files is new to FreeBASIC.
- FreeBASIC uses a different file format from QBASIC internally, unsupported by QBASIC.

**See also**

- BSave
- Palette
- ImageCreate
- ImageDestroy
- Internal Graphics Formats
Boolean

Standard data type

**Syntax**

```dim variable as boolean```

**Description**

Boolean data type. Can hold the values `True` or `False`.

**Notes on definition of boolean data type:** Ideally, the definition of the boolean data type is that it holds the value of `True` or `False`, and that's it. However, to make this concept a reality, we need a definition that uses real world connections. A more realistic definition is that the boolean data type is a 1-bit integer, having the value 0 to indicate `False` and 1 to indicate `True`. For a practical definition, we must consider, yet again, additional factors. The most significant factor is that the hardware (processor) on which code is executed does not directly support a 1-bit data type; the smallest register or memory size we can work with is 8-bits or 1-byte. Therefore, a practical definition of boolean data type is an integer, 8 bits wide, having the value 0 or 1, where all other values are undefined. However, because of longstanding differences between C/C++ and FB with respect to logical operations, the interpretation of the value must also be considered. Assume "false" is 0 in both C/C++ and FB. C/C++ has logical 'not' operator '!' such that '!0' produces '1'. FB has a bitwise `Not` operator such that 'not 0' produces '-1'. Therefore the definition for a C/C++ boolean is an unsigned 1-bit integer, zero extended to fill larger integer types, and the definition for a FB boolean is a signed 1-bit integer, sign extended to fill larger integer types. However, the purpose and intent of the boolean data type remains, that it should only ever hold a `True` value or `False` value, regardless of the underlying details.

**Example**

```dim boolvar as boolean```
```java
boolvar = True
Print "boolvar = ", boolvar
```

**Output:**

```
boolvar = true
```

**Dialect Differences**
- Not available in the `-lang qb` dialect unless referenced with the alias `__Boolean`.

**Differences from QB**
- New to FreeBASIC

**See also**
- `True`
- `False`
BSave

Saves an array of arbitrary data and palette information to a file on disk.

Syntax

Declare Function BSsave ( ByVal filename As String, ByVal source As Any Ptr, ByVal size As Ulong = 0, ByVal pal As Any Ptr = 0, ByVal bitsperpixel As Long = 0 ) As Long

Usage

result = BSsave( filename, source [[]][[, pal ][, bitsperpixel ]]] )

Parameters

filename
the name of the file to create for storing the pixel and palette data.

source
the address of the data to store, or null (0) to store pixel data from the current screen work page.

size
optional, the total number of bytes of data to store. This value is needed unless the output is a BMP file.

pal
optional, the address of a buffer holding 256 Palette colors, or null (0) for the current screen palette.

bitsperpixel
optional, a requested bit depth for the output BMP image.

Return Value

Returns zero (0) if successful, or a non-zero error code to indicate a failure. (throws a runtime error)

Description

BSave is used for saving arbitrary data from memory into a file, using a file format specific to FB, or saving images into a standard BMP image file, replacing an existing file if necessary.
**BSave** outputs a total of *size* bytes of arbitrary data located at *source* to a specified file. If *source* is null (0), then **BSave** outputs a maximum of *size* bytes from the current work page’s pixel buffer, which is structured in the current screen mode's internal pixel format. (This data is not compatible with the image buffer format as it has no header.) For 8-bit images, palette information is obtained from *pal* if present and non-null, or if *pal* omitted or null (0), from the current screen palette. A BMP image file can be created if *filename* has a file extension of ".bmp" (case insensitive). *source* is assumed to point to a valid image buffer whose entire pixel data will be stored in the BMP file. If *source* is null (0), the contents of the current work page will be stored instead. For 8-bit images, palette information is obtained from *pal* if non-null, or if null (0), from the current screen palette. The *size* parameter is ignored when saving BMP files.

The default bit depth for BMP files is 8-bit for 8-bit (palette) images, 24-bit for 16-bit images, and 32-bit for 32-bit images. The *bitsperpixel* parameter can be used to request 24-bit output for 8-bit images, or 24-bit output for 32-bit images.

**Runtime errors:**
**BSave** throws one of the following runtime errors:

(1) **Illegal function call**
- *size* is less than zero (0), or *size* is zero and *source* is non-null, or a problem is detected with the image buffer.

(2) **File not found**
- The file could not be created.

(3) **File I/O error**
- The file could not be written to.

**Example**

```plaintext
' Set gfx mode
ScreenRes 320, 200, 32
```
' Clear with black on white
Color RGB(0, 0, 0), RGB(255, 255, 255)
Cls

Locate 13, 15: Print "Hello world!"

' Save as BMP
BSave "hello.bmp", 0

Differences from QB

- Support for saving more than 64KiB of arbitrary data is new to FreeBASIC.
- Support for saving BMP files is new to FreeBASIC.
- QB cannot use BLoad to load files created with BSave in FreeBASIC, but FreeBASIC can use BLoad to load files created with BSave in QB

See also

- BLoad
- Palette
Byref (Parameters)

Declaration specifier to explicitly pass a parameter by reference

Syntax

\texttt{ByRef \hspace{0.5em} param \hspace{0.5em} As \hspace{0.5em} datatype}

Usage

\texttt{[ \hspace{0.5em} Declare \hspace{0.5em} ] \hspace{0.5em} \{} \hspace{0.5em} \texttt{Sub \hspace{0.5em} | \hspace{0.5em} Function \hspace{0.5em} } \hspace{0.5em} proc\_name \hspace{0.5em} ( \hspace{0.5em} \texttt{ByRef \hspace{0.5em} param \hspace{0.5em} As \hspace{0.5em} datatype} \hspace{0.5em} ) \hspace{0.5em} \}}

Description

Passes a variable by reference, that is its address, to a subroutine or function. When a variable is passed by reference, the contents of the variable can be changed by the target subroutine or function.

In \texttt{-lang \_qb} and \texttt{-lang \_fblite} dialects, \texttt{ByRef} is the default parameter passing convention, unless \texttt{Option \_ByVal} is in effect.

Opposite of \texttt{ByVal}.

Example

\begin{verbatim}
Dim MyVar As Integer

Sub ChangeVar(ByRef AVar As Integer)
    AVar = AVar + 1
End Sub

MyVar = 1
Print "MyVar: "; MyVar 'output = 1
ChangeVar MyVar
Print "MyVar: "; MyVar 'output = 2
Sleep
End
\end{verbatim}
Dialect Differences

- In **-lang fb** dialect, **ByVal** is the default parameter passing convention for all built-in types except **String** and user-defined **Type** which are passed **ByRef** by default.
- In **-lang qb** and **-lang fblite** dialects, **ByRef** is the default parameter passing convention.

Differences from QB

- New to FreeBASIC

See also

- **Passing Arguments to Procedures**
- **Declare**
- **ByVal**
- **Byref (Function Results)**
Byref (Function Results)

Specifies that a function result is returned by reference

**Syntax**

```
Function name ( parameter-list ) ByRef As datatype
```

**Description**

Causes the function result to be returned by reference, rather than by returning by value. This allows the caller of the function to modify the variable which the function result points to.

If **ByRef** is not specified, the default is to return the function result by value.

Functions with **ByRef** result should not return local variables from the function, because they will be destroyed upon returning from the function, invalidating any pointer or reference to them. To help with writing safe code, the compiler will show an error message when a local variable is used with **x** statements.

**Note:** On the left-hand side of an assignment expression using the '=>' symbol, the result of the function (returned by reference) must be enclosed in parentheses when the function calls one single argument, in order to solve the parsing ambiguity, allowing to avoid parsing ambiguity (without parentheses). As for the arguments list, it should always be surrounded with parentheses even if empty.

Operators (member or global), when used as functions, have also the **ByRef** capability.

**Example**

```vbnet
Function min( ByRef I As Integer , ByRef J As Integer )
" The smallest integer will be returned by reference.
    If I < J Then
        Return I
    Else
        Return J
    End If
End Function

Dim As Integer A = 13, B = 7
Print A, B
```
Print min( A , B )
min( A , B ) = 0
Print A, B

Function f( ) ByRef As Const ZString
    '' This string literal (because statically allocated in memory)
    Function = "abcd"
End Function

Print f( )

Dim Shared As String s

Function f1( ) ByRef As String
    '' This variable-length string will be returned
    Function = s
End Function

Function f2( ByVal _s As String ) ByRef As String
    '' This variable-length string will be returned
    Function = _s
End Function

s = "abcd"
Print s

f1( ) &= "efgh"
Print s

' At time of writing, the enclosing parentheses are required
( f2( s ) ) &= "ijkl"
Print s

Function power2( ByVal _I As Integer ) ByRef As Integer
```
_I *= _I
' This integer will be returned by reference,
    Function = _I
End Function

Dim As Integer I = 2
power2( power2( power2( I ) ) ) ' Function return
Print I
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Returning values
- Byref (Parameters)
Byte

Standard data type: 8 bit signed

Syntax

```vbnet
Dim variable As Byte
```

Description

8-bit signed whole-number data type. Can hold a value in the range of -128 to 127.

Example

```vbnet
Dim bytevar As Byte
bytevar = 100
Print "bytevar= ", bytevar
```

```vbnet
Dim x As Byte = CByte(&H80)
Dim y As Byte = CByte(&H7F)
Print "Byte Range = "; x; " to "; y
```

Output:

```
Byte Range = -128 to 127
```

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Byte.

Differences from QB
New to FreeBASIC

See also

- UByte
- CByte
**ByVal**

Declaration specifier to explicitly pass a parameter by value

**Syntax**

```
ByVal param As datatype
```

**Usage**

```
[ Declare ] { Sub | Function } proc_name ( ByVal param As datatype
```

**Description**

`ByVal` in a parameter list of a declare statement causes a copy of the parameter to be passed by value.

This means that if the value of the variable `x` is passed, then the original variable `x` could be modified by the called function. Opposite of `ByRef`.

The `ByVal` keyword is also used in the context of `ByRef Parameters` and `reference semantics` in order to pass or assign a pointer as-is to a `ByRef` parameter:

- Manually passing pointers to by-reference parameters
- Manually returning pointers as-is from Byref functions

**Example**

```basic
Sub MySub(ByVal value As Integer)
    value += 1
End Sub

Dim MyVar As Integer

MyVar = 1
Print "MyVar: "; MyVar 'output = 1
MySub MyVar
```
Print "MyVar: "; MyVar 'output = 1, because byval
Sleep
End

Dialect Differences

- In the -lang fb dialect, ByVal is the default parameter passing convention. All parameters are passed by **ByRef** by default.
- In -lang qb and -lang fblite dialects, **ByRef** is the default parameter passing convention.

Differences from QB

- QB only used **ByVal** in declarations to non-Basic subroutines

See also

- **Passing Arguments to Procedures**
- **Declare**
- **ByRef**
Call

Statement to invoke a subroutine

Syntax
Call procname ([parameter list])

Description
Calls a Sub or Function.

This keyword is a holdover from earlier dialects of BASIC, and is mainly deprecated.

In -lang qb, it can be used to call Subs in code before they are declared. Parameters passed ByRef As Any.
Note: until the function is declared, no type-checking is done on the parameters, they are of the correct type.

Example

```fblite
'' Compile with -lang qb or -lang fblite
#lang "fblite"

Declare Sub foobar(ByVal x As Integer, ByVal y As Integer) Call foobar(35, 42)

Sub foobar(ByVal x As Integer, ByVal y As Integer) Print x; y
End Sub

'' Compile with -lang qb or -lang fblite
#lang "fblite"
```
Function f () As Integer
f = 42
End Function

Call f ' execute function f, but ignore the answer

'' Compile with -lang qb
'$lang: "qb"

Call mysub(15, 16) '' call "mysub" before it has been declared

Sub mysub(ByRef a As Integer, ByRef b As Integer)
    Print a, b
End Sub

Dialect Differences
- The use of call is not allowed in the -lang fb dialect.
- The -lang fblite dialect does not allow you to call functions that

Differences from QB
- The procedure must have already been declared.
- call in QB will make a copy of all parameters, so changes made
  reflected in the variables in the caller.

See also
- Declare
- Sub
CAllocate

Allocates memory for a certain number of elements from the free store and clears the contents.

**Syntax**

```
Declare Function CAllocate cdecl ( ByVal num_elements As UInteger As UInteger = 1 ) As Any Ptr
```

**Usage**

```
result = CAllocate( num_elements [, size ] )
```

**Parameters**

- `num_elements`
  The number of elements to allocate memory for.
- `size`
  The size, in bytes, of each element.

**Return Value**

If successful, the address of the start of the allocated memory is returned; the null pointer (0) is returned.

**Description**

CAllocate initializes the allocated memory with zeros. Consequently, CAllocate can be also directly used with String or Udt containing string, because the descriptor is cleared (set to 0) first.

**Example**

```
' Allocate and initialize space for 10 integer elements.
Dim p As Integer Ptr = CAllocate(10, SizeOf(Integer))

' Fill the memory with integer values.
For index As Integer = 0 To 9
    p[index] = (index + 1) * 10
```
' Display the integer values.
For index As Integer = 0 To 9
    Print p[index];
Next

' Free the memory.
Deallocate(p)

Outputs:

10 20 30 40 50 60 70 80 90 100

Platform Differences
- This procedure is not guaranteed to be thread-safe.

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the __Callocate.

Differences from QB
- New to FreeBASIC

See also
- Allocate
- Deallocate
- Reallocate
Case

Control flow statement

**Syntax**

```
Case expression
```

**Differences from QB**

- None

**See also**

- [Select Case](#)
**Cast**

Converts an expression to a specified data type

**Syntax**

```plaintext
Cast( datatype, expression )
```

**Description**

Converts `expression` into a different `datatype`. Useful to be used in macros when converting to Type Alias.

Note: this is a general form of conversion operators such as `CInt` or `CDbl` used on types that have a Cast Operator, but don't have a built-in key; also suitable for use in cases where the type of a variable is not fixed earlier, or may be the Type Of a different variable or expression.

Note: If you want to use an operator specifically for converting to different types instead.

**Example**

```
' ' will print -128 because the integer literal will
' ' (this Casting operation is equivalent to using
Print Cast( Byte, &h0080 )

' ' will print 3 because the floating-point value will
' ' (this Casting operator is equivalent to using C
Print Cast( Integer, 3.1 )
```

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the

**Differences from QB**
- New to FreeBASIC

**See also**

- CPtr
- CInt
- TypeOf
Converts numeric or string expression to a boolean (Boolean)

**Syntax**
```
Declare Function Cbool ( ByVal expression As datatype ) As Boolean
```

**Usage**
```
result = Cbool( numeric expression )
result = Cbool( string expression )
result = Cbool( user defined type )
```

**Parameters**
- `expression`
a numeric, string, or user defined type to cast to a Boolean value
- `datatype`
any numeric, string, or user defined type
- `typename`
a user defined type

**Return Value**
A Boolean value.

**Description**
The `Cbool` function converts a zero value to False and a non-zero value to True.

The name can be explained as 'Convert to Boolean'.

If the argument is a string expression, it is converted to boolean using insensitive to the string "false" to return a False value or "true" to return True value.
Example

' Using the CBOOL function to convert a numeric value

'Create an BOOLEAN variable
Dim b As BOOLEAN

'Convert a numeric value
b = CBOOL(1)

'Print the result, should return True
Print b
Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Cbool.

Differences from QB

- New to FreeBASIC

See also

- CByte
- CUByte
- CShort
- CUSHort
- CInt
- CUINT
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDb1
- Str
CByte

Converts numeric or string expression to Byte.

**Syntax**

```basic
Declare Function CByte ( ByVal expression As datatype ) As Byte

Type typename
Declare Operator Cast ( ) As Byte
End Type
```

**Usage**

```basic
result = CByte( numeric expression )
result = CByte( string expression )
result = CByte( user defined type )
```

**Parameters**

- `expression`
  A numeric, string, or pointer expression to cast to a Byte value.
- `datatype`
  Any numeric, string, or pointer data type.
- `typename`
  A user defined type.

**Return Value**

A Byte value.

**Description**

The CByte function rounds off the decimal part and returns a 8-bit Byte function does not check for an overflow, and results are undefined for which are less than -128 or larger than 127.

The name can be explained as 'Convert to Byte'.

If the argument is a string expression, it is converted to numeric by us
**Example**

```vbnet
' Using the CBYTE function to convert a numeric value

'Declare a BYTE variable
Dim numeric_value As Byte

'Convert a numeric value
numeric_value = CByte(-66.30)

'Print the result, should return -66
Print numeric_value
Sleep
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the `__Cbyte`.

**Differences from QB**

- New to FreeBASIC

**See also**

- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDbl
**CDbl**

Converts numeric or string expression to Double precision floating point

**Syntax**

```coded"
Declare Function CDbl ( ByVal expression As datatype ) As Double

Type typename
Declare Operator Cast ( ) As Double
End Type
```

**Usage**

```coded"
result = CDbl( numeric expression )
result = CDbl( string expression )
result = CDbl( user defined type )
```

**Parameters**

- `expression`  
a numeric, string, or pointer expression to cast to a Double value
- `datatype`  
any numeric, string, or pointer data type
- `typename`  
a user defined type

**Return Value**

A Double precision value.

**Description**

The `CDbl` function returns a 64-bit Double value. The function does not an overflow, so be sure not to pass a value outside the representable the Double data type. The name can be explained as 'Convert to DouE

If the argument to `CDbl` is a string expression, it is first converted to nu using `Val`.

**Example**
' Using the CDBL function to convert a numeric value

'Create an DOUBLE variable
Dim numeric_value As Double

'Convert a numeric value
numeric_value = CDb1(-12345678.123)

'Print the result, should return -12345678.123
Print numeric_value
Sleep

**Differences from QB**

- The string argument was not allowed in QB

**See also**

- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
cdecl

Specifies a cdecl-style calling convention in a procedure declaration

**Syntax**

```plaintext
Sub name cdecl [Overload] [Alias "alias"] ( parameters )
Function name cdecl [Overload] [Alias "alias"] ( parameters ) As
```

**Description**

In procedure declarations, cdecl specifies that a procedure will use the (pushed onto the stack) in the reverse order in which they are listed, that is, from right to left. The procedures need not clean up the stack (pop any parameters) before it returns - the cdecl is allowed to be used with variadic procedure declarations (those

cdecl is the default calling convention on Linux, the *BSDs, and DOS, Blocks. cdecl is typically the default calling convention for C compilers

**Example**

```plaintext
' declaring 'strcpy' from the standard C library
Declare Function strcpy cdecl Alias "strcpy" (ByVal
```

**Differences from QB**

- New to FreeBASIC

**See also**

- pascal,stdcall
- Declare
- Sub, Function
**Chain**

Temporarily transfers control to an external program

**Syntax**

```
Declare Function Chain ( ByRef program As Const String ) As Long
```

**Usage**

```
result = Chain( program )
```

**Parameters**

`program`

The file name (including file path) of the program (executable) to transfer control to.

**Return Value**

Returns the external program's exit code if executed successfully, or negative one (-1) otherwise.

**Description**

Transfers control over to an external program. When the program exits, execution resumes immediately after the call to `Chain`.

**Example**

```java
# ifdef __FB_LINUX__
   Dim As String program = "./program"
# else
   Dim As String program = "program.exe"
# endif

Print "Running " & program & "..."
If (Chain(program) <> 0) Then
   Print program & " not found!"
```
Platform Differences

- Linux requires the *program* name case matches the real name of the file. Windows and DOS are case insensitive. The program chained may be case sensitive for its command line parameters.
- Path separators in Linux are forward slashes `/`. Windows uses backward slashes `\` but it allows for forward slashes `/`. DOS uses backward `\` slashes.
- Exit code is limited to 8 bits in DOS.

Differences from QB

- None

See also

- Exec  transfer temporarily, with arguments
- Run  one-way transfer
- Command  pick arguments
ChDir

Changes the current drive and directory

Syntax

    Declare Function ChDir ( ByVal path As Const String ) As Long

Usage

    result = ChDir( path )

Parameters

    path

    A String argument specifying the path to change to.

Return Value

    Returns zero (0) on success and negative one (-1) on failure.

Description

    Changes the current drive and directory to that specified.

Example

    Dim pathname As String = "x:\folder"
    Dim result As Integer = ChDir(pathname)
    If 0 <> result Then Print "error changing current"

Platform Differences

    - Linux requires the filename case matches the real name of the
    - Path separators in Linux are forward slashes / . Windows uses
      slashes. DOS uses backward \ slashes.
Differences from QB

- In QB, the drive could not be specified.

See also

- MkDir
- RmDir
# Chr

Returns a string of characters from one or more ASCII integer values

## Syntax

```vbnet
Declare Function Chr ( ByVal ch As Integer [, ... ] ) As String
```

## Usage

```vbnet
result = Chr($) ( ch0 [, ch1 ... chN ] )
```

## Parameters

- `ch`
  The ASCII integer value of a character.

## Return Value

Returns a string containing the character(s).

## Description

- `chr` returns a string containing the character(s) represented by the ASCII values passed to it.

When `chr` is used with numerical constants or literals, the result is evaluated at compile-time, so it can be used in variable initializers.

- Asc performs the opposite function, returning the ASCII code of a character represented by a string.

## Example

```vbnet
Print "the character represented by";
Print " the ASCII code of 97 is: "; Chr(97)
Print Chr(97, 98, 99) ' prints abc
```
' s initially has the value "abc"

Dim s As String = Chr(97, 98, 99)

Print s

**Dialect Differences**

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lang fb dialects.

**Differences from QB**

- FreeBASIC accepts multiple integer values as arguments, QB accepted only one.
- FreeBASIC evaluates the CHR function at compile time when used with constants or literals.

**See also**

- ASCII Character Codes
- Asc
- Str
- Val
CInt

Converts a numeric or string expression to an Integer or an Integer<bits>

Syntax

Declare Function CInt ( ByVal expression As datatype ) As Integer
Declare Function CInt<bits> ( ByVal expression As datatype ) As Type
typename
Declare Operator Cast ( ) As Integer
Declare Operator Cast ( ) As Integer<bits>
End Type

Usage

result = CInt( expression )
result = CInt( string expression )
result = CInt( user defined type )

Parameters

bits
A numeric constant expression indicating the size in bits of integer desired. Allowed are 8, 16, 32 or 64.
expression
a numeric, string, or pointer expression to cast to a Integer value
datatype
any numeric, string, or pointer data type
typename
a user defined type

Return Value

An Integer or Integer<bits> containing the converted value.

Description

If CInt is passed a numeric expression, it rounds it using using the round-to-even method - i.e. it rounds to the closest integer value, choosing the closest even integer if the number is equidistant from two integers - and returns an Integer, or if a bits is supplied, an integer type of the given size.
The function does not check for an overflow; for example, for a 32-bit results are undefined for values which are less than -2 147 483 648 or | 2 147 483 647.

If the argument is a string expression, it is converted to numeric by us `ValLng`, depending on the size of the result type.

The name "CINT" is derived from 'Convert to INTeger'.

Example

```vba
' Using the CINT function to convert a numeric value

'Create an INTEGER variable
Dim numeric_value As Integer

'Convert a numeric value
numeric_value = CInt(300.5)

'Print the result, should return 300, because 300
numeric_value = CInt(301.5)

'Print the result, should return 302, because 301
Print numeric_value
```

Dialect Differences

- In the `-lang qb` dialect, `CInt` will return a 16-bit integer, like in `C`.

Differences from QB

- The string argument was not allowed in QB
- The `<bits>` parameter was not allowed in QB
See also

- Cast
- CByte
- CUByte
- CShort
- CUShort
- CUInt
- CULng
- CLng
- CLngInt
- CULngInt
- CSng
- CDbl
- Integer
Circle

Graphics statement to draw an ellipse or a circle

Syntax

```
Circle [target,] [STEP] (x,y), radius[, [color][, [start][, [end
[aspect][, F]]]]]
```

Parameters

- `target`: optional; specifies the image buffer to draw on
- `STEP`: indicates that coordinates are relative
- `(x, y)`: coordinates of the center of the ellipse
- `radius`: the radius of the circle - or for an ellipse, the semi-major axis (i.e. the longest radius)
- `color`: the color attribute
- `start`: starting angle
- `end`: ending angle
- `aspect`: aspect ratio of the ellipse, the ratio of the height to the width
- `F`: fill mode indicator

Description

`Circle` will draw a circle, ellipse, or arc based on the parameters given.

`target` specifies a buffer to draw on. `target` may be an image created with `ImageCreate` or `Get (Graphics)`. If omitted, `target` defaults to the screen's current work page. (See `ScreenSet`)

The center of the shape will be placed on the destination surface at (x, y).
Radius denotes the radius of the shape. If aspect ratio is not 1.0, the radius must be given here.

Color denotes the color attribute, which is mode specific (see Color or Screen (Graphics) for details). If omitted, the current foreground color by the Color statement is used.

The step option specifies that x and y are offsets relative to the current graphics cursor position.

start and end are angles are in radians. These can range -2*PI to 2*PI where PI is the constant π, approximately 3.141593; if you specify a negative angle, its value is changed sign and a line is drawn from the up to that point in the arc. end angle can be less than start. If you do not specify start and end, a full circle/ellipse is drawn; if you you specify start but not end, end is assumed to be 2*PI; if you specify end but not start start is assumed to be 0.0.

aspect is the aspect ratio, or the ratio of the y radius over the x radius. If omitted, the default for ScreenRes modes is 1.0, while for Screen mode the default value is the value required to draw a perfect circle on the screen, keeping the pixel aspect ratio in mind. This value can be calculated as follows:

\[
\text{ratio} = \left( \frac{y\text{-radius}}{x\text{-radius}} \right) \times \text{pixel\_aspect\_ratio}
\]

Where pixel_aspect_ratio is the ratio of the current mode width over current mode height, assuming a 4:3 standard monitor. If aspect ratio than 1.0, radius is the x radius; if aspect is more or equal to 1.0, radius the y radius.

F is the fill flag. If you specify this flag, the circle/ellipse will be filled with selected color. This only takes effect if you are drawing a full circle/ellipse.

Custom coordinates system set up by Window and/or View (Graphics) the drawing operation; clipping set by View also applies. When Circle finishes drawing, the current graphics cursor position is set to the supplied center.
Example

' Set 640x480 mode, 256 colors
Screen 18

' Draws a circle in the center
Circle (320, 240), 200, 15

' Draws a filled ellipse
Circle (320, 240), 200, 2, , , 0.2, F

' Draws a small arc
Circle (320, 240), 200, 4, 0.83, 1.67, 3

Sleep
Differences from QB

- *target* is new to FreeBASIC
- The FreeBASIC implementation uses a different algorithm for ellipse/arc drawing than QB, so the result may not be equal to QB for every pixel.
- The *F* flag to draw filled circles/ellipses is new to FreeBASIC.

See also

- Screen (Graphics)
- Color
Class

Declares a class object

**Syntax**
```plaintext
class typename ...
```

**Parameters**
```plaintext
typename
name of the Class
```

**Description**
We would have put something useful here (honest) except this feature isn't implemented in the compiler yet. But since it will get added in future, and there are several other document pages that need to link here, we thought it safe to include in anyway.

**Example**
```
'' sample code
```

Output:
```
sample output
```

**Dialect Differences**
- Object-related features are supported only in the `-lang fb` optic

**Differences from QB**
- New to FreeBASIC
See also

- Enum
- Type
Clears or initializes some memory

**Syntax**

```plaintext
Declare Sub Clear cdecl ( ByRef dst As Any, ByVal value As Long
```

**Usage**

```plaintext
Clear( dst, [value], bytes )
```

**Parameters**

- `dst` starting address of some memory
- `value` the value to set all bytes equal to
- `bytes` number of bytes to clear

**Description**

`clear` sets one or more bytes in memory to a certain value (the default is zero). The starting address is taken from a reference to a variable or array element.

**NOTE:** In order to clear memory referenced by a `Pointer`, it must be dereferenced first. The `clear` function will try to clear the bytes at the `pointer variable's` memory location.

**Example**

```plaintext
'create an array with 100 elements
Dim array(0 To 99) As Integer

'clear the contents of the array to 0, starting with the first element
Clear array(0), , 100 * SizeOf(Integer)

'allocate 20 bytes of memory
Dim As Byte Ptr p = Allocate(20)
```
'set each of the first ten bytes to 0
Clear *p, 0, 10

'set each of the next ten bytes to 42
Clear p[10], 42, 10

'check the values of the allocated bytes
For i As Integer = 0 To 19
    Print i, p[i]
Next

'deallocate memory
Deallocate p

**Differences from QB**

- The behavior and usage is new to FreeBASIC
- The keyword CLEAR was used in QB to erase all variables, close the stack size. This use is not supported in FreeBASIC.

**See also**

- Erase
- Reset
**CLng**

Converts numeric or string expression to **Long**

**Syntax**

```vbnet
Declare Function CLng ( ByVal expression As datatype ) As Long

Type typename
Declare Operator Cast ( ) As Long
End Type
```

**Usage**

```
result = CLng( numeric expression )
result = CLng( string expression )
result = CLng( user defined type )
```

**Parameters**

- `expression`  
  a numeric, string, or pointer expression to cast to a **Long** value
- `datatype`  
  any numeric, string, or pointer data type
- `typename`  
  a user defined type

**Return Value**

A **Long** value.

**Description**

The **CLng** function rounds off the decimal part and returns a 32-bit **Long** value. The function does not check for an overflow, and results are undefined for values which are less than \(-2\,147\,483\,648\) or larger than \(2\,147\,483\,648\).

The name can be explained as 'Convert to LoNG'.

If the argument is a string expression, it is converted to numeric by **ValInt**.
Example

' Using the CLNG function to convert a numeric value

'Create an LONG variable
Dim numeric_value As Long

'Convert a numeric value
numeric_value = CLng(-300.23)

'Print the result, should return -300
Print numeric_value
Sleep

Differences from QB
- The string argument was not allowed in QB

See also
- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CULng
- CLngInt
- CULngInt
- CSng
- CDBl
CLngInt

Converts numeric or string expression to 64-bit integer (LongInt)

Syntax

Declare Function CLngInt ( ByVal expression As datatype ) As LongInt

Type typename
Declare Operator Cast ( ) As LongInt
End Type

Usage

result = CLngInt( numeric expression )
result = CLngInt( string expression )
result = CLngInt( user defined type )

Parameters

expression
a numeric, string, or pointer expression to cast to a LongInt value

datatype
any numeric, string, or pointer data type

typename
a user defined type

Return Value

A LongInt value.

Description

The CLngInt function rounds off the decimal part and returns a 64-bit integer. The function does not check for an overflow, and results are undefined for values which are less than -9223372036854775808 or larger than 9223372036854775807#.

The name can be explained as 'Convert to LoNG INTeger'.

If the argument is a string expression, it is converted to numer ValLng.
Example

' Using the CLNGINT function to convert a numeric value

' Create an LONG INTEGER variable
Dim numeric_value As LongInt

' Convert a numeric value
numeric_value = CLngInt(-12345678.123)

' Print the result, should return -12345678
Print numeric_value
Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Clngint.

Differences from QB

- New to FreeBASIC

See also

- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CULngInt
- CSng
- CDbl
Close

Stream I/O function to terminate access to a device

**Syntax**

```basic
close [[#filenum ] [, [#filenum ...]]
or
result = close( [#filenum] )
```

**Parameters**

`filenum`
List of file numbers to close.

**Description**

Closes the files whose file numbers are passed as arguments. If an `undefined` `close` without arguments closes all the files presently opened.

Terminating the program using an `End` statement will automatically close all opened files.

**Return Value**

`close` returns zero (0) on success and a non-zero error code otherwise.

**Example**

```basic
' Create a string and fill it.
Dim buffer As String, f As Integer

buffer = "Hello World within a file."

' Find the first free file number.
f = FreeFile

' Open the file "file.ext" for binary usage, using
Open "file.ext" For Binary As #f
```
' Place our string inside the file, using number
   Put #f, , buffer

' Close the file. We could also do 'Close #f', but
Close

' End of program. (Check the file "file.ext" upon

Differences from QB

- Close can be called as a function that returns an error code.
- FB throws an error on trying to close an unused file number, if

See also

- Open
- Put (File I/O)
- Get (File I/O)
- FreeFile
Cls

Clears the screen in both text modes and graphics modes

Syntax

\texttt{Declare Sub Cls ( ByVal mode As Long = 1 )}

Usage

\texttt{Cls mode}

Parameters

\textit{mode}

A optional numeric variable with a value from 0 to 2. If omitted, it defaults to 0.

Description

An optional \textit{mode} parameter may be given,

If omitted, \texttt{Cls} clears either the text or graphics viewport. If a graphics \texttt{(Graphics)} statement, the graphics viewport is cleared. Otherwise, the text viewport is cleared. (If there is no explicit text viewport defined, the entire screen is cleared.)

If 0, clears the entire screen

If 1, clears the graphics viewport if defined. Otherwise, clears the text viewport

If 2, clears the text viewport

Example

\begin{verbatim}
' set the color to light grey text on a blue background
Color 7, 1

' clear the screen to the background color
Cls
\end{verbatim}
' print text in the center of the screen
Locate 12, 33
Print "Hello Universe!"

In graphics modes, if you want to clear the entire screen to color 0, it can be faster using the screen memory than calling cls.

Dim scrbuf As Byte Ptr, scrszize As Integer
Dim As Integer scrhei, scrpitch
Dim As Integer r = 0, dr = 1

ScreenRes 640, 480, 8

scrbuf = ScreenPtr: Assert( scrbuf <> 0 )
ScreenInfo( , scrhei, , , scrpitch )
szize = scrpitch * scrhei

Do

' lock the screen (must do this while working
ScreenLock

' clear the screen (could useCls here):
Clear *scrbuf, 0, szize

' draw circle
Circle (320, 240), r

ScreenUnlock

' grow/shrink circle radius
r += dr
If r <= 0 Then dr = 1 Else If r >= 100 Then dr = -1

' short pause in each frame (prevents hogging
Sleep 1, 1

'' run loop until user presses a key
Loop Until Len(Inkey) > 0

Differences from QB

- None

See also

- Color
- Locate
- (Print | ?)
- View (Graphics)
Color

Sets the display foreground / background color that is used with console graphics output of text

Syntax

Declare Function Color ( ByVal foreground As Long , ByVal backgr ) As Long

Usage

Color [foreground] [, background]
result = Color [([foreground] [, background] )]

Parameters

foreground
the foreground color to set
background
the background color to set

Return Value

Returns a 32-bit value containing the current foreground color in the Low Word.
the current background color in the High Word. (In hi/truecolor modes, foreground color is returned, taking up the whole 32 bits.)
The old color values can be retrieved at the same time as setting new

Description

The Color statement sets the current foreground and/or background color.
Draw, Line (Graphics), Cls, Paint, Print, PReset and PSet all use the last color set by this function when you don't specify a color to them, where applicable.
Values that Color accepts depend on the current graphics mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>foreground is screen color (ranging 0-15). background is the emulated CGA palette to (green, red, and brown), 1 (cyan, magenta and white), 2 (same as 0, but with bright colors) (same as 1, but with bright colors) foreground is a color index in current palette (ranging 0-1). background is a color index</td>
</tr>
</tbody>
</table>
If you are using a color depth higher than 8bpp, foreground and background colors are direct RGB color values in the form \&h;AARRGGBB, where AA, RR, GG and BB are the alpha, red, green and blue components ranging \&h00; - \&hFF; (0-255 in decimal notation). While in hi/truecolor modes, you can use the RGB or RGBA macro to obtain a valid color value.

A Default Palette is automatically set when entering a Screen mode.

**Example**

```
' Sets 320x240 in 32bpp color depth
Screen 14, 32

' Sets orange foreground and dark blue background
Color RGB(255, 128, 0), RGB(0, 0, 64)

' Clears the screen to the background color
Cls

' Prints "Hello World!" in the middle of the screen
Locate 15, 14
Print "Hello World!"

Sleep
```
Dim c As UInteger

'retrieve current color values
c = Color()

'extraxt color values from c using LOWORD and HIWORD
Print "Console colors:"
Print "Foreground: " & LoWord(c)
Print "Background: " & HiWord(c)

Differences from QB

- Direct color modes were not supported in QB.
- There is no border argument.

See also

- RGB
- RGBA
- LoWord
- HiWord
- Locate
- Palette
Screen
**Command**

Returns command line parameters used to call the program

**Syntax**

```
Declare Function Command ( ByVal index As Long = -1 ) As String
```

**Usage**

```
result = Command[ ]( [ index ] )
```

**Parameters**

`index`

Zero-based index for a particular command-line argument.

**Return Value**

Returns the command-line arguments(s).

**Description**

`Command` returns command-line arguments passed to the program upon

If `index` is less than zero (`< 0`), a space-separated list of all command-
of zero (`0`) returns the name of the executable; and values of one (`1`) ε

If `index` is greater than the number of arguments passed to the progra

When the command line is parsed for arguments, everything between is returned without the double quotes.

By default, filename globbing for arguments (expansion of wildcards to the command line containing wildcards are typically not expanded if with redirection are typically not returned unless properly quoted. Consult the quoting of command line arguments.

**WARNING:** *By nature of constructor precedence in FreeBASIC and main constructor or UDT constructor called for static/shared object) is not s*
Disabling filename globbing under Win32
Define the following global variable(s) somewhere in the source:

```
' For MinGW.org and Cygwin runtimes:
Extern _CRT_glob Alias "_CRT_glob" As Long
Dim Shared _CRT_glob As Long = 0

' For MinGW-w64 runtime:
Extern _dowildcard Alias "_dowildcard" As Long
Dim Shared _dowildcard As Long = 0
```

Disabling filename globbing under Dos
Define the following function somewhere in the source:

```
Function __crt0_glob_function Alias "__crt0_glob_function"

Return 0
End Function
```

Disabling filename globbing under Linux
Filename globbing is handled by the command shell. Quote the argument executing the command. For example in bash use 'set -f' to disable wildcards.

Example

```
Print "program launched via: " & Command(0)

Dim As Integer i = 1
Do
    Dim As String arg = Command(i)
    If Len(arg) = 0 Then
        Exit Do
    End If

    Print "command line argument " & i & " = " & arg & 
    i += 1
```

Dialect Differences

- The string type suffix $ is obligatory in the *-lang qb* dialect.
- The string type suffix $ is optional in the *-lang fblite* and *-lang*

Differences from QB

- The numeric argument was not supported in QB.
- QB converted the parameter list to uppercase before returning
- By default arguments containing wildcard characters are expanded (filename globbing)

See also

- __FB_ARGC__
- __FB_ARGV__
- Exec
- Run
Common

Variable declaration and scope modifier

**Syntax**

```
Common [Shared] symbolname[()] [AS DataType] [, ...]
```

**Description**

Declares a variable which is shared between code modules. A matching must appear in all other code modules using the variable.

The `Shared` optional parameter makes the variable global so that it can be accessed from `Subs` and `Functions`, as well as at module level. `Common` arrays are always global and must be defined with an empty parameter list `()`, and its dimensions or `ReDim` statement.

**Example**

```
'' common1.bas

Declare Sub initme()

Common Shared foo() As Double

ReDim foo(0 To 2) As Double

initme()

Print foo(0), foo(1), foo(2)
```

```
'' common2.bas

Common Shared foo() As Double
```
Sub initme()
    foo(0) = 4*Atn(1)
    foo(1) = foo(0)/3
    foo(2) = foo(1)*2
End Sub

Output:

| 3.141592653589793 | 1.047197551196598 | 2.094395102393195 |

**Differences from QB**

- The arrays will be always variable-length.
- *blockname* is not needed and must be removed because the order longer matters, only the symbol names.

**See also**

- Dim
- Erase
-Extern
- LBound
- ReDim
- Preserve
- Shared
- Static
- UBound
- Var
**CondBroadcast**

Restarts all threads **CondBroadcast**ing for the handle

**Syntax**

```basic
declare sub CondBroadcast ( ByVal handle as any ptr )
```

**Usage**

```basic
CondBroadcast ( handle )
```

**Parameters**

`handle`

The handle of a conditional variable, or the null pointer (0) on failure.

**Description**

Once the conditional is **CondCreate** and the threads are started, one of more of them (including the main thread executing main program) can be set to **CondWait** for the conditional, they will be stopped until some other thread **CondSignal**s that the waiting thread can restart. **CondBroadcast** can be used to restart all threads waiting for the conditional. At the end of the program **CondDestroy** must be used to avoid leaking resources in the OS.

**CondBroadcast** must be used instead of **CondSignal** to restart all threads waiting on the conditional.

**Example**

See **CondCreate**

**Platform Differences**

- **CondBroadcast** is not available with the DOS version / target of FreeBASIC, because multithreading is not supported by DO kernel nor the used extender.
- In Linux the threads are always started in the order they are
created, this can't be assumed in Win32. It's an OS, not a FreeBASIC issue.

**Dialect Differences**
- Threading is not allowed in `-lang qb`

**Differences from QB**
- New to FreeBASIC

**See also**
- `CondCreate`
- `CondDestroy`
- `CondSignal`
- `CondWait`
- `ThreadCreate`
**CondCreate**

Creates a conditional variable to be used in synchronizing threads.

**Syntax**

```
Declare Function CondCreate() As Any Ptr
```

**Usage**

```
result = CondCreate
```

**Return Value**

A handle to a newly created conditional variable, or the null pointer (0).

**Description**

Once the conditional is **Condcreated** and the threads are started, one or more threads can be set to **CondWait** for the conditional, they will be stopped until some other thread is used to restart all threads waiting for the conditional. At the end of the program.

**Example**

See also **CondWait** and **CondSignal**

```basi
;' make newly-created threads wait until all threads are ready
;
Dim Shared hcondstart As Any Ptr
Dim Shared hmutexstart As Any Ptr
Dim Shared start As Integer = 0

Dim Shared threadcount As Integer
Dim Shared hmutexready As Any Ptr
Dim Shared hcondready As Any Ptr

Sub mythread(ByVal id_ptr As Any Ptr)
```
Dim id As Integer = Cast(Integer, id_ptr)
'' signal that this thread is ready
MutexLock hmutexready
threadcount += 1
Print "Thread " & id & " is waiting..."
CondSignal hcondready
MutexUnlock hmutexready

'' wait for the start signal
MutexLock hmutexstart
Do While start = 0
   CondWait hcondstart, hmutexstart
Loop

'' now this thread holds the lock on hmutexstart
MutexUnlock hmutexstart

'' print out the number of this thread
For i As Integer = 1 To 40
   Print id;
Next i
End Sub

Dim threads(1 To 9) As Any Ptr
hcondstart = CondCreate()
hmutexstart = MutexCreate()

hcondready = CondCreate()
hmutexready = MutexCreate()

threadcount = 0
MutexLock(hmutexready)
For i As Integer = 1 To 9
   threads(i) = ThreadCreate(@mythread, Cast(Any
   If threads(i) = 0 Then
Print "unable to create thread"
End If
Next i

Print "Waiting until all threads are ready..."

Do Until threadcount = 9
    CondWait(hcondready, hmutexready)
Loop
MutexUnlock(hmutexready)

Print
Print "Go!"

MutexLock hmutexstart
start = 1
CondBroadcast hcondstart
MutexUnlock hmutexstart

' wait for all threads to complete
For i As Integer = 1 To 9
    If threads(i) <> 0 Then
        ThreadWait threads(i)
    End If
Next i

MutexDestroy hmutexready
CondDestroy hcondready

MutexDestroy hmutexstart
CondDestroy hcondstart

'Visual example of mutual exclusion + mutual synchrony by using Mutex and CondVar:
'the "user-defined thread" computes the points coordinates
'and the "main thread" plots the points.
'Principle of mutual exclusion + mutual synchronisation
Thread#A XOR + <=>
.....
'MutexLock(mut)
' While Thread#A_signal <> false
'   CondWait(cond, mut)
' Wend
' Do_something#A_with_exclusion
' Thread#A_signal = true
' CondSignal(cond)
'MutexUnlock(mut)
.....

'Behavior:
'- Unnecessary to pre-calculate the first point.
'- Each calculated point is plotted one time only.

'If you comment out the lines containing "MutexLock", "CondWait" and "CondSignal", ".ready" 
'(inside "user-defined thread" or/and "main thread")
'there will be no longer mutual exclusion nor mutual synchronization 
'between computation of coordinates and plotting coordinates, 
'and many points will not be plotted on circle (due to non-coherent coordinates).

Type ThreadUDT
    Dim handle As Any Ptr
    Dim sync As Any Ptr
    Dim cond As Any Ptr
    Dim ready As Byte
    Dim quit As Byte
    Declare Static Sub Thread (ByVal As Any Ptr)
    Dim procedure As Sub (ByVal As Any Ptr)
    Dim p As Any Ptr
    Const false As Byte = 0
    Const true As Byte = Not false
End Type
Sub ThreadUDT.Thread (ByVal param As Any Ptr)
    Dim tp As ThreadUDT Ptr = param
    Do
        Static As Integer I
        MutexLock(tp->sync)
        While tp->ready <> false
            CondWait(tp->cond, tp->sync)
        Wend
        tp->procedure(tp->p)
        I += 1
        Locate 30, 38
        Print I;
        tp->ready = true
        CondSignal(tp->cond)
        MutexUnlock(tp->sync)
        Sleep 5
    Loop Until tp->quit = tp->true
End Sub

Type Point2D
    Dim x As Integer
    Dim y As Integer
End Type

Const x0 As Integer = 640 / 2
Const y0 As Integer = 480 / 2
Const r0 As Integer = 200
Const pi As Single = 4 * Atn(1)

Sub PointOnCircle (ByVal p As Any Ptr)
    Dim pp As Point2D Ptr = p
    Dim teta As Single = 2 * pi * Rnd
    pp->x = x0 + r0 * Cos(teta)
    Sleep 5
    pp->y = y0 + r0 * Sin(teta)
End Sub
SCREEN 12
LOCATE 30, 2
PRINT "<any_key> : exit";
LOCATE 30, 27
PRINT "calculated:";
LOCATE 30, 54
PRINT "plotted:";

DIM Pptr As Point2D Ptr = New Point2D

DIM Tptr As ThreadUDT Ptr = New ThreadUDT
Tptr->sync = MutexCreate
Tptr->cond = CondCreate
Tptr->procedure = @PointOnCircle
Tptr->p = Pptr
Tptr->handle = ThreadCreate(@ThreadUDT.Thread, Tptr)

DO
    Static As Integer I
    Sleep 5
    MutexLock(Tptr->sync)                           'Mutex (Lock) for main thread
    While Tptr->ready <> Tptr->true                 'Process loop against spurious wakeups
        CondWait(Tptr->cond, Tptr->sync)             'CondWait to receive signal from user-thread
    Wend
    PSet (Pptr->x, Pptr->y)                         'Plotting one point
    I += 1
    Locate 30, 62
    Print I;
    Tptr->ready = Tptr->false                      'Reset ready
    CondSignal(Tptr->cond)                         'CondSignal
    MutexUnlock(Tptr->sync)                        'Mutex (Unlock) for main thread
Loop Until Inkey <> ""

MutexLock(Tptr->sync)                           'Mutex (Lock) for main thread
Tptr->ready = Tptr->false                       'Reset ready
Tptr->quit = Tptr->true                         'Set quit
CondSignal(Tptr->cond)                         'CondSignal
MutexUnlock(Tptr->sync)
ThreadWait(Tptr->handle)
MutexDestroy(Tptr->sync)
CondDestroy(Tptr->cond)
Delete Tptr
Delete Pptr
Sleep

See also the similar MutexCreate example

Platform Differences

- **Condcreate** is not available with the DOS version / target of FreeBASIC used extender.

Dialect Differences

- Threading is not allowed in **-lang qb**

Differences from QB

- New to FreeBASIC

See also

- CondBroadcast
- CondDestroy
- CondSignal
- CondWait
- MutexCreate
- MutexLock
- MutexUnlock
- ThreadCreate
**CondDestroy**

Destroys a multi-threading conditional variable when it is no more needed.

**Syntax**

```vbnet
Declare Sub CondDestroy ( ByVal handle As Any Ptr )
```

**Usage**

```vbnet
CondDestroy ( handle )
```

**Parameters**

*handle*

The handle of a conditional variable to destroy.

**Description**

Once the conditional is **CondCreate** and the threads are started, one or more of them (including the main thread executing main program) can be set to **CondWait** for the conditional, they will be stopped until some other thread **CondSignal**s that the waiting thread can restart. **CondBroadcast** can be used to restart all threads waiting for the conditional. At the end of the program **CondDestroy** must be used to avoid leaking resources in the OS.

**Conddestroy** destroys a condition variable, freeing the resources it might hold. No threads must be waiting on the condition variable on entrance to **Conddestroy**.

**Example**

See **CondCreate**, **CondWait** and **CondSignal**

**Platform Differences**

- **Conddestroy** is not available with the DOS version / target of FreeBASIC, because multithreading is not supported by DOS kernel nor the used extender.
Dialect Differences

- Threading is not allowed in `lang qb`

Differences from QB

- New to FreeBASIC

See also

- CondCreate
- CondBroadcast
- CondSignal
- CondWait
- ThreadCreate
CondSignal

Restarts a thread suspended by a call to CondWait

Syntax

Declare Sub CondSignal ( ByVal handle As Any Ptr )

Usage

CondSignal ( handle )

Parameters

handle
The handle of a conditional variable, or the null pointer (0) on failure.

Description

Once the conditional is created with CondCreate and the threads are set to CondWait for the conditional, they will be stopped until some other thread all threads waiting for the conditional. At the end of the program CondD

CondSignal restarts one thread waiting. It should be called after mute: the conditional, nothing happens; if several are waiting, only one is re

Example

See also CondCreate and CondWait

' This very simple example code demonstrates the use
' The main routine initializes a string and creates a
' The main routine waits until receive the condition
' The thread complements the string, then sends a

'Principle of mutual exclusion + simple synchroniz
' Thread#A                      XOR + ==>
'......
'MutexLock(mut)
Dim Shared As Any Ptr mutex
Dim Shared As Any Ptr cond
Dim Shared As String txt
Dim As Any Ptr pt
Dim Shared As Integer ok = 0

Sub thread (ByVal p As Any Ptr)
    Print "thread is complementing the string"
    MutexLock(mutex)
    Sleep 400
    txt &= " complemented by thread"
    ok = 1
    CondSignal(cond)
    MutexUnlock(mutex)
    Print "thread signals the processing completed"
End Sub

mutex = MutexCreate
cond = CondCreate

txt = "example of text"
Print "main() initializes a string = " & txt
Print "main creates one thread"
Print pt = ThreadCreate(@thread)
MutexLock(mutex)
While ok <> 1
    CondWait(cond, mutex)
Wend
Print
Print "back in main(), the string = " & txt
Dialect Differences

- Threading is not allowed in `-lang qb`

Platform Differences

- **Condsignal** is not available with the DOS version / target of FreeBASIC.
- In Linux the threads are always started in the order they are created, this can’t be assumed in Win32. It’s an OS, not a FreeBASIC issue.

Differences from QB

- New to FreeBASIC

See also

- CondCreate
- CondDestroy
- CondBroadcast
- CondWait
- ThreadCreate
**CondWait**

Stops execution of current thread until some condition becomes true

**Syntax**

```vbnet
Declare Sub CondWait ( ByVal handle As Any Ptr, ByVal mutex As A
```

**Usage**

```vbnet
CondWait ( handle, mutex )
```

**Parameters**

- **handle**
  
The handle of a conditional variable, or the null pointer (0) on failure.

- **mutex**
  
The mutex associated with this conditional variable, which must be locked when testing the condition and calling

**Description**

Function that stops the thread where it is called until some other thread

Once the conditional variable is created with **CondCreate** and the threads are started, one or more of them (including the main thread executing the main program) can be set to **CondWait** for the conditional; they will be stopped until some other threads waiting for the conditional. At the end of the program **CondDestroy**

When calling **CondWait**, **mutex** should already be locked (using the same handle on the conditional variable will occur. The calling thread execution is suspended and does not consume any CPU time until the condition variable is signaled. **mutex** will be locked again for unlocking when the thread is finished with it.

**Note**: It is a good habit to use **CondWait** in a protected way against eventual spurious wakeups. For that, **CondWait** is put within a loop for checking that a Boolean predicate is indeed true (set by another thread just before executing another thread, and the condition variable becomes signaled) when the thread has finished waiting.

See example below for detailed coding.

**Example**

See also **CondCreate** and **CondSignal**
'This simple example code demonstrates the use of
' The main routine creates three threads.
' Two of the threads update a "count" variable.
' The third thread waits until the count variable

#define numThread 3
#define countThreshold 6

Dim Shared As Integer count = 0
Dim Shared As Any Ptr countMutex
Dim Shared As Any Ptr countThresholdCV
Dim As Any Ptr threadID(0 To numThread-1)
Dim Shared As Integer ok = 0

Sub threadCount (ByVal p As Any Ptr)
    Print "Starting threadCount(): thread#" & p
    Do
        Print "threadCount(): thread#" & p & ", locking mutex"
        MutexLock(countMutex)
        count += 1
        ' Check the value of count and signal waiting thread
        ' Note that this occurs while mutex is locked.
        If count >= countThreshold Then
            If count = countThreshold Then
                Print "threadCount(): thread#" & p
                ok = 1
                CondSignal(countThresholdCV)
            Else
                Print "threadCount(): thread#" & p
            End If
        End If
        MutexUnlock(countMutex)
        Exit Do
    End If
    Print "threadCount(): thread#" & p & ", count = ", count
    MutexUnlock(countMutex)
    Sleep 100
Loop
End Sub

Sub threadWatch (ByVal p As Any Ptr)
    Print "Starting threadWatch(): thread#" & p & 
    MutexLock(countMutex)
    ' Note that the Condwait routine will automatically and atomically unlock mutex while it waits.
    While ok = 0
        CondWait(countThresholdCV, countMutex)
    Wend
    Print "threadWatch(): thread#" & p & 
    Print "threadWatch(): thread#" & p & 
    MutexUnlock(countMutex)
End Sub

' Create mutex and condition variable
countMutex = MutexCreate
countThresholdCV = CondCreate
' Create threads
threadID(0) = ThreadCreate(@threadWatch, Cast(Any
threadID(1) = ThreadCreate(@threadCount, Cast(Any
threadID(2) = ThreadCreate(@threadCount, Cast(Any
' Wait for all threads to complete
For I As Integer = 0 To numThread-1
    ThreadWait(threadID(I))
    Print "Main(): Waited on thread#" & I+1 & " Done"
Next I
MutexDestroy(countMutex)
CondDestroy(countThresholdCV)

Platform Differences
- **Condwait** is not available with the DOS version / target of FreeBASIC, because multithreading is not supported by DOS kernel nor the used textender.
- In Linux the threads are always started in the order they are created, this can't be assumed in Win32. It's an OS, not a FreeBASIC issue.

Dialect Differences
- Threading is not allowed in `-lang qb`
Differences from QB

- New to FreeBASIC

See also

- CondCreate
- CondDestroy
- CondBroadcast
- CondSignal
- MutexCreate
- MutexLock
- MutexUnlock
- ThreadCreate
Non-modifiable variable declaration.

**Syntax**

```plaintext
Const symbolname1 [AS DataType] = value1 [, symbolname2 [AS Data
= value2, ...]
or
Const [AS DataType] symbolname1 = value1 [, symbolname2 = value2
```

**Description**

Declares non-modifiable constant data that can be integer or decimal (floating-point) numbers or strings. The constant type will be inferred if `DataType` isn't explicitly given.

Specifying `String * Size, Zstring * Size` or `Wstring * Size` as `DataType` is not allowed.

Specifying `String` as `DataType` is tolerated but without effect because the resulting type is always a `Zstring * Size`.

**Example**

```plaintext
Const Red = RGB(252, 2, 4)
Const Black As UInteger = RGB(0, 0, 0)
Const Text = "This is red text on a black bkgnd."

Locate 1, 1
Color Red, Black
Print Text
Sleep
End
```

**Differences from QB**

- QB does not support the `As datatype` syntax.
See also

- `#define`
- `Const (Qualifier)`
- `Const (Member)`
- `Enum`
- `Var`
Const (Member)

Specifies that a member procedure is read only.

Syntax

```
Type typename
Declare Const Sub|Function|Property|Operator ...
End Type

Const Sub|Function|... typename ...
...
End Sub|Function|...
```

Description

Specifies that a method does not change the object it is called on. The hidden This parameter will be considered read-only. The declaration can be read as 'invoking a const method promises not to change the object', and the compiler will error if the member procedure tries to change any of the data fields, or calls a non-const member procedure.

Read-only (Const) declarations are a measure of type safety that can be read as 'promises not to change.' The compiler uses the const declarations to check operations on variables and parameters and generate an error at compile time if their data could potentially change. There is no runtime overhead for using Const qualifiers since all of the checks are made at compile time.

Constructors and destructors cannot be Const (not useful). Member procedures can not be both Const and Static since static member procedures do not have a hidden This parameter.

For methods with Const in their declaration, Const can also be specified on the corresponding method bodies, for improved code readability.

Example

```
'' Const Member Procedures
```
Type foo
  x As Integer
  c As Const Integer = 0
Declare Const Sub Inspect1()
Declare Const Sub Inspect2()
Declare Sub Mutate1()
Declare Sub Mutate2()
End Type

Sub foo.Mutate1()
  '' we can change non-const data fields
  x = 1

  '' but we still can't change const data
  '' fields, they are promised not to change
  '' c = 1 '' Compile error
End Sub

Sub foo.Mutate2()
  '' we can call const members
  Inspect1()

  '' and non-const members
  Mutate1()
End Sub

Sub foo.Inspect1()
  '' can use data members
  Dim y As Integer
  y = c + x

  '' but not change them because Inspect1()
  '' is const and promises not to change foo
  '' x = 10 '' Compile error
Differences from QB

- New to FreeBASIC

See also

- Const
- Const (Qualifier)
- Dim
- Type
**Const (Qualifier)**

Specifies that a data type or pointer data type is read only.

**Syntax**

```plaintext
... As [Const] datatype [ [Const] Ptr ... ]
```

**Parameters**

`datatype`

Name of a standard or user defined data type.

**Description**

Specifies that the `datatype` or `Ptr` immediately to the right of the `Const` qualifier is to be considered as read only. Read-only (`Const`) declarations are a measure of type safety that can be read as 'promises not to change'.

The compiler uses the `Const` declarations to check operations on variables, parameters, and generate an error at compile time if their data could potentially change. There is no runtime overhead for using `Const` qualifiers since all checks are made at compile time.

`Const` can be used anywhere data type declarations are made. This includes variables, parameters, function return results, user defined type fields, aliases, and casting. The `datatype` can be any built-in standard data type or user defined type.

Read-only variables must have an initializer since modifying a read-only variable through an assignment will generate a compiler error. The initializer may appear after the declaration of the variable.

Both non-const and const variables may be passed to a procedure expecting a const parameter. However, a const variable may not be passed to a procedure taking a non-const parameter, and will generate a compile-time error.

Procedures can be overloaded based on the const-ness of parameters. For example, a procedure can be overloaded where one version of the procedure takes a `byref foo as bar` parameter and another version of the procedure takes a `byref foo as bar` parameter.
takes a 'byref foo as const bar' parameter.

With pointer declarations, `const` can be used to indicate which part of pointer declaration is read-only (all other parts are by default read-write). Read-only portion of the pointer data type could be the pointer itself (the address), what the pointer points to (the data), or both. In a declaration more than one level of `Ptr` indirection, the right most `Ptr` indicates the order level of indirection and is therefore dereferenced first.

The compiler has an internal hard-limit of eight (8) levels of pointer inc with respect to const qualifiers and the behavior of using `const` with `Ptr` types having greater than eight (8) levels of indirection is undefined.

**Example**

```vbnet
' Const Variables

'' procedure taking a const parameter
Sub proc1( ByRef x As Const Integer )

    '' can't change x because it is const
    '' x = 10 '' compile error

    '' but we can use it in expressions and
    '' assign it to other variables
    Dim y As Integer
    y = x
    y = y * x + x

End Sub

'' procedure taking a non-const parameter
Sub proc2( ByRef x As Integer )

    '' we can change the value
    x = 10

End Sub

'' declare a non-const and const variable
```
Dim a As Integer
Dim b As Const Integer = 5

' proc1() will accept a non-const or const argument because proc1() promises not to change the variable passed to it.
proc1(a)
proc1(b)

' proc2() will accept a non-const argument
proc2(a)

' but not a const argument because proc2() might change the variable's data and we promised that 'b' would not change.
' proc2(b) '' compile error

' Const Pointers

' an integer
Dim x As Integer = 1
Dim y As Integer = 2
Dim z As Integer = 3

' To check that the compiler generates errors when attempting to reassign const variables, uncomment the assignments below.

Scope
' a pointer to an integer
Dim p As Integer Ptr = @x

p = @y    '/' OK - pointer can be changed '/
*p = z    '/' OK - data can be changed '/
End Scope

Scope
  
  "' a pointer to a constant integer
  Dim p As Const Integer Ptr = @x

  p = @y  /' OK - pointer can be changed '/
  "' *p = z  /' Error - data is const '/

End Scope

Scope
  
  "' a constant pointer to an integer
  Dim p As Integer Const Ptr = @x

  "' p = @y  /' Error - pointer is const '/
  *p = z  /' OK - data can be changed '/

End Scope

Scope
  
  "' a constant pointer to a constant integer
  Dim p As Const Integer Const Ptr = @x

  "' p = @y  /' Error - pointer is const '/
  "' *p = z  /' Error - data is const '/

End Scope

'' Const Parameters in an Overloaded Procedure

'' procedure with non-const parameter
Sub foo Overload( ByRef n As Integer )
Print "called 'foo( byref n as integer )'"
End Sub

' procedure with const parameter
Sub foo Overload( ByRef n As Const Integer )
    Print "called 'foo( byref n as const integer )'"
End Sub

Dim x As Integer = 1
Dim y As Const Integer = 2

foo( x )
foo( y )

' OUTPUT:
' called 'foo( byref n as integer )'
' called 'foo( byref n as const integer )'

Differences from QB

- New to FreeBASIC

See also

- Const
- Const (Member)
- Dim
- Type
Constructor

Called automatically when a class or user defined type is created

Syntax

```
Type typename
Declare Constructor ( )
Declare Constructor ( [ ByRef | ByVal ] parameter As datatype [ ]
End Type

Constructor typename ( [ parameters ] ) [ Export ]
statements
End Constructor
```

Parameters

```
typename
name of the Type or Class
```

Description

Constructor methods are called when a user defined Type or Class variable is created.

```
typename
name of the type for which the constructor method is defined.
```

More than one constructor may exist for a type or class. The exact constructor method called depends on the signature matched when the variable is initialized. More than one parameter declaration.

A constructor method is passed a hidden This parameter having the same type as the constructor. This parameter allows access the fields of the Type or Class which is to be initialized in the constructor.

Constructors are called when declaring global or local static instances dynamically using the New operator. See examples below for different constructor syntaxes.

A copy Constructor is a special constructor that initializes a new object in cases where the copy Constructor is called: when instantiating one object from another (in one instruction), when passing an object by value, when an object is returned from a function by value (by using statement).
Note: When an object is returned from a function by value, but by using assignment, the Constructor is called once at first, and then the Let (Assign). A copy Constructor must be defined if the shallow implicit copy constructor is calle when the object manages dynamically allocated memory or other resources which need to be copied (for example if a member pointer points to dynamically allocated memory, it simply do an implicit pointer construction and a copy of value instead of allocating memory data).

Note: Even if is defined an explicit default Constructor, it is never called by the implicit copy constructor.

Chaining of constructors in nested types is supported. Any fields that have their own default constructor are called first. The keyword Constructor(parameters) can be used at the top of a constructor of same type. It prevents the compiler from emitting field initialization code (instead, it relies on the chained constructor to initialize everything).

Constructor can be also called directly from the typename instance like other member methods (same syntax, i.e. using a member access operator, e.g. obj.Constructor). thisConstructor(parameters) is not treated as chaining constructor, and is treated like other constructors. In general it's not safe to manually call the constructor on an object when the old object state - if any - is overwritten without any of its old members being destroyed, which could cause memory/resource leaks.

Example

Simple constructor example for beginners.

```plaintext
Type MyObj
  Foo As Integer Ptr
  
  ' ' Constructor to create our integer, and set it to 0.
Declare Constructor(ByVal DefVal As Integer = 0)
  ' ' Destroy our integer on object deletion.
Declare Destructor()
End Type

Constructor MyObj(ByVal DefVal As Integer = 0)
  Print "Creating a new integer in MyObj!"
  Print "The Integer will have the value of: " & DefVal
  Print ""
```
' Create a pointer, and set its value to the
' Constructor.
This.Foo = New Integer
*This.Foo = DefVal
End Constructor

Destructor MyObj()
    Print "Deleting our Integer in MyObj!"
    Print ""

    ' Delete the pointer we created in MyObj.
    Delete This.Foo
    This.Foo = 0
End Destructor

Scope
    ' Create a MyObj type object
    ' Send the value of '10' to the constructor
    Dim As MyObj Bar = 10

    ' See if the integer's been created. Print it
    Print "The Value of our integer is: " & *Bar.Foo
    Print ""

    Sleep
End Scope
    ' We've just gone out of a scope. The Destructor
    ' Because our objects are being deleted.
Sleep

More advanced construction example, showing constructor overloading among other things.

Type sample
    _text As String

Declare Constructor ()
Declare Constructor (a As Integer)
Declare Constructor (a As Single)
Declare Constructor (a As String, b As Byte)

Declare Operator Cast () As String

End Type

Constructor sample ()
    Print "constructor sample ()"
    Print
    this._text = "Empty"
End Constructor

Constructor sample (a As Integer)
    Print "constructor sample ( a as integer )"
    Print " a = "; a
    Print
    this._text = Str(a)
End Constructor

Constructor sample (a As Single)
    Print "constructor sample ( a as single )"
    Print " a = "; a
    Print
    this._text = Str(a)
End Constructor

Constructor sample (a As String, b As Byte)
    Print "constructor sample ( a as string, b as byte )"
    Print " a = "; a
    Print " b = "; b
    Print
    this._text = Str(a) + "," + Str(b)
End Constructor

Operator sample.cast () As String
    Return this._text
End Operator
```vbnet
Print "Creating x1"
Dim x1 As sample

Print "Creating x2"
Dim x2 As sample = 1

Print "Creating x3"
Dim x3 As sample = 99.9

Print "Creating x4"
Dim x4 As sample = sample("aaa", 1)

Print "Values:"
Print " x1 = "; x1
Print " x2 = "; x2
Print " x3 = "; x3
Print " x4 = "; x4
```

Example of copy constructor.

```vbnet
Type UDT
    Dim As String Ptr p
    Declare Constructor ()
    Declare Constructor (ByRef rhs As UDT)
    Declare Destructor ()
End Type

Constructor UDT ()
    This.p = CAllocate(1, SizeOf(String))
End Constructor

Constructor UDT (ByRef rhs As UDT)
    This.p = CAllocate(1, SizeOf(String))
    *This.p = *rhs.p
End Constructor

Destructor UDT ()
```
*This.p = ""
  Deallocate This.p
End Destructor

Dim As UDT u0
*u0.p = "copy constructor exists"
Dim As UDT u = u0
*u0.p = "" 'to check the independance of the result copy with the object copied
Print *u.p
Sleep

Dialect Differences

- Object-related features are supported only in the `-lang fb` optic

Differences from QB

- New to FreeBASIC

See also

- Class
- Constructor (Module)
- New
- Destructor
- Type
**Constructor (Module)**

Specifies execution of a procedure before module-level code

**Syntax**

```
[Public | Private] Sub procedure_name [Alias "external_identifier"
[priority] [Static]
{ procedure body }
End Sub
```

**Description**

The `Constructor` keyword is used in `Sub` definitions to force execution of module-level code. Procedures defined as constructors may be used like ordinary procedures, that is, they may be called from within module-level code.

The procedure must have an empty parameter list. A compile-time error will occur if the `Constructor` keyword is used in a `Sub` definition having one or more parameters.

Overloaded procedures, only one (1) constructor may be defined because multiple `Sub` definitions which take no arguments.

In a single module, constructors normally execute in the reverse order in which they are defined.

The `priority` attribute, an integer between 101 and 65535, can be used to force constructors to be executed in a certain order. The value of `priority` has no specific meaning other than the number with other constructor priorities. 101 is the highest priority and is executed first. Constructors having a `priority` attribute are executed before constructors with no attribute. A priority value of 65535 is the same as not assigning a priority value.

A module may define multiple constructor procedures, and multiple modules may define additional constructors provided no two `Public` constructors share the same `procedure_name`.

When linking with modules that also define constructors, the order of constructors is not guaranteed at link-time unless the `priority` attribute is used. Therefore, special care should be taken when using constructors that may call on a secondary module also defining a constructor. It is advisable to use a single constructor that explicitly calls initialization procedures in those modules.

**Example**
'' ConDesExample.bas : An example program that defines two sets of constructors and destructors. Demonstrates when and in what order they are called when linking a single module.

Sub Constructor1() Constructor
    Print "Constructor1() called"
End Sub

Sub Destructor1() Destructor
    Print "Destructor1() called"
End Sub

Sub Constructor2() Constructor
    Print "Constructor2() called"
End Sub

Sub Destructor2() Destructor
    Print "Destructor2() called"
End Sub

'' ----------------------
Print "module-level code"

End 0
'' ----------------------

Output:

Constructor2() called
Constructor1() called
module-level code
Destructor1() called
Destructor2() called

Differences from QB

- New to FreeBASIC
See also

- Constructor (Class)
- Destructor (Module)
- Sub
Continue

Control flow statement to continue next iteration of a loop

**Syntax**

```
Continue {Do | For | While}
```

**Description**

Skips all code until the end clause of a loop structure, i.e. `Do...Loop`, `For...Next`, `While...Wend` block, then executes the limit condition check. In the case where the variable is incremented according to the `Step` specified.

Where there are multiple `Do / For / While` blocks nested, it will continue on the innermost block of that type, i.e. the last one entered. You can continue an earlier block of that type by giving the word multiple times, separated by commas. e.g. `continue while...wend while...wend`.

**Example**

```basic
Dim As Integer n
Print "Here are odd numbers between 0 and 10!"
Print For n = 0 To 10
    If (n Mod 2) = 0 Then
        Continue For
    End If

    Print n
Next n
```

```
' simple prime number finder
```
Print "Here are the prime numbers between 1 and 20!"
Print

Dim n As Integer, d As Integer

For n = 2 To 20
    For d = 2 To Int(Sqr(n))
        If (n Mod d) = 0 Then ' d divides n
            Continue For, For ' n is not prime, so
            End If
            Next d
            Print n
        Next n

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the

Differences from QB
- New to FreeBASIC

See also
- Exit
Cos

Returns the cosine of an angle

**Syntax**

Declare Function Cos ( ByVal angle As Double ) As Double

**Usage**

`result = Cos( angle )`

**Parameters**

`angle`
the angle (in radians)

**Return Value**

Returns the cosine of the argument `angle` as a `Double` within the range...

**Description**

The argument `number` is measured in `radians` (not `degrees`).

The value returned by this function is undefined for values of `angle` with an absolute value of `2 ^ 63` or greater.

**Example**

```
Const PI As Double = 3.1415926535897932
Dim a As Double
Dim r As Double
Input "Please enter an angle in degrees: ", a
r = a * PI / 180  'Convert the degrees to Radians
Print ""
Print "The cosine of a" ; a; " degree angle is" ; Cos
Sleep
```
Output:

```
Please enter an angle in degrees: 30
The cosine of a 30 degree angle Is 0.8660254037844387
```

**Differences from QB**

- None

**See also**

- Acos
- Sin
- Tan
- A Brief Introduction To Trigonometry
CPtr

Converts a pointer expression to a specified data type pointer

**Syntax**

CPtr( PointerDataType, expression )

**Description**

Converts expression to PointerDataType.

PointerDataType must be a Pointer type (e.g. a DataType Ptr or an Any expression may have a different pointer type or be an Integer.

Note: Currently, FB does not actually enforce that PointerDataType must be a pointer. Currently, it will display a warning if you try to convert to a non-pointer, if you compile with the compiler switch.

**Example**

```vbnet
Dim intval As Integer
Dim intptr As Integer Ptr
intval = &h0080
intptr = @intval
'' will print -128 and 128, as the first expression
Print *CPtr( Byte Ptr, intptr ), *intptr
```

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC
See also

- Ptr
- Cast
- CByte
- CShort
- CInt
- CLngInt
- CSng
- CDb1
CShort

Converts numeric or string expression to an integer (Short)

Syntax

Declare Function CShort ( ByVal expression As datatype ) As Short

Type typename
Declare Operator Cast ( ) As Short
End Type

Usage

result = CShort( numeric expression )
result = CShort( string expression )
result = CShort( user defined type )

Parameters

expression
a numeric, string, or pointer expression to cast to a Short value
datatype
any numeric, string, or pointer data type
typename
a user defined type

Return Value

A Short value.

Description

The CShort function rounds off the decimal part and returns a 16-bit Short value. The function does not check for an overflow, and results are undefined which are less than -32768 or larger than 32767.

The name can be explained as 'Convert to Short'.

If the argument is a string expression, it is converted to numeric by us
Example

' Using the CSHORT function to convert a numeric value

' Create an SHORT variable
Dim numeric_value As Short

' Convert a numeric value
numeric_value = CShort(-4500.66)

' Print the result, should return -4501
Print numeric_value
Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Cshort.

Differences from QB

- New to FreeBASIC

See also

- CByte
- CUByte
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDbl
**CSign**

Converts an expression to signed

**Syntax**

\[ \text{CSign ( expression )} \]

**Usage**

\[ \text{variable} = \text{CSign ( expression )} \]

**Description**

Converts an unsigned expression to a signed one, useful to force signed behavior of division or multiplication (including with \text{sh1} and \text{Shr}).

This is the opposite of \text{CUnsg}.

**Example**

```basic
Dim value As UShort = 65535
Print CSign(value)  ' will print -1
```

**Dialect Differences**

- Not available in the \text{-lang qb} dialect unless referenced with the alias \text{__Csign}.

**Differences from QB**

- New to FreeBASIC

**See also**

- \text{CUnsg}
**CSng**

Converts numeric or string expression to **Single** precision floating point

**Syntax**

```vbnet
Declare Function CSng ( ByVal expression As datatype ) As Single

Type typename
Declare Operator Cast ( ) As Single
End Type
```

**Usage**

```vbnet
result = CSng( numeric expression )
result = CSng( string expression )
result = CSng( user defined type )
```

**Parameters**

- **expression**
  - a numeric, string, or pointer expression to cast to a **Single** value
- **datatype**
  - any numeric, string, or pointer data type
- **typename**
  - a user defined type

**Return Value**

- A **Single** precision value.

**Description**

The **csng** function returns a 32-bit **Single** value. The function does not an overflow, so be sure not to pass a value outside the representable the **Single** data type. The name can be explained as 'Convert to SiNG

If the argument to **csng** is a string expression, it is first converted to nu using **Val**.

**Example**
' Using the CSNG function to convert a numeric value

'Create an SINGLE variable
Dim numeric_value As Single

'Convert a numeric value
numeric_value = CSng(-12345.123)

'Print the result, should return -12345.123
Print numeric_value
Sleep

Differences from QB

- The string argument was not allowed in QB

See also

- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CULngInt
- CDbl
**CsrLin**

Returns the row position of the cursor

**Syntax**

```vbnet
Declare Function CsrLin ( ) As Integer
```

**Usage**

```vbnet
result = CsrLin
```

**Return Value**

An *Integer* specifying the current row of the cursor.

**Description**

Returns the current row the cursor is on (i.e. the "cursor line"). The topmost row is number 1.

**Example**

```vbnet
Print "The cursor is on row:"; CsrLin
```

**Differences from QB**

- None

**See also**

- Locate
- Pos
CUByte

Converts numeric or string expression to an unsigned byte (UByte)

Syntax

Declare Function CUByte ( ByVal expression As datatype ) As UByte

Type typename
Declare Operator Cast ( ) As UByte
End Type

Usage

result = CUByte( numeric expression )
result = CUByte( string expression )
result = CUByte( user defined type )

Parameters

expression
a numeric, string, or pointer expression to cast to a UByte value
datatype
any numeric, string, or pointer data type
typename
a user defined type

Return Value

A UByte value.

Description

The CUByte function rounds off the decimal part and returns a 8-bit UByte
The function does not check for an overflow, and results are undefined which are less than 0 or larger than 255.

The name can be explained as 'Convert to Unsigned Byte'.

If the argument is a string expression, it is converted to numeric by us
Example

```
' Using the CUBYTE function to convert a numeric value

'Create an UNSIGNED BYTE variable
Dim numeric_value As UByte

'Convert a numeric value
numeric_value = CUByte(123.55)

'Print the result, should return 124
Print numeric_value
Sleep
```

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Cubyte.

Differences from QB

- New to FreeBASIC

See also

- CByte
- CShort
- CUShort
- CInt
- CIUint
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDbl
CUInt

Converts numeric or string expression to a UInteger or UInteger<bits>

Syntax

Declare Function CUInt ( ByVal expression As datatype ) As UInteger
Declare Function CUInt<bits> ( ByVal expression As datatype ) As UInteger<bits>

Type typename
Declare Operator Cast ( ) As UInteger
Declare Operator Cast ( ) As UInteger<bits>
End Type

Usage

result = CUInt( numeric expression )
result = CUInt( string expression )
result = CUInt( user defined type )

Parameters

bits
A numeric constant expression indicating the size in bits of unsigned integer desired. The values allowed are 8, 16, 32 or 64.
expression
a numeric, string, or pointer expression to cast to a UInteger or UInteger<bits> value
datatype
any numeric, string, or pointer data type
typename
a user defined type

Return Value

A UInteger or UInteger<bits> containing the converted value.

Description

The CUInt function rounds off the decimal part and returns a UInteger a bits value is supplied, an unsigned integer type of the given size.
The function does not check for an overflow; for example, for a 32-bit results are undefined for values which are less than 0 or larger than 4.

The name can be explained as 'Convert to Unsigned INTeger'.

If the argument is a string expression, it is converted to numeric by us or ValULng, depending on the size of the result type.

**Example**

```plaintext
' Using the CUINT function to convert a numeric value

'Create an UNSIGNED INTEGER variable
Dim numeric_value As UInteger

'Convert a numeric value
numeric_value = CUInt(300.23)

'Print the result = 300
Print numeric_value
```

**Dialect Differences**

- Not available in the *-lang qb* dialect unless referenced with the __Cuint.

**Differences from QB**

- New to FreeBASIC

**See also**

- CByte
- CUByte
- CShort
- CUShort
- CInt
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDbl
- UIInteger
CULng

Converts numeric or string expression to $\text{Ulong}$

**Syntax**

```plaintext
Declare Function CULng ( ByVal expression As datatype ) As Ulong
```

```plaintext
Type typename
Declare Operator Cast () As Ulong
End Type
```

**Usage**

```plaintext
result = CULng( numeric expression )
result = CULng( string expression )
result = CULng( user defined type )
```

**Parameters**

- `expression` - a numeric, string, or pointer expression to cast to a $\text{Ulong}$ value
- `datatype` - any numeric, string, or pointer data type
- `typename` - a user defined type

**Return Value**

A $\text{Ulong}$ value.

**Description**

The `CULng` function rounds off the decimal part and returns a 32 bit $\text{ULong}$

The function does not check for an overflow. The name can be explained as 'Convert to Unsigned LoNG'.

If the argument is a string expression, it is converted to numeric by us

Of $\text{ValULng}$.

**Example**

---
' Using the CULNG function to convert a numeric value

'Dimension an UNSIGNED LONG variable
Dim numeric_value As ULONG

'Convert a numeric value
numeric_value = CULng(300.23)

'Print the result = 300
Print numeric_value
Sleep

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the __Culng.

Differences from QB
- New to FreeBASIC

See also
- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CLngInt
- CULngInt
- CSng
- CDbl
**CULngInt**

Converts numeric or string expression to 64-bit unsigned integer (*ULongInt*).

**Syntax**

```vba
Declare Function CULngInt ( ByVal expression As datatype ) As ULongInt
```

**Usage**

```
result = CULngInt( numeric expression )
result = CULngInt( string expression )
result = CULngInt( user defined type )
```

**Parameters**

- `expression`  
a numeric, string, or pointer expression to cast to a *ULongInt* value
- `datatype`  
any numeric, string, or pointer data type
- `typename`  
a user defined type

**Return Value**

A *ULongInt* value.

**Description**

The **CULngInt** function rounds off the decimal part and returns a 64-bit value. The function does not check for an overflow, and results are undefined for values which are less than 0 or larger than 18 446 744 073 709 551 615. casts from floating-point expressions are currently not guaranteed to work for values higher than $2^{63}$ (9 223 372 036 854 775 808).

The name can be explained as 'Convert to Unsigned LoNG INTeger'.
If the argument is a string expression, it is converted to numeric by us

**Example**

```vbnet
' Using the CLNGINT function to convert a numeric

'Create an UNSIGNED LONG INTEGER variable
Dim numeric_value As ULongInt

'Convert a numeric value
numeric_value = CULngInt(12345678.123)

'Print the result, should return 12345678
Print numeric_value
Sleep
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the `_CULngint`.

**Differences from QB**

- New to FreeBASIC

**See also**

- CByte
- CUByte
- CShort
- CUShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CSng
- CDb1
CUnsg

Converts an expression to unsigned

**Syntax**

```
CUnsg ( expression )
```

**Usage**

```
variable = CUnsg ( expression )
```

Converts a signed expression to an unsigned one, useful to force unsigned behavior of division or multiplication (including with sh1 and Shr).

This is the opposite of **cSign**.

**Example**

```
Dim value As Short = -1
Print CUnsg(value)  '' will print 65535
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Cunsg`.

**Differences from QB**

- New to FreeBASIC

**See also**

- **cSign**
CurDir

Returns the current directory/folder

**Syntax**

```
Declare Function CurDir ( ) As String
```

**Usage**

```
result = CurDir
```

**Return Value**

A **String** which is set to the name of the current directory/folder.

**Description**

Returns the current directory/folder.

**Example**

```
Print CurDir
```

output will vary.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias **_curdir**.

**Differences from QB**

- New to FreeBASIC

**See also**

- Open
 ■ Dir
 ■ MdDir
 ■ RmDir
**CUShort**

Converts numeric or string expression to an unsigned integer (UShort)

**Syntax**

```
Declare Function CUShort ( ByVal expression As datatype ) As UShort
```

```
Type typename
Declare Operator Cast ( ) As UShort
End Type
```

**Usage**

```
result = CUShort( numeric expression )
result = CUShort( string expression )
result = CUShort( user defined type )
```

**Parameters**

- `expression`  
a numeric, string, or pointer expression to cast to a UShort value
- `datatype`  
any numeric, string, or pointer data type
- `typename`  
a user defined type

**Return Value**

A UShort value.

**Description**

The *CUShort* function rounds off the decimal part and returns a 16-bit UShort. The function does not check for an overflow, and results are undefined for values which are less than 0 or larger than 65535.

The name can be explained as 'Convert to Unsigned Short'.

If the argument is a string expression, it is converted to numeric by us
Example

' Using the CUSHORT function to convert a numeric value

' Create an USHORT variable
Dim numeric_value As UShort

' Convert a numeric value
numeric_value = CUShort(36000.4)

' Print the result, should return 36000
Print numeric_value
Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Cushort.

Differences from QB

- New to FreeBASIC

See also

- CByte
- CUByte
- CShort
- CInt
- CUInt
- CLng
- CULng
- CLngInt
- CULngInt
- CSng
- CDbl
Custom Parameter to the **Put** graphics statement which selects a custom method.

**Syntax**

```
Put [ target, ] [ STEP ] ( x, y ), source [ , ( x1,y1 )-( x2,y2 )
```

**Parameters**

- **Custom**
  - **Required.**
  - **custom_function_ptr**
    - name of the custom user defined function.
  - **parameter**
    - optional **Pointer** to be passed to the custom function; if omitted, the default value is zero.

**Description**

**Custom** selects a custom user defined function as the method for blitting an image buffer.

The **Custom** method uses a user-defined function to calculate the final pixel values to be drawn to the destination buffer. The function has the form:

```
Declare Function identifier ( _
    ByVal source_pixel As UInteger, _
    ByVal destination_pixel As UInteger, _
    ByVal parameter As Any_Ptr _
) As UInteger
```

*identifier* is the name of the function.
*source_pixel* is the current pixel value of the source image.
*destination_pixel* is the current pixel value of the destination image.
*parameter* is the parameter that is passed by the **Put** command. If it was

**Example**

```
Function dither ( ByVal source_pixel As UInteger, B
```
''either returns the source pixel or the destination pixel, depending on the outcome of Rnd

Dim threshold As Single = 0.5
If parameter <> 0 Then threshold = *CPtr(Single)

If Rnd() < threshold Then
    Return source_pixel
Else
    Return destination_pixel
End If

End Function

Dim img As Any Ptr, threshold As Single

'' set up a screen
ScreenRes 320, 200, 16, 2
ScreenSet 0, 1

'' create an image
img = ImageCreate(32, 32)
Line img, ( 0, 0)-(15, 15), RGB(255, 0, 0), b
Line img, (16, 0)-(31, 15), RGB( 0, 0, 255), b
Line img, ( 0, 16)-(15, 31), RGB( 0, 255, 0), b
Line img, (16, 16)-(31, 31), RGB(255, 0, 255), b

'' dither the image with varying thresholds
Do Until Len(Inkey)

   Cls

    threshold = 0.2
    Put ( 80 - 16, 100 - 16), img, Custom, @dither,

    '' default threshold = 0.5
    Put (160 - 16, 100 - 16), img, Custom, @dither
threshold = 0.8
Put (240 - 16, 100 - 16), img, Custom, @dither,
ScreenCopy
Sleep 25
Loop
'' free the image memory
ImageDestroy img

Dialect Differences
- Not available in the -lang qb dialect.

Differences from QB
- New to FreeBASIC

See also
- Put (Graphics)
CVD

Converts a 64-bit integer or 8-byte string to a double-precision value

Syntax

Declare Function CVD ( ByVal l As LongInt ) As Double
Declare Function CVD ( ByRef str As Const String ) As Double

Usage

result = CVD( l )
result = CVD( str )

Parameters

l
A 64-bit LongInt with a binary copy of a double-precision variable stored in it.

str
A String at least 8 bytes in length with a binary copy of a double-precision variable stored in it.

Return Value

Returns a Double value holding a binary copy of the input value.

Description

Does a binary copy from a 64-bit LongInt or 8-byte String to a Double variable. A value of zero (0.0) is returned if the string is less than 8 bytes in length. The result will make sense only if the parameter contained a IEEE-754 formatted double-precision value, such as one generated by CVLongInt of MKD.

This function is useful to read numeric values from buffers without using a Type definition.

Example
Dim d As Double, l As LongInt

d = 1.125
l = CVLongInt(d)

Print Using "l = _&H&"; Hex(l)
Print Using "cvd(i) = &"; CVD(l)

**Differences from QB**

- QB did not support integer arguments.

**See also**

- MKD
- CVS
- CVLongInt
CVI

Converts a single-precision floating-point number or string to an integer variable using a binary copy

**Syntax**

`Declare Function CVI ( ByVal sng As Single ) As Integer`
`Declare Function CVI ( ByRef str As Const String ) As Integer`
`Declare Function CVI<bits> ( expr As DataType ) As Integer<bits>

**Usage**

```vbnet
result = CVI( sng )
result = CVI( str )
result = CVI<bits>( expr )
```

**Parameters**

- `sng`
  A Single floating-point number with a binary copy of an integer variable stored in it.
- `str`
  A String with a binary copy of an integer variable stored in it.
- `bits`
  Specifies a size of integer type to return. The types and sizes of `expr` accepted will depend on the corresponding function called.
- `expr`
  An expression that will be copied into an Integer<bits>.

**Return Value**

An Integer or Integer<bits> variable containing a binary copy of the input expression.

**Description**

Returns an integer value using the binary data contained in a Single, or a String. A value of zero (0) is returned if the string contains fewer characters than the size of the return type.
CVI is used to convert strings created with MKI.

This function can also be used to convert 32-bit integer values from a memory or file buffer without the need for a Type structure. However, just as with the type structure, special care should be taken when using CVI to convert strings that have been read from a buffer.

CVI supports an optional <bits> parameter before the argument. If bit is 16, CVShort will be called instead; if bits is 32, CVL will be called; if bits is 64, CVLongInt will be called. The return type and accepted argument types will depend on which function is called. See each function's page for more information.

Example

```vbnet
Dim i As Integer, s As String
s = "ABCD"
i = CVI(s)
Print Using "s = ""&""""; s
Print Using "i = _&H&"; Hex(i)
```

Dialect Differences

- In the -lang qb dialect, CVI expects a 2-byte string, since a QB integer is only 16 bits. Only the first two bytes of the string are used, even if the string happens to be longer than two bytes.

- In the -lang qb dialect, CVI will not take a floating-point argument, since a QB integer is only 16 bits and there is no 16 bit floating-point data type. Instead, CVI<32>/CVI<64> or CVL/CVLongInt may be used.

Differences from QB

- In QB an error occurs if the string passed is fewer than two bytes in length.

- QB did not support floating-point arguments.
QB did not support a `<bits>` parameter.

**See also**

- MKI
- CVShort
- CVL
- CVLongInt
- Integer
Converts a single-precision floating-point number or four-byte string to an integer (Long) variable

Syntax

```
Declare Function CVL ( ByVal sng As Single ) As Long
Declare Function CVL ( ByRef str As Const String ) As Long
```

Usage

```
result = CVL( sng )
result = CVL( str )
```

Parameters

- `sng`
  A Single floating-point number with a binary copy of an integer variable stored in it.

- `str`
  A String at least four bytes in length with a binary copy of an integer variable stored in it.

Return Value

A Long variable to copy the binary copy of a integer to.

Description

Returns a 32-bit Long integer value using the binary data contained in Single, or a String of at least four bytes in length. A value of zero (0) is returned if the string is less than four bytes in length.

CVL is used to convert 4-byte strings created with MKL.

This function can also be used to convert 32-bit integer values from a memory or file buffer without the need for a Type structure. However, just as with the type structure, special care should be taken when using CVL to convert strings that have been read from a buffer.
**Example**

```vbnet
Dim l As Long, s As String
s = "ABCD"
l = CVL(s)
Print Using "s = ""&""""; s
Print Using "l = &""; l
```

**Differences from QB**

- In QB an error occurs if the string passed is less than four byte in length.
- QB did not support floating-point arguments.

**See also**

- MKL
- CVShort
- CVI
- CVLongInt
CVLongInt

Converts a double-precision floating-point number or eight-byte string to a LongInt variable

Syntax

Declare Function CVLongInt ( ByVal dbl As Double ) As LongInt
Declare Function CVLongInt ( ByRef str As Const String ) As LongInt

Usage

result = CVLongInt( dbl )
result = CVLongInt( str )

Parameters

dbl
A Double floating-point number with a binary copy of a LongInt variable stored in it.

str
A String at least eight bytes in length with a binary copy of a LongInt variable stored in it.

Return Value

A LongInt variable holding a binary copy of the input variable.

Description

Returns a 64-bit LongInt value using the binary data contained in a Double, or a String of at least eight bytes in length. A value of zero (0) is returned if the string is less than eight bytes in length.

CVLongInt is used to convert 8-byte strings created with MKLongInt.

This function can also be used to convert 64-bit integer values from a memory or file buffer without the need for a Type structure. However, just as with the type structure, special care should be taken when using CVLongInt to convert strings that have been read from a buffer.
Example

```vbnet
Dim ll As LongInt, s As String
s = "ABCDEFGH"
ll = CVLongInt(ll)
Print Using "s = ""&""""; s
Print Using "ll = _&H&"; Hex(ll)
```

Differences from QB

- In QB an error occurs if the string passed is less than eight bytes in length.
- QB did not support floating-point arguments.

See also

- MKLongInt
- CVShort
- CVI
- CVL
CVS

Converts a 32-bit integer or 4-byte string to a single-precision variable

**Syntax**

```vbnet
Declare Function CVS ( ByVal i As Integer ) As Single
Declare Function CVS ( ByRef str As Const String ) As Single
```

**Usage**

```vbnet
result = CVS( i )
result = CVS( str )
```

**Parameters**

- **i**
  - A 32-bit Integer with a binary copy of a single-precision variable stored in it.
- **str**
  - A String at least 4 bytes in length with a binary copy of a single-precision variable stored in it.

**Return Value**

Returns a Single value holding a binary copy of the input value.

**Description**

Does a binary copy from a 32-bit Integer or 4-byte String to a Single variable. A value of zero (0.0) is returned if the string is less than 4 bytes in length. The result will make sense only if the parameter contained a IEEE-754 formatted single-precision value, such as one generated by CVI or MKS.

This function is useful to read numeric values from buffers without using a Type definition.

**Example**
Dim f As Single, i As Integer
f = 1.125
i = CVI(f)

Print Using "i = _&H&"; Hex(i)
Print Using "cvs(i) = &"; CVS(i)

Differences from QB

- QB did not support integer arguments.

See also

- MKS
- CVD
- CVI
CVShort

Converts a two-byte string to a short integer variable

Syntax

Declare Function CVShort ( ByRef str As Const String ) As Short

Usage

result = CVShort( str )

Parameters

str
A String at least two bytes in length with a binary copy of a short integer variable stored in it.

Return Value

Short variable holding the binary copy of a Keypgshort.

Description

Returns a 16-bit short integer value using the binary data contained in a String of at least two bytes in length. A value of zero (0) is returned if the string is less than two bytes in length.

cvShort is used to convert 2-byte strings created with MKShort.

This function can also be used to convert 16-bit integer values from a memory or file buffer without the need for a Type structure. However, just as with the type structure, special care should be taken when using cvShort to convert strings that have been read from a buffer.

Example

Dim si As Short, s As String
s = "AB"
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__cvshort`.

Differences from QB

- In QB this function is called CVI

See also

- MKShort
- CVI
- CVL
- CVLongInt
Data

Statement to store data at compile time.

Syntax

\[
\text{Data } constant\_expression1 [,constant\_expression2]... 
\]

Description

Data stores a list of constant numeric or alphabetical expressions that compile time (except with `-lang qb`) and stored as constants that can be read by using Read.

All the Data statements in the program behave as a single chained list. After one Data statement is read, the first element of the following Data statement will be read. The program should not attempt to Read after the last Data element. The results are (in all dialects) undefined, and the program may crash (Page Fault).

Data statements are only visible from within the module in which they are defined; they must be only entered in module-level code.

Data constants can only be of simple types (numeric or string). A numeric value can be read as a numeric literal into a string. A string read into a numeric variable will be evaluated by the Val function. Consts can be used as items of data except in the -lang qb dialects; names are considered as normal text.

The "Restore label" statement makes the first Data item after the label read, allowing the user to choose specific sections of data to read.

Data is normally used to initialize variables. FreeBASIC also allows the initialization of static variables when they are Dimensioned - see Variable Initializers for more.

Example

```'
Create an array of 5 integers and a string to hold the data.
Dim As Integer h(4)
Dim As String hs
```
Dim As Integer readindex

' Set up to loop 5 times (for 5 numbers... check the data)
For readindex = 0 To 4

' Read in an integer.
Read h(readindex)

' Display it.
Print "Number" ; readindex ; " = " ; h(readindex)

Next readindex

' Spacer.
Print

' Read in a string.
Read hs

' Print it.
Print "String = " + hs

' Await a keypress.
Sleep

' Exit program.
End

' Block of data.
Data 3, 234, 435/4, 23+433, 87643, "Good" + "Bye!"

**Dialect Differences**

- `-lang fb` and `-lang fblite` considers data items as constant expressions that are evaluated during compilation and its result stored in the program.
- `-lang qb` considers unquoted words, including names of variables and constants, as literal strings, and stores them without change, as in QBASIC.
delimited by commas, and a colon or a line-break signifies the statement. Unquoted strings are trimmed of whitespace at the

**Differences from QB**

- Outside of the `-lang qb` dialect, alphabetic string literals must be quotation marks, in QBASIC this was optional.
- In QBASIC empty items evaluated to number 0 or to empty string give a compile error. In QBASIC a comma at the end of the statement made an additional, empty item, evaluated to 0 or an empty string. In FreeBASIC they give a compile error.

**See also**

- Read
- Restore
**Date**

Returns the current system date as a string

**Syntax**

```basic
Declare Function Date () As String
```

**Usage**

```basic
result = Date
```

**Return Value**

Returns the current system date, in the format **mm-dd-yyyy**

**Description**

None

**Example**

```basic
Print Date ' prints the current date
```

**Differences from QB**

- The QB DATE statement (to set the system date) is now called **SetDate**.

**See also**

- **SetDate**
- **Time**
- **Timer**
**DateAdd**

Offset a date with a specified interval

**Syntax**

```
Declare Function DateAdd ( ByRef interval As Const String, ByVal number As Double, ByVal date_serial As Double ) As Double
```

**Usage**

```c
#include "vbcompat.bi"
result = DateAdd( interval, number, date_serial )
```

**Parameters**

- **interval**
  - string indicating which period of time corresponds to one unit of *number*

- **number**
  - the number of intervals to add to the base date. The number will be rounded to the nearest integer.

- **date_serial**
  - the base date

**Return Value**

Returns a *Date Serial* corresponding to the received *date_serial* plus the *number* of *intervals*.

**Description**

Interval is specified as follows:

<table>
<thead>
<tr>
<th>value</th>
<th>interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyy</td>
<td>years</td>
</tr>
<tr>
<td>q</td>
<td>quarter(three months)</td>
</tr>
<tr>
<td>m</td>
<td>months</td>
</tr>
<tr>
<td>ww</td>
<td>weeks</td>
</tr>
<tr>
<td>d,w,y</td>
<td>days</td>
</tr>
<tr>
<td>h</td>
<td>hours</td>
</tr>
</tbody>
</table>
The compiler will not recognize this function unless `vbcompat.bi` or `datetime.bi` is included.

**Example**

```vba
#include "vbcompat.bi"

Const fmt = "ddddd ttttt"
Dim d As Double
d = Now()

Print "1 hour from now is ";
Print Format( DateAdd( "h", 1, d ), fmt )

Print "1 day from now is ";
Print Format( DateAdd( "d", 1, d ), fmt )

Print "1 week from now is ";
Print Format( DateAdd( "ww", 1, d ), fmt )

Print "1 month from now is ";
Print Format( DateAdd( "m", 1, d ), fmt )
```

**Differences from QB**

- Did not exist in QB. This function appeared in Visual Basic.

**See also**

- Date Serials
DateDiff

Gets the difference of two dates measured by a specified interval

Syntax

Declare Function DateDiff ( ByVal interval As Const String, ByVal serial2 As Double, ByVal firstdayofweek As Long = fbUseSysfirstdayofyear As Long = fbUseSystem ) As Long

Usage

#include "vbcompat.bi"
result = DateDiff( interval, date_serial1, date_serial2 [, first
firstweekofyear ] ] )

Parameters

interval
the unit of time (interval) with which to measure the difference
date_serial1
starting date serial
date_serial2
end date serial
firstdayofweek
first day of the week
firstdayofyear
first day of the year

Return Value

Returns an integer corresponding to the number of intervals found by
If date_serial1 > date_serial2, the result is negative.

Description

interval is specified as follows:

<table>
<thead>
<tr>
<th>value</th>
<th>interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>yyyy</td>
<td>years</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>q</td>
<td>quarter(three months)</td>
</tr>
<tr>
<td>m</td>
<td>months</td>
</tr>
<tr>
<td>w</td>
<td>seven day periods</td>
</tr>
<tr>
<td>ww</td>
<td>calendar weeks</td>
</tr>
<tr>
<td>d,y</td>
<td>days</td>
</tr>
<tr>
<td>h</td>
<td>hours</td>
</tr>
<tr>
<td>n</td>
<td>minutes</td>
</tr>
<tr>
<td>s</td>
<td>seconds</td>
</tr>
</tbody>
</table>

*first_dayofweek* Affects the counting when 'ww' interval is used.

<table>
<thead>
<tr>
<th>value</th>
<th>first day of week</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>omitted</td>
<td>sunday</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>local settings</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>1</td>
<td>sunday</td>
<td>fbSunday</td>
</tr>
<tr>
<td>2</td>
<td>monday</td>
<td>fbMonday</td>
</tr>
<tr>
<td>3</td>
<td>tuesday</td>
<td>fbTuesday</td>
</tr>
<tr>
<td>4</td>
<td>wednesday</td>
<td>fbWednesday</td>
</tr>
<tr>
<td>5</td>
<td>thursday</td>
<td>fbThursday</td>
</tr>
<tr>
<td>6</td>
<td>friday</td>
<td>fbFriday</td>
</tr>
<tr>
<td>7</td>
<td>saturday</td>
<td>fbSaturday</td>
</tr>
</tbody>
</table>

*first_weekofyear* specifies which year (previous or next) that the week one year and the beginning of the next should included with.

<table>
<thead>
<tr>
<th>value</th>
<th>first week of year</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>local settings</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>1</td>
<td>January 1's week</td>
<td>fbFirstJan1</td>
</tr>
<tr>
<td>2</td>
<td>first weeks having 4 days in the year</td>
<td>fbFirstFourDays</td>
</tr>
<tr>
<td>3</td>
<td>first full week of year</td>
<td>fbFirstFullWeek</td>
</tr>
</tbody>
</table>
Notice if you do an arithmetical subtraction of two date serials you get

The compiler will not recognize this function unless \texttt{vbcompat.bi} or \texttt{datetime.bi}

Example

```vba
#include "vbcompat.bi"

Dim s As String, d1 As Double, d2 As Double

Line Input "Enter your birthday: ", s

If IsDate( s ) Then
  d1 = DateValue( s )
  d2 = Now()

  Print "You are " & DateDiff( "yyyy", d1, d2 ) & " years old."
  Print "You are " & DateDiff( "d", d1, d2 ) & " days old."
  Print "You are " & DateDiff( "s", d1, d2 ) & " seconds old."
Else
  Print "Invalid date"
End If
```

Differences from QB

- Did not exist in QB. This function appeared in Visual Basic.

See also

- Date Serials
**DatePart**

Gets an interval from a date

**Syntax**

```
Declare Function DatePart ( ByRef interval As Const String, ByVal date_serial As Double, ByVal firstdayofweek As Long = fbUseSystem, ByVal firstdayofyear As Long = fbUseSystem ) As Long
```

**Usage**

```
#include "vbcompat.bi"
result = DatePart( interval, date_serial, first_dayofWeek [, first_week_of_year ] )
```

**Parameters**

- `interval` string indicating which part of the date is required
- `date_serial` the date serial to decode
- `firstdayofweek` first day of the week
- `firstdayofyear` first day of the year

**Return Value**

Return an integer representing the `interval` in the Date Serial.

**Description**

`interval` string indicating which part of the date is required is specified as follows:

<table>
<thead>
<tr>
<th>value</th>
<th>interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyy</td>
<td>years</td>
</tr>
<tr>
<td>q</td>
<td>quarter(three months)</td>
</tr>
<tr>
<td>m</td>
<td>months</td>
</tr>
<tr>
<td>value</td>
<td>first day of week</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
</tr>
<tr>
<td>omitted</td>
<td>sunday</td>
</tr>
<tr>
<td>0</td>
<td>local settings</td>
</tr>
<tr>
<td>1</td>
<td>sunday</td>
</tr>
<tr>
<td>2</td>
<td>monday</td>
</tr>
<tr>
<td>3</td>
<td>tuesday</td>
</tr>
<tr>
<td>4</td>
<td>wednesday</td>
</tr>
<tr>
<td>5</td>
<td>thursday</td>
</tr>
<tr>
<td>6</td>
<td>friday</td>
</tr>
<tr>
<td>7</td>
<td>saturday</td>
</tr>
</tbody>
</table>

*first_dayofweek* Affects the output when 'w' interval is required.

<table>
<thead>
<tr>
<th>value</th>
<th>first week of year</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>local settings</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>1</td>
<td>January 1's week</td>
<td>fbFirstJan1</td>
</tr>
<tr>
<td>2</td>
<td>first weeks having 4 days in the year</td>
<td>fbFirstFourDays</td>
</tr>
<tr>
<td>3</td>
<td>first full week of year</td>
<td>fbFirstFullWeek</td>
</tr>
</tbody>
</table>

*first_weekofyear* specifies which year (previous or next) that the wee which spans the end of one year and the beginning of the next should included with. Affects the output when 'ww' interval is required.
The compiler will not recognize this function unless vbcompat.bi or datetime.bi is included.

Example

```vbnet
#include "vbcompat.bi"

Dim d As Double

d = Now()

Print "Today is day " & DatePart( "y", d );
Print " in week " & DatePart( "ww", d );
Print " of the year " & DatePart( "yyyy", d )
```

Differences from QB

- Did not exist in QB. This function appeared in Visual Basic.

See also

- Date Serials
DateSerial

Creates a date serial

Syntax

Declare Function DateSerial ( ByVal year As Long, ByVal month As Long, ByVal day As Long ) As Long

Usage

#include "vbcompat.bi"
result = DateSerial( year, month, day )

Parameters

year
the year
month
the month of the year
day
the day of the month

Return Value

Returns a date serial containing the date formed by the values in the year, month and day parameters. The date serial returned has no decimal part.

Description

The compiler will not recognize this function unless vbcompat.bi or datetime.bi is included.

Example

#include "vbcompat.bi"

Dim a As Double = DateSerial(2005, 11, 28)
Differences from QB

- Did not exist in QB. This function appeared in PDS and VBDO!

See also

- Date Serials
- DateSerial
- TimeValue
- DateValue
**DateValue**

Returns a **Date Serial** from a string

**Syntax**

```basic
Declare Function DateValue ( ByRef date_string As String ) As Double
```

**Usage**

```basic
#include "vbcompat.bi"
result = DateValue( date_string )
```

**Parameters**

- **date_string**
  
  The string to convert to a date serial

**Return Value**

Returns a **Date Serial** from a date string.

**Description**

The date string must be in the format set in the regional settings of the System.

**DateValue(Date())** will work correctly only if the regional settings specify a short date format QB used (mm-dd-yyyy). Consider using the **Now** function expression `Fix(Now())` to obtain the current date as a date serial.

The compiler will not recognize this function unless `vbcompat.bi` or `datetime.bi` is included.

**Example**

```basic
#include "vbcompat.bi"
Dim As Integer v1, v2
Dim As String s1, s2
```
Print "Enter first date: ";
Line Input s1

If IsDate( s1 ) = 0 Then
    Print "not a date"
    End
End If

Print "Enter second date: ";
Line Input s2

If IsDate( s2 ) = 0 Then
    Print "not a date"
    End
End If

' convert the strings to date serials
v1 = DateValue( s1 )
v2 = DateValue( s2 )

Print "Number of days between dates is " & Abs( v2

Differences from QB

- Did not exist in QB. This function appeared in PDS and VBDO'

See also

- Date Serials
- DateSerial
- TimeValue
Day

Gets the day of the month from a Date Serial

**Syntax**

```
Declare Function Day ( ByVal date_serial As Double ) As Long
```

**Usage**

```
#include "vbcompat.bi"
result = Day( date_serial )
```

**Parameters**

- `date_serial`
  - the date

**Return Value**

Returns the day of the month from a variable containing a date in Date Serial format.

**Description**

The compiler will not recognize this function unless vbcompat.bi is included.

**Example**

```
#include "vbcompat.bi"

Dim ds As Double = DateSerial(2005, 11, 28)
Print Format(ds, "yyyy/mm/dd "); Day(ds)
```
Differences from QB

- Did not exist in QB. This function appeared in PDS and VBDO!

See also

- Date Serials
**Deallocate**

Frees previously allocated memory

**Syntax**

```c
Declare Sub Deallocate cdecl ( ByVal pointer As Any Ptr )
```

**Usage**

```c
Deallocate( pointer )
```

**Parameters**

`pointer`  
the address of the previously allocated buffer.

**Description**

This procedure frees memory that was previously allocated with `Allocate` returns. `pointer` will be rendered invalid (pointing to an invalid memory address), and its use (dereferencing or calling `Deallocate` again) will result in undefined behavior.

Calling `Deallocate` on a null pointer induces no action.

`Deallocate` is an alias for the C runtime library's `free`, so it's not guar...
Although in this case it is unnecessary since the function immediately exits afterwards, setting the pointer to null is a good habit to get into. If the function deallocated memory from a pointer that was used in the function call will be rendered invalid, and it is up to the caller to reassign the pointer or set it to null. Example 3 shows how to correctly handle this kind of situation, and the next example shows the effects of deallocating memory with multiple references.

In the following example, a different pointer is used to free previously allocated memory.

```
```
" WARNING: "evil" example showing how things should NOT be done

Sub DeallocateExample2()
    Dim As Integer Ptr integerPtr = Allocate( Len( '' initialize ^^^ pointer to new memory

        Dim As Integer Ptr anotherIntegerPtr = integerPtr
        '' initialize ^^^ another pointer to the same memory

        *anotherIntegerPtr = 69
        Print *anotherIntegerPtr

        Deallocate( anotherIntegerPtr )
        anotherIntegerPtr = 0
        ''

    '' *integerPtr = 420
    ''

End Sub
```

DeallocateExample2()
End 0
Note that after the deallocation, both pointers are rendered invalid. This illustrates another one of the ways that bugs can arise when working with pointers. As a general rule, only deallocate memory when you know that there is only one (1) pointer currently pointing at it.

```vbnet
Function createInteger() As Integer Ptr
    Return Allocate( Len( Integer ) )
End Function

Sub destroyInteger( ByRef someIntegerPtr As Integer
    Deallocate( someIntegerPtr )
    someIntegerPtr = 0
End Sub

Sub DeallocateExample3()
    Dim As Integer Ptr integerPtr = createInteger()

    *integerPtr = 420
    Print *integerPtr

    destroyInteger( integerPtr )
    Assert( integerPtr = 0 )
End Sub

DeallocateExample3()
End 0
```

In the program above, a reference pointer in a function is set to null after it is used to test if the original pointer is in fact null after the function call. To functions that deallocate the memory they point to is by reference.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the
Differences from QB

- New to FreeBASIC

See also

- Allocate
- Reallocate
Declare

Declares a module-level or member procedure

Syntax

Declare Sub name [ param_list ]
Declare Function name [ param_list ] As return_type
Declare Operator op_symbol param_list [ As return_type ]

Type T
Declare Constructor [ param_list ]
Declare Destructor
Declare Sub name [ param_list ]
Declare Function name [ param_list ] As return_type
Declare Operator name [ param_list ] [ As return_type ]
Declare Property name [ ( [ param_list ] ) ] [ As return_type ]
End Type

Parameters

param_list
Parenthesized comma-separated list of parameters.
return_type
The return type of a Function, Operator, or Property procedure.
name
The name or symbol of the routine.
op_symbol
The name or symbol of an operator.
T
The name of a new user-defined type.

Description

The Declare statement declares a Sub, Function, Operator, Constructor routine.
The routine can be referred to in code without seeing its definition, all the Declare statement introduces a routine, and states that its definitic declared at the top of a source module, called, then defined at the bottom example.

A routine's declaration is almost identical to the first line of its definition Declare keyword and has no body. Also, attributes such as Export are
FreeBASIC, as QB, does not require the declaration of the functions unless in the same file past the point where they are called. This is no longer which must always be declared first in the Type's body before use. If an error.

As every file using a function must have its declaration, declarations are kept in one or more usage of the function by any module that needs it using the #include statement.

**Example**

Module-level Function:

```basic
' declare the function sum which takes two integers and returns an integer
Declare Function sum( As Integer, As Integer ) As Integer

    Print "the sum of 420 and 69 is: " & sum( 420,

' define the function sum which takes two integers
Function sum( a As Integer, b As Integer ) As Integer
    Return a + b
End Function
```

Type-level Sub:

```basic
Type my_type
    my_data As Integer
    Declare Sub increment_data( )
End Type

Sub my_type.increment_data( )
    my_data += 1
End Sub

Dim As my_type an_instance
an_instance.my_data = 68
```
an_instance.increment_data()

Print an_instance.my_data

**Dialect Differences**

- In the **-lang fb** dialect, **ByVal** is the default parameter passing convention.
- In the **-lang qb** and **-lang deprecated** dialects, **ByRef** is the default parameter passing convention.
- Type-level Sub/Function/Operator/Constructor/Destructor's are

**Differences from QB**

- In FreeBASIC, the parameter names are optional.

**See also**

- Sub
- Function
- Operator
- Property
- Constructor
- Destructor
- Constructor (Module)
- Destructor (Module)
- Type
- Dim
- Alias
DefByte

Specifies a default data type for a range of variable names

**Syntax**

```
DefByte start_letter[-end_letter ][, ...]
```

**Parameters**

- **start_letter**: the first letter in the range
- **end_letter**: the last letter in the range

**Description**

DefByte specifies that variables and arrays which aren't declared with data type - or not declared at all - are implicitly declared of type **Byte** if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make bNumber a **Byte** number since it's first letter starts with b

```'
'  Compile with -lang fblite or qb
#lang "fblite"

DefByte b
Dim bNumber
```

**Dialect Differences**

- Available in the **-lang fblite** dialect.
- Not available in the **-lang qb** dialect unless referenced with the alias __Defbyte.__
Differences from QB

- New to FreeBASIC

See also

- Byte
- DefInt
- DefUByte
- Dim
**DefDbl**

Specifies a default data type for a range of variable names

**Syntax**

```
DefDbl start_letter[-end_letter ][, ...]
```

**Parameters**

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

**Description**

`DefDbl` specifies that variables and arrays which aren't declared with a declared at all - are implicitly declared of type **Double** if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make `aNum` a **Double**-precision decimal number since it is in the range of `a-d`:

```
' Compile with -lang fblite or qb
#lang "fblite"

DefDbl a-d
Dim aNum 'implicit: As Double

Print Len(aNum) ' Prints 8, the number of bytes in
```

**Dialect Differences**

- Only available in the **-lang qb** and **-lang fblite** dialects.
Differences from QB
- None

See also
- DefInt
- DefSng
- Dim
- Double
Preprocessor function to test if a symbol has been defined

**Syntax**

```
defined (symbol_name)
```

**Parameters**

`symbol_name`

Name of the symbol to test

**Return Value**

Returns non-zero (-1) if the symbol has been defined, otherwise returns zero.

**Description**

Given the symbol name, the `defined()` preprocessor function returns true if the symbol has been defined - or false if the symbol is unknown.

This is used mainly with `#if`.

Similar to `#ifdef` except it allows more than one check to occur because of its flexibility.

**Example**

```
' e.g. - which symbols are defined out of a, b, c, n

Const a = 300
#define b 12
Dim c As Single

#if defined(a)
  Print "a is defined"
#endif
#if defined(b)
```

Print "b is defined"
#endif
#if defined(c)
    Print "c is defined"
#endif
#if defined(d)
    Print "d is defined"
#endif

**Differences from QB**

- New to FreeBASIC

**See also**

- `#define`
- `#macro`
- `#if`
- `#else`
- `#elseif`
- `#endif`
- `#ifdef`
- `#ifndef`
- `#ifndef`
- `#undef`
DefInt

Specifies a default data type for a range of variable names

Syntax

\[
\text{DefInt} \ start\_letter [-end\_letter \ [, \ ...]}
\]

Parameters

\[
\begin{align*}
\text{start\_letter} & \quad \text{the first letter in the range} \\
\text{end\_letter} & \quad \text{the last letter in the range}
\end{align*}
\]

Description

DefInt specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type Integer if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

Example

This will make iNumber an Integer number since its first letter starts with i.

```
' Compile with -lang fblite or qb
#lang "fblite"

DefInt i
Dim iNumber
```

Dialect Differences

- Only available in the -lang qb and -lang fblite dialects.
Differences from QB

- None

See also

- DefByte
- DefDb1
- DefLng
- Deflongint
- DefShort
- DefSng
- DefStr
- Integer
DefLng

Specifies a default data type for a range of variable names

Syntax

```
DefLng start_letter[-end_letter ][, ...]
```

Parameters

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

Description

`DefLng` specifies that variables and arrays which aren't declared with a declared at all - are implicitly declared of type `Long` if the first letter of a certain letter or lies within an inclusive range of letters.

Example

This will make `lNumber` a `Long` integer number since it starts with `l`.

```
' Compile with -lang fblite or qb

#lang "fblite"

DefLng l
Dim lNumber ' implicit: As Long

Print Len(lNumber) ' Displays 4, the number of byte
```

Dialect Differences

- Only available in the `-lang qb` and `-lang fblite` dialects.
Differences from QB

- None

See also

- DefInt
- Defulongint
- Dim
- LongInt
**Deflongint**

Specifies a default data type for a range of variable names

**Syntax**

```
Deflongint start_letter[start_letter , ..., end_letter]
```

**Parameters**

- **start_letter**
  
  the first letter in the range

- **end_letter**

  the last letter in the range

**Description**

**Deflongint** specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type **LongInt** if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make **lNumber** a **LongInt** number since it's first letter starts with **l**.

```
' Compile with -lang fblite

#lang "fblite"

deflongint l
Dim lNumber
```

**Dialect Differences**

- Available in the **-lang fblite** dialect.
- Not available in the **-lang qb** dialect unless referenced with the
alias __Deflongint.

**Differences from QB**

- New to FreeBASIC

**See also**

- `DefInt`
- `Defulongint`
- `Dim`
- `LongInt`
DefShort

Specifies a default data type for a range of variable names.

Syntax

```
DefShort start_letter[-end_letter ][, ...]
```

Parameters

- `start_letter`: the first letter in the range
- `end_letter`: the last letter in the range

Description

DefShort specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type Short if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

Example

This will make sNumber a Short number since its first letter starts with s.

```
' Compile with -lang fblite or qb

#lang "fblite"

DefShort s
Dim sNumber
```

Dialect Differences

- Available in the -lang fblite dialect.
- Not available in the -lang qb dialect unless referenced with the alias __Defshort.
Differences from QB

- New to FreeBASIC
- In QBasic, to make variables default to a 2 byte integer, DEFIN is used.

See also

- DefInt
- DefUShort
- Dim
- Integer
- Short
DefSng

Specifies a default data type for a range of variable names

**Syntax**

`DefSng start_letter[-end_letter ][, ...]`

**Parameters**

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

**Description**

DefSng specifies that variables and arrays which aren’t declared with a data type - or not declared at all - are implicitly declared of type *Single* if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make `sNumber` and `yNumber` a *single*-precision decimal number since it is in the range of `s-z`.

```
'' Compile with -lang fblite or qb

#lang "fblite"

DefSng s-z
Dim sNumber, yNumber
```

**Dialect Differences**

- Only available in the `-lang qb` and `-lang fblite` dialects.
Differences from QB

- None

See also

- DefInt
- DefDbl
- Single
DefStr

Specifies a default data type for a range of variable names

**Syntax**

```
DefStr start_letter[-end_letter ][, ...]
```

**Parameters**

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

**Description**

DefStr specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type `String` if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make `sMessage` a `String` since it starts with `s`.

```
' Compile with -lang fblite or qb

#lang "fblite"

DefStr s
Dim sMessage
```

**Dialect Differences**

- Only available in the `-lang qb` and `-lang fblite` dialects.

**Differences from QB**
- None

See also

- DefInt
- DefSng
- DefLng
- DefDb1
- Dim
- String
DefUByte

Specifies a default data type for a range of variable names

**Syntax**

```
DefUByte start_letter[-end_letter ][, ...]
```

**Parameters**

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

**Description**

`DefUByte` specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type `UByte` if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

```
This will make uNumber a UByte number since it's first letter starts with u.

' Compile with -lang fblite

#lang "fblite"

DefUByte u
Dim uNumber
```

**Dialect Differences**

- Available in the `-lang fblite` dialect.
- Not available in the `-lang qb` dialect unless referenced with the alias `__Defubyte`.

Differences from QB

- New to FreeBASIC

See also

- DefByte
- DefInt
- Dim
- UByte
DefUInt

Specifies a default data type for a range of variable names.

**Syntax**

```
DefUInt start_letter[-end_letter ][, ...]
```

**Parameters**

- **start_letter**
  - the first letter in the range

- **end_letter**
  - the last letter in the range

**Description**

DefUInt specifies that variables and arrays which aren't declared with data type - or not declared at all - are implicitly declared of typeUInteger if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make uNumber aUInteger number since its first letter starts with u.

```
' Compile with -lang fblite

#lang "fblite"

DefInt u
Dim uNumber
```

**Dialect Differences**

- Available in the `-lang fblite` dialect.
- Not available in the `-lang qb` dialect unless referenced with the
alias __Defuint.

**Differences from QB**
- New to FreeBASIC

**See also**
- DefInt
- Dim
-UInteger
Defulongint

Specifies a default data type for a range of variable names

Syntax

`Defulongint start_letter[-end_letter ][, ...]`

Parameters

- `start_letter`
  - the first letter in the range
- `end_letter`
  - the last letter in the range

Description

`Defulongint` specifies that variables and arrays which aren’t declared with a data type - or not declared at all - are implicitly declared of type `ULongInt` if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

Example

This will make `lNumber` a `ULongInt` number since its first letter starts with `l`.

```
' Compile with -lang fblite

#lang "fblite"

defulongint l
Dim lNumber
```

Dialect Differences

- Available in the `-lang fblite` dialect.
- Not available in the `-lang qb` dialect unless referenced with the
alias __Defulongint.

**Differences from QB**
- New to FreeBASIC

**See also**
- DefInt
- Deflongint
- Dim
- ULongInt
DefUShort

Specifies a default data type for a range of variable names

**Syntax**

```
DefUShort start_letter[-end_letter ][, ...]
```

**Parameters**

- `start_letter`:
  the first letter in the range
- `end_letter`:
  the last letter in the range

**Description**

DefUShort specifies that variables and arrays which aren't declared with a data type - or not declared at all - are implicitly declared of type UShort if the first letter of their names matches a certain letter or lies within an inclusive range of letters.

**Example**

This will make `uNumber` a UShort number since its first letter starts with `u`.

```
'' Compile with -lang fblite

#lang "fblite"

DefUShort u
Dim uNumber
```

**Dialect Differences**

- Available in the -lang fblite dialect.
- Not available in the -lang qb dialect unless referenced with the
alias __Defushort.

Differences from QB

- New to FreeBASIC

See also

- DefInt
- DefShort
- Dim
- UShort
Operator Delete

Operator to delete data allocated with the `New` operator

**Syntax**

```bodo
Declare Operator Delete ( buf As Any Ptr )
Declare Operator delete[] ( buf As Any Ptr )
```

**Usage**

```bodo
Delete buf
or
Delete[] buf
```

**Parameters**

`buf`  
A pointer to memory that has been allocated by `New` or `New[]` (a typed `buf` in accordance to the data type to delete).

**Description**

`Delete` is used to destroy and free the memory of an object created with `New` or `New[]`. The destructor will be called. `Delete` should only be used with addresses returned from `New`.

The array version of `Delete`, `Delete[]`, is used to destroy an array of objects. Destructors will be called here as well.

`Delete` must be used with addresses returned from `New`, and `Delete[]` must match the different versions of the operators.

After the memory is deleted, the `buf` pointer will be pointing at invalid memory. The same pointer value leads to undefined behaviour. It may be a good idea to guard against later code using it accidentally, since null pointer dereferences are easier to find and debug.

Calling `Delete` on a null pointer induces no action.

**Example**
Type Rational
    As Integer numerator, denominator
End Type

' Create and initialize a Rational, and store its
Dim p As Rational Ptr = New Rational(3, 4)

Print p->numerator & "/" & p->denominator

' Destroy the rational and give its memory back to
Delete p

' Set the pointer to null to guard against future
p = 0

' Allocate memory for 100 integers, store the addr
Dim p As Integer Ptr = New Integer[100]

' Assign some values to the integers in the array.
For i As Integer = 0 To 99
    p[i] = i
Next

' Free the entire integer array.
Delete[] p

' Set the pointer to null to guard against future
p = 0

Dialect Differences
- Only available in the -lang fb dialect.
Differences from QB

- New to FreeBASIC

See also

- New
- Deallocate
Destructor

Called automatically when a class or user defined type goes out of scope or is destroyed

**Syntax**

```plaintext
Type typename
field declarations
Declare Destructor ( )
End Type

Destructor typename ( ) [ Export ]
statements
End Destructor
```

**Parameters**

- `typename`
  - name of the Type of Class

**Description**

The destructor method is called when a user defined Type or Class variable goes out of scope or is destroyed explicitly with the Delete operator.

`typename` is the name of the type for which the Destructor method is declared and defined. Name resolution for `typename` follows the same rules as procedures when used in a Namespace.

The Destructor method is passed a hidden This parameter having the same type as `typename`.

The destructor in a type is called before the destructors on any of its fields. Therefore, all fields are accessible with the hidden This parameter in the destructor body.

Only one destructor may be declared and defined per type.

Since the End statement does not close any scope, object destructors...
will not automatically be called if the **End** statement is used to terminate the program.

**Destructor** can be also called directly from the *typename* instance like the other member methods (**Sub**) and with the same syntax, i.e. using member access operator, e.g. `obj.Destructor()`. The object, and all its members, are assumed to be constructed and in a valid state, otherwise its effects are undefined and may cause crashes. This syntax is useful in cases where `obj` has been constructed manually, e.g. with `obj.Constructor()` or **Placement New**.

**Example**

```plaintext
Type T
  value As ZString * 32
  Declare Constructor ( init_value As String )
  Declare Destructor ()
End Type

Constructor T ( init_value As String )
  value = init_value
  Print "Creating: "; value
End Constructor

Destructor T ()
  Print "Destroying: "; value
End Destructor

Sub MySub
  Dim x As T = ("A.x")
End Sub

Dim x As T = ("main.x")

Scope
  Dim x As T = ("main_scope.x")
End Scope
```
Output:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating</td>
<td>main.x</td>
</tr>
<tr>
<td>Creating</td>
<td>main.scope.x</td>
</tr>
<tr>
<td>Destroying</td>
<td>main.scope.x</td>
</tr>
<tr>
<td>Creating</td>
<td>A.x</td>
</tr>
<tr>
<td>Destroying</td>
<td>A.x</td>
</tr>
<tr>
<td>Destroying</td>
<td>main.x</td>
</tr>
</tbody>
</table>

**Dialect Differences**

- Object-related features are supported only in the `-lang fb` dialect.

**Differences from QB**

- New to FreeBASIC

**See also**

- Class
- Constructor
- Delete
- Destructor (Module)
- Type
Destructor (Module)

Specifies execution of a procedure at program termination

Syntax

```
[Public | Private] Sub identifier [Alias "external_identifier"]
[Static]
{ procedure body }
End Sub
```

Description

Defines a procedure to be automatically called from a compiled program generated by the compiler and is executed when the program terminates defined as destructors may be used the same way as ordinary procedures, called from within module-level code, as well as other procedures.

The procedure must have an empty parameter list. A compile-time error will be generated if the Destructor keyword is used in a Sub definition having one or more parameters. Overloaded procedures, only one (1) destructor may be defined because having multiple Subs which take no arguments.

In a single module, destructors normally execute in the order in which they are defined.

The priority attribute, an integer between 101 and 65535, can be used to execute in a certain order. The value of priority has no specific meaning, only the relationship of the number with other destructor priorities. 101 is the lowest priority and is executed first. Destructor having a priority attribute are executed after destructors with no attribute. The priority value of 65535 is the same as not assigning a priority value.

A module may define multiple destructor procedures. Destructor procedures may appear in more than one module. All procedures defined with the syntax shown above will be added to the list of procedures to be called during the program's termination.

The order in which destructors defined in multiple modules are executed is known only at link time. Therefore, special care should be taken when using destructors of secondary module also defining a destructor. In such a case it is advisable to use a single destructor that explicit calls termination procedures in multiple module termination of the application.
Destructors will be called if the program terminates normally or if error checking is enabled and the program terminates abnormally.

**Example**

```basic
Sub pauseonexit Destructor
    " If the program reaches the end, or aborts with an error, "
    " it will run this destructor before closing
    Print "Press any key to end the program..."
    Sleep
End Sub

Dim array(0 To 10, 0 To 10) As Integer
Dim As Integer  i = 0, j = 11

" this next line will cause the program to abort "
" error if you compile with array bounds checking exx ...")
Print array(i, j)
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Destructor (Class)
- Constructor (Module)
- Sub
Dim

Declares a variable

Syntax

```
Dim [Shared] name1 As DataType [, name2 As DataType, ...]
Or
Dim [Shared] As DataType name1 [, name2, ...]
```

Arrays:
```
Dim name ([lbound To] ubound [, ...] ) As DataType
Dim name ( Any [, Any...] ) As DataType
Dim name ( ) As DataType
```

Initializers:
```
Dim scalar_symbol As DataType = expression | Any
Dim array_symbol (arraybounds) As DataType = { expression [, ...] }
Dim udt_symbol As DataType = ( expression [, ...] ) | Any
```

Description

Declares a variable by name and reserves memory to accommodate it.

Variables must be declared before they can be used in the -lang fb dialect or when using other dialects. Only in the -lang qb and -lang fblite dialects variables in such a case they are called implicit variables.

Dim can be used to declare and assign variables of any of the supported data types,

Depending on where and how a variable or array is declared can change storage classes.

More than one variable may be declared in a single Dim statement by comma.

```
' Variable declaration examples
'
' One variable per DIM statement
Dim text As String
```
Explicit Variables with Implicit Data Types

In the -lang qb and -lang fblite dialects, even if the variable is declared explicit, its data type is not explicitly given either by name or by type suffix. In the -lang qb dialect and Integer in the -lang fblite dialect. The default data type can be changed throughout a source listing by use of the Def### statements. (for example, DefInt, DefStr, etc.)

```
' Compile with -lang qb

'$lang: "qb"

' All variables beginning with A through N default to the INTEGER type
DefInt I-N

' I and J are INTEGERS
' X and Y are SINGLES
' T$ is STRING
' D is DOUBLE

Dim I, J, X, Y, T$, D As Double
```

Arrays
As with most BASIC dialects, FreeBASIC supports arrays with indexes ranging from a lower bound to an upper bound. In the syntaxes shown, \textit{lbound} refers to the lower bound, or the smallest index. If a lower bound is not specified, it is assumed to be zero by default, unless \textit{Base} is used.

\begin{verbatim}
Const upperbound = 10
'' Declare an array with indexes ranging from 0 to
'' for a total of (upperbound + 1) indexes.
Dim array(upperbound) As Single
\end{verbatim}

Multidimensional arrays can be declared as well, and are stored in this order: values differing only in the last index are contiguous (row-major order). The maximum number of dimensions of a multidimensional array is 8.

\begin{verbatim}
'' declare a three-dimensional array of single
'' precision floating-point numbers.
Dim array(1 To 2, 6, 3 To 5) As Single
'' The first dimension of the declared array
'' has indices from 1 to 2, the second, 0 to 6,
'' and the third, 3 to 5.
\end{verbatim}

For more information on arrays see \textit{Arrays Overview}.

If the values used with \texttt{Dim} to declare the dimensions of an array are \texttt{Static} (unless \texttt{Option Dynamic} is specified), while using one or more variables to declare the dimensions of an array makes it variable length, even if \texttt{Option Static} is in effect.

Arrays can be declared as variable length in several ways: Using \texttt{Dim} with indexes that are variables or using the keyword \texttt{ReDim}, or declaring it past the metacommand \texttt{$Dynamic$}. Variable length arrays...
Arrays declared with **Dim** having constant indexes and not preceeded resizable at runtime) and can use initializers.

The upper bound can be an ellipsis (..., 3 dots). This will cause to upper bound to be set automatically based on the number of elements found in the initializer. When ellipsis is used, and it may not be **Any**. See the **Ellipsis** page for a short example.

See also **Fixed-Length Arrays** and **Variable-Length Arrays**.

**Initializers**

Arrays, variables, strings, and user defined types (UDTs) are initialized to zero (or strings by default when they are created.

To avoid the overhead of default variable initialization, the **Any** initializer can be used to only reserve the place for the variable in memory but not initialize it, so the variable will contain garbage. In this case the programmer should not make assumptions about the initial values.

Fixed-length arrays, variables, zstrings and UDTs may be given a value at the time of declaration following the variable declaration with an initializer. Note the difference between initializing different types.

Arrays, variables and UDTs are initialized as they would in a normal assignment. The **=** => sign can be used, allowing to avoid the declaration resembling an expression when declaring fixed length strings.

Array values are given in comma-delimited values enclosed by curly brackets or comma delimited values enclosed by parenthesis. These methods of initializing variables can be nested with one another for complex assignments. Nesting allows for arrays of any dimension to be initialized.

```
'' Declare an array of 2 by 5 elements
'' and initialize
Dim array(1 To 2, 1 To 5) As Integer => {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}}
```

```
'' declare a simple UDT
Type mytype
  var1 As Double
```

As Integer
End Type

' declare a 3 element array and initialize the first 2 mytype elements
Dim myvar(0 To 2) As mytype => {(1.0, 1), (2.0, 2)}

For module-level, fixed-length, or global variables, initialized values must be constant expressions. will report a compile-time error if otherwise.

Note: Initializing UDT's with strings is not supported at this time. Initial string is not valid.

Explicit Variables with Type Suffixes

In the -lang qb and -lang fblite dialects, the data type of a variable must

' Compile with -lang qb or fblite
'$lang: "qb"

' A string variable using the $ type suffix
Dim strVariable$

' An integer variable using the % type suffix
Dim intVariable%

' A long variable using the & type suffix
Dim lngVariable&

' A single precision floating point variable using
Dim sngVariable!

' A double precision floating point variable using
Dim dblVariable#
Example

Dim a As Byte
Dim b As Short
Dim c As Integer
Dim d As LongInt
Dim au As UByte
Dim bu As UShort
Dim cu As UInteger
Dim du As ULongInt
Dim e As Single
Dim f As Double
Dim g As Integer Ptr
Dim h As Byte Ptr
Dim s1 As String * 10  ' fixed length string
Dim s2 As String      ' variable length string
Dim s3 As ZString Ptr  ' zstring

s1 = "Hello World!"
s2 = "Hello World from FreeBASIC!"
s3 = Allocate( Len( s2 ) + 1 )
*s3 = s2

Print "Byte: "; Len(a)
Print "Short: "; Len(b)
Print "Integer: "; Len(c)
Print "Longint: "; Len(d)
Print "UByte: "; Len(au)
Print "UShort: "; Len(bu)
Print "UInteger: "; Len(cu)
Print "ULongint: "; Len(du)
Print "Single: "; Len(e)
Print "Double: "; Len(f)
Print "Integer Pointer: "; Len(g)
Print "Byte Pointer: "; Len(h)
Print "Fixed String: "; Len(s1)
Dialect Differences

- In the `-lang qb` and `-lang fblite` dialects, variables have procedure scope if the variable is defined inside a procedure, and for the entire module if the variable is defined with `Option` statements or `Def###` statements. Variables cannot be initialised. In the `-lang qb` dialect at the start of the procedure/module, and a statement is executed at runtime.
- In the `-lang fb` and `-lang deprecated` dialects, variables defined in `For..Next`, `While..Wend`, `Do..Loop`, `If..Then`, `Select..End Select` local working scopes, and are visible only within these blocks.
- In the `-lang fb` dialect, Option statements (e.g. `Option Base`, `Option Dynamic`, `$Static`) are not allowed.

Differences from QB

- Variable Initializers are new to FreeBASIC.
- The alternate syntax `Dim As DataType symbolname, [...]` is new.
- Multidimensional arrays are stored in this definite order: values contiguous (row-major order), they were stored in opposite order the first index was contiguous (column-major order).
- Variable length arrays up to 2 GiB in size are possible in FreeBASIC, to 64 KiB, or to the DOS memory available (several 100 KiB at best).
- The ellipsis form for upper bounds is new to FreeBASIC.

See also

- Var
- Common
- Extern
- ReDim
- Preserve
- Shared
- Static
- Erase
- LBound
- UBound
- ... (Ellipsis)
- Any
Dir

Searches for and returns information about an item in the filesystem; performs a directory search.

Syntax

```
# Include "dir.bi"

Declare Function Dir ( ByRef item_spec As Const String, ByVal attrib_mask As Integer = fbNormal,
                      out_attrib As Integer )
Declare Function Dir ( ByRef item_spec As Const String, ByVal attrib_mask As Integer = fbNormal,
                      p_out_attrib As Integer )
Declare Function Dir ( ByVal attrib_mask As Integer = fbNormal,
                      out_attrib As Integer )
Declare Function Dir ( p_out_attrib As Integer )
```

Usage

```
result = Dir( item_spec, attrib_mask, out_attrib )
result = Dir( item_spec, attrib_mask, p_out_attrib )
result = Dir( out_attrib )
result = Dir( p_out_attrib )
```

Parameters

- `item_spec`
  The pattern to match an item's name against.
- `attrib_mask`
  The bit mask to match an item's attributes against.
- `out_attrib`
  Reference to a bit mask that's assigned each of the found item's attributes.
- `p_out_attrib`
  Pointer to a bit mask that's assigned each of the found item's attribute.

Return Value

If no item matching the name `item_spec` or the attribute mask `attrib_mask` (or `p_out_attrib`) is assigned the attribute mask of the item, and the name is returned.

Description

If `item_spec` contains an absolute path, then the first procedure searches relative to the path. Otherwise, it searches relative to the current directory (see `CurDir`). In any case, if a matching item is not found, `out_attrib` is assigned with the attribute flags of the item, and the name is returned.
item_spec may include an asterisk (*, for matching any adjacent character) or one or more question marks (such as item.*. If found, subsequent calls with item_spec omitted, or set to an empty string, will return the next item matching the name omitted from these subsequent calls, the procedure searches for item.

The second syntax behaves the same as Dir( item_spec, attrib_mask ).
The third syntax behaves the same as Dir( "", , out_attrib ).
The fourth syntax behaves the same as Dir( "", , *p_out_attrib ).

**File Attributes:**
Files and directories and other items can be said to possess so-called file attributes, and the file system it uses.
The following defined constants are used as bit-flags in attrib_mask and metadata that the returned files are allowed to have. For example, fbReadOnly will be matched. (fbReadOnly or fbDirectory) will allow read-only directories and files. More powerful filtering can be done by checking the returned out_attrib.

```c
#define fbReadOnly &h01;
The item cannot be written to or deleted.
DOS & Windows: The item has the "read-only" attribute set.
Linux: The item has no write permissions associated with the current user.

#define fbHidden &h02;
The item is hidden in ordinary directory listings.
DOS & Windows: The item has the "hidden" attribute set.
Linux: The item's name has a period (.) as the first character.

#define fbSystem &h04;
The item is used almost exclusively by the system.
DOS & Windows: The item has the "system" attribute set.
Linux: The item is either a character device, block device, named pipes.

#define fbDirectory &h10;
The item is a directory. Includes the current (.) and parent (..) directories.
DOS & Windows & Linux: The item is a directory.

#define fbArchive &h20;
The item may be backed up after some automated operations.
DOS & Windows: The item has the "archive" attribute set (automatically set after every write access to a file).
Linux: The item is not a directory; typical filesystems do not support this attribute.
```
# define fbNormal (fbReadOnly or fbArchive)

The item is read-only or "archived".

(If attrib_mask does not include fbArchive, then Dir may widen the check to include Items found having no attributes are always matched, regardless of the example, fbArchive or fbDirectory will match against archived files, In general it is not possible to use attrib_mask to include a file/folder while directories while excluding read-only files (unless the files also have matching attributes.)

## Example

```vbnet
#include "dir.bi" 'provides constants to use for the attrib_mask parameter

Sub list_files (ByRef filespec As String, ByVal attrib As Integer) As String
    Dim As String filename = Dir(filespec, attrib)
    Do While Len(filename) > 0 ' If len(filename)
        Print filename
        filename = Dir()
    Loop
End Sub

Print "directories:", list_files "*", fbDirectory
Print
Print "archive files:", list_files "*", fbArchive
```

## Example

'' Example of using DIR function and retrieving attributes

#include "dir.bi" '' provides constants to match the attributes agains
Set input attribute mask to allow files that are normal, hidden, system or directory.

Const attrib_mask = fbNormal Or fbHidden Or fbSystem

Dim As UInteger out_attr ' unsigned integer to hold retrieved attributes

Dim As String fname ' file/directory name returned

Dim As Integer filecount, dircount

fname = Dir("*.*", attrib_mask, out_attr) ' Get first file name/attributes, according to supplied file spec and attribute mask

Print "File listing in " & CurDir & ":"

Do Until Len(fname) = 0 ' loop until Dir returns empty string

If (fname <> ".") And (fname <> "..") Then ' Ignore current and parent directory entries

    Print fname,

    If (out_attr And fbDirectory) <> 0 Then
        Print "- directory";
        dircount += 1
    Else
        Print "- file";
        filecount += 1
    End If

    If (out_attr And fbReadOnly) <> 0 Then Print
    If (out_attr And fbHidden) <> 0 Then Print
    If (out_attr And fbSystem) <> 0 Then Print
    If (out_attr And fbArchive) <> 0 Then Print

    End If

fname = Dir(out_attr) ' find next name/attributes

Loop

Print
Print "Found " & filecount & " files and " & dircount & " directories"

Platform Differences

- Linux requires the filename case to match the real name of the file.
- Path separators in Linux are forward slashes /. Windows uses backslashes \.
- In DOS, the attrib mask value of &h37; (&h3F; usually works also, but if current directory is not the main directory.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias.

Differences from QB

- Not found in QBasic but present in Visual Basic. The out_attrib

See also

- Open
- CurDir
- MkDir
- RmDir
Control flow statement for looping.

**Syntax**

```basic
Do [ { Until | While } condition ]
[ statement block ]
Loop
```

```basic
Do
[ statement block ]
Loop [ { Until | While } condition ]
```

**Differences from QB**

- None

**See also**

- `Do...Loop`
Control flow statement for looping

**Syntax**

```
Do [ { Until | While } condition ]
[ statement block ]
Loop
or
Do
[ statement block ]
Loop [ { Until | While } condition ]
```

**Description**

The **Do** statement executes the statements in the following `statement block`

If `Until` is used, the **Do** statement stops repetition of the `statement block` loop if `condition` evaluates to false. If both `condition` and either `Until` or `While` are used, the loop stops when `condition` evaluates to false.

If an **Exit Do** statement is encountered inside the `statement block`, the loop is terminated, and execution resumes immediately following the enclosing statement. If a **Continue Do** statement is encountered, the rest of the `statement block` is ignored.

In the first syntax, the `condition` is checked when the **Do** statement is first encountered, and if the second syntax, `condition` is initially checked after the `statement block` once.

`condition` may be any valid expression that evaluates to False (zero)

**Example**

In this example, a **Do** loop is used to count the total number of odd numbers.

```basic
Dim As Integer  n = 1   ' number to check
Dim As Integer total_odd = 0   ' running total of odd numbers
Do Until( n > 10 )
   If( ( n Mod 2 ) > 0 ) Then total_odd += 1   ' add to total if n is odd
   n += 1
Loop
Print "total odd numbers: " ; total_odd
```
Here, an infinite DO loop is used to count the total number of evens. We place the conditional check inside the loop via an if and when \( n > 10 \) becomes true:

```vbnet
Dim As Integer n = 1
Dim As Integer total_even = 0
Do
    If ( n > 10 ) Then Exit Do
    If ( ( n Mod 2 ) = 0 ) Then total_even += 1
    n += 1
Loop
Print "total even numbers: " ; total_even
```

**Dialect Differences**

- In the `-lang qb` and `-lang fblite` dialects, variables declared inside a loop are not available outside the loop.
- In the `-lang fb` and `-lang deprecated` dialects, variables declared inside a loop are not available outside the loop.

**Differences from QB**

- None

**See also**

- `Continue`
- `Exit`
- `For...Next`
- `While...Wend`
Double

Standard data type: 64 bit floating point

**Syntax**

```vba
Dim variable As Double
```

**Description**

Double is a 64-bit, floating-point data type used to store more precise decimal numbers. They can hold positive values in the range
4.940656458412465e-324 to 1.797693134862316e+308, or negative value in the range -4.940656458412465e-324 to -1.797693134862316e+308, or zero (0). They contain at most 53 bits of precision, or about 15 decimal digits.

**Example**

```vba
'Example of using a double variable.
Dim a As Double
a = 1.985766472453666
Print a
Sleep
```

**Differences from QB**

- None
See also

- **Single** Less precise float type
- **CDbl**
- **Table with variable types overview, limits and suffixes**
Statement for sequenced pixel plotting

**Syntax**

\[
\text{Draw} \ [\text{target}, \] \text{cmd}
\]

**Parameters**

- **target**: the buffer to draw on
- **cmd**: a string containing the sequence of commands

**Description**

Drawing will take place onto the current work page set via \texttt{ScreenSet} or \texttt{target Get/Put} buffer if specified.

The \texttt{Draw} statement can be used to issue several drawing commands at once; it is useful to quickly draw figures. The command string accepts the following commands:

**Commands to plot pixels:**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commands to plot pixels:</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Optional prefix: move but do not draw.</td>
</tr>
<tr>
<td>N</td>
<td>Optional prefix: draw but do not move.</td>
</tr>
<tr>
<td>M x,y</td>
<td>Move to specified screen location. If a '+' or '-' sign precedes x, movement is relative to current cursor position. x's sign has no effect on the sign of y.</td>
</tr>
<tr>
<td>U [n]</td>
<td>Move n units up. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>D [n]</td>
<td>Move n units down. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>L [n]</td>
<td>Move n units left. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>R [n]</td>
<td>Move n units right. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>E [n]</td>
<td>Move n units up and right. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>F [n]</td>
<td>Move n units down and right. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>G [n]</td>
<td>Move n units down and left. If n is omitted, 1 is assumed.</td>
</tr>
<tr>
<td>H [n]</td>
<td>Move n units up and left. If n is omitted, 1 is assumed.</td>
</tr>
</tbody>
</table>
Commands to color:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C n</strong></td>
<td>Changes current foreground color to n.</td>
</tr>
<tr>
<td><strong>P p,b</strong></td>
<td>PAINTs (flood fills) region of border color b with color p.</td>
</tr>
</tbody>
</table>

Commands to scale and rotate:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S n</strong></td>
<td>Sets the current unit length, default is 4. A unit length of 4 is equal to 1 pixel.</td>
</tr>
<tr>
<td><strong>A n</strong></td>
<td>Rotate n*90 degrees (n ranges 0-3).</td>
</tr>
<tr>
<td><strong>TA n</strong></td>
<td>Rotate n degrees (n ranges 0-359).</td>
</tr>
</tbody>
</table>

Extra commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X p</strong></td>
<td>Executes commands at p, where p is a STRING PTR.</td>
</tr>
</tbody>
</table>

Commands to set the color, size and angle will take affect all subsequent operations.

**Example**

```
Screen 13

'Move to (50,50) without drawing
Draw "BM 50,50"

'Set drawing color to 2 (green)
Draw "C2"

'Draw a box
Draw "R50 D30 L50 U30"

'Move inside the box
Draw "BM +1,1"

'Flood fill with color 1 (blue) up to border color
Draw "P 1,2"

Sleep
```
'' Draws a flower on-screen

Dim As Integer i, a, c
Dim As String fill, setangle

'' pattern for each petal
Dim As Const String petal = _

    _
    _
    _
    _
    _
    _
    _

    _
    _
    _
    _
    _
    _

    _
    _
    _
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    _
    _
    _

    _
    _
    _
    _
    _
    _
    _

'' set screen
ScreenRes 320, 240, 8
move to center
Draw "BM 160, 120"

set initial angle and color number
a = 0: c = 32

For i = 1 To 24

' make angle-setting and filling command strings
setangle = "TA" & a
fill = "P" & c & ",15"

' draw the petal pattern, which links to angle-setting and filling strings
Draw petal

' short delay
Sleep 100

' increment angle and color number
a += 15: c += 1

Next i

Sleep
Differences from QB

- *target* is new to FreeBASIC
- QB used the special pointer keyword VARPTR$ with the `X PPC` command.
- FB does not currently allow sub-pixel movements: all movements are rounded to the nearest integer coordinate.

See also

- Draw String
- Screen (Graphics)
- VarPtr
- Paint
Draw String

Graphics statement to render text to an image or screen.

**Syntax**

\[
\text{Draw String } \langle \text{buffer,}\rangle \ [\text{STEP}] \ (x, y), \ \text{text} [,\ \text{color} [,\ \text{font} [,\ \text{method} [,\ \text{parameters}]]]]
\]

**Usage**

\[
\text{Draw String } \langle \text{buffer,}\rangle \ [\text{STEP}] \ (x, y), \ \text{text} [,\ \text{color}]
\]

\[
\text{Draw String } \langle \text{buffer,}\rangle \ [\text{STEP}] \ (x, y), \ \text{text} ,\ , \ \text{font} [,\ \text{method} [,\ \text{parameters}]]]
\]

\[
\text{Draw String } \langle \text{buffer,}\rangle \ [\text{STEP}] \ (x, y), \ \text{text} ,\ , \ \text{font} ,\ \text{Custom}, \ \text{blender}
\]

**Parameters**

*buffer*

the sprite to draw the string on. If this is not supplied, it will be drawn to the screen.

*STEP*

use relative coordinates. If *STEP* is added, the *x* and *y* coordinates are interpreted as relative to the last drawn point. The top left corner of the text will be drawn at this position.

*text*

the string containing the text to draw

*color*

if no font is supplied, this allows you to choose the color of the text. If a font is supplied, *color* is ignored, and the font itself specifies the color for each pixel.

*font*

an image buffer containing a custom font. If no font is supplied, the standard font for the current text resolution is used, and the following parameters are ignored.

*method | Custom*

specifies how the font characters are drawn on top of the target surface. The same methods as found for the `Put (Graphic)` function are allowed, with the only difference that the default method is `Trans` for custom fonts.

*alpha*

alpha value, ranging 0-255. This parameter only applies to the `Add or Alpha` method.

*blender*

custom blender function for the `Custom` drawing method; see `Put (Graphic)` for details. This parameter only applies to the `Custom` method.

*parameter*

optional `Pointer` to be passed to the custom blender function; if omitted.
Description

This graphics keyword prints a string to the screen with pixel positioning, transparent background, and can use an user-supplied font. Draw String does not update any text or graphics cursor returns and other special characters have no special behavior in Draw String.

In graphics mode, this function provides a flexible alternative to Print.
- **Draw String** can print text to any coordinate on the screen, while **Print** Locate.
- **Print** will override the background behind the text with the current background color, the pixels in the background untouched.
- Like **Put**, **Draw String** has several different methods for printing text,
- **Draw String** isn't limited to a single character set: it is possible to support several different character sets.

Note: If a custom font isn't supplied, **Draw String** will default to the standard font, dictated by **Width.method** - if passed - will be ignored, and the text will be drawn using the color supplied, with a transparent background.

The custom font format:
The font is stored in a standard Get/Put buffer; the font has to be stored in the font buffer, otherwise **Draw String** will bump out with an illegal function call.

The first line of pixels in the font buffer holds the header of the font, or the font header version; currently this must be 0. The second byte gives the font; the third byte gives the ascii code of the last supported character, the contents of these two bytes.
Next comes the width of each of the supported characters, each in a byte from 32 to 127 (inclusive), the header would have the first three bytes widths of the corresponding chars.

The font height is obtained by subtracting 1 from the buffer height, the header, the remaining lines define the glyphs' layout. The buffer must be wide enough to hold all the supported character sprites in the same row, one after another.

Example

This gives an example of basic **Draw String** usage: it uses it to print "Hello world".
Const \texttt{w} = 320, \texttt{h} = 200 \ '' screen dimensions

Dim \texttt{x} As Integer, \texttt{y} As Integer, \texttt{s} As String

'\'' Open a graphics window
\texttt{ScreenRes \texttt{w}, \texttt{h}}

'\'' Draw a string in the centre of the screen:
\texttt{s} = "Hello world"
\texttt{x} = (\texttt{w} - \texttt{Len(s)} \times 8) \ \backslash 2
\texttt{y} = (\texttt{h} - 1 \times 8) \ \backslash 2

\texttt{Draw String (x, y), s}

'\'' Wait for a keypress before ending the program
\texttt{Sleep}

This example shows you how to create and use your own custom font to create the glyphs.

'\'' Define character range
\texttt{Const FIRSTCHAR = 32, LASTCHAR = 127}

\texttt{Const NUMCHARS = (LASTCHAR - FIRSTCHAR) + 1}
\texttt{Dim As UByte Ptr p, myFont}
\texttt{Dim As Integer i}

'\'' Open a 256 color graphics screen (320*200)
Create custom font into PUT buffer

```
myFont = ImageCreate(NUMCHARS * 8, 9)
```

Put font header at start of pixel data

```
#ifndef ImageInfo
p = myFont + If(myFont[0] = 7, 32, 4)
#else
ImageInfo( myFont, , , , , p )
#endif
```

```
p[0] = 0
p[1] = FIRSTCHAR
p[2] = LASTCHAR
```

PUT each character into the font and update width information

```
For i = FIRSTCHAR To LASTCHAR

' Here we could define a custom width for each
' a fixed width of 8 since we are reusing the
p[3 + i - FIRSTCHAR] = 8

' Create character onto custom font buffer by
Draw String myFont, ((i - FIRSTCHAR) * 8, 1),
```

```
Next i
```

Now the font buffer is ready; we could save it

```
Rem BSate "myfont.bmp", myFont
```

Here we draw a string using the custom font

```
Draw String (10, 10), "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
Draw String (10, 26), "abcdefghijklmnopqrstuvwxyz"
Draw String (66, 58), "Hello world!", , myFont
```

Free the font from memory, now we are done with
Differences from QB

- New to FreeBASIC

See also

- (Print | ?)
- Draw
- ImageCreate
- ImageDestroy
- ImageInfo
- Put (Graphics)
- Width
DyLibFree

Unloads a dynamic link library from memory

Syntax

```
Declare Sub DyLibFree ( ByVal library As Any Pointer )
```

Usage

```
DyLibFree( library )
```

Parameters

```
library
The handle of a library to unload.
```

Description

DyLibFree is used to release at runtime libraries previously linked to your program with DyLibLoad. The argument is the handle to the library returned by DyLibLoad.

Example

See the dynamic loading example on the Shared Libraries page.

Platform Differences

- Dynamic link libraries are not available in DOS, as the OS doesn't support them.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Dylibfree.

Differences from QB

- New to FreeBASIC
See also

- DyLibSymbol
- DyLibLoad
- Export
DyLibLoad

Loads to a Dynamic Link Library (DLL) into memory at runtime

Syntax

```basic
Declare Function DyLibLoad ( ByRef filename As String ) As Any Pointer
```

Usage

```basic
result = DyLibLoad ( filename )
```

Parameters

- `filename`  
  A String containing the filename of the library to load.

Return Value

- The Pointer handle of the library loaded. Zero on error

Description

`DyLibLoad` is used to link at runtime libraries to your program. This function does the link and returns a handle that must be used with `DyLibSymbol` when calling a function in the library and with `DyLibFree` when releasing the library.

Example

See the dynamic loading example on the Shared Libraries page.

Platform Differences

- Dynamic link libraries are not available in DOS, as the OS doesn't support them.

Dialect Differences
- Not available in the `-lang qb` dialect unless referenced with the alias `__Dylibload`.

**Differences from QB**

- New to FreeBASIC

**See also**

- `DyLibSymbol`
- `DyLibFree`
- `Export`
DyLibSymbol

Returns the address of a function or variable in a dll

**Syntax**

```vba
Declare Function DyLibSymbol ( ByVal library As Any Ptr, ByRef symbol As String ) As Any Ptr
Declare Function DyLibSymbol ( ByVal library As Any Ptr, ByVal symbol As Short ) As Any Ptr
```

**Usage**

```vba
result = DyLibSymbol ( library, symbol )
```

**Parameters**

- **library**
  The AnyPtr handle of a DLL returned by DyLibLoad

- **symbol**
  A String containing name of the function, or variable in the library to return the address of. In Windows only, can also be a Short containing the ordinal of the function/variable.

**Return Value**

A Pointer to the function or variable in the library.

If the function fails, the return value is 0.

**Description**

DyLibSymbol returns a pointer to the variable or function named `symbol` in the dll pointed by `libhandle`. `libhandle` is obtained by loading the dll with DyLibLoad. The symbol must have been Exported in the dll.

If `libhandle` is 0, the symbol is searched in the current executable or dll.

If using cdecl functions, only the name of the procedure needs to be specified. If dynamically linking to a function created using STDCALL (default in windows), then the function must be decorated. To decorate
a function, use its name, '@', then the number of bytes passed as arguments. For instance if the function `foo` takes 3 integer arguments, the decorated function would be 'FOO@12'. Remember, without an explicit Alias, the procedure name will be uppercase.

If linking to a dll created in Visual C++(tm), decoration need not be used. For GCC, decoration is needed.

**Note:** The dylibsymbol, if failing, will attempt to automatically decorate the procedure, from @0 to @256, in 4 byte increments.

**Example**

See the dynamic loading example on the Shared Libraries page.

**Platform Differences**

- Dynamic link libraries are not available in DOS, as the OS doesn't support them.
- Ordinals are not supported on Linux, 0 is always returned.

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the alias __Dylibsymbol.

**Differences from QB**

- New to FreeBASIC

**See also**

- DyLibLoad
- Export
Else

Control flow statement for conditional branching

Syntax

If expression Then statement(s) [Else statement(s)]
or
If expression Then : statement(s) [Else statement(s)] : End If
or
If expression Then
statement(s)
[ ElseIf expression Then ]
statement(s)
[ Else ]
statement(s)
End If

Differences from QB

- None

See also

- If...Then
Control flow statement for conditional branching

**Syntax**

```plaintext
If expression Then
statement(s)
[ ElseIf expression Then ]
statement(s)
[ Else ]
statement(s)
End If
```

**Differences from QB**

- None

**See also**

- `If...Then`
Encoding

Specifies character format of a text file

Syntax

Open filename for {Input|Output|Append} Encoding "utf-8"|"utf-16|"utf-32"|"ascii" as [#]filename

Parameters

filename for {Input|Output|Append}
file name to open for Input, Output, or Append
Encoding "utf-8"|"utf-16"|"utf-32"|"ascii"
indicates encoding type for the file
filename
unused file number to associate with the open file

Description

Encoding specifies the format for an Unicode text file, so Winput # and correct encoding. If omitted from an Open statement, "ascii" encoding is

Only little endian character encodings are supported at the moment.
- "utf8",
- "utf16"
- "utf32"
- "ascii" (the default)

Example

```
' This example will:
' 1) Write a string to a text file with utf-16 encoding
' 2) Display the byte contents of the file
' 3) Read the text back from the file

' WSTRING's will work as well but STRING has been
' used in this example since not all consoles support
```
' printing WSTRING's.

'' The name of the file to use in this example
Dim f As String
f = "sample.txt"

''
Scope
Dim s As String
s = "FreeBASIC"

Print "Text to write to " + f + "":"
Print s
Print

'' open a file for output using utf-16 encoding '' and print a short message
Open f For Output Encoding "utf-16" As #1

'' The ascii string is converted to utf-16
  Print #1, s
Close #1
End Scope

'' Scope
Dim s As String, n As Integer

'' open the same file for binary and read all the bytes
Open f For Binary As #1
n = LOF(1)
s = Space( n )
Get #1,,s
Close #1

Print "Binary contents of " + f + "":"
For i As Integer = 1 To n
  Print Hex( Asc( Mid( s, i, 1 )), 2); " ";
Next
```plaintext
Print
Print

End Scope

Scope
Dim s As String

' open a file for input using utf-16 encoding
' and read back the message
Open f For Input Encoding "utf-16" As #1

' The ascii string is converted from utf-16
Line Input #1, s
Close #1

'' Display the text
Print "Text read from " + f + ":"
Print s
Print
End Scope
```

Output:

```
Text to write to sample.txt:
FreeBASIC

Binary contents of sample.txt:
00 00 00 FF FE 46 00 72 00 65 00 65 00 42 00 41 00 53 00 49 00 43 00 4D

Text read from sample.txt:
FreeBASIC
```

**Platform Differences**

- Unicode (w)strings are not supported in the DOS port of FreeB
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the

Differences from QB

- QB had no support for Unicode

See also

- Open
End (Block)

Indicates the end of a compound statement block.

Syntax

```
End { Sub | Function | If | Select | Type | Enum | Scope | With
Namespace | Extern | Constructor | Destructor | Operator | Property }
```

Description

Used to indicate the end of the most recent code block.

The type of the block must be included in the command: one of `Sub`, `Function`, `If`, `Select`, `Type`, `Enum`, `Scope`, `With`, `Namespace`, `Extern`, `Constructor`, `Destructor`, `Operator`, `Or Property`.

Ending a `Sub`, `Function`, `If`, `Select`, `Scope`, `Constructor`, `Destructor`, `Operator`, or `Property` block also closes the scope for variables defined inside that block. When the scope is closed, variables defined inside the scope are destroyed, calling their destructors as needed.

To end a program, see `End (Statement)`.

Example

```
Declare Sub checkvalue( n As Integer )

Dim variable As Integer

Input "Give me a number: ", variable
If variable = 1 Then
  Print "You gave me a 1"
Else
  Print "You gave me a big number!"
End If
checkvalue(variable)
```
Sub checkvalue( n As Integer )
Print "Value is: " & n
End Sub

Differences from QB

- none

See also

- Constructor
- Destructor
- End (Statement)
- Enum
- Extern
- Function
- If...Then
- Namespace
- Operator
- Property
- Scope
- Select Case
- Sub
- Type
- With
End (Statement)

Control flow statement to end the program.

Syntax

Declare Sub End ( ByVal retval As Long = 0 )

Usage

End [ retval ]

Parameters

retval
Error code returned to system.

Description

Used to exit the program, and return to the operating system. An optional return value may be specified to indicate an error code to the system. If no return value is given, a value of 0 will be automatically returned at the end of the program.

Usage of this statement does not cleanly close scope. Local variables will not have their destructors called automatically, because FreeBASIC does not do stack unwinding. Only the destructors of global variables will be called in this case.

For this reason, it is discouraged to use End simply to mark the end of a program; it is better to come to an end automatically, and in a cleaner fashion, when the last line of module-level code has been executed.

Example

'' This program requests a string from the user, and returns an error code to the OS if the string was empty

Function main() As Integer

   '' assign input to text string

   [Code here]
Dim As String text
Line Input "Enter some text ( try ""abc"" ): "

'' If string is empty, print an error message 
'' return error code 1 (failure)
If( text = "" ) Then
    Print "ERROR: string was empty"
    Return 1
End If

'' string is not empty, so print the string an 
'' return error code 0 (success)
Print "You entered: " & text
Return 0
End Function

'' call main() and return the error code to the OS
End main()

Differences from QB
- The END statement supports specifying a custom return value system.

See also
- End (Block)
- Return
Control flow statement for conditional branching.

**Syntax**

```
If expression Then : statement(s) [Else statement(s)] : End If
or
If expression Then
statement(s)
End If
```

**Differences from QB**

- None

**See also**

- *If...Then*
**Enum**

Declares an enumerated type.

**Syntax**

```plaintext
Enum [typename [ Explicit ] ]
symbolname [= expression] [, ...]
...
End Enum
```

**Parameters**

- *typename*
  
  Name of the *Enum*

- *symbolname*
  
  Name of the constant

- *expression*
  
  A constant expression

- *Explicit*
  
  Requires that symbols must be explicitly referred to by `typename.symbolname`

**Description**

*Enum*, short for enumeration, declares a list of symbol names that correspond to discrete values. If no initial value is given, the first item will be set to 0. Each subsequent symbol has a value one more than the previous unless *expression* is given.

Symbols may be each on their own line, or separated on a single line by commas.

An *Enum* is a useful way of grouping together a set of related *Constants*. A symbol can be accessed like a constant, e.g: `a = symbolname`. But if the name clashes with another symbol, it must be resolved using `typename.symbolname`. This resolution method is always required if you make the enum Explicit.

A non-Explicit *Enum* declared inside an *Extern ... End Extern* block will add its constants to the parent namespace directly, as in C, instead
of acting as a namespace on its own. It disallows the `typename.symbolname` style of access, and the constants may conflict with other symbols from the parent namespace.

An `Enum` can be passed as a user defined type to `Overloaded` operator functions.

**Example**

```vbnet
Enum MyEnum
    option1 = 1
    option2
    option3
End Enum

Dim MyVar As MyEnum

MyVar = option1

Select Case MyVar
    Case option1
        Print "Option 1"
    Case option2
        Print "Option 2"
    Case option3
        Print "Option 3"
End Select
```

**Dialect Differences**

- Explicit Enum not available in the `-lang qb` dialect unless referenced with the alias `__Explicit`.

**Differences from QB**
- New to FreeBASIC

**See also**

- Const
- Operator
**SetEnviron**

Sets a system environment variable

**Syntax**

```
Declare Function SetEnviron ( ByRef varexpression As String ) As
```

**Usage**

```
result = SetEnviron( varexpression )
```

**Parameters**

`varexpression`

Name and setting of an environment variable in the following (or equivalent) form: `varname=varstring`. (`varname` being the name of the environment variable, and `varstring` being its text value to set)

**Return Value**

Return zero (0) if successful, non-zero otherwise.

**Description**

Modifies system environment variables. There are several variables a default ones on your system. An example of this would be `fbgfx`, where the FreeBASIC graphics library will use.

**Example**

'e.g. to set the system variable "path" to "c:":

```
Shell "set path" 'shows the value of path
SetEnviron "path=c:"
Shell "set path" 'shows the new value of path
```

'' WINDOWS ONLY EXAMPLE! - We just set the graph
GDI rather than DirectX.
You may note a difference in FPS.
SetEnviron("fbgfx=GDI")

Desktop width/height
Dim As Integer ScrW, ScrH, BPP
ScreenInfo ScrW, ScrH, BPP

Create a screen at the width/height of your monitor.
Normally this would be slow, but GDI is fairly fast for this kind of thing.
ScreenRes ScrW, ScrH, BPP

Start our timer/
Dim As Double T = Timer

Lock our page
ScreenLock
Do

Print time since last frame
Locate 1, 1
Print "FPS: " & 1 / (Timer - T)
T = Timer

Flip our screen
ScreenUnlock
ScreenLock
Commit a graphical change to our screen.
Cls
Loop Until Len(Inkey)

unlock our page.
ScreenUnlock
Differences from QB

- In QB, `SetEnviron` was called `Environ`.

See also

- `Environ`
- `Shell`
Environ

Returns the value of a system environment variable

Syntax

Declare Function Environ ( ByRef varname As Const String ) As String

Usage

result = Environ( varname )

Parameters

varname
The name of an environment variable.

Return Value

Returns the text value of the environmental variable, or the empty string (""") if the variable does not exist.

Description

Environ returns the text value of a system environment variable.

Example

'e.g. to show the system variable "path":

Print Environ("path")

Differences from QB

- The Environ statement is now called SetEnviron.
See also

- SetEnviron
- Shell
EOF

Checks to see if the end of an open file has been reached

**Syntax**

```
Declare Function EOF ( ByVal filenum As Long ) As Long
```

**Usage**

```
result = EOF( filenum )
```

**Parameters**

- `filenum`
  - File number of an open file.

**Return Value**

Returns true (-1) if end-of-file has been reached, zero (0) otherwise.

**Description**

When reading from files opened for **Input (File Mode)**, it is useful to know when the end of the file has been reached, avoiding errors caused by reading past the ends of files. Use `EOF` to determine this. `EOF` expects a valid file number from an already opened file. Use **FreeFile** to retrieve an available file number.

For file numbers bound to files opened for **output**, `EOF` always returns zero.

**Example**

```
' This code finds a free file number to use and attempts to open the file
' "file.ext" and if successful, binds our file number to the opened file
' reads the file line by line, outputting it to the screen
' returns true, in this case we ignore the loop if file is empty

Dim As String file_name
Dim As Integer file_num
```
file_name = "file.ext"
file_num = FreeFile( )                 '' retrieve a new file number

'' open our file and bind our file number to it, exit on error
If( Open( file_name For Input As #file_num ) ) Then
    Print "ERROR: opening file " ; file_name
End -1
End If

Do Until EOF( file_num )                '' loop until we have reached the end of the file
    Dim As String text
    Line Input #file_num, text          '' read a line of text...
    Print text                          '' ... and output it to the screen
Loop

Close #file_num                         '' close file via our file number
End 0

Because of underlying differences in the libraries used by the compiler when reading text files created in Linux (with LF line endings) in the Windows version of the compiler. The DOS and Linux compilers do not have this problem. One solution is to open the file for Binary access instead of for Input. Line Input# and EOF can still be used as in the above example, and the EOF function will work reliably. This solution will not detect the end of file character, but this is only used to mark the end of text streams that are

Differences from QB

- In QB the comm port signaled an EOF when there were no characters waiting to be read.
- In QB, for files opened in RANDOM or BINARY mode, EOF returns non-zero only after a read past the end of file has been attempted. In FreeBASIC, EOF returns true after the last item is read.

See also

- LOF
- LOC
- FreeFile
Operator Eqv (Equivalence)

Returns the bitwise-and (equivalence) of two numeric values

**Syntax**

```
Declare Operator Eqv ( ByRef lhs As T1, ByRef rhs As T2 ) As Ret
```

**Usage**

```
result = lhs Eqv rhs
```

**Parameters**

- **lhs**
  The left-hand side expression.
  - **T1**
    Any numeric or boolean type.

- **rhs**
  The right-hand side expression.
  - **T2**
    Any numeric or boolean type.

- **Ret**
  A numeric or boolean type (varies with **T1** and **T2**).

**Return Value**

Returns the bitwise-equivalence of the two operands.

**Description**

This operator returns the bitwise-equivalence of its operands, a logical operation that results in a value with bits set depending on the bits of the operands (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value).

The truth table below demonstrates all combinations of a boolean-equivalence operation:

<table>
<thead>
<tr>
<th>Lhs Bit</th>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
No short-circuiting is performed - both expressions are always evaluated.

The return type depends on the types of values passed. `Byte`, `UByte` and floating-point type values are first converted to `Integer`. If the left and right-hand side types differ only in signedness, then the return type is the same as the left-hand side type (\(T_1\)), otherwise, the larger of the two types is returned. Only if the left and right-hand side types are both `Boolean`, the return type is also `Boolean`.

This operator can be overloaded for user-defined types.

**Example**

```vba
Dim As UByte a = &b00110011
Dim As UByte b = &b01010101, c
c = a Eqv b '' c = &b10011001
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- None

**See also**

- Operator Truth Tables
Erase

Statement to erase arrays

Syntax

Declare Sub Erase ( array As Any [, ... ] )

Usage

Erase( array0 [, array1 ... arrayN ] )

Parameters

array
An array to be erased.

Description

Using Erase on a fixed-length array clears (re-initializes) all elements.

Using Erase on a variable-length array (array already sized) frees the memory used by the element data (does not allow to after resize it with a different number of dimensions).

Example

Dim MyArray1(1 To 10) As Integer
ReDim MyArray2(1 To 10) As Integer

Erase MyArray1, MyArray2

Differences from QB

- None

See also
- Common
- Dim
- Extern
- LBound
- ReDim
- Static
- UBound
- Var
Error reporting function

**Syntax**

`Declare Function Erfn( ) As ZString Ptr`

**Usage**

`result = Erfn( )`

**Return Value**

Returns a pointer to the string identifying the function where the error occurred.

Returns NULL if the source is not compiled with the `-exx` compiler option.

**Description**

An error reporting function returning a pointer to the name of the function.

**Example**

```
'' test.bas
'' compile with fbc -exx -lang fblite test.bas

#lang "fblite"

Sub Generate_Error
    On Error Goto Handler
    Error 1000
    Exit Sub
Handler:
    Print "Error Function: "; *Erfn()
    Print "Error Module : "; *Ernn()
```
Resume Next
End Sub

Generate_Error

Output:

Error Function: GENERATE_ERROR
Error Module : test.bas

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Erfn.

Differences from QB

- New to FreeBASIC

See also

- Er1
- Ermn
- On...Error
Erl

Error handling function to return the line where the error occurred

**Syntax**

Declare Function Erl ( ) As Integer

**Usage**

\[
\text{result} = \text{Erl}
\]

**Return Value**

An Integer return value containing the line number where the last error occurred.

**Description**

\text{Erl} will return the line number where the last error occurred. If no error has occurred, \text{Erl} will return 0.

\text{Erl} cannot always be used effectively -- QB-like error handling must be enabled.

\text{Erl} is reset by RESUME and RESUME NEXT

**Example**

```
' compile with -lang fblite or qb

#lang "fblite"

' note: compilation with '-ex' option is required

On Error Goto ErrorHandler
```
' Generate an explicit error
Error 100
End

ErrorHandler:
    Dim num As Integer = Err
    Print "Error "; num; " on line "; Erl
    Resume Next

' Expected output is
' Error 100 on line 6

Differences from QB
- FreeBASIC returns the source code line number and ignores the values of all explicit line numbers, where as QB returns the last encountered explicit line number, and will return zero (0) when explicit line numbers are not used.

See also
- Error Handling
- Err
Error reporting function

**Syntax**

Declare Function Ermn ( ) As ZString Ptr

**Usage**

`result = Ermn ( )`

**Return Value**

Returns a pointer to the string identifying the module where the error occurred.

Returns NULL if the source is not compiled with the `-exx` compiler option.

**Description**

An error reporting function returning a pointer to the name of the module.

**Example**

```bas
'' test.bas
'' compile with fbc -exx -lang fblite test.bas

#lang "fblite"

Sub Generate_Error
    On Error Goto Handler
    Error 1000
    Exit Sub
End Sub

Handler:
    Print "Error Function: "; *Erfn()
    Print "Error Module : "; *Ermn()
```
Resume Next
End Sub

Generate_Error

Output:

Error Function: GENERATE_ERROR
Error Module : test.bas

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Ermn.

Differences from QB

- New to FreeBASIC

See also

- Erfn
- Erl
- On...Error
Err

Get or set the run-time error number

Usage

\[
\begin{align*}
\text{result} &= \text{Err}( ) \\
or & \\
\text{Err} &= \text{number}
\end{align*}
\]

Description

The \text{Err()} function returns the FreeBASIC run-time error number which set by the built-in statements and functions, or by the program through \text{number} or \text{Error}. Unlike \text{Error}, \text{Err} = \text{number} sets the error number without invoking an error handler.

See \underline{Runtime Error Codes} for a listing of the predefined runtime error numbers and their associated meaning. The program may use additional custom numbers.

\text{Err} can always be used, even if QB-like error handling is not enabled. reset by \text{Resume} and \text{Resume Next}.

Note: Care should be taken when calling an internal function (such as after an error occurred, because it will reset the error value with its own status. To preserve the \text{Err} value, it is a good idea to store it in a variable soon as the error handler is entered.

Example

An example using QBASIC style error handling (compile with -ex option)

```
'' Compile with -lang fblite or qb

#lang "fblite"

On Error Goto Error_Handler
Error 150
End
```
Error_Handler:
    n = Err()
    Print "Error #"; n
    Resume Next

An example using inline error handling (note: `open` can also return its own status when called as a function)

'' compile without -e switch

Dim filename As String

Do
    Line Input "Input filename: ", filename
    If filename = "" Then End
    Open filename For Input As #1
Loop Until Err() = 0

Print Using "File '&' opened successfully"; filename
Close #1

Differences from QB

- Error numbers are not the same as in QB.

See also

- On Error
- Error
- Error Handling
- Runtime Error Codes
Error handling statement to force an error to be generated

**Syntax**

```
Declare Sub Error ( errno As Integer )
```

**Usage**

```
Error number
```

**Parameters**

`number`

The error number to generate

**Description**

`Error` invokes the error handler specified with `On Error` or, in case there was none set, aborts the program, printing an error message similar to those generated by the compiler's -exx run-time error checking. It's possible to use the built-in run-time error numbers and/or other custom error numbers for `number`. This can be used to simulate custom error numbers.

**Example**

To send an error alert of error 150 (just some arbitrary error code) one would do the following:

```
Error 150
```

**Differences from QB**

- Error numbers are not the same as in QB.

**See also**
- Err
- Error Handling
- Runtime Error Codes
Event (Message Data From Screenevent)

Pre-defined structure (UDT) from fbgfx.bi used by ScreenEvent to return event data

**Syntax**

```
#include once "fbgfx.bi"
using fb
Dim variable As Event
```

**Description**

Here we report the EVENT structure for clarity:

```vbnet
Type EVENT Field = 1
    Type As Long
    Union
        Type
            scancode As Long
            ascii As Long
        End Type
        Type
            x As Long
            y As Long
            dx As Long
            dy As Long
        End Type
        button As Long
        z As Long
        w As Long
    End Union
End Type
```

The Type field will contain the event type ID, while the remaining 4 integers will hold sensitive data to the event type.
Event types

The event type is identified by an ID number returned into the first integer of the \textit{event} buffer (the \texttt{.type} field in the \texttt{EVENT} structure).

Known event type IDs - and their values at time of writing - are:

- \texttt{EVENT_KEY_PRESS} (1) A key was pressed on the keyboard. The \texttt{.scancode} field contains the platform independent scancode value for the key; if the key has an ascii representation, it is held into the \texttt{.ascii} field, which otherwise has a value of 0.

- \texttt{EVENT_KEY_RELEASE} (2) A key was released on the keyboard. The \texttt{.scancode} and \texttt{.ascii} fields have the same meaning as with the \texttt{EVENT_KEY_PRESS} event.

- \texttt{EVENT_KEY_REPEAT} (3) A key is being held down repeatedly. The \texttt{.scancode} and \texttt{.ascii} fields have the same meaning as with the \texttt{EVENT_KEY_PRESS} event.

- \texttt{EVENT_MOUSE_MOVE} (4) The mouse was moved while it was on the program window. The \texttt{x} and \texttt{y} fields contain the new mouse position relative to the upper-left corner of the screen, while the \texttt{dx} and \texttt{dy} fields contain the motion deltas.

- \texttt{EVENT_MOUSE_BUTTON_PRESS} (5) One of the mouse buttons was pressed. The \texttt{.button} field has one bit set identifying the button that was pressed; bit 0 identifies the left mouse button, bit 1 the right mouse button and bit 2 the middle mouse button.

- \texttt{EVENT_MOUSE_BUTTON_RELEASE} (6) One of the mouse buttons was released. The \texttt{.button} field has the same meaning as with the \texttt{EVENT_MOUSE_BUTTON_PRESS} event.

- \texttt{EVENT_MOUSE_DOUBLE_CLICK} (7) One of the mouse buttons was double clicked. The \texttt{.button} field has the same meaning as with the \texttt{EVENT_MOUSE_BUTTON_PRESS} event.

- \texttt{EVENT_MOUSE_WHEEL} (8) The mouse wheel was used; the new wheel position is returned into the \texttt{.z} field.

- \texttt{EVENT_MOUSE_ENTER} (9) The mouse was moved into the program window.

- \texttt{EVENT_MOUSE_EXIT} (10) The mouse was moved out of the
program window.

- **EVENT_WINDOW_GOT_FOCUS** (11) The program window has got focus.
- **EVENT_WINDOW_LOST_FOCUS** (12) The program window has lost focus.
- **EVENT_WINDOW_CLOSE** (13) The user attempted to close the program window.
- **EVENT_MOUSE_HWHEEL** (14) The horizontal mouse wheel was used; the new horizontal wheel position is returned into the .w field.

The fbgfx.bi header file contains a definition of the **EVENT** user data type, so it is not necessary to declare it manually.

**Dialect Differences**

- In **lang fb**, the structure and constants are stored in the **FB Namespace**. This is not the case in other dialects.

**Differences from QB**

- New to FreeBASIC

**See also**

- **ScreenEvent**
**Exec**

Temporarily transfers execution to an external program

**Syntax**

```vbnet
Declare Function Exec ( ByRef program As Const String, ByRef arguments String ) As Long
```

**Usage**

```vbnet
result = Exec( program, arguments )
```

**Parameters**

- `program`  
The file name (including file path) of the program (executable) to transfer control to.
- `arguments`  
The command-line arguments to be passed to the program.

**Return Value**

The exit status of the program, or negative one (-1) if the program could not be executed.

**Description**

Transfers control over to an external program. When the program exits, execution resumes immediately after the call to `Exec`.

**Example**

```vbnet
'A Windows based example but the same idea applies
Const exename = "NoSuchProgram.exe"
Const cmdline = "arg1 arg2 arg3"
Dim result As Integer
result = Exec( exename, cmdline )
If result = -1 Then
    Print "Error running "; exename
Else
    Print "Exit code:"; result
```
Platform Differences

- Linux requires the *program* case matches the real name of the file.
- DOS are case insensitive. The program being executed may be case sensitive for its command line parameters.
- Path separators in Linux are forward slashes `/`. Windows uses backward slashes `\` but it allows for forward slashes. DOS uses backward `\` slashes.
- Exit code is limited to 8 bits in DOS.

Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias.

Differences from QB

- New to FreeBASIC

See also

- `Chain` transfer temporarily, without arguments
- `Run` one-way transfer
- `Command` pick arguments
**ExePath**

Returns the path of the running program

**Syntax**

```vbnet
Declare Function ExePath ( ) As String
```

**Usage**

```vbnet
result = ExePath
```

**Return Value**

A `String` variable set to the path of the running program.

**Description**

Returns the path (the location) of the calling program. This is not necessarily the same as `CurDir`.

**Example**

```vbnet
Dim pathname As String = ExePath
Print "This program's initial directory is: " & pathname
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the `__Exepath`.

**Differences from QB**

- New to FreeBASIC

**See also**
CurDir
Control flow statement to exit a compound statement block

**Syntax**

Exit \{Do | For | While | Select \} 
Exit \{Sub | Function | Operator | Property \}

Exit \{Do [, Do [, , ...] ] | 
For [, For [, , ...] ] | 
While [, While, [...] ] | 
Select [, Select [, , ...] ] \}

**Description**

Leaves a code block such as a Sub, Function, Do...Loop, For...Next, etc. The execution skips the rest of the block and goes to the line after its end.

Where there are multiple Do / For / While / Select blocks nested, it will skip to the end of that type. You can skip to the end of multiple blocks of that type by giving the word multiple times, separated by commas.

For example: Exit While, While

**Example**

'e.g. the print command will not be seen

Do 
  Exit Do ' Exit the Do...Loop and continues to
  Print "I will never be shown"
Loop

Dim As Integer i, j
For i = 1 To 10
For j = 1 To 10
    Exit For, For
Next j
Print "I will never be shown"
Next i

Differences from QB

- EXIT WHILE and EXIT SELECT are new to FreeBASIC.

See also

- Sub
- Function
- Do...Loop
- For...Next
- While...Wend
- Continue
Exp

Returns $e$ raised to the power of a given number

**Syntax**

```
Declare Function Exp cdecl ( ByVal number As Double ) As Double
```

**Usage**

```
result = Exp( number )
```

**Parameters**

- `number`  
The **Double** `number` that $e$ is raised to the power of.

**Return Value**

Returns the **Double** value of $e$ raised to power of `number`.

**Description**

The mathematical constant $e$, also called Euler's constant, is the base of the natural logarithm. Its first few significant figures is: 2.7182818284590452354. The required `number` argument can be any valid numeric expression within the range of the function. If `Exp` returns infinity. If `number` is too small, `Exp` returns zero (0.0). If `number`

**Example**

```basic
'Compute Continuous Compound Interest
Dim r As Double
Dim p As Double
Dim t As Double
Dim a As Double

Input "Please enter the initial investment (principal amount):";
Input "Please enter the annual interest rate (as a decimal):";
Input "Please enter the number of years to invest:"
```
\[ a = p \cdot \exp(r \cdot t) \]

Print ""
Print "After"; t; " years, at an interest rate of"; 

The output would look like:

Please enter the initial investment (principal amount): 100
Please enter the annual interest rate (As a decimal): .08
Please enter the number of years To invest: 20
After 20 years, at an interest rate of 8%, your initial investment of 100 would be worth 495.3032424395115

**Differences from QB**
- None

**See also**
- Log
- Operator ^ (Exponentiate)
Export

Declaration specifier to indicate that a procedure in a DLL should be visible from other programs

**Syntax**

\{ Sub | Function \} proc_name ( argumentlist ) [ As datatype ]

**Description**

If a function is declared with this clause in a DLL, it is added to the public export table, so external programs can dynamically link to it using **DyLibSymbol**.

**Example**

See the examples on the **Shared Libraries** page.

**Dialect Differences**

- Not available in the **-lang qb** dialect unless referenced with the alias __Export.

**Platform Differences**

- Dynamic link libraries are not available in DOS, as the OS doesn't support them.

**Differences from QB**

- New to Freebasic

**See also**

- **DyLibLoad**
- **DyLibSymbol**
- Alias
Extends

Specifies a base type from which to derive a new type

**Syntax**

```
Type|Union typename Extends base_typename
... End Type|Union
```

**Description**

`Extends` declares `typename` to be derived from `base_typename`. The derived base type. `typename` objects may be used in place of `base_typename` objects like regular members of `typename`.

However, a regular member will shadow an inherited member if they have the same identifier. The explicitly access members of the base type shadowed by local members.

User-defined types that extend another type will include the base type's structure at their beginning, and their size as reported by their base type's size plus the size needed for any regular members. A derived type is not required to have regular members of its own.

In `typename` (the derived user-defined type), the fields can share the same memory space, and it does not matter whether `base_typename` is a `Union` or not.

If only `base_typename` is a `Union`, then it will not be affected by fields from `typename`.

As a `Union` is not allowed to have complex fields (i.e. user-defined types), a derived type is allowed to have (contain) a complex `base_typename`.

The `Base (Initializer)` keyword can be used at the top of constructors for the base type.

Extending the built-in `Object` type allows a user-defined type to be used with `Abstract` methods, and to use the `Override` method attribute.

**Note:** Derived UDT pointer can only be casted to "compatible" pointer types first.

**Warning:** Before fbc version 0.24, these five keywords dedicated to inheritance (`Extends`, `End`, `Override`, `Abstract`, `Virtual`) were not supported. Three new keywords `Virtual`, `Abstract`, and `Virtual` were added after that version.
Example

```vbnet
Type SchoolMember 'Represents any school member'
    Declare Constructor ()
    Declare Sub Init (ByRef _name As String, ByVal As String Name
    As Integer age
End Type

Constructor SchoolMember ()
    Print "Initialized SchoolMember"
End Constructor

Sub SchoolMember.Init (ByRef _name As String, ByVal
    This.name = _name
    This.age = _age
    Print "Name: "; This.name; "    Age:"; This.age
End Sub

Type Teacher Extends SchoolMember 'Represents a teacher'
    Declare Constructor (ByRef _name As String, ByVal
    As Integer salary
    Declare Sub Tell ()
End Type

Constructor Teacher (ByRef _name As String, ByVal
    Print "Initialized Teacher"
    This.Init(_name, _age) 'implicit access to base
    This.salary = _salary
End Constructor

Sub Teacher.Tell ()
    Print "Salary:"; This.salary
End Sub
```
Type Student Extends SchoolMember 'Represents a student derived from SchoolMember'
Declare Constructor (ByRef _name As String, ByVal _marks As Integer)
  This.Init(_name, _age) 'implicit access to base
  This.marks = _marks
End Constructor

Sub Student.Tell()
  Print "Marks:"; This.marks
End Sub

Dim As Teacher t = Teacher("Mrs. Shrividya", 40, 30000)
t.Tell()
Print
Dim As Student s = Student("Swaroop", 22, 75)
s.Tell()

' Example using all eight keywords of inheritance: ' Extends', 'Base.', 'Base()', 'Object', 'Is' operator, 'Virtual', 'Abstract', 'Override'

Type root Extends Object 'Extends' to activate RTTI by inheritance of predefined Object type
Declare Function ObjectHierarchy () As String
Declare Abstract Function ObjectRealType () As String

Dim Name As String
Declare Virtual Destructor () 'Virtual' declares destructor with body ('Abstract' forbidden)
Protected:
  Declare Constructor () ' to avoid user construction
  Declare Constructor (ByRef rhs As root) '' to avoid copy-construction
End Type ' derived type may be member data empty
Constructor root ()
End Constructor

Function root.ObjectHierarchy () As String
  Return "Object(forRTTI) <- root"
End Function

Virtual Destructor root ()
  Print "root destructor"
End Destructor

Type animal Extends root ' 'Extends' to inherit of
  Declare Constructor (ByRef _name As String = "")
  Declare Function ObjectHierarchy () As String
  Declare Virtual Function ObjectRealType () As String

  Declare virtual Destructor () Override ' 'Virtual'
     ' 'Override'
End Type

Constructor animal (ByRef _name As String = "")
  This.name = _name
End Constructor

Function animal.ObjectHierarchy () As String
  Return Base.ObjectHierarchy & " <- animal" ' 'Base
End Function

Virtual Function animal.ObjectRealType () As String
  Return "animal"
End Function

Virtual Destructor animal ()
  Print " animal destructor: " & This.name
End Destructor
Type dog Extends animal 'Extends' to inherit of animal
Declare Constructor (ByRef _name As String = "")
Declare Function ObjectHierarchy () As String
Declare Function ObjectRealType () As String Override

Declare Destructor () Override 'Override' to check if the destructor is well an override
End Type 'derived type may be member data empty

Constructor dog (ByRef _name As String = "")
   Base(_name) 'Base()' allows to call parent constructor
End Constructor

Function dog.ObjectHierarchy () As String
   Return Base.ObjectHierarchy & " <- dog" 'Base()
End Function

Function dog.ObjectRealType () As String
   Return "dog"
End Function

Destructor dog ()
   Print "   dog destructor: " & This.name
End Destructor

Type cat Extends animal 'Extends' to inherit of animal
Declare Constructor (ByRef _name As String = "")
Declare Function ObjectHierarchy () As String
Declare Function ObjectRealType () As String Override

Declare Destructor () Override 'Override' to check if the destructor is well an override
End Type 'derived type may be member data empty

Constructor cat (ByRef _name As String = "")
   Base(_name) 'Base()' allows to call parent constructor
End Constructor

Function cat.ObjectHierarchy () As String
Function cat.ObjectRealType () As String
    Return "cat"
End Function

Destructor cat ()
    Print "    cat destructor: " & This.name
End Destructor

Sub PrintInfo (ByVal p As root Ptr) ' must be put
    Print "    " & p->Name, "    " & p->ObjectRealType,
    If *p Is dog Then " 'Is' allows to check compati
        Print Cast(dog Ptr, p)->ObjectHierarchy
    ElseIf *p Is cat Then " 'Is' allows to check com
        Print Cast(cat Ptr, p)->ObjectHierarchy
    ElseIf *p Is animal Then " 'Is' allows to check
        Print Cast(animal Ptr, p)->ObjectHierarchy
    End If
End Sub

Print "Name:", "Object (real):										Hierachy:" Dim a As root Ptr = New animal("Mouse")
PrintInfo(a) Dim d As root Ptr = New dog("Buddy")
PrintInfo(d) Dim c As root Ptr = New cat("Tiger")
PrintInfo(c) Print
Delete a
Delete d
Delete c

Dialect Differences
- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- Type
- Union
- Base (Initializer)
- Base (Member Access)
- Object
- Operator Is
- Virtual
- Abstract
- Override
**Extern**

Declares a variable, array or object having external linkage

**Syntax**

```plaintext
Extern [ Import ] symbolname[ (subscripts) ] [ Alias "aliasname"
] As DataType [, ...]
```

**Parameters**

- **symbolname**
  The name of the variable, array or object.
- **aliasname**
  An alternate external name for the variable, array or object.

**Description**

Declares *symbolname* as an external name, meaning it is global to external modules. **Extern** only declares variables, arrays and objects, and does not define them (different from **Common** or **Dim**). It also has the effect of making *symbolname* a **shared** name, meaning it is visible within procedures (see **Shared**). A *symbolname* declared as external name can be (re)defined (using **Dim** or **Redim**) only in a single external module.

If **Alias** is used, *aliasname* will be used as the external name rather than *symbolname*, and its case will be preserved.

If **Import** is used, the name will be added to the dynamic library import list so its address can be fixed at run-time.

**Example**

```plaintext
' extern1.bas

Extern Foo Alias "foo" As Integer

Sub SetFoo
  foo = 1234
```

End Sub

'' extern2.bas

Declare Sub SetFoo

Extern Foo Alias "foo" As Integer

Dim foo As Integer = 0

SetFoo

Print Foo

Output:

1234

Dialect Differences

- Not available in the -lang qb dialect.

Differences from QB

- New to FreeBASIC

See also

- Extern...End Extern
- Common
- Dim
- Shared
Statement block to allow calling of functions compiled for specific languages or platforms.

**Syntax**

```
Extern { "C" | "C++" | "Windows" | "Windows-MS" } [ Lib "libname 
declarative statements 
End Extern 
```

**Description**

`Extern` blocks provide default calling conventions for procedures and mandate a certain name decoration.

`Extern "C"` blocks provide a default cdecl calling convention to procedures declared within them. The same effect can be achieved without the `EXTERN` block by using `Alias` string containing the exact procedure name.

`Extern "C++"` blocks are exactly like `Extern "C"` blocks but they also name mangling compatible to that of `g++-4.x`.

`Extern "Windows"` blocks provide a default stdcall calling convention to procedures declared within them, and on the Windows platform, append an "@N" suffix size in bytes of any procedure parameters. Similar to the `Extern "C"` block, the `stdcall` and `Alias`.

`Extern "Windows-MS"` blocks are exactly like `Extern "Windows"` blocks but do not append the names on Windows.

`Lib "libname"` can be used to specify a library which will be linked in as if used. Additionally, all procedure declarations inside the `Extern` block will be specified as part of their declarations (but it can still be overridden with `Alias`).

**Example**

```
'\' This procedure uses the default calling convention 
'\' STDCALL on Win32 and CDECL on Linux/DOS/*BSD, and 
'\' "MYTEST1@4" on Win32 and "MYTEST1" on Linux/DOS 
'\' ALL-UPPER-CASE name mangling).
```
Sub MyTest1 ( ByVal i As Integer )
End Sub

Extern "C"
'' This procedure uses the CDECL convention and is seen externally as "MyTest2".
Sub MyTest2 ( ByVal i As Integer )
End Sub
End Extern

Extern "C++"
'' This procedure uses the CDECL convention and its name is mangled compatible to g++-4.x, specifically: "_Z7My
Sub MyTest3 ( ByVal i As Integer )
End Sub
End Extern

Extern "Windows"
'' This procedure uses the STDCALL convention and is seen externally as "MyTest4@4" on Windows, and "MyTest4" on Linux, *BSD and DOS.
Sub MyTest4 ( ByVal i As Integer )
End Sub
End Extern

Extern "Windows-MS"
'' This procedure uses the STDCALL convention and is seen externally as "MyTest5".
Sub MyTest5 ( ByVal i As Integer )
End Sub
End Extern

MyTest1( 0 )
MyTest2( 0 )
MyTest3( 0 )
MyTest4( 0 )
Dialect Differences

- `Extern` blocks are only available in the `-lang fb` dialect.

Differences from QB

- New to FreeBASIC

Platform Differences

- On Linux, *BSD and DOS platforms, `Extern "Windows"` blocks are equal to `Extern "Windows-MS"`.

See also

- `cdecl`
- `stdcall`
- `Extern`
**False**

Intrinsic constant set by the compiler

**Syntax**

\[
\text{Const \textit{False} As Boolean}
\]

**Description**

Gives the False \texttt{Boolean} value where used.

**Example**

```basic
Dim b As Boolean = False
If b Then
    Print "b is True"
Else
    Print "b is False"
End If
```

```
b is False
```

**Dialect Differences**

- Not available in the -\textit{lang qb} dialect unless referenced with the alias __\texttt{False}.

**Differences from QB**

- New to FreeBASIC

**See also**
- True
- Boolean
Field

Specifies field alignment.

Syntax

```
Type|Union typename Field = { 1 | 2 | 4 }
...
End Type|Union
```

Description

Field can be used to pack Types or Unions more tightly than the default. The most commonly used value is Field = 1, which causes the Type or Union to be packed as tightly as possible, without any padding bytes being added between the fields or at the end of the Type. Field can only be used to decrease field alignment, but it cannot be used to increase it. In order to add padding bytes, a Union with appropriate members could be used instead.

Example

```
Type bitmap_header Field = 1
    bfType       As UShort
    bfsize       AsUInteger
    bfReserved1  As UShort
    bfReserved2  As UShort
    bfOffBits    AsUInteger
    biSize       AsUInteger
    biWidth      AsUInteger
    biHeight     AsUInteger
    biPlanes     As UShort
    biBitCount   As UShort
    biCompression AsUInteger
    biSizeImage  AsUInteger
    biXPelsPerMeter AsUInteger
    biYPelsPerMeter AsUInteger
    biClrUsed    AsUInteger
    biClrImportant AsUInteger
End Type
```
Dim bmp_header As bitmap_header

'Open up bmp.bmp and get its header data:
'Note: Will not work without a bmp.bmp to load ..
Open "bmp.bmp" For Binary As #1

    Get #1, , bmp_header

Close #1

Print bmp_header.biWidth, bmp_header.biHeight

Sleep

Dialect Differences

- In the `-lang qb` dialect, the compiler assumes `Field = 1` by default if no other `Field` was specified, causing all structures to be tightly packed without added padding, as in QB.

Differences from QB

- In QB `Field` was used to define fields in a file buffer at run time. This feature is not implemented in FB, so the keyword has been replaced. To define fields in a file buffer, `Types` must be used.

See also

- Type
- Union
- Structure packing/field alignment
FileAttr

Returns information about an open file number

**Syntax**

```vbnet
Declare Function FileAttr ( ByVal filenum As Long, ByVal returntype Long = 1 ) As Integer
```

**Usage**

```vbnet
#include "file.bi"
result = FileAttr( filenum, [ returntype ] )
```

or

```vbnet
#include "vbcompat.bi"
result = FileAttr( filenum, [ returntype ] )
```

**Parameters**

- **filenum**
  The file number of a file or device opened with `Open`

- **returntype**
  An integer value indicating the type of information to return.

**Return Value**

A value associated with the return type, otherwise 0 on error.

**Description**

Information about the file number is returned based on the supplied `returntype`

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>File Mode</td>
<td>fbFileAttrMode</td>
</tr>
<tr>
<td>2</td>
<td>File Handle</td>
<td>fbFileAttrHandle</td>
</tr>
<tr>
<td>3</td>
<td>Encoding</td>
<td>fbFileAttrEncoding</td>
</tr>
</tbody>
</table>

For File Mode, `returntype = 1 (fbFileAttrMode)` the return value is the
one or more of the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>File Mode</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input</td>
<td>fbFileModeInput</td>
</tr>
<tr>
<td>2</td>
<td>Output</td>
<td>fbFileModeOutput</td>
</tr>
<tr>
<td>4</td>
<td>Random</td>
<td>fbFileModeRandom</td>
</tr>
<tr>
<td>8</td>
<td>Append</td>
<td>fbFileModeAppend</td>
</tr>
<tr>
<td>32</td>
<td>Binary</td>
<td>fbFileModeBinary</td>
</tr>
</tbody>
</table>

For File Handle, \textit{returntype} = 2 (fbFileAttrHandle), the return value is the handle as supplied by the C Runtime for file-type devices.

On Windows only: For File Handle, \textit{returntype} = 2 (fbFileAttrHandle) returned for COM devices is the handle returned by \texttt{CreateFile()} when the device was first opened. The value returned for LPT devices is the handle returned by \texttt{OpenPrinter()} when the device was first opened. This handle can be passed to other Windows API functions.

On Linux only: For File Handle, \textit{returntype} = 2 (fbFileAttrHandle), the value returned for COM devices is the file descriptor returned by \texttt{open()} when the device was first opened.

For Encoding, \textit{returntype} = 3 (fbFileAttrEncoding), the return value is one of the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Encoding</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Ascii</td>
<td>fbFileEncodASCII</td>
</tr>
<tr>
<td>1</td>
<td>UTF-8</td>
<td>fbFileEncodUTF8</td>
</tr>
<tr>
<td>2</td>
<td>UTF-16</td>
<td>fbFileEncodUTF16</td>
</tr>
<tr>
<td>3</td>
<td>UTF-32</td>
<td>fbFileEncodUTF32</td>
</tr>
</tbody>
</table>

\textbf{Example}

```c
#include "vbcompat.bi"
#include "crt.bi"
```
Dim f As FILE Ptr, i As Integer

' Open a file and write some text to it

Open "test.txt" For Output As #1
f = Cast( FILE Ptr, FileAttr( 1, fbFileAttrHandle
For i = 1 To 10
   fprintf( f, !"Line %i\n", i )
Next i
Close #1

' re-open the file and read the text back

Open "test.txt" For Input As #1
f = Cast( FILE Ptr, FileAttr( 1, fbFileAttrHandle
While feof(f) = 0
   i = fgetc(f)
   Print Chr(i);
Wend
Close #1

Differences from QB

- None for returnType = 1
- QBasic and 16-bit Visual Basic returned DOS file handle for returnType = 2
- returnType = 3 is new to FreeBASIC

See also

- Open
**FileCopy**

Copies a file

**Syntax**

```vbnet
Declare Function FileCopy ( ByVal source As ZString Ptr, ByVal destination As ZString Ptr ) As Long
```

**Usage**

```vbnet
#include "file.bi"

FileCopy source, destination

or

#include "file.bi"

result = FileCopy( source, destination )
```

**Parameters**

- **source**
  - A `String` argument specifying the filename of the file to copy from. This file must exist.

- **destination**
  - A `String` argument specifying the filename of the file to copy to. This file will be overwritten if it exists. This file should not be currently referenced by any open file handles.

**Return Value**

- Returns 0 on success, or 1 if an error occurred.

**Description**

Copies the contents of the source file into the destination file, overwriting the destination file if it already exists.

It is necessary to `#include` either "file.bi" or "vbcompat.bi" in order to gain access to this function.

**Example**
#include "file.bi"
FileCopy "source.txt", "destination.txt"

Platform Differences

- Linux requires the *filename* case matches the real name of the file. Windows and DOS are case insensitive.
- Path separators in Linux are forward slashes `/`. Windows uses backward slashes `\` but it allows forward slashes. DOS uses backward slashes `\`.

Differences from QB

- New to FreeBASIC. Existed in Visual Basic.

See also
**FileDateTime**

Returns the last modified date and time of a file as **Date Serial**

**Syntax**

```
Declare Function FileDateTime ( ByVal filename As ZString Ptr ) As Double
```

**Usage**

```
#include "file.bi"
result = FileDateTime( filename )
```

```
Or

#include "vbcompat.bi"
result = FileDateTime( filename )
```

**Parameters**

*filename*

Filename to retrieve date and time for.

**Return Value**

Returns a **Date Serial**.

**Description**

Returns the file's last modified date and time as **Date Serial**.

**Example**

```
#include "vbcompat.bi"

Dim filename As String, d As Double

Print "Enter a filename: "
Line Input filename
```
If FileExists( filename ) Then

    Print "File last modified: ";

    d = FileDateTime( filename )

    Print Format( d, "yyyy-mm-dd hh:mm AM/PM" )

Else

    Print "File not found"

End If

Platform Differences

- Linux requires the `filename` case matches the real name of the file. Windows and DOS are case insensitive.
- Path separators in Linux are forward slashes `/`. Windows uses backward slashes `\` but it allows forward slashes. DOS uses backward slashes `\`.

Differences from QB

- New to FreeBASIC

See also

- Date Serials
FileExists

Tests the existence of a file

Syntax

Declare Function FileExists ( ByVal filename As ZString Ptr ) As Long

Usage

#include "file.bi"
result = FileExists( filename )

Or

#include "vbcompat.bi"
result = FileExists( filename )

Parameters

filename
Filename to test for existence.

Return Value

Returns non-zero (-1) if the file exists, otherwise returns zero (0).

Description

FileExists tests for the existence of a file. Internally, it may issue an Open() and a Close() function, which may have consequences - eg, any existing Lock(s) on the file may be released. Depending on the exact requirements, alternative methods of checking for file existence may be to use the Dir() function (being careful of attributes and ensuring the path doesn't contain wildcards), or to try opening the file and checking the return value for success.

Example
#include "vbcompat.bi"

Dim filename As String

Print "Enter a filename: "
Line Input filename

If FileExists( filename ) Then
    Print "File found: " & filename
Else
    Print "File not found: " & filename
End If

**Platform Differences**

- Linux requires the *filename* case matches the real name of the file. Windows and DOS are case insensitive.
- Path separators in Linux are forward slashes /. Windows uses backward slashes \ but it allows for forward slashes. DOS uses backward \ slashes.

**Differences from QB**

- New to FreeBASIC

**See also**

- Dir
**FileLen**

Finds the length of a file given its filename

**Syntax**

```basic
Declare Function FileLen ( filename As String ) As LongInt
```

**Usage**

```basic
#include "file.bi"
result = FileLen(filename)
```

Or

```basic
#include "vbcompat.bi"
result = FileLen(filename)
```

**Parameters**

- `filename`  
  A **String** argument specifying the filename of the file whose length to return.

**Description**

Returns the size in bytes of the file specified by `filename`.

**Example**

```basic
#include "file.bi"
Dim length As Integer
length = FileLen("file.txt")
```

**Platform Differences**

- Linux requires the `filename` case matches the real name of the file. Windows and DOS are case insensitive.
Path separators in Linux are forward slashes /. Windows uses backward slashes \ but it allows for forward slashes . DOS use backward \ slashes.

**Differences from QB**

- New to FreeBASIC. Existed in Visual Basic.

**See also**

- L0F
Fix

Returns the integer part of a number, rounding towards zero

Syntax

Declare Function Fix ( ByVal number As Single ) As Single
Declare Function Fix ( ByVal number As Double ) As Double
Declare Function Fix ( ByVal number As Integer ) As Integer
Declare Function Fix ( ByVal number As UInteger ) As UInteger
Declare Function Fix ( ByVal number As LongInt ) As LongInt
Declare Function Fix ( ByVal number As ULongInt ) As ULongInt

Usage

result = Fix( number )

Parameters

number
the floating-point number to truncate

Return Value

Returns the integer part of number, rounding towards zero.

Description

Equivalent to: Sgn(number) * Int(Abs(number)). For example, Fix(1.3) will return 1.0, and Fix(-4.9) will return -4.0. For integer types, the number is returned unchanged.

Note: this function is also equivalent to number - Frac(number).

The Fix unary Operator can be overloaded with user defined types.

Example

Print Fix(1.9) '' will print 1
Print Fix(-1.9) '' will print -1
Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- `Int`
- `Frac`
- `CInt`
- `Operator`
Flip

Changes the current video display page

Syntax

Declare Sub Flip ( ByVal frompage As Long = -1, ByVal topage As

Usage

Flip [ frompage ] [, topage ]

Parameters

frompage
previous page
topage
new page to display

Description

In normal graphics mode, Flip is an alias for PCopy and ScreenCopy. See

In OpenGL mode, Flip does a hardware page flip and displays the contents of the backbuffer. It is recommended that you call while in OpenGL mode, otherwise your app may also become unresponsive.

Example

ScreenRes 320, 240, 32, 2 'Sets up the screen to be 320x240 in 32-bit color with 2 video pages.

For n As Integer = 50 To 270

    ScreenSet 1,0 'Sets the working page to 1
    Cls
    Circle (n, 50),50 ,RGB(255,255,0) 'Draws a circle with a 50 pixel radius in yellow on page 1
    Flip 1,0 'Copies our circle from page 1 to page 0
    Sleep 25
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC
For

Control flow statement, open statement clause, or operator depending on context.

Syntax

For iterator = startvalue To endvalue [ Step increment ]
or
Open [ device ] "filename" For filemode As #handle
or
declare operator For ( byref stp as datatype )

See also

- For...Next
- Open
- Operator
Control flow statement for looping

**Syntax**

```basic
For iterator [ As datatype ] = startvalue To endvalue [ Step stepvalue ]
[ statement block ]
Next [ iterator ]
```

**Parameters**

- `iterator`: a variable identifier that is used to iterate from an initial value to an end value.
- `datatype`: If specified, the variable `iterator` will automatically be declared with the `datatype`.
- `startvalue`: an expression that denotes the starting value of the iterator.
- `endvalue`: an expression used to compare with the value of the iterator.
- `stepvalue`: an expression that is added to the iterator after every iteration.

**Description**

A `For...Next` loop initializes `iterator` to `startvalue`, then executes the `iterator` by `stepvalue` until it exceeds `endvalue`. If `stepvalue` is not explicitly given, it will set to the default value of 1.

The values of `stepvalue` and `endvalue` are stored internally immediately following execution of the `For` statement and thus neither can be changed inside the `For` loop. Comparison operators such as `<` and `>` will not be effective as `stepvalue` or `endvalue` because the expressions will not be re-evaluated while the loop is running. (The results of the expressions used to define them may be changed, but these changes will not affect the execution of the `For` loop.) See examples.

Note: In some dialects, the temporary variables holding `stepvalue` and `endvalue` at the end of the loop, and their values are not guaranteed to remain unchanged once any code following the loop has been executed. For this reason, it is recommended never to branch out of a loop (using `Goto` or similar), and then jump back into the middle of it later with a `Next` statement. In the `deprecated` dialect.

The iterator must be an intrinsic scalar: only `Static/Shared` variables a
other kind can be used, including array elements, UDT members, ByRef dereferenced address.

The iterator may be defined having the same scope as the For statement syntax. With this syntax, iterator is created and destroyed within the differences below.

If endvalue is less than startvalue then a negative stepvalue must be not execute at all, since startvalue compares greater than endvalue.

The For statement causes the execution of the statements in the statement block greater than endvalue (or less than endvalue if stepvalue < 0). iterator of stepvalue following each execution of the statement block. If an increment is not given, implicitly incremented by 1.

If an Exit For statement is encountered inside the statement block, the rest of the statement block is skipped until the block's corresponding value is incremented and the loop restarted if it is still within the bounds given.

Note: for integer data types, it is not possible to loop up to the highest (or lowest possible value) that can be stored in the variable type, because incremented variable exceeds endvalue, which can never happen. For example, iterating a variable from 0 to 255, the loop will only break once the variable reaches 256. See Standard Data Type Limits to find the upper and lower limits.

Like all control flow statements, the For statement can be nested, that block of another For statement.

For, Next, and Step are operators that can be overloaded inside user-defined types. See Operator Next, Operator Step

**Example**

```vbnet
Print "counting from 3 to 0, with a step of -0.5"
For i As Single = 3 To 0 Step -0.5
    Print "i is " & i
```
Dim As Integer i, j, k, toTemp, stepTemp
j = 9: k = 1

For i = 0 To j Step k
    j = 0: k = 0 '' Changing j and k has no effect
    Print i;
Next i
Print

' Internally, this is what the above example does:
j = 9: k = 1

i = 0: toTemp = j: stepTemp = k
Do While IIf(stepTemp >= 0, i <= toTemp, i >= toTemp)
    j = 0: k = 0 '' Changing j and k has no effect
    Print i;
    i += stepTemp
Loop
Print

**Dialect Differences**

- In the **-lang fb** and **-lang deprecated** dialects, variables declared inside a visible only inside the block, and cannot be accessed outside it.
- In the **-lang qb** and **-lang fblite** dialects, variables declared inside a counter if declared, and any temporary variables used to hold a procedure-wide scope as in QB

**Differences from QB**
- **ByRef** arguments cannot be used as counters.

**See also**

- **Continue**
- **Do...Loop**
- **Exit**
Format

Formats a number in a specified format

Syntax

Declare Function Format ( ByVal numerical_expression As Double, formatting_expression As Const String = "" ) As String

Usage

#include "string.bi"
result = Format[$]( numerical_expression, formatting_expression )

Parameters

numerical_expression
number to format
formatting_expression
formatting pattern

Return Value

Format returns a string with the result of the numerical expression formatted according to the formatting expression. The formatting expression is a string that can yield numeric or date-time values.

Description

To recover meaningful date-time values the numerical expression must be obtained from the appropriate functions.
This function is part of FreeBASIC, however it is not recognized by the vbcompat.bi is included.

"Numeric Formats"

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null string</td>
<td>General format (no formatting)</td>
</tr>
<tr>
<td>0</td>
<td>Digit placeholder: If the number has fewer digits than there are zeros (on either side of the decimal), leading or trailing zeros are displayed. If there are more digits to the right of the decimal than zeros in the format, the number is rounded. If there are more digits to the left</td>
</tr>
</tbody>
</table>
the format the digits are all displayed

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>Digit placeholder: Follows the same rules as for the 0 digit except the leading or trailing zeros are not displayed.</td>
</tr>
<tr>
<td>.</td>
<td>Placeholder for decimal point. If the format contains only #’s to the left of the decimal point, then numbers smaller than 1 must begin with a decimal point.</td>
</tr>
<tr>
<td>%</td>
<td>Percentage: The expression is multiplied by 100 and the % character is inserted.</td>
</tr>
<tr>
<td>,</td>
<td>Thousands separator. Two adjacent commas, or a comma immediately to the left of the decimal point, (whether there is a decimal specified or not) means ‘Omit the three digits that fall between the comma and the decimal point, rounding as needed.’</td>
</tr>
<tr>
<td>E- E+ e- e+</td>
<td>Scientific format: If a format contains one digit placeholder (0 or #) to the right of an E or e, the number is displayed in scientific format and an E or e is inserted between the number and its exponent. The number of 0’s or #’s to the right determines the number of digits in the exponent. Use an E- or e- to place a minus sign next to negative exponents. Use an E+ or e+ to place a minus sign next to negative exponents and a plus sign next to positive exponents.</td>
</tr>
<tr>
<td>: $ () space</td>
<td>Display literal character: To display a character other than one of these, precede the character with a backslash () or enclose the character(s) in double quotation marks.</td>
</tr>
<tr>
<td>\</td>
<td>Display the next character in format string as is.</td>
</tr>
<tr>
<td>text between double quotes</td>
<td>Displays the text inside the double quotes.</td>
</tr>
<tr>
<td>:</td>
<td>Time separator is used to separate hours, minutes, and seconds when time values are formatted.</td>
</tr>
<tr>
<td>/</td>
<td>The date separator is used to separate day, month, and year when date values are formatted.</td>
</tr>
</tbody>
</table>

"Date-Time formats:"

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>d, dd</td>
<td>Display the day as a one-digit/two-digit number (1-31/01-31)</td>
</tr>
<tr>
<td>dddd</td>
<td>Display the day as an abbreviation (Sun-Sat)</td>
</tr>
<tr>
<td>ddd</td>
<td>Display the day as a full name (Sunday-Saturday)</td>
</tr>
<tr>
<td>dddddd</td>
<td>Display a serial date number as a complete date (including day, month and year)</td>
</tr>
<tr>
<td>m, mm</td>
<td>Display the month as a one-digit/two-digit number (1-12/01-12). If immediately following h or hh, the minute rather than the month is displayed.</td>
</tr>
<tr>
<td>M, MM</td>
<td>Display the month as a one-digit/two-digit number (1-12/01-12), even if immediately following h or hh.</td>
</tr>
<tr>
<td>mmm</td>
<td>Display the month as an abbreviation (Jan-Dec)</td>
</tr>
<tr>
<td>mmmm</td>
<td>Display the month as a full name (January-December)</td>
</tr>
<tr>
<td>y, yy</td>
<td>Display the year as a two-digit number (00-99)</td>
</tr>
<tr>
<td>yyyy</td>
<td>Display the year as a four-digit number (1900-2040)</td>
</tr>
<tr>
<td>h, hh</td>
<td>Display the hour as a one-digit/two-digit number (0-23/00-23)</td>
</tr>
<tr>
<td>m, mm</td>
<td>Display the minute as a one-digit/two-digit number (0-59/00-59). If not immediately following h or hh, the second rather than the minute is displayed.</td>
</tr>
</tbody>
</table>
the month rather than the minute is displayed

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n, nn</td>
<td>Display the minute as a one-digit/two-digit number (0-59/00-59), even if not immediately following hh</td>
</tr>
<tr>
<td>s, ss</td>
<td>Display the second as a one-digit/two-digit number (0-59/00-59)</td>
</tr>
<tr>
<td>tttt</td>
<td>Display a time serial number as a complete time, including hour, minute and second</td>
</tr>
<tr>
<td>AM/PM (Default), am/pm</td>
<td>Use the 12-hour clock displaying AM or am with any hour before noon, PM or pm with any hour between noon and 11:59</td>
</tr>
<tr>
<td>A/P, a/p</td>
<td>Use the 12-hour clock displaying A or a with any hour before noon, P or p with any hour between noon and 11:59</td>
</tr>
</tbody>
</table>

**Example**

<table>
<thead>
<tr>
<th>Sample numeric formats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format (fmt)</td>
</tr>
<tr>
<td>Null String</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0.00</td>
</tr>
<tr>
<td>#,#0</td>
</tr>
<tr>
<td>#,#0.00</td>
</tr>
<tr>
<td>0%</td>
</tr>
<tr>
<td>0.00%</td>
</tr>
<tr>
<td>0.00E+00</td>
</tr>
<tr>
<td>0.00E-00</td>
</tr>
</tbody>
</table>

**Sample Date And Time Formats**

The following are examples of Date And Time formats:

<table>
<thead>
<tr>
<th>Format Expression</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>m/d/yy</td>
<td>12/7/58</td>
</tr>
<tr>
<td>d-mmmm-yy</td>
<td>7-December-58</td>
</tr>
<tr>
<td>d-mmmm</td>
<td>7-December</td>
</tr>
<tr>
<td>mmmm-yy</td>
<td>December-58</td>
</tr>
<tr>
<td>h:mm AM/PM</td>
<td>8:50 PM</td>
</tr>
<tr>
<td>h:mm:ss AM/PM</td>
<td>8:50:35 PM</td>
</tr>
<tr>
<td>h:mm</td>
<td>20:50</td>
</tr>
<tr>
<td>h:mm:ss</td>
<td>20:50:35</td>
</tr>
<tr>
<td>m/d/yy h:mm</td>
<td>12/7/58 20:50</td>
</tr>
</tbody>
</table>

**Dialect Differences**

None
Differences from QB

- Does not exist in QB 4.5. This function appeared first in PDS 7

See also

- `(Print | ?) Using`
- `Str`
Frac

Returns the decimal part of a number

**Syntax**

```
Declare Function Frac ( ByVal number As Double ) As Double
Declare Function Frac ( ByVal number As Integer ) As Integer
Declare Function Frac ( ByVal number As UInteger ) As UInteger
Declare Function Frac ( ByVal number As LongInt ) As LongInt
Declare Function Frac ( ByVal number As ULongInt ) As ULongInt
```

**Usage**

```
result = Frac( number )
```

**Parameters**

`number`

the number or expression to get the fraction part of.

**Return Value**

Returns the fractional part of a number or expression.

**Description**

Equivalent to: `(number - Fix(number))`.  
For example, `Frac(4.25)` will return `0.25`, and `Frac(-1.75)` will return `-0.75`. For integer types, the value `0` is always returned.

The Frac unary Operator can be overloaded with user defined types.

**Example**

```
Print frac(10.625)  '' will print  0.625
Print frac(-10.625)  '' will print -0.625
```
Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- Fix
- Operator
Fre

Returns the amount of free memory available

Syntax

\[ \text{Declare Function } \text{Fre} \left( \text{ByVal } \text{value As Long} = 0 \right) \text{ As UInteger} \]

Usage

\[ \text{result } = \text{Fre} \left( [ \text{value} ] \right) \]

Parameters

\( \text{value} \)

Unused dummy parameter kept for backward compatibility; can be ignored.

Return Value

Returns the amount of free memory, in bytes.

Description

Returns the free memory (ram) available, in bytes.

Example

\[
\begin{align*}
\text{Dim } \text{mem As Integer } &= \text{Fre} \\
\text{Print } \"\text{Free memory:}\" \\
\text{Print } \\
\text{Print } \text{mem}; \" \text{ bytes}\" \\
\text{Print } \text{mem} \ \text{\(\backslash\) 1024}; \" \text{ kilobytes}\" \\
\text{Print } \text{mem} \ \text{\(\backslash\) (1024 \ast 1024)}; \" \text{ megabytes}\"
\end{align*}
\]

Differences from QB
The "value" argument is not checked, Fre will always return the free physical memory available

See also
- Dim
- ReDim
- Allocate
FreeFile

Returns a free file number

**Syntax**

```
Declare Function FreeFile ( ) As Long
```

**Usage**

```
result = FreeFile
```

**Return Value**

The next available file number, if any, otherwise zero (0).

**Description**

Returns the number of the next free file number with valid values 1 to 1024. This value is a required argument to `Open` a file. FreeFile is useful when the programmer can't keep track of the used file numbers. Make sure to always close files when no longer needed, otherwise you will not be able to open any files anymore after 255 filenumbers are exhausted with `FreeFile`. FreeFile will always return the smallest free file number. The file number returned by FreeFile can be opened, or until a smaller file number is closed. For this reason, it is wise to use `FreeFile` immediately before its corresponding `Open`, to ensure that the file number is not returned and opened elsewhere first.

**Example**

```
' Create a string and fill it.
Dim buffer As String, f As Integer
buffer = "Hello World within a file."

' Find the first free file number.
f = FreeFile

' Open the file "file.ext" for binary usage, using
Open "file.ext" For Binary As #f
```
' Place our string inside the file, using file number #f.
Put #f, , buffer

' Close the file.
Close #f

' End the program. (Check the file "file.ext" upon running to see the output.)
End

When using multiple FreeFile statements, FreeFile should be used immediately before the Dim.

Dim fr As Integer, fs As Integer
' The CORRECT way:
fr = FreeFile
Open "File1" For Input As #fr

fs = FreeFile
Open "File2" For Input As #fs

As opposed to:

Dim fr As Integer, fs As Integer
' The WRONG way:
fr = FreeFile
fs = FreeFile ' fs has taken the same file number
Open "file1" For Input As #fr
Open "file2" For Input As #fs ' error: file number

**Platform Differences**

- On Windows, a file number used in a dynamic link library is not the same as in the main program. File numbers cannot be passed or returned.
 executable.
- Besides FreeBASIC's limit of 255 files per program opened at the same time, there is an OS limit of opened files, but usually you won't touch it except in DOS, where the limit may be as low as 15 files total.

Differences from QB
- None

See also
- Open
- Put (File I/O)
- Get (File I/O)
Function

Defines a procedure returning a value

Syntax

```plaintext
[Public|Private] Function identifier [cdecl|pascal|stdcall] [Ove
[[[parameter_list]]] [As return_type] [Static] [Export]
statements
...
{ {Return [return_value]}|{Function = return_value}|{identifier
...}
End Function
```

Parameters

- `identifier`: the name of the function
- `external_identifier`: externally visible (to the linker) name enclosed i
- `parameter_list`: parameter[, parameter[, ...]]
- `parameter`: [ByRef|ByVal] identifier [As type] [= default_value]
- `identifier`: the name of the variable referenced in the function. If the followed by an empty parenthesis.
- `type`: the type of variable
- `default_value`: the value of the argument if none is specified in the ca
- `return_type`: the type of variable returned by the function
- `statements`: one or more statements that make up the function body
- `return_value`: the value returned from the function

Description

A function defines a block of code which can be executed with a single back to the caller when finished (a return value). There are several reasons:

- Reduces redundancy in your program
- Enables reuse of code in many programs
- Improves readability of the program
- Improves maintainability of the program
- Makes it easy to extend your program

Access Rights: The `Public` and `Private` keywords specify public or pr
respectively. If neither is given, the function defaults to public access (\texttt{public}).

\textit{Calling Convention} : Calling convention, or the order in which arguments function calls, is specified with the \texttt{cdecl}, \texttt{pascal} and \texttt{stdcall} keyword convention by default (\texttt{stdcall}).

\textit{Passing Arguments} : Functions may receive one or more variables, or listed as \texttt{parameters} in the \texttt{parameter_list}. The \texttt{ByRef} and \texttt{ByVal} keywords specify by reference or by value, respectively. The argument's type is given by \texttt{in} the declaration is given a default value, the parameter is optional. A \texttt{identifier} with an empty parenthesis. Note that array parameters are required nor allowed for array parameters. When calling a function with supplied there too; see the examples.

\textit{Overloaded Functions} : An overloaded function may share the same name \texttt{signature}. The \texttt{Overload} keyword specifies that a function may be overloaded using the \texttt{Overload} keyword prior to any functions that overload them.

\textit{Returning values} : \texttt{return_type} specifies the \texttt{data type} returned by a function then the function will return the default data type, which will be Integer, \texttt{DefDbl}, \texttt{DefStr}, etc. Functions can return values using three methods: function immediately, and returns that value to the caller. Functions can return keyword or the function's \texttt{identifier} to the desired return value. The \texttt{Return} keyword mixed with \texttt{Function=} keyword or function's \texttt{same function is unsupported when returning objects with constructors}}. evaluate to expressions. Thus, function calls can be made wherever \texttt{If} statements. Parentheses surrounding the argument list are required if there are no arguments. Functions can also return references.

\textit{Local Variable Preservation} : The \texttt{Static} keyword specifies that a function's local variables are preserved between function calls. Upon entering a function defined with \texttt{Static}, local variables have the same value as when the function was last called.

\textbf{Example}

```
'' This program demonstrates the declaration of a
'' and returning a value using Return command
```
Declare Function ReturnTen () As Integer
Print ReturnTen () '' ReturnTen returns an integer by default.
Function ReturnTen() As Integer
    Return 10
End Function

'' This program demonstrates the declaration of a function and returning a value using assignment to function name.
Declare Function ReturnTen () As Integer
Print ReturnTen () '' ReturnTen returns an integer by default.
Function ReturnTen() As Integer
    ReturnTen = 10
End Function

'' This program demonstrates function overloading.
'' The overloaded functions must be FIRST.
Declare Function ReturnTen Overload (a As Single) As Integer
Declare Function ReturnTen Overload (a As String) As Integer
Declare Function ReturnTen (a As Integer) As Integer

Print ReturnTen (10.000!) '' ReturnTen will take a single and return an integer
Print ReturnTen (10) '' ReturnTen will take an integer and return an integer
Print ReturnTen ("10") '' ReturnTen will take a string and return an integer
Function ReturnTen Overload (a As Single) As Integer
    Return Int(a)
End Function
Function ReturnTen Overload (a As String) As Integer
    Return Val(a)
End Function

Function ReturnTen (a As Integer) As Integer
    Return a
End Function

' The following example demonstrates optional parameters.
Function TestFunc(P As String = "Default") As String
    Return P
End Function

Print TestFunc("Testing:")
Print TestFunc

' This example shows how to declare and call functions taking array arguments.
Function x(b() As Double) As Integer
    x = UBound(b) - LBound(b) + 1
End Function

Dim a(1 To 10) As Double
Print x(a())
Dim c(10 To 20) As Double
Print x(c())

Dialect Differences
- In the -lang fb dialect, ByVal is the default parameter passing convention. String and user-defined Types are passed ByRef by default.
- In the -lang qb and -lang fblite dialects, ByRef is the default parameter passing convention.
- In the -lang qb dialect, the name of the function must be used in an assignment to specify the return value. Using Function = "..." to specify the return value may not be used.
- In the -lang qb and -lang fblite dialects, Return may only be used to return a value. In -lang qb, this must be done explicitly using the Option Nogosub statement.

**Differences from QB**

- Parameters can be optional in FreeBASIC.
- In QBASIC, the return type could only be specified with a suffix, not with a return a built-in type.
- Return value can now be specified by a Return statement.
- Function Overloading is supported in FreeBASIC.
- The return value of functions can be ignored in the calling code.

**See also**

- Sub
- Exit
- Return
- Declare
- Public
- Private
Function (Member)

Declares or defines a member procedure returning a value.

Syntax

```plaintext
{ Type | Class | Union } typename
Declare [ Static | Const ] Function fieldname [calling convention specifier] [ Alias external_name ] ( [ parameters ] ) As datatype [ Static ]
End { Type | Class | Union }

Function typename.fieldname ( [ parameters ] ) As datatype [ Export ]
statements
End Function
```

Parameters

- `typename` name of the Type, Class, or Union
- `fieldname` name of the procedure
- `external_name` name of field as seen when externally linked
- `parameters` the parameters to be passed to the procedure
- `calling convention specifier` can be one of: cdecl, stdcall or pascal

Description

Function members are accessed with Operator . (Member Access) or Operator -> (Pointer To Member Access) to call a member procedure that returns a value (a reference can also be returned by specifying ByVal As return_type). The procedure may optionally accept parameters either ByVal or ByRef. `typename` be overloaded without explicit use of the Overload keyword.

typename is the name of the type for which the Function method is declared and defined. Name resolution for typename follows the same
rules as procedures when used in a **Namespace**.

A hidden **This** parameter having the same type as `typename` is passed to non-static member procedures. **This** is used to access the fields of the **Type, Class, or Union**. To access duplicated symbols defined outside the Type, use: `.SomeSymbol` (or `.SomeSymbol` if inside a **With..End With** block).

A **Static (Member)** may be declared using the **Static** specifier. A **Const (Member)** may be declared using the **Const** specifier.

As for a normal **Function**, the return value of a **Function** member can be ignored in the calling code.

**Example**

```vb
#include "vbcompat.bi"

Type Date

    value As Double

Declare Static Function Today() As Date

Declare Function Year() As Integer
Declare Function Month() As Integer
Declare Function Day() As Integer

End Type

Function Date.Today() As Date
    Return Type(Now())
End Function

Function Date.Year() As Integer
    Return ..Year(value)
End Function
```
Function Date.Month() As Integer
   Return ..Month(value)
End Function

Function Date.Day() As Integer
   Return ..Day(value)
End Function

Dim d As Date = Date.Today
Print "Year = "; d.Year
Print "Month = "; d.Month
Print "Day = "; d.Day

Dialect Differences

- Only available in the -lang fb dialect.

See also

- Class
- Function
- Sub (Member)
- Type
Get (Graphics)

Gets a copy of a portion of the current work page or an image buffer

**Syntax**

```
Get [source,] [STEP]([x1, y1] - [STEP]([x2, y2]), dest
```

**Parameters**

- **source**
  the address of an image buffer.
- **STEP**
  indicates that the following co-ordinates are not absolute co-ordinates
  `[STEP]([x1, y1])`
  co-ordinates of the upper-left corner of the sub-image to copy. **STEP** indicates offsets are relative to the current graphics cursor position.
- **STEP ([x2, y2])**
  co-ordinates of the lower-right corner of the sub-image to copy. **STEP** indicates offsets are relative to `x1` and `y1`, respectively.
- **dest**
  the address of a previously allocated buffer to store the image data.

**Description**

Get copies a rectangular portion of the current work page specified by `(y1)` and `(x2, y2)`, which represent the upper-left and lower-right corners respectively. **STEP** specifies that the upper-left co-ordinates are relative to the graphics pen location, and/or that the lower-right co-ordinates are relative to the upper-left co-ordinates. The new image buffer is formatted to match the current screen format.

**dest** can be an address, an **array**, or a reference to the first element in a list to receive the new image buffer. This memory must be sufficiently allocated to store the new image buffer; the number of bytes required varies with the **-lang dialect** used to compile the program.

**source** can be an address, an **array**, or a reference to the first element in a list to retrieve a portion of. `x1, y1, x2, y2, step` and `dest` have the same meaning in this case.
The co-ordinates of the rectangle are affected by the most recent Win/Graphics) statements, and must both be within the current clipping re-/Graphics), otherwise an illegal function call runtime error will be trigg
will have no effect.

Runtime errors:
Get throws one of the following runtime errors:

(1) Illegal function call
- dest is an array, but is not big enough to hold the image
- The upper-left or lower-right co-ordinates of the rectang
current clipping region. See View (Graphics).

Dialect Differences
There are 2 types of buffers (details see GfxInternalFormats) dependi
used:

- In the -lang fb dialect, dest receives a new-style image buffer,
byte image header followed by pixel data which is row-padded
boundary (16 bytes). Use the following formula to calculate the
required to store the image buffer, where w and h are the respe
of the rectangular portion of the current work page or source in
the number of bytes per pixel of the current screen mode:
size = 32 + (((w * bpp + &hF;) and not &hF;) * h)

- In the -lang qb and -lang fblite dialects, dest receives a QB-st
which consists of a 4-byte image header followed by pixel data
padded. Use the following formula to calculate the total size, in
store the image buffer, where w and h are the respective width i
rectangular portion of the current work page or source image b
number of bytes per pixel of the current screen mode:
size = 4 + (w * h * bpp)

Example

```
#include once "fbgfx.bi"
```
'Setup a 400x300 32bit screen
ScreenRes 400, 300, 32

' First draw funny stuff...
Line (10,10)-(140,30), RGB(255,255,0), bf
Draw String (30, 20), "Hello there!", RGB(255,0,0)

' Now capture a 150x50 block from the top-left of the screen into an image
' buffer with GET...
Dim As fb.Image Ptr image = ImageCreate(150, 50)
Get (0,0)-(150-1,50-1), image

' And duplicate it all over the place!
Put (0,50), image
Put (0,100), image
Put (0,150), image
Put (0,200), image
Put (0,250), image
Put (150,0), image
Put (150,50), image
Put (150,100), image
Put (150,150), image
Put (150,200), image
Put (150,250), image

' And a frame around a whole screen..
Line (0,0)-(400-1,300-1), RGB(255,255,0), b

' Now get the whole screen...
Dim As fb.Image Ptr big = ImageCreate(400, 300)
Get (0,0)-(400-1,300-1), big

' And display that "screenshot" as if it was scrolling
Dim As Integer x = -350
While ((Inkey() = "") And (x < 350))
    ScreenLock
    Cls
Put ($x,0$), big
ScreenUnlock

Sleep 100, 1

$x += 10$
Wend

See also

- Put (Graphics)
- Get (File I/O)
- Screen (Graphics)
- Window
- View (Graphics)
- Internal graphics formats
Get (File I/O)

Reads data from a file to a buffer

**Syntax**

```basicscript
Get #filenum As Long, [position As LongInt], ByRef data As Any [,
Get #filenum As Long, [position As LongInt], data As String [, ,
Get #filenum As Long, [position As LongInt], data() As Any [, ,
```

**Usage**

```basicscript
Get #filenum, position, data [, [amount] [, bytesread ] ]
varres = Get (#filenum, position, data [, [amount] [, bytesread
```

**Parameters**

- **filenum**
  The value passed to Open when the file was opened.
- **position**
  The position where the read must start. If the file was opened For Ran reading starts at the present file pointer position. The position is 1-based. If position is omitted or zero (0), file reading will start from the current position.
- **data**
  The buffer where data is written. It can be a numeric variable, a string operation will try to fill completely the variable, unless the EOF is reached. When getting arrays, data should be followed by an empty pair of brackets: `[]` is not allowed.
  When getting Strings, the number of bytes read is the same as the number of bytes in the string.
  Note: If you want to read values into a buffer, you should NOT pass a pointer to the buffer. (This can be done by dereferencing the pointer with Operator `*`, overwrite the pointer variable, not the memory it points to.
- **amount**
  Makes Get read amount consecutive variables from file to memory, i.e. memory starting at data's memory location. If amount is omitted it defaults to position.
- **bytesread**
  An unsigned integer variable to accept the result of the number of bytes

**Return Value**

Zero (0) on success; non-zero on error. Note: if EOF (end of file) is reached.
actually read can be checked by passing a $bytesread$ variable.

**Description**

Reads binary data from a file to a buffer variable

The `Get` can be used as a function, and will return 0 on success or an error code on failure.

For files opened in Random mode, the size in bytes of the data to read must match the specified record size.

**Example**

```
Dim Shared f As Integer

Sub get_integer()
    Dim buffer As Integer ' Integer variable
    ' Read an Integer (4 bytes) from the file into
    Get #f, , buffer
    ' print out result
    Print buffer
    Print
End Sub

Sub get_array()
    Dim an_array(0 To 10-1) As Integer ' array of
    ' Read 10 Integers (10 * 4 = 40 bytes) from the
    Get #f, , an_array()
    ' print out result
    For i As Integer = 0 To 10-1
        Print an_array(i)
    Next
```
Sub get_mem

    Dim pmem As Integer Ptr

    ' allocate memory for 5 Integers
    pmem = Allocate(5 * SizeOf(Integer))

    ' Read 5 integers (5 * 4 = 20 bytes) from the file
    Get #f, , *pmem, 5 ' Note pmem must be dereferenced

    ' print out result using [] Pointer Indexing
    For i As Integer = 0 To 5-1
        Print pmem[i]
    Next
    Print

    ' free pointer memory to prevent memory leak
    Deallocate pmem

End Sub

' Find the first free file file number.
f = FreeFile

' Open the file "file.ext" for binary usage, using
Open "file.ext" For Binary As #f

    get_integer()

    get_array()

    get_mem()

' Close the file.
Close #f
' Load a small text file to a string

Function LoadFile(ByRef filename As String) As String

    Dim h As Integer
    Dim txt As String

    h = FreeFile

    If Open( filename For Binary Access Read As #h) Then

        If LOF(h) > 0 Then

            txt = String(LOF(h), 0)
            If Get( #h, ,txt ) <> 0 Then txt = ""

        End If

        Close #h

    Return txt

End Function

Dim ExampleStr As String
ExampleStr = LoadFile("smallfile.txt")
Print ExampleStr

Differences from QB

- Get in FB can read full arrays as in VB or, alternatively, read a multiple of the data size into the memory.
- Get can be used as a function in FB, to find the success/error code returned without having to use error handling procedures.
- FB allows the bytesread parameter, to check how many bytes have been successfully read in.
See also

- Get (Graphics) different usage of same keyword
- Put (File I/O)
- Open
- Close
- Binary
- Random
- FreeFile
- File I/O methods comparison
GetJoystick

Reads buttons and axis information from attached gaming devices

**Syntax**

```vba
Declare Function GetJoystick ( ByVal id As Long, ByRef buttons As Integer = 0, ByRef a2 As Single = 0, ByRef a3 As Single = 0, ByRef a4 As Single = 0, ByRef a6 As Single = 0, ByRef a7 As Single = 0, ByRef a8 As Single )
```

**Usage**

```vba
result = GetJoystick( id[, buttons[, a1[, a2[, a3[, a4[, a5[, a6]]]]]]])
```

**Parameters**

- `id`  
  the device id number (0 - 15)

- `buttons`  
  the button status

- `a1`  
  first axis value

- `a2`  
  second axis value

- `a3`  
  third axis value

- `a4`  
  fourth axis value

- `a5`  
  fifth axis value

- `a6`  
  sixth axis value

- `a7`  
  seventh axis value

- `a8`  
  eighth axis value

**Return Value**

0 on success or 1 on failure. All of the axis positions are returned in floating point format.

**Description**
GetJoystick will retrieves the button state, and the axis positions for u by id, a number between 0 and 15. Buttons are stored in a similar man

A single precision value between \(-1.0\) and \(1.0\) is returned for each valid controller, a value of \(-1000.0\) is returned.

GetJoystick will return 0 upon successful completion; It will return 1 upon specifying an illegal joystick number, specifying a joystick which doesn't exist or joystick error.

**Example**

```
Screen 12

Dim x As Single
Dim y As Single
Dim buttons As Integer
Dim result As Integer
Dim a As Integer

Const JoystickID = 0

' This line checks to see if the joystick is ok.
If GetJoystick(JoystickID, buttons, x, y) Then
    Print "Joystick doesn't exist or joystick error"
    Print "Press any key to continue."
    Sleep
End If

Do
    result = GetJoystick(JoystickID, buttons, x, y)
    Locate 1,1
```


Print ;"result:";result;" x:" ;x;" y:";y;" Button

'This tests to see which buttons from 1 to 27
For a = 0 To 26
    If (buttons And (1 Shl a)) Then
        Print "Button ";a;" pressed."
    Else
        Print "Button ";a;" not pressed."
    End If
Next a
Loop

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the

Differences from QB
- New to FreeBASIC

See also
- Screen (Graphics)
- SetMouse
- GetMouse
- MultiKey
GetKey

Returns the ascii code of the first key in the keyboard buffer

**Syntax**

Declare Function GetKey ( ) As Long

**Usage**

result = GetKey

**Return Value**

The value of the ascii code returned.

**Description**

It returns the ascii code of the first key in the keyboard buffer. The key removed from the buffer. If no key is present, `GetKey` waits for it. For extended keys (returning two characters), the extended code is returned in the first byte, and the regular code is returned in the second byte. (see example below)

The key read is not echoed to the screen.

For a keyword not stopping the program if no key is at the buffer see `Inkey` or `MultiKey`.

**Example**

```
Dim As Integer foo
Do
    foo = GetKey
    Print "total return: " & foo
    If (foo > 255) Then
        Print "extended code: " & (foo And &hff)
        Print "regular code: " & (foo Shr 8)
```

Else
    Print "regular code: " & (foo)
End If
Print
Loop Until foo = 27

Dialect Differences
   • Not available in the `-lang qb` dialect unless referenced with the alias `__Getkey`.

Differences from QB
   • New to FreeBASIC

See also
   • `GetMouse`
   • `Inkey`
   • `Input()`
   • `MultiKey`
GetMouse

Retrieves the status of the mouse pointing device

Syntax

Declare Function GetMouse ( ByRef x As Integer, ByRef y As Integer, ByRef clip As Integer = 0 ) As Long

Usage

result = GetMouse (x, y [, [ wheel ] [, [ buttons ] [, [ clip ] ]])

Parameters

\( x\)
x coordinate value

\( y\)
y coordinate value

\( \text{wheel}\)
scroll wheel value

\( \text{buttons}\)
button status

\( \text{clip}\)
clip status

Return Value

\( 0\) on success, or \( 1\) on error (for example because the mouse is outside)

Description

GetMouse retrieves the mouse position and buttons status; information not available, all variables will contain the \(-1\) value.

If in console mode, the \( x\) and \( y\) coordinates are the character cell coordinates \( 0, 0\). If the mouse moves out of the console window, GetMouse console mode and fullscreen, the scroll wheel value is not returned.

If in graphics mode, \( x\) and \( y\) will always be returned in pixel coordinates case; custom coordinates system set via \texttt{View} or \texttt{Window} do not affect t
If the mouse runs off the graphic window, all values are set to -1 and the return value of the function is set to -1 for the buttons and wheel if the return value of the function is not also tested.

**Wheel** is the mouse wheel counter; rotating the wheel away from you reduces the count, rotating the wheel toward you makes it to increase. At program startup or when a new graphics mode is set via mouse wheels for a given platform, in which case 0 is always returned.

**Buttons** stores the buttons status as a bitmask: bit 0 is set if left mouse button is down; bit 1 is set if right mouse button is down; bit 2 is set if middle mouse button / wheel is down.

**Clip** stores the mouse clipping status; if 1, the mouse is currently clipped to the graphics window.

### Example

```plaintext
Dim As Integer x, y, buttons, res
' Set video mode and enter loop
ScreenRes 640, 480, 8
Do
  ' Get mouse x, y and buttons. Discard wheel position.
  res = GetMouse (x, y, , buttons)
  Locate 1, 1
  If res <> 0 Then ' ' Failure

#ifdef __FB_DOS__
  Print "Mouse or mouse driver not available"
#else
  Print "Mouse not available or not on window"
#endif

Else
  Print Using "Mouse position: ###:###  Buttons: L R M"
  If buttons And 1 Then Print "L"
  If buttons And 2 Then Print "R"
  If buttons And 4 Then Print "M"
  Print " "
End If
Loop While Inkey = ""
End
```
'Example 2: type-union-type structure

Type mouse
  As Integer res
As Integer x, y, wheel, clip
Union
  buttons As Integer
  Type
    Left: 1 As Integer
    Right: 1 As Integer
    middle: 1 As Integer
  End Type
End Union
End Type

Screen 11
Dim As mouse m

Do
  m.res = GetMouse( m.x, m.y, m.wheel, m.buttons
  ScreenLock
  Cls
  Print Using "res = "; m.res
  Print Using "x = ###; y = ###; wheel = +###; ";
  Print Using "buttons = ##; left = #; middle = ";
  ScreenUnlock
  Sleep 10, 1
Loop While Inkey = ""

**Dialect Differences**

- Not available in the *lang qb* dialect unless referenced with the Integer.

**Platform Differences**
- On Win32, scroll wheel changes are not guaranteed to be detected in full-screen console mode.
- In DOS, the "clip" value has no relevance. Additionally the wheel mouse driver. See also FaqDOS.

**Differences from QB**

- New to FreeBASIC

**See also**

- [ScreenRes](#) setting graph mode by resolution
- [Screen (Graphics)](#) setting mode the QB-like way
- [SetMouse](#)
- [MultiKey](#)
- [GetJoystick](#)
GoSub

Control flow statement to use a section of code and return.

Syntax

GoSub  label

Description

Execution jumps to a subroutine marked by a line label. Always use Return to exit a GoSub, execution will continue on next statement after GoSub.

The line label where GoSub jumps must be in the same main/function/sub block as GoSub. All the variables in the subroutine are shared with the block, no arguments can be used. For this reason Gosub is considered bad programming practice as it can generate unreadable and untraceable code. It is better to use Sub or Function instead.

Example

```
' Compile with -lang qb

'$lang: "qb"

GoSub  message
End

message:
Print "Welcome!"
Return
```

Dialect Differences

- Only available in the -lang qb and -lang fblite dialects.
- **GoSub** support is disabled by default in the `-lang fblite` unless the **Option Gosub** statement is used.

**Differences from QB**

- None when using the `-lang qb` dialect.

**See also**

- **Goto**
- **Return**
- **Sub**
- **Function**
- **Option Gosub**
Goto

Control flow statement to jump to another part of the program

**Syntax**

```
Goto label
```

**Description**

Jumps code execution to a line label.

For better source code readability, overuse of `Goto` should be avoided in favor of more modern structures such as `Do...Loop`, `For...Next`, `Sub` and `Function`.

**Example**

```
Goto there

backagain:
   End

there:
   Print "Welcome!"
   Goto backagain
```

'' Compile with -lang qb or fblite

'$lang: "qb"

1 Goto 3
2 End
3 Print "Welcome!"
4 Goto 2
Dialect Differences

- Line numbers are allowed only in the `-lang qb` and `-lang deprecated` dialects.

Differences from QB

- None

See also

- GoSub
- Sub
- Function
Hex

Returns the hexadecimal of the given number

Syntax

Declare Function Hex ( ByVal number As UByte ) As String
Declare Function Hex ( ByVal number As UShort ) As String
Declare Function Hex ( ByVal number As ULong ) As String
Declare Function Hex ( ByVal number As ULongInt ) As String
Declare Function Hex ( ByVal number As Const Any Ptr ) As String
Declare Function Hex ( ByVal number As UByte, ByVal digits As Long ) As String
Declare Function Hex ( ByVal number As UShort, ByVal digits As Long ) As String
Declare Function Hex ( ByVal number As ULong, ByVal digits As Long ) As String
Declare Function Hex ( ByVal number As ULongInt, ByVal digits As Long ) As String
Declare Function Hex ( ByVal number As Const Any Ptr, ByVal digits As Long ) As String

Usage

result = Hex[$]( number [, digits ] )

Parameters

number
A number or expression evaluating to a number. A floating-point number will be converted to a LongInt.
digits
Optional number of digits to return.

Return Value

A String containing the unsigned hexadecimal representation of number.

Description

Returns the unsigned hexadecimal string representation of the integer.
Hexadecimal digits range from 0-9, or A-F.

If you specify digits > 0, the result string will be exactly that length. It will be truncated or padded with zeros on the left, if necessary.

The length of the string will not go longer than the maximum number of digits required for the type of number (8 for a Long, 16 for a LongInt).

If you want to do the opposite, i.e. convert a hexadecimal string back into a number, the easiest way to do it is to prepend the string with "&H;", and convert it to an integer type, using a function like CInt, similarly to a normal numeric string. E.g. CInt("&HFF;")

**Example**

```
'54321 is D431 in hex
Print Hex(54321)
Print Hex(54321, 2)
Print Hex(54321, 5)
```

will produce the output:

```
D431
31
0D431
```

**Dialect Differences**

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

**Differences from QB**

- In QBASIC, there was no way to specify the number of digits
returned.

- The size of the string returned was limited to 32 bits, or 8 hexadecimal digits.

**See also**

- Bin
- Oct
- ValInt
- ValLng
HiByte

Gets the second byte of the operand.

**Syntax**

```c
#define HiByte(expr) ((Cast(UInteger, expr) And &h0000FF00;) Shr 8)
```

**Usage**

```c
result = HiByte(expr)
```

**Parameters**

`expr`

A numeric expression, converted to an `UInteger` value.

**Return Value**

Returns the value of the high byte of the low 16bit word of `expr`.

**Description**

This macro converts the numeric expression `expr` to an `UInteger` value representing the value of its second byte - that is the most-significant significant (low) 16bit word of `expr`.

**Example**

```vbnet
Dim N As UInteger

'Note there are 16 bits
N = &b1010101110000001
Print "N is"
Print "The binary representation of N is"
Print "The most significant byte (MSB) of N is"
Print "The least significant byte (LSB) of N is"
Print "The binary representation of the MSB is"
Print "The binary representation of the LSB is"
```
The output would look like:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Is</td>
<td>43905</td>
</tr>
<tr>
<td>The Binary representation of N Is</td>
<td>1010101110000001</td>
</tr>
<tr>
<td>The most significant Byte (MSB) of N Is</td>
<td>171</td>
</tr>
<tr>
<td>The least significant Byte (LSB) of N Is</td>
<td>129</td>
</tr>
<tr>
<td>The Binary representation of the MSB Is</td>
<td>10101011</td>
</tr>
<tr>
<td>The Binary representation of the LSB Is</td>
<td>10000001</td>
</tr>
</tbody>
</table>

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- LoByte
- LoWord
- HiWord
HiWord

Gets the second 16bit word of the operand.

Syntax

```c
#define HiWord( expr ) ((Cast(UInteger, expr) and &hFFFF0000;) Shr 16)
```

Usage

```c
result = HiWord( expr )
```

Parameters

`expr`  
A numeric expression, converted to an `UInteger` value.

Return Value

Returns the value of the high 16bit word of the low 32bit dword of `expr`.

Description

This macro converts the numeric expression `expr` to an `UInteger` value representing the value of its second 16bit word - that is the most-significant (high) 16bit word of the least-significant (low) 32bit dword of `expr`.

Example

```vbs
Dim N As UInteger

'Note there are 32 bits
N = &b100000000000000001111111111111111

Print "N is"
Print "The binary representation of N is"
Print "The most significant word (MSW) of N is"
Print "The least significant word (LSW) of N is"
Print "The binary representation of the MSW is"
```
Print "The binary representation of the LSW is

Sleep

The output would look like:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Is</td>
<td>2147614719</td>
</tr>
<tr>
<td>The Binary representation of N Is</td>
<td>100000000000000011111111</td>
</tr>
<tr>
<td>The most significant word (MSW) of N Is</td>
<td>32769</td>
</tr>
<tr>
<td>The least significant word (LSW) of N Is</td>
<td>65535</td>
</tr>
<tr>
<td>The Binary representation of the MSW Is</td>
<td>10000000000000000001</td>
</tr>
<tr>
<td>The Binary representation of the LSW Is</td>
<td>1111111111111111111</td>
</tr>
</tbody>
</table>

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- LoByte
- HiByte
- LoWord
**Hour**

Gets the hour of day from a **Date Serial**

**Syntax**

```
Declare Function Hour ( ByVal date_serial As Double ) As Long
```

**Usage**

```
#include "vbcompat.bi"
result = Hour( dateserial )
```

**Parameters**

- **date_serial**
  the date serial

**Return Value**

Returns the hour from a variable containing a date in **Date Serial** form.

**Description**

The compiler will not recognize this function unless **vbcompat.bi** is included.

**Example**

```
#include "vbcompat.bi"
Dim ds As Double = DateSerial(2005, 11, 28) + TimeSerial
Print Format(ds, "yyyy/mm/dd hh:mm:ss "); Hour(ds)
```

**Differences from QB**

- Did not exist in QB. This function appeared in PDS and VBDO!
See also

- Date Serials
If...Then

Control flow statement for conditional branching

Syntax

If expression Then [statement(s)] [Else [statement(s)]] [End If]
or
If expression Then : [statement(s)] [Else [statement(s)]] : End
or
If expression Then
[statement(s)]
[ ElseIf expression Then ]
[statement(s)]
[ Else ]
[statement(s)]
End If

Description

If...Then is a way to make decisions. It is a mechanism to execute code only if a condition is true, and can provide alternative code to execute based on more conditions.

expression can be one of several forms:

- a conditional expression, for example:
  
x = 5

- multiple conditions separated by logical bit-wise operators:
  
x >= 5 And x <= 10

- multiple conditions separated by logical short-circuit operators:
  
y <> 0 AndAlso x \ y = 1
  (in this case, "x \ y = 1" will only be evaluated if "y <> 0" is True)

- any numerical expression, in which case a value of zero value represents True

Both multi-line and single-line Ifs can be nested. In the latter case, the control where nested Ifs begin and end.

In the -lang fb and -lang fblite dialects, colons (:) can be used instead of newlines to construct multi-line blocks on a single line.
Example

' Here is a simple "guess the number" game using if...then for a decision.
Dim As Integer num, guess
Randomize
num = Int(Rnd * 10) + 1 'Create a random number between 1 and 10...
Print "guess the number between 1 and 10"
Do 'Start a loop
  Input "Guess"; guess 'Input a number from the user
  If guess > 10 OrElse guess < 1 Then 'The user's guess is out of range
    Print "The number can't be greater then 10 or less than 1!"
  ElseIf guess > num Then 'The user's guess is too high
    Print "Too high"
  ElseIf guess < num Then 'The user's guess is too low
    Print "Too low"
  ElseIf guess = num Then 'The user guessed the right number!
    Print "Correct!"
    Exit Do 'Exit the loop
  End If
Loop 'Go back to the start of the loop

Dialect Differences
- In the -lang qb and -lang fblite dialects, variables declared inside wide scope as in QB
- In the -lang fb and -lang deprecated dialects, variables declared only inside the block, and cannot be accessed outside it.
- In the -lang qb dialect, if there is a new line or a single-line comment (will be multi-line. A colon, a Rem or any other statement will result
In the -lang fb and -lang fblite dialects, if there is a new line, a Rem statement directly after THEN, then the IF will be multi-line.

Differences from QB

- END IF was not supported in single-line IFs in QBASIC.

See also

- Do...Loop
- #if
- Select Case
Conditional function that returns one of two values.

**Syntax**
```
IIf( condition, expr_if_true, expr_if_false )
```

**Parameters**
- `condition`:
  The condition to test.
  A non-zero value evaluates as true, while a value of zero evaluates as false.

- `expr_if_true`:
  An expression to evaluate and return if `condition` is true.
  It must return:
  - a numeric value, which can be an integer, floating point, or a string value,
  - or an UDT value.

- `expr_if_false`:
  An expression to evaluate and return if `condition` is false.
  It must be the same type as `expr_if_true` (either numeric, either string or UDT value).

**Description**
`IIf` returns a different numeric or string or UDT value depending on the conditional expression. Its typical use is in the middle of an expression to put a conditional in the middle.

`IIf` only evaluates the expression that it needs to return. This saves time and can be useful to prevent evaluating expressions that might be invalid depending on `condition`.

**Warning:** The ability to accept mixed numeric types, strings and UDTs is only supported from the fbc version 0.90.

**Example**
```
Dim As Integer a, b, x, y, z
a = (x + y + IIf(b > 0, 4, 7)) \ z

is equivalent to:

Dim As Integer a, b, x, y, z, temp
If b > 0 Then temp = 4 Else temp = 7
a = (x + y + temp) \ z

Dim As Integer I
I = -10
Print I, IIf(I>0, "positive", IIf(I=0, "null", "negative")
I = 0
Print I, IIf(I>0, "positive", IIf(I=0, "null", "negative")
I = 10
Print I, IIf(I>0, "positive", IIf(I=0, "null", "negative")
Sleep

Type UDT1
  Dim As Integer I1
End Type

Type UDT2 Extends UDT1
  Dim As Integer I2
End Type

Dim As UDT1 u1, u10 = (1)
Dim As UDT2 u2, u20 = (2, 3)

u1 = IIf(0, u10, u20)
Print u1.I1
u1 = IIf(1, u10, u20)
Print u1.I1

u2 = IIf(0, u10, u20)
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- `If...Then`
**ImageConvertRow**

Converts a row of image data into another color depth

**Syntax**

```vbnet
Declare Sub ImageConvertRow ( ByVal src As Any Ptr, ByVal srcbpp As Long, ByVal dstbpp As Long, ByVal width As Long, ByVal isrgb As Long )
```

**Usage**

```vbnet
ImageConvertRow( src, srcbpp, dst, dstbpp, width [, isrgb ] )
```

**Parameters**

- **src**
  The address of the start of the source row. The source can either be a 32 bits per pixel, or a paletted image with a bit depth of 1-8 bits per pixel: only work properly if you are in a screen mode that is using the correct conversion.

- **srcbpp**
  The number of bits per pixel in the source row. 1-8, 24 and 32.

- **dst**
  The address of the start of the destination row. The image can be a full color if the source is a paletted image, the destination can also be a palette.

- **dstbpp**
  The number of bits per pixel in the destination row. Valid values for this are 1-8, 16 and 32.

- **width**
  The length of the row in pixels.

- **isrgb**
  A value of zero indicates that the Red and Blue channels are the other way round in the source image.
  This switch if you want the Red and Blue channels to be swapped in the conversion.

**Description**

Copies the row of an image from one memory location to another, converting the color information in each pixel to match the destination image.

**Example**

```c
#include "fbgfx.bi"
```
Const As Integer w = 64, h = 64
Dim As IMAGE Ptr img8, img32
Dim As Integer x, y

'' create a 32-bit image, size w*h:
ScreenRes 1, 1, 32, , GFX_NULL
img32 = ImageCreate(w, h)

If img32 = 0 Then Print "Imagecreate failed on img32!"

'' create an 8-bit image, size w*h:
ScreenRes 1, 1, 8, , GFX_NULL
img8 = ImageCreate(w, h)

If img8 = 0 Then Print "Imagecreate failed on img8!"

'' fill 8-bit image with a pattern
For y = 0 To h - 1
   For x = 0 To w - 1
      PSet img8, (x, y), 56 + (x + y) Mod 24
   Next x
Next y

'' open a graphics window in 8-bit mode, and PUT the image into it:
ScreenRes 320, 200, 8
WindowTitle "8-bit color mode"
Put (10, 10), img8

Sleep
' copy the image data into a 32-bit image

Dim As Byte Ptr p8, p32
Dim As Integer pitch8, pitch32

#ifndef ImageInfo '' older versions of FB don't have
#define GETPITCH(img_) IIf(img_->Type=PUT_HEADER_NEW,img_->old.width*img_->old.bpp)
#define GETP(img_) CPtr(Byte Ptr,img_)+IIf(img_->Type=PUT_HEADER_NEW,SizeOf(PUT_HEADER),SizeOf(_OLD_HEADER))
pitch8 = GETPITCH(img8): p8 = GETP(img8)
pitch32 = GETPITCH(img32): p32 = GETP(img32)
#else
ImageInfo( img8, , , , pitch8, p8 )
ImageInfo( img32, , , , pitch32, p32 )
#endif

For y = 0 To h - 1
    ImageConvertRow(@p8 [ y * pitch8 ], 8, _
                    @p32[ y * pitch32], 32, _
                    w)
Next y

' open a graphics window in 32-bit mode and PUT the image into it:
ScreenRes 320, 200, 32
WindowTitle "32-bit color mode"
Put (10, 10), img32

Sleep

' free the images from memory:
ImageDestroy img8
ImageDestroy img32

Dialect Differences
- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- ScreenRes
- Get (Graphics)
- Put (Graphics)
- ImageCreate
- ImageDestroy
- ImageInfo
ImageCreate

Allocates and initializes storage for an image

Syntax

Declare Function ImageCreate ( ByVal width As Long, ByVal height Ulong = transparent_color ) As Any Ptr
Declare Function ImageCreate ( ByVal width As Long, ByVal height Ulong = transparent_color, ByVal depth As Long ) As Any Ptr

Usage

result = ImageCreate( width, height [, [ color ][, depth ]] )

Parameters

width
The desired width, in number of pixels.
height
The desired height, in number of pixels.
color
The pixel value to fill the area of the image.
depth
The desired color depth, in bits per pixel.

Return Value

If the image could not be created, NULL (0) is returned, otherwise, the returned. ImageCreate must be called after graphic mode initialization,

Consequently, in case of Shared variable declaration, ImageCreate can initializer, even inside an udt (in member field or constructor), because shared variable) is set at the start of the program before any user code allocation call must be in a separated executable instruction, and after initialization.

Description

Both procedures attempt to allocate memory for an image of the spec successful, NULL (0) is returned. Otherwise, an image of that size is c
filling the entire area of pixels with the value color. If not specified, color is the transparent color for the current graphics screen, which can be found by calling ScreenControl. In any case, the address of the image is returned, which is then controlled by the user, and must be destroyed using ImageDestroy.

The first procedure creates an image with a color depth matching that of the current screen, which can be found by calling ScreenControl. The second procedure creates an image with a color depth of depth, in bits per pixel. For both procedures, the resulting image can be used in drawing procedures while in any screen mode -- and across mode changes -- as long as the color depth of the image matches that of the graphics screen.

ImageCreate is the recommended way to allocate memory for new images of any size, structure, etc. -- while documented, may change from version to version -- calculation of the sizes involved is error-prone. However, ImageInfo can be used to retrieve, among other things, the size, in bytes, of an existing image, allowing memory to be manually allocated for a copy of an image, or to be read from or written to a file or device.

Get (Graphics) can be used to initialize an image using pre-allocated memory.

Example

```vbnet
' ' Create a graphics screen.
ScreenRes 320, 200, 32

' ' Create a 64x64 pixel image with a darkish green background.
Dim image As Any Ptr = ImageCreate(64, 64, RGB(0, 192, 0))

If image = 0 Then
    Print "Failed to create image."
    Sleep
End If

' ' Draw a semi-transparent, red circle in the center.
Circle image, (32, 32), 28, RGBA(255, 0, 0, 128)

' ' Draw the image onto the screen using various blitting methods.
Put (120, 60), image, PSet
```
Put (140, 80), image, Alpha

'' Destroy the image.
ImageDestroy image

Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- ImageDestroy
- ImageInfo
- Get (Graphics)
- Internal pixel formats
ImageDestroy

Destroys and deallocates storage for an image

Syntax

Declare Sub ImageDestroy ( ByVal image As Any Ptr )

Usage

ImageDestroy( image )

Parameters

image

The address of the image to destroy.

Description

Destroys the image pointed to by image, which must be an address returned from a call to ImageCreate.

Calling ImageDestroy on a null pointer induces no action.

Example

See ImageCreate for an example on using ImageDestroy.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Imagedestroy.

Differences from QB

- New to FreeBASIC

See also

- ImageCreate
ImageInfo

Retrieves information about an image

Syntax

Declare Function ImageInfo ( ByVal image As Any Ptr, ByRef width As Integer = 0, ByRef pitch As Integer = 0, ByRef pixdata As Any

Usage

result = ImageInfo( image [, [width] [, [height] [, [bypp] [, [p

Parameters

image
The address of the image.

width
Stores the width of the image, in pixels.

height
Stores the height of the image, in pixels.

bypp
Stores the bytes per pixel of the image - i.e. the size of a single pixel,

pitch
Stores the pitch of the image - i.e. the size of each scanline (row), in b
because the scanlines may be padded to allow them to be aligned be

pixdata
Stores the address of the start of the first scanline of the image.

size
Stores the size of the image in memory, in bytes.

Return Value

If image doesn't point to a valid image, one (1) is returned. Otherwise,
appropriate values, and zero (0) is returned.

Description

ImageInfo provides various information about an image, such as its di
It can also provide the size of the image in memory, which is useful for image to a file.

Example

```
'' pixelptr(): use imageinfo() to find the pointer
'' returns null on error or x,y out of bounds
Function pixelptr(ByVal img As Any Ptr, ByVal x As Integer, ByVal y As Integer, ByVal w As Integer, ByVal h As Integer, ByVal bpp As Integer, ByVal pitch As Any Ptr, ByVal pixdata As Any Ptr, ByVal success As Integer) As Integer

    Dim As Integer w, h, bpp, pitch
    Dim As Any Ptr pixdata
    Dim As Integer success

    success = (ImageInfo(img, w, h, bpp, pitch, pixdata)

    If success Then
        If x < 0 Or x >= w Then Return 0
        If y < 0 Or y >= h Then Return 0
        Return pixdata + y * pitch + x * bpp
    Else
        Return 0
    End If

End Function

'' usage example:

'' 320*200 graphics screen, 8 bits per pixel
ScreenRes 320, 200, 8

Dim As Any Ptr ip '' image pointer
Dim As Byte Ptr pp '' pixel pointer (use byte for
ip = ImageCreate(32, 32) '' create an image (32*32
If ip <> 0 Then
```
' draw a pattern on the image
For y As Integer = 0 To 31
    For x As Integer = y - 5 To y + 5 Step 5
        ' find the pointer to pixel at x,y position
        ' note: this is inefficient to do for every pixel!
p = pixelptr(ip, x, y)
        If (pp <> 0) Then *pp = 15
    Next x
Next y

' put the image and draw a border around it
Put (10, 10), ip, PSet
Line (9, 9)-Step(33, 33), 4, b

' destroy the image to reclaim memory
ImageDestroy ip

Else
    Print "Error creating image!"
End If

Sleep

' Create 32-bit graphics screen and image.
ScreenRes 320, 200, 32
Dim image As Any Ptr = ImageCreate(64, 64)

Dim pitch As Integer
Dim pixels As Any Ptr
Get enough information to iterate through the pixel data.
If 0 <> ImageInfo( image, ,,, pitch, pixels ) Then
    Print "unable to retrieve image information."
    Sleep
End
End If

Draw a pattern on the image by directly manipulating pixel memory.
For y As Integer = 0 To 63
    Dim row As ulong Ptr = pixels + y * pitch

    For x As Integer = 0 To 63
        row[x] = RGB( x * 4, y * 4, (x Xor y) * 4)
    Next x
Next y

Draw the image onto the screen.
Put (10, 10), image

ImageDestroy( image )
Sleep

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the

Differences from QB
- New to FreeBASIC
See also

- ImageCreate
- ImageDestroy
- ImageConvertRow
- Get (Graphics)
- Put (Graphics)
- Internal pixel formats
Operator Imp (Implication)

Returns the bitwise-and (implication) of two numeric values

Syntax

Declare Operator Imp ( ByRef lhs As T1, ByRef rhs As T2 ) As Ret

Usage

result = lhs Imp rhs

Parameters

lhs
The left-hand side expression.
T1
Any numeric or boolean type.

rhs
The right-hand side expression.
T2
Any numeric or boolean type.
Ret
A numeric or boolean type (varies with T1 and T2).

Return Value

Returns the bitwise-implication of the two operands.

Description

This operator returns the bitwise-implication of its operands, a logical operation that results in a value with bits set depending on the bits of the operands (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value).

The truth table below demonstrates all combinations of a boolean-implication operation:

<table>
<thead>
<tr>
<th>Lhs Bit</th>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
No short-circuiting is performed - both expressions are always evaluated.

The return type depends on the types of values passed. **Byte, UByte** and floating-point type values are first converted to **Integer**. If the left and right-hand side types differ only in signedness, then the return type is the same as the left-hand side type ($T_1$), otherwise, the larger of the two types is returned. Only if the left and right-hand side types are both **Boolean**, the return type is also **Boolean**.

This operator can be overloaded for user-defined types.

**Example**

```plaintext
Dim As UByte a, b, c
a = &b00001111
b = &b01010101
c = a Imp b '' c = &b11101011
```

**Dialect Differences**

- In the **-lang qb** dialect, this operator cannot be overloaded.

**Differences from QB**

- None

**See also**
- Operator Truth Tables
Implements

Specifies an interface to be implemented by a user-defined type
Note: Stub page. Even though this keyword is reserved already, interfaces are not implemented yet.

**Syntax**

```
Type typename Implements interface
...
End Type
```

**Description**

**Example**

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Implements`.

**Differences from QB**

- New to FreeBASIC

**See also**

- Type
- Extends
External linkage attribute for public data located in DLL's

**Syntax**

```plaintext
Extern Import symbolname[( subscripts)] [ Alias "aliasname"] [ A [, ..., ]]
```

**Description**

Is used only on Win32 platforms with the `Extern` keyword and is needed for global variables in DLLs. This is due to the level of indirection on any such access: an implicit pointer dereference.

**Example**

```plaintext
/* mydll.c : 
   compile With 
       gcc -Shared -Wl,-strip-all -o mydll.dll mydll.c */
__declspec( dllexport ) Int MyDll_Data = 0x1234;

/* import.bas : 
   Compile with 
       fbc import.bas */
#inclib "mydll"

Extern Import MyDll_Data Alias "MyDll_Data" As Int
Print "&h" + Hex( MyDll_Data )

' Output:
' &h1234
```
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __Import.

Differences from QB

- New to FreeBASIC

See also

- Extern
Inkey

Returns a string representing the first key waiting in the keyboard buffer

**Syntax**

```
Declare Function Inkey ( ) As String
```

**Usage**

```
result = Inkey[$]
```

**Return Value**

The first character found in the keyboard buffer, or an empty string ("")

**Description**

Peeks into the keyboard buffer and returns a `String` representation of removed from the buffer, and is not echoed to the screen. If the keyboard returned without waiting for keys.

If the key is in the ASCII character set, a one-character `String` consists of an "extended" one (numeric pad, cursors, functions) a two-character `String` character. (See dialect differences below)

The Shift, Ctrl, Alt, and AltGr keys can't be read independently by this function (although, perhaps obviously, Shift-A will be reported by `Inkey` differently than Control-A et cetera; Alt-A is an extended key a la the above).

See also `Input()` or `GetKey`, or `Sleep` to wait for a key press if the keyb

**Example**

```
Print "press q to quit"
Do
    Sleep 1, 1
Loop Until Inkey = "q"
```
Dim k As String

Print "Press a key, or Escape to end"
Do

    k = Inkey$

Select Case k

    Case "A" To "Z", "a" To "z": Print "Letter"
    Case "1" To "9": Print "Number"

    Case Chr$(32): Print "Space"
    Case Chr$(27): Print "Escape"
    Case Chr$(9): Print "Tab"
    Case Chr$(8): Print "Backspace"

    Case Chr$(32) To Chr$(127)
        Print "Printable character: " & k

    Case EXTCHAR & "G": Print "Up Left / Home"
    Case EXTCHAR & "H": Print "Up"
    Case EXTCHAR & "I": Print "Up Right / PgUp"

    Case EXTCHAR & "K": Print "Left"
    Case EXTCHAR & "L": Print "Center"
    Case EXTCHAR & "M": Print "Right"
Case EXTCHAR & "O": Print "Down Left / End"
Case EXTCHAR & "P": Print "Down"
Case EXTCHAR & "Q": Print "Down Right / PgDn"
Case EXTCHAR & "R": Print "Insert"
Case EXTCHAR & "S": Print "Delete"
Case EXTCHAR & "k": Print "Close window / Alt-F4"
Case EXTCHAR & Chr$(59) To EXTCHAR & Chr$ (133) To EXTCHAR & Chr$
Print "Function key: F" & Asc(k, 2) -
Case Else
   If Len(k) = 2 Then
      Print Using "Extended character: chr$(###)"
   ElseIf Len(k) = 1 Then
      Print Using "Character chr$ (#)#)"
   End If
End Select
If k = Chr$(27) Then Exit Do
Sleep 1, 1
Loop

Dialect Differences
- The extended character is chr(255) in the -lang fb and -lang fblite dialects.
- In the -lang qb dialect, the extended character depends on how the keyword is written.
  - If the QB form is used, the extended character is chr(0).
  - If it is referenced, the extended character is chr(0).
- In all other dialects, the extended character is always chr(255).
- The string type suffix $ is optional in the `-lang fblite` and `-lang

**Differences from QB**

- None in the `-lang qb` dialect.
- QBBasic returned a `chr(0)` as the first character for an extended character in the `-lang fb` and `-lang fblite` dialects.

**See also**

- `Sleep`
- `GetKey`
- `Input()`
- `MultiKey`
Inp

Returns a value at a hardware port.

**Syntax**

```
Declare Function Inp ( ByVal port As UShort ) As Integer
```

**Usage**

```
value = Inp(port)
```

**Parameters**

- `port`  
  Port number to read.

**Return Value**

The value at the specified port.

**Description**

This function retrieves the value at 'port' and returns immediately.

**Example**

```qbasic
'' Turn off PC speaker
Out &h61, Inp(&h61) And &hfc
```

**Platform Differences**

- In the Windows and Linux versions three port numbers (&H3C7;, &H3C8;, &H3C9;) are hooked by the graphics library when a graphics mode is in use to emulate QB’s VGA palette handling. This use is deprecated; use Palette to retrieve and set palette colors.
Using true port access in the Windows version requires the program to install a device driver for the present session. For that reason, Windows executables using hardware port access should be run with administrator permits each time the computer is restarted. Further runs don't require admin rights as they just use the already installed driver. The driver is only 3K in size and is embedded in the executable.

See also

- Out
- Wait
- Palette
Input

Reads a list of values from the keyboard

Syntax

Input [;] ["prompt" ,; ] variable_list

Parameters

prompt
    an optional string literal that is written to the screen as a prompt. If it is a semicolon (;), a question mark ("? ") will be appended to the prompt. comma, nothing will be appended.
variable_list
    a list of comma-separated variables used to hold the values read from

Description

Reads a list values from the keyboard up until the first carriage return. Numerical values are converted from their string representation into the corresponding types. Characters are echoed to the screen as they are typed.

If there is more than one value in the input list, then the input line will look for delimiters - commas (,) after strings, or commas and whitespace after numbers. Surrounding whitespace will be trimmed from string values. If an input value contains a comma, it must be wrapped in quotes ("...") to prevent it being split up.

For inputting to a single string without delimiting, Line Input should be used.

The prompt - if any - is written to the screen at the current cursor location, and read are echoed to the screen immediately following the prompt. If no characters are echoed at the current cursor location.

The optional leading semicolon (;) after Input is similar to the optional Print statement: the cursor will remain on the same line after all of the values have been echoed, otherwise, the cursor will move to the beginning of the next line.

If more values are read than are listed in the variable list, extra values will be ignored; if fewer values are read (i.e. the user presses enter before inputting all values)
variables will be initialized - numeric variables to zero (0), and string variables to the empty string ("").

Numeric values are converted using methods similar to the procedure using the most appropriate function for the number format, converting characters as possible.

**Input** has a limited edit capacity: it allows to erase characters using the backspace key. A better user interface is needed, a custom input routine should be used.

**Example**

**Example #1**

```vba
Dim n As String, a As Integer
Input "Enter [Name, Age]: ", n, a
Print n
Print a
```

**Example #2**

```vba
Dim As Double a, b
Dim As String yn

Do
    Input "Please enter a number: ", a
    Input ; "And another: ", b
    Print , "Thank you"
    Sleep 500
    Print
    Print "The total is "; a + b
    Print

Do
    Input "Would you like to enter some more numbers? ", yn
    yn = LCase(yn)
```

Loop Until yn = "y" Or yn = "n"

Loop While LCase(yn) = "y"

Differences from QB

- If the user inputs the wrong number of values, or if it expects a number and gets a string that is not a valid number, then QBASIC issues the message "Redo from start", and does not continue further until it receives a valid input.
- QB does not treat space as a delimiter when inputting a number.

See also

- Input #
- Input()
- Line Input
Input (File Mode)

Specifies text file to be opened for input mode

Syntax

```plaintext
Open filename for Input [Encoding encoding_type] [Lock lock_type [#]filenum
```

Parameters

- **filename**
  file name to open for input
- **encoding_type**
  indicates encoding type for the file
- **lock_type**
  locking to be used while the file is open
- **filenum**
  unused file number to associate with the open file

Description

A file mode used with `open` to open a text file for reading.

This mode allows to read sequentially lines of text with `Line Input #`, read comma separated values with `Input #`.

Text files can't be simultaneously read and written in FreeBASIC, so if functions are required on the same file, it must be opened twice.

**filename** must be a string expression resulting in a legal file name in the OS, without wildcards. The file will be sought for in the present directory unless the **filename** contains a path. If the file does not exist, an error is issued. The pointer is set at the first character of the file.

**Encoding_type** indicates the Unicode **Encoding** of the file, so characters are correctly read. If omitted, "ascii" encoding is defaulted. Only little endian character encodings are supported at the moment.

- "utf8",
- "utf16"
Lock_type indicates the way the file is locked for other processes, it is:
- **Read** - the file can be opened simultaneously by other processes but not for reading
- **Write** - the file can be opened simultaneously by other processes, but not for writing
- **Read Write** - the file cannot be opened simultaneously by other processes (the default)

`filenum` is a valid FreeBASIC file number (in the range 1..255) not being used for any other file presently open. The file number identifies the file for the rest of file operations. A free file number can be found using the `FreeFile` function.

**Example**

```freebasic
Dim ff As UByte
Dim randomvar As Integer
Dim name_str As String
Dim age_ubyte As UByte

ff = FreeFile
Input "What is your name? ", name_str
Input "What is your age? ", age_ubyte
Open "testfile" For Output As #ff
Write #ff, Int(Rnd(0)*42), name_str, age_ubyte
Close #ff
randomvar=0
name_str=""
age_ubyte=0

Open "testfile" For Input As #ff
Input #ff, randomvar, name_str, age_ubyte
Close #ff

Print "Random Number was: ", randomvar
```
```plaintext
Print "Your name is: " + name_str
Print "Your age is: " + Str(age_ubyte)

'File outputted by this sample will look like this:
'minus the comment of course:
'23,"Your Name",19

Differences from QB

See also
- Append
- Open
- Output
```
**Input #**

Reads a list of values from a text file

**Syntax**

```
Input # filenum, variable_list
```

**Parameters**

- `filenum`
  a file number of a file or device opened for Input
- `variable_list`
  a list of variables used to hold the values read

**Description**

Reads from a text file through a bound file number a delimiter-separated set of values and writes them in reading order into the variables in `variable_list`. If a variable is numeric the read value is converted from its string representation into the corresponding type.

Numeric values are converted in a similar way to the procedures `Val` and `ValLng`, using the most appropriate function for the number format.

Delimiters may be commas or line breaks. Whitespace is also treated as a separator after numbers. A string including a comma or a whitespace must be surrounded by double quotes.

To read an entire line into a string, use `Line Input` instead. **Write #** can be used to create a file readable with **Input #**.

**Example**

```
Dim a As Integer
Dim b As String
Dim c As Single

Open "myfile.txt" For Output As #1
```
Write #1, 1, "Hello, World", 34.5
Close #1

Open "myfile.txt" For Input As #1
Input #1, a, b, c
Close #1
Print a, b, c

Differences from QB

- QB has a bug in INPUT # that causes it to read past the end of the line if it does not find a matching end-quote when reading a string. If you are porting QB code that relies upon this bug, you may need to edit your data files to remove newlines from inside quoted strings, or to use a custom function to piece back together the multiline string.

See also

- Input
- Line Input #
- Write #
- Open
- Input (File Mode)
Input()

Reads a number of characters from console or file

**Syntax**

```
Declare Function Input ( n As Integer ) As String
Declare Function Input ( n As Integer, filenum As Integer ) As String
```

**Usage**

```
result = Input[$]( n [, [#]filenum ] )
```

**Parameters**

- **n**
  Number of bytes to read.
- **filenum**
  File number of a bound file or device.

**Return Value**

Returns a `String` of the characters read.

**Description**

Reads a number of characters from the console, or a bound file/device specified by `filenum`.

The first version waits for and reads $n$ characters from the keyboard buffer. Extended keys are not read. The characters are not echoed to the screen.

The second version waits for and reads $n$ characters from a file or device. The file position is updated.

**Example**

```
Print "Select a color by number"
```
PRINT "1. blue"
PRINT "2. red"
PRINT "3. green"
DIM choice AS STRING
DO
    choice = Input(1)
LOOP UNTIL choice >= "1" AND choice <= "3"

Differences from QB
- None

See also
- Winput()
- GetKey
- Inkey
InStr

Locates the first occurrence of a substring or character within a string

**Syntax**

```vba
Declare Function InStr (ByRef str As Const String, [ Any ] ByRef
Declare Function InStr (ByRef str As Const WString, [ Any ] ByR
Declare Function InStr (ByVal start As Integer, ByRef str As Co
Declare Function InStr (ByVal start As Integer, ByRef str As Co
```

**Usage**

```vba
first = InStr( [ start, ] str, [ Any ] substring )
```

**Parameters**

- `str`
  The string to be searched.

- `substring`
  The substring to find.

- `start`
  The position in `str` at which the search will begin. The first character starts at position 1.

**Return Value**

The position of the first occurrence of `substring` in `str`.

**Description**

Locates the position of the first occurrence of a substring or character search begins at the first character.

Zero (0) is returned if: either `substring` is not found, either `str` or `substring`.

If the `Any` keyword is specified, `InStr` returns the first occurrence of an

**Example**

```vba
' It will return 4
```
Print InStr("abcdefg", "de")
' It will return 0
Print InStr("abcdefg", "h")
' It will search for any of the characters "f", "b"
Print InStr("abcdefg", Any "fbc")

Dim test As String
Dim idx As Integer

test = "abababab"
idx = InStr(test, "b")

Do While idx > 0 'if not found loop will be skipped
    Print """"b"""" at " & idx
    idx = InStr(idx + 1, Test, "b")
Loop

'A Unicode example:
dim text as wstring*20
text = "Привет, мир!"
print instr(text,"ет") ' displays 5

**Platform Differences**

- The wide-character string version of **InStr** is not supported for

**Differences from QB**

- QB returns *start* if *search* is a zero length string.
- QB does not support Unicode.

**See also**
- InStrRev
- Mid (Function)
**InStrRev**

Locates the last occurrence of a substring or character within a string

**Syntax**

```
Declare Function InStrRev ( ByRef str As Const String, [ Any ] ByRef substring As Const String, ByVal start As Integer = -1 ) As Integer
Declare Function InStrRev ( ByRef str As Const WString, [ Any ] ByRef substring As Const WString, ByVal start As Integer = -1 ) As Integer
```

**Usage**

```
last = InStrRev( str, [ Any ] substring [, start ] )
```

**Parameters**

- **str**
  - The string to be searched.
- **substring**
  - The substring to find.
- **start**
  - The position in `str` at which the search will begin. The first character starts at position 1.

**Return Value**

The position of the last occurrence of `substring` in `str`.

**Description**

Locates the position of the last occurrence of a substring or character string. If `start` parameter is not given or is -1, the search begins at the character.

Zero (0) is returned if: either `substring` is not found, or either `str` or `su` are empty strings, or `start` is less than 1 (except for -1), or start is greater than the length of `str`.

If the Any keyword is specified, `InStrRev` returns the last occurrence of character in `substring`. 
Example

' It will return 4
Print InStrRev("abcdefg", "de")

' It will return 0
Print InStrRev("abcdefg", "h")

Dim test As String
Dim idx As Integer

test = "abababab"
idx = InStrRev(test, "b")

Do While idx > 0 'if not found loop will be skipped
    Print """"b"" at " & idx
    idx = InStrRev(test, "b", idx - 1)
Loop

'A Unicode example:
dim text as wstring*20
text = "Привет, мир!"
print instrrev(text,"ет") ' displays 5

Platform Differences

- The wide-character string version of InStrRev is not supported target.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the
__Instrrev__.

**Differences from QB**
- New to FreeBASIC

**See also**
- `InStr`
- `Mid (Function)`
**Int**

Returns the floor of a number

**Syntax**

```
Declare Function Int ( ByVal number As Single ) As Single
Declare Function Int ( ByVal number As Double ) As Double
Declare Function Int ( ByVal number As Integer ) As Integer
Declare Function Int ( ByVal number As UInteger ) As UInteger
Declare Function Int ( ByVal number As LongInt ) As LongInt
Declare Function Int ( ByVal number As ULongInt ) As ULongInt
```

**Usage**

```
result = Int( number )
```

**Parameters**

- `number`
  the floating-point number to round

**Return Value**

Returns the floor of `number`, i.e. the largest integer that is less than or equal to it.

**Description**

`Int` returns the floor of `number`. For example, `Int(4.9)` will return `4.0`, and `Int(-1.3)` will return `-2.0`. For integer types, the number is returned unchanged.

The `Int` unary operator can be overloaded with user defined types.

**Example**

```
Print Int(1.9) ' will print 1
Print Int(-1.9) ' will print -2
```
Dialect Differences

- In the *-lang qb* dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- Fix
- CInt
- Operator
Integer

Standard data type: 32-bit or 64-bit signed, same size as `SizeOf(Any Ptr)`

**Syntax**

```
Dim variable As Integer
Dim variable As Integer<bits>
```

**Parameters**

`bits`

A numeric constant expression indicating the size in bits of integer desired. The values allowed are 8, 16, 32 or 64.

**Description**

32-bit or 64-bit signed whole-number data type, depending on the platform.

**Integer** is the main data type FreeBASIC uses for integer math and bitwise operations. It is the default type for number literals.

If an explicit bit size is given, a data type is provided that can hold values from `-1LL Shl (bits-1)` up to `(1LL Shl (bits-1)) - 1`.

**Example**

```basic
#if __FB_64BIT__
    Dim x As Integer = &H8000000000000000
    Dim y As Integer = &H7FFFFFFFFFFFFFFFFFF
    Print "Integer Range = "; x; " to "; y
#else
    Dim x As Integer = &H80000000
    Dim y As Integer = &H7FFFFFFF
    Print "Integer Range = "; x; " to "; y
#endif
```
Dialect Differences

- In the `-lang fb` and `-lang fblite` dialects, the `Integer` data type is 32-bit.
- In the `-lang qb` dialect, the `Integer` data type is 16-bit, regardless of platform.

Differences from QB

- The ability to select a bit size is new to FreeBASIC.
- The `INTEGER` type is always 16 bits wide in QB.

See also

- Long
- LongInt
- UInteger
- CInt
Clause in the `Select Case` statement block.

**Syntax**

```
Case Is expression
```

**Description**

`Is` specifies that a particular case inside a `Select Case` block will be evaluated based on an expression including the greater than (`>`) or less than (`<`) operator and a value.

**See also**

- `Select Case`
- `Operator Is`
Operator Is (Run-Time Type Information)

Checks whether an object is compatible to a type derived from its compile-time type.

**Syntax**

\[ result = expression \text{ Is typename} \]

**Parameters**

- **expression**
  - The expression to check, an object of a type that is directly or indirectly derived from `typename`.

- **typename**
  - The child type to check for. This type must be directly or indirectly derived from `expression` (the compile-time type of the object).

**Return Value**

Returns negative one (-1) if the expression is an object of real-type `typename` base-types derived from the `expression` type, or zero (0) if it's an object of another type.

**Description**

The `Is` operator is a binary operator that checks whether an object is compatible with derived types at run-time. Because `Is` relies on run-time type information, it can only be used with types that are derived from the built-in `object` type. The compiler disallows checks that can be solved at compile-time.

The `Is` operator is successful not only for the real-type (the "lowest"), but also for its base-types, as long as they are still below the type of `expression` (the compile-time type). To determine the real-type, all possibilities from lowest to highest must be checked.

Extending the built-in `object` type allows to add an extra hidden vtable pointer field at the top of the `Type`. The vtable is used to access information for run-time type checks of the `Is` operator.

**Example**
Type Vehicle extends object
   As String Name
End Type

Type Car extends Vehicle
End Type

Type Cabriolet extends Car
End Type

Type Bike extends Vehicle
End Type

Sub identify(ByVal p As object Ptr)
    Print "Identifying:"
    
    '' Not a Vehicle object?
    If Not (*p Is Vehicle) Then
        Print , "unknown object"
        Return
    End If
    
    '' The cast is safe, because we know it's a Vehicle
    Print , "name: " & CPtr(Vehicle Ptr, p)->Name

    If *p Is Car Then
        Print , "It's a car"
    End If

    If *p Is Cabriolet Then
        Print , "It's a cabriolet"
    End If

    If *p Is Bike Then
        Print , "It's a bike"
    End If
End Sub
```vbs
Dim As Car ford
ford.name = "Ford"
identify(@ford)

Dim As Cabriolet porsche
porsche.name = "Porsche"
identify(@porsche)

Dim As Bike mountainbike
mountainbike.name = "Mountain Bike"
identify(@mountainbike)

Dim As Vehicle v
v.name = "some unknown vehicle"
identify(@v)

Dim As Object o
identify(@o)
```

**Differences from QB**
- New to FreeBASIC

**See also**
- Extends
- Object
- Is (Select Case)
IsDate

Tests if a string can be converted to a Date Serial

Syntax

Declare Function IsDate ( ByRef stringdate As Const String ) As Long

Usage

#include "vbcompat.bi"
result = IsDate( stringdate )

Parameters

stringdate
the string to test

Return Value

Returns non-zero (-1) if the date string can be converted to a Date Serial, otherwise returns zero (0).

Description

Date strings must be in the format set in the regional settings of the OS to be considered valid dates.

IsDate(Date) will return non-zero (-1) only if the regional settings specify the same date format that QB used.

The compiler will not recognize this function unless vbcompat.bi or datetime.bi is included.

Example

#include "vbcompat.bi"
Dim s As String, d As Integer
Do
  Print
  Print "Enter a date: "

Line Input s

If s = "" Then Exit Do

If IsDate( s ) = 0 Then
  Print "'"; s; "'	is
not	a	valid
date"
Else
  d = DateValue( s )
  Print "year	=	"; Year( d )
  Print "month	=	"; Month( d )
  Print "day	=	"; Day( d )
End If

Loop

Differences from QB
- New to FreeBASIC

See also
- Date Serials
- DateSerial
- TimeValue
- DateValue
**IsRedirected**

Checks whether stdin or stdout is redirected to a file.

**Syntax**

```basic
Declare Function IsRedirected ( ByVal is_input As Long = 0 ) As
```

**Usage**

```basic
#include "fbio.bi"
result = IsRedirected( is_input )
```

**Parameters**

`is_input`

A `Long` indicating the type of information to return.

**Return Value**

Returns non-zero (-1) if stdin or stdout is redirected, otherwise returns zero.

**Description**

`IsRedirected` checks whether stdin or stdout is redirected to a file, instead of being connected to the console/terminal as usual.

If `is_input` is equal to non-zero (-1), `IsRedirected` checks stdin.
If `is_input` is equal to zero (0), `IsRedirected` checks stdout.

**Example**

```basic
' A Windows based example, just for the use principle
' Self-sufficient example, using his own .exe file as dummy
Dim As String pathExe = "" & ExePath & ""
Dim As String fileExe = Mid(Command(0), InStrRev(Command(0), " "), InStrRev(Command(0), " ") - 1) & ""
#include "fbio.bi"

' Quotation marks wrapping for compatibility with
```

Dim As String redirection = " < """ & Command(0)
If LCase(Right(Command(0), 4)) = " .exe" Then
    redirection &= """
Else
    redirection &= " .exe"
End If

If Command() = "" Then '' First process without stdin redirection
    Print "First process without stdin redirection:
    '' Creation of asynchronous second process with
    Shell("start /d " & pathExe & " /b " & fileExe &
    " Waiting for termination of asynchronous second
    Sleep
    ElseIf Command() = "secondprocess" Then '' Second
    '' Check stdin redirection
    Print "Second process with stdin redirection :
End If

**Differences from QB**
- New to FreeBASIC.

**See also**
- Reset(Streamno)
Kill

Deletes a file from disk / storage media.

**Syntax**

```basic
Declare Function Kill ( ByRef filename As Const String ) As Long
```

**Usage**

```basic
result = Kill( filename )
```

**Parameters**

*filename*

The *filename* is the name of the disk file to delete. If the file is not in the current directory, the path must also be given as *path/file*.

**Return Value**

Returns zero (0) on success, or non-zero on error.

**Description**

Kill deletes a file from disk / storage media.

**Example**

```basic
Dim filename As String = "file.ext"
Dim result As Integer = Kill( filename )

If result <> 0 Then Print "error trying to kill "
```

**Platform Differences**

On some platforms, Kill may be able to remove folders and read-only files. If it fails here, it is not currently defined. It may be necessary to check the attributes of the file you are deleting, and decide accordingly whether you want to try killing it.
Differences from QB

- KILL can optionally be used as function in FreeBASIC.

See also

- Shell
- Rmdir
LBound

Returns the lower bound of an array's dimension

Syntax

```
Declare Function LBound ( array() As Any, ByVal dimension As Int = 1 ) As Integer
```

Usage

```
result = LBound( array [, dimension ] )
```

Parameters

- **array**: an array of any type
- **dimension**: the dimension to get lower bound of

Return Value

Returns the lower bound of an array's dimension.

Description

LBound returns the lowest value that can be used as an index into a particular dimension of an array.

Array dimensions are numbered from one (1) to \( n \), where \( n \) is the total number of dimensions. If \( dimension \) is not specified, LBound will return the lower bound of the first dimension.

If \( dimension \) is zero (0), LBound returns 1, corresponding to the lower bound of the array dimensions 1..\( n \). UBound returns \( n \), the number of dimensions in this case. This can be used to detect the array's number of dimensions.

For any other (non-zero) \( dimension \) values outside of the valid range 1..\( n \), LBound returns 0. UBound returns -1 in this case. This can be used to detect whether a certain dimension exists in the array, and also works when
on an empty array which does not have any valid dimensions.

Thus, for empty dynamic arrays, we get:

- `Lbound(array) = 0` and `Ubound(array) = -1` (dimension does not exist)
- `Lbound(array, 0) = 1` and `Ubound(array, 0) = 0` (zero dimensions)
- `@array(Lbound(array)) = 0` (no data buffer allocated)

**Example**

```
Dim array(-10 To 10, 5 To 15, 1 To 2) As Integer

Print LBound(array) 'returns -10
Print LBound(array, 2) 'returns 5
Print LBound(array, 3) 'returns 1
```

**See also**

- `UBound`
- `Static`
- `Dim`
- `ReDim`
**LCase**

Returns a lower case copy of a string

**Syntax**

```basic
Declare Function LCase ( ByRef str As Const String, ByVal mode As Long = 0 ) As String
Declare Function LCase ( ByRef str As Const WString, ByVal mode As Long = 0 ) As WString
```

**Usage**

```basic
result = LCase$( str [, mode ] )
```

**Parameters**

- **str**
  String to convert to lowercase.
- **mode**
  The conversion mode: 0 = current locale, 1 = ASCII only

**Return Value**

Lowercase copy of `str`.

**Description**

Returns a copy of `str` with all of the letters converted to lower case.

If `str` is empty, the null string ("") is returned.

**Example**

```basic
Print LCase("AbCdEfG")
```

Output:

```basic
abcdefg
```
Platform Differences

- The wide-character string version of LCase is not supported for DOS target.

Dialect Differences

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

Differences from QB

- QB does not support Unicode.

See also

- UCase
**Left**

Returns the leftmost substring of a string

**Syntax**

```basic
Declare Function Left ( ByRef str As Const String, ByVal n As Integer ) As String
Declare Function Left ( ByRef str As Const WString, ByVal n As Integer ) As WString
```

**Usage**

```basic
result = Left$( str, n )
```

**Parameters**

- `str`
  The source string.
- `n`
  The number of characters to return from the source string.

**Return Value**

Returns the leftmost substring from `str`.

**Description**

Returns the leftmost `n` characters starting from the left (beginning) of `str`. If `str` is empty, then the null string (""") is returned. If `n <= 0` then the null string (""") is returned. If `n > len(str)` then the entire source string is returned.

**Example**

```basic
Dim text As String = "hello world"
Print Left(text, 5)
```

will produce the output:
An Unicode example:

```qbasic
dim text as wstring*20
text = "Привет, мир!"
print left(text, 6) 'displays "Привет"
```

**Platform Differences**

- DOS does not support the wide-character string version of `Left`

**Dialect Differences**

- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lang fb` dialects.

**Differences from QB**

- QB does not support Unicode.

**See also**

- `Right`
- `Mid (Function)`
Len

Returns the length of an expression or data type

**Syntax**

```
Declare Function Len ( ByRef expression As String ) As Integer
Declare Function Len ( ByRef expression As ZString ) As Integer
Declare Function Len ( ByRef expression As WString ) As Integer

Declare Operator Len ( ByRef expression As datatype ) As datatype
Declare Function Len ( datatype ) As Integer
```

**Usage**

```
result = Len( expression )
```

or

```
result = Len( DataType )
```

**Parameters**

- expression
  
  An expression of any type.

- datatype
  
  A **DataType**.

**Return Value**

Returns the size of an expression or **DataType** in bytes.

**Description**

**Len** returns the length of an expression or the size of a **DataType**, in bytes.

In the first form, if *expression* is of type **String**, **WString** or **ZString**, the length of the string in characters will be returned. If the expression is of a user defined type, an **Operator Len** compatible with that data type is called. Otherwise, the size of the *expression's* data type in bytes is returned.
In the second form, if `expression` is `ZString` or `WString`, the size in bytes of an ASCII or Unicode character is returned, respectively. If `datatype` is `String`, the size of the string descriptor type is returned.

If there is both a user defined type and a variable visible with the same name in the current scope, the user defined type takes precedence over the variable. To ensure that the `Len` takes the variable instead of the user defined type, wrap the argument to `Len` with parentheses to force it to be seen as an expression. For example `Len((variable))`.

The `Len` unary `Operator` can be overloaded with user defined types.

**Example**

```
Print Len("hello world") 'returns "11"
Print Len(Integer) ' returns 4

Type xyz
  a As Integer
  b As Integer
End Type

Print Len(xyz) ' returns 8
```

**Dialect Differences**

- `Len` only allows expressions in the `-lang qb` dialect.
- Can be used with built-in types and user-defined types in the `-lang fb` and `-lang fblite` dialects.

**Differences from QB**

- Can be used with built-in types and user-defined types in the `-lang fb` and `-lang fblite` dialects.
- None in the `-lang qb` dialect.
See also

- `SizeOf`
Let

Indicates the assignment operator.

**Syntax**

```plaintext
Let variable = value
or
Let( variable1 [, variable2 [, ... ]] ) = udt
or
Operator typename.Let ( [ ByRef | ByVal ] rhs As datatype )
statements
end operator
```

**Description**

Command intended to help the programmer to distinguish an assignment statement (e.g. `Let a = 1`) from an equality test (e.g. `If a = 1 then ...`). As the compiler does not require it, it is usually omitted.

`Let` can be used as a left-hand side operator to assign the members of a user defined type to multiple variables. See *Operator Let() (Assignment)*

`Let` is used with operator overloading to refer the assignment operator. See *Operator Let (Assignment)*

**Example**

```
' Compile with -lang fblite or qb

#lang "fblite"

' these two lines have the same effect:
Let x = 100
x = 100
```

**Dialect Differences**
- The use of `Let` to indicate an assignment statement (`Let variable = expr`) is not allowed in the `-lang fb` dialect.
- The UDT to multi-variable Let assignment is only available in the `-lang fb` dialect.
- Overloading of operators is not available in the `-lang qb` and `-lang fblite` dialects.

**Differences from QB**
- None in the `-lang fb` dialect.
- The Let operator is new to FreeBASIC.
- The UDT to multi-variable Let assignment is new to FreeBASIC.

**See also**
- Operator `=>` (Assignment)
- Operator `Let` (Assignment)
- Operator `Let()` (Assignment)
- Operator
Lib

Specifies the library where a sub or function can be found as part of a declaration.

Syntax

```
Declare { Sub | Function } proc_name Lib "libname" [ Alias "symbol_name" ] ( arguments list ) As return_type

Extern "mangling" lib "libname"
declarative statements
end Extern

Type T
As Integer dummy
Declare Constructor Lib "libname" [ Alias "symbol_name" ] ( arguments list )
end Type
```

Description

In Sub or Function declarations, and also in class method declarations (including constructors and destructors), Lib indicates the library containing the function. Libraries specified in this way are linked in as if #Inclib "Libname" or -l libname had been used.

Lib can also be used with Extern ... End Extern Blocks to specify all declarations inside.

Example

```
'' mydll.bas
'' compile with:
''  fbc -dll mydll.bas

Public Function GetValue() As Integer Export
  Function = &h1234
End Function
```
Declare Function GetValue Lib "mydll" () As Integer

Print "GetValue = &h"; Hex(GetValue())

' Expected Output :
' GetValue = &h1234

Differences from QB

- New to FreeBASIC

See also

- Declare
- #inclib
Line (Graphics)

Draws a line

Syntax

```
Line [target,] [[STEP] (x1, y1)]-[STEP] (x2, y2) [, [color][, [B|BF][, style]]]
```

Parameters

- **target** specifies buffer to draw on
- **STEP** indicates that the starting coordinates are relative 
  
  \((x1, y1)\)

  starting coordinates of the line

  **STEP** indicates that ending coordinates are relative 

  \((x2, y2)\)

  ending coordinates of the line

- **color** the color attribute.

- **B|BF** specifies box or box filled mode

- **style** line style

Description

Graphics statement that draws a straight line or a box between two points on the current work page set via `ScreenSet`, or onto the buffer `Get/Put` buffer.

Line coordinates are affected by custom coordinates system set via `Window` statements, and respect clipping rectangle set by `View (Graphics)`. If by the **STEP** keyword, the coordinates are assumed to be relative to the last graphics cursor position. If the **B** flag is specified, a rectangle will be drawn instead of a line, with coordinates of the opposite rectangle corners. If **BF** is specified, a filled rectangle will be drawn.

**Color** denotes the color attribute, which is mode specific (see `Color` and...
omitted, the current foreground color as set by the `color` statement is

`style`, if specified, allows styled line drawing; its value is interpreted as a 16-bit bitmask, use it to skip pixel drawing. Starting at \((x_1, y_1)\), the most significant bit of the pixel is drawn, if \(0\), it’s skipped. This repeats for all the line pixels with the mask being reused when the 16 bits are all checked.

When `line` is used as `line - (x2, y2)`, a line is drawn from the current cursor coordinates specified by `line`. Alternatively, `point` can be used to get the

**Example**

```
  '' draws a diagonal red line with a white box, and
  Screen 13
  Line (20, 20)-(300, 180), 4
  Line (140, 80)-(180, 120), 15, b
  Line - (200, 200 ), 15
  Sleep 3000
```

```
  ' Draws 2 lines with 2 different line styles in 2
  ScreenRes 320, 240

  Line (10, 100)-
  (309, 140), 4, B, &b1010101010101010 ' red box with

  Line (20, 115)-(299, 115), 9, , &b1111000011111111
  Line (20, 125)-(299, 125), 10, , &b0000000011110000

  Sleep
```

**Differences from QB**

- `target` is new to FreeBASIC
See also

- Circle
- Window
- View (Graphics)
**Line Input**

Reads one line of input from the keyboard

**Syntax**

```plaintext
Line Input [ ; ] [ promptstring { ; | , } ] stringvariable
```

**Parameters**

- `promptstring` 
  - prompt to display before waiting for input
- `stringvariable` 
  - variable to receive the line of text

**Description**

Reads a line of text from the keyboard and stores it in a string variable.

**Example**

```plaintext
Dim x As String
Line Input "Enter a line:" , x
Print "You entered '"; x; "'
```

**Differences from QB**

- QBASIC only allowed literal strings for the prompt text.
  - FreeBASIC allows any variable or constant string expression.

**See also**

- `Line Input #`
- `Input`
**Line Input #**

Reads one line of text from a file

**Syntax**

```
Line Input  #file number, string_variable
```

**Parameters**

- `file number`
  - file number of an file opened for **Input**
- `string_variable`
  - variable to receive the line of text

**Description**

Reads a line from an open text file (opened for **Input** through a bound file number) and stores it in a string variable.

A line of text ends at, but does not include the end of line characters. An end of line character may be the **LF** character (**Chr(10)**) or the **CRLF** character pair (**Chr(13,10)**).

**Example**

```
Dim s As String

Open "myfile.txt" For Output As #1
Print #1, "Hello, World"
Close #1

Open "myfile.txt" For Input As #1
Line Input #1, s
Close #1, s
Print s
```
Differences from QB

- None

See also

- Input #
- Open
- Input (File Mode)
LoByte

Gets the lowest byte of the operand.

**Syntax**

```c
#define LoByte( expr ) ( Cast(UInteger, expr) And &h000000FF; )
```

**Usage**

```c
result = LoByte( expr )
```

**Parameters**

- `expr`
  A numeric expression, converted to an `UInteger` value.

**Return Value**

Returns the value of the low byte of `expr`.

**Description**

This macro converts the numeric expression `expr` to an `UInteger` value representing the value of its least-significant (low) byte.

**Example**

```vbnet
Dim N As UInteger

'Note there are 16 bits
N = &b1010101110000001
Print "N is"
Print "The binary representation of N is"
Print "The most significant byte (MSB) of N is"
Print "The least significant byte (LSB) of N is"
Print "The binary representation of the MSB is"
Print "The binary representation of the LSB is"
Sleep
```
The output would look like:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Is</td>
<td>43905</td>
</tr>
<tr>
<td>The Binary representation of N Is</td>
<td>1010111000001</td>
</tr>
<tr>
<td>The most significant Byte (MSB) of N Is</td>
<td>171</td>
</tr>
<tr>
<td>The least significant Byte (LSB) of N Is</td>
<td>129</td>
</tr>
<tr>
<td>The Binary representation of the MSB Is</td>
<td>10101011</td>
</tr>
<tr>
<td>The Binary representation of the LSB Is</td>
<td>10000001</td>
</tr>
</tbody>
</table>

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- HiByte
- LoWord
- HiWord
LOC

Returns the file position where the last file read/write was performed

Syntax

Declare Function LOC ( ByVal filenum As Long ) As LongInt

Usage

result = LOC( filenum )

Parameters

filenum

The file number of an open file.

Return Value

The file position where the last read/write was performed.

Description

Returns the position where the last file read/write was performed.

The position is indicated in records:
In files opened FOR RANDOM the record length specified when file was opened.
In text files (FOR INPUT|OUTPUT|APPEND, a record length of 128 bytes is supposed.
In files opened for BINARY a 1 byte record length is used.

In FreeBASIC the file position is 1 based, the first record of a file is record 1.

When used with a serial device, LOC returns the number of bytes waiting to be read from the serial device's input buffer.

Example

Dim b As String
If Open Com ("com1:9600,n,8,1,cs,rs,ds,bin" For Bi
   Print "unable to open serial port"
   End
End If

Print "Sending command: AT"

Print #1, "AT" + Chr(13, 10);

Sleep 500,1

Print "Response:"

While ( LOC(1) > 0 )
   b = Input(LOC(1), 1)
   Print b;
Wend

Close #1

**Differences from QB**

- !!WRIEME!! ?

**See also**

- LOF
- EOF
- Seek (Function)
- Open
Error handling statement to set the current error handler

**Syntax**

```
On Local Error Goto label
```

**Description**

The `Local` clause in an `On Error` construction allows to define an error handler in the same `Sub` or `Function` the `On Local Error` is in.

**Remark:** Presently, the `Local` clause (authorized only inside `Sub`/`Function`) is ignored by the compiler, and the error handler can be either in the scope of the same `On [Local] Error` is in, or in the main part of the module (if defined before). Exception if -gen gcc is used: when the `On [Local] Error` is inside a `Sub` procedure, the error handler also must always be inside that same procedure.

**Example**

```
' compile with -lang fblite or qb

#lang "fblite"

Declare Sub foo

foo
Print "ok"
Sleep

Sub foo
    Dim errno As Integer
    On Local Error Goto fail
    Open "xzxwz.zwz" For Input As #1
    On Local Error Goto 0
    Exit Sub
fail: ' here starts the error handler
```
Differences from QB

- The LOCAL clause comes from PDS 7.1. QB 4.5 does not allow handling.

See also

- On Error
Locate

Sets the current cursor position

**Syntax**

```
Declare Function Locate( row As Long = 0, column As Long = 0, state As Long = -1, start As Long = 0, stop As Long = 0 ) As Long
```

**Usage**

```
Locate [row], [column], [state]
```

- `result = Locate( [row], [column], [state] )`
- `new_column = LoByte( result )`
- `new_row = HiByte( result )`
- `new_state = HiWord( result )`

**Parameters**

- `row` the 1-based vertical character position in the console.
- `column` the 1-based horizontal character position in the console.
- `state` the state of the cursor. 0 is off, 1 is on (console-mode only).
- `start` Ignored. Allowed for `-lang qb` dialect compatibility only.
- `stop` Ignored. Allowed for `-lang qb` dialect compatibility only.

**Return Value**

Returns a 32 bit `Long` containing the current cursor position and state. The Low Byte Of The Low Word contains the column, the High Byte Of The Low Word contains the row, and the High Word contains the cursor state.

If any of the `row`, `column` or `state` parameters were just set by the call to `Locate`, then the return value will reflect these new values, not the previous ones. If any of the parameters were omitted in the call to `Locate`, then the return value will reflect the current values, which are
the same as before the call to Locate.

**Description**

Sets the text cursor in both graphics and console modes.

**Example**

```
Locate 10
Print "Current line:"; CsrLin

' Text cursor + mouse tracking
Dim As Integer x = 0, y = 0, dx, dy

Cls
Locate , , 1

While Inkey <> Chr(27)
    GetMouse dx, dy
    If ( dx <> x Or dy <> y ) Then
        Locate y+1, x+1: Print " ";
        x = dx
        y = dy
        Locate 1, 1: Print x, y, ""
        Locate y+1, x+1: Print "X";
    End If
Wend
```

**Differences from QB**

- The *start* and *stop* arguments have no effect in FreeBASIC.

**See also**
- CsrLin
- Pos
- (Print | ?)
Lock

Restricts read/write access to a file or portion of a file.

Syntax

Lock #filenum, record
Lock #filenum, start To end

Parameters

filenum
The file number used to Open the file.
record
The record (Random files) to lock.
start
The first byte position (Binary files) to lock from.
end
The last byte position (Binary files) to lock to.

Description

Lock temporarily restricts access by other threads or programs to a file, usually to allow safe writing to it.

After modifying the data, an Unlock with the same parameters as the Lock is necessary.

Note: This command does not always work, neither as documented nor as expected. It appears to be broken at the moment.

Example

```
' e.g. locking a file, reading 100 bytes, and unlocking it
' To run, make sure there exists a file called 'file.ext'
in the current directory that is at least 100 bytes.

Dim array(1 To 100) As Integer
Dim f As Integer, i As Integer
f = FreeFile
Open "file.ext" For Binary As #f
```
Lock #f, 1 To 100
For i = 1 To 100
    Get #f, i, array(i)
Next
Unlock #f, 1 To 100
Close #f

**Differences from QB**

- Currently, FB cannot implicitly lock the entire file
- In **Random** mode, FB cannot lock a range of records

**See also**

- **Open**
- **Unlock**
- **ScreenLock**
LOF

Returns the length of an open disk file

**Syntax**

Declare Function LOF ( ByVal filenum As Long ) As LongInt

**Usage**

result = LOF( filenum )

**Parameters**

*filenum*

The file number of an open disk file.

**Return Value**

The length in bytes of an open disk file.

**Description**

Returns the length, in bytes, of a file opened previously with `Open` using the given `filenum`.

With `Open Com` it returns the length of the data pending to be read in the receive buffer.

**Example**

```basic
Dim f As Integer
f = FreeFile
Open "file.ext" For Binary As #f
Print LOF(f)
Close #f
```
Differences from QB

- None

See also

- LOC
- EOF
- Open
Log

Returns the natural logarithm of a given number

Syntax

Declare Function Log cdecl ( ByVal number As Double ) As Double

Usage

result = Log( number )

Parameters

number

The number to calculate the natural log.

Return Value

Returns the logarithm with the base e (also known as the natural logarithm).

Description

There can be some confusion with this notation given that in mathematics, the natural logarithm is usually denoted LN, while the logarithm of base 10 is often denoted as LOG. Most programming languages, such as FreeBASIC, use LOG to denote the natural logarithm. The function requires a valid numeric expression greater than zero. If number is zero, FreeBASIC returns a special value representing "-infinity", printing like "-Inf". If number is less than zero, Log returns a special value representing "not defined", printing like "NaN" or "IND", exact text is platform dependent. If number is less than zero, Log returns a special value representing "not defined", printing like "NaN" or "IND", exact text is platform dependent.

Example

'Find the logarithm of any base
Function LogBaseX ( ByVal Number As Double, ByVal BaseX As Double )
    LogBaseX = Log( Number ) / Log( BaseX )
'For reference: 1/log(10)=0.43429448
Print "The log base 10 of 20 is:"; LogBaseX (20, );
Print "The log base 2 of 16 is:"; LogBaseX (16, );
Sleep

The output would look like:

The log base 10 of 20 is: 1.30102995663981
The log base 2 of 16 is: 4

Differences from QB
- None

See also
- Exp
Long

Standard data type: 32-bit signed integer

**Syntax**

```basic
Dim variable As Long
```

**Description**

32-bit signed whole-number data type. Can hold values from -2,147,483,648 to 2,147,483,647. Corresponds to a signed DWORD.

**Example**

```basic
Dim x As Long = &H80000000
Dim y As Long = &H7FFFFFFF
Print "Long Range = "; x; " to "; y
```

**Output:**

```text
Long Range = -2147483648 to 2147483647
```

**See also**

- Integer
- LongInt
- Ulong
LongInt

Standard data type: 64 bit signed

**Syntax**

```
Dim variable As LongInt
```

**Description**

A 64-bit signed whole-number data type. Can hold values from -9 223 036 854 775 808 to 9 223 372 036 854 775 807. Corresponds to a signed QWORD.

**Example**

```
Dim x As LongInt = &H8000000000000000
Dim y As LongInt = &H7FFFFFFFFFFFFFFF
Print "LongInt Range = "; x; " to "; y
```

**Output:**

```
LongInt Range = -9223372036854775808 to 9223372036854775807
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Longint`.

**Differences from QB**

- New to FreeBASIC

**See also**
- ULongInt
- CLngInt
Loop

Control flow statement for looping.

Syntax

Do
  [ statement block ]
Loop [ { Until | While } condition ]

See also

- Do...Loop
LoWord

Gets the lowest 16bit word of the operand.

Syntax

```plaintext
#define LoWord( expr ) (Cast(UINTeger, expr) And &h0000FFFF;)
```

Usage

```plaintext
result = LoWord( expr )
```

Parameters

expr

A numeric expression, converted to an UINTeger value.

Return Value

Returns the value of the low word of expr.

Description

This macro converts the numeric expression expr to an UINTeger value representing the value of its least-significant (low) 16bit word.

Example

```plaintext
Dim N As UINTeger

'Note there are 32 bits
N = &b10000000000000011111111111111111

Print "N is
Print "The binary representation of N is
Print "The most significant word (MSW) of N is
Print "The least significant word (LSW) of N is
Print "The binary representation of the MSW is
Print "The binary representation of the LSW is
```
The output would look like:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N Is</td>
<td>2147614719</td>
</tr>
<tr>
<td>The Binary representation of N Is</td>
<td>10000000000000001111</td>
</tr>
<tr>
<td>The most significant word (MSW) of N Is</td>
<td>32769</td>
</tr>
<tr>
<td>The least significant word (LSW) of N Is</td>
<td>65535</td>
</tr>
<tr>
<td>The Binary representation of the MSW Is</td>
<td>10000000000000000001</td>
</tr>
<tr>
<td>The Binary representation of the LSW Is</td>
<td>11111111111111111111</td>
</tr>
</tbody>
</table>

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- LoByte
- HiByte
- HiWord
**Lpos**

Returns the number of characters sent to the printer port in the last `LPrint`.

**Syntax**

```basic
Declare Function Lpos ( ByVal printer As Long ) As Long
```

**Usage**

```basic
result = LPOS(printer)
```

**Parameters**

*printer*

Either 0, 1, 2 or 3. Represents the printer port (LPT#).

**Return Value**

Returns the number of characters sent.

**Description**

Used to determine, from the last `LPrint`, how many characters were sent.

**Example**

```basic
' compile with -lang fblite or qb

#lang "fblite"

Dim test As String = "LPrint Example test"

Print "Sending " + test + " to LPT1 (default)"
LPrint test
Print "LPT1 last recieved " + Str(LPOS(1)) + " characters"
Print "String sent was " + Str(Len(test)) + " characters"

Sleep
```
Differences from QB

- None

See also

- LPrint
LPrint

Writes text to the default printer.

Syntax

LPrint [ Using formatstring, ] [expressionlist] [((, | ;)) ...]

Parameters

formatstring
String specifying the output format.
expressionlist
List of variables to output according to the specified format.

Description

Prints expressionlist to the printer attached to the parallel port LPT1, or if it does not exist, to the default printer. To print to a printer different from the default one, use Open Lpt.

The Using clause formats expressionlist according to formatstring. Except an UDT, any data type can be passed to LPrint expressionlist, expressions do not need to be first converted to strings.

Using a comma (,) as separator or in the end of the expressionlist will place the cursor in the next column (every 14 characters), using a semi-colon (;) won't move the cursor. If neither of them are used in the end of the expressionlist, then a new-line will be printed.

Some printers will not print at all until a Chr($12) (End of Page) character is printed.

Internally, FreeBASIC uses the special file number -1 for printing using LPrint. This file number may be safely closed using Close -1. The next use of LPrint will automatically reopen it as needed.

Example
'' Compile with -lang fblite or qb

#lang "fblite"

'' new-line
LPrint "Hello World!"

'' no new-line
LPrint "Hello"; "World"; "!";

LPrint

'' column separator
LPrint "Hello!", "World!"

'' end of page
LPrint Chr$(12)

Differences from QB

- None

Dialect Differences

- LPrint is not supported in the -lang fb dialect. In this dialect the printer must be properly opened with Open Lpt and Print # must be used to print.

See also

- Open Lpt
- (Print | ?)
- (Print | ?) #
- Write
**LSet**

Left-justifies a string

**Syntax**

Declare Sub LSet ( ByRef dst As String, ByRef src As Const String )
Declare Sub LSet ( ByVal dst As WString Ptr, ByVal src As Const WString Ptr )

**Usage**

LSet dst, src
LSet dst_udt, src_udt

**Parameters**

*dst*
String *String* to receive the data.

*src*
Source *String* to get the data.

*dst_udt*
User defined *Type* to receive the data.

*src_udt*
User defined *Type* to copy the data from.

**Description**

LSet left-justifies text into the string buffer *dst*, filling the left part of the string with *src* and the right part with spaces. The string buffer size is not modified.

If text is too long for the string buffer size, LSet truncates characters from the right.

For compatibility with QBasic, LSet can also copy a user defined type variable into another one. The copy is made byte for byte, without any care for fields or alignment. It's up to the programmer to take care for the validity of the result.

**Example**
Dim buffer As String
buffer = Space(10)
LSet buffer, "91.5"
Print "-['" & buffer & "]-"

Type mytype1
    x As Integer
    y As Integer
End Type

Type mytype2
    z As Integer
End Type

Dim a As mytype1, b As mytype2
b.z = 1234

LSet a, b
Print a.x

Differences from QB
- In QB, the syntax was LSet dst = src. That syntax is also supported by FB.

See also
- RSet
- Space
- Put (File I/O)
- MKD
- MKI
- MKL
- MKS
LTrim

Removes surrounding substrings or characters on the left side of a string.

**Syntax**

```basic
Declare Function LTrim ( ByRef str As Const String, [ Any ] ByRef trimset As Const String = " " ) As String
Declare Function LTrim ( ByRef str As Const WString, [ Any ] ByRef trimset As Const WString = WStr(" ") ) As WString
```

**Usage**

```basic
result = LTrim[$]( str [, [ Any ] trimset ] )
```

**Parameters**

- `str`  
The source string.
- `trimset`  
The substring to trim.

**Return Value**

Returns the trimmed string.

**Description**

This procedure trims surrounding characters from the left (beginning) of a source string. Substrings matching `trimset` will be trimmed if specified, otherwise spaces (ASCII code 32) are trimmed.

If the `Any` keyword is used, any character matching a character in `trimset` will be trimmed.

All comparisons are case-sensitive.

**Example**

```basic
Dim s1 As String = " 101 Things to do."
```
Print "'" + LTrim(s1) + "'"
Print "'" + LTrim(s1, " 01") + "'"
Print "'" + LTrim(s1, Any " 01") + "'"

Dim s2 As String = "BaaBaaBAA Test Pattern"
Print "'" + LTrim(s2, "Baa") + "'"
Print "'" + LTrim(s2, Any "BaA") + "'"

will produce the output:

'101 Things to do.'
' 101 Things to do.'
'Things to do.'
'BAA Test Pattern'
'Test Pattern'

**Platform Differences**

- DOS version/target of FreeBASIC does not support the wide-character version of LTrim.

**Dialect Differences**

- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lang fb` dialects.

**Differences from QB**

- QB does not support specifying a `trimset` string or the `ANY` clause.

**See also**

- RTrim
- Trim
Overwrites a substring of a string with another

**Syntax**

```
Declare Sub Mid ( ByRef text As String, ByVal start As Integer,
                 ByVal length As Integer, ByVal expression As Const String )
```

```
Declare Sub Mid ( ByVal text As WString Ptr, ByVal start As Integer,
                 ByVal length As Integer, ByVal expression As Const WString Ptr )
```

**Usage**

```
Mid( text, start ) = expression
Or
Mid( text, start, length ) = expression
```

**Parameters**

- **text**
  The string to work with.
- **start**
  The start position in `text` of the substring to overwrite. The first character starts at position 1.
- **length**
  The number of characters to overwrite.

**Description**

Copies a maximum of `length` characters of `expression` into `text`, starting at `start`.

If `length` is not specified, all of `expression` is copied. The size of the string `text` is unchanged; if `expression` is too big, as much of it is copied up to the end of `text`.

`Mid` can also be used as a function to return part of another string. See `Mid (Function)`.

**Example**
Dim text As String

text = "abc 123"
Print text 'displays "abc 123"

' replace part of text with another string
Mid(text, 5, 3) = "456"
Print text 'displays "abc 456"

Differences from QB

- None

See also

- Mid (Function)
Mid (Function)

Returns a substring of a string

**Syntax**

```基本
Declare Function Mid ( ByRef str as Const String, ByVal start as integer ) as String
Declare Function Mid ( ByVal str as Const WString Ptr, ByVal start as integer ) as WString
Declare Function Mid ( ByRef str as Const String, ByVal start as integer, ByVal n as integer ) as String
Declare Function Mid ( ByVal str as Const WString Ptr, ByVal start as integer, ByVal n as integer ) as WString
```

**Usage**

```基本
result = Mid[]( str, start [, n ] )
```

**Parameters**

- **str**
  The source string.
- **start**
  The start position in str of the substring. The first character starts at position 1.
- **n**
  The substring length, in characters.

**Description**

Returns a substring starting from start in str. If str is empty then the null string (""") is returned. If start <= 0 then the null string (""") is returned.

In the first form of Mid, all of the remaining characters are returned. In the second form, if n < 0 or n >= len(str) then all of the remaining characters are returned.

**Example**
Print Mid("abcdefg", 3, 2)
Print Mid("abcdefg", 3)
Print Mid("abcdefg", 2, 1)

will produce the output:

cd
cdefg
b

A Unicode example:
Wiki: code rendered this way to allow display of the Unicode characters.

dim text as wstring * 20
text = "Привет, мир!"
print mid(text, 6, 4) ' displays "т, м"

**Platform Differences**
- DOS does not support the wide-character string versions of Mid.

**Dialect Differences**
- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lang fb dialects.

**Differences from QB**
- QB does not support Unicode.

**See also**
- InStr
- Mid (Statement)
- Left
- Right
- Asc
**Minute**

Gets the minute of the hour from a Date Serial

**Syntax**

Declare Function Minute ( ByVal date_serial As Double ) As Long

**Usage**

#include "vbcompat.bi"
result = Minute( date_serial )

**Parameters**

date_serial
the date serial

**Return Value**

Returns the minute from a variable containing a date in Date Serial format.

**Description**

The compiler will not recognize this function unless vbcompat.bi is included.

**Example**

```
#include "vbcompat.bi"

Dim ds As Double = DateSerial(2005, 11, 28) + TimeSerial(12.34)
Print Format(ds, "yyyy/mm/dd hh:mm:ss "); Minute(ds)
```

**Differences from QB**

- Did not exist in QB. This function appeared in PDS and VBDOSS.
See also

- Date Serials
MKD

Does a binary copy from a `Double` variable to a `String`, setting its length to 8 bytes.

**Syntax**

```
Declare Function MKD ( ByVal number As Double ) As String
```

**Usage**

```
result = MKD[$]( number )
```

**Parameters**

- `number`
  
  A `Double` variable to binary copy to a `String`.

**Return Value**

Returns a `String` with a binary copy of the `Double`.

**Description**

Does a binary copy from a `Double` variable to a `String`, setting its length to 8 bytes. The resulting string can be read back to a `Double` by `CVD`.

This function is useful to write numeric values to buffers without using a `Type` definition.

**Example**

```basic
Dim n As Double, e As String
n = 1.2345
e = MKD(n)
Print n, CVD(e)
```
Dialect Differences

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

Differences from QB

- None

See also

- MKI
- MKL
- MKS
- CVD
- CVI
- CVL
- CVS
**MkDir**

Makes a folder/directory on the local file system

**Syntax**

```vbnet
Declare Function MkDir ( ByRef folder As Const String ) As Long
```

**Usage**

```vbnet
result = MkDir( folder )
```

**Parameters**

*folder*

The folder/directory to be created.

**Return Value**

Returns zero (0) on success, and negative one (-1) on failure.

**Description**

Creates a folder on the local file system.

**Example**

```vbnet
Dim pathname As String = "foo\bar\baz"
Dim result As Integer = MkDir( pathname )
If 0 <> result Then Print "error: unable to create"
```

**Platform Differences**

- Linux requires the *filename* case matches the real name of the file.
- Path separators in Linux are forward slashes / . Windows uses backward \ slashes.
Differences from QB

- None

See also

- Shell
- ChDir
- RmDir
Does a binary copy from an integer variable to a String of the same length as the size of the input variable.

**Syntax**

```vba
Declare Function MKI ( ByVal number As Integer ) As String
 Declare Function MKI<bits> ( ByVal number As Integer<bits> ) As String
```

**Usage**

```vba
result = MKI[$]( number )
result = MKI[$]<bits>( number )
```

**Parameters**

- `number`
  A Integer or Integer<bits> variable to binary copy to a String.

**Return Value**

Returns a String containing a binary copy of `number`.

**Description**

Does a binary copy from an Integer or Integer<bits> variable to a String, setting its length to the number of bytes in the type. The resulting string can be read back to an integer type using cvi or cvi<bits>.

This function is useful to write numeric values to buffers without using a Type definition.

**MKI** supports an optional <bits> parameter before the argument. If `bits` is 16, MKShort will be called instead; if `bits` is 32, MKL will be called; if `bits` is 64, MKLongInt will be called. The length of the return value and the required `number` argument type will depend on which function is called. See each function’s page for more information.
Example

```
Dim a As Integer, b As String
a = 4534
b = MKI(a)
Print a, CVI(b)
```

Dialect Differences

- In the `-lang qb` dialect, `MKI` returns a 2-byte-string, since a QB integer is only 16 bits.
- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lan fb` dialects.
- QB did not support a `<bits>` parameter.

See also

- CVI
- MKShort
- MKL
- MKLongInt
- Integer
Does a binary copy from a Long variable to a String, setting its length to 4 bytes.

**Syntax**

```vbnet
Declare Function MKL ( ByVal number As Long ) As String
```

**Usage**

```vbnet
result = MKL( number )
```

**Parameters**

- **number**
  A Long variable to binary copy to a String.

**Return Value**

Returns a String with a binary copy of the Long.

**Description**

Does a binary copy from a Long variable to a String, setting its length to 4 bytes. The resulting string can be read back to a Long by CVL.

This function is useful to write numeric values to buffers without using a Type definition.

**Example**

```vbnet
Dim a As Long, b As String
a = 4534
b = MKL(a)
Print a, CVL(b)
Sleep
```
Dialect Differences

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

Differences from QB

- None

See also

- MKD
- MKI
- MKS
- CVD
- CVI
- CVL
- CVS
**MKLongInt**

Does a binary copy from a **LongInt** variable to a **String**, setting its length to 8 bytes

**Syntax**

```
Declare Function MKLongInt ( ByVal number As LongInt ) As String
```

**Usage**

```
result = MKLongInt[$]( number )
```

**Parameters**

`number`

A **LongInt** variable to binary copy to a **String**.

**Return Value**

Returns a **String** with a binary copy of the **LongInt**.

**Description**

Does a binary copy from a **LongInt** variable to a string, setting its length to 8 bytes. The resulting string can be read back to a longint by **CVLongInt**

This function is useful to write numeric values to buffers without using a **Type** definition.

**Example**

```
Dim a As LongInt, b As String
a = 4534
b = MKLongInt(a)
Print a, CVLongInt(b)
Sleep
```
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Mklongint`.

Differences from QB

- New to FreeBASIC

See also

- `CVLongInt`
Does a binary copy from a `Single` variable to a `String`, setting its length to 4 bytes

**Syntax**

```
Declare Function MKS ( ByVal number As Single ) As String
```

**Usage**

```
result = MKS$( number )
```

**Parameters**

`number`

A `Single` variable to binary copy to a `String`.

**Return Value**

Returns a `String` with a binary copy of the `Single`.

**Description**

Does a binary copy from a `single` variable to a `String`, setting its length to 4 bytes. The resulting string can be read back to a `Single` by `cvs`.

This function is useful to write numeric values to buffers without using a `Type` definition.

**Example**

```
Dim n As Single, e As String
n = 1.2345
e = MKS(n)
Print n, CVS(e)
```
Dialect Differences

- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lan fb` dialects.

Differences from QB

- None

See also

- MKI
- MKL
- MKS
- CVD
- CVI
- CVL
- CVS
**MKShort**

Does a binary copy from a **Short** variable to a **String**, setting its length to 2 bytes.

**Syntax**

`Declare Function MKShort ( ByVal number As Short ) As String`

**Usage**

`result = MKShort[$](number)`

**Parameters**

`number`

A **Short** variable to binary copy to a **String**.

**Return Value**

Returns a **String** with a binary copy of the **Short**.

**Description**

Does a binary copy from a **SHORT** variable to a string, setting its length to 2 bytes. The resulting string can be read back to a **Short** by **CVShort**

This function is useful to write numeric values to buffers without using a **Type** definition.

**Example**

```basic
Dim a As Short, b As String
a = 4534
b = MKShort(a)
Print a, CVShort(b)
Sleep
```
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Mkshort.

Differences from QB

- In QBasic this function is called MKI.

See also

- CVShort
Operator Mod (Modulus)

Finds the remainder from a division operation

**Syntax**

```
Declare Operator Mod ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
```

**Usage**

```
result = lhs Mod rhs
```

**Parameters**

- `lhs`  
The left-hand side dividend expression.
- `rhs`  
The right-hand side divisor expression.

**Return Value**

Returns the remainder of a division operation.

**Description**

Operator Mod (Modulus) divides two Integer expressions and returns the remainder. Numeric values are converted to Integer by rounding up or down.

Neither of the operands are modified in any way.

This operator can be overloaded for user-defined types.

**Example**

```
Print 47 Mod 7
Print 5.6 Mod 2.1
Print 5.1 Mod 2.8
```
Output:

<table>
<thead>
<tr>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

This is because:
- 47 divided by 7 gives a remainder of 5
- 5.6 is rounded to 6 while 2.1 is rounded to 2. This makes the problem 6 MOD 2 which means 6 divided by 2 which gives a remainder of 0
- 5.1 is rounded to 5 while 2.8 is rounded to 3. This makes the problem 5 MOD 3 which means 5 divided by 3 which gives a remainder of 2

**Dialect Differences**
- In the *-lang qb* dialect, this operator cannot be overloaded.

**Differences from QB**
- None

**See also**
- Mathematical Functions
Month

Gets the month of the year from a Date Serial

Syntax

`Declare Function Month ( ByVal date_serial As Double ) As Long`

Usage

```c
#include "vbcompat.bi"
result = Month( date_serial )
```

Parameters

- `date_serial`
  the date

Return Value

Returns the month number from a variable containing a date in Date Serial.

The month values are in the range 1-12 being 1 for January and 12 for December.

Description

The compiler will not recognize this function unless vbcompat.bi is included.

Example

```c
#include "vbcompat.bi"
Dim a As Double = DateSerial(2005,11,28) + TimeSerial
Print Format(a, "yyyy/mm/dd hh:mm:ss"); Month(a)
```
Differences from QB

- Did not exist in QB. This function appeared in PDS and VBDO.

See also

- Date Serials
MonthName

Gets the name of a month from its integral representation

**Syntax**

```
Declare Function MonthName ( ByVal month As Long, ByVal abbreviate As Boolean )
```

**Usage**

```
#include "vbcompat.bi"
result = MonthName( month_number [, abbreviate ] )
```

**Parameters**

- **month**
  
  the number of the month of the year - 1:January through 12:December

- **abbreviate**
  
  flag to indicate that name should be abbreviated

**Return Value**

Returns the local operating system language month name from `month`

**Description**

If `abbreviate` is true, the month name abbreviation is returned. If omitted, the whole name is returned.

The compiler will not recognize this function unless `vbcompat.bi` or `datetime.bi` is included.

**Example**

```
#include "vbcompat.bi"
Dim ds As Double = DateSerial(2005, 11, 28) + TimeSerial(0, 0, 0)
Print Format(ds, "yyyy/mm/dd hh:mm:ss "); MonthName
```
Differences from QB

- Did not exist in QB. This function appeared in Visual Basic.

See also

- Date Serials
**MultiKey**

Detects the status of keys by keyboard scancode.

**Syntax**

```vbnet
Declare Function MultiKey (ByVal scancode As Long) As Long
```

**Usage**

```vbnet
result = MultiKey(scancode)
```

**Parameters**

`scancode`

The **scan code** of the key to check.

**Return Value**

Returns -1 if the key for the specified **scan code** is pressed, otherwise returns 0.

**Description**

`MultiKey` is a function which will detect the status of any key, determined return -1 if the key is pressed, otherwise it will return 0. The keyboard use `MultiKey`; that is, pressed keys will be stored and subsequently released means you have to empty `Inkey` manually when you finish using `MultiKey` method:

```vbnet
While Inkey <> "": Wend  ' loop until the Inkey buffer is empty
```

Keeping `Inkey` to work while you use `MultiKey` allows more flexibility a `Chr(255)+"k"` combo returned on window close button click, if a windowed graphics mode has been set via the `Screen` statement. For a list of accepted scancodes, see **DOS keyboard scancodes** guaranteed to be valid for all FreeBASIC supported platforms.

`MultiKey` should always work in graphics mode, as long as the screen depends on the platform the program is run on though, and cannot be

**Example**
```plaintext
#include "fbgfx.bi"
#if __FB_LANG__ = "fb"
Using FB ' ' Scan code constants are stored in the FB namespace in lang FB #endif

Dim As Integer x, y

ScreenRes 640, 480

Color 2, 15

x = 320: y = 240

Do
    ' Check arrow keys and update the (x, y) position
    If MultiKey(SC_LEFT ) And x > 0 Then x = x -
    If MultiKey(SC_RIGHT ) And x < 639 Then x = x +
    If MultiKey(SC_UP    ) And y > 0 Then y = y -
    If MultiKey(SC_DOWN  ) And y < 479 Then y = y +

    ' Lock the page while we work on it
    ScreenLock
    ' Clear the screen and draw a circle at the position
    Cls
    Circle(x, y), 30, , , , ,F
    ScreenUnlock

    Sleep 15, 1

    ' Run loop until user presses Escape
    Loop Until MultiKey(SC_ESCAPE)

    ' Clear Inkey buffer
    While Inkey <> "": Wend

Print "Press CTRL and H to exit..."

Do
```
Sleep 25

'' Stay in loop until user holds down CTRL and
If MultiKey(SC_CONTROL) And MultiKey(SC_H) Then
Loop

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Keyboard scancodes
- GetMouse
- GetJoystick
- Screen (Graphics)
- Inkey
**MutexCreate**

Creates a mutex used for synchronizing the execution of threads

**Syntax**

```basic
Declare Function MutexCreate() As Any Ptr
```

**Usage**

```basic
result = MutexCreate
```

**Return Value**

The Any Ptr handle of the mutex created, or the null pointer (0) on fail.

**Description**

 Mutexes, short for "Mutually Exclusive", are a way of synchronizing shared data (or a local static variable used by a single thread called multiple times) within threads. (or a local static variable used by a single thread called multiple times) MutexLock with that mutex (including the main thread executing main program), until it is unlocked with Mutexcreate creates a mutex, returning a handle which is to be referred to when locking, unlocking, or destroying the mutex. Mutexcreate should be destroyed when no longer needed or before the program ends.

A mutex is a lock that guarantees three things:

1. Atomicity - Locking a mutex is an atomic operation, meaning that no other thread succeeded in locking this mutex at the same time.
2. Singularity - If a thread managed to lock a mutex, it is assured that the lock.
3. Non-Busy Wait - If a thread attempts to lock a thread that was locked (any CPU resources) until the lock is freed by the second thread. At this time, the first thread will wake up and continue execution, having the mutex locked by it.

**Example**

See also the ThreadCreate examples.

```
'Visual example of mutual exclusion between 2 threads
```

"Visual example of mutual exclusion between 2 threads"
the "user-defined thread" computes the points coordinates on a circle, and the "main thread" plots the points.

Principle of mutual exclusion
Thread#A XOR Thread#B

.....
MutexLock(mut)
Do_something#A_with_exclusion
MutexUnlock(mut)

.....

Behavior:
- The first point must be pre-calculated.
- Nothing prevents that a same calculated point could be plotted several times (depends on execution times of the loops between main thread and user thread).
- Nothing prevents that a calculated point could be not plotted (same remark on the loop times).

If you comment out the lines containing "MutexLock" and "MutexUnlock" (inside "user-defined thread" or/and "main thread"), there will be no longer mutual exclusion between the computation of coordinates and plotting of points, and many points will not be plotted on circle (due to non-coherent coordinates).

Type ThreadUDT
Dim handle As Any Ptr
Dim sync As Any Ptr
Dim quit As Byte
Declare Static Sub Thread(ByVal param As Any Ptr)
Dim procedure As Sub (ByVal As Any Ptr)
Dim p As Any Ptr
Const false As Byte = 0
Const true As Byte = Not false
End Type

Static Sub ThreadUDT.Thread(ByVal param As Any Ptr)
Dim tp As ThreadUDT Ptr = param
Do
Static As Integer I
MutexLock(tp->sync)
   tp->procedure(tp->p)
   I += 1
   Locate 30, 38
   Print I;
   MutexUnlock(tp->sync)
   Sleep 5
Loop Until tp->quit = tp->true
End Sub

'-----------------------------------------------------------------------------------------------------

Type Point2D
   Dim x As Integer
   Dim y As Integer
End Type

Const x0 As Integer = 640 / 2
Const y0 As Integer = 480 / 2
Const r0 As Integer = 200
Const pi As Single = 4 * Atn(1)

Sub PointOnCircle (ByVal p As Any Ptr)
   Dim pp As Point2D Ptr = p
   Dim teta As Single = 2 * pi * Rnd
   pp->x = x0 + r0 * Cos(teta)
   Sleep 5
   pp->y = y0 + r0 * Sin(teta)
End Sub

Screen 12
Locate 30, 2
Print "<any_key> : exit";
Locate 30, 27
Print "calculated:"
Locate 30, 54
Print "plotted:";
Dim Pptr As Point2D Ptr = New Point2D
PointOnCircle(Pptr) ' Computation

Dim Tptr As ThreadUDT Ptr = New ThreadUDT
Tptr->sync = MutexCreate
Tptr->procedure = @PointOnCircle
Tptr->p = Pptr
Tptr->handle = ThreadCreate(@ThreadUDT.Thread, Tptr)

Do
    Static As Integer I
    Sleep 5
    MutexLock(Tptr->sync) ' Mutex (Lock) for main
    PSet (Pptr->x, Pptr->y) ' Plotting one point
    I += 1
    Locate 30, 62
    Print I;
    MutexUnlock(Tptr->sync) ' Mutex (Unlock) for main
Loop Until Inkey <> ""

Tptr->quit = Tptr->true
ThreadWait(Tptr->handle)
MutexDestroy(Tptr->sync)
Delete Tptr
Delete Pptr

Sleep

See also the similar CondCreate example

**Dialect Differences**

- Threading is not allowed in the `-lang qb` dialect.

**Platform Differences**

- The DOS version of FreeBASIC does not allow for threads, as
In Linux the threads are always started in the order they are created, this can’t be assumed in Win32. It’s an OS, not a FreeBASIC issue.

**Differences from QB**

- New to FreeBASIC

**See also**

- `MutexDestroy`
- `MutexLock`
- `MutexUnlock`
- `ThreadCreate`
- `ThreadWait`
MutexDestroy

Destroys a mutex

Syntax

Declare Sub MutexDestroy ( ByVal id As Any Ptr )

Usage

MutexDestroy( id )

Parameters

id

The Any_Ptr handle of the mutex to be destroyed.

Description

Mutexdestroy discards a mutex created by MutexCreate. This call should be executed after any threads using the mutex are no longer in use.

See MutexCreate for more general information on mutexes.

Example

See the examples in MutexCreate and also ThreadCreate.

Dialect Differences

- Threading is not allowed in the -lang qb dialect.

Platform Differences

- The DOS version of FreeBASIC does not allow for threads, as the OS does not support them.
- In Linux the threads are always started in the order they are created, this can't be assumed in Win32. It's an OS, not a FreeBASIC issue.
Differences from QB

- New to FreeBASIC

See also

- MutexCreate
- MutexLock
- MutexUnlock
- ThreadCreate
- ThreadWait
MutexLock

Acquires a mutex

Syntax

```plaintext
Declare Sub MutexLock ( ByVal id As Any Ptr )
```

Usage

```plaintext
MutexLock( id )
```

Parameters

```plaintext
id
The Any Ptr handle of the mutex to be locked.
```

Description

MutexLock halts any other threads using a mutex "handle", generated by
unlocked with MutexUnlock.

See MutexCreate for more general information on mutexes.

Example

See also the examples in MutexCreate and also ThreadCreate.

```plaintext
'Example of mutual exclusion for synchronization by
by using 2 Mutexes only (by self lock and mutual
'The Producer works one time, then the Consumer works

'Principle of synchronisation by mutual exclusion
'(initial condition: mut#A and mut#B locked)

' Thread#A XORs
'Do_something#A_with_exclusion MutexLock(mut#A)
'MutexUnlock(mut#A)
'Do_somet
'.....
```

```plaintext
MutexUnlock(mut#B)
```
Dim Shared produced As Any Ptr
Dim Shared consumed As Any Ptr
Dim consumer_id As Any Ptr
Dim producer_id As Any Ptr

Sub consumer ( ByVal param As Any Ptr )
    For i As Integer = 0 To 9
        MutexLock produced
        Print "",consumer gets:" ; i
        MutexUnlock consumed
        Sleep 5
    Next i
End Sub

Sub producer ( ByVal param As Any Ptr )
    For i As Integer = 0 To 9
        Print "Producer puts:" ; i;
        MutexUnlock produced
        MutexLock consumed
        Sleep 5
    Next i
End Sub

produced = MutexCreate
consumed = MutexCreate
If ( produced = 0 ) Or ( consumed = 0 ) Then
    Print "Error creating mutexes! Exiting..."
    Sleep
    End
End If

MutexLock produced
MutexLock consumed
consumer_id = ThreadCreate ( @ consumer )
producer_id = ThreadCreate ( @ producer )
If ( producer_id = 0 ) Or ( consumer_id = 0 ) Then
    Print "Error creating threads! Exiting..."
    Sleep
    End
End If

ThreadWait consumer_id
ThreadWait producer_id

MutexDestroy consumed
MutexDestroy produced

Sleep

**Dialect Differences**

- Threading is not allowed in the *-lang qb* dialect.

**Platform Differences**

- The DOS version of FreeBASIC does not allow for threads, as
- In Linux the threads are always started in the order they are created in Win32. It's an OS, not a FreeBASIC issue.

**Differences from QB**

- New to FreeBASIC

**See also**

- MutexCreate
- MutexDestroy
- MutexUnlock
- ThreadCreate
- ThreadWait
MutexUnlock

Releases a mutex lock

**Syntax**

```
Declare Sub MutexUnlock ( ByVal id As Any Ptr )
```

**Usage**

```
MutexUnlock( id )
```

**Parameters**

`id`

The *Any_Ptr* handle of the mutex to be unlocked.

**Description**

`MutexUnlock` releases a mutex "handle" created by `MutexCreate`, and locked with `MutexLock`. This allows other threads sharing the mutex to continue execution.

See `MutexCreate` for more general information on mutexes.

**Example**

See the examples in `MutexCreate` and also `ThreadCreate`.

**Dialect Differences**

- Threading is not allowed in the `-lang qb` dialect.

**Platform Differences**

- The DOS version of FreeBASIC does not allow for threads, as the OS does not support them.
- In Linux the threads are always started in the order they are created, this can't be assumed in Win32. It's an OS, not a FreeBASIC issue.
Differences from QB

- New to FreeBASIC

See also

- MutexCreate
- MutexDestroy
- MutexLock
- ThreadCreate
- ThreadWait
Naked

Write functions without prolog/epilog code

Syntax

\{
Sub \mid Function\} identifier Naked [calling_convention] \{ param_list
asm_statements
End \{Sub \mid Function\}

Parameters

identifier - name of the procedure.
calling_convention - calling convention of the procedure - can be cdecl
asm_statements - the code in the procedure body. The code for handling these can change, depending on the calling convention.
param_list - parameters to be passed to the procedure.
data_type - the data type of the function.

Description

Naked allows the programmer to write procedures without the compiler adding any unnecessary overhead.

Example

```
'' Naked cdecl function
Function subtract_c Naked cdecl _ '' parameters
( _
   ByVal a As Long, _
   ByVal b As Long _
   ) As Long

Asm
   mov eax, dword Ptr [esp+4] '' eax = a
   sub eax, dword Ptr [esp+8] '' eax -= b
   ret
End Asm
```
End Function

Print subtract_c( 5, 1 ) '' 5 - 1

---------------------------------------------------------------------------------------------------------------------

'' Naked stdcall function
Function subtract_s Naked stdcall _ '' parameters
                  _  '' called procedure
                  _  '' (appending
                  
                  ByVal a As Long, _
                  ByVal b As Long _  '' parameter push
                  ) As Long

Asm
      mov eax, dword Ptr [esp+4]  '' eax = a
      sub eax, dword Ptr [esp+8]  '' eax -= b
      ret 8                      '' return result
End Asm

End Function

Print subtract_s( 5, 1 ) '' 5 - 1

---------------------------------------------------------------------------------------------------------------------

'' Naked pascal function
Function subtract_p Naked pascal _ '' parameters
                  _  '' called procedure
                  _  '' (appending
                  
                  ByVal a As Long, _  '' parameter push
                  ByVal b As Long _
                  ) As Long

Asm
      mov eax, dword Ptr [esp+8]  '' eax = a
      sub eax, dword Ptr [esp+4]  '' eax -= b
'' Naked cdecl function
'' plus ecx register preserved in asm block by creating user stack
Function subtract_cp Naked cdecl _
( _
    ByVal a As Long, _
    ByVal b As Long _
) As Long

Asm
    push ebp
    mov ebp, esp
    push ecx
    mov eax, dword Ptr [(ebp+4)+4]  ' eax = a
    mov ecx, dword Ptr [(ebp+8)+4]  ' ecx = b
    Sub eax, ecx
    pop ecx
    mov esp, ebp
    pop ebp
    ret
End Asm

End Function

Print subtract_cp( 5, 1 ) '' 5 - 1

Platform Differences
- The default calling convention depends on the target platform,

**Differences from QB**

- New to FreeBASIC

**See also**

- Asm
- Calling Conventions
- Function
- Sub
- cdecl
- pascal
- stdcall
Name

Renames a file on disk

Syntax

Declare Function Name( ByRef oldname As Const String, ByRef newname As Long)

Usage

result = Name( oldname, newname )

Parameters

oldname
Name of an existing file.

newname
New name of the file.

Return Value

Returns zero (0) on success and non-zero on failure.

Description

Renames a file or folder originally called oldname to newname.

The function is not guaranteed to succeed if a file/folder exists with the same name. It may succeed, overwriting the original, or it may fail. For greater control, FileExists could be used to test for an existing file, and Kill could be used to delete an existing file.

Example

Dim OldName As String
Dim NewName As String
Dim result As Integer

OldName = "dsc001.jpg"
NewName = "landscape.jpg"
result = Name( OldName, NewName )
If 0 <> result Then
  Print "error renaming " & oldname & " to " & newname
End If

Differences from QB

- In QB, NAME required AS rather than a comma between the old and new names because NAME was a language keyword rather than a function.

See also

- Kill
- FileExists
Namespace

Declares a namespace block

Syntax

```
Namespace identifier [ Alias "aliasname" ]
statements
End Namespace
```

Parameters

- `identifier`
  The name of the namespace (including nested names specifier).
- `aliasname`
  An alternate external name for the namespace.

Description

Namespaces allow to group entities like objects (predefined data-type declarations) under a name. This way the global scope can be divided.

Whether or not explicitly declared a namespace in a source file, the common namespace, is present in every file.

Any identifier in the global namespace is available for use in a named declared inside a namespace).

Namespaces implicitly have public access and this is not modifiable.

A variable declared inside a namespace is always implicitly static and not specified (static and shared are optional, but this may improve code readability).

Namespaces do not have any effect on the visibility of a define.

It is possible to define a namespace in two or more declarations.

Namespaces are commonly used in libraries where you don’t want all symbols defined in the global namespace.

For example, if you used the "Forms" library, it might define the Point type for another purpose. This can be resolved by creating the namespace Forms for the Point.

To access duplicated symbols defined in the global namespace, use:
Namespaces are GCC C++ compatible, the following code aims to test:

```cpp
// mylib.cpp
// To compile:
```
// g++ -c mylib.cpp -o mylib.o
// ar rcs libmylib.a mylib.o

#include
#include

namespace mylib
{
    int test()
    {
        return 123;
    }
}

'' test.bas

Extern "c++" Lib "mylib"
    Namespace mylib Alias "mylib"
        Declare Function test() As Integer
    End Namespace
End Extern

Print mylib.test()
Control flow statement to mark the end of a `For...Next` loop.

**Syntax**

```
Next [ identifier_list ]
```

**Description**

Indicates the end of a statement block associated with a matching `For` statement.

When `Next` is used on its own without an `identifier_list`, it closes the most recent `For` statement block.

`identifier_list` is optional and may be one or more variable names separated by commas. This form of the `Next` statement is retained for compatibility with QB. `identifier_list`, if given, must match the identifiers used in the associated `For` statements in reverse order, from inner to outer.

**Example**

```
For i As Integer = 1 To 10
    For j As Integer = 1 To 2
        ...
    Next
Next
```

```
For i As Integer = 1 To 10
    For j As Integer = 1 To 2
        ...
    Next j
Next i
```
For i As Integer = 1 To 10
For j As Integer = 1 To 2
    '
    ...
Next j, i

**Differences from QB**

- **ByRef** arguments cannot be used as counters.

**See also**

- **For...Next**
Operator New

Operator to dynamically allocate memory and construct data of a specified type.

Syntax

Declare Operator New ( size As UInteger ) As Any Ptr
Declare Operator new[] ( size As UInteger ) As Any Ptr

Usage

result = New datatype
or
result = New datatype ( initializers, ... )
or
result = New datatype[ count ]

Parameters

size
Number of bytes to allocate.
initializers
Initial value(s) for the variable.
datatype
Name of the data type to create.
count
Exact number of elements to allocate.

Return Value

A pointer of type datatype to the newly allocated data.

Description

The New operator dynamically allocates memory and constructs a specified type such as integers, an initial value can be given. For types without constructors, default values for those types will be set.

Types that have constructors can have their constructors called by New. The default constructor for the type will be used to set the initial values.

New[] is the array-version of the New operator and allocates enough memory for the specified number of objects. The default constructor for the type will be used to set the initial values.
Objects created with `New` must be freed with `Delete`. Memory allocated with `Delete` must be freed with `Delete`. You cannot mix and match the different versions of `Delete`.

Specifying an initial value of `Any`, as in `New datatype(Any)` will allocate memory for the data. This is only valid on data types that do not have constructors (other than the syntax of simple memory allocation with pointer conversion, like `Cptr(type)`). It can be substituted to the invalid use of `New...Any`.

Specifying an initial value of `Any`, as in `New datatype[count]{}(Any)` will allocate memory for the array. This is only valid on data types that do not have constructors (other than the syntax of simple memory allocation with pointer conversion, like `Cptr(type)`) can be substituted to the invalid use of `New...Any`.

### Example

```plaintext
Type Rational
    As Integer numerator, denominator
End Type

Scope

    ' Create and initialize a "rational" and store its address.
    Dim p As Rational Ptr = New Rational(3, 4)

    Print p->numerator & "/" & p->denominator

    ' Destroy the rational and give its memory back to the system.
    Delete p

End Scope

Scope

    ' Allocate memory for 100 integers and store the address.
    Dim p As Integer Ptr = New Integer[100]

    ' Assign some values to the integers in the array.
```
For i As Integer = 0 To 99
    p[i] = i
Next

' Free the entire integer array.
Delete[] p
End Scope

Dialect Differences

- Only available in the -lang fb dialect.

Differences from QB

- New to FreeBASIC

See also

- Delete
- Placement New
### Operator Placement New

Operator to construct an object at a specified memory address.

#### Syntax

```plaintext
result = New(address) datatype  
or
result = New(address) datatype ( initializers, ... )  
or
result = New(address) datatype[ count ]
```

#### Parameters

- **address**
  - the location in memory to construct. The parenthesis are **not** optional.
- **initializers**
  - Initial value(s) for the variable.
- **datatype**
  - name of the data type to construct.
- **count**
  - Number of elements to construct.

#### Return Value

A pointer of type `datatype` to the newly constructed data.

#### Description

The `Placement New` operator constructs a specified data type at the specified memory location.

For simple types, like integers, an initial value can be given. For types with field, types that have constructors can have their constructors called, values for those types will be set.

Memory is **not** allocated when using the `Placement New` operator. Instead, it is incorrect to call `Delete` on the address. The proper way is to only use syntax as for a member method by using member access operator. See examples below for proper `placement new` usage.

Specifying an initial value of `Any`, as in `New(address)datatype(Any)` or `New(address)datatype[](Any)`, is not valid.
This is only valid on data types that do not have constructors (otherwise, conversion, like \texttt{Cptr(datatype Ptr, address)}, can be substituted to the

Example

\begin{verbatim}
' ' "placement new" example

Type Rational
   As Integer   numerator, denominator
Declare Constructor ( ByVal n As Integer, ByVal d As String  ratio = "/"
End Type

Constructor Rational ( ByVal n As Integer, ByVal d As String)
   This.numerator = n
   This.denominator = d
End Constructor

Scope

' ' allocate some memory to construct as a Rational
Dim As Any  Ptr ap = CAllocate(Len(Rational))

' ' make the placement new call
Dim As Rational  Ptr r = New (ap) Rational( 3,

' ' you can see, the addresses are the same, just:
Print ap, r

' ' confirm all is okay
Print r->numerator & r->ratio & r->denominator

' ' delete must not be used with placement new
' ' destroying must be done explicitly if a destructor
' ' (in this example, the var-string member induces
r->Destructor( )

' ' we explicitly allocated, so we explicitly deal
\end{verbatim}
Deallocate( ap )

End Scope

Dialect Differences

- Only available in the `-lang fb` dialect.

Differences from QB

- New to FreeBASIC

See also

- Destructor
- New
**Resume Next**

Error handling statement to resume execution after a jump to an error handler.

**Syntax**

```
Resume Next
```

**Description**

`Resume Next` is used in the traditional QB error handling mechanism with the line after the one that caused the error. Usually this is used to avoid executing the same line and causing the error again.

`Resume Next` resets the `Err` value to 0.

**Example**

```
' Compile with -lang fblite or qb

#lang "fblite"

Dim As Single i, j

On Error Goto ErrHandler

i = 0
j = 5
j = 1 / i ' this line causes a divide-by-zero error

Print "ending..."

End ' end the program so that execution does not fall through to the error handler again

ErrHandler:

Resume Next ' execution jumps to 'Print "ending..."
```
Dialect Differences

- RESUME NEXT is not supported in the -lang fb dialect. Stater

```vbnet
If Open( "text" For Input As #1 ) <> 0 Then
    Print "Unable to open file"
End If
```

Differences from QB

- Must compile with -ex option

See also

- Err
- Resume
- Error Handling
Operator Not (Complement)

Returns the bitwise-not (complement) of a numeric value

Syntax

Declare Operator Not ( ByRef rhs As Byte ) As Integer
Declare Operator Not ( ByRef rhs As UByte ) As Integer
Declare Operator Not ( ByRef rhs As Single ) As Integer
Declare Operator Not ( ByRef rhs As Double ) As Integer
Declare Operator Not ( ByRef rhs As T ) As T

Usage

result = Not rhs

Parameters

rhs
The right-hand side expression.
T
Any numeric or boolean type.

Return Value

Returns the bitwise-complement of its operand.

Description

This operator returns the bitwise-complement of its operand, a logical bits set depending on the bits of the operand.
(for a boolean type, 'Not false' returns 'true' and 'Not true' returns 'false

The truth table below demonstrates all combinations of a boolean-con

<table>
<thead>
<tr>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
This operator can be overloaded for user-defined types.

Example

' Using the NOT operator on a numeric value

Dim numeric_value As Byte
numeric_value = 15 '00001111

'Result = -16 = 11110000
Print Not numeric_value

' Using the NOT operator on conditional expressions

Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 15
numeric_value2 = 25

If Not numeric_value1 = 10 Then Print "Numeric_Value1 is not equal to 10"
If Not numeric_value2 = 25 Then Print "Numeric_Value2 is not equal to 25"

' This will output "Numeric_Value1 is not equal to 10" because the first IF statement is false.
' It will not output the result of the second IF statement because the condition is true.

Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB

- None
See also

- Operator Truth Tables
Now

Gets the current system time as a Date Serial

Syntax

    Declare Function Now ( ) As Double

Usage

    #include "vbcompat.bi"
    result = Now

Return Value

Returns a date serial containing the system's date and time at execution time.

Description

As the time is the decimal part of a date serial, if the value of Now is saved to an integer, the time in it will be reset to 00:00:00

The compiler will not recognize this function unless vbcompat.bi is included.

Example

    #include "vbcompat.bi"
    Dim a As Double = Now()
    Print Format(a, "yyyy/mm/dd hh:mm:ss")

Differences from QB

* Did not exist in QB. This function appeared in PDS and VBDOS
See also

- Date Serials
Object

Built-in type providing run-time type information

Syntax

Type object
As fb_BaseVT Ptr vtable_ptr
Declare Constructor()
End Type

Usage

Type typename Extends object
End Type

Dim variable As object

Description

Object is a built-in type which provides run-time type information for a types derived from it using Extends, allowing them to be used with Operator Is, and to support Virtual and Abstract methods.

Extending the built-in Object type allows to add an extra hidden vtable pointer field at the top of the Type. The vtable is used to dispatch Virtual and Abstract methods and to access information for run-time type identification used by Operator Is.

Example

See the Operator Is page, the Virtual and Abstract pages.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Object.

Differences from QB

- New to FreeBASIC
See also

- Extends
- Operator Is
- Virtual
- Abstract
Oct

Converts a number to octal representation

Syntax

Declare Function Oct ( ByVal number As UByte ) As String
Declare Function Oct ( ByVal number As UShort ) As String
Declare Function Oct ( ByVal number As ULong ) As String
Declare Function Oct ( ByVal number As ULongInt ) As String
Declare Function Oct ( ByVal number As Const Any Ptr ) As String
Declare Function Oct ( ByVal number As UByte, ByVal digits As Long ) As String
Declare Function Oct ( ByVal number As UShort, ByVal digits As Long ) As String
Declare Function Oct ( ByVal number As ULong, ByVal digits As Long ) As String
Declare Function Oct ( ByVal number As ULongInt, ByVal digits As Long ) As String
Declare Function Oct ( ByVal number As Const Any Ptr, ByVal digits As Long ) As String

Usage

result = Oct[$]( number [, digits ] )

Parameters

number
A number or expression evaluating to a number. A floating-point number will be converted to a LongInt.
digits
Desired number of digits in the returned string.

Return Value

A string containing the unsigned octal representation of number.

Description

Returns the unsigned octal string representation of number. Octal digits range from 0 to 7.
If you specify digits > 0, the result string will be exactly that length. It will be truncated or padded with zeros on the left, if necessary.

The length of the returned string will not be longer than the maximum number of digits required for the type of number (3 characters for Byte, 6 for Short, 11 for Long, and 22 for LongInt).

If you want to do the opposite, i.e. convert an octal string back into a number, the easiest way to do it is to prepend the string with "&O;", and convert it to an integer type, using a function like CInt, similarly to a normal numeric string. E.g. CInt("&O77;")

**Example**

```plaintext
Print Oct(54321)
Print Oct(54321, 4)
Print Oct(54321, 8)
```

will produce the output:

```plaintext
152061
2061
00152061
```

**Dialect Differences**

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

**Differences from QB**

- In QBASIC, there was no way to specify the number of digits returned.
The size of the string returned was limited to 32 bits, or 11 octal digits.

See also

- Bin
- Hex
- ValInt
- ValLng
**OffsetOf**

Returns the offset of a field within a type.

**Syntax**

```c
#define OffsetOf(typename, fieldname) CInt( @Cast( typename Ptr, 0 )->fieldname )
```

**Usage**

```c
result = OffsetOf( typename, fieldname )
```

**Parameters**

- **typename**
  Name of the type as defined using the `Type...End Type` statements.

- **fieldname**
  Name of the field as defined within the type (or within the base types for a derived type).

**Description**

For a non-derived type, `OffsetOf` will return the location `fieldname` as offset in bytes from the beginning of `typename`.

For a derived type, `OffsetOf` will return the location `fieldname` as offset in bytes from the beginning of its highest base type.

Note: if a member of the base type is overridden by a new member, the offset of the old member cannot be accessed from the derived type.

**Example**

```c
Type MyType
    x As Single
    y As Single
Union
    b As Byte
    i As Integer
End Union
```
End Type

Print "OffsetOf x = "; OffsetOf(MyType, x)
Print "OffsetOf y = "; OffsetOf(MyType, y)
Print "OffsetOf b = "; OffsetOf(MyType, b)
Print "OffsetOf i = "; OffsetOf(MyType, i)

Output

OffsetOf x = 0
OffsetOf y = 4
OffsetOf b = 8
OffsetOf i = 8

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Offsetof.

Differences from QB

- New to FreeBASIC

See also

- Type...End Type
- SizeOf
**On Error**

Error handling statement to set the current error handler

**Syntax**

```
On [Local] Error Goto label
```

**Parameters**

*label*

Label to jump to when an error occurs

**Description**

**On Error** triggers a jump to an error handler when an error occurs. Such errors can be triggered by built-in statements such as `Open`, or when the `Error` statement is used.

Note: The error checking for built-in statements is only enabled if the `e`, `-ex` or `-exx` options. **On Error** remains working with `Error` even if these options are used.

**On Local Error** can be used to specify a local error handler inside a procedure. Specialized per-procedure error handling and will override the global `Error` clause. If `Local`, the handler must be in the main part of the module.

Remark: Presently, the `Local` clause is ignored by the compiler.

**On Error Goto 0** deactivates the current error handler.

**Example**

```
' Compile with QB (-lang qb) dialect

'$lang: "qb"

On Error Goto errorhandler
Error 24 ' simulate an error
Print "this message will not be seen"
```
errorhandler:
  Print "Error #"; Err; "!"
End

' compile as: fbc onerror.bas -ex

#lang "fblite"

Function hFileExists( filename As String ) As Integer
  Dim f As Integer

  hFileExists = 0
  On Local Error Goto exitfunction

  f = FreeFile
  Open filename For Input As #f

  Close #f

  hFileExists = -1
exitfunction:
  Exit Function
End Function

  Print "File exists (0=false): "; hFileExists
  On Error Goto errhandler
  Error 1234
  Print "back from resume next"
  End 0

errhandler:
  Print "error number: " + Str( Err ) + " at line"
Differences from QB

- QB has no LOCAL clause and requires the label to be in the m

See also

- Error
- Local
- Err
- Runtime Error Codes
- Error Handling
On...Gosub

Calls a label based on an expression

Syntax

On expression Gosub label1[, ...]

Description

Branches to different labels depending on the value of expression. An expression value of 1 will branch to the first label, a value of 2 to the second, etc. If the value of expression is zero (0) or greater than the number of items in the list, execution continues on the next statement following the On...Gosub.

This statement behaves exactly like Gosub and execution may return to the statement following the On...Gosub using Return.

It is recommended that the structured Select Case conditional statement be used instead of On...Gosub.

Example

' Compile with -lang qb

'$lang: "qb"

choice = 3
On choice Gosub labela, labelb, labelc
Print "Good bye."
End

labela:
Print "choice a"
Return

labelb:
Dialect Differences

- Only available in the `-lang qb` and `-lang fblite` dialects.
- `On Gosub` support is disabled by default in the `-lang fblite` unless the `Option Gosub` statement is used.

Differences from QB

- FreeBASIC does not generate a run-time error if `expression` is negative or greater than 255.

See also

- `Select Case`
- `On...Goto`
- `GoSub`
- `Return`
- `Option Gosub`
On...Goto

Jumps to a label based on an expression.

Syntax

\[
\text{On expression Goto label1[, ...]}
\]

Description

Branches to different labels depending on the value of \textit{expression}. An expression value of 1 will branch to the first label, a value of 2 to the second, etc. If the value of \textit{expression} is zero (0) or greater than the number of items in the list, execution continues on the next statement following the \textbf{On...Goto}.

It is recommended that the structured \textbf{Select Case} conditional statement be used instead of \textbf{On...Goto}.

Example

\begin{verbatim}
Dim choice As Integer

Input "Enter a number: ", choice

On choice Goto labela, labelb, labelc

labela:
Print "choice a"
End

labelb:
Print "choice b"
End

labelc:
Print "choice c"
End
\end{verbatim}
Differences from QB

- FreeBASIC does not generate a run-time error if expression is negative or greater than 255.

See also

- Select Case
- On...Gosub
- Goto
Open a disk file for reading or writing using file operations

Syntax

```
Open filename For Input [encoding_type] [lock_type] As [#]filenumber
Open filename For Output [encoding_type] [lock_type] As [#]filenumber
Open filename For Append [encoding_type] [lock_type] As [#]filenumber
Open filename For Binary [access_type] [lock_type] As [#]filenumber
Open filename For Random [access_type] [lock_type] As [#]filenumber
```

Usage

```
result = Open( filename[], For {Input|Output|Append}[], As filenumber)
or
result = Open( filename[], For Binary[], Access {Read|Write}[], As filenumber)
or
result = Open( filename[], For Random[], Access {Read|Write}[], As filenumber)
or
Open filename For {Input|Output|Append} As filenumber
or
Open filename For Binary Access {Read|Write} As filenumber
or
Open filename For Random Access {Read|Write} As filenumber [Len]
```

Parameters

- **filename**
  A string value of the name of the disk file to open. Relative file paths are CurDir).

- **encoding_type**
  The encoding to be used when reading or writing text, can be one of:
  - Encoding "ascii" (ASCII encoding is used, default)
  - Encoding "utf8" (8-bit Unicode encoding is used)
  - Encoding "utf16" (16-bit Unicode encoding is used)
  - Encoding "utf32" (32-bit Unicode encoding is used)

- **access_type**
The type of access requested by the calling process.

- Access [Read] [Write] *(both read and write access can be used, which is the default)*

**lock_type**

Imposes restrictions on disk file access from other processes (threads or programs), can be either:

- Shared *(the file can be freely accessed by other processes)*
- Lock [Read] [Write] *(both read and write access can be denied to other processes)*

**filenum**

An available file number to bind to the disk file, which can be found with FreeFile.
The size, in bytes, of each record read from or written to the disk file. The record length can be specified.

**Return Value**

In the first usage, open returns zero (0) on success and a non-zero error code otherwise.

**Description**

Opens a disk file for reading and/or writing. The file number *file_num* is used for subsequent file operations, such as Input # and Lock. The next available file number can be retrieved with FreeFile.

The Input, Output and Append file modes open disk files for sequential text I/O, useful for reading or writing plain text files.
When the Input mode is specified, only reading file operations can be used; if the disk file does not exist a runtime error will be thrown.
The Append mode specifies that only writing operations can be used, like the Input mode.
The Append mode will take place at the end of the disk file if it exists, preserving the existing data.
The Output mode is like the Append mode, except that if the file exists then its contents are deleted and its length reset to zero before writing.

The Input, Output and Append file modes also allow selection of a character encoding type when reading from or writing text to the disk file. ASCII or a Unicode encoding may be specified (see the description of the encoding_type parameter above).

The Binary and Random file modes open disk files for random-access reading or writing. The Binary file mode allows reading and writing of simple data type values, while the Random file mode is similar to Binary. It is always used for reading or writing of arbitrary-sized data. The Binary read or write operations, like Get #, LOC and Seek, are among the procedures used for reading and writing to arbitrary locations in the disk file. The Random file mode is similar to Binary.
By default, the **Binary** and **Random** file modes allow both reading and writing operations on the opened disk file, but this can be changed by specifying an access type (see the description above).

For any file mode, access to the opened disk file can be restricted or granted to other threads or programs by specifying a lock type (see the description for the `lock_type` parameter above). Threads of the current program can freely open the disk file (Shared), while other programs cannot (Write). **Lock** and **Unlock** can be used to temporarily restrict access to parts of a file.

The error code returned by `Open` can be checked using `Err` in the next line directly the error code as an integer.

**Example**

```vbnet
' Create a string and fill it.
Dim buffer As String, f As Integer
buffer = "Hello World within a file."

' Find the first free file number.
f = FreeFile

' Open the file "file.ext" for binary usage, using
Open "file.ext" For Binary As #f
If Err>0 Then Print "Error opening the file":End

' Place our string inside the file, using number "f"
Put #f, , buffer

' Close all open files.
Close

' End the program. (Check the file "file.ext" upon
End

'OPEN A COM PORT```
Open Com "COM1:9600,N,8,1" As #1
If Err>0 Then Print "The port could not be opened."

'COM1, 9600 BAUD, NO PARITY BIT, EIGHT DATA BITS, ONE STOP BIT

'function version of OPEN
If Open("file.ext" For Binary Access Read As #1) =

    Print "Successfully opened file"
    ' ...

    Close #1

Else

    Print "Error opening file"

End If

Platform Differences

- Linux requires the filename case matches the real name of the file insensitive.
- Path separators in Linux are forward slashes /. Windows uses both forward slashes / and backward slashes \.
- On Windows, a file number used in a dynamic link library is not the same as the file number used in the main program. File numbers can not be passed or returned and then used between a DLL and an executable.
- If you try to open a directory on Linux, the open command will succeed.

Differences from QB

- Using MS-DOS device names to open streams or hardware devices only in the -lang qb dialect; for other modes FreeBASIC's new com
Open Com, Open Cons, Open Err, Open Pipe, Open Lpt, Open Scrn.

- Open can be called as a function that returns an error code.

**Dialect Differences**

- The `-lang qb` dialect supports the old GW-BASIC-style syntax of [length] with mode_string being "I" for input, "O" for output, "A" binary.

**See also**

- **Err** (and a list of error codes)
- Close
- FreeFile
- Open Cons, Open Err, Open Pipe, Open Lpt, Open Com, Open Scrn
Open Com

Opens a serial port for input and output

Syntax

Declare Function Open Com ( byref options As String, As filenum As Long ) As Long

Usage

result = Open Com( options[, ] As[#] filenum )

Parameters

options
A String containing options used in controlling the port.
filenum
The file number to bind to the port.

Return Value

Returns zero (0) on success and a non-zero error code otherwise.

Description

This command opens a serial port of the PC, allowing to send and receive data by using the normal file commands as Print #, Input #, Get #, ...

The main parameter is a String that describes, at the very least, which communications port to open. It has the format:

"Comn: [ baudrate ][ , [ parity ][ , [ data_bits ][ , [ stop_bit ][ , [ extended_options ]]]]]"

where,

n
Com port to open. "1", "2", "3", "4", etc. Some platforms will support more serial ports depending on how the operating system is configured. Where n is not given, "com:" will map to "com1:", except o
Linux where "\texttt{com:}" maps to "/dev/modem"

\textit{baudrate}

"300" (default), "1200", ..., etc.

\textit{parity}

"N" (none), "E" (even, default), "O" (odd), "S" (space), "M" (mark), "PE" (QB-quirk: checked, even parity)

\textit{data bits}

"5", "6", "7" (default) or "8".

\textit{stop_bits}

"1", "1.5" or "2". \textit{(default value depends on baud rate and data bits, see table below)}

\begin{center}
\begin{tabular}{|l|c|}
\hline
\textbf{Condition} & \textbf{Default number of stop bits} \\
\hline
baud rate <= 110 and data bits = 5 & 1.5 \\
baud rate <= 110 and data bits >= 6 & 2 \\
baud rate > 110 & 1 \\
\hline
\end{tabular}
\end{center}

\textit{extended_options}

Miscellaneous options. \textit{(See table below)}

\begin{center}
\begin{tabular}{|l|l|}
\hline
\textbf{Option} & \textbf{Action} \\
\hline
'CSn' & Set the CTS duration (in ms) (n>=0), 0 = turn off, default = 1000 \\
'DSn' & Set the DSR duration (in ms) (n>=0), 0 = turn off, default = 1000 \\
'CDn' & Set the Carrier Detect duration (in ms) (n>=0), 0 = turn off \\
'OPn' & Set the 'Open Timeout' (in ms) (n>=0), 0 = turn off \\
'TBn' & Set the 'Transmit Buffer' size (n>=0), 0 = default, depends on platform \\
'RBN' & Set the 'Receive Buffer' size (n>=0), 0 = default, depends on platform \\
'RS' & Suppress RTS detection \\
'LF' & Communicate in ASCII mode (add LF to every CR) - Win32 doesn't support this one \\
'ASC' & same as 'LF' \\
'BIN' & The opposite of LF and it'll always work \\
'PE' & Enable 'Parity' check \\
'DT' & Keep DTR enabled after CLOSE \\
'FE' & Discard invalid character on error \\
'ME' & Ignore all errors \\
'IRn' & IRQ number for COM (only supported (?) on DOS) \\
\hline
\end{tabular}
\end{center}
All items except for the COM port are optional. The order of \textit{baudrate}, \textit{parity}, \textit{data~bits}, \textit{stop~bits} is fixed. Any skipped fixed item (\textit{baudrate}, etc...) must be empty.

\textbf{Example}

\begin{verbatim}
Open Com  "COM1:9600,N,,2" As 1
\end{verbatim}

Opens COM1 with 9600 baud, no parity, 7 data bits and 2 stop bits.

\begin{verbatim}
Open Com  "COM1:115200" As 1
\end{verbatim}

Opens COM1 with 115200 baud, "even" parity, 7 data bits and 1 stop bits.

\textbf{Platform Differences}

\begin{itemize}
  \item On the Windows platform "\texttt{COM:}" maps to "\texttt{COM1:}"
  \item On the Linux platform
    \begin{itemize}
      \item "\texttt{COM:}" maps to "/dev/modem"
      \item "\texttt{COM1:}" maps to "/dev/ttyS0"
      \item "\texttt{COM2:}" maps to "/dev/ttyS1", etc
      \item "/dev/xyz:" maps to "/dev/xyz", etc
    \end{itemize}
  \item The DOS serial driver is experimental and can access COM ports 1 to 4
\end{itemize}

It uses the following base io and IRQ's as default:
COM1 - &h3f8; - IRQ4
COM2 - &h2f8; - IRQ3
COM3 - &h3e8; - IRQ4
COM4 - &h2e8; - IRQ3
Since fbc-0.18.4, an alternate IRQ can be specified using the the "\texttt{IR}\texttt{n}" protocol option where \textit{n} is 3 through 7.
Currently not supported: IRQ's on the slave PIC, alternate base I/O
addresses, Timeouts and most errors as detected in QB, hardware flow control, FIFO's. "COM:" maps to "COM1:"

**Dialect Differences**

- In the **-lang qb** dialect the old syntax OPEN "COMx:... is supported.

**Differences from QB**

- In QB the syntax was OPEN "COMx:[baudrate] [,parity, [data_bits, [stop_bits, [extended_options]]]]" FOR INPUT|OUTPUT|RANDOM AS [#] n

- In QB, only "COM1:" and "COM2:" are supported. In FreeBASIC, any correctly configured serial port may be used.

**See also**

- Open
Open Cons

Opens the console's standard input (stdin) or output (stdout) streams for use in file operations.

Syntax

Open Cons As [#]filenumber
Open Cons For Input As [#]filenumber
Open Cons For Output As [#]filenumber

Usage

result = Open Cons( [For {Input|Output}[,] As filenumber )
(or using the QB-like syntax.)
Open Cons [For {Input|Output}] As filenumber

Parameters

filenumber
An available file number to bind to the stdin or stdout stream, which can be found with FreeFile.

Return Value

In the first usage, Open Cons returns zero (0) on success and a non-zero error code otherwise.

Description

Open Cons opens the console's stdin or stdout streams for reading or writing. A file number is bound to the stream, which is used in subsequent file operations, such as Input#. An available file number can be retrieved with FreeFile.

The Input file mode opens the stdin stream for reading file operations, such as Line Input#, while the Output file mode opens the stdout stream for writing file operations, such as Print#. The Output file mode is the default if not specified.
The stdin and stdout streams are the ones used when the calling process' input or output is redirected (piped) by OS commands, or when it is opened with Open Pipe.

To open both the stdin and stdout streams for file operations, a process must use multiple file numbers.

**Runtime errors:**

Open Cons throws one of the following runtime errors:

1. **Illegal function call**
   - `filenumber` was not free at the time. Use `FreeFile` to ensure that `filenumber` is free.

**Example**

```vba
Dim a As String
Open Cons For Input As #1
Open Cons For Output As #2
Print #2, "Please write something and press ENTER"
Line Input #1, a
Print #2, "You wrote : "; a
Close
Sleep
```

**Differences from QB**

- In QB the syntax was `OPEN "CON:" FOR INPUT|OUTPUT AS [#]` after `filenum`

**See also**

- Open
- Open Scrn
- Open Err
- FreeFile
Open Err

Opens both the standard input (stdin) and standard error (stderr) stream file operations.

**Syntax**

```
Open Err [for mode] As [#]filenum As Long
```

**Usage**

```
Open Err [for mode] as [#]filenum
or
result = Open Err( [for mode[,]] as [#]filenum )
```

**Parameters**

- **mode**
  Ignored.
- **filenum**
  An unused file number.

**Return Value**

Zero is returned if `Open Err` completed successfully, otherwise a non-zero value is returned to indicate failure.

**Description**

This command opens stdin to read from and stderr to write to the console, allowing read and write operations with normal file commands.

`stderr` is an output stream different from stdout allowing error messages to be redirected separately from the main console output.

The normal console commands, such as `Color` and `Locate`, do not work in this mode, because they do not accept a file number.

The `[For Input|Output] mode` is allowed for compatibility, but is ignored.

**Runtime errors:**
Open Err throws one of the following runtime errors:

(1) Illegal function call
   - Filenumber was not free at the time. use FreeFile to ensure that filenumber is free.

Example

```basic
Dim a As String
Open Err For Input As #1
Print #1,"Please write something and press ENTER"
Line Input #1, a
Print #1, "You wrote"; a
Close
Sleep
```

Differences from QB
- New to FreeBASIC

See also
- Open
Open Lpt

Open a printer device

Syntax

```plaintext
Open Lpt ["[LPT[x]:][Printer_Name][,TITLE=Doc_Title][,EMU=TTY]"]
```

Usage

```plaintext
Open Lpt "LPT..." As [#]filenum
or
result = Open Lpt( "LPT...", [ As [#]filenum ]
```

Parameters

- `x`
  Specifies a port number. If omitted, output is sent to the system print spooler.
- `Printer_Name`
  Name of printer to open. This parameter is ignored on DOS.
- `TITLE=Doc_Title`
  Title of the print job as seen by the printer spooler. This parameter is ignored.
- `EMU=TTY`
  Emulation of TTY output on a Windows GDI printer, using driver text imaging.
  For Input|Output clause is allowed for compatibility, but it is ignored.
- `filenum`
  An unused file number to assign to the device.

Return Value

0 is returned if `Open Lpt` completed successfully, otherwise a non-zero value is returned.

Description

`Open Lpt` opens a connection to a printer device. The connection is treated as a file, so data may be written to the printer using any printer attached to the system may be opened with `Open Lpt`.

`Open Lpt "LPT:" ...` will try to open the default printer on Windows and
**LPrint** will automatically try to open the default printer on Windows and Linux.

Platform specific notes:

**Windows**
The argument `EMU=TTY` assumes printable ASCII or Unicode text, and supports `TAB`, `FF`, etc., for virtual print-head movement...even when the printer is omitted, the data must be sent in the printer's language (ESC/P, HPGL, PostScript, etc...).

**Linux**
A printer spooler available through `lp` must be installed to access printers by name or access printers by spoolers that are invoked through `lp`. Port are zero-based on Linux.

The data must be sent in the printer's language (ESC/P, HPGL, PostScript, etc...). Emulation modes aren't supported yet.

**DOS**
FreeBASIC does not support print spoolers on DOS. Printers must be accessible through a port.

The data must be sent in the printer's language (ESC/P, HPGL, PostScript, etc...).

### Example

```vba
' Send some text to the Windows printer on LPT1:
Open Lpt "LPT1:EMU=TTY" For Output As #1
Print #1, "Testing!"
Close

' Sends contents of text file test.txt to Windows
Dim RptInput As String
Dim PrintFileNum As Integer, RptFileFileNum As Integer

RptFileFileNum = FreeFile
Open "test.txt" For Input As #RptFileFileNum

PrintFileNum = FreeFile
Open Lpt "LPT:ReceiptPrinter,TITLE=ReceiptWinTitle,EMU=TTY" For Output As #PrintFileNum
```

While (EOF(RptFileFileNum) = 0)
    Line Input #RptFileFileNum, RptInput
    Print #PrintFileNum, RptInput
Wend

Close #PrintFileNum  ' Interestingly, does not requ
Close #RptFileFileNum

Print "Press any key to end program..."
GetKey

End

'Data simple program will print a PostScript file
Dim As UByte FFI, PPO
Dim As String temp

FFI = FreeFile()
Open "sample.ps" For Input Access Read As #FFI
PPO = FreeFile()
Open Lpt "LPT1:" For Output As #PPO
While (EOF(FFI) = 0)
    Line Input #FFI, temp
    Print #PPO, temp
Wend

Close #FFI
Close #PPO

Print "Printing Completed!"

Dialect Differences
In the `-lang qb` dialect the old syntax is supported OPEN "LPT:

See also

- Open
- LPrint
Open Pipe

Opens an external process' standard input (stdin) or output (stdout) stream for file operations.

Syntax

Open Pipe shell_command For Input As [#]filenumber
Open Pipe shell_command For Output As [#]filenumber
Open Pipe shell_command For Binary access_type [#]filenumber

Usage

result = Open Pipe( command[,] For {Input|Output}[,] As filenumber)
or,
result = Open Pipe( command[,] For Binary[,] access_type[,] As filenumber)
(or in the QB-like syntax,)
Open Pipe filename For {Input|Output} As filenumber
(or,)
Open Pipe filename For Binary access_type As filenumber

Parameters

shell_command
The external process to execute in the operating system command shell. Relative file paths are relative to the current directory (see CurDir). When opening a pipe for a process that requires double quotes in its executable path, or its arguments, the entire pipe string should be nested inside of double quotes.

access_type
The type of read or write access requested by the calling process.
- Access {Read|Write} (either the stdin or stdout stream of the external process)

filenumber
An available file number to bind to the external process' stdin or stdout stream.

Return Value

In the first usage, Open Pipe returns zero (0) on success and a non-zero error code otherwise.

Description

Open Pipe executes another process in the command shell and opens either its reading or writing. A file number is bound to the stream, which is used in
Input #. An available filenumber can be retrieved with FreeFile. If the error is thrown.

The Input and Output file modes open the external process' stdin and stdout text I/O, useful for reading or writing plain text. Characters, words or whole text-mode file operations, such as Line Input # and Print #.

The Binary file mode opens the external process' stdin or stdout stream specified (see description of the access_type parameter above) - for random access reading or writing of arbitrarily sized and interpreted raw data. Simple data type values, like memory can be read from or written to the streams with binary-mode file operations. Bidirectional pipes are not supported by FB and must be implemented using the OS' API functions.

Runtime errors:
Open Pipe throws one of the following runtime errors:

(1) Illegal function call
   - filenumber was not free at the time. use FreeFile to ensure

Example

```
' This example uses Open Pipe to run a shell command
#ifdef __FB_UNIX__
Const TEST_COMMAND = "ls *
#else
Const TEST_COMMAND = "dir *."
#endif

Open Pipe TEST_COMMAND For Input As #1

Dim As String ln
Do Until EOF(1)
   Line Input #1, ln
   Print ln
Loop

Close #1
```
**Platform Differences**

- The **Binary file mode** is not supported on all platforms; `Open Pipe` the external process' `stdin` or `stdout` streams in binary mode.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Shell`
- `Open`
- `Open Cons`
- `Open Err`
- `FreeFile`
Open Scrn

Opens the console directly for input and output as a file

Syntax

```
Open Scrn [for mode] As [#]filenum As Long
```

Usage

```
Open Scrn [for mode] as [#]filenum
or
result = Open Scrn( [for mode[,] as [#]filenum )
```

Parameters

- **mode**
  - Either **Input** or **Output**. If omitted, **Output** is assumed.
- **filenum**
  - An unused file number.

Return Value

Zero (0) is returned if **Open Err** completed successfully, otherwise a non-zero value is returned to indicate failure.

Description

This command opens the console for both input and output as a file, allowing to read/write from/to it with normal file commands.

This command may use direct access to the console for speed in some implementations, so it should not be used when the input / output is required to be redirected or piped with OS commands.

The normal console commands, such as **Color** and **Locate**, do not work in this mode, because they do not accept a file number.

The **[For Input|Output]** clause is allowed for compatibility, but is ignored.

**filenum** is an unused file number.
An unused file number can be found using FreeFile.

**Runtime errors:**

Open Cons throws one of the following runtime errors:

1. **Illegal function call**
   - filenumber was not free at the time. Use FreeFile to ensure that filenumber is free.

**Example**

```plaintext
Dim a As String
Open Scrn For Input As #1
Print #1,"Please write something and press ENTER"
Line Input #1,a
Print #1, "You wrote";a
Close
Sleep
```

**Differences from QB**

- QB used OPEN "SCRN:" ...

**See also**

- Open
- Open Cons
Operator declares or defines an overloaded operator.

**Syntax**

```
{ Type | Class | Union | Enum } typename
Declare Operator Cast () [ ByRef ] As datatype
Declare Operator @ () [ ByRef ] As datatype Ptr
Declare Operator assignment_op ( [ ByRef | ByVal ] rhs As datatype )
Declare Operator [] ( index As datatype ) [ ByVal ] As datatype
Declare Operator New ( size As UInteger ) As Any Ptr
Declare Operator New[] ( size As UInteger ) As Any Ptr
Declare Operator Delete ( buf As Any Ptr )
Declare Operator Delete[] ( buf As Any Ptr )
End { Type | Class | Union | Enum }
```

```
{ Type | Class | Union } typename
Declare Operator For ( )
Declare Operator For ( [ ByRef | ByVal ] stp As typename )
Declare Operator Step ( )
Declare Operator Step ( [ ByRef | ByVal ] stp As typename )
Declare Operator Next ( [ ByRef | ByVal ] cond As typename ) As
Declare Operator Next ( [ ByRef | ByVal ] cond As typename, [ ByVal ]
End { Type | Class | Union }
```

```
Declare Operator unary_op ( [ ByRef | ByVal ] rhs As datatype )
Declare Operator binary_op ( [ ByRef | ByVal ] lhs As datatype,
Operator typename.Cast () [ ByRef ] As datatype [ Export ]
Operator typename.@ () [ ByRef ] As datatype Ptr [ Export ]
Operator typename.assignment_op ( [ ByRef | ByVal ] rhs As datatype )
Operator [] ( index As datatype ) [ ByRef ] As datatype [ Export
Operator unary_op ( [ ByRef | ByVal ] rhs As datatype ) As datatype
Operator binary_op ( [ ByRef | ByVal ] lhs As datatype, [ ByRef
Operator typename.New ( size as uinteger ) As Any Ptr [ Export ]
Operator typename.New[] ( size As UInteger ) As Any Ptr [ Export
Operator typename.Delete ( buf As Any Ptr ) [ Export ]
Operator typename.Delete[] ( buf As Any Ptr ) [ Export ]
```

**Parameters**

*typename*
Name of the **Type, Class, Union, or Enum**.

*assignment_op*
let += -= *= &= /= \= mod= shl= shr= and= or= xor= imp= eqv= ^=
**Description**

The built-in operators like =, +, and `cast` have predefined behaviors when used to do something other than predefined operations when at least one of the arguments to the operator is a data type.

Operators are just functions. The operator `'+' has functionality like `Fun`. See **Operator Overloading** for more information. Operators can be overloaded to accept different data types as parameters.

Non-static operator members are declared inside the `Type` or `Class`. Global operators are declared outside. (procedure bodies) must appear outside.

`Let`, `Cast`, and other assignment operators must be declared inside the `Type` or `Class` they are declared in, and have a return data type same as the `Type` or `Class` they are declared in.

Unary operators must be declared outside the `Type`, `Class`, or `Enum` and can be overloaded to return any valid data type, except for `Operator -` data type.

Binary operators must be declared outside the `Type`, `Class`, or `Enum` and can be overloaded with valid data types, except for relational operators.

`Let` refers to the assignment operator, as in `LET a=b`. The `Let` keyword is invalid in the `fb` dialect. However, `Let()` can be used to assign the fields of a UDT to.

See **For**, **Step**, and **Next** for more information on overloading the `For..` operator.

**Example**
Type Vector2D
    As Single x, y

' Return a string containing the vector data.
Declare Operator Cast() As String

' Multiply the vector by a scalar.
Declare Operator *= ( ByVal rhs As Single ) End Type

' Allow two vectors to be able to be added together.
Declare Operator +( ByRef lhs As Vector2D, ByRef rhs As Vector2D ) As Vector2D

Operator Vector2D.cast () As String
    Return "(" + Str(x) + ", " + Str(y) + ")"
End Operator

Operator Vector2D.*=( ByVal rhs As Single )
    This.x *= rhs
    This.y *= rhs
End Operator

Operator +( ByRef lhs As Vector2D, ByRef rhs As Vector2D ) As Vector2D
    Return Type<Vector2D>( lhs.x + rhs.x, lhs.y + rhs.y )
End Operator

Operator Abs ( ByRef rhs As Vector2D ) As Single
    Return Sqr( rhs.x * rhs.x + rhs.y * rhs.y )
End Operator

Dim a As Vector2D = Type<Vector2D>( 1.2, 3.4 )
Dim b As Vector2D = Type<Vector2D>( 8.9, 6.7 )
Dim c As Vector2D = Type<Vector2D>( 4.3, 5.6 )
Print "a = "; a, "abs(a) ="; Abs( a )
Print "b = "; b, "abs(b) ="; Abs( b )
Print "a + b = "; a + b, "abs(a+b) ="; Abs( a + b
Print "c = "; c, "abs(c) ="; Abs( c )
Print "'c * = 3'"
c *= 3
Print "c = "; c, "abs(c) ="; Abs( c )

Aligned memory allocator:
- by using the overloaded member operators "New" and "ALIGN" bytes (256 bytes in this example),
- the real pointer of the allocated memory is saved just at

'' operator2.bas

Const ALIGN = 256

Type UDT
    Dim As Byte a(0 To 10 * 1024 * 1024 - 1) '" 10 m
    Declare Operator New (ByVal size As UInteger) As Any Ptr
    Declare Operator Delete (ByVal buffer As Any Ptr)
    Declare Constructor ()
    Declare Destructor ()
End Type

Operator UDT.New (ByVal size As UInteger) As Any Ptr
    Print " Overloaded New operator, with parameter size"
    Dim pOrig As Any Ptr = CAllocate(ALIGN-1 + SizeOf(UDT Ptr)
    Dim pMin As Any Ptr = pOrig + SizeOf(UDT Ptr)
    Dim p As Any Ptr = pMin + ALIGN-1 - (CULng(pMin
    Cast(Any Ptr Ptr, p)[-1] = pOrig
    Operator = p
    Print " real pointer = &h" & Hex(pOrig), "return"
End Operator

Operator UDT.Delete (ByVal buffer As Any Ptr)
    Print " Overloaded Delete operator, with parameter buffer"

Dim pOrig As Any Ptr = Cast(Any Ptr Ptr, buffer)
Deallocate(pOrig)
Print "    real pointer = &h" & Hex(pOrig)
End Operator

Constructor UDT ()
    Print "    Constructor, @This = &h" & Hex(@This)
End Constructor

Destructor UDT ()
    Print "    Destructor, @This = &h" & Hex(@This)
End Destructor

Print "'Dim As UDT Ptr p = New UDT'
Dim As UDT Ptr p = New UDT

Print "    p = &h" & Hex(p)

Print "'Delete p'
Delete p"

Output example:

'Dim As UDT Ptr p = New UDT'
Overloaded New operator, with parameter size = &hA00000;
    real pointer = &h420020;    return pointer = &h420100;
    Constructor, @This = &h420100;
    p = &h420100;
'Delete p'
    Destructor, @This = &h420100;
    Overloaded Delete operator, with parameter buffer = &h420100;
    real pointer = &h420020;

Small use case of the operator "[]": simplest smart pointers for byte buffer

'    operator3.bas

'    A smart pointer is an object which behaves like a
'    - This object is flexible as a pointer and has
'    like constructor and destructor called automa
Therefore, the destructor of the smart pointer will be automatically called when this object goes out of scope, and it will delete the user pointer.

Example of simplest smart pointers for byte buffers:
- Constructor and destructor allow to allocate, deallocate, and resize the byte buffer.
- Pointer index operator allows to access buffer elements.
- Copy-constructor and let-operator are just declared in private section in order to disallow copy construction and assignment.

```plaintext
Type smartByteBuffer
    Public:
        Declare Constructor (ByVal size As UInteger = 0)
        Declare Operator [] (ByVal index As UInteger)
        Declare Destructor ()
    Private:
        Declare Constructor (ByRef rhs As smartByteBuffer)
        Declare Operator Let (ByRef rhs As smartByteBuffer)
        Dim As Byte Ptr psbb
End Type

Constructor smartByteBuffer (ByVal size As UInteger = 0)
    This.destructor()
    If size > 0 Then
        This.psbb = New Byte[size]
        Print "Byte buffer allocated"
    End If
End Constructor

Operator smartByteBuffer.[] (ByVal index As UInteger)
    Return This.psbb[index]
End Operator

Destructor smartByteBuffer ()
    If This.psbb > 0 Then
        Delete[] This.psbb
        This.psbb = 0
        Print "Byte buffer deallocated"
    End If
End Destructor
```
Scope
    Dim As smartByteBuffer sbb = smartByteBuffer(256)
    For I As Integer = 0 To 255
        sbb[I] = I - 128
    Next I
    Print
    For I As Integer = 0 To 255
        Print Using "#####"; sbb[I];
    Next I
    Print
End Scope

Dialect Differences

- Only available in the -lang fb dialect.

See also

- Class
- Enum
- Type
Option()

Specifies additional attributes and/or characteristics of symbols.

Syntax

```plaintext
Option( "literal-text" )
```

Parameters

`literal-text`

The literal text specifying the option. See description.

Description

`Option()` allows the programmer to specify additional attributes or characteristics of symbols.

Enclosing the string into quotes and parentheses is required in the syntax. Unrecognized options are ignored.

`Option()` can also be used as a statement to specify other compile time options.

```plaintext
Declare Function ValueInXmm0 () As Double Option("sse")
```

SSE

`Option("SSE")` indicates that a floating point value (Single or Double) returned from a function is stored in the xmm0 register. `Option("Sse")` is ignored unless compiled with the `-fpu SSE` command line option. This option may be immediately after the return type in a function declaration or function definition. `Option("Sse")` is an optimization only and not required to compile programs using the `-fpu SSE` command line option.

FPU
Option("FPU") indicates that a floating point value (Single or Double) return value from a function is stored in the st(0) register. This option may be used immediately after the return type in a function declaration or function definition.

```
Declare Function ValueInStZero () As Double Option
```

**Differences from QB**

- New to FreeBASIC

**See also**

- Compiler Option: -fpu
- Compiler Switches
**Option Base**

Specifies a default lower bound for array declarations

**Syntax**

```
Option Base base_subscript
```

**Parameters**

`base_subscript`

an numeric literal value

**Description**

`Option Base` is a statement that sets the default lower bound for any following array declarations. This default remains in effect for the rest of the module in which it is used, and can be overridden by declaring arrays with an explicit lower bound, or with another `Option Base` statement.

Note: initially, the default base is 0.

**Example**

```
' Compile with the "-lang qb" or "-lang fblite" compiler switches

#lang "fblite"

Dim foo(10) As Integer ' declares an array with indices 0-10
Option Base 5

Dim bar(15) As Integer ' declares an array with indices 5-15
Dim baz(0 To 4) As Integer ' declares an array with indices 0-4
```
Dialect Differences

- Only available in the `-lang fblite` and `-lang qb` dialects.
- In `-lang fb`, `Option Base` is not allowed, and the default lower b

Differences from QB

- QBASIC only supported values of 0 or 1 for `base_subscript`.
- In QBASIC the word `Base` was a reserved keyword, and couldn name.
- Arrays must always be explicitly created in FreeBASIC. QBASI an array from `base_subscript` to 10 if one was used in code wit

See also

- `Dim`
- `ReDim`
- `LBound`
Option ByVal

Specifies parameters are to be passed by value by default in procedure declarations.

**Syntax**

```
Option ByVal
```

**Description**

*Option ByVal* is a statement that sets the default passing convention for procedure parameters to *by value*, as if declared with *ByVal*. This default remains in effect for the rest of the module in which *Option ByVal* is used, and can be overridden by specifying *ByRef* in parameter lists.

**Example**

```
' compile with the "-lang fblite" compiler switch

#lang "fblite"

Sub TestDefaultByref( a As Integer )
'' change the value
    a = a * 2
End Sub

Option ByVal

Sub TestDefaultByval( a As Integer )
    a = a * 2
End Sub

Dim a As Integer = 1
Print "a = "; a
```
TestDefaultByref( a )
Print "After TestDefaultByref : a = "; a
Print
Print "a = "; a
TestDefaultByval( a )
Print "After TestDefaultByval : a = "; a
Print

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.

Differences from QB

- New to FreeBASIC

See also

- __FB_OPTION_BYVAL__
### Option Dynamic

Specifies variable-length array declarations

#### Syntax

```
Option Dynamic
```

#### Description

`Option Dynamic` is a statement that specifies that any following array declarations are variable-length, whether they are declared with constant subscript ranges or not. This remains in effect for the rest of the module in which `Option Dynamic` is used, and can be overridden with `Option Static` equivalent to the `$Dynamic` metacommand.

#### Example

```
'' Compile with "-lang fblite" compiler switch

#lang "fblite"

Dim foo(99) As Integer        ' declares a fixed-length array

Option Dynamic

Dim bar(99) As Integer        ' declares a variable-length array
  '...

ReDim bar(199) As Integer    ' resize the array
```

#### Dialect Differences

- Only available in the `-lang fblite` and `-lang qb` dialects.

#### Differences from QB
New to FreeBASIC

See also

- __FB_OPTION_DYNAMIC__
- '$Dynamic
- '$Static
- Option Static
- Dim
- ReDim
Option Escape

Specifies that string literals should be processed for C-like escape sequences by default.

Syntax

```
Option Escape
```

Description

Option Escape is a statement that causes string literals to be processed for C-like escape sequences by default. Normally, escape sequences have no effect in string literals unless the string is prefixed with the ! Operator (Escaped String Literal). This default remains in effect for the rest of the module in which Option Escape is used, and can be overridden by prefixing string literals with the Operator (Non-Escaped String Literal).

See Literals in the Programmer's Guide to learn more about escape sequences.

Example

```
'' Compile with the "-lang fblite" compiler switch.
#lang "fblite"
Option Escape
Print "Warning \a The path is:\r\n c:\\Freebasic"
Print "$This string doesn't have expanded escape sequences$"
#include "crt.bi"
Dim As Integer a = 2, b = 3
printf("%d * %d = %d\r\n", a, b, a * b)
```

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.
Differences from QB

- New to FreeBASIC

See also

- __FB_OPTION_ESCAPE__
- Operator ! (Escaped String Literal)
- Operator $ (Non-Escaped String Literal)
- Literals
Option Explicit

Forces variables, objects and arrays to be declared before they are used.

Syntax

Option Explicit

Description

Option Explicit is a statement that forces any following variable, object a declaration, with, for example, Dim or Static. This rule remains in effect which Option Explicit is used, and cannot be overridden.

Example

```
'' Compile with the "-lang qb" or "-lang fblite" compiler switches

#lang "fblite"

Option Explicit

Dim a As Integer          ' 'a' must be declared
a = 1                     ' ..or this statement
```

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.

Differences from QB

- New to FreeBASIC

See also

- __FB_OPTION_EXPLICIT__
**Option Gosub**

Enables support for GoSub and On Gosub.

**Syntax**

Option Gosub

**Description**

Option Gosub enables support for GoSub and Return (from gosub).

Because Return could mean return-from-gosub or return-from-procedure, Option Gosub and Option Nogosub can be used to enable and disable GoSub support. When GoSub support is disabled, Return is then recognized as return-from-procedure.

**Example**

```
' Compile with the "-lang fblite" compiler switch
#lang "fblite"

' turn on gosub support
Option GoSub

GoSub there
backagain:
    Print "backagain"
End

there:
    Print "there"
Return
```
Dialect Differences

- Only available in the `-lang fblite` and `-lang qb` dialects.

Differences from QB

- New to FreeBASIC

See also

- `__Fb_Option_Gosub__`
- `Option Nogosub`
- `GoSub`
- `Return`
**Option Nogosub**

Disables support for **GoSub** and **On GoSub**.

**Syntax**

```
Option Nogosub
```

**Description**

```
Option Nogosub disables support for GoSub and Return (from gosub).

Because Return could mean return-from-gosub or return-from-
procedure, Option GoSub and Option Nogosub can be used to enable
and disable GoSub support. When GoSub support is disabled, Return is
then recognized as return-from-procedure.
```

**Example**

```
'' Compile with the "-lang qb" compiler switch

'$lang: "qb"

'' turn off gosub support
Option nogosub

Function foo() As Integer
  Return 1234
End Function

Print foo
```

**Dialect Differences**

- Only available in the **-lang fblite** and **-lang qb** dialects.
Differences from QB

- New to FreeBASIC

See also

- __Fb_Option_Gosub__
- Option Gosub
- GoSub
- Return
Option NoKeyword

"Undefines" a reserved keyword

Syntax

Option NoKeyword keyword

Parameters

keyword
the keyword to undefine

Description

Option NoKeyword is a statement that undefines a FreeBASIC reserved keyword, allowing it to be used as an identifier for a variable, object, procedure or any other symbol. The keyword is undefined for the rest of the module in which Option NoKeyword is used.

Example

'' Compile with the "-lang fblite" compiler switch

#lang "fblite"

Option NoKeyword Int ' remove the keyword ' symbol table

Dim Int As Integer ' declare a variable with the name ' Int

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.

Differences from QB

- New to FreeBASIC
See also

- `#undef`
**Option Private**

Specifies internal linkage by default for procedure declarations

**Syntax**

Option Private

**Description**

Option Private is a statement that gives any following procedure declarations internal linkage by default, as if declared with Private. This default remains in effect for the rest of the module in which Option Private is used, and can be overridden by declaring procedures with Public.

**Example**

```
'' Compile with the "-lang fblite" compiler switch

#lang "fblite"

Sub ProcWithExternalLinkage()
    ' ...
End Sub

Option Private

Sub ProcWithInternalLinkage()
    ' ...
End Sub

Public Sub AnotherProcWithExternalLinkage()
    ' ...
End Sub
```
Dialect Differences

- Only available in the `-lang fblite` and `-lang qb` dialects.

Differences from QB

- New to FreeBASIC

See also

- `__FB_OPTION_PRIVATE__`
- `Private`
- `Public`
Option Static

Reverts to default array declaration behavior

Syntax

Option Static

Description

Option Static is a statement that overrides the behavior of Option Dynamic. Arrays declared with constant subscript ranges are fixed-length. This remains in effect for the rest of the module in which Option Static is used, and can be overridden with Option Dynamic. It is equivalent to the "$Static metacommand.

Example

```
' Compile with the "-lang fblite" compiler switch

#lang "fblite"

Option Dynamic

Dim foo(100) As Integer ' declares a variable-length array

Option Static

Dim bar(100) As Integer ' declares a fixed-length array
```

Dialect Differences

- Only available in the -lang fblite and -lang qb dialects.

Differences from QB
New to FreeBASIC

See also

- '$Dynamic
- '$Static
- Dim
- Erase
- ReDim
- Option Dynamic
- Static
Operator Or (Inclusive Disjunction)

Returns the bitwise-or (inclusive disjunction) of two numeric values

**Syntax**

```
Declare Operator Or ( ByRef lhs As T1, ByRef rhs As T2 ) As Ret
```

**Usage**

```
result = lhs Or rhs
```

**Parameters**

- `lhs`
  - The left-hand side expression.
  - `T1`
  - Any numeric or boolean type.
- `rhs`
  - The right-hand side expression.
  - `T2`
  - Any numeric or boolean type.
- `Ret`
  - A numeric or boolean type (varies with `T1` and `T2`).

**Return Value**

Returns the bitwise-disjunction of the two operands.

**Description**

This operator returns the bitwise-disjunction of its operands, a logical operation depending on the bits of the operands (for conversion of a boolean to -1 integer value).

The truth table below demonstrates all combinations of a boolean-disj

<table>
<thead>
<tr>
<th>Lhs Bit</th>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
No short-circuiting is performed - both expressions are always evaluated.

The return type depends on the types of values passed. *Byte, UByte a Integer*. If the left and right-hand side types differ only in signedness, type (\(T_1\)), otherwise, the larger of the two types is returned. Only if the return type is also *Boolean*.

This operator can be overloaded for user-defined types.

**Example**

```vbnet
' Using the OR operator on two numeric values
Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 15 '00001111
numeric_value2 = 30 '00011110

'Result = 31 = 00011111
Print numeric_value1 Or numeric_value2
Sleep

' Using the OR operator on two conditional expressions
Dim As UByte numeric_value
numeric_value = 10

If numeric_value = 5 Or numeric_value = 10 Then Print
Sleep

' This will output "Numeric_Value equals 5 or 10"
' while the first condition of the first IF statement
```
Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- `OrElse`
- `Operator Truth Tables`
Parameter to the **Put** graphics statement which uses a bit-wise **or** as the

**Syntax**

```
Put [ target, ] [ STEP ] ( x, y ), source [ , ( x1, y1 )-( x2, y2 )]
```

**Parameters**

- **or**
  - Required.

**Description**

The **or** method combines each source pixel with the corresponding destination pixel using the bit-wise **or** function. The result of this is output as the destination pixel. This method works in all graphics modes. There is no mask color, although color values of \( \text{RGBA}(0, 0, 0, 0) \) in full-color modes will have no effect, because of the behavior of **or**.

In full-color modes, each component (red, green, blue and alpha) is kept in a set of bits, so the operation can be made to only affect some of the channels by making sure the all the values of the other channels are set to 0.

**Example**

```basicscript
'open a graphics window
ScreenRes 320, 200, 16

'create 3 sprites containing red, green and blue
Const As Integer r = 32
Dim As Any Ptr cr, cg, cb
cr = ImageCreate(r * 2 + 1, r * 2 + 1, RGB(0, 0, 0),
    cg = ImageCreate(r * 2 + 1, r * 2 + 1, RGB(0, 0, 0),
    cb = ImageCreate(r * 2 + 1, r * 2 + 1, RGB(0, 0, 0),
    Circle cr, (r, r), r, RGB(255, 0, 0), , , 1, f
Circle cg, (r, r), r, RGB(0, 255, 0), , , 1, f
Circle cb, (r, r), r, RGB(0, 0, 255), , , 1, f
```
''put the sprite at three different multiplier levels, overlapping each other in the middle
Put (146 - r, 108 - r), cr, Or
Put (174 - r, 108 - r), cg, Or
Put (160 - r, 84 - r), cb, Or

''free the memory used by the sprites
ImageDestroy cr
ImageDestroy cg
ImageDestroy cb

''pause the program before closing
Sleep

Differences from QB

- None

See also

- Or
- Put (Graphics)
Operator Orelse (Short Circuit Inclusive Disjunction)

Returns the short circuit-or (Inclusive Disjunction) of two numeric values

**Syntax**

\[
\text{Declare Operator } \text{OrElse} (\ \text{ByRef} \ \text{lhs} \ \text{As} \ \text{T1}, \ \text{ByRef} \ \text{rhs} \ \text{As} \ \text{T2}) \ \text{As}
\]

**Usage**

\[
\text{result} = \text{lhs} \ \text{OrElse} \ \text{rhs}
\]

**Parameters**

- \(\text{lhs}\)
  - The left-hand side expression.
  - \(\text{T1}\)
  - Any numeric or boolean type.
- \(\text{rhs}\)
  - The right-hand side expression.
  - \(\text{T2}\)
  - Any numeric or boolean type.
- \(\text{Ret}\)
  - A numeric or boolean type (varies with \(\text{T1}\) and \(\text{T2}\)).

**Return Value**

Returns the short circuit-or (inclusive disjunction) of the two operands.

**Description**

This operator evaluates the left hand side expression. If the result is nonzero, then -1 (true) is immediately returned. If the result is zero the right hand side is evaluated, and the logical result from that is returned, returning -1 (true) for a nonzero value or 0 (false) for zero. (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value)

The truth table below demonstrates all combinations of a short circuit-operation, the '-' denotes that the operand is not evaluated.
<table>
<thead>
<tr>
<th>Lhs Value</th>
<th>Rhs Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>nonzero</td>
<td>-1</td>
</tr>
<tr>
<td>nonzero</td>
<td>-</td>
<td>-1</td>
</tr>
</tbody>
</table>

Short-circuiting is performed - only expressions needed to calculate the result are evaluated.

The return type is almost always an `Integer`, of the value 0 or -1, denoting false and true respectively. Except if the left and right-hand side types both are `Boolean`, then the return type is also `Boolean`.

This operator cannot be overloaded for user-defined types.

**Example**

```vbnet
' Using the ORELSE operator on two numeric values
Dim As Integer numeric_value1, numeric_value2
numeric_value1 = 15
numeric_value2 = 30

'Result = -1
Print numeric_value1 ORELSE numeric_value2
Sleep
```

**Differences from QB**

- This operator was not available in QB.

**See also**

- ` AndAlso`
- ` Or`
- `Operator Truth Tables`
**Out**

Outputs a value to a hardware port.

**Syntax**

```plaintext
Declare Function Out ( ByVal port As UShort , ByVal data As UByte )
```

**Usage**

```
Out port, value
```

**Parameters**

- **port**
  Hardware port to write to.
- **data**
  Data value to write.

**Description**

This function sends *value* to *port* and returns immediately.

**Example**

```plaintext
'speakersound.bas
Sub Sound( ByVal freq As UInteger, dur As UInteger )
  Dim t As Double, f1 As Unsigned Short
  f1 = 1193181 \ freq
  Out &h61, Inp(&h61) Or 3
  Out &h43, &hb6
  Out &h42, LoByte(f1)
  Out &h42, HiByte(f1)
  t = Timer
  While ((Timer - t) * 1000) < dur
    Sleep 0,1
  Wend
  Out &h61, Inp(&h61) And &hfc
End Sub
```
<table>
<thead>
<tr>
<th>Sound</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(523, 60)</td>
<td>'D5</td>
</tr>
<tr>
<td>(587, 60)</td>
<td>'E5</td>
</tr>
<tr>
<td>(659, 60)</td>
<td>'F5</td>
</tr>
<tr>
<td>(698, 60)</td>
<td>'G5</td>
</tr>
<tr>
<td>(784, 60)</td>
<td>'A5</td>
</tr>
<tr>
<td>(880, 60)</td>
<td>'B5</td>
</tr>
<tr>
<td>(988, 60)</td>
<td>'C6</td>
</tr>
<tr>
<td>(1046, 60)</td>
<td>'C6</td>
</tr>
</tbody>
</table>

**Platform Differences**

- In the Windows and Linux versions three port numbers (&H3C, &H3C8, &H3C9) are hooked by the graphics library when a graphics mode is in use to emulate QB's VGA palette handling. This use is deprecated; use Palette to retrieve and set palette colors.

- Using true port access in the Windows version requires the program to install a device driver for the present session. For that reason, Windows executables using hardware port access should be run with administrator permits each time the computer is restarted. Further runs don't require admin rights as they just use the already installed driver. The driver is only 3K in size and is embedded in the executable.

**See also**

- Inp
- Wait
- Palette
Output

Specifies text file to be opened for output mode

**Syntax**

```basic
Open filename for Output [Encoding encoding_type] [Lock lock_typ [#]filenum
```

**Parameters**

- `filename`
  - file name to open for output
- `encoding_type`
  - indicates encoding type for the file
- `lock_type`
  - locking to be used while the file is open
- `filenum`
  - unused file number to associate with the open file

**Description**

A file mode used with `open` to open a text file for writing.

This mode is used to write text with `Print #`, or comma separated values with `Write #`.

Text files can't be simultaneously read and written in FreeBASIC, so if functions are required on the same file, it must be opened twice.

`filename` must be a string expression resulting in a legal file name in the OS, without wildcards. The file will be sought for in the present directory unless the `filename` contains a path. If the file does not exist, it is created. The pointer is set at the first character of the file.

`Encoding_type` indicates the Unicode Encoding of the file, so characters are correctly read. If omitted, "ascii" encoding is defaulted. Only little endian character encodings are supported at the moment.

- "utf8"
- "utf16"
- "utf32"
- "ascii" (the default)

`Lock_type` indicates the way the file is locked for other processes, it is:
- **Read** - the file can be opened simultaneously by other processes, but not for reading
- **Write** - the file can be opened simultaneously by other processes, but not for writing
- **Read Write** - the file cannot be opened simultaneously by other processes (the default)

`filenum` is a valid FreeBASIC file number (in the range 1..255) not being for any other file presently open. The file number identifies the file for all of file operations. A free file number can be found using the `FreeFile` function.

### Example

```vbnet
Dim ff As UByte
Dim randomvar As Integer
Dim name_str As String
Dim age_ubyte As UByte

ff = FreeFile
Input "What is your name? ", name_str
Input "What is your age? ", age_ubyte
Open "testfile" For Output As #ff
Write #ff, Int(Rnd(0)*42), name_str, age_ubyte
Close #ff
randomvar=0
name_str="
age_ubyte=0

Open "testfile" For Input As #ff
Input #ff, randomvar, name_str, age_ubyte
Close #ff
```
Print "Random Number was: ", randomvar
Print "Your name is: " + name_str
Print "Your age is: " + Str(age_ubyte)

'File outputted by this sample will look like this
'minus the comment of course:
'23,"Your Name",19

Differences from QB

See also
- Append
- Input (File Mode)
- Open
Overload

Specifies that a procedure name can be overloaded

**Syntax**

```plaintext
Declare [Static] Sub procedure_name [cdecl|stdcall|pascal] Overload	([[parameter_list]]) [Constructor [priority]] [Static] [Export]

Declare [Static] Function procedure_name [cdecl|stdcall|pascal] "external_name" [[([parameter_list]))] As return_type [Static] [E

[Public|Private] Sub procedure_name [cdecl|stdcall|pascal] Overload	([[parameter_list])) [Constructor [priority]] [Static] [Export]

..procedure body..
End Sub

[Public|Private] Function procedure_name [cdecl|stdcall|pascal] "external_name" [[([parameter_list]))] As return_type [Static] [E

..procedure body..
End Function
```

**Description**

In procedure declarations, **Overload** allows procedure names to be overloaded. Procedures can then be declared with the same name if their parameter lists are unique if they contain a different number of parameters or different types. Note that this means that two or more procedures cannot have the same name if they differ in return type alone.

Once a procedure name has been declared overloaded, further declarations need not specify **Overload**, but it is allowed.

**Overload** is not necessary in member procedure declarations, as they are implicitly overloaded.

When calling an overloaded procedure, the compiler determines the most appropriate definition to use among a set of compatible candidates, by comparing the argument types used to call the procedure with the parameter types specified in the definitions. If no match or an ambiguous match is found, the compiler generates an error at compile time.

**Example**
Declare Function SUM Overload (A As Integer, B As Integer)
Declare Function SUM Overload (A As Single, B As Single)
Function SUM (A As Integer, B As Integer) As Integer
    Function = A + B
End Function
Function SUM (A As Single, B As Single) As Single
    Function = A + B
End Function
Dim As Integer A, B
Dim As Single A1, B1
A = 2
B = 3
A1 = 2.
b1 = 3.
Print SUM(A, B)
Print SUM(A1, B1)
Sleep

**Differences from QB**
- New to FreeBASIC

**See also**
- Declare
- Sub, Function
## Override

Method attribute; specifies that a method must override a virtual method.

### Syntax

```
Type typename Extends basename
...
Declare Sub|Function|Operator|Property|Destructor ... (  
[parameterlist] ) As datatype Override
...
End Type
```

### Description

In method declarations, `Override` can be used to indicate that this method is expected to override a `Virtual` or `Abstract` method from the base class. Then the compiler will show an error if the method does not override anything (only a non-static method can override a virtual or abstract method).

Use of `Override` is not mandatory to override a virtual or abstract method, it is highly recommended, as it will help prevent inadvertent errors (name/signature not matching).

`Override` can only be specified on the method declaration in the UDT block, but not on the method body, because it is just a compile-time check in the context of the inheritance hierarchy, and does not affect the method in any way.

`Override` is only recognized as a keyword at the end of member procedure declarations. It can still be used as identifier elsewhere.

### Example

```
Type A Extends Object
  Declare Virtual Sub f1( )
  Declare Virtual Function f2( ) As Integer
End Type
```
Type B Extends A
   Declare Sub f1( ) Override
   Declare Function f2( ) As Integer Override
End Type

Sub A.f1( )
End Sub

Function A.f2( ) As Integer
   Function = 0
End Function

Sub B.f1( )
End Sub

Function B.f2( ) As Integer
   Function = 0
End Function

Differences from QB
   • New to FreeBASIC

See also
   • Virtual, Abstract
Paint

Fills an area delimited by a border of a specified color

Syntax

\[
\text{Paint} \ [\text{target},] \ [\text{STEP}] \ (x, y)[, \ [\text{paint}][, \ [\text{border\_color}]]]\]

Parameters

\text{target}

specifies buffer to draw on.

\text{STEP}

indicates that coordinates are relative

\((x, y)\)

coordinates of the pixel on which to start the flood fill (paint)

\text{paint}

the color attribute or fill pattern

a numeric value indicates a color, while a string indicates a fill pattern

\text{border\_color}

boundary color for the fill

Description

Graphics command to fill an area delimited by a border of specified color.

\text{Paint} can operate on the current work page as set by the \text{ScreenSet} statement

Filling starts at specified \((x, y)\) coordinates; if \text{STEP} is specified, these are relative.

Coordinates are also affected by custom coordinates system set up by \text{View} also applies.

If the \text{paint} argument is a number, it is assumed a color in the same format is flood-filled using that color. If \text{paint} is a \text{String}, the region will be filled, and the passed string must hold pixels data in a format dependent on color depth. For pixels row by row, and its size should be as follows:

For color depths 1, 2, 4 and 8:

\[
\text{size} = 8 \times 8 = 64
\]

For color depths 15 and 16:

\[
\text{size} = (8 \times 8) \times 2 = 128
\]
For color depths 24 and 32:
size = (8 * 8) * 4 = 256

If the passed string is smaller, missing pixels will be 0. If the *paint* argument is omitted, the current foreground color set by *color*. Flood-filling continues until the *border_color* is omitted, the current background color is assumed.

**Example**

```vbnet
' draws a white circle painted blue inside
Screen 13
Circle (160, 100), 30, 15
Paint (160, 100), 1, 15
Sleep
```

' draws a circle and fills it with a checkered pattern
'' choose the bit depth for the Screen
'' try setting this to other values: 8, 16 or 32

**Const** bit_depth = 8

'' function for returning a pixel color, represented as a string
' returns a the string in the appropriate format
**Function** paint_pixel( ByVal c As UInteger, ByVal bit_depth_ As Integer ) As String

  **If** bit_depth_ <= 8 **Then** '' 8-bit:
    **Function** = **Chr**( UCByte(c) )

  **ElseIf** bit_depth_ <= 16 **Then** '' 16-bit:
    **Function** = MKShort( c Shr 3 And &h1f Or _
                      c Shr 5 And &h7e0 Or _
                      c Shr 8 And &hf800 )

  **ElseIf** bit_depth_ <= 32 **Then** '' 32-bit:
    **Function** = MKL(c)
End If

End Function

' open a graphics window at the chosen bit depth
ScreenRes 320, 200, bit_depth

' declare variables for holding colors
Dim As UInteger c, c1, c2, cb

' declare string variable for holding the pattern
Dim As String paint_pattern = ""

' set colors
If bit_depth <= 8 Then
    c1 = 7 ' pattern color 1
    c2 = 8 ' pattern color 2
    cb = 15 ' border color
Else
    c1 = RGB(192, 192, 192) ' pattern color 1
    c2 = RGB(128, 128, 128) ' pattern color 2
    cb = RGB(255, 255, 255) ' border color
End If

' make the pattern to be used in Paint
For y As UInteger = 0 To 7
    For x As UInteger = 0 To 7

        ' choose the color of the pixel (c)
        If (x \ 4 + y \ 4) Mod 2 > 0 Then
            c = c1
        Else
            c = c2
        End If

        ' add the pixel to the pattern
        paint_pattern = paint_pattern + paint_pixel
    End For
End For
the following line can be used if you want to draw the pattern tile in the top left hand corner:

```
pset (x, y), c
```

Next x
Next y

draw a circle with the border color

```
Circle (160, 100), 50, cb, ,, 1.0
```

paint the circle region with paint_pattern, stopping at the border color

```
Paint (160, 100), paint_pattern, cb
```

pause before ending the program

```
Sleep
```

Differences from QB

- *target* is new to FreeBASIC
- In QB, the fill pattern was always 8-bits wide, and the height was the length of the string (up to 64). In FreeBASIC, the fill pattern is 8 pixels wide, independent of the color depth,
- The background color parameter supported by QB is not supported

See also

- *Screen*
Palette

Customizes colors in modes with paletted colors

Syntax

Palette [Get] [index, color]
Palette [Get] [index, r, g, b]
Palette [Get] Using arrayname(idx)

Parameters

Get
indicates getting palette information rather than setting palette informa
index
palette index
color
color attribute
r
red color component
g
green color component
b
blue color component
Using
indicates using array of color values
arrayname(idx)
array and index to get/set color attributes

Description

The **Palette** statement is used to retrieve or customize the current palette for graphics modes with a color depth of up to 8bpp; using **Palette** while in a mode with a higher color depth will have no effect. Calling **Palette** without an argument restores the default palette for current graphics mode, as set by the **Screen (Graphics)** statement.
The GfxLib sets a **default palette** when a **Screen** mode is initialized.

First form
If you specify index and color, these are dependent on the current mo

| Screen mode | index range | color range |
In screen modes 1, 2, 7, 8 and 9 you can assign to each color index or the colors in the available range. In other screen modes, the color must be specified in the form `&hBBGRR`, where `BB`, `GG` and `RR` are the blue, green and red components ranging `&h0`-`&h3F` in hexadecimal (`0-63` in decimal). If you don't like hexadecimal form, you can use the following formula to compute the integer value to pass to this parameter:

```
color = red Or (green Shl 8) Or (blue Shl 16)
```

Where red, green and blue must range `0-63`. Please note that color values accepted by `Palette` are not in the same form as returned by the `RGB` macro (the red and blue fields are inverted, and the range is different) is for backward compatibility with QB.

**Second form**

In the second form, you specify the red, green and blue components for a palette entry directly, by calling `Palette` with 4 parameters. In this case, `a` and `b` must be in the range `0-255`.

**Third form**

Calling `Palette Using` allows to set a list of color values all at once; you should pass an array holding enough elements as the color indices available for your current graphics mode color depth (2 for 1bpp, 4 for 16 for 4bpp or 256 for 8bpp). The array elements must be integer color values in the form described above. The colors stored into an array starting with given `idx` index are then assigned to each palette index, starting with index `0`.

Form 1 and 3 are for backward compatibility with QB; form 2 is meant for ease palette handling. Any change to the palette is immediately visible on screen.

If the `Get` option is specified, `Palette` retrieves instead of setting color for the current palette. The parameters have the same meaning as specified above.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-3</td>
<td>0-15</td>
</tr>
<tr>
<td>2</td>
<td>0-1</td>
<td>0-15</td>
</tr>
<tr>
<td>7,8</td>
<td>0-15</td>
<td>0-15</td>
</tr>
<tr>
<td>9</td>
<td>0-15</td>
<td>0-63</td>
</tr>
<tr>
<td>11</td>
<td>0-1</td>
<td>see below</td>
</tr>
<tr>
<td>12</td>
<td>0-15</td>
<td>see below</td>
</tr>
<tr>
<td>13 to 21</td>
<td>0-255</td>
<td>see below</td>
</tr>
</tbody>
</table>
for the form being used, but in this case color, \( r, g \) and \( b \) must be variables passed by reference that will hold the color RGB values on function exit.

Example

```
' Setting a single color, form 1.
Screen 15
Locate 1,1: Color 15
Print "Press any key to change my color!"
Sleep
' Now change color 15 hues to bright red
Palette 15, &h00003F
Sleep

' Getting a single color, form 2.
Dim As Integer r, g, b
Screen 13
Palette Get 32, r, g, b
Print "Color 32 hues:"
Print Using "Red:### Green:### Blue:###"; r; g; b
Sleep

' Getting whole palette, form 3.
Dim pal(0 To 255) As Integer
Screen 13
Palette Get Using pal
For i As Integer = 0 To 15
    Print Using "Color ## = &"; i; Hex(pal(i), 6)
Next i
Sleep
```
Differences from QB

- QBasic did not support PALETTE GET to retrieve a palette.
- QBasic did not allow passing individual red/green/blue values.

See also

- Screen (Graphics)
- Color
- Using
- Internal Pixel Formats
Specifies a *Pascal*-style calling convention in a procedure declaration

**Syntax**

```
Sub name pascal [Overload] [Alias "alias"] ( parameters )
Function name pascal [Overload] [Alias "alias"] ( parameters )
```

**Description**

In procedure declarations, `pascal` specifies that a procedure will use the calling convention, any parameters are to be passed (pushed onto the stack) in the same order in which they are listed, that is, from left to right. The procedures need not preserve the up the stack (pop any parameters) before it returns.

`pascal` is not allowed to be used with variadic procedure declarations `"..."`).

`pascal` is the default calling convention for procedures in Microsoft Qu used in the Windows 3.1 API.

**Example**

```
Declare Function MyFunc pascal Alias "MyFunc" (MyP
```

**Differences from QB**

- New to FreeBASIC

**See also**

- cdecl, stdcall
- Declare
- Sub, Function
PCopy

Copies one graphical or text page onto another

**Syntax**

```basic
Declare Function PCopy ( ByVal source As Long = -1, ByVal destination As Long = -1 )
```

**Usage**

```basic
PCopy [ source ] [, destination ]
```

**Parameters**

- `source`
  - page to copy from
- `destination`
  - page to copy to

**Description**

Copies one graphical or text video page to another. Useful for drawing to the active visible page - creating smooth graphics and animation. Known as 'double buffering' or 'page flipping'.

`source` and `destination` refer to page numbers. The 'source' page is copied over the 'destination' page when `PCopy` is called.

If the `source` argument is omitted, the current working page is assumed.

`PCopy` is inactive if the `destination` page is locked.

**Example**

```basic
'Sets up the screen to be 320x200 in 8-bit color with 2 video pages.
ScreenRes 320, 200, 8, 2

'Sets the working page to 1 and the displayed page to 0
PCopy 1, 0
```
ScreenSet 1, 0

'Draws a circle moving across the top of the screen
For x As Integer = 50 To 269
  Cls 'Clears the screen so we can start fresh
   Circle (x, 50), 50, 14 'Draws a yellow circle
   PCopy 1, 0 'Copies our image from
   Sleep 25 'Waits for 25 milliseconds
Next x

'Wait for a keypress before the screen closes
Sleep

' Console mode example:

' Set the working page number to 0, and the visible page number
#if __FB_LANG__ = "QB"
   Screen,, 0, 1
#else
   Screen, 0, 1
#endif

Dim As Integer i, frames, fps
Dim As Double t

t = Timer

Do
   ' Fill working page with a certain color and character
   Cls
   Locate 1, 1
   Color (i And 15), 0
   Print String$(80 * 25, Hex$(i, 1));
   i += 1

   ' Show frames per second
   DoEvents
   t = t + 0.01
   frames = frames + 1
   If t > 1 Then frames = 0
   fps = frames / t
   Print "Frames per second: ", fps

Loop
Color 15, 0
Locate 1, 1
Print "fps: " & fps,
If Int(t) <> Int(Timer) Then
    t = Timer
    fps = frames
    frames = 0
End If
frames += 1

' ' Copy working page to visible page
PCopy

' ' Sleep 50ms per frame to free up cpu time
Sleep 50, 1

' ' Run loop until the user presses a key
Loop Until Len(Inkey$)

Platform Differences
- Maximum number of text pages in Windows is 4.
- Maximum number of text pages in DOS is 8.
- Maximum number of text pages in all other targets is 1.
- Maximum number of graphics pages depends on what was specified.

Differences from QB
- None

See also
- ScreenCopy
- Flip
- Screen
**Peek**

Gets the value of an arbitrary type at an address in memory

**Syntax**

```
Declare Function Peek ( ByVal address As Any Ptr ) ByRef As UByte
Declare Function Peek ( datatype, ByVal address As Any Ptr ) ByRef As datatype
```

**Usage**

```
Peek( [ datatype, ] address )
```

**Parameters**

- `address`
  The address in memory to get the value from.
- `datatype`
  The type of value to get. If omitted, it defaults to the type of the pointer passed; or to `UByte`, if the address is an `Integer` or an `Any Ptr`.

**Description**

This procedure returns a reference to the value in memory given by a memory address, and is equivalent to

```
*cast(ubyte ptr, address)
```

or

```
*cast(datatype ptr, address)
```

**Example**

```
Dim i As Integer, p As Integer Ptr
p = @i

Poke Integer, p, 420
Print Peek(Integer, p)
```
will produce the output:

```
420
```

**Differences from QB**

- **Peek** did not support the *datatype* parameter in QB, and could only return individual bytes.
- **Peek** returns a reference in FB, so can be used to set the memory contents of the address, like with `Operator * (Value Of)`.
- **DEF SEG** isn't needed anymore because the address space is 32-bit flat in FreeBASIC.

**See also**

- **Poke**
- **Operator * (Value Of)**
**PMap**

Maps coordinates between view and physical mapping.

**Syntax**

Declare Function PMap ( ByVal coord As Single, ByVal func As Long )

**Usage**

result = PMap( coord, func )

**Parameters**

*coord*
An expression indicating the coordinate to be mapped.

*func*
The mapping function number to be applied to given coordinate.

**Return Value**

The mapped coordinate value.

**Description**

This function converts a coordinate between view (as defined by the `Window` statement) and physical (as set by the `View (Graphics)` statement) mappings. Depending on the value of *func*, *expr* is used to compute a different mapping to be returned by PMap:

<table>
<thead>
<tr>
<th>func value</th>
<th>return value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Treats <em>expr</em> as x view coordinate and returns corresponding x physical coordinate.</td>
</tr>
<tr>
<td>1</td>
<td>Treats <em>expr</em> as y view coordinate and returns corresponding y physical coordinate.</td>
</tr>
<tr>
<td>2</td>
<td>Treats <em>expr</em> as x physical coordinate and returns corresponding x view coordinate.</td>
</tr>
<tr>
<td>3</td>
<td>Treats <em>expr</em> as y physical coordinate and returns corresponding y view coordinate.</td>
</tr>
</tbody>
</table>

**Example**


Screen 12
Window Screen (0, 0)-(100, 100)
Print "Logical x=50, Physical x"; PMap(50, 0)
Print "Logical y=50, Physical y"; PMap(50, 1)
Print "Physical x=160, Logical x"; PMap(160, 2)
Print "Physical y=60, Logical y"; PMap(60, 3)
Sleep

Differences from QB

- None

See also

- Window
- View (Graphics)
Point

Returns the color attribute of a specified pixel coordinate

Syntax

\[ \text{result} = \text{Point}(\ coord_x, \ coord_y [,buffer] \ ) \]

or

\[ \text{result} = \text{Point}(\ function_index \ ) \]

Usage

- **coord_x**: x coordinate of the pixel
- **coord_y**: y coordinate of the pixel
- **buffer**: the image buffer to read from
- **function_index**: the type of screen coordinate to return: one of the values 0, 1, 2, 3

Return Value

If the x, y coordinates of a pixel are provided, `Point` returns the color attribute as an 8-bit palette index in 8 bpp indexed modes, a 24-bit RGB value in 16 bpp modes (upper 8 bits of the integer unused, limited precision of R,G,B), and a 32-bit RGB or RGBA value in 32 bpp modes (upper 8 bits unused or holding Alpha). Note that it does not return a 16-bit value (5 bits R + 6 bits G + 5 bits B).

If the argument is a function index, `Point` returns one of the graphics cursor coordinates set by the last graphics command.

<table>
<thead>
<tr>
<th>Argument</th>
<th>Value Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The current physical x coordinate.</td>
</tr>
<tr>
<td>1</td>
<td>The current physical y coordinate.</td>
</tr>
<tr>
<td>2</td>
<td>The current view x coordinate. This returns the same value as the POINT(0) function if the WINDOW statement has not been used.</td>
</tr>
<tr>
<td>3</td>
<td>The current view y coordinate. This returns the same value as the POINT(1) function if the WINDOW statement has not been used.</td>
</tr>
</tbody>
</table>
**Description**

GfxLib Function with two different uses. If supplied with two coordinates it reads the color of the pixel at the coordinate on the screen, or of the *buffer*, if supplied. The value return is a color index in a 256 or less color Screen, and any modes. If the coordinates are off-screen or off-buffer, -1 is returned.

If supplied with a single value it returns the one of the coordinates of the last graphics command executed. If the last command was executed in a buffer, the values returned will be coordinates in the buffer. Arguments out of the range 0 - 255 return -1.

The function **Point** does not work in text modes.

Speed note: while **Point** provides valid results, it is quite slow to call repeatedly due to the overhead of additional calculations and checks. Much better performance can be achieved by using direct memory access using the results obtained from **ImageInfo**.

**Example**

```plaintext
' Set an appropriate screen mode - 320 x 240 x 8bpp
ScreenRes 320, 240, 8

' Draw a line using color 12 (light red)
Line (20,20)-(100,100), 12

' Print the color of a point on the line
Print Point(20,20)

' Sleep before the program closes
Sleep
```

**Output:**
Differences from QB

- *buffer* is new to FreeBASIC
- In 16 bpp and 32 bpp modes, a 32-bit value is returned instead.

See also

- **PSet** - write pixels
- **PMap**
- **Color**
- **View (Graphics)**
- **Window**
- **Internal pixel formats**
Pointcoord

Queries Draw's pen position in graphics mode

Syntax

```
Declare Function PointCoord(ByVal func As Long) As Single
```

```
result = PointCoord(func)
```

Description

The PointCoord function can be used to query x and y position of the graphics mode. The result value depends on the passed func value:

<table>
<thead>
<tr>
<th>func value</th>
<th>return value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>x physical coordinate, same as PMap(PointCoord(2), 0)</td>
</tr>
<tr>
<td>1</td>
<td>y physical coordinate, same as PMap(PointCoord(3), 1)</td>
</tr>
<tr>
<td>2</td>
<td>x view coordinate</td>
</tr>
<tr>
<td>3</td>
<td>y view coordinate</td>
</tr>
</tbody>
</table>

Example

```
Screen 12

Print "--- Default window coordinate mapping ---"
Print "DRAW pen position, at the default (0,0):"
Print "Physical:", PointCoord(0), PointCoord(1)
Print "View:", PointCoord(2), PointCoord(3)

Draw "BM 50,50"
Print "DRAW pen position, after being moved to (50,50):"
Print "Physical:", PointCoord(0), PointCoord(1)
Print "View:", PointCoord(2), PointCoord(3)

Print "--- Changing window coordinate mapping ---"
Window Screen (-100, -100) - (100, 100)
```
```basic
Draw "BM 0,0"
Print "DRAW pen position, after being moved to (0,0):"
Print "Physical:" , PointCoord( 0 ), PointCoord( 1 )
Print "View:" , PointCoord( 2 ), PointCoord( 3 )
Draw "BM 50,50"
Print "DRAW pen position, after being moved to (50,50):"
Print "Physical:" , PointCoord( 0 ), PointCoord( 1 )
Print "View:" , PointCoord( 2 ), PointCoord( 3 )
Sleep
```

**Differences from QB**

- New to FreeBASIC

**See also**

- PMap
- Window
A variable declaration type modifier

**Syntax**

\[
\text{Dim } \text{symbolname As DataType } \{\text{Pointer} \mid \text{Ptr}\}
\]

**Description**

Declares a pointer variable. The same as `Ptr`.

**Example**

```basic
Dim p As ZString Pointer
Dim text As String
text = "Hello World!"
p = StrPtr(text) + 6
Print text
Print *p

' ' Output:
' ' Hello World!
' ' World!
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Pointer`.

**Differences from QB**

- New to FreeBASIC

**See also**
- $\text{Ptr}$
**Poke**

Assigns a value to a location in memory.

**Syntax**

Declare Sub Poke ( ByVal address As Any Ptr, ByRef value As UByte )
Declare Sub Poke ( datatype, ByVal address As Any Ptr, ByRef value As datatype )

**Usage**

Poke [ datatype, ] address, value

**Parameters**

* datatype
The type of data at the specified address.
* address
The location in memory to assign to.
* value
The value to assign.

**Description**

Poke assigns a value to a location in memory. It is equivalent to

* cast(ubyte ptr, address) = value

or

* cast(datatype ptr, address) = value

When datatype is a user-defined type, Poke assigns value using the type's Operator Let.

**Example**

```
Dim i As Integer, p As Integer Ptr
p = @i

Poke Integer, p, 420
```
Print Peek(Integer, p)

Will produce the output:

420

Differences from QB

- Only the byte form were supported in QB.
- DEF SEG isn't needed anymore because the address space is 32-bit flat in FreeBASIC.

See also

- Peek
Pos

Returns the horizontal (left to right) position of the text cursor

**Syntax**

```
Declare Function Pos ( ) As Long
Declare Function Pos ( ByVal dummy As Long ) As Long
```

**Usage**

```
result = Pos( dummy )
```

**Parameters**

 dummy
An unused parameter retained for backward compatibility with QBASIC.

**Return Value**

Returns the horizontal position of the text cursor.

**Description**

Returns the horizontal (left to right) position of the text cursor. The leftmost column is number 1.

**Example**

```
Dim As Integer p

' print starting column position
p = Pos()
Print "position: "; p

' print a string, without a new-line
Print "ABCDEF";

' print new column position:
```
\begin{verbatim}
p = Pos()
Print: Print "position: "; p
Print
''position changes after each Print:
Print "Column numbers: 
Print Pos(), Pos(), Pos(), Pos(), Pos(), Pos()
\end{verbatim}

Differences from QB

- The \textit{dummy} parameter was not optional in QBASIC.

See also

- CsrLin
- Tab
- Locate
Preserve

Used with `ReDim` to preserve contents will resizing an array

**Syntax**

```
ReDim Preserve array(...) [As datatype]
```

**Description**

Used with `ReDim` so that when an array is resized, data is not reset but is preserved. This means when the array is enlarged that only new data is reset, while the old data remains the same.

**NOTE:** `ReDim Preserve` may not work as expected in all cases: `Preserve`'s current behavior is to keep the original data contiguous in memory, and only expand or truncate the size of the memory. Its behavior is only well-defined when the upper bound is changed. If the lower bound is changed, the current result is that the data is in effect shifted to start at the new lower bound. If there are multiple dimensions, only the upper bound of the first dimension may be changed safely. If lower-order dimensions are resized at all, the effects can be hard to predict.

**Example**

```
ReDim array(1 To 3) As Integer
Dim i As Integer

array(1) = 10
array(2) = 5
array(3) = 8

ReDim Preserve array(1 To 10)

For i = 1 To 10
    Print "array(; i; ") = "; array(i)
Next
```
Differences from QB

- Preserve wasn't supported until PDS 7.1

See also

- Dim
- LBound
- ReDim
- UBound
PReset

Plots a single pixel

**Syntax**

```
PReset [target ,] [STEP] (x, y) [,color]
```

**Parameters**

- `target`: specifies buffer to draw on.
- `STEP`: indicates that coordinates are relative to the upper left-hand corner of the pixel.
- `color`: the color attribute.

**Description**

`target` specifies buffer to draw on. `target` may be an image created with `omitted`, `target` defaults to the screen's current work page.

`(x, y)` are the coordinates of the pixel. `STEP` if present, indicates that graphics cursor position. If omitted, `(x, y)` are relative to the upper left coordinates are affected by the last call to the `View (Graphics)` and `Window` clipping region as set by the `View (Graphics)` statement.

`color` specifies the color attribute. If omitted, `color` defaults to the current background color.

**Example**

```Screen 13
'Set background color to 15
Color , 15```
'Draw a pixel with the background color at 10, 10
\texttt{PReset (10,10)}

'Draw a pixel with the background color at Last x
\texttt{PReset Step (10,10)}
\texttt{Sleep}

\textbf{Differences from QB}

- \textit{target} is new to FreeBASIC

\textbf{See also}

- \texttt{PSet}
(Print | ?)

Writes text to the screen

**Syntax**

```
(Print | ?) [ expressionlist ] [ , | ; ]
```

**Parameters**

- `expressionlist`
  - list of items to print

**Description**

*Print* outputs a list of values to the screen. Numeric values are converted to string representation, with left padding for the sign. Objects of user-defined types must overload `Operator Cast () As String`.

Consecutive values in the expression list are separated either by a comma (,) or a semicolon (;). A comma indicates printing should take place at the next column boundary, while a semicolon indicates values are printed with no space between them. This has a similar effect to concatenating expressions using `+` or `Concatenate`.

*Print* also supports the special expressions, `Spc()` and `Tab()`. These can be used to space out expressions, or to align the printing to a specific column.

A new-line character is printed after the values in the expression list unless the expression list is followed by a comma or semicolon. A *Print* without any expressions or separators following it will just print a new-line.

NOTE: *Print* resets the `Err` value after each expression is printed.

NOTE: In graphics mode, *Draw String* provides a flexible alternative to printing a string to the screen with pixel positioning, transparent background, and can use a user-supplied font.

**Example**
' print "Hello World!", and a new-line
Print "Hello World!"

' print several strings on one line, then print a line
Print "Hello";
Print "World"; "!";
Print

' column separator
Print "Hello!", "World!"

' printing variables/expressions
Dim As Double pi = Atn(1) * 4
Dim As String s = "FreeBASIC"

Print "3 * 4 ="; 3 * 4
Print "Pi is approximately"; pi
Print s; " is great!"

Dialect Differences

- In the -lang qb dialect, an extra space is printed after numbers

Differences from QB

- None, when using QBASIC's variable types in -lang qb.
- Unsigned numbers are printed without a space before them.
- QB did not support casting for UDTs, so didn't allow them to be

See also

- Spc
- Tab
- (Print | ?) #
- (Print | ?) Using
- Write
- Draw String
- Input
(Print | ?) #

Writes a list of values to a file or device

Syntax

(Print | ?) # filenum, [ expressionlist ] [ , | ; ]

Parameters

filenum
The file number of a file or device opened for Output or Append.

expressionlist
List of values to write.

Description

Print # outputs a list of values to a text file or device. Numeric values are converted to their string representation, with left padding for the sign. Objects of user-defined types must overload Operator Cast () As String.

Consecutive values in the expression list are separated either by a comma (,) or semicolon (;). A comma indicates printing should take place at the next 14 column boundary, while a semicolon indicates values are printed with no space between them.

A new-line character is printed after the values in the expression list unless the expression list is followed by a comma or semicolon.

Note that the comma (,) immediately following the file number is still necessary, even the expression list is empty. In this case a new-line is printed, just as with a normal expression list that doesn't have a comma or semicolon at the end.

Example

Open "bleh.dat" For Output As #1
Dialect Differences

- In the -lang qb dialect, an extra space is printed after numbers.

Differences from QB

- None, when using QBASIC's variable types in -lang qb.
- Unsigned numbers are printed without a space before them.
- QB did not support casting for UDTs, so didn't allow them to be printed.

See also

- (Print | ?) Using
- (Print | ?)
- Write #
- Open
(Print | ?) Using

Outputs formatted text to the screen or output device

Syntax

(Print | ?) [# filenum ,] [ printexpressionlist {,|;} ] Using fo

Parameters

filenum
The file number of a file or device opened for Output or Append. (Alternatively where appropriate, instead of Print #)

printexpressionlist
Optional preceding list of items to print, separated by commas (,) or semi-colons.

formatstring
Format string to use.

expressionlist
List of items to format, separated by semi-colons (;).

Description

Print to screen various expressions using a format determined by the format string. Internally, Print Using uses a buffer size of 2048 bytes: while it is highly unlikely that this buffer would be filled, it should be noted that output would be truncated should this limit be reached.

If no expression list is given, the format string will be printed up to the semi-colon after formatstring is still necessary, even if no expression list is given.

The format string dictates how the expressions are to be formatted with indicated by the use of special marker characters. There are markers for string and numeric output:

String formatting

<table>
<thead>
<tr>
<th>Marker</th>
<th>Formatting</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>prints the first character of a string</td>
</tr>
<tr>
<td>Marker</td>
<td>Formatting</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>\</td>
<td>prints as many characters of a string as occupied between the pair \</td>
</tr>
<tr>
<td>&amp;</td>
<td>prints the entire string</td>
</tr>
</tbody>
</table>

**Numeric formatting**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Formatting</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>placeholder for either an integer digit, or a decimal digit if a decimal point precedes it</td>
</tr>
<tr>
<td>,</td>
<td>placed after integer digit indicates groups of 3 digits should be separated by commas</td>
</tr>
<tr>
<td>.</td>
<td>placed near # indicates place for the decimal point</td>
</tr>
<tr>
<td>^^^^^</td>
<td>uses exponential notation (E+/-###) when placed after the digit characters</td>
</tr>
<tr>
<td>+</td>
<td>placed before/after the format string, controls whether the sign of a number is prepended/appended, and causes an explicit '+' sign to be printed for positive numbers</td>
</tr>
<tr>
<td>-</td>
<td>placed after the format string, causes the sign of the number to be appended rather than prepended, and appends a space/negative sign for positive/negative numbers</td>
</tr>
<tr>
<td>$$</td>
<td>placed at the start of integer digits, causes a dollar sign to be prepended to the number after the sign if one is prepended</td>
</tr>
<tr>
<td>**</td>
<td>placed at the start of integer digits, causes any padding on the left to be changed from spaces to asterisks</td>
</tr>
<tr>
<td>$$&amp;</td>
<td>placed at the start of integer digits, pads on the left with asterisks, and prepends a dollar sign after the asterisks</td>
</tr>
</tbody>
</table>

All of the special marker characters can be escaped by preceding them with "_", allowing them to be printed directly. For example, "_!" is printed as "!".

If a numerical value cannot fit in the number of digits indicated by the format string, the number is adapted to fit the number, possibly switching to scientific notation, and preceded by the percent "%" character. E.g., the number 1234 with a formatstring of "%1234.00".

All other characters within the format string are printed as they appear.

A new-line character is printed after the values in the expression list unless the expression list is followed by a semicolon (;).

**Example**
**Print Using** "The value is #.## seconds"; 1.019
**Print Using** "The ASCII code for the pound sign (#) is \#"
**Print Using** "The last day in the year is \& \\"; 31

will produce the output:

The value is 1.02 seconds
The ASCII code for the pound sign (#) is 35
The last day in the year is 31 Dec

**Differences from QB**

- QB didn't allow "&" to be used for printing numbers.

**See also**

- (Print | ?)
- (Print | ?) #
- Format
- Using
- Palette Using
**Private**

Specifies a procedure having internal linkage

**Syntax**

```plaintext
Private Sub procedure_name [cdecl|stdcall|pascal] [Overload]
[Alias "external_name"] [[(parameter_list)]] [Constructor
[priority]] [Static] [Export]
..procedure body..
End Sub

Private Function procedure_name [cdecl|stdcall|pascal] [Overload
[Alias "external_name"] [[(parameter_list)]] As return_type
[Static] [Export]
..procedure body..
End Function
```

**Description**

In procedure definitions, **Private** specifies that a procedure has internal linkage, meaning its name is not visible to external modules.

The **Option Private** statement allows procedures to be defined with internal linkage by default.

**Example**

```plaintext
'e.g.

Private Sub i_am_private
End Sub

Sub i_am_public
End Sub
```

**Differences from QB**

- New to FreeBASIC
See also

- **Private**: (Access Control)
- Public
- **Option Private**
- Sub
- **Function**
**Private: (Access Control)**

Specifies private member access control in a **Type** or **Class**

**Syntax**

```plaintext
Type typename
Private:
    member declarations
End Type
```

**Parameters**

- `typename`
  - name of the **Type** or **class**
  - `member declarations`
  - declarations for fields, functions, or enumerations

**Description**

- **Private**: indicates that `member declarations` following it have private access and are for the **Type** or **Class**.

  - `member declarations` following **Private**: are private until a different access control specifier is given.

  - Members in a **Type** declaration are **Public**: by default if no member access control specifier is given.

**Example**

```plaintext
Type testing
    number As Integer
Private:
    nome As String
    Declare Sub setNome( ByRef newnome As String )
End Type

Sub testing.setnome( ByRef newnome As String )
    '' This is OK. We're inside a member function for this.nome = newnome
End Sub
```
Dim As testing myVariable

' This is OK, number is public
myVariable.number = 69

' this would generate a compile error
' - nome is private and we're trying to access it
' myVariable.nome = "FreeBASIC"

**Dialect Differences**

- Available only in the `-lang fb` dialect.

**Differences from QB**

- New to FreeBASIC

**See also**

- **Private**
- **Public:** (Access Control)
- **Protected:** (Access Control)
- **Type**
Operator ProcPtr (Procedure Pointer)

Returns the address of a procedure

**Syntax**

Declare Operator ProcPtr ( ByRef lhs As T ) As TPtr

**Usage**

result = ProcPtr ( lhs )

**Parameters**

- **lhs**
  A procedure.

- **T**
  The type of procedure.

**Return Value**

Returns the address of the procedure.

**Description**

This operator returns the address of a Sub or Function procedure.

Operator @ (Address Of), when used with procedures, has identical b

**Example**

' This example uses ProcPtr to demonstrate function
Declare Function Subtract( x As Integer, y As Integer )
Declare Function Add( x As Integer, y As Integer )
Dim myFunction As Function( x As Integer, y As Integer )

' myFunction will now be assigned to Add
myFunction = ProcPtr( Add )
Print myFunction(2, 3)
' myFunction will now be assigned to Subtract. Notice the
different output.
myFunction = ProcPtr( Subtract )
Print myFunction(2, 3)

Function Add( x As Integer, y As Integer) As Integer
    Return x + y
End Function

Function Subtract( x As Integer, y As Integer) As Integer
    Return x - y
End Function

**Dialect Differences**

- Not available in the *-lang qb* dialect unless referenced with the

**Differences from QB**

- New to FreeBASIC

**See also**

- Sub
- VarPtr
- StrPtr
- Pointers
Property

Declares or defines a property in a type or class

**Syntax**

```
{ Type | Class } typename
Declare Property filename () As datatype
Declare Property filename ([ ByRef | ByVal ] new_value As datatype)
Declare Property filename ([ ByRef | ByVal ] index As datatype)
Declare Property filename ([ ByRef | ByVal ] index As datatype datatype)
End { Type | Class }

Property typename.fieldname () As datatype [ Export ] statements
End Property

Property typename.fieldname ([ ByRef | ByVal ] new_value As datatype)
statements
End Property

Property typename.fieldname ([ ByRef | ByVal ] index As datatype)
statements
End Property

Property typename.fieldname ([ ByRef | ByVal ] index As datatype datatype)
[ Export ] statements
End Property
```

**Parameters**

- `typename` name of the **Type** or **Class**
- `fieldname` name of the property
- `new_value` the value passed to property to be assigned
- `index` the property index value

**Description**
**Property** fields are used to get and set values of a **Type** or **Class** in the except instead of a simple assignment to a field or a value retrieved fr

typename is the name of the type for which the **Property** method is dec for typename follows the same rules as procedures when used in a **Nam**

A **Property** may optionally have one index parameter. When indexed, nameof(Index) = Value.

A hidden This parameter having the same type as typename is passed used to access the fields of the **Type** or **Class**.

**Note:** A standard **Property** (get & set) does not work with combination byref get-**Property** (as more generally any result byref function) works.

**Example**

```
Type Vector2D
    As Single x, y
    Declare Operator Cast() As String
    Declare Property Length() As Single
    Declare Property Length( ByVal new_length As Single ) As Single
End Type

Operator Vector2D.cast () As String
    Return "(" + Str(x) + ", " + Str(y) + ")"
End Operator

Property Vector2D.Length() As Single
    Length = Sqr( x * x + y * y )
End Property

Property Vector2D.Length( ByVal new_length As Single ) As Single
    Dim m As Single = Length
    If m <> 0 Then
        ' new vector = old / length * new_length
        x *= new_length / m
        y *= new_length / m
    End If
End Type
```
End If
End Property

Dim a As Vector2D = (3, 4)

Print "a = "; a
Print "a.length = "; a.length
Print
a.length = 10

Print "a = "; a
Print "a.length = "; a.length

Output:

a = (3, 4)
a.length = 5

a = (6, 8)
a.length = 10

Property Indexing:

' ' True/False
Namespace BOOL
    Const FALSE = 0
    Const TRUE = Not FALSE
End Namespace

Type BitNum
    Num As UInteger

    ' ' Get/Set Properties each with an Index.
    Declare Property NumBit( ByVal Index As Integer
    Declare Property NumBit( ByVal Index As Integer, End Type

    ' ' Get a bit by it's index.
Property BitNum.NumBit( ByVal Index As Integer ) As Bit
    Return Bit( This.Num, Index )
End Property

' Set a bit by it's index.
Property BitNum.NumBit( ByVal Index As Integer, ByVal Value As BOOL ) As Bit
    ' Make sure index is in Integer range.
    If Index >= ( SizeOf( This.Num ) * 8 ) Then
        Print "Out of uInteger Range!"
        Exit Property
    Else
        If Index < 0 Then Exit Property
    End If

    If Value = BOOL.FALSE Then
        This.Num = BitReset( This.Num, Index )
    End If

    If Value = BOOL.TRUE Then
        This.Num = BitSet( This.Num, Index )
    End If

End Property

Dim As BitNum Foo

Print "Testing property indexing with data types:" 
Print "FOO Number's Value: " & Foo.Num

' Set the bit in the number as true.
Foo.NumBit(31) = BOOL.TRUE
Print "Set the 31st bit of FOO"

' Print to see if our bit has been changed.
Print "FOO Number's Value: " & Foo.Num
Print "FOO 31st Bit Set? " & Foo.NumBit(31)
Output:

<table>
<thead>
<tr>
<th>Testing property indexing with data types:</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOO Number's Value: 0</td>
</tr>
<tr>
<td>Set the 31st bit of FOO</td>
</tr>
<tr>
<td>FOO Number's Value: 2147483648</td>
</tr>
<tr>
<td>FOO 31st Bit Set? -1</td>
</tr>
</tbody>
</table>

**See also**

- **Class**
- **Type**
Protected: (Access Control)

Specifies protected member access control in a **Type** or **Class**

**Syntax**

```
Type typename
Protected:
    member declarations
End Type
```

**Parameters**

- **typename**
  - name of the **Type** or **Class**
  - member declarations

**Description**

**Protected:** indicates that **member declarations** following it have protected access. Protected members are accessible only from inside a member function for the **Type** or **Class**, and classes which are derive from the **Type** or **Class**.

**member declarations** following **Protected:** are protected until a different access control specifier is given, like **Private:** or **Public:**.

Members in a **Type** declaration are **Public:** by default if no member access control specifier is given.

**NOTE:** This keyword is useful only since fbc version 0.24 because inheritance is then supported.

**Example**

```
' ' Example pending classes feature ...
```
Dialect Differences

- Available only in the -lang fb dialect.

Differences from QB

- New to FreeBASIC

See also

- Class
- Private: (Access Control)
- Public: (Access Control)
- Type
**PSet**

Plots a single pixel

**Syntax**

```
PSet [target,] [STEP] (x, y [,color]
```

**Parameters**

*target*

specifies buffer to draw on.

*STEP*

indicates that coordinates are relative

*(x, y)*

coordinates of the pixel.

*color*

the color attribute.

**Description**

*target* specifies buffer to draw on. *target* may be an image created with

*target* defaults to the screen’s current work page.

*(x, y)* are the coordinates of the pixel. *STEP* if present, indicates that (cursor position. If omitted, *(x, y)* are relative to the upper left-hand corner affected by the last call to the View (Graphics) and Window statements by the View (Graphics) statement.

*color* specifies the color attribute, as an 8-bit palette index in 8 bpp indexed modes (upper 8 bits of the integer unused, limited precision of R,G,B) modes (upper 8 bits unused or holding Alpha). Note that it does NOT affect B). If omitted, *color* defaults to the current foreground color.

Speed note: while **pset** provides valid results, it is quite slow to call repeatedly due to overhead of additional calculations and checks. Much better performance can be achieved by obtaining from **ImageInfo** and **ScreenInfo/ScreenPtr**.
Example

Set an appropriate screen mode - 320 x 240 x 8bpp
ScreenRes 320, 240, 8

Plot a pixel at the coordinates 100, 100, Color 15
PSet (100, 100), 15
' Confirm the operation.
Locate 1: Print "Pixel plotted at 100, 100"
' Wait for a keypress.
Sleep

Plot another pixel at the coordinates 150, 150, Color 4
PSet (150, 150), 4
' Confirm the operation.
Locate 1: Print "Pixel plotted at 150, 150"
' Wait for a keypress.
Sleep

Plot a third pixel relative to the second, Color 15
' This pixel is given the coordinates 60, 60. It will be placed at 60, 60 plus the previous coordinates (150, 150)
PSet Step (60, 60), 15
' Confirm the operation.
Locate 1: Print "Pixel plotted at 150 + 60, 150 + 60"
' Wait for a keypress
Sleep

Explicit end of program
End

Differences from QB

- target is new to FreeBASIC
- In 16 bpp and 32 bpp modes, a 32-bit value is required instead
See also

- Point - read out pixels
- PReset
- View (Graphics)
- Window
- Internal pixel formats
Parameter to the **Put** graphics statement which selects **PSet** as the blitting method.

**Syntax**

```
Pput [ target, ] [ STEP ] ( x, y ), source [ , ( x1, y1 )-( x2, y2 ) ]
```

**Parameters**

- **PSet**
  - Required.

**Description**

The **PSet** method copies the source pixel values onto the destination pixels. This is the simplest **Put** method. The pixels in the destination buffer are directly overwritten with the pixels in the source buffer. No additional operations are done, and there are no color values that are treated as transparent. It has the same effect as individually.

**Example**

```plaintext
' set up a screen: 320 * 200, 16 bits per pixel
ScreenRes 320, 200, 16
Line (0, 0)-(319, 199), RGB(0, 128, 255), bf

' set up an image with the mask color as the background
Dim img As Any Ptr = ImageCreate(33, 33, RGB(255, 0, 255), img, (16, 16), 15, RGB(255, 255, 0), ,
Circle img, (10, 10), 3, RGB(0, 0, 0), ,
Circle img, (23, 10), 3, RGB(0, 0, 0), ,
Circle img, (16, 18), 10, RGB(0, 0, 0), 3.14,

Dim As Integer x = 160 - 16, y = 100 - 16

' Put the image with PSET
Put (x, y), img, PSet
```
'' free the image memory
ImageDestroy img

'' wait for a keypress
Sleep

Differences from QB

- None

See also

- PSet
- Put (Graphics)
Ptr

A variable declaration type modifier

Syntax

\[
\text{Dim symbolname As DataType \{Ptr | Pointer\}}
\]

Description

Declares a pointer variable. The same as \texttt{Pointer}.

Operator \texttt{@ (Address Of)} operator or \texttt{VarPtr} are used to take the address of a variable. Operator \texttt{* (Value Of)} operator is used to dereference the pointer, that is, access the actual value stored in the memory location the pointer is pointing at.

Example

```
' Create the pointer.
Dim p As Integer Ptr

' Create an integer value that we will point to using pointer "p"
Dim num As Integer = 98845

' Point \texttt{p} towards the memory address that variable \texttt{num} occupies.
p = @num

' Print the value stored in memory pointed to by \texttt{p}
Print "Pointer 'p' ="; *p
Print

' Print the actual location in memory that pointer \texttt{p} points to
Print "Pointer 'p' points to memory location:"
Print p
```
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Pointer
- Allocate
Public

Specifies a procedure having external linkage.

**Syntax**

```plaintext
Public Sub procedure_name [cdecl|stdcall|pascal] [Overload] [Alias "external_name"] [([parameter_list])] [Constructor [priority]] [Static] [Export] ..procedure body.. End Sub

Public Function procedure_name [cdecl|stdcall|pascal] [Overload] [Alias "external_name"] [([parameter_list])] As return_type [Static] [Export] ..procedure body.. End Function
```

**Description**

In procedure definitions, `Public` specifies that a procedure has external linkage, meaning its name is visible to external modules. If `Public` or `Private` is not specified, a procedure is defined as if `Public` was specified.

**Example**

```plaintext
Private Sub i_am_private
End Sub

Public Sub i_am_public
End Sub
```

**Differences from QB**

- New to FreeBASIC

**See also**
- **Public**: *(Access Control)*
- **Private**
- **Option Private**
- **Sub**
- **Function**
Public: (Access Control)

Specifies public member access control in a Type or Class

Syntax

Type typename
Public:
member declarations
End Type

Parameters

typename
name of the Type or Class
member declarations
declarations for fields, functions, or enumerations

Description

Public: indicates that member declarations following it have public access.
Public members are accessible with any usage of the Type or Class.

member declarations following Public: are public until a different access control specifier is given, like Private: or Protected:

Members in a Type declaration are Public: by default if no member access control specifier is given.

Example

Type testing
Private:
    nome As String
Public:
    number As Integer
    Declare Sub setName( ByRef newnome As String )
End Type

Sub testing.setName( ByRef newnome As String )
```vbnet
this.nome = newnome
End Sub

Dim As testing myVariable

' We can access these members anywhere since '' they're public
myVariable.number = 69 ''
myVariable.setNome( "FreeBASIC" )
```

**Dialect Differences**

- Available only in the `-lang fb` dialect.

**Differences from QB**

- New to FreeBASIC

**See also**

- Class
- **Private:** (Access Control)
- **Protected:** (Access Control)
- Public
- Type
Put (Graphics)

Copies an image on to another image or screen

**Syntax**

```
Put [target, ] [ [STEP](x, y), source [, (x1, y1)-[STEP](x2, y2)
```

**Parameters**

*target*

is the address of the buffer where the image is to be drawn. If it's omitted, the address of the destination buffer, or screen, is used.

*STEP*(x, y)

specify offsets from the upper-left corner of the destination buffer, or graphics cursor position.

*source*

is the address of the buffer of the image to be drawn. See below.

(x1, y1)-[STEP](x2, y2)

specify a rectangular area in the source buffer to draw. If omitted, the entire buffer is drawn.

*method*

specifies the method used to draw the image to the destination buffer,

Background-independent methods

**PSet** : Source pixel values are copied without modification.

**PRESET** : Source pixel values are 1's-complement negated before being copied.

**Trans** : Source pixel values are copied without modification. Does not draw source pixels of mask color. See below.

Background-dependent methods

**And** : Destination pixels are bitwise Anded with source pixels. See below.

**Or** : Destination pixels are bitwise Or ed with source pixels. See below.

**Xor** : Destination pixels are bitwise Xor ed with source pixels. See below.

**Alpha** : Source is blended with a transparency factor specified either in an ADD or ALPHA blender. See below.

**Add** : Source is multiplied by a value and added with saturation to the destination. See below.

**Custom** : Uses a user-defined function to perform blending the source with the destination. See below.

*value*

is a 0..255 value specifying the transparency value for an ADD or ALPHA blender.

*blender*

specifies the address of a user-defined function to be called in a CUSTOM blender.

*param*

specifies a parameter to pass to the custom blender.
Description
The Put statement can be used to draw an image onto another image. The plotted image respects the current clipping region set by last call to the Valid Image Buffers

The source and target image buffers must be valid image buffers. Valid image buffers are created using the specified in a Put statement using an array name with optional index, or a pointer with optional index.

Drawing methods
Depending on the method used, the existing pixel values in the destination buffer are used to calculate the pixel values that are actually drawn. The TRANS methods do not use the destination buffer for calculating final pixel values, while the latter methods will look differently depending on the content of the destination buffer.

Different pixel formats
The pixel format of an image buffer must be compatible with the current graphics mode color depth; that is, if you acquire an image using screen mode via the Screen statement, the image data may not be valid in the new graphics mode, and you may not be able to draw it onto the screen. You should note however that you will always be able to draw image buffers onto other image buffers.

The AND, OR and XOR methods produce different results depending on the details.

Mask Color
The TRANS, ALPHA and ADD methods do not draw pixels in the source image buffer. Instead, they use the mask color depends on target (being it an image buffer or the screen) depth: in depths up to 8 bpp (paletted modes) it is equal to color index 255. Note that in 32 bpp modes the alpha value of a color does not affect the identification of the transparent color; only the lower 24 bits are used to identify it. See Internal pixel formats for details.

Alpha drawing
The ALPHA method can be used in two modes. If the value parameter is specified, this is used to specify the level of transparency for the whole image to be drawn; a value of 0 will draw a completely transparent image, whereas a value of 255 will draw a completely solid one. This method works only when drawing onto hi/truecolor targets (16 and 32 bpp).

If the value parameter is omitted, the ALPHA method will take the alpha level value on a per-pixel basis, allowing to draw images with an alpha channel (certain parts of the image can be made more or less transparent than others). This method works only with 32 bpp image buffers, as this is the only color depth that allows for an embedded alpha value in each pixel.

Dealing with the alpha channel
Normally Put only allows to draw image buffers onto targets with the same pixel format, but there is an exception. When drawing an 8 bpp image buffer onto a 32 bpp target, the alpha value is used to specify the level of transparency for the whole image.
and the ALPHA method is used, the 8 bpp source image is drawn into the image without having to deal with low level access of its pixel data.

**Custom Blend Function**
The CUSTOM method uses a user-defined function to calculate the final pixel values to be drawn to the destination buffer. The function has the form:

```plaintext
Declare Function identifier ( ByVal source_pixel As UInteger, ByVal destination_pixel As UInteger, ByVal parameter As UInteger) As UInteger
```

*identifier* is the name of the function. Can be anything.  
*source_pixel* is the current pixel value of the source image.  
*destination_pixel* is the current pixel value of the destination image.  
*parameter* is the parameter that is passed by the *Put* command. It should be a data pointer.

### Example

The following program gives a simple example of how to *Put* an image:

```plaintext
'' set up the screen and fill the background with ScreenRes 320, 200, 32 Paint (0, 0), RGB(64, 128, 255)

'' set up an image and draw something in it Dim img As Any Ptr = ImageCreate(32, 32, RGB(255, 255, 255), Circle img, (16, 16), 15, RGB(255, 255, 0), , Circle img, (10, 10), 3, RGB(0, 0, 0), , Circle img, (23, 10), 3, RGB(0, 0, 0), , Circle img, (16, 18), 10, RGB(0, 0, 0), 3.14,

'' PUT the image in the center of the screen Put (160 - 16, 100 - 16), img, Trans

'' free the image memory ImageDestroy img

'' wait for a keypress Sleep
```
The following example shows how to allocate memory for an image, draw that image using various methods, including a custom blender, and free the memory for the image:

```vbnet
Declare Function checkered_blend(ByVal src As UInteger)

Screen 14, 32

Dim As Any Ptr sprite
Dim As Integer counter = 0

sprite = ImageCreate(32, 32)

Line sprite, (0, 0)-(31, 31), RGBA(255, 0,
Line sprite, (4, 4)-(27, 27), RGBA(255, 0,
Line sprite, (0, 0)-(31, 31), RGB(0, 255, 0,
Line sprite, (23, 23), RGBA(255, 0,
Line sprite, (1, 1)-(30, 30), RGBA(0, 0, 25,
Line sprite, (30, 1)-(1, 30), RGBA(0, 0, 25

Cls

Dim As Integer i: For i = 0 To 63
    Line( i,0)-( i,240 ), RGB( i * 4, i * 4, i
Next i

' demonstrate all drawing methods ...
Put( 8,14 ), sprite, PSet
Put Step( 16,20 ), sprite, PReset
Put Step( -16,20 ), sprite, And
Put Step( 16,20 ), sprite, Or
Put Step( -16,20 ), sprite, Xor
Put Step( 16,20 ), sprite, Trans
Put Step( -16,20 ), sprite, Alpha, 96
Put Step( 16,20 ), sprite, Alpha
Put Step( -16,20 ), sprite, add, 192
```
Put Step( 16,20 ), sprite, Custom, @checkered_blend

' print a description near each demo
Draw String (100, 26), "<- pset"
Draw String Step (0, 20), "<- preset"
Draw String Step (0, 20), "<- and"
Draw String Step (0, 20), "<- or"
Draw String Step (0, 20), "<- xor"
Draw String Step (0, 20), "<- trans"
Draw String Step (0, 20), "<- alpha (uniform)"
Draw String Step (0, 20), "<- alpha (per pixel)"
Draw String Step (0, 20), "<- add"
Draw String Step (0, 20), "<- custom"

ImageDestroy( sprite )
Sleep : End 0

' custom blender function: chequered put
Function checkered_blend( ByVal src As UInteger, ByVal dim As Integer Ptr counter)
Dim As UInteger pixel

    counter = Cast(Integer Ptr, param)
    pixel = IIf((*(counter And 4) Shr 2) Xor (*counter + 1)
Return pixel
End Function

Differences from QB
- *target* is new to FreeBASIC
- The TRANS, ALPHA, ADD and CUSTOM methods are new to FreeBASIC
- FB uses a different image format internally, which is unsupported
- QB throws a run-time error instead of clipping out-of-bounds in
- In QB, only arrays can be specified as source images

**See also**

- **Put (File I/O)**
- **Get (Graphics)**
- **ImageCreate**
- **Alpha**
- **Internal pixel formats**
Put (File I/O)

Writes data from a buffer to a file

Syntax

```
Put #filenum As Long, [position As LongInt], data As Any [, amount]
Put #filenum As Long, [position As LongInt], data As String
Put #filenum As Long, [position As LongInt], data() As Any
```

Usage

```
Put #filenum, position, data [, amount]
varres = Put (#filenum, position, data [, amount])
```

Parameters

- **filenum**
  The value passed to Open when the file was opened.
- **position**
  Is the position where Put must start in the file. If the file was opened For Random, given in bytes. If omitted, writing starts at the present file pointer position or byte of a file is at position 1.
  If position is omitted or zero (0), file writing will start from the current file pointer.
- **data**
  Is the buffer where data is written from. It can be a numeric variable, an operation will try to transfer to disk the complete variable, unless amount is not allowed.
  When putting arrays, data should be followed by an empty pair of brackets: 'array.
  When putting Strings, the number of bytes written is the same as the not allowed.
  Note: If you want to write values from a buffer, you should NOT pass a pointer to the first variable in the buffer. (This can be done by dereferencing the pass a pointer directly, then Put will put the memory from the pointer variable.
- **amount**
  Makes Put write to file amount consecutive variables to the file - i.e. it will starting at data’s location in memory, into the file. If amount is omitted it single variable.

Return Value
on success; nonzero on error. "disk full" is considered as an error, and results in return code
of data written before is not available, and wouldn't be really useful anyway.

**Description**

Writes binary data from a buffer variable to a file opened in *Binary* or *Random* mode. *Put* can be used as a function, and will return 0 on success or an error code on failure.

For files opened in *Random* mode, the size in bytes of the data to write

### Example

```vbscript
' Create variables for the file number, and the number to put
Dim As Integer f
Dim As Long value

' Find the first free file number
f = FreeFile()

' Open the file "file.ext" for binary usage, using file number f
Open "file.ext" For Binary As #f

value = 10

' Write the bytes of the integer 'value' into the file, starting at the beginning of the file (position 1)
Put #f, 1, value

' Close the file
Close #f

' Create an integer array
Dim buffer(1 To 10) As Integer
For i As Integer = 1 To 10
    buffer(i) = i
```
Next

' Find the first free file number
Dim f As Integer
f = FreeFile()

' Open the file "file.ext" for binary usage, using
Open "file.ext" For Binary As #f
' Write the array into the file, using file number
' starting at the beginning of the file (position
Put #f, 1, buffer()

' Close the file
Close #f

Example

Dim As Byte Ptr lpBuffer
Dim As Integer hFile, Counter, Size

Size = 256

lpBuffer = Allocate(Size)
For Counter = 0 To Size-1
   lpBuffer[Counter] = (Counter And &HFF)
Next

' Get free file number
hFile = FreeFile()

' Open the file "test.bin" in binary writing mode
Open "test.bin" For Binary Access Write As #hFile

' Write 256 bytes from the memory pointed to by
Put #hFile, , lpBuffer[0], Size
' Close the file
Close #hFile

' Free the allocated memory
Deallocate lpBuffer

**Differences from QB**

- **Put** can write full arrays as in VB or, alternatively, write a multiple location.
- **Put** can be used as a function in FB, to find the success/error code without having to use error handling procedures.

**See also**

- **Put (Graphics)** different usage of same keyword
- **Get (File I/O)**
- **Open**
- **Close**
- **Random**
- **Binary**
- **FreeFile**
Random

Specifies file or device to be opened for binary mode

Syntax

\[
\text{Open } \text{filename for Random [Access access_type] [Lock lock_type] a}
\]

Parameters

- \(\text{filename}\)
  file name to open
- \(\text{access_type}\)
  indicates whether the file may be read from, written to or both
- \(\text{lock_type}\)
  locking to be used while the file is open
- \(\text{filenum}\)
  unused file number to associate with the open file
- \(\text{record_length}\)
  the size of the record used for the file

Description

Opens a file or device for reading and/or writing binary data in the given record_length.
If the file does not exist, a new file will be created, otherwise any data
The file pointer is initialized by Open at the start of the file, at record number
position in steps of record_length bytes.
This file mode uses an user-defined Type buffer variable to read/write
uses to include several fields.
The data is saved in binary mode, in the same internal format FreeBA

\(\text{filename}\) must be string expression resulting in a legal file name in the
be sought for in the present directory, unless a path is given.
\(\text{Access_type}\) - By default Random mode allows to both read and write the
must be one of:

- **Read** - the file is opened for input only
- **Write** - the file is opened for output only
- **Read Write** - the file is opened for input and output (the default)
Lock_type indicates the way the file is locked for other processes (users or threads), it is one of:

- **Shared** - The file can be freely accessed by other processes.
- **Lock Read** - The file can’t be opened simultaneously for reading.
- **Lock Write** - The file can’t be opened simultaneously for writing.
- **Lock Read Write** - The file cannot be opened simultaneously for reading and writing.

If no lock type is stated, the file will be **Shared** for other threads of the program.

Lock and Unlock can be used to restrict temporarily access to parts of a file.

`filenum` is a valid FreeBASIC file number (in the range 1..255) not being used for any other file presently open. This number identifies the file for the rest of file operations. A free file number can be found using the function.

`record_length` is the amount of bytes the file pointer will move for each size of the buffer variable used when Getting and Putting data. If omitted, it defaults to 10.

**Example**

```
' This example generates a test file and then lets you view the random records that are read live from the file.

Type Entry
    slen As Byte
    sdata As String * 10
End Type

Dim u As Entry
Dim s As String

Open "testfile" For Random As #1 Len = SizeOf(Entry)

' Write out 9 records with predefined data
For i As Integer = 1 To 9
    Read s
    u = Type( Len(s), s )
    Put #1, i, u
Next
```
Let the user view records by specifying their index number.

```
Dim i As Integer
Input "Record number: ", i
If i < 1 Or i > 9 Then Exit Do

Get #1, i, u
Print i & ": " & Left( u.sdata, u.slen )
Print
Loop
Close #1
```

```
Type ScoreEntry Field = 1
  As String * 20 Name
  As Single score
End Type

Dim As ScoreEntry entry

' Generate a fake boring highscore file
Open "scores.dat" For Random Access Write As #1 Len
For i As Integer = 1 To 10
  entry.name = "Player " & i
  entry.score = i
  Put #1, i, entry
Next
Close #1

' Read out and display the entries
Open "scores.dat" For Random Access Read As #1 Len
```
For i As Integer = 1 To 10
Get #1, i, entry
Print i & ":", entry.name, Str(entry.score), e
Next
Close #1

Differences from QB

- Care must be taken with dynamic or fixed length strings inside warning at KeyPgType.
- The keyword Field can only be used with Type to specify the pa

See also

- Open
- Binary
- Get #
- Put #
Randomize

Seeds the random number generator

Syntax

Declare Sub Randomize ( ByVal seed As Double = -1.0, ByVal algorithm As Long = 0 )

Usage

Randomize [ seed ][, algorithm ]

Parameters

seed
A Double seed value for the random number generator. If omitted, a value based on Timer will be used instead.

algorithm
An integer value to select the algorithm. If omitted, the default algorithm for the current language dialect is used.

Description

Sets the random seed that helps Rnd generate random numbers, and selects the algorithm to use. Valid values for algorithm are:

0 - Default for current language dialect. This is algorithm 3 in the -lan fb dialect, 4 in the -lang qb dialect and 1 in the -lang fblite dialect.
1 - Uses the C runtime library's rand() function. This will give different results depending on the platform.
2 - Uses a fast implementation. This should be stable across all platforms, and provides 32-bit granularity, reasonable degree of randomness.
3 - Uses the Mersenne Twister. This should be stable across all platforms, provides 32-bit granularity, and gives a high degree of randomness.
4 - Uses a function that is designed to give the same random number sequences as QBASIC. This should be stable across all platforms, an provides 24-bit precision, with a low degree of randomness.
Available on Win32 and Linux, using system features (Win32 Crypto API, Linux /dev/urandom) to provide cryptographically random numbers. If those system APIs are unavailable, algorithm 3 will be used instead.

For any given seed, each algorithm will produce a specific, deterministic sequence of numbers for that seed. If you want each call to `Randomize` to produce a different sequence of numbers, a seed that is not quite predictable should be used - for example, the value returned from `Timer`. Omitting the `seed` parameter will use a value based on this. Note: using the `Timer` value directly as a parameter will produce the same seed if used more than once in the same second. However, it is generally not worth calling `Randomize` twice with unpredictable seeds anyway, because the second sequence will be no more random than the first. In most cases, the Mersenne twister should provide a sufficiently random sequence of numbers, without requiring reseeding between `Rnd` calls.

When you call `Randomize` with the QB compatible algorithm, part of the old seed is retained. This means that if you call `Randomize` several times with the same seed, you will not get the same sequence each time. To get a specific sequence in QB compatible mode, set the seed by calling `Rnd` with a negative parameter.

**Example**

```plaintext
' Seed the RNG to the method using C's rand()
Randomize , 1

' Print a sequence of random numbers
For i As Integer = 1 To 10
   Print Rnd
Next
```

**Dialect Differences**
The default algorithm used depends on the current dialect in use:

- With the `-lang fb` dialect, a 32 bit Mersenne Twister function with a granularity of 32 bits is used.
- With the `-lang qb` dialect, a function giving the same output as `Rnd` in QB is used. The granularity is 24 bits.
- With the `-lang deprecated` and `-lang fblite` dialects, the function in the C runtime available in the system is used. The function has a granularity of 15 bits in Win32, and 32 bits in Linux and DOS.

**Differences from QB**

- The `algorithm` parameter is new to FreeBASIC.
- QBASIC only had one algorithm (replicated in FB in algorithm number 4, and set as the default in the `-lang qb` dialect).

**See also**

- `Rnd`
- `Language dialects`
Read values stored with the `Data` statement.

**Syntax**

```plaintext
Read variable_list
```

**Description**

Reads data stored in the application with the `Data` command.

The elements of the `variable_list` must be of basic types, numeric, strings or elements of arrays and user defined types.

All the `Data` statements in the program behave as a single list, after the `Data` statement is read, the first element of the following `Data` statement. The program should not attempt to `Read` after the last `Data` element. The result is (in all dialects) undefined, and the program may crash (Page Fault).

Data constants can only be of simple types (numeric or string). A string read into a numeric variable will be evaluated by the `Val` function.

The "`Restore label`" statement makes the first `Data` item after `label` the next item to be read, allowing the user to choose specific sections of data to be read.

**Example**

```plaintext
' Create an array of 5 integers and a string to hold
Dim As Integer h(4)
Dim As String hs
Dim As Integer readindex

' Set up to loop 5 times (for 5 numbers... check the data)
For readindex = 0 To 4

  ' Read in an integer.
  Read h(readindex)
```
' Display it.
   Print "Number" ; readindex ; " = " ; h(readindex)

Next readindex

' Spacer.
Print

' Read in a string.
Read hs

' Print it.
Print "String = " + hs

' Await a keypress.
Sleep

' Exit program.
End

' Block of data.
Data 3, 234, 4354, 23433, 87643, "Bye!"

**Dialect Differences**

- None in syntax and usage of Read
- See the Data page for more information on differences in storing

**Differences from QB**

- None in syntax and usage of Read
- See the Data page for more information on differences in storing

**See also**
- Data
- Restore
Read (File Access)

File access specifier

**Syntax**

```
Open filename As String For Binary Access Read As #filenum As Integer
```

**Description**

Specifier for the **Access** clause in the **Open** statement. **Read** specifies that the file is accessible for input.

**Example**

See example at **Access**

**Differences from QB**

- None known.

**See also**

- **Access**
- **Open**
Read Write (File Access)

File access specifier

**Syntax**

Open *filename* As String For Binary Access *Read Write* As #*filenum*

As Integer

**Description**

Specifier for the *Access* clause in the *Open* statement. *Read Write* specifies that the file is accessible for both input and output.

**Example**

See example at *Access*

**Differences from QB**

- None known.

**See also**

- *Access*
- *Open*
Reallocate
Reallocates storage for an existing reserved block of memory

**Syntax**
```
Declare Function Reallocate cdecl ( ByVal pointer As Any Ptr, ByVal usage result = Reallocate( pointer, count )
```

**Parameters**
- `pointer`
The address of allocated memory to be reallocated.
- `count`
The number of bytes, in total, to be reallocated.

**Return Value**
The address of the reallocated memory. A null (0) pointer is returned if reallocation was unsuccessful, and the original memory pointed to by `pointer` remains unchanged.

**Description**
Attempts to reallocate, or resize, memory previously allocated with `Allocate`. Preservation of the added memory range is not initialized to anything.

When using `Reallocate`, the `result` pointer must be saved to prevent it no longer being valid after reallocation. The value of the new pointer should be checked - if the original `pointer` remains valid, and the amount of memory allocated to that block has not changed.

Reallocated memory must be freed with `Deallocate` when no longer needed.

If `pointer` is null (0), then `ReAllocate` behaves identically to `Allocate`. It behaves similar to `Deallocate` and a null (0) pointer is returned.

If the memory has previously been deallocated by a call to `Deallocate`
When manually allocating memory for **String** descriptors (or **Udts** that memory block, the new extra memory range must be explicitly cleared with **Clear**). Otherwise accessing the string will cause undefined results (trying to write or read at a random place in memory, or trying to deallocate a random pointer).

This function is not part of the FreeBASIC runtime library, it is an alias to be thread safe in all platforms.

**NOTE**: Reallocating a pointer inside an object function, when that pointer contains the parent object of the function, is undefined, and will likely result in horrible crashes.

**Example**

```basic
Dim a As Integer Ptr, b As Integer Ptr, i As Integer
a = Allocate( 5 * SizeOf(Integer) ) ' Allocate memory for 5 integers
If a = 0 Then Print "Error Allocating a": End
For i = 0 To 4
    a[i] = (i + 1) * 2 ' Assign integers to the buffer
Next i

b = Reallocate( a, 10 * SizeOf(Integer) ) ' Reallocate memory for 5 additional integers
If b <> 0 Then
    a = b ' Discard the old pointer and use the new one
    For i = 5 To 9
        a[i] = (i + 1) * 2 ' Assign more integers to the buffer
    Next i
    For i = 0 To 9 ' Print the integers
        Print i, a[i]
    Next i
    Print
```
Else '' Reallocate failed, memory unchanged

    Print "Error Reallocating a"

    For i = 0 To 4   ' Print the integers
        Print i, a[i]
    Next i
    Print

End If

Deallocate a   ' Clean up

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Allocate
- CAllocate
- Deallocate
ReDim

Defines or resizes a variable-length array

Syntax

Declaring a Dynamic Array:
ReDim [ Shared ] symbolname([subscript [, ...]]) As datatype [, 
ReDim [ Shared ] As datatype symbolname([subscript [, ...]]) [, 

Resizing a Dynamic Array:
ReDim [ Preserve ] symbolname([subscript [, ...]]) [, ...]

Parameters

Shared
Specifies shared (file-scope) access to the array throughout the module.

Preserve
When used with an existing array, the contents of the array will be preserved during resize. Note that in some cases, Preserve may not preserve data at its original index, see below.

symbolname
A new or existing array id.

subscript: [ lowerbound To ] upperbound
The lower and upper bound range for a dimension of the array. Lower specified.

datatype
The type of elements contained in the array.

Description

ReDim can be used to define new variable-length arrays, or resize existing ones while keeping the number of dimensions. ReDim always produces variable-length arrays, with constant subscripts.

When defining a new variable-length array, its elements are default constructed. For example, for Double, the elements are initialized to zero (0). For user-defined types

NOTES:

- ReDim Preserve may not work as expected in all cases: Preserve's current behavior is to keep the original data contiguous in memory, and only expand or truncate the size of the array.
memory. Its behavior (with a single dimension) is well-defined only when the upper bound is changed. The current result is that the data is in effect shifted to start at the new upper bound. With multiple dimensions, only the upper bound of only the first dimension may be safely increased. If lower-order dimensions are reduced, the existing mappable data may be lost. If lower-order dimensions are resized at all, the effects can be hard to predict.

- **ReDim** cannot be used on fixed-size arrays - i.e. arrays with fixed-size arrays contained in UDTs (user-defined Types parameters in a function. FreeBASIC cannot prevent you from doing this at compile-time, but the results at runtime will be undefined.
- Using **ReDim** within a member procedure with an array the lower bound of which is undefined, and will [hopefully] result in horrible crashes.
- For use of **ReDim** (resizing) with a complex expression, (especially if the array expression itself contains parentheses), the array expression must be enclosed in parentheses.

### Example

```freibas
' Define a variable-length array with 5 elements
ReDim array(0 To 4) As Integer

For index As Integer = LBound(array) To UBound(array)
    array(index) = index
Next

'Resize a variable-length array with 10 elements
' (the lower bound should be kept the same)
ReDim Preserve array(0 To 9) As Integer

Print "index", "value"
For index As Integer = LBound(array) To UBound(array)
    Print index, array(index)
Next
```

This program will produce the following output:
'' Define a variable-length array
Dim array() As Integer

'' ReDim array to have 3*4 elements
ReDim array(1 To 3, 1 To 4)

Dim As Integer n = 1, i, j

Print "3 * 4:"
Print
For i = LBound(array, 1) To UBound(array, 1)
    For j = LBound(array, 2) To UBound(array, 2)
        array(i, j) = n
        Print Using "##		"; array(i, j);
        n += 1
    Next
Print
Next
Print

'' ReDim Preserve array to have 4*4 elements, preserving contents
'' (only the first upper bound should be changed)
ReDim Preserve array(1 To 4, 1 To 4) As Integer

Print "4 * 4:"
Print
For i = LBound(array, 1) To UBound(array, 1)
    For j = LBound(array, 2) To UBound(array, 2)
        Print Using "##		"; array(i, j);
    Next
    Print
Next
Print

'T' ReDim Preserve array to have 2*4 elements, preserving
'(only the first upper bound should be changed)
ReDim Preserve array(1 To 2, 1 To 4) As Integer

Print "2 * 4:"
Print
For i = LBound(array, 1) To UBound(array, 1)
    For j = LBound(array, 2) To UBound(array, 2)
        Print Using "##	"; array(i, j);
    Next
    Print
Next
Print
This program will produce the following output:

3 * 4:
1 2 3 4
5 6 7 8
9 10 11 12

4 * 4:
1 2 3 4
5 6 7 8
9 10 11 12
0 0 0 0

2 * 4:
Differences from QB

- *Preserve* was in Visual Basic, but not in QBASIC.
- Multi-dimensional arrays in FreeBASIC are in row-major order,

See also

- Common
- Dim
- Erase
- Extern
- LBound
- Preserve
- Shared
- Static
- UBound
- Var
**Rem**

Indicates comments in the source code.

**Syntax**

```
Rem comment
'
Comment

/' Multi-line
comment '/
```

**Description**

A source code line beginning with `Rem` indicates that the line is a comment and will not be compiled.

The single quote character ('`) may also be used to indicate a comment and may appear after other keywords on a source line.

Multi-line comments are marked with the tokens `/' and `'/`. All text between the two markers is considered comment text and is not compiled.

**Example**

````
/' this is a multi line
comment as a header of
this example '/

Rem This Is a Single Line comment
'
this is a single line comment

? "Hello" : Rem comment following a statement

Dim a As Integer ' comment following a statement

? "FreeBASIC" : ' also acceptable
```
Dim b As /* can comment in here also */ Integer

#if 0
    This way of commenting Out code was required before version 0.16
#endif

Differences from QB

- Multiline comments are new to FreeBASIC

See also

- #if
Closes all open files, or resets standard I/O handles.

**Syntax**

```
Declare Sub Reset (  )
Declare Sub Reset ( ByVal streamno As Long )
```

**Usage**

```
Reset
or
Reset( streamno )
```

**Parameters**

*streamno*

The stream number to reset, 0 for stdin or 1 for stdout.

**Description**

*Reset*, when called with no arguments, closes all disk files.

*Reset*, when called with the *streamno* argument, will reset the redirected or piped streams associated with stdin (0), or stdout (1).

**Runtime errors:**

*Reset(streamno)* can set one of the following **runtime errors**:

1. *Illegal function call*
   - *streamno* was neither 0 nor 1

2. *File I/O error*
   - Resetting of stdin or stdout failed

**Example**

```
Open "test.txt" For Output As #1
```
Print #1, "testing 123"
Reset

Dim x As String

' Read from STDIN from piped input
Open Cons For Input As #1
While EOF(1) = 0
    Input #1, x
    Print ""; x; ""
Wend
Close #1

' Reset to read from the keyboard
Reset(0)

Print "Enter some text:"
Input x

' Read from STDIN (now from keyboard)
Open Cons For Input As #1
While EOF(1) = 0
    Input #1, x
    Print ""; x; ""
Wend
Close #1

Note: Under Windows, to specify to the program that data entry is completed (transfer EOF), you can press CTRL+Z then press ENTER.

Differences from QB

- None for Reset().
- The Reset(streamno) usage is new to FreeBASIC.
See also

- Close
- Open
- Open Cons
- Isredirected
Changes the next read location for values stored with the `Data` statement.

**Syntax**

```
Restore label
```

**Description**

Sets the next-data-to-read pointer to the first element of the first `Data` statement following the label. The label must be contained in the same module as the currently-executing code. Normal top to bottom order in which `Data` are read. It allows re-reading sets of `Data` in a single module.

**Example**

```
' Create an 2 arrays of integers and a 2 strings to hold the data.
Dim h(4) As Integer
Dim h2(4) As Integer
Dim hs As String
Dim hs2 As String
Dim read_data1 As Integer
Dim read_data2 As Integer

' Set the data read to the label 'dat2:'
Restore dat2

' Set up to loop 5 times (for 5 numbers... check the data)
For read_data1 = 0 To 4

  ' Read in an integer.
  Read h(read_data1)

  ' Display it.
  Print "Bloc 1, number"; read_data1;" = "; h(read_data1)

Next
```
' Spacer.
Print

' Read in a string.
Read  hs

' Print it.
Print  "Bloc 1 string = " + hs

' Spacers.
Print
Print

' Set the data read to the label 'dat1:'
Restore  dat1

' Set up to loop 5 times (for 5 numbers... check t
For  read_data2 = 0 To 4

' Read in an integer.
Read  h2(read_data2)

' Display it.
Print  "Bloc 2, number"; read_data2;" = "; h2(read

Next

' Spacer.
Print

' Read in a string.
Read  hs2

' Print it.
Print  "Bloc 2 string = " + hs2

' Await a keypress.
Sleep
' Exit program.
End

' First block of data.
dat1:
Data 3, 234, 4354, 23433, 87643, "Bye!"

' Second block of data.
dat2:
Data 546, 7894, 4589, 64657, 34554, "Hi!"

Differences from QB
- None

See also
- Data
- Read
Resume

Error handling statement to resume execution after a jump to an error handler.

Syntax

Resume

Description

Resume is used in the traditional QB error handling mechanism within a line that caused the error. Usually this is used after the error has been handled gracefully in order to try the previously erroneous operation again with corrected data.

Resume resets the Err value to 0

Example

```
' Compile with -lang fblite or qb

#lang "fblite"

Dim As Single i, j

On Error Goto ErrHandler

i = 0
j = 1 / i ' this line causes a divide-by-zero error on the first try; execution jumps to ErrHandler label

Print j ' after the value of i is corrected, prints 0.5

End ' end the program so that execution does not fall through to the error handler again

ErrHandler:

i = 2
Resume ' execution jumps back to 'j = 1 / i' line,
```
Dialect Differences

- RESUME is not supported in the \textit{-lang fb} dialect. Statements of the form:

\begin{verbatim}
If Open( "text" For Input As #1 ) <> 0 Then
  Print "Unable to open file"
End If
\end{verbatim}

Differences from QB

- Does not accept line numbers or labels
- Must compile with \texttt{-ex} option

See also

- \texttt{Err}
- \texttt{Resume Next}
- \texttt{Error Handling}
Control flow statement to return from a procedure or GoSub.

**Syntax**

Return [ expression ]

or

Return [ label ]

**Description**

Return is used to return from a procedure or return from a gosub GoSub.

Because Return could mean return-from-gosub or return-from-procedure, it can be used to enable and disable GoSub support. When GoSub support is recognized as return-from-procedure. When GoSub support is enabled, Return is from-gosub.

Return (from procedure) is used inside a procedure to exit the procedure. It cannot specify a return return value. In a Function, Return must specify a return value. It is roughly equivalent to the Function = expression : Exit Function idiom.

Return (from gosub) is used to return control back to the statement immediately following a previous call. When used in combination with GoSub, no return value can be specified. If no GoSub was specified, execution continues at the specified label. If no GoSub was made, a run-time error is generated.

A GoSub should always have a matching Return statement. However, if no GoSub was made, a run-time error is generated.

**Example**

```
'' GOSUB & RETURN example, compile with "-lang qb"

'$lang: "qb"

Print "Let's Gosub!"
```
GoSub MyGosub
Print "Back from Gosub!"
Sleep
End

MyGosub:
Print "In Gosub!"
Return

' ' Return from function

Type rational
    numerator As Integer
    denominator As Integer
End Type

' ' multiplies two rational types
Function rational_multiply( r1 As rational, r2 As rational )

    Dim r As rational
    ' multiply the divisors ...
    r.numerator = r1.numerator * r2.numerator
    r.denominator = r1.denominator * r2.denominator

    ' ... and return the result
    Return r
End Function

Dim As rational r1 = ( 6, 105 ) ' define some rational numbers
Dim As rational r2 = ( 70, 4 )
Dim As rational r3

r3 = rational_multiply( r1, r2 ) ' multiply and store the result
'' display the expression
Dialect Differences

- In the `-lang fb` dialect `Return` always means return-from-procedure.
- In the `-lang qb` dialect, `Return` means return-from-gosub by default unless changed with `Nogosub`, in which case the compiler will recognize `Return` as return-from-procedure.
- In the `-lang fblite` dialect, `Return` means return-from-procedure by default unless changed with `Option Gosub`, in which case the compiler will recognize `Return` as return-from-gosub.

Differences from QB

- None when using the `-lang qb` dialect.

See also

- Sub
- Function
- GoSub
- Option Gosub
- Option Nogosub
Computes a valid color value for hi/truecolor modes

**Syntax**

```
#define RGB(r,g,b) (((CUInt(r) Shl 16) Or (CUInt(g) Shl 8) Or CUI
```

**Usage**

```
result = RGB(red, green, blue)
```

**Parameters**

- **red**
  red color component value
- **green**
  green color component value
- **blue**
  blue color component value

**Return Value**

The combined color.

**Description**

```
red, green and blue are components ranging 0-255.
```

The RGB function can be used to compute a valid color value for use with integers in the format \&h;AARRGGBB, where RR, GG and BB equal the value AA is the implicit alpha value and is automatically set to \&hFF; (opaque). It is possible to retrieve the red, green, blue and alpha values from a color. The second example below shows how to \#define and use macros.

**Note for Windows API programmers:** The macro named RGB in the FB headers for Windows to avoid collisions.

**Example**
See *Put (Graphics)* example in addition.

```plaintext
ScreenRes 640,480,32  '32 bit color
Line(0,0)-
(319,479), RGB(255,0,0)  'draws a bright red box on
Line(639,0)-
(320,479), RGB(0,0,255)  'draws a bright blue box on
Sleep 'wait before exiting

' setting and retrieving Red, Green, Blue and Alpha values
#define RGBA_R(c) (CUInt(c) Shr 16 And 255)
#define RGBA_G(c) (CUInt(c) Shr 8 And 255)
#define RGBA_B(c) (CUInt(c) And 255)
#define RGBA_A(c) (CUInt(c) Shr 24)

Dim As UInteger r, g, b, a
Dim As UInteger col = RGB(128, 192, 64)
Print Using "Color: _&H\\
\"; Hex(col, 8)
r = RGBA_R(col)
g = RGBA_G(col)
b = RGBA_B(col)
a = RGBA_A(col)
Print
Print Using "Red: _&H\\ = ###"; Hex(r, 2);
Print Using "Green: _&H\\ = ###"; Hex(g, 2);
Print Using "Blue: _&H\\ = ###"; Hex(b, 2);
Print Using "Alpha: _&H\\ = ###"; Hex(a, 2);
```
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- RGBA
- Color
- `#define`
Computes a valid color value including alpha (transparency) for hi/truecolor modes.

**Syntax**

```c
#define RGBA(r, g, b, a) (((CUInt(r) Shl 16) Or (CUInt(g) Shl 8) Or 24))
```

**Usage**

```c
result = RGBA(red, green, blue, alpha)
```

**Parameters**

- `red` red color component value
- `green` green color component value
- `blue` blue color component value
- `alpha` alpha component value

**Return Value**

the combined color

**Description**

`red, green, blue` and `alpha` are components ranging 0-255.

The `RGBA` function can be used to compute a valid color value including alpha in hi/truecolor modes. It returns an unsigned integer in the format `&h;AARRGGBB` equal the values passed to this function, in hexadecimal format. It is possible to retrieve the red, green, blue and alpha values from a color value using a combination of `And` and `Shr`. The second example below shows how to do this.

**Example**

```c
result = RGBA(red, green, blue, alpha)
```
'open a graphics screen (320 * 240, 32-bit)
ScreenRes 320, 240, 32

Dim As Any Ptr img
Dim As Integer x, y

'make an image that varies in transparency and color
img = ImageCreate(64, 64)
For x = 0 To 63
    For y = 0 To 63
        PSet img, (x, y), RGBA(x * 4, 0, y * 4, (x + y
    Next y
Next x
Circle img, (31, 31), 25, RGBA(0, 127, 192, 1)
transparent blue circle
Line img, (26, 20)-
(38, 44), RGBA(255, 255, 255, 0), BF 'transparent
white rectangle

'draw a background (diagonal white lines)
For x = -240 To 319 Step 10
    Line (x, 0)-Step(240, 240), RGB(255, 255, 255)
Next

Line (10, 10)-(310, 37), RGB(127, 0, 0), BF 'red box for text
Line (10, 146)-
(310, 229), RGB(0, 127, 0), BF 'green box for Putting

'draw the image and some text with PSET
Draw String(64, 20), "PSet"
Put(48, 48), img, PSet
Put(48, 156), img, PSet

'draw the image and some text with ALPHA
Draw String (220, 20), "Alpha"
Put(208, 48), img, Alpha
Put(208, 156), img, Alpha
'Free the image memory
ImageDestroy img

'Keep the window open until the user presses a key
Sleep

'' setting and retrieving Red, Green, Blue and Alpha values

#define RGBA_R( c ) ( CIUInt( c ) Shr 16 And 255 )
#define RGBA_G( c ) ( CIUInt( c ) Shr 8 And 255 )
#define RGBA_B( c ) ( CIUInt( c ) And 255 )
#define RGBA_A( c ) ( CIUInt( c ) Shr 24 )

Dim As UInteger r, g, b, a

Dim As UInteger col = RGBA(255, 192, 64, 128)

Print Using "Color: _&H\"\"; Hex(col, 8)

r = RGBA_R( col )
g = RGBA_G( col )
b = RGBA_B( col )
a = RGBA_A( col )
Print
Print Using "Red: _&H\" = ###"; Hex(r, 2);
Print Using "Green: _&H\" = ###"; Hex(g, 2);
Print Using "Blue: _&H\" = ###"; Hex(b, 2);
Print Using "Alpha: _&H\" = ###"; Hex(a, 2);

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- RGB
- Color
- #define
Right

Returns the rightmost substring of a string

**Syntax**

```
Declare Function Right ( ByRef str As Const String, ByVal n As Integer ) As String
Declare Function Right ( ByRef str As Const WString, ByVal n As Integer ) As WString
```

**Usage**

```
result = Right[$]( str, n )
```

**Parameters**

- **str**
  - The source string.
- **n**
  - The substring length, in characters.

**Return Value**

Returns the rightmost substring from `str`.

**Description**

Returns the rightmost `n` characters starting from the right (end) of `str`. If `str` is empty, then the null string (""") is returned. If `n <= 0` then the null string ("") is returned. If `n > len(str)` then the entire source string is returned.

**Example**

```
Dim text As String = "hello world"
Print Right(text, 5)
```

will produce the output:
An Unicode example:

```
dim text as wstring*20
text = "Привет, мир!"
print right(text, 5) 'displays " мир!"
```

**Platform Differences**

- DOS does not support the wide-character string version of `Right`.

**Dialect Differences**

- The string type suffix "\$" is obligatory in the `-lang qb` dialect.
- The string type suffix "\$" is optional in the `-lang fblite` and `-lan fb` dialects.

**Differences from QB**

- QB does not support Unicode.

**See also**

- `Left`
- `Mid (Function)`
**RmDir**

Removes a folder/directory from the file system

**Syntax**

```vbscript
Declare Function RmDir ( ByRef folder As Const String ) As Long
```

**Usage**

```vbscript
result = RmDir( folder )
```

**Parameters**

- `folder`  
The folder/directory to be removed.

**Return Value**

Returns zero (0) on success, and negative one (-1) on failure.

**Description**

Removes a folder from the file system. The function will fail if the folder is not empty.

**Example**

```vbscript
Dim pathname As String = "foo\bar\baz"
Dim result As Integer = RmDir( pathname )
If 0 <> result Then Print "error: unable to remove"
```

**Platform Differences**

- Linux requires the `folder` case matches the real name of the file.
- Path separators in Linux are forward slashes `/`. Windows uses backward `\` slashes.
Differences from QB

- None

See also

- Shell
- ChDir
- MkDir
**Rnd**

Returns a random **Double** precision number in the range \([0, 1)\)

**Syntax**

```vbnet
Declare Function Rnd ( ByVal seed As Single = 1.0 ) As Double
```

**Usage**

```vbnet
result = Rnd( seed )
```

**Parameters**

- **seed**
  - Optional **Single** argument. If **seed** has a value of zero (0.0), the last random number a new random number is returned. With the QB-compatible algorithm, a negative number fully reseeds the generator. The default for no argument is to return a new random number.

**Return Value**

Returns the random number generated.

**Description**

Returns a number of type **Double** in the range \([0, 1)\) (i.e. \(0 \leq Rnd < 1\)).

**Rnd** can use a variety of different algorithms - see **Randomize** for details.

**Rnd** will return the same sequence of numbers every time a program is run.

**Example**

```vbnet
' Function to a random number in the range [first, last)
Function rnd_range (first As Double, last As Double) = Rnd * (last - first) + first
End Function
```
'' seed the random number generator, so the sequence
Randomize

'' prints a random number in the range [0, 1), or
Print Rnd

'' prints a random number in the range [0, 10), or
Print Rnd * 10

'' prints a random integral number in the range [1, 11), or
'' with integers, this is equivalent to [1, 10], or
Print Int(Rnd * 10) + 1

'' prints a random integral number in the range [69, 421), or {69 <= n <= 421},
'' this is equivalent to [69, 420], or {69 <= n <= 420).
Print Int(rnd_range(69, 421))

**Dialect Differences**

The default algorithm used depends on the current dialect in use:

- With the `-lang fb` dialect, a 32 bit Mersenne Twister function
- With the `-lang qb` dialect, a function giving the same output
- With the `-lang deprecated` and `-lang fblite` dialects, the standard function is used. The function available in Win32 has a granularity

**Differences from QB**

- None, if compiled in the `-lang qb` dialect. Other dialects can also be used by calling `Randomize` with the appropriate parameter.
- For the non-QB-compatible algorithms, if the optional argument is less than 0, passing an argument of 1.

**See also**

- `Randomize`
- `Timer`
- Int
RSet

Right justifies a string in a string buffer

**Syntax**

```vbscript
Declare Sub RSet ( ByRef dst As String, ByRef src As Const String )
Declare Sub RSet ( ByVal dst As WString Ptr, ByVal src As Const WString Ptr )
```

**Usage**

```vbscript
RSet dst, src
```

**Parameters**

- **dst**
  - A `String` or `WString` buffer to copy the text into.
- **src**
  - The source `String` or `WString` to be right justified.

**Description**

RSet right justifies text into the string buffer `dst`, filling the right part of the string with `src` and the left part with spaces. The string buffer size is not modified.

If text is too long for the string buffer size, `RSet` truncates characters from the right.

**Example**

```vbscript
Dim buffer As String
buffer = Space(10)
RSet buffer, "91.5"
Print "-[" & buffer & "]-"
```

**Differences from QB**
In QBasic the syntax was `RSet dst = src`. That syntax is also supported by FB.

See also

- `LSet`
- `Space`
- `Put (File I/O)`
- `MKD`
- `MKI`
- `MKL`
- `MKS`
**RTrim**

Removes surrounding substrings or characters on the right side of a string

**Syntax**

```vbscript
Declare Function RTrim ( ByRef str As Const String, [ Any ] ByRef trimset As Const String = " " ) As String
Declare Function RTrim ( ByRef str As Const WString, [ Any ] ByRef trimset As Const WString = WStr(" ") ) As WString
```

**Usage**

```vbscript
result = RTrim[$]( str [, [ Any ] trimset ] )
```

**Parameters**

- `str`
  The source string.
- `trimset`
  The substring to trim.

**Return Value**

Returns the trimmed string.

**Description**

This procedure trims surrounding characters from the right (end) of a source string. Substrings matching `trimset` will be trimmed if specified otherwise spaces (ASCII code 32) are trimmed.

If the `Any` keyword is used, any character matching a character in `trimset` will be trimmed.

All comparisons are case-sensitive.

**Example**
```
Dim s1 As String = "Article 101  
Print "'" + RTrim(s1) + "'
Print "'" + RTrim(s1, " 01") + "'
Print "'" + RTrim(s1, Any " 10") + "'

Dim s2 As String = "Test Pattern aaBBaaBaa"
Print "'" + RTrim(s2, "Baa") + "'
Print "'" + RTrim(s2, Any "Ba") + "'
```

will produce the output:

```
'Article 101'
'Article 101 '
'Article'
'Test Pattern aaB'
'Test Pattern '
```

**Platform Differences**

- DOS version/target of FreeBASIC does not support the wide-character version of `RTrim`

**Dialect Differences**

- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lang fb` dialects.

**Differences from QB**

- QB does not support specifying a `trimset` string or the `ANY` clause.

**See also**
- LTrim
- Trim
Run

Transfers execution to an external program

**Syntax**

```vba
Declare Function Run ( ByVal program As String, ByVal arguments As String )
```

**Usage**

```vba
result = Run( program [, arguments ] )
```

**Parameters**

- `program`
  The file name (including file path) of the program (executable) to transfer control to.
- `arguments`
  The command-line arguments to be passed to the program.

**Return Value**

Returns negative one (-1) if the program could not be executed.

**Description**

Transfers control over to an external program. When the program exits, execution will return to the system.

**Example**

```vba
' Attempt to transfer control to "program.exe" in the current directory.
Dim result As Integer = Run("program.exe")

' at this point, "program.exe" has failed to execute.
' result will be set to -1.
```

**Platform Differences**

- Linux requires the `program` case matches the real name of the
Insensitive. The program being run may be case sensitive for it

- Path separators in Linux are forward slashes ("/"). Windows uses some versions of Windows allow forward slashes. DOS uses backslashes ("\")

**Differences from QB**

- **Run** needs the full executable name, including extension (.exe) on DOS.
- Returning an error code is new to FreeBASIC.

**See also**

- **Exec** transfer temporarily, with arguments
- **Chain** transfer temporarily, without arguments
- **Command** pick arguments
SAdd

Returns a pointer to a string variable's data

Syntax

 Declare Function SAdd ( ByRef str As String ) As ZString Ptr
 Declare Function SAdd ( ByRef str As WString ) As ZString Ptr
 Declare Function SAdd ( ByRef str As ZString ) As ZString Ptr

Usage

 result = SAdd( str )

Parameters

 str
  the string expression or variable to get the address of

Return Value

A pointer to the data associated with str.

Description

Returns the memory offset of the string data in the string variable.

Example

 Dim s As String
 Print SAdd(s)
 s = "hello"
 Print SAdd(s)
 s = "abcdefg, 1234567, 54321"
 Print SAdd(s)

Differences from QB
QB returned an integer instead of a pointer.

See also

- StrPtr
- VarPtr
- ProcPtr
**Scope...End Scope**

Statement to begin a new scope block

**Syntax**

```
Scope
[statements]
End Scope
```

**Description**

The Scope block allows variables to be (re)defined and used locally in a program.

When a variable is (re)defined with `Dim` within a scope structure, this local working variable can be used from its (re)definition until the end of the scope. During this time, any variables outside the scope that have the same name will be ignored, and will not be accessible by that name. Any statements in the Scope block before the variable is redefined will use the variable as defined outside the Scope.

`Scope...End Scope` is not permitted when compiling with in the `-lang qt` dialect.

**Example**

```
Dim As Integer x = 5, y = 2
Print "x ="; x; ", "; "y ="; y
Scope
    Dim x As Integer = 3
    Print "x ="; x; ", "; "y ="; y
Scope
    Dim y As Integer = 4
    Print "x ="; x; ", "; "y ="; y
End Scope
End Scope
Print "x ="; x; ", "; "y ="; y
```
Dialect Differences

- Explicit Scope..End Scope blocks are available only in the -lang fb and -lang deprecated dialects.
- Explicit Scope..End Scope blocks are not available in the -lang fblite and -lang qb dialects.

Differences from QB

- New to FreeBASIC

See also

- Dim
- ReDim
- Static
- Var
Screen (Graphics)

Initializes a graphics mode using QB-like mode numbers

**Syntax**

- `lang fb|fblite` dialects:
  ```
  Screen , [ active_page ] [, [ visible_page ]]
  ```

- `lang qb` dialect:
  ```
  ```

**Parameters**

- **mode**
  is a QB style graphics screen mode number (see below). If `mode` is 0, then normal console-mode functionality. See below for available modes.

- **depth**
  is the color depth in bits per pixel. This only has an effect for modes 1, aliases for 16 and 32, respectively. If omitted, it defaults to 8.

- **num_pages**
  is the number of video pages you want, see below. If omitted, it defaults.

- **flags**
  Are used to select several things as graphics driver, fullscreen mode. `ScreenRes` for available flags.

- **refresh_rate**
  requests a refresh rate. If it is not available in the present card or the `flags`

- **active_page**
  Used to set the active page, where printing/drawing commands take effect

- **visible_page**
  Used to set the visible page, which is shown to the user

- **colormode**
  Unused - allowed for compatibility with the QB syntax

**Description**

`Screen` tells the compiler to link the GfxLib and initializes a QB-only, QBasic-

In QB-only modes a dumb window or fullscreen resolution is set, one or more buffers in standard memory are created, console commands are redirected to their graphic versions, a default palette is set and an autowndow is created.
statements can be used.

In QB-on-GUI modes one or more buffers in standard memory are created and a palette is set. QB-like graphics and console statements can be used in graphics buffers.

In OpenGL modes a dumb window or fullscreen resolution is set, one or more buffers in standard memory are created, console commands are redirected to their graphic versions and a palette is set. QB-like graphics and console statements can be used in graphics buffers.

Any buffer that is created in standard memory uses one of three supported pixel formats for details.

If Screen fails to set the required mode, an "Illegal function call" error is issued. If using standard On Error processing or retrieving the screen pointer with Screen GL Proc, the screen pointer will be set to zero.

Before setting a fullscreen mode the program should check if that mode is available in the graphics card using mode details.

Available modes list:

**QB compatibility modes:**

<table>
<thead>
<tr>
<th>Mode nr</th>
<th>Resolution</th>
<th>Emulation</th>
<th>Text</th>
<th>char size</th>
<th>colors on screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>320x200</td>
<td>CGA</td>
<td>40x25</td>
<td>8x8</td>
<td>16 background, 1 of four sets</td>
</tr>
<tr>
<td>2</td>
<td>640x200</td>
<td>CGA</td>
<td>80x25</td>
<td>8x8</td>
<td>16 colors to 2 attributes</td>
</tr>
<tr>
<td>7</td>
<td>320x200</td>
<td>EGA</td>
<td>40x25</td>
<td>8x8</td>
<td>16 colors to 16 attributes</td>
</tr>
<tr>
<td>8</td>
<td>640x200</td>
<td>EGA</td>
<td>80x25</td>
<td>8x8</td>
<td>16 colors to 16 attributes</td>
</tr>
<tr>
<td>9</td>
<td>640x350</td>
<td>EGA</td>
<td>80x25 or 80x43</td>
<td>8x14 or 8x8</td>
<td>16 colors to 16 attributes</td>
</tr>
<tr>
<td>11</td>
<td>640x480</td>
<td>VGA</td>
<td>80x30 or 80x60</td>
<td>8x16 or 8x8</td>
<td>256K colors to 2 attributes</td>
</tr>
<tr>
<td>12</td>
<td>640x480</td>
<td>VGA</td>
<td>80x30 or 80x60</td>
<td>8x16 or 8x8</td>
<td>256K colors to 16 attributes</td>
</tr>
<tr>
<td>13</td>
<td>320x200</td>
<td>MCGA</td>
<td>40x25</td>
<td>8x8</td>
<td>256K colors to 256 attributes</td>
</tr>
</tbody>
</table>

**New FreeBASIC modes:**

<table>
<thead>
<tr>
<th>Mode nr</th>
<th>Resolution</th>
<th>Emulation</th>
<th>Text</th>
<th>char size</th>
<th>colors on screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>320x240</td>
<td></td>
<td>40x30</td>
<td>8x8</td>
<td>256K colors to 256 attributes</td>
</tr>
<tr>
<td>15</td>
<td>400x300</td>
<td></td>
<td>50x37</td>
<td>8x8</td>
<td>256K colors to 256 attributes</td>
</tr>
</tbody>
</table>
depth details
For modes 14 and up, the depth parameter changes the color depth to the specified new one; if depth is not specified, these modes run in 8bpp.

num_pages details
You can request any number of pages for any video mode; if you omit the parameter, only the visible page (number of the visible screen or an offscreen buffer, you can show a page while working on another one; see the created in standard memory, the video card memory is never used for

flags details:
(documented at the page ScreenRes)

Other details
While in windowed mode, clicking on the window close button will add a keypress to the specified mode one (see Default palettes), resets the palette to the specified mode one (see Default palettes), resets the clipping region to the size of the screen, disables custom coordinates mappings, moves the graphics cursor to the center of the screen, moves the text cursor to the top-left corner of the screen and sets foreground and background colors to bright white and black respectively.

Example

' Sets screen mode 13 (320*200, 8bpp)
Screen 13
Print "Screen mode 13 set"

Sleep
#include "fbgfx.bi"
#if __FB_LANG__ = "fb"
Using FB

Screen mode flags are in the FB namespace
#endif

' Sets screen mode 18 (640*480) with 32bpp color depth, 4 pages, in windowed mode; switching disabled.
Screen 18, 32, 4, (GFX_WINDOWED Or GFX_NO_SWITCH)

' Check to make sure Screen was opened successfully.
If ScreenPtr = 0 Then
  Print "Error setting video mode!"
End
End If

Print "Successfully set video mode"
Sleep

Platform Differences

- In DOS, Windowing and OpenGL related switches are not available.

Dialect Differences

- In the -lang fb and -lang fblite dialects, the usage is:
  or:
  Screen , [active_page] [, [visible_page]]

- In the -lang qb dialect, the usage is:
  Screen [mode] [, [colormode] [, [active_page] [, [visible_page]]]]

Differences from QB

- None in the -lang qb dialect.
- In QB the syntax was Screen mode,colormode,active_page,visible_page, the rest. The use of Screen , , apage,vpage to swap screen pages...
- **ScreenSet** should be used in the `-lang fb` and `-lang fblite` dialects.

**See also**

- **Screen (Console)**
- **ScreenRes** More flexible alternative to **Screen**
- **ScreenList** Check display modes available for FB GfxLib to use
- **ScreenControl** Select driver and more
- **ScreenLock**
- **ScreenUnlock**
- **ScreenPtr** Semi-low level access
- **ScreenSet**
- **ScreenCopy**
- **ScreenInfo**
- **ScreenGLProc**
- **Internal pixel formats**
Screen (Console)

Gets the character or color attribute at a given location

Syntax

Declare Function Screen ( ByVal row As Long, ByVal column As Long, ByVal colorflag As Long = 0 ) As Long

Usage

result = Screen( row, column [, colorflag ] )

Parameters

row
1-based offset from the top left corner of the console.

column
1-based offset from the top left corner of the console.

colorflag
If equal to 0, the ASCII code is returned, otherwise the color attribute omitted, it defaults to 0.

Return Value

The ASCII or color attribute of the character.

Description

Screen returns the character or the color attribute found at a given position of the console output. It works in console mode and in graphics mode.

The format of the color attribute depends on the current color depth:

If the color type is a palette type with up to 4 bits per pixel (such as the Win32 console), then the color attribute is an 8-bit value, where the higher four bits hold the background color and the lower four bits hold the foreground (character) color.

If the color type is an 8-bit palette, then the color attribute is a 16-bit value, where the high byte holds the background color and the low byte holds the foreground color.
If the color type is full color, then the color attribute is a 32-bit integer, color value. If colorflag is equal to 1, then the foreground color is returned; if equal to 2, then the background color is returned.

The color values for the standard 16 color palette are:

<table>
<thead>
<tr>
<th>Value</th>
<th>Color</th>
<th>Value</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Black</td>
<td>8</td>
<td>Gray</td>
</tr>
<tr>
<td>1</td>
<td>Blue</td>
<td>9</td>
<td>Bright Blue</td>
</tr>
<tr>
<td>2</td>
<td>Green</td>
<td>10</td>
<td>Bright Green</td>
</tr>
<tr>
<td>3</td>
<td>Cyan</td>
<td>11</td>
<td>Bright Cyan</td>
</tr>
<tr>
<td>4</td>
<td>Red</td>
<td>12</td>
<td>Bright Red</td>
</tr>
<tr>
<td>5</td>
<td>Magenta</td>
<td>13</td>
<td>Pink</td>
</tr>
<tr>
<td>6</td>
<td>Brown</td>
<td>14</td>
<td>Yellow</td>
</tr>
<tr>
<td>7</td>
<td>White</td>
<td>15</td>
<td>Bright White</td>
</tr>
</tbody>
</table>

Example

```vbscript
Dim character_ascii_value As Integer
Dim attribute As Integer
Dim background As Integer
Dim cell_color As Integer
Dim row As Integer, col As Integer

character_ascii_value = Screen( row, col )
attribute = Screen( row, col, 1 )
background = attribute Shr 4
cell_color = attribute And &hf

' open a graphics screen with 4 bits per pixel
' (alternatively, omit this line to use the console)
ScreenRes 320, 200, 4
```
' print a character
Color 7, 1
Print "A"

Dim As UInteger char, col, fg, bg

' get the ASCII value of the character we've just printed
char = Screen(1, 1, 0)

' get the color attributes
col = Screen(1, 1, 1)
fg = col And &HF
bg = (col Shr 4) And &HF

Print Using "ASCII value: ### ("!!")"; char; Chr(char)
Print Using "Foreground color: ##"; fg
Print Using "Background color: ##"; bg
Sleep

' open a graphics screen with 8 bits per pixel
ScreenRes 320, 200, 8

' print a character
Color 30, 16
Print "Z"

Dim As UInteger char, col, fg, bg

' get the ASCII value of the character we've just printed
char = Screen(1, 1, 0)

' get the color attributes
col = Screen(1, 1, 1)
fg = col And &HFF
bg = (col Shr 8) And &HFF
Print Using "ASCII value: ### ("!")"); char; Chr( 
Print Using "Foreground color: ###"); fg 
Print Using "Background color: ###"); bg 
Sleep

' ' open a full-color graphics screen 
ScreenRes 320, 200, 32

' ' print a character 
Color RGB(255, 255, 0), RGB(0, 0, 255) 'yellow on 
Print "M"

Dim As Integer char, fg, bg

' ' get the ASCII value of the character we've just 
char = Screen(1, 1, 0)

' ' get the color attributes 
fg = Screen(1, 1, 1) 
bg = Screen(1, 1, 2)

Print Using "ASCII value: ### ("!")"); char; Chr( 
Print Using "Foreground color: "; Hex(fg, 8) 
Print Using "Background color: "; Hex(bg, 8) 
Sleep

Platform Differences

- On the Linux version, the value returned can differ from the character on the console. For example, unprintable control codes - such as (10) that implicitly occurs after the end of printed text - may be picked up instead of the untouched character in its place.

Differences from QB
In QB screen triggered an error if the coordinates were out of screen.

See also

- Screen (Graphics)
- Color
ScreenCopy

Copies the contents of a graphical page into another graphical page

Syntax

Declare Function ScreenCopy ( ByVal from_page As Long = -1, ByVal to_page As Long = -1 ) As Long

Usage

ScreenCopy [ from_page ] [, to_page ]

Parameters

from_page
page to copy from
to_page
page to copy to

Description

from_page is the page to copy from. If this argument is omitted, the current work page is assumed. to_page is the page to copy to. If this argument is omitted, the currently visible page is assumed. Page numbers range from 0 to num_pages - 1, where num_pages is the number of pages specified when setting the graphics mode with ScreenRes or Screen.

You can use this function to add a double buffer to your graphics. Any graphics screen mode with multiple pages supports this function.

ScreenCopy is inactive if the destination page is locked.

There are two other functions similar to this: Flip and PCopy. Flip is designed to work in OpenGL modes, while PCopy supports console page on some platforms. Both do the same thing as ScreenCopy in normal graphics modes.

Example
See also `ScreenSet` example.

```vbs
' 320x200x8, with 3 pages
Screen 13, 3

' image for working page #1 (visible page #0)
ScreenSet 1, 0
Cls
Circle( 160, 100 ), 90, 1 ,,,,, f
Circle( 160, 100 ), 90, 15
Print "Press 2 to copy page #2 to visible page"
Print "Press escape to exit"

' image for working page #2 (visible page #0)
ScreenSet 2, 0
Cls
Line( 50, 50 )-( 270, 150 ), 2, bf
Line( 50, 50 )-( 270, 150 ), 15, b
Print "Press 1 to copy page #1 to visible page"
Print "Press escape to exit"

' page #0 is the working page (visible page #0)
ScreenSet 0, 0
Cls
Print "Press 1 to copy page #1 to visible page"
Print "Press 2 to copy page #2 to visible page"
Print "Press escape to exit"

Dim k As String

Do
    k = Inkey
    Select Case k
    Case Chr(27)
        Exit Do
    Case "1"
        ScreenCopy 1, 0
    Case "2"
```
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Screencopy`.

Differences from QB

- New to FreeBASIC. It is a graphics-only version of `PCopy` - which works in both text and graphics modes.

See also

- `PCopy`
- `Screen (Graphics)`
- `ScreenRes`
- `ScreenSet`
ScreenControl

Sets or gets internal graphics library settings

Syntax

```vba
Declare Sub ScreenControl ( ByVal what As Long, ByRef param1 As Integer = 0, ByRef param3 As Integer = 0, ByRef param4 As Integer = 0 )
Declare Sub ScreenControl ( ByVal what As Long, ByRef param As String )
```

Usage

```vba
ScreenControl( what [, [ param1 ][, [ param2 ][, [ param3 ][, [ param4 ]]]] )
ScreenControl( what [, param ] )
```

Parameters

- **what**
  - specifies the function to perform
- **param1**
  - optional first integer parameter, contains value to be set on entry or value got on exit
- **param2**
  - optional second integer parameter, contains value to be set on entry or value got on exit
- **param3**
  - optional third integer parameter, contains value to be set on entry or value got on exit
- **param4**
  - optional fourth integer parameter, contains value to be set on entry or value got on exit
- **param**
  - optional string parameter, contains text to be set on entry or text got on exit

Description

This function can be used to set or get internal GfxLib states. The what parameter specifies the function to perform. On operations that set states, the param* parameters must contain the values to be set. On operations that get states, param* will hold the values returned by GfxLib. The meaning of the param* parameters depend on the what parameter, which is a constant defined in fbgfx.bi. In lang fb, they are set to be stored in the FB Namespace. Below is a list of the supported what constants - and their values as defined in fbgfx.bi - along with the parameters associated with them.
Supported operations

Note: * denotes operations that are allowed while a graphics mode has (Graphics) or ScreenRes. For all other operations, return values are zero (operation has no effect if a graphics mode is not available at call time.

Get operations

- GET_WINDOW_POS (0) Returns the current window position, in desktop coordinates.
  
  [OUT] param1 x
  [OUT] param2 y

- * GET_WINDOW_TITLE (1) Returns the title of the program window.
  
  [OUT] param title

- GET_WINDOW_HANDLE (2) Returns a handle to the program window.
  
  [OUT] param1 handle; this is a HWND in Windows, a "Window" XID in X11

- * GET_DESKTOP_SIZE (3) Returns the desktop size, in pixels.
  
  [OUT] param1 width
  [OUT] param2 height

- GET_SCREEN_SIZE (4) Returns the current screen size in pixels.
  
  [OUT] param1 width
  [OUT] param2 height

- GET_SCREEN_DEPTH (5) Returns current graphics mode screen depth.
  
  [OUT] param1 bits per pixel

- GET_SCREEN_BPP (6) Returns current graphics mode BPP.
  
  [OUT] param1 bytes per pixel

- GET_SCREEN_PITCH (7) Returns the current graphics mode framebuffer pitch.
  
  [OUT] param1 pitch

- GET_SCREEN_REFRESH (8) Returns the current graphics mode refresh rate.
  
  [OUT] param1 rate

- GET_DRIVER_NAME (9) Returns the current graphics mode driver name.
  
  [OUT] param name

- GET_TRANSPARENT_COLOR (10) Returns the transparent color value for the current graphics mode.
  
  [OUT] param1 value

- GET_VIEWPORT (11) Returns the current viewport as set by the View commands.
  
  [OUT] param1 x1
  [OUT] param2 y1
[OUT] param3 x2
[OUT] param4 y2

- **GET_PEN_POS (12)** Returns the last graphical pen position, in screen graphics functions supporting relative coordinates using the Step

[OUT] param1 x
[OUT] param2 y

- **GET_COLOR (13)** Returns the current graphics mode color.

[OUT] param1 foreground
[OUT] param2 background

- **GET_ALPHA_PRIMITIVES (14)** Returns if primitives drawing support alpha channel enabling.

[OUT] param1 TRUE (-1) if alpha primitives is enabled, FALSE (0) otherwise

- **GET_GL_EXTENSIONS (15)** Returns a string holding all supported GL in OpenGL mode.

[OUT] param supported GL extensions

- **GET_HIGH_PRIORITY (16)** Returns if GFX_HIGH_PRIORITY was specified in ScreenRes.

[OUT] param1 higher priority graphics processing enabled

**Set operations**

- **SET_WINDOW_POS (100)** Sets the current program window position, in desktop coordinates.

[IN] param1 x
[IN] param2 y

- **SET_WINDOW_TITLE (101)** Sets the current program window title. 1

```
WindowTitle(param).
```

[IN] param title

- **SET_PEN_POS (102)** Sets the current graphical pen position, in screen graphics functions supporting relative coordinates using the Step

[IN] param1 x
[IN] param2 y

- **SET_DRIVER_NAME (103)** Sets the name of the internal graphics driver to be used in subsequent calls to Screen or ScreenRes.

[IN] param driver name

- **SET_ALPHA_PRIMITIVES (104)** Sets if primitives drawing should honor alpha channel.

[IN] param1 enabled

- **SET_GL_COLOR_BITS (105)** Sets the number of bits dedicated to the OpenGL color buffer.

[IN] param1 bits
- *SET_GL_COLOR_RED_BITS (106)* Sets the number of bits dedicated to the red component of the OpenGL color buffer
  
  **[IN]** param1 bits

- *SET_GL_COLOR_GREEN_BITS (107)* Sets the number of bits dedicated to the green component of the OpenGL color buffer
  
  **[IN]** param1 bits

- *SET_GL_COLOR_BLUE_BITS (108)* Sets the number of bits dedicated to the blue component of the OpenGL color buffer
  
  **[IN]** param1 bits

- *SET_GL_COLOR_ALPHA_BITS (109)* Sets the number of bits dedicated to the alpha component of the OpenGL color buffer
  
  **[IN]** param1 bits

- *SET_GL_DEPTH_BITS (110)* Sets the number of bits dedicated to the depth buffer
  
  **[IN]** param1 bits

- *SET_GL_STENCIL_BITS (111)* Sets the number of bits dedicated to the stencil buffer
  
  **[IN]** param1 bits

- *SET_GL_ACCUM_BITS (112)* Sets the number of bits dedicated to the accumulation buffer
  
  **[IN]** param1 bits

- *SET_GL_ACCUM_RED_BITS (113)* Sets the number of bits dedicated to the red component of the OpenGL accumulation buffer
  
  **[IN]** param1 bits

- *SET_GL_ACCUM_GREEN_BITS (114)* Sets the number of bits dedicated to the green component of the OpenGL accumulation buffer
  
  **[IN]** param1 bits

- *SET_GL_ACCUM_BLUE_BITS (115)* Sets the number of bits dedicated to the blue component of the OpenGL accumulation buffer
  
  **[IN]** param1 bits

- *SET_GL_ACCUM_ALPHA_BITS (116)* Sets the number of bits dedicated to the alpha component of the OpenGL accumulation buffer
  
  **[IN]** param1 bits

- *SET_GL_NUM_SAMPLES (117)* Sets the number of samples to be used for OpenGL multisampling
  
  **[IN]** param1 samples

**Other operations**

- *POLL_EVENTS (200)* Cause the library to poll all events, i.e., to check the system event queue, specifically used for retrieving keyboard and mouse events. This is most useful...
used, as normally \texttt{Flip} will cause these events to be polled.

\textbf{Example}

```
'' include fbgfx.bi for some useful definitions
#include "fbgfx.bi"

'' use FB namespace for easy access to types/constants
Using FB

Dim e As EVENT
Dim As Integer x0, y0, x, y
Dim As Integer shakes = 0
Dim As Any Ptr img

ScreenRes 320, 200, 32
Print "Click to shake window"

'' find window coordinates
ScreenControl GET_WINDOW_POS, x0, y0

Do

    If (shakes > 0) Then

        '' do a shake of the window

        If (shakes > 1) Then

            '' move window to a random position near
            x = x0 + Int(32 * (Rnd() - 0.5))
            y = y0 + Int(32 * (Rnd() - 0.5))
            ScreenControl SET_WINDOW_POS, x, y

        Else

            '' move window back to its original coordinates
            ScreenControl SET_WINDOW_POS, x0, y0

        End If

    Else

        ScreenControl SET_WINDOW_POS, x0, y0

    End If

```

End If

shakes -= 1

End If

If (ScreenEvent(@e)) Then
Select Case e.type

' user pressed the mouse button
Case EVENT_MOUSE_BUTTON_PRESS

If (shakes = 0) Then
' set to do 20 shakes
    shakes = 20

    ' find current window coordinates
    ScreenControl GET_WINDOW_POS, x0, y0

End If

' user closed the window or pressed a key
Case EVENT_WINDOW_CLOSE, EVENT_KEY_PRESS
    ' exit to end of program
    Exit Do

End Select
End If

' free up CPU for other programs
Sleep 5

Loop

' include fbgfx.bi for some useful definitions
#include "fbgfx.bi"
Dim As String driver

#ifdef __FB_WIN32__
' set graphics driver to GDI (Win32 only), before ScreenControl FB.SET_DRIVER_NAME, "GDI"
#endif

ScreenRes 640, 480

' fetch graphics driver name and display it to use ScreenControl FB.GET_DRIVER_NAME, driver
Print "Graphics driver name: " & driver

' wait for a keypress before closing the window
Sleep

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the ε

Differences from QB
- New to FreeBASIC

See also
- Screen (Graphics)
- ScreenEvent
- ScreenInfo
- WindowTitle
- View (Graphics)
ScreenEvent

Queries for and retrieves system events.

**Syntax**

```
Declare Function ScreenEvent ( ByVal event As Any Ptr = 0 ) As Long
```

**Usage**

```
result = ScreenEvent( [ event ] )
```

**Parameters**

`event`

Specifies the buffer where the function should store the event data.

**Return Value**

Returns -1 if there are pending events to be retrieved, 0 otherwise.

**Description**

This function returns the latest available system event from the internal keyboard activity, for example.

The event data (if available) will be copied into the buffer pointed That

**Querying for events**

The function returns -1 if there are pending events to be retrieved, 0 o

**ScreenEvent** will not be able to copy the event data and it will not dequ

**Note**

If you receive a KEY_PRESS, KEY_RELEASE or KEY_REPEAT event, it will not be clear after you receive the event, you will need to clear it manually.

**Example**
' include fbgfx.bi for some useful definitions
#include "fbgfx.bi"
#if __FB_LANG__ = "fb"
Using fb ' constants and structures are stored in
#endif

Dim e As EVENT

ScreenRes 640, 480
Do
    If (ScreenEvent(@e)) Then
        Select Case e.type
            Case EVENT_KEY_PRESS
                If (e.scancode = SC_ESCAPE) Then
                    End
                End If
                If (e.ascii > 0) Then
                    Print "'" & e.ascii & "'";
                Else
                    Print "unknown key";
                End If
            End Case
            Case EVENT_KEY_RELEASE
                If (e.ascii > 0) Then
                    Print "'" & e.ascii & "'";
                Else
                    Print "unknown key";
                End If
                Print " was released (scancode " & e.scancode & ")"
            Case EVENT_KEY_REPEAT
                If (e.ascii > 0) Then
                    Print "'" & e.ascii & "'";
                Else
                    Print "unknown key";
                End If
                Print " is being repeated (scancode " & e.scancode & ")"
            Case EVENT_MOUSE_MOVE
                Print "mouse moved to " & e.x & "," & e.y & ""
            End Case
        End Select
    End If
Loop
Case EVENT_MOUSE_BUTTON_PRESS
    If (e.button = BUTTON_LEFT) Then
        Print "left";
    ElseIf (e.button = BUTTON_RIGHT) Then
        Print "right";
    Else
        Print "middle";
    End If
    Print " button pressed"
Case EVENT_MOUSE_BUTTON_RELEASE
    If (e.button = BUTTON_LEFT) Then
        Print "left";
    ElseIf (e.button = BUTTON_RIGHT) Then
        Print "right";
    Else
        Print "middle";
    End If
    Print " button released"
Case EVENT_MOUSE_DOUBLE_CLICK
    If (e.button = BUTTON_LEFT) Then
        Print "left";
    ElseIf (e.button = BUTTON_RIGHT) Then
        Print "right";
    Else
        Print "middle";
    End If
    Print " button double clicked"
Case EVENT_MOUSE_WHEEL
    Print "mouse wheel moved to position "
Case EVENT_MOUSE_ENTER
    Print "mouse moved into program window"
Case EVENT_MOUSE_EXIT
    Print "mouse moved out of program window"
Case EVENT_WINDOW_GOT_FOCUS
    Print "program window got focus"
Case EVENT_WINDOW_LOST_FOCUS
    Print "program window lost focus"
Case EVENT_WINDOW_CLOSE
    End
```
Case EVENT_MOUSE_HWHEEL
    Print "horizontal mouse wheel moved to"
End Select
End If
Sleep 1
Loop
```

**Platform Differences**

- ScreenEvent does not return window related events in the DOS

**Dialect Differences**

- Not available in the -lang qb dialect.

**Differences from QB**

- New to FreeBASIC

**See also**

- Event
- Screen (Graphics)
- Inkey
- MultiKey
- GetMouse
ScreenInfo

Retrieves information about current video mode or the desktop.

**Syntax**

```
Declare Sub ScreenInfo ( ByRef w As Integer = 0, ByRef h As Integer = 0, ByRef bpp As Integer = 0, ByRef pitch As Integer = 0, ByRef rate As String = "" )
```

**Usage**

```
```

**Parameters**

- **w**
  - Width.
- **h**
  - Height.
- **depth**
  - Color depth in bits.
- **bpp**
  - Bytes per pixel.
- **pitch**
  - Bytes per scan line.
- **rate**
  - Refresh rate.
- **driver**
  - Driver name.

**Description**

This function can be useful to get current mode informations like graphics size and more.

If `ScreenInfo` is called when no graphics mode is set, it returns the information about the desktop.

Here's a description of available fields:

| w   | Width of the screen in pixels |
### Example

```basic
Dim w As Integer, h As Integer
Dim depth As Integer
Dim driver_name As String

Screen 15, 32
' Obtain info about current mode
ScreenInfo w, h, depth,, , driver_name
Print Str(w) + "x" + Str(h) + "x" + Str(depth);
Print " using " + driver_name + " driver"
Sleep
' Quit graphics mode and obtain info about desktop
Screen 0
ScreenInfo w, h, depth
Print "Desktop running at " + Str(w) + "x" + Str(h)
```

### Dialect Differences
- Not available in the `-lang qb` dialect unless referenced with the

### Differences from QB
- New to FreeBASIC

### See also
- `Screen (Graphics)`
ScreenGLProc

Gets the address of an OpenGL procedure

**Syntax**

```basic
Declare Function ScreenGLProc ( ByRef proname As Const String )
```

**Parameters**

`proname`
name of the procedure to retrieve the address of

**Description**

This function can be used to get the address of any OpenGL procedure functions associated with OpenGL extensions. If given procedure name will return NULL (0).

**Example**

```basic
' include fbgfx.bi for some useful definitions
#include "fbgfx.bi"

Dim SwapInterval As Function(ByVal interval As Integer)
Dim extensions As String

' Setup OpenGL and retrieve supported extensions
ScreenRes 640, 480, 32,, FB.GFX_OPENGL
ScreenControl FB.GET_GL_EXTENSIONS, extensions

If (InStr(extensions, "WGL_EXT_swap_control") <> 0) Then
    ' extension supported, retrieve proc address
    SwapInterval = ScreenGLProc("wglSwapIntervalEXT")
    If (SwapInterval <> 0) Then
        ' Ok, we got it. Set OpenGL to wait for vertical sync on buffer swaps
        SwapInterval(1)
    End If
End If
```
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the

Platform Differences

- Not available for DOS target.

Differences from QB

- New to FreeBASIC

See also

- `Screen (Graphics)`
- `ScreenControl`
**ScreenList**

Finds available fullscreen video modes

**Syntax**

```plaintext
Declare Function ScreenList ( ByVal depth As Long = 0 ) As Long
```

**Usage**

```plaintext
result = ScreenList( [ depth ] )
```

**Parameters**

- `depth`
  the color depth for which the list of modes is requested (supported depths are 8, 15, 16, 24 and 32)

**Return Value**

returns 0, when there are no more resolutions to read.

**Description**

It works like the `Dir` function: the first call to the function requires the `depth` parameter to be specified, it returns the lowest supported resolution for the requested depth. Further calls to `ScreenList` without arguments return next resolutions. When no more resolutions are available, `ScreenList` returns 0.

The result of `ScreenList` is encoded as a 32 bit value, with the screen as the **High Word** and the height as the **Low Word**.

Resolutions are returned from lowest to highest supported ones.

It is safe to call this function before any graphics mode has been set.

```plaintext
Dim As Integer mode, w, h
```
Print "Resolutions supported at 8 bits per pixel:

mode = ScreenList(8)
While (mode <> 0)
    w = HiWord(mode)
    h = LoWord(mode)
    Print w & "x" & h
    mode = ScreenList()
Wend

Dialect Differences

- Not available in the \texttt{lang qb} dialect unless referenced with the \texttt{__Screenlist}.

Differences from QB

- New to FreeBASIC

See also

- Screen
- ScreenRes
ScreenLock

Locks the working page's frame buffer

**Syntax**

```basic
Declare Sub ScreenLock()
```

**Usage**

`ScreenLock`

**Description**

All of FreeBASIC's Graphics Library functions draw to a frame buffer and an automatic routine copies the frame buffer to the actual screen memory at each draw. If the user program does a lot of drawing, the automatic refreshes may take a significant amount of time.

The `ScreenLock` function locks the automatic refresh, so several drawing operations may be done before the screen refresh is performed, thus increasing the speed of execution, and preventing the user from seeing partial results.

Frame buffer memory may be freely accessed by using pointers (see `ScreenPtr`) ONLY while the screen is locked. Primitive graphics statements (`Line, PSet, Draw String, ...`) may be used at any time.

The screen refresh remains locked until the use of `ScreenUnlock` statement, which resumes it.

Calls to `ScreenLock` must be paired with a matching call to `ScreenUnlock`. The graphics driver keeps track of how many times `ScreenLock` has been called using a counter. Only the first call to `ScreenLock` actually performs a locking operation. Subsequent calls to `ScreenLock` only increment the counter. Conversely, `ScreenUnlock` only decrements the lock counter until it reaches zero at which time the actual unlock operation will be performed. Using `Screen` or `ScreenRes` will release all locks and set the
lock counter back to zero before changing screen modes.

It is strongly recommended that the lock on a page be held for as short a time as possible. Only screen drawing should occur while the screen is locked, input/output and waiting must be avoided. In Win32 and Linux the screen is locked by stopping the thread that processes also the OS' events. If the screen is kept locked for a long time the event queue could overflow and make the system unstable. When the induced lock time becomes too long, use preferably the method of double buffering (with ScreenCopy).

The automatic refresh takes place only in the visible page of the frame buffer. ScreenLock has no effect when drawing to pages other than the visible one.

**Example**

```
' Draws a circle on-screen at the mouse cursor
Dim As Integer  mx, my
Dim As String   key

ScreenRes 640, 480, 32

Do

'process
GetMouse(mx, my)
key = Inkey()

'draw
ScreenLock()
Cls()
Circle (mx, my), 8, RGB(255, 255, 255)
ScreenUnlock()

'free up CPU time
Sleep(18, 1)
```
Loop Until key = Chr(27) Or key = Chr(255, 107)

Platform Differences
- In DOS, the mouse arrow does not react to mouse movements while the screen is locked

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the alias __Screenlock.

Differences from QB
- New to FreeBASIC

See also
- Screen (Graphics) - Setting mode
- ScreenRes - Setting mode
- ScreenUnlock
- ScreenPtr
**ScreenPtr**

Returns a pointer to the current work page's frame buffer

**Syntax**

```basic
Declare Function ScreenPtr () As Any Ptr
```

**Usage**

```basic
result = ScreenPtr
```

**Return Value**

A pointer to the current work page frame buffer memory, or NULL (0) if any read or writes are attempted. The pointer returned is valid up until which invalidates it.

**Description**

`ScreenPtr` provides a way to directly read/write the working page's frame buffer, and also the width and height to avoid going out of bounds. This information can be found out using `ScreenInfo`.

Because of the design of FreeBASIC graphics library, `ScreenPtr` (if non-NULL) will always point to the backbuffer, and never to actual video RAM.

**Example**

```basic
Const SCREEN_WIDTH = 640, SCREEN_HEIGHT = 480
Dim As Integer w, h, bypp, pitch
```
' Make 8-bit screen.
ScreenRes SCREEN_WIDTH, SCREEN_HEIGHT, 8

' Get screen info (w and h should match the constants above, bypp should be 1)
ScreenInfo w, h, , bypp, pitch

' Get the address of the frame buffer. An Any Ptr is used here to allow simple pointer arithmetic
Dim buffer As Any Ptr = ScreenPtr()
If (buffer = 0) Then
    Print "Error: graphics screen not initialized.
    Sleep
    End -1
End If

' Lock the screen to allow direct frame buffer access
ScreenLock()

' Find the address of the pixel in the center of the screen
' It's an 8-bit pixel, so use a UByte Ptr.
Dim As Integer x = w \ 2, y = h \ 2
Dim As UByte Ptr pixel = buffer + (y * pitch)

' Set the pixel color to 10 (light green).
*pixel = 10

' Unlock the screen.
ScreenUnlock()

' Wait for the user to press a key before closing
Sleep

Const SCREEN_WIDTH = 256, SCREEN_HEIGHT = 256
Dim As Integer w, h, bypp, pitch

' Make 32-bit screen.
ScreenRes SCREEN_WIDTH, SCREEN_HEIGHT, 32

' Get screen info (w and h should match the constants above, bypp should be 4)
ScreenInfo w, h, , bypp, pitch

' Get the address of the frame buffer. An Any Ptr is used here to allow simple pointer arithmetic
Dim buffer As Any Ptr = ScreenPtr()
If (buffer = 0) Then
  Print "Error: graphics screen not initialized.
  Sleep
  End -1
End If

' Lock the screen to allow direct frame buffer access
ScreenLock()

' Set row address to the start of the buffer
Dim As Any Ptr row = buffer

' Iterate over all the pixels in the screen:
For y As Integer = 0 To h - 1
  ' Set pixel address to the start of the row
  ' It's a 32-bit pixel, so use a ULong Ptr
  Dim As ULong Ptr pixel = row

  For x As Integer = 0 To w - 1
    ' Set the pixel value
    *pixel = RGB(x, x Xor y, y)
    ' Get the next pixel address
    ' (ULong Ptr will increment by 4 bytes)
    pixel += 1
  Next x
'' Go to the next row
row += pitch

Next y

'' Unlock the screen.
ScreenUnlock()

'' Wait for the user to press a key before closing
Sleep

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- Screen (Graphics)
- ScreenRes
- ScreenInfo
- ScreenLock
- ScreenUnlock
ScreenRes

Initializes a graphics mode by specifying horizontal and vertical resolution

Syntax

```
Declare Function ScreenRes ( ByVal width As Long, ByVal height As Long = 1, ByVal num_pages As Long = 1, ByVal flags As Long = 0, ByVal refresh_rate As Long = 0 )
```

Usage

```
```

Parameters

- **width, height**
  The display width and height, respectively. For fullscreen mode, the user resolution using `ScreenList`.
- **depth**
  The color depth in bits per pixel. Valid color depths are: 1, 2, 4, 8, 16 and allowed as aliases for 16 and 32, respectively. If omitted, the default is to give a palette image. The default palette will be the first $2^\text{depth}$ colors of the 256-color palette used in Screen 13.
- **num_pages**
  The number of video pages to create, defaults to 1. (see below)
- **flags**
  Used to set various properties of the screen, including fullscreen mode, below or the standard header "fbgfx.bi" for available flags)
- **refresh_rate**
  The desired refresh rate of the screen, only has an effect for fullscreen only. Defaults to an appropriate value, invalid refresh rates will be ignored.

Return Value

Returns zero (0) if successful, or a non-zero error code to indicate a failure.

Description
**ScreenRes** tells the compiler to link the GfxLib and initializes a QB-only mode depending on the **flags** setting.

**ScreenRes** clears the created window or the full screen. In non-fullscreen mode, it does not match any resolution of the graphics card. Resolutions like 555x111 are possible; GfxLib will create a window of such size. See the page **GfxLib overview** for DOS issues.

The font size in **ScreenRes** modes is set to 8x8 by default. This can be changed by setting the number of text rows/columns, using the **Width** function.

In QB-only modes a dumb window or fullscreen resolution is set, one or more buffers in standard memory are created, console commands are redirected to their graphic versions, and a screen refresh thread is started. QB-like graphics and console statements are implemented in the window, the events manager and refresh the screen as needed. FreeBASIC drawing functions with API-driven windows. Alternatively, it allows to process graphics (for example files) without making it visible on the screen, even in a purely console application.

In **QB-on-GUI** modes one or more buffers in standard memory are created, console commands are redirected to their graphic versions and a **default palette** is set. QB-like graphics and console commands are forbidden. It is up to the user to create a window and to refresh it with the contents.

In **OpenGL** modes a dumb window or fullscreen resolution is set, one or more buffers in standard memory are created, and the system's OpenGL library is initialized. From here only OpenGL commands can be used to write to the graphics buffer. QB-like and console commands are forbidden.

**flags details:**

If flags are omitted, FreeBASIC uses QB-compatible graphics in windowed mode. Constants are defined in *fbgfx.bi*. In the **-lang fb** dialect, these constants can be combined to form a mask using **Operator Or**. Note that most flags are not supported in DOS.

Available flags:

**graphic mode flags**

**GFX_NULL**: Starts a QB-on-GUI graphics mode. It creates a graphics buffer, implements the window, the events manager and refresh the screen as needed. FreeBASIC drawing functions with API-driven windows. Alternatively, it allows to process graphics (for example files) without making it visible on the screen, even in a purely console application. See an **Example of GFX_NULL** in Windows.

**GFX_OPENGL**: Initializes OpenGL to draw in a dumb window. FreeBASIC
screen is not automatically updated, **Flip** must be used. This option provides a portable way to initialize the OpenGL Library.

If none of the above options is specified, FreeBASIC enters the QB-only graphics mode: it creates a buffer and a dumb window and sets a thread that automatically updates the screen. The FreeBASIC drawing functions can be used.

**window mode flags**

Window mode flags are meaningless if **GFX_NULL** mode is used
- **GFX_WINDOWED**: If windowed mode is supported, FreeBASIC opens a window on the present desktop.
- **GFX_FULLSCREEN**: The graphics card switch mode is switched to the requested mode. If the mode is not available in the present card, it is switched to windowed mode.

If **GFX_FULLSCREEN** is not specified, the behavior for **GFX_WINDOWED** is assumed.

- **GFX_NO_SWITCH**: Prevents the user from changing to fullscreen or to windowed mode.
- **GFX_NO_FRAME**: Creates a window without a border.
- **GFX_SHADED_WINDOW**: Creates transparent regions wherever RGBA(255, 0, 255, 0) is drawn on the screen.
- **GFX_ALWAYS_ON_TOP**: Creates a window that stays always on top.

**option flags**

Flags working in any mode, they activate special behaviors

- **GFX_ALPHA_PRIMITIVES**: Tells the graphics library to enable alpha channel support. This means the alpha specified in a color value (via either the **RGBA** macro or direct color in the form &h; AARRGGBB) will always be used by all primitives.
- **GFX_HIGH_PRIORITY**: Tells the graphics library to enable a higher priority for graphics processing. This has an effect on gdi and DirectX drivers on Win32 platform.

**OpenGL Buffer flags**

These flags work only in OpenGL graphics mode, must be combined with **GFX_OPENGL** flag

- **GFX_STENCIL_BUFFER**: Forces OpenGL to use Stencil buffer
- **GFX_ACCUMULATION_BUFFER**: Forces OpenGL to use Accumulation buffer
- **GFX_MULTISAMPLE**: Requests fullscreen anti-aliasing through the ARB_notify extension

Depending on whether the **GFX_FULLSCREEN** parameter is present or not, the video mode in fullscreen or windowed mode, respectively. If fullscreen mode is specified, FreeBASIC will try in fullscreen mode. If windowed mode is specified, FreeBASIC will try full screen. If everything fails, execution will resume from the statement following the **Screen** call. You should take care of checking if a graphics mode has been set or not, and behave accordingly; a way to
the return value of the `ScreenPtr` function; see its page for details.

**Graphics mode console**

Console commands (`Locate, Print`), input can be used both with standard extended ones too, provided the standard color depth is not modified. Where the table says more than one text resolution is available for the text mode, the required text resolution can be requested by using `Width`. Any characters `Print`ed will erase the background around them; it does not use a transparent background.

**Example**

```vbnet
' Set the screen mode to 320*200, with 8 bits per pixel
ScreenRes 320, 200, 8

' Draw color bands in a diagonal pattern over the whole screen
For y As Integer = 0 To 200-1
    For x As Integer = 0 To 320-1
        PSet (x,y),(x + y) And 255
    Next x
Next y

' Display the text "Hello World!!" over the lines drawn
Print "Hello world!!"

' Keep the window open until the user presses a key
Sleep
```

**Platform Differences**

- In DOS, Windowing and OpenGL related switches are not available.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `overview`
Differences from QB

- New to FreeBASIC

See also

- Screen The QB-like way to set graphics mode
- ScreenList Check display modes available for FB GfxLib to use
- ScreenControl Select driver and more
- ScreenLock
- ScreenUnlock
- ScreenPtr Semi-low level access
- ScreenSet
- ScreenCopy
- ScreenInfo
- ScreenGLProc
- Internal pixel formats
- FaqPggfxlib2
**ScreenSet**

Sets current work and visible pages

**Syntax**

```basic
Declare Sub ScreenSet ( ByVal work_page As Long = -1, ByVal visible_page
```

**Usage**

```basic
ScreenSet [ work_page ] [, visible_page ]
```

**Parameters**

- `work_page`:
  - index to working page
- `visible_page`:
  - index to visible page

**Description**

`ScreenSet` allows to set the current working page and the current visible page. The number of pages specified when setting the graphics mode with `ScreenRes` with double-buffering.

If you provide `visible_page` but omit `work_page`, only the visible page is changed. If you omit both arguments, both work page and visible page are reset to page 0.

`ScreenSet` provides one method of writing to the screen without instantly displaying changes to the user. There are other alternative methods of doing this.

**Example**

```basic
' Open graphics screen (320*200, 8bpp) with 2 pages
ScreenRes 320, 200, 8, 2

' Work on page 1 while displaying page 0
ScreenSet 1, 0
```
Dim As Integer x = -40

Do
   ' Clear the screen, draw a box, update x
   Cls
   Line (x, 80)-Step(39, 39), 4, BF
   x += 1: If (x > 319) Then x = -40

   ' Wait for vertical sync: only used to control
   ScreenSync

   ' Copy work page to visible page
   ScreenCopy
Loop While Inkey = ""

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the

Differences from QB
- New to FreeBASIC

See also
- Screen (Graphics)
- ScreenRes
- ScreenCopy
- ScreenLock
- ScreenUnlock
**ScreenSync**

Synchronizes display updates with hardware

**Syntax**

```plaintext
Declare Function ScreenSync ( ) As Long
```

**Usage**

```plaintext
result = ScreenSync
```

**Return Value**

Zero if successful, or non-zero if a graphics mode was not previously set.

**Description**

This GfxLib statement stops the execution of the program until the graphics card signals it has ended tracing a frame and is going to start the new one.

If the program uses this small interval of time between frames to redraw the image, the flickering is greatly reduced. In that use, **ScreenSync** is a reminiscence of QB where there was only that equivalent method (`Wait &H3DA;,, 8`) to improve the flickering. It is an empirical method because it only allows to synchronize the beginning of the drawing with the fixed dead time between two frames. To be used occasionally to avoid flickering when only very short time of drawing.

Except the purpose to reduce the flickering, **ScreenSync** can be also used simply as a method of synchronization of graphic drawing with the screen frame tracing (similarly to statement `Sleep`).

The use of the QB-compatible form `Wait &H3DA;,, 8` is deprecated.

**Example**
'main loop
Do
  ' do user input
  ' calculate_a_frame
  ScreenSync
  ' draw_ a_ frame
Loop Until Inkey <> ""

Dialect Differences
  - Not available in the -lang qb dialect unless referenced with the alias __screensync.

Differences from QB
  - New to FreeBASIC.
  - QBasic used Wait &H3DA;, 8 for this purpose.

See also
  - Wait
**ScreenUnlock**

Unlocks work page's framebuffer

**Syntax**

```
Declare Sub ScreenUnlock ( ByVal startline As Long = -1, ByVal endline As Long = -1 )
```

**Usage**

```
ScreenUnlock [ start_line ] [, end_line ]
```

**Parameters**

- **startline**
  - optional argument specifying first screen line to be updated. If omitted top screen line is assumed.
- **endline**
  - optional argument specifying last screen line to be updated. If omitted bottom screen line is assumed.

**Description**

`ScreenUnlock` unlocks the current work page assuming it was previously locked by calling `ScreenLock` and lets the system restart updating the screen regularly. When called with `start_line` and `end_line`, only the screen area between those lines is assumed to have changed, and will be updated.

An internal counter exists that remembers the screen lock state, thus `ScreenUnlock` has an effect only on a screen that is locked. A screen that has not been locked with `ScreenLock` cannot get unlocked, however `ScreenUnlock` still will force an update of given area or full screen.

Calls to `ScreenUnlock` must be paired with matching calls to `ScreenLock`. Only the first call to `ScreenLock` actually performs a locking operation. Subsequent calls to `ScreenLock` only increment the lock counter. Conversely, `ScreenUnlock` only decrements the lock counter until it
reaches zero at which time the actual unlock operation will be performed. Using \texttt{Screen} or \texttt{ScreenRes} will release all locks and set the lock counter back to zero before changing screen modes.

All graphic statements automatically lock the screen before the function call, and unlock the screen afterwards, so you do not need to do this explicitly using \texttt{ScreenLock} and \texttt{ScreenUnlock}. You only need to lock the screen when you wish to access the screen (framebuffer) directly using \texttt{ScreenPtr} or when you wish to group several graphic statements together so their effects appear simultaneously on screen, thus avoiding potential screen flicker during screen updates.

Warning (Win32, Linux) : The screen is locked by stopping the thread that processes also the OS' events. This means the screen should be locked only for the short time required to redraw it, and no user input will be received while the screen is locked. When the induced lock time becomes too long, use preferably the method of double buffering (with \texttt{ScreenCopy}).

**Example**

See \texttt{ScreenPtr} example.

**Dialect Differences**

- Not available in the \texttt{-lang qb} dialect unless referenced with the alias \texttt{__Screenunlock}.

**Differences from QB**

- New to FreeBASIC

**See also**

- \texttt{Screen (Graphics)}
- \texttt{ScreenLock}
- \texttt{ScreenPtr}
Second

Gets the seconds from a **Date Serial**

**Syntax**

```vbnet
Declare Function Second ( ByVal date_serial As Double ) As Long
```

**Usage**

```vbnet
#include "vbcompat.bi"
result = Second( date_serial )
```

**Parameters**

- `date_serial`  
  the date serial

**Return Value**

Returns the seconds from a variable containing a date in **Date Serial**

**Description**

The compiler will not recognize this function unless `vbcompat.bi` is included.

**Example**

```vbnet
#include "vbcompat.bi"
Dim ds As Double = DateSerial(2005, 11, 28) + TimeSerial
Print Format(ds, "yyyy/mm/dd hh:mm:ss "); Second(ds)
```

**Differences from QB**

- Did not exist in QB. This function appeared in PDS and VBDOSS.
See also

- Date Serials
Seek (Statement)

Sets the position of the next read/write operation on a file.

**Syntax**

```
Seek  [#]filename, position
```

**Parameters**

- `filename`: file number of an opened file
- `position`: the new position for I/O operations

**Description**

Sets the position at which the next read or write operation on a file will occur.

The position is given in records if the file was opened in `Random` access mode, in bytes in any other case. The position is 1 based -- the first record of a file is at position 1.

The `Seek` function is used to get the position of the next read or write operation.

**Example**

```
' e.g. if you want to skip to the 100th byte in the file

Dim f As Integer

f = FreeFile
Open "file.ext" For Binary As #f

Seek f, 100
Close #f
```
Differences from QB

- None

See also

- Seek (Function)
- Open
**Seek (Function)**

Gets the position of the next read/write operation for a file or device

**Syntax**

```
Declare Function Seek ( ByVal filenum As Long ) As LongInt
```

**Parameters**

- `filenum`  
  file number of an open file

**Return Value**

The file position where the next read or write operation will take place.

**Description**

The position is given in records if the file was opened in Random access mode, in bytes in any other case. The file position returned is 1-based, so the first record of a file is 1.

The `Seek` statement is used to set the position of the next read or write operation.

**Example**

```vbnet
Dim f As Integer, position As Integer

f = FreeFile
Open "file.ext" For Binary As #f

position = Seek(f)

Close #f
```
Differences from QB

- None

See also

- Seek (Statement)
- LOC
- Open
Select Case

Conditional statement block

Syntax

Select Case expression
[ Case expressionlist]
[statements]
[ Case Else ]
[statements]
End Select

or

Select Case As Const integer_expression
[ Case constant | enumeration ]
[ statements ]
[ Case Else ]
[ statements ]
End Select

Description

Select Case executes specific code depending on the value of an expression evaluated once, and compared against each case, in order, until a match is found. The code inside the matching Case branch is executed, and the end of the Select Case block. Case Else matches any case not already matched. If no case Else is a Case Else, at least one Case is guaranteed to be executed. If no case Else is specified, the Select Case block will be skipped.

End Select is used to close the Select Case...End Select block.

Note for C users: In FreeBASIC, Select Case works like a switch block. Case Else matches any case not already matched. If no case Else is specified, the Select Case block will be skipped.

End Select is used to close the Select Case...End Select block.

Besides integer types, floating point and string expressions are also supported with the first syntax.

Syntax of an expression list:
{ expression | expression To expression | Is relational operator

...
- **expr**: evaluates `expr`, and compares for equality with the original expression. If they are equal, then a match has been found. This could be considered as "`expr`" (see below).

- **`expr1 To expr2`**: evaluates `expr1` and checks to see if it is less than or equal to the original expression. If so, it evaluates `expr2`, and checks to see if it is greater than or equal to the original expression. If so, then a match has been found.

- **`Is relational_operator expr`**: evaluates `expr`, and compares the original operation against it, using the supplied `relational_operator` (`=`, `>`, `<`, `<>`, `<=`). If the condition is true, then a match has been found.

Multiple checks can be made in each `Case`, by separating them by a comma (`,`). If a match is found, the program finishes its checks, and goes on to execute the code statements for that `Case` block. No further expressions are evaluated or checked.

**Example of expression lists:**

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>constant</td>
</tr>
<tr>
<td>Case 5.4 To 10.1</td>
<td>range</td>
</tr>
<tr>
<td>Case <code>Is &gt; 3</code></td>
<td>bigger than-smaller than</td>
</tr>
<tr>
<td>Case 1, 3, 5, 7 to 9</td>
<td>match against a set of values</td>
</tr>
<tr>
<td>Case <code>x</code></td>
<td>value of a variable</td>
</tr>
</tbody>
</table>

If **As Const** is used, only integer constants (all numeric constants excluding floating-point constants: single and double) can be evaluated and the expression lists support simple constants and enumerations only. "To" ranges are supported, but "Is" ranges are not.

With **As Const**, a jump table is created to contain the full range of integer values, allowing `Select Case As Const` to be faster than `Select Case`. However, the range of values is limited, and the largest value in the range may be no higher than 8191.

**Example**

```vbnet
Dim choice As Integer
```
Input "Choose a number between 1 and 10: "; choice

Select Case As Const choice
Case 1
    Print "number is 1"
Case 2
    Print "number is 2"
Case 3, 4
    Print "number is 3 or 4"
Case 5 To 10
    Print "number is in the range of 5 to 10"
Case Else
    Print "number is outside the 1-10 range"
End Select

' ' SELECT CASE vs. SELECT CASE AS CONST speed test

Const N = 50000000

Dim As Integer dummy = 0
Dim As Double t = Timer()

For i As Integer = 1 To N
    Select Case i
        Case 1, 3, 5, 7, 9
            dummy += 1
        Case 2, 4, 6, 8, 10
            dummy += 1
        Case 11 To 20
            dummy += 1
        Case 21 To 30
            dummy += 1
        Case 31
            dummy += 1
        Case 32
            dummy += 1
    End Select
Next i
dummy += 1
Case 33
dummy += 1
Case Is >= 34
dummy += 1
Case Else
    Print "can't happen"
End Select
Next

Print Using "SELECT CASE: ###.##### seconds"; Timer()
t = Timer()

For i As Integer = 1 To N
    Select Case As Const i
    Case 1, 3, 5, 7, 9
        dummy += 1
    Case 2, 4, 6, 8, 10
        dummy += 1
    Case 11 To 20
        dummy += 1
    Case 21 To 30
        dummy += 1
    Case 31
        dummy += 1
    Case 32
        dummy += 1
    Case 33
        dummy += 1
    Case Else
        If( i >= 34 ) Then
            dummy += 1
        Else
            Print "can't happen"
        End If
    End Select
Next

Print Using "SELECT CASE AS CONST: ###.##### seconds"
Differences from QB

- `Select Case As Const` did not exist in QB
- In an "`expr1 TO expr2`" case, QB would always evaluate both expressions if `expr1` was higher than the original expression.

See also

- `If...Then`
**SetDate**

Sets the current system date

**Syntax**

```
Declare Function SetDate ( ByRef newdate As Const String ) As Long
```

**Usage**

```
result = SetDate( newdate )
```

**Parameters**

- **newdate**
  the new date to set

**Return Value**

Returns zero on success or non-zero on failure on all ports except DOS.

**Description**

To set the date you just format `newdate` and send to `SetDate` in a valid format following one of the following: "mm-dd-yy", "mm-dd-yyyy", "mm/dd/yy", or "mm/dd/yyyy" (mm is the month, dd is the day, yy or yyyy the year.

**Example**

```
Dim m As String, d As String, y As String
m = "03" 'march
d = "13" 'the 13th
y = "1994" 'good ol' days
SetDate m + "/" + d + "/" + y
```
Differences from QB

- The DATE statement was used in QB and the syntax was "DATE = string"

See also

- Date
- SetTime
SetMouse

Sets the position and visibility of the mouse cursor

**Syntax**

```
Declare Function SetMouse ( ByVal x As Long = -1, ByVal y As Long = -1, ByVal clip As Long = -1 ) As Long
```

**Usage**

```
result = SetMouse([ x ] [, [ y ] [, [ visibility ] [, [ clip ]]]]
```

**Parameters**

(For each parameter, -1 is a special value indicating "no changes.")

- **x**
  - optional - set x coordinate
- **y**
  - optional - set y coordinate
- **visibility**
  - optional - set visibility: 1 indicates visible, 0 indicates hidden
- **clip**
  - optional - set clipping: 1 indicates mouse is clipped to graphics window

**Return Value**

Zero (0) on success, non-zero to indicate failure.

**Description**

`SetMouse` will set the (x, y) coordinates of the mouse pointer, as well as position is set using the x and y parameters. The mouse will be invisible if `visibility` is set to 0. `SetMouse` is intended for graphics modes initiated using the `Graphics` statement only.

**Example**

```
Dim As Integer x, y, buttons
```
' create a screen 640*480
ScreenRes 640, 480
Print "Click the mouse button to center the mouse"

Do
  ' get mouse x, y and button state (wait until
  Do: Sleep 1: Loop While GetMouse( x, y , , but

    If buttons And 1 Then
      ' on left mouse click, center mouse
      SetMouse 320, 240
    End If

  ' run loop until a key is pressed or the window
Loop While Inkey = ""

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- GetMouse
- Screen
- MultiKey
- GetKey
SetTime

Sets the current system time

Syntax

Declare Function SetTime ( ByRef newtime As Const String ) As Long

Usage

result = SetTime( newtime )

Parameters

newtime
the new time to set

Return Value

Returns zero on success or non-zero on failure on all ports except DOS.

Description

To set the time, format the date and send to SetTime in one of the following formats: "hh:mm:ss", "hh:mm", or "hh" (hh is the hour, mm is the minute, and ss is the second).

Example

SetTime "1:20:30"

Differences from QB

- The Time statement was used QB and the syntax was TIME = newtime.
See also

- Time
- SetDate
Sgn

Returns the sign part of a number

**Syntax**

```vba
Declare Function Sgn ( ByVal number As Integer ) As Integer
Declare Function Sgn ( ByVal number As LongInt ) As LongInt
Declare Function Sgn ( ByVal number As Double ) As Double
```

**Usage**

```vba
result = Sgn( number )
```

**Parameters**

*number*

the number to find the sign of

**Return Value**

Returns the sign part of *number*.

- If *number* is greater than zero, then *Sgn* returns 1.
- If *number* is equal to zero, then *Sgn* returns 0.
- If *number* is less than zero, then *Sgn* returns -1.

**Description**

The required *number* argument can be any valid numeric expression. Unsigned numbers will be treated as if they were signed, i.e. if the highest bit is set the number will be treated as negative, and -1 will be returned.

The *Sgn* unary *Operator* can be overloaded with user defined types.

**Example**

```vba
Dim N As Integer = 0
```
Print Sgn ( -1.87 )
Print Sgn ( 0 )
Print Sgn ( 42.658 )
Print Sgn ( N )

The output would look like:

```
-1
0
1
0
```

**Dialect Differences**

- In the *-lang qb* dialect, this operator cannot be overloaded.

**Differences from QB**

- None

**See also**

- Abs
- Operator
Shared

Variable declaration modifier specifying visibility throughout a module

Syntax

```
Dim Shared ...
ReDim Shared ...
Common Shared ...
Static Shared ...
```

Description

```
Shared makes module-level variables visible inside Subs and Functions.
If Shared is not used on a module-level variable's declaration, the variable is only visible to the module-level code in that file (furthermore, only a variable declared with Dim without inside a Namespace block, is stored on the stack).
```

NOTES (for Shared variables excluding Common variables):

- Generally a Shared variable may only be initialized with a constant value at the start of the program in the .data section (it cannot depend on any variables or functions in it).
- A first exception is a Shared variable of var-len string type even with a constant string (because of its structure without but to point to a dynamic memory block).
- A second exception is a Shared variable of user-defined type having a constructor even implicit, that can be initialized with a non-constant value code, called when the program starts, which writes the 'initial' values into the .data section.

Example

```
'' Compile with -lang qb or fblite

'$lang: "qb"

Declare Sub MySub
Dim Shared x As Integer
```
Dim y As Integer

x = 10
y = 5

MySub

Sub MySub
    Print "x is "; x 'this will report 10 as it is shared
    Print "y is "; y 'this will not report 5 because it is not shared
End Sub

Differences from QB

- The Shared statement inside scope blocks -- functions, subs, ifs/theses, and loops -- is not supported. Use Dim|Redim|Common|Static Shared in the main program instead.
- a scope block and Redimming a variable or array previously set without Shared; it will work fine and won't ruin anything.

See also

- Common
- Dim
- Erase
- Extern
- LBound
- ReDim
- Preserve
- Static
- UBound
- Var
**Shell**

Sends a command to the system command interpreter

**Syntax**

```basic
Declare Function Shell ( ByRef command As Const String ) As Long
```

**Usage**

```basic
result = Shell( command )
```

**Parameters**

- `command`
  A string specifying the command to send to the command interpreter.

**Return Value**

If the command could not be executed, -1 is returned. Otherwise, the command is executed and its exit code is returned.

**Description**

Program execution will be suspended until the command interpreter exits.

**Example**

```basic
' e.g. for windows:
Shell "dir c:*.*"

' e.g. for linux:
Shell "ls"
```

**Platform Differences**

- Linux requires the `command` case matches the real name of th
command. Windows and DOS are case insensitive. The program being shelled may be case sensitive for its command line parameters.

- Path separators in Linux are forward slashes / . Windows uses backward slashes \ but it allows for forward slashes. DOS uses backward \ slashes.
- If an empty *command* string is passed, DOS will open an interactive command prompt. On Windows, an error may be returned.

**Differences from QB**

- QB allowed SHELL on its own without a "command" argument which caused a default command shell to be started. Execution in the main program would suspend until exit from the command shell. The behaviour in FB is platform-dependent.

**See also**

- Exec
- Run
**Operator Shl (Shift Left)**

Shifts the bits of a numeric expression to the left

**Syntax**

```plaintext
Declare Operator Shl ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator Shl ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As UInteger
Declare Operator Shl ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As LongInt
Declare Operator Shl ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt
```

**Usage**

```plaintext
result = lhs Shl rhs
```

**Parameters**

- `lhs`
  The left-hand side expression.
- `rhs`
  The right-hand side shift expression.

**Return Value**

Returns the result of `lhs` being shifted left `rhs` number of times.

**Description**

*Operator Shl (Shift left)* shifts all of the bits in the left-hand side expression (`lhs`) left a number of times specified by the right-hand side expression (`rhs`). Numerically, the result is the same as `

```
CInt( lhs * ^ rhs )
```

For example, 

```
&b0101; Shl 1
```

returns the binary number 

```
&b01010;
```

and 

```
5 Shl 1
```

returns 10.

Neither of the operands are modified in any way.

If the result is too large to fit inside the result's data type, the leftmost bits are discarded ("shifted out").
The results of this operation are undefined for values of \( \text{rhs} \) less than zero, or greater than or equal to the number of bits in the result's data type.

This operator can be overloaded for user-defined types.

**Example**

```basic
' Double a number
For i As Integer = 0 To 10
    Print 5 Shl i, Bin(5 Shl i, 16)
Next i
```

Output:

<table>
<thead>
<tr>
<th>Number</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0000000000000101</td>
</tr>
<tr>
<td>10</td>
<td>0000000000001010</td>
</tr>
<tr>
<td>20</td>
<td>0000000000010100</td>
</tr>
<tr>
<td>40</td>
<td>0000000000101000</td>
</tr>
<tr>
<td>80</td>
<td>0000000001010000</td>
</tr>
<tr>
<td>160</td>
<td>0000000010100000</td>
</tr>
<tr>
<td>320</td>
<td>0000001010000000</td>
</tr>
<tr>
<td>640</td>
<td>0000101000000000</td>
</tr>
<tr>
<td>1280</td>
<td>0010100000000000</td>
</tr>
<tr>
<td>2560</td>
<td>1010000000000000</td>
</tr>
<tr>
<td>5120</td>
<td>1000000000000000</td>
</tr>
</tbody>
</table>
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Shl`.

**Differences from QB**

- New to FreeBASIC
See also

- Operator Shl= (Shift Left And Assign)
- Operator Shr (Shift Right)
- Bin
- Mathematical Functions
**Operator Shr (Shift Right)**

Shifts the bits of a numeric expression to the right

**Syntax**

```plaintext
Declare Operator Shr ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator Shr ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As UInteger
Declare Operator Shr ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As LongInt
Declare Operator Shr ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt
```

**Usage**

```plaintext
result = lhs Shr rhs
```

**Parameters**

- **lhs**
  The left-hand side expression.
- **rhs**
  The right-hand side shift expression.

**Return Value**

Returns the result of `lhs` being shifted right `rhs` number of times.

**Description**

Operator **Shr (Shift right)** shifts all of the bits in the left-hand side expression (`lhs`) right a number of times specified by the right-hand side expression (`rhs`). Numerically, the result is the same as `Int(lhs * 2 ^ rhs)`. For example, `&b0101; Shr 1` returns the binary number `&b010;`, and `5 Shr 1` returns 2.

If the left-hand side expression is signed and negative, the sign bit is copied in the newly created bits on the left after the shift. For example `-5 Shr 2` returns -2.
Neither of the operands are modified in any way.

The results of this operation are undefined for values of \( rhs \) less than zero, or greater than or equal to the number of bits in the result's data type.

This operator can be overloaded for user-defined types.

**Example**

```vbnet
'Halve a number
For i As Integer = 0 To 10
    Print 1000 Shr i, Bin(1000 Shr i, 16)
Next i
```

### Output:

<table>
<thead>
<tr>
<th>i</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0000000000000000</td>
</tr>
<tr>
<td>1</td>
<td>0000000000000001</td>
</tr>
<tr>
<td>2</td>
<td>0000000000000011</td>
</tr>
<tr>
<td>3</td>
<td>0000000000000111</td>
</tr>
<tr>
<td>4</td>
<td>0000000000001111</td>
</tr>
<tr>
<td>5</td>
<td>0000000000011111</td>
</tr>
<tr>
<td>6</td>
<td>0000000000111111</td>
</tr>
<tr>
<td>7</td>
<td>0000000001111111</td>
</tr>
<tr>
<td>8</td>
<td>0000000011111111</td>
</tr>
<tr>
<td>9</td>
<td>0000000111111111</td>
</tr>
<tr>
<td>10</td>
<td>0000001111111111</td>
</tr>
</tbody>
</table>

### Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Shr`.

### Differences from QB
New to FreeBASIC

See also

- Operator Shr= (Shift Right And Assign)
- Operator Shl (Shift Left)
- Bin
- Mathematical Functions
**Short**

Standard data type: 16 bit signed

**Syntax**

```basic
Dim variable As Short
```

**Description**

16-bit signed whole-number data type. Can hold values from -32768 to 32767.

**Example**

```basic
Dim x As Short = CShort(&H8000)
Dim y As Short = CShort(&H7FFF)
Print "Short Range = "; x; " to "; y
```

**Output:**

```
Short Range = -32768 to 32767
```

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the alias __Short.

**Differences from QB**

- The name "short" is new to FreeBASIC, however they are the same as integers in QB

**See also**
- UShort
- CShort
**Sin**

Returns the sine of an angle

**Syntax**

Declare Function Sin ( ByVal angle As Double ) As Double

**Usage**

result = Sin( angle )

**Parameters**

angle
the angle (in radians)

**Return Value**

Returns the sine of the argument angle as a Double within the range of

**Description**

The argument angle is measured in radians (not degrees).

The value returned by this function is undefined for values of angle with an absolute value of $2^{63}$ or greater.

**Example**

```basic
Const PI As Double = 3.1415926535897932
Dim a As Double
Dim r As Double
Input "Please enter an angle in degrees: ", a
r = a * PI / 180 'Convert the degrees to Radians
Print 
Print "The sine of a" ; a; " degree angle is"; Sin
Sleep
```
The output would look like:

Please enter an angle in degrees: 30
The sine of a 30 degree angle is 0.5

Differences from QB

- None

See also

- Asin
- Cos
- Tan
- A Brief Introduction To Trigonometry
Single

Standard data type: 32 bit floating point

**Syntax**

```vbnet
Dim variable As Single
```

**Description**

Single is a 32-bit, floating point data type used to store decimal numbers. They can hold positive values in the range 1.401298e-45 to 3.402823e+38, or negative values in the range -1.401298e-45 to -3.402823e+38, or zero (0). They contain at most 24 bits of precision, or about 6 decimal digits.

They are similar to **Double** data types, but less precise.

**Example**

```vbnet
'Example of using a single variable.

Dim a As Single
a = 1.9857665
Print a

Sleep
```

**Differences from QB**

- None

**See also**

- **Double** More precise float type
- **CSng**
Table with variable types overview, limits and suffixes
SizeOf

Returns the size of a variable or type in bytes.

**Syntax**

\[
\text{SizeOf} \ ( \ variable \ | \ \text{DataType} \ )
\]

**Description**

The `SizeOf` operator returns the number of bytes taken up by a `variable` or `DataType`.

Different from `Len`, when used with fixed-length strings (including fixed length `ZStrings` and `WStrings`) it will return the number of bytes they use, and when used with variable-length strings, it will return the size of the string descriptor.

If there is both a user defined type and a variable visible with the same name in the current scope, the user defined type takes precedence over the variable. To ensure that the `SizeOf` takes the variable instead of the user defined type, wrap the argument to `SizeOf` with parentheses to force it to be seen as an expression. For example `Sizeof((variable))`.

Note: When used with arrays, `SizeOf` returns the size of a single element of the array. This differs from its behavior in C, where arrays could only be a fixed size, and `sizeof()` would return the number of it used. For clarity, it is recommended that you avoid this potential confusion, and use `SizeOf` directly on an array element, rather than the whole array.

Remark: When used with a dereferenced z/wstring pointer, `SizeOf` always returns the number of bytes taken up by one z/wstring character (instead of 0 before fbc version 0.90).

**Example**

```
Print SizeOf(Byte) ' returns 1

Type bar
    a As Integer
    b As Double
End Type
Dim foo As bar
Print SizeOf(foo)

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __sizeof.

Differences from QB

- New to FreeBASIC

See also

- Len
Sleep

Waits until a specified time has elapsed, or a key is pressed.

Syntax

Declare Sub Sleep ( ByVal amount As Long = -1 )
Declare Function Sleep ( ByVal amount As Long , ByVal keyflag As Long ) As Long

Usage

Sleep [ amount [, keyflag ]]
result = Sleep ( amount, keyflag )

Parameters

amount
Optional number of milliseconds to wait (default is to wait for a key press).

keyflag
Optional flag; give it a value of 0 for a normal sleep, or 1 to specify that the wait cannot be interrupted by a key press.

Return Value

Returns 1 if keyflag was not a valid value (i.e. something other than 0 or 1) to indicate failure, or 0 otherwise.

Description

Sleep will wait until amount milliseconds (can be seconds in -lang qb, see below) given elapsed (if any value was passed) or until the user presses a key. If amount is below 100 ms then Sleep will always wait the full requested amount (key presses are ignored).

Include the second parameter, 1, for a "deep" sleep, which cannot be interrupted by pressing a key.

The accuracy of Sleep is variable depending on the OS cycle time (Windows NT/2K/XP: 15 ms, 9x/Me: 50 ms, Linux 10ms, DOS 55 ms)
Call `sleep` with 25ms or less to release time-slice when waiting for user input or looping inside a thread. This will prevent the program from unnecessarily hogging the CPU.

`sleep` does not clear the keyboard buffer and any keys pressed during a call to `sleep` are retained and can be read using `Inkey`. In order to wait for a key press, and remove the key from the buffer, `GetKey` can be used instead.

**Example**

```plaintext
Print "press a key"
Sleep
GetKey 'clear the keyboard buffer
Print "waiting half second"
Sleep 500
```

**Dialect Differences**

- In the `-lang fb` and `-lang fblite` dialects, the `amount` value is in milliseconds.
- In the `-lang qb` dialect, the `amount` value is in seconds as in QB. If the second parameter `keyflag` is given, or the keyword is written as `__sleep` the value is expected to be in milliseconds.

**Differences from QB**

- None in the `-lang qb` dialect.
- In QB, the delay was given in whole seconds only and did not support the `keyflag` parameter.

**See also**

- Timer
- Inkey
Space

Creates a string of a given length filled with spaces (" ")

Syntax

    Declare Function Space( ByVal count As Integer ) As String

Usage

    result = Space[$]( count )

Parameters

    count
    An integer type specifying the length of the string to be created.

Return Value

    The created string. An empty string will be returned if count <= 0.

Description

    Space creates a string with the specified number of spaces.

Example

    Dim a As String
    a = "x" + Space(3) + "x"
    Print a ' prints: x     x

Dialect Differences

    - The string type suffix $ is obligatory in the -lang qb dialect.
    - The string type suffix $ is optional in the -lang fblite and -lang fb dialects.
Differences from QB

- None

See also

- WSpace
- Spc
- String (Function)
**Spc**

Output function to skip spaces when writing to screen or file

**Syntax**

```
Spc( columns )
```

**Usage**

```
Print Spc( spaces ) [(, | ;)] ...
```

**Parameters**

`spaces`

number of spaces to skip

**Description**

`Spc` skips over the given number of `spaces` when `Print`ing to screen or to a file. The character cells skipped over are left unchanged.

**Example**

```
Print "foo"; Spc(5); "bar"
Print "hello"; Spc(4); "world"
```

```
" " Uses Spc to justify text instead of Tab
```

```
Dim As String  A1, B1, A2, B2
A1 = "Jane"
B1 = "Doe"
A2 = "Bob"
B2 = "Smith"
Print "FIRST NAME"; Spc(35 - 10); "LAST NAME"
```
Print "----------"; Spc(35 - 10); "----------"
Print A1; Spc(35 - Len(A1)); B1
Print A2; Spc(35 - Len(A2)); B2

The output would look like:

<table>
<thead>
<tr>
<th>FIRST NAME</th>
<th>LAST NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Jane</td>
<td>Doe</td>
</tr>
<tr>
<td>Bob</td>
<td>Smith</td>
</tr>
</tbody>
</table>

**Differences from QB**

- In QBasic, spaces were printed in the gap, while in FreeBASIC, the characters are just skipped over and left untouched. The `Space` function can still be used to achieve this effect.

**See also**

- Tab
- Space
- `(Print | ?)`
Sqr

Returns a square root of a number

**Syntax**

```
Declare Function Sqr ( ByVal number As Double ) As Double
```

**Usage**

```
result = Sqr( number )
```

**Parameters**

*number*

the number (greater than or equal to zero)

**Return Value**

Returns the square root of the argument *number*.

If *number* equals zero, *sqr* returns zero (0.0).

If *number* is less than zero, *sqr* returns a special value representing "not defined", "NaN" or "IND", exact text is platform dependent.

**Description**

This is the same as raising the argument *number* to the one-half power. The required *number* argument can be any valid numeric expression greater than or equal to zero.

If a *LongInt* or *ULongInt* is passed to *sqr*, it may be converted to *Double* numbers over $2^{52}$, this will cause a very small loss of precision. Without assumptions about the rounding method, the maximum error due to this conversion is

$$\text{Sqr}(2^{64}-2^{12})$$

which is about $4.8\times10^{-7}$. However this may cause errors if the floor or ceiling of this value is taken, and the result of this may be out by 1, particularly for square numbers and numbers that are close by.

**Example**

```
'' Example of Sqr function: Pythagorean theorem
Dim As Single a, b
Print "Pythagorean theorem, right-angled triangle"
Print Input "Please enter one leg side length: ", a
Input "Please enter the other leg side length: ", b
Print "The hypotenuse has a length of: " & Sqr( a + b)

The output would look like:

Pythagorean theorem, right-angled triangle
Please enter one leg side length: 1.5
Please enter the other leg side length: 2
The hypotenuse has a length of: 2.5

Differences from QB

- None

See also

- Operator ^ (Exponentiate)
- Arithmetic Operators
**Static**

Defines variables, objects and arrays having static storage

**Syntax**

```plaintext
Static symbol1 [ (array-dimensions) ] As DataType [ = expression 
[ (array-dimensions) ] As DataType [ = expression], ...] 
or
Static As DataType symbol1 [ (array-dimensions) ] [ = expression 
[ (array-dimensions) ] [ = expression], ...] 
or

Sub|Function procedurename ( parameters ) [As DataType] Static 
...
End Sub|Function
```

**Parameters**

- `symbol` variable or array symbol name.
- `array-dimensions` lower-bound To upper-bound [, ...]
  or
  Any [, Any...]
  or empty.
- `expression` An constant expression, or an array of constant expressions

**Description**

Specifies **static storage** for variables, objects and arrays; they are all allocated at program startup and deallocated upon exit. Objects are constructed once when they are defined, and destructed upon program exit.

When declaring static arrays, only numeric literals, **Constants** or **Enumerations** may be used as subscript range values. Static variable-length arrays must be declared empty (no subscript range list) and resized using **ReDim** before use.

In both iterative and recursive blocks, like looping **control flow statements** procedures, static variables, objects and arrays local to the block are
occupy the same storage across all instantiations of the block. For example, procedures that call themselves - either directly or indirectly - share the instances of their local static variables.

A static variable may only be initialised with a constant value: its start value at the start of the program before any code is run, and so it cannot depend on variables or functions in it.

When used with module-level and member procedure declarations, static storage for all local variables, objects and arrays.

At module-level variable declaration only, the modifier Shared may be used instead of the keyword static to make module-level static variables visible inside procedures.

When used with in a user-defined type, static creates Static Member Procedures or Variables.

**Example**

```
Sub f
    ' times called is initially 0
    Static timesCalled As Integer = 0
    timesCalled += 1
    Print "Number of times called: " & timesCalled
End Sub

' the static variable in f() retains its value between multiple procedure calls.
f()
f()
```

Will output:

```
Number of times called: 1
Number of times called: 2
```
Dialect Differences

- Variables cannot be initialised in the -lang qb dialect.

Differences from QB

- QuickBASIC allows variables and arrays to be declared using the `keyword` within procedures and `DEF FN` routines only.
- `static` forces local visibility of variables and arrays in QuickBASIC routines. FreeBASIC supports neither `DEF FN` routines nor this usage of `Static`.

See also

- `Static (Member)`
- `Dim, ReDim`
- `Shared`
- `Sub (Module), Function (Module)`
- `Sub (Member), Function (Member)`
- `Option Static`
- `Storage Classes`
Declare a static member procedure or variable

**Syntax**

```
Type typename
Static variablename As DataType [, ...]
Declare Static Sub|Function procedurename ...
...
End Type

Dim typename.variablename As DataType [= initializer] [, ...]

[Static] Sub|Function typename.procedurename ...
...
End Sub|Function
```

**Description**

- Static member procedures

Static methods do not have an implicit `This` instance argument passed, member procedures (for example with callback procedure pointers). All are encapsulated in the `typename` namespace, and therefore have the ability of instances of `typename`.

Static methods can be called directly anywhere in code, like normal non-static methods, however either way there is no implicit or explicit a static method.

For member procedures with a `Static` declaration, `Static` may also be used for improved code readability.

- Static member variables

Static member variables are created and initialized only once independently of instance ("instance") member variables which are created again and again for each instance, even if `Shared` was not specified in the declaration. Thus, `Static` member variables are declared in a `Type` namespace.

Each `Static` member variable declared in a `Type` must be explicitly allocated by a `Dim` statement. The declaration inside the `Type` is the prototype that is visible
definition outside the Type allocates and optionally initializes the static member variable: it can only be allocated in a single module, not variables.

A static member variable is subject to member access control except its definition. A private member variable is to be explicitly initialized outside the Type's member definition.

**Example**

```vbnet
' Example showing how the actual procedure invoked by a member can be set at runtime.
Type _Object

Enum handlertype
    ht_default
    ht_A
    ht_B
End Enum

Declare Constructor( ByVal ht As handlertype = ht_default)

Declare Sub handler()

Private:
    Declare Static Sub handler_default( ByRef obj As _Object)
    Declare Static Sub handler_A( ByRef obj As _Object)
    Declare Static Sub handler_B( ByRef obj As _Object)
    handler_func As Sub( ByRef obj As _Object )

End Type

Constructor _Object( ByVal ht As handlertype )
    Select Case ht
    Case ht_A
        handler_func = @_Object.handler_A
    Case ht_B
        handler_func = @_Object.handler_B
    End Select
```

Example showing how the actual procedure invoked by a member can be set at runtime.

Type _Object

Enum handlertype
    ht_default
    ht_A
    ht_B
End Enum

Declare Constructor( ByVal ht As handlertype = ht_default)

Declare Sub handler()

Private:
    Declare Static Sub handler_default( ByRef obj As _Object)
    Declare Static Sub handler_A( ByRef obj As _Object)
    Declare Static Sub handler_B( ByRef obj As _Object)
    handler_func As Sub( ByRef obj As _Object )

End Type

Constructor _Object( ByVal ht As handlertype )
    Select Case ht
    Case ht_A
        handler_func = @_Object.handler_A
    Case ht_B
        handler_func = @_Object.handler_B
    End Select
```
Case Else
    handler_func = @Object.handler_default
End Select
End Constructor

Sub _Object.handler()
    handler_func(This)
End Sub

Sub _Object.handler_default( ByRef obj As _Object )
    Print "Handling using default method"
End Sub

Sub _Object.handler_A( ByRef obj As _Object )
    Print "Handling using method A"
End Sub

Sub _Object.handler_B( ByRef obj As _Object )
    Print "Handling using method B"
End Sub

Dim objects(1 To 4) As _Object => {
    _Object.handlertype.ht_B, _Object.handlertype.ht_default, _Object.handlertype.ht_A
}
'' 4th array item will be _Object.handlertype.ht_default

For i As Integer = 1 To 4
    Print i,
    objects(i).handler()
Next i

'' Assign an unique ID to every instance of a Type
Type UDT
    Public:
        Declare Property getID () As Integer
        Declare Constructor ()
    Private:
        Dim As Integer ID
        Static As Integer countID
End Type
Dim As Integer UDT.countID = 0

Property UDT.getID () As Integer
    Property = This.ID
End Property

Constructor UDT ()
    This.ID = UDT.countID
    UDT.countID += 1
End Constructor

Dim As UDT uFirst
Dim As UDT uSecond
Dim As UDT uThird

Print uFirstgetID
Print uSecondgetID
Print uThirdgetID

**Differences from QB**

- New to FreeBASIC

**See also**

- Class
- Declare
- **Type**
- **Static**
Specifies a stdcall-style calling convention in a procedure declaration

**Syntax**

```plaintext
Sub name stdcall [Overload] [Alias "alias"] ( parameters )
Function name stdcall [Overload] [Alias "alias"] ( parameters )
```

**Description**

In procedure declarations, **stdcall** specifies that a procedure will use the parameters to be passed (pushed onto the stack) in the reverse order in which they are listed, that is, from right to left. The procedures need not preserve the EAX, ECX or EDX registers, and must clean up the stack (pop any parameters) before it returns.

**stdcall** is not allowed to be used with variadic procedure declarations.

**stdcall** is the default calling convention on Windows, unless another **stdcall** is also the standard (or most common) calling convention used.

**Example**

```plaintext
Declare Function Example stdcall (param1 As Integer)
Declare Function Example2 cdecl (param1 As Integer)

Function Example stdcall (param1 As Integer, param2 As Integer)
' This is an STDCALL function, the first parameter is on the stack
Print param1, param2
Return param1 Mod param2
End Function

Function Example2 cdecl (param1 As Integer, param2 As Integer)
' This is a CDECL function, the first parameter is on the stack
Print param1, param2
Return param1 Mod param2
End Function
```
Platform Differences

- On Windows systems, stdcall procedures have an "@N" decoration added to their internal/external name, in bytes.

Differences from QB

- New to FreeBASIC

See also

- pascal, cdecl
- Declare
- Sub, Function
**Step**

Statement modifier.

**Syntax**

For iterator = initial_value To end_value Step increment

Line [ buffer, ] Step ( x1, y1 ) - Step ( x2, y2 ) [, [ color ][ B|BF ][, style ] ]


Paint [ target, ] STEP ( x, y ) [, [ paint ][, [ border_color ] ] ]

**Description**

In a For statement, step specifies the increment of the loop iterator with each loop.

In a Line, Circle or Paint statement, step indicates that the following coordinate has values relative to the graphics cursor.

**Example**

```
Dim i As Integer
For I=10 To 1 Step -1
Next
```

```
Line -Step(10,10),13
```

**See also**
- For...Next
- Line
- Circle
- Paint
Stick

Reads axis position from attached gaming devices

Syntax

Declare Function Stick ( ByVal axis As Long ) As Long

Usage

result = Stick( axis )

Parameters

axis

the axis number to query for position

Return Value

Returns a number between 1 and 200 for specified axis, otherwise zero (0), if the device is not attached.

Description

Stick will retrieve the axis position for the first and second axes on the second gaming devices. axis must be a number between 0 and 3 having the following meaning:

<table>
<thead>
<tr>
<th>Axis</th>
<th>Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>X position of gaming device A</td>
</tr>
<tr>
<td>1</td>
<td>Y position of gaming device A when STICK(0) was called</td>
</tr>
<tr>
<td>2</td>
<td>X position of gaming device B when STICK(0) was called</td>
</tr>
<tr>
<td>3</td>
<td>Y position of gaming device B when STICK(0) was called</td>
</tr>
</tbody>
</table>

Stick(0) must first be called to obtain the positions for the other axes.

Example
'' Compile with -lang qb

'$lang: "qb"

Screen 12

Do
  Locate 1, 1
  Print "Joystick A-X position : "; Stick(0); 
  Print "Joystick A-Y position : "; Stick(1); 
  Print "Joystick B-X position : "; Stick(2); 
  Print "Joystick B-Y position : "; Stick(3); 
  Print
  Print "Button A1 was pressed : "; Strig(0); 
  Print "Button A1 is pressed : "; Strig(1); 
  Print "Button B1 was pressed : "; Strig(2); 
  Print "Button B1 is pressed : "; Strig(3); 
  Print "Button A2 was pressed : "; Strig(4); 
  Print "Button A2 is pressed : "; Strig(5); 
  Print "Button B2 was pressed : "; Strig(6); 
  Print "Button B2 is pressed : "; Strig(7); 
  Print
  Print "Press ESC to Quit"

  If Inkey$ = Chr$(27) Then
    Exit Do
  End If

  Sleep 1
Loop

Dialect Differences

- Only available in the -lang qb dialect.
Differences from QB

- None

See also

- GetJoystick
- Strig
Stop

Halts program execution, and waits for a key press before ending the program.

**Syntax**

```basic
Declare Sub Stop ( ByVal retval As Long = 0 )
```

**Usage**

```basic
Stop
```

**Parameters**

`retval`

Error code returned to system.

**Description**

Halts the execution of the program and stands by. It's provided as a help to debugging, as it preserves the memory and doesn't close files. For normal program termination the `End` keyword should be used. An optional return value, an integer, can be specified to return an error code to the system. If no return value is given, a value of 0 is automatically returned.

Note: STOP is not implemented properly yet; currently it is the same as `System`.

**Example**

```basic
Print "this text is shown"
Sleep
Stop
Print "this text will never be shown"
```
**Differences from QB**

- None

**See also**

- End
Str

Returns a string representation of a number, boolean or Unicode character string

Syntax

```basic
Declare Function Str ( ByVal n As Byte ) As String
Declare Function Str ( ByVal n As UByte ) As String
Declare Function Str ( ByVal n As Short ) As String
Declare Function Str ( ByVal n As UShort ) As String
Declare Function Str ( ByVal n As Long ) As String
Declare Function Str ( ByVal n As ULong ) As String
Declare Function Str ( ByVal n As LongInt ) As String
Declare Function Str ( ByVal n As ULongInt ) As String
Declare Function Str ( ByVal n As Single ) As String
Declare Function Str ( ByVal n As Double ) As String
Declare Function Str ( ByVal b As Boolean ) As String
Declare Function Str ( ByRef str As Const String ) As String
Declare Function Str ( ByVal str As Const WString ) As String
```

Usage

```basic
result = Str[$]( number )
or
result = Str( string )
```

Parameters

- `number`
  Numeric expression to convert to a string.
- `string`
  String expression to convert to a string.

Description

`str` converts numeric variables to their string representation. Used this way it is the `String` equivalent to `WStr` applied to numeric variables, and the opposite of the `val` function, which converts a string into a number.

`str` converts boolean variables to their string representation "false" / "true".
str also converts Unicode character strings to ASCII character strings. Used this way it does the opposite of wstr. If an ASCII character string is given, that string is returned unmodified.

Example

```vbnet
Dim a As Integer
Dim b As String
a = 8421
b = Str(a)
Print a, b
```

Dialect Differences

- In the -lang qb dialect, str will left pad a positive number with a space.
- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lang fb dialects.

Platform Differences

- DOS version/target of FreeBASIC does not support the wide-character string version of str.

Differences from QB

- QB does not support the wide-character string version of str.

See also

- Val
- Cbool
- Chr
Asc
Reads button state from attached gaming devices

**Syntax**

```plaintext
Declare Function Strig ( ByVal button As Long ) As Long
```

**Usage**

```plaintext
result = Strig( button )
```

**Parameters**

- `button`: the button to query for state

**Return Value**

Returns -1 (pressed) or 0 (not-pressed) to indicate the state of the button requested.

**Description**

`Strig` will retrieve the button state for the first and second buttons on the first and second gaming devices. `button` must be a number between 0 and 7 and has the following meaning:

<table>
<thead>
<tr>
<th>Button</th>
<th>State to return</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>First button on gaming device A pressed since STICK(0) was called</td>
</tr>
<tr>
<td>1</td>
<td>First button on gaming device A is pressed</td>
</tr>
<tr>
<td>2</td>
<td>First button on gaming device B pressed since STICK(0) was called</td>
</tr>
<tr>
<td>3</td>
<td>First button on gaming device B is pressed</td>
</tr>
<tr>
<td>4</td>
<td>Second button on gaming device A pressed since STICK(0) was called</td>
</tr>
<tr>
<td>5</td>
<td>Second button on gaming device A is pressed</td>
</tr>
<tr>
<td>6</td>
<td>Second button on gaming device B pressed since STICK(0) was called</td>
</tr>
<tr>
<td>7</td>
<td>Second button on gaming device B is pressed</td>
</tr>
</tbody>
</table>
Calling `stick(0)` will reset the state returned where `button` is equal to 6.

**Example**

```
' Compile with -lang qb
'${lang: "qb"

Screen 12

Do
    Locate 1, 1
    Print "Joystick A-X position : "; Stick(0); "
    Print "Joystick A-Y position : "; Stick(1); "
    Print "Joystick B-X position : "; Stick(2); "
    Print "Joystick B-Y position : "; Stick(3); "
    Print "Button A1 was pressed : "; Strig(0); "
    Print "Button A1 is pressed : "; Strig(1); "
    Print "Button B1 was pressed : "; Strig(2); "
    Print "Button B1 is pressed : "; Strig(3); "
    Print "Button A2 was pressed : "; Strig(4); "
    Print "Button A2 is pressed : "; Strig(5); "
    Print "Button B2 was pressed : "; Strig(6); "
    Print "Button B2 is pressed : "; Strig(7); "
    Print "Press ESC to Quit"

    If Inkey$ = Chr$(27) Then
        Exit Do
    End If

    Sleep 1
Loop
```
Dialect Differences

- Only available in the *lang qb* dialect.

Differences from QB

- None

See also

- GetJoystick
- Stick
String (Function)

Creates and fills a string of a certain length with a certain character.

Syntax

```vbnet
Declare Function String ( ByVal count As Integer, ByVal ch_code As Long ) As String
Declare Function String ( ByVal count As Integer, ByRef ch As Const String ) As String
```

Usage

```vbnet
result = String$( count, ch_code )
or
result = String$( count, ch )
```

Parameters

- `count`
  An integer specifying the length of the string to be created.
- `ch_code`
  A long specifying the ASCII character code to be used to fill the string.
- `ch`
  A string whose first character is to be used to fill the string.

Return Value

The created string. An empty string will be returned if either `ch` is an empty string, or `count` <= 0.

Description

A list of ASCII character codes.

Example

```vbnet
Print String( 4, 69 )   '' prints "EEEE"
Print String( 5, "Indeed" )  '' prints "IIIII"
End 0
```
Dialect Differences

- The string type suffix "$" is obligatory in the `-lang qb` dialect.
- The string type suffix "$" is optional in the `-lang fblite` and `-lang fb` dialects.

Differences from QB

- None

See also

- String (data type)
- Space
String

Standard data type: 8 bit character string

Syntax

Dim variable As String [ * size]

Description

A String is an array of characters.

A String declared without the size parameter is dynamically resized from 0 bytes to 2 gigabytes. A descriptor contains a pointer to the actual string, VarPtr will return a pointer to the descriptor, while StrPtr will point to the actual string.

Because of the hidden descriptor with a string, manual allocation of space (preferentially), for a string is not encouraged. The common way to ensure that unnecessary allocations inside a loop for instance, is to use the Space

Nevertheless if necessary, dynamic allocation may be carefully used by Reallocate (see precautions for use) and string pointer (which is a pointer to a string descriptor, not string data). When memory is allocated to hold string descriptors, the string must always be destroyed (setting the memory taken up by the string data), otherwise, it is not possible to deallocate it later, and it may induce memory leak in the program.

Despite the use of the descriptor, an implicit NULL character (Chr(0)) is added to the end of the string, to allow passing them to functions in external libraries without making slow copies. FreeBASIC's internal functions will ignore this character, and not treat it as part of the string.

A String declared with a fixed size is a QB-style fixed length string, what "-lang" compiler option is used. It has no descriptor and it is not resized, if data overflows the size of the string, it is truncated on the right side.

Fixed length strings are also terminated with a NULL character, and so removed in future, to prevent the redundant character complicating data layout.

String variable names need not end in a dollar sign $ as in other dialects, disallowed entirely.
Example

```
'' Variable length
Dim a As String

a = "Hello"
Print a

a += ", world!"
Print a

Var b = "Welcome to FreeBASIC"
Print b + "! " + a
```

```
'' QB-like $ suffixes
#lang "qb"

'' DIM based on $ suffix
Dim a$
a$ = "Hello"

'' Implicit declaration based on $ suffix
b$ = ",, world!"

Print a$ + b$
```

```
'' Variable-length strings as buffers

'' Reserving space for a string,
'' using Space() to produce lots of space characters
Var mybigstring = Space(1024)
Print "buffer address: &h" & Hex( StrPtr( mybigstr
Explicitly destroying a string
mybigstring = ""
Print "buffer address: &h & Hex( StrPtr( mybigstr

Variable-length string as Const parameter

Const qualifier preventing string from being modified
Sub silly_print( ByVal printme As Const String )
   Print "o0( " & printme & " =0o.""
   'next line will cause error if uncommented
   'printme = "silly printed"
End Sub

Var status = "OK"
silly_print( "Hello FreeBASIC!" )
silly_print( "Status: " + status )

Differences from QB

- In QB the strings were limited to 32767 characters.
- In QB, the unused characters of a fixed-length string were initialized
  with space (or ", in ASCII).
- In QB static or fixed-size strings were often used in records to
  represent 1 byte in a UDT read from a file. This is not possible
  in FreeBASIC since strings always have a length.

When converting QBasic code that reads UDTs from files, make
sure all instances of "uByte (0 to n - 1)" or your files will be incompatible.

See also

- String (Function)
- Space
- ZString
- WString
- Str
- StrPtr
- VarPtr
Operator Strptr (String Pointer)

Returns the address of a string's character data.

**Syntax**

```basic
Declare Operator StrPtr ( ByRef lhs As String ) As ZString Ptr
Declare Operator StrPtr ( ByRef lhs As WString ) As ZString Ptr
```

**Usage**

```basic
result = StrPtr ( lhs )
```

**Parameters**

*lhs*

A string.

**Return Value**

Returns a `ZString Ptr` to a string's character data.

**Description**

This operator returns a `ZString Ptr` that points to the beginning of a string. `Strptr` is the proper method for acquiring the address of a string's character data.

Note that when passed a `WString`, `Operator Strptr` still returns a `ZString` for the desired result.

The related `Operator Varptr (Variable Pointer)` and `Operator @ (Address Of)` return the address of the internal string descriptor.

**Example**

```vbnet
'' This example uses Strptr to demonstrate using pointers
Dim myString As String
Dim toMyStringDesc As Any Ptr
Dim toMyString As ZString Ptr
```
Note that using standard VARPTR notation will return a descriptor, not the string data itself:

```freebasic
myString = "Improper method for Strings"
toMyStringDesc = @myString
Print myString
Print Hex( toMyStringDesc )
Print

However, using Strptr returns the proper pointer:

```freebasic
myString = "Hello World Examples Are Silly"
toMyString = StrPtr(myString)
Print *toMyString
Print
```

And the pointer acts like pointers to other types:

```freebasic
myString = "MyString has now changed"
Print *toMyString
Print
```

**Differences from QB**

- New to FreeBASIC, but does exactly the same thing as SAdd

**See also**

- SAdd
- VarPtr
- ProcPtr
- Pointers
**Sub**

Defines a procedure

**Syntax**

```
[Public|Private] Sub identifier [cdecl|pascal|stdcall] [Overload [( [parameter_list] )]] [Static] [Export]
statements
...[Return]
End Sub

[Public] Sub identifier [cdecl|pascal|stdcall] [Overload] [Alias [Constructor|Destructor] [Static]
statements
...[Return]
...End Sub
```

**Parameters**

- **identifier**: the name of the subroutine
- **external_identifier**: externally visible (to the linker) name enclosed in quotes
- **parameter_list**: parameter[, parameter[, ...]]
- **parameter**: [ByRef|ByVal] identifier [As type] [= default_value]
- **identifier**: the name of the variable referenced in the subroutine
- **type**: the type of variable
- **default_value**: the value of the argument if none is specified in the call
- **statements**: one or more statements that make up the subroutine body

**Description**

A subroutine is a block of code which may be called at any time from anywhere in a program, to be executed multiple times, and subroutines provide an invaluable means to replace these blocks of code with a single subroutine call. A subroutine also allows a user to extend the FreeBASIC language to provide custom commands. Many of the built-in functions of FreeBASIC are merely subroutines part of a "runtime library" linked to the program at runtime.

The **Sub** keyword marks the beginning of a subroutine, and its end is marked by the **End Sub** statement.
parameter is the name by which this subroutine is called. For instance, "Sub ", the user can execute the code in between "Sub foo" and "End Sub". This code is executed separate from the code which calls the subroutine unless they are shared, are not available to the subroutine. Values can be passed using parameters.

Parameters are the arguments passed to any statement. For instance, as "Print 4", the value "4" is passed to the function "Print". Parameters to the subroutine are supplied by one or more parameter arguments in the "Sub...End Sub", allows the code in between to refer to the first passed argument as "foo" and the second passed argument as "bar". If a given default argument as "foo" and the second passed argument as "bar" is given a default value, that parameter is optional.

In the default dialect -lang fb, parameters must also have a supplied type". Type suffixes are not allowed.

In the -lang qb and -lang fblite dialects only, it will be given a default type if not given either by name or by type suffix. The default type is Single in the -lang fblite dialect.

A subroutine can also specify how parameters are passed, either as "ByRef" syntax definition. If a parameter is "ByRef", the parameter name literally becomes a reference to the original variable passed to the subroutine. Any changes made to that variable are reflected outside of the subroutine. If a parameter is passed "ByVal", however, the value is copied into a new variable, and any changes made to it will not affect the original variable. (Currently apply to Strings, and "ByVal" should be avoided with them for a variety of reasons.)

The Static specifier indicates that the values of all local variables defined should be preserved between calls. To specify individual local variables as static.

Sub is the same as Function, except it does not allow a value to be returned.

The second syntax defines either a constructor or destructor using the keywords, respectively. Constructor subroutines are executed before the first line of code in the module, while destructors execute on module exit. Note the public access parameter list for both constructors and destructors.

Example
Example of writing colored text using a sub:

```vbnet
Sub PrintColoredText( ByVal colour As Integer, ByVal Color colour, Print text
End Sub

PrintColoredText( 1, "blue" ) ' a few colors
PrintColoredText( 2, "green" )
PrintColoredText( 4, "red" )
Print

Dim i As Integer
For i = 0 To 15 ' all 16 colors
    PrintColoredText( i, ("color " & i) )
Next i
```

The following demonstrates optional parameters.

```vbnet
Sub TestSub(P As String = "Default")
    Print P
End Sub

TestSub "Testing:"
TestSub
```

Dialect Differences

- The -lang qb and -lang fblite dialects keep the QB convention default.
- In the -lang fb dialect, numeric parameters are passed ByVal by default.

Differences from QB
- Public and Private access specifiers are new to FreeBASIC.
- Constructor subroutines are new to FreeBASIC.

**See also**

- Declare
- Function
- Exit
- Public
- Private
- Static
Sub (Member)

Declares or defines a member procedure.

Syntax

\[
\{ \text{Type} \mid \text{Class} \mid \text{Union} \} \ \text{typename} \\
\text{Declare} \ [ \text{Static} \mid \text{Const} ] \ \text{Sub} \ \text{fieldname} \ [\text{calling convention specifier}] \ [ \text{Alias} \ \text{external\_name} ] \ ( \ [ \text{parameters} \ ] \ ) \ [ \text{Static} ] \\
\text{End} \ \{ \text{Type} \mid \text{Class} \mid \text{Union} \} \\
\text{Sub} \ \text{typename}.\text{fieldname} \ ( \ [ \text{parameters} \ ] \ ) \ [ \text{Export} \ ] \\
\text{statements} \\
\text{End} \ \text{Sub}
\]

Parameters

\text{typename} \\
name of the \text{Type, Class, or Union} \\
\text{fieldname} \\
name of the procedure \\
\text{external\_name} \\
name of field as seen when externally linked \\
\text{parameters} \\
the parameters to be passed to the procedure \\
\text{calling convention specifier} \\
can be one of: cdecl, stdcall or pascal

Description

\text{Sub} members are accessed with \text{Operator . (Member Access)} or \text{Operator -> (Pointer To Member Access)} to call a member procedure and may optionally accept parameters either \text{ByVal} or \text{ByRef}. \text{typename} be overloaded without explicit use of the \text{Overload} keyword.

\text{typename} is the name of the type for which the \text{Sub} method is declared and defined. Name resolution for \text{typename} follows the same rules as procedures when used in a \text{Namespace}.

A hidden \text{This} parameter having the same type as \text{typename} is passed to non-static member procedures. \text{This} is used to access the fields of
the **Type**, **Class**, or **Union**.
To access duplicated symbols defined outside the Type, use:
..SomeSymbol (or ..SomeSymbol if inside a **With..End With** block).

A **Static** (Member) may be declared using the **static** specifier. A **Const** (Member) may be declared using the **const** specifier.

**Example**

```vbnet
Type Statistics
    count As Single
    sum As Single
    Declare Sub AddValue( ByVal x As Single )
    Declare Sub ShowResults( )
End Type

Sub Statistics.AddValue( ByVal x As Single )
    count += 1
    sum += x
End Sub

Sub Statistics.ShowResults( )
    Print "Number of Values = "; count
    Print "Average = ";
    If( count > 0 ) Then
        Print sum / count
    Else
        Print "N/A"
    End If
End Sub

Dim stats As Statistics

stats.AddValue 17.5
stats.AddValue 20.1
stats.AddValue 22.3
stats.AddValue 16.9
```
Output:

<table>
<thead>
<tr>
<th>Number of Values</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>19.2</td>
</tr>
</tbody>
</table>

**Dialect Differences**
- Only available in the `-lang fb` dialect.

**See also**
- **Class**
- **Function (Member)**
- **Sub**
- **Type**
Swap

Exchanges the values of two variables

**Syntax**

```vba
Declare Sub Swap ( ByRef a As Any, ByRef b As Any )
```

**Parameters**

- `a`
  A variable to swap.
- `b`
  A variable to swap.

**Description**

Swaps the value of two variables.

**Example**

```vbnet
' using swap to order 2 numbers:
Dim a As Integer, b As Integer

Input "input a number: "; a
Input "input another number: "; b
If a > b Then Swap a, b
Print "the numbers, in ascending order are:"
Print a, b
```

**Differences from QB**

- None

**See also**

- Operator = (Assignment)
Closes all open files and ends the program

**Syntax**

```
Declare Sub System ( ByVal retval As Long = 0 )
```

**Usage**

```
System( [ retval ] )
```

**Parameters**

`retval`

Error code returned to system.

**Description**

Closes all open files, exits the program, and returns to the operating system. An optional return value, an integer, can be specified to return an error code to the system. If no return value is given, a value of 0 is automatically returned. This is the same as `End` and is here for compatibility between older BASIC dialects. It is recommended to use `End` instead.

Usage of this statement does not cleanly close scope. Local variables will not have their destructors called automatically, because FreeBASIC does not do stack unwinding. Only the destructors of global variables will be called in this case.

For this reason, it is discouraged to use `System` simply to mark the end of a program; the program will come to an end automatically, and in a cleaner fashion, when the last line of module-level code has executed.

**Example**

```
Print "this text is shown"
System
```
Differences from QB

- None

See also

- End
Tab

Sets the column when writing to screen or file

**Syntax**

`Tab( col_num )`

**Usage**

`Print Tab( column ) [,( | ;)] ...`

**Parameters**

`column`

1-based column number to move to

**Description**

`Tab` will move the cursor to given `column` number when `Print`ing to screen or to a file. Character cells skipped over between the old and new cursor positions are left unchanged. If the current column is greater than `column`, then `Tab` will move the cursor to the requested column number on the next line. If the current column is equal to `column`, then the cursor will not move anywhere.

**Example**

```
'' Using Print with Tab to justify text in a table

Dim As String A1, B1, A2, B2

A1 = "Jane"
B1 = "Doe"
A2 = "Bob"
B2 = "Smith"

Print "FIRST NAME"; Tab(35); "LAST NAME"
Print "----------"; Tab(35); "----------"
```
The output would look like:

<table>
<thead>
<tr>
<th>FIRST NAME</th>
<th>LAST NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>Doe</td>
</tr>
<tr>
<td>Bob</td>
<td>Smith</td>
</tr>
</tbody>
</table>

**Differences from QB**

- In QBASIC, spaces were printed in the gap, while in FreeBASIC characters are just skipped over and left untouched.

**See also**

- Spc
- Locate
- Pos
- (Print | ?)
Returns the tangent of an angle

Syntax

Declare Function Tan ( ByVal angle As Double ) As Double

Usage

result = Tan( angle )

Parameters

angle

the angle (in radians)

Return Value

Returns the tangent of the argument angle as a Double within the range of -infinity to infinity.

Description

The argument angle is measured in radians (not degrees).

The value returned by this function is undefined for values of angle with an absolute value of $2^{63}$ or greater.

Example

```
Const PI As Double = 3.1415926535897932
Dim a As Double
Dim r As Double
Input "Please enter an angle in degrees: ", a
r = a * PI / 180 'Convert the degrees to Radian
Print """The tangent of a" ; a; " degree angle is"
Sleep
```
The output would look like:

<table>
<thead>
<tr>
<th>Please enter an angle in degrees: 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>The tangent of a 75 degree angle is 3.732050807568878</td>
</tr>
</tbody>
</table>

Differences from QB
- None

See also
- Atn
- Atan2
- Sin
- Cos
- A Brief Introduction To Trigonometry
Control flow statement for conditional branching.

**Syntax**

If expression Then statement(s) [Else statement(s)]

or

If expression Then : statement(s) [Else statement(s) ] : End If

or

If expression Then
statement(s)
[ ElseIf expression Then ]
statement(s)
[ Else ]
statement(s)
End If

**Differences from QB**

- None

**See also**

- *If...Then*
Hidden instance parameter passed to non-static member functions in a
**Type** or **Class**

### Syntax

```
This.fieldname
or
With This
    .fieldname
End With
```

### Description

*This* is a reference to an instance of a **Type** or **Class** that is passed as
hidden argument to all non-static member functions of that type or
class. Non-static member functions are procedures declared inside th
body of a **Type** or **Class** and include **Sub**, **Function**, **Constructor**,
**Destructor**, assignment or cast **Operator**, and **Property** procedures.

The *This* additional parameter has the same data type as the **Type** or
**Class** in which the procedure is declared.

The *This* parameter can be used just like any other variable, ie., pass
to procedures taking an object of the same type, call other member
procedures and access member data using **Operator** . (**Member
Access**), etc.

Most of the time, using *This* explicitly for member access is
unnecessary; member procedures can refer to other members of the
instance which they are passed directly by name, without having to
qualify it with *This* and **Operator** . (**Member Access**). The only times
when you need to qualify member names with *This* is when the
member name is hidden, for example, by a local variable or paramete
In these situations, qualifying the member name is the only way to
refer to these hidden member names.

### Example
Type sometype
    Declare Sub MyCall()
    value As Integer
End Type

Dim example As sometype

' Set element test to 0
example.value = 0
Print example.value

example.MyCall()

' Output should now be 10
Print example.value

End 0

Sub sometype.MyCall()
    This.value = 10
End Sub

**Differences from QB**

- New to FreeBASIC

**See also**

- Base
- Class
- Type
**Threadcall**

Starts a user-defined procedure with parameters in a separate execution thread.

*Threadcall* uses *LibFFI* internally: people who write programs using this function should be careful to follow LibFFI’s license, which can be found at [http://github.com/atgreen/libffi/blob/master/LICENSE](http://github.com/atgreen/libffi/blob/master/LICENSE).

**Syntax**

```plaintext
Function Threadcall subname([paramlist]) As Any Ptr
```

**Usage**

```plaintext
threadid = Threadcall subname([paramlist])
```

**Parameters**

- `subname`
  The name of a subroutine
- `paramlist`
  A list of parameters to pass to the subroutine, as with a normal sub call.

**Return Value**

- *Threadcall* returns an *Any Ptr* handle to the thread created, or the null pointer.

**Description**

Like *ThreadCreate*, *Threadcall* creates a thread which runs at the same time as the code calling it. By placing "*Threadcall*" before almost any normal call to sub rutine inside of a new thread and returns a pointer to that thread.

Using *Threadcall* is a simpler method of creating threads, and allows data to be shared between threads without global variables or pointers which are not type safe. However, it is more efficient and should be used for programs creating a large number of threads.

While most subroutines are supported, the following types of subroutines may not be called:

- Subroutines using *Variable Arguments*
- Subroutines with unions which are passed *ByVal*
Subroutines with user types containing unions, arrays, strings, or bitfields which are passed ByVal.

When using **Threadcall**, parenthesis around the parameter list are required unless the subroutine has no parameters.

**WARNING:** Presently when **Threadcall** involves to pass parameters to the thread, there is no guarantee that the corresponding data are still maintained after the end statement and this until the thread is launched. That can cause bad behavior.

**Example**

```qbasic
'' Threading using "ThreadCall"

Sub thread( id As String, tlock As Any Ptr, count
   For i As Integer = 1 To count
      MutexLock tlock
      Print "thread " & id;
      Locate , 20
      Print i & "/" & count
      MutexUnlock tlock
   Next
End Sub

Dim tlock As Any Ptr = MutexCreate()
Dim a As Any Ptr = ThreadCall thread("A", tlock, 6
Dim b As Any Ptr = ThreadCall thread("B", tlock, 4
ThreadWait a
ThreadWait b
MutexDestroy tlock
Print "All done (and without Dim Shared!)"
```

**Dialect Differences**

- Threading is not allowed in the `-lang qb` dialect.
Platform Differences

- **Threadcall** is not available with the DOS version / target of FreeBASIC. Multithreading is not supported by DOS kernel nor the used extension.
- In Linux, the threads are always started in the order they are created. This cannot be assumed in Win32. It's an OS, not a FreeBASIC issue.
- In Linux, the `stdcall` and `pascal` calling conventions are not supported.
- In Windows, the `pascal` calling convention is not supported.

Differences from QB

- New to FreeBASIC

See also

- `ThreadCreate`
- `ThreadWait`
- `MutexCreate`
- `MutexLock`
- `MutexUnlock`
- `MutexDestroy`
**ThreadCreate**

Starts a user-defined procedure in a separate execution thread

**Syntax**

```vbnet
Declare Function ThreadCreate _
( ByVal procptr As Sub ( ByVal userdata As Any Ptr ), ByVal param As Any Ptr = 0, ByVal stack_size As Integer = 0 ) _
) As Any Ptr
```

**Usage**

```vbnet
result = ThreadCreate ( procptr [, [ param ] [, stack_size ] ] )
```

**Parameters**

- **procptr**
  A pointer to the **Sub** intended to work as a thread. The sub must have the same calling convention to be compatible to **procptr**:
  ```vbnet
  Declare Sub myThread ( ByVal userdata As Any Ptr )
  ``

- **userdata**
  The Any Ptr parameter of the **Sub** intended to work as a thread. FreeB must not be omitted!

- **param**
  Any Ptr argument that will be passed to the thread **Sub** pointed to by **procptr**.
  For example, this can be a pointer to a structure or an array containing variables with. If **param** is not given, 0 (zero) will be passed to the thread sub's **userdata**

- **stack_size**
  Optional number of bytes to reserve for this thread's stack.

**Return Value**

**ThreadCreate** returns an Any Ptr handle to the thread created, or a null pointer.

**Description**

The sub pointed to by **procptr** is started as a thread. It will be passed the specified, in its **userdata** parameter.
The sub that was started as a thread will execute in parallel with the main part of the program. The OS achieves this by assigning it to a different processor if it exists, or by alternating between execution threads on a single processor. There is no guarantee about the order in which different threads execute, or the order in which multiple create threads actually start executing.

Before closing, programs should wait for the termination of all launched threads. It's not necessary to safely wait for a thread to finish execution. The function `ThreadWait` is used to wait for a thread to finish its execution. When `ThreadWait` exits while some threads are still active, those threads will be aborted. Programs should call either `ThreadWait` or `Threaddetach` to ensure that thread handles are released. Otherwise, there may be memory or system resource leaks.

Due to the nature of threads, no assumptions about execution order can be made between multiple threads, including a thread and the main part of the program. Mutexes must be used for exclusion locks. These mutual exclusion locks can be "owned" by a single thread while doing critical work, causing other threads to wait for their turn. See `MutexCreate`, `MutexLock`, `MutexUnlock`, `MutexDestroy`.

`stack_size` can be used to change the thread's stack size from the system's default. This can be useful when the program requires a big stack, for example due to lots of procedure recursion or when allocating huge strings/arrays on the stack. On some systems (Linux), the stack automatically grows beyond the reserved size; on others (Win32), this is the fixed maximum allowed. Behavior is undefined when more stack is used than the reserved size on systems where stacks are not able to grow.

**Example**

```vba
dim ttylock as any ptr
Const MAX_THREADS = 10

sub teletype(ByRef text as string, ByVal x as integer)
		
		" This MutexLock makes simultaneously running other, so only one at a time can continue a"
'Otherwise, their Locates would interfere, since there is only one cursor.'

'It's impossible to predict the order in which threads will arrive and which one will be the first to acquire the lock, causing the rest to wait.'

MutexLock ttylock

For i As Integer = 0 To (Len(text) - 1)
    Locate x, y + i
    Print Chr(text[i])
    Sleep 25
Next

MutexUnlock ttylock
End Sub

Sub thread(ByVal userdata As Any Ptr)
    Dim As Integer id = CInt(userdata)
teletype "Thread (" & id & ").........", 1 + i
End Sub

'This is the main thread. Now wait until all child threads have finished.'

For i As Integer = 0 To MAX_THREADS-1
If handles(i) <> 0 Then
    ThreadWait(handles(i))
End If
Next

' ' Clean up when finished
MutexDestroy(ttylock)

Sub print_dots(ByRef char As String)
    For i As Integer = 0 To 29
        Print char;
        Sleep CInt(Rnd() * 100), 1
    Next
End Sub

Sub mythread(param As Any Ptr)
    ' ' Work (other thread)
    print_dots("*")
End Sub

Randomize(Timer())

Print " main thread: ."
Print " other thread: *"

' ' Launch another thread
Dim As Any Ptr thread = ThreadCreate(@mythread)

' ' Work (main thread)
print_dots(".")

' ' Wait until other thread has finished, if needed
ThreadWait(thread)
Print
Sleep
'' Threaded consumer/producer example using mutexes

Dim Shared As Any Ptr produced, consumed

Sub consumer( ByVal param As Any Ptr )
    For i As Integer = 0 To 9
        MutexLock produced
        Print ", consumer gets:", i
        Sleep 500
        MutexUnlock consumed
    Next i
End Sub

Sub producer( ByVal param As Any Ptr )
    For i As Integer = 0 To 9
        Print "Producer puts:", i;
        Sleep 500
        MutexUnlock produced
        MutexLock consumed
    Next i
End Sub

Dim As Any Ptr consumer_id, producer_id

produced = MutexCreate
consumed = MutexCreate
If( ( produced = 0 ) Or ( consumed = 0 ) ) Then
    Print "Error creating mutexes! Exiting..."
End If

MutexLock produced
MutexLock consumed
consumer_id = ThreadCreate(@consumer)
producer_id = ThreadCreate(@producer)
If( ( producer_id = 0 ) Or ( consumer_id = 0 ) )
Print "Error creating threads! Exiting..."
End 1
End If

ThreadWait consumer_id
ThreadWait producer_id

MutexDestroy consumed
MutexDestroy produced

Sleep

**Dialect Differences**
- Threading is not allowed in the `-lang qb` dialect.

**Platform Differences**
- **Threadcreate** is not available with the DOS version / target of supported by DOS kernel nor the used extender.
- In Linux the threads are always started in the order they are created, this can't be assumed in Win32. It's an OS, not a FreeBASIC issue.

**Differences from QB**
- New to FreeBASIC

**See also**
- ThreadWait
- Threaddetach
- MutexCreate
- MutexLock
- MutexUnlock
- MutexDestroy
ThreadDetach

Releases a thread handle without waiting for the thread to finish

**Syntax**

```basic
Declare Sub ThreadDetach ( ByVal id As Any Ptr )
```

**Usage**

```basic
#include "fbthread.bi"
ThreadDetach( id )
```

**Parameters**

- `id`  
  Any Pointer handle of a thread created by [ThreadCreate](#) or [Threadcall](#)

**Description**

ThreadDetach releases resources associated with a thread handle returned by [ThreadCreate](#) or [Threadcall](#). The thread handle will be destroyed by ThreadDetach and cannot be used anymore. Unlike [ThreadWait](#), ThreadDetach does not wait for the thread to finish and thread execution continues independently. Any allocated resources will be freed once the thread exits.

**Example**

```basic
#include "fbthread.bi"

Sub mythread( ByVal param As Any Ptr )
    Print "hi!"
End Sub

Var thread = ThreadCreate( @mythread )
threaddetach( thread )

threaddetach( ThreadCreate( @mythread ) )
```
Sleep

**Dialect Differences**

- Threading is not allowed in the `-lang qb` dialect.

**Platform Differences**

- **ThreadDetach** is not available with the DOS version of FreeBASIC, because multithreading is not supported by DOS kernel nor the used extender.

**Differences from QB**

- New to FreeBASIC

**See also**

- ThreadWait
- ThreadCreate
ThreadWait

Waits for a thread to finish execution and releases the thread handle

Syntax

Declare Sub ThreadWait ( ByVal id As Any Ptr )

Usage

ThreadWait( id )

Parameters

id

Any_Ptr handle of a thread created by ThreadCreate or Threadcall

Description

ThreadWait waits for a thread created by ThreadCreate or Threadcall to finish execution, and then releases the resources associated with the thread handle. ThreadWait does not return until the thread designated by id ends.

In order to release a thread handle without waiting for the thread to finish, use Threaddetach.

ThreadWait does not force the thread to end; if a thread requires a signal to force its end, a mechanism such as shared variables and mutexes must be used.

Example

See the ThreadCreate examples.

Dialect Differences

- Threading is not allowed in the -lang qb dialect.
Platform Differences

- **ThreadWait** is not available with the DOS version of FreeBASIC, because multithreading is not supported by DOS kernel nor the used extender.

Differences from QB

- New to FreeBASIC

See also

- ThreadCreate
- Threaddetach
**Time**

Returns the current system time as a string

**Syntax**

```plaintext
Declare Function Time ( ) As String
```

**Usage**

```plaintext
result = Time
```

**Return Value**

Returns the current system.

**Description**

Returns the current system time in the format `hh:mm:ss`.

**Example**

```plaintext
Print "the current time is: "; Time
```

**Differences from QB**

- The QB TIME statement (to set the system time) is now called `SetTime`.

**See also**

- `Date`
- `Timer`
TimeSerial

Gets a Date Serial for the specified hours, minutes, and seconds

Syntax

Declare Function TimeSerial ( ByVal hour As Long, ByVal minute As Long ) As Double

Usage

#include "vbcompat.bi"
result = TimeSerial( hours, minutes, seconds )

Parameters

hour
number of hours, in the range 0-23
minute
number of minutes
second
number of seconds

Return Value

Returns a date serial containing the time formed by the values in the parameters. The date serial returned has no integer part.

Description

hours must be specified in the range 0-23

The compiler will not recognize this function unless vbcompat.bi or dat

Example

#include "vbcompat.bi"
Dim ds As Double = DateSerial(2005, 11, 28) + Time
**Print Format (ds, "yyyy/mm/dd hh:mm:ss")**

**Differences from QB**
- Did not exist in QB. This function appeared in PDS and VBDO!

**See also**
- Date Serials
- DateSerial
- TimeValue
- DateValue
TimeValue

Gets a Date Serial from a time string

Syntax

Declare Function TimeValue ( ByRef timestring As String ) As Double

Usage

#include "vbcompat.bi"
result = TimeValue( timestring )

Parameters

timestring
the string to convert

Return Value

Returns a Date Serial from a time string.

Description

The time string must be in the format "23:59:59" or "11:59:59PM"

The compiler will not recognize this function unless vbcompat.bi or datetime.bi is included.

Example

#include "vbcompat.bi"

Dim ds As Double = TimeValue("07:12:28AM")
Print Format(ds, "hh:mm:ss")
Differences from QB

- Did not exist in QB. This function appeared in PDS and VBDO!

See also

- Date Serials
- DateSerial
- TimeValue
- DateValue
Timer

Returns the amount of time that has passed since a static reference point.

Syntax

```
Declare Function Timer ( ) As Double
```

Usage

```
result = Timer
```

Return Value

Returns a Double precision result with the time, in seconds, since a static reference point.

Description

The Timer function is useful for finding out how long a section of code takes to run, or for control the timing of your code. To find out how much time has passed between two points in your program, you can record the value of Timer at the start and end points, and then subtract the start value from the end value.

On some platforms, the value of Timer resets to zero at midnight (see below) so if the start and end time are on either side of the reset point, the difference will be negative. This could cause unexpected behavior in some programs. In those cases, adding 86400 (the number of seconds in 24 hours) to the difference should return the correct result. If the time taken is longer than a day, then it will be also be necessary to check the number of days that elapsed.

The value returned by Timer is NOT affected by the automatic changing of the system clock, in Spring and Autumn, for DST (Daylight Savings Time).

Example
Example of using TIMER function

Note: see text about correct waiting strategies

```
Dim Start As Double
Print "Wait 2.5 seconds."
Start = Timer
Do
    Sleep 1, 1
Loop Until (Timer - Start) > 2.5
Print "Done."
```

**Platform Differences**

- On Win32 and Linux, if the program must wait for periods of 0.1 seconds or more, `Sleep` should be used, this allows other programs to run during the waiting period. For shorter delays, a loop using `Timer` can be more precise.

- The reference point chosen varies, depending on the platform. Windows, the time is measured relative to the point the computer was booted up. On DOS, the time is measured relative to Jan 1 1970.

*Note for DOS users: today, the number of seconds since 1970 is in excess of $10^{10}$, and is therefore unsuitable for storing in single-precision variables. It shouldn't be multiplied (to get 1/10 seconds or so) and stored in 32-bit integer variables then*

- The precision of TIMER varies, depending on the computer used. If the processor has a precision timer (as the Performance Counters on Pentium processors from Intel have) and the OS uses it, the precision is linked to the processor clock and microseconds can be expected. With older processors (386, 486), and always in DOS, the resolution is 1/18 second.

- Usage of TIMER can cause disk accesses in DOS, see forum analysis and solutions
Differences from QB

- In QB, TIMER returned the number of seconds from last midnight, its accuracy was 1/18 secs

See also

- Time
- Sleep
To

Statement modifier to specify a range.

Syntax

For iterator intial_value To ending_value
statement(s).
Next [ iterator ]
or
Select Case case_comparison_value
Case lower_bound To upper_bound
statement(s).
End Select
or
Dim variable_identifier( lower_bound To upper_bound ) As type

Description

The To keyword is used to define a certain numerical range. This keyv
In the first syntax, the To keyword defines the initial and ending values
In the second syntax, the To keyword defines lower and upper bounds
In the third syntax, the To keyword defines the array bounds in a Dim s
For more information, see For...Next, Dim and Select Case.

Example

'' this program uses bound variables along with the temperatures inside the array, and to determine
Randomize Timer

'' define minimum and maximum number of temperature
Const minimum_temp_count As Integer = 1
Const maximum_temp_count As Integer = 10

'' define the range of temperatures zones in which
Const min_low_danger As Integer = 40
Const max_low_danger As Integer = 69
Const min_medium_danger As Integer = 70
Const max_medium_danger As Integer = 99
Const min_high_danger As Integer = 100
Const max_high_danger As Integer = 130

' Define array to hold temperatures using our min/max temp count bounds
Dim As Integer array( minimum_temp_count To maximum_temp_count )

' Declare a for loop that iterates from minimum to maximum
Dim As Integer it
For it = minimum_temp_count To maximum_temp_count

    array( it ) = Int( Rnd( 1 ) * 200 ) + 1

    ' Display a message based on temperature using our min/max danger zone bounds
    Select Case array( it )
        Case min_low_danger To max_low_danger
            Color 11
            Print "Temperature" ; it ; " is in the low danger zone at"
        Case min_medium_danger To max_medium_danger
            Color 14
            Print "Temperature" ; it ; " is in the medium danger zone at"
        Case min_high_danger To max_high_danger
            Color 12
            Print "Temperature" ; it ; " is in the high danger zone at"
        Case Else
            Color 3
            Print "Temperature" ; it ; " is safe at"
    End Select

Next it

Sleep
Differences from QB

- none

See also

- For...Next
- Dim
- Select Case
**Trans**

Parameter to the `Put` graphics statement which selects transparent background as the blitting method.

**Syntax**

```
Put [ target, ] [ STEP ] ( x,y ), source [ , ( x1,y1 )-( x2,y2 )]
```

**Parameters**

- `Trans`
- Required.

**Description**

`Trans` selects transparent background as the method for blitting an image.
For 8-bit color images, the mask color is palette index 0. For 16/32-bit images, the mask color in 32-bit images.

Note: for 32-bit images, the alpha value of pixels may be changed to 0. Example below.

**Example**

```
' set up a screen: 320 * 200, 16 bits per pixel
ScreenRes 320, 200, 16

' set up an image with the mask color as the background
Dim img As Any Ptr = ImageCreate( 32, 32, RGB(255, 255, 0),
Circle img, (16, 16), 15, RGB(255, 255, 0),
Circle img, (10, 10), 3, RGB( 0, 0, 0),
Circle img, (23, 10), 3, RGB( 0, 0, 0),
Circle img, (16, 18), 10, RGB( 0, 0, 0), 3.14

' Put the image with PSET (gives the exact contents of the image buffer)
Draw String (110, 50 - 4), "Image put with PSET"
Put (60 - 16, 50 - 16), img, PSet

' Put the image with TRANS
```
Draw String (110, 150 - 4), "Image put with TRANS"
Put (60 - 16, 150 - 16), img, Trans

' free the image memory
ImageDestroy img

' wait for a keypress
Sleep

Function trans32 ( ByVal source_pixel As UInteger, 
    ' returns the source pixel
    ' unless it is &hff00ff (magenta), then return
    If (source_pixel And &ffffff) <> &hff00ff Then
        Return source_pixel
    Else
        Return destination_pixel
    End If
End Function

' set up a screen: 320 * 200, 16 bits per pixel
ScreenRes 320, 200, 32

' set up an image with the mask color as the back
Dim img As Any Ptr = ImageCreate( 32, 32, RGB(255, 
Circle img, (16, 16), 15, RGB(255, 255, 0), 
Circle img, (10, 10), 3, RGB( 0, 0, 0), 

Circle img, (23, 10), 3, RGB( 0, 0, 0), 3.14,
Circle img, (16, 18), 10, RGB( 0, 0, 0), 3.14,

'' Put the image with PSET (gives the exact contents)
Draw String (110, 50 - 4), "Image put with PSET"
Put (60 - 16, 50 - 16), img, PSet

'' Put the image with TRANS
Draw String (110, 100 - 4), "Image put with TRANS"
Put (60 - 16, 100 - 16), img, Trans

'' Put the image with TRANS
Draw String (110, 150 - 4), "Image put with trans3"
Put (60 - 16, 150 - 16), img, Custom, @trans32

'' free the image memory
ImageDestroy img

'' wait for a keypress
Sleep

**Differences from QB**

- New to FreeBASIC

**See also**

- Put (Graphics)
- Custom
Removes surrounding substrings or characters on the left and right side string

**Syntax**

```vba
Declare Function Trim ( ByRef str As Const String, [ Any ] ByRef trimset As Const String = " " ) As String
Declare Function Trim ( ByRef str As Const WString, [ Any ] ByRef trimset As Const WString = WStr(" ") ) As WString
```

**Usage**

```vba
result = Trim[$]( str [, [ Any ] trimset ] )
```

**Parameters**

- `str`  
The source string.
- `trimset`  
The substring to trim.

**Return Value**

Returns the trimmed string.

**Description**

This procedure trims surrounding characters from the left (beginning) right (end) of a source string. Substrings matching `trimset` will be trimmed specified, otherwise spaces (ASCII code 32) are trimmed.

If the `Any` keyword is used, any character matching a character in `trim` be trimmed.

All comparisons are case-sensitive.

**Example**
Dim s1 As String = " ... Stuck in the middle ... "
Print "'" + Trim(s1) + "'
Print "'" + Trim(s1, Any " .") + "'

Dim s2 As String = "BaaBaaaaB With You aaBBaBaa"
Print "'" + Trim(s2, "Baa") + "'
Print "'" + Trim(s2, Any "Ba") + "'

will produce the output:

'... Stuck in the middle ...
'Stuck in the middle'
'aaB With You aaB'
' With You '

**Platform Differences**

- DOS version/target of FreeBASIC does not support the wide-character version of Trim.

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the _Trim.
- The string type suffix "$" is optional in the -lang fblite and -lan dialects.

**Differences from QB**

- New to FreeBASIC

**See also**

- LTrim
- RTrim
True

Intrinsic constant set by the compiler

**Syntax**

```
Const True As Boolean
```

**Description**

Gives the True `Boolean` value where used.

**Example**

```vbnet
Dim b As Boolean = True
If b Then
    Print "b is True"
Else
    Print "b is False"
End If
```

```
b is True
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__True`.

**Differences from QB**

- New to FreeBASIC

**See also**
- False
- Boolean
**Type (Alias)**

Declares an alternative name for a type

**Syntax**

```plaintext
Type typename As symbol
```

**Parameters**

- `typename`
- `new alternative name`
- `symbol`
- `symbol or data type declaration to associate with typename`

**Description**

`symbol` may refer to any declared data type including a built-in data type, `Sub` or `Function` pointer, `Type` declaration, `Union` declaration, or `Enum` declaration.

A type alias can be used to allow forward declarations of parameters in procedure declarations, but only used with pointers or parameters passed by reference (excluding arrays).

A type alias can also be used to allow forward declarations of data fields in User Defined Types, but only used with pointers.

**Example**

```plaintext
Type ParentFwd As Parent
Type Child
    Name As ZString * 32
ParentRef As ParentFwd Ptr
''...
End Type

Type Parent
    Name As ZString * 32
```
ChildList(0 To 9) As Child

End Type

Dim p As Parent
p.Name = "Foo"
With p.ChildList(0)
  .Name = "Jr."
  .ParentRef = @p
End With

With p.ChildList(0)
  Print .Name; " is child of "; .parentRef.
End With

Differences from QB
  ▪ New to FreeBASIC

See also
  ▪ Type...End Type
  ▪ Type (Temporary)
Temporary Types

Creates a temporary copy of a user defined type

**Syntax**

```
result = Type( initializers, ... )
or
result = Type<typename>( initializers, ... )
```

**Parameters**

- `initializers`
  - Initial values for the type
- `typename`
  - The name of the Type or Union

**Return Value**

A temporary copy of the type.

**Description**

Used to create a temporary type. If `typename` is not explicitly given, it will be inferred from its usage if possible.

Usage of the temporary copy may include assigning it to a variable, passing it as a parameter to a procedure, or returning it as a value from a procedure.

For a type without constructor, the temporary type syntax is allowed if all type data-fields are numeric primitives only and without any default initializers, but the compiler does not create a temporary copy if at the same time the type is without destructor.

The **Constructor** for the type, if there is one, will be called when the temporary type expression is created, and the **Destructor** for the type, if there is one, will be called immediately after the temporary type expression is used.

It can create not only a temporary copy of an user defined type, but also a temporary copy of predefined data-type as a variable-length string or any numeric data-type (all standard strings).

It can also be used as an even shorter shortcut than `with` (see below).
Example

```vbnet
Type Example
    As Integer field1
    As Integer field2
End Type

Dim ex As Example

' Filling the type by setting each field
ex.field1 = 1
ex.field2 = 2

' Filling the type by setting each field using WITH
With ex
    .field1 = 1
    .field2 = 2
End With

' Fill the variable's fields with a temporary type
ex = Type( 1, 2 )

' Passing a user-defined types to a procedure using
' where the type can be inferred.

Type S
    As Single x, y
End Type

Sub test ( v As S )
    Print "S", v.x, v.y
End Sub

test( Type( 1, 2 ) )
```
Passing a user-defined type to a procedure using temporary types where the type is ambiguous and the name of the type must be specified.

```
Type S
  As Single x, y
End Type

Type T
  As Integer x, y
End Type

Union U
  As Integer x, y
End Union

'' Overloaded procedure test()
Sub test Overload ( v As S )
  Print "S", v.x, v.y
End Sub

Sub test ( v As T )
  Print "T", v.x, v.y
End Sub

Sub test ( v As U )
  Print "U", v.x, v.y
End Sub

'' Won't work: ambiguous
'' test( type( 1, 2 ) )

'' Specify name of type instead
test( Type<S>( 1, 2 ) )
test( Type<T>( 1, 2 ) )
test( Type<U>( 1 ) )
```
Differences from QB

- New to FreeBASIC

See also

- Type...End Type
- Type (Alias)
**Type**

Declares a user-defined type.

**Syntax**

```
Type typename
    fieldname1  As DataType
    fieldname2  As DataType
    As DataType fieldname3, fieldname4

    ... End Type
```

```
Type typename [Extends base_typename] [Field = alignment]
    [Private]|[Public]|[Protected]:

    Declare Sub|Function|Constructor|Destructor|Property|Operator ..
    Static variablename As DataType
```

```
    fieldname  As DataType  [= initializer]
    fieldname(array dimensions)  As DataType  [= initializer]
    fieldname(Any [, Any...])  As DataType
    fieldname : bits  As DataType  [= initializer]

    As DataType fieldname  [= initializer], ...
    As DataType fieldname(array dimensions)  [= initializer], ...
    As DataType fieldname(Any [, Any...])
    As DataType fieldname : bits  [= initializer], ...
```

```
Union
    fieldname  As DataType
```

```
Type
    fieldname  As DataType

    ... End Type
```

```
... End Union
```

```
... End Type
```

**Description**

**Type** is used to declare custom data types containing one or more data fields, such as integer types, floating point types, fixed-size or variable-length (dynamic) arrays, fixed-size or variable-length strings,
Types support various functionality related to object-oriented programming:

- Inheritance through the use of the `Extends` keyword
- Member procedures such as `Subs` or `Functions`, including:
  - Member procedures with special semantic meaning such as `Static`
- `Static` member variables
- Member visibility specifiers: `Public:`, `Private:`, `Protected:`

Types may also contain nested types or unions, allowing data members to be grouped as desired. Nested types/unions are not allowed to contain member procedures or static member variables (same restriction for local types/unions).

**Memory layout**
Types lay out their fields consecutively in memory, following the native alignment and padding rules (described on the care must be taken when using Types for file I/O or interacting with other programs, as the alignment and padding rules are different. The optional `Field = number` specifier can be used to change the behavior on the FreeBASIC side.

**Variable-length data**
In FreeBASIC, Type data structures must ultimately be fixed-size, such that Type. Nevertheless, Types may contain variable-length (dynamic) strings, not be embedded in the Type directly. Instead, the Type will only contain the scenes to manage the variable-length string/array data. For sizing (dynamic) array data member must be always declared by using `Any(:)` dimensions based on the number of Anys specified.

Because of that, saving such a Type into a file will write out the descriptor into Types directly, fixed-length strings/arrays must be used.

Similarly, when maintaining dynamic data manually through the use of a Type to a file, because the address stored in the pointer field will be written to file, not meaningful to a specific process only though, and cannot be shared the same way.

**Special note on fixed-length strings**
Currently, fixed-length string fields of `String * N` type have an extra null terminator at their end, for compatibility with C strings, making them incompatible with QB strings inside Types, because they actually use the field `As String * (N-1)`, though this will not work in future versions of FreeBASIC.

A `Byte` or `UByte` array with the proper size.

**Example**
This is an example of a QB-style type, not including procedure definitions:

```
Type clr
    red As UByte
    green As UByte
    blue As UByte
End Type

Dim c As clr
c.red = 255
c.green = 128
c.blue = 64
```

And this is an example of a type working as an object:

```
'' Example showing the problems with fixed length
'' Suppose we have read a GIF header from a file
''                             signature         width
Dim As ZString*(10+1) z => "GIF89a" + MKShort(10)

Print "Using fixed-length string"

Type hdr1 Field = 1
    As String*(6-1) sig /' We have to dimension the
    /' less to avoid misalignment
    As UShort wid, hei
End Type

Dim As hdr1 Ptr h1 = CPtr(hdr1 Ptr, @z)
Print h1->sig, h1->wid, h1->hei '' Prints GIF89 (misses a char!)

'' We can do comparisons only with the 5 visible characters.
If Left(h1->sig, 5) = "GIF89" Then Print "ok" Else
    '' Using a ubyte array, we need an auxiliary function
```
Function ub2str( ub() As UByte ) As String
Dim As String res = Space(UBound(ub)) - LBound(ub)
For i As Integer = LBound(ub) To UBound(ub)
    res[i - LBound(ub)] = ub(i)
Next
Function = res
End Function

Print
Print "Using an array of ubytes"

Type hdr2 Field = 1
    sig(0 To 6-1) As UByte '' Dimension 6
    As UShort wid, hei
End Type

Dim As hdr2 Ptr h2 = CPtr(hdr2 Ptr, @z)
'' Viewing and comparing is correct but a conversi

Print ub2str(h2->sig()), h2->wid, h2->hei '' Print
If ub2str(h2->sig()) = "GIF89a" Then Print "ok" Else

Platform Differences

- The default Field alignment parameter is 4 bytes for DOS and
- The default Field alignment parameter is 8 bytes for Windows and Double members).

Dialect Differences

- Object-related features such as functions declared inside Type
- In the -lang fb and -lang fblite dialects, the default Field align
- With the -lang qb dialect the fields are aligned to byte boundar
- To force byte alignment use FIELD=1.
Differences from QB

- At present, fixed-length strings have an extra, redundant character on the end, which means they take up one more byte than they do in QB. For this reason, UDTs that use them are not compatible.

See also

- Type (Alias)
- Type (Temporary)
- Union
- Enum
- TypeOf
- OffsetOf
- Field
- Extends
- With
**TypeOf**

Returns the type of a variable.

**Syntax**

```
TypeOf ( variable | datatype )
```

**Parameters**

- `variable`
  A variable of any type.
- `datatype`
  A [DataType](#).

**Description**

`TypeOf` is a compiler intrinsic that replaces itself with the type of the variable in a variable declaration (Example 1) or it can be used in the preprocessor for comparison, printing. (Example 2)

`TypeOf` also supports passing any intrinsic data type, or user-defined types. Also supported are expressions, the type is inferred from the expression (much like `If`).

If there is both a user defined type and a variable visible with the same name in the current scope, the user defined type takes precedence over the variable. To ensure that the type of the user defined type, wrap the argument to `TypeOf` with parentheses to force it to be seen as an expression. For example `TypeOf((variable))`.

**Example**

Example 1:

```
Dim As Integer foo
Dim As TypeOf(67.2) bar '' '67.2' is a literal double
Dim As TypeOf( foo + bar ) teh_double '' double +
Print SizeOf(teh_double)
```
Example 2:

```vbnet
Dim As String foo
#print TypeOf(foo)
#if TypeOf(foo) = TypeOf(Integer)
   #print "Never happened!"
#endif

#if TypeOf(foo) = TypeOf(String)
   #print "It's a String!"
#endif
```

Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the

Differences from QB

- New to FreeBASIC

See also

- `SizeOf`
- `Var`
- `Type (Alias)`
- `Type...End Type`
**UBound**

Returns the upper bound of an array's dimension

**Syntax**

```
Declare Function UBound ( array() As Any, ByVal dimension As Int
```

**Usage**

```
result = UBound( array [, dimension ] )
```

**Parameters**

- **array**
  - an array of any type
- **dimension**
  - the dimension to get upper bound of

**Return Value**

Returns the upper bound of an array's dimension.

**Description**

**UBound** returns the largest value that can be used as an index into a particular dimension of an array.

Array dimensions are numbered from one (1) to \( n \), where \( n \) is the total number of dimensions in the array. If dimension is zero (0), **UBound** returns \( n \), the number of dimensions in the array. If dimension is outside the valid range \( 1..n \), the result is -1. This can be used to detect the number of dimensions in combination with the result of **Lbound()** for such cases, whether a given dimension exists or whether the array is empty (zero dimensions). See the **LBound** page for more information.

**Example**

```
Dim array(-10 To 10, 5 To 15, 1 To 2) As Integer
```
Print UBound(array) 'returns 10
Print UBound(array, 2) 'returns 15
Print UBound(array, 3) 'returns 2

'' determining the size of an array
Dim As Short array(0 To 9)
Dim As Integer arraylen, arraysize

arraylen = UBound(array) - LBound(array) + 1
arraysize = arraylen * SizeOf( Short )

Print "Number of elements in array: ", arraylen
Print "Number of bytes used in array: ", arraysize

'' determining the size of a multi-dimensional array
Dim As Long array4D(1 To 2, 1 To 3, 1 To 4, 1 To 5)
Dim As Integer arraylen, arraysize

arraylen = (UBound(array4D, 4) - LBound(array4D, 4)
* (UBound(array4D, 3) - LBound(array4D, 3)
* (UBound(array4D, 2) - LBound(array4D, 2)
* (UBound(array4D, 1) - LBound(array4D, 1)

arraysize = arraylen * SizeOf( Long )

Print "Number of elements in array: ", arraylen
Print "Number of bytes used in array: ", arraysize

'' determining whether an array is empty
Dim array() As Integer
Print "lbound: "; LBound( array ), "ubound: "; UBound( array )

If LBound( array ) > UBound( array ) Then
    Print "array is empty"
Else
    Print "array is not empty"
End If

Sub printArrayDimensions( array() As Integer )
    Print "dimensions: " & UBound( array, 0 )
    '' For each dimension...
    For d As Integer = LBound( array, 0 ) To UBound( array, 0 )
        Print "dimension " & d & ": " & LBound( array, d ) & " To " & UBound( array, d )
    Next
End Sub

Dim array() As Integer
printArrayDimensions( array() )

Print "---"

ReDim array(10 To 11, 20 To 22)
printArrayDimensions( array() )

See also
- LBound
- Static
- Dim
- ReDim
- SizeOf
**UByte**

Standard data type: 8 bit unsigned

**Syntax**

\[ \text{Dim variable As UByte} \]

**Description**

8-bit unsigned whole-number data type. Can hold a value in the range of 0 to 255.

**Example**

```vbnet
Dim ubytevar As UByte
ubytevar = 200
Print "ubytevar= ", ubytevar
```

**Example**

```vbnet
Dim x As UByte = 0
Dim y As UByte = &HFF
Print "UByte Range = "; x; " to "; y
```

**Output:**

```
UByte Range = 0 to 255
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Ubyte`. 
Differences from QB

- New to FreeBASIC

See also

- Byte
- CUByte
UCase

Returns an upper case copy of a string

**Syntax**

```vba
Declare Function UCase ( ByRef str As Const String, ByVal mode As Long = 0 ) As String
Declare Function UCase ( ByRef str As Const WString, ByVal mode As Long = 0 ) As WString
```

**Usage**

```vba
result = UCase[$]( str [, mode ] )
```

**Parameters**

- `str`
  String to convert to uppercase.
- `mode`
  The conversion mode: 0 = current locale, 1 = ASCII only

**Return Value**

Uppercase copy of `str`.

**Description**

Returns a copy of `str` with all of the letters converted to upper case.

If `str` is empty, the null string ("") is returned.

**Example**

```vba
Print UCase("AbCdEfG")
```

will produce the output:
Platform Differences

- The wide-character string version of uCase is not supported for DOS target.

Dialect Differences

- The string type suffix "$" is obligatory in the -lang qb dialect.
- The string type suffix "$" is optional in the -lang fblite and -lan fb dialects.

Differences from QB

- QB does not support Unicode.

See also

- LCase
UInteger

Standard data type: 32-bit or 64-bit unsigned, same size as SizeOf(AnyPtr)

Syntax

```basic
Dim variable As UInteger
Dim variable As UInteger<bits>
```

Parameters

- `bits`
  A numeric constant expression indicating the size in bits of unsigned integer desired. The values allowed are 8, 16, 32 or 64.

Description

32-bit or 64-bit unsigned whole-number data type, depending on the platform.

If an explicit bit size is given, a data type is provided that can hold values from 0 up to (1ULL Shl (bits)) - 1.

Example

```basic
#if __FB_64BIT__
  Dim x As UInteger = 0
  Dim y As UInteger = &HFFFFFFFFFFFFFFFF
  Print "UInteger Range = "; x; " to "; y
#else
  Dim x As UInteger = 0
  Dim y As UInteger = &HFFFFFFFF
  Print "UInteger Range = "; x; " to "; y
#endif
```

Dialect Differences
Not available in the `-lang qb` dialect unless referenced with the alias `__Uinteger`.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Integer`
- `Unsigned`
- `CUInt`
**Ulong**

Standard data type: 32-bit unsigned integer

**Syntax**

```basic
Dim variable As Ulong
```

**Description**

32-bit unsigned whole-number data type. Can hold values from 0 to 4294967295. Corresponds to an unsigned DWORD.

**Example**

```basic
Dim x As ULong = 0
Dim y As ULong = &HFFFFFFFF
Print "ULong Range = "; x; " to "; y
```

**Output:**

```
ULong Range = 0 to 4294967295
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Ulong`.

**Differences from QB**

- New to FreeBASIC

**See also**

- Long
-UInteger
- ULongInt
Standard data type: 64 bit unsigned

**Syntax**

```
Dim variable As ULongInt
```

**Description**

A 64-bit unsigned whole-number data type. Can hold values from 0 to 18446744073709551615. Corresponds to an unsigned QWORD.

**Example**

```
Dim x As ULongInt = 0
Dim y As ULongInt = &HFFFFFFFFFFFFFFFFFFFFFull
Print "ULongInt Range = "; x; " to "; y
```

**Output:**

```
ULongInt Range = 0 to 18446744073709551615
```

**Dialect Differences**

- Not available in the -lang qb dialect unless referenced with the alias __Ulongint.

**Differences from QB**

- New to FreeBASIC

**See also**

- LongInt
- CULngInt
Union
declares a union user defined type.

Syntax

```
Union typename
  fieldname as datatype
Declare member function declaration ...
...
End Union
```

Parameters

- **typename**
  - Name of the Union
- **fieldname**
  - Name of a data field member
- **member function declaration**
  - Any of the supported member functions

Description

Unions are similar to a `Type` structure, except that the elements of a union occupy the same space in memory.

Like `Type`, `Union` can use the optional `Field = number` specifier and support inheritance through the use of the `Extends` keyword.

Unlike `Type`, `Union` can not contain variable-length strings, and more generally fields (or can not have bases) with constructors or destructors.

The size of the Union is the size of the largest data item. A data item can be an unnamed since they occupy the same space, only a single element can be used.

Unions support member functions including `Constructor`, `Destructor`, `Property` and `Sub`. All members of a union are public and access control is not supported.

Nested unnamed type or union cannot have procedure members or static data members (same restriction for local named type/union).

A `Union` can be passed as a user defined type to overloaded operator...
Example

' Example 1: bitfields.
Type unitType
    Union
        Dim attributeMask As UInteger
        Type   ' 32-bit uintegers can support up to 32
            isMilitary : 1 As UInteger
            isMerchant : 1 As UInteger
        End Type
    End Union
End Type

Dim myunit As unitType
myunit.isMilitary = 1
myunit.isMerchant = 1
Print myunit.isMilitary    ' Result: 1.
Print myunit.isMerchant    ' Result: 1.
Print myunit.attributeMask ' Result: 3.
Sleep

' Example 2.
' Define our union.
Union AUnion
    a As UByte
    b As Integer
End Union
' Define a composite type.
Type CompType
    s As String * 20
    ui As Byte 'Flag to tell us what to use in union
    Union
        au As UByte
        bu As Integer
    End Union
End Type

' Flags to let us know what to use in union.
' You can only use a single element of a union.
Const IsInteger = 1
Const IsUByte = 2

Dim MyUnion As AUnion
Dim MyComposite As CompType

' Can only set one value in union.
MyUnion.a = 128
MyComposite.s = "Type + Union"
MyComposite.ui = IsInteger ' Tells us this is an integer union.
MyComposite.bu = 1500

Print "Union: "; MyUnion.a
Print "Composite: ";
If MyComposite.ui = IsInteger Then
    Print MyComposite.bu
ElseIf MyComposite.ui = IsUByte Then
    Print MyComposite.au
Else
    Print "Unknown type."
End If

Sleep

Dialect Differences

- Object-related features as functions defined inside the Union block are supported only in the -lang fb dialect.
- Not available in the -lang qb dialect unless referenced with the alias from QB

Differences from QB

- New to FreeBASIC
See also

- Type
Unlock

Removes a previous access restriction (lock) on a file

Syntax

Unlock #filenum, record
Unlock #filenum, start To end

Parameters

* filenum
  The file number used to *Open* the file.
  *record*
  The record (*Random* files) to unlock.
  *start*
  The first byte position (*Binary* files) in a range to unlock.
  *end*
  The last byte position (*Binary* files) in a range to unlock.

Description

*Unlock* removes the temporary access restriction set by *Lock*.

It is strongly recommended to use the same arguments used in the previous *Lock*.

**Note:** This command does not always work, neither as documented nor as expected. It appears to be broken at the moment.

Example

For an example see *Lock*.

Differences from QB

- Currently, FB cannot implicitly unlock the entire file
- In *Random* mode, FB cannot unlock a range of records
See also

- Lock
- Open
- ScreenUnlock
**Unsigned**

Integer data type modifier

**Syntax**

```basic
Dim variable As Unsigned {integer-based data type}
```

**Description**

Forces an integer-based data type to be unsigned (cannot contain negative numbers, but has its maximum value doubled).

**Example**

```basic
' e.g. notice what is displayed:

Dim x As Unsigned Integer
x = -1
Print x

' output is 4294967295
```

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__unsigned`.

**Differences from QB**

- New to FreeBASIC

**See also**

- `UInteger`
Conditional clause used in `Do...Loop` statements.

**Syntax**

```plaintext
Do Until condition
or
Loop Until condition
```

**Description**

`Until` is used with the `Do...Loop` structure.

**Example**

```vbnet
Dim a As Integer

a = 1
Do
    Print "hello"
    a = a + 1
Loop Until a > 10

' This will continue to print "hello" on the screen
```

**Differences from QB**

- None

**See also**

- `Do...Loop`
**UShort**

Standard data type: 16 bit unsigned

**Syntax**

```basica
Dim variable As UShort
```

**Description**

16-bit unsigned whole-number data type. Can hold values from 0 to 65535.

**Example**

```basica
Dim x As UShort = 0
Dim y As UShort = &HFFFF
Print "UShort Range = "; x; " to "; y
```

**Output:**

```
UShort Range = 0 to 65535
```

**Dialect Differences**

- Not available in the *-lang qb* dialect unless referenced with the alias `__Ushort`.

**Differences from QB**

- New to FreeBASIC

**See also**

- Short
- CUShort
Using (Namespaces)

Brings namespace symbols into the current scope

**Syntax**

Using *identifier [, identifier [, ...]]*

**Parameters**

*identifier*: The name of the *Namespace* that you want to use.

**Description**

The `Using` command allows all symbols from a given namespace to be accessed without the namespace's name prefix. Unlike C++ but like C#, the *Namespace* keyword is not needed after `Using`, because individual symbols cannot be inherited from a namespace. Inheriting a whole namespace can save typing, but sometimes some meaning of the code can be lost, and conflicts with other symbols could be created.

**Example**

```basic
Namespace Sample
    Type T
        x As Integer
    End Type
End Namespace

' Just using the name T would not find the symbol
' because it is inside a namespace.
Dim SomeVariable As Sample.T

' Now the whole namespace has been inherited into
' the global namespace.
Using Sample

' This statement is valid now, since T exists
```
'' without the "Sample." prefix.
Dim OtherVariable As T

Differences from QB

- QB had the `using` keyword, but for other purposes. Namespaces did not exist in QB.

See also

- `(Print | ?) Using`
- `Palette Using`
- `Namespace`
va_arg

Returns the current argument from a variable argument list.

**Syntax**

```
variable = va_arg ( argument_list, datatype )
```

**Description**

The `va_arg` macro allows the use of a variable number of arguments within a function. `va_arg` returns the current argument in the list, `argument_list`, with an expected data type of `datatype`. Before `va_arg` can be used, it must be initialized with the command `va_first`. Unlike the C macro with the same name, `va_arg` does not automatically increment `argument_list` to the next argument within the list. Instead, `va_next` must be used to find the next argument.

**Example**

See the `Va_First()` examples.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__va_arg`.

**Differences from QB**

- New to FreeBASIC

**See also**

- ... (Ellipsis)
- `va_first`
- `va_next`
va_first

Returns a pointer to the first argument in a variable argument list

Syntax

\[ \text{pointer\_variable} = \text{va\_first}() \]

Description

The \text{va\_first} function provides an untyped \textbf{pointer} value that points to the first variable argument passed to a function.

Example

```basic
Function average cdecl(count As Integer, ... ) As Double
    Dim arg As Any Ptr
    Dim sum As Double = 0
    Dim i As Integer

    arg = va_first()

    For i = 1 To count
        sum += va_arg(arg, Double)
        arg = va_next(arg, Double)
    Next

    Return sum / count
End Function

Print average(4, 3.4, 5.0, 3.2, 4.1)
Print average(2, 65.2, 454.65481)
Sleep
```

The output would look like:

3.925
259.927405
Example of a simple custom printf

Sub myprintf cdecl(ByRef formatstring As String, ...
    ' Get the pointer to the first var-arg
    Dim As Any Ptr arg = va_first()

    ' For each char in format string...
    Dim As UByte Ptr p = StrPtr(formatstring)
    Dim As Integer todo = Len(formatstring)
    While (todo > 0)
        Dim As Integer char = *p
        p += 1
        todo -= 1

        ' Is it a format char?
        If (char = Asc("%")) Then
            If (todo = 0) Then
                ' % at the end
                Print ";
                Exit While
            End If
        End If

        ' The next char should tell the type
        char = *p
        p += 1
        todo -= 1

        ' Print var-arg, depending on the type
        Select Case char
            ' integer?
            Case Asc("i")
                Print Str(va_arg(arg, Integer));
                ' Note, different from C: va_next
                ' used as va_arg() won't update t
                arg = va_next(arg, Integer)
        End Select

        ' long integer? (64-bit)
Case Asc("l")
    Print Str(va_arg(arg, LongInt));
    arg = va_next(arg, LongInt)

' single or double?
' Note: because the C ABI, all single
' var-args are converted to doubles.
Case Asc( "f" ), Asc( "d" )
    Print Str(va_arg(arg, Double));
    arg = va_next(arg, Double)

' string?
Case Asc("s")
    ' Strings are passed byval, so the
    Print *va_arg(arg, ZString Ptr);
    arg = va_next(arg, ZString Ptr)

End Select

' Ordinary char, just print as-is
Else
    Print Chr( char );
End If
Wend
End Sub

Dim As String s = "bar"

myprintf(!"integer=%i, longint=%l single=%f, d 1, ill Shl 32, 2.2, 3.3, "foo", s)

Sleep

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the
Differences from QB

- New to FreeBASIC

See also

- ... (Ellipsis)
- va_arg
- va_next
**va_next**

Returns a pointer to the next argument in a variable argument list

**Syntax**

```
Argument_Pointer = va_next ( Argument_List, datatype )
```

**Description**

The `va_next` macro points to the next argument within the list `Argument_List, datatype` being the type of the current argument being stepped over.

**Example**

See the `Va_First()` examples.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__va_next`.

**Differences from QB**

- New to FreeBASIC

**See also**

- ... (Ellipsis)
- `va_arg`
- `va_first`
Val

Converts a string to a floating point number

Syntax

Declare Function Val ( ByRef str As Const String ) As Double
Declare Function Val ( ByRef str As Const WString ) As Double

Usage

result = Val( strnum )

Parameters

strnum
the string containing a number to convert

Return Value

Returns a converted Double precision number

If the first character of the string is invalid, Val will return 0.

Description

Val("10") will return 10.0, and Val("10.10") will return 10.1. The function parses the string from the left, skipping any white space, and returns the longest number it can read, stopping at the first non-suitable character it finds. Scientific notation is recognized, with "d" or "E" used to specify the exponent.

Val can be used to convert integer numbers in binary / octal / hexadecimal format, if they have the relevant identifier ("&B;" / "&O;" / "&H;"> prefixed, for example: Val("&HFF;") returns 255.

Note:
If you want to get an integer value from a string, consider using ValInt or ValLng instead. They are faster, since they don't use floating-point numbers, and only ValLng provides full 64-bit precision for LongInt.
If you want to convert a number into string format, use the `str` function.

**Example**

```
Dim a As String, b As Double
a = "2.1E+30xa211"
b = Val(a)
Print a, b
```

```
2.1E+30xa211  2.1e+030
```

**Differences from QB**

- None

**See also**

- **CDBL**
- **ValInt**
- **ValUInt**
- **ValLng**
- **ValULng**
- **Str**
- **Chr**
- **Asc**
ValLng

Converts a string to a 64bit integer

Syntax

```
Declare Function ValLng ( ByRef strnum As Const String ) As LongInt
Declare Function ValLng ( ByRef strnum As Const WString ) As LongInt
```

Usage

```
result = ValLng ( strnum )
```

Parameters

- `strnum`
  
  the string to convert

Return Value

Returns a `LongInt` of the converted string

If the first character of the string is invalid, `ValLng` will return 0.

Description

For example, `ValLng("10")` will return 10, and `ValLng("10.60")` will return 10 as well. The function parses the string from the left, skipping any white space, and returns the longest number it can read, stopping at the first non-suitable character it finds. Any non-numeric characters including decimal points and exponent specifiers, are considered non-suitable, for example, `ValLng("23.1E+6")` will just return 23.

`ValLng` can be used to convert integer numbers in `Binary / Octal / Hexadecimal` format, if they have the relevant identifier ("&B; / "&O; / "&H;") prefixed, for example: `ValLng("&HFF")` returns 255.

If you want to convert a number into string format, use the `Str` function.
Example

```basic
Dim a As String, b As LongInt
a = "20xa211"
b = ValLng(a)
Print a, b
```

```
20xa211  20
```

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __ValLng.

Differences from QB

- New to FreeBASIC

See also

- CLngInt
- Val
- ValInt
- ValULng
- Str
- Chr
- Asc
Converting a string to a 32bit integer

**Syntax**

```vbnet
Declare Function ValInt ( ByRef strnum As Const String ) As Long
Declare Function ValInt ( ByRef strnum As Const WString ) As Long
```

**Usage**

```vbnet
result = ValInt ( strnum )
```

**Parameters**

- `strnum`
  - the string to convert

**Return Value**

Returns a `Long` value of the converted string.

If the first character of the string is invalid, `ValInt` will return 0.

**Description**

For example, `ValInt("10")` will return 10, and `ValInt("10.60")` will return 10 as well. The function parses the string from the left, skipping any white space, and returns the longest number it can read, stopping at the first non-suitable character it finds. Any non-numeric characters including decimal points and exponent specifiers, are considered non-suitable, for example, `ValInt("23.1E+6")` will just return 23.

`ValInt` can be used to convert integer numbers in Binary / Octal / Hexadecimal format, if they have the relevant identifier (`"&B;" / "&O;" "&H;" ) prefixed, for example: `ValInt("&HFF;")` returns 255.

If you want to convert a number into string format, use the `Str` function.

**Example**
Dim a As String, b As Integer
a = "20xa211"
b = ValInt(a)
Print a, b

20xa211  20

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the alias __ValInt.

Differences from QB
- New to FreeBASIC

See also
- CLng
- Val
- ValUInt
- ValLng
- Str
- Chr
- Asc
ValUInt

Converts a string to an unsigned 32bit integer

**Syntax**

```vba
Declare Function ValUInt ( ByRef strnum As Const String ) As Ulong
Declare Function ValUInt ( ByRef strnum As Const WString ) As Ulong
```

**Usage**

```vba
result = ValUInt ( strnum )
```

**Parameters**

*strnum*

the string to convert

**Return Value**

Returns a `Ulong` value of the converted string

If the first character of the string is invalid, `ValUInt` will return 0.

**Description**

For example, `ValUInt("10")` will return 10, and `ValUInt("10.60")` will return 10 as well. The function parses the string from the left, skipping any white space, and returns the longest number it can read, stopping at the first non-suitable character it finds. Any non-numeric characters including decimal points and exponent specifiers, are considered non-suitable, for example, `ValUInt("23.1E+6")` will just return 23.

`ValUInt` can be used to convert integer numbers in **Binary / Octal / Hexadecimal** format, if they have the relevant identifier ("&B;" / "&O;" / "&H;") prefixed, for example: `ValUInt("&HFF;")` returns 255.

If you want to convert a number into string format, use the `Str` function.
Example

```vbnet
Dim a As String, b As UInteger
a = "20xa211"
b = ValUInt(a)
Print a, b
```

20xa211  20

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Valuint.

Differences from QB

- New to FreeBASIC

See also

- Val
- ValInt
- ValULng
- CULng
- Str
- Chr
- Asc
ValULng

Converts a string to a unsigned 64bit integer

**Syntax**

Declare Function ValULng ( ByRef strnum As Const String ) As ULongInt  
Declare Function ValULng ( ByRef strnum As Const WString ) As ULongInt

**Usage**

`result = ValULng ( strnum )`

**Parameters**

`strnum`
the string to convert

**Return Value**

Returns a ULongInt of the converted string

If the first character of the string is invalid, `ValULng` will return 0.

**Description**

For example, `ValULng("10")` will return 10, and `ValULng("10.60")` will return 10 as well. The function parses the string from the left, skipping any white space, and returns the longest number it can read, stopping at the first non-suitable character it finds. Any non-numeric characters including decimal points and exponent specifiers, are considered non-suitable, for example, `ValULng("23.1E+6")` will just return 23.

`ValULng` can be used to convert integer numbers in **Binary / Octal / Hexadecimal** format, if they have the relevant identifier (",&B;" / ",&O;" ",&H;") prefixed, for example: `ValULng("&HFF;">` returns 255.

If you want to convert a number into string format, use the `Str` function.
Example

```vbnet
Dim a As String, b As ULongInt
a = "20xa211"
b = ValULng(a)
Print a, b
```

```
20xa211 20
```

Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__ValULng`.

Differences from QB

- New to FreeBASIC

See also

- `CULngInt`
- `Val`
- `ValUInt`
- `ValLng`
- `Str`
- `Chr`
- `Asc`
Var

Declares a variable whose type is implied from the initializer expression

**Syntax**

```plaintext
Var [Shared] symbolname = expression[, symbolname = expression]
```

**Description**

Var declares a variable whose type is implied from the initializer expression. It is illegal to specify an explicit type in a var declaration. The initializer expression can be either a constant or any variable of any type.

Note: WString is not supported with var, due to the fact that there is no var-len WString type. This isn't likely to change, due to the complexities involved with handling Unicode.

Since the type of the variable is inferred from what you assign into it, it's helpful to know how literals work. Any literal number without a decimal point defaults to Integer. A literal number with a decimal point defaults to Double. See ProPgLiterals for further information.

All ZString expressions, including string literals and dereferenced ZString Ptrs, will be given the String variable type.

Explicit suffixes may be used on literal variables, to change/clarify the type. See Literals and Variable Types for some more information about suffixes that can be used on literals.

Note: Suffixes must appear on the initializer, not on the variable. Tryin to use var with a variable that has a suffix will throw a compile error.

**Example**

```plaintext
Var a  = Cast(Byte, 0)
Var b  = Cast(Short, 0)
```
Var c = Cast(Integer, 0)
Var d = Cast(LongInt, 0)
Var au = Cast(UByte, 0)
Var bu = Cast(UShort, 0)
Var cu = Cast(UInteger, 0)
Var du = Cast(ULongInt, 0)
Var e = Cast(Single, 0.0)
Var f = Cast(Double, 0.0)
Var g = @c '' integer ptr
Var h = @a '' byte ptr
Var s2 = "hello" '' var-len string

Var ii = 6728 '' implicit integer
Var id = 6728.0 '' implicit double

Print "Byte: ";Len(a)
Print "Short: ";Len(b)
Print "Integer: ";Len(c)
Print "Longint: ";Len(d)
Print "UByte: ";Len(au)
Print "UShort: ";Len(bu)
Print "UInteger: ";Len(cu)
Print "ULongint: ";Len(du)
Print "Single: ";Len(e)
Print "Double: ";Len(f)
Print "Integer Pointer: ";Len(g)
Print "Byte Pointer: ";Len(h)
Print "Variable String: ";Len(s2)
Print
Print "Integer: ";Len(ii)
Print "Double: ";Len(id)

Sleep

**Differences from QB**
- New to FreeBASIC 0.17
Dialect Differences

- Only valid in the `-lang fb` dialect.

See also

- Common
- Dim
- Erase
- Extern
- LBound
- ReDim
- Preserve
- Shared
- Static
- UBound
**Operator Varptr (Variable Pointer)**

Returns the address of a variable or object

**Syntax**

```basic
Declare Operator VarPtr ( ByRef lhs As T ) As T Ptr
```

**Syntax**

```basic
result = VarPtr ( lhs )
```

**Parameters**

- **lhs**
  A variable or object.
- **T**
  Any data type.

**Return Value**

Returns the address of a variable or object.

**Description**

This operator returns the address of its operand.

When the operand is of type **String**, the address of the internal string **Strptr (String Pointer)** to retrieve the address of the string data.

The operand cannot be an array, but may be an array element. For example, address of "myarray(0)".

**Example**

```basic
Dim a As Integer, addr As Integer
a = 10
'
' place the address of a in addr
addr = CInt( VarPtr(a) )
```
'' change all 4 bytes (size of INTEGER) of a
Poke Integer, addr, -1000
Print a

'' place the address of a in addr (same as above)
addr = CInt( @a )

'' print the least or most significant byte, depending
Print Peek( addr )

Differences from QB
  - None

See also
  - Pointers
  - Peek
  - Poke
View Print

Sets the printable area of the screen

**Syntax**
```
View Print [ firstrow To lastrow ]
```

**Parameters**
- `firstrow`: first row of print area
- `lastrow`: last row of print area

**Description**
Sets the boundaries of the console screen text area to the lines starting including last. Lines are counted starting with 1. The text cursor is moved to the beginning of the first line specified.
If the row numbers are omitted, the entire screen is used as the text area.

**Example**
```
Cls
View Print 5 To 6
Color , 1
' clear only View Print area
Cls
```

View Print can be used in graphics mode to avoid the text output overwriting:
```
Screen 12
Dim As Integer  R,Y,x,y1
Dim As Single  y2
View Print 20 To 27
Line (0,0)-(639,300),1,BF
```
Line (100,50)-(540,200),0,BF
Do
   r = (r + 1) And 15
For y = 1 To 99
   y1 = ((1190 \ y + r) And 15)
   y2 = 6 / y
   For x = 100 To 540
      PSet (x, y + 100), CInt((319 - x) * y2) And 15
   Next x,y
If r=0 Then Color Int(Rnd*16): Print "blah"
Loop Until Len(Inkey)

Differences from QB

- None.

See also

- Cls
- (Print | ?)
- Color
View (Graphics)

Sets new physical coordinate mapping and clipping region

**Syntax**

```basic
View
View ( x1, y1 )-( x2, y2 ) [ [, fill_color ] [, border_color ] ]
View Screen ( x1, y1 )-( x2, y2 ) [ [, fill_color ] [, border_color ] ]
```

**Parameters**

- `x1 As Integer, y1 As Integer`
  The horizontal and vertical offsets, in pixels, of one corner of the viewport relative to the top-left corner of the screen.
- `x2 As Integer, y2 As Integer`
  The horizontal and vertical offsets, in pixels, of the opposite corner of the viewport relative to the top-left corner of the screen.
- `fill_color As UInteger`
  The color to fill the new viewport.
- `border_color As UInteger`
  The color of the border to draw around the new viewport.

**Description**

The viewport, or clipping region, is a rectangular area of the graphics screen, outside of which no drawing will be done. That is, only drawing done within this area will be shown. A graphics screen must be created with `Screen` or `ScreenRes` before calling `View` or `View Screen`.

The first statement sets the viewport to encompass the entire screen, which is the default viewport for a new graphics screen.

The second and third statements both allow a new viewport to be defined. The corners of the viewport are specified by the `x1, y1, x2` and `y2` parameters. `fill_color` and `border_color` are both in the format accepted by `Color`. The indicated effects for each parameter only occur if that parameter is specified.
The second statement modifies the coordinate mapping of the graphics screen such that coordinates specified for drawing statements and procedures are relative to the top-left corner of the viewport.

The third statement modifies the coordinate mapping of the graphics screen such that coordinates specified for drawing statements and procedures are relative to the top-left corner of the screen.

Example

```vba
Screen 12
Dim ip As Any Ptr
Dim As Integer x, y

'simple sprite
ip = ImageCreate(64,64)
For y = 0 To 63
    For x = 0 To 63
        PSet ip, (x, y), (x\4) Xor (y\4)
    Next x
Next y

'viewport with blue border
Line (215,135)-(425,345), 1, bf
View (220,140)-(420,340)

'move sprite around the viewport
Do

    x = 100*Sin(Timer*2.0)+50
    y = 100*Sin(Timer*2.7)+50

    ScreenSync
    ScreenLock

    'clear viewport and put image
   Cls 1
   Put (x, y), ip, PSet
```
ScreenUnlock

Loop While Inkey = ""

ImageDestroy(ip)

Differences from QB

- QBASIC preserves the WINDOW coordinate mapping after subsequent calls to VIEW.
- FreeBASIC's current behavior is to preserve the WINDOW coordinates after calls to VIEW, or when working on images, meaning that the coordinate mapping may undergo scaling/translations if the viewport changes. (If a WINDOW hasn't been set, there is no coordinate mapping, and so it doesn't change after calls to VIEW.) The behavior may change in future, but consistent behavior can be assured over inconsistent viewport coordinates by re-calling WINDOW whenever you change the VIEW.

See also

- View Print
- Screen (Graphics)
- Window
- PMap
Virtual

Declare virtual methods

**Syntax**

```
Type typename Extends base_typename
Declare Virtual Sub|Function|Property|Operator|Destructor ... 
End Type
```

**Description**

**Virtual** methods are methods that can be overridden by data types derived from the type they were declared in, allowing for polymorphism. In contrast to **Abstract** methods, virtual methods must have an implementation, which is used when the virtual is not overridden.

A derived type can override virtual methods declared in its base type by declaring a method with the same identifier and signature, meaning same number and type of parameters, same return type (if any) and same calling convention:

- if that differs only in parameter passing mode or calling convention or return type, then an overriding error is returned at compile time,
- otherwise shadowing only is permitted for any other signature difference, corresponding to case where both methods would be overloadable.

The property of being a virtual method is not implicitly inherited by the overriding method in the derived type.

When calling virtual methods, the compiler may need to do a vtable lookup in order to find out which method must be called for a given object. This requires an extra hidden vtable pointer field to be added at the top of each type with virtual methods. This hidden vptr is provided by the built-in **Object** type. Because of that, virtual methods can only be declared in a type that directly or indirectly Extends **Object**.

**Constructors** cannot be virtual because they create objects, while
virtual methods require an already-existing object with a specific type. The type of the constructor to call is determined at compile-time from the code.
In addition, when calling a virtual method inside a constructor, only the version of the method corresponding to an object of type of this constructor is used. That is because the vptr has not yet been set up by the derived type constructor, but only by the local type constructor.

**Destructors** often must be virtual when deleting an object manipulate through a pointer to its base type, so that the destruction starts at the most derived type and works its way down to the base type. To do this it may be necessary to add virtual destructors with an empty body anywhere an explicit destruction was not yet required, in order to supersede each non-virtual implicit destructor induced by the destructor in its base.
On the other hand, when calling a virtual (or abstract) method inside a destructor (virtual or not), only the version of the method corresponding to an object of type of this destructor is used because the vptr is reset at the top of the destructor according to its own type's vtable. This avoids to access child methods and so to refer to child members previously destroyed by the child destructor execution.

For member methods with `virtual` in their declaration, `virtual` can also be specified on the corresponding method bodies, for improved code readability.

**Note:** In a multi-level inheritance, a same named method (same identifier and signature) can be declared `Abstract`, `Virtual` or normal (without specifier) at each inheritance hierarchy level. When there is mixing of specifiers, the usual order is abstract -> virtual -> normal, from top to bottom of the inheritance hierarchy.
The access control (`Public/Protected/Private`) of an overriding method is not taken into account by the internal polymorphism process, but only for the initial call at compile-time.
**Base.method()** calls always the base's own method, never the overriding method.
A derived static method cannot override a base virtual/abstract method, but can shadow any base method (including virtual/abstract).
Example

Type Hello extends object
    Declare virtual Sub hi( )
End Type

Type HelloEnglish extends Hello
    Declare Sub hi( )
End Type

Type HelloFrench extends Hello
    Declare Sub hi( )
End Type

Type HelloGerman extends Hello
    Declare Sub hi( )
End Type

Sub Hello.hi( )
    Print "hi!"
End Sub

Sub HelloEnglish.hi( )
    Print "hello!"
End Sub

Sub HelloFrench.hi( )
    Print "Salut!"
End Sub

Sub HelloGerman.hi( )
    Print "Hallo!"
End Sub

Randomize( Timer( ) )
Dim As Hello Ptr h

For i As Integer = 0 To 9
    Select Case( Int( Rnd( ) * 4 ) + 1 )
        Case 1
            h = New HelloEnglish
        Case 2
            h = New HelloFrench
        Case 3
            h = New HelloGerman
        Case Else
            h = New Hello
    End Select

    h->hi( )
    Delete h
Next

Dialect Differences

- Only available in the -lang fb dialect.

Differences from QB

- New to FreeBASIC

See also

- Type
- Object
- Extends
- Abstract
**Wait**

Reads from a hardware port with a mask.

**Syntax**

```basic
Declare Function Wait ( ByVal port As UShort, ByVal and_mask As Long = 0 ) As Long
```

**Usage**

```basic
Wait port, and_value [, xor_value]
```

**Parameters**

- `port`
  Port to read.
- `and_mask`
  Mask value to **And** the port value with.
- `xor_mask`
  Mask value to **Xor** the port value with.

**Return Value**

0 if successful, -1 on failure.

**Description**

`Wait` keeps reading `port` until the reading ANDed with `and_mask` and optionally XORed with `xor_mask` gives a non-zero result.

**Example**

```basic
Wait &h3da, &h8 'Old Qbasic way of waiting for the ScreenSync
ScreenSync 'FreeBASIC way of accomplishing the same
```

**Platform Differences**
- In the Windows and Linux versions three port numbers (&H3C7, &H3C8, &H3C9) are hooked by the graphics library when a graphics mode is in use handling as in QB. This use is deprecated; use Palette to retrieve palette colors.

- Using true port access in the Windows version requires the program to install a device driver for the present session. For that reason, Windows executables should be run with administrator permits each time the computer is restarted. Further runs don't require admin rights as they just use the already installed driver that is only 3K in size and is embedded in the executable.

See also

- Inp
- Out
WBin

Returns the binary **WString** (Unicode) representation of a number

**Syntax**

```vbscript
Declare Function WBin ( ByVal number As UByte ) As WString
Declare Function WBin ( ByVal number As UShort ) As WString
Declare Function WBin ( ByVal number As Ulong ) As WString
Declare Function WBin ( ByVal number As ULongInt ) As WString
Declare Function WBin ( ByVal number As Const Any Ptr ) As WString
Declare Function WBin ( ByVal number As UByte, ByVal digits As Long ) As WString
Declare Function WBin ( ByVal number As UShort, ByVal digits As Long ) As WString
Declare Function WBin ( ByVal number As Ulong, ByVal digits As Long ) As WString
Declare Function WBin ( ByVal number As ULongInt, ByVal digits As Long ) As WString
Declare Function WBin ( ByVal number As Const Any Ptr, ByVal digits As Long ) As WString
```

**Usage**

```vbscript
result = WBin( number [, digits] )
```

**Parameters**

- **number**
  A whole number or expression evaluating to a whole number.
- **digits**
  Optional number of digits to return.

**Return Value**

Returns a binary **WString** representation of *number*, truncated or padded with zeros ("0") to fit the number of digits, if specified.

**Description**

Returns a **WString** (Unicode) representing the binary value of the integer *number*. Binary digits range from 0 to 1.
If you specify `digits > 0`, the result wstring will be exactly that length. will be truncated or padded with zeros on the left, if necessary.

The length of the returned string will not be longer than the maximum number of digits required for the type of `expression` (32 for a `Long`, 64 for floating point or `LongInt`)

**Example**

```
Print WBin(54321)
Print WBin(54321, 5)
Print WBin(54321, 20)
```

will produce the output:

```
1101010000110001
10001
00001101010000110001
```

**Platform Differences**

- Unicode strings are not supported in the DOS port of FreeBASIC.

**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Wbin`.

**Differences from QB**

- New to FreeBASIC

**See also**
- Bin
- WHex
- WOct
WChr

Returns a wide-character string containing one or more Unicode characters.

**Syntax**

Declare Function Wchr ( ByVal ch As Integer [, ... ] ) As WString

**Usage**

\[\text{result} = \text{WChr}( ch0 [, ch1 \ldots chN ] )\]

**Parameters**

- **ch**
  The Unicode integer value of a character.

**Return Value**

Returns a wide-character string.

**Description**

Wchr returns a wide-character string containing the character(s) represented by the Unicode values passed to it.

When Wchr is used with numerical constants or literals, the result is evaluated at compile-time, so it can be used in variable initializers.

Not all Unicode characters can be displayed on any machine, the characters available depend on the font presently in use in the console. Graphics modes can't display Unicode, not Unicode.

**Example**

```
Print "The character represented by the UNICODE codepoint 934 is:”; WChr(934)
Print "Multiple UNICODE characters: "; WChr(933, 934)
```

will produce the output:
The character represented by the UNICODE code of 934 is: Φ
Multiple UNICODE characters: ΥΦΧ

**Platform Differences**
- DOS does not support wChr.

**Dialect Differences**
- Not available in the -lang qb dialect unless referenced with the

**Differences from QB**
- New to FreeBASIC

**See also**
- Chr
- WStr
Weekday

Gets the number of day of the week from a Date Serial

Syntax

Declare Function Weekday ( ByVal serial As Double , ByVal firstd fbusesystem ) As Long

Usage

#include "vbcompat.bi"
result = Weekday( date_serial [, firstdayofweek ] )

Parameters

date_serial
the date
firstdayofweek
the first day of the week

Return Value

Returns the week day number from a variable containing a date in Da

Description

The week day values must be in the range 1-7, its meaning depends on the parameter

firstdayofweek is optional.

<table>
<thead>
<tr>
<th>value</th>
<th>first day of week</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>omitted</td>
<td>sunday</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>0</td>
<td>local settings</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>1</td>
<td>sunday</td>
<td>fbSunday</td>
</tr>
<tr>
<td>2</td>
<td>monday</td>
<td>fbMonday</td>
</tr>
<tr>
<td>3</td>
<td>tuesday</td>
<td>fbTuesday</td>
</tr>
<tr>
<td>4</td>
<td>wednesday</td>
<td>fbWednesday</td>
</tr>
</tbody>
</table>
The compiler will not recognize this function unless `vbcompat.bi` is included.

**Example**

```vbnet
#include "vbcompat.bi"

Dim a As Double = DateSerial(2005, 11, 28) + TimeSerial
Print Format(a, "yyyy/mm/dd hh:mm:ss "); Weekday(a)
```

**Differences from QB**

- Did not exist in QB. This function appeared in PDS and VBDO.

**See also**

- Date Serials
WeekdayName

Gets the name of a week day from its integral representation

**Syntax**

```vbnet
Declare Function WeekdayName ( ByVal weekday As , ByVal abbreviate firstdayofweek As Long = fbUseSystem ) As String
```

**Usage**

```vbnet
#include "vbcompat.bi"
result = WeekdayName( weekday [, abbreviate [, firstdayofweek ]] )
```

**Parameters**

- **weekday**
  - the number of the day of the week
- **abbreviate**
  - flag to indicate that name should be abbreviated
- **firstdayofweek**
  - first day of the week

**Return Value**

Returns the local operating system language day of week name from

**Description**

*How weekday* is interpreted depends on the *firstdayofweek* parameter

If *abbreviate* is true, a 3 letter abbreviation is returned, if false or omitted returned.

*firstdayofweek* is an optional parameter specified as follows:

<table>
<thead>
<tr>
<th>value</th>
<th>first day of week</th>
<th>constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>omitted</td>
<td>sunday</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>local settings</td>
<td>fbUseSystem</td>
</tr>
<tr>
<td>1</td>
<td>sunday</td>
<td>fbSunday</td>
</tr>
</tbody>
</table>
The compiler will not recognize this function unless vbcompat.bi or dat

Example

```vbnet
#include "vbcompat.bi"
Dim a As Double = DateSerial(2005, 11, 28) + TimeSerial
Print Format(a, "yyyy/mm/dd hh:mm:ss "); WeekdayName
```

Differences from QB

- Did not exist in QB. This function appeared in Visual Basic.

See also

- Date Serials
Wend

Control flow statement.

Syntax

```
While [condition]  
[statement block]  
Wend
```

Description

Wend specifies the end of a While...Wend loop block.

Differences from QB

- None

See also

- While...Wend
While

Control flow statement.

Syntax

Do While condition
[statement block]
Loop
or
Do
[statement block]
Loop While condition
or
While [condition]
[statement block]
Wend

Description

While specifies that a loop block will continue if the condition following it evaluates as true. This condition is checked during each loop iteration.

Differences from QB

- None

See also

- Do...Loop
- While...Wend
**While...Wend**

Control flow statement for looping

**Syntax**

```markdown
While [condition]
[statement block]
Wend
```

**Description**

The **While** statement will cause the following set of statements in the **statement block** while the expression **condition** evaluates to true.

If **condition** evaluates to false when the **While** statement is first executed, then the execution resumes immediately following the enclosing **Wend** statement.

If an **Exit While** statement is encountered inside the **statement block**, immediately following the enclosing **Wend** statement. If a **Continue While** statement **statement block** is skipped and execution resumes at the **While** statement.

Like all control flow statements, the **While** statement can be nested, that is, another **While** statement.

**note:** the **While** keyword is also used in the **Do...Loop** statement to indicate the type of comparison. Used in this way, the **Do** statement becomes functionally equivalent to the **While** statement **Loop and Wend**, respectively.

**Example**

In this example, a **While** loop is used to reverse a string by iterating than 0 (**0 being the first index in the string**).

```basic
Dim As String sentence
sentence = "The quick brown fox jumps over the lazy dog.

Dim As String ecnetnes
Dim As Integer index
index = Len( sentence ) - 1
```
```plaintext
While( index >= 0 )
    ecnetnes += Chr( sentence[index] )
    index -= 1
Wend

Print "original: "" ; sentence ; """
Print "reversed: "" ; ecnetnes ; ""

End 0
```

**Dialect Differences**

- In the `-lang qb` and `-lang fblite` dialects, variables declared inside a scope as in QB
- In the `-lang fb` and `-lang deprecated` dialects, variables declared inside the block, and can't be accessed outside it.

**Differences from QB**

- None

**See also**

- Exit
- Continue
- Do...Loop
**WHex**

Returns the hexadecimal **WString** (Unicode) representation of a number

**Syntax**

Declare Function WHex ( ByVal number As UByte ) As WString  
Declare Function WHex ( ByVal number As UShort ) As WString  
Declare Function WHex ( ByVal number As Ulong ) As WString  
Declare Function WHex ( ByVal number As ULongInt ) As WString  
Declare Function WHex ( ByVal number As Const Any Ptr ) As WString  

Declare Function WHex ( ByVal number As UByte, ByVal digits As Long ) As WString  
Declare Function WHex ( ByVal number As UShort, ByVal digits As Long ) As WString  
Declare Function WHex ( ByVal number As Ulong, ByVal digits As Long ) As WString  
Declare Function WHex ( ByVal number As ULongInt, ByVal digits As Long ) As WString  
Declare Function WHex ( ByVal number As Const Any Ptr, ByVal digits As Long ) As WString

**Usage**

```
result = WHex( number [, digits ] )
```

**Parameters**

- **number**
  
  A whole number or expression evaluating to a whole number.

- **digits**

  Optional number of digits to return.

**Return Value**

Returns a hexadecimal **WString** representation of **number**, truncated or padded with zeros ("0") to fit the number of digits, if specified.

**Description**

Hexadecimal digits range from 0-9, or A-F.
If you specify $\textit{digits} > 0$, the resulting $\textit{WString}$ will be exactly that length. It will be truncated or padded with zeros on the left, if necessary.

The length of the wstring will not go longer than the maximum number of digits required for the type of $\textit{expression}$ (8 for a $\textit{Long}$, 16 for floating point or $\textit{LongInt}$)

**Example**

```
Print Hex(54321)
Print Hex(54321, 2)
Print Hex(54321, 5)
```

will produce the output:

```
D431
31
0D431
```

**Platform Differences**

- Unicode strings are not supported in the DOS port of FreeBASIC.

**Dialect Differences**

- Not available in the $\textit{-lang qb}$ dialect unless referenced with the alias $\textit{__Whex}$.

**Differences from QB**

- New to FreeBASIC.
See also

- Hex
- WBin
- WOct
Width

Sets or gets the number of rows and columns of the display

Syntax

\[
\text{Width} \ [\text{columns}] \ [, \text{rows}] \\
\text{Width} \ \text{LPrint} \ \text{columns} \\
\text{Width} \ { \#\text{filenum} \ | \ \text{devicename} }, \ \text{columns} \\
\text{result} = \text{Width}( )
\]

Parameters

- \text{columns}
  columns (in characters) for output
- \text{rows}
  rows (in characters) for output
- \text{filenum}
  file number to apply to
- \text{devicename}
  device name to apply to

Return Value

Returns a 32 bit \text{Long} where the \text{High Word} is the number of rows and the \text{Low Word} is the number of columns currently set.

Description

Sets the maximum number of columns of characters of an output device (console, printer or text file). If text sent to the device reaches the width an automatic carriage return is generated.

Using \text{width} as a function returns the current console width in the low word and the current height in the high word.

If a device is not given then \text{width} takes effect on the active console/graphics screen, and a second argument specifying maximum number of rows is allowed.

In graphics modes \text{width} is used to indirectly select the font size by
setting one of the character height * width pairs allowed (See Screen/Graphics). If rows/cols is an invalid combination, no changes are made to the screen display.

Valid font heights are 8 pixels, 14 pixels and 16 pixels. The fonts all have a fixed width of 8 pixels.

Using the width command in graphic mode also forces a screen clear (Cls).

**Example**

```vbg
Dim As Integer w
w = Width
Print "rows: " & HiWord(w)
Print "cols: " & LoWord(w)

'' Set up a graphics screen
Const W = 320, H = 200
ScreenRes W, H

Dim As Integer twid, tw, th

'' Fetch and print current text width/height:
twid = Width()
tw = LoWord(twid): th = HiWord(twid)
Print "Default for current screen (8*8)"
Print "Width: " & tw
Print "Height: " & th
Sleep

Width W\8, H\16 '' Use 8*16 font

twid = Width()
tw = LoWord(twid): th = HiWord(twid)
```
Platform Differences

- In a Windows console any values > 0 can be used in windowed mode.
- On a DOS or Windows full-screen console, the valid dimensions depend on the capabilities of the hardware.
- Linux doesn't allow applications to change the console size.

Differences from QB

- columns was limited to 40 or 80, while rows could be 25, 30, 43, 50 or 60, depending on the graphics hardware and screen mode being used.
See also

- LoWord
- HiWord
- CsrLin
- Pos
**Window**

Sets new view coordinates mapping for current viewport

**Syntax**

```plaintext
Window [ [Screen] ( x1, y1 )-( x2, y2 ) ]
```

**Parameters**

- **Screen**
  Optional argument specifying y coordinates increase from top to bottom.
  
  ```plaintext
  ( x1, y1 )-( x2, y2 )
  ```
  
  New floating point values corresponding to the opposite corners of the viewport.

**Description**

**Window** is used to define a new coordinates system. \((x1, y1)\) and \((x2, y2)\) affected by this new mapping. If **Screen** is omitted, the new coordinate system will be Cartesian, that is, with y coordinates increasing from bottom to top.

FreeBASIC's current behavior is to keep track of the corners of the **Window**. The **Window** corners are also currently taken into account when working on image buffers, so when a **Window** is in effect, the effective coordinate system will be constant, independent of image buffer sizes or resolutions.

When there is no **Window** in effect, there is no coordinate mapping in effect, so the effective coordinate system is constant, independent of image buffer sizes or resolutions.

**Example**

```basic
Declare Sub Zoom (ByVal X As Integer)
Dim As Integer X = 500, Xdelta = 50
Screen 12
Do
  Do While X < 525 And X > 50
    X += Xdelta
  '' Change window
```

'' The program shows how changing the view coordinates...
'' The effect is one of zooming in and out:
'' - As the viewport coordinates get smaller, the...
'' - As the viewport coordinates get larger, the...

```
Zoom(X)
   If Inkey <> "" Then Exit Do, Do " Stop if key
   Sleep 100
   Loop
   X += Xdelta
   Xdelta *= -1
   Loop

Sub Zoom (ByVal X As Integer)
   Window (-X,-X)-(X,X) " Define new
   ScreenLock
   Cls
   Circle (0,0), 60, 11, , , 0.5, F " Draw ellipse
   ScreenUnlock
End Sub

Screen 13

' define clipping area
View ( 10, 10 ) - ( 310, 150 ), 1, 15

' set view coordinates
Window ( -1, -1 ) - ( 1, 1 )

' Draw X axis
Line (-1,0)-(1,0),7
Draw String ( 0.8, -0.1 ), "X"

' Draw Y axis
Line (0,-1)-(0,1),7
Draw String ( 0.1, 0.8 ), "Y"

Dim As Single x, y, s

' compute step size
s = 2 / PMap( 1, 0 )
'' plot the function
For x = -1 To 1 Step s
    y = x ^ 3
    PSet( x, y ), 14
Next x

'' revert to screen coordinates
Window

'' remove the clipping area
View

'' draw title
Draw String ( 120, 160 ), "Y = X ^ 3"
Sleep

Differences from QB

- QBASIC preserves the coordinate mapping after subsequent calls to VIEW.
- FreeBASIC's current behavior is to preserve the WINDOW coordinate mapping, and so it doesn't change after you change the VIEW.

See also
- Screen (Graphics)
- View (Graphics)
- PMap
**WindowTitle**

Sets the program window title

**Syntax**

```basic
Declare Sub WindowTitle ( ByRef title As Const String )
```

**Usage**

`WindowTitle title`

**Parameters**

`title`

the string to be assigned as new window title.

**Description**

This statement is useful to change the program window title. The new title set will become active immediately if the program already runs in windowed mode, otherwise will become the new title for any window produced by subsequent calls to the *Screen (Graphics)* statement. If this function is not called before setting a new windowed mode via *Screen (Graphics)*, the program window will use the executable file name (without the extension) as title by default. This command has no effect in consoles.

**Example**

```
'Set screen mode
Screen 13

'Set the window title
WindowTitle "FreeBASIC example program"

Sleep
```
Platform Differences

- Not present in DOS version / target of FreeBASIC

Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Windowtitle`.

Differences from QB

- New to FreeBASIC

See also

- Screen (Graphics)
Winput()

Reads a number of wide-characters from console or file

Syntax

Declare Function WInput( ByVal num As Integer ) As WString
Declare Function WInput( ByVal num As Integer, ByVal filenum As

Usage

result = WInput( num [, [#]filenum } )

Parameters

num

Number of characters to read.

filenum

File number of bound file or device.

Return Value

Returns a WString of the characters read.

Description

Reads a number of wide-characters from the console, or a bound file/

The first version waits for and reads $n$ wide characters from the keybo characters are not echoed to the screen.

The second version waits for and reads $n$ wide characters from a file

Note: FreeBASIC does not currently support reading wide-characters

Example

```
Dim char As WString * 2

Dim filename As String, enc As String
```
Dim f As Integer

Line Input "Please enter a file name: ", filename
Line Input "Please enter an encoding type (optional): ", enc
If enc = "" Then enc = "ascii"

f = FreeFile
If Open(filename For Input Encoding enc As #f) = 0 Then

    Print "Press space to read a character from the file, or escape to exit."
    Do

        Select Case Input(1)

            Case " " 'Space
                If EOF(f) Then
                    Print "You have reached the end of the file."
                    Exit Do
                End If

            char = WInput(1, f)
            Print char & " (char no " & Asc(char) & " )"

            Case Chr(27) 'Escape
                Exit Do

        End Select

    Loop

Close #f
Else
Print "There was an error opening the file."

End If

Dialect Differences

- Not available in the -lang qb dialect.

Differences from QB

- QB does not support Unicode

See also

- Input()
- Open
With

Statement block to allow implicit access to fields in a user defined type variable

Syntax

```
With user_defined_var
    statements
End With
```

Description

The `With...End With` block allows the omission of the name of a variable when referring to its fields. The fields may then be accessed with just a single period (.) before them, e.g. if the `Type` contains an field element called "element", then it could be accessed within the block as ".element".

It can be used as a shorthand to save typing and avoid cluttering the source. `With` can also be used with dereferenced pointers, as the second example shows.

`With` blocks may be nested. In this case, only the innermost `With` block is active, and any outer ones are ignored until the inner one is closed again. See the third example for an illustration of this.

Internally, a reference to the variable is taken at the start of the `With` block and is used to calculate any element accesses within the block. This means that `Goto` should not be used to jump into a `With` block otherwise the reference will not have been set, and the results of trying access it will be undefined.

*Note for `With` block used inside member procedure:*
To access duplicated symbols defined outside the `Type`, use "..SomeSymbol"

Example

```
Type rect_type
```
Type rect_type
    x As Single
    y As Single
End Type

Dim the_rectangle As rect_type
Dim As Integer temp, t

With the_rectangle
    temp = .x
    .x = 234 * t + 48 + .y
    .y = 321 * t + 2
End With

Type rect_type
    x As Single
    y As Single
End Type

Dim the_rectangle As rect_type Ptr

the_rectangle = CAllocate( 5 * Len( rect_type ) )

Dim As Integer loopvar, temp, t

For loopvar = 0 To 4
    With the_rectangle(loopvar)
        temp = .x
        .x = 234 * t + 48 + .y
        .y = 321 * t + 2
    End With
End For
Type rect_type
    x As Single
    y As Single
End Type

Dim As rect_type rect1, rect2

' Nested With blocks
With rect1
    .x = 1
    .y = 2

    With rect2
        .x = 3
        .y = 4

    End With
End With

Print rect1.x, rect1.y '' 1, 2
Print rect2.x, rect2.y '' 3, 4

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the __With.

Differences from QB

- New to FreeBASIC
See also

- Type
WOct

Converts a number to a Unicode octal representation

**Syntax**

```vba
Declare Function WOct ( ByVal number As UByte ) As WString
Declare Function WOct ( ByVal number As UShort ) As WString
Declare Function WOct ( ByVal number As Ulong ) As WString
Declare Function WOct ( ByVal number As ULongInt ) As WString
Declare Function WOct ( ByVal number As Const Any Ptr ) As WString

Declare Function WOct ( ByVal number As UByte, ByVal digits As Long ) As WString
Declare Function WOct ( ByVal number As UShort, ByVal digits As Long ) As WString
Declare Function WOct ( ByVal number As Ulong, ByVal digits As Long ) As WString
Declare Function WOct ( ByVal number As ULongInt, ByVal digits As Long ) As WString
Declare Function WOct ( ByVal number As Const Any Ptr, ByVal digits As Long ) As WString
```

**Usage**

```vba
result = WOct( number [, digits ] )
```

**Parameters**

- **number**
  Number to convert to octal representation.
- **digits**
  Desired number of digits in the returned string.

**Return Value**

The Unicode octal representation of the number, truncated or padded with zeros ("0") to fit the number of digits, if specified.

**Description**

Returns the octal **WString** (Unicode) representation of *number*. Octal digits range from 0 to 7.
If you specify $\text{digits} > 0$, the result string will be exactly that length. It will be truncated or padded with zeros on the left, if necessary.

The length of the returned string will not be longer than the maximum number of digits required for the type of $\text{number}$ (3 characters for Byte, 6 for Short, 11 for Long, and 22 for LongInt)

\textbf{Example}

\begin{verbatim}
Print WOct(54321)
Print WOct(54321, 4)
Print WOct(54321, 8)
\end{verbatim}

will produce the output:

\begin{verbatim}
152061
  2061
  00152061
\end{verbatim}

\textbf{Dialect Differences}

- Not available in the \texttt{-lang qb} dialect unless referenced with the alias \texttt{__Woct}.

\textbf{Platform Differences}

- Unicode strings are not supported in the DOS port of FreeBASIC.

\textbf{Differences from QB}

- In QBASIC Unicode was not supported.
See also

- WBin
- WHex
**Write**

Outputs a comma-separated list of values to the screen

**Syntax**

`Write [ expressionlist ]`

**Parameters**

`expressionlist`
Comma-separated list of items to print

**Description**

Outputs the values in `expressionlist` to the screen. The values are separated with commas, and strings are enclosed in double quotes. Numeric values with an absolute value of less than one are prefixed with a zero (0) if none is given (e.g. 0.5, -0.123). Floating-point numbers with absolute values greater than or equal to $10^{16}$, or with absolute values greater than 0 and less than $10^{-5}$ are printed in scientific notation (e.g. 1.8e+019, 3e-005)

If no expression list is given, `write` outputs a carriage return.

**Example**

```basic
Dim i As Integer = 10
Dim d As Double = 123.456
Dim s As String = "text"

Write 123, "text", -.45600
Write i, d, s
```

will produce the output:
Differences from QB

- QBASIC might print format floating-point values in slightly different ways.

See also

- Write #
- (Print | ?)
Write #

Outputs a comma-separated list of values to a text file or device

**Syntax**

```
Write # filenum , [ expressionlist ]
```

**Parameters**

- `filenum`
  File number of an open file or device opened for **Output** or **Append**.

- `expressionlist`
  Comma-separated list of items to print

**Description**

Outputs the values in `expressionlist` to the text file or device bound to `filenum`. The values are separated with commas, and strings are enclosed in double quotes. Numeric values greater than zero (0) and less than one (1) are prefixed with a zero (0) if none is given (e.g., a value of -.123 will be output as 0-.123). Extra zeroes are truncated.

If no expression list is given, `Write #` outputs a carriage return (note the comma after `filenum` is still necessary, even if no expression list is given). The purpose of `Write #` is to create a file that can be read back by using `Read`.

**Example**

```basic
Const filename As String = "file.txt"

Dim filenum As Integer = FreeFile()
If 0 <> Open(filename, For Output, As filenum) Then
  Print "error opening " & filename & " for output."
End If

Dim i As Integer = 10
```
Dim d As Double = 123.456
Dim s As String = "text"

Write #filenum, 123, "text", -.45600
Write #filenum,
Write #filenum, i, d, s

will produce the file:

123,"text",-0.456
10,123.456,"text"

Differences from QB

- None

See also

- Write
- (Print | ?) #
- Input #
Write (File Access)

File access specifier

**Syntax**

Open *filename* As String For Binary Access *Write* As #*filenum* As Integer

**Description**

Specifier for the *Access* clause in the *Open* statement. *Write* specifies that the file is accessible for output.

**Example**

See example at *Access*

**Differences from QB**

- None known.

**See also**

- *Access*
- *Open*
**WSpace**

Creates a `WString` of a given length filled with spaces (" ")

**Syntax**

```basic
Declare Function WSpace( ByVal count As Integer ) As WString
```

**Usage**

```basic
result = WSpace( count )
```

**Parameters**

- `count`
  An integer type specifying the length of the string to be created.

**Return Value**

The created `WString`. An empty string will be returned if `count <= 0`.

**Description**

`WSpace` creates a wstring (wide character string- Unicode) with the specified number of spaces.

**Example**

```
Dim a As WString * 10
a = "x" + WSpace(3) + "x"
Print a ' prints: x     x
```

**Platform Differences**

- Unicode strings are not supported in the DOS port of FreeBASIC.
**Dialect Differences**

- Not available in the `-lang qb` dialect unless referenced with the alias `__Wspace`.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Space`
- `WString`
WStr

Returns a wide-character string representation of a number or ASCII character string.

Syntax

Declare Function WStr ( ByVal n As Byte ) As WString
Declare Function WStr ( ByVal n As UByte ) As WString
Declare Function WStr ( ByVal n As Short ) As WString
Declare Function WStr ( ByVal n As UShort ) As WString
Declare Function WStr ( ByVal n As Long ) As WString
Declare Function WStr ( ByVal n As Ulong ) As WString
Declare Function WStr ( ByVal n As LongInt ) As WString
Declare Function WStr ( ByVal n As ULongInt ) As WString
Declare Function WStr ( ByVal n As Single ) As WString
Declare Function WStr ( ByVal n As Double ) As WString
Declare Function WStr ( ByRef str As Const String ) As WString
Declare Function WStr ( ByVal str As Const WString Ptr ) As WStr

Usage

result = WStr( number )
or
result = WStr( string )

Parameters

number
Numeric expression to convert to a wide-character string.
string
String expression to convert to a wide-character string.

Return Value

Returns the wide-character representation of the numeric or string expression.

Description

WStr converts numeric variables to their wide-character string representation.
WStr also converts ASCII character strings to Unicode character strings; the original string is returned unmodified.
Example

```basic
#if defined( __FB_WIN32__ )
#include "windows.bi"
#endif

Dim zs As ZString * 20
Dim ws As WString * 20

zs = "Hello World"
ws = WStr(zs)

#if defined( __FB_WIN32__ )
MessageBox(null, ws, WStr("Unicode 'Hello World'"))
#else
Print ws
Print WStr("Unicode 'Hello World'")
#endif
```

Platform Differences

- DOS does not support WStr.

Dialect Differences

- Not available in the -lang qb dialect unless referenced with the

Differences from QB

- New to FreeBASIC
See also

- Str
- WString
**WString**

Standard data type: wide character string

**Syntax**

```
Dim variable As WString * size
Dim variable As WString Ptr
```

**Description**

A `WString` is a fixed-size array of wide-chars that never overflows if the size is known at compile-time. It never resize unless it's a pointer and `Allocate/Reallocate/Deallocate` are used directly. When the variable has a fixed size, the compiler, i.e., a fixed-size `WString` variable is passed directly, not as a dereferenced pointer or a function argument.

FreeBASIC avoids any overflow that could occur on assignment, by truncating the contents to a length of the specified size.

The end of the string is marked by the character 0 automatically added by the FreeBASIC string handling functions, so that character must never be part of a `WString` or the content will be truncated. The character 0 will be appended when the string is created, and the length will be calculated by scanning the string for the first null character.

In a `WString`, `Len` returns the size of the contained string and `SizeOf` returns the space allocated to the string. The size is known by the compiler, i.e., a fixed-size `WString` variable is passed directly, not as a dereferenced pointer or a function argument.

This type is provided for support non-Latin based alphabets. Any intrinsic string function or any string operator.

When processing source files, FreeBASIC can parse ASCII files with Unicode escape sequences (\u), 16BE, UTF-32LE and UTF-32BE.

The FreeBASIC text file functions can read and write Unicode files in different encodings, provided the file is opened. The text is automatically converted to the internal encoding at read and converted back to the file encoding at write.

`SizeOf(WString)` returns the number of bytes used by a `WString` character.

**Example**

```
Dim As WString * 13 str1 => "hello, world"
Print str1
```
Print Len(str1)  'returns 12, the length of the string
Print SizeOf(str1)  'returns 13 * sizeof(wstring),

Dim As WString Ptr str2
str2 = Allocate( 13 * Len(WString) )
*str2 = "hello, world"
Print *str2
Print Len(*str2)  'returns 12, the length of the string it points to

Platform Differences

Support for wstrings relies in the C runtime library available in the platform:
- Unicode is not supported in the DOS port of FreeBASIC and will behave as standard ASCII zstrings
- On Win32 wstrings are encoded in UCS-2 and a character as FreeBASIC doesn't bother with surrogates introduced by UCS-4 understands with a character may not represent a full codepoint.
- On Linux wstrings are encoded in UCS-4 and a character

Dialect Differences

Not available in the -lang qb dialect unless referenced with the alias

Differences from QB

New to FreeBASIC

See also

- String (data type)
- ZString (data type)
- WString (data type)
- String (function)
- WString (function)
- WSpace
- WStr
- WChr
- WBin
- WHex
- WOct
- Winput()
**WString (Function)**

Fills a WString with a certain length of a certain wide character

**Syntax**

```vbnet
Declare Function WString ( ByVal count As Integer, ByVal ch_code As Long ) As WString
Declare Function WString ( ByVal count As Integer, ByRef ch As Const WString ) As WString
```

**Usage**

```vbnet
result = WString( count, ch_code )
or
result = WString( count, ch )
```

**Parameters**

- `count`
  An Integer specifying the length of the string to be created.
- `ch_code`
  A Long specifying the Unicode char to be used to fill the string.
- `ch`
  A WString whose first character is to be used to fill the string.

**Return Value**

The created WString. An empty string will be returned if either `ch` is an empty string, or `count` <= 0.

**Description**

WString generates a temporary WString filled with `count` copies of a Unicode character. This string can be printed or assigned to a previously Dimed WString.

**Example**

```vbnet
Print WString( 4, 934 )
Print WString( 5, WStr("Indeed") )
```
Platform Differences

- Unicode strings are not supported in the DOS port of FreeBASIC.

Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Wstring`.

Differences from QB

- QBasic does not support `Unicode`

See also

- `String` (data type)
- `WSpace`
- `WString` (data type)
Operator Xor (Exclusive Disjunction)

Returns the bitwise-xor (exclusive disjunction) of two numeric values

Syntax

Declare Operator Xor ( ByRef lhs As T1, ByRef rhs As T2 ) As Ret

Usage

result = lhs Xor rhs

Parameters

lhs
The left-hand side expression.
T1
Any numeric or boolean type.
rhs
The right-hand side expression.
T2
Any numeric or boolean type.
Ret
A numeric or boolean type (varies with T1 and T2).

Return Value

Returns the bitwise-xor of the two operands.

Description

This operator returns the bitwise-exclusion of its operands, a logical operation that results in a value with bits set depending on the bits of the operands (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value).

The truth table below demonstrates all combinations of a boolean-excl

<table>
<thead>
<tr>
<th>Lhs Bit</th>
<th>Rhs Bit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
No short-circuiting is performed - both expressions are always evaluated.

The return type depends on the types of values passed. **Byte, UByte** and floating-point type values are first converted to types that differ only in signedness, then the return type is the same as the left-hand side type (and right-hand side types are both **Boolean**, the return type is also **Boolean**).

This operator can be overloaded for user-defined types.

**Example**

```vbnet
' Using the XOR operator on two numeric values
Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 15 '00001111
numeric_value2 = 30 '00011110

' Result = 17 = 00010001
Print numeric_value1 Xor numeric_value2
Sleep

' Using the XOR operator on two conditional expressions
Dim As UByte numeric_value1, numeric_value2
numeric_value1 = 10
numeric_value2 = 15

If numeric_value1 = 10 Xor numeric_value2 = 20 Then
    Sleep

' This will output "Numeric_Value1 equals 10 or Numeric_Value2 equals 20" because only the first condition of the IF statement is true.
```
Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- Operator Truth Tables
Xor

Parameter to the **Put** graphics statement which uses a bit-wise **Xor** as the blitting method.

**Syntax**

```
Put [ target, ] [ STEP ] ( x, y ), source [ , ( x1, y1 )-( x2, y2 )]
```

**Parameters**

- **Xor**
  - Required.

**Description**

The **Xor** method combines each source pixel with the corresponding destination pixel using the bit-wise **Xor** function. The result of this is output as the destination pixel. This method works in all graphics modes. There is no mask color, although color values of \((\text{RGBA}(0, 0, 0, 0))\) in full-color modes will have no effect, because of the behavior in full-color modes.

In full-color modes, each component (red, green, blue and alpha) is kept in a discrete set of bits, so the operation can be made to only affect some of the channels, by ensuring all the values of the other channels are set to 0.

**Example**

```
'open a graphics window
ScreenRes 320, 200, 16

'create a sprite containing a circle
Const As Integer r = 32
Dim c As Any Ptr = ImageCreate(r * 2 + 1, r * 2 + 1)
Circle c, (r, r), r, RGBA(255, 255, 255, 0), , , 1

'put the three sprites, overlapping each other in
Put (146 - r, 108 - r), c, Xor
Put (174 - r, 108 - r), c, Xor
Put (160 - r, 84 - r), c, Xor
```
''free the memory used by the sprite
ImageDestroy c

''pause the program before closing
Sleep

Differences from QB
- None

See also
- Xor
- Put (Graphics)
Year

Gets the year from a **Date Serial**

**Syntax**

```
Declare Function Year ( ByVal date_serial As Double ) As Long
```

**Usage**

```
#include "vbcompat.bi"
result = Year( date_serial )
```

**Parameters**

- `date_serial`
  - the date

**Return Value**

Returns the year from a variable containing a date in **Date Serial** format.

**Description**

The compiler will not recognize this function unless `vbcompat.bi` is included.

**Example**

```
#include "vbcompat.bi"

Dim a As Double = DateSerial(2005, 11, 28) + TimeSerial
Print Format(a, "yyyy/mm/dd hh:mm:ss "); Year(a)
```

**Differences from QB**

- Did not exist in QB. This function appeared in PDS and VBDO.
See also

- Date Serials
ZString

Standard data type: 8 bit character string

Syntax

Dim variable As ZString * size
Dim variable As ZString Ptr

Description

A ZString is a C-style fixed-size array of chars. It has no descriptor so pass it as an argument to functions. When the variable has a fixed size overflow that could occur on assignment, by truncating the contents to

A ZString Ptr can point to a standard ZString, also can be used to implement a ZString, in this case Allocate/Reallocate/Deallocate must be used to avoid overflows.

The end of the string is marked by a null character (\0 ASCII). This is a FreeBASIC string handling functions. A null character will be appended when the length will be calculated by scanning the string for the first null character.

A null character (e.g. Chr(0)) may never be contained in the text of a ZString or the rest of the string will be truncated.

In a ZString, Len returns the size of the contained string and SizeOf returns the size of the variable. SizeOf only works if the size is known by the compiler, i.e. a fixed-size passed directly, not as a dereferenced pointer or a ByRef function argument.

This type is provided for easy interfacing with C libraries and to also replace fixed-length strings, that can't be managed through pointers. Any intrinsic string functions like too, plus any string operator.

Example

Dim As ZString * 13 str1 => "hello, world"
Print str1
Print Len(str1) 'returns 12, the size of the string
Print SizeOf(str1) 'returns 13, the size of the variable
Dim As ZString Ptr str2
str2 = Allocate( 13 )
*str2 = "hello, world"
Print *str2
Print Len(*str2)  'returns 12, the size of the

Dialect Differences
- Not available in the -lang qb dialect unless referenced with the

Differences from QB
- New to FreeBASIC

See also
- String
- WString
List of FreeBASIC keywords sorted by the function they perform.

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- Open Com
- Open Lpt
- Lpt
- Lpos
- LPrint

**Assignment Operators**
- //= (Assignment)
- &= (Concatenate And Assign)
- += (Add And Assign)
- -= (Subtract And Assign)
- *= (Multiply And Assign)
- /= (Divide And Assign)
- \= (Integer Divide And Assign)
- ^= (Exponentiate And Assign)
- Mod= (Modulus And Assign)
- And= (Conjunction And Assign)
- Eqv= (Equivalence And Assign)

**String functions**
- InStr
- InStrRev
- LCase
- Left
- Len
- LSet
- LTrim
- Mid (Statement)
- Mid (Function)
- Right
- RSet
- RTrim
- Space
- String (Function)
- Trim
- UCase
- WSpace
- Wstring (Function)

**String and number conversion**
- Asc
- Bin
- Chr
- CVD
- CVI
- CVL
- **Imp** = (Implication And Assign)
- **Or** = (Inclusive Disjunction And Assign)
- **Xor** = (Exclusive Disjunction And Assign)
- **Shl** = (Shift Left And Assign)
- ** Shr** = (Shift Right And Assign)
- **Let** (Assignment)
- **Let()** (Assignment)

**Arithmetic Operators**
- + (Add)
- - (Subtract)
- * (Multiply)
- / (Divide)
- \ (Integer Divide)
- ^ (Exponentiate)
- Mod (Modulus)
- - (Negate)
- Shl (Shift Left)
- Shr (Shift Right)

**Bitwise operators**
- And
- Eqv
- Imp
- Or
- Not

**CVLongInt**
**CVS**
**CVShort**
**Format**
**Hex**
**MKD**
**MKI**
**MKL**
**MKLongInt**
**MKS**
**MKShort**
**Oct**
**Str**
**Val**
**ValLng**
**ValInt**
**ValUInt**
**ValULng**
**WBin**
**WChr**
**WHex**
**WOct**
**WStr**

**Type casting/conversion**
- **Cast**
- **Cbool**
- **CByte**
- **CDbl**
- **CInt**
- **CLng**
- **CLngInt**
- Xor
- **Short Circuit operators**
  - AndAlso
  - OrElse
- **Math**
  - Abs
  - Acos
  - Asin
  - Atan2
  - Atn
  - Cos
  - Exp
  - Fix
  - Frac
  - Int
  - Log
  - Randomize
  - Rnd
  - Sgn
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  - Sqr
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- **CPtr**
- **CShort**
- **CSign**
- **CSng**
- **CUByte**
- **CUInt**
- **CULng**
- **CULngInt**
- **CUnsg**
- **CUShort**
- **Memory**
  - Allocate
  - CAllocate
  - Clear
  - Deallocate
  - Field
  - Fre
  - Peek
- **User input**
  - GetJoystick
  - GetKey
  - GetMouse
  - Inkey
  - Input
  - Input (Statement)
  - Line Input
  - MultiKey
  - SetMouse
  - Stick
  - Strig
  - WInput
- Poke
- Reallocate

**Meta Commands**
- $Dynamic
- $Static
- $Include
- $Lang
Assigns a value to a variable

**Syntax**

Declare Operator Let ( ByRef lhs As T1, ByRef rhs As T2 )

**Usage**

lhs = rhs

or

lhs => rhs (from fbc version 0.90)

or, in the QB dialect,

[ Let ] lhs = rhs

or

[ Let ] lhs => rhs (from fbc version 0.90)

**Parameters**

lhs  
The variable to assign to.

T1  
Any numeric, boolean, string or pointer type.

rhs  
The value to assign to lhs.

T2  
Any type convertible to T2.

**Description**

This operator assigns the value of its right-hand side operand (rhs) to its left-hand side operand (lhs). The right-hand side operand must be implicitly convertible to the left-hand side type (T1) (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). For example, you cannot assign a numeric value to a string type; to do that, first convert the numeric value to a string using **Str** or **WStr**.
Assignment between arrays is not supported presently.

Avoid confusion with **Operator = (Equal)**, which also uses the '-' symbol.
For this purpose and for solving some cases of ambiguity of the parser (see **Byref (Function Results)**), the alternative symbol '=>' can be used for assignments (in place of '=') from fbc version 0.90 (same as already for the initializers).

*Note: the '=>' symbol has been chosen against '<=' (already the operator 'Less Than Or Equal') and ':=' (':' used as statement separator).*

This operator can be overloaded for user-defined types.

**Example**

```plaintext
Dim i As Integer
i = 420  ' <- this is the assignment operator

If i = 69 Then  ' <-
  this is the equivalence operator
  Print "ERROR: i should equal 420"
  End -1
End If

Print "All is good."
End 0
```

' compile with -lang fblite or qb

#lang "fblite"

Dim i As Integer
Let i = 300  ' <-alternate syntax
Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.
- In the -lang qb dialect, an assignment expression can be preceded by the Let keyword.

Differences from QB

- None

See also

- Operator = (Equal)
- Operator Let (Assignment)
- Swap
Operator &= (Concatenate And Assign)

Appends and assigns a string onto another string

**Syntax**

\[
\text{Declare Operator } \&= ( \text{ByRef } \text{lhs As String, ByRef } \text{rhs As T2} )
\]

\[
\text{Declare Operator } \&= ( \text{ByRef } \text{lhs As WString, ByRef } \text{rhs As T2} )
\]

**Usage**

\[
\text{lhs } \&= \text{ rhs}
\]

**Parameters**

- **lhs**
  
  The string to assign to.

- **rhs**
  
  The value to append to \(\text{lhs} \).

- **T2**
  
  Any numeric, string or user-defined type that can be converted to a string.

**Description**

This operator appends one string onto another. The right-hand side expression (\(\text{rhs}\)) is converted to a string before concatenation. It is functionally equivalent to,

\[
\text{lhs } = \text{ lhs } \& \text{ rhs}
\]

where the result is assigned back to the left-hand side string.

This operator can be overloaded for user-defined types.

Note: This operator exists in C/C++ with a different meaning - there it performs a bitwise \texttt{And=}.

**Example**
Dim s As String = "Hello, "
s &= " world!"
Print s

will produce the output:

Hello, world!

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- Operator & (String Concatenation With Conversion)
- Operator += (Add And Assign)
Operator += (Add And Assign)

Adds and assigns a value to a variable

Syntax

Declare Operator += ( ByRef lhs As T1, ByRef rhs As T2 )

Declare Operator += ( ByRef lhs As T Ptr, ByRef rhs As Integer )

Declare Operator += ( ByRef lhs As String, ByRef rhs As String )
Declare Operator += ( ByRef lhs As WString, ByRef rhs As WString )

Usage

lhs += rhs

Parameters

lhs
The variable to assign to.
T1
Any numeric type.
rhs
The value to add to lhs.
T2
Any numeric type.
T
Any data type.

Description

This operator adds and assigns a value to a variable. It is functionally equivalent to:

lhs = lhs + rhs

For numeric types, the right-hand side expression (rhs) will be converted to the left-hand side type (T1).

For string types, this operator is functionally equivalent to Operator &=
(Concatenate And Assign).

This operator can be overloaded for user-defined types.

**Example**

```vbnet
Dim n As Double
n = 6
n += 1
Print n
Sleep
```

Output:

```
7
```

**Dialect Differences**

- In the **-lang qb** dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- Operator + (Add)
- Mathematical Functions
Operator -= (Subtract And Assign)

Subtracts and assigns a value to a variable

**Syntax**

```
Declare Operator -= ( ByRef lhs As T1, ByRef rhs As T2 )

Declare Operator -= ( ByRef lhs As T Ptr, ByRef rhs As Integer )
```

**Usage**

```
lhs -= rhs
```

**Parameters**

- `lhs`  
  The variable to assign to.  
  `T1`  
  Any numeric type.  
- `rhs`  
  The value to subtract from `lhs`.  
  `T2`  
  Any numeric type.  
- `T`  
  Any data type.

**Description**

This operator subtracts and assigns a value to a variable. It is functionally equivalent to:

```
lhs = lhs - rhs
```

For numeric types, the right-hand side expression (`rhs`) will be converted to the left-hand side type (`T1`).

This operator can be overloaded for user-defined types.

**Example**
Dim n As Double
n = 6
n -= 2.2
Print n
Sleep

Output:
3.8

Dialect Differences
- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB
- New to FreeBASIC

See also
- Operator - (Subtract)
- Mathematical Functions
Operator *= (Multiply And Assign)

Multiplies and assigns a value to a variable

**Syntax**

```
Declare Operator *= ( ByRef lhs As T1, ByRef rhs As T2 )
```

**Usage**

```
lhs *= rhs
```

**Parameters**

- **lhs**
  - The variable to assign to.
  - **T1**
    - Any numeric type.
- **rhs**
  - The value to multiply **lhs** by.
  - **T2**
    - Any numeric type.

**Description**

This operator multiplies and assigns a value to a variable. It is functionally equivalent to:

```
lhs = lhs * rhs
```

The right-hand side expression (**rhs**) will be converted to the left-hand side type (**T1**).

This operator can be overloaded for user-defined types.

**Example**

```
Dim n As Double
n = 6
n *= 2
```
Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- Operator * (Multiply)
- Mathematical Functions
### Operator /= (Divide And Assign)

Divides and assigns a value to a variable.

#### Syntax

```plaintext
Declare Operator /= ( ByRef lhs As T1, ByRef rhs As T2 )
```

#### Usage

```
lhs /= rhs
```

#### Parameters

- **lhs**
  - The variable to assign to.
  - **T1**
  - Any numeric type.
- **rhs**
  - The value to divide `lhs` by.
  - **T2**
  - Any numeric type.

#### Description

This operator divides and assigns a value to a variable. It is functionally equivalent to:

```
lhs = lhs / rhs
```

This operator can be overloaded for user-defined types.

#### Example

```plaintext
Dim n As Double
n = 6
n /= 2.2
Print n
Sleep
```
Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- Operator / (Divide)
- Mathematical Functions
**Operator \= (Integer Divide And Assign)**

Integer divides and assigns a value to a variable

**Syntax**

```plaintext
Declare Operator \= ( ByRef lhs As T1, ByRef rhs As T2 )
```

**Usage**

```plaintext
lhs \= rhs
```

**Parameters**

- **lhs**: The variable to assign to.  
  - **T1**: Any numeric type.
- **rhs**: The value to divide `lhs` by.  
  - **T2**: Any numeric type.

**Description**

This operator multiplies and assigns a value to a variable. It is functionally equivalent to:

```plaintext
lhs = lhs \ rhs
```

This operator can be overloaded for user-defined types.

**Example**

```plaintext
Dim n As Double
n = 6
n \= 2.2
Print n
Sleep
```
Dialect Differences

- In the *-lang qb* dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- **Operator \ (Integer Divide)**
- **Mathematical Functions**
Operator ^= (Exponentiate And Assign)

Exponentiates and assigns a value to a variable

Syntax

Declare Operator ^= ( ByRef lhs As Double, ByRef rhs As Double )

Usage

lhs ^= rhs

Parameters

lhs
The variable to assign to.

rhs
The value to exponentiate lhs by.

Description

This operator exponentiates and assigns a value to a variable. It is functionally equivalent to:

lhs = lhs ^ rhs

This operator can be overloaded for user-defined types.

Note: This operator exists in C/C++ with a different meaning - there it performs a Bitwise xor=.

Example

Dim n As Double
n = 6
n ^= 2
Print n
Sleep
Output:

```
36
```

**Dialect Differences**

- In the *lang qb* dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- **Operator ^ (Exponentiate)**
- **Mathematical Functions**
Operator Mod= (Modulus And Assign)

Divides a value and assigns the remainder to a variable

**Syntax**

```plaintext
Declare Operator Mod= ( ByRef lhs As Integer, ByRef rhs As Integer )
```

**Usage**

```plaintext
lhs Mod= rhs
```

**Parameters**

- **lhs**
  The variable to assign to.
- **rhs**
  The value to divide lhs by.

**Description**

This operator divides two values of **Integer** type and assigns the remainder to its left-hand side (lhs) variable. It is functionally equivalent to:

```plaintext
lhs = lhs Mod rhs
```

This operator can be overloaded for user-defined types.

**Example**

```plaintext
Dim n As Integer
n = 11
n Mod= 3
' The result is 2
Print n
Sleep
```
Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- Operator + (Modulus)
- Mathematical Functions
Operator And= (Conjunction And Assign)

Performs a bitwise-and (conjunction) and assigns the result to a variable.

**Syntax**

```
Declare Operator And= (ByRef lhs As T1, ByRef rhs As T2)
```

**Usage**

```
lhs And= rhs
```

**Parameters**

- **lhs**
  The variable to assign to.
  - **T1**
    Any numeric or boolean type.
- **rhs**
  The value to perform a bitwise-and (conjunction) with **lhs**.
  - **T2**
    Any numeric or boolean type.

**Description**

This operator performs a bitwise-and and assigns the result to a variable (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). It is functionally equivalent to:

```
lhs = lhs And rhs
```

**And=** compares each bit of its operands, **lhs** and **rhs**, and if both bits are 1, then the corresponding bit in the first operand, **lhs**, is set to 1, otherwise it is set to 0.

**And=** cannot be used in conditional expressions.

This operator can be overloaded for user-defined types.

**Example**
Dialect Differences

- In the **-lang qb** dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- And
Operator Eqv= (Equivalence And Assign)

Performs a bitwise-eqv (equivalence) and assigns the result to a variable.

**Syntax**

```
Declare Operator Eqv= ( ByRef lhs As T1, ByRef rhs As T2 )
```

**Usage**

```
lhs Eqv= rhs
```

**Parameters**

- **lhs**
  The variable to assign to.
  - **T1**
    Any numeric or boolean type.

- **rhs**
  The value to perform a bitwise-eqv (equivalence) with *lhs*.
  - **T2**
    Any numeric or boolean type.

**Description**

This operator performs a bitwise-eqv and assigns the result to a variable (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). It is functionally equivalent to:

```
lhs = lhs Eqv rhs
```

**Example**

```
Eqv= compares each bit of its operands, lhs and rhs, and if both bits are the same (either both 0 or both 1), then the corresponding bit in the first operand, lhs, is set to 1, otherwise it is set to 0.
```

This operator can be overloaded for user-defined types.
Dim As UByte a = &b00110011
Dim As UByte b = &b01010101
a Eqv b
' Result a = &b10011001
Print Bin(a)

Dialect Differences
- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB
- New to FreeBASIC

See also
- Eqv
Operator Imp= (Implication And Assign)

Performs a bitwise-imp (implication) and assigns the result to a variable.

**Syntax**

`Declare Operator Imp= ( ByRef lhs As T1, ByRef rhs As T2 )`

**Usage**

`lhs Imp= rhs`

**Parameters**

- `lhs`
  The variable to assign to.
  - `T1`
  Any numeric or boolean type.
- `rhs`
  The value to perform a bitwise-imp (implication) with `lhs`.
  - `T2`
  Any numeric or boolean type.

**Description**

This operator performs a bitwise-imp and assigns the result to a variable (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). It is functionally equivalent to:

`lhs = lhs Imp rhs`

**Imp** is a bitwise operator which is the same as `(Not lhs) Or rhs`. **Imp=** compares each bit of its operands, `lhs` and `rhs`, and if the bit in `lhs` is or the bit in `rhs` is 1, then the corresponding bit in the first operand, `lhs` is set to 1, otherwise it is set to 0.

This operator can be overloaded for user-defined types.

**Example**
```vbnet
Dim As UByte a = &b00110011
Dim As UByte b = &b01010101
a Imp= b
' Result a = &b11011101
Print Bin(a)
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- `Imp`
- `Assignment Operators`
Operator Or= (Inclusive Disjunction And Assign)

Performs a bitwise-or (inclusive disjunction) and assigns the result to a variable

**Syntax**

Declare Operator Or= ( ByRef lhs As T1, ByRef rhs As T2 )

**Usage**

lhs Or= rhs

**Parameters**

* lhs
  The variable to assign to.
  * T1
    Any numeric or boolean type.
  * rhs
    The value to perform a bitwise-or (inclusive disjunction) with *lhs*.  
    * T2
      Any numeric or boolean type.

**Description**

This operator performs a bitwise-or and assigns the result to a variable (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). It is functionally equivalent to:

lhs = lhs Or rhs

Or= compares each bit of its operands, *lhs* and *rhs*, and if either bits are 1, then the corresponding bit in the first operand, *lhs*, is set to 1, otherwise it is set to 0.

This operator can be overloaded for user-defined types.

**Example**
Dim As UByte a = &b00110011
Dim As UByte b = &b01010101
a Or= b
' Result a = &b01110111
Print Bin(a)

**Dialect Differences**

- In the *-lang qb* dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- Or
Operator Xor= (Exclusive Disjunction And Assign)

Performs a bitwise-xor (exclusive disjunction) and assigns the result to a variable.

Syntax

Declare Operator Xor= ( ByRef lhs As T1, ByRef rhs As T2 )

Usage

lhs Xor= rhs

Parameters

lhs
The variable to assign to.
T1
Any numeric or boolean type.

rhs
The value to perform a bitwise-xor (exclusive or) with lhs.
T2
Any numeric or boolean type.

Description

This operator performs a bitwise-or and assigns the result to a variable (for conversion of a boolean to an integer, false or true boolean value becomes 0 or -1 integer value). It is functionally equivalent to:

lhs = lhs Xor rhs

Xor= compares each bit of its operands, lhs and rhs, and if both bits are the same (both 1 or both 0), then the corresponding bit in the first operand, lhs, is set to 0, otherwise it is set to 1.

This operator can be overloaded for user-defined types.

Example
Dim As UByte a = &b00110011
Dim As UByte b = &b01010101
a Xor= b
' Result  a = &b01100110
Print Bin(a)

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- New to FreeBASIC

**See also**

- Xor
Operator Shl= (Shift Left And Assign)

Shifts left and assigns a value to a variable

**Syntax**

```
Declare Operator Shl= ( ByRef lhs As Integer, ByRef rhs As Integer )
Declare Operator Shl= ( ByRef lhs As UInteger, ByRef rhs As UInteger )
Declare Operator Shl= ( ByRef lhs As LongInt, ByRef rhs As LongInt )
Declare Operator Shl= ( ByRef lhs As ULongInt, ByRef rhs As ULongInt )
```

**Usage**

```
lhs shl= rhs
```

**Parameters**

- **lhs**
  The variable to assign to.
- **rhs**
  The value to shift `lhs` left by.

**Description**

This operator shifts the bits in its left-hand side (`lhs`) parameter a number of times specified by its right-hand side (`rhs`) parameter, and assigns the result to `lhs`. It is functionally equivalent to:

```
lhs = lhs Shl rhs
```

This operator can be overloaded for user-defined types.

**Example**

```
Dim i As Integer
i = &b000000011  '' = 3
i Shl= 3  '' = i*2^3
```
Dialect Differences

- Not available in the `-lang qb` dialect unless referenced with the alias `__Shl=`.

Differences from QB

- New to FreeBASIC

See also

- Operator Shl (Shift Left)
- Operator Shr= (Shift Right And Assign)
- Mathematical Functions
Operator Shr= (Shift Right And Assign)

Shifts right and assigns a value to a variable

**Syntax**

```plaintext
Declare Operator Shr= ( ByRef lhs As Integer, ByRef rhs As Integer )
Declare Operator Shr= ( ByRef lhs As UInteger, ByRef rhs As UInteger )
Declare Operator Shr= ( ByRef lhs As LongInt, ByRef rhs As LongInt )
Declare Operator Shr= ( ByRef lhs As ULongInt, ByRef rhs As ULongInt )
```

**Usage**

```plaintext
lhs shr= rhs
```

**Parameters**

- **lhs**
  The variable to assign to.

- **rhs**
  The value to shift `lhs` right by.

**Description**

This operator shifts the bits in its left-hand side (`lhs`) parameter a number of times specified by its right-hand side (`rhs`) parameter, and assigns the result to `lhs`. It is functionally equivalent to:

```plaintext
lhs = lhs Shr rhs
```

This operator can be overloaded for user-defined types.

**Example**

```plaintext
Dim i As Integer
i = &b00011000 "' = 24
i Shr= 3 "' = i\2^3
```
Dialect Differences

- Not available in the -lang qb dialect unless referenced with the alias __Shr=.

Differences from QB

- New to FreeBASIC

See also

- Operator Shr (Shift Right)
- Operator Shl= (Shift Left And Assign)
- Mathematical Functions
Operator Let (Assign)

Indicates the assignment operator when overloading `Operator = (Assign)`

**Syntax**

```plaintext
{ Type | Class | Union | Enum } typename
Declare Operator Let ( [ ByRef | ByVal ] rhs As datatype )
End { Type | Class | Union }

Operator typename.Let ( [ ByRef | ByVal ] rhs As datatype )
```

**Usage**

```plaintext
lhs = rhs
or
lhs => rhs (from fbc version 0.90)
```

**Parameters**

- `typename` name of the `Type, Class, Union, or Enum`
- `lhs` The variable to assign to.
- `rhs` The value to assign.

**Description**

`Let` is used to overload the `Operator =[>] (Assignment)` operator and to

`lhs =[>] rhs` will assign the `rhs` to `lhs` by invoking the `Let` operator proc.
This includes the case of an object returned from a function by value, by assignment.
Assigning one array is not supported presently.

An operator `Let` (assign) must be defined if the shallow implicit copy is required when dynamically allocated memory or other resources which need to be specially copied (for example if a member pointer points to dynamically allocated memory, the implicit assignment operator will simply copy the pointer value instead of allocate memory and then perform the copy of data).

Note: It is safe to do a check for self-assignment at the top of the `Let` proc.
address of 'rhs' parameter) to avoid object destruction if previously alloc

**Example**

```vbscript
Type UDT
    Public:
        Declare Constructor (ByVal zp As Const ZString)
        Declare Operator Let (ByRef rhs As UDT)
        Declare Function getString () As String
        Declare Destructor ()
    Private:
        Dim zp As ZString Ptr
End Type

Constructor UDT (ByVal zp As Const ZString Ptr)
    This.zp = CAllocate(Len(*zp) + 1)
    *This.zp = *zp
End Constructor

Operator UDT.Let (ByRef rhs As UDT)
    If @This <> @rhs Then  '' check for self-assignme
        Deallocate(This.zp)
        This.zp = CAllocate(Len(*rhs.zp) + 1)
        *This.zp = *rhs.zp
    End If
End Operator

Function UDT.getString () As String
    Return *This.zp
End Function

Destructor UDT ()
    Deallocate(This.zp)
End Destructor

Dim u As UDT = UDT(""
u = Type<UDT>("Thanks to the overloading operator Let")
```

Print u.getString
Sleep

Output:

Thanks to the overloading operator Let (assign)

**Dialect Differences**

- In the -lang qb and -lang fblite dialects, this operator cannot be overloaded.
- In the -lang qb and -lang fblite dialects, an assignment expression can be preceded by the `Let` operator.

**Differences from QB**

- None

**See also**

- Let
  - Operator Let() (Assignment)
- Operator =[…] (Assignment)
- Operator = (Equal)
Operator Let() (Assignment)

Assigns fields of a user defined type to a list of variables

**Syntax**

```
Let( variable1 [, variable2 [, ... ]] ) = UDT_var
or
Let( variable1 [, variable2 [, ... ]] ) => UDT_var (from fbc version 0.90)
```

**Parameters**

- `variable1 [, variable2 [, ... ]]`
  Comma separated list of variables to receive the values of the `UDT` variable's fields.
- `UDT_var`
  A user defined type variable.

**Description**

Assigns the values from the `UDT_var` variable's fields to the list of variables.
Union is not supported.

**Example**

```
Type Vector3D
    x As Double
    y As Double
    z As Double
End Type

Dim a As Vector3D = ( 5, 7, 9 )
Dim x As Double, y As Double

' Get the first two fields only
Let( x, y ) = a
```
Print "x = "; x
Print "y = "; y

Output:

x = 5
y = 7

Dialect Differences

- Only available in the -lang fb dialect.

Differences from QB

- New to FreeBASIC

See also

- Let
- Operator =[>] (Assignment)
- Operator Let (Assignment)
Operator + (Addition)

Sums two expressions

**Syntax**

Declare Operator + ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator + ( ByRef lhs AsUInteger, ByRef rhs As UInteger ) AsUInteger
Declare Operator + ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As LongInt
Declare Operator + ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt

Declare Operator + ( ByRef lhs As Single, ByRef rhs As Single ) As Single
Declare Operator + ( ByRef lhs As Double, ByRef rhs As Double ) As Double

Declare Operator + ( ByRef lhs As T Pointer, ByRef rhs As Integer ) As T Pointer
Declare Operator + ( ByRef rhs As Integer, ByRef lhs As T Pointer ) As T Pointer

Declare Operator + ( ByRef lhs As T, ByRef rhs As Integer ) As T
Declare Operator + ( ByRef lhs As Integer, ByRef rhs As T ) As T

**Usage**

\[ \text{result} = \text{lhs} + \text{rhs} \]

**Parameters**

- \( \text{lhs} \)
  The left-hand side expression to sum.
- \( \text{rhs} \)
  The right-hand side expression to sum.
- \( T \)
  Any pointer type.

**Return Value**

Returns the sum of two expressions.
**Description**

When the left and right-hand side expressions are numeric values, `Operator + (Add)` returns the sum of the two values.

When the left and right-hand side expressions are string values, `Operator + (Add)` concatenates the two strings and returns the result.

If an integral value \( n \) is added to a \( T \) Pointer type, the operator performs pointer arithmetic on the address, returning the memory position of a \( T \) value, \( n \) indices away (assuming \( n \) is within bounds of a contiguous array of \( T \) values). This behaves differently from numeric addition, because the Integer value is scaled by `SizeOf( T )`.

Neither operand is modified in any way.

This operator can be overloaded to accept user-defined types.

**Example**

```vba
Dim n As Single
n = 4.75 + 5.25
Print n
```

will produce the output:

```
10
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**
None

See also

- Operator + (String Concatenation)
- Mathematical Functions
Operator - (Subtract)

Subtracts two expressions

Syntax

Declare Operator - ( ByRef lhs As Integer, ByRef rhs As Integer As Integer
Declare Operator - ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As UInteger
Declare Operator - ( ByRef lhs As LongInt, ByRef rhs As LongInt As LongInt
Declare Operator - ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt
Declare Operator - ( ByRef lhs As Single, ByRef rhs As Single ) As Single
Declare Operator - ( ByRef lhs As Double, ByRef rhs As Double ) As Double
Declare Operator - ( ByRef lhs As T Pointer, ByRef rhs As T Pointer ) As T Pointer
Declare Operator - ( ByRef lhs As T Pointer, ByRef rhs As Integer ) As Integer
Declare Operator - ( ByRef lhs As T, ByRef rhs As T ) As Integer
Declare Operator - ( ByRef lhs As T, ByRef rhs As Integer ) As T
Declare Operator - ( ByRef lhs As Integer, ByRef rhs As T ) As T

Usage

result = lhs - rhs

Parameters

lhs
The left-hand side expression to subtract from.

rhs
The right-hand side expression to subtract.

T
Any pointer type.

Return Value

Returns the subtraction of two expressions.
**Description**

When the left and right-hand side expressions are numeric values, `Operator - (Subtract)` returns the subtraction of the two values.

If the left and right-hand side expressions are both of the `T Pointer` type, for some type `T`, the operator performs pointer subtraction on the address, returning the result. This is different from numeric subtraction because the difference is divided by `SizeOf( T )`.

If an integral value `n` is subtracted from a `T Pointer` type, the operator performs pointer arithmetic on the address, returning the memory position of a `T` value, `n` indices before (assuming `(-n)` is within bounds of a contiguous array of `T` values). This behaves differently from numeric subtraction, because the `Integer` value is scaled by `SizeOf( T )`.

Neither operand is modified in any way.

This operator can be overloaded to accept user-defined types.

**Example**

```vbnet
Dim n As Single
n = 4 - 5
Print n
```

will produce the output:

```
-1
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.
Differences from QB

- None

See also

- Mathematical Functions
Operator * (Multiply)

Multiplies two numeric expressions

**Syntax**

```vbnet
Declare Operator * ( ByRef lhs As Integer, ByRef rhs As Integer As Integer
Declare Operator * ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As UInteger
Declare Operator * ( ByRef lhs As LongInt, ByRef rhs As LongInt As LongInt
Declare Operator * ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt

Declare Operator * ( ByRef lhs As Single, ByRef rhs As Single ) As Single
Declare Operator * ( ByRef lhs As Double, ByRef rhs As Double ) As Double
```

**Usage**

```
result = lhs * rhs
```

**Parameters**

- `lhs`
  The left-hand side multiplicand expression.
- `rhs`
  The right-hand side multiplicand expression.

**Return Value**

Returns the product of two multiplicands.

**Description**

Operator * (Multiply) returns the product of two multiplicands.

Neither operand is modified in any way.

This operator can be overloaded to accept user-defined types.
Example

```
Dim n As Double
n = 4 * 5
Print n
Sleep
```

Output:

```
20
```

Dialect Differences

- In the `-lang qb` dialect, this operator cannot be overloaded.

Differences from QB

- None

See also

- `Mathematical Functions`
**Operator / (Divide)**

Divides two numeric expressions

**Syntax**

```
Declare Operator / ( ByRef lhs As Single, ByRef rhs As Single ) As Single
Declare Operator / ( ByRef lhs As Double, ByRef rhs As Double ) As Double
```

**Usage**

```
result = lhs / rhs
```

**Parameters**

- **lhs**
  The left-hand side dividend expression.
- **rhs**
  The right-hand side divisor expression.

**Return Value**

Returns the quotient of a dividend and divisor.

**Description**

**Operator / (Divide)** returns the quotient of a dividend and divisor.

Neither operand is modified in any way. Unlike with integer division, float division by zero is safe to perform, the quotient will hold a special value representing infinity, converting it to a string returns something like "Inf" or "INF", exact text is platform specific.

This operator can be overloaded to accept user-defined types.

**Example**

```
Dim n As Double
```
```
Print n / 5
n = 6 / 2.3
Print n
Sleep
```

Output:

```
0
2.608695652173913
```

**Dialect Differences**

- In the `lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- None

**See also**

- Operator \ (Integer Divide)
- Mathematical Functions
### Operator \ (Integer Divide)

Divides two Integer expressions

#### Syntax

```basic
Declare Operator \ ( ByRef lhs As Integer, ByRef rhs As Integer As Integer
Declare Operator \ ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As UInteger
Declare Operator \ ( ByRef lhs As LongInt, ByRef rhs As LongInt As LongInt
Declare Operator \ ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As ULongInt
```

#### Usage

```basic
result = lhs \ rhs
```

#### Parameters

- **lhs**
  The left-hand side dividend expression.
- **rhs**
  The right-hand side divisor expression.

#### Return Value

Returns the quotient of an Integer dividend and divisor.

#### Description

**Operator \ (Integer division)** divides two Integer expressions and returns the result. Float numeric values are converted to Integer by rounding up or down, and the fractional part of the resulting quotient is truncated.

If the divisor (rhs) is zero (0), a division by zero error (crash) will be raised.

Neither of the operands are modified in any way.
This operator can be overloaded for user-defined types.

**Example**

```
Dim n As Double
Print n \ 5
n = 7 \ 2.6   ' ' => 7 \ 3  => 2.33333  => 2
Print n
n = 7 \ 2.4   ' ' => 7 \ 2  => 3.5  => 3
Print n
Sleep
```

Output:

```
0
2
3
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- None

**See also**

- Operator `/` (Floating-Point Divide)
- Operator `Mod` (Modulus)
- Mathematical Functions
Operator ^ (Exponentiate)

Raises a numeric expression to some power

Syntax

```
Declare Operator ^ ( ByRef lhs As Double, ByRef rhs As Double )
As Double
```

Usage

```
result = lhs ^ rhs
```

Parameters

- **lhs**
  The left-hand side base expression.
- **rhs**
  The right-hand side exponent expression.

Return Value

Returns the exponentiation of a base expression raised to some exponent.

Description

**Operator ^ (Exponentiate)** returns the result of a base expression (**lhs**) raised to some exponent expression (**rhs**). ^ works with double float numbers only, operands of other types will be converted into double before performing the exponentiation. Exponent of a fractional value (1/n) is the same as taking nth root from the base, for example, ^ (1/3) is the cube root of 2.

Neither of the operands are modified in any way.

Note: this operation is not guaranteed to be fully accurate, and there may be some inaccuracy in the least significant bits of the number. This is particularly noticeable when the result is expected to be an exact number: in these cases, you may find the result is out by a very
small amount. For this reason, you should never assume that an exponentiation expression will be exactly equal to the value you expect. This also means that you should be wary of using rounding methods such as `Int` and `Fix` on the result: if you expect the result to be an integer value, then there's a chance that it might be slightly lower, and will round down to a value that is one less than you would expect.

This operator can be overloaded for user-defined types.

Note: This operator exists in C/C++ with a different meaning - there it performs a Bitwise `Xor`.

**Example**

```plaintext
Dim As Double n
Input "Please enter a positive number: ", n
Print n;" squared is "; n ^ 2
Print "The fifth root of "; n;" is "; n ^ 0.2
Sleep
```

Output:

```
Please enter a positive number: 3.4
3.4 squared is 11.56
The fifth root of 3.4 is 1.27730844458754
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- None
See also

- Mathematical Functions
Operator - (Negate)

Changes the sign of a numeric expression

Syntax

Declare Operator - ( ByRef rhs As Integer ) As Integer
Declare Operator - ( ByRef rhs As Single ) As Single
Declare Operator - ( ByRef rhs As Double ) As Double

Usage

result = - rhs

Parameters

rhs
The right-hand side numeric expression to negate.

Return Value

Returns the negative of the expression.

Description

Operator - (Negate) is a unary operator that negates the value of its operand.

The operand is not modified in any way.

This operator can be overloaded for user-defined types.

Example

Dim n As LongInt
Print -5
n = 65432568459
n = - n
Print n
Sleep
### Dialect Differences

- In the *-lang qb* dialect, this operator cannot be overloaded.

### Differences from QB

- None

### See also

- **Mathematical Functions**
## Graphics Keyword List

A list of the keywords and procedures of FreeBASIC's graphics library.

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# Operators List

List of operators used in FreeBASIC.

## Assignment Operators
- `=[>]` (Assignment)
- `&=` (Concatenate And Assign)
- `+=` (Add And Assign)
- `-=` (Subtract And Assign)
- `*=` (Multiply And Assign)
- `/=` (Divide And Assign)
- `\=` (Integer Divide And Assign)
- `^=` (Exponentiate And Assign)
- `Mod=` (Modulus And Assign)
- `And=` (Conjunction And Assign)
- `Eqv=` (Equivalence And Assign)
- `Imp=` (Implication And Assign)
- `Or=` (Inclusive Disjunction And Assign)
- `Xor=` (Exclusive Disjunction And Assign)
- `Shl=` (Shift Left And Assign)
- `Shr=` (Shift Right And Assign)
- `Let` (Assignment)

## Relational Operators
- `=` (Equal)
- `<>` (Not Equal)
- `<` (Less Than)
- `<=` (Less Than Or Equal)
- `>` (Greater Than)
- `>=` (Greater Than Or Equal)

## Bitwise Operators
- `And` (Conjunction)
- `Eqv` (Equivalence)
- `Imp` (Implication)
- `Not` (Complement)
- `Or` (Inclusive Disjunction)
- `Xor` (Exclusive Disjunction)

## Short Circuit Operators
- `Andalso` (Short Circuit Conjunction)
- `Orelse` (Short Circuit Inclusive Disjunction)

## Preprocessor Operators
- `#` (Argument Stringize)
- `##` (Argument Concatenation)
- Let() (Assignment)

**Type Cast Operators**
- Cast
- CPtr

**Arithmetic Operators**
- + (Add)
- - (Subtract)
- * (Multiply)
- / (Divide)
- \ (Integer Divide)
- ^ (Exponentiate)
- Mod (Modulus)
- - (Negate)
- Shl (Shift Left)
- Shr (Shift Right)

**Indexing Operators**
- () (Array Index)
- [] (String Index)
- [] (Pointer Index)

**String Operators**
- + (String Concatenation)
- & (String Concatenation With Conversion)
- Strptr (String Pointer)

- ! (Escaped String Literal)
- $ (Non-Escaped String Literal)

**Pointer Operators**
- @ (Address Of)
- * (Value Of)
- Varptr (Variable Pointer)
- Procptr (Procedure Pointer)

**Type or Class Operators**
- . (Member Access)
- -> (Pointer To Member Access)
- Is (Run-Time Type Information Operator)

**Memory Operators**
- New
- Placement New
- Delete

**Iteration Operators**
- For, Next, and Step
Operator () (Array Index)

Returns a reference to an element in an array

Syntax

Declare Operator () ( lhs() As T, ByRef rhs As Integer, ... ) By As T

Usage

result = lhs ( rhs [, ... ] )

Parameters

lhs
An array.

rhs
An index of an element in the array.

T
Any data type.

Description

This operator returns a reference to an element in an array. For multidimensional arrays, multiple indexes must be specified (up to the number of dimensions of the array).

For any dimension \( d \) in array \( a \), any index less than \( \text{LBound}(a, d) \) or greater than \( \text{UBound}(a, d) \) will result in a runtime error.

Example

Dim array(0 To 4) As Integer = { 0, 1, 2, 3, 4 }

For index As Integer = 0 To 4
    Print array(index);
Next
Print

will produce the output:

```
0 1 2 3 4
```

**Differences from QB**

- None

**See also**

- Operator [] (Pointer Index)
Operator [] (String Index)

Returns a reference to a character in a string

**Syntax**

```
Declare Operator [] ( ByRef lhs As String, ByRef rhs As Integer ByRef As UByte
Declare Operator [] ( ByRef lhs As ZString, ByRef rhs As Integer ) ByRef As UByte
Declare Operator [] ( ByRef lhs As WString, ByRef rhs As Integer ) ByRef As T
```

**Usage**

```
result = lhs [ rhs ]
```

**Parameters**

- `lhs`
  The string (a string reference, not a string returned as local copy).
- `rhs`
  A zero-based offset from the first character.
- `T`
  The wide-character type (varies per platform).

**Description**

This operator returns a reference to a specific character in a string:
- This operator must not be used in case of empty string because reference is undefined (inducing runtime error)
- Otherwise, the user must ensure that the index does not exceed the range "[0, Len(lhs) - 1]". Outside this range results are undefined.

**Example**

```
Dim a As String = "Hello, world!"
Dim i As Integer
```
For i = 0 To Len(a) - 1
    Print Chr(a[i]) & " ";
Next i
Print

Will print

Hello, world!

**Differences from QB**

- New to FreeBASIC

**See also**

- String Operators
Operator [] (Pointer Index)

Returns a reference to memory offset from an address

Syntax

Declare Operator [] ( ByRef lhs As T Pointer, ByRef rhs As Integer ByRef As T

Usage

result = lhs [ rhs ]

Parameters

lhs
The base address.

rhs
A signed offset from lhs.

T
Any data type.

Description

This operator returns a reference to a value some distance in memory from a base address. It is essentially shorthand for "*(lhs + rhs)"; both exactly the same thing. Like pointer arithmetic, any type of Pointer can be indexed except for an Any Pointer. Also, like pointer arithmetic, it is up to the user to make sure meaningful data is being accessed.

When indexing a '2-dimensional' pointer (i.e. a T Ptr Ptr), the first (leftmost) index is applied before the second: For example, Pt[I1][I2]

(Pt[I1] + I2) = *(Pt + I1) + I2)

In general, when using an 'n-dimensional' pointer: Pt[I1][I2].....[Ir]

the index order (from left to right) corresponds to the dereferencing or

This operator can be overloaded for user-defined types.

Example
' initialize a 5-element array
Dim array(4) As Integer = { 0, 1, 2, 3, 4 }

' point to the first element
Dim p As Integer Ptr = @array(0)

' use pointer indexing to output array elements
For index As Integer = 0 To 4
    Print p[index];
Next
Print

Will give the output,

0 1 2 3 4

Differences from QB

- New to FreeBASIC

See also

- Pointer Arithmetic
- Operator * (Value Of)
- Operator [] (String Index)
- Operator () (Array Index)
- Operator + (Add)
- Operator - (Subtract)
- Pointer Operators
Operator + (String Concatenation)

Concatenates two strings

**Syntax**

Declare Operator + ( ByRef lhs As String, ByRef rhs As String ) As String
Declare Operator + ( ByRef lhs As ZString, ByRef rhs As ZString ) As ZString
Declare Operator + ( ByRef lhs As WString, ByRef rhs As WString ) As WString

**Usage**

\[ result = lhs + rhs \]

**Parameters**

- \( lhs \)
  - The left-hand side string to concatenate.
- \( rhs \)
  - The right-hand side string to concatenate.

**Description**

This operator concatenates two strings. Unlike **Operator & (String Concatenation With Conversion)** both expressions *must* be strings, and may not be converted (in fact, any attempt to concatenate a string with a non-string or two non-strings will result in a type mismatch error with the exception of when operator overloading is used in a UDT).

**Example**

```plaintext
Dim As String a = "Hello, ", b = "World!"
Dim As String c
  c = a + b
Print c
```

Output:
Hello, World!

Differences from QB

- None

See also

- Operator + (Add)
- Operator & (String Concatenation With Conversion)
- Str
Operator & (String Concatenation With Conversion)

Concatenates two strings, converting non-strings to strings as needed.

**Syntax**

```c
Declare Operator & ( ByRef lhs As T, ByRef rhs As U ) As V
```

**Usage**

```c
result = lhs & rhs
```

**Parameters**

- `lhs`  
The left-hand side expression to concatenate.  
  `T`  
  Any standard data type or user-defined type that can be converted to standard data type.

- `rhs`  
The right-hand side expression to concatenate.  
  `U`  
  Any standard data type or user-defined type that can be converted to standard data type.

- `V`  
The resultant string type (varies with operands).

**Description**

This operator concatenates two expressions. If either of the expressions is not a string type, it is converted to `String` with `Str`.

If either of the expressions is a `WString`, a `WString` is returned, otherwise a `String` is returned.

Note: This operator exists in C/C++ with a different meaning - there it performs a bitwise `And`.

**Example**
```vbnet
Dim As String A, C
Dim As Single B
A = "The result is: 
B = 124.3
C = A & B
Print C
Sleep
```

Output:
```
The result is: 124.3
```

**Differences from QB**
- New to FreeBASIC

**See also**
- Operator + (String Concatenation)
- Str
Operator = (Equal)

Compares two expressions for equality

**Syntax**

```basic
Declare Operator = ( ByRef lhs As Byte, ByRef rhs As Byte ) As Integer
Declare Operator = ( ByRef lhs As UByte, ByRef rhs As UByte ) As Integer
Declare Operator = ( ByRef lhs As Short, ByRef rhs As Short ) As Integer
Declare Operator = ( ByRef lhs As UShort, ByRef rhs As UShort ) As Integer
Declare Operator = ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator = ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As Integer
Declare Operator = ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As Integer
Declare Operator = ( ByRef lhs As ULONGInt, ByRef rhs As ULONGInt ) As Integer
Declare Operator = ( ByRef lhs As Single, ByRef rhs As Single ) As Integer
Declare Operator = ( ByRef lhs As Double, ByRef rhs As Double ) As Integer
Declare Operator = ( ByRef lhs As String, ByRef rhs As String ) As Integer
Declare Operator = ( ByRef lhs As ZString, ByRef rhs As ZString ) As Integer
Declare Operator = ( ByRef lhs As WString, ByRef rhs As WString ) As Integer
Declare Operator = ( ByRef lhs As T, ByRef rhs As T ) As Integer
Declare Operator = ( ByRef lhs As Boolean, ByRef rhs As Boolean ) As Integer
```

**Usage**

```basic
result = lhs = rhs
```

**Parameters**

- **lhs**
  The left-hand side expression to compare to.
- **rhs**
  The right-hand side expression to compare to.
- **T**
  Any pointer type.

**Return Value**

Returns negative one (-1) if expressions are equal, or zero (0) if unequal.

**Description**
Operator  = (Equality) is a binary operator that compares two expressions for equality and returns the result — a boolean value mainly in the form of an Integer: negative one (-1) for true and zero (0) for false. The arguments are not modified in any way. This operator can be overloaded to accept user-defined types as well.

Operator  = (Equality) should not be confused with initializations or assignments, both of which also use the " = " operator.

Example

```
Dim i As Integer = 0    " initialization: initialise i with a value of 0
i = 420                 " assignment: assign to i the value of 420
If (i = 69) Then        " equation: compare the equality of the value of i and 69
    Print "serious error: i should equal 420"
End If
```

Operator <> (Inequality) is complement to Operator  = (Equality), and Operator Not (Bit-wise Complement).

```
If (420 = 420) Then Print "(420 = 420) is true.
If Not (69 <> 69) Then Print "not (69 <> 69) is true.
```

Dialect Differences

- In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB

- none
See also

- **Operator <>** (Inequality)
- **Operator =[]** (Assignment)
Operator <> (Not Equal)

Compared two expressions for inequality

**Syntax**

```
Declare Operator <> ( ByRef lhs As Byte, ByRef rhs As Byte ) As
Declare Operator <> ( ByRef lhs As UByte, ByRef rhs As UByte ) As
Declare Operator <> ( ByRef lhs As Short, ByRef rhs As Short ) As
Declare Operator <> ( ByRef lhs As UShort, ByRef rhs As UShort ) As
Declare Operator <> ( ByRef lhs As Integer, ByRef rhs As Integer ) As
Declare Operator <> ( ByRef lhs AsUInteger, ByRef rhs AsUInteger ) As
Declare Operator <> ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As
Declare Operator <> ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As
DECLARE Operator <> ( ByRef lhs As Single, ByRef rhs As Single ) As
DECLARE Operator <> ( ByRef lhs As Double, ByRef rhs As Double ) As
DECLARE Operator <> ( ByRef lhs As String, ByRef rhs As String ) As
DECLARE Operator <> ( ByRef lhs As ZString, ByRef rhs As ZString ) As
DECLARE Operator <> ( ByRef lhs As WString, ByRef rhs As WString ) As
DECLARE Operator <> ( ByRef lhs As T, ByRef rhs As T ) As Integer
DECLARE Operator <> ( ByRef lhs As Boolean, ByRef rhs As Boolean ) As Integer
```

**Usage**

```
result = lhs <> rhs
```

**Parameters**

- **lhs**
  The left-hand side expression to compare to.

- **rhs**
  The right-hand side expression to compare to.

- **T**
  Any pointer type.

**Return Value**

Returns negative one (-1) if expressions are not equal, or zero (0) if equal.
Operator <> (Not equal) is a binary operator that compares two expressions for inequality and returns the result - a boolean value mainly in the form of negative one (-1) for true and zero (0) for false. Only if the left and right-hand types are both Boolean, the return type is also Boolean. The arguments are not modified in any way.

This operator can be overloaded to accept user-defined types as well.

**Example**

```vbnet
Dim As String a = "hello", b = "world"
Dim As Integer i = 10, j = i

If (a <> b) Then
    Print a & " does not equal " & b
End If

If (i <> j) Then
    Print "error: " & i & " does not equal " & j
End If
```

Operator = (Equal) is complement to operator <> (Not equal), and is functionally identical when combined with Operator Not (Bit-wise Complement).

```vbnet
If (69 <> 420) Then Print "(69 <> 420) is true.
If Not (69 = 420) Then Print "not (69 = 420) is true."
```

**Dialect Differences**

- In the -lang qb dialect, this operator cannot be overloaded.

**Differences from QB**
- none

**See also**

- *Operator* = *(Equal)*
Operator < (Less Than)

Compares an expression less than another expression

**Syntax**

```plaintext
Declare Operator < ( ByRef lhs As Byte, ByRef rhs As Byte ) As Integer
Declare Operator < ( ByRef lhs As UByte, ByRef rhs As UByte ) As Integer
Declare Operator < ( ByRef lhs As Short, ByRef rhs As Short ) As Integer
Declare Operator < ( ByRef lhs As UShort, ByRef rhs As UShort ) As Integer
Declare Operator < ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator < ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As Integer
Declare Operator < ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As Integer
Declare Operator < ( ByRef lhs As ULONGInt, ByRef rhs As ULONGInt ) As Integer
Declare Operator < ( ByRef lhs As Single, ByRef rhs As Single ) As Integer
Declare Operator < ( ByRef lhs As Double, ByRef rhs As Double ) As Integer
Declare Operator < ( ByRef lhs As String, ByRef rhs As String ) As Integer
Declare Operator < ( ByRef lhs As ZString, ByRef rhs As ZString ) As Integer
Declare Operator < ( ByRef lhs As WString, ByRef rhs As WString ) As Integer
Declare Operator < ( ByRef lhs As T, ByRef rhs As T ) As Integer
```

**Usage**

```plaintext
result = lhs < rhs
```

**Parameters**

- `lhs`
  The left-hand side expression to compare to.
- `rhs`
  The right-hand side expression to compare to.
- `T`
  Any pointer type.

**Return Value**

Returns negative one (-1) if the left-hand side expression is less than expression, or zero (0) if greater than or equal.

**Description**
**Operator < (Less than)** is a binary operator that compares two expressions and returns the result - a boolean value in the form of an `Integer`: negative one (-1) for **true** and zero (0) for **false**. The arguments are not modified in any way.

This operator can be overloaded to accept user-defined types as well.

**Example**

```
Const size As Integer = 4
Dim array(size - 1) As Integer = { 1, 2, 3, 4 }

Dim index As Integer = 0
While (index < size)
    Print array(index)
    index += 1
Wend
```

**Operator >= (Greater than or equal)** is complement to `operator < (Less than)` functionally identical when combined with **Operator Not (Bit-wise Complement)**.

```
If (69 < 420) Then Print "(69 < 420) is true."
If Not (69 >= 420) Then Print "not (69 >= 420)"
```

**Dialect Differences**

- In the `-lang qb` dialect, this operator cannot be overloaded.

**Differences from QB**

- none

**See also**

- `Operator >= (Greater than or equal)`
Operator <= (Less Than Or Equal)

Compares an expression less than or equal to another expression

**Syntax**

```plaintext
Declare Operator <= ( ByRef lhs As Byte, ByRef rhs As Byte ) As Integer
Declare Operator <= ( ByRef lhs As UByte, ByRef rhs As UByte ) As Integer
Declare Operator <= ( ByRef lhs As Short, ByRef rhs As Short ) As Integer
Declare Operator <= ( ByRef lhs As UShort, ByRef rhs As UShort ) As Integer
Declare Operator <= ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator <= ( ByRef lhs As UInteger, ByRef rhs As UInteger ) As Integer
Declare Operator <= ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As Integer
Declare Operator <= ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As Integer
Declare Operator <= ( ByRef lhs As Single, ByRef rhs As Single ) As Integer
Declare Operator <= ( ByRef lhs As Double, ByRef rhs As Double ) As Integer
Declare Operator <= ( ByRef lhs As String, ByRef rhs As String ) As Integer
Declare Operator <= ( ByRef lhs As ZString, ByRef rhs As ZString ) As Integer
Declare Operator <= ( ByRef lhs As WString, ByRef rhs As WString ) As Integer
Declare Operator <= ( ByRef lhs As T, ByRef rhs As T ) As Integer
```

**Usage**

```plaintext
result = lhs <= rhs
```

**Parameters**

- `lhs`
  The left-hand side expression to compare to.
- `rhs`
  The right-hand side expression to compare to.
- `T`
  Any pointer type.

**Return Value**

Returns negative one (-1) if the left-hand side expression is less than right-hand side expression, or zero (0) if greater than.

**Description**
**Operator <= (Less than or Equal)** is a binary operator that compares less than or equal to another expression and returns the result - a boolean form of an **Integer**: negative one (-1) for true and zero (0) for false. The arguments are not modified in any way.

This operator can be overloaded to accept user-defined types as well.

**Example**

Operator > (Greater than) is complement to **Operator <= (Less than or Equal)** functionally identical when combined with **Operator Not (Bit-wise Complement)**:

```
If (69 <= 420) Then Print "(69 <= 420) is true.
If Not (60 > 420) Then Print "not (420 > 69) is true.
```

**Dialect Differences**

- In the **-lang qb** dialect, this operator cannot be overloaded.

**Differences from QB**

- none

**See also**

- **Operator > (Greater than)**
Operator >= (Greater Than Or Equal)

Compares an expression greater than or equal to another expression

Syntax

Declare Operator >= ( ByRef lhs As Byte, ByRef rhs As Byte ) As
Declare Operator >= ( ByRef lhs As UByte, ByRef rhs As UByte ) As
Declare Operator >= ( ByRef lhs As Short, ByRef rhs As Short ) As
Declare Operator >= ( ByRef lhs As UShort, ByRef rhs As UShort ) As
Declare Operator >= ( ByRef lhs As Integer, ByRef rhs As Integer ) As
Declare Operator >= ( ByRef lhs AsUInteger, ByRef rhs AsUInteger ) As
Declare Operator >= ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As
Declare Operator >= ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As
Declare Operator >= ( ByRef lhs As Single, ByRef rhs As Single ) As
Declare Operator >= ( ByRef lhs As Double, ByRef rhs As Double ) As
Declare Operator >= ( ByRef lhs As String, ByRef rhs As String ) As
Declare Operator >= ( ByRef lhs As ZString, ByRef rhs As ZString ) As
Declare Operator >= ( ByRef lhs As WString, ByRef rhs As WString ) As
Declare Operator >= ( ByRef lhs As T, ByRef rhs As T ) As Integer

Usage

result = lhs >= rhs

Parameters

lhs
The left-hand side expression to compare to.

rhs
The right-hand side expression to compare to.

T
Any pointer type.

Return Value

Returns negative one (-1) if the left-hand side expression is greater than the right-hand side expression, or zero (0) if less than.

Description
**Operator >= (Greater than or Equal)** is a binary operator that compares greater than or equal to another expression and returns the result - a boolean value in the form of an *Integer*: negative one (-1) for true and zero (0) for false. The arguments are not modified in any way.

This operator can be overloaded to accept user-defined types as well.

**Example**

Operator < (Less than) is complement to operator >= (Greater than or Equal) functionally identical when combined with Operator Not (Bit-wise Complement).

```
If (420 >= 69) Then Print "(420 >= 69) is true.
If Not (420 < 69) Then Print "not (420 < 69) is
```

**Dialect Differences**

- In the -lang qb dialect, this operator cannot be overloaded.

**Differences from QB**

- none

**See also**

- **Operator < (Less than)**
**Operator > (Greater Than)**

Compares an expression greater than another expression

**Syntax**

```
Declare Operator > ( ByRef lhs As Byte, ByRef rhs As Byte ) As Integer
Declare Operator > ( ByRef lhs As UByte, ByRef rhs As UByte ) As Integer
Declare Operator > ( ByRef lhs As Short, ByRef rhs As Short ) As Integer
Declare Operator > ( ByRef lhs As UShort, ByRef rhs As UShort ) As Integer
Declare Operator > ( ByRef lhs As Integer, ByRef rhs As Integer ) As Integer
Declare Operator > ( ByRef lhs AsUInteger, ByRef rhs As UInteger ) As Integer
Declare Operator > ( ByRef lhs As LongInt, ByRef rhs As LongInt ) As Integer
Declare Operator > ( ByRef lhs As ULongInt, ByRef rhs As ULongInt ) As Integer
Declare Operator > ( ByRef lhs As Single, ByRef rhs As Single ) As Integer
Declare Operator > ( ByRef lhs As Double, ByRef rhs As Double ) As Integer
Declare Operator > ( ByRef lhs As String, ByRef rhs As String ) As Integer
Declare Operator > ( ByRef lhs As ZString, ByRef rhs As ZString ) As Integer
Declare Operator > ( ByRef lhs As WString, ByRef rhs As WString ) As Integer
Declare Operator > ( ByRef lhs As T, ByRef rhs As T ) As Integer
```

**Usage**

```
result = lhs > rhs
```

**Parameters**

- `lhs`
  The left-hand side expression to compare to.

- `rhs`
  The right-hand side expression to compare to.

- `T`
  Any pointer type.

**Return Value**

Returns negative one (-1) if the left-hand side expression is greater than the right-hand side expression, or zero (0) if less than or equal.
Operator > (Greater than) is a binary operator that compares one expression to another expression and returns the result - a boolean value in the form negative one (-1) for true and zero (0) for false. The arguments are not modified in any way.

This operator can be overloaded to accept user-defined types as well.

**Example**

Operator <= (Less than or equal) is complement to operator > (Greater than) functionally identical when combined with Operator Not (Bit-wise Complement).

```plaintext
If (420 > 69) Then Print "(420 > 69) is true."
If Not (420 <= 69) Then Print "not (420 <= 69)"
```

**Dialect Differences**

- In the -lang qb dialect, this operator cannot be overloaded.

**Differences from QB**

- none

**See also**

- Operator <= (Less than or equal)
Operator # (Preprocessor Stringize)

Preprocessor operator to convert macro arguments to strings

Syntax

```
#macro_argument
```

Description

This operator converts the `macro_argument` into a string whose value is the name of the argument. This substitution is made during the macro expansion, previous to compilation.

_Note: because of this feature, care should be taken when using file-handling statements in a macro. Because of potential ambiguity with file-handling statements that take a "#filenum" parameter, if filenum is one of the macro parameters, it may be necessary to wrap the filenum expression in parenthesis (e.g. "#(filenum)") to separate it from the # sign. Otherwise, filenum will be stringized in the macro._

Example

```vbnet
#define SEE(x) Print #x ;" = "; x
Dim variable As Integer, another_one As Integer
variable=1
another_one=2
SEE(variable)
SEE(another_one)
```

Output:

```
variable = 1
another_one = 2
```
Differences from QB

- New to FreeBASIC

See also

- Preprocessor
Operator ## (Preprocessor Concatenate)

Preprocessor operator to concatenate strings

Syntax

text##text

Description

This operator creates a new token by concatenating the texts at both sides of it. This text can be recognized by other macros and further expanded. One use, is to create a macro that expands to different macro names, variable names, and function names depending on the arguments received.

Example

```plaintext
#define Concat(t,n) t##n

Print concat (12,34)

Dim Concat (hello,world) As Integer
Concat (hello,world)=99
Print helloworld
```

Output:

```
1234
99
```

Differences from QB

- New to FreeBASIC

See also
- **Preprocessor**
Operator ! (Escaped String Literal)

Explicitly indicates that a string literal should be processed for escape sequences.

**Syntax**

```
!"text"
```

**Parameters**

```
!
```

The preprocessor escaped string operator

```
"text"
```

The string literal containing escape characters

**Description**

This operator explicitly indicates that the string literal following it (wrapped in double quotes) should be processed for escape sequences. This a preprocessor operator and can only be used with string literals at compile time.

The default behavior for string literals is that they not be processed for escape sequences. Option Escape can be used in the -lang fblite dialect to override this default behaviour causing all strings to be processed for escape sequences.

Use the $ Operator (Non-Escaped String Literal) operator to explicitly indicate that a string should not be processed for escape sequences.

**Example**

```
Print "Some escape sequence examples:"
Print !"1.\tsingle quote (\\\') : \"
Print !"2.\tdouble quote (\\\\") : \"
Print !"3.\tbackslash (\\\\\\\") : "
Print !"4.\tascii char (\\65) : \65"
```
OUTPUT:

```
Some escape sequence examples:
1. single quote (\') : ' 
2. double quote (\") : " 
3. backslash (\\) : \ 
4. ascii char (\65) : A 
```

Differences from QB

- New to FreeBASIC

See also

- Operator $ (Non-Escaped String Literal)
- Option Escape
- Preprocessor
- Literals
- Escape Sequences
Operator $ (Non-Escaped String Literal)

Explicitly indicates that a string literal should not be processed for escape sequences.

**Syntax**

```
$"text"
```

**Parameters**

$  
The preprocessor non-escaped operator
"text"  
The string literal

**Description**

This operator explicitly indicates that the string literal following it (wrapped in double quotes) should not be processed for escape sequences. This a preprocessor operator and can only be used with string literals at compile time.

The default behavior for string literals is that they not be processed for escape sequences. However, Option Escape in the `-lang fblite` dialect can be used to override this default behaviour causing all strings to be processed for escape sequences.

Use the ! Operator (Escaped String Literal) to explicitly indicate that a string should be processed for escape sequences.

**Example**

```
'' Compile with -lang fblite or qb
#lang "fblite"
Print "Default"
Print "Backslash  : \\"
```
Print !"Backslash !: \\
Print "$"Backslash $: \\
Print

Option Escape

Print "Option Escape"
Print "Backslash : \\
Print !"Backslash !: \\
Print "$"Backslash $: \\
Print

'' OUTPUT:

'' Default
'' Backslash : \\
'' Backslash !: \\
'' Backslash $: \\

'' Option Escape
'' Backslash : \\
'' Backslash !: \\
'' Backslash $: \\

---

**Differences from QB**

- New to FreeBASIC

**See also**

- **Operator ! (Escaped String Literal)**
- **Option Escape**
- **Preprocessor**
- **Literals**
- **Escape Sequences**
Operator @ (Address Of)

Returns the address of a string literal, variable, object or procedure

Syntax

Declare Operator @ ( ByRef rhs As T ) As T Pointer

Usage

result = @ rhs

Parameters

rhs

The string literal, variable, object or procedure to retrieve the address

T

Any standard, user-defined or procedure type.

Return Value

Returns the address of the right-hand side (rhs) operand.

Description

Operator @ (Address of) returns the memory address of its operand.

When the operand is of type String, the address of the internal string pointer) to retrieve the address of the string data.

The operand cannot be an array, but may be an array element. For ex
"myarray(0)".

This operator can be overloaded for user-defined types.

Example

'This program demonstrates the use of the @ operator.

Dim a As Integer
Dim b As Integer
Dim addr As Integer Ptr

a = 5 'Here we place the values 5 and 10 into a
b = 10

'Here, we print the value of the variables, then we
Print "The value in A is "; a; " but the pointer to
Print "The value in B is "; b; " but the pointer to

'Now, we will take the integer ptr above, and use
'Note that the * will check the value in the ptr,
'for a normal variable.

addr = @a

Print "The pointer addr is now pointing at the mem
addr = @b

Print "The pointer addr is now pointing at the mem

'This program demonstrates how the @ symbol can be
'to create pointers to subroutines.

Declare Sub mySubroutine ()

Dim say_Hello As Sub() 

say_Hello = @mySubroutine 'We tell say_Hello to
'sub() datatype ac

say_Hello() 'Now we can run say_Hello just like my

Sub mySubroutine
Dialect Differences

- In the *-lang qb* dialect, this operator cannot be overloaded.

Differences from QB

- New to FreeBASIC

See also

- Operator * (Value Of)
- Pointers
Operator * (Value Of)

Dereferences a pointer

**Syntax**

```plaintext
Declare Operator * ( ByRef rhs As T Pointer ) ByRef As T
```

**Usage**

```plaintext
result = * rhs
```

**Parameters**

- `rhs`
  - The address to dereference.
- `T`
  - Any **standard, user-defined** or procedure type.

**Return Value**

Returns a reference to the value stored at the address `rhs`.

**Description**

- **Operator * (Value of)** returns a reference to the value stored at an address. The operand is not modified in any way.

- As a reference, the result of this operator can be used on the left-hand side of assignments.

- This operator can be overloaded for user-defined types.

**Example**

```plaintext
'This program demonstrates the use of * to utilize
Dim a As Integer
Dim pa As Integer Ptr

pa = @a 'Here, we use the @ operator to point our integer pointer to
```
' 'a' is, in this case, a standard integer variable.
a = 9  'Here we give 'a' a value of 9.
Print "The value of 'a' is"; *pa  'Here, we display
*pa = 1  'Here we use our pointer to change the value
Print "The new value of 'a' is"; a  'Here we display

Output:

The value of 'a' is 9
The new value of 'a' is 1

Dialect Differences
  - In the -lang qb dialect, this operator cannot be overloaded.

Differences from QB
  - New to FreeBASIC

See also
  - Operator @ (Address Of)
  - Operator [] (Pointer Index)
  - Pointers
Operator . (Member Access)

Returns a reference to a member from a reference to an object

Syntax

Declare Operator . ( ByRef lhs As T ) ByRef As U

Usage

result = lhs . rhs

Parameters

lhs
An object.

T
A user-defined type.

rhs
The name of a member to access.

U
The type that rhs refers to.

Return Value

Returns a reference to the member specified by rhs.

Description

Operator . (Member access) returns a reference to a member of an object.

Operator . (Member access) can also be used to access members of an implicit object inside a With..End With block.

This operator cannot be overloaded.

Example
Type T
   As Integer  a, b
End Type

Dim x As T

' ' Access the member 'a' of x.
x.a = 10

' ' Access the member 'b' of x.
With x
   .b = 20
End With

**Dialect Differences**
- None

**Differences from QB**
- None

**See also**
- Operator -> (Pointer To Member Access)
- Operator @ (Address Of)
- Operator * (Value Of)
- With..End With
Operator -> (Pointer To Member Access)

Returns a reference to a member from a pointer to an object

Syntax

Declare Operator -> ( ByRef lhs As T Ptr ) ByRef As U

Usage

result = lhs -> rhs

Parameters

lhs
The address of an object.
T
A user-defined type.
rhs
The name of a member to access.
U
The type that rhs refers to.

Return Value

Returns a reference to the member specified by rhs.

Description

Operator -> (Pointer to member access) returns a reference to a member of an object through a pointer to that object. It has the effect of dereferencing a pointer to an object, then using Operator . (Member Access). For example, "p->member" is equivalent to "x.member", if x is an object of user-defined type and p is a pointer to an object of the same type.

This operator can be overloaded for user-defined types.

Example
Type rect
    x As Integer
    y As Integer
End Type

Dim r As rect
Dim rp As rect Pointer = @r

rp->x = 4
rp->y = 2

Print "x = " & rp->x & ", y = " & rp->y
Sleep

Dialect Differences

- Not available in the `-lang qb` dialect.

Differences from QB

- New to FreeBASIC

See also

- Operator . (Member Access)
- Operator @ (Address Of)
- Operator * (Value Of)
Operator For (Iteration)

Declares or defines operators used by a For...Next loop with user defined type variables

Syntax

{ Type | Class | Union } typename
Declare Operator For ()
Declare Operator For ( [ ByVal ] stp As typename )
...
End { Type | Class | Union }

Usage

For iterator [ As typename ] = start_value To end_value [ Step step_value ]
[ ...statements... ]
Next

Parameters

typename
name of the Type, Class, or Union
stp, step_value
a typename object used as an incremental value
iterator
a typename object used as an iterator
end_value
a typename object used as a loop-terminating value
start_value
a typename object used to copy construct or assign to the iterator initially

Description

Operator For, Operator Next and Operator Step can be overloaded in user-defined type definitions to allow objects of that type to be used as iterators and step values in For...Next loops.

Operator For is called immediately after copy constructing or assigning to the iterator object, and allows the object to perform any additional
initialization needed in preparation for the loop.

The first version of **Operator For** is used if no step value is given in the **For...Next** statement. If a step value is given, the second version is used and is passed the step value.

**Example**

See the **Operator Step** examples.

**Dialect Differences**

- Only available in the `-lang fb` dialect.

**See also**

- **Operator Next**
- **Operator Step**
- **For...Next**
# Variable Declarations

Statements to declare and allocate space for variables.

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## User Defined Types

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Standard Data Types

Built-in data types

**Integer types**
Types that store integer values, whose range is determined by the size of the data type and its signedness.

**Floating-point types**
Types that store real number values, whose range and precision is determined by the size of the data type.

**Boolean types**
Types that store boolean values.

**Data Type Modifiers**
Specifies additional characteristics of a standard or user-defined data type.

**String types**
Types that store or point to an array of characters.

**Class types**
Types that provide special capabilities to be used directly or to be extended by user-defined types

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<td>management.</td>
</tr>
<tr>
<td><strong>LongInt and ULongInt</strong></td>
<td></td>
</tr>
<tr>
<td>64-bit wide data types</td>
<td></td>
</tr>
<tr>
<td>that store integer</td>
<td></td>
</tr>
<tr>
<td>values.</td>
<td></td>
</tr>
</tbody>
</table>
Floating-point types

**Single**
32-bit wide data types that store real number values.

**Double**
64-bit wide data types that store real number values.

Boolean types

**Boolean**
1-bit wide data types that store boolean values.

See also

- Variable types and limits

Class types

**Object**
Super class providing run-time type information
# Standard Data Type Limits

Standard variable types and limits.

## Numeric Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Size in bits</th>
<th>Format</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BYTE</td>
<td>8</td>
<td>signed integer</td>
<td>-128</td>
<td>+127</td>
</tr>
<tr>
<td>UBYTE</td>
<td>8</td>
<td>unsigned integer</td>
<td>0</td>
<td>+255</td>
</tr>
<tr>
<td>SHORT</td>
<td>16</td>
<td>signed integer</td>
<td>-32768</td>
<td>+32767</td>
</tr>
<tr>
<td>USHORT</td>
<td>16</td>
<td>unsigned integer</td>
<td>0</td>
<td>65535</td>
</tr>
<tr>
<td>LONG</td>
<td>32</td>
<td>signed integer</td>
<td>-2147483648</td>
<td>+2147483647</td>
</tr>
<tr>
<td>ULONG</td>
<td>32</td>
<td>unsigned integer</td>
<td>0</td>
<td>+4294967295</td>
</tr>
<tr>
<td>INTEGER</td>
<td>32/64 [*]</td>
<td>signed integer</td>
<td>[*]32bit: -2147483648, 64bit: -9223372036854775808</td>
<td>[*]32bit: +2147483647, 64bit: +9223372036854775807</td>
</tr>
<tr>
<td>UINTGER</td>
<td>32/64 [*]</td>
<td>unsigned integer</td>
<td>0</td>
<td>[*]32bit: +4294967295, 64bit: +18446744073709551615</td>
</tr>
<tr>
<td>LONGINT</td>
<td>64</td>
<td>signed integer</td>
<td>-9223372036854775808</td>
<td>+9223372036854775807</td>
</tr>
<tr>
<td>ULONGINT</td>
<td>64</td>
<td>unsigned integer</td>
<td>0</td>
<td>+18446744073709551615</td>
</tr>
<tr>
<td>SINGLE</td>
<td>32</td>
<td>floating point</td>
<td>[<em>]</em>/-1.401 298 E-45</td>
<td>[<em>]</em>/-3.402 823 E+38</td>
</tr>
<tr>
<td>DOUBLE</td>
<td>64</td>
<td>floating point</td>
<td>[<em>]</em>/-4.940 656 458 412 465 E-324</td>
<td>[<em>]</em>/-1.797 693 134 862 31 E+308</td>
</tr>
<tr>
<td>enums</td>
<td>32/64 [*]</td>
<td>signed integer</td>
<td>[*]32bit: -2147483648, 64bit: -9223372036854775808</td>
<td>[*]32bit: +2147483647, 64bit: +9223372036854775807</td>
</tr>
</tbody>
</table>

[*] Integer and UINTGER data types vary with platform, matching the size of pointers.

[**] The minimum and maximum values for the floating-point types SINGLE and DOUBLE respectively, the values closest to zero and the values closest to positive infinity.
infinity.

### String Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Character Size (in bytes)</th>
<th>Minimum Size (in characters)</th>
<th>Maximum Size (in characters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>1</td>
<td>0</td>
<td>[**]32bit: +2147483647, 64bit: +9223372036854775807</td>
</tr>
<tr>
<td>Zstring</td>
<td>1</td>
<td>0</td>
<td>[**]32bit: +2147483647, 64bit: +9223372036854775807</td>
</tr>
<tr>
<td>Wstring</td>
<td>[*]</td>
<td>[*]0</td>
<td>[*,**]32bit: +2147483647, 64bit: +9223372036854775807</td>
</tr>
</tbody>
</table>

[*] Unicode, or "wide", characters vary in both size and availability with platform.

[**] All runtime library string procedures take and produce Integer values for sizes and positions. The actual maximum size will vary (smaller) with storage location and/or platform.

### Arrays

<table>
<thead>
<tr>
<th>Platform</th>
<th>Maximum Subscript Range</th>
<th>Maximum Elements per Dimension</th>
<th>Minimum/Maximum Dimensions</th>
<th>Max:</th>
</tr>
</thead>
<tbody>
<tr>
<td>32bit</td>
<td>[*][−2147483648, +2147483647]</td>
<td>[*]+2147483647</td>
<td>1/9</td>
<td>[*]+</td>
</tr>
<tr>
<td>64bit</td>
<td>[*][−9223372036854775808, +9223372036854775807]</td>
<td>[*]+9223372036854775807</td>
<td>1/9</td>
<td>[*]+</td>
</tr>
</tbody>
</table>

[*] All runtime library array procedures take and produce Integer values for indexes. The actual limits will vary (smaller) with the number of dimensions, size, storage location and/or platform.

### See also

- ProPgIdentifierRules usage of suffixes for variables
- ProPgLiterals usage of suffixes for literals / numbers
Converting Data Types

Operators and procedures that convert between different types.

**Generic conversions**
Operators to convert between arbitrary types.

**Conversions to integral types**
Operators to convert to integral types.

**Conversions to floating-point types**
Operators to convert to floating-point types.

**Conversions to/from string types**
Operators to convert top an from string types.

**Conversion to boolean types**
Operators to convert to boolean types.

<table>
<thead>
<tr>
<th>Generic conversions</th>
<th>Conversions to floating-point types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cast</strong> and <strong>CPtr</strong></td>
<td><strong>CSng</strong> and <strong>CDbI</strong></td>
</tr>
<tr>
<td>Converts expressions between different types.</td>
<td>Converts a numeric or string expression to floating-point values.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Conversions to integral types</strong></th>
<th><strong>Conversions to/from string types</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CByte</strong> and <strong>CUByte</strong></td>
<td><strong>Str</strong> and <strong>WStr</strong></td>
</tr>
<tr>
<td>Converts numeric expressions to 8-bit values.</td>
<td>Converts numeric expressions or booleans to their string representation.</td>
</tr>
<tr>
<td><strong>CShort</strong> and <strong>CUShort</strong></td>
<td><strong>Val</strong></td>
</tr>
<tr>
<td>Converts numeric expressions to 16-bit values.</td>
<td>Converts a numeric string expression to a floating-point value.</td>
</tr>
<tr>
<td><strong>CLng</strong> and <strong>CULng</strong></td>
<td><strong>ValInt</strong> and <strong>ValUInt</strong></td>
</tr>
<tr>
<td>Converts numeric expressions to 32-bit values.</td>
<td>Converts numeric string expressions to integer values.</td>
</tr>
<tr>
<td><strong>CInt</strong> and <strong>CUInt</strong></td>
<td><strong>ValLng</strong> and <strong>ValULng</strong></td>
</tr>
<tr>
<td>Converts numeric expressions to 32-bit or 64-bit values.</td>
<td>Converts numeric string</td>
</tr>
<tr>
<td><strong>CLngInt</strong> and <strong>CULngInt</strong></td>
<td></td>
</tr>
<tr>
<td>Converts numeric expressions to 64-bit values.</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>CUnsg</td>
<td>Converts a numeric expression to a signed-type value.</td>
</tr>
<tr>
<td>CUnsg</td>
<td>Converts a numeric expression to an unsigned-type value.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion to boolean types Cbool</td>
<td>Converts a numeric or string expression to a boolean value.</td>
</tr>
</tbody>
</table>
Operators

Procedures that operate on one or more operands.

FreeBASIC has numerous operators that perform a certain function with their operands. Many operators use a "operand operator operand" syntax, like `Operator = (Assignment)` or `Operator +`, while others are called like normal procedures, like `Operator Strptr`.

<table>
<thead>
<tr>
<th>Assignment operators</th>
<th>String operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators which assign the value of one operand to the other.</td>
<td>Operators overloaded to work with strings.</td>
</tr>
<tr>
<td><strong>Arithmetic operators</strong></td>
<td><strong>Preprocessor operators</strong></td>
</tr>
<tr>
<td>Operators that perform mathematical computations on their operands and return the result.</td>
<td>Operators that control preprocessor behavior.</td>
</tr>
<tr>
<td><strong>Conditional operators</strong></td>
<td><strong>Pointer operators</strong></td>
</tr>
<tr>
<td>Operators that compare the relationship between their operands.</td>
<td>Operators that work with pointers and addresses.</td>
</tr>
<tr>
<td><strong>Logical operators</strong></td>
<td><strong>Type or Class operators</strong></td>
</tr>
<tr>
<td>Operators that perform bitwise computations with their operands and return the result.</td>
<td>Operators that provide access to Type or Class members.</td>
</tr>
<tr>
<td><strong>Short circuit operators</strong></td>
<td><strong>Memory operators</strong></td>
</tr>
<tr>
<td>Operators that perform short circuit evaluations with their operands and return the result.</td>
<td>Operators that allocate memory for and construct objects.</td>
</tr>
<tr>
<td><strong>Indexing operators</strong></td>
<td><strong>Iterating operators</strong></td>
</tr>
<tr>
<td>Operators that return references to variables or objects based on an index value.</td>
<td>Operators that use iterator objects in <code>For...Next</code> statements.</td>
</tr>
</tbody>
</table>
Assignment Operators

Operators that assign values to operands

The assignment operators perform an assignment to the first, or *left-hand side*, operand based on the value of the second, or *right-hand side*, operand. Most of the assignment operators are combination operators, i.e., they first perform a mathematical or bitwise operation on the two operands, then assign the result to the *left-hand side* operand.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>=</code></td>
<td>(Assignment) Assigns the value of one operand to the other.</td>
</tr>
<tr>
<td><code>&amp;=</code></td>
<td>(Concatenate And Assign) Assigns the value of a concatenation between two operands.</td>
</tr>
<tr>
<td><code>+=</code></td>
<td>(Add And Assign) Assigns the value of an addition between two operands.</td>
</tr>
<tr>
<td><code>-=</code></td>
<td>(Subtract And Assign) Assigns the value of a subtraction between two operands.</td>
</tr>
<tr>
<td><code>*=</code></td>
<td>(Multiply And Assign) Assigns the value of a multiplication between two operands.</td>
</tr>
<tr>
<td><code>/=</code></td>
<td>(Divide And Assign) Assigns the value of a division between two operands.</td>
</tr>
<tr>
<td><code>\=</code></td>
<td>(Integer Divide And Assign) Assigns the value of an integer division.</td>
</tr>
<tr>
<td><code>Mod=</code></td>
<td>(Modulus And Assign) Assigns the value of a modulus between two operands.</td>
</tr>
<tr>
<td><code>And=</code></td>
<td>(Conjunction And Assign) Assigns the value of a bitwise conjunction between two operands.</td>
</tr>
<tr>
<td><code>Eqv=</code></td>
<td>(Equivalence And Assign) Assigns the value of a bitwise equivalence between two operands.</td>
</tr>
<tr>
<td><code>Imp=</code></td>
<td>(Implication And Assign) Assigns the value of a bitwise implication between two operands.</td>
</tr>
<tr>
<td><code>Or=</code></td>
<td>(Inclusive Disjunction And Assign) Assigns the value of a bitwise inclusive or between two operands.</td>
</tr>
<tr>
<td><code>Xor=</code></td>
<td>(Exclusive Disjunction And Assign) Assigns the value of a bitwise exclusive or between two operands.</td>
</tr>
</tbody>
</table>
divide between two operands. **Operator ^= (Exponentiate And Assign)**
Assigns the value of a exponentiation between two operands.

**Operator Let (Assignment)**
Assigns the value of one user defined type to another.

**Operator Let() (Assignment)**
Assigns the fields of a user defined type to a list of variables.

exclusive or between two operands. **Operator Shl= (Shift Left And Assign)**
Assigns the value of a bitwise shift left of an operand.

**Operator Shr= (Shift Right And Assign)**
Assigns the value of a bitwise shift right of an operand.
### Arithmetic Operators

Operators that can be used in mathematical expressions

The mathematical operators perform mathematical operations with the values of their operands and return the results.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ (Add)</td>
<td>Returns the result of an addition of two operands.</td>
</tr>
<tr>
<td>- (Subtract)</td>
<td>Returns the result of a subtraction of two operands.</td>
</tr>
<tr>
<td>* (Multiply)</td>
<td>Returns the result of a multiplication of two operands.</td>
</tr>
<tr>
<td>/ (Divide)</td>
<td>Returns the result of a division of two operands.</td>
</tr>
<tr>
<td>\ (Integer Divide)</td>
<td>Returns the result of an integer divide of two operands.</td>
</tr>
<tr>
<td>^ (Exponentiate)</td>
<td>Returns the result of an exponentiation of two operands.</td>
</tr>
<tr>
<td>Mod</td>
<td>Returns the result of a modulus of two operands.</td>
</tr>
<tr>
<td>- (Negate)</td>
<td>Returns the result of a negation of an operand.</td>
</tr>
<tr>
<td>Shl</td>
<td>Returns the result of a bitwise shift left of an operand.</td>
</tr>
<tr>
<td>Shr</td>
<td>Returns the result of a bitwise shift right of an operand.</td>
</tr>
</tbody>
</table>
Relational Operators

Operators that compare relationships

The relational operators perform comparisons between the values of two operands. Each operator returns a boolean result that is true (-1) if the relationship holds true, or false (0) if not.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator = (Equal)</td>
<td>Compares the equal relation of two operands.</td>
</tr>
<tr>
<td>Operator &lt;&gt; (Not Equal)</td>
<td>Compares the inequality relation of two operands.</td>
</tr>
<tr>
<td>Operator &lt; (Less Than)</td>
<td>Compares the less than relation of two operands.</td>
</tr>
<tr>
<td>Operator &lt;= (Less Than Or Equal)</td>
<td>Compares the less than or equal relation of two operands.</td>
</tr>
<tr>
<td>Operator &gt;= (Greater Than Or Equal)</td>
<td>Compares the greater than or equal relation of two operands.</td>
</tr>
<tr>
<td>Operator &gt; (Greater Than)</td>
<td>Compares the greater than relation of two operands.</td>
</tr>
</tbody>
</table>

| Operator Is (Run-Time Type Information) | Checks whether an object is of a certain type. |

Logical Operators

Operators that perform bitwise logic

The logical operators perform logical operations on the values of their operands, and return the results. These operators are *bitwise* operators, in that the results are found by performing logical operations on each bit of their operands.

<table>
<thead>
<tr>
<th>Operator And (Conjunction)</th>
<th>Operator Eqv (Equivalence)</th>
<th>Operator Imp (Implication)</th>
<th>Operator Not (Complement)</th>
<th>Operator Or (Inclusive Disjunction)</th>
<th>Operator Xor (Exclusive Disjunction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns the result of a bitwise conjunction of two operands.</td>
<td>Returns the result of a bitwise equivalence of two operands.</td>
<td>Returns the result of a bitwise implication of two operands.</td>
<td>Returns the result of a bitwise complement of an operand.</td>
<td>Returns the result of a bitwise inclusive or of two operands.</td>
<td>Returns the result of a bitwise exclusive or of two operands.</td>
</tr>
</tbody>
</table>
Short Circuit Operators

Operators that perform a short circuit logical evaluation.

The short circuit operators perform a evaluation on the left hand operand and depending on the result, may go on to evaluate the right hand side. The evaluations take place logically, in a comparison to zero.

<table>
<thead>
<tr>
<th>Operator Andalso (Short Circuit Conjunction)</th>
<th>Operator Orelse (Short Circuit Inclusive Disjunction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns the result of a short circuit conjunction of two operands.</td>
<td>Returns the result of a short circuit inclusive or of two operands.</td>
</tr>
</tbody>
</table>
Indexing Operators

Operators that return references based on an index

The indexing operators return references to some memory based on the value of their second, or *right-hand side*, operand. This operand is used as an index, or offset, from the beginning of some memory represented by the first, or *left-hand side*, operand.

<table>
<thead>
<tr>
<th>Operator () (Array Index)</th>
<th>Returns a reference to an element in an array.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator [] (String Index)</td>
<td>Returns a reference to a character in a string.</td>
</tr>
<tr>
<td>Operator [] (Pointer Index)</td>
<td>Returns a reference to memory offset from a base address.</td>
</tr>
</tbody>
</table>
String Operators

Operators that work with strings

These operators provide conversion to string, concatenation and retrieval of character data.

**Operator + (String Concatenation)**
Concatenates two strings.

**Operator & (String Concatenation With Conversion)**
Concatenates two values converted to strings.

**Operator Strptr (String Pointer)**
Returns the address of a string's character data.
**Preprocessor Operators**

Operators that are executed by the preprocessor

These operators control how text is interpreted by the preprocessor.

<table>
<thead>
<tr>
<th>Operator # (Stringize)</th>
<th>Operator ! (Escaped String Literal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns a text operand converted to a <strong>String literal.</strong></td>
<td>Indicates string literal immediately following must be processed for escape sequences.</td>
</tr>
<tr>
<td><strong>Operator ## (Concatenation)</strong></td>
<td><strong>Operator $ (Non-Escaped String Literal)</strong></td>
</tr>
<tr>
<td>Concatenates two text operands.</td>
<td>Indicates string literal immediately following must not be processed for escape sequences.</td>
</tr>
</tbody>
</table>
Operators that work with pointers

The pointer operators provide the ability to retrieve the addresses in memory of their operands, and to use, or dereference, that memory.

<table>
<thead>
<tr>
<th>Operator Varptr (Variable Pointer)</th>
<th>Operator @ (Address Of)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns the memory address of a variable.</td>
<td>Returns the memory address of a variable, object or procedure.</td>
</tr>
<tr>
<td>Operator Strptr (String Pointer)</td>
<td>Operator * (Value Of)</td>
</tr>
<tr>
<td>Returns the memory address of a string's character data.</td>
<td>Returns a reference to a variable or object at some memory address.</td>
</tr>
<tr>
<td>Operator Procptr (Procedure Pointer)</td>
<td></td>
</tr>
<tr>
<td>Returns the memory address of a procedure.</td>
<td></td>
</tr>
</tbody>
</table>
## Type or Class Operators

Operators that work with objects

These operators return references to members of objects, given an object or its memory address.

<table>
<thead>
<tr>
<th>Operator . (Member Access)</th>
<th>Operator Is (Run-Time Type Information)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns a reference to a member.</td>
<td>Checks whether an object is compatible to a type derived from its runtime-type.</td>
</tr>
<tr>
<td><strong>Operator -&gt; (Pointer To Member Access)</strong></td>
<td></td>
</tr>
<tr>
<td>Returns a reference to a member from a pointer.</td>
<td></td>
</tr>
</tbody>
</table>
Memory Operators

Operators that work with memory

The memory operators provide a way to dynamically allocate and deallocate variables and objects.

<table>
<thead>
<tr>
<th>Operator New</th>
<th>Operator Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocates memory for and constructs objects.</td>
<td>Destroys and deallocates memory for objects.</td>
</tr>
<tr>
<td><strong>Operator Placement New</strong></td>
<td></td>
</tr>
<tr>
<td>Constructs objects at a specified memory location.</td>
<td></td>
</tr>
</tbody>
</table>
Iterating Operators

Operators that work with iterator objects

These operators allow objects of user-defined types to be used as iterators and step values in `For...Next` statements.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator For</strong></td>
<td>Allows an iterator a chance to prepare for the loop.</td>
</tr>
<tr>
<td><strong>Operator Step</strong></td>
<td>Increments an iterator object.</td>
</tr>
<tr>
<td><strong>Operator Next</strong></td>
<td>Determines if the loop should terminate or continue iterating.</td>
</tr>
</tbody>
</table>
Operator Step (Iteration)

Increments the iterator of a `For...Next` loop

**Syntax**

```vbc
{ Type | Class | Union } typename
Declare Operator Step ()
Declare Operator Step ( [ ByRef | ByVal ] stp As typename )
...
End { Type | Class | Union }
```

**Usage**

```vbc
For iterator [ As typename ] = start_value To end_value [ Step s ]
[ ...statements... ]
Next
```

**Parameters**

- `typename`
  - name of the `Type`, `Class`, or `Union`
- `stp`, `step_value`
  - a `typename` object used as an incremental value
- `iterator`
  - a `typename` object used as an iterator
- `end_value`
  - a `typename` object used as a loop-terminating value
- `start_value`
  - a `typename` object used to copy construct or assign to the iterator initia

**Description**

*Operator For, Operator Next* and *Operator Step* can be overloaded in and step values in `For...Next` loops.

*Operator Step* is called to increment the iterator immediately after all statements in the loop, and is passed the step value.

The first version of *Operator Step* is used if no step value is given in the loop and is passed the step value.
Example

' Example Type
Type T
  '' value is set by the constructor
  value As Double
Declare Constructor( ByVal x As Double = 0 )

Declare Operator For( ByRef stp As T )
Declare Operator Step( ByRef stp As T )
Declare Operator Next( ByRef cond As T, ByRef stp As T )
End Type

Constructor T ( ByVal x As Double )
  Print "T iterator constructed with value " & x
  value = x
End Constructor

Operator T.for( ByRef stp As T )
End Operator

Operator T.step( ByRef stp As T )
  Print "incremented by " & stp.value & " in step"
  value += stp.value
End Operator

Operator T.next( ByRef cond As T, ByRef stp As T )
  '' iterator's moving from a high value to a low
  If( stp.value < 0 ) Then
    Return( value >= cond.value )
  Else
    '' iterator's moving from a low value to a high
    Return( value <= cond.value )
  End If
End Operator

' Example Usage. It looks like we are working with numbers, but the iterators have overloaded constructors. The 10, 1, and -1
For i As T = 10 To 1 Step -1
    Print i.value;
Next i

A more practical example demonstrating file iteration based on cha0s

' a class which iterates through files
Type FileIter
    As String pathName, fileName
Declare Constructor( ByRef pathName As String

        Declare Operator For()
        Declare Operator Step()
        Declare Operator Next( ByRef endCond As FileIter
    End Type

Constructor FileIter( ByRef pathName As String )
    this.pathName = pathName
End Constructor

Operator FileIter.for( )
    fileName = Dir(pathName & "/*.*")
End Operator

Operator FileIter.step( )
    fileName = Dir(""")
End Operator

Operator FileIter.next( ByRef endCond As FileIter
    Return(fileName <> endCond.pathName)
    '' the c'tor sets the path name and so we check
End Operator

' example code
' change it to any directory
For i As FileIter = "./" To ""
    Print i.fileName
Next
Another example working with strings:

```vbnet
Type CharIterator
    '' used to build a step var
    Declare Constructor( ByVal r As ZString Ptr )

    '' implicit step versions
    Declare Operator For ( )
    Declare Operator Step( )
    Declare Operator Next( ByRef end_cond As CharIterator )

    '' explicit step versions
    Declare Operator For ( ByRef step_var As CharIterator)
    Declare Operator Step( ByRef step_var As CharIterator)
    Declare Operator Next( ByRef end_cond As CharIterator)

    '' give the current "value"
    Declare Operator Cast( ) As String

Private:
    '' data
    value As String

    '' This member isn't necessary - we could
    '' the step variable on each iteration -
    '' but we choose this method, since we have
    '' to compare strings otherwise. See below.
    is_up As Integer

End Type

Constructor CharIterator( ByVal r As ZString Ptr )
    value = *r
End Constructor

Operator CharIterator.cast( ) As String
    Operator = value
End Operator
```
' implicit step versions

' In this example, we interpret implicit step
' to always mean 'up'

Operator CharIterator.for( )
    Print "implicit step"
End Operator

Operator CharIterator.step( )
    value[0] += 1
End Operator

Operator CharIterator.next( ByRef end_cond As CharIterator)
    Return this.value <= end_cond.value
End Operator

' explicit step versions

' In this example, we calculate the direction
' at FOR, but since the step var is passed to
' each operator, we have the choice to also calcu
' it "on-the-fly". For strings such as this, repe
' may penalize, but if you're working with simpl
' then you may prefer to avoid the overhead of
' an 'is_up' variable.

Operator CharIterator.for( ByRef step_var As CharIterator)
    Print "explicit step"
    is_up = (step_var.value = "up")
End Operator

Operator CharIterator.step( ByRef step_var As CharIterator)
    If( is_up ) Then
        value[0] += 1
    Else
        value[0] -= 1
    End If
End Operator

Operator CharIterator.next( ByRef end_cond As CharIterator)
If( this.is_up ) Then
    Return this.value <= end_cond.value
Else
    Return this.value >= end_cond.value
End If
End Operator

For i As CharIterator = "a" To "z"
    Print i; " ";
Next
Print "done"

For i As CharIterator = "a" To "z" Step "up"
    Print i; " ";
Next
Print "done"

For i As CharIterator = "z" To "a" Step "down"
    Print i; " ";
Next
Print "done"

For i As CharIterator = "z" To "a" Step "up"
    Print i; " ";
Next
Print "done"

Iterating with fractions:

Type fraction
    ' Used to build a step var
Declare Constructor( ByVal n As Integer, ByVal
    ' Implicit step versions
Declare Operator For ( )
Declare Operator Step( )
Declare Operator Next( ByRef end_cond As fract
' Explicit step versions
Declare Operator For ( ByRef step_var As fraction
Declare Operator Step( ByRef step_var As fraction
Declare Operator Next( ByRef end_cond As fraction

' Give the current "value"
Declare Operator Cast( ) As Double
Declare Operator Cast( ) As String

Private:
   As Integer num, den
End Type

Constructor fraction( ByVal n As Integer, ByVal d
   this.num = n : this.den = d
End Constructor

Operator fraction.cast( ) As Double
   Operator = num / den
End Operator

Operator fraction.cast( ) As String
   Operator = num & "/" & den
End Operator

'Some fraction functions
Function gcd( ByVal n As Integer, ByVal m As Integer
   Dim As Integer t
   While m <> 0
      t = m
      m = n Mod m
      n = t
   Wend
   Return n
End Function

Function lcd( ByVal n As Integer, ByVal m As Integer
   Return (n * m) / gcd( n, m )
End Function
Implicit step versions

In this example, we interpret implicit step to mean 1

Operator fraction.for( )
    Print "implicit step"
End Operator

Operator fraction.step( )
    Var lowest = lcd( this.den, 1 )
    Var mult_factor = this.den / lowest
    Dim As fraction step_temp = fraction( 1, 1 )
    this.num *= mult_factor
    this.den *= mult_factor
    step_temp.num *= lowest
    step_temp.den *= lowest
    this.num += step_temp.num
End Operator

Operator fraction.next( ByVal end_cond As fraction )
    Return This <= end_cond
End Operator

Explicit step versions

Operator fraction.for( ByVal step_var As fraction )
    Print "explicit step"
End Operator

Operator fraction.step( ByVal step_var As fraction )
    Var lowest = lcd( this.den, step_var.den )
Var mult_factor = this.den / lowest
Dim As fraction step_temp = step_var

this.num *= mult_factor
this.den *= mult_factor

mult_factor = step_temp.den / lowest

step_temp.num *= mult_factor
step_temp.den *= mult_factor

this.num += step_temp.num
End Operator

Operator fraction.next( ByRef end_cond As fraction)
    If(( step_var.num < 0 ) Or ( step_var.den < 0
        Return This >= end_cond
    Else
        Return This <= end_cond
    End If
End Operator

For i As fraction = fraction(1,1) To fraction(4,1)
    Print i; " ";
Next
Print "done"

For i As fraction = fraction(1,4) To fraction(1,1)
    Print i; " ";
Next
Print "done"

For i As fraction = fraction(4,4) To fraction(1,4)
    Print i; " ";
Next
Print "done"

For i As fraction = fraction(4,4) To fraction(1,4)
    Print i; " ";
Dialect Differences

- Only available in the `-lang fb` dialect.

See also

- Operator For
- Operator Next
- For...Next
Operator Next (Iteration)

Determines if a `For...Next` loop should be terminated

**Syntax**

```basic
{ Type | Class | Union } typename
Declare Operator Next ( [ ByRef | ByVal ] cond As typename ) As Integer
Declare Operator Next ( [ ByRef | ByVal ] cond As typename, [ ByRef | ByVal ] stp As typename ) As Integer
...
End { Type | Class | Union }
```

**Usage**

```basic
For iterator [ As typename ] = start_value To end_value [ Step step_value ]
[ ...statements... ]
Next
```

**Parameters**

- `typename` name of the `Type, Class, or Union`
- `cond, end_value` a `typename` object used as a loop-terminating value
- `stp, step_value` a `typename` object used as an incremental value
- `iterator` a `typename` object used as an iterator
- `start_value` a `typename` object used to copy construct or assign to the iterator initially

**Description**

Operator `For`, `Operator Next` and `Operator Step` can be overloaded in user-defined type definitions to allow objects of that type to be used as iterators and step values in `For...Next` loops.

`Operator Next` is called every time the iterator needs to be checked
against the end value. This happens immediately after the call to its \texttt{Operator For}, and immediately after any calls to its \texttt{Operator Step}. \texttt{Operator Next} should return zero (0) if the loop should be terminated, or non-zero if the loop should continue iterating. The first time \texttt{Operator Next} is called, no statements in the \texttt{For...Next} body, if any, have been executed yet.

The first version of \texttt{Operator Next} is used if no step value is given in the \texttt{For...Next} statement. If a step value is given, the second version is used and is passed the step value.

**Example**

See the \texttt{Operator Step} examples.

**Dialect Differences**

- Only available in the \texttt{-lang fb} dialect.

**See also**

- \texttt{Operator For}
- \texttt{Operator Step}
- \texttt{For...Next}
Operator Precedence

When several operations occur in a single expression, each operation is evaluated and resolved in a predetermined order. This is called the order of operation or operator precedence.

If an operator in an expression has a higher precedence, it is evaluated before an operator of lower precedence.

If operators have equal precedence, they then are evaluated in the order of their associativity. The associativity may be Left-to-Right or Right-to-Left.

As a rule, binary operators (such as +, ^) and unary postfix operators (such as (), ->) are evaluated Left-to-Right, and unary prefix operators (such as Not, @) are evaluated Right-to-Left.

Operators that have an associativity of "N/A" indicate that there is no expression in which the operator can be used where its order of operation would need to be checked, either by precedence or by associativity. Function-like operators such as cast are always the first to be evaluated due to the parentheses required in their syntax. And assignment operators are always the last to be evaluated.

Parentheses can be used to override operator precedence. Operations within parentheses are performed before other operations. Within the parentheses normal operator precedence is used.

The following table lists operator precedence from highest to lowest. Breaks in the table mark the groups of operators having equal precedence.

**Highest Precedence**

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
<th>Associativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAST</td>
<td>Type Conversion</td>
<td>N/A</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Direction</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>PROCPTR</td>
<td>Procedure pointer</td>
<td>N/A</td>
</tr>
<tr>
<td>STRPTR</td>
<td>String pointer</td>
<td>N/A</td>
</tr>
<tr>
<td>VARPTR</td>
<td>Variable pointer</td>
<td>N/A</td>
</tr>
<tr>
<td>[]</td>
<td>String index</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>[]</td>
<td>Pointer index</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>()</td>
<td>Array index</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>()</td>
<td>Function Call</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>.</td>
<td>Member access</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>-&gt;</td>
<td>Pointer to member access</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>@</td>
<td>Address of</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>*</td>
<td>Value of</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>New</td>
<td>Allocate Memory</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>Delete</td>
<td>Deallocate Memory</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>^</td>
<td>Exponentiate</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>-</td>
<td>Negate</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>*</td>
<td>Multiply</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>/</td>
<td>Divide</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>\</td>
<td>Integer divide</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>MOD</td>
<td>Modulus</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>SHL</td>
<td>Shift left</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>SHR</td>
<td>Shift right</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>+</td>
<td>Add</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>-</td>
<td>Subtract</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&amp;</td>
<td>String concatenation</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>Is</td>
<td>Run-time type information check</td>
<td>N/A</td>
</tr>
<tr>
<td>Operator</td>
<td>Description</td>
<td>Direction</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>=</td>
<td>Equal</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Not equal</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>NOT</td>
<td>Complement</td>
<td>Right-to-Left</td>
</tr>
<tr>
<td>AND</td>
<td>Conjunction</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>OR</td>
<td>Inclusive Disjunction</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>EQV</td>
<td>Equivalence</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>IMP</td>
<td>Implication</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>XOR</td>
<td>Exclusive Disjunction</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>ANDALSO</td>
<td>Short Circuit Conjunction</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>OREELSE</td>
<td>Short Circuit Inclusive Disjunction</td>
<td>Left-to-Right</td>
</tr>
<tr>
<td>[=]</td>
<td>Assignment</td>
<td>N/A</td>
</tr>
<tr>
<td>&amp;=</td>
<td>Concatenate and Assign</td>
<td>N/A</td>
</tr>
<tr>
<td>+=</td>
<td>Add and Assign</td>
<td>N/A</td>
</tr>
<tr>
<td>-=</td>
<td>Subtract and Assign</td>
<td>N/A</td>
</tr>
<tr>
<td>*=</td>
<td>Multiply and Assign</td>
<td>N/A</td>
</tr>
<tr>
<td>/=</td>
<td>Divide and Assign</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| \\
| /=       | Integer Divide and Assign    | N/A        |
| ^=       | Exponentiate and Assign      | N/A        |
| MOD=     | Modulus and Assign           | N/A        |
| AND=     | Conjunction and Assign       | N/A        |
| EQV=     | Equivalence and Assign       | N/A        |
| IMP=     | Implication and Assign       | N/A        |
| OR=      | Inclusive Disjunction and Assign | N/A        |
| XOR=     | Exclusive Disjunction and Assign | N/A        |
| SHL=     | Shift Left and Assign        | N/A        |
In some cases, the order of precedence can cause confusing or counter intuitive results. Here are some examples:

```
'' trying to raise a negated number to a power
-2 ^ 2
Desired result: (-2) ^ 2 = 4
Actual result:   -(2 ^ 2) = -4

'' trying to test a bit in a number
n And 1 <> 0
Desired result: (n And 1) <> 0
Actual result:   n And (1 <> 0)

'' trying to shift a number by n+1 bits
a Shl n+1
Desired result: a Shl (n + 1)
Actual result:   (a Shl n) + 1
```

For expressions where the operator precedence may be ambiguous, it is recommended to wrap parts of the expression in parentheses, in order both to minimise the possibility of error and to aid comprehension for people reading the code.

**See also**

- Operators
Computed values for the bitwise logical operators.

**Binary operators**
Operators that take two operands.

**Unary operator**
Operator that take a single operand.

These logical operators return a value based on the value of their operand(s). For the binary operators, each bit in the left-hand side value is applied logically to the corresponding bit in the right-hand side value. The result of this operation is returned. For the unary operator, (Operator Not), the logic is applied to its right-hand side operand only.

### Binary operators

**Operator And (Conjunction)**
Bits in the result are set if and only if both of the corresponding bits in the left and right-hand side operands are set.

<table>
<thead>
<tr>
<th>Lhs</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhs</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Result</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Operator Eqv (Equivalence)**
Bits in the result are set if and only if both of the corresponding bits in the left and right-hand side operands are both either set or unset.

<table>
<thead>
<tr>
<th>Lhs</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhs</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Result</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

### Operator Xor (Exclusive Disjunction)
Bits in the result are set if and only if one of the corresponding bits in the left and right-hand side operands is set.

### Unary operators

**Operator Not (Complement)**
Bits in the result are set if the corresponding bits in the right-hand side operand are unset, and unset if they are set.


### Operator Imp (Implication)

Bits in the result are set if and only if the corresponding bit in the left-hand side operand implies the bit in the right-hand side operand.

<table>
<thead>
<tr>
<th>Lhs</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhs</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Result</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

### Operator Or (Inclusive Disjunction)

Bits in the result are set if either of the corresponding bits in the left and right-hand side operands are set.

<table>
<thead>
<tr>
<th>Lhs</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhs</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Result</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Control Flow Statements

Statements that direct the flow of program execution.

Transferring Statements
Statements that transfer control to another part of a program.

Branching Statements
Statements that execute one of a number of code branches.

Looping Statements
Statements that execute code repeatedly.

<table>
<thead>
<tr>
<th>Transferring Statements</th>
<th>Looping Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goto</strong></td>
<td><strong>While..Wend</strong></td>
</tr>
<tr>
<td>Transfers execution to another point in code defined by a text label.</td>
<td>Executes a block of statements while a condition is met.</td>
</tr>
<tr>
<td><strong>GoSub</strong></td>
<td><strong>For..Next</strong></td>
</tr>
<tr>
<td>Temporarily transfers execution to another point in code, defined by a text label.</td>
<td>Executes a block of statements while an iterator is less than or greater than an expression.</td>
</tr>
<tr>
<td><strong>On Goto</strong></td>
<td><strong>Do..Loop</strong></td>
</tr>
<tr>
<td>Transfers execution to one of a number of points in code defined by text labels, based on the value of an expression.</td>
<td>Executes a block of statements while or until a condition is met.</td>
</tr>
<tr>
<td><strong>On Gosub</strong></td>
<td></td>
</tr>
<tr>
<td>Temporarily transfers execution to one of a number of points in code defined by text labels, based on the value of an expression.</td>
<td><strong>Intra-loop control</strong></td>
</tr>
<tr>
<td><strong>Return</strong></td>
<td><strong>Continue While, Continue For and Continue Do</strong></td>
</tr>
<tr>
<td>Returns from a call using <strong>GoSub</strong> or from a procedure returning a value.</td>
<td>Prematurely re-enters a loop.</td>
</tr>
<tr>
<td></td>
<td><strong>Exit While, Exit For and Exit Do</strong></td>
</tr>
<tr>
<td></td>
<td>Prematurely breaks out of a loop.</td>
</tr>
</tbody>
</table>

Branching Statements
If..End If
Executes a block of statements if a condition is met.

..Else If..
Executes a block of code if a condition is met and all previous conditions weren't met.

..Else..
Executes a block of code if all previous conditions weren't met.

Select..End Select
Executes one of a number of statement blocks using a set of conditions.

..Case..
Executes a block of code if a condition is met.

..Case Else..
Executes a block of code if all previous conditions weren't met.

Intra-branch control
Exit Select
Prematurely breaks out of a Select..End Select statement.
**Procedures**

Keywords that work with procedures.

**Description**

These keywords control the declaration and definition of both module-level procedures and member procedures, how they are called, how arguments are passed and how their names are seen externally to other modules. Procedures can also be declared to be executed automatically before any module-level code is executed.

**Declaration**

Keywords that declare and define procedures.

- **Decl**are
  Declares a module-level or member procedure.

- **Sub**
  Specifies a procedure that does not return an argument.

**Linkage**

Keywords that specify how procedure names are seen by external modules.

**Calling conventions**

Keywords that specify how arguments are used when calling procedures.

**Parameter passing conventions**

Keywords that specify how arguments are passed to procedures.

**Variadic Procedures**

Macros that allow for an arbitrary number of arguments to be passed to a procedure.

**Automatic execution**

Keywords that specify automatic execution of procedures.

**Miscellaneous**

Miscellaneous keywords.

<table>
<thead>
<tr>
<th><strong>Declaration</strong></th>
<th><strong>Parameter passing conventions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Declare</td>
<td>Enum</td>
</tr>
<tr>
<td>Sub</td>
<td>ByRef</td>
</tr>
</tbody>
</table>

**Decl**are

Declares a module-level or member procedure.

**Sub**

Specifies a procedure that does not return an argument.

**ByRef**

Specifies passing an argument by reference.

**ByVal**

Specifies passing an argument
**Function**
Specifies a procedure that returns an argument.

**Overload**
Specifies that the procedure name can be used in other procedure declarations.

**Static**
Specifies static storage for all variables and objects in the procedure body.

**Const (Member)**
Specifies a const member procedure in user-defined type definitions.

**Static (Member)**
Specifies a static member procedure in user-defined type definitions.

**Linkage**

<table>
<thead>
<tr>
<th>Public</th>
<th>Specifies external linkage for a procedure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>Specifies internal linkage for a procedure.</td>
</tr>
<tr>
<td>Alias</td>
<td>Specifies an alternate external name for a procedure.</td>
</tr>
</tbody>
</table>

**Export**
Specifies a procedure is to be exported from a shared library.

**Lib**
Specifies automatic loading of a library.

**Calling conventions**

| stdcall | Invokes a procedure. |

**Byref (Function Results)**
Specifies that a function returns by reference rather than by value.

**Call**
Invokes a procedure.

**Naked**

**Variadic Procedures**

| ... (Ellipsis) | Indicates a variadic procedure in a declaration. |
| va_first       | Macro to obtain the argument list in a variadic procedure. |
| va_arg         | Macro to obtain the current argument in a variadic procedure. |
| va_next        | Macro to move to the next argument in a variadic procedure. |

**Automatic execution**

| Constructor (Module) | Indicates a procedure is to be executed before module-level code. |
| Destructor (Module)  | Indicates a procedure is to be executed after module-level code. |

**Miscellaneous**

| Byref (Function Results) | Invokes a procedure. |

**Any**
Disables type-checking on arguments.
| Specifies the standard calling convention for BASIC languages, including FreeBASIC.  |
|---|---|
| **cdecl**  |
| Specifies the standard calling convention in the C and C++ languages.  |
| **pascal**  |
| Specifies the standard calling convention in the Fortran, Pascal and Microsoft QuickBASIC/QBasic languages.  |
| Specifies that a function body is not to be given any prolog/epilog code |
Modularizing

Keywords helpful when writing modular programs.

- Common
- DyLibFree
- DyLibLoad
- DyLibSymbol
- Export
- Extern

- Extern...End Extern
- Import
- Namespace
- Private
- Public
- Using (Namespaces)
Preprocessor

Commands that control the preprocessor.

**Description**

Preprocessor commands are sent to the compiler to control what gets compiled and how. They can be used to choose to compile one block of code rather than another for cross-platform compatibility, include headers or other source files, define small inline functions called macros, or alter how the compiler handles variables.

**Conditional Compilation**
Commands that allow for branches in compilation based on conditions.

**Text Replacement**
Commands that create text-replacement macros.

**File Directives**
Commands that indicate to the compiler how other files relate to the source file.

**Control Directives**
Commands that set compile options, control compilation, and report compile time information.

**Metacommands**
Commands that are kept for backward compatibility.

<table>
<thead>
<tr>
<th>Conditional Compilation</th>
<th>File Directives</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>#if</code></td>
<td><code>#include</code></td>
</tr>
<tr>
<td>Compiles the following code block based on a condition.</td>
<td>Inserts text from a file.</td>
</tr>
<tr>
<td><code>#ifdef</code></td>
<td><code>#inclib</code></td>
</tr>
<tr>
<td>Compiles the following code block if a symbol is defined.</td>
<td>Includes a library in the linking processes.</td>
</tr>
<tr>
<td><code>#ifndef</code></td>
<td><code>#libpath</code></td>
</tr>
<tr>
<td>Compiles the following code block if a symbol is not defined.</td>
<td>Includes a path to search for libraries in the linking process.</td>
</tr>
<tr>
<td><code>#elseif</code></td>
<td></td>
</tr>
<tr>
<td><code>#else</code></td>
<td></td>
</tr>
<tr>
<td><code>#pragma</code></td>
<td></td>
</tr>
</tbody>
</table>
block if a condition is true and the previous conditions was false.
#else
Compiles the following code block if previous conditions were false.
#endif
Signifies the end of a code block.
defined
Returns "-1" if a symbol is defined, otherwise "0".

Text Replacement
#define
Creates a single-line text-replacement macro.
#macro and #endmacro
Creates a multi-line text-replacement macro.
#undef
Undefines a symbol.
# Preprocessor Stringize
Converts text into a string literal.
## Preprocessor Concatenate
Concatenates two pieces of text.
! Escaped String Literal
Indicates string literal immediately following must be processed for escape sequences.
$ Non-Escaped String Literal
Indicates string literal immediately following must not be processed for escape sequences.

Sets compiling options.
#lang
Sets dialect from source.
#print
Outputs a messages to standard output while compiling.
#error
Outputs a messages to standard output and stops compilation.
#Assert
Stops compilation with an error message if a given condition is false.
#line
Sets the current line number and file name.

Metacommands
'$Include
Alternate form of the #include directive.
'$Dynamic
Alternate form of the Option Dynamic statement.
'$Static
Alternate form of the Option Static statement.
'$Lang
Alternate form of the #lang directive.
Escape sequences can be used in string literals by using the operator `!`.

**Usage**

```
result = !"text"
```

**Description**

The accepted escape sequences in `text` are:

<table>
<thead>
<tr>
<th>Escape Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\a</td>
<td>beep</td>
</tr>
<tr>
<td>\b</td>
<td>backspace</td>
</tr>
<tr>
<td>\f</td>
<td>formfeed</td>
</tr>
<tr>
<td>\r or \n</td>
<td>newline</td>
</tr>
<tr>
<td>\r</td>
<td>carriage return</td>
</tr>
<tr>
<td>\t</td>
<td>tab</td>
</tr>
<tr>
<td>\unnnnn</td>
<td>unicode char in hex</td>
</tr>
<tr>
<td>\v</td>
<td>vertical tab</td>
</tr>
<tr>
<td>\nnnn</td>
<td>ascii char in decimal</td>
</tr>
<tr>
<td>&amp;hnn</td>
<td>ascii char in hex</td>
</tr>
<tr>
<td>&amp;onnn</td>
<td>ascii char in octal</td>
</tr>
<tr>
<td>&amp;bnnnnnnnnnn</td>
<td>ascii char in binary</td>
</tr>
<tr>
<td>&quot;</td>
<td>backslash</td>
</tr>
<tr>
<td>(double quote)</td>
<td>double quote</td>
</tr>
<tr>
<td>'</td>
<td>single quote</td>
</tr>
</tbody>
</table>

Note: The zero-character (\000 = \&h00; = \&o000; = \&b00000000;) is the null terminator. Only characters before the first null terminator can be seen when the literal is used as a `String`. To get a zero character in a string use `Chr(0)` instead.

**See also**

- **Operator ! (Escaped String)**
- Operator $ (Non-Escaped String)
- Option Escape
- String
- Chr
- Literals
# Compiler Switches

Statements that affect how code is compiled.

## Description

These statements affect how the compiler declares variables, arrays and procedures, parses string literals, passes procedure parameters and more.

<table>
<thead>
<tr>
<th>Metacommands</th>
<th>Set Default Datatypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• '$Dynamic'</td>
<td>• DefByte</td>
</tr>
<tr>
<td>• '$Include'</td>
<td>• DefDbI</td>
</tr>
<tr>
<td>• '$Static'</td>
<td>• DefInt</td>
</tr>
<tr>
<td>• '$Lang'</td>
<td>• DefLng</td>
</tr>
</tbody>
</table>

## Compiler Options

- Option Base
- Option ByVal
- Option Dynamic
- Option Escape
- Option Explicit
- Option Gosub
- Option Nogosub
- Option NoKeyword
- Option Private
- Option Static

## Dialect Differences

- `Deflongint` and `Defulongint` available only in the `-lang fblite` dialect.
- `OPTION` statements are available only in the `-lang fblite` and `-lang qb` dialects only.

**See also**

- `Preprocessor`
Intrinsic Defines

Preprocessor symbols defined by the compiler.

**Description**

Intrinsic defines are set by the compiler and may be used as any other defined symbol. Intrinsic defines often convey information about the state of the compiler, either in general or at a specific point in the compilation process. Most intrinsic defines are associated with a value.

**Platform Information**
Defines that provide information on the system.

**Version Information**
Defines that provide information on the fbc compiler version being used.

**Command-line switches**
Defines that provide information with the command-line switches used with fbc.

**Environment Information**
Defines that provide information about the operating system environment.

**Context-specific Information**
Defines that provide context information about the compilation process.

<table>
<thead>
<tr>
<th>Platform Information</th>
<th>Environment Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FB_WIN32</strong></td>
<td><strong>FB_ARGC</strong></td>
</tr>
<tr>
<td>Defined if compiling for Windows.</td>
<td>Defined as an integer literal of the number of command-line arguments passed to the program.</td>
</tr>
<tr>
<td><strong>FB_LINUX</strong></td>
<td><strong>FB_ARGV</strong></td>
</tr>
<tr>
<td>Defined if compiling for Linux.</td>
<td>Defined as a ZString Ptr Ptr to the command line arguments passed to the program.</td>
</tr>
<tr>
<td><strong>FB_DOS</strong></td>
<td><strong>DATE</strong></td>
</tr>
<tr>
<td>Defined if compiling for DOS.</td>
<td>Defined as a string literal of the</td>
</tr>
<tr>
<td><strong>FB_CYGWIN</strong></td>
<td></td>
</tr>
<tr>
<td>Defined if compiling for Cygwin.</td>
<td></td>
</tr>
<tr>
<td><strong>FB_FREEBSD</strong></td>
<td></td>
</tr>
<tr>
<td>Defined if compiling for</td>
<td></td>
</tr>
</tbody>
</table>
FreeBSD.
__FB_NETBSD__
Defined if compiling for NetBSD.
__FB_OPENBSD__
Defined if compiling for OpenBSD.
__FB_DARWIN__
Defined if compiling for Darwin.
__FB_XBOX__
Defined if compiling for Xbox.
__FB_BIGENDIAN__
Defined if compiling on a system using big-endian byte-order.
__Fb_Pcos__
Defined if compiling for a common PC OS (e.g. DOS, Windows, OS/2).
__Fb_Unix__
Defined if compiling for a Unix-like OS.
__Fb_64Bit__
Defined if compiling for a 64bit target.
__Fb_Arm__
Defined if compiling for the ARM architecture.

Version Information
__FB_VERSION__
Defined as a string literal of the compiler version.
__FB_VER_MAJOR__
Defined as an integral literal of the compiler major version number.
__FB_VER_MINOR__
Defined as an integral literal of the compiler minor version

compilation date in "mm-dd-yyyy" format.
__Date_Iso__
Defined as a string literal of the compilation date in "yyyy-mm-dd" format.
__TIME__
Defined as a string literal of the compilation time.
__PATH__
Defined as a string literal of the absolute path of the module.

Context-specific Information
__FILE__ and __FILE_NQ__
Defined as the name of the module.
__FUNCTION__ and __FUNCTION_NQ__
Defined as the name of the procedure where it's used.
__LINE__
Defined as an integer literal of the line of the module where it's used.
__FB_OPTION_BYVAL__
True (-1) if parameters are declared by value by default, zero (0) otherwise.
__FB_OPTION_DYNAMIC__
True (-1) if all arrays are variable-length, zero (0) otherwise.
__FB_OPTION_ESCAPE__
True (-1) if string literals are processed for escape sequences, zero (0) otherwise.
__Fb_Option_Gosub__
True (-1) if gosub support is
number.

__FB_VER_PATCH__
Defined as an integral literal of the compiler patch number.

__FB_MIN_VERSION__
Macro to check for a minimum compiler version.

__FB_BUILD_DATE__
Defined as a string literal of the compiler build date.

__FB_SIGNATURE__
Defined as a string literal of the compiler signature.

Command-line switches

__Fb_Asm__
Defined to either "intel" or "att" depending on -asm.

__Fb_Backend__
Defined to either "gas" or "gcc" depending on -gen.

__Fb_Gcc__
True (-1) if -gen gcc is used, false (0) otherwise.

__FB_MAIN__
Defined if compiling a module with an entry point.

__FB_DEBUG__
True (-1) if the "-g" switch was used, false (0) otherwise.

__FB_ERR__
Zero (0) if neither the "-e", "-ex" or "-exx" switches were used.

__Fb_Fpmode__
Defined as "fast" if compiling for fast SSE math, "precise" otherwise.

__Fb_Fpu__
enabled, zero (0) otherwise.

__FB_OPTION_EXPLICIT__
True (-1) if variables and objects need to be explicitly declared, zero (0) otherwise.

__FB_OPTION_PRIVATE__
True (-1) if all procedures are private by default, zero (0) otherwise.
Defined as "sse" if compiling for SSE floating point unit, or "x87" for normal x87 floating-point unit.

__FB_LANG__
Defined to a string literal of the "-lang" dialect used.

__FB_MT__
True (-1) if the "-mt" switch was used, false (0) otherwise.

__FB_OUT_DLL__
True (-1) in a module being compiled and linked into a shared library, false (0) otherwise.

__FB_OUT_EXE__
True (-1) in a module being compiled and linked into an executable, false (0) otherwise.

__FB_OUT_LIB__
True (-1) in a module being compiled and linked into a static library, zero (0) otherwise.

__FB_OUT_OBJ__
True (-1) in a module being compiled only, zero (0) otherwise.

__FB_SSE__
Defined if compiling for SSE floating point unit.

__Fb_Vectorize__
Defined as the level of automatic vectorization (0 to 2)
Error Handling

Handling runtime errors.

FreeBASIC can handle the errors in the following ways:

- By default the program does nothing with the errors - they are silently ignored and code continues. In this case code should process possible errors by using the \texttt{Err} function.
- If compiled with \texttt{-e} or \texttt{-ex} options, FreeBASIC uses QB-like error handling.
- \textbf{Future} OOP versions of FreeBASIC may have a java-like TRY..C exception handler implemented.

\textbf{NOTE:} The following information is valid unless the error produces an OS General Protection Fault (for example if the program writes outside the process region). In these cases the OS will immediately stop the program and issue an error - nothing can avoid it from inside FreeBASIC.

\textbf{Default error handling}

The default FreeBASIC behavior is to set the ERR variable and continue.

```
Dim As Integer e
Open "xzxwz.zwz" For Input As #1
e = Err
Print e
Sleep
```

(The example program supposes there is no \texttt{xzxwz.zwz} file). The program does not stop; it sets the ERR variable and continues. The error can be processed in the next line.

Some IO functions such as \texttt{Open} and \texttt{Put} ... can be used in function form. \texttt{Error} number or zero if successful.
QuickBASIC-like error handling

If the `-e` or `-ex` switch is used at compile time, the program is expected like error handler enabled. If no handler processes the error, the program error.

Notice: if QB-Like error handling is used, the programmer should be prepared handle all error conditions.

```vbnet
' Compile with QB (-lang qb) dialect
'$lang: "qb"

On Error Goto FAILED
Open "xzxwz.zwz" For Input As #1
On Error Goto 0
Sleep
End

FAILED:
Dim e As Integer
e = Err
Print e
Sleep
End

On Error sets an error handling routine which the program will jump to found. On Error Goto 0 disables the error handling.

If an error handling routine is not set when an error occurs, the program send the console an error message.
Abort program due to runtime error 2 (file not found)

The error handler routine can be at the end of the program, as in QB. The Error statement allows the setting of a local error handler routine at the same Sub or Function in which the error occurs.

```
'' Compile with -e
'' The -e command line option is needed to enable error handling.

Declare Sub foo
  foo
  Sleep

Sub foo

  Dim filename As String
  Dim errmsg As String
  filename = ""
  On Local Error Goto fail
  Open filename For Input Access Read As #1
  Print "No error"
  On Local Error Goto 0
  Exit Sub

fail:
  errmsg = "Error " & Err & _
             " in function " & *Erfn & _
             " on line " & Erl
  Print errmsg

End Sub
```

If the -e switch is used (whatever the -lang dialect), the error handler is
the program.
With -ex and -lang qb dialect only, the error routine can end by using
the statement that caused the error) or Resume Next (continues at the i

Error codes

See Runtime Error Codes for a listing of runtime error numbers and
meaning.

No user error code range is defined. If Error is used to set an error co
use high values to avoid collisions with the list of built-in error codes. (m
ay be expanded later.)

See also
  - Error Handling Functions
  - Runtime Error Codes
Array Functions

Statements and procedures for working with arrays.

**Defining Arrays**
Statements that create arrays.

**Clearing Array Data**
Procedures that work with array memory.

**Retrieving Array Size**
Procedures that return bounds of an array's dimension.

<table>
<thead>
<tr>
<th>Defining Arrays</th>
<th>Clearing Array Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option Dynamic</strong></td>
<td><strong>Erase</strong></td>
</tr>
<tr>
<td>Forces arrays to be defined as variable-length arrays.</td>
<td>Destroys variable-length array elements and initializes fixed-length array elements.</td>
</tr>
<tr>
<td><code>$Dynamic</code></td>
<td></td>
</tr>
<tr>
<td>Alternate form of the <strong>Option Dynamic</strong> statement.</td>
<td></td>
</tr>
<tr>
<td><strong>Option Static</strong></td>
<td><strong>Retrieving Array Size</strong></td>
</tr>
<tr>
<td>Reverts a previous <strong>Option Dynamic</strong> command.</td>
<td><strong>LBound</strong></td>
</tr>
<tr>
<td><code>$Static</code></td>
<td>Returns the lower bound of an array's dimension.</td>
</tr>
<tr>
<td>Alternate form of the <strong>Option Static</strong> statement.</td>
<td><strong>UBound</strong></td>
</tr>
<tr>
<td><strong>ReDim</strong></td>
<td>Returns the upper bound of an array's dimension.</td>
</tr>
<tr>
<td>Defines and resizes variable-length arrays.</td>
<td></td>
</tr>
<tr>
<td><strong>Preserve</strong></td>
<td></td>
</tr>
<tr>
<td>Preserves array contents when used with <strong>ReDim</strong>.</td>
<td></td>
</tr>
</tbody>
</table>
Bit Manipulation

Macros that work with the bits and bytes of numbers.

**Description**

The macros documented here provide access to the individual bits, bytes and words of integer values.

**Byte Manipulation Macros**

*Gets the value of individual bytes or words of UInteger values.*

**Bit Manipulation Macros**

*Gets the state of individual bits of numeric values.*

<table>
<thead>
<tr>
<th>Byte Manipulation Macros</th>
<th>Bit Manipulation Macros</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LoByte</strong></td>
<td><strong>Bit</strong></td>
</tr>
<tr>
<td>Gets the least significant byte (LSB, or <em>lo-byte</em>) value of an UInteger value.</td>
<td>Gets the state of an individual bit in an integer value.</td>
</tr>
<tr>
<td><strong>HiByte</strong></td>
<td><strong>BitReset</strong></td>
</tr>
<tr>
<td>Gets the most significant byte (MSB, or <em>hi-byte</em>) value of the least significant word (LSW, or <em>lo-word</em>) of an UInteger value.</td>
<td>Gets the value of an integer with a specified bit cleared.</td>
</tr>
<tr>
<td><strong>LoWord</strong></td>
<td><strong>BitSet</strong></td>
</tr>
<tr>
<td>Gets the least significant word (LSW, or <em>lo-word</em>) value of an UInteger value.</td>
<td>Gets the value of an integer with a specified bit set.</td>
</tr>
<tr>
<td><strong>HiWord</strong></td>
<td></td>
</tr>
<tr>
<td>Gets the most significant word (LSW, or <em>hi-word</em>) value of an UInteger value.</td>
<td></td>
</tr>
</tbody>
</table>
Console Functions

Procedures that work with the console.

Description

These procedures provide ways to output text to the console, as well as control where and how text is output.

Configuring the Console

Statements that affect how text is displayed.

Cursor Color and Positioning

Procedures that move the cursor and change its color.

Writing Text to the Console

Procedures that output text to the console.

<table>
<thead>
<tr>
<th>Configuring the Console</th>
<th>Writing Text to the Console</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cls</strong></td>
<td><strong>Print</strong></td>
</tr>
<tr>
<td>Clears the entire screen or text viewport.</td>
<td></td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td><strong>?</strong></td>
</tr>
<tr>
<td>Sets or returns the number of rows and columns of the console display.</td>
<td>Writes text to the console.</td>
</tr>
<tr>
<td><strong>View Print</strong></td>
<td><strong>Print Using</strong></td>
</tr>
<tr>
<td>Sets the printable area of the console screen.</td>
<td>Writes formatted text to the console.</td>
</tr>
</tbody>
</table>

**Cursor Color and Positioning**

**Color**

Changes the foreground and background color of text to be written.

**CsrLin**

Returns the row position of the cursor.

**Pos**

Skips a number of spaces when writing text.

**Tab**

Skips to a certain column when writing text.
Returns the column position of the cursor.

**Locate**
Sets the row and column position of the cursor and its visibility.

**Screen (Console)**
Gets the character or color attribute at a given location.
### Date and Time Functions

Procedures that work with dates and time.

#### Description

These procedures provide ways to deal with date and time intervals in a consistent way. Additional procedures are provided to set and get the current system date and time, and to retrieve a time stamp for sensitive timing algorithms.

#### VisualBasic compatible procedures

Procedures for working with so-called date serials, similar to those used in Visual Basic(r).

#### Date and time procedures

Procedures for working with the system date and time.

<table>
<thead>
<tr>
<th>VisualBasic compatible procedures</th>
<th>Date and time procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Now</strong></td>
<td><strong>Date</strong></td>
</tr>
<tr>
<td>Gets a date serial of the current date and time.</td>
<td>Gets the String representation of the current system date.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Creating Date serials</strong></th>
<th><strong>Time</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DateSerial</strong></td>
<td>Gets the String representation of the current system time.</td>
</tr>
<tr>
<td>Gets the date serial representation of a date.</td>
<td><strong>SetDate</strong></td>
</tr>
<tr>
<td><strong>TimeSerial</strong></td>
<td>Sets the current system date.</td>
</tr>
<tr>
<td>Gets the date serial representation of a time.</td>
<td><strong>SetTime</strong></td>
</tr>
<tr>
<td><strong>DateString</strong></td>
<td>Sets the current system time.</td>
</tr>
<tr>
<td>Gets the String representation of a date expressed as a String.</td>
<td><strong>Time</strong></td>
</tr>
<tr>
<td><strong>TimeValue</strong></td>
<td>Gets the date serial representation of a time</td>
</tr>
<tr>
<td>Gets the date serial representation of a time.</td>
<td><strong>Timer</strong></td>
</tr>
<tr>
<td><strong>DateString</strong></td>
<td>Gets a counter expressed in seconds.</td>
</tr>
</tbody>
</table>
expressed as a String.

**Extracting information from Date serials**

**Second**
Gets the seconds of the hour from a date serial.

**Minute**
Gets the minutes of the hour from a date serial.

**Hour**
Gets the hour of the day from a date serial.

**Day**
Gets the day of the month from a date serial.

**Weekday**
Gets the day of the week from a date serial.

**Month**
Gets the month of the year from a date serial.

**Year**
Gets the year from a date serial.

**DatePart**
Gets a time interval from a date serial.

**Extracting information from Date serials**

**DateAdd**
Gets the result of a time interval added to a date serial.

**DateDiff**
Gets a time interval between two date serials.

**Miscellaneous**
**IsDate**
Tests if a *String* can be converted to a *date serial*.

**MonthName**
Gets the month name of its integer representation.

**WeekdayName**
Gets the weekday name of its integer representation.
**Error Handling Functions**

Statements and procedures that provide runtime error-handling capabilities.

**Description**

These statements and procedures provide ways of dealing with runtime errors. Specific modules, procedures and source code lines can be retrieved, and error handlers can be set up.

**Determining Errors**

Procedures that retrieve information about an error.

**Handling Errors**

Statements that allow handling of errors.

<table>
<thead>
<tr>
<th><strong>Determining Errors</strong></th>
<th><strong>Handling Errors</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Erl</strong></td>
<td><strong>On Error</strong></td>
</tr>
<tr>
<td>Gets the line in source code where the error occurred.</td>
<td>Sets a global error handler using a label.</td>
</tr>
<tr>
<td><strong>Erfn</strong></td>
<td><strong>On Local Error</strong></td>
</tr>
<tr>
<td>Gets the name of the function where the error occurred.</td>
<td>Sets a local error handler using a label.</td>
</tr>
<tr>
<td><strong>Ermn</strong></td>
<td><strong>Resume</strong></td>
</tr>
<tr>
<td>Gets the name of the source file where the error occurred.</td>
<td>Resumes execution at the line where the error occurred.</td>
</tr>
<tr>
<td><strong>Err</strong></td>
<td><strong>Resume Next</strong></td>
</tr>
<tr>
<td>Gets the error number of the last error that occurred.</td>
<td>Resumes execution at the line after where the error occurred.</td>
</tr>
<tr>
<td><strong>Error</strong></td>
<td></td>
</tr>
<tr>
<td>Generates an error using an error number.</td>
<td></td>
</tr>
</tbody>
</table>

**See also**

- Error Handling
- Runtime Error Codes
Statements and procedures for working with files and devices.

**Description**

These statements and procedures provide file and device i/o capabilities. So called *file numbers* can be bound to files or devices, which can be read or written to using formatted (text mode) or unformatted (binary mode) data. In binary mode, files and devices can be read from or written to in arbitrary locations. For multithreaded applications, files and devices can also be locked.

**Opening Files or Devices**
Procedures and other keywords that provide read or write access to a file or device.

**Reading from and Writing to Files or Devices**
Procedures that read and write data to an opened file or device.

**File Position and other Info**
Procedures that determine where reading and writing will take place within an opened file.

<table>
<thead>
<tr>
<th>Opening Files or Devices</th>
<th>Reading from and Writing to Files or Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FreeFile</strong></td>
<td><strong>Input #</strong></td>
</tr>
<tr>
<td>Gets an available file number that can be used to read or write from files or devices.</td>
<td>Reads a list of values from a file or device.</td>
</tr>
<tr>
<td><strong>Open</strong></td>
<td><strong>Write #</strong></td>
</tr>
<tr>
<td>Binds a file number to a physical file to provide reading and writing capabilities.</td>
<td>Writes a list of values to a file or device.</td>
</tr>
<tr>
<td><strong>Open Com</strong></td>
<td><strong>Input()</strong></td>
</tr>
<tr>
<td>Binds a file number to a communications port.</td>
<td>Reads a number of characters from a file or device.</td>
</tr>
<tr>
<td><strong>Open Cons</strong></td>
<td><strong>Winput()</strong></td>
</tr>
<tr>
<td>Binds a file number to the standard input and output</td>
<td>Reads a number of wide characters from a file or device.</td>
</tr>
<tr>
<td><strong>Line Input #</strong></td>
<td></td>
</tr>
</tbody>
</table>
streams.

**Open Err**
Binds a file number to the standard input and error streams.

**Open Lpt**
Binds a file number to a printer device.

**Open Pipe**
Binds a file number to the input and output streams of a process.

**Open Scrn**
Binds a file number directly to the console.

**Close**
Unbinds a file number from a file or device.

**Reset**
Unbinds all active file numbers.

### File I/O modes

**Input (File Mode)**
Text data can be read from the file.

**Output**
Text data can be written to the file.

**Append**
Text data is added to the end of a file when output.

**Binary**
Arbitrary data can be read from or written to the file.

**Random**
Blocks of data of certain size can be read from and written to the file.

Reads a line of text from a file or device.

**Print #**
Writes text data to a file or device.

**Put #**
Writes arbitrary data to a file or device.

**Get #**
Reads arbitrary data from a file or device.

### File Position and other Info

**LOF**
Gets the length (in bytes) of a file.

**LOC**
Gets the file position of the last read or write operation.

**EOF**
Returns true if all of the data has been read from a file.

**Seek (Statement)**
Sets the file position of the next read or write operation.

**Seek (Function)**
Gets the file position of the next read or write operation.

**Lock**
Restricts read or write access to a file or portion of a file.

**Unlock**
Remove read or write restrictions from a previous Lock command.
### File access privileges

**Access**
An overview of file access privileges.

**Read (File Access)**
Binary data can only be read from the file.

**Write (File Access)**
Binary data can only be written to the file.

**Read Write (File Access)**
Binary data can be read from and written to the file.

---

### Character encoding

**Encoding**
Specifies the character encoding of a file.
Mathematical Functions

Procedures that work with numbers mathematically.

**Description**

This set of procedures provide basic algebraic and trigonometric function. Random numbers can also be retrieved, using a variety of random number generators.

**Algebraic Procedures**

Absolute values, logarithms, square roots and more.

**Trigonometry Procedures**

Sine, Cosine and other trigonometry-related procedures.

**Miscellaneous Procedures**

Miscellaneous procedures.

<table>
<thead>
<tr>
<th>Algebraic Procedures</th>
<th>Trigonometric Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abs</strong></td>
<td><strong>Sin</strong></td>
</tr>
<tr>
<td><strong>Exp</strong></td>
<td><strong>Asin</strong></td>
</tr>
<tr>
<td><strong>Log</strong></td>
<td><strong>Cos</strong></td>
</tr>
<tr>
<td><strong>Sqr</strong></td>
<td><strong>Acos</strong></td>
</tr>
<tr>
<td><strong>Fix</strong></td>
<td><strong>Tan</strong></td>
</tr>
<tr>
<td><strong>Frac</strong></td>
<td><strong>Atn</strong></td>
</tr>
<tr>
<td><strong>Int</strong></td>
<td><strong>Atan2</strong></td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Sgn</strong></td>
<td>Returns the sign of a number.</td>
</tr>
</tbody>
</table>

**Randomize**
Seeds the random number generator used by **Rnd**.

**Rnd**
Returns a random **Double** in the range [0, 1).
Memory Functions

Procedures that work with static and dynamic memory.

Description

These procedures provide access to the free store, or heap. Memory from the free store can be reserved and freed, and procedures are provided to read and write directly to that memory.

Working with Dynamic Memory

Procedures that reserve, resize or free dynamic memory.

Miscellaneous Procedures

Procedures that read or write values to and from addresses in memory.

<table>
<thead>
<tr>
<th>Working with Dynamic Memory</th>
<th>Miscellaneous Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocate</td>
<td>Peek</td>
</tr>
<tr>
<td>Reserves a number of bytes of uninitialized memory and returns the address.</td>
<td>Reads some type of value from an address.</td>
</tr>
<tr>
<td>CAllocate</td>
<td>Poke</td>
</tr>
<tr>
<td>Reserves a number of bytes of initialized (zeroed) memory and returns the address.</td>
<td>Writes some type of value to an address.</td>
</tr>
<tr>
<td>Reallocate</td>
<td>Clear</td>
</tr>
<tr>
<td>Changes the size of reserved memory.</td>
<td>Clears data in an array with a specified value.</td>
</tr>
<tr>
<td>Deallocate</td>
<td>Swap</td>
</tr>
<tr>
<td>Returns reserved memory back to the system.</td>
<td>Exchange the contents of two variables.</td>
</tr>
<tr>
<td></td>
<td>SAdd</td>
</tr>
<tr>
<td></td>
<td>Returns the address for the data in a string variable.</td>
</tr>
</tbody>
</table>
Operating System Functions

Statements and procedures for working with files, directories and the system.

Description
The statements and procedures listed here provide access to the operating system environment. They transfer execution to external programs, get information about files and directories, manipulate the file system and send commands to the command shell.

Working with Files
Procedures that deal with files.

Working with Directories
Various directory management procedures.

File Properties
Get information about files.

System Procedures
Procedures for working with the environment.

<table>
<thead>
<tr>
<th>Working with Files</th>
<th>File Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exec and Chain</td>
<td>FileAttr</td>
</tr>
<tr>
<td>Temporarily transfers control to another program.</td>
<td>Gets information about a file bound to a file number.</td>
</tr>
<tr>
<td>Run</td>
<td>FileCopy</td>
</tr>
<tr>
<td>Transfers control to another program.</td>
<td>Copies a file.</td>
</tr>
<tr>
<td>Kill</td>
<td>FileDateTime</td>
</tr>
<tr>
<td>Deletes an existing file.</td>
<td>Gets the last modified date and time of a file.</td>
</tr>
<tr>
<td>Name</td>
<td>FileExists</td>
</tr>
<tr>
<td>Renames an existing file.</td>
<td>Tests for the existence of a file.</td>
</tr>
<tr>
<td></td>
<td>FileLen</td>
</tr>
<tr>
<td></td>
<td>Gets the length (in bytes) of a file.</td>
</tr>
</tbody>
</table>

Working with Directories
CurDir
Gets the current working directory.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChDir</td>
<td>Sets the current working directory.</td>
</tr>
<tr>
<td>Dir</td>
<td>Gets the names of files or directories matching certain attributes.</td>
</tr>
<tr>
<td>ExePath</td>
<td>Gets the directory of the current running program.</td>
</tr>
<tr>
<td>MkDir</td>
<td>Creates a new directory.</td>
</tr>
<tr>
<td>RmDir</td>
<td>Deletes an existing directory.</td>
</tr>
<tr>
<td>Fre</td>
<td>Gets the amount of free memory (in bytes) available.</td>
</tr>
<tr>
<td>Command</td>
<td>Gets the command-line parameters passed to the program.</td>
</tr>
<tr>
<td>Environ</td>
<td>Gets the value of an environment variable.</td>
</tr>
<tr>
<td>Isredirected</td>
<td>Checks whether stdin or stdout is redirected to a file or not.</td>
</tr>
<tr>
<td>SetEnviron</td>
<td>Sets the value of an environment variable.</td>
</tr>
<tr>
<td>Shell</td>
<td>Sends a command to the system command interpreter.</td>
</tr>
<tr>
<td>System</td>
<td>Closes all open files and exits the program.</td>
</tr>
</tbody>
</table>
String Functions

Statements and Procedures that work with strings.

Description

These statements and procedures provide many ways to create and manipulate strings and substrings. Numbers can be converted to strings and vice-versa. Procedures are also provided to aid in serialization of numeric data, perhaps for persistent storage.

Creating Strings
String data types and procedures that create new strings.

Character Conversions
Procedures that convert from character codes to strings and back.

Numeric/Boolean to String Conversions
Procedures that convert numeric values to strings.

String to Numeric Conversions
Procedures that convert strings to numeric values.

Numeric Serializations
Procedures that convert raw numeric data to and from strings suitable for storage.

Working with Substrings
Procedures that return subsets of strings, or that modify subsets of strings.

Creating Strings
<table>
<thead>
<tr>
<th>String</th>
<th>Standard data type: 8 bit character string.</th>
</tr>
</thead>
<tbody>
<tr>
<td>String (Function)</td>
<td>Returns a String of multiple characters.</td>
</tr>
<tr>
<td>ZString</td>
<td>Standard data type: null terminated 8 bit character string.</td>
</tr>
<tr>
<td>WString</td>
<td></td>
</tr>
</tbody>
</table>

Numeric Serialization
| MKD                | Returns an eight character String representation of a Double. |
| MKI                | Returns a four character String representation of a Integer. |
| MKL                | Returns a four character String representation of a Long.    |
Standard data type: wide character string.

**Wstring (Function)**
Returns a **WString** of multiple characters.

**Space**
Returns a **String** consisting of spaces.

**WSpace**
Returns a **WString** consisting of spaces.

**Len**
Returns the length of a string in characters.

---

**Character Conversion**

**Asc**
Returns an **Integer** representation of an character.

**Chr**
Returns a string of one or more characters from their ASCII **Integer** representation.

**WChr**
Returns a **WString** of one or more characters from their Unicode **Integer** representation.

---

**Numeric/Boolean to String Conversions**

**Bin**
Returns a binary **String** representation of an integral value.

**WBin**
Returns a binary **WString** representation of an integral value.

**Hex**

**MKLongInt**
Returns an eight character **String** representation of a **LongInt**.

**MKS**
Returns a four character **String** representation of a **Single**.

**MKShort**
Returns a two character **String** representation of a **Short**.

**CVD**
Returns a **Double** representation of an eight character **String**.

**CVI**
Returns an **Integer** representation of a four character **String**.

**CVL**
Returns a **Long** representation of a four character **String**.

**CVLongInt**
Returns a **LongInt** representation of an eight character **String**.

**CVS**
Returns a **Single** representation of a four character **String**.

**CVShort**
Returns a **Short** representation of a two character **String**.

---

**Working with Substrings**

**Left**
Returns a substring of the leftmost characters in a string.

**Mid (Function)**
Returns a substring of a string.

**Right**
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns a hexadecimal String representation of an integral value.</td>
<td>Returns a substring of the rightmost characters in a string.</td>
</tr>
<tr>
<td>WHex</td>
<td>Returns a hexadecimal WString representation of an integral value.</td>
</tr>
<tr>
<td>Oct</td>
<td>Returns an octal String representation of an integral value.</td>
</tr>
<tr>
<td>WOct</td>
<td>Returns an octal WString representation of an integral value.</td>
</tr>
<tr>
<td>Str</td>
<td>Returns the String representation of numeric value or boolean.</td>
</tr>
<tr>
<td>WStr</td>
<td>Returns the WString representation of numeric value.</td>
</tr>
<tr>
<td>Format</td>
<td>Returns a formatted String representation of a Double.</td>
</tr>
<tr>
<td>StrToNumeric Conversions</td>
<td></td>
</tr>
<tr>
<td>Val</td>
<td>Returns the Double conversion of a numeric string.</td>
</tr>
<tr>
<td>ValInt</td>
<td>Returns the Integer conversion of a numeric string.</td>
</tr>
<tr>
<td>ValLng</td>
<td>Returns the Long conversion of a numeric string.</td>
</tr>
<tr>
<td>ValUint</td>
<td>Returns the UInteger</td>
</tr>
</tbody>
</table>

InStr, InStrRev
Returns the first occurrence of a substring or character within a string.

Mid (Statement)
Copies a substring to a substring of a string.

LSet
Left-justifies a string.

RSet
Right-justifies a string.
conversion of a numeric string.

**ValULng**

Returns the **Ulong** conversion of a numeric string.
Threading Support Functions

Procedures for working with multithreaded applications.

Description
These procedures allow for multithreaded programming. Threads and conditional variables can be created and destroyed, and so-called *mutexes* can be obtained to protect thread-sensitive data.

**Threads**
Procedures that start and wait for threaded procedures.

**Conditional Variables**
Procedures that create and signal conditional variables.

**Mutexes**
Procedures that deal with mutexes.

<table>
<thead>
<tr>
<th>Threads</th>
<th>Mutexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threadcall</td>
<td>MutexCreate</td>
</tr>
<tr>
<td>Starts a procedure with parameters in a separate thread of execution.</td>
<td>Creates a mutex.</td>
</tr>
<tr>
<td>ThreadCreate</td>
<td>MutexLock</td>
</tr>
<tr>
<td>Starts a procedure in a separate thread of execution.</td>
<td>Acquires a lock on a mutex.</td>
</tr>
<tr>
<td>Threaddetach</td>
<td>MutexUnlock</td>
</tr>
<tr>
<td>Releases a thread handle without waiting for the thread to finish.</td>
<td>Releases a lock on a mutex.</td>
</tr>
<tr>
<td>ThreadWait</td>
<td>MutexDestroy</td>
</tr>
<tr>
<td>Waits for a thread to finish and releases the thread handle.</td>
<td>Destroys a mutex that is no longer needed.</td>
</tr>
</tbody>
</table>

**Conditional Variables**

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ConCreate</td>
</tr>
<tr>
<td>Creates a conditional variable.</td>
</tr>
<tr>
<td>ConWait</td>
</tr>
</tbody>
</table>
Pauses execution of a threaded procedure.

**CondSignal**
Resumes execution of a threaded procedure waiting for a conditional.

**CondBroadcast**
Resumes all threaded procedures waiting for a conditional.

**CondDestroy**
Destroys a conditional variable that is no longer needed.

### Platform Differences
- These procedures are not supported in DOS.
User Input

Statements and procedures that get input from the user.

Description

These statements and procedures allow access to the keyboard buffer and provide ways of getting input from the user.

Reading keys from the keyboard buffer

Procedures that read individual keys from the keyboard buffer.

Reading values from the keyboard buffer

Procedures that read characters and values from the keyboard buffer.

<table>
<thead>
<tr>
<th>Reading values from the keyboard buffer</th>
<th>Reading keys from the keyboard buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td><strong>Inkey</strong></td>
</tr>
<tr>
<td>Reads values from the keyboard buffer.</td>
<td>Gets the first key, if any, waiting in the keyboard buffer.</td>
</tr>
<tr>
<td><strong>Line Input</strong></td>
<td><strong>GetKey</strong></td>
</tr>
<tr>
<td>Reads a line of text from the keyboard buffer.</td>
<td>Gets and waits for the first key in the keyboard buffer.</td>
</tr>
<tr>
<td><strong>Input()</strong></td>
<td></td>
</tr>
<tr>
<td>Reads a number of characters from the keyboard buffer, file or device.</td>
<td></td>
</tr>
<tr>
<td><strong>Winput()</strong></td>
<td></td>
</tr>
<tr>
<td>Reads a number of wide characters from the keyboard buffer, file or device.</td>
<td></td>
</tr>
</tbody>
</table>
2D Drawing Functions

Statements and procedures for working with 2D graphics.

**Description**

The statements and procedures listed here provide ways of drawing to the screen. Image buffers can be created and blitted to the screen using a variety of blending methods. Palette colors can be retrieved or set in graphics modes that support them.

**Working with Color**

Procedures that control the color used by other drawing procedures.

**Drawing to Image Buffers**

Procedures that draw shapes and text onto image buffers or to the screen.

**Image Buffer Creation**

Procedures that create, free and save image buffers.

**Blitting Image Buffers**

Procedures that draw image buffers onto other image buffers or to the screen.

<table>
<thead>
<tr>
<th><strong>Working with Color</strong></th>
<th><strong>Blitting Image Buffers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Color</strong></td>
<td><strong>Put (Graphics)</strong></td>
</tr>
<tr>
<td>Sets the foreground and background color to use with the drawing procedures.</td>
<td>Blits an image buffer to another image buffer or screen.</td>
</tr>
<tr>
<td><strong>Palette</strong></td>
<td></td>
</tr>
<tr>
<td>Gets or sets color table information in paletted modes.</td>
<td></td>
</tr>
<tr>
<td><strong>RGB</strong></td>
<td></td>
</tr>
<tr>
<td>Returns a color value for hi/truecolor modes.</td>
<td></td>
</tr>
<tr>
<td><strong>RGBA</strong></td>
<td></td>
</tr>
<tr>
<td>Returns a color value including alpha (transparency) for hi/truecolor modes.</td>
<td></td>
</tr>
<tr>
<td><strong>Blending Methods</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Add</strong></td>
<td></td>
</tr>
<tr>
<td>Saturated addition of the source and target components.</td>
<td></td>
</tr>
<tr>
<td><strong>Alpha</strong></td>
<td></td>
</tr>
<tr>
<td>Blend using a uniform transparency or the image buffer's alpha channel.</td>
<td></td>
</tr>
<tr>
<td><strong>And</strong></td>
<td></td>
</tr>
<tr>
<td>Combine the source and target</td>
<td></td>
</tr>
</tbody>
</table>
**Point**
Gets a pixel value from an image buffer or screen.

**Drawing to Image Buffers**

- **PSet and PReset**
  Plots a single pixel on an image buffer or screen.
- **Line (Graphics)**
  Plots a line of pixels on an image buffer or screen.
- **Circle**
  Plots circles and ellipses on an image buffer or screen.
- **Draw**
  Draws in a sequence of commands on an image buffer or screen.
- **Draw String**
  Writes text to an image buffer or screen.
- **Paint**
  Fills an area with color on an image buffer or screen.

**Image Buffer Creation**

- **Get (Graphics)**
  Creates an image buffer from a portion of another image buffer or screen.
- **ImageCreate**
  Creates an image buffer of a certain size and pixel depth.
- **ImageDestroy**
  Frees an image buffer resource.
- **ImageConvertRow**
  Converts a row of pixels in an image buffer to a different color depth.

- **Trans**
  Pixels matching the transparent mask color are not blitted.
- **Custom**
  Allows a custom blending procedure to be used.
- **Xor**
  Combine the source and target components using a bitwise **Xor**

- **And**
  Combine the source and target components using a bitwise **And**

- **Or**
  Combine the source and target components using a bitwise **Or**

Directly copy pixel colors from the source to the destination.

Combine the source and target components using a bitwise **And**

Combine the source and target components using a bitwise **Or**

Combine the source and target components using a bitwise **Xor**
<table>
<thead>
<tr>
<th><strong>ImageInfo</strong></th>
<th>Retrieves useful information about an image buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BLoad</strong></td>
<td>Creates an image buffer from a file.</td>
</tr>
<tr>
<td><strong>BSave</strong></td>
<td>Saves an image buffer to a file.</td>
</tr>
</tbody>
</table>
User Input Functions

Procedures for working with mice, gaming devices and keyboards.

**Description**

These procedures provide access to external devices such as keyboards, mice and gamepads.

**Mouse and Joystick Input**

Procedures that provide state information of the mouse or joystick.

**Keyboard Input**

Procedures that provide keyboard state information.

<table>
<thead>
<tr>
<th>Mouse and Joystick Input</th>
<th>Keyboard Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>GetMouse</td>
<td>MultiKey</td>
</tr>
<tr>
<td>Gets button and axis information for the mouse.</td>
<td>Gets key information for the keyboard.</td>
</tr>
<tr>
<td>SetMouse</td>
<td></td>
</tr>
<tr>
<td>Sets position and visibility of the mouse cursor.</td>
<td></td>
</tr>
<tr>
<td>GetJoystick</td>
<td></td>
</tr>
<tr>
<td>Gets button and axis information for gaming devices.</td>
<td></td>
</tr>
<tr>
<td>Stick</td>
<td></td>
</tr>
<tr>
<td>Gets axis position for gaming devices.</td>
<td></td>
</tr>
<tr>
<td>Strig</td>
<td></td>
</tr>
<tr>
<td>Gets button state for gaming devices.</td>
<td></td>
</tr>
</tbody>
</table>
Screen Functions

Statements and procedures that work with the graphics display.

Description

These statements and procedures control the graphics capabilities of the FreeBASIC graphics library. Screen modes can be set with varying resolutions and color depths, window events can be handled, and specific OpenGL procedures can be retrieved.

Working with screen modes
Procedures for setting and retrieving information about screen modes

Working with pages
Procedures that manipulate screen pages.

Working video memory
Procedures that provide direct access to framebuffer memory.

Screen Metrics
Procedures that control the way coordinates are interpreted.

<table>
<thead>
<tr>
<th>Working with screen modes</th>
<th>Working video memory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ScreenList</strong></td>
<td><strong>ScreenPtr</strong></td>
</tr>
<tr>
<td>Gets the available fullscreen resolutions.</td>
<td>Gets the address of the working page's framebuffer.</td>
</tr>
<tr>
<td><strong>Screen</strong> and <strong>ScreenRes</strong></td>
<td><strong>ScreenLock</strong></td>
</tr>
<tr>
<td>Sets a new graphics display mode.</td>
<td>Locks the current working page's framebuffer for direct access.</td>
</tr>
<tr>
<td><strong>ScreenInfo</strong></td>
<td><strong>ScreenUnlock</strong></td>
</tr>
<tr>
<td>Gets information about the system desktop or current display mode.</td>
<td>Reverts a previous <strong>ScreenLock</strong> command.</td>
</tr>
<tr>
<td><strong>ScreenControl</strong></td>
<td><strong>ScreenMetrics</strong></td>
</tr>
<tr>
<td>Gets or sets internal graphics library settings.</td>
<td>View (Graphics)</td>
</tr>
<tr>
<td><strong>ScreenEvent</strong></td>
<td>Sets a clipping region for all drawing and blitting procedures.</td>
</tr>
<tr>
<td>Gets system events.</td>
<td><strong>Window</strong></td>
</tr>
</tbody>
</table>
Returns the address of an OpenGL procedure.

**WindowTitle**
Sets the running program's window caption.

**Working with pages**

**Cls**
Clears the entire screen or viewport.

**ScreenSet**
Sets the current work and visible pages.

**ScreenCopy and PCopy and Flip**
Copies pixel data from one page to another.

**ScreenSync**
Waits for the vertical refresh of the monitor.

Sets a new coordinate mapping for the current viewport.

**PMap**
Converts coordinates between physical and view mappings.

**Pointcoord**
Queries Draw's pen position.
GfxLib - FreeBASIC graphics library overview

GfxLib is the built-in graphics library included in FreeBASIC. As well as re-creating every QuickBASIC graphics command, GfxLib has built-in commands to handle input from the keyboard and mouse. Major contributors of the library are Lillo, CoderJeff and DrV.

The library supports various drivers depending on the platform:

- **All:**
  - **Null** Does nothing, allows to use graphics functions on in-memory buffers and such, without anything being displayed in a graphics window. ([gfxlib2/gfx_driver_null.c](gfxlib2/gfx_driver_null.c))

- **Win32:**
  - **DirectX** The default selection of FB GfxLib. May not be available on old Windows installations. ([gfxlib2/win32/gfx_driver_ddraw.c](gfxlib2/win32/gfx_driver_ddraw.c))
  - **GDI** The "safest" one, available in all Win32 versions. Bug note: broken in FB versions 0.20 to 0.24 (crash), and minor problems 0.18.5, and 0.90.x and 1.xx ("banding effects", try extra SCREENUNLOCK), ([forum discussion: p=106600](gfxlib2/win32/gfx_driver_gdi.c))
  - **OpenGL** ([gfxlib2/win32/gfx_driver_opengl.c](gfxlib2/win32/gfx_driver_opengl.c))

- **Linux & others:**
  - **X11** The default on Unix systems ([gfxlib2/unix/gfx_driver_x11.c](gfxlib2/unix/gfx_driver_x11.c))
  - **OpenGL** (on top of X11) ([gfxlib2/unix/gfx_driver_opengl_x11.c](gfxlib2/unix/gfx_driver_opengl_x11.c))
  - **FBDev** Linux framebuffer device -- fallback in case X11 is disabled ([gfxlib2/linux/gfx_driver_fbdev.c](gfxlib2/linux/gfx_driver_fbdev.c))

- **DOS:**
  - **BIOS** ([gfxlib2/dos/gfx_driver_bios.c](gfxlib2/dos/gfx_driver_bios.c))
- **ModeX** "tuned" 320x240x8bpp VGA mode *(gfxlib2/dos/gfx_driver_modex.c)*
- **VESA** banked compatible with very old VESA 1.x implementations *(gfxlib2/dos/gfx_driver_vesa_bnk.c)*
- **VESA** linear needs VESA version at least 2.0, usually faster than banked VESA *(gfxlib2/dos/gfx_driver_vesa_lin.c)*
- **VGA** *(gfxlib2/dos/gfx_driver_vga.c)*
- Bug note: **Palette** doesn't work well *(forum discussion: t=12691 2008) (forum discussion: t=19980 2012)*

**ScreenControl** can be used (SET_DRIVER_NAME 103) to override the default driver preferences.

**Platform Differences**

- In DOS, GfxLib will create and "manage" a mouse arrow if a mouse driver is detected. There is no "official" way to disable this. Also note that the arrow doesn't react to mouse movements while the screen is locked.
- In DOS, Windowing and OpenGL related commands and switches are not available (they exist but do nothing, or return some values with no meaning)
- In DOS, the refresh rate setting is not available (some VESA cards do support it, but FreeBASIC for now doesn't)
- In DOS, the resolution must match one supported by the graphics card. GfxLib will try to find an appropriate mode from VGA modes, ModeX or VESA, preferring VESA LFB interface if available, or banked VESA otherwise. Unsupported resolutions may currently crash the program (if you fail to check SCREENPTR for ZERO before using it), though in future GfxLi may try to find a close match instead. For optimal compatibility, you should support "safe" resolutions like 640x480 and 800x600, and maybe 1024x768. There are various additional modes like 768x576 around, but they are vendor specific and lacking on many other cards. Also modes 1024x768 and above are not available on older cards and laptops.
- It has been observed that SCREEN and SCREENRES may fai
to clear the screen in DOS, actually this is probably a BIOS bug that GfxLib currently doesn't workaround.

**Differences from QB**

- Graphics support was internally redesigned. QB used VGA graphics modes, and wrote directly into the VGA RAM. Multiple pages were available as long as the card supported them. FB uses backbuffers, one per defined page, and copies them to the video RAM (VGA (DOS), VESA (DOS), DirectX (Win32), ...) in the background. Graphics commands do work as they used to in QB, but a few notable differences are present:
  - The background screen updating eats a considerable amount of CPU performance.
  - There is a thread (Win32 and Linux) or ISR (DOS, uses the PIT) active for this.
  - Mixing FB's graphics support with low-level screen accesses (VGA) is not supported, even in DOS. However direct screen memory access is possible using Screenptr and Screenlock and is fully portable. In DOS VGA and VESA are still available, but can't be mixed with FB's graphics support.

**See also**

- **GFX Functions Index**
- **Screen** The QB-like way to set graphics mode
- **ScreenRes** More flexible alternative to Screen
- **ScreenList** Check display modes available for FB GfxLib to use
- **ScreenControl** Select driver and more
- **ScreenLock**
- **ScreenUnlock**
- **ScreenPtr** Semi-low level access
- **ScreenSet**
- **ScreenCopy**
- ScreenInfo
- ScreenGLProc
- Internal pixel formats
Listing of keyboard scancodes.

**Description**

Here follows a list of hardware keyboard scancodes accepted by the `MultiKey` function. These are equal to DOS scancodes, and are guaranteed to be recognized on all platforms.

These constants are also defined in the `fbgfx.bi` include file you can use in your programs. If you are using the `lang fb` dialect then everything inside `fbgfx.bi` is enclosed in the `FB` *Namespace*. To use these constants in `lang fb` either prepend "FB." to the constant name, or put "Using FB" after the `#include` line.

The hexadecimal code is not required and provided only for reference.

<table>
<thead>
<tr>
<th>SC</th>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC</td>
<td>SC_ESC</td>
<td>&amp;h01</td>
</tr>
<tr>
<td>1</td>
<td>SC_1</td>
<td>&amp;h02</td>
</tr>
<tr>
<td>2</td>
<td>SC_2</td>
<td>&amp;h03</td>
</tr>
<tr>
<td>3</td>
<td>SC_3</td>
<td>&amp;h04</td>
</tr>
<tr>
<td>4</td>
<td>SC_4</td>
<td>&amp;h05</td>
</tr>
<tr>
<td>5</td>
<td>SC_5</td>
<td>&amp;h06</td>
</tr>
<tr>
<td>6</td>
<td>SC_6</td>
<td>&amp;h07</td>
</tr>
<tr>
<td>7</td>
<td>SC_7</td>
<td>&amp;h08</td>
</tr>
<tr>
<td>8</td>
<td>SC_8</td>
<td>&amp;h09</td>
</tr>
<tr>
<td>9</td>
<td>SC_9</td>
<td>&amp;h0A</td>
</tr>
<tr>
<td>0</td>
<td>SC_0</td>
<td>&amp;h0B</td>
</tr>
<tr>
<td>-</td>
<td>SC_MINUS</td>
<td>&amp;h0C</td>
</tr>
<tr>
<td>=</td>
<td>SC_EQUALS</td>
<td>&amp;h0D</td>
</tr>
<tr>
<td></td>
<td>SC_BACKSPACE</td>
<td>&amp;h0E</td>
</tr>
<tr>
<td></td>
<td>SC_TAB</td>
<td>&amp;h0F</td>
</tr>
<tr>
<td>Q</td>
<td>SC_Q</td>
<td>&amp;h10</td>
</tr>
<tr>
<td>W</td>
<td>SC_W</td>
<td>&amp;h11</td>
</tr>
<tr>
<td>E</td>
<td>SC_E</td>
<td>&amp;h12</td>
</tr>
<tr>
<td>R</td>
<td>SC_R</td>
<td>&amp;h13</td>
</tr>
<tr>
<td>T</td>
<td>SC_T</td>
<td>&amp;h14</td>
</tr>
<tr>
<td>Y</td>
<td>SC_Y</td>
<td>&amp;h15</td>
</tr>
<tr>
<td>Key</td>
<td>Hex Code</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>SC_U</td>
<td>&amp;h16</td>
<td></td>
</tr>
<tr>
<td>SC_I</td>
<td>&amp;h17</td>
<td></td>
</tr>
<tr>
<td>SC_O</td>
<td>&amp;h18</td>
<td></td>
</tr>
<tr>
<td>SC_P</td>
<td>&amp;h19</td>
<td></td>
</tr>
<tr>
<td>SC_LEFTBRACKET</td>
<td>&amp;h1A</td>
<td></td>
</tr>
<tr>
<td>SC_RIGHTBRACKET</td>
<td>&amp;h1B</td>
<td></td>
</tr>
<tr>
<td>SC_ENTER</td>
<td>&amp;h1C</td>
<td></td>
</tr>
<tr>
<td>SC_CONTROL</td>
<td>&amp;h1D</td>
<td></td>
</tr>
<tr>
<td>SC_A</td>
<td>&amp;h1E</td>
<td></td>
</tr>
<tr>
<td>SC_S</td>
<td>&amp;h1F</td>
<td></td>
</tr>
<tr>
<td>SC_D</td>
<td>&amp;h20</td>
<td></td>
</tr>
<tr>
<td>SC_F</td>
<td>&amp;h21</td>
<td></td>
</tr>
<tr>
<td>SC_G</td>
<td>&amp;h22</td>
<td></td>
</tr>
<tr>
<td>SC_H</td>
<td>&amp;h23</td>
<td></td>
</tr>
<tr>
<td>SC_J</td>
<td>&amp;h24</td>
<td></td>
</tr>
<tr>
<td>SC_K</td>
<td>&amp;h25</td>
<td></td>
</tr>
<tr>
<td>SC_L</td>
<td>&amp;h26</td>
<td></td>
</tr>
<tr>
<td>SC_SEMICOLON</td>
<td>&amp;h27</td>
<td></td>
</tr>
<tr>
<td>SC_QUOTE</td>
<td>&amp;h28</td>
<td></td>
</tr>
<tr>
<td>SC_TILDE</td>
<td>&amp;h29</td>
<td></td>
</tr>
<tr>
<td>SC_LSHIFT</td>
<td>&amp;h2A</td>
<td></td>
</tr>
<tr>
<td>SC_BACKSLASH</td>
<td>&amp;h2B</td>
<td></td>
</tr>
<tr>
<td>SC_Z</td>
<td>&amp;h2C</td>
<td></td>
</tr>
<tr>
<td>SC_X</td>
<td>&amp;h2D</td>
<td></td>
</tr>
<tr>
<td>SC_C</td>
<td>&amp;h2E</td>
<td></td>
</tr>
<tr>
<td>SC_V</td>
<td>&amp;h2F</td>
<td></td>
</tr>
<tr>
<td>SC_B</td>
<td>&amp;h30</td>
<td></td>
</tr>
<tr>
<td>SC_N</td>
<td>&amp;h31</td>
<td></td>
</tr>
<tr>
<td>SC_M</td>
<td>&amp;h32</td>
<td></td>
</tr>
<tr>
<td>SC_COMMA</td>
<td>&amp;h33</td>
<td></td>
</tr>
<tr>
<td>SC_PERIOD</td>
<td>&amp;h34</td>
<td></td>
</tr>
<tr>
<td>SC_SLASH</td>
<td>&amp;h35</td>
<td></td>
</tr>
<tr>
<td>SC_RSHIFT</td>
<td>&amp;h36</td>
<td></td>
</tr>
<tr>
<td>SC_MULTIPLY</td>
<td>&amp;h37</td>
<td></td>
</tr>
<tr>
<td>SC_ALT</td>
<td>&amp;h38</td>
<td></td>
</tr>
<tr>
<td>SC_SPACE</td>
<td>&amp;h39</td>
<td></td>
</tr>
<tr>
<td>SC_CAPSLOCK</td>
<td>&amp;h3A</td>
<td></td>
</tr>
<tr>
<td>SC_F1</td>
<td>&amp;h3B</td>
<td></td>
</tr>
<tr>
<td>SC_F2</td>
<td>&amp;h3C</td>
<td></td>
</tr>
</tbody>
</table>
Extra scancodes not compatible with DOS scancodes

See also

- MultiKey
Default Palettes

Default color values for FreeBASIC graphics and text screen modes.

FreeBASIC initializes the palette indexes with the colors in the tables below in graphics mode, and colors can be changed using the `Palette` statement. There is no portable way to change the palette in console mode.

**Screen mode 1**
4 colors: Black and white, and two others

**Screen modes 2, 10 and 11**
Monochromatic: black and white.

**Screen modes 7, 8, 9, 12, and Console**
Two sets of 8 colors: normal and intense (bright)

**Screen 13 and 8-bit modes**
Multiple color and grayscale bands

<table>
<thead>
<tr>
<th>Value</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>black</td>
</tr>
<tr>
<td>1</td>
<td>cyan</td>
</tr>
<tr>
<td>2</td>
<td>magenta</td>
</tr>
<tr>
<td>3</td>
<td>white</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>black</td>
</tr>
<tr>
<td>1</td>
<td>cyan</td>
</tr>
</tbody>
</table>

**Screen modes 2, 10 and 11**

<table>
<thead>
<tr>
<th>Value</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>blue</td>
</tr>
<tr>
<td>32</td>
<td>56</td>
</tr>
</tbody>
</table>

**Screen 12 color band**
Colors 0 through 15.

**Grayscale band**
Colors 16 through 31.

**Brightness/saturation bands**
3 bands of decreasing brightness, each containing 3 bands of decreasing saturation, and ending at blue.

<table>
<thead>
<tr>
<th>Name</th>
<th>HB/HS</th>
<th>HB/MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>blue</td>
<td>32</td>
<td>56</td>
</tr>
</tbody>
</table>
### Screen modes 7, 8, 9, 12, and Console

![Color Palette](image)

<table>
<thead>
<tr>
<th>Normal Value</th>
<th>Normal Name</th>
<th>Intense Value</th>
<th>Intense Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>black</td>
<td>8</td>
<td>dark grey</td>
</tr>
<tr>
<td>1</td>
<td>blue</td>
<td>9</td>
<td>bright blue</td>
</tr>
<tr>
<td>2</td>
<td>green</td>
<td>10</td>
<td>bright green</td>
</tr>
<tr>
<td>3</td>
<td>cyan</td>
<td>11</td>
<td>bright cyan</td>
</tr>
<tr>
<td>4</td>
<td>red</td>
<td>12</td>
<td>bright red</td>
</tr>
<tr>
<td>5</td>
<td>pink</td>
<td>13</td>
<td>bright pink</td>
</tr>
<tr>
<td>6</td>
<td>yellow</td>
<td>14</td>
<td>bright yellow</td>
</tr>
<tr>
<td>7</td>
<td>grey</td>
<td>15</td>
<td>white</td>
</tr>
</tbody>
</table>

**Black band**

Colors 248 through 255 are black.
FreeBASIC programmer's guide.

**Work in Progress:** *New pages created for this guide should use the ProPg* prefix.

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<thead>
<tr>
<th>Getting Started</th>
<th>Statements and Expressions</th>
</tr>
</thead>
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<td>Hello World</td>
<td>Assignments</td>
</tr>
<tr>
<td>FreeBASIC Primer #1</td>
<td>Operators List</td>
</tr>
<tr>
<td></td>
<td>Operator Precedence</td>
</tr>
<tr>
<td></td>
<td>Control Flow Statements</td>
</tr>
<tr>
<td>Source Files</td>
<td></td>
</tr>
<tr>
<td>Source Files (.bas)</td>
<td>Procedures</td>
</tr>
<tr>
<td>Header Files (.bi)</td>
<td>Procedures Overview</td>
</tr>
<tr>
<td>Using Prebuilt Libraries</td>
<td>Passing Arguments to Procedures</td>
</tr>
<tr>
<td>Lexical Conventions</td>
<td>Returning a Value</td>
</tr>
<tr>
<td>Comments</td>
<td>Procedure Scopes</td>
</tr>
<tr>
<td>Identifier Rules</td>
<td>Calling Conventions</td>
</tr>
<tr>
<td>Literals</td>
<td>Recursion</td>
</tr>
<tr>
<td>Labels</td>
<td>Constructors and Destructors</td>
</tr>
<tr>
<td>Line continuation</td>
<td>Pointers to Procedures</td>
</tr>
<tr>
<td>Variables and Datatypes</td>
<td>Variable Arguments</td>
</tr>
<tr>
<td>Constants and Enumerations</td>
<td></td>
</tr>
<tr>
<td>Numeric Types</td>
<td>Making Binaries</td>
</tr>
<tr>
<td>Strings (string, zstring, and wstring)</td>
<td>Executables</td>
</tr>
<tr>
<td>Coercion and Conversion</td>
<td>Static Libraries</td>
</tr>
<tr>
<td>Constants</td>
<td>Shared Libraries (DLLs)</td>
</tr>
<tr>
<td>Variables</td>
<td>Profiling</td>
</tr>
<tr>
<td>Arrays</td>
<td></td>
</tr>
<tr>
<td>Overview</td>
<td>Preprocessor</td>
</tr>
<tr>
<td>Fixed-length Arrays</td>
<td>Overview</td>
</tr>
<tr>
<td>Variable-length Arrays</td>
<td>Conditional Compilation</td>
</tr>
<tr>
<td>Array Indexing</td>
<td>Macros</td>
</tr>
<tr>
<td></td>
<td>Other Topics</td>
</tr>
</tbody>
</table>
Passing Arrays to Procedures

Pointers
Overview
Pointer Arithmetic

Declarations
Implicit Declarations
Initialization
Storage Classes
Variable Lifetime
Variable Scope
Namespaces
Variable and Procedure Linkage

User Defined Types
Overview
Type Aliases
Temporary Types
Constructors and Destructors
Member Procedures
Properties
Member Access Rights
Operator Overloading
Iterators
New and Delete
Types as Objects

(And topics that need to get placed elsewhere)
ASCII
Date Serials
Radians
FreeBASIC GfxLib overview
Internal Graphics Formats
External Graphics File Formats
Inline Asm
Error Handling
Intrinsic Defines
C Standard Library Functions
File I/O in FreeBASIC

NOTE: Existing CatPg pages should be recreated as ProPg pages providing a general overview to the grouping of keywords.
This example is a classic in any programming language.

More as a sanity check than anything else, a good place to start with any programming language is to try a very simple program to test that the compiler is installed correctly and that a valid executable can be made.

Open up any editor capable of saving text files and type in the following source code:

```
Print "Hello World"
```

Save the file with a '.bas' extension. For example 'hello.bas'

From a command prompt or shell in the directory where 'hello.bas' was saved, type the following command:

```
fbc hello.bas
```

Depending on the operating system, this should create an executable file in the same directory as 'hello.bas'. It might be named 'hello.exe' or './hello', for example.

Run the executable, and we should have the following output:

```
Hello World
```

**See also**

- Freebasic FAQ
- Main Features
- Requirements
- Installing
- Running
This primer is intended for beginning beginners, for those who are just starting to learn how to program and using FreeBASIC do to it.

**Learning the language**

Learning a programming language means learning the words to write they mean when they are written. We don't need to learn them all at once. A few important words that do something will help us get started. Here we are just going to concentrate on these keywords:

- **Dim**
- **Print**
- **Input**
- **For...Next**
- **If...Then**
- **Do...Loop**

**Hello World!**

No beginners reference is complete without this example.

```plaintext
Print "Hello World!"
```

The text between the pair of double quotes is a literal string. The `Print` output text to the display. If you can edit, compile, and execute this example, you are on your way.

**Using a Variable to Store Data**

Sometimes in a program we will want to store some information some and then use it later. To store something in memory we use a variable. FreeBASIC are of some specific type, like a number or a string. We use declare a variable name and specify what type of information we want
Dim text As String
    text = "Hello World!"
Print text

We are using Dim to let the compiler know that we want to use a variable in our program and that we will be putting String data in it. We then assign (copy) "Hello World!" to the variable. Finally, we use Print to output it to the display.

Using a Variable in an Expression

An expression is a generic term for describing a part of the source code that can be evaluated. After an expression is evaluated, we can then do something with it, like assign (copy) it to a variable.

```vbnet
Dim a As String, b As String, text As String
    a = "Hello"
    b = "World"
    text = a + " " + b + "!"
Print text
```

We are assigning the variables a and b with some data. We are then using a and b in an expression which is then assigned to text. Finally, we output the result to the display.

Getting Input from the User

Often, we have no idea what data is needed for a program unless the user tells us what it is. We can't put it in our source code since we won't know what it is until the user runs the program and tells us what it is.

```vbnet
Dim answer As String
    Input "Type something and press enter:";, answer
    Print "You typed: "; answer; ""
```
Here the Input statement will first, output some information to the display, and then wait for the user to give the program some data. In this example, we just output exactly what the user typed in.

**Doing Some Math**

Variables and expressions are not just limited to strings. Most early languages didn't handle strings very well if at all. Writing mathematical expressions is similar to how they might be written with pencil and paper.

```plaintext
Dim a As Integer, b As Integer, c As Integer

a = 5
b = 7
c = a + b

Print "a = "; a
Print "a = "; b
Print "a + b = "; c
```

We are assigning values to the variables a, b and c. We are using Integer data type. An integer can be positive or negative, but not have any fractions.

**Doing Some Math with Input**

This is similar to the previous example, except we will let the user choose the numbers we are going to add together.

```plaintext
Dim a As Integer, b As Integer, r As Integer
Input "Enter a number: ", a
Input "Enter another number: ", b

r = a + b
Print "The sum of the numbers is "; r
```
Dim lets the compiler know which variable names we want to use and hold Integer data. We are using Input to get the numbers from the user and display the results.

**Doing More Math with Input**

Numeric variables are not limited to just integers. We can also use Single precision data types which can represent fractions. In this example we will take some input from the user to convert a weight in pounds to kilograms.

```vba
Dim lb As Single, kg As Single
Input "Enter a weight in pounds:“, lb

kg = lb * 0.454
Print lb; " lb. is equal to "; kg; " kg"
```

**Repeating Statements**

Using For...Next statement we can tell the program to do something a set number of times. For example lets say we wanted to add up all the numbers from 1 to 100.

```vba
Dim total As Integer
Dim number As Integer
total = 0
For number = 1 To 100
    total = total + number
Next
Print "The sum of number from 1 to 100 is "; total
```

**Making a Decision**

A program can choose which statements to execute using a condition
**If...Then.** We can use the value of a variable or the result of an expression to decide if we should, or should not, execute one or more statements.

```vbnet
Dim number As Integer
Input "Enter a number : ", number
Print "Your number is ";
If number < 0 Then
    Print "negative"
ElseIf number > 0 Then
    Print "positive"
Else
    Print "zero"
End If
```

After getting a number from the user, we are going to output a word (positive, negative, or zero) based on which condition matches the statement.

**Repeating Statements (Again)**

Here we will use another looping structure `Do...Loop` to repeat some statements. When will the program know to stop repeating the statements? We will use `If...Then` decision when to get out of the loop.

```vbnet
Dim total As Single, count As Single, number As Single
Dim text As String

Print "This program will calculate the sum and average for a list of numbers. Enter an empty value to end."
Print

Do
    Input "Enter a number : ", text
    If text = "" Then
        Exit Do
    End If
End If
```
count = count + 1
total = total + Val(text)

Loop

Print
Print "You entered "; count; " numbers"
Print "The sum is "; total
If count <> 0 Then
    Print "The average is "; total / count
End If

See also

- Dim
- (Print | ?)
- Input
- For...Next
- If...Then
- Do...Loop
Text files read by FreeBASIC and compiled into executable code.

A source file is a text file that contains FreeBASIC language statements. Just one source file or possibly hundreds. Source files are read by the `cc` command. Object code is then linked to create an executable or can be stored on a command line.

FreeBASIC by default, automatically takes care of compiling sources and executables, so normally it is possible to make an executable program by specifying source files on the `fbc` command line. For example, assuming we had made a program, we could create an executable for the program by running:

```
fbc myprog.bas tools.bas funcs.bas
```

**Unicode support**

- Besides ASCII files with Unicode escape sequences (\u), FreeBASIC can parse UTF-8, UTF-16LE, UTF-16BE, UTF-32LE and UTF-32BE source (.bas) or header (.bi) files, they can be freely mixed with other sources/headers in the same project (also with other ASCII files).

- Literal strings can be typed in the original non-Latin alphabet, just use a text-editor that supports one of the Unicode formats listed above.

**Implicit main()**

Some languages require a special `main()` procedure be defined as an entry point to the program which define the first statements that will be executed when the program starts. Statements in module level code and normally the first source file passed on a command line will be used as the "main" module. The main module can be explicitly named on the command line, where `filename` is the name of the main module without the .bas extension.

```
' sample.bas
Declare Sub ShowHelp()

' This next line is the first executable statement
If Command(1) = "" Then
    ShowHelp
```
End 0
End If

Sub ShowHelp()
    Print "no options specified."
End Sub

Header Files
A header file is a special kind of source file that typically only contains extension. See Header Files (.bi).

See also
- fbc command-line
- Header Files (.bi)
Header Files (.bi)

Provides an interface for a module.

A header file is a special kind of source file that typically only contains preprocessor statements, defines, declarations, prototypes, constants, enumerations, statements, however, a header file can contain any valid source code if the purpose suits. What makes them different from other module (.bas) source files, is instead of being compiled directly, they are included by another source file (module or header) using a preprocessor directive. All compiled libraries typically have one or more can be included in another source file and will introduce to the compiler all the procedures usable in a particular library.

FreeBASIC Header Files

Some of the keywords, constants, and procedures documented in this manual are not normally available when compiling a source code unless a specific header file is included first.

- datetime.bi
- dir.bi
- fbgfx.bi
- file.bi
- string.bi
- vbcompat.bi

Case Sensitivity

Although the FreeBASIC language itself is not case-sensitive, the file system running might be. If a header file can not be found, check that FreeBASIC is searching for it in the correct location and ensure that name of both the directory and filename specified in the `#include` statement is using the correct upper and lowercase letters.

Path Separators

FreeBASIC will automatically switch backslash (\) and forward slash (/) characters as needed for a given platform. This allows source code to be easily cross-platform.
Including a header only once

It is common that header files need to `#include` other header files to compile correctly. FreeBASIC offers three methods for guarding against including a header file more than once.

- `#ifndef` guards in the header file
- `#include once` where the file is included
- `#pragma once` in the header file itself

 ifndef guards in the header file

The use of `#ifndef` and `#define` is a common practice in nearly any language that supports preprocessing. The first time a file is included, a unique symbol is defined. If the same header file is included again, the definition of the symbol is checked, and if it is already defined, the contents of the header file are skipped.

```
'' header.bi
#ifndef __HEADER_BI__
#define __HEADER_BI__

#define __HEADER_BI__

#include once

endif
```

#include once

At the point in the source code where the header file is included, the `once` specifier of the `#include` directive can tell the compiler to only include the source file one time.

```
'' header.bi
#include once "fbgfx.bi"
```

```
'' module.bas
```
#pragma once

#pragma once can be used in a header file to indicate that the header file should be included once.

```
'' header.bi
#pragma once
#print This header will only ever be included once
```

See also

- Source Files (.bas)
- Header Files Index
Using Prebuilt Libraries

FreeBASIC is distributed with many headers for common or popular libraries. These headers allow a programmer to use functions available in these existing shared libraries (DLLs).

The libraries themselves are not distributed with FreeBASIC, but most can be downloaded from the web and readily installed. Some other libraries may be first compiled from sources to be used. Please see the documentation for the specific library on how to configure, install, and use them.

Some static or shared libraries (DLLs) may be already present on the system; they might be part of FreeBASIC itself or the operating system.

Although many headers can be used on any of the platforms supported by FreeBASIC, some headers are platform specific and will not be usable on other platforms.

FreeBASIC headers

There are a few headers that are specific to FreeBASIC and expose functions that are otherwise not available:

- **datetime.bi** - Declarations for `DateSerial`, `DateValue`, `IsDate`, `Year`, `Month`, `Day`, `Weekday`, `TimeSerial`, `TimeValue`, `Hour`, `Minute`, `Second`, `Now`, `DatePart`, `DateDiff`, `MonthName`, `WeekdayName`
- **dir.bi** - Constants to be used with `Dir`
- **fbgfx.bi** - Additional constants and structures to be used with graphics commands such as `MultiKey`, `ScreenControl`, and `ScreenEvent`, `ImageCreate`.
- **file.bi** - Declarations for `FileCopy`, `FileAttr`, `FileLen`, `FileExi`, `FileDateTime`
- **string.bi** - Declarations for `Format`
- **vbcompat.bi** - Includes `datetime.bi`, `dir.bi`, `file.bi`, and `string.bi` plus additional constants compatible with Microsoft Visual Basic.

C Runtime (CRT)
Where possible cross-platform compatible headers have been provided. For example,

```c
#include once "crt.bi"
printf( "Hello World\n" )
```

To include a specific CRT header, prefix the name of the header file with `crt/`.
For example:

```c
#include once "crt/stdio.bi"
Dim f As FILE Ptr
f = fopen("somefile.txt", "w")
fprintf( f, "Hello File\n")
fclose( f )
```

**Windows API**

Many (many) headers for the Windows API are available for inclusion in FreeBASIC source code. In most cases the only include file needed is "windows.bi". For example,

```c
#include once "windows.bi"
MessageBox( null, "Hello World", "FreeBASIC", MB_OK )
```

To include a specific Windows API header, prefix the name of the header file with "win/".
For example:

```c
#include once "win/ddraw.bi"
```

Browse the "inc/win/" directory where FreeBASIC was installed to see available Windows API headers.

**Other Headers Provided**

Browse the "inc/" directory located where FreeBASIC was installed to find other headers. It is possible that headers might be available for a library you
Some headers are located in "inc/" and others might be located in a subdirectory. To include headers located in a subdirectory of "inc/", prefix the header with the name of the directory where it is located. For example:

```
" located at inc/curl.bi
#include once "curl.bi"

" located at inc/GL/gl.bi
#include once "GL/gl.bi"
```

**Requirements for Using Prebuilt Static Libraries**

- The source code must include the appropriate headers using `#include`.
- The static library must be linked at compile time by using either the source code or by using the `-l` option on the command line to specify the name of the library.

**Requirements for Using Prebuilt Shared Libraries**

- The source code must include the appropriate headers using `#include`.
- The shared library (.DLL) must be present on the host computer where the compiled program will run.
Comments

Comments are regions of text that the compiler will ignore but may contain information that is useful to the programmer. One exception are metacommmands which appear in certain types of comments.

**Single Line comments**

The single quote character (‘) may be used to indicate a comment and may appear after other keywords on a source line. The rest of the statement will be treated as a comment.

```
' comment text
```

**The comment statement: Rem**

A source code statement beginning with `Rem` indicates that the rest of the line is comment and will not be compiled. `Rem` behavior is the same as above, except it must be the first keyword in the statement.

```
Rem comment
```

**Multi-line comments**

Multi-line comments are marked with the tokens `/` and `'/`. All text between markers is considered comment text and is not compiled.

Multi-line comments can span several lines, and can also be used in statements. After the end of the comment, the statement will continue as normal (even if the comment crosses line breaks).

```
/* Multi-line comment */

Print "Hello" /* embedded comment*/ "world"
```
Note: If FreeBASIC encounters a close-comment marker while it's not in a multi-line comment, it will treat it as a normal single-line comment due to the single quote.

**Nested Comments**

A multi-line comment can contain other multi-line comments inside it. Each inner comment has its own open- and close-comment markers.

```vbnet
This is a comment.
This is a comment inside a comment
This Is a comment.
```

A multi-line comment can contain unlimited levels of nested comments. It will continue to parse the multi-line comment for more markers until the number of close-comment markers reaches the number of open-comment markers, i.e., when it has closed all the comments it has opened.

**Comments after line continuation**

A single-line comment may appear after the line continuation character, even if it's part of a multi-line statement. FreeBASIC does not parse the text after the line continuation character, though, so you can't open multi-line comments after them.

```vbnet
Print _ ' line
"This is part of the previous line's statement"
```

**Metacommands**

Metacommands, such as `$Static` and `$Include`, can be placed in single-line comments. The `$` sign and the keyword must be the first two things in the comment.
not including white space.

```
Rem compile With -lang fblite Or qb
#lang "fblite"
Rem $Static
' $include: 'vbcompat.bi'
```

**Single-line comment parsing**

When you make a single-line comment, FreeBASIC will parse the comment to check for a metacommand. If it finds a multi-line comment, it will treat it as usual and continue parsing the single-line comment after the close-comment marker.

If you want to prevent FreeBASIC from parsing the single-line comment, put a single quote ('), at the start of the comment. FreeBASIC will treat the rest of the line, including multi-line comment markers and metacommands, as ordinary text, and will ignore it. Other words encountered in a comment will also stop the parsing.

- **Note:** As of version 0.21.0, this will not longer apply in the dialect, and multi-line comment markers will be completely ignored inside single-line comments.

```
' $static <-- will not get parsed
'' this multiline comment marker ('/''') will be ignored
Print "This line is not a comment."
```

**Example**

```
/* this is a multi line comment as a header of this example */
```
Rem This Is a Single Line comment

'this is a single line comment

Dim a As Integer 'comment following a statement

Dim b As /* can comment in here also */ Integer

#if 0
    before version 0.16, This was the only way of commenting Out sections With multiple lines of code.
#endif

See also

- Rem
Identifier Rules

Naming conventions for FreeBASIC symbols.

Description

An identifier is a symbolic name which uniquely identifies a variable, Type, Union, Enum, Function, Sub, or Property, within its scope or Namespace.

Identifiers may contain only uppercase and lowercase Latin character a-z and A-Z), digits (0-9), and the underscore character (_). The first character of an identifier must be a letter or underscore, not a digit.

Identifiers are case-insensitive: F00 and f00 (and all other permutation of uppercase and lowercase) refer to the same symbol.

In the -lang qb and -lang fblite dialects, identifiers may have a type suffix at the end indicating one of the standard data types:

- % for Integer
- & for Long
- ! for Single
- # for Double
- $ for String

The use of these symbols is generally discouraged in and is not allowed in the -lang fb dialect (the default).

The alternative is to be explicit - for example, Dim As Integer foo or Dim foo As Integer instead of Dim foo%.

In the -lang qb and -lang fblite dialects, identifiers may contain one or more periods (.)

Dialect Differences
- Periods in symbol names are only supported in the `-lang qb` and `-lang fblite` dialects.

**Differences from QB**

- Support for the underscore character (`_`) in symbol names is new to FreeBASIC.

**See also**

- Variables
**Literals**

Non-variable compile-time string, numeric values and boolean values.

Literals are numbers, strings of characters or boolean truths specified directly in the source code. Literal values may be used by assigning them to a variable or constant, passing them to a procedure, or using them in an expression.

Numeric literals come in two forms - integer and floating-point.

**Integer Literals**

**Decimal**

Decimal digits (0 1 2 3 4 5 6 7 8 9).

*Note: to get negative values, a "-" sign (Operator - (Negate)) can be placed before a numeric literal*

```
Dim x As Integer = 123456
Dim b As Byte = -128
```

**Hexadecimal**

"&H;", followed by hexadecimal digits (0 1 2 3 4 5 6 7 8 9 A B C D E F)

```
Dim x As Integer = &h1E240
Dim b As Byte = &H80
```

**Octal**

"&0;" (O as in "Octal"), followed by octal digits (0 1 2 3 4 5 6 7)

```
Dim x As Integer = &O361100
Dim b As Byte = &O200
```
Binary
"&B;", followed by binary digits (0 1)

```vbnet
Dim x As Integer = &B11110001001000000
Dim b As Byte = &B10000000
```

**Integer size suffixes**

If an integer literal suffix is not given, the number field size required to literal is automatically calculated. Specifying a size suffix guarantees the compiler will consider a number as a specific integer size.

Integer literals ending with:

- "%", are considered as signed 32/64 (depending on platform) bit integers. (Integer)
- "L", "&", are considered as signed 32 bit long integers. (Long)
- "u", are considered as unsigned 32/64 (depending on platform) bit integers. (UInteger)
- "UL", are considered as unsigned 32 bit integers. (Ulong)
- "LL", are considered as signed 64 bit integers. (LongInt)
- "ULL", are considered as unsigned 64 bit integers. (ULongInt)

The prefixes, suffixes, and hexadecimal letter digits are all case-insensitive.

```vbnet
Dim a As Long = 123L
Dim b As UInteger = &h1234u
Dim c As LongInt = 76543LL
Dim d As ULongInt = &b1010101ULL
```

**Floating Point Literals**

Floating point numbers are specified in decimal digits, may be positive or negative, have a fractional portion, and optionally an exponent. The floating point literals are:

```vbnet
Dim e As Single = 1.23
Dim f As Double = 1.23456789012345678901234567890
Dim g As Float = 1.23f
Dim h As Double = 1.23456789012345678901234567890d
Dim i As Double = 1.23E10
Dim j As Double = 1.23E-10
```
floating point literal is as follows:

number[[[fraction]]][((D|E) [+|-] exponent)|(D|E)][[suffix]]

or

.fraction[[(D|E) [+|-] exponent)|(D|E)][[suffix]]

By default, floating point numbers that do not have either an exponent are considered as a double precision floating point value, except in the dialect, where numbers of 7 digits or fewer are considered to be single precision.

```
Dim a As Double = 123.456
Dim b As Double = -123.0
```

The letter "d" or "e", placed after the number/fraction part, allows the number to be given an exponent. The exponent may be specified as either positive or negative with a plus ("+") or minus ("-") sign. Exponents that do not have a sign are positive. An exponent is not required after the letter, so the letter can be used just to specify the type. "d" specifies a double-precision floating-point number, and "e" specifies a floating-point number using the default precision. When the letter is used on its own in combination with a suffix (see below) the type denoted by the suffix overrules the type specified by the letter.

```
Dim a As Double = -123.0d
Dim b As Double = -123e
Dim c As Double = 743.1e+13
Dim d As Double = 743.1D-13
Dim e As Double = 743.1E13
Dim f As Single = 743D!
```

A suffix of "!" or "f" on a number specifies a single precision (32 bit) floating point value. A suffix of "#" specifies a double precision float. Note that the letter suffixes and exponent specifiers are all case-insensitive.
Dim a As Single = 3.1!
Dim b As Single = -123.456e-7f
Dim c As Double = 0#
Dim d As Double = 3.141592653589e3#

**String Literals**

String literals are a sequence of characters contained between two double quotes. The sequence of characters escaped or non-escaped.

Double quotes can be specified in the string literal by using two double quotes together.

```vbnet
Print "Hello World!"
Print "That's right!"
Print "See the ""word"" contained in double quotes.
```

String literals can contain escape sequences if the string literal is prefixed with `!` operator (Escaped String Literal). See [Escape Sequences](#) for a list of accepted escape sequences.

```vbnet
Print !"Hello\nWorld!"
```

By default, string literals are non-escaped unless `Option Escape` was used in the source in which case all string literals following are by default escaped.

A string may be explicitly specified as non-escaped when prefixed by `$` operator (Non-Escaped String Literal).

```vbnet
Print "$C:\temp"
```

Besides ASCII files with Unicode escape sequences (`\u`), FreeBASIC
UTF-8, UTF-16LE, UTF-16BE, UTF-32LE and UTF-32BE source files allow unicode characters directly in the string literal.

**Boolean Literals**

The boolean type has two values, represented by literals `True` and `False`

```vbnet
Dim a As Boolean = False
Dim b As Boolean = True
```

**See also**
- `TypeOf`
- `#define`
- `Const`
- `Standard Data Types`
- `Table with variable types overview, limits and suffixes`
Labels

Defines a location in a program.

Syntax

\[
\text{symbolname :}
\quad \text{or}
\quad \text{literalnumber}
\]

Description

Defines a place in a program where \texttt{Goto} or \texttt{GoSub} can jump to.

A label can be a positive integer line number or a \textit{symbolname}. In both cases, a label must end with a colon (:) character.

Example

```
'' Compile with -lang fblite or qb

#lang "fblite"

beginning:
3 Print "Hello World!"
Goto beginning

'' compile with -lang qb

'$lang: "qb"

'' Labels can be used to "bookmark" DATA blocks, a
Read a,b,c
Restore here
Read d,e
Print a,b,c,d,e
```
Data $1,2,3,4,5$
here:
Data $6,7,8$

Output:

1, 2, 3, 6, 7

**Dialect Differences**
- Line numbers with decimals is available only in the *-lang qb* dialect.

**Differences from QB**
- None if compiled in the *-lang qb* dialect.

**See also**
- GoSub
- Goto
Line continuation

A single _ (underscore) character at the end of a line of code tells the compiler (for this code) to be spread across multiple lines in the input file, which can be a nice formatting help.

```
' This Dim statement is spread across multiple lines
Dim myvariable _
As Integer
```

This is often used to make very long lines of code easier to read, for example:

```
' Here's an example:
Declare Sub drawRectangle( ByVal x As Integer, ByVal y As Integer, ByVal w As Integer, ByVal h As Integer, ByVal...
' which can also be written as:
Declare Sub drawRectangle( ByVal x As Integer, ByVal y As Integer, ByVal w As Integer, ByVal h As Integer, ByVal...
' or:
Declare Sub drawRectangle _
( _
   ByVal x As Integer, _
   ByVal y As Integer, _
   ByVal w As Integer, _
   ByVal h As Integer _
)
' (or any other formatting you like)
```

The _ line continuation character can be inserted at pretty much any point in a line of code.
Be careful when adding the _ line continuation character right behind an otherwise it would be treated as part of the identifier or keyword.

```vbnet
'' Declare variable "a_
'' (no line continuation happening, because the '_'
'' the "a_" identifier)
Dim As Integer a_

'' Declare variable "a" and initialize to value 5
'' (line continuation happening, because the '_' char
'' was separated from the identifier "a" with a space)
Dim As Integer a_
  = 5
```

**Warning:** When an erroneous code line is spread over a multiple lines block, the error message refers only to the last line of the block.
Coercion and Conversion

Coercion of Numeric Data Types in Expressions.

When two different data types are used in a binary operation, like + (Addition) or = (Assignment), the smaller data type is automatically promoted to the larger data type regardless of the order in which the arguments are given.

Promotions are as follows:
- where both arguments are each one of byte, ubyte, short, ushort, or integer: the smaller sized argument is promoted to have the same size as the larger sized argument.
- where one of the arguments is longint or ulongint, and the other argument is of any integer type, the smaller sized argument is promoted to have the same size as the larger sized argument.
- where one of the arguments is a single or a double, both arguments are converted and/or promoted to double.

All unsigned integer types are handling like signed integer types for the purpose of promotion, and the most significant bit is extended (sign extension).

Conversion of Numeric Data Types

A type conversion will occur implicitly when an expression or variable is assigned, passed as a parameter to a procedure, or returned as a result from a procedure. Conversions may also be explicit when using CAST or one of the built-in conversion functions.

Integer To Integer, any combination of Signed and Unsigned
- Any integer type to a smaller integer type: least significant bits are retained
- Any integer type to a larger integer type: sign extended to fill more significant bits

Integer to Single or Double
- Possible loss of precision

**Double to Single**
- Possible loss of precision
- If the value of the Double exceeds the range of a Single result is +/- INF

**Double or Single to Integer**
- Possible loss of precision
- If the value of the floating point number exceeds the range of the target type are results are undefined. A run-time error is not raised.

**See also**
- Standard Data Types
- Variable Types
- Casting and Conversion Functions
Constants

Description

Constants are numbers which cannot be changed after they are defined.

In FreeBASIC, a constant definition differs from a variable definition by usage of the `Const` command.

Such constants are then available globally, meaning that once defined to a constant anywhere in your program.

After being defined with the `Const` command, constants cannot be altered. If code tries to alter a constant, an error message will result upon code compilation.

Example

```
Declare Sub PrintConstants ()

Const FirstNumber = 1
Const SecondNumber = 2
Const FirstString = "First string."

Print FirstNumber, SecondNumber 'This will print 1 2
Print FirstString   'This will print First string.

PrintConstants ()

Sub PrintConstants ()
    Print FirstNumber, SecondNumber 'This will also
    Print FirstString              'This will also print First
End Sub
```

See also
- Const
- Enum
Variables

Symbols representing data in memory.

Description

Variables are name symbols which can be manipulated. They are decomposed of letters, numbers, and character "_". These reference name symbols because such symbols are part of the FreeBASIC programming language. These reference name symbols cannot contain most other symbols because such symbols are part of the FreeBASIC programming language. They also cannot contain spaces. See Identifier Rules.

In FreeBASIC, variables can be defined using the Dim statement.

Variables are available for later access depending on where and how is given. Depending on the scope of a variable, a defined variable can be available within the main area of a program, within a procedure, through an entire module, or through Variable Scope.

Variables are also made available when they are passed as parameters to procedures or Sub.

After a variable is declared with the Dim statement, they can be assigned in expressions wherever their Standard Data Type is similar. Sometimes variables are automatically converted to other data types before being used in expressions, or passed. See Coercion and Conversion.

Example

' compile with -lang qb or fblite

'$lang: "qb"

Declare Sub PrintConstants()

Dim FirstNumber As Integer
Dim Shared SecondNumber As Integer

FirstNumber = 1
SecondNumber = 2

PrintConstants ()
Print FirstNumber, SecondNumber, ThirdNumber 'This

Sub PrintConstants ()
    Dim ThirdNumber As Integer
    ThirdNumber = 3
    Print FirstNumber, SecondNumber, ThirdNumber 'This
End Sub

See also
  - Coercion and Conversion
  - Dim
  - Identifier Rules
  - Variable Scope
Arrays

Multi-dimensional container types.

Overview

Arrays are special kinds of variables which act as containers for a number of elements. An array can store elements of any type, and all of its elements are of the same type. For example, an array can store Integer elements or Single elements, but not both. These elements are accessed--read from or written to--through an Integer value representing their position in the array. Arrays have lengths, or sizes, which are equal to the number of elements they are storing at any given time. Fixed-length arrays have constant sizes throughout their lifetimes, while the sizes of variable-length arrays can change dynamically.

Elements and positions

The values that an array stores are its elements. Each element of an array has a position, which is an Integer value ranging from the array's lower bound inclusive. These positions are used to access individual elements in the array, which takes a position and returns a reference to the element at that position. An array is greater than or equal to its lower bound, and less than or equal to its upper bound.

```
' Create an array of 3 elements all having the value zero (0.0f).
Dim array(1 To 3) As Single

' Assign a value to the first element.
array(1) = 1.2

' Output the values of all the elements ("1.2 0 0")
For position As Integer = 1 To 3
    Print array(position)
Next
```

Sizes and bounds

The size of an array is equal to the number of elements it stores at any
have a size of zero (0), meaning it's not storing any values at the moment. Size is greater than zero, that many elements are being stored. An array's size is equal to one more than the difference between its upper and lower bounds, or $UBound + 1$.

The lower and upper bounds not only determine the size of an array, but also the valid positions of individual elements. For example, an array with lower and upper bounds of (0, 4) stores five (5) elements, the first element being at position 0, the last at position 5. These bounds may be specified when the array is declared, or, for some arrays, changed by resizing the array. An array's lower and upper bounds can be retrieved using $LBound$ and $UBound$.

When creating or resizing an array, if a lower bound is not specified it defaults to zero (0).

```
' Declares and initializes an array of four integer elements.
Dim array(3) As Integer = { 10, 20, 30, 40 }

' Outputs all of the element values ("10 20 30 40")
For position As Integer = LBound(array) To UBound(array)
    Print array(position) ;
Next
```

**Fixed-length and variable-length**

There are two fundamental kinds of arrays: fixed-length and variable-length. The difference between the two is that the bounds of fixed-length arrays cannot change, so they always store the same number of elements in the same positions. Variable-length array bounds can be changed, affecting the number of elements stored and the positions of the elements.

Since fixed-length arrays never change size, the compiler chooses to allocate memory for the array elements either in static storage or on the program stack, depending on the array's storage class. This can be an advantage, since the cost of creating these kinds of arrays doesn't include any adverse run-time penalty. Fixed-length arrays are declared using $Extern$, $Static$ and $Dim$. At least an upper bound must be specified, and compile-time constant values, such as numeric literals, $Const$ variables:
Variable-length arrays can change in size, so the compiler chooses to allocate memory for the array elements at run-time, in the free store. The advantage here of course is that we can dynamically resize the arrays, however, run-time performance could vary when they are created, resized or destroyed. Variable-length arrays are declared using the `Extern` keyword. When using `Extern`, `Static` or `Dim`, the lower and upper bounds can be left unspecified—resulting in an empty array—or either one must have a variable value, such as a `Function` result. `ReDim` can be used to resize an existing variable-length array.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Const totalSingles = 5</code></td>
<td>Creates a fixed-length array that holds 5 single elements.</td>
</tr>
<tr>
<td><code>Dim flarray(1 To totalSingles) As Single</code></td>
<td></td>
</tr>
<tr>
<td><code>Dim vlarray() As Integer</code></td>
<td>Creates an empty variable-length array that holds integer values.</td>
</tr>
<tr>
<td><code>ReDim vlarray(1 To 10) As Integer</code></td>
<td>Resizes the array to 10 elements.</td>
</tr>
</tbody>
</table>

**Multi-dimensional arrays**

The arrays discussed so far have been one-dimensional, that is, the elements are accessed through a single position. One-dimensional arrays can be thought of as a simple row of elements. Arrays can also have more than one dimension; an individual element is accessed using two or more positions. Two-dimensional arrays use two positions--a row and a column--to refer to individual elements, like a grid or table. Three-dimensional arrays use three positions--a row, column and perhaps depth position--to refer to individual elements, like a cube. Four-dimensional arrays can be thought of as one or more three-dimensional arrays, and so on. Multi-dimensional arrays are declared just like one-dimensional arrays, except that more than one lower and upper bound range is specified.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Dim As Integer multidim(1 To 2, 1 To 5) = {{0, 0, 0, 0, 0}}</code></td>
<td>Take Care while initializing multi-dimensional array.</td>
</tr>
</tbody>
</table>
See also

- Fixed-length Arrays
- Variable-length Arrays
- Variable Scope
Fixed-length Arrays

Fixed-size homogeneous data structures.

Overview

Fixed-length arrays are **arrays** that have a fixed constant size throughout the execution of a program. The memory used by a fixed-length array to store its elements is allocated at compile-time, either on the stack or in the `.BSS` or `.DATA` sections of the executable, depending on whether or not it is defined. This may allow for quicker program execution since the memory for the array is already allocated, unlike **variable-length arrays**, whose element memory isn’t defined until runtime.

Fixed-length arrays with **automatic storage**, have their elements allocated on the stack, and pointers to these elements remain valid only while the array is in scope. Arrays with **static storage** are allocated in the `.DATA` or `.BSS` sections of the executable, so pointers to these elements remain valid for the entire execution of the program. Fixed-length arrays of any storage class cannot be resized during program execution, only **variable-length arrays** can.

Fixed-length arrays may also be used as data members inside **user-defined types**. Each array is directly allocated as part of the user-defined type structure.

Declaration

A fixed-length array is declared with either the `Dim` or `Static` keywords, followed by a parenthesized list of boundaries and an element **data type**.

```
'' Defines a one-dimensional fixed-length array of type INTEGER having automatic storage.
Dim arrayOfIntegers(69) As Integer

'' Defines a one-dimensional fixed-length array of type SHORT having static storage.
Static arrayOfShorts(420) As Short
```

There are various ways to specify an array's amount of elements. Each
dimensions. Each dimension has a lower bound and an upper bound.

```vb
Dim a(1) As Integer  '' 1-dimensional, 2 elements
Dim b(0 To 1) As Integer  '' 1-dimensional, 2 elements
Dim c(5 To 10) As Integer  '' 1-dimensional, 5 elements (5, 6, 7, 8, 9 and 10)

Dim d(1 To 2, 1 To 2) As Integer  '' 2-dimensional, 4 elements: (1,1), (1,2), (2,1), (2,2)
Dim e(255, 255, 255, 255) As Integer  '' 4-dimensional, 256 * 256 * 256 * 256 elements
```

For an array to be declared fixed-length, the boundaries must be specified using `Const` values or `Enum` constants.

```vb
Const myLowerBound = -5
Const myUpperBound = 10

'' Declares a one-dimensional fixed-length array, holding myUpperBound - myLowerBound + 1 String objects.
Dim arrayOfStrings(myLowerBound To myUpperBound) As String

'' Declares a one-dimensional fixed-length array of bytes big enough to hold an INTEGER.
Dim arrayOfBytes(0 To SizeOf(Integer) - 1) As Byte
```
Variable-length Arrays

Resizable homogeneous data structures. Also known as "dynamic array

Overview

Variable-length arrays are arrays that can, during program execution, have their dimension[s] use a different subscript range. The memory is allocated at runtime in the heap, as opposed to fixed-length arrays whose memory is allocated at compile-time in the .BSS or .DATA sections of the executable, depending on whether the array is defined on the program stack or in the executable.

Variable-length arrays may also be used as data members inside use though, the array is not allocated as part of the user-defined type structure. Instead, the user-defined type only contains the array descriptor of the array behind the scenes, and the array is still allocated on the heap, as with variable-length array variables.

Variable-length arrays are often called "dynamic arrays" because their size can change dynamically at runtime, instead of being fixed-size.

Declaration

A variable-length array is declared with either the Dim or ReDim keywords, followed by a variable identifier, a list of boundaries, and an element data type. For an array to be declared as variable-length, the boundaries must be unknown boundaries, or with variable (non-constant) boundaries. ReDim always defines variable-length arrays, whether the specified boundaries are constant or not.

```vbnet
' Declares a one-dimensional variable-length array of integers, with initially 2 elements
ReDim a(0 To 1) As Integer

' Declares a 1-dimensional variable-length array
' It must be resized using Redim before it can be used
Dim b(Any) As Integer

' Same, but 2-dimensional
Dim c(Any, Any) As Integer

Dim myLowerBound As Integer = -5
```
```
Dim myUpperBound As Integer = 10

' Declares a 1-dimensional variable-length array by specifying variable (non-constant) boundaries.
' The array will have myUpperBound - myLowerBound + 1 elements.
Dim d(myLowerBound To myUpperBound) As Integer

' Declares a variable-length array whose amount of dimensions will be determined by the first Redim or array access found. The array must be resized using Redim before it can be used for the first time.
Dim e() As Integer
```

**Resizing**

Resizing a variable-length array refers to "redefining" the array with different boundaries. Elements outside the new subscript range(s) are erased; object elements will be destroyed. If the array is resized to a larger size, new elements are added initialized with a zero or null value; object elements are default-constructed. Variable-length arrays are resized using the `ReDim` keyword following the same form as definition. In this case the element data type may be omitted from the `ReDim` statement.

```
' Define an empty 1-dimensional variable-length array...
Dim array(Any) As Single

' Resize the array to hold 10 SINGLE elements...
ReDim array(0 To 9) As Single

' The data type may be omitted when resizing:
ReDim array(10 To 19)
```

Resizing an array cannot change its amount of dimensions, but only the boundaries of each dimension.

By default, element values of a variable-length array are lost when resized. To retain the previous element values during a resize, use the `Preserve` keyword.
Array Index

An array index is the number used to access an Array of Variables created using the Description.

**Description**

The following examples illustrate the use of array elements.

If we have an array `myArray` with elements of 1 to 10, filled with random data:

<table>
<thead>
<tr>
<th>Index</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

One can access each piece of data separately by pointing to the Index:

```plaintext
Print myArray(5)
```

Printing the data contained in the fifth element of `myArray` results in an output of:

```
9
```

To change the contents of an array, use it like any other Variable:

```plaintext
myArray(3) = 0
```

To print the contents of `myArray(3)`, use the command:
Print myArray(3)

Which results in an output of:

0

Array elements can be indexed using another Variable. In this example:

Dim a As Integer
For a = 1 To 10
    myArray(a) = 0
Next a

To change a random array element to a random value:

Dim Index As Integer
Dim Value As Integer
index = Int(Rnd(1) * 10) + 1 'This line will simulate selecting a random index between 1 and 10.
Value = Int(Rnd(1) * 10) + 1 'This line will simulate selecting a random value between 1 and 10.
myArray(index) = Value

Example

Declare Sub PrintArray()

Dim Numbers(1 To 10) As Integer
Dim Shared OtherNumbers(1 To 10) As Integer
Dim a As Integer

Numbers(1) = 1
Numbers(2) = 2
OtherNumbers(1) = 3
OtherNumbers(2) = 4

PrintArray ()

For a = 1 To 10
    Print Numbers(a)
Next a

Print OtherNumbers(1)
Print OtherNumbers(2)
Print OtherNumbers(3)
Print OtherNumbers(4)
Print OtherNumbers(5)
Print OtherNumbers(6)
Print OtherNumbers(7)
Print OtherNumbers(8)
Print OtherNumbers(9)
Print OtherNumbers(10)

Sub PrintArray ()
    Dim a As Integer
    For a = 1 To 10
        Print otherNumbers(a)
    Next a
End Sub

See also

- Arrays
- Dim
- Function
- Sub
- Variables
- Variable Scope
Pointers

Data types whose values are addresses in memory.

Declaration

Pointers are **Variables** whose values are addresses in memory, and they point to memory. The type of data that is pointed to depends on the type of pointer (points to **Integer** data). Pointers are declared like any other variable, but with an "ptr" following the type name.

Accessing pointed to data

The data pointed to by a pointer can be accessed with **Operator * (Value of)** returns a reference to the data that its operand points to. The following:

```basic
Dim myInteger As Integer = 10
Dim myPointer As Integer Pointer = @myInteger
*myPointer = 20
Print myInteger
```

defines an **Integer** variable called `myInteger` and an **Integer** pointer called `myPointer` to the location in memory where `myInteger` is stored. **Operator @ (Address of)** returns the address of `myInteger`. The value of 20 is assigned to the location at the address of `myInteger`, or `@myInteger`. Changes to `*myPointer` directly affect the value of `myInteger` (the expression "*myPointer" is the same thing as "myInteger").

Pointers to user-defined types

Pointers to user-defined types are defined and used like all other pointers of a **Type** or **Class** requires one of the following two methods:

```basic
Type myType
    a As Integer
    b As Double
End Type
```
Dim x As myType
Dim p As myType Pointer = @x

'' 1) dereference the pointer and use the member access
(*p).a = 10
(*p).b = 12.34

'' 2) use the shorthand form of the member access
Print p->a
Print p->b

The first method uses **Operator . (Member Access)**. This operator accesses members from references, so the pointer is dereferenced first. The member access operator has higher priority over the dereference operator, so parenthesis are needed to dereference the pointer before using it with the member access operator.

The second method uses **Operator -> (Pointer To Member Access)**. This operator accesses members from pointers, which are automatically dereferenced. This can make code a little clearer, although both forms produce identical results.

**See also**

- **Operator @ (Address Of)**
- **Operator * (Value Of)**
- **Operator . (Member Access)**
- **Operator -> (Pointer To Member Access)**
- VarPtr
- StrPtr
- ProcPtr
**Overview**

It is often useful to iterate through memory, from one address to another. Pointers are used to accomplish this. While the type of a pointer determines the type of variable or object retrieved when the pointer is dereferenced (using `Operator * (Value Of)`), it also determines the *distance*, in bytes, its pointer type takes up in memory. For example, a `Short` takes up two (2) bytes memory, while a `Single` needs four (4) bytes.

**Adding and subtracting from pointers**

Pointers can be added to and subtracted from just like a numeric type result of this addition or subtraction is an address, and the type of pointer determines the distance from the original pointer.

For example, the following,

```
Dim p As Integer Ptr = New Integer[2]
*p = 1
*(p + 1) = 2
```

will assign the values "1" and "2" to each integer in the array pointer to. Since `p` is an `Integer Pointer`, the expression "*(p + 1)" is saying to dereference an `Integer` four (4) bytes from `p`; the "1" indicates a distance *the size of an Integer", or four (4) bytes.
Subtraction follows the exact same principle. Remember, $a - b = a + -b$.

**Incrementing and decrementing pointers**

Sometimes it is more convenient to modify the pointer itself, in which case combination addition and subtraction operators will work just like above. For example, the following,

```vbnet
Dim array(5) As Short = { 32, 43, 66, 348, 112, 0
Dim p As Short Ptr = @array(0)

While (*p <> 0)
    If (*p = 66) Then Print "found 66"
    p += 1
Wend
```

iterates through an array until it finds an element with the value of "0". If it finds an element with the value "66" it displays a nice message.

**Distance between two pointers**

The distance between two pointers is retrieved with `Operator - (Subtract)` and is measured in values, not bytes. For example, the following,

```vbnet
Type T As Single

Dim array(5) As T = { 32, 43, 66, 348, 112, 0 }
Dim p As T Ptr = @array(0)

While (*p <> 0)
    p += 1
Wend
Print p - @array(0)
```
will output "s" regardless of what type T is. This is because there is a five (5) element difference between the first element of array (32) and the element pointed to by p (θ).

Specifically, if a and b are both pointers of type T, the distance between them is the number of bytes between them, divided by the size, in bytes, of:

```
Abs(cast(byte ptr, a) - cast(byte ptr, b)) / SizeOf(T)
```

**See also**
- Operator + (Add)
- Operator - (Subtract)
- Operator @ (Address Of)
- Operator * (Value Of)
- Pointer Operators
Implicit Declarations

Lazy declaration of variables.

The *qb* and *fblite* FreeBASIC language dialects allow variable names to be used without declaring them first. This is called implicit or lazy declaration since the actual declaration is inferred from how the name is first used.

**Variable Type**

When a variable is implicitly declared, its type depends on one of two things: the most recent default implicit type directive, if any, or the variable type suffix symbol used, if any.

**Default type**

In the *qb* dialect, implicitly declared variables default to *Single* type, while in the *fblite* dialect they default to *Integer* type.

**Default implicit type directives**

"DEFxxx" directives dictate the new default type for any following implicit variable declarations. These directives are: DefByte, DefUByte, DefShort, DefUShort, DefInt, DefUInt, DefLng, DefSng, DefDbl and DefStr.

**Variable type suffix symbols**

Variable names suffixed with one of a certain set of symbols will be implicitly declared of a certain type. These symbols are: '%' for *Integer*, '&' for *Long*, '!' for *Single*, '#' for *Double* and '$' for *String*. These symbols override previous "DEFxxx" directives, if any.

**Implicit Array Declaration**
Currently, FreeBASIC does not support implicit declaration of arrays.

**Debugging**

For full debugging support, all variables must be explicitly declared and suffixes should not be used. The use of `Option Explicit` is recommended to turn off support for implicit declarations, so that mistyped variable names are caught at compile time by the compiler.

**See also**

- `Option Explicit`
- `FreeBASIC Language Dialects`
Variable Initializers

Variable initializers are supported for initializing Arrays, variables and UDTs.

Syntax

- `Dim scalar_symbol [AS DataType] = expression`
- `Dim array_symbol ([lboun TO ubound]) [AS DataType] => { expression [, ..., ] }`
- `Dim udt_symbol AS DataType = ( expression [, , ..., ] )`

Description

Arrays, variables and UDTs may be given a value at the time of their declaration using the syntax shown above. Please note the important differences between initializing them and initializing as they would in a normal assignment, using an equals sign followed by a greater than symbol (=>). Array values are given in comma delimited values enclosed by curly brackets, and UDT values are given in comma delimited values enclosed by parenthesis.

These methods of initializing variables can be nested within one another, to initialize a multidimensional array:

```plaintext
Dim array(1 To 2, 1 To 5) As Integer => {{1, 2, 3,

In this declaration, the values for the left-most dimension are given as arrays of any dimension to be initialized.

UDTs and arrays can be nested within each other as well. For instance:

```plaintext
Type mytype
    var1 As Double
    var2 As Integer
    var3 As ZString Ptr
End Type

Dim MyVar(2) As mytype => _
{ _, _
```
For module-level, static, or global variables, initialized values must be report a compile-time error if otherwise.

**Differences from QB**

- Variable Initializers are new to FreeBASIC

**See also**

- Dim
Visibility and lifetime of variables, objects and arrays

A variable, object or array's storage class determines when and where memory is allocated for it and when that memory is destroyed. There are 2 storage classes in FreeBASIC: *automatic* and *static*.

**Automatic**

*Automatic* variable, object and array lifetimes begin at the point of declaration and end when leaving the scope they are declared in.

*Automatic* entities are guaranteed to have unique storage for each instance of the block in which they are declared. For example, the *automatic* variables declared within a procedure will be allocated at different addresses and have unique state (value) for each call to the procedure.

*Automatic* variables, objects and arrays are defined using the `Dim`, `ReDim` and `Var` keywords without the `Shared` specifier.

The memory for *automatic* variables, objects and arrays is allocated on the program stack.

*Automatic* variables, objects and arrays have no linkage.

**Static**

*Static* variable, object and array lifetimes begin at program creation and end with program termination.

*Static* entities are guaranteed to have the same storage for each instance of the block in which they are declared. For example, the *static* variables declared within a procedure will be allocated at the same address, and retain their state (value) across each call to the procedure.
Static variables, objects and arrays are declared using the Static keyword. Entities declared using the Shared specifier are implicitly static. All entities declared within a procedure that is declared using the Static specifier are also implicitly static.

The memory for static variables, objects and arrays is allocated in the .BSS section of the executable, or in the .DATA section if they are initialized when defined. Static variable-length arrays must be declare empty, with an empty subscript range list; their element data is still allocated in the free store (when they are resized), but the internal array data is allocated in the .DATA section of the executable to allow the element data to persist throughout program execution.

Static variables, objects and arrays have internal linkage by default, unless previously declared using the Extern or Common keywords.

Platform Differences

- In DOS and Windows platforms, the size of the program stack can be adjusted at compile-time using the -t command-line switch. In Linux platforms, the size of the program stack can be adjusted at load-time by modifying /etc/security/limits.conf, or on a per-thread basis using the shell built-in ulimit.

Differences from QB

- QuickBASIC allows static entities to be declared within procedures and DEF FN routines only.

See also

- Extern, Common
- Dim, ReDim, Var, Shared
- Static
- Linkage
Variable Scope

Visibility and access rules for variables and objects

A variable's scope refers to its visibility in a program. A variable is not visible (cannot be accessed) outside the scope in which it was declared. Where and how a variable is declared determines its scope.

In FreeBASIC, there are 4 categories of scope: local, shared, common, different visibility rules, which are detailed below.

Local Scope

Variables declared in the local scope are visible only in the most local block in which they are declared.

- **Sub, Function**, the main body, and each compound statement in it
- Explicitly declared variables using Dim or ReDim take the scope of
- Implicit variables take the scope of the the local most Scope...End Scope block...End Scope take the scope of the Sub, Function, or main body in which they

In the local scope, there is no visibility between module-level code and function level code. Furthermore, variables dimensioned within a block decision or loop statement will only be visible within the block in which they were dimensioned. Variables declared in the local scope of a module are not visible in any of the functions within the module. Variables declared in functions are not visible in the module-level code, nor any other function within the same module.

Variables declared inside Scope blocks may only be declared of local scope, however, inherit the surrounding scope, so local variables declared outside the block (see Implicit Declarations). The example program local.bas.

Local.bas

```
'' visible only in this module
Dim As Integer local_moduleLevel1
```
' OK.
Print local_moduleLevel1

Scope
' OK; SCOPE Blocks inherit outer scope
Print local_moduleLevel1

' visible only in this SCOPE Block
Dim As Integer local_moduleLevel2

' OK.
Print local_moduleLevel2
End Scope

' Error; can't see inner-SCOPE vars
' print local_moduleLevel2

Function some_function( ) As Integer
' visible only in this function
Dim As Integer local_functionLevel

' OK.
Print local_functionLevel

' Error; can't see local module-level vars
' print local_moduleLevel1

' Error; can't see local module-level vars
' print local_moduleLevel2

Function = 0
End Function

' print local_functionLevel
End 0
**Shared Scope**

Variables declared in the shared scope of a module are visible to both the module and all functions of that module. Unlike the local scope, the shared scope makes module-level variables visible to functions of that module. In other words, the module shares its declarations with its functions.

Variables can only be declared to be of shared scope at the module-level; functions nor Scope blocks can declare variables in the shared scope, function or block.

You can declare a variable to be of shared scope by using the DIM statement with the `shared_scope.bas` demonstrates visibility rules for the shared scope.

```bas
'' visible throughout this module
Dim Shared As Integer shared_moduleLevel1

'' OK.
Print shared_moduleLevel1

Scope
  '' OK; can see outer-scope vars
  Print shared_moduleLevel1

  '' Error; SCOPE-level vars cannot be shared
  '' dim shared as integer shared_ModuleLevel2
End Scope

End 0

Function some_function( ) As Integer
  '' OK; can see shared module-level vars
  Print shared_moduleLevel1

  '' Error; function-level vars cannot be shared
  '' dim shared as integer sharedFunctionLevel
```

```bash
shared.bas

'' visible throughout this module
Dim Shared As Integer shared_moduleLevel1

'' OK.
Print shared_moduleLevel1

Scope
  '' OK; can see outer-scope vars
  Print shared_moduleLevel1

  '' Error; SCOPE-level vars cannot be shared
  '' dim shared as integer shared_ModuleLevel2
End Scope

End 0

Function some_function( ) As Integer
  '' OK; can see shared module-level vars
  Print shared_moduleLevel1

  '' Error; function-level vars cannot be shared
  '' dim shared as integer sharedFunctionLevel
```
**Common Scope**

Variables declared in the common scope are visible to all modules.

Variables declared with `Common` are visible to other modules with a matching name must match from between modules.

**module1.bas**

```vbnet
' compile with:
'   fbc -lang qb module1.bas module2.bas

$lang: "qb"

Declare Sub Print_Values()
Common m1 As Integer
Common m2 As Integer
    ' This is executed after all
m1 = 1

Print "Module1"
Print "m1 = "; m1   ' m1 = 1 as set in this mod
Print "m2 = "; m2   ' m2 = 2 as set in module2

Print_Values
```

**module2.bas**

```vbnet
Common m1 As Integer
Common m2 As Integer

m2 = 2
```
Print "Module2" ' This is executed first
Print "m1 = "; m1 ' m1 = 0 (by default)
Print "m2 = "; m2 ' m2 = 2

Sub Print_Values()
    Print "Module2.Print_Values"
    Print "m1 = "; m1 ' Implicit variable = 0
    Print "m2 = "; m2 ' Implicit variable = 0
End Sub

Output:

Module2
m1 = 0
m2 = 2
Module1
m1 = 1
m2 = 2
Module2.Print_Values
m1 = 0
m2 = 0

Common Shared Scope

Variables declared in the common shared scope are visible to all modules.

Variables declared with Common are visible to other modules with a matching declaration. Within a module the Shared statement makes the variable visible to all subs and functions.

module3.bas

'' compile with:
''    fbc module3.bas module4.bas

Declare Sub Print_Values()
Common m1 As Integer
Common m2 As Integer

' This is executed after all other modules
m1 = 1

Print "Module3"
Print "m1 = "; m1 ' m1 = 1 as set in this module
Print "m2 = "; m2 ' m2 = 2 as set in module2

Print_Values

module4.bas

Common Shared m1 As Integer
Common Shared m2 As Integer

m2 = 2

Print "Module4" ' This is executed first
Print "m1 = "; m1 ' m1 = 0 (by default)
Print "m2 = "; m2 ' m2 = 2

Sub Print_Values()
    Print "Module4.Print_Values"
    Print "m1 = "; m1 ' m1 = 1
    Print "m2 = "; m2 ' m2 = 2
End Sub

Output:

Module4
m1 = 0
m2 = 2
Module3
m1 = 1
m2 = 2
Module4.Print_Values
m1 = 1
m2 = 2

Example
See examples above.

See also
- Scope
- Dim
- Common
- Shared
- Variables
- Implicit Declarations
Variable and Procedure Linkage

Name visibility within and between modules

Linkage refers to the visibility of the name of a variable, object or procedure between one or more modules of a program. In other words, linkage dictates how a name is shared between modules. There are two main types of linkage a name can have: internal and external.

Internal linkage

Names with internal linkage only refer to variables, objects or procedures defined within their own module; they are not outwardly visible to other modules. This means that two or more modules can refer to different things using the same name. Note that linkage only refers to visibility of a name, and depending on storage class and lifetime, a variable, object or procedure with internal linkage may be shared between modules using its address.

Module-scope declarations

Variable and object names declared at module-scope have internal linkage unless otherwise declared with Extern or Common. For example, variable names first introduced with Dim or Static have internal linkage, and those variables can only be referred to by name within the module in which they are defined. Note that using Shared only allows name visibility within the module's procedures, and does not contribute to the name's linkage.

Procedure names declared with Private have internal linkage.

Local-scope declarations

All variable and object names declared at local-scope (in a Do loop, or procedure body, for instance) have internal linkage.
**External linkage**

Names with *external linkage* may refer to variables, objects or procedures defined within their module or in another module. Having external linkage means that a name is outwardly visible to other modules, and all modules that use that same external name all refer to the same variable, object or procedure. Thus, only one module may define an external name (the compiler will complain about a duplicated definition if it finds an additional definition of a name with external linkage).

**Module-scope declarations**

Variable and object names declared at module-scope are declared to have external linkage with *Extern* or *Common*.

*Extern* declares the variable having external linkage, but does not define it. This external declaration must come before any definition of the same name (a declaration without *Extern* specifies internal linkage and currently, any further external declarations of that name signify a duplicated definition). Variable and object names with external linkage declared using *Extern* are always in the shared scope, and so can be referred to within procedure bodies.

*Common* declares the variable having external linkage as well as defining the variable. But, it is different from *Extern* in that the *Common* definition of the variable may appear in more than one module. When used with arrays, only variable-length arrays without subscripts may be declared and the array must be sized at run-time using *Dim* or *ReDim* before it can be used. Variable and object names with external linkage declared using *Common* are only in the shared scope if the *Shared* scope specifier is also given. Shared variables can be referred to within procedure bodies.

When both *Extern* and *Common* are both used to declare and define a variable, the effect is that the meaning of *Common* statement is altered to behave as though it were a *Dim* declaration. So it is generally, not
recommended to mix Extern and Common on the same variable in the same module. However, variables may be declared and defined with Common in one module and then referenced with Extern in another module without confusion.

Procedure names are declared to have external linkage by default. Declarations using Public explicitly specify external linkage.

**Local-scope declarations**

Currently, names declared at local-scope cannot have external linkage.
User Defined Types

Custom types.

Overview

User-Defined Types are special kinds of variables which can be created. A Defined Type (UDT) is really just a container that contains a bunch of variables. Unlike arrays UDTs can hold different variable types (whereas arrays always hold many variables of the same type). In fact, UDTs can even have procedures inside of them!

Members

The different variables and/or procedures stored inside a UDT are called members, or more generally, items. Members can be variables of just about any type, including numerical types, Enums, and even arrays. Variables are created in UDTs much the same way variables are created normally, except that the Dim keyword is optional. UDT members are accessed via the UDT variable's name followed by ".someVar". Here is an example:

```basic
'Define a UDT called myType, with an Integer member
Type myType
  As Integer  someVar
End Type

'Create a variable of that type
Dim myUDT As myType

'Set the member someVar to 23, then display its contents on the screen
myUDT.someVar = 23
Print myUDT.someVar
```

Notice that the Type...End Type does not actually create a variable of that type but defines what variables of that type contain. You must create a variable of that type to actually use it!

UDT Pointers
UDT Pointers are, as the name implies, pointers to UDTs. They are created like regular pointers, but there is a special way to use them. To access the member of a UDT pointed to by a pointer, you use the -> Operator. For example, if myUDTPtr is a pointer to a UDT which has a member someVar, you would access the member as myUDTPtr->someVar, which is a much cleaner shorthand for (myUDTPtr).someVar.

```
Type rect
  x As Integer
  y As Integer
End Type

Dim r As rect
Dim rp As rect Pointer = @r

rp->x = 4
rp->y = 2

Print "x = " & rp->x & ", y = " & rp->y
Sleep
```

See also

- Type Aliases
- Temporary Types
- Constructors and Destructors
- Member Procedures
- Member Access Rights
- Operator Overloading
Type Aliases

Additional names for variable or object types

Overview

Declaration

Overload resolution

Pointers to procedure pointers

Type forwarding

Incomplete types

Overview

Type aliases are alternative names for a type. They can be used to facilitate a mass change from one type to another, save typing, or make circular dependency possible.

Declaration

Type aliases are declared using the `Type` keyword much like declaring `Extern` or `Dim`.

The following example declares a type alias to `Single` called "float", and initializes two variables of that type:

```basic
Type float As Single

Declare Function add (a As float, b As float) As float

Dim foo As float = 1.23
Dim bar As float = -4.56
```

Procedure pointer type aliases are declared in the same fashion, as shown in the following example:

```basic
Declare Function f (ByRef As String) As Integer
```
Type func_t As Function (ByRef As String) As Integer
Dim func As func_t = @f

Function f (ByRef arg As String) As Integer
    Function = CInt(arg)
End Function

Overload resolution
Type aliases are just that - aliases. For all intents and purposes, a type as far as procedure overload resolution is concerned, a procedure declared with a type alias "alias_to_T" is the same as a procedure declared with a parameter of type T (overloading member procedures as well).

In other words, it is an error - duplicated definition - to declare a procedure only in a type and its alias, as the following example shows:

Type float As Single
Declare Sub f Overload (a As Single)

' ' If uncommented, this will generate a duplicated definition
' ' Declare Sub f (a As float)

Pointers to procedure pointers
Pointers to procedure pointers are just like any other pointer type, except for procedure pointers. Because the syntax for declaring procedure pointers doesn't allow directly creating a pointer to procedure pointer when the procedure is a function (because pointers apply to return type and not on procedure), a type alias is used.

The following example declares a pointer to a procedure returning an integer:

...
**Type forwarding**

Type aliases can be forward referencing: an alias can refer to some other type that is not yet fully defined:

```plaintext
Type foo As bar

Type sometype
  f As foo Ptr
End Type

Type bar
  st As sometype
  a As Integer
End Type
```

Using a type alias and forward referencing allows circular dependencies:

```plaintext
Type list As list_

Type listnode
  parent As list Ptr
  text As String
End Type

Type list_
```
Incomplete types

A type is considered incomplete until the size of it, that is the number of bytes it would occupy in memory is known, and the offsets of all of its fields are known. It is not possible to declare a variable having the data type of an incomplete type, pass an incomplete type as a parameter, or access the members of an incomplete type.

However, pointers to incomplete types may be allocated, declared as members in other types, or passed as parameters to procedures since the size of a pointer is known.

```
Type sometype As sometype_
  '' Not allowed since size of sometype is unknown
  '' TYPE incomplete
  ''   a AS sometype
  '' END TYPE

  '' Allowed since size of a pointer is known
Type complete
  a As sometype Ptr
End Type
Dim x As complete
  '' Not allowed since size of sometype is still unknown
  '' DIM size_sometype AS INTEGER = SIZEOF( sometype

  '' Complete the type
Type sometype_
  value As Integer
End Type
```
" Allowed since the types are now completed
Dim size_sometype As Integer = SizeOf( sometype )

Type completed
    a As sometype
End Type

Dim size_completed As Integer = SizeOf( completed
Constructors and Destructors

In charge of the creation and destruction of objects.

**Overview**

Constructors and destructors are responsible for creating and destroying objects. Constructors give objects their initial state, that is, they give meaningful values to their objects' member data. Destructors perform the opposite function; they make sure any resources owned by their objects are properly freed.

Simply, constructors are special member procedures that are called when an object is created, and destructors are special member procedures called when an object is destroyed. Constructors are called automatically by the compiler whenever an object is explicitly with the use of the `Dim` or `New` keywords, or implicitly by passing an object to a procedure by value or through an object going out of scope.

**Declaration**

Constructors and destructors are declared like member procedures but instead of `Sub` or `Function`, and without a name. Similarly, they are declared in a `Type` or `Class` they are declared in.

A `Type` or `Class` can have multiple constructors, but only one destructor.

**Default constructors**

Default constructors are constructors that either have no parameters, default value. They are called when an object is defined but not initialized, array, with the `Dim`, `ReDim` or `New[]` keywords. The first constructor declared in the example below is a default constructor.
Copy constructors

Copy constructors are constructors called when an object is created, or cloned, from another object of the same type (or an object that can be converted to that type). This happens explicitly when initializing an object with another object, or implicitly by passing an object to a procedure. They are declared having one parameter: an object of the same type passed by reference.

Copy constructors are only called when creating and initializing object instances. Assignment to objects is handled by the Member Operator Let.

Calling constructors

Unlike other member procedures, constructors are generally not called directly from an object instance. Instead, a constructor is specified in a `Dim` statement either with an initializer or in a statement with or without arguments.

When specifying an initializer for an object, the name of the type followed by any arguments it requires is used.

```
Type foo
  ' Declare a default ctor, copy ctor and normal ctor
  Declare Constructor
  Declare Constructor (ByRef As foo)
  Declare Constructor (As Integer)

  ' Declare a destructor
  Declare Destructor

  ints As Integer Ptr
  numints As Integer
End Type

' Define a constructor that creates 100 integers
Constructor foo
  ints = New Integer(100)
  numints = 100
End Constructor
```
'' Define a constructor that copies the integers from another object

Constructor foo (ByRef x As foo)
  ints = New Integer(x.numints)
  numints = x.numints
End Constructor

'' Define a constructor that creates some integers

Constructor foo (n As Integer)
  ints = New Integer(n)
  numints = n
End Constructor

'' Define a destructor that destroys those integers

Destructor foo
  Delete[] ints
End Destructor

Scope
  '' calls foo's default ctor
  Dim a As foo
  Dim x As foo Ptr = New foo

  '' calls foo's copy ctor
  Dim b As foo = a
  Dim y As foo Ptr = New foo(*x)

  '' calls foo's normal ctor
  Dim c As foo = foo(20)
  Dim z As foo Ptr = New foo(20)

  '' calls foo's dtor
  Delete x
  Delete y
  Delete z
End Scope  '' <- a, b and c are destroyed here as well
Compiler-provided constructors and destructors

If no copy constructor is declared for a Type or Class, the compiler provides a default constructor.

The compiler-provided default constructor initializes member data to default values: numeric and pointer members are set to zero (0), and object members are default-constructed. The compiler-declared copy constructor shallow-copies all member data from one type to another: numeric and pointer types are initialized with the corresponding data members in the object that is copied, and object members are copy-constructed from their corresponding object members. This means that dynamic resources, such as memory pointed to by a pointer data member, is not copied. So if an object owns a resource, meaning it is responsible for its creation and destruction, then the compiler-generated copy constructor will not be sufficient.

If a destructor is not declared, the compiler generates one. This destructor calls object members' destructors and does nothing for numeric and pointer types. Again, if an object owns a dynamic resource, then the compiler-generated destructor will not be sufficient, as the resource will not be freed when the object is destroyed.

This is commonly referred to as the "Rule of 3": If an object needs a custom copy constructor, assignment operator or destructor, chances are it needs all three.
**Member Procedures**

Procedures with full access to members of a *Type* or *Class*.

**Declaration and definition**
Declaring and defining member procedures.

**Usage**
Calling member procedures.

**The hidden parameter, This**
Implicit access to the instance with which non-static member procedures are called.

**Access rights**
Referring to other members in member procedures.

**Overloading**
Declaring two or more member procedures with the same name.

**Static member procedures**
Differences from non-static member procedures.

*The term 'member procedure' refers to both static and non-static members.*

**Declaration and definition**
Member procedures are declared much like normal module-level procedures, except that they are declared within, and defined outside, a *Type* or *Class* definition [1].

When defining member procedures, the procedure name is prefixed with the member access operator (`operator . (Member Access)`). It is an error to define a member procedure without a matching declaration in the *Type* or *Class* definition.

The following example declares and defines a *Sub* and *Function* member procedures:

```
'' foo1.bi

Type foo
  Declare Sub f (As Integer)
  Declare Function g As Integer
  i As Integer
End Type
```
Sub foo.f (n As Integer)
  Print n
End Sub

Function foo.g As Integer
  Return 420
End Function

Usage

Member procedures are referred to just like member data, that is, their object instance and the member access operator (Operator . (Member Access))

The following example, using the code from the last example, calls Sub foo.f

'' ... foo with non-static members as before ... 
#include once "foo1.bi"

Dim bar As foo
bar.f(bar.g())

The_hidden_parameter, This

Member procedures actually have an additional parameter than what are called, using the name of an instance and Operator . (Member Access) passed along with any other arguments in the call, allowing the member instance.

The additional parameter added by the compiler is called This, and since This are actually modifications to the instance that was passed to the member procedure. You can use This just like any other variable, ie., pass it to procedures, other member procedures and access member data using Operator .
Most of the time, however, using `This` explicitly is unnecessary; members of the instance which they are passed directly by name, with `Operator . (Member Access)`. The only times when you need to qualify member name is hidden, for example, by a parameter or local variable member name is the only way to refer to these hidden member names.

**Note:**

*To access duplicated symbols defined outside the Type, use: `.SomeSymbol inside a With..End With block).*

The following example uses the `This` keyword to refer to member data and local variable:

```vbscript
type foo
declare sub f (i as integer)
declare sub g ()
    i as integer = 420
end type

sub foo.f (i as integer)
    '' A parameter hides T.i, so it needs to be qualified to be used:
    print this.i
end sub

sub foo.g ()
    '' A local variable hides T.i, so it needs to be qualified:
    dim i as integer
    print this.i
end sub
```

**Access rights**

Unlike normal module-level procedures, member procedures have full `Type` or `Class` they are declared in; they can refer to the public, protected `Class`.

Overloading

A member procedure can be declared to have the same name as another, provided the parameters are different, either in number or in type. This is referred to as overloading.

Only the parameters are used to determine if a procedure declaration is a valid overload. For example, a procedure could have static and non-static member procedures with the same name.

Unlike a module-level procedure, which needs to specify the Overload attribute, a member procedure is overloadable by default, and does not need it.

```vbnet
Type T
    Declare Sub f

    ' Different number of parameters:
    Declare Sub f (As Integer)

    ' Different type of parameters:
    Declare Sub f (ByRef As String)

    ' Again, parameters are different:
    Declare Function f (As UByte) As Integer

    ' Following three members would cause an error:
    ' number of parameters and/or types do not differ:
    Declare Function f As Integer
    Declare Function f (As UByte) As String
    Declare Static Function f (As UByte) As Integer

    ' ...
    somedata As Any Ptr
End Type
```

Static member procedures
Static member procedures are declared and defined much in the same way as non-static procedures, with the `Static` keyword preceding the declaration and definition.

Member procedures defined using the `Static` keyword must be declared in a `Type` or `Class` definition, or a compiler error will occur. Like non-static member procedures, it is an error to define a static member procedure without a matching declaration in the `Type` or `Class` definition.

Do not confuse this with procedure definitions that specify static storage by appending the `Static` keyword to the procedure header. The `Static` keyword can be used in both contexts, however; static member procedures can be defined with static variable and object storage.

The following example declares two static member procedures, the first of which also has static variable and object storage. Note that the `Static` keyword is optional in the member procedure definition:

```
' foo2.bi

Type foo
  Declare Static Sub f (As Integer)
  Declare Static Function g As Integer
    i As Integer
End Type

Static Sub foo.f (n As Integer) Static
  Print n
End Sub

Function foo.g As Integer
  Return 420
End Function
```

Static member procedures can be called like non-static member procedures with the name of an instance and the member access operator. They can also be called by qualifying the procedure name with the name declared in and the member access operator.
required in order to call static-member procedures.

The following example, using the code from the last example, uses both ways to call static member procedures:

```
' ... foo with static members as before ...
#include once "foo2.bi"

Dim bar As foo
bar.f(foo.g())
```

Unlike non-static member procedures, which are declared with an extra procedures do not get passed an instance when called. Because of this, refer to constants, enumerations, other static members (data or procedure names. Static member procedures can still refer to non-static member example: a parameter or local variable.

The following example refers to a non-static member from a static pro

```
Type foo
    Declare Static Sub f (ByRef As foo)
        i As Integer
    End Type

Sub foo.f (ByRef self As foo)
    ' Ok, self is an instance of foo:
    Print self.i

    ' would cause error
    ' cannot access non-static members, no foo in
    ' Print i
End Sub
```
[1] In the future, member procedures may be able to be defined within.
[2] Static member procedures do not require an object instance in order.
[3] Static member procedures do not have this extra parameter added. the object instance from which it was called with.
Properties

Properties are a special mix of member variable and member procedure. They set or retrieve values of an object, through normal looking assignments or also let the object perform actions if it needs to update itself.

Basic properties
Declaring and using setter and getter properties.

Indexed properties
Properties with an additional parameter.

Basic properties

A property is declared similar to a member procedure, except that they use instead of Sub or Function. For example, let's consider a window system or GUI library.

```basic
Type Window
Private:
    As String title_
End Type

Dim As Window w
```

In order to set the window's title, a setter property can be added:

```basic
Type Window
    Declare Property title(ByRef s As String)
Private:
    As String title_
End Type

Property Window.title(ByRef s As String)
    this.title_ = s
```
End Property

Dim As Window w
w.title = "My Window"

It is very similar to a member Sub, as it takes a parameter and updates the state based on the parameter. However, the syntax for sending this parameter is an assignment, not a function call. By assigning the new value to the title procedure, the procedure will automatically be called with the given new value, and can reflect the change. It is up to the object how to represent the property internally.

By design, properties can only be assigned one value at a time, and a procedure can not have more than one parameter.

After setting the window title, it should also be possible to retrieve it. - property:

Type Window
  ' setter
  Declare Property title(ByRef s As String)
  ' getter
  Declare Property title() As String
Private:
  As String title_
End Type

' setter
Property Window.title(ByRef s As String)
  this.title_ = s
End Property

' getter
Property Window.title() As String
  Return this.title_
End Property
Dim As Window w
w.title = "My Window"
Print w.title

The getter is very similar to a **Function**. It is supposed to return the current value of the property, and it allows the current value to be calculated from other internal values, if needed. Note that both **setter** and **getter** use the same identifier, indicating they handle the same property.

Just like **method overloading**, it is possible to specify multiple setters with different parameter types:

```vba
type Window
    Declare Property title(ByRef s As String) As String
    Declare Property title(ByVal i As Integer) As String
    Private As String title_
End Type

Property Window.title(ByRef s As String)
    this.title_ = s
End Property

Property Window.title(ByVal i As Integer)
    this.title_ = "Number: " & i
End Property

Property Window.title() As String
    Return this.title_
End Property
```

Dim As Window w
w.title = "My Window"
Print w.title
w.title = 5
In comparison to this example of properties, here is similar code that does not use properties:

```vba
Type Window
    Declare Sub set_title(ByRef s As String)
    Declare Sub set_title(ByVal i As Integer)
    Declare Function get_title() As String
Private:
    As String title
End Type

Sub Window.set_title(ByRef s As String)
    this.title = s
End Sub

Sub Window.set_title(ByVal i As Integer)
    this.title = "Number: " & i
End Sub

Function Window.get_title() As String
    Return this.title
End Function

Dim As Window w
w.set_title("My Window")
Print w.get_title()
w.set_title(5)
Print w.get_title()
```

The code is basically the same, only the syntax is different. Properties to combine the setter/getter concept and the language's normal way of accessing values to a class' member variables. It is up to the programmer to decide which way they prefer.
Here is an example demonstrating a text user interface window class and title using properties:

```
Namespace tui
    Type Point
        Dim As Integer x, y
    End Type

    Type char
        Dim As UByte value
        Dim As UByte Color
    End Type

    Type Window
        ' public
        Declare Constructor _
            ( _
                x As Integer = 1, y As Integer = 1
                w As Integer = 20, h As Integer =
                title As ZString Ptr = 0 _
            )
        Declare Destructor
        Declare Sub show

        ' title property
        Declare Property title As String
        Declare Property title( new_title As String

        ' position properties
        Declare Property x As Integer
        Declare Property x( new_x As Integer )

        Declare Property y As Integer
        Declare Property y( new_y As Integer )
```
Private:
    Declare Sub redraw
    Declare Sub remove
    Declare Sub drawtitle

    Dim As String p_title
    Dim As Point Pos
    Dim As Point siz
End Type

Constructor Window _
( _
    x_ As Integer, y_ As Integer, _
    w_ As Integer, h_ As Integer, _
    title_ As ZString Ptr _
)

    pos.x = x_
    pos.y = y_
    siz.x = w_
    siz.y = h_

    If( title_ = 0 ) Then
        title_ = @"untitled"
    End If

    p_title = *title_
End Constructor

Destructor Window
    Color 7, 0
   Cls
End Destructor

Property window.title As String
    title = p_title
End Property

Property window.title( new_title As String )
p_title = new_title

drawtitle
End Property

Property window.x As Integer
    Return pos.x
End Property

Property window.x( new_x As Integer )
    remove
    pos.x = new_x
    redraw
End Property

Property window.y As Integer
    Property = pos.y
End Property

Property window.y( new_y As Integer )
    remove
    pos.y = new_y
    redraw
End Property

Sub window.show
    redraw
End Sub

Sub window.drawtitle
    Locate pos.y, pos.x
    Color 15, 1
    Print Space( siz.x );
    Locate pos.y, pos.x + (siz.x \ 2) - (Len( p_title;
    Print p_title;
End Sub

Sub window.remove
    Color 0, 0
    Var sp = Space( siz.x )
For i As Integer = pos.y To pos.y + siz.y
    Locate i, pos.x
    Print sp;
Next
End Sub

Sub window.redraw
drawtitle
Color 8, 7
Var sp = Space( siz.x )
For i As Integer = pos.y + 1 To pos.y + siz.y
    Locate i, pos.x
    Print sp;
Next
End Sub
End Namespace

Dim win As tui.window = tui.window( 3, 5, 50, 15 )

win.show
Sleep 500

win.title = "Window 1"
Sleep 250
win.x = win.x + 10
Sleep 250

win.title = "Window 2"
Sleep 250
win.y = win.y - 2
Sleep 250

Locate 25, 1
Color 7, 0
Print "Press any key..."
Sleep
Indexed properties

Properties can have an additional parameter that is called an index (currently only one additional parameter is allowed). The index is specified in parentheses behind the property name, as if the property was an array (with only one dimension). For example:

```vbnet
Type IntArray
   ''' setters
   Declare Property value(index As Integer, v As Integer) As Integer
   Declare Property value(index As String, v As Integer) As Integer
   Declare Property value(index As Integer, v As String) As Integer
   Declare Property value(index As String, v As String) As Integer

   ''' getters
   Declare Property value(index As Integer) As Integer
   Declare Property value(index As String) As Integer

Private:
   Dim As Integer data_(0 To 9)
End Type

Property IntArray.value(index As Integer) As Integer
   Return This.data_(index)
End Property

Property IntArray.value(index As String) As Integer
   Return This.data_(CInt(index))
End Property

Property IntArray.value(index As Integer, v As Integer)
   This.data_(index) = v
End Property

Property IntArray.value(index As String, v As Integer)
   This.data_(index) = v
End Property
```
This.simulates.an.integer.array.that.can.be.assigned.strings,.and.even.be.indexed.with.strings.
See.KeyPgProperty.for.another.example.
Member Access Rights

Restricting member access to certain parts of code.

Overview
Public members
Protected members
Private members
Constructors and destructors
Inherited members

Overview
All members of a Type or Class - including member data, procedures, constants, etc. - belong in one of three different classifications, each with its own rules dictating where in code they may be accessed, or referred to. These rules are called access rights. There are public, protected and private members, and they are declared in a Type or Class definition following a Public, Protected or Private label, respectively.

By default, that is, without an access classification label, members of a Type are public, and members of a Class are private.

Public members
Public members can be referred to from anywhere; they are accessibl from, for example, member procedures or module-level code or procedures.

Protected members
Protected members can only be accessed from member procedures of the Type or Class they are declared in, or member procedures of a derived Type or Class. They are not accessible to outside code.

Private members
Private members can only be accessed from member procedures of
the Type or Class they are declared in. They are not accessible to outside code or member procedures from a derived Type or Class.

**Constructors and destructors**

Constructors and destructors follow the same rules as any other member. When public, objects can be instantiated and destroyed from anywhere in code. When protected, objects can be instantiated and destroyed only from member procedures of their Type or Class or a derived Type or Class. Private constructors and destructors restrict object instantiation solely to member procedures of their Type or Class.

**Inherited members**

...
Operator Overloading

Changing the way user defined types work with built-in operators.

Overview
Global Operators
Member Operators

Overview

Simply, operators are procedures, and their arguments are called operands. Operators that take one operand (Operator Not) are called unary operators, operators that take two operands (called binary operators) and operators taking three operands (Operator Iif operators).

Most operators are not called like procedures. Instead, their operator symbol is placed next to their operands. For unary operators, their sole operand is placed to the right of the operator symbol. For binary operators, their operands - referred to as the left and right-hand side operands - are placed to the left and right of the operator symbol. FreeBASIC has one ternary operator, like a procedure, with its operands comma-separated surrounded by parenthais. The following code calls Operator Iif to determine if a pointer is valid. If it is, called to dereference the pointer, and if not, Operator / (Divide) is called to find the value of twenty divided by four.

```
Dim i As Integer = 420
Dim p As Integer Ptr = @i

Dim result As Integer = IIf( p, *p, CInt( 20 / 4 ) )
```

Notice the call to Operator Iif is similar to a procedure call, while the and Operator / (Divide) are not. In the example, p is the operand to and 4 are the left and right-hand side operands of Operator / (Divide).

All operators in FreeBASIC are predefined to take operands of standard Single, but they may also be overloaded for user-defined types; that is, operands that are objects as well. There are two types of operators that operators and member operators.
Global Operators

Global operators are those that are declared in module-level scope (globally). These are the operators:
- (Negate), Not (Bitwise Not), -> (Pointer To Member Access), * (Multiply), / (Divide), \ (Integer Divide), & (Concatenate), Mod (Modulus), >> (Shift Right), And (Bitwise And), Or (Bitwise Or), Xor (Bitwise Xor), ^ (Exponentiate), = (Equal), <> (Not Equal), < (Less Than), <= (Less Than Or Equal) and >= (Greater Than Or Equal).

Declaring a custom global operator is similar to declaring a procedure with the Operator keyword. The operator symbol is placed next followed by the comma-separated list of parameters surrounded in parenthesis that will represent the operands passed to the operator. Unlike procedures, operators can be overloaded by default, so the Overload keyword is not necessary when declaring custom operators. At least one of the operator's parameters (after all, operators with built-in type parameters are already defined).

The following example declares the global operators - (Negate) and + (Multiply) of a user-defined type.

```pascal
Type Rational
  As Integer numerator, denominator
End Type

Operator - (ByRef rhs As Rational) As Rational
  Return Type(-rhs.numerator, rhs.denominator)
End Operator

Operator * (ByRef lhs As Rational, ByRef rhs As Rational) As Rational
  Return Type(lhs.numerator * rhs.numerator, _
               lhs.denominator * rhs.denominator)
End Operator

Dim As Rational r1 = (2, 3), r2 = (3, 4)
Dim As Rational r3 = -(r1 * r2)
Print r3.numerator & "/" & r3.denominator
```
Here the global operators are defined for type *Rational*, and are used in the initialization expression for \( r_3 \). The output is \(-6/12\).

**Member Operators**

Member operators are declared inside a *Type* or *Class* definition, like the cast and assignment operators *Let (Assign)*, *Cast (Cast)*, *+= (Add And Assign)*, *-= (Subtract And Assign)*, **= (Multiply And Assign)*, 
/\= (Divide And Assign)*, \&= (Concat And Assign)*, Mod= (Modulus And Assign)*, Shr= (Shift Right And Assign)*, And= (Conjunction And Assign)*, Xor= (Exclusive Disjunction And Assign)*, and Eqv= (Equivalence And Assign)*.

When declaring member operators, the *Declare* and *Operator* keywords are used followed by the operator symbol and its parameter list. Like member procedures, member operators are defined outside the *Type* or *Class* definition, and the symbol name is prefixed with the name.

The following example overloads the member operators *Cast (Cast)* and assignment operators for objects of a user-defined type.

```plaintext
Type Rational
    As Integer numerator, denominator

    Declare Operator Cast () As Double
    Declare Operator Cast () As String
    Declare Operator *= (ByRef rhs As Rational)
End Type

Operator Rational.cast () As Double
    Return numerator / denominator
End Operator

Operator Rational.cast () As String
    Return numerator & "/" & denominator
End Operator

Operator Rational.*= (ByRef rhs As Rational)
```
Dim As Rational r1 = (2, 3), r2 = (3, 4)
r1 *= r2
Dim As Double d = r1
Print r1, d

Notice that the member operator **Cast (Cast)** is declared twice, once for the conversion to **String**. This is the only operator (or procedure) that can be declared multiple times when only the return type differs. The compiler decides which cast overload to call based on how the object is used (in the initialization of the **Double d**, **Rational.Cast as Double** and in the **Print** statement, **Rational.Cast as String** is used instead).
Types as Objects

An example of the overloadable operators and member procedures

Description

!!! WRITEME !!!

'' Sample Type showing available methods and operators
'' Practically this is a pointless example, as the
'' data member is an Integer. It serves only as a
'' demonstration and guide.
''
'' There are many other combinations that can be
'' used in pass parameters. For simplicity
'' This example only uses byref and type T
'' where ever possible.

'' The type 'DataType' is included to show where
'' any data type might be used
Type DataType As Integer

'' The type 'UDT' is included to show where only
'' a UDT data type can be used
Type UDT
  value As DataType
End Type

'' Our main type
Type T
  value As DataType
  value_array( 0 ) As DataType

'' let, cast, combined assignment operators,
'' constructors, and the destructor, must be
'' declared inside the type.
''
'' Parameters can be passed ByVal or Byref
in most (All? - verify this).

All procs can be overloaded with different types as parameters. In many cases this is not necessary as the TYPE can be coerced and converted depending on the CAST methods it exposes. The compiler will try to evaluate statements and expressions if there is enough information to complete the operation.

For example,
Even though operator += may not be overloaded but operator let and operator + are, the compiler will convert the T += datatype to T = T + datatype.

Nonstatic members must be declared inside the type.

All Nonstatic members are implicitly passed a hidden **this** parameter having the same type as the TYPE in which they are declared.

Nonstatic member overloaded operators do not return a type. All operations are done on the hidden this parameter.

Properties: Can be value properties or single indexed value properties
GET/SET methods must be each declared if used.

Nonstatic Member Declarations:

Assignment

Declare Operator Let ( ByRef rhs As T )
Declare Operator Let ( ByRef rhs As DataType )
'' Cast can be overloaded to return multiple type

Declare Operator Cast () As String
Declare Operator Cast () As DataType

'' Combined assignment

Declare Operator += ( ByRef rhs As T )
Declare Operator += ( ByRef rhs As DataType )

Declare Operator -= ( ByRef rhs As DataType )
Declare Operator *= ( ByRef rhs As DataType )
Declare Operator /= ( ByRef rhs As DataType )
Declare Operator \/= ( ByRef rhs As DataType )
Declare Operator Mod= ( ByRef rhs As DataType )
Declare Operator Shl= ( ByRef rhs As DataType )
Declare Operator Shr= ( ByRef rhs As DataType )
Declare Operator And= ( ByRef rhs As DataType )
Declare Operator Or= ( ByRef rhs As DataType )
Declare Operator Xor= ( ByRef rhs As DataType )
Declare Operator Imp= ( ByRef rhs As DataType )
Declare Operator Eqv= ( ByRef rhs As DataType )
Declare Operator ^= ( ByRef rhs As DataType )

'' Address of

Declare Operator @ () As DataType Ptr

'' Constructors can be overloaded

Declare Constructor()
Declare Constructor( ByRef rhs As T )
Declare Constructor( ByRef rhs As DataType )

'' There can be only one destructor

Declare Destructor()
'' Nonstatic member functions and subs
'' overloaded procs must have different parameters

Declare Function f( ) As DataType
Declare Function f( ByRef arg1 As DataType ) As

Declare Sub s( )
Declare Sub s( ByRef arg1 As T )
Declare Sub s( ByRef arg1 As DataType )

'' Properties

Declare Property p () As DataType
Declare Property p ( ByRef new_value As DataType )

Declare Property pidx ( ByVal index As DataType,
Declare Property pidx ( ByVal index As DataType,
End Type

'' These must be global procedures
'' Globals are not prefixed with the the TYPE name

'' At least one parameter must be of Type 'T'
'' For simplicity, type 'T' is always given first
'' in this example

Declare Operator - ( ByRef rhs As T ) As DataType
Declare Operator Not ( ByRef rhs As T ) As DataType

Declare Operator -> ( ByRef rhs As T ) As UDT
Declare Operator * ( ByRef rhs As T ) As DataType

Declare Operator + ( ByRef lhs As T, ByRef rhs As
Declare Operator - ( ByRef lhs As T, ByRef rhs As
Declare Operator * ( ByRef lhs As T, ByRef rhs As
Declare Operator / ( ByRef lhs As T, ByRef rhs As
Declare Operator \ ( ByRef lhs As T, ByRef rhs As
Declare Operator Mod ( ByRef lhs As T, ByRef rhs As
Declare Operator Shl ( ByRef lhs As T, ByRef rhs As T )
Declare Operator Shr ( ByRef lhs As T, ByRef rhs As T )
Declare Operator And ( ByRef lhs As T, ByRef rhs As T )
Declare Operator Or ( ByRef lhs As T, ByRef rhs As T )
Declare Operator Xor ( ByRef lhs As T, ByRef rhs As T )
Declare Operator Imp ( ByRef lhs As T, ByRef rhs As T )
Declare Operator Eqv ( ByRef lhs As T, ByRef rhs As T )
Declare Operator ^ ( ByRef lhs As T, ByRef rhs As T )
Declare Operator = ( ByRef lhs As T, ByRef rhs As T )
Declare Operator <> ( ByRef lhs As T, ByRef rhs As T )
Declare Operator < ( ByRef lhs As T, ByRef rhs As T )
Declare Operator > ( ByRef lhs As T, ByRef rhs As T )
Declare Operator <= ( ByRef lhs As T, ByRef rhs As T )
Declare Operator => ( ByRef lhs As T, ByRef rhs As T )

'' Global procedures (subs and funcs) can also accept the TYPE as a parameter or return it as a value, as could in previous versions of FreeBASIC.
'' No example given. See function or sub in the manual.

'' All TYPE members are defined outside the TYPE

'' Nonstatic members must be prefixed with type name in this case 'T'

'' Name resolution in a NAMESPACE is same as other subs/funcs. Use USING or prefix the namespace

Operator T.let ( ByRef rhs As T )
  value = rhs.value
End Operator

Operator T.let ( ByRef rhs As DataType )
  value = rhs
End Operator

Operator T.cast ( ) As String
  Return Str( value )
End Operator
Operator T.cast ( ) As DataType
  Return value
End Operator

Operator T.+= ( ByRef rhs As T )
  value += rhs.value
End Operator

Operator T.+= ( ByRef rhs As DataType )
  value += rhs
End Operator

Operator T.-= ( ByRef rhs As DataType )
  value -= rhs
End Operator

Operator T.*= ( ByRef rhs As DataType )
  value *= rhs
End Operator

Operator T./= ( ByRef rhs As DataType )
  value /= rhs
End Operator

Operator T.\= ( ByRef rhs As DataType )
  value \= rhs
End Operator

Operator T.mod= ( ByRef rhs As DataType )
  value Mod= rhs
End Operator

Operator T.shl= ( ByRef rhs As DataType )
  value Shl= rhs
End Operator

Operator T.shr= ( ByRef rhs As DataType )
  value Shr= rhs
End Operator

Operator T.and= ( ByRef rhs As DataType )
    value And= rhs
End Operator

Operator T.or= ( ByRef rhs As DataType )
    value Or= rhs
End Operator

Operator T.xor= ( ByRef rhs As DataType )
    value Xor= rhs
End Operator

Operator T.imp= ( ByRef rhs As DataType )
    value Imp= rhs
End Operator

Operator T.eqv= ( ByRef rhs As DataType )
    value Eqv= rhs
End Operator

Operator T. ^= ( ByRef rhs As DataType )
    value ^= rhs
End Operator

Operator T. () As DataType Ptr
    Return( Cast( DataType Ptr, @This ) )
End Operator

' Constructors:

Constructor T()
    value = 0
End Constructor

Constructor T( ByRef rhs As T )
    value = rhs.value
End Constructor

Constructor T( ByRef rhs As DataType )
    value = rhs
End Constructor

' ' There can be only one destructor

Destructor T()
    ' ' clean-up, none in this example
End Destructor

' ' Globals must specify all arguments and return type

Operator - ( ByRef rhs As T ) As DataType
    Return (-rhs.value)
End Operator

Operator Not ( ByRef rhs As T ) As DataType
    Return (Not rhs.value)
End Operator

Operator -> ( ByRef rhs As T ) As UDT
    Return Type(4)
End Operator

Operator * ( ByRef rhs As T ) As DataType
    Return 5
End Operator

Operator + ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value + rhs)
End Operator

Operator - ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value - rhs)
End Operator
Operator * ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value * rhs)
End Operator

Operator / ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value / rhs)
End Operator

Operator \ ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value \ rhs)
End Operator

Operator Mod ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Mod rhs)
End Operator

Operator Shl ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Shl rhs)
End Operator

Operator Shr ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Shr rhs)
End Operator

Operator And ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value And rhs)
End Operator

Operator Or ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Or rhs)
End Operator

Operator Xor ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Xor rhs)
End Operator

Operator Imp ( ByRef lhs As T, ByRef rhs As DataType
    Return (lhs.value Imp rhs)
End Operator

Operator Eqv ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value Eqv rhs)
End Operator

Operator ^ ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value ^ rhs)
End Operator

Operator = ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value = rhs)
End Operator

Operator <> ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value <> rhs)
End Operator

Operator < ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value < rhs)
End Operator

Operator > ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value > rhs)
End Operator

Operator <= ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value <= rhs)
End Operator

Operator >= ( ByRef lhs As T, ByRef rhs As DataType)
    Return (lhs.value >= rhs)
End Operator

' Nonstatic member methods

Function T.f( ) As DataType
    Dim x As DataType
Return x
End Function

Function T.f( ByRef arg1 As DataType ) As DataType
    arg1 = this.value
    Return value
End Function

Sub T.s( )
    '' refer to the type using
    '' with block
    With This
        .value = 1
    End With

    '' field access
    this.value = 2

    '' directly
    value = 3
End Sub

Sub T.s( ByRef arg1 As T )
    value = arg1.value
End Sub

Sub T.s( ByRef arg1 As DataType )
    value = arg1
End Sub

Property T.p () As DataType
    '' GET property
    Return value
End Property

Property T.p ( ByRef new_value As DataType )
    '' SET property
value = new_value
End Property

Property T.pidx ( ByVal index As DataType ) As DataType
    '' GET indexed property
    Return value_array( index )
End Property

Property T.pidx ( ByVal index As DataType, ByRef new_value )
    '' SET indexed property
    value_array( index ) = new_value
End Property

'' new, delete, delete[]

'' Allocate object
Dim X As T Ptr = New T

'' Deallocate object
Delete X

'' Allocate object vector
Dim Xlist As T Ptr = New T[10]

'' Deallocate object vector
Delete[] Xlist

See also

- Type
Control Flow Statements

Statements that direct the flow of execution.

Description

Control flow statements control program execution from one statement to the next; they determine what statements get executed and when, based on some kind of condition. The condition is always some expression that evaluates to true or false. Most control flow statements check for some kind of condition, and direct code flow accordingly, that is, they do or do not execute a block of code (except for the transferring control flow statements and Do...Loop, which has an optional condition). Additionally, all control flow statements can be nested, that is, they can have other control flow statements within the statement block.

Control flow statements come in three flavors: transferring, branching and looping. Transferring control flow statements transfer execution to different parts of code. Branching control flow statements execute certain statements blocks based on a condition, while looping control flow statements execute code repeatedly while or until a condition is met.

Transferring Statements

These statements are used for either unconditional or conditional, temporary or permanent transfer of execution. The "ON" variants conditionally select a point of transfer from a list of text labels. Execution may be transferred between different scopes provided that the branching does not cross any local array, variable length string or object definition.

Goto
Unconditionally transfers execution to another point in code defined by a text label. Execution resumes with the first statement after the label.

GoSub
Unconditionally and temporarily transfers execution to another point in
code, defined by a text label. Execution resumes with the first
statement after the label. Execution is then brought back to its original
location with the Return keyword. Yes, GoSub statements can be
nested, that is, multiple GoSub statements can be executed before the
first corresponding Return, but there must always be a corresponding
Return throughout the course of an application.

On Goto
Transfers execution to one of a number of points in code defined by
text labels, based on the value of an expression.

On Gosub
Temporarily transfers execution to one of a number of points in code
defined by text labels, based on the value of an expression.

Branching Statements

These statements are used for executing one of a number of statement
blocks.

If..End If
Executes a block of statements if an expression evaluates to true (the
condition). If and only if the expression evaluates to false, another
statement block can be executed if yet another expression evaluates
true using the ElseIf keyword. If and only if all of those expressions
evaluate to false, a statement block can be execute using the Else
keyword.

Select..End Select
Executes one of a number of statement blocks. This branching
statement tries to meet a condition of an expression and one of a
number of case expressions. The case expressions are checked in th
order in which they are given, and the first case expression that is met
has its associated statement block executed. Like If..End If, a default
case can be defined when no other case expression meets the
condition, and, as with the looping control flow statements, a case's
statement block can be prematurely broken out of with the Exit
keyword.
**Looping Statements**

These statements are used for executing a block of statements repeatedly. Within a statement block, the loop can be prematurely re-executed using the `Continue` keyword, or broken out of using the `Exit` keyword. Whether the loop is terminated by the condition or with the `Exit` keyword, execution always begins at the first statement after the block.

**While..Wend**

Executes a block of statements while some expression evaluates to true (the condition). The expression is evaluated and checked before the block of statements is executed.

**For..Next**

Like `While..Wend`, but more suited to loop a certain number of times. This loop initializes a so-called iterator with an initial value that is checked against a test expression. If the iterator compares less than or equal to the test expression (the condition), the block of statements is executed and the iterator gets incremented. The loop can also be setup so that the iterator gets decremented after every loop, in which case it is compared greater than or equal to the test expression. Iterators can be numeric data types like `Integer` or `Double`, or user-defined types. User-defined types must implement `Operator For`.

**Do..Loop**

The most versatile of the looping control flow statements, this loop can execute a block of statements while or until an expression evaluates to true (the condition). It can also delay the checking of the expression until after the block has executed the first time, useful when a block of statements needs to be executed at least once. Finally, this loop can have no condition at all, and merely loop indefinitely.
Overview of the different FB procedure types.

Procedures are blocks of code that can be executed, or called, from any number of times. The code that is executed is called the procedure body. There are two types of procedures in FreeBASIC: procedures that don't return a value and procedures that do.

**Subs**

Subs are procedures that don't return values. They are declared using the `Sub` keyword. Declaring a procedure introduces its name so that it can be called, and a procedure definition lists the statements of code that will be executed when called simply by using its name somewhere in the program.

```
' introduces the sub 'MyProcedure'
Declare Sub MyProcedure

' calls the procedure 'MyProcedure'
MyProcedure

' defines the procedure body for 'MyProcedure'
Sub MyProcedure
    Print "the body of MyProcedure"
End Sub
```

will produce the output:

```
the body of MyProcedure
```

Notice that only the declaration is needed to call the procedure. The procedure can be defined later in code, or even in a different source file altogether.

**Functions**
Functions are procedures that return a value back to the point in code. You can think of a function call as evaluating to some expression, just like declared using the `Declare` keyword, and defined using the `Function` keyword that functions return is specified at the end of the declaration.

```
' introduces and defines a procedure that returns an integer value
Function MyProcedure As Integer
    Return 10
End Function

' calls the procedure, and stores its return value
Dim i As Integer = MyProcedure
Print i
```

will produce the output:

```
10
```

Since a definition is a declaration, a procedure can be called after it has been defined.

It is a common convention when calling a procedure to place parentheses around the name, to signify a procedure call. FreeBASIC does not require this, however.

See also

- Passing Arguments to Procedures
- Returning a Value
- Declare
- Sub
- Function
Passing Arguments to Procedures

Passing information to procedures.

**Declaring parameters**

Procedures can get passed information in the form of variables and objects when they are called. In the context of a procedure call, these variables and objects are called arguments. These arguments are then represented as so-called parameters inside the procedure body. Parameters can be used just like any other variable or object.

To specify that a procedure should get passed arguments when called, use a parameter list. A parameter list is a list of one or more names a procedure will use when referring to the arguments that are passed to it. Parameter lists are surrounded by parenthesis.

```
Sub Procedure (s As String, n As Integer)
    Print "The parameters have the values: " & s & 
End Sub

Procedure "abc", 123
```

will produce the following output:

```
The parameters have the values: abc and 123
```

There are two ways to pass arguments to procedures: by value and by reference. By default, arguments are passed by value unless otherwise specified.

**Passing arguments by value**

Arguments that are passed by value are not actually passed to procedures; a copy of the argument is made and passed instead. This allows the procedure to modify the copy, and the original variable or object remains unchanged.

When passing objects to procedures by value, the copy is made by calling the copy constructor.
constructor of the **Type** or **Class**.

To specify that an argument should be passed by value, precede the parameter name in the procedure declaration with the **ByVal** keyword:

```vba
Sub Procedure (ByVal param As Integer)
    param *= 2
    Print "The parameter 'param' = " & param
End Sub
```

```vba
Dim arg As Integer = 10
Print "The variable 'arg' before the call = " & arg
Procedure(arg)
Print "The variable 'arg' after the call = " & arg
```

will produce the following output:

```
The variable 'arg' before the call = 10
The parameter 'param' = 20
The variable 'arg' after the call = 10
```

Notice how parenthesis surround the arguments - in this case only on the argument name. These parenthesis are optional, but are a common convention to indicate a procedure call.

**Passing arguments by reference**

Unlike arguments that are passed by value, arguments that are passed by reference really do get passed; no copy is made. This allows the procedure to modify the original variable or object that was passed to it.

A reference is like an alias for a variable or object. Whenever you refer to the reference parameter of a procedure as the argument that is passed to it, the reference parameter are actually changes to the argument it represents.

To specify that an argument should be passed by reference, precede the parameter name in the procedure declaration with the **ByRef** keyword:
**Sub** Procedure *(ByRef param As Integer)*
  param *= 2
  Print "The parameter 'param' = " & param
End Sub

Dim arg As Integer = 10
Print "The variable 'arg' before the call = " & arg
Procedure(arg)
Print "The variable 'arg' after the call = " & arg

will produce the following output:

The variable 'arg' before the call = 10
The parameter 'param' = 20
The variable 'arg' after the call = 20

**Manually passing pointers to by-reference parameters**

By specifying the ByVal keyword in front of an argument to a ByRef parameter (usually stored in a pointer) can be passed directly as-is, forcing the ByRef reference the same memory location which the address pointed to.

**Sub** f( ByRef i As Integer )
  i = 456
End Sub

Dim i As Integer = 123
Dim pi As Integer Ptr = @i

Print i
f( ByVal pi )
Print i
See also

- Procedures Overview
- Returning a Value
- Declare
- Sub
- Function
- ByVal
- ByRef
Returning Values

... refers to the ability of a Function procedure to have a value when the function finishes such that the value can be used in an expression or assigned to a variable.

The value of a function can be returned in three ways:

'' Using the name of the function to set the return value and continue executing the function:
Function myfunc1() As Integer
    myfunc1 = 1
End Function

'' Using the keyword 'Function' to set the return value and continue executing the function:
Function myfunc2() As Integer
    Function = 2
End Function

'' Using the keyword 'Return' to set the return value and immediately exit the function:
Function myfunc3() As Integer
    Return 3
End Function

'' This program demonstrates a function returning a value.
Declare Function myFunction () As Integer
Dim a As Integer

'Here we take what myFunction returns and add 10.
a = myFunction() + 10

'Knowing that myFunction returns 10, we get 10+10=20.
Function myFunction () As Integer  
'Here we tell myFunction to return 10.  
    Function = 10  
End Function

Returning References
Function results can also be returned by reference, rather than by value.  
When assigning a ByRef function result through a Function = variable, return the variable's value. Instead, it returns a reference to that variable. The reference returned from the function, without having to use pointers manually.  

For more information, refer to: ByRef (Function Results)

Manually returning pointers as-is from Byref functions
By specifying the ByVal keyword in front of the result variable in the Function = variable (usually stored in a pointer) can be passed directly as-is, forcing the ByRef the address pointed to. For example:

Dim Shared i As Integer = 123
Function f( ) ByRef As Integer  
    Dim pi As Integer  
    Dim pi As Integer P ptr = @i
    Function = ByVal pi
    Return ByVal pi  
End Function
Print i, f( )
See also

- Function
- Byref (Function Results)
Calling Conventions

Specifying how procedures are called.

Calling conventions determine how calling code interacts with procedures when called. They specify rules about how parameters are pushed onto the call stack, how values are returned and when the call stack is cleaned up. This information is useful when interacting with code written in other languages, particularly assembly language. In some cases, calling conventions also apply some kind of name decoration to procedure names.

FreeBASIC supports 3 calling conventions: **stdcall, cdecl** and **pascal**, specified with **stdcall**, **cdecl** and **pascal**, respectively. Calling convention can be specified in either a procedure declaration or definition immediately following the procedure name. The declaration of a procedure must have the same calling convention as the definition.

In all calling conventions, integral procedure return values are returned in the **EAX**, **EDX** register(s), and floating-point return values are stored in the **ST(0)** register (the top of the floating-point stack). User-defined type (UDT) values are returned in the **EAX**, **EDX** register(s) if eight (8) bytes or smaller, otherwise they are returned in memory by having their address pushed onto the call stack after any parameters.

**stdcall**

In the **stdcall** convention, procedure parameters are pushed onto the call stack prior to the procedure call (which will push the return address just above parameters) in the reverse order they are declared, that is, from right to left. The procedure is in charge of popping any parameters from the call stack (commonly by appending a constant to the **RET** instruction, signifying the number of bytes to release).

**stdcall** is the default calling convention on Windows, and for procedures within **Extern "Windows"** and **Extern "Windows-Ms"** blocks. is also the default convention used in the Windows API.
Platform Differences

- In DOS and Windows platforms, the procedure name is decorated with an "@N" suffix, where \( N \) is the total size, in bytes, of any parameters passed.

**cdecl**

In the cdecl convention, procedure parameters are pushed onto the call stack prior to the procedure call, in the reverse order they are declared, that is, from right to left. The calling code is in charge of popping parameters from the call stack.

cdecl is the default calling convention on Linux, the *BSDs, and DOS and for procedures within `Extern "C"` and `Extern "C++"` blocks. It is also the default convention used by most C and C++ compilers.

**pascal**

In the pascal convention, procedure parameters are pushed onto the call stack, in the order they are declared, that is, from left to right. The procedure is in charge of popping any parameters from the call stack.

pascal is the default convention used by Pascal and the Microsoft QuickBASIC series of compilers.

The following table summarizes the differences between the various calling conventions:

<table>
<thead>
<tr>
<th>Calling convention</th>
<th>Parameters are pushed onto the call stack from</th>
<th>Parameters are popped off the call stack by</th>
</tr>
</thead>
<tbody>
<tr>
<td>stdcall</td>
<td>right to left</td>
<td>the procedure</td>
</tr>
<tr>
<td>cdecl</td>
<td>right to left</td>
<td>the calling code</td>
</tr>
<tr>
<td>pascal</td>
<td>left to right</td>
<td>the procedure</td>
</tr>
</tbody>
</table>

Platform Differences
In DOS and Windows platforms, all calling conventions decorate procedure names with an underscore ("_") prefix.

The default calling convention changes depending on the platform. For Windows it is **stdcall**; while on Linux, the *BSDs, and DOS, it is **cdecl**.

**See also**

- Declare, Sub, Function
- stdcall, cdecl, pascal
- Extern..End Extern
Pointers to Procedures

Pointers that point to procedures

Just as pointers can be made to point to an Integer or Single type, pointers can also point to procedures, that is, they can store the address of a procedure.

Declaration

To declare a pointer to procedure, use the Sub or Function keywords, for example:

```
Dim pointerToProcedure As Sub
```

Procedure pointers store procedure addresses, which are retrieved using the pfunc.bi function:

```
Function Add (a As Integer, b As Integer) As Integer
    Return a + b
End Function

Dim pFunc As Function (As Integer, As Integer) As Integer
```

Calling a procedure pointer

The interesting thing about procedure pointers is that they can be called just like a procedure:

```
' .. Add and pFunc as before ..
#include once "pfunc.bi"

Print "3 + 4 = " & pFunc(3, 4)
```

For a calling example of subroutine pointer, see the Operator @ (Address)
Passing procedure pointers to procedures

Passing procedure pointers to other procedures is similar as well:

```
' .. Add and pFunc as before ..
#include once "pfunc.bi"

Function DoOperation (a As Integer, b As Integer, 
   Return op(a, b)
End Function

Print "3 + 4 = " & DoOperation(3, 4, @Add)
```

Because procedure pointer declarations can be lengthy, it often helps

```
' .. Add and pFunc as before ..
#include once "pfunc.bi"

Type operation As Function (As Integer, As Integer)

Function DoOperation (a As Integer, b As Integer, 
   Return op(a, b)
End Function

Print "3 + 4 = " & DoOperation(3, 4, @Add)
```

Pointers to procedure pointers

Because the syntax of a procedure pointer does not allow declaration and not on procedure), a type alias is used. Notice how it is necessary. This is because the function-call operator '()' has higher precedence tl
Function Halve (ByVal i As Integer) As Integer
Return i / 2
End Function

Function Triple (ByVal i As Integer) As Integer
Return i * 3
End Function

Type operation As Function (ByVal As Integer) As Integer

' an array of procedure pointers, NULL indicates the end of the array
Dim operations(20) As operation = _
{ @Halve, @Triple, 0 }

Dim i As Integer = 280

' apply all of the operations to a variable by iterating with a pointer to procedure pointer
Dim op As operation Ptr = @operations(0)
While (*op <> 0)
' call the procedure that is pointed to, note i = (*op)(i)
   i = (*op)(i)
   op += 1
Wend

Print "Value of 'i' after all operations performed:

Pointers to member procedures

Method pointers are not implemented yet, but it is possible to work-around..."
Type T
    Declare Function test(ByVal number As Integer) As Integer
    Declare Static Function test(ByVal This As T, Dim As Integer i = 420
End Type

Function T.test(ByVal number As Integer) As Integer
    Return i + number
End Function

Function T.test(ByVal This As T, ByVal number As Integer) As Integer
    Return this.test(number)
End Function

Dim p As Function(ByVal As T, ByVal As Integer) As Integer
    p = @T.test

Dim As T obj

Print p(obj, 69) '' prints 489

See also
- Sub
- Function
- Pointer
- Operator @ (Address Of)
- Procptr Operator
Variable Arguments

- ... (Ellipsis)
- va_first
- va_arg
- va_next
Static Libraries

A static library is compiled code that can be later used when building an executable.

When the compiler makes an executable, the basic source files are first turned into object files. These files are then linked together to make an executable. When we compile source code, we don't necessarily have to make an executable. We could instead group all of the object files (made from sources) into a single file called a static library.

The library is referred to as static, because when the object files which it contains are later linked in to an executable, a copy of all the needed code in the library is added to the executable.

Once the library is made, we can then use the code that it contains just as if we were compiling the source directly with our program.

Following is a simple example of creating a static library using these three files:

- mylib.bas - the source for the library
- mylib.bi - the header for the library
- mytest.bas - a test program

Our library will be a single module providing a single function:

```
'' mylib.bas
'' compile with: fbc -lib mylib.bas

'' Add two numbers together and return the result
Public Function Add2( ByVal x As Integer, ByVal y As Integer )
    Return( x + y )
End Function
```

Compile the library with:

```
fbc -lib mylib.bas
```

The `-lib` option tells the compiler to take the source code, mylib.bas, and then store the object file in to a library file, also called an archive, libmylib.a. Modules (source files) each with many functions, but for this simple example...
To make use of the library in some other source code, we need some way of telling the compiler what is in the library. A good way to do this is to put the declarations (also called an interface, or API) for the library in a header file.

```
'' mylib.bi
#include "mylib"
Declare Function Add2( ByVal x As Integer, ByVal y As Integer ) As Integer
```

There is no need to compile the header. We want this in its source form so it can be included with other source files. The `#inclib` statement will tell the compiler the name of a static library that we need to link with when eventually making an executable.

With our library (.a file) and a header (.bi file) we can try them out in a test program:

```
'' mytest.bas
'' compile with: fbc mytest.bas
#include once "mylib.bi"
Print Add2(1,2)
```

The `#include` statement tells the compiler to include the source code from the header file to the original source. With the way we have written our include file, it tells the compiler everything it needs to know about the library.

We compile this with:

```
fbc mytest.bas
```

Then when we run the `mytest` executable, we should get the result of:

```
3
```

More than one source module can be used when making a library. And by including each needed header. Some libraries are so large that they might use several headers. On very large projects, making libraries out of some code modules that seldom change can improve compile times dramatically.

Libraries can optionally contain debugging information specified with the
Object files, and therefore libraries, are platform specific and in some cases specific to the compiler and FreeBASIC runtime library.

See also

- Shared Libraries
- #inlib
- #include
- Compiler Option: -lib
A shared library is compiled code that can be loaded and used later when running an executable.

When the compiler makes an executable, the basic source files are first turned into object files. A shared library is much like a static library in that it contains object files, and the library is referred to as shared, because the code in the library is loaded by an executable at runtime and can be loaded by more than one executable, even though there might only be one copy of the shared library.

Once the library is made, we can then use the code that it contains just as if we were compiling the source directly with our program.

**Shared Library Example**

**Using Shared Libraries on Windows**

**Using Shared Libraries on Linux**

**Executables that export symbols**

**Loading Shared Libraries Dynamically**

**Shared Library Example**

Following is a simple example of creating a shared library using these files:

- `mylib.bas` - the source for the library
- `mylib.bi` - the header for the library
- `mytest.bas` - a test program

Our library will be a single module providing a single function:

```
'' mylib.bas
'' compile with: fbc -dll mylib.bas

'' Add two numbers together and return the result
Public Function Add2( ByVal x As Integer, ByVal y As Integer )
    Return( x + y )
End Function
```
Compile the library with:

```
fbc -dll mylib.bas
```

The `-dll` option tells the compiler to take the source code, `mylib.bas`, and name of the shared library will have a `.so` extension or `.dll` extension depending on if the platform is the Linux or Windows version. A library might contain many modules (source files) each with many functions, but for this simple example, it is just one each.

Making a shared library is almost identical to making a static library except for the addition of function visible to other executables loading the shared library.

To make use of the library in some other source code, we need some declarations (also called an interface, or API) for the library in a header file.

```
'' mylib.bi
#inclib "mylib"
Declare Function Add2( ByVal x As Integer, ByVal y As Integer)

'' mytest.bas
'' compile with: fbc mytest.bas
#include_once "mylib.bi"
Print Add2(1,2)
```

There is no need to compile the header. We want this in its source form so it can be included with other source files.

With our library (.dll / .so file) and a header (.bi file) we can try them out in a test program:

```
'' mytest.bas
'' compile with: fbc mytest.bas
#include_once "mylib.bi"
Print Add2(1,2)
```

The `#include` statement tells the compiler to include the source code file. If written our include file, it tells the compiler everything it needs to know.

We compile this with:

```
fbc mytest.bas
```
Then when we run the mytest executable, we should get the result of:

3

More than one source module can be used when making a library. And libraries are so large that they might use several headers. On very large projects, it can improve compile times and link times dramatically.

Shared libraries can optionally contain debugging information specified in the Object files, and therefore shared libraries, are platform specific and in some cases version specific of the compiler and FreeBASIC runtime library.

Using Shared Libraries on Windows

On Windows, the shared library must be stored in a location where it can be found by the executable that needs it at run-time. The operating system may search the following directories:

- The directory from which the executable was loaded.
- The current directory.
- The Windows and Windows system folder.
- Directories list in the PATH environment variable.

The order in which directories are searched may depend on the Windows version in use, and on what settings the operating system is configured with.

Using Shared Libraries on Linux

By default, Linux will not normally search the current directory or the directory from which the executable was loaded. To run the executable ./mytest/ and temporarily tell Linux to search the current directory:

```
LD_LIBRARY_PATH=./:$LD_LIBRARY_PATH ./mytest
```
**Executables that export symbols**

If an executable has symbols that must be available to other shared libraries, specify the `-export` command line option when making (linking) the executable.

The `-export` option has no extra effect when used with the `-dylib` or `-dll` option.

**Loading Shared Libraries Dynamically**

Shared libraries can be loaded and used at run time by dynamically loading the library and its symbols at runtime.

- `DyLibLoad` can be used to load and obtain a handle to a shared library.
- `DyLibSymbol` is used to obtain the address of a symbol in a loaded shared library.
- `DyLibFree` is used to unload a shared library when it is no longer needed.

Procedures in the shared library must use the `Export` specifier to ensure that the symbols name is placed in the shared library's export table.

```'
mymdll.bas
'' compile as: fbc -dll mymdll.bas
'' This will create mydll.dll (and libmydll.dll.a
'' and libmydll.so on Linux.
''
'' Note: libmydll.dll.a is an import library, it's
'' an executable that calls any of mydll's functions.
'' the DLL files with your apps, do not include this
'' they are useless to end-users.
''
'' Simple exported function; the <alias "..."> dis
'' all-upper-case name mangling, so the DLL will ex
'' ADDNUMBERS().
Function AddNumbers Alias "AddNumbers"( ByVal a As Function = a + b
End Function
```
'load.bas: Loads mydll.dll (or libmydll.so) at runtime, calls one of mydll's functions and prints the result. mydll is not needed at compile time. compile as: fbc test.bas
'

' Note: The compiled mydll.dll (or libmydll.so) dynamically library is expected to be available in the current directory.

' Note we specify just "mydll" as library file name for compatibility between Windows and Linux, where a dynamic library has different file name and extension.
Dim As Any Ptr library = DyLibLoad( "mydll" )
If( library = 0 ) Then
    Print "Failed to load the mydll dynamic library"
End 1
End If

' This function pointer will be used to call the function after the address has been found. Note: It must have the same calling convention and parameters.
Dim AddNumbers As Function( ByVal As Integer, ByVal As Integer )
AddNumbers = DyLibSymbol( library, "AddNumbers" )
If( AddNumbers = 0 ) Then
    Print "Could not retrieve the AddNumbers() function"
End 1
End If

Randomize Timer

Dim As Integer x = Rnd * 10
Dim As Integer y = Rnd * 10

Print x; " +"; y; " ="; AddNumbers( x, y )

' Done with the library; the OS will automatically unload it by a process when it terminates, but we can also force unloading during our program execution to save resources; this is

"
''Remember that once you unload a previously loaded library, you got from it via dylibsymbol will become invalid, and accessing them will cause the application to crash.

DyLibFree( library )

See also

- Static Libraries
- #inclib
- #include
- Compiler Option: -dll
- Compiler Option: -export
- Compiler Option: -dylib
Profiling can be used to analyze the performance of an application.

The performance of an application might be measured by how many times functions are called, how much time is spent executing those functions, and which functions are calling other functions. This can help to identify functions that might be taking too long to execute or executed too many times and that might be worth reviewing for optimization.

FreeBASIC uses GPROF for analyzing the execution of an application. The profiler information is collected while the program is running, and GPROF is used to report on the collected data afterward.

The three basic steps to profiling a program are:

1) Prepare the program for profiling by compiling source with the profile option.
2) Run the program to collection information (stored in gmon.out).
3) Analyze the information collected using GPROF.

Full documentation on GPROF is available here: http://www.gnu.org/software/binutils/manual/gprof-2.9.1/gprof.html
If the documentation has moved from that location, simply search the web for "GNU GPROF" and a relevant link should be returned.

FreeBASIC supports function profiling; not basic-block or line-by-line profiling.

**Preparing a Program for Profiling**

Only code that is compiled with the -profile command line option can be profiled. Pass the -profile option to the FreeBASIC compiler to prepare the program to be profiled. This will tell the compiler to insert special startup code at the beginning of the application as well as at the beginning of each function.

```
fbc program.bas -profile
```
Profiling the Program

The information needed to analyze execution of the program is gathered while the program is running. Run the program to begin collecting the function call information. This information is automatically stored in a file named `gmon.out` in the same directory as the program.

Analyzing the Program's Output

Use GPROF to analyze the output. The default report for GPROF includes descriptions on what each of the columns of values mean. If you are new to using GPROF, you may want to first run the default report and read through the descriptions. The output from GPROF can be saved to a file by redirection.

Save output from GPROF to `profile.txt`:

```
gprof program[.exe] > profile.txt
```

Show just the flat report with no descriptions:

```
gprof program[.exe] --brief --flat-profile > profile.txt
```

Combining the Results of More than One Session

GPROF also has a 'sum' option for conveniently combining results from multiple execution sessions. Here is an example of usable:

- Run your program once. This will create `gmon.out`.
- Use the command:
  ```
  mv gmon.out gmon.sum
  or
  rename gmon.out gmon.sum.
  ```
- Run your program again. This will create new data in `gmon.out`.
- Merge the new data in `gmon.out` into `gmon.sum` using the command:
  ```
  gprof program[.exe] --sum > gmon.sum
  ```
gprof --sum program[.exe] gmon.out gmon.sum
- Repeat the last two steps as often as needed.
- Analyze the summary data using the command:
gprof program[.exe] gmon.sum > profile.txt

**FreeBASIC Profiling Internals**

When the '-profile' option is enabled, one or more bits of code are added to the program.
- Call to "_monstartup()" at the beginning of the implicit main to initialize the profiling library.
- Call to "mcount()" at the beginning of each procedure. This is how the profiling library keeps track of what function is being and by which other function.
- Linking of additional program startup object code. (e.g. gcrt?.o)

The profiling library itself may be in a separate library or part of the C runtime library.
- mingw will require gcrt2.o and libgmon.a
- cygwin will require gcrt0.o and libgmon.a
- dos will require gcrt0.o (profiler code is in libc.a)
- linux will require gcrt1.o (profiler code is in libc.a)

The details may vary from one port of FreeBASIC to the next, but source code built for profiling with FreeBASIC should be compatible with other languages also supporting GPROF.
FreeBASIC graphics programs support in all versions the same "ASCII extended" USA character set the old DOS (and QBasic) supported. It is also called CP437 or Code page 437. Each character is represented with one (1) byte of data. Here is a table. Each entry has decimal code, hex code, and printed representation.

<table>
<thead>
<tr>
<th>Decimal Code</th>
<th>Hex Code</th>
<th>Printed Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>00</td>
<td>sp</td>
</tr>
<tr>
<td>001</td>
<td>01</td>
<td>@</td>
</tr>
<tr>
<td>002</td>
<td>02</td>
<td>#</td>
</tr>
<tr>
<td>003</td>
<td>03</td>
<td>$</td>
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<tr>
<td>004</td>
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<td>%</td>
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<tr>
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<tr>
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<tr>
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<td>3D</td>
<td>1</td>
</tr>
<tr>
<td>062</td>
<td>3E</td>
<td>2</td>
</tr>
<tr>
<td>063</td>
<td>3F</td>
<td>3</td>
</tr>
</tbody>
</table>

- Note: The table entries are placeholders and should be replaced with actual character codes and representations.
Many of the standard ASCII characters cannot be printed in FreeBASIC because the console interprets some characters as controls: 7 is bell, 8 is backspace, 9 is tab, 10 is line feed, 13 is carriage return, and others. There are symbols associated with these characters also, but there is no way in FreeBASIC to output them to the screen.

The acronym ASCII stands for American Standard Code for Information Interchange. For more information, see http://en.wikipedia.org/wiki/Ascii. The symbols for codes 32 through 127 are the same as the standard Latin ISO-8859-1 char set most Windows fonts use. Others are often very different.

In console mode (i.e. Screen 0/ non-graphics mode) the characters less than 32 or greater than 127 may display using different characters, depending on the operating system and code page of the screen / console in use. UNICODE is a newer standard of character sets involving two or more bytes per character, and may be used to print other characters to a Unicode-enabled console.

In graphics modes, Draw String does not give special meaning to control characters allowing an alternative to display all characters in the set.
**Date Serials**

**Description**

A date serial is a number that holds a date and time value in the same used by PDS or VBDOS. The value is a count of the days from 0:00 AM December 30, 1899; it's mainly used for easy counting of the time between dates.

The date serial unit is one day and the fractional part represents the time of the day. If a date serial is written into an integer, the time is lost. FreeBASIC date serials are not limited to dates between 1753 and 2078 as in VBDOS. FreeBASIC date serial handling functions use `Double` arguments.

FreeBASIC date serial handling functions require the inclusion of `vbcompat.bi` and `datetime.bi` in the source.

A date serial can be created by the functions `Now`, `TimeSerial+DateSerial`, `DateValue+TimeValue`.

The functions `Year`, `Month`, `Weekday`, `Day`, `Hour`, `Minute`, `Second` allow to recover different components of a date serial.

The `Format` function has formatting expressions to print date serials in readable way.

**Example**

```basic
#include "vbcompat.bi"
Dim a As Double, b As Double

a = 0
Print "The origin of the date serials is:", a
Print Format(a, "yyyy/mm/dd hh:mm:ss")
Print

a = Now
Print "The time now is: "
```

Print Format(a, "yyyy/mm/dd hh:mm:ss")
Print

b = DateSerial(2000,1,1)
Print Int(a-b) & " days have passed since 2000/01/
Radian system of measuring angles

All of the built-in trigonometric functions in FreeBASIC express angles in radians.

A full circle is divided into 2 * pi radians or 360 degrees, which leads to the following conversions:

\[
\begin{align*}
\text{radians} &= \text{degrees} \times \pi / 180 \\
\text{degrees} &= \text{radians} \times 180 / \pi
\end{align*}
\]

Pi is a constant equal to the ratio of the circumference of a circle to its diameter. It can be calculated programmatically by multiplying the arctangent of 1 by 4:

\[
\pi = \atn(1) \times 4
\]
Internal graphics formats

Pixel formats

When a graphics mode is set via the Screen or ScreenRes functions, GfxLib creates also a framebuffer in standard system memory and sets an appropriate internal pixel format for the mode. There are basically three internal pixel formats, selected depending on the screen depth, as described in the following table:

<table>
<thead>
<tr>
<th>Screen depth</th>
<th>Internal bytes per pixel</th>
<th>Range bitmask</th>
<th>Pixel format</th>
</tr>
</thead>
<tbody>
<tr>
<td>1bpp</td>
<td>1</td>
<td>&amp;h1</td>
<td>palette color index</td>
</tr>
<tr>
<td>2bpp</td>
<td>1</td>
<td>&amp;h3</td>
<td>palette color index</td>
</tr>
<tr>
<td>4bpp</td>
<td>1</td>
<td>&amp;hF</td>
<td>palette color index</td>
</tr>
<tr>
<td>8bpp</td>
<td>1</td>
<td>&amp;hFF</td>
<td>palette color index</td>
</tr>
<tr>
<td>15/16bpp</td>
<td>2</td>
<td>&amp;hFFFF</td>
<td>RRRRRGGGGGGBBBBB</td>
</tr>
<tr>
<td>24/32bpp</td>
<td>4</td>
<td>&amp;hFFFFFFFF</td>
<td>AAAAAAAARRRRRRRGGGGGGGGGBBBBBB</td>
</tr>
</tbody>
</table>

All drawing operations work on this RAM framebuffer; when the actual display needs to be updated, GfxLib copies the contents of the framebuffer to the real display memory, automatically converting in the process from the current internal pixel format to whatever pixel format the real display uses. By limiting the internal pixel formats to 3, the library prevents you having to deal with the plethora of real display formats.

Color values

When calling a graphics primitive that accepts a color, this can be specified in two ways. In 8bpp or less modes, the color value must be a direct 8 bits color index in the current palette, and this matches the internal pixel format for those modes. In higher color depths, the color value should always have the form &hAARRGGGBB; this is what the RGB and RGBA macros return, and is equivalent to the 24/32bpp internal pixel format representation. If the current color depth is 24 or 32bpp, this means the color value passes in unaltered. If a 15/16bpp mode is in use
internally each primitive automatically converts the color from the &hAARRGGBB; form into the RRRRRGGGGGGBBBBB internal pixel format (note that in this process the alpha channel is lost, as 15/16bpp modes do not support it). Once the color value is in one of the three pixel formats, the primitive limits its range to the range supported by the current color depth, by using a bitwise And operation with a range bitmask. So if in 8bpp, the color value passed is Anded by &hFF; for example.

Notes on transparency

For 8bpp or less modes, color index 0 is always treated as the transparent color for the Put modes that support transparency. For higher depths, RGB(255, 0, 255) always represents the transparent color. In 15/16bpp modes, this translates to the internal value &hF81F;, whereas in 24/32bpp modes it becomes &hFFFF00FF;. Note that in 24/32bpp modes, Put identifies the transparent color by looking just at the red, green and blue components of the color value, while the alpha value can assume any value. This means that in 24/32bpp modes, &h00FF00FF;, &h10FF00FF;, &hABFF00FF; and &hFFFF00FF; for example all represent the transparent color, since the lower 24 bits are always &hFF00FF;.

Buffer formats

In FreeBASIC, images can be used as arrays (as in QB) or as pointers. Either way, the image data is contained in one continuous chunk. The chunk consists of an header followed by the image data. The header can be of two types (old-style and new-style) and determines the format of the following image data.

Old-style chunk header consists of 4 bytes (32 bits, or 4 bytes). The first 3 bits contain the image color depth in bytes per pixel (8-bit color depth -> 1; 16-bit color depth -> 2; 32-bit color depth -> 4). The next 13 bits contain the image width. The last 16 bits contain the image's height. Please note the intrinsic nature of the header allows only for sizes up to 8191 * 65535 pixels. The actual pixel data follows the header, and is compacted one row of pixels after another; no data alignment is assumed. The final size of the chunk can then be computed using the formula:
size = 4 + ( width * height * bytes_per_pixel )

**New-style** chunk header consists of 32 bytes. The first dword (32 bits) must be equal to the value 7, allowing GfxLib to identify the new type of chunk. The second dword contains the image color depth in bytes per pixel. The third and fourth dwords contain the image width and height respectively, effectively removing the image size limit enforced by the old-style image chunks. The fifth dword contains the pixel row pitch in bytes; this tells how many bytes a row of pixels in the image takes up. The pitch in new-style chunks is always padded to a multiple of 16, to allow pixels' row data to be aligned on the paragraph boundary. The remaining 3 dwords (total 12 bytes) of the header are currently unused and reserved for future use. The final size of the image is:

\[size = 32 + ( ( ( width \times bytes\_per\_pixel ) + \&hF; ) \text{ and not } \&hF \text{ ) } \times height )\]

The format of images created by `ImageCreate` and `Get` depend on the dialect used. In the `-lang fb` dialect, images will be created with the new style header. In the `-lang fblite` and `-lang qb` dialects, the old-style image header is created.

All graphics primitives can work with both old-style and new-style image chunks. For easy access to image information, `ImageInfo` can be used to obtain useful properties of an image buffer - such as its dimensions, color depth, pitch, and a pointer to the pixel data - whichever format is used. It is also possible to access the image header directly to access this information. For more information on accessing the header structure, please refer to [this example](#).

**See also**

- Screen (Graphics)
- ScreenRes
- Get (Graphics)
- Put (Graphics)
- ImageCreate
- ImageInfo
- Trans
- Alpha
# C Standard Library Functions

This is a list of function prototypes in the standard C library in alphabetical order and a list of prototypes grouped by functionality.

<table>
<thead>
<tr>
<th>Alphabetical List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer Manipulation</td>
</tr>
<tr>
<td>Character Classification and Conversion</td>
</tr>
<tr>
<td>Data Conversion</td>
</tr>
<tr>
<td>Directory Manipulation</td>
</tr>
<tr>
<td>File Manipulation</td>
</tr>
<tr>
<td>Stream I/O</td>
</tr>
<tr>
<td>Low level I/O</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Memory Allocation</td>
</tr>
<tr>
<td>Process Control</td>
</tr>
<tr>
<td>Searching and Sorting</td>
</tr>
<tr>
<td>String Manipulation</td>
</tr>
<tr>
<td>Time</td>
</tr>
</tbody>
</table>

## Description

The Comments column contains a very brief description of the use of the function. The list is not complete, however it provides information on the major functions in the C Runtime Library. It should, at the very least, indicate what functions are available in the standard C library allow you to do more investigation on your own. Some of the C library functions documented elsewhere may not be available in FreeBASIC. Check the appropriate include file for more information.

**Note:** The following prototypes are not the official FreeBASIC prototypes (see the include files), however, they will give you enough information to properly use the functions.

The Include File column contains the name of the file which you must include, using the `#include` directive at the beginning of your program. If you don't include the appropriate include file, the program either will not compile, or it will compile apparently correctly but give incorrect
results when run. All of the C Runtime headers are located in the **crt** directory; for example, if the specified header is **math.bi**, use **#include "crt/math.bi"** or **#include "crt\math.bi"**, our just **#include "crt.bi"** including all the others.

The Prototype column contains the following information:

- The name of the function;
- The parameters required for the function in parenthesis, together with the data-type of the parameters;
- The data-type of the value returned by the function.

For example **atoi(a as zstring ptr) as integer** means that the function **atoi** returns a value of type **integer** and requires a character **zstring ptr** as its argument.

**Note:** In order to make calling the C runtime functions very easy, any string type argument may be directly passed to a procedure referring to a parameter declared as 'zstring ptr'. The compiler performs itself an automatic conversion (without warning message) between string and 'zstring ptr'.

### Alphabatical List

<table>
<thead>
<tr>
<th>Name</th>
<th>Prototype (with parameters)</th>
<th>Include File</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>abs_</td>
<td>abs_(n as integer) as integer</td>
<td>stdlib.bi</td>
<td>Returns the absolute value (i.e. positive value)</td>
</tr>
<tr>
<td>acos</td>
<td>acos_(a as double) as double</td>
<td>math.bi</td>
<td>Returns the inverse cosine (angle in radians)</td>
</tr>
<tr>
<td>asin</td>
<td>asin_(a as double) as double</td>
<td>math.bi</td>
<td>Returns the inverse sine (angle in radians)</td>
</tr>
<tr>
<td>atan</td>
<td>atan_(a as double) as double</td>
<td>math.bi</td>
<td>Returns the inverse tan (angle in radians)</td>
</tr>
<tr>
<td>atan2</td>
<td>atan2_(y as double, x as double) as double</td>
<td>math.bi</td>
<td>Returns the inverse tan (pass the opposite as y and the adjacent as x)</td>
</tr>
<tr>
<td>atoi</td>
<td>atoi(s as zstring ptr) as integer</td>
<td>stdlib.bi</td>
<td>Converts a character zstring of digits to a number of type integer.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>atof</td>
<td>Converts a character zstring of digits to a number of type double.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>calloc</td>
<td>Allocates memory. Returns a pointer to a buffer for an array having NumElts elements, each of size EltSiz bytes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ceil</td>
<td>Returns the nearest whole number above the value passed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>clearerr</td>
<td>Clears the error indicators on a file stream (read or write).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cos_</td>
<td>Returns the cosine of an angle measured in radians.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cosh</td>
<td>Returns the hyperbolic cosine of an angle measured in radians.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>div</td>
<td>Returns the quotient and remainder of a division as a structure of type div_t.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ecvt</td>
<td>Converts a number to a zstring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exit_</td>
<td>Exits a program. It will flush file buffers and closes all opened files, and run any functions called by atexit().</td>
<td></td>
<td></td>
</tr>
<tr>
<td>exp_</td>
<td>Returns the value of e raised to the power of the argument (Inverse to natural logarithm).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fabs</td>
<td>Returns the absolute value (i.e. positive value) of type double.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fclose</td>
<td>Closes a file. Returns 0 if successful otherwise EOF.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feof</td>
<td>Returns value of end-of-file indicator . (0 if not eof). Indicator will clear itself but can be reset by clearerr().</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ferror</td>
<td>Returns error indicator for a stream (0 if no error). Error indicator is reset by clearerr() or rewind().</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fflush</td>
<td>Flushes (i.e. deletes) a stream (use stdin to flush the stream from the keyboard). Returns 0 if successful.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fgetc</td>
<td>Single character input (in ASCII) from passed stream (stdin for keyboard).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fgetpos</td>
<td>Saves the position of the file pointer on stream s at the location pointed to by c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fgets</td>
<td>From the stream s reads up to n-1 characters to buffer b.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **floor** | floor(d as double) as double  
**math.bi**  
Returns the nearest whole number below the value passed. |
| **fmod** | fmod(x as double, y as double) as double  
**math.bi**  
Calculates the remainder of x divided by y. |
| **fopen** | fopen(file as zstring ptr, mode as zstring ptr) as FILE ptr  
**stdio.bi**  
Opens a file. Pass the DOS name of the file and a code to indicate whether for reading, writing, or appending. Codes are r for read, w for write, + for read and write, a for append and b to indicate binary. |
| **fprintf** | fprintf(s as FILE ptr, fmt as zstring ptr, ...) as integer  
**stdio.bi**  
Prints on stream s as many items as there are single % signs in fmt that have matching arguments in the list. |
| **fputc** | fputc(c as integer, s as FILE ptr) as integer  
**stdio.bi**  
Outputs the single character c to the stream s. |
| **fputs** | fputs(b as zstring ptr, s as FILE ptr) as integer  
**stdio.bi**  
Sends the character stream in b to stream s, returns 0 if the operation fails. |
| **freopen** | freopen(file as zstring ptr, mode as zstring ptr, s as FILE ptr) as FILE ptr  
**stdio.bi**  
Opens a file for redirecting a stream. e.g. freopen("myfile", "w", stdout) will redirect the standard output to the opened "myfile". |
| **frexp** | frexp(x as double, p as integer ptr) as double  
**math.bi**  
Calculates a value m so that x equals m times 2 to some power. p is a pointer to m. |
| **fscanf** | fscanf(s as FILE ptr, fmt as zstring ptr, ...) as integer  
**stdio.bi**  
Reads from stream s as many items as there are % signs in fmt with corresponding listed pointers. |
| **fseek** | fseek(s as FILE ptr, offset as integer, origin as integer) as integer  
**stdio.bi**  
Locates a file pointer. With origin 0, 1 or 2 for the beginning, offset bytes into and at the end of the stream. |
| **fsetpos** | fsetpos(s as FILE ptr, p as fpos_t ptr) as integer  
**stdio.bi**  
Sets the file pointer for the stream s to the value pointed to by p. |
| **ftell** | ftell(s as FILE ptr) as long  
**stdio.bi**  
Locates the position of the file pointer for the stream s. |
<p>| <strong>fwrite</strong> | fwrite(buf as any |</p>
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fwrite</td>
<td>Writes the number c items of data of size b bytes from the buffer buf to the file s. Returns the number of data items actually written.</td>
</tr>
<tr>
<td>getc</td>
<td>Macro for single character input (in ASCII) from passed stream. (stdin for keyboard)</td>
</tr>
<tr>
<td>getchar</td>
<td>Single character input from the standard input</td>
</tr>
<tr>
<td>gets</td>
<td>Reads a stream of characters from the standard input until it meets \n or EOF.</td>
</tr>
<tr>
<td>hypot</td>
<td>Calculates the hypotenuse from the sides x and y.</td>
</tr>
<tr>
<td>isalnum</td>
<td>Returns a non zero value if character c is alphabetic or a digit.</td>
</tr>
<tr>
<td>isalpha</td>
<td>Returns a non zero value if character c is alphabetic.</td>
</tr>
<tr>
<td>iscntrl</td>
<td>Returns a non zero value if character c is a control character.</td>
</tr>
<tr>
<td>isdigit</td>
<td>Returns a non zero value if character c is a digit.</td>
</tr>
<tr>
<td>isgraph</td>
<td>Returns a non zero value if character c is alphabetic.</td>
</tr>
<tr>
<td>islower</td>
<td>Returns a non-zero value if character c is a lower case character.</td>
</tr>
<tr>
<td>isprint</td>
<td>Returns a non zero value if character c is printable.</td>
</tr>
<tr>
<td>ispunct</td>
<td>Returns a non zero value if character c is a punctuation character.</td>
</tr>
<tr>
<td>isspace</td>
<td>Returns a non zero value if character c denotes a space.</td>
</tr>
<tr>
<td>isupper</td>
<td>Returns a non-zero value if character c is an upper case character.</td>
</tr>
<tr>
<td>isxdigit</td>
<td>Returns a non-zero value if character c is a hex digit (0 to F or f).</td>
</tr>
<tr>
<td>ldexp</td>
<td>Returns the product of x and 2 to the power n.</td>
</tr>
<tr>
<td>ldiv</td>
<td>Returns the quotient and remainder of a division as a structure of type ldiv_t.</td>
</tr>
<tr>
<td>log_</td>
<td>Returns the natural logarithm of the argument.</td>
</tr>
<tr>
<td>log10</td>
<td>Returns the logarithm to the base 10 of the argument.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>malloc</td>
<td>Allocates memory. Returns a pointer to a buffer comprising storage for the specified size.</td>
</tr>
<tr>
<td>modf</td>
<td>Returns the fractional part of a floating point number d. p points to the integral part expressed as a float.</td>
</tr>
<tr>
<td>perror</td>
<td>Prints on the stream stderr a message passed as the argument.</td>
</tr>
<tr>
<td>pow</td>
<td>Returns x to the power y.</td>
</tr>
<tr>
<td>pow10</td>
<td>Returns 10 to the power x (inverse function to log10()).</td>
</tr>
<tr>
<td>printf</td>
<td>Prints on standard output as many items as there are single % signs in fmt with matching arguments in the list.</td>
</tr>
<tr>
<td>putc</td>
<td>Macro to output the single character c to the stream s.</td>
</tr>
<tr>
<td>putchar</td>
<td>Macro to output the single character c to the standard output.</td>
</tr>
<tr>
<td>puts</td>
<td>Sends the character stream in b to the standard output, returns 0 if operation fails.</td>
</tr>
<tr>
<td>rand</td>
<td>Returns a pseudo random number. A seed is required. The seed is set with srand.</td>
</tr>
<tr>
<td>realloc</td>
<td>Allocates memory. Returns a pointer to a buffer for a change in size of object pointed to by p.</td>
</tr>
<tr>
<td>rewind</td>
<td>Clears the error indicators on a file stream (read or write). Necessary before reading an amended file.</td>
</tr>
<tr>
<td>scanf</td>
<td>Reads from standard input as many items as there are % signs in fmt with corresponding listed pointers.</td>
</tr>
<tr>
<td>sin_</td>
<td>Returns the sine of an angle measured in radians.</td>
</tr>
<tr>
<td>sinh</td>
<td>Returns the hyperbolic sine of an angle measured in radians.</td>
</tr>
<tr>
<td>sprintf</td>
<td>Prints on zstring p as many items as there are single % signs in fmt that have matching arguments in the list.</td>
</tr>
<tr>
<td>sqrt</td>
<td>Returns the square root of the value passed. Domain error if value is negative.</td>
</tr>
<tr>
<td>srand</td>
<td>Sets the seed for a random number. A possible seed is the current time.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><code>sscanf</code></td>
<td>Reads from buffer <code>b</code> as many items as there are <code>%</code> signs in <code>fmt</code> with corresponding listed pointers.</td>
</tr>
<tr>
<td><code>strcat</code></td>
<td>Concatenates (appends) <code>zstring</code> <code>s2</code> to <code>s1</code>.</td>
</tr>
<tr>
<td><code>strchr</code></td>
<td>Returns a pointer to the first occurrence of <code>c</code> in <code>s</code> or NULL if it fails to find one.</td>
</tr>
<tr>
<td><code>strcmp</code></td>
<td>Compares <code>zstring</code> <code>s2</code> to <code>s1</code>. Returns 0 or signed difference in ASCII values of first non matching character.</td>
</tr>
<tr>
<td><code>strcpy</code></td>
<td>Copies <code>s2</code> into <code>s1</code>.</td>
</tr>
<tr>
<td><code>strcspn</code></td>
<td>Returns the number of characters in <code>s1</code> encountered before meeting any of the characters in <code>s2</code>.</td>
</tr>
<tr>
<td><code>strerror</code></td>
<td>Returns a pointer to a system error message corresponding to the passed error number.</td>
</tr>
<tr>
<td><code>strlen</code></td>
<td>Returns the number of bytes in the null terminated <code>zstring</code> pointed to by <code>s</code> (does not count null).</td>
</tr>
<tr>
<td><code>strncat</code></td>
<td>Concatenates (appends) <code>n</code> bytes from <code>zstring</code> <code>s2</code> to <code>s1</code>.</td>
</tr>
<tr>
<td><code>strncpy</code></td>
<td>Copies <code>n</code> bytes from <code>s2</code> into <code>s1</code>.</td>
</tr>
<tr>
<td><code>strpbrk</code></td>
<td>Returns a pointer to the first character encountered in <code>s1</code> that is also in <code>s2</code>.</td>
</tr>
<tr>
<td><code>strrchr</code></td>
<td>Returns a pointer to the last occurrence of <code>c</code> in <code>s</code> or NULL if it fails to find one.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>strspn</strong></td>
<td>Returns the number of characters in s1 encountered before meeting a character which is not in s2.</td>
</tr>
<tr>
<td><strong>strstr</strong></td>
<td>Finds the location of the zstring s2 in s1 and returns a pointer to its leading character.</td>
</tr>
<tr>
<td><strong>strtok</strong></td>
<td>Returns pointers to successive tokens utilizing the zstring s1. Tokens regarded as separators are listed in s2.</td>
</tr>
<tr>
<td><strong>system</strong></td>
<td>Executes, from within a program, a command addressed to the operating system written as a zstring (e.g. DIR on Windows and DOS and LS on Linux).</td>
</tr>
<tr>
<td><strong>tan_</strong></td>
<td>Returns the tangent of an angle measured in radians.</td>
</tr>
<tr>
<td><strong>tanh</strong></td>
<td>Returns the hyperbolic tangent of an angle measured in radians.</td>
</tr>
<tr>
<td><strong>tolower</strong></td>
<td>Converts a character from upper case to lower case (uses ASCII code).</td>
</tr>
<tr>
<td><strong>toupper</strong></td>
<td>Converts a character from lower case to upper case (uses ASCII code).</td>
</tr>
<tr>
<td><strong>ungetc</strong></td>
<td>Pushes a character c back into the stream s, returns EOF if unsuccessful. Do not push more than one character.</td>
</tr>
</tbody>
</table>

**Buffer Manipulation**

```c
#include "crt/string.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>memchr(s as any ptr, c as integer, n as size_t) as any ptr</code></td>
<td>Search for a character in a buffer.</td>
</tr>
<tr>
<td><code>memcmp(s1 as any ptr, s2 as any ptr, n as size_t) as integer</code></td>
<td>Compare two buffers.</td>
</tr>
<tr>
<td><code>memcpy(dest as any ptr, src as any ptr, n as size_t) as any ptr</code></td>
<td>Copy one buffer into another.</td>
</tr>
<tr>
<td><code>memmove(dest as any ptr, src as any ptr, n as size_t) as any ptr</code></td>
<td>Move a number of bytes from one buffer.</td>
</tr>
</tbody>
</table>
### Character Classification and Conversion

```c
#include "crt/ctype.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>isalnum(c as integer) as integer</td>
<td>True if c is alphanumeric.</td>
</tr>
<tr>
<td>isalpha(c as integer) as integer</td>
<td>True if c is a letter.</td>
</tr>
<tr>
<td>isascii(c as integer) as integer</td>
<td>True if c is ASCII.</td>
</tr>
<tr>
<td>iscntrl(c as integer) as integer</td>
<td>True if c is a control character.</td>
</tr>
<tr>
<td>isdigit(c as integer) as integer</td>
<td>True if c is a decimal digit.</td>
</tr>
<tr>
<td>isgraph(c as integer) as integer</td>
<td>True if c is a graphical character.</td>
</tr>
<tr>
<td>islower(c as integer) as integer</td>
<td>True if c is a lowercase letter.</td>
</tr>
<tr>
<td>isprint(c as integer) as integer</td>
<td>True if c is a printable character.</td>
</tr>
<tr>
<td>ispunct(c as integer) as integer</td>
<td>True if c is a punctuation character.</td>
</tr>
<tr>
<td>isspace(c as integer) as integer</td>
<td>True if c is a space character.</td>
</tr>
<tr>
<td>isupper(c as integer) as integer</td>
<td>True if c is an uppercase letter.</td>
</tr>
<tr>
<td>isxdigit(c as integer) as integer</td>
<td>True if c is a hexadecimal digit.</td>
</tr>
<tr>
<td>toascii(c as integer) as integer</td>
<td>Convert c to ASCII.</td>
</tr>
<tr>
<td>tolower(c as integer) as integer</td>
<td>Convert c to lowercase.</td>
</tr>
<tr>
<td>toupper(c as integer) as integer</td>
<td>Convert c to uppercase.</td>
</tr>
</tbody>
</table>

### Data Conversion

```c
#include "crt/stdlib.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>atof(string1 as zstring ptr) as double</td>
<td>Convert zstring to floating point value.</td>
</tr>
</tbody>
</table>
### Directory Manipulation

```c
#include "crt/io.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>_chdir(path as zstring ptr) as integer</code></td>
<td>Change current directory to given path.</td>
</tr>
<tr>
<td><code>_getcwd(path as zstring ptr, numchars as integer) as zstring ptr</code></td>
<td>Returns name of current working directory.</td>
</tr>
<tr>
<td><code>_mkdir(path as zstring ptr) as integer</code></td>
<td>Create a directory using given path name.</td>
</tr>
<tr>
<td><code>_rmdir(path as zstring ptr) as integer</code></td>
<td>Delete a specified directory.</td>
</tr>
</tbody>
</table>

### File Manipulation

```c
#include "crt/sys/stat.bi"
#include "crt/io.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>chmod(path as zstring ptr, pmode as integer) as integer</code></td>
<td>Change permission settings of a file.</td>
</tr>
</tbody>
</table>
### Stream I/O

```c
#include "crt/stdio.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>clearerr(file_pointer as FILE ptr)</td>
<td>Clear error indicator of stream,</td>
</tr>
<tr>
<td>fclose(file_pointer as FILE ptr) as integer</td>
<td>Close a file,</td>
</tr>
<tr>
<td>feof(file_pointer as FILE ptr) as integer</td>
<td>Check if end of file occurred on a stream.</td>
</tr>
<tr>
<td>ferror(file_pointer as FILE ptr) as integer</td>
<td>Check if any error occurred during file I/O.</td>
</tr>
<tr>
<td>fflush(file_pointer as FILE ptr) as integer</td>
<td>Write out (flush) buffer to file.</td>
</tr>
<tr>
<td>fgetc(file_pointer as FILE ptr) as integer</td>
<td>Get a character from a stream.</td>
</tr>
<tr>
<td>fgetpos(file_pointer as FILE ptr, fpos_t current_pos) as integer</td>
<td>Get the current position in a stream.</td>
</tr>
<tr>
<td>fgets(string1 as zstring ptr, maxchar as integer, file_pointer as FILE ptr) as zstring ptr</td>
<td>Read a zstring from a file.</td>
</tr>
<tr>
<td>fopen(filename as zstring ptr, access_mode as zstring ptr) as FILE ptr</td>
<td>Open a file for buffered I/O.</td>
</tr>
<tr>
<td>fprintf(file_pointer as FILE ptr, format_string as zstring ptr, args) as integer</td>
<td>Write formatted output to a file,</td>
</tr>
<tr>
<td>fputc(c as integer, file_pointer as FILE ptr) as integer</td>
<td>Write a character to a stream.</td>
</tr>
<tr>
<td>fputchar(c as integer) as integer</td>
<td>Write a character to stdout.</td>
</tr>
<tr>
<td>puts(string1 as zstring ptr, file_pointer as FILE ptr) as integer</td>
<td>Write a zstring to a stream.</td>
</tr>
<tr>
<td>fread(buffer as zstring ptr, size as size_t count as size_t, file_pointer as FILE ptr) as size_t</td>
<td>Read unformatted data from a stream into a buffer.</td>
</tr>
<tr>
<td>freopen(filename as zstring ptr, access as zstring ptr mode, file_pointer as FILE ptr) as FILE ptr</td>
<td>Reassign a file pointer to a different file.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>fscanf(file_pointer as FILE ptr, format as zstring ptr zstring, args) as integer</td>
<td>Read formatted input from a stream.</td>
</tr>
<tr>
<td>fseek(file_pointer as FILE ptr, offset as long, origin as integer) as integer</td>
<td>Set current position in file to a new location.</td>
</tr>
<tr>
<td>fsetpos(file_pointer as FILE ptr, current_pos as fpos_t) as integer</td>
<td>Set current position in file to a new location.</td>
</tr>
<tr>
<td>ftell(file_pointer as FILE ptr) as long</td>
<td>Get current location in file.</td>
</tr>
<tr>
<td>fwrite(buffer as zstring ptr, size as size_t, count as size_t file_pointer as FILE ptr) as size_t</td>
<td>Write unformatted data from a buffer to a stream.</td>
</tr>
<tr>
<td>getc(file_pointer as FILE ptr) as integer</td>
<td>Read a character from a stream.</td>
</tr>
<tr>
<td>getchar() as integer</td>
<td>Read a character from stdin.</td>
</tr>
<tr>
<td>gets(buffer as zstring ptr) as zstring ptr</td>
<td>Read a line from stdin into a buffer.</td>
</tr>
<tr>
<td>printf(format as zstring ptr_string, args) as integer</td>
<td>Write formatted output to stdout.</td>
</tr>
<tr>
<td>putc(c as integer, file_pointer as FILE ptr) as integer</td>
<td>Write a character to a stream.</td>
</tr>
<tr>
<td>putchar(c as integer) as integer</td>
<td>Write a character to stdout.</td>
</tr>
<tr>
<td>puts(string1 as zstring ptr) as integer</td>
<td>Write a zstring to stdout.</td>
</tr>
<tr>
<td>rewind(file_pointer as FILE ptr)</td>
<td>Rewind a file.</td>
</tr>
<tr>
<td>sscanf(buffer as zstring ptr, format_string as zstring ptr, args) as integer</td>
<td>Read formatted input from a zstring.</td>
</tr>
<tr>
<td>setbuf(file_pointer as FILE ptr, buffer as zstring ptr)</td>
<td>Set up a new buffer for the stream.</td>
</tr>
<tr>
<td>setvbuf(file_pointer as FILE ptr, buffer as zstring ptr, buf_type as integer, buf as size_t size) as integer</td>
<td>Set up new buffer and control the level of buffering on a stream.</td>
</tr>
<tr>
<td>sprintf(string1 as zstring ptr, format_string as zstring ptr, args) as integer</td>
<td>Write formatted output to a zstring.</td>
</tr>
<tr>
<td>sscanf(buffer as zstring ptr, format_string as zstring ptr, args) as integer</td>
<td>Read formatted input from a zstring.</td>
</tr>
<tr>
<td>tmpfile() as FILE ptr</td>
<td>Open a temporary file.</td>
</tr>
<tr>
<td>tmpnam(file_name as zstring ptr) as zstring ptr</td>
<td>Get temporary file name.</td>
</tr>
<tr>
<td>ungetc(c as integer, file_pointer as FILE ptr) as integer</td>
<td>Push back character into stream’ s buffer</td>
</tr>
</tbody>
</table>

**Low level I/O**

#include "crt/io.bi"

So far Win32 only, connects to MSVCRT.DLL (headers missing for
other platforms)

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>_close(handle as integer) as integer</td>
<td>Close a file opened for unbuffered I/O.</td>
</tr>
<tr>
<td>_creat(filename as zstring ptr, pmode as integer) as integer</td>
<td>Create a new file with specified permission setting.</td>
</tr>
<tr>
<td>_eof(handle as integer) as integer</td>
<td>Check for end of file.</td>
</tr>
<tr>
<td>_lseek(handle as integer, offset as long, origin as integer) as long</td>
<td>Go to a specific position in a file.</td>
</tr>
<tr>
<td>_open(filename as zstring ptr, oflag as integer, pmode as uinteger) as integer</td>
<td>Open a file for low-level I/O.</td>
</tr>
<tr>
<td>_read(handle as integer, buffer as zstring ptr, length as uinteger) as integer</td>
<td>Read binary data from a file into a buffer.</td>
</tr>
<tr>
<td>_write(handle as integer, buffer as zstring ptr, count as uinteger) as integer</td>
<td>Write binary data from a buffer to a file.</td>
</tr>
</tbody>
</table>

**Mathematics**

```c
#include "crt/math.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>abs_(n as integer) as integer</td>
<td>Get absolute value of an integer.</td>
</tr>
<tr>
<td>acos_(x as double) as double</td>
<td>Compute arc cosine of x.</td>
</tr>
<tr>
<td>asin_(x as double) as double</td>
<td>Compute arc sine of x.</td>
</tr>
<tr>
<td>atan_(x as double) as double</td>
<td>Compute arc tangent of x.</td>
</tr>
<tr>
<td>atan2_(y as double, x as double) as double</td>
<td>Compute arc tangent of y/x.</td>
</tr>
<tr>
<td>ceil(x as double) as double</td>
<td>Get smallest integral value that exceeds x.</td>
</tr>
<tr>
<td>cos_(x as double) as double</td>
<td>Compute cosine of angle in radians.</td>
</tr>
<tr>
<td>cosh(x as double) as double</td>
<td>Compute the hyperbolic cosine of x.</td>
</tr>
<tr>
<td>div(number as integer, denom as integer) as div_t</td>
<td>Divide one integer by another.</td>
</tr>
<tr>
<td>exp_(x as double) as double</td>
<td>Compute exponential of x.</td>
</tr>
<tr>
<td>fabs(x as double) as double</td>
<td>Compute absolute value of x.</td>
</tr>
<tr>
<td>floor(x as double) as double</td>
<td>Get largest integral value less than x.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>fmod(x as double, y as double) as double</td>
<td>Divide x by y with integral quotient and return remainder.</td>
</tr>
<tr>
<td>frexp(x as double, expptr as integer ptr) as double</td>
<td>Breaks down x into mantissa and exponent of no.</td>
</tr>
<tr>
<td>labs(n as long) as long</td>
<td>Find absolute value of long integer n.</td>
</tr>
<tr>
<td>ldexp(x as double, exp as integer) as double</td>
<td>Reconstructs x out of mantissa and exponent of two.</td>
</tr>
<tr>
<td>ldiv(number as long, denom as long) as ldiv_t</td>
<td>Divide one long integer by another.</td>
</tr>
<tr>
<td>log_(x as double) as double</td>
<td>Compute log(x).</td>
</tr>
<tr>
<td>log10(x as double) as double</td>
<td>Compute log to the base 10 of x.</td>
</tr>
<tr>
<td>modf(x as double, intptr as double ptr) as double</td>
<td>Breaks x into fractional and integer parts.</td>
</tr>
<tr>
<td>pow(x as double, y as double) as double</td>
<td>Compute x raised to the power y.</td>
</tr>
<tr>
<td>rand() as integer</td>
<td>Get a random integer between 0 and 32767.</td>
</tr>
<tr>
<td>random(max_num as integer) as integer</td>
<td>Get a random integer between 0 and max_num.</td>
</tr>
<tr>
<td>randomize()</td>
<td>Set a random seed for the random number generator.</td>
</tr>
<tr>
<td>sin_(x as double) as double</td>
<td>Compute sine of angle in radians.</td>
</tr>
<tr>
<td>sinh(x as double) as double</td>
<td>Compute the hyperbolic sine of x.</td>
</tr>
<tr>
<td>sqrt(x as double) as double</td>
<td>Compute the square root of x.</td>
</tr>
<tr>
<td>srand(seed as unsigned)</td>
<td>Set a new seed for the random number generator (rand).</td>
</tr>
<tr>
<td>tan_(x as double) as double</td>
<td>Compute tangent of angle in radians.</td>
</tr>
<tr>
<td>tanh(x as double) as double</td>
<td>Compute the hyperbolic tangent of x.</td>
</tr>
</tbody>
</table>

---

**Memory Allocation**

```cpp
#include "crt/stdlib.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>calloc(num as size_t elems, elem_size as size_t) as any ptr</td>
<td>Allocate an array and initialise all elements to zero.</td>
</tr>
<tr>
<td>free(mem_address as any ptr)</td>
<td>Free a block of memory.</td>
</tr>
<tr>
<td>malloc(num as size_t bytes) as any ptr</td>
<td>Allocate a block of memory.</td>
</tr>
<tr>
<td>realloc(mem_address as any ptr, newsize as any)</td>
<td>Reallocate (adjust size) a block of</td>
</tr>
</tbody>
</table>

---
Process Control

```c
#include "crt/stdlib.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>abort()</td>
<td>Abort a process.</td>
</tr>
<tr>
<td>execl(path as zstring ptr, arg0 as zstring ptr, arg1 as zstring ptr,..., NULL) as integer</td>
<td>Launch a child process (pass command line).</td>
</tr>
<tr>
<td>execlp(path as zstring ptr, arg0 as zstring ptr, arg1 as zstring ptr,..., NULL) as integer</td>
<td>Launch child (use PATH, pass command line).</td>
</tr>
<tr>
<td>execv(path as zstring ptr, argv as zstring ptr) as integer</td>
<td>Launch child (pass argument vector).</td>
</tr>
<tr>
<td>execvp(path as zstring ptr, argv as zstring ptr) as integer</td>
<td>Launch child (use PATH, pass argument vector).</td>
</tr>
<tr>
<td>exit_(status as integer)</td>
<td>Terminate process after flushing all buffers.</td>
</tr>
<tr>
<td>getenv(varname as zstring ptr) as zstring ptr</td>
<td>Get definition of environment variable,</td>
</tr>
<tr>
<td>perror(string1 as zstring ptr)</td>
<td>Print error message corresponding to last system error.</td>
</tr>
<tr>
<td>putenv(envstring as zstring ptr) as integer</td>
<td>Insert new definition into environment table.</td>
</tr>
<tr>
<td>raise(signum as integer) as integer</td>
<td>Generate a C signal (exception).</td>
</tr>
<tr>
<td>system_(string1 as zstring ptr) as integer</td>
<td>Execute a resident operating system command.</td>
</tr>
</tbody>
</table>

Searching and Sorting

```c
#include "crt/stdlib.bi"
```

**Note:** The `compare` callback function required by `bsearch` and `qsort` must be declared as `cdecl`. It must return a value <0 if its first argument should be located before the second one in the sorted array, >0 if the first argument should be located after the second one, and
zero if their relative positions are indifferent (equal values).

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>bsearch(key as any ptr, base as any ptr, num as size_t, width as size_t, compare as function(elem1 as any ptr, elem2 as any ptr) as integer) as any ptr</td>
<td>Perform binary search.</td>
</tr>
<tr>
<td>qsort(base as any ptr, num as size_t, width as size_t, compare as function(elem1 as any ptr, elem2 as any ptr) as integer)</td>
<td>Use the quicksort algorithm to sort an array.</td>
</tr>
</tbody>
</table>

**String Manipulation**

```c
#include "crt/string.bi"
```

<table>
<thead>
<tr>
<th>Prototype (with parameters)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>stpcpy(dest as zstring ptr, src as zstring ptr) as zstring ptr</td>
<td>Copy one zstring into another.</td>
</tr>
<tr>
<td>strcmp(string1 as zstring ptr, string2 as zstring ptr) as integer</td>
<td>Compare string1 and string2 to determine alphabetic order.</td>
</tr>
<tr>
<td>strcpy(string1 as zstring ptr, string2 as zstring ptr) as zstring ptr</td>
<td>Copy string2 to string1.</td>
</tr>
<tr>
<td>strerror(errnum as integer) as zstring ptr</td>
<td>Get error message corresponding to specified error number.</td>
</tr>
<tr>
<td>strlen(string1 as zstring ptr) as integer</td>
<td>Determine the length of a zstring.</td>
</tr>
<tr>
<td>strncat(string1 as zstring ptr, string2 as zstring ptr, n as size_t) as zstring ptr</td>
<td>Append n characters from string2 to string1.</td>
</tr>
<tr>
<td>strncmp(string1 as zstring ptr, string2 as zstring ptr, n as size_t) as integer</td>
<td>Compare first n characters of two strings.</td>
</tr>
<tr>
<td>strncpy(string1 as zstring ptr, string2 as zstring ptr, n as size_t) as zstring ptr</td>
<td>Copy first n characters of string2 to string1.</td>
</tr>
<tr>
<td>strnset(string1 as zstring ptr, c as integer, size_t n) as zstring ptr</td>
<td>Set first n characters of zstring to c.</td>
</tr>
<tr>
<td>strrchr(string1 as zstring ptr, c as integer) as zstring ptr</td>
<td>Find last occurrence of character c in zstring.</td>
</tr>
</tbody>
</table>

**Time**
#include "crt/time.bi"

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<td>asctime(time as type tm ptr) as zstring ptr</td>
<td>Convert time from type tm to zstring.</td>
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<tr>
<td>clock() as clock_t</td>
<td>Get elapsed processor time in clock ticks.</td>
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<tr>
<td>ctime(time as time_t ptr) as zstring ptr</td>
<td>Convert binary time to zstring.</td>
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<tr>
<td>difftime(time_t time2, time_t time1) as double</td>
<td>Compute the difference between two times in seconds.</td>
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<tr>
<td>gmtime(time as time_t ptr) as type tm ptr</td>
<td>Get Greenwich Mean Time (GMT) in a tm structure.</td>
</tr>
<tr>
<td>localtime(time as time_t ptr) as type tm ptr</td>
<td>Get the local time in a tm structure.</td>
</tr>
<tr>
<td>time_(timeptr as time_t ptr) as time_t</td>
<td>Get current time as seconds elapsed since 0 hours GMT 1/1/70.</td>
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**See also**

- #include
In FreeBASIC, there are 4 possible ways to perform file I/O:

1. Using the built-in BASIC commands like `Open`, `Get`, `Put`, and `Close`. The platforms supported by FreeBASIC. Open files are identified by "file numbers" can't be passed into functions from below.

2. Using the C stream I/O functions like `fopen`, `fread`, `ftell`, `fclose` (see Stream I/O in the C library FreeBASIC relies on. This is slightly faster than and adds still well portable. Open files are identified by file pointers, as in the C language. The `FileAttr` function can be used to return a stream I/O pointer from a.

3. Using the C low-level I/O functions like `_open`, `_read`, `_write`, `_close` (see Functions). Those functions should be portable, but so far headers are, them will not compile to any other platform by now.

4. Talk directly to the OS kernel (DOS: use DOS and DPMI INT's, Win32: This is no longer portable. Files are identified by handles generated by a.

This example shows and compares methods 1. and 2. described above, functions used. It expects 2 commandlne arguments, providing names of compare the reading performance (make sure the file cache is empty be

### Example

```basic
Example
```

```basic
Hidden  " File I/O example & test GET vs FREAD | (CL)"
Hidden  " http://www.freebasic.net/wiki/wikka.php?wakka=ProPgFileIO"
Hidden  Rem
Hidden  Rem Compile With FB 0.20 Or newer
Hidden  Rem
Hidden  Rem In the commandline supply preferably 2 different
Hidden  Rem Default Is "BLAH" For both (bad)
Hidden  Rem In both loops (Get And FREAD) the last Read can

#include "crt\stdio.bi" '' Otherwise the "C"-stuff won't work

Dim As FILE Ptr QQ '' This is the C-like file
```
Dim As UByte Ptr  BUF  ' Buffer used for both FB-like and C-like read
Dim As UInteger  FILN  ' FB-like "filenumber"
Dim As UInteger  AA, BB, CC, DD, EE
Dim As ULongInt  II64  ' We do try to support files >= 4 GiB
Dim As String    VGSTEMP, VGSFILE1, VGSFILE2


VGSTEMP=Command$(1) : VGSFILE1="BLAH"
If (VGSTEMP<>"") Then VGSFILE1=VGSTEMP
VGSTEMP=Command$(2) : VGSFILE2=VGSFILE1
If (VGSTEMP<>"") Then VGSFILE2=VGSTEMP

BUF = Allocate(32768)  ' 32 KiB - hoping it won't

? : ? "FB - OPEN - GET , """"+VGSFILE1+"""": Sleep
FILN = FreeFile : AA=0 : II64=0  ' AA counts blocks
BB=Open (VGSFILE1 For Binary Access Read As #FILN)
' Result 0 is OK here, <>0 is evil
' "ACCESS READ" should prevent file creation if it
? "OPEN result : " ; BB
If (BB=0) Then '' BB will be "reused" for timer below
     BB=Cast(UInteger,(Timer*100))  ' No UINTeger TIMER in FB
CC=Get (#FILN,"*BUF,32768,DD)
'' CC has the success status, 0 is OK, <>0 is bad
'' DD is the amount of data read
' EOF is __NOT__ considered as error here
? "0th GET : ";CC;" ";DD
? "2 bytes read : ";BUF[0];" ";BUF[1]
Do
    AA=AA+1 : II64=II64+Cast(ULongInt,DD)
    If (DD<32768) Or (CC<>0) Then Exit Do  ' Give
    CC=Get (#FILN,"*BUF,32768,DD)
Loop
EE=Cast(UInteger,(Timer*100))-BB
? "Time : ";(EE+1)*10;" ms"
If (AA>1) Then ? "Last GET : ";CC;" ";DD
"Got __EXACTLY__ ";II64;" bytes in ";AA;" call Close #FILN
ENDIF

? : ? "C - FOPEN - FREAD , """"+VGSFILE2+"""": Sleep AA=0 : II64=0 ' AA counts blocks per 32 KiB already
QQ=FOPEN(VGSFILE2,"rb")
' Here 0 is evil and <>0 good, opposite from above
" File will not be created if it doesn't exist (good)
" "rb" is case sensitive and must be lowercase, S
? "FOPEN result : "; QQ
If (QQ<>0) Then
BB=Cast(UInteger,(Timer*100)) ' No UINTeger TIME
DD=FREAD(BUF,1,32768,QQ) ' 1 is size of byte -
' Returns size of data read, <32768 on EOF, 0 a
? "0th FREAD : ";DD
? "2 bytes read : ";BUF[0];" ";BUF[1]
Do
AA=AA+1
If (DD<=32768) Then II64=II64+Cast(ULongInt,DD)
If (DD<>32768) Then Exit Do ' ERR or EOF
DD=FREAD(BUF,1,32768,QQ)
Loop
EE=Cast(UInteger,(Timer*100))-BB
? "Time : ";(EE+1)*10;" ms"
If (AA>1) Then ? "Last FREAD : ";DD
? "Got __EXACTLY__ ";II64;" bytes in ";AA;" call FCLOSE(QQ)
ENDIF

Deallocate(BUF): Sleep 1000 ' Crucial

End

See also
- File I/O Functions
- C Standard Library Functions
- Get (File I/O Command)
### Community Tutorials

Tutorials submitted by the FreeBASIC community:

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<td>- Introduction to Function Overloading in FreeBASIC by :stylin:</td>
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### Mathematics
- Different ways angles are measured by RandyKeeling
- A Brief Introduction To Trigonometry by RandyKeeling

### Windows API
- Introduction to Message-Based Programming by rdc

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- Interfacing with C by UtenNavn
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- Using FreeBASIC Built Libraries with GCC by
Def by rdc
- New To Programming? by The FB Community
- Compiling a BIG QB program by Antoni

Game Programming
- How to Program a Game: Lesson 1 by Lachie Dazdarian
- Managing A High Score Table by Lachie Dazdarian

Flow Control Statements
- The IF Statement by rdc
- The Select Case Statement by rdc

Pre Processor
- Conditional Compilation And You by AetherFox

Memory Management
- Introduction to Pointers by rdc
- Pointers, Data Types and Memory by rdc
- The Pointer Data Type by rdc
- Using Linked Lists by Parker
- Dynamic Arrays in Types by rdc

Jeff Marshall

Object Oriented Programming
- Introduction to the Extended Type by rdc
- Simulating Polymorphism by rdc
- OOP in non-OOP languages by KevinWhitefoot
- Const Qualifiers and You by notthecheatr

FBgfx
- Creating and Understanding Your FBgfx Img and Font Buffer by The FB Community
Community Code Library

FreeBASIC Code, Games, and Libraries. Written in FreeBASIC, by FreeBASIC Community Members.

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Lock Mouse to Grid Positions by Pritchard

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Drive a Parallax servo controller by phishguy
Modbus device finder by Antoni
Serial port terminal program by Antoni

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In memory dialogs by MichaelW
Talking program using Win Voice API, by coder guy
Using GfxLib in Windows API by MichaelW
Print a bitmap file by MichaelW
ShellExecute wrapper by RayBritton
FBWiki to chm format converter by coderjeff

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FreeBASIC Games Directory

This is a place to post worthy projects/code snippets for FreeBASIC, in their relative categories. To add a page, link to either its wiki page, website, or thread on the FreeBASIC Forums. State the project name and who it's by. Sections may be broken down into their own separate pages some time in the future. Note: Due to FB being in Beta stage of development, earlier coded projects may need to be reconfigured or recompiled to work on later versions of FreeBASIC.
External Libraries Index

This is the list of external library bindings currently included in FreeBASIC. Visit the link shown for each individual library below to see more information. To obtain a needed external library or DLL, please visit the library's homepage. If you translated additional headers, or updated existing ones, please post them on the FreeBASIC forum or submit them to the fbc project's patch tracker!

**Graphical/test-based user interfaces**
- **CGUI** - Library for making GUls in a simple way.
- **Curses** - Standardized console user interface library.
- **GTK+** - Cross-platform Graphical User Interface Library.
- **IUP** - Portable toolkit for building graphical user interfaces.
- **wxC** - Cross-platform Graphical User Interface Library.
- **Windows API** - Windows GUls and more
- **X11** - Windowing system commonly used on Linux systems

**Graphics**
- **Allegro** - Game programming library.
- **DUGL** - Game and graphics library for DOS.
- **caca** - A colour ASCII art library.
- **Cairo** - 2D graphics library with support for multiple output devices.
- **DISLIN** - Library of subroutines and functions that display data graphically.
- **freeglut** - A free alternative to GLUT, an OpenGL library for window creation and callback-based input handling
- **Freimage** - Open Source library to support popular graphics image formats.
- **Freetype2** - A Free, High-Quality, and Portable Font Engine.
- **GD** - Open source code library for the dynamic creation of images by programmers.
- **GIFLIB** - Portable tools and library routines for working with GIF images
- **GLUT** - the original (but now inactive) OpenGL Utility Toolkit
- **GLFW** - An OpenGL library for creating an OpenGL window and handling input from the user's main loop
- **GRX** - 2D graphics library.
- **IL (DevIL)** - A full featured cross-platform image library.
japi - Open source free software GUI toolkit using Java's AWT Toolkit.
jpeglib - Cross-platform library for reading/writing jpeg images.
JPGalleg - A small add-on for Allegro that adds JPG images handling capabilities to the library.
libpng - Allows reading and writing PNG images.
OpenGL - Cross-platform 3D Graphics library.
PDFlib - Portable library for dynamically generating PDF documents.
SDL - Cross-platform multimedia library.
TinyPTC - A small and easy to use framebuffer graphics library.

Music/Sound, Audio/Video
BASS - Audio library for use in Windows with a beta for Linux.
BASSMOD - BASSMOD is a MOD only (XM, IT, S3M, MOD, MTM, UM) version of BASS
Flite - Run time speech synthesis engine
FMOD - Audio library supporting just about any format.
MediaInfo - Library to read out technical and tag information from many media file formats
mpg123 - MPEG (including MP3) decoder library
Ogg - Ogg multimedia container format creation/decoder library
OpenAL - Cross-platform 3D audio API.
PortAudio - Cross-platform audio I/O library
sndfile - Library to read/write/convert audio files in various formats
VLC - Audio/video playback
Vorbis - Ogg Vorbis audio compression library

Database
GDBM - Database functions using extensible hashing, primarily for storing key/data pairs to data files
MySQL - High-Quality, widely used database engine.
PostgreSQL - Free software object-relational database management system
SQLite - Small C library that implements a self-contained, embeddable, zero-configuration SQL database engine.

Development Helpers
CUnit - Lightweight system for writing, administering, and running unit tests in C.
GDSL - The Generic Data Structures Library is a collection of routines for
generic data structures.

**gettext (includes libintl)** - Internationalization mechanism

**GNU ASpell** - Free and Open Source spell checker.

**libbfd** - Allows applications to use the same routines to operate on object files whatever the object file format.

**Embeddable Languages**

**JNI** - Standard programming interface for writing Java native methods and embedding the Java virtual machine into native applications.

**json-c** - A JSON implementation in C

**libffi** - Foreign function interface and closure library

**libjit** - Runtime (just in time) compilation library

**Lua** - Lightweight, embeddable scripting engine using the Lua language

**SpiderMonkey** - Embeddable javascript engine.

**Cryptography**

**cryptlib** - A powerful security toolkit which allows even inexperienced crypto programmers to easily add encryption and authentication services to their software.

**UUID** - Universally Unique Identifier generation and parsing library

**Mathematics**

**big_int** - Library for using arbitrarily large integers.

**Chipmunk** - 2D rigid body physics library

**GMP** - Free library for arbitrary precision arithmetic, operating on signed integers, rational numbers, and floating point numbers.

**GSL** - Provides a wide range of mathematical routines such as random number generators, special functions and least-squares fitting.

**Newton** - Integrated solution for real time simulation of physics environments.

**ODE** - Open source, high performance library for simulating rigid body dynamics.

**Networking**

**cgi-util** - Small C library for creating CGI programs for Websites.

**curl** - Free and easy-to-use client-side URL transfer library supporting almost every protocol.

**FastCGI** - Open extension to CGI that provides high performance without the limitations of server specific APIs.
ZeroMQ - High-performance asynchronous messaging library

**eXtensible Markup Language (XML)**
- Expat - Stream oriented XML parser library with several useful features.
- libxml - De-facto standard library for accessing xml files.
- libxslt - XSLT itself is an XML language to define transformation for XML.
- Mini-XML - Small XML parsing library that you can use to read XML and XML-like data files in your application.

**Regular Expressions**
- PCRE - Regular expression pattern matching using the same syntax as Perl.
- TRE - Lightweight, robust, and efficient POSIX compliant regexp matching library.

**Compression**
- bzip2 - For reading/writing .bz2 files or in-memory (de)compression using the bzip2 algorithms
- libzip - Easy-to-use library for creating and unpacking .zip files
- liblzma - Strong LZMA-based compression library used for .lzma and .xz file formats
- LZO - Offers fast compression and very fast decompression.
- QuickLZ - Very fast Compression Library
- zlib - Lossless data compression library unencumbered by patents.

**System APIs**
- C Runtime Library
- DOS API
- disphelper - Helper library to use COM objects from plain C
- GLib - GNOME's universal cross-platform software utility library
- Windows API
- X11 - Windowing system commonly used on Linux systems

**User Contributed Libraries**
Visit http://www.freebasic.net/old_site/arch/ for other libraries.
Library for making GUIs in a simple way.

Website: http://cgui.sourceforge.net/index.html,
http://www.allegro.cc/resource/Libraries/GUI/CGUI
Platforms supported: Win32, Linux
Headers to include: cgui.bi
Header version: 2.0.4
Example Usage: yes, in examples/GUI/CGUI/
Curses

Standardized console user interface library

Website: http://pdcurses.sourceforge.net/ and http://www.gnu.org/software/ncurses/
Platforms supported: DOS, Win32, Linux
Headers to include: curses.bi
Header versions: pdcurses 3.4, ncurses 5.9
Note: On Win32 systems pdcurses is used, on Linux it uses the standard
Examples: yes, in examples/console/curses/

Example

```plaintext
#include once "curses.bi"

initscr()
cbreak()
noecho()
start_color()

' The default pair 0 will have the console's default colors

' Set pair 1 to be white/blue
init_pair(1, COLOR_WHITE, COLOR_BLUE)

' Select pair 1, so from now on output will be white on blue
attrset(COLOR_PAIR(1))

printw(!"Hello, world!\n")

' Reset to pair 0
attrset(COLOR_PAIR(0))

' Sleep
printw(!"Waiting for keypress...\n")
getch()

endwin()
```
GTK+, The GIMP ToolKit

Cross-platform Graphical User Interface library

Website: http://www.gtk.org
Platforms supported: Win32, Linux
Headers to include: gtk/gtk.bi
Example Usage: yes, in examples/GUI/GTK+
Header version: 2.24.27, 3.14.10

By default, gtk/gtk.bi will use the GTK+ 2 API.
Define __USE_GTK3__ before including gtk/gtk.bi to use GTK+ 3.

Example

```basic
#include once "gtk/gtk.bi"

Dim Shared As GtkWidget Ptr win

Private Sub on_clicked cdecl(ByVal button As GtkButton
    Static As Integer clickcount = 0
    clickcount += 1
    gtk_window_set_title(GTK_WINDOW(win), "clicked")
End Sub

gtk_init(NULL, NULL)

win = gtk_window_new(GTK_WINDOW_TOPLEVEL)
gtk_window_set_title(GTK_WINDOW(win), "A small GTK+", 300,
gtk_container_set_border_width(GTK_CONTAINER(win),

g_signal_connect(G_OBJECT(win), "destroy", G_CALLBACK

Dim As GtkWidget Ptr button = gtk_button_new_with_label
    gtk_container_add(GTK_CONTAINER(win), button)

    g_signal_connect(G_OBJECT(button), "clicked", G_CALLBACK
```
gtk_widget_show_all(win)
gtk_main()
Portable toolkit for building graphical user interfaces.

Website: http://www.tecgraf.puc-rio.br/iup/
Platforms supported: Win32, Linux
Headers to include: IUP/iup.bi
Header version: 3.13
Example Usage: yes, in examples/GUI/IUP/
wx-c, C Interface for WxWidgets

Cross-platform Graphical User Interface library

Website: http://wxnet.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: wx-c/wx.bi
Header version: 0.9.0.2
Example Usage: yes, in examples/GUI/wx-c/
Windows API

Standard API for all Windows Systems, used for example for creating Windows GUIs (forms and controls), socket programming, inter-process communication, and so much more.

Platforms supported: Win32, Linux (using WINE)
Headers to include: windows.bi
Examples: yes, in examples/win32/
The X Windowing System is widely used on Linux as the layer that coordinates drawing to the screen by providing windows. It also delivers events such as mouse and keyboard input from the kernel to applications. It is designed to run as a server that can be contacted through a specific protocol. The client's side of the protocol is implemented by libraries such as the old Xlib or the more modern XCB. Applications can use these to create windows and draw to them. However, typically most developers will choose to use a GUI library such as GTK+ (which has an X11 backend) instead.

Website: http://www.x.org/, http://xcb.freedesktop.org/
Platforms supported: Linux
Headers to include: X11/*.bi
Allegro

Game programming library

Website: http://alleg.sourceforge.net/index.html
Platforms supported: Win32, Linux, DOS
Headers to include: allegro.bi (Allegro 4) or allegro5/allegro.bi (Allegro 5)
Header version: 4.4.2, 5.0.11
Example Usage: yes, in examples/graphics/Allegro/
Graphics and game programming library

Website: http://dugl.50webs.com
Platforms supported: DOS
Headers to include: DUGL.BI (not yet included with FB, see link below)
Example of usage: see link below
Note: use DUGL 1.13 or newer (see link below), older version have a bug and do crash when used with FB

See forum thread: http://www.freebasic.net/forum/viewtopic.php?t=11046
A colour ASCII art library.

Website: http://libcaca.zoy.org/
Platforms supported: Win32, Linux, DOS
Headers to include: caca.bi (new API) or caca0.bi (old API)
Header version: libcaca-0.99.beta19
Example Usage: yes, in examples/console/caca/
Cairo

2D graphics library with support for multiple output devices. It can be used to draw into a Win32 window or device context.

Website: http://www.cairographics.org
Platforms supported: Win32, Linux
Headers to include: cairo/cairo.bi
Header version: 1.14.2
Examples: yes, in examples/graphics/cairo/

Example

```
' Example showing cairo being used to draw into the FB graphics window
#include once "cairo/cairo.bi"

Const SCREEN_W = 400
Const SCREEN_H = 300

ScreenRes SCREEN_W, SCREEN_H, 32

' Create a cairo drawing context, using the FB screen as surface.
Var surface = cairo_image_surface_create_for_data(
Var c = cairo_create(surface)

ScreenLock()

' Draw the entire context white.
cairo_set_source_rgba(c, 1, 1, 1, 1)
cairo_paint(c)

' Draw a red line
cairo_set_line_width(c, 1)
cairo_set_source_rgba(c, 1, 0, 0, 1)
ccairo_move_to(c, 0, 0)
ccairo_line_to(c, SCREEN_W - 1, SCREEN_H - 1)
ccairo_stroke(c)
```
ScreenUnlock()

Sleep

' ' Clean up the cairo context
cairo_destroy(c)
DisLin

Library of subroutines and functions that display data graphically.

Website: http://www.mps.mpg.de/dislin/
Platforms supported: Win32, Linux
Headers to include: dislin.bi
Header version: from 2005
Free alternative to the OpenGL Utility Toolkit

Just like GLUT, freeglut is a helper library that can be used to create OpenGL applications. It allows easy creation of windows with OpenGL drawing contexts and callback-based input event handling.

Website: http://freeglut.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: GL/freeglut.bi
Header version: 3.0.0
FreeImage is an Open Source library project for developers who would like PNG, BMP, JPEG, TIFF and others as needed by today's multimedia applications. It is multithreading safe, compatible with all 32-bit versions of Windows, and cross-platform (works both with Linux and Mac OS X).

Website: http://freeimage.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: FreeImage.bi
Header version: 3.15.1
Example included: yes, in examples/files/FreeImage

Example

Here follows an example of using FreeImage in FreeBASIC. If using Windows you will require freeimage.dll which is available from the FreeImage site.

'' Code example for loading all common image types
'' The example loads an image passed as a command line argument.
'' The function FI_Load returns a null pointer (0) on loading. Otherwise it returns a 32-bit PUT compatible buffer.

#include "FreeImage.bi"
#include "crt.bi"
#include "fbgfx.bi"

Function FI_Load(filename As String) As Any Ptr
    If Len(filename) = 0 Then
        Return NULL
    End If

    '' Find out the image format
    Dim As FREE_IMAGE_FORMAT form = FreeImage_GetFileType(filename)
    If form = FIF_UNKNOWN Then
        form = FreeImage_GetFIFFromFilename(StrPtr(filename))
    End If

    Return FreeImage_Load(filename)
End Function
' Exit if unknown
If form = FIF_UNKNOWN Then
  Return NULL
End If

' Always load jpegs accurately
Dim As UInteger flags = 0
If form = FIF_JPEG Then
  flags = JPEG_ACCURATE
End If

' Load the image into memory
Dim As FIBITMAP_Ptr image = FreeImage_Load(form)
If image = NULL Then
  ' FreeImage failed to read in the image
  Return NULL
End If

' Flip the image so it matches FB's coordinate system
FreeImage_FlipVertical(image)

' Convert to 32 bits per pixel
Dim As FIBITMAP_Ptr image32 = FreeImage_ConvertTo32Bits(image)

' Get the image's size
Dim As UInteger w = FreeImage_GetWidth(image)
Dim As UInteger h = FreeImage_GetHeight(image)

' Create an FB image of the same size
Dim As fb.Image_Ptr sprite = ImageCreate(w, h)
Dim As Byte_Ptr target = CPtr(Byte_Ptr, sprite)
Dim As Integer target_pitch = sprite->pitch

Dim As Any_Ptr source = FreeImage_GetBits(image)
Dim As Integer source_pitch = FreeImage_GetPitch(source)

' And copy over the pixels, row by row
For y As Integer = 0 To (h - 1)
memcpy(target + (y * target_pitch), _
source + (y * source_pitch), _
w * 4)

Next

FreeImage_Unload(image32)
FreeImage_Unload(image)

Return sprite
End Function

ScreenRes 640, 480, 32

Dim As String filename = Command(1)

Dim As Any Ptr image = FI_Load(filename)
If image <> 0 Then
    Put (0, 0), image
Else
    Print "Problem while loading file : " & filename
End If

Sleep
Freetype2

A Free, High-Quality, and Portable Font Engine

Website: http://www.freetype.org
Platforms supported: Win32, Linux
Headers to include: freetype2/freetype.bi
Header version: 2.5.5
Examples: yes, in examples/graphics/FreeType/

Example

```
'' Example of rendering a char using freetype

#include "freetype2/freetype.bi"

#ifndef __FB_LINUX__
Const TTF_FONT = "/usr/share/fonts/truetype/ttf-dejavu/DejaVuSans.ttf"
#else
Const TTF_FONT = "Vera.ttf"
#endif

Dim As FT_Library library
If (FT_Init_FreeType(@library) <> 0) Then
    Print "FT_Init_FreeType() failed" : Sleep : End If

''

'' Load a font and render an '@' character on to a

Dim As FT_Face face
If (FT_New_Face(library, TTF_FONT, 0, @face) <> 0)
    Print "FT_New_Face() failed (font file '" & TTF_FONT & "')": End If

If (FT_Set_Pixel_Sizes(face, 0, 200) <> 0) Then
    Print "FT_Set_Pixel_Sizes() failed": Sleep : End If
```
End If

If (FT_Load_Char(face, Asc("@"), FT_LOAD_DEFAULT))
    Print "FT_Load_Char() failed" : Sleep : End 1
End If

If (FT_Render_Glyph(face->glyph, FT_RENDER_MODE_NO_SUBPIXEL))
    Print "FT_Render_Glyph() failed" : Sleep : End
End If

'' Draw the rendered bitmap
''

ScreenRes 320, 200, 32

Dim As FT_Bitmap Ptr bitmap = @face->glyph->bitmap

For y As Integer = 0 To (bitmap->rows - 1)
    For x As Integer = 0 To (bitmap->Width - 1)
        Dim As Integer col = bitmap->buffer[y * bi
        PSet(x, y), RGB(col, col, col)
    Next
Next

Sleep
Open source code library for the dynamic creation of images by programmers.

Website: http://www.libgd.org
Platforms supported: Win32, Linux
Headers to include: gd.bi
Header version: 2.1.0 development version
Examples: yes, in examples/files/GD/
GIFLIB is a package of portable tools and library routines for working with GIF images

Website: http://giflib.sourceforge.net/intro.html
Platforms supported: Win32, Linux, DOS
Headers to include: gif_lib.bi
Header version: 4.2.1, 5.0.4 (#define __GIFLIB_VER__ to 4 or 5 if needed; default = 5)
Examples: yes, in examples/files/GIFLIB/
GLUT is a helper library that can be used to create OpenGL applications. It allows easy creation of a window with an OpenGL drawing context and also handles events such as mouse and keyboard input or timers. GLUT appears to be no longer maintained, however there is an active alternative: freeglut.

Website: http://www.opengl.org/resources/libraries/glut/
Platforms supported: Win32
Headers to include: GL/glut.bi
Header version: 3.7
Examples: in examples/graphics/OpenGL/
GLFW, an OpenGL library

GLFW is a helper library that can be used to create OpenGL applications. It allows the creation of a window with an OpenGL drawing context and input handling while still allowing the program to have its own main loop.

Website: http://www.glfw.org/
Platforms supported: Win32, Linux
Headers to include: GL/glfw.bi, GLFW/glfw3.bi
Header version: 2.7.9, 3.1.1
Examples: in examples/graphics/OpenGL/
2D graphics library

Website: http://grx.gnu.de/
Platforms supported: Win32, Linux, DOS
Headers to include: grx/grx20.bi
Header version: 2.4.6
Examples: in examples/graphics/grx/
DevIL

A full featured cross-platform image library.

Website: http://openil.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: IL/il.bi, IL/ilu.bi, IL/ilut.bi
Header version: 1.7.8
Examples: in examples/files/DevIL/

Example

```basic
'' DevIL example

#include once "IL/il.bi"

'' Version check
If (ilGetInteger(IL_VERSION_NUM) < IL_VERSION) Then
  Print "DevIL version is different"
End If

'' Good practice to explicitly initialize it
ilInit()

'' Load a bitmap
Dim As ILuint fblogo
ilGenImages(1, @fblogo)
ilBindImage(fblogo)

Print "Loading fblogo.bmp..."
ilLoadImage("fblogo.bmp")

'' Save a copy
Print "Saving a copy, fblogo-copy.bmp..."
ilEnable(IL_FILE_OVERWRITE)
ilSaveImage("fblogo-copy.bmp")
```
'' Clean up
ilDeleteImages(1, @fblogo)
Open source free software GUI toolkit using Java's AWT Toolkit

Website: http://www.japi.de/
Platforms supported: Win32, Linux
Headers to include: japi.bi
Header version: from 2005
Cross-platform library for reading/writing jpeg images

Website: http://ijg.org/
Platforms supported: Win32, Linux, DOS
Headers to include: jpeglib.bi
Header version: 6.2, 7.0, 8.4, 9.0 (#define __JPEGLIB_VER__ to one of 6,7,8,9 if needed; default = 9)
Example Usage: yes, in examples/files/jpeglib
JPGAlleg is a small addon for Allegro that adds JPG images handling capabilities to the library

Website: http://www.ecplusplus.com/index.php?page=projects&pid=1
Platforms supported: Win32, Linux
Headers to include: jpgalleg.bi
Header version: 2.5
libPNG

Allows reading and writing PNG images.

Website: http://www.libpng.org/pub/png/libpng.html
Platforms supported: Win32, Linux, DOS
Headers to include: png.bi
Header versions: 1.2.53, 1.4.16, 1.5.21, 1.6.16
Examples: in examples/files/libpng/

When #including png.bi, you can #define __LIBPNG_VERSION to one of 12, 14, 15, 16 in order to select the desired libpng version. The default is the latest version.

Overriding the default allows you to match the exact libpng version on your system (interesting for Linux distros which, for example, use the libpng 1.2 series instead of the latest version).
OpenGL is a standardized and widely used cross-platform 3D graphics library.

Usually OpenGL support comes as part of the system and the graphics drivers. There are many different projects providing a library that implements the main OpenGL API, and which one is used depends on the platform and system setup. For example, on Windows, the client API is implemented in Microsoft's opengl32.dll, while on Linux, there is for example the free Mesa3D project, which provides a libGL implementation. It depends on the used library or system setup which way the OpenGL API does its rendering, typically it uses OpenGL hardware drivers and is hardware-accelerated, but there also is software-rendered OpenGL (e.g. standalone Mesa3D). The system's graphics hardware drivers may provide additional OpenGL extensions, access to which is again system dependant.

Besides plain OpenGL, there are several utility, helper and wrapper libraries, such as GLUT, freeglut and GLFW, and even FreeBASIC's built-in graphics library has an OpenGL mode, see Screen And Fb.Gfx_Opengl.

Websites:
OpenGL standard: http://www.opengl.org
Mesa3D: http://mesa3d.org/

Platforms supported: Win32, Linux
Headers to include: GL/gl.bi
Header version: Mesa-3D 10.5.1, MinGW-w64 3.3.0
Examples: yes, in examples/graphics/OpenGL/
Portable library for dynamically generating PDF documents

Website: http://www.pdflib.com
Platforms supported: Win32, Linux
Headers to include: pdflib.bi
Header version: 4.0.2
Examples: in examples/files/pdflib/
SDL, the Simple DirectMedia Layer

Cross-platform multimedia library

Website: http://www.libsdl.org
Platforms supported: Win32, Linux
Headers to include: SDL/SDL.bi or SDL2/SDL.bi
Header version: SDL 1.2.15, SDL2 2.0.3
Examples: yes, in examples/graphics/SDL/
TinyPTC

A small and easy to use framebuffer graphics library.

Website: http://sourceforge.net/projects/tinyptc/
Platforms supported: Win32, Linux, DOS
Headers to include: tinyptc.bi
Examples: in examples/graphics/tinyptc/
Audio library for use in Windows with a Beta Version for Linux.

Website: http://www.un4seen.com/bass.html
Platforms supported: Win32, Linux (beta)
Headers to include: bass.bi
Header version: 2.4.8
Examples: in examples/sound/BASS/

Example

```basic
#include once "bass.bi"

Const SOUND_FILE = "test.mod"

If (BASS_GetVersion() < MAKELONG(2,2)) Then
    Print "BASS version 2.2 or above required!"
End If

If (BASS_Init(-1, 44100, 0, 0, 0) = 0) Then
    Print "Could not initialize BASS"
End If

Dim As HMUSIC test = BASS_MusicLoad(FALSE, @SOUND_FILE)
If (test = 0) Then
    Print "BASS could not load " & SOUND_FILE & ""
    BASS_Free()
End If

BASS_ChannelPlay(test, FALSE)

Print "Sound playing; waiting to keypress to stop"
Sleep
```
BASS_ChannelStop(test)
BASS_MusicFree(test)
BASS_Stop()
BASS_Free()
BASSMOD

BASSMOD is a MOD only (XM, IT, S3M, MOD, MTM, UMX) version of E
else where you want to play some MOD music.

Website: http://www.un4seen.com/bassmod.html
Platforms supported: Win32, Linux
Headers to include: bassmod.bi
Header version: 2.0
Examples: in examples/sound/BASS/

Example

```
#include once "bassmod.bi"

Const SOUND_FILE = "test.mod"

If (BASSMOD_GetVersion() < 2) Then
    Print "BASSMOD version 2 or above required!"
    End 1
End If

If (BASSMOD_Init(-1, 44100, 0) = 0) Then
    Print "Could not initialize BASSMOD"
    End 1
End If

If (BASSMOD_MusicLoad(FALSE, SOUND_FILE, 0, 0, BASS_MUSIC_LOOP) = 0) Then
    Print "BASSMOD could not load '" & SOUND_FILE
    BASSMOD_Free()
    End 1
End If

BASSMOD_MusicPlay()

Print "Sound playing; waiting for keypress to stop"
Sleep
```
<table>
<thead>
<tr>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASSMOD_MusicStop()</td>
</tr>
<tr>
<td>BASSMOD_MusicFree()</td>
</tr>
<tr>
<td>BASSMOD_Free()</td>
</tr>
</tbody>
</table>
Flite is a run-time speech synthesis engine.

Website: http://www.speech.cs.cmu.edu/flite/
Platforms supported: Win32, Linux
Headers to include: flite/flite.bi
Header version: 1.4, machine-translated only
FMOD

Audio library supporting just about any format.

Website: http://www.fmod.org/index.php/products#FMOD3Programmers
Platforms supported: Win32, Linux
Headers to include: fmod.bi
Header version: 3.75
Examples: in examples/sound/FMOD/

**Example**

```basic
#include once "fmod.bi"

Const SOUND_FILE = "test.mod"

If (FSOUND_GetVersion() < FMOD_VERSION) Then
    Print "FMOD version mismatch"
End If

If (FSOUND_Init(44100, 32, 0) = 0) Then
    Print "Could not initialize FMOD"
End If

Dim As FMUSIC_MODULE Ptr song = FMUSIC_LoadSong(SOUND_FILE)
If (song = 0) Then
    Print "FMOD could not load '" & SOUND_FILE & "'",
    FSOUND_Close()
End If

FMUSIC_PlaySong(song)

Print "Sound playing; waiting for keypress to stop" Sleep
```
FMUSIC_FreeSong(song)
FSOUND_Close()

'' mp3 player based on FMOD

#include once "fmod.bi"

Const SOUND_FILE = "test.mp3"

Sub print_all_tags(ByVal stream As FSOUND_STREAMPtr, ByVal count As Integer) As Integer
    Dim As Integer count = 0
    FSOUND_Stream_GetNumTagFields(stream, @count)

    For i As Integer = 0 To (count - 1)
        Dim As Integer tagtype, taglen
        Dim As ZString Ptr tagnam, tagvalue
        FSOUND_Stream_GetTagField(stream, i, @tagtype, @taglen)
        Print Left(*tagnam, taglen)
    Next
End Sub

Function get_tag_( ByVal stream As FSOUND_STREAM_Ptr, ByVal tagv1 As ZString_Ptr, ByVal tagv2 As ZString_Ptr ) As String
    Dim tagnam As ZString_Ptr, taglen As Integer
    FSOUND_Stream_FindTagField(stream, FSOUND_TAGFIELD_ID3V1, @tagnam)
    If (taglen = 0) Then
        FSOUND_Stream_FindTagField(stream, FSOUND_TAGFIELD_ID3V2, @tagnam)
    End If
    Return Left(*tagnam, taglen)
End Function

    If (FSOUND_GetVersion < FMOD_VERSION) Then
        Print "FMOD version " + Str(FMOD_VERSION)
    End If

    If (FSOUND_Init(44100, 4, 0) = 0) Then
        Print "Could not initialize FMOD"
    End If

    FSOUND_Stream_SetBufferSize(50)

    Dim As FSOUND_STREAM_Ptr stream = FSOUND_Stream_Open
    If (stream = 0) Then
        Print "FMOD could not load " & SOUND_FILE
        FSOUND_Close()
    End If

    '' Read out mp3 tags to show some meta information
    Print "Title:" , get_tag(stream, "TITLE", "TIT2"
    Print "Album:" , get_tag(stream, "ALBUM", "TALB"
    Print "Artist:" , get_tag(stream, "ARTIST", "TPE1"
    ''print_all_tags(stream)

    Print "Playing mp3, press a key to exit..."
    FSOUND_Stream_Play(FSOUND_FREE, stream)

    While (Inkey() = "")
        If (FSOUND_StreamGetPosition(stream) >= F)
            Exit While
        Exit If
        Sleep 50, 1
    Wend

    FSOUND_Stream_Stop(stream)
    FSOUND_Stream_Close(stream)
FSOUND_Close()
MediaInfo

MediaInfo is a cross-platform library allowing you to read out technical and tag information from audio and video files in various formats.

Website: http://mediainfo.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: MediaInfo.bi
Header version: from October 2011
libmpg123 is the decoder library used by the mpg123 MPEG player.

Website: http://mpg123.org/
Platforms supported: Win32, Linux
Headers to include: mpg123.bi
Header version: from 2010, machine-translated only
Ogg multimedia container format creation/decoder library

Website: http://www.xiph.org/ogg/
Platforms supported: Win32, Linux
Headers to include: ogg/ogg.bi
Header version: from 2007
OpenAL is a cross-platform 3D audio API appropriate for use with gaming applications and many other types of audio applications. ALUT is the OpenAL utility toolkit, a library providing additional functions to work with OpenAL.

Website: http://www.openal.org
Platforms supported: Win32, Linux
Headers to include: AL/al.bi, AL/alut.bi
Header version: openal-soft-1.16.0, freealut 1.1.0
Examples: in examples/sound/OpenAL/
PortAudio

PortAudio is a cross-platform audio I/O library that allows programs to access the system's audio devices to record or play sounds.

Website: http://www.portaudio.com/
Platforms supported: Win32, Linux
Headers to include: portaudio.bi
Header version: from 2010, machine-translated only
libsndfile is a library allowing programs to access or modify audio files in various formats, for example .wav files, and also convert between them.

Website: http://www.mega-nerd.com/libsndfile/
Platforms supported: Win32, Linux
Headers to include: sndfile.bi
Header version: 1.0.X
libVLC

Audio/video playback library from the VLC media player.

Website: http://www.videolan.org/, http://wiki.videolan.org/Libvlc
Platforms supported: Win32, Linux
Headers to include: vlc/*.bi
Header version: 1.1.x
libvorbis

Ogg Vorbis audio compression library

Website: http://xiph.org/vorbis/
Platforms supported: Win32, Linux
Headers to include: vorbis/vorbisenc.bi, vorbis/vorbisfile.bi
Header version: from 2007
GDBM, the GNU Database manager

Provides database functions using extensible hashing, primarily for storing key/data pairs to data files

Website: http://www.gnu.org.ua/software/gdbm/
Platforms supported: Win32, Linux
Headers to include: gdbm.bi
Header version: from 2010
MySQL

High-Quality, widely used database engine.

Website: http://www.mysql.org
Platforms supported: Win32, Linux
Headers to include: mysql/mysql.bi
Header version: 4.0.17
Examples: in examples/database/
PostgreSQL

Free software object-relational database management system

Website: http://www.postgresql.org/
Platforms supported: Win32, Linux
Headers to include: postgresql/postgres_ext.bi
Header version: from 2006
Example Usage: yes, in examples/database/
SQLite

Small C library that implements a self-contained, embeddable, zero-configuration SQL database engine.

Website: http://sqlite.org
Platforms supported: Win32, Linux, DOS
Headers to include: sqlite2.bi or sqlite3.bi
Header versions: 2.8.17, 3.7.8
Examples: in examples/database/
CUnit

Lightweight system for writing, administering, and running unit tests in C.

Website: http://cunit.sourceforge.net/
Platforms supported: Win32, Linux, DOS
Headers to include: CUnit/CUnit.bi
Header version: 2.1-3
Examples: in examples/misc/CUnit/
The Generic Data Structures Library is a collection of routines for generic data structures.

Website: http://home.gna.org/gdsl/
Platforms supported: Win32, Linux, DOS
Headers to include: gdsl/gdsl.bi
Header version: from 2005
Examples: in examples/misc/gdsl/
An internationalization library/toolchain

Website: http://www.gnu.org/software/gettext/gettext.html
Platforms supported: Win32, Linux, DOS
Headers to include: libintl.bi, gettext-po.bi
Header version: from 2010, 0.17
GNU Aspell

Free and Open Source spell checker.

Website: http://aspell.net/
Platforms supported: Win32, Linux
Headers to include: aspell.bi
Header version: 0.60.6.1

Example

```
' GNU-ASpell example, converted from http://aspell.net/win32/

#include once "aspell.bi"

Dim As AspellConfig Ptr spell_config = new_aspell_config

' Change this to suit the installed dictionary language
aspell_config_replace(spell_config, "lang", "en_CA"

' Create speller object
Dim As AspellCanHaveError Ptr possible_err = new_aspell_speller
If (aspell_error_number(possible_err) <> 0) Then
    Print *aspell_error_message(possible_err)
End If
Dim As AspellSpeller Ptr speller = to_aspell_speller(possible_err)

Dim As String word
Do
    Print
    Input "Enter a word (blank to quit): ", word
    If (Len(word) = 0) Then
        Exit Do
    End If
    If (aspell_speller_check(speller, StrPtr(word))
        Print "Word is Correct"
```
Else
    Print "Suggestions:"
    Dim As AspellStringEnumeration Ptr elements
    aspell_word_list_elements(aspell_spell)
    Do
        Dim As ZString Ptr w = aspell_string_enumeration_next
        If (w = 0) Then
            Exit Do
        End If
        Print "			"; *w
    Loop
    delete_aspell_string_enumeration(elements)
    End If

' - Report the replacement
' aspell_speller_store_repl(speller, misspelled, correctly_spelled_word)

' - Add to session or personal dictionary
' aspell_speller_add_to_session|personal(speller, word)
Loop

delete_aspell_speller(speller)
BFD, the Binary File Descriptor Library

Provides an API to read and write object files in many different object file formats. libbfd is the core of the GNU binutils.

Website: http://sourceware.org/binutils/
Platforms supported: Win32, Linux, DOS
Headers to include: bfd.bi
Header version: binutils versions from 2.16 to 2.25

Define __BFD_VER__ to 216, 217, 218, ..., 225 to include the bfd header for the corresponding binutils version.

Example

```
#define __BFD_VER__ 217
#include "bfd.bi"
```
JNI, The Java Native Interface

Standard programming interface for writing Java native methods and embedding the Java virtual machine into native applications.

Website: http://download.oracle.com/javase/6/docs/technotes/guides/jni/
Platforms supported: Win32, Linux
Headers to include: jni.bi
Header version: from 2006
Examples: in examples/other-languages/Java/

Example

Three files:

- mylib.bas - A DLL writing in FreeBASIC

```cpp
#include "jni.bi"

'' Note: The mangling must be "windows-ms" or the
Extern "windows-ms"
    Function Java_MyLib_add( env As JNIEnv Ptr, obj
        Return l + r
    End Function
End Extern
```

- Mylib.java - The Java class that represents the interface to the

```cpp
class MyLib {
    public native int add( int l, int r );
    static {
        System.loadLibrary( "mylib" );
    }
}
```
Test.java - The Java main() that uses the Mylib class

```cpp
class Test {
    public static void main(String[] args) {
        MyLib lib = new MyLib();
        System.out.println("2+2=" + lib.add(2, 2));
    }
}
```

Steps to test it:

- Compile the FreeBASIC DLL: `fbc mylib.bas -dll`
- Compile the two Java classes: `javac Mylib.java Test.java`
- Run the Test class: `java Test`
A JSON implementation in C

Website: http://oss.metaparadigm.com/json-c/
Platforms supported: Win32, Linux
Headers to include: json-c/json.bi
Header version: 0.9 (not sure)
LibFFI is a foreign function interface library allowing programs to arbitrarily call native functions without pointers and to bind function pointers to generic functions which take variable arguments via closures. It is used to bind native code in modern scripting languages.

Website: http://sourceware.org/libffi/
Platforms supported: Windows, Linux, DOS
Headers to include: ffi.bi
Header version: 3.1

**Example**

Hello world:

```basic
#include "ffi.bi"

' Simple "puts" equivalent function
Function printer cdecl (ByVal s As ZString Ptr) As Print *
  Return 42
End Function

' Initialize the argument info vectors
Dim s As ZString Ptr
Dim args(0 To 0) As ffi_type_Ptr = {ffi_type_pointer}
Dim values(0 To 0) As Any_Ptr = {s}

' Initialize the cif
Dim cif As ffi_cif
Dim result As ffi_status
result = ffi_prep_cif( __
  @cif,         _ ' call interface object
  FFI_DEFAULT_ABI, _ ' binary interface type
  1,            _ ' number of arguments
  @ffi_type_uint, _ ' return type
  @args(0)      _ ' arguments
)

' Call function
```
```plaintext
Dim return_value As Integer
If result = FFI_OK Then
    s = @"Hello world"
    ffi_call(@cif, FFI_FN(@printer), @return_value)
    ' values holds a pointer to the function's argument
    ' call puts() again all we need to do is change
    ' value of s */
    s = @"This is cool!"
    ffi_call(@cif, FFI_FN(@printer), @return_value)
    Print Using "Function returned &"; return_value
End If

Closures:

#include "ffi.bi"

' Acts like puts with the file given at time of enclosures.
Sub Printer cdecl(ByVal cif As ffi_cif_Ptr, ByVal
    Write #*CPtr(Integer_Ptr, file), **CPtr(ZString
    *CPtr(UInteger_Ptr, ret) = 42
End Sub

' Allocate the closure and function binding
Dim PrinterBinding As Function(ByVal s As ZString
Dim closure As ffi_closure_Ptr
    closure = ffi_closure_alloc(SizeOf(ffi_closure), @
If closure <> 0 Then
    ' Initialize the argument info vector
    Dim args(0 To 0) As ffi_type_Ptr = {ffi_type_

    ' Initialize the call interface
    Dim cif As ffi_cif
    Dim prep_result As ffi_status = ffi_prep_cif(
        @cif, _ ' call interface object
        FFI_DEFAULT_ABI, _ ' binary interface type
        1, _ ' number of arguments
```
If prep_result = FFI_OK Then
    ' Open console file to send to PrinterBinding
    Dim ConsoleFile As Integer = FreeFile()
    Open Cons For Output As ConsoleFile

    ' Initialize the closure, setting user data
    prep_result = ffi_prep_closure_loc( _
        closure, _ ' closure object
        @cif, _ ' call interface object
        @Printer, _ ' actual closure function
        @ConsoleFile, _ ' user data, our console file
        PrinterBinding _ ' pointer to binding
    )
    If prep_result = FFI_OK Then
        ' Call binding as a natural function call
        Dim Result As Integer
        Result = PrinterBinding("Hello World!")
        Print Using "Returned &"; Result
    End If

    Close ConsoleFile
End If
End If

' Clean up
ffi_closure_free(closure)
LibJIT is a fairly straightforward, lightweight library for runtime compilation.

Website: http://www.gnu.org/software/libjit/
Platforms supported: Windows, Linux, DOS
Headers to include: jit.bi
Header version: git a8293e141b79c28734a3633a81a43f92f29fc2d7

Example

```
'' Simple mul/add example

#include "jit.bi"

' initialize libjit
Dim context As jit_context_t = jit_context_create(
jit_context_build_start(context)

' define function mul_add(x, y, z)
Dim params(0 To 2) As jit_type_t = {jit_type_int,
Dim signature As jit_type_t = jit_type_create_signature
   jit_abi_cdecl,   _ ' C-style function
   jit_type_int,   _ ' Return type
   @params(0),     _ ' Parameter array
   3,             _ ' Number of components
   1               _ ' Count references?
)
Dim mul_add As jit_function_t = jit_function_create(

' build function (result = (x*y)+z)
Dim As jit_value_t x, y, z, temp1, temp2
x = jit_value_get_param(mul_add, 0)
y = jit_value_get_param(mul_add, 1)
temp1 = jit_insn_mul(mul_add, x, y)
z = jit_value_get_param(mul_add, 2)
temp2 = jit_insn_add(mul_add, temp1, z)
jit_insn_return(mul_add, temp2)
```
' compile function function
jit_function_compile(mul_add)
jit_context_build_end(context)
'
call function
Dim As Integer a=3, b=5, c=2, result
Dim args(0 To 2) As Integer Ptr = {@a, @b, @c}
jit_function_apply(mul_add, @args(0), @result)
Print Using "mul__add(&, &, &)=&"; a; b; c; result
'
clean up libjit
jit_context_destroy(context)

'' GCD calculation example

#include "jit.bi"

' initialize libjit
Dim context As jit_context_t = jit_context_create()
jit_context_build_start(context)

' define function gcd(x as uinteger, y as uinteger)
Dim params(0 To 1) As jit_type_t = {jit_type_uint,
Dim signature As jit_type_t = jit_type_create_signature
jit_abi_cdecl, _ ' C-style function
jit_type_uint, _ ' Return type
@params(0), _ ' Parameter array
2, _ ' Number of components
1 _ ' Count references?
}
Dim gcd As jit_function_t = jit_function_create(context)

' build function
' check x = y
Dim As jit_value_t x, y, x_eq_y
x = jit_value_get_param(gcd, 0)
y = jit_value_get_param(gcd, 1)
x_eq_y = jit_insn_eq(gcd, x, y)

' if x = y, return x
Dim label_x_ne_y As jit_label_t = jit_label_undefined
jit_insn_branch_if_not(gcd, x_eq_y, @label_x_ne_y)
jit_insn_return(gcd, x)

' else if...
jit_insn_label(gcd, @label_x_ne_y)

' check x < y
Dim As jit_value_t x_lt_y
Dim label_x_gte_y As jit_label_t = jit_label_undefined
x_lt_y = jit_insn_lt(gcd, x, y)
jit_insn_branch_if_not(gcd, x_lt_y, @label_x_gte_y)

' if x < y, return gcd(x, y-x)
Dim As jit_value_t gcd_args(0 To 2), gcd_result
gcd_args(0) = x
gcd_args(1) = jit_insn_sub(gcd, y, x)
gcd_result = jit_insn_call( _
    gcd, _ ' where we are calling from
    "gcd", _ ' function name
    gcd, _ ' function reference
    0, _ ' signature = auto
    @gcd_args(0), _ ' arguments
    2, _ ' argument count
    0 _ ' flags = nothing special
)
jit_insn_return(gcd, gcd_result)

' else...
jit_insn_label(gcd, @label_x_gte_y)

' return gcd(x-y, y)
gcd_args(0) = jit_insn_sub(gcd, x, y)
gcd_args(1) = y
gcd_result = jit_insn_call( _
    gcd,            _ ' where we are calling from
    "gcd",         _ ' function name
    gcd,           _ ' function reference
    0,             _ ' signature = auto
    @gcd_args(0),  _ ' arguments
    2,             _ ' argument count
    0               _ ' flags = nothing special
  )
jit_insn_return(gcd, gcd_result)

' compile function
jit_function_compile(gcd)
jit_context_build_end(context)

' call function
Dim As jit_uint a=21, b=14, result
Dim As jit_uintPtr args(0 To 1) = {@a, @b}
jit_function_apply(gcd, @args(0), @result)
Print Using "gcd(&, &) = &"; a; b; result

' clean up libjit
jit_context_destroy(context)
Lua

Lightweight, embeddable scripting engine using the Lua language.

Website: http://www.lua.org/
Platforms supported: Win32, Linux, DOS
Headers to include: Lua/lua.bi
Header version: 5.2.3
Examples: in examples/other-languages/Lua/
SpiderMonkey

Embeddable javascript engine.

Website: http://www.mozilla.org/js/spidermonkey/
Platforms supported: Win32, Linux
Headers to include: spidermonkey/jsapi.bi
Header version: from 2006

Example

```
'' Evaluating javascript code
#include once "spidermonkey/jsapi.bi"

Dim Shared As JSClass global_class = _
  ( _
      @"global", 0, _
      @JS_PropertyStub, @JS_PropertyStub, @JS_PropertyStub,
      @JS_EnumerateStub, @JS_ResolveStub, @JS_ConvertStub
  )

Dim As JSRuntime Ptr rt = JS_NewRuntime(1048576 /*memory limit*/)
Dim As JSContext Ptr cx = JS_NewContext(rt, 4096 /*stack size*/)
Dim As JSONObject Ptr global = JS_NewObject(cx, @global_class)
JS_InitStandardClasses(cx, global)

'' This string could also be read in from a file or
Const TEST_SCRIPT = _
  !!"function fact(n)
  !!{"                   \n"          if (n <= 1) \n"            return 1;
  !!{"                   \n"            return n * fact(n - 1);
  !!"}                   \n"                  \n"        fact(5)\n"```
Dim As jsval rval
If (JS_EvaluateScript(cx, global, TEST_SCRIPT, Len(TEST_SCRIPT), Len(TEST_SCRIPT)) = -1) Then
    Print "JS_EvaluateScript failed"
    Sleep
End If

Print "result: " & *JS_GetStringBytes(JS_ValueToString(rval))
JS_DestroyContext(cx)
JS_DestroyRuntime(rt)

' Callback example: Functions that are used by the Javascript code, but are implemented in FB.
#include once "spidermonkey/jsapi.bi"

Dim Shared As JSClass global_class = _
( _
    @"global", 0, _
    @JS_PropertyStub, @JS_PropertyStub, @JS_PropertyStub,
    @JS_EnumerateStub, @JS_ResolveStub, @JS_ConvertStub)

Private Function print_callback cdecl _
( _
    ByVal cx As JSContext Ptr, _
    ByVal obj As JObject Ptr, _
    ByVal argc As uintN, _
    ByVal argv As jsval Ptr, _
    ByVal rval As jsval Ptr _
) As JSBool

    If (argc < 1) Then
        Return 0
    End If
Print *JS_GetStringBytes(JS_ValueToString(cx, "Get the first argument
Dim As ZStringPtr arg1 = JS_GetStringBytes(cx, "Get a buffer for the result string
Dim As ZStringPtr result = JS_malloc(cx, Len(*arg1)
'' Do the work
*result = UCase(*arg1)
'' Return it in rval
*rval = STRING_TO_JSVAL(JS_NewString(cx, result)
Return 1
End Function

Dim As JSRuntimePtr rt = JS_NewRuntime(1048576)
Dim As JSCtxGetStringBytes(cx, "Globalization Options
JS_InitStandardClasses(cx, global)
JS_DefineFunction(cx, global, "print", @print_
JS_DefineFunction(cx, global, "ucase", @ucase_

Const TEST_SCRIPT = "print(ucase('hello'));"

Dim As jsval rval
If (JS_EvaluateScript(cx, global, TEST_SCRIPT, Print "JS_EvaluateScript failed"
    Sleep
    End 1
End If

JS_DestroyContext(cx)
JS_DestroyRuntime(rt)
cryptlib

A powerful security toolkit which allows even inexperienced crypto programmers to easily add encryption and authentication services to their software.

Website: http://www.cs.auckland.ac.nz/~pgut001/cryptlib/
Platforms supported: Win32, Linux
Headers to include: cryptlib.bi
Header version: from 2005
Examples: in examples/math/cryptlib/

Example

```basic
#include once "cryptlib.bi"

Function calc_hash( ByVal filename As String, ByVal Const BUFFER_SIZE = 8192
Dim As Byte buffer( 0 To BUFFER_SIZE-1 )

' create a new context using the wanted algorithm
Dim As CRYPT_CONTEXT ctx
cryptCreateContext( @ctx, CRYPT_UNUSED, algo )

' open input file in binary mode
Dim As Integer f = FreeFile()
If( Open( filename For Binary Access Read As #
   Return ""
End If

' read until end-of-file
Do Until( EOF( f ) )
   Dim As Integer oldpos = Seek( f )
   Get #f, , buffer()
   Dim As Integer readlength = Seek( f ) - oldpos
   ' encrypt
   cryptEncrypt( ctx, @buffer(0), readlength
Loop
```
' close input file
Close #f

' finalize
cryptEncrypt( ctx, 0, 0 )

' get the hash result
Dim As Integer buffersize = BUFFER_SIZE
cryptGetAttributeString( ctx, CRYPT_CTXINFO_HASHVALUE

' convert to hexadecimal
Dim As String result = ""
For i As Integer = 0 To buffersize-1
    result += Hex( buffer(i) )
Next

' free the context
cryptDestroyContext( ctx )

Return result
End Function

Dim As String filename = Trim( Command(1) )
If( Len( filename ) = 0 ) Then
    Print "Usage: hash.exe filename"
    End -1
End If

' init cryptlib
cryptInit( )

' calculate hashes
Print "md5: "; calc_hash( filename, CRYPT_ALGO_MD5
Print "sha: "; calc_hash( filename, CRYPT_ALGO_SHA

' shutdown cryptlib
cryptEnd( )

Sleep
The UUID library can be used to generate universally unique identifiers. It's part of the e2fsprogs utilities.

Website: http://e2fsprogs.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: uuid.bi
Header version: from 2010
Library for using arbitrarily large integers. Note: This library seems to be dead, a possible alternative is **gmp**.

Website: http://valyala.narod.ru/big_int/ (Russian) [the site apparently is gone]
Platforms supported: Win32, Linux
Headers to include: big_int/big_int.bi
Header version: from 2005
Examples: in examples/math/big_int/

**Example**

```basic
#include once "big_int/big_int_full.bi"

Sub print_num(ByVal num As big_int Ptr)
    Dim As big_int_str Ptr s = big_int_str_create()
    If (s = 0) Then
        Exit Sub
    End If

    If (big_int_to_str(num, 10, s) <> 0) Then
        Exit Sub
    End If

    Print *s->Str;

    big_int_str_destroy(s)
End Sub

Dim As big_int Ptr bignum = big_int_create(1)
big_int_from_int(2, bignum)
big_int_pow(bignum, 65536, bignum)

Print "2^65536 = ";
print_num(bignum)
Print
```
big_int_destroy(bignum)
Chipmunk Physics

Chipmunk is a physics library designed specifically for 2D games.

Website: http://chipmunk-physics.net/
Platforms supported: Win32, Linux
Headers to include: chipmunk/chipmunk.bi
Header version: 4.1.0
gmp, The GNU Multiple Precision Arithmetic Library

Free library for arbitrary precision arithmetic, operating on signed integers, rational numbers, and floating point numbers.

Website: http://www.gmplib.org
Platforms supported: Win32, Linux
Headers to include: gmp.bi
Header version: 4.1.4

Example

```basic
#include once "gmp.bi"

Dim As mpz_ptr bignum = Allocate(SizeOf(__mpz_struct
mpz_init_set_si(bignum, 2)
mpz_pow_ui(bignum, bignum, 65536)

Print "2^65536 = ";
Dim As ZString Ptr s = mpz_get_str(0, 10, bignum)
Print *s;
Deallocate(s)
Print

mpz_clear(bignum)
Deallocate(bignum)
```
gsl, The GNU Scientific Library

Provides a wide range of mathematical routines such as random number generators, special functions and least-squares fitting.

Website: http://www.gnu.org/software/gsl/, Windows port: http://gnuwin3

Platforms supported: Win32, Linux

Headers to include: gsl/*.bi

Header version: 1.6

Examples: in examples/math/GSL/

Example

```
'' Elementary math example
#include "gsl/gsl_math.bi"

'' Raise the value of 3.141 to the fourth power
? "3.141 ^ 4 = "; gsl_pow_4(3.141)
?

'' Find the hypotenuse of a right triangle with sides of length 3 and 4
? "The hypotenuse of a right triangle with sides of length 3 and 4 is"

Sleep

'' Matrix example
#include "gsl/gsl_matrix.bi"

'' gsl uses the c-style row major order, unlike VB
? "A 3x3 matrix"
Dim As gsl_matrix Ptr m = gsl_matrix_alloc(3, 3)
For i As Integer = 0 To 2
    For j As Integer = 0 To 2
        gsl_matrix_set (m, i, j, 0.23 + 100*i + j)
    Next
Next```
Next

For i As Integer = 0 To 2
    For j As Integer = 0 To 2
        Print "m(",i,",",j,") = "; gsl_matrix_get
    Next
Next

? gsl_matrix_transpose(m)

? "And its transpose"
For i As Integer = 0 To 2
    For j As Integer = 0 To 2
        Print "m(",i,",",j,") = "; gsl_matrix_get
    Next
Next

Sleep
Newton

The Newton Physics Engine is an integrated solution for real time simulation of physics environments.

Website: http://newtondynamics.com/
Platforms supported: Win32, Linux
Headers to include: Newton.bi
Header version: from 2005
Examples: in examples/math/Newton/
ODE, the Open Dynamics Engine

Open source, high performance library for simulating rigid body dynamics.

Website: http://www.ode.org/
Platforms supported: Win32, Linux
Headers to include: ode/ode.bi
Header version: 0.11.1
Examples: in examples/math/ODE/
Small C library for creating CGI programs for Websites.

Website: http://www.newbreedsoftware.com/cgi-util/
Platforms supported: Win32, Linux
Headers to include: cgi-util.bi
curl

Free and easy-to-use client-side URL transfer library supporting almost every protocol.

Website: http://curl.haxx.se/libcurl/
Platforms supported: Win32, Linux, DOS
Headers to include: curl.bi
Header version: 7.39.0
Examples: in examples/network/curl/

Example

```
'curl HTTP Get example

#include once "curl.bi"
#include once "crt/string.bi"

' this callback will be called when any data is received
Private Function write_callback cdecl _
    ( ByVal buffer As Byte Ptr, ByVal size As Integer, ByVal nititems As Integer, ByVal outstream As Any Ptr _ ) As Integer

    Static As ZString Ptr zstr = 0
    Static As Integer maxbytes = 0

    Dim As Integer bytes = size * nititems

    ' current zstring buffer too small?
    If( maxbytes < bytes ) Then
        zstr = Reallocate( zstr, bytes + 1 )
        maxbytes = bytes
    End If

    ' "buffer" is not null-
```

terminated, so we must dup it and add the null-terminate.

```plaintext
copy( zstr, buffer, bytes )
```

```
zstr[bytes] = 0
```

'' just print it..
Print *zstr

Return bytes
End Function

'' init
Dim As CURL Ptr curl = curl_easy_init( )
If( curl = 0 ) Then
  End 1
End If

'' set url and callback
curl_easy_setopt( curl, CURLOPT_URL, "freebasic.net"
```
curl_easy_setopt( curl, CURLOPT_WRITEFUNCTION, '

'' execute..
```
curl_easy_perform( curl )

'' shutdown
```
curl_easy_cleanup( curl )
```
FastCGI

Open extension to CGI that provides high performance without the limitations of server specific APIs.

Website: http://www.fastcgi.com
Platforms supported: Win32, Linux
Headers to include: fastcgi/fastcgi.bi, fastcgi/fcgiapp.bi, fastcgi/fcgi_stdio.bi
Header version: 2.4.1-SNAP-031112127

Example

```basic
#include "fastcgi/fcgi_stdio.bi"

Dim As Integer count = 0
While (FCGI_Accept() >= 0)
    count += 1
    Print !"Content-type: text/html\r\n"
    Print !"\r\n"
    Print "<title>FastCGI Hello!</title>"
    Print "<h1>FastCGI Hello!</h1>"
    Print Using "Request number ### running on host <i>&</i>"; count; *getenv("SERVER_NAME");
Wend
```
ZeroMQ

High-performance asynchronous messaging library

Website: http://www.zeromq.org/
Platforms supported: Win32, Linux
Headers to include: zmq/zmq.bi
Header version: 2.1.10
Stream oriented XML parser library with several useful features.

Website: http://expat.sourceforge.net/
Platforms supported: Win32, Linux
Headers to include: expat.bi
Header version: 1.95.8
Examples: in examples/xml/

**Example**

```basic
' ' XML file parser command line tool based on libexpat
' ' Can use zstring or wstring (libexpat or libexpatw):
' #define XML_UNICODE

#include once "expat.bi"

#define FALSE 0
#define NULL 0

Const BUFFER_SIZE = 1024

Type Context
    As Integer nesting
    As XML_char * (BUFFER_SIZE+1) text
    As Integer textlength
End Type

Dim Shared As Context ctx

' ' Callback called by libexpat when begin of XML tag is found
Sub elementBegin cdecl _
    ( _
        ByVal userdata As Any Ptr, _
        ByVal element As XML_char Ptr, _
        ByVal attributes As XML_char Ptr Ptr _
    )
```
Show its name
Print Space(ctx.nesting);*element;

and its attributes (attributes are given as much like argv, for each attribute there will be an element representing the name and a second specified value)
While (*attributes)
  Print " ";**attributes;
  attributes += 1
  Print "=";**attributes;
  attributes += 1
Wend
Print

ctx.nesting += 1
ctx.text[0] = 0
ctx.textlength = 0
End Sub

Callback called by libexpat when end of XML tag
Sub elementEnd cdecl(ByVal userdata As Any Ptr, By
  Show text collected in charData() callback
  Print Space(ctx.nesting);ctx.text
  ctx.text[0] = 0
  ctx.textlength = 0
  ctx.nesting -= 1
End Sub

Sub charData cdecl _
  ByVal userdata As Any Ptr, _
  ByVal chars As XML_char Ptr, _  '' Note: null
  ByVal length As Integer _
)

This callback will apparently receive every
'' (really?), including newlines and space.

'' Append to our buffer, if there still is free room
If (length <= (BUFFER_SIZE - ctx.textlength))
    fb_MemCopy (ctx.text[ctx.textlength], chars
    ctx.textlength += length
    ctx.text[ctx.textlength] = 0
End If
End Sub
''
'' Main
''
Dim As String filename = Command(1)
If (Len(filename) = 0) Then
    Print "Usage: expat <xmlfilename>"
    End 1
End If

Dim As XML_Parser parser = XML_ParserCreate(NULL)
If (parser = NULL) Then
    Print "XML_ParserCreate failed"
    End 1
End If

''XML_SetUserData(parser, userdata_pointer)
XML_SetElementHandler(parser, @elementBegin, @)
XML_SetCharacterDataHandler(parser, @charData)

If (Open(filename, For Input, As #1)) Then
    Print "Could not open file: "';filename;'"
    End 1
End If

Static As UByte buffer(0 To (BUFFER_SIZE-1))
Dim As Integer reached_eof = FALSE
Do
    Dim As Integer size = BUFFER_SIZE
    Dim As Integer result = Get(#1, , buffer(0)
    If (result Or (size <= 0)) Then
        Print "File input error"
        End 1
    End If

    reached_eof = (EOF(1) <> FALSE)

    If (XML_Parse(parser, @buffer(0), size, reached_eof
    Print filename & "" (" & XML_GetCurrentLineNumber(parser) & "): Error"
    Print *XML_ErrorString(XML_GetErrorCode(parser)
    End 1
    End If
Loop While (reached_eof = FALSE)

XML_ParserFree(parser)
libxml2

De-facto standard library for accessing xml files.

Website: http://xmlsoft.org/
Platforms supported: Win32, Linux
Headers to include: libxml/*.bi
Header version: 2.6.17
Examples: in examples/xml/

Example

```basic
#include_once "libxml/xmlreader.bi"
#define NULL 0

Dim As String filename = Command(1)
If( Len( filename ) = 0 ) Then
    Print "Usage: libxml filename"
End If

Dim As xmlTextReaderPtr reader = xmlReaderForFile(filename)
If (reader = NULL) Then
    Print "Unable to open "; filename
End If

Dim As Integer ret = xmlTextReaderRead( reader )
Do While( ret = 1 )
    Dim As ZString Ptr constname = xmlTextReaderConstName(reader)
    Dim As ZString Ptr value = xmlTextReaderConstValue(reader)

    Print xmlTextReaderDepth( reader ); _
    xmlTextReaderNodeType( reader ); _
    " "; *constname; _
    xmlTextReaderIsEmptyElement(reader); _
    xmlTextReaderHasValue( reader ); _
    *value
```
ret = xmlTextReaderRead( reader )
Loop
xmlFreeTextReader( reader )
If( ret <> 0 ) Then
  Print "failed to parse: "; filename
End If
xmlCleanupParser( )
xmlMemoryDump()
XSLT itself is an XML language to define transformation for XML.

Website: http://xmlsoft.org/XSLT/
Platforms supported: Win32, Linux
Headers to include: libxslt/libxslt.bi
Header version: 1.1.13
Mini-XML is a small XML parsing library that you can use to read XML and XML-like data files in your application without requiring large non-standard libraries.

Website: http://www.minixml.org/
Platforms supported: Win32, Linux
Headers to include: mxml.bi
Header version: 2.7
PCRE, Perl Compatible Regular Expressions

Consists of a set of functions that implement regular expression pattern matching using the same syntax and semantics as Perl 5.

Website: http://www.pcre.org
Platforms supported: Win32, Linux
Headers to include: pcre.bi, pcre16.bi, prceposix.bi
Version: 8.31
Examples: in examples/regex/PCRE/
TRE (regex matching library)

Lightweight, robust, and efficient POSIX compliant regexp matching library

Website: http://laurikari.net/tre/
Platforms supported: Win32, Linux
Headers to include: tre/tre.bi, tre/regex.bi
Header version: 0.8.0
Examples: in examples/regex/TRE/
libbzip2 is the library implementing .bz2 file or in-memory compression and extraction, with interfaces similar to zlib.

Website: http://bzip.org/
Platforms supported: Win32, Linux, DOS
Headers to include: bzlib.bi
Header version: 1.0.6
Examples: in examples/compression/
libzip

Easy-to-use library for creating, reading out or modifying .zip archives.

Website: http://www.nih.at/libzip/
Platforms supported: Win32, Linux, DOS
Headers to include: zip.bi
Header version: 0.11.2
Examples: in examples/compression/

Example

'' .zip unpacking using libzip
#include once "zip.bi"

Sub create_parent_dirs(ByVal file As ZString Ptr)
   '' Given a path like this:
   '' foo/bar/baz/file.ext
   '' Do these mkdir()'s:
   '' foo
   '' foo/bar
   '' foo/bar/baz
   Dim As UByte Ptr p = file
   Do
      Select Case (*p)
      Case Asc("/")
         *p = 0
         MkDir(*file)
      Case 0
         Exit Do
      End Select
   Do
      p += 1
   Loop
   End Sub

'' Asks libzip for information on file number 'i'
'' and then extracts it, while creating directories
Private Sub unpack_zip_file(ByVal zip As zip_Ptr,
  #define BUFFER_SIZE (1024 * 512)
  Static As UByte chunk(0 To (BUFFER_SIZE - 1))
  #define buffer (@chunk(0))

  ' Retrieve the filename.
  Dim As String filename = *zip_get_name(zip, i,
  Print "file: " & filename & ", ";

  ' Retrieve the file size via a zip_stat().
  Dim As zip_stat stat
  If (zip_stat_index(zip, i, 0, @stat)) Then
    Print "zip_stat() failed"
    Return
  End If

  If ((stat.valid And ZIP_STAT_SIZE) = 0) Then
    Print "could not retrieve file size from zip_stat()"
    Return
  End If

  Print stat.size & " bytes"

  ' Create directories if needed
  create_parent_dirs(filename)

  ' Write out the file
  Dim As Integer fo = FreeFile()
  If (Open(filename, For Binary, Access Write, A) Then
    Print "could not open output file"
    Return
  End If

  ' Input for the file comes from libzip
  Dim As zip_file_Ptr fi = zip_fopen_index(zip, Do
    ' Write out the file content as returned
    ' also does the decoding and everything.
    ' zip_fread() fills our buffer
Dim As Integer bytes = _
    zip_fread(fi, buffer, BUFFER_SIZE)
If (bytes < 0) Then
    Print "zip_fread() failed"
    Exit Do
End If

' EOF?
If (bytes = 0) Then
    Exit Do
End If

' Write <bytes> amount of bytes of the file
If (Put(#fo, , *buffer, bytes)) Then
    Print "file output failed"
    Exit Do
End If
Loop

' Done
zip_fclose(fi)
Close #fo
End Sub

Sub unpack_zip(ByRef archive As String)
    Dim As zip Ptr zip = zip_open(archive, ZIP_CHECKCONS)
    If (zip = NULL) Then
        Print "could not open input file " & archive
        Return
    End If

    ' For each file in the .zip... (really nice API!
    For i As Integer = 0 To (zip_get_num_entries(zip))
        unpack_zip_file(zip, i)
    Next

    zip_close(zip)
End Sub
unpack_zip("test.zip")
liblzma

Configurable compression library based around the LZMA algorithm with zlib-like API. liblzma is the heart of the xz-utils used to handle the .lzma and .xz file formats. It is based on 7-Zip's LZMA SDK.

Website: http://tukaani.org/xz/
Platforms supported: Win32, Linux, DOS
Headers to include: lzma.bi
Header version: 5.0.2
Examples: in examples/compression/
LZO is a compression library offering fast compression and very fast decompression.

Website: http://www.oberhumer.com/opensource/lzo/
Platforms supported: Win32, Linux, DOS
Headers to include: lzo/lzo.bi
Header version: 2.02

**Example**

```basic
#include "lzo/lzo1x.bi"

Dim inbuf As ZString Ptr = @"string to compress (or not, since it's so short)"
Dim inlen As Integer = Len(*inbuf) + 1
Dim complen As lzo_uint = 100
Dim compbuf As ZString Ptr = Allocate(complen)
Dim decomplen As lzo_uint = 100
Dim decomppbuf As ZString Ptr = Allocate(decomplen)
Dim workmem As Any Ptr

Print "initializing LZO: ";
If lzo_init() = 0 Then
  Print "ok"
Else
  Print "failed!"
  End 1
End If

Print "compressing '" & *inbuf & "': ";
workmem = Allocate(LZO1X_1_15_MEM_COMPRESS)

If lzo1x_1_15_compress(inbuf, inlen, compbuf, @complen) Then
  Print "ok (" & inlen & " bytes in, " & complen & " bytes out)
Else
  Print "failed!"
  End 1
```
End If

Deallocate(workmem)

Print "decompressing: ";

workmem = Allocate(LZO1X_MEM_DECOMPRESS)

If lzo1x_decompress(compbuf, complen, decompbuff, @
    Print "ok: " & *decompbuff & " (" & complen &
Else
    Print "failed!"
End If
End If

Deallocate(workmem)
QuickLZ

Cross-platform fast compression library

Website: http://www.quicklz.com
Platforms supported: Win32, Linux, DOS
Headers to include: quicklz.bi
Header version: 1.5.0
Example: examples/compression/QuickLZ.bas
zlib

Loss-less data compression library using the Deflate algorithm unencumbered by patents.

Website: http://www.zlib.net
Platforms supported: Win32, Linux, DOS
Headers to include: zlib.bi
Header version: 1.2.8
Examples: in examples/compression/

Example


In-memory compression example:

```
'' Zlib compress/decompress example, by yetifoot

#include once "zlib.bi"

Dim As Integer errlev

'' This is the size of our test data in bytes.
Dim As Integer src_len = 100000

Print "ZLib test - Version " & *zlibVersion()
Print
Print "Test data size : " & src_len & " bytes

'' The size of the destination buffer for the compressed data is calculated by the compressBound function.
Dim As Integer dest_len = compressBound(src_len)

'' Allocate our needed memory.
Dim As UByte Ptr src = Allocate(src_len)
Dim As UByte Ptr dest = Allocate(dest_len)

'' Fill the src buffer with random, yet still compressible data.
For i As Integer = 0 To src_len - 1
```
src[i] = Rnd * 4
Next
'' Store the crc32 checksum of the input data, so
'' uncompression has worked.
Dim As UInteger crc = crc32(0, src, src_len)
'' Perform the compression. dest_len is passed as
'' the function returns it will contain the size of
errlev = compress(dest, @dest_len, src, src_len)
If errlev <> 0 Then
'' If the function returns a value other than
    Print **** Error during compress - code " & errlev
End If
Print "Compressed to : " & dest_len & " bytes.
'' NOTE: in normal use in a program, you would stop
'' be able to tell uncompress the output size. How:
'' just leave it in src_len. The same goes for dest
'' datas size.
'' Wipe the src buffer before we uncompress to it,
'' decompression has worked.
For i As Integer = 0 To src_len - 1
    src[i] = 0
Next
'' Perform a decompression. This time we uncompress
'' src_len is passed as its address, because when
'' the function returns it will contain the size of
errlev = uncompress(src, @src_len, dest, dest_len)
If errlev <> 0 Then
'' If the function returns a value other than
    Print **** Error during uncompress - code " & errlev
End If
Print "Uncompressed to : " & src_len & " bytes.
'' Make sure the checksum of the uncompressed data
If crc <> crc32(0, src, src_len) Then
Print "crc32 checksum  : FAILED"
Else
    Print "crc32 checksum  : PASSED"
End If

' Free the buffers used in the test.
Deallocate(src)
Deallocate(dest)

Print
Print "Press any key to end . . ."
Sleep
Standard C language functions. On Windows, this is implemented in msvcr.dll (however, there also are version-specific msvcrXX.dlls, the Microsoft Visual C++ runtimes). On Linux, the C runtime is typically implemented by glibc. For DOS, FreeBASIC uses DJGPP, which provides a libc library.

Platforms supported: Win32, Linux, DOS
Headers to include: crt.bi
Function reference: C Runtime Functions
DOS API

Provides access to low-level BIOS and DOS calls.

Website: http://freedos.org
Platforms supported: DOS
Headers to include: dos/dos.bi
Examples: in examples/DOS/
Disphelper is a COM helper library that can be used in plain C. No MFC

Website: http://disphelper.sourceforge.net/
Platforms supported: Win32, Linux (using WINE)
Headers to include: disphelper/disphelper.bi
Header version: from 2005

Example

```
'' HTTP GET example, using MSXML2

#define UNICODE
#include "disphelper/disphelper.bi"

DISPATCH_OBJ(objHTTP)

dhInitialize(TRUE)
dhToggleExceptions(TRUE)

dhCreateObject("MSXML2.XMLHTTP.4.0", NULL, @objHTTP)

dhCallMethod(objHTTP, ".Open(%s, %s, %b)", "GET",
dhCallMethod(objHTTP, ".Send"

Dim As ZString Ptr szResponse

dhGetValue("%s", @szResponse, objHTTP, ".ResponseText"

Print "Response: "; *szResponse
dhFreeString(szResponse)

SAFE_RELEASE(objHTTP)
dhUninitialize(TRUE)
```
' IExplorer example

#define UNICODE
#include "disphelper/disphelper.bi"

Sub navigate(ByRef url As String)
    DISPATCH_OBJ(ieApp)
    dhInitialize(TRUE)
    dhToggleExceptions(TRUE)

    dhCreateObject("InternetExplorer.Application",
    dhPutValue(ieApp, "Visible = %b", TRUE)
    dhCallMethod(ieApp, ".Navigate(%s)", url)

    SAFE_RELEASE(ieApp)
    dhUninitialize(TRUE)
End Sub

navigate("www.freebasic.net")

' VB Script example

#define UNICODE
#include "disphelper/disphelper.bi"

' This function runs a script using the MSScriptControl. Optionally returns a result.
Sub RunScript _
    ( _
        ByVal result_identifier As LPWSTR, _
        ByVal result As LPVOID, _
        ByVal script As LPWSTR, _
        ByVal language As LPWSTR _
    )
DISPATCH_OBJ(control)
If (SUCCEEDED(dhCreateObject("MSScriptControl.ScriptControl")))
    If (SUCCEEDED(dhPutValue(control, ".Language = %T")))
        dhPutValue(control, ".AllowUI = %b", TRUE)
        dhPutValue(control, ".UseSafeSubset = %b")
Else
    End If
End If

SAFE_RELEASE(control)
End Sub

dhInitialize(TRUE)
dhToggleExceptions(TRUE)

' VBScript sample
RunScript(NULL, NULL, "MsgBox("This Is a VBS"

' JScript sample
Dim As Integer result
RunScript("%d", @result, "Math.round(Math.pow(5, 2) * Math.PI)"
Print "Result ="; result

Print "Press any key to exit..."
Sleep

dhUninitialize(TRUE)
GLib

Universal utility library most commonly used with GTK+ and GNOME. Provides a main loop implementation for event-based programming, portable multi-threading, portable file/pipe I/O, many utilities such as command line parsing, timers, XML parsing, regular expressions, Unicode manipulation, and also general-purpose data structures.

Website: http://developer.gnome.org/glib/
Platforms supported: Linux, Win32
Headers to include: glib.bi
Version: 2.42.2
Examples: in examples/misc/glib/
Installing FreeBASIC, any additionally needed packages, and perhaps a text editor or IDE.

**Windows 32bit**

- Download the latest `FreeBASIC-x.xx.x-win32.exe` installer
- Run it and click through it. The installer will install FreeBASIC at C:`\%ProgramFiles%\FreeBASIC`, or if you chose a different installation directory, in your chosen directory. Start Menu shortcuts to the website will be installed as well.
- Unless you already have a source code editor or IDE, you should install one too, as FreeBASIC itself does not include one. An IDE can be used to write and save .bas files and to launch the FreeBASIC Compiler to compile them. The following IDEs are known to explicitly support FreeBASIC:
  - FBIDE
  - FBEdit

To uninstall FreeBASIC, remove it from the system's list of installed software (*Add/remove programs, Uninstall or change a program*).

**Windows x64**

- Download the latest `FreeBASIC-x.xx.x-win64.zip` package
- Extract it where you like, for example at C:`\%ProgramFiles%\FreeBASIC` (no further installation required to use fbc).
- You may want to install a source code editor or IDE; also see the **Windows 32bit** section.

To uninstall FreeBASIC, simply deleted the directory where you extracte it.

**Linux**
- Download the latest `FreeBASIC-x.xx.x-linux-x86.tar.gz (32bit)` or `FreeBASIC-x.xx.x-linux-x86_64.tar.gz (64bit)` package
- Extract the archive, for example by doing right-click -> Extract Here, or manually in a terminal:

```
$ cd Downloads
$ tar xzf FreeBASIC-x.xx.x-linux-x86.tar.gz
```

- The `FreeBASIC` compiler can be used from where it was extracted. Usually it is installed into the `/usr/local` system directory though, so that the `fbc` program is available throughout the whole system. To do that, run the included installation script:

```
$ cd FreeBASIC-x.xx.x-linux-x86
$ sudo ./install.sh -i
```

The `install.sh` script can also be given a path as in `./install.sh -i/usr` if you prefer to install into a directory other than the default `/usr/local`. This default is a good choice though, as it avoids mixing with the content of `/usr` which is usually managed by the distribution's packaging tool.

- `FreeBASIC` requires several additional packages to be installed before it can be used to compile executables. In general, these are:
  - `binutils`
  - `libc` development files (installing `gcc` will typically install these too)
  - `gcc`
  - `libncurses` development files
  - `X11` development files (for `FB` graphics programs)
  - `libffi` development files (for the `Threadcall` keyword)
  - `gpm` (general purpose mouse) daemon and `libgpm`
The actual package names to install vary depending on the GNU/Linux distribution.

For native development (32bit FB on 32bit system, or 64bit FB on 64bit system):

- Debian/Ubuntu:
  - gcc
  - libncurses5-dev
  - libffi-dev
  - libgl1-mesa-dev
  - libx11-dev libxext-dev libxrender-dev
  - libxrandr-dev libxpm-dev

- Fedora:
  - gcc
  - ncurses-devel
  - libffi-devel
  - mesa-libGL-devel
  - libX11-devel libXext-devel libXrender-devel
  - libXrandr-devel libXpm-devel

- OpenSUSE:
  - gcc
  - ncurses-devel
  - libffi46-devel
  - xorg-x11-devel

For 32bit development on a 64bit system:

- Debian/Ubuntu:
  - gcc-multilib
  - lib32ncurses5-dev
  - libx11-dev:i386 libxext-dev:i386 libxrender-dev:i386 libxrandr-dev:i386 libxpm-dev:i386
  - (See comment below re Ubuntu 10.04 LTS)
OpenSUSE:
- gcc-32bit
- ncurses-devel-32bit
- xorg-x11-devel-32bit
- xorg-x11-libX11-devel-32bit
- xorg-x11-libXext-devel-32bit
- xorg-x11-libXrender-devel-32bit
- xorg-x11-libXpm-devel-32bit
- libffi46-devel-32bit

Unless you already have a text editor or IDE, you should install one too, as FreeBASIC itself does not include one. An IDE can be used to write and save .bas files and to launch the FreeBASIC Compiler to compile them. The following IDEs are known to explicitly support FreeBASIC:

- **Geany**

To uninstall FreeBASIC from /usr/local, you can run the install.sh script again, but with the -u option:

```
sudo ./install.sh -u
```

**DOS**

- Download the latest `FreeBASIC-x.xx.x-dos.zip` archive
- Find a place for FreeBASIC with at least 13 MiB free space.
- Unpack the ZIP archive, making sure that the directory structure as used inside the archive is preserved ("PKUNZIP -d" for example).
- The top-level directory is named FreeBASIC-x.xx.x-dos (will be truncated to "FREEBASI" in DOS without full LFN support), so you might want to rename it then to a convenient DOS-compliant name not longer than 8 characters and containing no white-spaces, like "FB".
- All the important files used by the compiler (includes, libs) inside the archive do have DOS-compliant names, therefore DOSLFN is not required to use FreeBASIC, however, some examples and texts do have longer names and will be truncated when extracted without full LFN support.
(Note: you can install the DOS version "over" the Windows one or vice-versa, or "merge" those installations later, but rename the FBC.EXE file of the previous installation to FBCW.EXE, FBCD.EXE or such, or it will be overwritten by the new one. Other platform specific files are placed in subdirectories making sure that they won't conflict.)

**Compiling under Ubuntu 10.04 LTS, 64-bit:**
This comment applies to FB 1.01.0, and may apply to other builds also. Install all of the Libraries listed above; some of the entries ending in ":i386" may throw “not found” errors.
To verify that you’re using a 64-bit build, use: “uname -a” or “uname -m” (it’ll show x86_64 for 64-bit, i386 for 32-bit).
Then, when running FBC, an error may appear: “error while loading shared libraries: libtinfo.so.5: cannot open shared object file: No such file or directory”.

“libtinfo.so.5” is available as a separate library in Ubuntu 11.10+, but it is built into “ncurses.so.5” in 10.04 LTS. So, we need to re-direct the libtinfo references into the ncurses.so.5 libraries:

- Issue: find / -name 'libtinfo.so.5' - just to verify that there are no confusing references to these libraries anywhere. Any references should be checked, and probably deleted?
- Change to the folder containing the FBC executable (perhaps “/usr/local/bin/”).
- Issue: ldd fbc - it will list the various library folder(s) being searched (probably “/lib32” in most cases).
- Issue: sudo ln -s /lib32/libncurses.so.5 /lib32/libtinfo.so.5 (assuming “/lib32” was emitted in the previous step).
- Issue: sudo ln -s /lib32/libtinfo.so.5 /lib32/libtinfo.so (assuming “/lib32”...)
- Retry!
- [Unrelated point: if "private" Libraries are needed for compiles, they were expected to be in /usr/local/lib/freebasic/. Now, they may have to be in /usr/local/lib/freebasic/linux-x86/].
- [Mike Kennedy, Jan, 2015. (This note was not acceptable as a standard "comment" - I don't know why?)].
See also

- Invoking the Compiler
- Compiler Command Line Options
Requirements

Windows version

- The FreeBASIC compiler (fbc.exe) and the executables generated by it, need at least Windows 98 to run.
- The msvcrtd.dll (the Microsoft's C runtime library) must be present (note: it wasn't shipped with Windows 95, but it's installed by many applications and can be also downloaded at: Microsoft).
- The gfx routines will use DirectX 5.0 or later if found on the host system, otherwise they'll fall back on standard Win32 GDI which will work on any Windows system.
- Unicode wide strings (WSTRING's) only work in Windows NT/2000/XP/2003/Vista or above. Applications that depend on wide-strings will run in Windows 98/Me, but no input/output will work if the character set isn't Latin-based, because those platforms don't support Unicode strings. Windows 95 has most Unicode API functions missing; applications using wide strings won't even be loaded by this specific OS.

Linux version

- The FreeBASIC compiler (fbc) and the executable generated by it depend on libc, libm, libpthread, libdl and libncurses. These are standard Linux libraries and should be available by default on all modern distros.
- When using the gfx routines, the dependencies will increase. FreeBASIC gfx programs will also need libX11, libXext, libXpm, libXrender and libXrandr to be installed on the host system to be executed. This is usually not a problem as long as there's a recent X11 server installed in the system (at least XFree86 4.3.0 or any X.org version).
- If having a working X11 installation is enough to run FreeBASIC gfx programs, it may be not enough to compile them; you may need to install the X11 development libraries from your Linux packages repository.
- Unicode wide-strings (WSTRING's) with non-ASCII character set can only be displayed in console if the locale is set to an UTF-8
version - most modern distros come with support that and character sets other than latin may work only in xterm.

**DOS version**

- Official requirement: A DPMI (DOS Protected-Mode Interface) server must be present to run fbc.exe and any executable generated by it. This is not as bad as it looks. It simply means, that the "CWSDPMI.EXE" file (cca 20 KiB) must be present in the same directory or a place where the PATH environment variable points to. CWSDPMI package: [homer.rice.edu...cwsdpmi](http://homer.rice.edu...cwsdpmi) (note: FreeDOS comes with it already installed). Further, there is a possibility to bypass this problem, and to use alternatively HDPMI for details see [DOS related FAQ](http://delorie.com/djgpp/...).

- You need a 80386 or newer CPU and cca 4 MiB of RAM. For compiling of large programs or libraries, you will need more. Similar applies to executables generated by FBC, those using FB's graphics library however will need a better/faster CPU (200 MHz (?), work in progress, code not yet fully optimized, and exact minimum not known by now). FBC and executables generated by it need an FPU (80387, 80487, always built-in since Pentium). This requirement can be bypassed using "EMU387" (auto-loaded if needed, but not included in FB packages, see [delorie.com/djgpp/...](http://delorie.com/djgpp/...)), or by avoiding floats and (non-trivial) removing float-related startup code.

- The DOS version should run in any DOS, like FreeDOS, [Enhanced-]DR-DOS (do **not** use the DR-EMM386's included DPMI, use CWSDPMI or HDPMI), or MS-DOS. It also works properly under a number of "DOS box" environments that emulate a DOS system, such as the Windows NTVDM; however, some of these environments are not implemented faithfully and contain bugs, so caution should be exercised.

- Long filenames are supported under systems that supply the long filename API defined by Windows 95, including DOS with an LFN TSR (for example DOSLFN [1](http://example.com) [2](http://example.com)). Long filename support is not required to use the compiler; however, care must be taken in unpacking the distribution, for example, with a Windows program which creates short names with numeric tails (FREEBA~1) instead of truncating to 8 characters (FREEBASI). The filenames of all
files in the distribution should be truncated to 8.3 if the compiler is to be used without long filename support.

- There are a few limitations, see DOS related FAQ.

See also

- Installing FreeBASIC
- Compiler Command Line Options

and

- Compiler FAQ
- Win32 related FAQ
- DOS related FAQ
- LINUX related FAQ
Invoking the compiler after installation.

**Windows**
The compiler can be manually invoked from the command-line, or automatically by your IDE/Code Editor. If you're using an IDE, you will usually have to tell it where the compiler was installed, so it can find it. How exactly to do that depends on the IDE.

To compile manually, you should append the FreeBASIC installation directory to your PATH environment variable, separating it from previous entries using a semi-colon. Now you can simply use "fbc" from the command prompt, instead of always having to type in the full path (e.g. "C:\FreeBASIC\fbc.exe").

Then, open a console/command prompt/MS DOS prompt, in the same directory as your program. To compile your program, you can use:

```
C:\mystuff\myprogram> fbc myprogram.bas
```

and `myprogram.exe` will be created in the same directory.

A console can be launched in a specific directory from Explorer by using Microsoft's "Open Command Window Here" PowerToy on Windows XP. On Windows Vista & above you can SHIFT+RightClick on a folder in Explorer to see the 'Open Command Window Here' option. As a last resort, you can also select Start -> Run, type "cmd" and hit Enter, and use the "cd" command to change the current directory.

Note: You can in fact invoke the compiler from any directory you like, but you have to specify the correct path to your program, so the compiler can find it, for example:

```
C:\> fbc mystuff\myprogram\myprogram.bas
```

The resulting executable will still be put in the same directory as the
program.

**Linux**

If the install.sh script was successfully executed with enough privileges the compiler binary should have been copied `/usr/local/bin/fbc`, allowing any user access to the compiler from any directory.

From the prompt, type,

```
fbc
```

to see a list of options. To compile the "Hello, world!" example program, navigate to the directory where the FreeBASIC examples were installed (`/usr/local/share/freebasic`), and type,

```
fbc examples/misc/hello.bas
```

and a ./hello executable file will be created in the examples/misc directory.

**Linux (standalone)**

If the install script `install-standalone.sh` was successfully executed with enough privileges, a link to the compiler binary should have been created at `/usr/bin/fbc`, allowing any user access to the compiler from any directory. If it was not possible to create the link, you may want to alter your `PATH` environmental variable to be able to invoke the compiler from any directory. Navigate to the directory where FreeBASIC was installed.

From the prompt, type,

```
fbc
```

to see a list of options. To compile the "Hello, world!" example program type,

```
fbc examples/misc/hello.bas
```

and a ./hello executable file will be created in the examples/misc directory.
DOS

Navigate to the directory where FreeBASIC was installed. For example, FreeBASIC is installed in the directory C:\FB, type,

C:
CD FB

Some DOSes accept "CDD C:\FB" as well. You can also add the FreeBASIC directory to your PATH environment variable (usually something like "SET PATH=C:\FB;%PATH%") so you can invoke the compiler from any directory.

At the prompt, type,

fbc

to see a list of options. To compile the "Hello, world!" example program type,

fbc examples\misc\hello.bas

and a hello.exe executable file will be created in the examples\misc directory.

See also

- Installing FreeBASIC
- Compiler Command Line Options
- Compiler FAQ
fbc command-line

Using the fbc command-line.

The official FreeBASIC distribution comes with fbc, FreeBASIC's flagship compiler. fbc is a command line compiler, and can be launched from the console - from DOS, the Windows command prompt or a Linux shell. Running fbc from the console without any arguments displays a list of available options, or command-line switches, that can be used to adjust the behavior of the compiler.

At its simplest, fbc takes a source file as a command-line argument and produces an executable file. It does this by compiling the source file (.bas) into an assembly (.asm) file, then compiling this into an object file (.o) using GAS and finally linking using LD this object file to other object files and libraries it needs to run, producing the final executable file. The assembly and compiled object files are deleted at this point by default. For example, the following command,

fbc foo.bas

produces the executable foo.exe in DOS and Windows, and ./foo in Linux. fbc can accept multiple source files at once, compile and link them all into one executable. For example, the following command,

fbc foo.bas bar.bas baz.bas

produces the executable foo.exe in DOS and Windows, and ./foo in Linux. Since foo.bas was listed first, it will be the main entry point into the executable, and also provide its name. To specify a different entry point or executable name, use the "-m" and "-x" switches, respectively. To have, for example, baz.bas provide the main entry point into an executable called foobar.exe, you would use

fbc -x foobar.exe -m baz foo.bas bar.bas baz.bas

The "-x" switch names the executable verbatim, so in Linux, the executable produced from the above command would be called ./foobar.exe.
**Syntax**

```
fbc [ options ] [ input_list ]
```

Where *input_list* is a list of filenames. Accepted files are:

<table>
<thead>
<tr>
<th>File extension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.bas</td>
<td>FreeBASIC source file</td>
</tr>
<tr>
<td>.a</td>
<td>Library</td>
</tr>
<tr>
<td>.o</td>
<td>Object file</td>
</tr>
<tr>
<td>.rc</td>
<td>Resource script (Windows only)</td>
</tr>
<tr>
<td>.res</td>
<td>Compiled resource (Windows only)</td>
</tr>
<tr>
<td>.xpm</td>
<td>X icon pixmap (Linux only)</td>
</tr>
</tbody>
</table>

**Source code**

- `-b < name >`  
  Add a source file to compilation
- `-i < name >`  
  Add a path to search for include files
- `-include < name >`  
  Include a header file on each source compiled
- `-d < name=val >`  
  Add a preprocessor's define
- `-lang < name >`  
  Select language mode: fb, fblite, qb, deprecated
- `-forcelang < name >`  
  Select language mode: fb, fblite, qb, deprecated (overrides statements in code)

**Linking**

- `-a < name >`  
  Add an object file to linker's list
- `-l < name >`  
  Add a library file to linker's list
- `-p < name >`  
  Add a path to search for libraries
- `-mt`  
  Link with thread-safe runtime library
- `-nodeflibs`  
  Do not include the default libraries
- `-static`  
  Prefer static libraries over dynamic ones when linking
- `-map < name >`  
  Save the linking map to file name
- `-Wl < opt >`  
  Pass options to LD (separated
Set the target platform for cross compilation
-\texttt{gen < backend >}
Sets the compiler backend (default is 'gas').
-\texttt{asm < format >}
Sets the assembler format for Asm block.
-\texttt{arch < type >}
Set target architecture (default: 486)
-\texttt{O < level >}
Set the optimization level (-\texttt{gen gcc}).
-\texttt{vec < level >}
Set level of vector optimizations enabled by the compiler (default: 0)
-\texttt{fpu < type >}
Set the floating point arithmetics unit (default: FPU)
-\texttt{fpmode < type >}
Select between fast and accurate floating-point operations (default: PRECISE)
-\texttt{z < value >}
Sets miscellaneous or experimental options.

**Compilation**
-\texttt{m < name >}
Main file without extension, the entry point (default is the first .bas file on the command line)
-\texttt{g}
Add debug info
-\texttt{profile}
Enable function profiling
-\texttt{e}

by commas)
-\texttt{export}
Export symbols for dynamic linkage
-\texttt{lib}
Create a static library
-\texttt{dylib}
Create a DLL, including the import library
-\texttt{dll}
Create a DLL, including the import library. (Same as -\texttt{dylib})
-\texttt{x < name >}
Set executable/library path/name

**Behaviour**
-\texttt{prefix < path >}
Set the compiler prefix path
-\texttt{version}
Show compiler version on the command line, do not compile or link.
-\texttt{v}
Be verbose
-\texttt{print < option >}
Display certain information (host, target, etc.)
-\texttt{pp}
Emit the preprocessed input file only, do not compile
-\texttt{r}
Compile into intermediate file(s) only, do not assemble or link
-\texttt{rr}
Compile into asm file(s) only, do not assemble or link
-\texttt{c}
Compile and assemble source
Add error checking
-ex
Add error checking with RESUME support
-exx
Same as -ex plus array bounds and null-pointer checking
-Wa < opt >
Pass options to GAS (separated by commas)
-Wc < opt >
Pass options to GCC (separated by commas)
-o < name >
Set object file path/name (must be passed after the .bas file)

file only, do not link
-R
Do not delete the intermediate file(s)
-RR
Do not delete the asm file(s)
-C
Do not delete the object file(s)
-w < value >
Set min warning level: all, pedantic, next or a value
-maxerr < val >
Only stop parsing if <val> errors occurred
-noerrline
Do not show source line where error occurred

Target specific
-s < name >
Set subsystem (gui, console)
-t < value >
Set stack size in kbytes (default: 1M)

Meta
@< file >
Read (additional) command-line options from a file

Example
fbc myfile.bas
(With DOS version of FBC, compile and link a DOS executable MYFILE.EXE.)

fbc -s gui myfile.bas
(With Windows version of FBC, compile and link a Windows executable myfile.exe. Running the program will not show the console window ("MS-DOS Prompt"))

fbc -lib module1.bas module2.bas module3.bas -x libmylib.a
(Compile and link a static library libmylib.a from the three source files)

fbc -m main_module -c main_module.bas
(Compile an object file main_module.o and mark it as an entry point)
fbc -c sub_module.bas
(Compile an object file sub_module.o)
fbc -x application.exe main_module.o sub_module.o
(Link an executable application.exe)

**Note:** How to include an icon in a FB executable program
There is a simple command line option to compile a FB program into an executable with an Icon:
- Create a *.rc file, for example appicon.rc, with this info:
  
  FB_PROGRAM_ICON ICON "appicon.ico"
  (where appicon.ico is the name of icon)
- Then when compiling program, add appicon.rc in the list of files to compile.

**See also**
- Compiler Options
- Installing FreeBASIC
- Invoking the FreeBASIC compiler
Compiler Options

Command line compiler options for the fbc compiler:

@< file >
  ■ Read (additional) command-line options from the file
-a < name >
  ■ Add an object file to linker's list
-arch < type >
  ■ Set target architecture (default: 486)
-asm < format >
  ■ Sets the assembler format for Asm block
-b < name >
  ■ Add a source file to compilation
-c
  ■ Compile only, do not link
-C
  ■ Do not delete the object file(s)
-d < name=val >
  ■ Add a preprocessor's define
-dll
  ■ Create a DLL, including the import library. (Same as -dylib)
-dylib
  ■ Create a DLL, including the import library
-e
  ■ Add error checking
-ex
  ■ Add error checking with RESUME support
-exx
  ■ Same as -ex plus array bounds and null-pointer checking
-export
  ■ Export symbols for dynamic linkage
-forceclang <name>
  ■ Select language compatibility, overriding #lang/$lang in
code
-fpomode < type >
  ■ Select between fast and accurate floating-point operations (default: PRECISE)
-fpu < type >
  ■ Set the floating point arithmetics unit (default: FPU)
-g
  ■ Add debug info
-gen < backend >
  ■ Sets the compiler backend (default is 'gas')
-i < name >
  ■ Add a path to search for include files
-include < name >
  ■ Include a header file on each source compiled
-l < name >
  ■ Add a library file to linker's list
-lang < name >
  ■ Select language compatibility: fb, fblite, qb, deprecated
-lib
  ■ Create a static library
-m < name >
  ■ Main file without extension, the entry point (default is the first .bas file on the command line)
-map < name >
  ■ Save the linking map to file name
-maxerr < val >
  ■ Only stop parsing if <val> errors occurred
-mt
  ■ Link with thread-safe runtime library
-nodeflibs
  ■ Do not include the default libraries
-noerrline
  ■ Do not show source line where error occurred
-o < name >
  ■ Set object file path/name (must be passed after the .bas
-O < level >
  ■ Set the optimization level (-gen gcc)

-p < name >
  ■ Add a path to search for libraries

-pic
  ■ Generate position-independent code (non-x86 Unix shared libs)

-pp
  ■ Emit the preprocessed input file only, do not compile

-prefix < path >
  ■ Set the compiler prefix path

-print < option >
  ■ Let the compiler display certain information (host, target,)

-profile
  ■ Enable function profiling

-r
  ■ Compile into *.asm/*.c/*.ll file(s) only, do not assemble or link

-R
  ■ Preserve intermediate *.asm/*.c/*.ll file(s) generated by compilation

-rr
  ■ Compile into *.asm file(s) only, do not assemble or link

-RR
  ■ Preserve intermediate *.asm files generated by compilation

-s < name >
  ■ Set subsystem (gui, console)

-showincludes
  ■ Display a tree of file names of #included files

-static
  ■ Prefer static libraries over dynamic ones when linking

-target < platform >
  ■ Set the target platform for cross compilation

-t < value >
-v
  ■ Be verbose

-vec < level >
  ■ Set level of vector optimizations enabled by the compiler (default: 0)

-version
  ■ Show compiler version

-w < value >
  ■ Set min warning level: all, pedantic or a value

-Wa < opt >
  ■ Pass options to GAS (separated by commas)

-Wc < opt >
  ■ Pass options to GCC (separated by commas)

-Wl < opt >
  ■ Pass options to LD (separated by commas)

-x < name >
  ■ Set executable/library path/name

-z < value >
  ■ Sets miscellaneous or experimental options

See also
  ■ Using the Command Line
Compiler Option: @file

Read (additional) command-line options from the file

**Syntax**

@file

**Parameters**

*file*

Name of a text file containing command line options. It's possible to use multiple lines in the file. The options may be separated by spaces or line breaks, and support double-quoted strings to allow spaces in parameters (like the real command line). This file can itself contain additional @file options.

**Description**

The @file compiler option tells the compiler to parse the specified file to find more command line options. The options found in the file are treated as if they were found on the command line. This can be useful to pass very long command lines to the compiler, for example on DOS where command lines are limited in length.

**Example**

options.txt:

```plaintext
-d TEST=123
```

opts.bas:

```plaintext
Print "TEST=" & TEST
```

Compile with:

```sh
fbc @options.txt opts.bas
```
Output:

| TEST=123 |

See also

- Using the Command Line
Compiler Option: -a

Add an object file to the linker's list

**Syntax**

[ -a ] < object file >

**Parameters**

*object file*

Name of the object file with extension.

**Description**

The `-a` compiler option adds a compiled object file to the linker's list. The "-a" is optional if the object file name has a ".o" file extension.

**See also**

- Compiler Option: -b
- Using the Command Line
Compiler Option: -arch

Set target architecture for improved/restricted code generation or cross-compiling

Syntax
-arch < architecture >

Parameters
architecture
The target architecture. Recognized values:

- Related to 32bit x86:
  - 386
  - 486 (default for x86)
  - 586
  - 686
  - athlon
  - athlon-xp
  - athlon-fx
  - k8-sse3
  - pentium-mmx
  - pentium2
  - pentium3
  - pentium4
  - pentium4-sse3

- Related to 64bit x86_64:
  - x86_64, x86-64, amd64

- Related to 32bit ARM:
  - armv6
  - armv7-a (default for ARM)

- Related to 64bit ARM (AArch64):
  - aarch64
Others:

- native: For compiling to the architecture which the compiler is running on.
- 32, 64: For quick cross-compiling to the 32bit or 64bit version of the default architecture.

Description

The -arch compiler option sets the target CPU architecture. This can be used for multiple purposes:

- Improving code generation; for example: You can use -arch 686 to override the default -arch 486, and the compiler will generate faster code in some cases, by using certain instructions which were not available on i486 (or other CPUs older than i686).
- Restricting code generation; for example: You can use -arch 386 to limit the compiler to using only i386-compatible instructions.
- Cross-compiling; for example: You can use -arch x86_64 on 32bit x86 systems to cross-compile to 64bit x86_64.

The exact impact which the -arch setting has on code generation depends on the code generation backend that is being used. The x86 ASM backend (-gen gas) handles the -arch setting and adjusts code generation accordingly in some cases. When using the GCC backend (-gen gcc), the specified architecture will be passed on to gcc via gcc -march=<...>, causing gcc to generate code for the specified architecture.

However, -arch only affects newly generated code, but not pre-compiled code such as the FreeBASIC runtime libraries, or any other library from the \lib/ directory. For example, using -arch 386 is not necessarily enough to get a pure i386 executable -- it also depends on how all the libraries that will be linked in were compiled.

The -arch 32 and -arch 64 shortcuts are similar to gcc's -m32/-m64
options. On 32bit architectures, -arch 64 is an abbreviation for cross-compiling to the default 64bit version of the architecture (e.g. from 32bit x86 to 64bit x86_64, or 32bit ARM to 64bit AArch64), and -arch 32 does nothing. On 64bit systems, it is the other way round: -arch 32 cross-compiles to the default 32bit architecture, while -arch 64 does nothing.

The -arch native shortcut is similar to gcc's -march=native option. On x86, it causes fbc to try and detect the host CPU automatically based on the cpuid instruction and its availability or results. On other architectures, this will currently simply use the architecture which the compiler itself was built for. Under -gen gcc this will use gcc -march=native.

Specifying an -arch setting incompatible to the native architecture will trigger cross-compilation, just like the -target option, except that only the target architecture, but not the target operating system, is changed.

See also

- Using the Command Line
- -target
- FB and cross-compiling
Compiler Option: -asm

Set assembler format for inline assembly under -gen gcc

**Syntax**

```-asm < format >```

**Parameters**

*format*

The assembler format: *intel* or *att*

**Description**

The `-asm` compiler option sets the assembler format for inline Asm blocks when using `-gen gcc`.

- `-gen gcc -asm intel`: FB inline assembly blocks must use FB's usual Intel syntax format. Under -gen gcc, fbc will try to translate it to gcc's format automatically. For example:

```Dim a As Long = 1
Print a
Asm
    inc dword Ptr [a]
End Asm
Print a```

- `-gen gcc -asm att`: FB inline assembly blocks must use gcc's format. For example:

```Dim a As Long = 1
Print a
Asm
    "incl %0\n" : "+m" (a) :
End Asm```
The x86 ASM backend (`-gen gas`) currently only supports `asm intel` and using `asm att` results in an error.

See also

- `__Fb_Asm__`
- `Using the Command Line`
Add a source file to compilation

**Syntax**

```
[ -b ] < source file >
```

**Parameters**

`source file`

The name with extension, and optionally a path, of the basic source file.

**Description**

The `-b` option adds a source file to the compilation list. In general, this option is redundant since source files with a `.bas` extension can be specified without it, but is useful if a source file does not have a `.bas` extension, or if exists in an other directory.

To compile and link the source files `file1.bas`, `file2.bas` and `file3.fb` into an executable (`file1.exe` in DOS/Windows, `file1` in Linux), type,

```
fbc -b file1.bas file2.bas -b file3.fb
```

Note that the `-b` option was not needed for `file1.bas` or `file2.bas`.

**See also**

- Compiler Option: `-a`
- Using the Command Line
Compiler Option: -c

Compile and assemble source file only, do not link

Syntax
- c

Description
The -c option specifies that any source files listed are to be compiled and assembled into object files, and not linked into an executable (the default behavior). When using the "-c" switch, "-m" must be specified when compiling a main source file.

See also
- Compiler Option: -C
- Compiler Option: -r
- Compiler Option: -m
- Compiler Option: -o
- Using the Command Line
Compiler Option: -C

Do not delete the object file(s)

Syntax

-\texttt{c}

Description

The -c compiler option causes the object file(s) that are generated during the compile process to not be deleted.

See also

- Compiler Option: -c
- Compiler Option: -R
- Using the Command Line
Compiler Option: -d

Add a preprocessor definition

Syntax
- `d < name=value >`
- `d < name >`

Parameters
- **name**
  Name of the preprocessor macro to define. No parameters are allowed.
- **value**
  Value to give to the macro. If omitted, it will be defined as 1

Description
The `-d` compiler option adds a preprocessor macro to all source files.
The same as using the preprocessor directive `#define` or `#macro`.

See also
- `#define`
- `#macro`
- Intrinsic Defines
- Using the Command Line
Compiler Option: -dll

Create a DLL and import library

Syntax
-dll

Description
The -dll compiler option creates a dynamic link library. This creates a DLL under Windows (including the import library), and creates a .so under Linux.

The intrinsic macro __FB_OUT_DLL__ is set to non-zero (-1) if the -dll option was specified, and set to zero (0) otherwise.

Platform Differences
- Not supported on the DOS platform.

See also
- __FB_OUT_DLL__
- Shared Libraries
- Using the Command Line
Compiler Option: -dylib

Create a DLL and import library

Syntax
- dylib

Description
The -dylib compiler option creates a dynamic link library. This creates a DLL under Windows (including the import library), and creates a .so under Linux.

The intrinsic macro __FB_OUT_DLL__ is set to non-zero (-1) if the -dll option was specified, and set to zero (0) otherwise.

Platform Differences
- Not supported on the DOS platform.

See also
- __FB_OUT_DLL__
- Shared Libraries
- Using the Command Line
Compiler Option: -e

Add error checking

**Syntax**
- -e

**Description**
Adds QuickBASIC-like error checking.

**See also**
- __FB_ERR__
- Compiler Option: -ex
- Compiler Option: -exx
- Error Handling
- Using the Command Line
Compiler Option: -ex

Add error checking with Resume support

Syntax
- ex

Description
The -ex compiler option adds error handling as with the -e option plus support for Resume.

See also
- __FB_ERR__
- Compiler Option: -e
- Compiler Option: -exx
- Error Handling
- Using the Command Line
Compiler Option: -exx

Add error checking with Resume support and array bounds and null-pointer checking

**Syntax**

```
-exx
```

**Description**

The -exx compiler option adds error checking with Resume support plus array bounds and null-pointer checking (including the procedure pointers).

**See also**

- `__FB_ERR__`
- Compiler Option: -e
- Compiler Option: -ex
- Error Handling
- Using the Command Line
**Compiler Option: -export**

Export symbols for dynamic linkage

**Syntax**

-export

**Description**

The **-export** compiler option exports symbols for dynamic linkage.

**See also**

- Export
- Shared Libraries
- Using the Command Line
Compiler Option: -forcelang

Provides QuickBASIC or backward compatibility

Syntax

- forcelang dialect

Parameters

dialect
The dialect to use in compilation, one of fb (default), fblite, qb or deprecated.

Description

The -forcelang compiler option changes the way source code is interpreted, and is meant as a tool to users wanting traditional QuickBASIC-like behavior, or behavior deprecated from previous versions of FreeBASIC. It overrides any #lang statements within the code.

The intrinsic macro __FB_LANG__ is set to the string name of the dialect specified on the command line, or "fb" by default.

To learn more about the differences between each of these language dialects, see Compiler Dialects.

fb

This is the default dialect, and allows compilation of source code adhering to the most recent version of the FreeBASIC language.

fblite

This dialect provides support for FreeBASIC syntax and functionality, but with a more traditional QuickBASIC programming style.

qb
This dialect provides the best support for older QuickBASIC code.

**deprecated**

This dialect is for backward compatibility with some previous versions of FreeBASIC, however, this dialect may not exist in future versions. Programmers should consider using the "fblite" dialect instead.

**See also**

- `#1ang`
- `__FB_LANG__`
- Compiler Option: `-lang`
- Compiler Dialects
- Using the Command Line
Compiler Option: -fpmode

Selects faster, less accurate or slower, more precise floating-point math.

**Syntax**

```
-fpmode  < mode >
```

**Parameters**

`mode`

The floating point mode: FAST | PRECISE.

**Description**

The `-fpmode` compiler option specifies whether speed or precision is more important for floating point math. If this option is not specified, the default is `-fpmode PRECISE`.

- `-fpmode FAST` will generate faster, less accurate instructions for certain floating point operations.

- `-fpmode PRECISE` will generate standard floating point instructions that operate at the default speed and accuracy of the selected floating point unit.

Currently, the only floating point operations that behave differently when using `-fpmode FAST` are: `Sin()`, `Cos()`, reciprocal, and reciprocal `Square Root`, all of which must operate on `Single` precision values.

Using `-fpmode PRECISE` is dependent on the `-fpu SSE` command line option. Using `-fpmode PRECISE` without using `-fpu SSE` will generate an error.

**See also**

- **Using the Command Line**
- **Compiler Option: -fpu**
- `__Fb_Fpmode__`
Compiler Option: \(-fpu\)

Sets the math unit to be used for floating point arithmetics.

**Syntax**

\[-fpu \ < \ type \ >\]

**Parameters**

*\(type\)*

The floating point unit: \(X87\) | \(SSE\).

**Description**

The \(-fpu\) compiler option sets the math unit to be used for floating point arithmetics. If this option is not specified, the default is \(-fpu \ X87\).

\(-fpu \ X87\) will generate floating point instructions for the 387.

\(-fpu \ SSE\) will generate floating point instructions for SSE and SSE2 with some math support still done by the 387.

Functions normally return a floating point value (**Single** or **Double**) in the \(st(0)\) register. Sometimes, this may be optimized by returning the value in the \(xmm0\) register instead. This can be specified with \(Option("Sse")\) after the return type in a function's declaration or definition. \(Option("Sse")\) is ignored unless the source is compiled with the \(-fpu \ SSE\) command line option.

**See also**

- Using the Command Line
- \(Option()\)
- \(\_Fb\_Fpu\_\)
Compiler Option: -g

Add debug information

**Syntax**

-g

**Description**

The -g compiler option inserts debugging symbols into output files, to use with GDB-compatible debuggers.

The intrinsic macro `__FB_DEBUG__` is set to non-zero (-1) if the option was specified, and set to zero (0) otherwise.

**See also**

- `__FB_DEBUG__`
- Debugging
- Using the Command Line
Compiler Option: -gen

Sets the backend code emitter.

**Syntax**
-\texttt{-gen \ < backend >}

**Parameters**
\texttt{backend}
-\texttt{gas} for x86 GAS assembly, \texttt{gcc} for GNU C, \texttt{llvm} for LLVM IR.

**Description**
The \texttt{-gen} compiler option sets the backend code emitter and assembler.

-\texttt{gen gas}
The compiler will emit GAS assembler code to a .asm file which will then be compiled to an object file using 'as'. This is fbc's original x86 code generation backend.

-\texttt{gen gcc}
The compiler will emit C code to a .c file which will then be compiled to an .asm file using 'gcc' as a high level assembler. The C backend is intended to make FB portable to more platforms than just x86. This requires gcc to be installed so that fbc can invoke it to compile the C code, also see \texttt{Installing gcc for -gen gcc}.

-\texttt{gen llvm}
The compiler will emit LLVM IR code to a .ll file which will then be compiled to an .asm file using 'llc'. The LLVM backend is still a work in progress. It is intended for the same purpose as the C backend, and could theoretically solve some of the C backend's problems, such as debugging meta data support.

**See also**
- Tools used by fbc
- Using the Command Line
Compiler Option: -i

Add a path to search for include files

**Syntax**

- `i < include path >`

**Parameters**

*include path*

The directory path, relative or absolute, of where to search for include files.

**Description**

The `-i` option allows an additional directory to be used when searching for header files. By default, `fbc` searches in the current directory, and `prefix/inc--in that order--where, prefix` is the location where FreeBASIC is installed. A directory specified with the `-i` option will be searched before these default directories, and when the `-i` option is used multiple times, `fbc` will search the directories in the order they are listed on the command-line.

To search in the subdirectory `includes` first for header files while compiling the source file `file.bas`, type,

```
fbc -i includes file.bas
```

**See also**

- `#include`
- **Compiler Option: -include**
- **Header Files**
- **Using the Command Line**
Include a header file on each source compiled

**Syntax**

```
#include < include file >
```

**Parameters**

`include file`

The header file name with extension, and optionally a path, to include.

**Description**

The `-include` option has the effect of adding an `#include` preprocessor directive to the very beginning of each source file before processing it. When used multiple times, the files will be included in the order they are listed on the command-line.

To include the file `header.bi` when processing `file1.bas` and `file2.bas`, type:

```
fbc -include header.bi file1.bas file2.bas
```

**See also**

- `#include`
- **Compiler Option: -i**
- `Header Files`
- `Using the Command Line`
**Compiler Option: -l**

Add a library file to the linker's list.

**Syntax**

- `-l < libname >`

**Parameters**

- `libname`
  
  Name of the library to link in. The library file name's extension should not be included. For example, when using `-l something`, the linker will look for the files:

  - `Libsomething.a`
  - `Libsomething.dll.a (Windows)`
  - `something.dll (Windows)`
  - `Libsomething.so (Linux)`

**Description**

The `-l` compiler option adds a library file to the linker's list, to be linked into the final executable or library if needed to satisfy dependencies.

**See also**

- `#inclib`
- **Compiler Option: -p**
- **Using the Command Line**
Compiler Option: -lang

Provides QuickBASIC or backward compatibility

**Syntax**
-lang dialect

**Parameters**
dialect
The dialect to use in compilation, one of fb (default), fblite, qb or deprecated.

**Description**
The -lang compiler option changes the way source code is interpreted and is meant as a tool to users wanting traditional QuickBASIC-like behavior, or behavior deprecated from previous versions of FreeBASIC.

The intrinsic macro __FB_LANG__ is set to the string name of the dialect specified on the command line, or "fb" by default.

To learn more about the differences between each of these language dialects, see Compiler Dialects.

**fb**

This is the default dialect, and allows compilation of source code adhering to the most recent version of the FreeBASIC language.

**fblite**

This dialect provides support for FreeBASIC syntax and functionality, but with a more traditional QuickBASIC programming style.

**qb**
This dialect provides the best support for older QuickBASIC code.

**deprecated**

This dialect is for backward compatibility with some previous versions of FreeBASIC, however, this dialect may not exist in future versions. Programmers should consider using the "fblite" dialect instead.

Note: this command-line option can be overridden by any `#lang` statements used in the code.

**See also**

- `#lang`
- `__FB_LANG__`
- Compiler Option: -forcelang
- Compiler Dialects
- Using the Command Line
Compiler Option: -lib

Create a static library

**Syntax**

- `lib`

**Description**

The `-lib` compiler option creates a static library.

The intrinsic macro `__FB_OUT_LIB__` is set to non-zero (-1) if the `-lib` option was specified, and set to zero (0) otherwise.

**See also**

- `__FB_OUT_LIB__`
- Static Libraries
- Using the Command Line
Compiler Option: -m

Main file without extension to indicate the main module

Syntax
-m < source file >

Parameters

source file
The name without extension of the main module source file

Description
The -m compiler option specifies a main entry point for a source file; the argument is the name of a source file minus its extension. If "-m" is not specified, the first source file listed is given a main entry point. When using the "-c" or "-r" switch, "-m" must be specified when compiling a main source file.

The intrinsic macro __FB_MAIN__ is defined in the main module and not defined in other modules.

See also
- __FB_MAIN__
- Compiler Option: -c
- Compiler Option: -r
- Using the Command Line
Compiler Option: -map

Save the linking map to file name

**Syntax**

-\*map < map file >

**Parameters**

\*map file

Name of the map file to save generated during linking.

**Description**

The -map compiler option saves the a map file of the executable made

**See also**

- Using the Command Line
Compiler Option: -maxerr

Set maximum number of errors to report before aborting compilation

**Syntax**

- `maxerr < value | "inf" >`

**Parameters**

`value | "inf"`

Specifies the maximum number of errors or no maximum if "inf" is given instead of a value.

**Description**

The `-maxerr` compiler option sets the maximum number of errors the compiler must find before stopping. The default is 10. If `inf`, for infinite is specified the compiler continues until it finds the end of the source. Useful if an IDE is parsing the error messages.

**See also**

- **Using the Command Line**
Compiler Option: -mt

Link with thread-safe runtime library

**Syntax**
- **-mt**

**Description**
The -mt compiler option forces linking with thread-safe runtime library for multithreaded applications. The thread-safe version is always used automatically if the FreeBASIC built-in threading functions are used, so you only need to specify this option if using your own threading routines.

The intrinsic macro __FB_MT__ is set to non-zero (-1) if the -mt option was specified, and set to zero (0) otherwise.

**See also**

- __FB_MT__
- Using the Command Line
Compiler Option: **-nodeflibs**

Do not include the default libraries

**Syntax**

- **-nodeflibs**

**Description**

The **-nodeflibs** compiler option causes default libraries not to be used when linking. The libraries which are normally linked by default can still be used, but only if they are explicitly specified.

**See also**

- Using the Command Line
Compiler Option: -noerrline

Do not show source line where error occurred

**Syntax**

-noerrline

**Description**

The -noerrline compiler option causes reported errors to not show the place in source where error occurred. Useful if an IDE is parsing the error messages.

**See also**

- [Using the Command Line](#)
Compiler Option: -o

Set object file path/name

Syntax

-o < output file >

Parameters

output file
The name, with optional path, of the object file to create.

Description

The -o option can be used to specify the file name for the object file created while compiling an input file. By default, the name for the object file (and other temporaries like assembly files) is based on the name of the corresponding input file, but with an .o extension. This option is useful for example in combination with -c, or to force the compiler to create temporary object files in other directories (if, for example, the source code directory is or should be treated as read-only).

Given -o options are only assigned to input files that need to be compiled, namely *.bas, *.rc, *.res and *.xpm.

Note: -o options can appear in front of or behind the input file they correspond to, but there cannot be multiple -o options for one input file. For example, these are all accepted:
  fbc 1.bas -o 1.o
  fbc -o 1.o 1.bas
  fbc 1.bas -o 1.o 2.bas -o 2.o
  fbc 1.bas -o 1.o -o 2.o 2.bas

However, this is an error:
  fbc 1.bas 2.bas -o 1.o -o 2.o

The -v option makes the compiler show the actual file names that it uses.

See also
- Compiler Option: -b
- Compiler Option: -c
- Using the Command Line
Compiler Option: -O

Set the optimization level for GCC

Syntax

-0 < level >

Parameters

level

The optimization level: 0, 1, 2, 3 or max (3).

Description

Specifies the optimization level to be passed to GCC when using -gen gcc.

See also

- Compiler Option: -gen gcc
- Using the Command Line
Compiler Option: -p

Add a path to search for libraries

**Syntax**

```
-p < library path >
```

**Parameters**

`library path`

The directory path, relative or absolute, of where to search for library files.

**Description**

The -p compiler option adds a path to search for libraries. By default, libraries are looked for in the system FreeBASIC libraries directory and in the current directory.

**See also**

- #libpath
- Using the Command Line
Compiler Option: -pic

Generate position-independent code (non-x86 Unix shared libs)

Syntax
- pic

Description
The -pic compiler option tells the compiler to generate position-independent code. This is needed for creating shared libraries on x86_64 or ARM Linux/BSD platforms except Win64 (and also not on 32bit x86). This option should not be used when creating executables (as opposed to shared libraries) though.

By default, -pic is enabled when using -dll or -dylib, and disabled for all other compilation modes. Usually you only have to specify -pic if you are using -c or -lib and want to link them into shared libraries later.

-pic is implemented by passing -fPIC to gcc (when using the -gen gcc backend). The -gen gas backend does not support position-independent code since it only supports 32bit x86 and there is no special position-independent code needed for shared libraries on 32bit x86.

See also
- Using the Command Line
**Compiler Option: -pp**

Emit the preprocessed input file only, do not compile

**Syntax**

-pp

**Description**

The -pp compiler option enables the preprocessor-only mode. The code is parsed & checked as usual, but is not compiled. A pre-processed version of every input source.bas is generated, named source.pp.bas.

**See also**

- Using the Command Line
**Compiler Option: -prefix**

Set the compiler prefix path

**Syntax**

```
-prefix < path >
```

**Parameters**

`path`

The directory, relative or absolute to where fbc is located.

**Description**

The `-prefix` compiler option sets the compiler prefix (where the compiler finds the bin, lib, and inc directories); and defaults to the path where fbc resides, if this can be determined.

**See also**

- Using the Command Line
Compiler Option: -print

Print out information

**Syntax**

- `print option`

**Description**

The `-print` option can be used to query the compiler for certain information which may be useful especially for build scripts. It does not prevent compilation of input files given besides the `-print` option, but the compiler also can be invoked with only a `-print` option and no input files, in which case it will not compile anything but only respond to the `-print` option.

Currently, the following `-print` options are recognized:

<table>
<thead>
<tr>
<th>option</th>
<th>effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>host</code></td>
<td>Prints the host system on which fbc is running</td>
</tr>
<tr>
<td><code>target</code></td>
<td>Prints the target system for which fbc is compiling (can be affected by the <code>-target</code> option)</td>
</tr>
<tr>
<td><code>x</code></td>
<td>Prints the file name of the output executable or library that fbc will or would generate (named after the <code>-x</code> option), depending on other command line options</td>
</tr>
</tbody>
</table>

**Example**

A makefile could use `target := $(shell $(FBC) -print target)` to find out the compilation target, which would even work when cross-compiling, with `FBC` set to something like `fbc -target foo`.

- `fbc -print x` alone will print out the executable file extension for the target system.
- `fbc -print x -dll` on the other hand will print out the dynamic library file name format.
- `fbc -print x -m foo` will print out the executable file name that would
be used when compiling a module called foo.bas.

`fbc 1.bas 2.bas -lib -print x` will compile 1.bas and 2.bas into a library, whose file name will be displayed.

See also

- `-X`
- `-target`
- Using the Command Line
Compiler Option: -profile

Enable function profiling

**Syntax**

- profile

**Description**

The -profile compiler option enables function profiling. After running an executable compiled with this option, a gmon.out file will be created in the program directory, allowing use of GPROF for analysis of the program's execution.

**See also**

- Profiling
- Using the Command Line
Compiler Option: **-r**

Compile into *.asm/*.c/*.ll file(s) only, do not assemble or link

**Syntax**

`-r`

**Description**

The `-r` option specifies that any source files listed are to be compiled to *.asm/*.c/*.ll files, depending on the used code generation backend, and not compiled or linked into an executable.

When using the `-r` option, `-m` must be specified when compiling the main module.

Use the `-R` option to preserve intermediate files without affecting compilation/assembling/linking.

Use the `-rr` option to compile input source files to *.asm regardless of the code generation backend.

**See also**

- Compiler Option: `-c`
- Compiler Option: `-R`
- Compiler Option: `-m`
- Compiler Option: `-gen`
- Compiler Option: `-rr`
- Using the Command Line
Compiler Option: -R

Preserve intermediate *.asm/*.c/*.ll file(s) generated by compilation

Syntax

-R

Description

The -R compiler option causes the intermediate *.asm/*.c/*.ll file(s) that are generated during the compile process to be preserved. Other than that, compilation is performed as usual. Which files are generate exactly depends on the used code generation backend and compilation target.

When compiling a Windows DLL, -R also preserves the intermediate *.def file used for generating the import library for the DLL.

See also

- Compiler Option: -C
- Compiler Option: -r
- Compiler Option: -gen
- Using the Command Line
Compiler Option: -rr

Compile into *.asm file(s) only, do not assemble or link

**Syntax**

-rr

**Description**

The -rr option specifies that any source files listed are to be compiled to *.asm files, and not compiled or linked into an executable. Unlike with the -r option, this works regardless of the used code generation backend.

When using the -rr option, -m must be specified when compiling a main source file.

Use the -RR option to preserve the generated *.asm files without affecting compilation/assembling/linking.

**See also**

- Compiler Option: -c
- Compiler Option: -r
- Compiler Option: -RR
- Compiler Option: -m
- Compiler Option: -gen
- Using the Command Line
Compiler Option: -RR

Preserve intermediate *.asm files generated by compilation

Syntax
-RR

Description
The -RR compiler option causes the intermediate *.asm file(s) that are generated during the compile process to be preserved. Other than the compilation is performed as usual.

See also
- Compiler Option: -C
- Compiler Option: -rr
- Compiler Option: -R
- Using the Command Line
Compiler Option: -s

Sets the executable subsystem

**Syntax**

```
-s < subsystem >
```

**Parameters**

`subsystem`

The executable subsystem: gui or console.

**Description**

The -s compiler option specifies the executable subsystem. Allowed subsystems are gui and console (by default, console is used). Specifying a gui subsystem prevents the console window from appearing behind the program window.

**Platform Differences**

- Supported on Windows and Cygwin only.

**See also**

- Using the Command Line
Compiler Option: -showincludes

Display a tree of file names of #included files

**Syntax**

- showincludes

**Description**

Tells the compiler to display the file names of loaded source code files in form of a tree. This includes the *.bas files at the toplevel, aswell as the names of #included files as they are being #included. This is intended to be used for debugging #include dependencies, etc.

**See also**

- Using the Command Line
Compiler Option: -static

Prefer static libraries over dynamic ones when linking

**Syntax**

- -static

**Description**

When creating an executable or a shared library/DLL, the -static compiler option can be used to tell the compiler to prefer linking against static libraries rather than shared libraries/DLLs. That way, if the linker finds both static and shared versions of a library, it will use the static version, rather than defaulting to the shared version.

Installing the proper static libraries and then using -static can be used to avoid some or all dependencies on shared libraries.

**Platform Differences**

- On Linux & co it is possible to create purely statically linked executables, because static versions of the system libraries used by FreeBASIC are available.

- On Windows, there are no static versions of the system libraries, but -static can still be useful to decide between static library or DLL versions of other libraries, if both are installed.

**See also**

- Using the Command Line
Compiler Option: -target

Set the target platform for cross compilation

**Syntax**

```
-target < platform >
```

**Parameters**

*platform*

The target platform. Recognized values:

- dos
- win32
- win64
- xbox
- <os>-<arch>

<os> can be one of:

- linux
- cygwin
- darwin
- freebsd
- netbsd
- openbsd

<arch> can be one of:

- x86
- x86_64
- arm
- aarch64

**Examples:**

- linux-x86
- linux-x86_64
- linux-arm
- linux-aarch64
For backwards compatibility, the following values are recognized. They will select the corresponding operating system, together with the compiler’s default architecture (same as the host), because these values do not specify an architecture explicitly.

- linux
- cygwin
- darwin
- freebsd
- netbsd
- openbsd

The **Normal** fbc (e.g. FB-linux release) additionally recognizes GNU triplets, for example

- i686-w64-mingw32
- x86_64-w64-mingw32
- i686-pc-linux-gnu
- arm-linux-gnueabihf
- ...

**Description**

The `-target` compiler option can be used to create an executable for a platform which is different from the host on which the source code is being compiled and linked. Appropriate libraries and cross compilation tools (assembler, linker) must be installed for cross compilation to work (also see [FB and cross-compiling](#)).

If `-target <platform>` is given, the compiler will compile programs more or less as if they were compiled on the given platform. This affects which `__FB_*__` operating-system-specific symbol will be predefined, the default calling convention, the object and executable file
format (e.g. ELF/COFF), the available runtime libraries and functions, etc.

With a standalone FB setup such as the FB-dos or FB-win32 releases:

- Specifying \texttt{-target <platform>} causes the compiler to use the compiler tools in the \texttt{bin/<platform>/} directory, and target-specific libraries in the \texttt{lib/<platform>/} directory. For example, \texttt{-target win32} causes the compiler to compile for Win32 and use tools from \texttt{bin/win32/} and libraries from \texttt{lib/win32/}.

- It is unnecessary (but safe) to specify a \texttt{-target} option that matches the host (for example \texttt{-target win32 on win32}). It does not make a difference to the compilation process.

- If \texttt{-target} is not specified, the compiler defaults to compiling for the native system. It will then use the compiler tools and libraries from the \texttt{bin/} and \texttt{lib/} directories corresponding to the native system.

With a normal FB setup such as the FB-linux release:

- Specifying \texttt{-target <platform>} causes the compiler to prefix the \texttt{<platform>-} string to the executable names of binutils and gcc. For example, specifying \texttt{-target i686-w64-mingw32} causes the compiler to invoke \texttt{i686-w64-mingw32-ld} instead of \texttt{ld} (same for other tools besides the linker). This allows fbc to integrate with binutils/gcc cross-compiler toolchains and matches how cross-compiling tools are typically installed on Linux distributions.

- Note that specifying something like \texttt{-target win32} does not usually make sense here. It causes the compiler to try to use \texttt{win32-ld} which usually does not exist, because binutils/gcc toolchains for cross-compilation to Windows typically have names such as \texttt{i686-pc-mingw32}, not just \texttt{win32}. Thus, it is necessary to specify something like \texttt{-target i686-pc-mingw32} instead of \texttt{-target win32}. 
For backwards compatibility, if the given platform string describes the host and is an FB target name (the values accepted by the -target option with a standalone FB setup) instead of a GNU triplet, then the -target option will be ignored, and the <platform>- string will not be prefixed to compiler tools. For example, this allows -target linux to work with the FB-linux release. It will be ignored instead of causing the compiler to try to use linux-ld instead of ld.

If -target is not specified, the compiler defaults to compiling for the native system, and it will invoke binutils/gcc without a target-specific prefix. This allows fbc to integrate with usual Linux (and similar) systems where binutils/gcc for native compilation are installed without any target-specific prefix.

Libraries besides FB's own runtime libraries are located by running gcc -print-file-name=... (or <platform>-gcc -print-file-name=...). This allows fbc to use the system and gcc libraries installed on Linux and similar systems without knowing the exact installation directories.

See also
- Using the Command Line
- FB and cross-compiling
Compiler Option: -t

Set stack size in kilobytes

Syntax
- t < stack size >

Parameters
stack size
Stack size in kilobytes.

Description
The -t compiler option sets the stack size in kilobytes (defaults to 102 KBytes). The local arrays are created in the stack, so 1MB of stack is not always enough.

Platform Differences
- Supported on Windows, Cygwin and DOS only.

See also
- Using the Command Line
Compiler Option: -v

Be verbose

Syntax
-v

Description
The -v compiler option activates verbose mode. In this mode the compiler shows its actions step by step

See also
- Using the Command Line
**Compiler Option: -vec**

Enables vector optimizations by the compiler.

**Syntax**

```
-vec < level >
```

**Parameters**

`level`

The level of vectorization: (0 | none) | 1 | 2.

**Description**

The `-vec` compiler option enables multiple levels of optimizations by searching for multiple scalar expressions that can be merged into a single vector expression. If this option is not specified, the default is `-vec 0`.

- `-vec 0 | none` will disable vector optimizations.

- `-vec 1` will enable complete expression merging vectorization.

- `-vec 2` includes `-vec 1` but also enables intra-expression vectorization.

This option is dependent on the `-fpu SSE` command line option. Attempting to enable vector optimizations without using `-fpu SSE` will generate an error.

**See also**

- [Using the Command Line](#)
- [Compiler option -fpu](#)
Compiler Option: -version

Show compiler version

Syntax

-version

Description

The -version compiler option makes FBC show the compiler version and exit. Any other command-line options are ignored, and no compilation will be performed.

See also

- Using the Command Line
Compiler Option: -w

Set minimum warning level.

**Syntax**

-w *level* | all | param | Escape | pedantic | Next

**Parameters**

*level*
Warning messages only with a level equal or greater to this value will be output.

*all*
Equivalent to specifying a *level* of zero (0).

*param*
Warn when procedure parameters aren't specified with either *ByVal* or *ByRef*.

*Escape*
Warn when string literals contain any number of escape characters (\).

*pedantic*
Equivalent to specifying the *param* and *Escape* arguments.

*Next*
Warn when *Next* is followed by an identifier.

**Description**

The -w compiler option determines which compiler warnings, if any, are output. Each possible warning is associated with a warning level, starting from zero (0) and increasing with the potential problems that may occur. A significantly high *level* value will have the effect of suppressing all warning messages.

Note that the *param*, *Escape*, *pedantic* and *Next* arguments provide additional warnings not ordinarily output, even by default.

If the -w option is not specified, it's as if -w 0 was used. The -w option can be specified multiple times.

**See also**
Using the Command Line
**Compiler Option: -Wa**

Pass options to the assembler when using the assembly emitter (-gen gas), the default.

**Syntax**

-`-Wa < options >`

**Parameters**

`options`  
Additional options to pass to the assembler.

**Description**

The `-wa` compiler option passes additional options to GAS, the assembler. Options must be separated by commas only. For example:

```
fbc -Wa -o,output.o,--verbose
```

**See also**

- Compiler Option: -gen
- Compiler Option: -Wc
- Compiler Option: -WI
- Using the Command Line
**Compiler Option: -Wc**

Pass options to the C compiler when using the C emitter (-gen gcc).

**Syntax**

-`-Wc < options >`

**Parameters**

`options`

Additional options to pass to the C compiler.

**Description**

The `-Wc` compiler option passes additional options to GCC, the C compiler. Options must be separated by commas only.

For example:

```bash
fbc -gen gcc -Wc -m32,--verbose,-include,some-header.h
```

**See also**

- Compiler Option: `-gen`
- Compiler Option: `-Wa`
- Compiler Option: `-Wl`
- Using the Command Line
Pass options to linker

**Syntax**

```
-Wl < options >
```

**Parameters**

`options`
Additional options to pass to the linker.

**Description**

The `-Wl` compiler option passes additional options to LD, the linker. Options must be separated by commas only.

**See also**

- [Compiler Option: -Wa](#)
- [Using the Command Line](#)
Compiler Option: -x

Set executable/library path/name

**Syntax**

- `x < name >`

**Parameters**

*name*

Name of the executable or library file.

**Description**

The `-x` compiler option set the executable or library name, with extension. Defaults to the name of the first source file passed on the command line. When compiling libraries, be sure to add the "lib" prefix to the file name, otherwise the linker will not be able to find it. If compiling and linking separately, this option must be set only in the linker.

**See also**

- [Using the Command Line](#)
Compiler Option: -z

Sets miscellaneous or experimental compiler options.

**Syntax**

\[-z \ < \ value \ >\]

**Parameters**

*value*

Miscellaneous compiler option.

**Description**

The -z compiler option sets miscellaneous, obscure, temporary, or experimental options used by the developers. There is no guarantee that these options will be supported in future versions of the compiler.

**-z gosub-setjmp**

Specifies that the `setjmp/longjmp` implementation of `GoSub` should be used even when the GAS backend is used. By default, `GoSub` will be supported in `-gen gas` using `CALL/RET` assembly instructions and in `-gen gcc` using `setjmp/longjmp` C runtime functions.

**See also**

- Using the Command Line
Debugging

The debugger is in the bin\win32 or bin\dos directories (the GDB.EXE file), for the Windows and DOS versions respectively. It usually comes already installed in most Linux distros.

(Note: all commands should be typed without quotes and then [return] must be pressed.)

- Compile the sources using the -g cmd-line option to add debugging support.
- Load it in GDB using: "gdb myapplicationname.exe"
- Set the arguments to the application been debugged using: "set args arg1 arg2 argn". You can also run GDB and pass the arguments directly to the application been debugged: "gdb --args myapp.exe arg1 arg2 arg3".
- If the executable isn't in the same directory of the source files where it was compiled, type: "dir path/to/my/application/sources".
- Place a breakpoint in the first line using: "b main". To place a breakpoint in a function called "abc" use: "b ABC" (note: all in uppercase, GDB is case sensitive by default, but you can use the "set language pascal" command to change GDB to case-insensitive mode).
- Type "r" to start the application.
- Type "n" to step over function calls. Keep pressing [return] to skip to the next line.
- Type "s" to step into function calls. Same as above.
- Type "c" to continue execution until the next breakpoint.
- Use "print ABC" to show the contents of the variable called "abc". GDB supports pointer/pointer field dereferencing, indexing and arithmetics too, so "print *MYPOINTER" will also work. (note: undeclared variables or the ones with suffixes like % & ! # $ can't be printed).
- Use "disp ABC" to display the contents of a variable called "abc".
- Use "watch ABC" to stop each time a variable called "abc" is changed.
- Use "r" again to restart the application when finished.
- Type "q" to quit.
- Type "help" to see a list of commands, there are many others.
Compiler Error Messages

During the program compilation three types of errors can arise:

**Compiler Warnings:**
The warnings don't stop the compilation, just alert the user some non-recommended and error-prone operation is attempted in the code. Sometimes one of these operations is coded deliberately to achieve a result, in this case the warnings can be disabled by setting the `-w 1` option at the command line.

- 1 Passing scalar as pointer
- 2 Passing pointer to scalar
- 3 Passing different pointer types
- 4 Suspicious pointer assignment
- 5 Implicit conversion
- 6 Cannot export symbol without `-export` option
- 7 Identifier's name too big, truncated
- 8 Literal number too big, truncated
- 9 Literal string too big, truncated
- 10 UDT with pointer or var-len string fields
- 11 Implicit variable allocation
- 12 Missing closing quote in literal string
- 13 Function result was not explicitly set
- 14 Branch crossing local variable definition
- 15 No explicit `BYREF` or `BYVAL`
- 16 Possible escape sequence found in
- 17 The type length is too large, consider passing `BYREF`
- 18 The length of the parameters list is too large, consider passing UDT's `BYREF`
- 19 The ANY initializer has no effect on UDT's with default constructors
- 20 Object files or libraries with mixed multithreading (`-mt`) options
- 21 Object files or libraries with mixed language (-lang) options
- 22 Deleting ANY pointers is undefined
- 23 Array too large for stack, consider making it var-len or SHARED
- 24 Variable too large for stack, consider making it SHARED
- 25 Overflow in constant conversion
- 26 Variable following NEXT is meaningless
- 27 Cast to non-pointer
- 28 Return method mismatch
- 29 Passing Pointer
- 30 Command line option overrides directive
- 31 Directive ignored after first pass
- 32 'IF' statement found directly after multi-line 'ELSE'
- 33 Shift value greater than or equal to number of bits in data type
- 34 '=' parsed as equality operator in function argument, not assignment to BYREF function result
- 35 Mixing signed/unsigned operands
- 36 Mismatching parameter initializer
- 37
- 38 Mixing operand data types may have undefined results
- 39 Redefinition of intrinsic

Compiler Error messages:
The error messages stop the compilation after 10 errors (see the -maxerr command-line option to change that default value) or a fatal error occurred, and require a correction by the user before the compilation can be continued. The compiler signals the lines where the errors have been found, so the correction can be done quickly. In a few cases the place pointed at by the error messages is not where the errors can be found, it's the place where the compiler has given up in waiting for something that should be somewhere.

- 1 Argument count mismatch
- 2 Expected End-of-File
- 3 Expected End-of-Line
- 4 Duplicated definition
- 5 Expected 'AS'
- 6 Expected '('
- 7 Expected ')'
- 8 Undefined symbol
- 9 Expected expression
- 10 Expected '='
- 11 Expected constant
- 12 Expected 'TO'
- 13 Expected 'NEXT'
- 14 Expected identifier
- 15 Expected '-'
- 16 Expected ','
- 17 Syntax error
- 18 Element not defined
- 19 Expected 'END TYPE' or 'END UNION'
- 20 Type mismatch
- 21 Internal!
- 22 Parameter type mismatch
- 23 File not found
- 24 Invalid data types
- 25 Invalid character
- 26 File access error
- 27 Recursion level too deep
- 28 Expected pointer
- 29 Expected 'LOOP'
- 30 Expected 'WEND'
- 31 Expected 'THEN'
- 32 Expected 'END IF'
- 33 Illegal 'END'
- 34 Expected 'CASE'
- 35 Expected 'END SELECT'
- 36 Wrong number of dimensions
- 37 Array boundaries do not match the original EXTERN declaration
- 38 'SUB' or 'FUNCTION' without 'END SUB' or 'END FUNCTION'
- 39 Expected 'END SUB' or 'END FUNCTION'
- 40 Illegal parameter specification
- 41 Variable not declared
- 42 Variable required
- 43 Illegal outside a compound statement
- 44 Expected 'END ASM'
- 45 Function not declared
- 46 Expected ';
- 47 Undefined label
- 48 Too many array dimensions
- 49 Array too big
- 50 User Defined Type too big
- 51 Expected scalar counter
- 52 Illegal outside a CONSTRUCTOR, DESTRUCTOR, FUNCTION, OPERATOR, PROPERTY or SUB block
- 53 Expected var-len array
- 54 Fixed-len strings cannot be returned from functions
- 55 Array already dimensioned
- 56 Illegal without the -ex option
- 57 Type mismatch
- 58 Illegal specification
- 59 Expected 'END WITH'
- 60 Illegal inside functions
- 61 Statement in between SELECT and first CASE
- 62 Expected array
- 63 Expected '{'
- 64 Expected '}'
- 65 Expected ']'
- 66 Too many expressions
- 67 Expected explicit result type
- 68 Range too large
- 69 Forward references not allowed
- 70 Incomplete type
- 71 Array not dimensioned
- 72 Array access, index expected
- 73 Expected 'END ENUM'
- 74 Var-len arrays cannot be initialized
- 75 '...' ellipsis upper bound given for dynamic array (this is not supported)
- 76 '...' ellipsis upper bound given for array field (this is not supported)
- 77 Invalid bitfield
- 78 Too many parameters
- 79 Macro text too long
- 80 Invalid command-line option
- 81 Selected non-x86 CPU when compiling for DOS
- 82 Selected -gen gas ASM backend for non-x86 CPU
- 83 -asm att used for -gen gas, but -gen gas only supports -asm intel
- 84 -pic used when making executable (only works when making a shared library)
- 85 -pic used, but not supported by target system (only works for non-x86 Unixes)
- 86 Var-len strings cannot be initialized
- 87 Recursive TYPE or UNION not allowed
- 88 Recursive DEFINE not allowed
- 89 Identifier cannot include periods
- 90 Executable not found
- 91 Array out-of-bounds
- 92 Missing command-line option for
- 93 Expected 'ANY'
- 94 Expected 'END SCOPE'
- 95 Illegal inside a compound statement or scoped block
- 96 UDT function results cannot be passed by reference
- 97 Ambiguous call to overloaded function
- 98 No matching overloaded function
- 99 Division by zero
- 100 Cannot pop stack, underflow
- 101 UDT's containing var-len string fields cannot be initialized
- 102 Branching to scope block containing local variables
- 103 Branching to other functions or to module-level
- 104 Branch crossing local array, var-len string or object definition
- 105 LOOP without DO
- 106 NEXT without FOR
- 107 WEND without WHILE
- 108 END WITH without WITH
- 109 END IF without IF
- 110 END SELECT without SELECT
- 111 END SUB or FUNCTION without SUB or FUNCTION
- 112 END SCOPE without SCOPE
- 113 END NAMESPACE without NAMESPACE
- 114 END EXTERN without EXTERN
- 115 ELSEIF without IF
- 116 ELSE without IF
- 117 CASE without SELECT
- 118 Cannot modify a constant
- 119 Expected period ('.')
- 120 Expected 'END NAMESPACE'
- 121 Illegal inside a NAMESPACE block
- 122 Symbols defined inside namespaces cannot be removed
- 123 Expected 'END EXTERN'
- 124 Expected 'END SUB'
- 125 Expected 'END FUNCTION'
- 126 Expected 'END CONSTRUCTOR'
- 127 Expected 'END DESTRUCTOR'
- 128 Expected 'END OPERATOR'
- 129 Expected 'END PROPERTY'
- 130 Declaration outside the original namespace
- 131 No end of multi-line comment, expected ""/
- 132 Too many errors, exiting
- 133 Expected 'ENDMACRO'
- 134 EXTERN or COMMON variables cannot be initialized
- 135 EXTERN or COMMON dynamic arrays cannot have initial bounds
- 136 At least one parameter must be a user-defined type
- 137 Parameter or result must be a user-defined type
- 138 Both parameters can't be of the same type
- 139 Parameter and result can't be of the same type
- 140 Invalid result type for this operator
- 141 Invalid parameter type, it must be the same as the parent TYPE/CLASS
- 142 Vararg parameters are not allowed in overloaded functions
- 143 Illegal outside an OPERATOR block
- 144 Parameter cannot be optional
- 145 Only valid in -lang
- 146 Default types or suffixes are only valid in -lang
- 147 Suffixes are only valid in -lang
- 148 Implicit variables are only valid in -lang
- 149 Auto variables are only valid in -lang
- 150 Invalid array index
- 151 Operator must be a member function
- 152 Operator cannot be a member function
- 153 Method declared in anonymous UDT
- 154 Constant declared in anonymous UDT
- 155 Static variable declared in anonymous UDT
- 156 Expected operator
- 157 Declaration outside the original namespace or class
- 158 A destructor should not have any parameters
- 159 Expected class or UDT identifier
- 160 Var-len strings cannot be part of UNION's or nested TYPE's
- 161 Dynamic arrays cannot be part of UNION's or nested TYPE's
- 162 Fields with constructors cannot be part of UNION's or nested TYPE's
- 163 Fields with destructors cannot be part of UNION's or nested TYPE's
- 164 Illegal outside a CONSTRUCTOR block
- 165 Illegal outside a DESTRUCTOR block
- 166 UDT's with methods must have unique names
- 167 Parent is not a class or UDT
- 168 CONSTRUCTOR() chain call not at top of constructor
- 169 BASE() initializer not at top of constructor
- 170 REDIM on UDT with non-CDECL constructor
- 171 REDIM on UDT with non-CDECL destructor
- 172 REDIM on UDT with non-parameterless default constructor
- 173 ERASE on UDT with non-CDECL constructor
- 174 ERASE on UDT with non-CDECL destructor
- 175 ERASE on UDT with non-parameterless default constructor
- 176 This symbol cannot be undefined
- 177 RETURN mixed with 'FUNCTION =' or EXIT FUNCTION (using both styles together is unsupported when returning objects with constructors)
- 178 'FUNCTION =' or EXIT FUNCTION mixed with RETURN (using both styles together is unsupported when returning objects with constructors)
- 179 Missing RETURN to copy-construct function result
- 180 Invalid assignment/conversion
- 181 Invalid array subscript
- 182 TYPE or CLASS has no default constructor
- 183 Function result TYPE has no default constructor
- 184 Missing BASE() initializer (base UDT without default constructor requires manual initialization)
- 185 Missing default constructor implementation (base UDT without default constructor requires manual initialization)
- 186 Missing UDT.constructor(byref as UDT) implementation (base UDT without default constructor requires manual initialization)
- 187 Missing UDT.constructor(byref as const UDT) implementation (base UDT without default constructor requires manual initialization)
- 188 Invalid priority attribute
- 189 PROPERTY GET should have no parameter, or just one if indexed
- 190 PROPERTY SET should have one parameter, or just two if indexed
- 191 Expected 'PROPERTY'
- 192 Illegal outside a PROPERTY block
- 193 PROPERTY has no GET method/accessor
- 194 PROPERTY has no SET method/accessor
- 195 PROPERTY has no indexed GET method/accessor
- 196 PROPERTY has no indexed SET method/accessor
- 197 Missing overloaded operator:
- 198 The NEW[] operator does not allow explicit calls to constructors
- 199 The NEW[] operator only supports the { ANY } initialization
- 200 The NEW operator cannot be used with fixed-length strings
- 201 Illegal member access
- 202 Expected ':'
- 203 The default constructor has no public access
- 204 Constructor has no public access
- 205 Destructor has no public access
- 206 Accessing base UDT's private default constructor
- 207 Accessing base UDT's private destructor
- 208 Illegal non-static member access
- 209 Constructor declared ABSTRACT
- 210 Constructor declared VIRTUAL
- 211 Destructor declared ABSTRACT
- 212 Member cannot be static
- 213 Member isn't static
- 214 Only static members can be accessed from static functions
- 215 The PRIVATE and PUBLIC attributes are not allowed with REDIM, COMMON or EXTERN
- 216 STATIC used here, but not the in the DECLARE statement
- 217 CONST used here, but not the in the DECLARE statement
- 218 VIRTUAL used here, but not the in the DECLARE statement
- 219 ABSTRACT used here, but not the in the DECLARE statement
- 220 Method declared VIRTUAL, but UDT does not extend OBJECT
- 221 Method declared ABSTRACT, but UDT does not extend OBJECT
- 222 Not overriding any virtual method
- 223 Implemented body for an ABSTRACT method
- 224 Override has different return type than overridden method
- 225 Override has different calling convention than overridden method
- 226 Implicit destructor override would have different calling convention
- 227 Implicit LET operator override would have different calling convention
- 228 Override is not a CONST member like the overridden method
- 229 Override is a CONST member, but the overridden method is
- 230 Override has different parameters than overridden method
- 231 This operator cannot be STATIC
- 232 This operator is implicitly STATIC and cannot be VIRTUAL or ABSTRACT
- 233 This operator is implicitly STATIC and cannot be CONST
- 234 Parameter must be an integer
- 235 Parameter must be a pointer
- 236 Expected initializer
- 237 Fields cannot be named as keywords in TYPE's that contain member functions or in CLASS'es
- 238 Illegal outside a FOR compound statement
- 239 Illegal outside a DO compound statement
- 240 Illegal outside a WHILE compound statement
- 241 Illegal outside a SELECT compound statement
- 242 Expected 'FOR'
- 243 Expected 'DO'
- 244 Expected 'WHILE'
- 245 Expected 'SELECT'
- 246 No outer FOR compound statement found
- 247 No outer DO compound statement found
- 248 No outer WHILE compound statement found
- 249 No outer SELECT compound statement found
- 250 Expected 'CONSTRUCTOR', 'DESTRUCTOR', 'DO', 'FOR', 'FUNCTION', 'OPERATOR', 'PROPERTY', 'SELECT', 'SUB' or 'WHILE'
- 251 Expected 'DO', 'FOR' or 'WHILE'
- 252 Illegal outside a SUB block
- 253 Illegal outside a FUNCTION block
- 254 Ambiguous symbol access, explicit scope resolution required
- 255 An ENUM, TYPE or UNION cannot be empty
- 256 ENUM's declared inside EXTERN .. END EXTERN blocks
**don’t open new scopes**

- 257 STATIC used on non-member procedure
- 258 CONST used on non-member procedure
- 259 ABSTRACT used on non-member procedure
- 260 VIRTUAL used on non-member procedure
- 261 Invalid initializer
- 262 Objects with default [con|de]structors or methods are only allowed in the module level
- 263 Static member variable in nested UDT (only allowed in toplevel UDTs)
- 264 Symbol not a CLASS, ENUM, TYPE or UNION type
- 265 Too many elements
- 266 Only data members supported
- 267 UNIONs are not allowed
- 268 Arrays are not allowed
- 269 COMMON variables cannot be object instances of CLASS/TYPE’s with cons/destructors
- 270 Cloning operators (LET, Copy constructors) can’t take a byval arg of the parent’s type
- 271 Local symbols can’t be referenced
- 272 Expected 'PTR' or 'POINTER'
- 273 Too many levels of pointer indirection
- 274 Dynamic arrays can’t be const
- 275 Const UDT cannot invoke non-const method
- 276 Elements must be empty for strings and arrays
- 277 GOSUB disabled, use 'OPTION GOSUB' to enable
- 278 Invalid -lang
- 279 Can’t use ANY as initializer in array with ellipsis bound
- 280 Must have initializer with array with ellipsis bound
- 281 Can’t use ... as lower bound
- 282 FOR/NEXT variable name mismatch
- 283 Selected option requires an SSE FPU mode
- 284 Expected relational operator ( =, >, <, <=, >= )
- 285 Unsupported statement in -gen gcc mode
- 286 Too many labels
- 287 Unsupported function
- 288 Expected sub
- 289 Expected ‘#ENDIF’
- 290 Resource file given for target system that does not support them
- 291 -o <file> option without corresponding input file
- 292 Not extending a TYPE/UNION (a TYPE/UNION can only extend other TYPEs/UNIONS)
- 293 Illegal outside a CLASS, TYPE or UNION method
- 294 CLASS, TYPE or UNION not derived
- 295 CLASS, TYPE or UNION has no constructor
- 296 Symbol type has no Run-Time Type Info (RTTI)
- 297 Types have no hierarchical relation
- 298 Expected a CLASS, TYPE or UNION symbol type
- 299 Casting derived UDT pointer from incompatible pointer type
- 300 Casting derived UDT pointer from unrelated UDT pointer type
- 301 Casting derived UDT pointer to incompatible pointer type
- 302 Casting derived UDT pointer to unrelated UDT pointer type
- 303 ALIAS name string is empty
- 304 LIB name string is empty
- 305 UDT has unimplemented abstract methods
- 306 Non-virtual call to ABSTRACT method
- 307 #ASSERT condition failed
- 308 Expected ‘>’
- 309 Invalid size
- 310 ALIAS name here is different from ALIAS given in DECLARE prototype
- 311 vararg parameters are only allowed in CDECL procedures
- 312 the first parameter in a procedure may not be vararg
- 313 CONST used on constructor (not needed)
- 314 CONST used on destructor (not needed)
- 315 Byref function result not set
- 316 Function result assignment outside of the function
- 317 Type mismatch in byref function result assignment
- 318 -asm att\intel option given, but not supported for this target (only x86 or x86_64)
- 319 Reference not initialized
- 320 Incompatible reference initializer
- 321 Array of references - not supported yet
- 322 Invalid CASE range, start value is greater than the end value
- 323 Fixed-length string combined with BYREF (not supported)

Third party programs errors
These errors occur after the source has been compiled into assembler, they come from the auxiliary programs FB requires to compile a source into an executable: the linker, the assembler and (for Windows programs) the resource compiler.

If an IDE or a make utility are been used, additional errors can arise. These errors are outside the scope of this help.
Tools used by fbc

External tools the FreeBASIC compiler (fbc) may invoke during the compilation process.

Description

FreeBASIC uses several tools for compiling source code in addition to the fbc compiler. The exact tools used by fbc and how they are invoked depends on how fbc was configured, the host platform (where fbc is running), the target platform (where the produced executable will be run), and other options (like environment variables and command line options).

FreeBASIC (fbc) may have been configured in one of two ways: either as standalone or prefixed. The standalone version searches directories relative to where the executable is located. The prefixed version has a hardcoded path configured in to the compiler indicating where it expects to find additional tools and libraries. For more information on configuring FreeBASIC, see the INSTALL text file located in the src/compiler directory of the FreeBASIC sources.

You can check if your installed version of fbc is "standalone" or "prefixed" by invoking fbc with the -version command line option.

Standalone

If fbc was configured as "standalone", it will search for files relative to where the fbc executable is located. fbc is at the "top" of the directory tree and searches sub-directories below it. The "top" directory (which defaults to the location where fbc is located) can be overridden with the -prefix command line option. "topdir" shown in the directories below represents the directory where the fbc executable is located, or the directory specified with the -prefix command line option (if it was given). "<target>" refers to the target platform having the same name as specified by the -target option.

If not cross compiling, fbc looks in these locations:

- /topdir/inc
- /topdir/lib/<target>
- /topdir/bin/<target>

GCC is queried for missing libraries (currently on linux/freebsd only)

If cross compiling, fbc looks in these locations:
- /topdir/inc
- /topdir/lib/<target>
- /topdir/bin/<target>

GCC is not queried (only target library directory is used)

**Prefixed**

If fbc was configured as "prefixed", it will search for files relative to the configured prefix (hardcoded in the fbc executable). "prefix" shown in the directories below represents the configured prefix, or the directory specified with the -prefix command line option (if it was given). "<target>" refers to the target platform having the same name as specified by the -target option.

If not cross compiling, fbc looks in these locations:
- /prefix/include/freebasic
- /prefix/lib/freebasic/<target>
- /prefix/bin/freebasic/<target>

GCC is queried for missing libraries (currently on linux/freebsd only)

If cross compiling, fbc looks in these locations:
- /prefix/include/freebasic
- /prefix/lib/freebasic/<target>
- /prefix/bin/freebasic/<target>

GCC is not queried (only target library directory is used)

**GCC Queries**

If fbc is unable to locate a file, it may invoke gcc -print-file-name= <file> to query the location of the file. The following are files that may
be located using gcc:
- crt1.o
- crtbegin.o
- crtend.o
- cti.o
- crtn.o
- gcrt1.o
- libgcc.a
- libsupc++.a
- libc.so (Linux only)

Finding Binaries
fbc will invoke additional tools (binary executables) as part of the compiling and linking process. The following is a list of tools (executables) that may be invoked by fbc depending on the host platform, target, or type of executable or library to be produced:
- as
- ar
- ld
- gcc
- GoRC
- dlltool
- pexports
- cxbe

fbc will search for these tools in the following manner:
- If an environment variable (having same name as the tool without any extension, all in uppercase) has been set, it explicitly indicates the path and name of the executable to be invoked.
- If the file (or a symlink) exists in
  prefix/bin/freebasic/<target>, or ./bin/<target> for the standalone version, then use it.
- On Linux, if the tool could not be found in
prefix/bin/freebasic/<target>, or ./bin/<target> for the standalone version, fbc tries to invoke it anyway as it may be installed on the system and located on the PATH.

"<target>" refers to the target platform having the same name as specified by the -target option.

See also

- Running FreeBASIC
- Compiler Command Line Options
- Compiler FAQ
**FreeBASIC the Successor**
FreeBASIC is designed as an official successor of sorts to a high level compiler for MS-DOS titled "QuickBASIC", which compiled BASIC code, an easy-to-read programming language created in 1964 by John Kemeny and Thomas Kurtz. "QB" was packaged with a user-friendly IDE and interpreter that made it very easy to write custom applications. This line of products is officially continued today in the form of "Visual Basic", part of Microsoft's Visual Studio .NET programming suite.

**Microsoft and BASIC Products**
Microsoft and BASIC extend far prior to QuickBASIC. In fact, Microsoft's first product was a small BASIC interpreter for Altair computers released in 1975, and until the early 1980s Microsoft was known only as a language vendor. They ported their BASIC software to several different personal computers at the time and made decent business doing it.

In August of 1981 Microsoft released the next major step in its BASIC line, "Advanced BASIC", as part of a commission for IBM's PC-DOS, and is more often called by its executable name, BASICA.EXE. For Microsoft's new MS-DOS, they released GW-BASIC, which was, for the most part, a port of BASICA that did not require IBM's Basic ROM included with its systems.

BASICA and GW-BASIC are interpreters. Interpreters read source code and "interpret" it into computer code as it is read. This is useful, but slow. Microsoft, in 1983, released BASCOM for MS-DOS. BASCOM compiled BASIC code into native machine code, which ran much faster than interpreted code. This was repackaged with an IDE and released as QuickBASIC in 1985.

**QuickBASIC**
From 1985 to 1992, QuickBASIC was the primary BASIC product, released by Microsoft and using BASCOM, and later the Microsoft BASI Compiler. In 1991, a slimmed down interpreter often thought to be the
missing "QuickBASIC 5.0" was packaged with MS-DOS 5.0 and released as "QBasic 1.1".

QuickBASIC as a BASIC dialect provides a loose standard for modern BASIC compilers. It abolishes the need for line numbers as used in previous BASIC interpreters, is case sensitive and has keywords that are in plain English. QuickBASIC also featured a runtime library, a library compiled by default and usable in source code, with many useful commands.

In 1991, Microsoft combined a drag-and-drop GUI designer made in 1988 called 'Ruby' with QuickBASIC. This product was called "Visual Basic", and marks the beginning of the end of QuickBASIC. Microsoft released one last version of QuickBASIC called "Visual Basic for DOS" in 1992, and discontinued the product forever.

The Internet and QBasic's Second Wind

Because the "QBasic 1.1" interpreter was packaged with MS-DOS, it was released with every copy of DOS until its dying days, Windows 3.1, and even Windows 95, 98 and ME. With the wild success of Windows, QBasic became the most widely available programming tool available for Microsoft operating systems.

When the World Wide Web became popular in the mid-90s, many hobbyist programmers made websites dedicated to QuickBASIC not as an application tool, but as a platform for their demos and games. Many assembly libraries were created for it after Microsoft dropped support, and as these demos and games became more elaborate, so did the "QE Community". From the mid-90s, through the new millennium to today, QuickBASIC has enjoyed a small but present cult following.

Andre Victor, FreeBASIC's creator, was first known over the internet as the author of several extensions to QuickBASIC in the form of libraries. He created routines to improve the speed of floating point operations, access the internet, use SVGA graphics, and provide powerful QBasic language programming features. In the late summer of 2004, he began work on a 32-bit compiler using Visual Basic for DOS.
FreeBASIC is Born
FreeBASIC was first programmed in VB-DOS, with the goal of compiling itself. Because of this, both its syntax and runtime library are designed to emulate QB's syntax and runtime as far as it is practical in a 32-bit Windows environment. For the most part, the two dialects are extremely similar, and most code can be ported with little or no modification, though in some cases routines reliant on 16-bit DOS must be rewritten. The resulting compiler shares a greater similarity to QB than any compiler on the market, including Visual Basic.

Because of its open source, its well-written code and its similarity to QB, FreeBASIC has become popular among the "QB Community" and its boundaries continue to grow as it receives more attention and gathers more features that promise to move BASIC into the future.
Differences from QB

Since version 0.17, FreeBASIC introduced a -lang command-line option that is used to change the language compatibility mode. Use the -lang qb option when compiling to select the most QB compatible parser. All differences listed below assume that -lang qb was used.

Architecture/Platform incompatibilities

- FreeBASIC is written for 32-bit operating systems and a 32 bit DOS extender, and cannot utilize code which depends on 16-bit DOS, 16 bit assembly or memory model (segment & offset, XMS/EMS, ...).
- DEF SEG is no longer necessary and will not work - any code which POKEs to video memory this way will no longer function, however, for DOS it can be easily rewritten using DPMI features.
- CALL INTERRUPT no longer functions, as it relies on 16-bit DOS. DOS interrupts can be called in the DOS32 version by using the DPMI library, but they might work slowly because of the 32bit-16bit-32bit mode changes the processor will have to perform.

Changed due to ambiguity

- A scalar variable and an array with the same name and suffix can no longer share the same name.
- SHARED can’t be used inside a SUB or FUNCTION as it resulted in shared variables not defined in the main program. A proper DIM SHARED in the main program must be used.
- COMMON declarations do not depend on the order they are made, variables are matched by name and for that reason named COMMON is no longer supported. All COMMON arrays are variable-length arrays in FB.
- If a single line IF has an (unnecessary) colon directly after the THEN, it has to be terminated by an End If in FB. If that unneeded colon is removed, FB will behave as QB.

Design differences

- Graphics support was internally redesigned, see GfxLib overview
• CLEAR is no longer used to reset all variables and set the stack. Variables must be reset one by one, and stack size can be changed in the compiler command line. The keyword CLEAR is used to do memory fills in FB.

• String DATA items must be enclosed in quotes in FB, in QB this was optional.

• All functions must have been declared, even with a CALL in FreeBASIC. With CALL it was possible to invoke prototype-less functions in QuickBASIC. (to be supported in future with -lang qb)

• In FreeBASIC all arrays must be explicitly declared. (Interpreted QuickBASIC arrays are automatically created with up to 10 indices.)

• Strings use a null (char 0) terminator to be compatible with C libraries and the Windows API, fixed-length strings can't contain chr$(0) chars for now.

• When INKEY[] reads an extended key (Num Pad, Arrows...) it returns a two character string. In FB the first character is CHR[] (255), while in QB this first char is CHR$(0).

• With fixed length strings FreeBASIC gives the real length as Len plus one (null-char), even on Type fields.

• In FreeBASIC, unused characters of fixed-length strings are set to 0, regardless of what "-lang" compiler option is used. In QB, unused characters are set to 32 (space, or " ", in ASCII).

• When a fixed-length string is declared, but still not initialized, all characters are set to 0, both in FreeBASIC and QB.

• The arrays are stored in row-major order in FB, they were stored in column-major order in QB by default. Row major order: data with the same last index are contiguous. Column-major order: data with the same first index are contiguous. For example, if you have DIM A(1 TO 3, 1 TO 8), in row-major order the elements are stored such that A(3, 5) is followed in memory by A(3, 6); in column-major order A(3, 5) is followed in memory by A(4, 5).

• Programs don't stop anymore on runtime errors unless -e or -ex option is used in the command line. Using these options allow the use of QB style error handling (ON ERROR, RESUME...).

• Octal numbers are written &o...;, whereas in QB they could be
written as \&0...; or \&....

- In FB FOR loops in subs/functions do not accept arguments received byref as counters. A local variable must be used.
- FB's Locate does not respect the fourth and fifth arguments for cursor shape.
- FB's Screen does not allow switching the visible or the work-page. Use ScreenSet instead.
- FB's Color does not allow a third argument for border color.
- FB's Timer returns the number of seconds since the computer started, while QB's TIMER returns the number of seconds since midnight. (Win32 and Linux only: No more wrapping at midnight! :))
- In QB a chr$(13) inside a string did a CR+LF when printed. In FB the CHR(13) prints just at what it is, a CR.
- EOF can no longer be used to detect an empty comms buffer. Empty buffer should be tested comparing LOC with 0 in FB. Also, for files opened in RANDOM or BINARY mode, EOF returns non-zero already after reading exactly the file size, see EOF.
- Integer variables do not signal overflow errors in FB, even with the -ex option on. Any QB code relying in catching integer overflow errors will not work in FB.

**Archaic commands**

- BSAVE and BLOAD can be used in FB only to save and retrieve screens or graphic buffers. They will work only if gfxlib is linked, this is, if a graphics screen mode is requested somewhere in the program. The console can’t be saved with BSAVE or retrieved with BLOAD. The other use of BSAVE-BLOAD, saving and loading full array, can be achieved easily with GET and PUT.
- FIELD statement (for record definition at runtime) has been left aside. The keyword FIELD is used in FB to specify field alignment in Type variables.
- PC Speaker commands no longer function: Any references to SOUND or PLAY statements will result in an error message. There is a third party library available to emulate this functionality, but it's not included with FreeBASIC.
- Fake event-driven programming (ON KEY, ON PEN, ON STRIG, ON TIMER) no longer works. They could be emulated by a separate library.

- MKSMBFS and all the MKXMBFS commands supporting the pre-QB4.0 Microsoft proprietary floating point format (MBF) are not implemented.

- The use of parenthesis in the arguments passed to a function to emulate by-value passing is not permitted. The CALL quirk resulting in all arguments being passed by value, no longer works. The proper ByVal and ByRef keywords must be used.

- FILES is not implemented. Instead, PDS 7.1-compatible Dir[$] can be used.

- IOCTL, ERRDEV and ERRDEV$, low level functions to access hardware are not implemented as they were OS-dependent.

- CALL ABSOLUTE to run inline machine code is no longer supported. Instead you can use Asm...End Asm blocks to insert inline assembler commands. Or use the Asm... one line command.
FreeBASIC Dialects

FreeBASIC version 0.17b introduces a `-lang` command-line option, used to change the language compatibility mode for different dialects of the basic language.

Starting with version 0.18.3b the `-lang qb` dialect has been further restricted to only allow what would have been allowed in QuickBASIC.

In version 0.18.4b the `-lang fblite` dialect was added, intended to replace `-lang deprecated` in future.

In version 0.20.0b the `#lang` directive and `$Lang` metacommand were added to specify a dialect from source.

<table>
<thead>
<tr>
<th>-lang option</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fb</td>
<td>FreeBASIC compatibility (default)</td>
</tr>
<tr>
<td>qb</td>
<td>qbasic compatibility</td>
</tr>
<tr>
<td>fblite</td>
<td>FreeBASIC language compatibility, with a more QBASIC-compatible coding style</td>
</tr>
<tr>
<td>deprecated</td>
<td>compatibility with FB 0.16</td>
</tr>
</tbody>
</table>

The `-lang` option was needed to allow FreeBASIC to support object-orientation and other features in the future, without crippling the QuickBASIC support or breaking compatibility with old FreeBASIC sources, and without making FreeBASIC difficult to maintain with many different versions of very similar packages. The QuickBASIC support can continue to be improved, if needed, without breaking the sources written specifically for FreeBASIC.

To compile old GW-BASIC or QuickBASIC/QBasic sources without too many changes, use the `-lang qb` option on the command-line when running fbc. This option will evolve into a better compatibility with QuickBASIC/QBasic code.

To compile FreeBASIC sources from 0.16b, use the `-lang deprecated` option. This option is maintained for compatibility and will not evolve in
the future, and it's likely to disappear when FreeBASIC reaches a non-beta release.

For programmers who want to access some of FreeBASIC's newer features, but want to retain a more QBASIC-friendly programming style, use the **-lang fblite** option. This dialect will not undergo significant changes in the future, but will continue to be maintained and supported. This option is also the most compatible with sources that were made using older versions of FreeBASIC.

It is recommended to use **-lang fb** for new projects, as new features (object classes, inheritance..) will be added exclusively to this dialect.

**-lang fb (the default mode)**

Not supported:

1) implicit variable declaration
   - All variables must be explicitly declared, using Dim, ReDim, Var, Const, Extern Or Common.

2) type suffixes (!, #, $, %, &)
   - They are only allowed for numeric literals, but it's recommended to use Cast or the f (single), d (double), ll (longint), ul (ulong), ull (ulongint) numeric literal suffixes to resolve overloading.

3) DefByte, DefUByte, DefShort, DefUShort, DefInt, DefUInt, DefLng, DefLongInt, DefULongInt, DefSng, DefDbl, DefStr
   - An explicit type ("As τ") is needed when declaring variable using Dim, ReDim, Extern or Common. Variables declared using Var or Const have their types inferred from an initialization value (an explicit type is optional using Const).

4) all parameters passed by reference by default
   - By default, all intrinsic scalar types - numeric and pointer types - are passed by value (ByVal). Any other type - Strir or user-defined type - is passed by reference (ByRef).
- Use the -w pedantic command-line option to have parameters without explicit ByVal or ByRef reported.

5) OPTIONS of any kind (no context-sensitivity)
   - Instead of Option NoKeyword, use #undef.
   - Instead of Option Escape, use: !"some esc seq \n\r" (notice the '!' char) and pass -w pedantic to check for possible escape sequences.
   - Option Explicit isn't needed, see item 1.
   - Instead of Option Dynamic, declare variable-length arrays using ReDim. Dim can also be used to declare variable-length arrays using variable or no subscripts.
   - Instead of Option Base, use explicit lower-bound subscripts in arrays declarations.
   - Instead of Option Private, use Private to declare procedures with internal linkage.
   - Instead of Option Gosub and Option Nogosub, use procedures with Sub or Function.

6) periods in symbol names
   - Use namespaces instead.

7) GoSub or Return (From Gosub)
   - Nested procedures may be allowed in future.

8) On Gosub or On Goto
   - Use Select Case As Const expr for the latter.

9) Resume
   - Most runtime and graphics library procedures now return an error code, like: IF OPEN( "text" FOR INPUT AS #1 ) <> 0 THEN error...

10) '$DYNAMIC, '$STATIC, '$INCLUDE meta-commands embedded in comments
    - See item 5 about Option Dynamic.
- Use `#include "filename"` instead of `'$include'.

11) **Call** or **Let**
   - Just remove them.

12) numeric labels
   - Named labels can be used instead, e.g. `label_name: / Goto label_name`.

13) global symbols with the same name as keywords
   - Declare them inside a namespace.

**-lang deprecated**

**Supported:** *Anything allowed in version 0.16b, but:*

1) **GOSUB/RETURN** and **ON ... GOSUB** (even at module-level)
   - so the **GOSUB** implementation could be thread-unsafe in the `-lang qb` mode, allowing fast execution (-lang qb doesn't support multi-threading, while -lang deprecated does).

**Not supported:**

1) **Classes**
   - Periods allowed in symbol names make it too difficult and/or ambiguous.

2) **Operator overloading**
   - Periods allowed in symbol names make it too difficult and/or ambiguous.

3) **Constructors, destructors and methods in TYPES.**
   - Periods allowed in symbol names make it too difficult and/or ambiguous.
-lang fblite

**Supported:** *Anything allowed in the -lang deprecated dialect, plus..*

1) **GOSUB/RETURN**
   - Use `Option Gosub` to enable. This will disable `RETURN` from exiting a procedure, due to ambiguity.

**Not supported:**

1) **Scope** blocks
   - All variables are given procedure scope. Explicit `Scope` blocks may be added later.

-lang qb

**Supported:** *Everything not supported/allowed in the -lang fb dialect, plus..*

1) **call** can be used with forward-referenced functions.

2) **Shared** can be used inside functions. (W.I.P.)

3) All variables, implicitly or explicitly declared, are always allocated in the procedure scope, like in QuickBASIC.

4) The **Data** statement won't look up symbols, every token is assumed to be a literal string even without quotes, like in QuickBASIC.

**Not supported:**

1) Multi-threading
   - None of the `threading` procedures may be used.

2) Classes and Namespaces

3) Procedure and operator overloading
4) Constructors, destructors and other member procedures in Type definitions.

5) **Scope** blocks

6) **Extern** blocks

7) Variable initialization
   - All variables are moved to the procedure scope (like in QuickBASIC), making initializing local variables too difficult to support.
FreeBASIC questions:

- What is FreeBASIC?
- Who is responsible for FreeBASIC?
- Why should I use FreeBASIC rather than QBasic?
- Why should I use FreeBASIC rather than some other newer BASIC?
- How fast is FreeBASIC?
- How compatible is FreeBASIC with QuickBASIC?
- How compatible is FreeBASIC with Windows? DOS? Linux?
- Does FreeBASIC support Object Oriented Programming?
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- Is there a limit on how big my source files can be?
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- I'm developing an OS, can FreeBASIC be ported to my OS?
- Does FreeBASIC support returning reference from Functions, like in C++?

See also

FreeBASIC questions

What is FreeBASIC?
FreeBASIC is a free, 32-bit BASIC compiler for Windows (32-bit), 32 bit protected-mode DOS (COFF executables, like DJGPP), and Linux (x86). It began as an attempt to create a code-compatible, free alternative to Microsoft QuickBASIC, but has quickly grown into a powerful development tool, already including support for libraries such as Allegro, SDL, OpenGL, and many others with its default installation.

Aside from having a syntax mostly compatible with QuickBASIC, FreeBASIC introduces several new features to the aged language, including pointers to variables and functions, and unsigned data types.

FreeBASIC compiler is self-hosting - written in FreeBASIC, the libraries however are written in C.

Who is responsible for FreeBASIC?
The first versions of FreeBASIC were developed exclusively by V1ctor. Later versions gained contributions from many people, including Lillo, who developed the Linux port and the graphics library, and DrV, who developed the DOS port.

See the FreeBASIC Credits page.
Why should I use FreeBASIC rather than QBasic?
FreeBASIC has innumerable advantages over QBasic, QuickBASIC, PDS, and Visual Basic for DOS.

- It supports 32-bit processors, where QBasic is designed for 16-bit CPU's.
- It supports modern OSes. It has ports to Windows, Linux, and 32-bit DOS.
- It supports modern APIs such as SDL, DirectX, Win32, and OpenGL.
- It is distributed under the GPL, meaning it's free and legal to use, unlike most copies of QuickBASIC / other BASICS.
- The library is distributed under the LGPL with additional exception, meaning you may do whatever you want with your compiled programs, including selling them.
- FreeBASIC is many times faster than QuickBASIC / other BASICS.
- FreeBASIC supports many features, such as pointers and inline Assembly, which are not available in QuickBASIC / other BASICS.
- QuickBASIC only supports DOS. Windows support for DO emulation (and thus QuickBASIC) is becoming thinner with every new version. Vista does not support graphics or fullscreen text for DOS applications.

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Why should I use FreeBASIC rather than some other newer BASIC
FreeBASIC has many traits which make it more desirable than most other BASIC language implementations:

- FreeBASIC adheres closely to the standard BASIC syntax making it easier to use.
- FreeBASIC is compiled to actual programs (executables), not bytecode.
- FreeBASIC has a large, dedicated community which has actively participated in the development of FreeBASIC.
- FreeBASIC utilizes standard methods of accessing
common C libraries. SDL, for example, is standard C SDL not a new set of intrinsic commands.

- FreeBASIC has ports to Windows, Linux, and 32-bit DOS. It retains consistent syntax between the three ports.

How fast is FreeBASIC?
Most tests run by the community have shown FreeBASIC is significantly faster than QuickBASIC, faster than most other GPL or commercial BASICs, and often approaching GCC in terms of speed. The Computer Languages Benchmark Game, an independent test team, give FreeBASIC for Linux a speed 1.8 times slower than GNU g++. Tests are about calculation, memory and disk access speed in console programs, no graphics capabilities were tested. This is not a bad result considering FreeBASIC is not yet an optimizing compiler. One area where there is a notable speed deficiency is in 32-bit console modes. While FreeBASIC is consistently on-par with other 32-bit console mode applications, 32-bit console mode operations are significantly slower than 16-bit console operations, as seen in QuickBASIC. In DOS version, some I/O operations can slow down after porting from a 16-bit BASIC to FB - optimizing the code brings the speed back.

How compatible is FreeBASIC with QuickBASIC?
The FreeBASIC built in graphics library emulates the most used QB graphics modes (modes 7,12,13) and implements all the drawing primitives featured in QB. Most compatibility problems arise from the use of 8086-DOS-hardware specific low-level techniques in the old QB programs. VGA port programming, DOS interrupts, memory segment switching, poking to the screen memory or music playing using the PC speaker are not directly supported, even if they can be supported/emulated by external libraries. Other issues in porting old QB programs, like variable name clashes with new FB keywords, variables with the name of a QB keyword plus a type suffix, default integer size being 32 bits in FB, are addressed by running FreeBASIC with the commandline switch -lang qb.
See Differences between FreeBASIC and QuickBASIC.

How compatible is FreeBASIC with Windows? DOS? Linux?
FreeBASIC is fully compatible with Windows, MS-DOS, FreeDOS and Linux. When planning to create a program for all three platforms, however, keep API availability in mind -- code utilizing OpenGL will work in Windows and Linux, for example, but won't in DOS, because OpenGL is not available for DOS.

Does FreeBASIC support Object Oriented Programming?
FreeBASIC (since version 0.90) supports classes (user-defined types) with member functions (methods), static methods, static member variables, constructors, destructors, properties, operator overloading, single inheritance, virtual and abstract methods (polymorphism) and run time type information. Future plans regarding OOP functionality include adding support for multiple inheritance and/or interfaces. For more information see: A Beginners Guide to Types as Objects.

What are the future plans with FB / ToDo list?
You can find out what's planned for the future releases by directly looking at fbc's todo.txt.

Can I program GUI applications in FB?
Yes, you can. Headers allowing you to call the GUI API of Windows and Linux are supplied with the respective versions, but the programs made this way are not portable.
There are some API wrappers and experimental RAD applications that create non-portable GUI code for Windows.
For portable programming a multiplatform GUI wrapper library as GTK o
wx-Widgets may be used. GTK headers are provided with FB, but the OOP functionality currently available in FB prevents the use of wx-Widgets. The programs created with these libraries may require the user to install the wrapper libraries in their systems. For games and small graphics applications there are some FB-specific libraries that draw and manage simple controls as buttons and edit boxes inside the graphics screen, programs made with those libs are entirely portable.

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**Is FB suitable for complex / big applications?**

The FB compiler is self-hosting, it is programmed itself in FB. That means more than 120 000 lines of code at the moment, a fairly complex application.

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**Can I use a non-latin charset in my FreeBASIC applications?**

FreeBASIC has the Unicode support provided by the C runtime library for the given platform. This means FB DOS won't help you with Unicode. On other platforms you can use **Wstrings** to support any charset you need. The File OPEN keyword has an additional **Encoding** parameter allowing for different encodings. As FreeBASIC is coded itself in FB, this means you can code your source in an Unicode editor so the comments and string literals can be in any character set (keywords, labels and names for variables and procedures must be kept inside the ASCII set.). For the output to screen the support is different from console to graphics. In console mode wstring printing in non latin charsets is supported if the console font supports them. Graphics mode uses an internal CP437 charset (the old DOS charset) font so non-latin output requires a custom made raster font and the use of the **Draw String** keyword. Third party tools exist to grab an external font and convert it to the DRAW STRING format.

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**Can I use Serial/COM and Hardware/CPU ports in FB?**
Yes, FB has built in functions to access the serial/COM port and hardware/CPU ports with no need of external libraries. See the OS specific FAQ's for details for your OS, and Open Com, Inp and Out.

Getting Started with FreeBASIC questions

Where can I find more information about FreeBASIC?
The FreeBASIC Wiki is the most up-to-date manual for using FreeBASIC available here.

Active FreeBASIC related forums, besides the official one, can be found at qbasicnews, Pete's QB Site, the FB Games directory or freebasic portal.de (in German).

Active magazines which regularly have FreeBASIC related articles are QB Express and QBXL Magazine. These magazines are always looking for new articles, so if you think you've got a good idea for an article about FreeBASIC, submit it!

Why doesn't the QB GUI open when I start FreeBASIC?
QB had an Integrated Development Environment (IDE). FreeBASIC does not. FreeBASIC is only a compiler, not a complete QuickBASIC clone. It is a console mode application. It will accept a BAS file on the command line, and spit out an EXE file.

You can create the BAS file with the simplest plain text editor in your OS (Notepad, EDIT, nano,...), then run the compiler. If you can't live without syntax coloring, error highlighting, multiple file managing, integrated debugger, context help or other features, you need an IDE. See the OS specific FAQ's for the IDE's and editors available.

Can I have an offline version of the documentation?
This online Wiki is the official documentation for FB. Usually it is up-to-date with the latest improvements found in the development version of FB.

Offline versions of this wiki (in CHM, HTML and other formats) are available from the [Documentation directory at fbc's downloads site on SourceForge](https://sourceforge.net/download/fbc/).

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**What's the idea behind the FB dialects?**

The idea is to allow improvements in the language while maintaining backwards compatibility with QB code. The quirks of the QB syntax are not compatible with the more rigid style required by OOP. The new FB keywords often clashed with variable names in old QB programs. QB allowed to use freely dots in variable names and procedures not being UDT's.

The three dialects (-lang fb, -lang qb, -lang fblite) allow to combine the best of two worlds.

- **lang fb** provides the framework required for OOP programming. Other dialects don't give access to OOP.

- **lang qb** will allow the developers to keep increasing the compatibility with qb programs. Newer keywords in FB can be used by preceding them with two underscores. For example, `Getmouse` can be called by using `__Getmouse`.

- **lang fblite** offers FreeBASIC language compatibility, with a more QBASIC-compatible coding style.

See [Compiler Dialects](https://sourceforge.net/download/fbc/) for details.

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**Why does my program crash when I define an array larger than xx?**

This generally happens because you made an `automatic` fixed-length array too large, and it is corrupting the program stack. You have a couple of options:

- if possible, reduce the size of the `automatic` array
- create a variable-length array, by
  - defining the array with an empty subscript list (using `Dim`), or
  - defining the array with variable subscripts instead of numeric literals, `Constants` or `Enums` (using `Dim`), or
  - defining the array with `ReDim`

- reserve more memory for the program stack by using the `-t` command-line option when compiling. The default is `-t 1024` (kilobytes). Note: it's a bad idea to use very large values here.

- create a `static` array by defining the array with `Static` rather than `Dim` (only locally visible, but globally preserved)

- define the array with `Shared` access using `Dim` (this makes the array fully global)

- use `Pointers` and `Memory Functions` like `Allocate` and `Deallocate` to manage memory yourself - this is the preferred way for storing big buffers, but not for beginners.

*Static* and *variable-length* arrays don't use the program stack for their element data, so do not have the problem associated with *automatic* fixed-length arrays. See *Storage Classes* for more information. Note that storing huge buffers as `static` or increasing the stack size far above the default is not a very good idea, since it increases the fixed amount of memory needed to load and start your program, even if most of it is not used later, and can result in performance degrade, or even refusing your program to load at all.

**Why does my program fail to compile with the message 'cannot find -llibname'"?**

This is an error raised by the linker. The program is supposed to link to an external library, designated in the program code with `#inclib` or on the compiler command line with `-l`. However, the linker has been unable to find a matching file in any of the library paths. Check the homepage of the library you want to compile with to find out how to download it, or check ExtLibTOC to see if information about the library can be found there.

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How do I link to C libraries?
C libraries are set up in much the same way in FreeBASIC as they are in C. Every library included with FreeBASIC has a basic include file named "library name.bi" which uses the #inclib metacommand to include the library, and the Declare Statement to declare the functions within the library. FreeBASIC includes hundreds of BI files, see full list of library headers here.

Can I use a debugger?
FreeBASIC can use preferably a debugger compatible with GNU GDB.
- Win32: Insight is an user friendly wrapper for GDB, see Win32 related FAQ.
- DOS: Be warned that DOS also has product named "Insight", but it's a real mode debugger not usable with FreeBASIC, use GDB or some DPMI32 debugger at least.
- Linux: use GDB.

See the OS specific FAQ's for details for your OS.

What's the goal of the AR.EXE, AS.EXE and LD.EXE files included with FB?
AS.EXE is GAS, the "GNU assembler". It is always involved in compilation. LD.EXE is the "GNU linker", involved in creation of executables. AR.EXE is the "GNU archiver", in fact a librarian, creating .a libraries.

Is there a limit on how big my source files can be?
Yes, since FreeBASIC is a fully 32-bit compiler it may operate on source files up to theoretically 4GB or 4294967296 bytes, however your RAM capacity should be significantly above the size of your source, otherwise the compilation won't finish or will be very slow at least.

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**Can I write an OS in FreeBASIC ?**

YES and NO. If you really insist to write an OS and involve FB, the answer is YES. If the question is, whether it is a good idea that you, even more if a beginner, should start coding an OS using FB now, the answer is NO. Several pitfalls apply:

- OS development is hard, see http://www.osdev.org/wiki/Getting_Started.
- FB won't help you to bypass the need to deal with assembly, also C might be almost impossible to avoid.
- You won't be able to use most of the trusted FB features, like graphics, file I/O, threads, memory management, even console I/O ... just control flow, math and logic. If you need those library functions, you will have to reimplement them.

FreeBASIC relies on GCC, and available informations about developing an OS in C apply to FreeBASIC as well. FB will help you neither more nor less than GCC.

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**I'm developing an OS, can FreeBASIC be ported to my OS ?**

Depends. If your OS at least egalizes the functionality of DOS with DPMI32 (console I/O (seeking, multiple files open, ...), file I/O, memory management) and has a port of GCC, then the answer is YES. If you have at least an other somewhat compliant C compiler with libraries, it might be possible. You can't reasonably port FB for example to an OS allowing to load or save a file in one block only, or a 16-bit OS.

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Does FreeBASIC support returning references from Functions, like in C++?

Yes, this functionality exists since version 0.90.0. Procedures can now return references using `ByRef as datatype` for the return type.

See also

- Win32 related FAQ
- DOS related FAQ
- Linux related FAQ

and

- FB Runtime Library FAQ
- Frequently Asked FreeBASIC Graphics Library Questions
Frequently Asked FreeBASIC Graphics Library Questions

FreeBASIC Graphics Library questions:
- How can I link/use Gfxlib?
- What about the fbgfx.bi header file?
- How are Get/Put arrays managed?
- Why is Bsave/Bload crashing?
- How can I get the red, green, blue, or alpha component of a colour?
- How can I make the 'x' button in the window header close my application?
- Can't run programs using Screen 13 or 14 in fullscreen!
- Why does Imagecreate return a NULL pointer?

How can I link/use Gfxlib?
Gfxlib is "built in" into the language, it is not necessary to include any .bi library explicitly. FreeBASIC detects you want to use Gfxlib when you use ScreenRes statements. So to use Gfxlib, just start a graphics screen mode and use graphics commands.

What about the fbgfx.bi header file?
The fbgfx.bi header file is available for inclusion by your program, and it contains constant and type definitions that may be helpful to the programmer when using Gfxlib. You do not have to explicitly include this file to use Gfxlib however; the header is only an aid. It contains the constants for the mode flags that can be passed to ScreenRes, and also definitions of Keyboard scancodes and the fb.Image structure.
How are Get/Put arrays managed?
In FreeBASIC, images can be used as arrays (as in QB) or as pointers. Image data is contained in one continuous chunk. The chunk consists of an header followed by the image data. The header can be of two types (old-style and new-style) and determines the format of the following image data, for details see GfxInternalFormat.

Why is Bsave/Bload crashing?
Bsave/Bload can only be used to load and save graphics screens in FreeBASIC. It can't be used to save a text mode screen. To load and save an array check this snippet using file Get/Put.

How can I get the red, green, blue, or alpha component of a color?
Each byte in a color attribute corresponds with the red, green, blue, and alpha components. The following example shows how to extract the component values from a color attribute.

```
#define rgb_a(x) ((x) Shr 24)
#define rgb_r(x) ((x) Shr 16 And 255)
#define rgb_g(x) ((x) Shr 8 And 255)
#define rgb_b(x) ((x) And 255)

Dim As UInteger c
Dim As Integer x, y
Dim As UByte red, green, blue, Alpha

' Assume a 16, 24, or 32 bit screen mode has been set
 c = Point(x, y)
 red = rgb_r(c)
 green = rgb_g(c)
 blue = rgb_b(c)
 Alpha = rgb_a(c)
```
How can I make the 'x' button in the window header close my application?

In windowed graphics mode you can test for the press of the window's X button with `Inkey`, checking for the value `Chr(255) + "k"` (which is also the code returned for Alt+F4).

This applies to Win32 and Linux, in DOS there is no "X" button.

Here is a small example:

```
' "X" close button example , Win32 and Linux only
Dim As String key
Screen 13
Do
    Print "Click the 'x' to close this app."
    Sleep
    key = Inkey
Loop Until key = Chr(27) Or key = Chr(255, 107) 'escape or x-button
```

Can't run programs using Screen 13 or 14 in full-screen!

It's a hardware/driver limitation (Win32 and Linux only?). Video cards don't implement those low resolution graphic modes nowadays. If full-screen is required you should at least Screen 17 or 18, or a resolution of 640x480 or higher to be sure modern hardware can handle it.

Why does Imagecreate return a NULL pointer?

`ImageCreate` needs to create an image buffer that fits the current screen, it cannot do so if there is no screen mode setup yet, so it returns NULL, in a NULL pointer access later on that crashes the program.
This is known to happen when Imagecreate is called *before* the graphics library is initialized with a call to `Screen` or `ScreenRes`, as may happen when `Imagecreate` is called in a global constructor that is invoked before the `Screen` or `Screenres` call in the main part of the program. In such a case it is necessary to move the screen initialization into a constructor too, and have it execute before the image-creating constructor.

**See also**

- Compiler FAQ
- FB Runtime Library FAQ
- Frequently Asked FreeBASIC Graphics Library Questions
Frequently Asked FB Runtime Library Questions

FreeBASIC Runtime Library questions:

- How do I play sound?
- How do I access the serial ports?
- How do I print?
- How do I access the hardware ports?

How do I play sound?
Of the QB's sound keywords only BEEP is implemented in FB. If PC speaker sound is required, it should be programmed using IN and OUT. See the example in the OUT keyword for a replacement of SOUND. There is a library called QBSound that allows to emulate qb's ability to PLAY in the background tunes encoded in strings, it uses the soundcard's synthesizer. If what's required is to play .wav or .mp3 files thru a soundcard, external libraries as FMOD or BASS can be used in Linux and Windows. For DO see the DOS FAQ section.

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How do I access the serial ports?

DOS
See DOS FAQ section.

Windows and Linux
See Open Com.

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**How do I print?**
Since version 0.15 FB supports character output to printer.
To print graphics two approaches are possible:

- Preprocess the graphics data, program the printer, and send the data to it (see [wikipedia.org/wiki/ESC/P](https://wikipedia.org/wiki/ESC/P)). This is OS-portable but depends on the printer model. The only way for DOS, see also DOS FAQ section.
- In Windows and Linux there are specific API calls. This is not OS portable but the OS's printer driver makes it printer-independent.

**How do I access the hardware ports?**

INP, OUT and WAIT known from QB are implemented since version 0.15 of FB.
The GfxLib intercepts the calls to some VGA ports to emulate the widely used QB’s palette manipulation and vsync methods. So ports &H3DA;, &H3C7;, &H3C8; and &H3C9; can't be accessed it GfxLib is used. All other ports are accessible.
No further tricks are required to use INP and OUT in Linux or DOS. For the Windows version the required device driver is installed each first time the program is run in a windows session; this requires Administrator rights for this first run or the program will end with an error. Note that accessing hardware ports by applications is not common practice in Windows and Linux.

**See also**

- Compiler FAQ
- Frequently Asked FreeBASIC Graphics Library Questions
- Win32 related FAQ
- DOS related FAQ
Can FreeBASIC really make Xbox games?

In theory, yes. A copy of FreeBASIC 0.13 was ported to the Xbox in July 2005, and produced working executables. However, changes to the compiler for the 0.14 release broke compatibility.

The Xbox port is currently in zombie mode; nobody in the project team has the console at the moment - the original port was done by SJ Zero, but it got broken with the runtime library modifications done in v0.14.
The port is on hold until the GCC backend port is complete, because it is believed that this port will fix the Xbox port.

**How was the FreeBASIC Xbox port made?**

FreeBASIC for Xbox is possible because of the efforts of Open Source developers who created OpenXDK, the legal software development kit for Xbox. OpenXDK is created for a unixish environment, which is quite compatible with the FreeBASIC source.

The port was created by forcing the FreeBASIC runtime library to use the OpenXDK version of Glibc instead of the mingw32 version. When compiled with the correct flags, this creates what looks like a standard EXE file. CXBE then strips the Windows PE header on this executable file and replaces it with an Xbox header.

In effect, all the port really does is change the runtime library and link in a certain way to allow the CXBE utility to create an Xbox executable.

**How about a port for Xbox 360?**

The Xbox is an Intel Pentium 3 running a derivative of the NVIDIA nForce chipset, with an NVIDIA video chip and an NVIDIA SoundStorm sound card. This is why the Xbox port was possible and relatively straightforward to do.

The Xbox 360, on the other hand, uses an alien CPU, and similarly alien hardware. FreeBASIC cannot presently be made to produce executables for the Xbox 360.

Another problem is the lack of an equivalent to OpenXDK for the Xbox 360. This would force any port to use the Xbox 360 XDK, a copyrighted piece of software created by Microsoft. This would be illegal, immoral, and would put FreeBASIC in legal jeopardy.

Therefore, a port to the Xbox 360 is to be considered impossible at this time.
How about a port for PlayStation or another console?

The Xbox is an Intel Pentium 3 running a derivative of the NVIDIA nForce chipset, with an NVIDIA video chip and an NVIDIA SoundStorm sound card. This is why the Xbox port was possible and relatively straightforward to do.

The PlayStation, on the other hand, uses a RISC chip, which FreeBASIC cannot currently produce code for. Almost all consoles utilize non x86 processors, stopping development using FreeBASIC from being possible.

Another problem is the lack of an equivalent to OpenXDK for many consoles. This would force any port to use the commercial software development kit, a copyrighted piece of software created by the console manufacturer. This would be illegal, immoral, and would put FreeBASIC in legal jeopardy.

Therefore, a port to other consoles are to be considered impossible at this time. However, many ports to consoles and other platforms with legally available development kits will be possible when the GCC backend port is complete.

Why don't you use an emulator until a developer gets a modded Xbox?

No known Xbox emulator is capable of running FreeBASIC code. A legitimate hardware console is required to run the programs made. This makes an emulator completely useless for development.

Why don't you use the Microsoft XDK?

There are two main reasons not to use the Microsoft XDK.

1) Microsoft's XDK is a piece of copyrighted software, and utilizing it would be illegal and immoral, putting FreeBASIC at risk of legal action. Furthermore, no member of the FreeBASIC team has ever had any access to the Microsoft XDK, to prevent "tainting" FreeBASIC legally.

2) OpenXDK is developed around gcc and UNIX-style systems such as MinGW or Cygwin. This means that it can be integrated into FreeBASIC...
with very little effort. Microsoft's XDK, on the other hand, is developed around Microsoft based compilers, and thus would not easily integrate into the source code of FreeBASIC.

NOTE: PROTECTION OF MICROSOFT'S COPYRIGHT, AND BY PROXY OF FREEBASIC, IS OF PRIMARY IMPORTANCE IN THIS PROJECT. WE DO NOT WANT HELP FROM ANYONE WITH THE XDK NOR DO WE WANT HELP FROM ANYONE WITH A DEBUGGER XBOX. ANY ATTEMPT TO OFFER THE XDK OR XDK RELATED HELP SHALL BE FORWARDED TO THE PROPER LAW ENFORCEMENT AGENCIES.

Why don't you use the Microsoft debugger to fix it?

There are two very good reasons not to use the Microsoft debugger.

1) Microsoft's XDK is a piece of copyrighted software, and utilizing it would be illegal and immoral, putting FreeBASIC at risk of legal action. Furthermore, no member of the FreeBASIC team has ever had any access to the Microsoft XDK, to prevent "tainting" FreeBASIC legally.

2) Microsoft's debugger requires a specially modified Xbox which neither SJ Zero nor any development team member has, and frankly, nobody who has worked on the port believes the debugger would work with FreeBASIC executables -- just as Microsoft's debugger can't read FreeBASIC debugger files, we doubt the Xbox debugger could read FreeBASIC debugger files. Regardless, point #1 trumps any attempt.

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Isn't this illegal? Can't Microsoft sue you?
Copyright is important for the protection of both commercial firms like Microsoft, and for small projects such as FreeBASIC. Without copyright, neither could enforce any rights over the code (In our case, such as the GPL). Generally speaking, it is copyright issues which are most often the cause of problems for open source projects attempting to do things like this.

Because the FreeBASIC Xbox port is created using software tools whose legality has already been established, themselves often derived from other sources whose legality has been established, FreeBASIC for Xbox is not illegal. Careful care has been taken to protect FreeBASIC from using any Microsoft copyrighted code, and diligence is and will be followed to prevent access to copyrighted code.

**Getting Started with FreeBASIC on Xbox questions**

**What do I need to compile Xbox games with FreeBASIC?**

The port isn't currently working, but when it is ready, you will only need a copy of FreeBASIC for Xbox.

**How would you get input?**

Initially, input will be acquired through SDL, as a gfxlib port is not yet complete. One of the developers is working on a generic SDL version of gfxlib, however, and it will provide full gfxlib functionality to the Xbox port.

**Does it only run on certain Xboxes?**

FreeBASIC for Xbox executables will only run on modded Xboxes. However, modding an Xbox is often as simple as loading a savegame in a certain game. More information is available on the [Xbox-Linux](http://www.xbox-linux.org) website.
Is another language (eg C or ASM) needed for the job?

No. FreeBASIC for Xbox is the only thing needed.

Do you need a special lib?

No. FreeBASIC for Xbox will come with all supported libraries.

Can you use premade functions (inkey, line etc)?

Currently, input and output commands such as inkey and line aren't available, but all other functions, including file I/O, are. One of the developers is working on a generic SDL version of gfxlib, however, and if it functions, it will provide full gfxlib functionality to the xbox port.

What else should I know?

Executables created by FreeBASIC for Xbox are free of copyrighted Microsoft code, making them legal for distribution.

Windows and Linux source files which are designed to use SDL and rtlib will be capable of compiling for Xbox out of the box. While the Xbox does have keyboard support through the gamepad ports (proprietary USB connection), the input scheme will have to be altered to account for a gamepad.
DOS

The FreeBASIC port to DOS is based on the DJGPP port of the GNU to mode DOS.

The current maintainer of this port is DrV.

To be written: platform-specific information, differences from Win32/Linux, tutorials, etc.

WANTED TESTERS

The DOS version/target of FreeBASIC needs more testers. If you are interested on DOS, please don't wait for future releases, give it a try now. Tests from old and new PC's are welcome (graphics, file I/O, serial port, ...). If something doesn't work, please place a detailed bug report into the forum or bug Tracker. If all works well, you can write about your success as well. Make sure to test a recent version of FB (reports from FB older than 0.90 will be considered as obsolete and useless), and check this document before complaining about anything.

Limitations

The DOS target is fairly well working and supported by FreeBASIC, and compared to other platforms exist, however. The features missing are mainly the operating system or DOS extender or C runtime:

- Cross-compiling to an other target
- Multithreading (see FAQ 23)
- Graphics in windowed mode or using OpenGL
- Setting ScreenRes to a size not matching any resolution supported
- Unicode isn't supported in DOS, WString will be the same as ZString
- Latin aren't supported. (do it yourself)
- Shared libraries (DLL's) can't be created/used (at least not "easily"
- external libraries usable with DOS is limited

FreeBASIC DOS related questions:
1. FB is a 32-bit compiler - do I need a 32-bit DOS?
2. What about FreeDOS-32? Does/will FB work, is/will there be a version?
3. When running FreeBASIC in DOS, I get a 'Error: No DPMI' message!
4. Is there a possibility how to get rid of this CWSDPMI.EXE and CWSDPMI.SWP?
5. Can I use other DOS extenders, like DOS/4GW, Causeway, DOS/32?
6. Where is the nice blue screen with all the ... / where is the IDE?
7. How can I view the documentation in CHM or PDF format in DOS?
8. How can I write/edit my source code?
9. How can I play sound in DOS?
10. How can I use USB in DOS?
11. How can I use graphics in DOS?
12. DEF SEG is missing in FB! How can I workaround this in my code?
13. How can I rewrite QB’s CALL INTERRUPT / access the DOS and BIOS interrupts?
14. How can I rewrite QB’s XMS/EMS handling?
15. FBC gives me a 'cannot find lsupcxx' error!
16. How can I use the serial or parallel port?
17. How can I use a printer?
18. How can I make a screenshot of a FreeBASIC program running in DOS?
19. Graphics mode doesn't work (freeze / black screen / garbage output)?
20. Mouse trouble! Mouse doesn't work at all in DOS / arrow 'jumps' / etc.
21. What about the 64 KiB and 640 KiB problems / how much memory is supported by FB in DOS?
22. My program crashes when I try to use more than cca 1 MiB RAM in FreeBASIC?
23. Threading functions are disallowed in DOS? Help!
24. Executables made with FB DOS are bloated!
25. Compilation is very slow with FB!
26. SLEEP doesn't work! How can I cause a delay?
27. The performance is very bad in DOS!
28. Can I access disk sectors with FB?
29. Can I use inline ASM with advanced instructions like SSE in DOS?

See also

FreeBASIC DOS related questions
1. **FB is a 32-bit compiler - do I need a 32-bit DOS?**
No, the DOS version of FreeBASIC uses a **DOS extender**, allowing you of a 16 bit DOS kernel. You can use FreeDOS (16-bit), Enhanced-Dr-DOS even MS-DOS down to version cca 4. You need at least 80386 CPU, see...

2. **What about FreeDOS-32? Does/will FB work, is/will there be a version?**
FreeDOS-32 is experimental at time of writing, but it should execute FreeBASIC generated by it with no change. While FB DOS support already works on FreeDOS-32 as well.

3. **When running FreeBASIC in DOS, I get a 'Error: No DPMI' message!**
You need a DPMI host (DPMI kernel, DPMI server), means the file "CWS\DPMI32.EXE" (cca 34 KiB). See requirements, and FAQ 4 for more details.

4. **Is there a possibility how to get rid of this CWSDPMI.EXE and CW?**
Yes, 2 possibilities. To get rid of CWSDPMI.EXE and create a standalone embedding CWSDPMI, you need the CWSDPMI package and the "EXE2COFF", you remove the CWSDPMI.EXE loader (file loses 2 KiB of size, without extension), and then glue the file "CWSDSTUB.EXE" before this is cca 21 KiB bigger than the original one, but it is standalone, no additional rid of CWSDPMI.SWP, you can then edit your executable with CWSPAR swapping (occasionally also - incorrectly - referred as paging). Note, how memory that can be allocated to the amount of physical memory that is. Work can be done both with the FBC.EXE file and all executables created in the CWSDPMI docs in the package. Alternatively, you can use an extender. They don't swap and create standalone executables. Since the Ring 0, the crash handling of them is not very good and can cause freezes other hosts exit the "civil" way with a register dump. Also, spawning might WDOSX or D3X. Finally, you can use **HDPMI**. Download the "HXRT.ZIP" (here: japheth.de/HX.html), extract "HDPMI32.EXE" (cca 34 KiB) and "HDPMI.TXT". Include it to your DOS startup ("HDPMI resident and prevent all FreeBASIC (also FreePASCAL and DJGPP), crying about missing DPMI and swapping. HDPMI can **not** (easily / yet) executables. Running an executable containing D3X, CWSDPMI or some HDPMI or other external host is fine - the built-in host will be simply skip required for FreeBASIC, since it can't generate 16-bit real mode code, all to execute 32-bit code in DOS.

5. **Can I use other DOS extenders, like DOS/4GW, Causeway, DOS/3...**
Not any extender around. So-called WATCOM-like extenders can't be used differences in memory management and executable structure. WDOSX are a multi-standard extenders, not only WATCOM-like. You also can us Tran's PMODE, nor PMODE/W (!), saves cca 5 KiB compared to CWSD EXE, but might affect stability or performance) or, as aforementioned, HI

6. Where is the nice blue screen with all the ... / where is the IDE?
The FreeBASIC project focuses on the compiler, generating the executa It looks unspectacular, but is most important for the quality of software d does not include an IDE. There are several external IDEs for FreeBASIC have a DOS version by now. If you really need one, you could try Rhide, and buggy, so use it at your own risk. See also FAQ 7 and 8.

7. How can I view the documentation in CHM or PDF format in DOS
There is no good way to view CHM or PDF files in DOS by now. But you documentation nevertheless. One of the FreeBASIC developers, coderJ documentation viewer with the docs included in a special format, and ha looks similar the QB's built-in help viewer, but does not contain an editor http://www.execulink.com/~coder/FreeBASIC/docs.html

8. How can I write/edit my source code?
There are many editors for DOS around, but only few of them are good FreeDOS EDIT (use version 0.7d (!!!) or 0.9, 64 KiB limit, suboptimal stal regularly) ), SETEDIT, INFOPAD (comes with CC386 compiler, can edit highlighting for C and ASM, but not for BASIC).

9. How can I play sound in DOS?
There are 2 ways how to play sound in DOS: either the ("archaic") PC speaker something goes wrong, or a soundcard. The speaker is easy to control, think, even to play audio files (WAV, with decompression code also OGG re-use most of existing QB code easily (example: o-bizz.de/qb...speaker.zip) ASM, but provides one channel and 6 bits only, and of course significant soundcard, and, on some newest (P4) PC's the speaker quality is very low at all. For old ISA soundcards, there is much example code around, a new placed (supposing bare DOS in this category) either using a ("emulation") if it is available for your card (unfortunately, this is becoming more and more drivers are poor or even inexistent), or access the card directly (this is low hardware-related, assembler is also needed, and you need technical docs a few sources of inspiration like the DOS audio player MPXPLAY (written
supporting both methods (native + "emu" drivers), see an up-to-date list drdos.org/...wiki...SoundCardChip. Support of sound in DOS is not by FB doesn't "support" sound on Win32 and Linux either - the games "con use FreeBASIC commands or libraries. To play compressed files (MP3, additionally need the decompressing code, existing DJGPP ports of those for this.

10. How can I use USB in DOS?
Again, not business of FB, you need a driver, FB doesn't "support" USB other Wiki: drdos.org/...wiki...USB about possibilities of USB usage in I

11. How can I use graphics in DOS?
GUI or graphics in DOS is definitely possible, there are several approach

- Use the FB graphics library. It uses VESA (preferably linear to access the video card and supports any resolution repo driver, in addition to standard VGA modes.

Note: use preferably FB version 0.20 or newer, the FB DOS graphics wc does not work at all in previous releases.

- VGA mode 320x200x8bpp: very simple, maximum reliability and 256 colours only, see example.
- VGA "ModeX" 320x240x8bpp: similar to above, less easy, compatibility, but low resolution and 256 colours only, see
- VGA "planed" mode 640x480x4bpp: difficult to set pixels, compatibility, but low resolution and 16 colours only, no pu
- Some other "odd" VGA "ModeX" modes (like 360x240x8bpp only ;)
- Write your own VESA code: More difficult, good compatibility possible, there might be reliability problems if not implement
- Use an external library (DUGL, Allegro, MGL, WxWidgets) graphics & GUI's, bloats EXE size, need to respect library reliability.

Note that some graphic cards report limited features through VESA, most example 8 MiB instead of 64 MiB) or less modes (for example only 24 bpp hidden, only lower resolutions visible (up to cca 1280x1024) while higher visible while "wide" modes hidden). This is a problem of the card, not of see the additional features in systems other than DOS, or in DOS only use going to the lowest level bypassing VESA.
12. DEF SEG is missing in FB! How can I workaround this in my code?

DEF SEG is related to 16-bit RM addressing and was removed because VGA or other low memory areas is not possible, because FreeBASIC's memory model (same as DJGPP's) is not zero-based. For accessing low DOS memory, use DOSMEMGET and DOSMEMPUT, see "vga13h.bas" example, or "_dos_ds" selector for inline ASM, see example:

```
'' DOS only example of inline ASM accessing low memory
'' Run in text mode 80x25 only

'' Including dos/go32.bi will define "_dos_ds"
'' "pointing" into G032 block

#include "dos/go32.bi"

Dim As UInteger DDS

DDS=_dos_ds

? : ? "Hello world !"
? "_dos_ds=$";Hex$(DDS)
? "This is just a tEst - abcd ABCD XYZ xyz @[`{ - press any key ...

Do
    Sleep 1000
    If Inkey$<>"" Then Exit Do
Asm
    mov eax,[DDS]  '' Directly using "_dos_ds" won't work there !!!
    push eax
    pop gs
    Xor ebx,ebx
    aa3:
    mov al,[gs:0xB8000+2*ebx]
    cmp al,65  '' "a"
    jb aa1
    cmp al,122  '' "z"
    ja aa1
    cmp al,90  '' "Z"
```

jbe aa2
cmp al,97    '' "a"
jb aa1
aa2:
Xor al,32    '' Swap case
aa1:
mov [gs:0xB8000+2*ebx],al
inc ebx
cmp ebx,2000
jne aa3
End Asm
Loop
? : ? "Bye"
End

13. How can I rewrite QB's CALL INTERRUPT / access the DOS and
Those interrupts can be accessed only using the DOS version/target of I

The access to interrupts is slower than in QB: with FB the DPMI host will
switches, going to real-mode and coming back. All of that will eat hundred
thousands of clocks if emm386 is loaded or if inside a Windows' DOS box.
Negligible or relevant, it depends. You should try to minimize the number
more data per call - at least several KiB, not just one byte or a few bytes

Use DJGPP's DPMI wrapper:

#include "dos/dpmi.bi"

Type RegTypeX As __dpmi_regs

#define INTERRUPTX(v,r) __dpmi_int( v, @r )

Alternatively you can call INT's via inline ASM, 2 important things you ha
that FB's memory model is not zero-based (see also FAQ 12, "DEF SEC
"direct" passing of addresses (like DS:[E]DX) to an INT will not work except with "DOS API translation".

14. How can I rewrite QB's XMS/EMS handling?
Depends why original code uses it. If it's just to bypass low memory limits, use "ordinary" FB's data types / memory handling features instead. If it is used for sound, you are out of luck and have to redesign the code completely, about sound see FAQ 9. Preferably the low memory (should be no big problem, since the application data are in DPMI memory instead), DMA in DPMI memory is possible but more difficult.

15. FBC gives me a 'cannot find Isupcxx' error!
The source of this problem is the libsupcxx.a file in LIB\DOS\ directory, name. Your fault is to have extracted the ZIP with long file names enabled, then using FB in DOS with no LFN support, resulting in this file looks like LIBSUP~1.A found. Rename the file in LIBSUPCX.A (one X only) or extract the ZIP again in FB 0.18, retest needed.

16. How can I use the serial or parallel port?
The DOS INT14 is not very useful/efficient as it sends/reads a single char in each call. So it's better to use an external DOS32 comms library. /* does someone know a good one that doesn't support OPEN COM on DOS target, coderJeff has an experimental library/driver available, included with FB since 0.18.3.

17. How can I use a printer?
DOS kernel won't help you here, so you have to prepare the text (trivial) easy for printers compatible with the "ESC/P" standard) yourself and send it to the parallel port or USB using an additional driver (see FAQ 10). So-called "GDI" or "Windows" printers can't be made working in DOS with reasonable effort.

18. How can I make a screenshot of a FreeBASIC program running?
Ideally include this feature into your own code. DOS TSR based screen shooters will work with text based screens, but probably none of them with FreeBASIC graphics. It's really a bug on one or other side, it's a problem "by design".

19. Graphics mode doesn't work (freeze / black screen / garbage output)
Place a bug report into the forum. To make it as useful and productive as possible, proceed given steps and provide all related information:
- Check the limitations listed on the page GfxLib
- The graphics might not work well / at all on very old PC's. 500 MHz, provide exact info about it, if you don't know, use program to test.
- Exact info about your graphics card is needed. Test on DC (reports info only) and RayeR's VESATEST (also tries to see inspection of the result). Find out what "useful" modes (64 supported and with what bitdepths (8, 16, 24, 32 bpp), and look correctly.
- Find out and describe exactly what's wrong ("mode works FB", "no graphics but no error either", "black screen and from messy/incomplete", ...).
- If some sophisticated program doesn't work, try also a minimal test like placing a circle in middle of the screen.
- Try without a mouse driver (this reduces the CPU "cost").
- Find out what modes are affected. If a mode doesn't work, bitdepth, make sure to test the "cheapest"/safest modes 640x480 with 4 bpp, and 320x200 with 8bpp.
- For some old cards there are VESA drivers available (S3VBE/UVIVBE). Test both with and without, and include this info into your report.
- Remove potentially problematic content (memory managers, drivers) from DOS startup files. Nothing of such is required for FB, except a DPMI host (see also FAQ 4). Portsmouth
- Post info about your graphics card, CPU (if old), DOS type and version, bug symptoms, and a simple example code.

RayeR's VESATEST and CPUID can be downloaded here: rayer.ic.cz/programe.htm
VBEDIAG here drv.nu/vbediag/.

20. Mouse trouble! Mouse doesn't work at all in DOS / arrow 'jumps'
To use a mouse in DOS, you need a compatible driver, recognizing your FreeBASIC library. For optimal results, you need a good driver and a suitable

Mouse: the optimal choice, and pretty well available nowadays, is a PS/2 mouse. If be a serial mouse, also this one should work. The newest is USB mouse use in DOS, since it would need a compatible (INT33) high quality native available by now, only some experimental), or rely on BIOS emulation (re "unprecise").

Driver: the preferred choice is CTMOUSE from FreeDOS project. There
and 2.1b4 from 2008-July available. It is included with (but not limited to) FreeDOS, or download a version from here: ibiblio.org/pub/...mouse . None of them is perfect, but better than most competitors. 1.9xx and 2.1xx will cooperate with BIOS, but 2.0xx bypasses BIOS and thus USB emulation will NOT work. Also Logitech does a good job, download from here: uwe-sieber.de/util_e.html - version 6.9.

Problems are DRMOUSE and some (old ?) versions of MSMOUSE.

If the mouse does not work at all, then most likely the driver is not loaded, mouse (see driver messages), or is not compatible with the INT33 "standard", activating the "USB mouse emulation" in BIOS settings can help.

If the mouse control is "unprecise", the arrow "jumps", then you either have a bad driver - use a better one, or the BIOS emulation is bad - the solution is to buy a PS/2 mouse.

21. What about the 64 KiB and 640 KiB problems / how much memory does FB use in DOS?
Memory management is business of the DPMI host, rather than the compiler. Executables generated by it do not suffer from this problem, since they run in protected mode. You can use almost all the memory of your PC, with some restrictions above 64 or 640 KiB. CWSDPMI r5 is verified to work well up to 512 MiB, does not crash it (unlike some older versions), but is silently ignored. HDPMI is supposed to support more: up to 4 GiB (the limit of 32-bit addressing), but there was not much testing on such huge machines - verified up to cca 1.5 GiB. FreeBASIC and code generated by DOS based memory managers (HIMEM/XMS and EMM386/EMS), but use them if they are present. All this of course applies to true DOS only, things like "Dos Box" will keep the control over the memory management and provide only a small piece of memory (cca 64 MiB) to your DOS code.

22. My program crashes when I try to use more than cca 1 MiB RAM in FreeBASIC?
No, it's not a bug in FreeBASIC and it's not really DOS specific, see also beginner, the easy solution is to use Shared for arrays. More advanced users could consider using memory management functions like Allocate. This is even more important for application to run on (old) PCs with little memory (and still edit at least small texts for example), as well as to use all huge RAM if available (and edit huge texts for example).

23. Threading functions are disallowed in DOS? Help!
The Threading Support Functions are not supported for DOS target, at least soon/ever. The reason is simple: neither the DOS kernel, nor the DPMI
DOS Extender support threading, unlike the Win32 or Linux kernel. How DOS: you can set up your threading on the top of DPMI. There are multi are:

- Set up an ISR, see "ISR_TIMER.BAS" example. This is not sufficient in some cases.
- There is a **threads** library for DJGPP allowing to "emulate" some degree. It works acceptably for [P]7-ZIP DJGPP port with FB yet.
- See forum **t=21274**

**24. Executables made with FB DOS are bloated!**
This is true but there is no easy/fast way to fix. FB is a 32-bit HLL compiler imported from DJGPP. !writeme! (see forum: **t=11757**)

**25. Compilation is very slow with FB!**
Problem: "FBC takes 10 seconds to compile a "Hello world" program! That VBDOS / PowerBASIC do take < 1 second for the same job ..."

True, but this is "by design": FB compiles your sources in 3 steps, saving described in CompilerCmdLine, while many older compilers do just 1 pass mostly to file I/O performance, see FAQ 27 below about possibilities of improving small improvement can be achieved here by making the DPMI host resident (CWSDPMI -p, see FAQ 4 above). Note that the delay is mostly "additive" with bigger projects.

**26. SLEEP doesn't work! How can I cause a delay?**
**sleep** does work ... but has a resolution of cca 55ms = 1/18s only, thus "example using "SLEEP 2" for 2 milliseconds won't work. !writeme! / !fixme!

- PIT / BIOS timer (runs at 18.2 Hz by default), peek the BIOS "ISR_TIMER.BAS" example, raise PIT frequency (use with care)
- Poll the BIOS timer + PIT counter, method from TIMERHLP.ASM from DKRNL32, allows to enhance precision of above without raising the PIT
- RDTSC instruction (Pentium and newer)
- RTC clock
- Delay loops

**27. The performance is very bad in DOS!**
Problem: "The performance in DOS is poor compared to Win32 / Linux but from the same source!" or "Even worse, the very same DOS binary runs much faster in NTVD than in DOS!"

Both indeed can happen, nevertheless, DOS is no way predestined to be slow, the inefficiencies can be fixed. First you have to identify the area where you code looses performance.

File I/O: DOS by default uses very little memory for its buffers, while other systems are "aggressive" with file caching. When dealing with many small files, performance degrade. The solution is to install a filecache, for example LBACache a RAMDISK (a good one: SRDISK ) and copy the "offending" files (for example FreeBASIC installation) there in and work there (make sure to backup your work to a more durable media regularly). Both will need an XMS host (use HIMEMX ). Also DOS by default uses BIOS to access the hard drives, while other systems try hard to find and use DMA. Test util: (Download: japheth.de/Download/IDECheck.zip) - run it in "I13" and "DMA" modes and compare results. If "DMA" is much faster (can be 1...10 times, depends from PC model) a DMA driver (for example XDMA 3.1 is worth to try) can bring a big speedup. Make sure to read and write data in large pieces (16 KiB at least), not just single bytes. Other OSes are more forgiving here, but on DOS every single file I/O call causes a small "additive" delay, thus an efficient code design with good buffering is crucial.

Graphics: Pentium 2 and newer CPU's have a cache related feature called "MTRR" to speed up writes to video RAM. Drivers of other OSes usually do enable it. DOS does not (since it does not deal with graphics at all), neither does FB GFX. Use "VESAMTRR" tool by Japheth (in "HXGUI.ZIP" package), it will enable the speedup, surviving also mode switches and most "non-fatal" application crashes, up to a reboot. The possible speedup factor varies from model, up to cca 20 times. Also the mouse handling eats some (too much) CPU performance on DOS, this is a known weak point (the design of DOS FB GFX is not "very" "standard" - which is not very good), fixing is theoretically possible but not easy, you just can try several mouse drivers (see FAQ 20).

28. Can I access disk sectors with FB?
You can ... but FreeBASIC won't help you too much here: no "portable" solution. For DOS 3 methods are possible:

- Use logical disk access features of DOS for sector access, see example in the forum: freebasic.net/forum/viewtopic
- Use physical disk BIOS INT 13, bypassing DOS
- Use CPU ports, lowest level, bypassing both DOS and BIOS
Note that such experiments are a bit "dangerous" - you can easily lose data or make your PC unbootable if something goes wrong.

29. Can I use inline ASM with advanced instructions like SSE in DOS?
You can ... but SSE2 and above need to get enabled before. This is usually done by the DPMI host, HDPMI32 and CWSDPMI 7 will do that, most other hosts won't. Make sure to properly set CPUID for such instructions before using them. It's a good idea to provide code branches compatible with older CPU's (early Pentium, 80386) besides supporting latest instructions, and to avoid CMOV in those too.

See also
- Compiler FAQ.
- FB Runtime Library FAQ.
- Frequently Asked FreeBASIC Graphics Library Questions
Windows Related FAQ

Windows:

- Which IDEs are available for Windows?
- Can I get rid of the console / 'DOS' screen in a graphics application?
- My GUI program does nothing when run / The program compiles but I get a permission denied error in the linker
- How can I debug my program?
- Why Windows refuses to run my code using OUT and/or INP?
- I get the error 'Cannot start blah.exe because xxxx.dll was not found.' or similar. What is missing?
- Does FreeBASIC work with Windows Vista/7?
- Where can I find some tutorials on programming the Windows GUI?
- Are there Windows GUI code builders for FB?

FreeBASIC Windows questions

Which IDEs are available for Windows?

At the moment three full featured IDEs have been developed specifically for FB: FB1de (not being updated, avoid using of old versions of FBC bundled with it), FbEdit and JellyFishPro. These IDEs require a minimum configuration -as path to the compiler- to work.
You can also download FB1de and FbEdit as bundles (Editor + Compile that install in a single operation. But the bundled version of the compiler may be out of date.
Commercial "general use" IDEs can be used with FreeBASIC but may require an extensive setup. They are handy for multi language programming, as they provide a unified user interface.
Instructions for installing FB JFish Pro, FB1de, and FbEdit can be found
Can I get rid of the console / 'DOS' screen in a graphics application?
Yes. You have to give FreeBASIC the right command for it when you compile your program.

- If you compile from a command prompt, simply add "-s gui" to the end, like "fbc myprg.bas -s gui"
- If you compile in a specific IDE, you have to edit the "Compiler Defaults".
  - In Jelly-Fish Pro, its "Compiler->Set Compiler Defaults->Compiler Options". Add "-s gui" (NO QUOTES) in that box.
  - In FbEdit select Windows GUI in the targets dropdown list in the right of the tool bar.

My GUI program does nothing when run / The program compiles but I get a permission denied error in the linker
The problem may be related with the previous question. If a program tries to PRINT and it was compiled with "-s gui" it will freeze because no console is available. If the PRINT is issued before the first window is registered/opened, nothing will show in the screen or in the taskbar. The running program can only be seen in (and killed from) the task manager processes tab. If a new compilation is tried before killing the process it will give a "Permission denied" error when the compiler tries to modify a still running .exe.
In Windows GUI programs do not use console commands. Use MessageBox or print to a log file to issue any error message to the user. Be sure any PRINT to console you used for debugging is not compiled in the final version.

How can I debug my program?
FreeBASIC can use any debugger compatible with GNU GDB. Insight Win32 debugger is an user friendly wrapper for GDB.

- Get Insight from Dev-C++
- Rename the file to Insight.tar.bz2, and decompress it to an empty folder
- Compile your program with the -g switch
- Run <Your_Insight_Dir>\bin\usr\bin\Insight.exe
- Do File>Open to load your program into Insight
- From there you can watch, set breakpoints, step, examine memory and registers. Check Insight’s help

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Why Windows refuses to run my code using OUT and/or INP?
Windows requires a driver to be installed to access the hardware ports. FB-Win32 programs using INP and OUT include a built-in driver that installs temporarily for a session. Windows allows only users with Admin rights to run driver installations. This means if you usually run your windows sessions without Admin rights, you will have to use the window command line command RUNAS to run your program for the first time in each session so Windows allows it to install the driver. If this behavior is not acceptable you can use an external library as PortIO32 that installs a permanent port driver.

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I get the error 'Cannot start blah.exe because xxxx.dll was not found.' or similar. What is missing?
You are trying to run a program using a third party library that resides in dll not installed in your system.
FreeBASIC comes with headers and wrappers required to code for a lot of third party libraries but does not provide the actual runtime dll files. You have to download and install these from their home page. Find in th Links thread in the Libraries subforum the URL’s of the home pages of the libraries provided. You need the binaries for Win32 of the libraries If you want to develop programs with the libs you will need the documentation too.
When releasing compiled code it is good etiquette to provide the third party dll's required to run it.

Does FreeBASIC work with Windows Vista/7?  
Yes. (Write me!!!)

Where can I find some tutorials on programming the Windows GUI?  
See the answers to this question in this [thread in the forum](https://www.freecode.com/forum/thread).  
More advanced use requires a frequent consultation of the reference at the [Microsoft Developers Network](https://msdn.microsoft.com).  
A local install of the API reference is possible, search Microsoft for the Platform SDK (a huge download) or install just the documentation.

Are there Windows GUI code builders for FB?  
Yes there are some 3rd party developments generating Windows API code from a windows designer à la Visual Basic:  
**Jerry Fielden' Ezeegui** (freeware) uses a "graphical" textmode interface to let you build your code.  
**mrhx Software's VISG** (GPL) has a more classical user interface.  
Less helpful may be the graphical resource editors generating scripts for the resource compiler. Any editor generating scripts compatible with GoRC can be used, as the one included with FbEdit. Graphical resource editors are a great help in designing dialogs and menus, but they leave you the task of writing the window procedures required to make them active.

See also  
[Compiler FAQ](#)  
[FB Runtime Library FAQ](#)
FreeBASIC Linux questions:

- FreeBASIC gives me an error 'ld: can't find -lx11' or something similar!
- How do I install FreeBASIC in Ubuntu?

FreeBASIC gives me an error 'ld: can't find -lx11' or something similar!
FreeBASIC uses ld to link its files under linux. This program requires that any libraries you use have the '-dev' versions installed. For example, for the above error message, you'd want to install xlib-dev for your distribution. Other common errors are for glibc, which requires glibc-dev, and sdl, which requires sdl-dev. Most distributions make these easily available on your install media.

How do I install FreeBASIC in Ubuntu?"
See This thread in the FB forums

See also

- Compiler FAQ
- FB Runtime Library FAQ
Obsolete Keywords

Along the way FB has had a few keywords changed. Here is the list of those no longer supported. Old code must be updated if recompiled.

OPEN "CON:"
Use Open Cons
OPEN "ERR:"
Use Open Err
OPEN "PIPE:"
Use Open Pipe
POKEI
Use Poke (Integer,Address,N)
POKES
Use Poke (Short,Address,N)
SCREENINFO (Function returning a pointer to a structure)
Use Screeninfo, Sub Returning Values In Its Arguments
VAL64
Use Valng()
GOSUB
Do not use GoSub in SUBs or FUNCTIONs anymore; allowed in -lang qb mode.
Glossary

Brief definitions and explanations for words and phrases used in the FreeBASIC manual.


A

access rights
The level of access associated with Type or Class members. Public members are accessible to any code; protected members are accessible to member functions and any derived Type or Class member functions; private members are accessible only to member functions of that Type or Class. By default, Type members have public access rights, while Class members are private.

any pointer
A variable or expression that points to a memory address where it is not known, at least from the compiler’s point of view, what type of data is stored at that address. In C this would be the same as a void pointer or (void *). See Ptr.

archive
An archive is a group or files or a single file packed into a container format and usually compressed before or afterward. Typical container formats are GNU Tar and Zip. Typical compression formats are Gzip and Zip.

argument
Data that is passed to a procedure. The procedure refers to this data using the parameter(s) in its parameter list.

argument passing convention
The method in which arguments are passed to procedures, being either By Reference or By Value. See Passing Arguments to Procedures.
array (container)
A collection of data whose elements are stored contiguously in memory (one after the other, in increasing order). Because of this, an array offers random-access to its elements (any element can be accessed at any time). Insertion or removal of elements anywhere but at the back of the container requires that those elements that follow be relocated, so a linked-list is typically preferred when insertion or removal needs to be efficient.

assembler
A component in the tool chain for translating source code into executable programs. The assembler converts the low level assembly instruction mnemonics emitted by the compiler to object code.

assignment
Assignment is one of the fundamental operations of computing. All it means is copying a value into the memory location pointed at by a variable. The value might be a literal, another variable, or the result of some expression. For an instance of a Type or Class, this involves calling one of its assignment operators. Not to be confused with initialization.

automatic storage
Refers to storage on the call stack. Local procedure variables, objects and arrays with automatic storage are allocated when the procedure is called, initialized when defined, destroyed (in the case of objects) when leaving the scope they're declared in and deallocated when returning from the procedure.

automatic variable/object/array
A variable, object or array with automatic storage.

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B

byref
**ByRef** specifies passing arguments to procedures by reference. Arguments passed by reference can be modified by the procedure and the changes seen by the caller.

**byval**

**ByVal** specifies passing arguments to procedures by value. Procedures receive a copy of the argument passed. With Type or Class instances, this involves instantiating temporary objects by calling their copy constructor. These temporaries are destroyed upon procedure exit.

**binaries**

Binaries are the end result of source code. Binaries include executable files (.exe on windows), static library files (.a), dynamic library files (.dll on windows, .so on Linux), and relocatable object files (.o).

**.BSS section**

The part of the executable program that will contain zero bytes only when the program starts. Since all of the bytes are zero, the final size of the executable can often be reduced by placing uninitialized data, or zero initialized data in this section.

**buffer**

A region of memory that allows data to be saved or manipulated before being copied somewhere else. In a communications device this may hold incoming or outgoing data yet to be processed. In graphics, a buffer may contain an image before being copied to the screen.

**call back**

A control mechanism where a caller lets a procedure call another procedure (the call back) provided by the caller typically through a function pointer.

**call stack**
A chunk of memory reserved for a process or thread that is used as a stack for storing various information needed by procedures when they are called. Among the information stored on the call stack are all of the local automatic variables, objects and array data and usually whatever parameters are passed to the procedure. These items are allocated (*pushed* onto the call stack) when the procedure is called and deallocated (*popped* from the call stack) when the procedure returns, either by the caller or the callee, depending on the calling convention used. The initial and maximum sizes of this reserved memory vary by platform.

**caller**
A misnomer used to refer to the point in code in which a procedure is called.

**cast**
A cast operation changes one data type to another using specified rules. A *Type* structure can implement a custom *Cast* for any intrinsic data type and/or other *TYPEs*, See *Cast*.

**code block**
Several lines of source code grouped together all sharing at least one common scope. For example a procedure's code block will be all the lines of code between *Sub* and *End Sub*.

**com port**
A short name for serial communications port. A program can communicate with an external device, such as modem or another computer through a com port (nowadays the good old com ports are deprecated in favor of USB). See *Open Com*.

**compiler**
A compiler is a computer program which takes source code and transforms it into machine or object code.

**compiler directives**
These are instructions included in the text of the program that affect the way the compiler behaves. For instance the compiler might be directed to include one section of code or another of depending on the target
operating system.

**compound statement**
A statement composed one or more additional statements. Typically, a compound statement has a beginning (opening statement), a middle (a statement block) and an end (closing or ending statement), while some have additional parts. Examples of compound statements would be **If** and **Function**.

**constant**
A symbol that retains a consistent value throughout the execution of the program. See **Const**.

**constructor (module)**
A special type of module-level procedure that is automatically called prior to the module-level code flow. See **Constructor (Module)**.

**constructor (TYPE or CLASS)**
A special member function of a **Type** or **Class** that is called when an object is instantiated.

**CVS**
Concurrent Versions System. The file manager implemented at Sourceforge where sources are stored, it keeps the history of the changes introduced by the developers. Used by FB in the past. (see also SVN and GIT)

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**D**

**.DATA section**
The part of the executable program that will data that can be changed while to program is running.

**debugger**
A program that allows controlled execution of compiled code. The values of variables can be tracked, execution can be paused, stepped or accelerated, etc. A debugger is typically used to help find the source of programmer errors in source code, called 'bugs'.

**declaration**
A source code statement that introduces a symbol, constant, variable, procedure, data type, or similar, to the compiler but not necessarily allocate any space for it. See Dim, Declare, Extern, Type.

**definition**
A source code statement (or statements) that allocates space for data or code. For example, Sub defines a procedure by allocating space for the program code it will contain. Some statements can be both a declaration and a definition. For example, Dim both declares and defines a variable.

**dereference**
The act of obtaining a value from memory at a given address. See Operator * (Valueof), Pointers.

**descriptor**
Refers to the internal data structure used by the compiler and runtime library for managing variable length strings and arrays.

**destroy (TYPE or CLASS)**
The act of deconstructing and deallocating memory for an object instance. When an object is destroyed, its destructor is called. This happens automatically when an object goes out of scope, or when Delete is called with a pointer to an object.

**destructor (module)**
A special type of module-level procedure that is automatically called at program termination. See Destructor (Module).

**destructor (TYPE or CLASS)**
A special member function of a Type or Class that is called when an object is destroyed.
Shorthand for dynamically linked library.

DPMI
A method / standard allowing to execute protected mode code (mostly also 32-bit) on a 16-bit real mode DOS kernel. Affects only DOS version of FreeBASIC. See also DOS related FAQ

DJGPP
A complete 32-bit C/C++ development system for Intel 80386 (and higher) PCs running DOS and includes ports of many GNU development utilities.

dynamically linked library
A file containing executable code that is loaded by another application when it is started. Also referred to as a dll or shared library. See Shared Libraries (DLLs).

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E

enum
A data type restricted to a sequence of named values given in a particular order. See Enum.

executable
A binary file that can be run. It consists of libraries and object files bound together by the linker.

exit sub/function
When called inside a procedure, leaves the procedure and returns control to the calling program.

expression
An instruction to execute a statement that will evaluate/return a value.

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**F**

**field**
Commonly refers to a data member in a **Type** or **Class**.

**file number**
An integer associated with an open file or device as given in **Open**. All subsequent operations on the opened file or device must use the same file number.

**format string**
A sequence of characters that controls how data should be presented. See **Format**, **Print Using**.

**function**
A procedure defined using **Function**, optionally taking parameters and returning a value.

**function pointer**
A variable containing the address of a function. The address (function) to which the variable points can be changed while the program is running allowing for dynamic program flow, such as call back functions.

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**G**

**get/put buffer**
See: Image Buffer. An image buffer in FreeBASIC's native format.

**GIT**
The file manager implemented at Sourceforge where sources are stored it keeps the history of the changes introduced by the developers. Used by FB now. (see also CVS, SVN and Git).
**global variable**
A variable that is visible to all procedures within a module, across multiple modules, or both. See Common and Extern.

**GNU**
A mass collaboration project with the primary goal to provide a free and non-proprietary Unix-like operating system.

**GPL**
Short hand for GNU General Public License: a license for software and other kinds of works. Open source, obligates the user to keep the project open source and under the GPL.

**graphics primitive**
A graphics primitive is another term for common shapes like circles and rectangles.

**hash table**
A data structure that associates keys with values allowing for efficient look-up of values based on a given key.

**header**
When talking about a collection of data, this is generally the first part of that data that describes the rest. When talking about (header) files, this refers to an include file. In FreeBASIC the file extension '.bi' is usually used.

**heap**
The area of memory (free store) provided by the runtime library (and operating system) from which the program can dynamically allocate memory. See Allocate.
image buffer
A collection of data used to describe an image, containing such information as width, height, color depth and pixel data.

include file
A kind of source file that typically contains type definitions and declarations for variables and procedures that one or more other source files refer to. In general, these files provide a public interface to some module or modules, although a file that is #included can contain any text whatsoever.

initialization
The act of giving a variable a value at the point of its creation. For object instances, this involves calling one of its constructors. Not to be confused with assignment, which gives an already existing variable another value.

instance
An instantiated object of a Type or Class.

instantiate
The act of creating an object of a Type or Class, either directly with Dim, or indirectly by, for example, passing an object to a procedure by value.
library
Compiled code stored in a single file that can be used when making other programs. A library typically has one or more headers (or include files) to provide all the needed declarations for using the library.

linked list (container)
A collection of data whose elements are typically stored on the heap. The linked list's elements store the addresses of their adjacent elements, and so only sequential access (an element is accessed by following the links from adjacent elements) is possible. This scheme does provide constant-time insertion of elements anywhere into the container, however, and because of this is often preferred over the array.

linker
A program which combines multiple modules and libraries into a single executable which can be loaded into the computer's memory and followed by the computer. FreeBASIC uses the LD linker. Linkers are the most common, but not the only way to produce executables.

LGPL
Shorthand for GNU Lesser General Public License. Like the GNU GPL, but more permissive allowing non-(L)GPL'd works to be statically linked to the LGPL'd work, provided that the new work can have the LGPL'd portion relinked or replaced.

local variable
A variable that is visible only within the scope in which it is declared, and that is destroyed when program execution leaves that scope.

lock
A synchronization mechanism such that only one thread or process can have access to a shared object, for example a global variable, a device,
or a file.

member
A data field, procedure, enumeration, type alias or anything else declare within a Type or Class definition.

member data
Variables associated with a Type or Class. Member data can be static or non-static.

member function
A procedure associated with a Type or Class. Member functions have full access rights to the members of its type or class, and can be static or non-static.

method
See member function.

module
A source file in its entirety, including any include files that may be present as well. Typically, a module is a logical unit of code, containing parts of a program that relate to one another. For example, if making a game, one may separate the procedures needed for error logging from the procedures that control graphics into their own modules.

non-static member data
Member data that each instance of a Type or Class gets their own copy
non-static member function
A member function that has an implicit This reference as an argument.

null
A constant usually associated with pointers denoting a 'nothing' value. This value is typically an integer '0' (zero) - the 'NULL terminator' appended to zstrings is chr(0), or asc('"\0") - but can also be defined as pointer type, like Cast(any ptr, 0).

object code
Code in machine-readable form that can be executed by your computer's CPU and operating system, usually linked with libraries to create an executable file.

operand
One of the arguments passed to an operator. For example, in the expression a = b + c, the operands are a, b and c, while the operators are = and +.

operator
A function taking one or more operands (arguments) and returning a value. Operators can work on built-in data types, or can be overloaded to work on user defined types. See Operators.

overload
To declare a procedure having the same name as another, but with different parameters. Free functions, or module-level functions, can be overloaded using the Overload keyword. Type or Class member functions can be overloaded by default.
page buffer
A buffer used for holding the contents of the screen before being displayed on screen. Where multiple page buffers are allowed, one page will be visible to the users while all others are hidden. Also the active page (the one to which changes are made) need not be the visible one allowing changes to one page while showing another.

parameter
The name used by a procedure that corresponds to the argument that is passed to it.

parameter list
The parenthesized comma-separated list of parameters in a procedure declaration or definition.

PDS
Professional Development System. Sometimes referred to as QB7.1.

pitch
The number of bytes per row, in an image or screen buffer. If there is no padding between rows, then this can be calculated by width * bytes_per_pixel, but this is not necessarily safe to assume. The screen's pitch can be found using ScreenInfo, and an image buffer's pitch can be found by checking the pitch value in the image's header.

pointer
A data type used to hold addresses. The kind of pointer determines how the data at the address is interpreted when the pointer is dereferenced, or when used with Operator -> (Pointer To Member Access). See Pointers.

preprocessor
The FreeBASIC preprocessor is responsible for expanding Macros and replacing Defined values with their values.
**procedure**
A generic name for any block of code that can be called from somewhere else in a program. See Sub, Function.

**property**
A property is a special sort of type/class members, intermediate between a field (or data member) and a method. See Property.

**ptr**
Shorthand for pointer. See pointer.

---

**queue (container)**
A collection of data that offers first-in first-out (FIFO) storage and retrieval. Typically, elements can only be inserted at the back and removed from the front but can be accessed from either end.

**real number**
Any positive or negative number including fractions, irrational and transcendental numbers (like π or e) and zero. Variables containing a real number have a limited range and precision depending on the number of bits used to represent the number. See: Single and Double.

**registers**
Places inside the CPU for data storage. 80386 and compatible 32-bit models have EAX, EBX, ECX, EDX, ESI, EDI, EBP and ESP, plus some special (control/test/debug) registers. **NOT** related to "Windows registry"

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**S**

**scope**
Refers to the life-time and visibility of some component of the program, like a variable or a procedure. For example, a variable defined inside a procedure would have procedure scope: it is visible throughout the procedure, but not outside the procedure's code block. When the procedure ends, the variable goes out of scope and no longer exists.

**scope block**
A code block where all the lines of source have the same scope. An explicit scope block can be indicated with the **Scope** statement. Scope blocks may also be implicit with the usage of **If..Then, For..Next**, and other compound statements.

**shared library**
A library that exists once on a system that multiple executables can link to at runtime. See **Shared Libraries (DLLs)**.

**source code**
Code written by the programmer, in a human-readable form, not yet compiled.

**stack (container)**
A collection of data that offers last-in first-out (LIFO) storage and retrieval. Typically, elements can only be inserted, accessed and removed from the top of the stack.

**statement block**
One or more lines of code bookended by a compound statement.
**static library**
A library that is linked into a program at link time. There is one copy of the library for each executable that links to it. All data is executable specific. See Static Libraries.

**static member data**
Member data that each instance of a Type or Class shares. This data is defined outside of any Type or Class, and takes up no space in the resulting object instance.

**static member function**
A member function without an implicit this reference as an argument. Static member functions can be called normally through a variable, or directly using the type's name and the scope resolution operator See Static (Member).

**static storage**
Refers to storage in the .BSS or .DATA sections of an executable. Variables, objects and arrays with static storage are allocated and initialized at compile-time and destroyed (in the case of objects) and deallocated at program-termination. Explicitly initialized variables, object and arrays are allocated in the .DATA section.

**static variable/object/array**
A variable, object or array with static storage.

**sub**
A procedure defined using sub, optionally taking parameters and not returning a value.

**SVN**
Subversion. A version control system that allows users to keep track of changes made to sources and documents. Used by FB in the past. (see also CVS and GIT)

**SWIG**
A tool that automatically translates C headers to FreeBASIC (although not always perfectly).
**symbol**
Used to refer to variables, labels, functions, methods, procedures, or other programmatic constructs in a program.

**.TEXT section**
The part of the executable program that will contain program instructions and constant data.

**this reference**
A reference to an instance of a Type or Class that is passed as a hidden argument to non-static member functions of that type or class. Throughout the member function, this instance is referred to using the this keyword, See This.

**thread**
A thread of execution within a process (running program) that shares execution time with other threads in the same process. See Threading.

**trace**
To follow the execution of a program step-by-step either manually by examining the source code, or more practically with a debugger.

**union**
A structure that can be used to store different types of variables, such as integers, doubles and fixed-length strings in the same location, but only one at a time. See Union.
**user defined data type**
A *Type, Union, Enum, or Class* data type.

**V**

**variable**
A symbol representing data in memory.

**VBDOS**
Visual BASIC for DOS, a historical BASIC compiler by M$ from 1992, following after QBASIC. DOS platform dropped very soon, VBDOS never became popular.

**vector**
A series of data items in memory that can be accessed by an index number. Similar to an array except that vector elements are not necessarily all contained within a single block of memory.

**W**

**warning**
A message displayed by the compiler during compilation that suggests there may be potential problems with the current code.

**wiki**
An on-line system that provides a set of pages containing information that can be viewed and modified by the public. In this context, it is typically used to refer to the FreeBASIC on line documentation.
x86
Refers to the instruction set compatible with the 8086 (and later) CPU architecture, FreeBASIC only supports 80386 and later.

zstring
A zstring is in essence a standard C style string terminated by a null character. This data type is provided for greater compatibility with C libraries.
## Miscellaneous Keywords

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Runtime error codes and messages used by the runtime library.

**Description**

Freebasic returns the following runtime error codes:

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<th>Code</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>No error</td>
</tr>
<tr>
<td>1</td>
<td>Illegal function call</td>
</tr>
<tr>
<td>2</td>
<td>File not found signal</td>
</tr>
<tr>
<td>3</td>
<td>File I/O error</td>
</tr>
<tr>
<td>4</td>
<td>Out of memory</td>
</tr>
<tr>
<td>5</td>
<td>Illegal resume</td>
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<tr>
<td>6</td>
<td>Out of bounds array access</td>
</tr>
<tr>
<td>7</td>
<td>Null Pointer Access</td>
</tr>
<tr>
<td>8</td>
<td>No privileges</td>
</tr>
<tr>
<td>9</td>
<td>interrupted signal</td>
</tr>
<tr>
<td>10</td>
<td>illegal instruction signal</td>
</tr>
<tr>
<td>11</td>
<td>floating point error signal</td>
</tr>
<tr>
<td>12</td>
<td>segmentation violation signal</td>
</tr>
<tr>
<td>13</td>
<td>Termination request signal</td>
</tr>
<tr>
<td>14</td>
<td>abnormal termination signal</td>
</tr>
<tr>
<td>15</td>
<td>quit request signal</td>
</tr>
<tr>
<td>16</td>
<td>return without gosub</td>
</tr>
<tr>
<td>17</td>
<td>end of file</td>
</tr>
</tbody>
</table>

No user error code range is defined. If `Error` is used to set an error code it is wise to use high values to avoid collisions with the list of built-in error codes. (This built-in list may be expanded later.)

**See also**

- `Err`
- `Error`
- On Error
- Error Handling
## Comparison of C/C++ and FreeBASIC

<table>
<thead>
<tr>
<th>C/C++</th>
<th>FreeBASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>variable declaration</strong></td>
<td></td>
</tr>
<tr>
<td>int a; int a, b, c;</td>
<td>dim a as integer dim as integer a, b, c</td>
</tr>
<tr>
<td><strong>uninitialized variable</strong></td>
<td></td>
</tr>
<tr>
<td>int a;</td>
<td>dim a as integer = any</td>
</tr>
<tr>
<td><strong>zero-initialized variable</strong></td>
<td></td>
</tr>
<tr>
<td>int a = 0;</td>
<td>dim a as integer</td>
</tr>
<tr>
<td><strong>initialized variable</strong></td>
<td></td>
</tr>
<tr>
<td>int a = 123;</td>
<td>dim a as integer = 123</td>
</tr>
<tr>
<td><strong>array</strong></td>
<td></td>
</tr>
<tr>
<td>int a[4]; a[0] = 1;</td>
<td>dim a(0 to 3) as integer a(0) = 1</td>
</tr>
<tr>
<td><strong>pointer</strong></td>
<td></td>
</tr>
<tr>
<td>int a; int *p; p = &amp;a; *p = 123;</td>
<td>dim a as integer dim p as integer ptr p = @a</td>
</tr>
</tbody>
</table>
*p = 123

**structure, user-defined type**

```c
struct UDT {
    int myfield;
}
```

type UDT
myfield as integer
end type

**typedef, type alias**

```c
typedef int myint;
```

type myint as integer

**struct pointer**

```c
struct UDT x;
struct UDT *p;
p = &x;
p->myfield = 123;
```

dim x as UDT
dim p as UDT ptr
p = @x
p->myfield = 123

**function declaration**

```c
int foo( void );
```
declare function foo() as integer

**function body**

```c
int foo( void ) {
    return 123;
}
```

function foo() as integer
return 123
end function

**sub declaration**

```c
void foo( void );
```
declare sub foo( )

**sub body**

```c

```
void foo( void ) {
}

sub foo( )
end sub

byval parameters

void foo( int param );
foo( a );

declare sub foo( byval param as integer )
foo( a );

byref parameters

void foo( int *param );
foo( &a; );

void foo( int& param );
foo( a );

declare sub foo( byref param as integer )
foo( a )

statement separator

;

: end-of-line
for loop

for ( int i = 0; i < 10; i++ ) {
  ...
}

for i as integer = 0 to 9
  ...
next

while loop

while ( condition ) {
  ...
}
while condition
  ...
wend

do-while loop

do {
  ...
} while (condition);

do
  ...
loop while condition

if block

if (condition) {
  ...
} else if (condition) {
  ...
} else {
  ...
}
if condition then
  ...
elseif condition then
  ...
else
  ...
end if

switch, select

switch (a) {
  case 1:
    ...
    break;
  case 2:
  case 3:
    ...
    break;
  default:
    ...
    break;
}
select case a
  case 1
  ...

case 2, 3
...

case else
...

end select

string literals, zstrings

char *s = "Hello!";
char s[] = "Hello!";
dim s as zstring ptr = @"Hello!"
dim s as zstring * 6+1 = "Hello!"

hello world

#include <stdio.h>
int main()
{
  printf("Hello!\n");
  return 0;
}

print "Hello!"

comments

// foo
/* foo */
'
foo
'/

compile-time checks

#if a
#elif b
#else
#endif
#if a
#elif b
#else
#endif

compile-time target system checks
#ifdef _WIN32

#ifdef __FB_WIN32__

module/header file names

foo.c, foo.h

foo.bas, foo.bi

typical compiler command to create an executable

  gcc foo.c -o foo

fbc foo.bas
Comparison of integer data types: FreeBASIC vs. C/C++ (using GCC)

<table>
<thead>
<tr>
<th></th>
<th>C int</th>
<th>C long long [int]</th>
<th>C long [int]</th>
<th>FB Long</th>
<th>FB LongInt</th>
<th>FB Integer</th>
</tr>
</thead>
<tbody>
<tr>
<td>32bit win32</td>
<td>32</td>
<td>64</td>
<td>32 (ILP32)</td>
<td>32</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>32bit linux-x86</td>
<td>32</td>
<td>64</td>
<td>32 (ILP32)</td>
<td>32</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>64bit win64</td>
<td>32</td>
<td>64</td>
<td>32 (LLP64)</td>
<td>32</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>64bit linux-x86_64</td>
<td>32</td>
<td>64</td>
<td>64 (LP64)</td>
<td>32</td>
<td>64</td>
<td>64</td>
</tr>
</tbody>
</table>

See also

- Creating FB bindings for C libraries - How to translate C data types to FB
Information for hacking on FreeBASIC

This area of the Wiki is for documenting everything about the compiler and the runtime libraries. It is, however, incomplete. If you find that information provided here does not match what the source is doing then please update the relevant pages here. New pages and articles may be added freely, provided they help understanding what's going on inside FB.

Developing FreeBASIC Itself

Compiling a Development Version of FreeBASIC
Getting the source code
Compiling FB for DOS
Compiling FB on Linux
Compiling FB on Windows
Getting source code updates and recompiling FB
Debugging FB
FB build configuration options
Known problems when compiling FB
GCC toolchain choice

Running the FreeBASIC test suite
Normal vs. Standalone
Glossary
Notes on the creation of FB releases
FB and cross-compiling
Bootstraping/cross-compiling fbc

Creating FB bindings for C libraries
C Header Translation Tutorial
Header Style Guidelines
External Libraries Index (header status)

Compiler internals

Quick overview of all modules
The objinfo feature
Memory management
Lexer & preprocessor
Parser & compiler (fb, parser, symb, rtl)

Purpose
Top level parsing process

Symbols
Representation of data types
SELECT CASE
Profiling FB programs
Structure packing/field alignment

Run-time (rtlib) and Graphics (gfxlib2) Libraries

Keyboard input: inkey(), multikey(), etc.
Overview of drivers (backends)
Pixel formats
**Licenses**

**Compiler**
The FreeBASIC compiler (fbc) is released under the **GPL** license.

**Libraries**
With the exception of **LibFFI** (which is used for Threadcall), the runtime released under the **LGPL** license, for both the single-threaded and multi-threaded versions, with this extension to allow linking to it statically:

"As a special exception, the copyright holders of this library give you permission to link this library with independent modules to produce an executable, regardless of the license terms of these independent modules, and to copy and distribute the resulting executable under terms of your choice, provided that you also meet, for each linked independent module, the terms and conditions of the license of that module. An independent module is a module which is not derived from or based on this library. If you modify this library, you may extend this exception to your version of the library, but you are not obligated to do so. If you do not wish to do so, delete this exception statement from your version."

The Gfx library (libfbgfx) is released under the **LGPL** license.

**LibFFI** is released under the following license, found at http://github.com/atgreen/libffi/blob/master/LICENSE:

```plaintext
libffi - Copyright (c) 1996-2011 Anthony Green, Red Hat, Inc and others.
See source files for details.

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```
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Documentation
The documentation is released under the GFDL license.
About the FreeBASIC project.

The FreeBASIC project is a set of cross-platform development tools initially created by Andre Victor, consisting of a compiler, GNU-based assembler, linker and archiver, and supporting runtime libraries, including a software-based graphics library. The compiler, \textit{fbc}, currently supports building for i386-based architectures on the DOS, Linux, Windows and Xbox platforms. The project also contains thin bindings (header files) to some popular 3rd party libraries such as the \textit{C runtime library}, \textit{Allegro SDL}, \textit{OpenGL}, \textit{GTK+}, \textit{the Windows API} and many others, as well as example programs for many of these libraries.

FreeBASIC is a high-level programming language supporting procedural, object-orientated and meta-programming paradigms, with a syntax compatible to \textit{Microsoft QuickBASIC}. In fact, the FreeBASIC project originally began as an attempt to create a code-compatible, free alternative to QuickBASIC, but it has since grown into a powerful development tool. FreeBASIC can be seen to extend the capabilities of QuickBASIC in a number of ways, supporting more data types, language constructs, programming styles, and modern platforms and APIs.
Most Important Features

BASIC compatibility

- FreeBASIC is not a "new" BASIC language. You don't need to learn much new if you are familiar with any Microsoft-BASIC variant. You can use either "-lang qb" for compatibility, or (default) "-lang fb" for some of the new features, but it also brings some restrictions and some similarity with the "C" programming language. See also CompilerDialects.
- FreeBASIC is case-insensitive; explicit "main" procedure is not required; most of the graphic and console statements and procedures found in Microsoft QuickBASIC are implemented, et cetera.
- Only with "-lang qb": scalar variables don't need to be dimensioned and suffixes can be used; line numbers are supported; GoSub supported.

Clean syntax

- Only a small number of keywords have been added. All procedures are implemented as libraries, so for the most part, there are no new intrinsic routines, and therefore there is a low chance of having name duplication with old code.

Thin bindings (header files) to existing C libraries and APIs

- No wrappers or helpers are necessary, just a ported header file, making usage of external C libraries very easy
- The official distribution comes with several bindings to existing C libraries already, see External Libraries TOC for a complete up-to-date list

Multi-platform

- FreeBASIC currently runs on 32-bit Windows, Linux, and DOS (a 16-bit DOS is good enough, although FreeBASIC itself and compiler output are 32-bit) and also creates applications for the Xbox console. More platforms to come.
- The runtime library was written with portability in mind. All third-
party tools used exist on most operating systems already as they are from the GNU binutils. The compiler is written in 100% FreeBASIC code (that is, FreeBASIC compiles itself.), which makes it simple to be bootstrapped as it doesn't depend on non-portable tools.

**Unicode support**
- Besides ASCII files with Unicode escape sequences (\u), FreeBASIC can parse UTF-8, UTF-16LE, UTF-16BE, UTF-32LE and UTF-32BE source (.bas) or header (.bi) files, they can be freely mixed with other sources/headers in the same project (also with other ASCII files).
- Literal strings can be typed in the original non-Latin alphabet, just use a text-editor that supports some of the Unicode formats listed above.
- The WString type holds wide-characters, all string procedures (like Left, Trim, etc) will work with wide-strings too.
- Open was extended to support UTF-8, UTF-16LE and UTF-32LE files with the Encoding specifier. Input # and Line Input #, as well as Print # and Write # can be used normally, and any conversion between Unicode to ASCII is done automatically if necessary.
- Print also supports Unicode output (see Requirements).

**A large number of built-in data types**
- Integer: Byte, UByte, Short, UShort, Integer,UInteger, Long, ULong LongInt, ULongInt
- Floating-point: Single, Double
- String: fixed, variable-length or null-terminated (ZString), up to 2GB long
- Unicode strings (wString), like zString, but with support for wide characters. Use the Windows Unicode API procedures directly, etc.

**User-defined types (UDTs)**
- Unlimited nesting.
- BASIC's Type statement is supported, along with the new Union
statement (including anonymous nested unions).
- Array fields utilizing up to eight dimensions can be used.
- Procedure pointer fields.
- Bit fields.

**Enumerations (enums)**
- Easily declare a list of constants with sequential values with `Enum`.

**Arrays**
- Fixed- and variable-length arrays are supported, up to 2 GB in size.
- Up to eight dimensions, including arrays with unknown dimensions.
- Any lower and upper boundaries.
- Element data can be preserved during a re-size of variable-length arrays with `ReDim` using the new `Preserve` specifier.

**Pointers**
- Pointers to any of the data types listed above, including string characters, array elements and UDT's.
- Uses the same syntax as C.
- Unlimited indirection levels (e.g., pointer to pointer to ...).
- Procedure pointers.
- Indexing []'s (including string indexing).
- Type casting.

**Variable, object and array initialization**
- For static, module-level or local variables, arrays and UDT's.

**Default procedure parameter values**
- For numeric, string and UDT parameter types.

**Procedure overloading**
- Including procedures with default parameter values.
**In-line assembly**
- Intel syntax.
- Reference variables directly by name; no "trick code" needed.

**Traditional preprocessor support**
- Same syntax as in C.
- Single-line macros supported with the `#define` command, including parameters.
- Multi-line macros supported with the `#macro` command.

**Type aliases**
- Supporting forward referencing as in C, including UDT and procedure pointer types.

**C-like escape sequences for string literals**
- Same as in C (except numbers are interpreted as decimal, not octal).

**Debugging support**
- Full debugging support with GDB (the GNU debugger) or Insight (a GDB GUI frontend).
- Array bounds checking (only enabled by the `-exx` command-line option).
- Null pointer checking (same as above).

**Create OBJ's, LIB's, DLL's, and console or GUI EXE's**
- You are in no way locked to an IDE or editor of any kind.
- You can create static and dynamic/shared libraries adding just one command-line option (`-lib` or `-dylib/-dll`).

**As a 32-bit application**
- FreeBASIC can compile source code files up to 2 GB in size.
- The number of symbols (variables, constants, et cetera) is only limited by the total memory available during compile time. (You can, for example, include OpenGL, GTK/SDL, BASS, simultaneously in your source code.)
**Optimized code generation**
- While FreeBASIC is not an optimizing compiler, it does many kinds of general optimizations to generate the fastest possible code on x86 CPU's, not losing to other BASIC alternatives, including the commercial ones.

**Completely free**
- All third-party tools are also free. No piece of abandoned or copyrighted software is used (except GoRC on Win32). The assembler, linker, librarian/archiver, and other command-line applications come from the GNU binutils programming tools.
Data Types

- Standard Data Types
- User Defined Types
Different ways angles are measured

Written by Randy Keeling
This very simple tutorial assumes that you know what an angle is.

There are three commonly used ways to measure the size of an angle:

- Degrees (deg)
- Radians (rad)
- Gradients (grad)

Degrees

Most people are familiar with angles measured in degrees. A full circle \( \pi \) radians can be divided into three ways, degrees decimal and DMS (degree, minute, second).

We can always show a degree as we would any decimal number by showing its whole units followed by its fractional part. For example, 75.23\(^\circ\) means that we have 75 degrees and twenty-three hundredths of a degree.

In the DMS system, each degree is made up of 60 minutes (or arcminutes) and is marked with a `\` . So a degree measure like 36\(^\circ\) 14\(`\) 52\(``\) means 36 degrees, 14 minutes, 52 seconds.

To convert DMS to decimal degrees you can use the following code.

```basic
Dim D As Integer
Dim M As Integer
Dim S As Integer
Dim DD As Single

' Convert to degree decimal
DD = D + M / 60 + S / 3600 ' 3600 comes from 1/60
```

Radians
Radians are more common in computer programming and mathematics. The constant Pi (often given the symbol of the lowercase Greek letter \( \pi \)). Pi is an irrational and transcendental number (its decimal notation never ends) and is the circumference of any circle divided by that circle's diameter. An approximate value (to 20 decimal places) is \( \pi = 3.1415926535897932385 \). The value of \( \pi \) can also be found using this code.

\[
\pi = 4 \times \text{Atn} (1)
\]

With the radian system, a full circle has \( 2\pi \) \( (6.2831853071795864770) \) radians. Unlike degrees, radians are not marked with any form of a symbol. FreeBASIC, like most programming languages, accepts angle measurements in radians and not degrees.

To convert between radians and degrees (decimal) you can use the following code.

```plaintext
Const PI As Double = 3.1415926535897932
Dim D As Double
Dim R As Double
R = D * PI / 180  '' A full circle has 360 degrees
D = R * 180 / PI
```

The value of \( \pi \) is used so often, it is not uncommon to find it defined in libraries and commonly used routines. The following are useful constants.

```plaintext
Const PI As Double = 3.1415926535897932
Const TWO_PI As Double = 6.283185307179586
Const HALF_PI As Double = 1.570796326794896
Const DegToRAD As Double = 0.0174532925199433  '' PI/180
Const RADToDeg As Double = 57.29577951308233
```
Gradients

Gradients are used mainly in some forms of engineering. Within the grad
A Brief Introduction To Trigonometry

Written by RandyKeeling
This tutorial includes:

- Right Triangles
- Pythagoras' Theorem
- Trigonometric Functions
- Applying Trigonometric functions
- Inverse Trigonometric functions
- Other Trigonometric functions
- Law of Sines, Law of Cosines, and other relationships

Trigonometry can be thought of as the study of triangles. There is more to it than that, but this will suffice for this tutorial. While this may seem to be of limited use, many problems in both the real and virtual worlds can be solved by creative application of triangles.

A triangle has three sides and in 'normal' (i.e. Euclidean) space has three angles whose measurements add to be exactly 180 degrees (or Pi radians). For this tutorial we will deal only with 'normal' triangles (for those interested in other spaces, search for non-Euclidean triangles or non-Euclidean geometry).

Right Triangles
To begin with, we will deal with a special class of triangles known as right triangles. A right triangle has one angle that measures 90 degrees. Because the angles of a triangles must be exactly 180 degrees, there can be only one 90 degree angle in a triangle (and it is the largest angle in a right triangle). Below is FreeBASIC code to draw an image of a right triangle. (This image will be referred to throughout the tutorial.) In this image, uppercase letters denote sides, and their corresponding lowercase letters denote the angle opposite of the side. For example, angle y is the angle opposite side Y.
The box in the lower right hand corner means that it is a right angle (measures 90 degrees). The side opposite of that angle (side Z) is called the hypotenuse and is the longest side in a right triangle.

Pythagoras' Theorem
Perhaps the first bit of trigonometry that most people learn is the relationship commonly known as Pythagoras' Theorem. It simply states that the square of the hypotenuse of a right triangle is equal to the sum of the square of the other two sides. It is easier to understand in equation form.

\[ Z^2 = X^2 + Y^2 \]

A trivial example application of this law might be the following.

If player one is 100 meters due east of a marked location (the origin) and player two is 150 meters due north of the same location, how far apart are they?

\[ D = \sqrt{100^2 + 150^2} \]

**Trigonometric Functions**

Long ago people discovered that regardless of the size of the triangle, certain ratios were always the same. For example, in the image of the triangle above, if the measure of angle \( y \) is 45 degrees, then regardless of the size of the triangle, the ratio \( Y/X \) will always be the same. Collections of these ratios are trigonometric functions.

The three primary functions are Sine (\( \text{Sin} \)), Cosine (\( \text{Cos} \)), and Tangent (\( \text{TAN} \)). There are many different ways to define these three functions. One way is with relationships between sides of a right triangle.

- Sine (\( \text{Sin} \)) is the ratio of the side opposite the angle in question to the hypotenuse. In the above triangle, the sine of the angle \( y \) (written as \( \text{SIN}(y) \)) is the length of side \( Y \) divided by the length of side \( Z \).
- Cosine (\( \text{Cos} \)) is the ratio of the side adjacent to the angle in question to the hypotenuse. In the above triangle, the cosine of angle \( y \) (written \( \text{COS}(y) \)) is the length of Side \( X \) divided by the length of side \( Z \).
- Tangent (\( \text{Tan} \)) is the ratio of the side opposite to the angle in question to the side adjacent to the angle in question. In the above
triangle, the tangent of angle y (written as \( \text{Tan}(y) \)) is the length of side Y divided by the length of side X.

Many people remember these relationships with the mnemonic device SOHCAHTOA (pronounced Sow Cah Toe-a) which is of course \( \text{Sin} = \) opposite/hypotenuse, \( \text{Cos} = \) adjacent/hypotenuse, and \( \text{Tan} = \) opposite/adjacent.

FreeBASIC has functions for these trigonometric functions and others.

**Applying Trigonometric functions**

Referring again to the triangle image above, let's say that player one is on the ground at the point near angle y and player two is at the point near angle x (off of the ground). If player one knows how far he or she is from the side Y (let's say 25.2 meters) and can measure the value of angle y (let's say 31.5 degrees) how far off the ground is player two? How far away is player one from player two?

To solve this we look at what pieces of information we know. We know the adjacent side to angle y (25.2 meters) and the measure of angle y (31.5 degrees). This is enough information to use the tangent function. \( \text{Tan} \ (y) = \) Opposite/adjacent, or \( \text{TAN}(31.5 \text{ degrees}) = \) Opposite/25.2 meters. Using a little algebra to rearrange this we get opposite = \( \text{Tan}(31.5 \text{ degrees}) \times 25.2 \text{ meters} \). To find the distance between the players we could use Pythagoras’s Theorem now that we know the two non-hypotenuse sides of the triangle or we could use the cosine. Using cosine would give \( \text{Cos} \ (y) = \) adjacent/hypotenuse. With some algebra we get, hypotenuse = 25.2/\( \text{Cos}(31.5 \text{ degrees}) \).

Before we can write a program to solve this, we must remember that FreeBASIC, like most programming languages, works with radians, not degrees (see **Angles**).

In FreeBASIC we could get the answer with this code.

```
Const PI As Double = 3.1415926535897932
Dim Opposite As Double
```
Dim Hypotenuse As Double
Dim Angle As Double

Angle = 31.5 * Pi / 180

Opposite = Tan ( Angle ) * 25.2
Hypotenuse = 25.2 / Cos ( Angle )

Print Opposite
Print Hypotenuse
Sleep

The above code tells us that player two is about 15.4 meters off the ground and around 29.5 meters away (along the hypotenuse).

Inverse Trigonometric functions

But what if you know the sides of a triangle and need to find the angle? You would then use the inverse trigonometric functions.

- ArcSine (or Inverse Sine)
- ArcCosine (or Inverse Cosine)
- ArcTangent (or Inverse Tangent)

For example, using the above set-up, if player two was 30 meters off the ground and 50 meters away from player one (along the hypotenuse) what is the measure of angle $y$? Looking at our trigonometric functions it looks like we have need of the sine function (an opposite and a hypotenuse). $\sin (y) = \text{opposite}/\text{hypotenuse}$, $\text{ArcSine} (\text{opposite}/\text{hypotenuse}) = y$.

Print Asin (30/50)
This gives an angle of about 0.6435 radians, or around 36.9 degrees. The FreeBASIC command for each of these inverse functions are:

- **Asin** (arcsine)
- **Acos** (arccosine)
- **Atn** (arctan, there is also **Atan2** which takes the opposite and adjacent sides of the triangle, not their ratio)

**Other Trigonometric functions**

There are other trigonometric functions that are defined in terms of the above functions. Although none of the below are defined in FreeBASIC.

- Secant (sec(y)) is $1/\cos(y)$
- Cosecant (csc(y)) is $1/\sin(y)$
- Cotangent (cot(y)) is $1/\tan(y)$

Each of these has an inverse (or arc) functions as well.

**Law of Sines, Law of Cosines, and other relationships**

All of the above has assumed a right triangle, but this was an aid in explaining the basic trigonometric functions. The following does not rely on right triangles; these identities are valid for any triangle.

**Law of Sines**

$$\sin(y)/Y = \sin(x)/X = \sin(z)/Z$$

**Law of Cosines**

$$Z^2 = X^2 + Y^2 - 2*X*Y*\cos(z)$$

**Other Identities**

$$\sin^2(y) + \cos^2(y) = 1$$

This means the same as $\sin(y) * \sin(y) + \cos(y) * \cos(y) = 1$

$$\tan(y) = \sin((y)/\cos(y))$$
There are several more useful identities out there. Search for trigonometric identities or consult any higher mathematical reference.
x86 or 80x86 is the generic name of a microprocessor architecture first developed and manufactured by Intel. More information can be obtained by reading this Wikipedia article.
Structure packing/field alignment

The default layout of Type and Union structures in FreeBASIC is compatible to that of GCC, following the SysV (Linux/BSD) and Microsoft (Windows) ABIs. This allows for binary compatibility with GCC and other compilers.

By default, fields are aligned to their natural boundaries, which are:

- A multiple of 1 for 1-byte data types
- A multiple of 2 for 2-byte data types
- A multiple of 4 for 4-byte data types
- A multiple of 4 for 8-byte data types (32bit x86 DOS(DJGPP)/Linux/BSD)
- A multiple of 8 for 8-byte data types (Win32/Win64, 32bit ARM Linux, 64bit x86_64/AArch64 Linux/BSD)
- The largest natural boundary of the fields of Type/Union data types
- Dynamic string descriptors are handled as Type structures with the data pointer field being the one with the largest natural alignment
- Fixed-length strings are aligned according to the alignment required for the character size.
- Static arrays are aligned according to the alignment required for the element data type.

The compiler aligns fields by inserting padding bytes in front of them in order to move them to an offset that corresponds to their natural boundary, or to a multiple of the value given with Field = N, if it is smaller than the field's natural alignment. On the x86 architecture, such proper alignment is not required but can result in better performance when accessing the fields. Other architectures might actually require proper alignment.

In addition to field alignment, the whole structure's size is rounded up to a multiple of the largest natural alignment of its fields, by adding padding bytes at the end of the structure. This ensures that in an array of such structures, each individual one is properly aligned as required by the fields.
Using the **GFX_NULL** driver in Windows

The client area of the window is updated using GfxLib. Menus, toolbars or dialogs can be added to the window using normal Win API calls.

```vbnet
' Example of use of the GFX_NULL driver in windows
' The GfxLib is set up in the ON_Create sub
' The GFXLib buffer is drawn to screen in the On_Paint sub
' The GfxLib is updated in the event loop

#include "fbgfx.bi"
#include once "windows.bi"

Using fb

Dim Shared bmi As bitmapv4header
Dim Shared mywin As rect

Function on_paint(ByVal hwnd As HWND, ByVal wparam As

Dim rct As RECT
Dim pnt As PAINTSTRUCT
Dim hDC As HDC

'draw the gfx buffer to screen
hDC = BeginPaint(hwnd, @pnt)
GetClientRect( hwnd, @rct )
With rct
    StretchDIBits hDC, 0, 0, .Right-.Left+1, .bottom-.top+1, ScreenPtr, CPtr(bmi), 1, 0, 0
End With

EndPaint hwnd, @pnt
```
Function on_Create(ByVal hwnd As HWND, ByVal wparam As LPARAM) As Integer
    Dim rct As RECT
    'set a gfxscreen of the size of the client area
    GetClientRect hwnd, @mywin
    ScreenRes mywin.right+1, mywin.bottom+1, 32, 1, 0
    'and create a bmp header, required to paint it you
    With bmi
        .bV4Size = Len(BITMAPV4HEADER)
        .bv4width = mywin.right+1
        .bv4height = -(mywin.bottom+1) 'negative value
        '(standard BMP's are bottom to top)
        .bv4planes = 1
        .bv4bitcount = 32
        .bv4v4compression = 0
        .bv4sizeimage = mywin.right+1*mywin.bottom+1*4
        .bV4RedMask = &h0F00
        .bV4GreenMask = &h00F0
        .bV4BlueMask = &h000F
        .bV4AlphaMask = &hF000
    End With
    Function = 0
End Function

Function on_Destroy(ByVal hwnd As HWND, ByVal wparam As LPARAM) As Integer
    'clear arrays....
    PostQuitMessage(0)
    Function = 0
End Function
Function WndProc ( ByVal hWnd As HWND, ByVal message As Long, ByVal wParam As WPARAM, ByVal lParam As LPARAM )

    Function = 0

    Select Case As Const message
    Case WM_CREATE
        Function = On_create(hWnd, wParam, lParam)
    Case WM_PAINT
        Function = On_paint(hWnd, wParam, lParam)
    Case WM_DESTROY
        Function = On_destroy(hWnd, wParam, lParam)
    Case Else
        Function = DefWindowProc(hWnd, message, wParam, lParam)
    End Select

End Function

''
''-----------------------------------------------------------------------------

''main program create window + event loop

Dim wMsg As MSG
Dim wcls As WNDCLASS
Dim szAppName As ZString * 30 => "Random Rectangles"
Dim hWnd As HWND
Dim i As Integer

With wcls
    .style = CS_HREDRAW Or CS_VREDRAW
    .lpfnWndProc = @WndProc
    .cbClsExtra = 0
    .cbWndExtra = 0
    .hInstance = GetModuleHandle(NULL)
    .hIcon = LoadIcon(NULL, IDI_APPLICATION)
.hCursor = LoadCursor(NULL, IDC_ARROW)
.hbrBackground = GetStockObject(WHITE_BRUSH)
.lpszMenuName = NULL
.lpszClassName = @szAppName
End With

If( RegisterClass( @wcls ) = FALSE ) Then
  End
End If

'make a non-resizable screen
hWnd = CreateWindowEx( 0, szAppName, "Example of GFX", WS_OVERLAPPEDWINDOW And Not (WS_sizebox Or WS_MAXIMIZEBOX), CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, NULL, NULL, wcls.hinstance, NULL )

ShowWindow( hWnd, SW_NORMAL )
UpdateWindow( hWnd )

While 1
  If PeekMessage( @wMsg, NULL, 0, 0, PM_REMOVE)
    If wmsg.message = WM_QUIT Then
      Exit While
    End If
    TranslateMessage( @wMsg )
    DispatchMessage( @wMsg )
  Else
    'update the gfx buffer
    Line (Rnd*mywin.right, Rnd*mywin.bottom), RGB(Rnd*255, Rnd*255, Rnd*255), bf
    redrawwindow (hwnd, 0, 0, rdw_invalidate)
  End If
Wend

End wMsg.wparam
Unicode

A worldwide standard for storing, categorizing and interpreting characters

Unicode is an industry standard designed to allow text and symbols from all of the writing systems of the world to be consistently represented and manipulated by computers. Developed in tandem with the Universal Character Set standard and published in book form as The Unicode Standard, Unicode consists of a character repertoire, an encoding methodology and set of standard character encodings, a set of code charts for visual reference, an enumeration of character properties such as upper and lower case, a set of reference data computer files, and rules for normalization, decomposition, collation and rendering.

The Unicode Consortium, the non-profit organization that coordinates Unicode's development, has the ambitious goal of eventually replacing existing character encoding schemes with Unicode and its standard Unicode Transformation Format (UTF) schemes, as many of the existing schemes are limited in size and scope, and are incompatible with multilingual environments. Unicode's success at unifying character sets has led to its widespread and predominant use in the internationalization and localization of computer software. The standard has been implemented in many recent technologies, including XML, the Java programming language, and modern operating systems.

Common Unicode formats include:
- UTF-8
- UTF-16
- UTF-32
Example showing the two different headers used for image buffers.

Note: **ImageInfo** is provided as a simpler alternative to reading the image structures directly.

```
'' fbgfx.bi contains the necessary structures and constants for working directly with image headers
#include "fbgfx.bi"

'' in lang fb, structures and constants are contained in the FB namespace
#if __FB_LANG__ = "fb"
Using FB
#endif

'' function to show info on an image
Sub show_image_info( ByVal image As Any Ptr )
    Dim As PUT_HEADER Ptr header
    Dim As Integer w, h, bpp, pitch

    header = image
    If( header->Type = PUT_HEADER_NEW ) Then

        Print "New style header"

        w = header->Width
        h = header->height
        bpp = header->bpp
        pitch = header->pitch

    Else

        Print "Old style header"

        w = header->old.width
        h = header->old.height
        bpp = header->old.bpp
```

pitch = w * bpp

End If

Print "Image dimensions are " & w & "*" & h
Print "Image uses " & bpp & " bytes for each pixel"
Print "A row of image pixels takes " & pitch & " bytes"

End Sub

Dim As Any Ptr picture

ScreenRes 320, 200, 32

picture = ImageCreate( 10, 10, RGB(128, 192, 255) )

Put( 40, 40 ), picture, PSet

show_image_info( picture )

ImageDestroy picture

Sleep

NOTE: To use this code with an array, pass your array to the function, like

show_image_info( VarPtr( myarray( L ) ) )

where L is the lower bound of myarray().
Getting Started

This is a good introduction to FB for QBasic programmers, based on SJ

Getting started with the software

You can download FreeBASIC here: http://www.freebasic.net/index.php/
And FBIDE here: http://fbide.sourceforge.net/

When installing FBIDE, select "FBIDE only," to not install the old version package.
When running FBIDE the first time, you will have to browse to find the FBIDE on your computer.

Hello World!

Open up FBIDE and type the following:

```
PRINT "Hello World!"
SLEEP
```

Now press F5. Congratulations, you've just seen how much like QB FreeBASIC really is. Now you can use most console commands for QB just like you remember. For example:

```
LOCATE 10,10
PRINT "I'm the center of the universe!"
SLEEP
```

The Amazing Screen 13

Now, put "SCREEN 13" before your code, to see how easy it is to use graphics:

```
SCREEN 13
PRINT "Hello World!"
SLEEP
```
From there, all of the standard QB graphics commands work as you remember, as you can see in this example:

```
SCREEN 13
LINE (1,1)-(100,100),1,bf
PRINT "Hello World!"
CIRCLE (10,10),10,2
PSET (30,15),3
SLEEP
```

FreeBASIC also has new graphics features. For example, QB has never had screen 14 or greater. Try running this program:

```
SCREEN 15
LINE (1,1)-(100,100),1,bf
PRINT "Hello World!"
CIRCLE (10,10),10,2
PSET (30,15),3
SLEEP
```

After opening a graphics window via the SCREEN command, you can also change between windowed and fullscreen modes.

Another nice feature of the graphics library in FreeBASIC is that you can do page flipping in any video mode. The following code demonstrates this.

```
DIM as integer page
DIM as integer notpage
DIM as integer a, b

screen 12, , 2 'This sets the screen for 2 pages
notpage = 1 'This sets the backpage
DO
```
This works for any mode, so you can use the high resolution modes for page flipping, using standard QB graphics commands!

**Why ASM is No Longer Required**

I wouldn't be saying this if it wasn't true. Using ASM in BASIC to increase the functionality of your program is no longer necessary. Ignoring SDL, Allegro, DirectX, OpenGL, etc., for a minute, you've got the above page flipping and advanced graphics modes at your disposal, as well as Inkey, which we've all grown to love or hate, but there are also two new things QBers have had to resort to assembly code to do since the dawn of time:

```
DIM as integer x, y, buttons
CONST as integer escapeKey = 1
SCREEN 12

WHILE NOT MULTIKEY(escapeKey) 'this checks the escape key every
GETMOUSE x, y, , buttons 'This gets the mouse state
PRINT x,y,buttons
WEND
```

With this knowledge, you should be able to begin programming in FreeBASIC that it entails; Speed, power, and portability!
Who I Am
I am a hobbyist software developer whose tool of choice is FreeBASIC. I have Quest for a King, Nietzsche, Star Phalanx, and Rambo vs. Kitty Cat under my belt.

What I Do
I'm an instrumentation engineering technologist, not a programmer.

Contact Me
Don't.
FreeBASIC's greatest strength is its ability to seamlessly integrate with a number of standard C libraries while maintaining the ease of use that is QB. Even before FB had a built-in graphics library, intrepid coders were using SDL to get graphics and sound routines working. Before the SDL_net and Winsock, a number of coders, myself included, fought with the headers to get network support into FreeBASIC. Today, I'm just going to cover how to get started with three advanced libraries: SDL, fmod, and tinyPTC. After understanding the fundamentals, you'll see that using C libraries is simple enough that with few exceptions, C libraries are no more difficult to use in FreeBASIC than QB libraries were to use.

What are these Libraries, Anyway?

These libraries are particularly useful because they tend to provide functions for games.

SDL is a library with graphics and input support built in, and a bunch of stuff like font support and audio. It can be used with OpenGL, but I won't be covering that today.

TinyPTC is primarily a graphics library, the simplest one available. It does little more than give you a pointer to the graphics region to draw to.

FMod is a 3d sound and music library. Though its license is strange, it works and it nicely encapsulates 3D sound.

Including the Library

The first step in getting any of these libraries to work is including their headers in your project. For SDL, it's simply

```
$INCLUDE: "SDL\SDL.bi"
```

For FMod, it's

```
$Include: 'fmod.bi'
```
and for tinyPTC, you'll want

'$INCLUDE: 'tinyptc.bi'

'2. Initializing the library, loading a file'

Obviously, you can't just include the lib and fire away if it's got to do stuff first. To initialize SDL and load a bitmap into memory, you must:

```plaintext
CONST SCR_WIDTH = 640
CONST SCR_HEIGHT = 480
DIM MenuScreen AS SDL_Surface ptr 'our bitmap
DIM Shared video AS SDL_Surface ptr 'our screen surface

SDL_Init ( SDL_INIT_VIDEO )
video = SDL_SetVideoMode( SCR_WIDTH, SCR_HEIGHT, 32, 0 ) 'sets the video mode for 640x480x32
MenuScreen = SDL_LoadBMP("bitmap.bmp")
```

To initialize FMOD and load a sound into memory, you must:

```plaintext
DIM sound AS INTEGER 'it's just a handle, so it's an int!

IF FSOUND_GetVersion <= FMOD_VERSION THEN
    ErrorQuit "FMOD version " + STR$(FMOD_VERSION) + " or greater required"
End If

IF FSOUND_Init(44100, 32, 0) = FALSE Then
    ErrorQuit "Can't initialize FMOD"
End If

sound = FSOUND_Sample_Load(FSOUND_FREE,"sound.wav", FSOUND_HW3D,
```

Finally, there's no data formats to load with tinyPTC because it's so simple:

```plaintext
const SCR_WIDTH = 320
const SCR_HEIGHT = 200
const SCR_SIZE = SCR_WIDTH*SCR_HEIGHT

if( ptc_open( "tinyPTC test", SCR_WIDTH, SCR_HEIGHT ) = 0 ) then
end
end if
```
**Blitting, Playing, or Plotting**

The most important step, obviously, is to get whatever you want to do to the screen means going:

```vbnet
SUB BlitImage(x as integer,y as integer,image as sdl_surface ptr, dim Rectangle as SDL_Rect, dim Rectangle2 as SDL_Rect

Rectangle.X = 0
Rectangle.Y = 0
rectangle.w = image->w
rectangle.h = image->h
Rectangle2.x = x
Rectangle2.y = y

SDL_BlitSurface image, @rectangle, dest, @rectangle2

END SUB
```

For FMOD, the steps to play a sound aren't that difficult either:

```vbnet
FUNCTION fModPlayWave( samp1 as integer ) AS INTEGER
'where samp1 is the number returned by FSOUND_SampleLoad

DIM position(0 to 2)' as FSound_Vector
DIM vel(0 to 2)' FSound_Vector

fModPlayWave = FSOUND_PlaySoundEx(FSOUND_FREE, samp1, NULL, TRUE)

END FUNCTION
```

And TinyPTC, which is again, not a high level library like the other two, can use the following code:

```vbnet
SUB putd(BYREF buffer(), BYVAL x AS INTEGER, BYVAL y AS INTEGER, BYVAL colr as INTEGER)
buffer((y * SCR_WIDTH) + x) = colr

ptc_update @buffer(0) 'This is a pageFlip

END SUB
```
Shutting Down
So you don't have to manage memory and do all the boring mundane tasks, you must remember to shut down the library before your program exits. Luckily, all three programs allow this with one line. If you can't shut it down, the library no longer cares. It's beautiful.

<table>
<thead>
<tr>
<th>SDL: SDL_Quit ()</th>
</tr>
</thead>
<tbody>
<tr>
<td>fmod: FSOUND_Close ()</td>
</tr>
<tr>
<td>tinyPTC: PTC_Close ()</td>
</tr>
</tbody>
</table>

That's all there is to quitting!
As you can see, there is nothing inherently more difficult in using libraries in FreeBASIC. In fact, because coders don't need to jump through hoops easier, even with the more modern OS and hardware.
Using the Mouse in FreeBASIC

After doing some searches, I quickly noticed that there simply wasn't an official tutorial or technique for manipulating the mouse in a Windows console application in FreeBasic. Therefore, I decided to write this tutorial in order to give such an example to the FreeBasic Community. As you know, a Windows Console is a Windows console, which means it's created with the use of the Windows API, which means that the mouse can be accessed from the Console Window. So there's no need to turn the mouse on or off in your code. All you need to do is get or set the X and Y coordinates and get the states of the mouse buttons.

- **Getting Mouse Coordinates:**
The mouse cursor, when the mouse is moved, continuously updates its position. You can get these values to determine where the pointer currently is on the screen.

- **Setting Mouse Coordinates:**
For some reason there may be a need to position the mouse pointer at a different location than where it is.

- **Getting The Mouse Button Statues:**
Quite simply, when the user presses a button on the mouse, it returns a value that says that a button is pressed, and which buttons are pressed, too. From these values you can decide what part of your code gets executed.

As with most tutorials, this one too can be better explained with the use of an example program. We will be creating a very simple program that acts upon the user’s interaction with the mouse and certain areas of the screen. It should provide the bases of code needed to efficiently operate and control the mouse in your own programs.

**IMPORTANT:** It is mandatory that you set yourself in a graphic mode in order to use the mouse. The mouse commands will always return -1 for a value if the graphic mode is not set.

**THE SAMPLE PROGRAM DESCRIPTION**

For the sake of a demonstration program, things will be quite simple and straight forward. The program will show 3 items at the top of the screen and depending on which one you click, a different message will be displayed on the screen. This should give you enough information to know how to work with the mouse in FreeBasic.

In FreeBasic, there's basically 2 commands that you need to worry about. Here they are with their syntax explained as per the documentation.
Syntax
GETMOUSE x, y[, [wheel][, [buttons]]]

Description
GETMOUSE retrieves the mouse position and button status.

Mouse position is stored in X and Y when the function is called. If the be -1.

'wheel' is the mouse wheel counter. Rotating the wheel away from you makes it to decrease. If mouse is not present or out of the program wi

'buttons' stores the button status. On function termination, this will retu left mouse button is down; bit 1 is set if right mouse button is down; bi

*GETMOUSE is for use in graphics modes, set using the SCREEEN co

Syntax
SETMOUSE x, y, visibility

Description
SETMOUSE will set the X,Y coordinates of the mouse pointer, as well

Mouse position is set using the X and Y parameters.

The mouse will be visible if visibility is set to 1, and invisible if visibility

*SETMOUSE is intended for graphics modes initiated using the SCRE
THE CODING BEGINS

Here are a set of constants that I declare at the beginning of the module and the rest of the programming example.

```
Const LEFTBUTTON = 1
Const MIDDLEBUTTON = 4
Const RIGHTBUTTON = 2
Const SHOWMOUSE = 1
Const HIDE MOUSE = 0
```

As a first step in this example, we will be declaring variables that we will be using throughout the example program. Of course you don't have to declare your variables, but me I like to do so you're declaring your variables. To me that's good practice.

```
Dim CurrentX As Integer
Dim CurrentY As Integer
Dim MouseButtons As Integer
Dim CanExit As Integer
Dim As String A, B, C
```

The idea here is to do everything within a loop so that we can also control how the program exits. So we'll create a loop that will exit when the "CanExit" variable is equal to 0. In the loop we'll interrogate the mouse and print some basic values. (This part is extracted from the example provided in the GETMOUSE syntax explanation in the gfxlib.txt file).

Don't forget to set your graphics mode as it is a must to get valid return values. (Screen 12 for our example.

```
Screen 12
CanExit = 1

Do While CanExit <> 0
    GetMouse CurrentX, CurrentY, , MouseButtons
    If CurrentX < 0 Then
        Print "Mouse is out of context."
    Else
        If MouseButtons And LEFTBUTTON Then A="L"
```
If MouseButtons And MIDDLEBUTTON Then B="M"
If MouseButtons And RIGHTBUTTON Then C="R"
Print Using "Mouse position: ###.### Buttons: A="";B="";C=""
End If
Loop

This sample will basically continuously display information about Where the mouse is, which mouse button is pressed if any. The GETMOUSE statement basically puts the current X and Y coordinates in our CurrentX and CurrentY variables and the status of the mouse buttons in our MouseButtons variable. Statements will print L if the left button was pressed, M if the middle button was pressed.

For the next step, since we want to control a bit what's happening with the beginning of the program and control what happens with them afterwards displayed, this could be replaced by a series of line commands or something. But that is outside the scope of this tutorial. So far, by getting rid of the print statements from the code above, the loop should now look like this:

Screen 12
SetMouse 1, 1, 1
CanExit = 1
Locate 1,1
Print " | FIRST | SECOND | THIRD | EXIT | "
Do While CanExit <> 0
  Locate 1,1
  GetMouse CurrentX, CurrentY, , MouseButtons
Loop

Basically we print the line that has | FIRST | SECOND | THIRD | EXIT | and then a loop that interrogates the mouse. Of course, right now nothing will happen for it. In our example, we'll add code that simple prints which option was selected. If the user selects the EXIT option, we'll print the Option and we'll exit the loop. We'll also add a print statement that we are truly outside the loop and therefore the program is ended.

Const LEFTBUTTON = 1
Const MIDDLEBUTTON = 4 ' UNUSED IN THIS DEMO
Const RIGHTBUTTON  = 2  ' UNUSED IN THIS DEMO
Const SHOWMOUSE   = 1
Const HIDEMOUSE    = 0

Dim CurrentX       As Integer
Dim CurrentY       As Integer
Dim MouseButtons   As Integer
Dim CanExit        As Integer

Screen 12
SetMouse 1, 1, SHOWMOUSE
CanExit = 1
Locate 1,1
Print " | FIRST | SECOND | THIRD | EXIT | 

Do
  GetMouse CurrentX, CurrentY, , MouseButtons
  If MouseButtons And LEFTBUTTON Then
    If CurrentY <= 12 Then
      If CurrentX >= 0 And CurrentX <=75 Then
        Locate 12, 1
        Print "First Option Selected ";
      ElseIf CurrentX >= 76 And CurrentX <= 147
        Locate 12, 1
        Print "Second Option Selected";
      ElseIf CurrentX >= 148 And CurrentX <= 212
        Locate 12, 1
        Print "Third Option Selected ";
      ElseIf CurrentX >= 213 And CurrentX <=268
        Locate 12, 1
        Print "Last Option Selected ";
    Exit Do
  End If
  End If
  End If
Loop While Inkey$ = ""

SetMouse 1, 1, HIDEMOUSE
Print
You can see the many IF statements in this last piece of code. The numbers returned coordinates. They should work in all graphics modes in Console Graphics Window. Each if represents where the different options are written on the screen. If you would have used a graphics button routine you could simply use the same width and height to know which button was clicked.

IN CONCLUSION

As you can see, using the mouse has been made very simple in FreeBasic. You can use simple statements like the print command to draw your screens or you can use graphics commands like LINE to draw your screens graphically. No matter which way you choose to draw your screens with, the SETMOUSE and GETMOUSE statements will work the same way and return the very same values. All you have to do is get that information and make your programs do what you want them to do if they press a button, select an option, or even in the case of a game, the main character move towards the location where you clicked on the screen.

As always, if you have any questions regarding this tutorial or any other, feel free to email me and we'll see what we can do about solving your particular problem.

MystikShadows
Stéphane Richard
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Basic Input

Get Information into your Program.

Input is the life of any program. If you can't get something into your program, you can't get anything out of it. What you will find here is the basics of how to get information into your program.

Here's a very basic program that will ask for your name:

```basic
'Create a place to put the user's name
Dim As String strMyName

' Ask for the user's name and store it in the string
Input "What is your name? ", strMyName

' Wait half a second
Sleep 500

' Show them their name
Print
Print "I now know your name is "; strMyName
Print

' Wait until someone presses a button before you exit
Print "Press any button to exit"
Sleep
```

INPUT is the easiest way to get information from someone. They just type in some text and press Enter when they are done.

What if you only want one keystroke? The easiest way is to use the ASCII value of a key that was pressed.

```basic
' Ask the user for input
```
Print "Press your favorite key:"

' Set a place to keep the ASCII value of the key
Dim As Integer strKeyPress

' Keep going until a key is pressed
Do
    strKeyPress = GetKey
Loop Until strKeyPress <> 0

' Show the key the user pressed
Print
Print "Your favorite key is: "; Chr(strKeyPress)

' Wait until someone presses a button before you exit
Print
Print "Press any button to exit"
Sleep

For more information check out the User Input Section.
TekRat

Contact me at: tekrat@2d.com
Dynamic Arrays

Hello, this page explains the proper use of dynamic arrays in FreeBASIC, putting into the "Getting Started" tutorial page.

Arrays are neat; they can be used and resized throughout a program, which I will explain how to redimension a Dynamic Shared Array within a sub or function.

```
Declare Sub mySub()

' as of 0.17, OPTION DYNAMIC and '$DYNAMIC are unnecessary. you must define an array to be dynamic each time you can see, both following ways are successful.
Dim Shared myArray1() As UByte
ReDim Shared myArray2(0) As UByte

mySub

' because we shared the arrays, they are accessible
Print myArray1(5) ' will print 2
Print myArray2(6) ' will print 3

Sub mySub()
' do NOT use "redim shared" within a sub or function!
ReDim myArray1(0 To 9) As UByte
ReDim myArray2(0 To 9) As UByte
myArray1(5) = 2
myArray2(6) = 3
End Sub
```

Now, you may be wondering how you can redimension an array while using the PRESERVE keyword. Normally, you simply add PRESERVE as the syntax for REDIM will state. Yet in fact, this only works if the first array dimension is the only one changing! For example, the following program would not work properly:

```
' declare the dynamic array the cleaner way
ReDim Shared myArray(0 To 9, 0 To 9) As UByte
Dim As UByte x, y, i
```
' fill the array with values
For y = 0 To 9
    For x = 0 To 9
        i += 1
        myArray(x, y) = i
    Next x
Next y

' proves the values are good originally:
For y = 0 To 9
    For x = 0 To 9
        Print Using "##,"; myArray(x, y);
    Next x
    Print
Next y
Print
Print "Press a key..."
Sleep
Cls

' redimension the arrays
ReDim Preserve myArray(0 To 18, 0 To 12) As UByte

' the values have not been preserved properly!
For y = 0 To 9
    For x = 0 To 9
        Print Using "##,"; myArray(x, y);
    Next x
    Print
Next y
Sleep
End

Try it out! You can see that it does not work properly. This is because on PRESERVE to work properly.
There is a workaround, which I will post later, after I edit it in order to make sense to any program, not just mine, and make some revisions so it does not go out of bounds. For the moment, get creative ;)}
Beginners Guide to Types as Objects

Introduction

This tutorial is aimed at people who want to know more about the new features being referred to as 'types as objects', and 'that OOP stuff'. It aims to walk you through these new features, so it is aimed at people who don't really understand it yet, but want to learn. A data type, like a struct in C, or a record in Pascal. Here's just a short sample:

```pascal
Type person_info
    first_name As String
    last_name As String
    house_number As Integer
    street_name As String
    town As String
End Type
```

In this usage it's used as a kind of container for related data; in this example it could be as an entry in an address book. With the new features, however, it can be used more like much more than contain just simple fields of data. It becomes a way to express an idea of an object, and this makes object oriented programming much simpler. We will now look at the new feature:

Property

We'll start by looking at property. When you add a property to a Type, you get a member, but what happens, is instead of just getting or setting a variable, it calls a function instead. Take a look at this example:

```pascal
Type bar
    Declare Property x() As Integer
    Declare Property x(ByVal n As Integer) As Integer
    p_x As Integer
End Type

Property bar.x() As Integer
```
We include in our Type some declarations for a Property; they are very similar to ordinary function declarations. The first one declares a getter, the second a setter. The \texttt{p_x} member.

Next we write the code for the properties; again, the syntax is very similar. The way we return a value: instead of \texttt{Function = value}, we do \texttt{Property = value} as well. Also note that you can refer to the member directly as \texttt{p_x}; you can use \texttt{example this.p_x = n}; using \texttt{this} isn't usually needed, but it can help in ambiguous circumstances.

Then follows some testing code; this shows how we can use the properties. When you run the program it will also print to screen to show that the properties have been called.

Now this code is fairly trivial, but as you get used to the idea you'll see it can be put to some good uses. Imagine as an example you are writing a GUI, and the \texttt{TYPE} represents a button on the screen, you could do \texttt{button.text = "Hello World!"}, and make the property code update the button.

\texttt{maybe you are using the Type to maintain some kind of list; you could do code in your property to make the list larger.}

\textbf{Constructor/Destructor}

\texttt{ConstructorS are functions that are called when the Type gets created - \texttt{bar.x()}\end{verbatim}
Destructor is a function that gets called when the Type goes out of scope, ends, for a Type in the main code, or when a function ends, for a local Type expanded from the last.

```vbs
Type bar
    Declare Constructor()
    Declare Destructor()
    Declare Property x() As Integer
    Declare Property x(ByVal n As Integer)
    p_x As Integer Ptr
End Type

Constructor bar()
    Print "Constructor bar()"
    p_x = Allocate(SizeOf(Integer))
    *p_x = 10
End Constructor

Destructor bar()
    Print "Destructor bar()"
    Deallocate(p_x)
End Destructor

Property bar.x() As Integer
    Print "bar.x()"
    Property = *p_x
End Property

Property bar.x(ByVal n As Integer)
    Print "bar.x(ByVal n As Integer)"
    *p_x = n
End Property

'---
Dim foo As bar
Print foo.x
```
foo.x = 5
Print foo.x

Again the syntax is somewhat similar to normal functions. Note that this time I changed ptr. The constructor then Allocates the memory for this when foo is created, and it De-Allocate this memory once it is destroyed. So you can use Constructor up for you, then clean up once its finished with. Again a trivial example, but kind of list, and having it set the list up for you, and clean it up when it's finished.

Methods

You can also have regular Subs and Functions inside your Type; in some methods. We'll carry on our example:

```plaintext
Type bar
    Declare Constructor()
    Declare Destructor()
    Declare Property x() As Integer
    Declare Property x(ByVal n As Integer)
    Declare Sub Mul5()
    Declare Function Addr() As Integer Ptr
    p_x As Integer Ptr
End Type

Constructor bar()
    Print "Constructor bar()"
    p_x = Allocate(SizeOf(Integer))
    *p_x = 10
End Constructor

Destructor bar()
    Print "Destructor bar()"
    Deallocate(p_x)
End Destructor

Property bar.x() As Integer
```
So this time we added a Sub, that multiplies the integer pointed to by p_x memory address that the pointer holds.

**Private/Public**

By default all of the members of the bar type are public; that means that
However, sometimes you might want to make them private. Take for exa currently do Print *foo.p_x, and it will allow us to print the value it points so that only the members of the bar type (the constructor, destructor, prc
That way we can make sure we only deal with \( p_x \) by the ways we choose. 'DeAllocate(foo.p_x)' in our main code, then when the destructor runs, it 'double free'. Change the \texttt{Type} declaration as follows:

\begin{verbatim}
Type bar
  Declare Constructor()
  Declare Destructor()
  Declare Property x() As Integer
  Declare Property x(ByVal n As Integer)
  Declare Sub Mul5()
  Declare Function Addr() As Integer Ptr
Private:
  p_x As Integer Ptr
End Type
\end{verbatim}

Now try adding \texttt{Print *foo.p_x} to the main code and compile it. You'll get an 'Illegal member access, found 'p_x' in 'Print *foo.p_x'' message, showing that the compiler is enforcing the fact we made \( p_x \) private. When you use \texttt{private:} or \texttt{public:} statement follow the rule. Here's a rather pointless example just to show:

\begin{verbatim}
Type bar
Private:
  a As Integer
  b As Integer
Public:
  c As Integer
  d As Integer
Private:
  e As Integer
End Type
\end{verbatim}

In the above type, the members \( a, b, \) and \( e \) are private; \( c \) and \( d \) are public.

\textbf{Operator overloading}
Operator overloading is a way of telling the compiler what to do in the case of a kind of operation involving our \texttt{Type}. Take this example:


define a new \texttt{Type} for \texttt{bar} with a \texttt{n} field:

\begin{verbatim}
Type bar
    n As Integer
End Type
\end{verbatim}

\texttt{Dim} \texttt{as} \texttt{bar} \texttt{x, y, z}

\texttt{z = x + y}

Now normally the compiler will throw an error when it sees this, as it has no idea how to add together two \texttt{Types}, but we can define what we want to happen. Here's how:


declare \texttt{Operator} +

\begin{verbatim}
Operator +(ByRef lhs As bar, ByRef rhs As bar) As bar
    Operator = Type(lhs.n + rhs.n)
End Operator
\end{verbatim}

\texttt{Dim} \texttt{as} \texttt{bar} \texttt{x, y, z}

\texttt{x.n} = \texttt{5}
\texttt{y.n} = \texttt{10}
\texttt{z = x + y}

\texttt{Print z.n}

In this code, I use \texttt{lhs} and \texttt{rhs} to refer to the left and right hand side of the operator expression \texttt{type(lhs.n + rhs.n)}; this builds the \texttt{Type} that will be returned.
Type bar
   x As Integer
   y As Integer
   z As Integer
End Type

Then you would build it like type(xpart, ypart, zpart).

Most or all operators can be overloaded, and most of them are binary ops like the + example above. Some are unary ops having only a right hand would be done like 'Operator Not(ByRef rhs As bar) As bar'.

There are some special cases where they have to be declared inside the operators and casts.

Assignment operators are things like += -= mod= etc, and also Let. Let is like:

Dim As bar foo
Dim As Integer x
foo = x

And casts are kind of the reverse; they are used when you cast to another

Dim As bar foo
Dim As Integer x
x = foo

Here's a short example using Let and Cast:
Type bar
    n As Integer
    Declare Operator Let(ByRef rhs As Integer)
    Declare Operator Let(ByRef rhs As String)
    Declare Operator Cast() As String
End Type

Operator bar.Let(ByRef rhs As Integer)
    n = rhs
End Operator

Operator bar.Let(ByRef rhs As String)
    n = Val(rhs)
End Operator

Operator bar.Cast() As String
    Operator = Str(n)
End Operator

Operator +(ByRef lhs As bar, ByRef rhs As bar) As bar
    Operator = Type(lhs.n + rhs.n)
End Operator

Dim As bar x, y, z
x = 5
y = "10"
z = x + y
Print z

You need to have separate lets and casts for each data type you want to declaring within the type are known as non-static, and the ones that don technical reason for this; the non-static ones need to know which instance example above, we would say that x is an instance of bar) of the Type the call refers to
here's a list of the ones that currently can be:

Assignment ops:
let, +=, -=, *=, /=, \=, mod=, shl=, shr=, and=, or=, xor=, imp=, eqv=, ^=

Unary ops:
-, not, @, *, ->

Binary ops:
+, -, *, /, \, mod, shl, shr, and, or, xor, imp, eqv, ^, =, <=, <, >, <=, =>

**Overloaded Constructors/Methods**

As with normal functions, our Type's constructor and methods can be overloaded to provide a way to specify details on how the instance should be constructed.

```
Type bar
    Declare Constructor()
    Declare Constructor(ByVal initial_val As Integer)
        x As Integer
    End Type

Destructor bar()
    x = 10
End Destructor

Constructor bar(ByVal initial_val As Integer)
    x = initial_val
End Constructor

Dim foo As bar
Print foo.x

Dim baz As bar = bar(25)
Print baz.x
```

The first constructor, that had no arguments, is known as the default constructor. It provides an initial value of 10. However, we have also specified another constructor that will accept an initial value.
the way we ask for this to be called Dim baz As bar = bar(25). You can, and then you will always have to specify the initial value using the constructor.

Overloaded methods are very similar:

```
Type bar
    Declare Sub foo()
    Declare Sub foo(ByVal some_value As Integer)
    Declare Sub foo(ByRef some_value As String, ByVal x As Integer)
End Type
```

They work just they same as normal overloaded functions.

**Closing**

I hope this tutorial has been useful for you, although there are still a few things left to learn; if you've got this far, it shouldn't be too hard for you to pick them up. There is some more information available in the wiki and on the forums, and also in part 2 of this tutorial, available here - [Beginners Guide to Types as Objects (Part 2)](#).

**More reading**

- Property
- Constructor
- Destructor
- Operator
- This
- Type
- Types as Objects
- Public:
- Private:
- Protected:
Introduction.

Welcome to the second part of the tutorial. In this part I assume that you’ve read through Part 1, tried the examples, and experimented with some tests of your own. I’ll now cover some topics that I didn’t include in Part 1.

Indexed property.

An indexed property is a property that behaves like an array, except that instead of a property, a function gets called when you access it. I’ll start with a very simple example to show the syntax.

```basic
Type foo
    Declare Property bar(ByVal index As Integer, ByVal value As Integer) As Integer
End Type

Property foo.bar(ByVal index As Integer, ByVal value As Integer)
    Print "Property set, index=" & index & ", value=" & value
End Property

Property foo.bar(ByVal index As Integer) As Integer
    Property = 0
End Property

Dim baz As foo

baz.bar(0) = 42
Print baz.bar(0)
```

As you can see, the declaration for our indexed property is very similar to a regular property. We add an argument for the index. I include a dummy integer member, because a type must have at least one member.

Indexed property example.
least one data member. As you can see, the property is then used with (the zeroth index, just the same as we would for an ordinary array. Now I useful example, and I will describe it:

```vbnet
Type foo
    Declare Constructor(ByVal num_elements As Integer)
    Declare Destructor()
    Declare Property bar(ByVal index As Integer, ByVal value As Integer) As Integer
Private:
    x As Integer Ptr
    size As Integer
End Type

Constructor foo(ByVal num_elements As Integer)
    x = CAllocate(num_elements * SizeOf(Integer))
    size = num_elements
End Constructor

Destructor foo()
    Deallocate(x)
End Destructor

Property foo.bar(ByVal index As Integer, ByVal value As Integer) As Integer
    If (index >= 0) And (index < size) Then
        x[index] = value
    Else
        Error 6
    End If
End Property

Property foo.bar(ByVal index As Integer) As Integer
    If (index >= 0) And (index < size) Then
        Property = x[index]
    Else
        Error 6
    End If
End Property
```
Dim baz As foo = foo(10)
baz.bar(1) = 42
Print baz.bar(1)

This time, I've added a constructor and destructor, which will allocate an array, x, with the number of elements specified in the constructor. Then, when property functions are invoked, I check if the index is within the bounds of the array, if it is then the property is set. If the index specified is out of bounds, then 'Error 6' occurs, which is FB's 'out of bounds error', you could replace this with your own error handling. Changing the code 'baz.bar(1) = 42' to 'baz.bar(10) = 42', and you'll see in 10 elements (index 0-9)

**Copy constructor.**

A copy constructor is a special type of constructor, that is used to make a copy from an existing object. When you write code like this:

```plaintext
Type foo
  ...
End Type

Dim As foo a
Dim As foo b = a
```

What happens is FreeBASIC automatically generates hidden code to construct b, by making a copy of a, this is the default copy constructor, and simply copies the data fields (members) across. If we declare our own copy constructor, here's just a brief snippet to show how we declare:

```plaintext
Type foo
  Declare Constructor(ByRef obj As foo)
  ...
End Type
```
This will come in very useful for a reason I will now explain.

**Deep/Shallow copy.**

In that previous example, where we did the code 'Dim As foo b = a', that copy, it just simply copied the data fields across, however sometimes this is not desirable, imagine that one of the members is a pointer, what will happen is that the address that points to will be copied across, so both objects will point to the same memory. An example of this follows:

```plaintext
Type foo
    x As Integer Ptr
End Type

Dim As foo a
a.x = Allocate(SizeOf(Integer))
*a.x = 42

Dim As foo b = a

Print *a.x, *b.x
*a.x = 420

Print *a.x, *b.x
Deallocate(a.x)
```

As you see, because they both point to the same memory, changing one affects the other. In the previous section on the copy constructor, FreeBASIC creates the code to do shallow copies by default. This is also true if we do an assignment like:

```plaintext
Dim As foo a, b
```
In this case also, FreeBASIC creates a default assignment operator (Let) to perform a shallow copy. To do deep copies, we need to define a copy constructor, and an assignment operator, that is overloaded to accept our type. Here's an example using them.

```basic
Type foo
    Declare Constructor()
    Declare Constructor(ByRef obj As foo)
    Declare Destructor()
    Declare Operator Let(ByRef obj As foo)
    x As Integer Ptr
End Type

Constructor foo()
    Print "Default ctor"
    x = CAllocate(SizeOf(Integer))
End Constructor

Constructor foo(ByRef obj As foo)
    Print "Copy ctor"
    x = CAllocate(SizeOf(Integer))
    *x = *obj.x
End Constructor

Destructor foo()
    Print "dtor"
    Deallocate(x)
End Destructor

Operator foo.Let(ByRef obj As foo)
    Print "Let"
    *x = *obj.x
End Operator
```
Dim As foo a
*a.x = 42

Dim As foo b = a 'Uses the copy constructor

Print *a.x, *b.x
*a.x = 420

Print *a.x, *b.x

As you can see, the copy constructor gets called on the line 'Dim As foo b = a' without memory, and copy the data in the new copy constructor, so that we can adjust x in one object without it affecting the other. If we change the main code as follows:

Dim As foo a, b
*a.x = 42
b = a 'The assignment operator (Let) gets used this time.

Print *a.x, *b.x
*a.x = 420

Print *a.x, *b.x

Then this time the assignment operator is used. Note that in the assignment operator we don't need to allocate any memory because it has already been allocated in the default constructor, and we just need to copy the data across. The line '*x = *obj.x' performs this copy. If we had something more advanced, like a dynamic memory array, then we would need to reallocate the memory to be the correct size to fit the data being copied. Here's a more advanced version just to show that.

Type foo
Declare Constructor(ByVal num_elements As Integer)
Declare Constructor(ByRef obj As foo)
Declare Destructor()
Declare Operator Let(ByRef obj As foo)
  x As Integer Ptr
  size As Integer
End Type

Constructor foo(ByVal num_elements As Integer)
  Print "Default ctor"
  x = CAllocate(SizeOf(Integer) * num_elements)
  size = num_elements
End Constructor

Constructor foo(ByRef obj As foo)
  Print "Copy ctor"
  x = CAllocate(SizeOf(Integer) * obj.size)
  size = obj.size
  For i As Integer = 0 To size - 1
    x[i] = obj.x[i]
  Next i
End Constructor

Destructor foo()
  Print "dtor"
  Deallocate(x)
End Destructor

Operator foo.Let(ByRef obj As foo)
  Print "Let"
  x = Reallocate(x, SizeOf(Integer) * obj.size)
  size = obj.size
  For i As Integer = 0 To size - 1
    x[i] = obj.x[i]
  Next i
End Operator

Dim As foo a = foo(5)
This may seem quite complex at first, it's worth just reading through it a few times, examples, it's not too tricky once you're used to it.

### Passing objects to functions ByVal

The idea of deep and shallow copies also applies to passing an object to a function. When you pass a reference to an object (ByRef), you can modify the object, and the changes will persist outside of the function. When an object is passed by value to a function, a new copy is created, and if that object has a copy constructor, then this is invoked, if it doesn't, then the hidden shallow copy is performed. Once the function ends, the objects destructor is called.

### New/Delete

New and delete are special operators for dynamically allocating memory. New is used with dynamic memory, it is used with pointers. In all the examples we create our objects, this will create them on the stack, but by using new we allocate memory which can allow more flexibility, just like using Allocate/DeAllocate with normal memory. The important thing about new, is that you don't need to check if the pointer is NULL after new, like you would if you did allocate. If new fails, it causes an exception, which will end the program. FreeBASIC, it is likely that some kind of try..catch mechanism will be created.
handling, but as of the time of writing, this is not yet implemented.

There are two different varieties of the new/delete. The first type, creates for example:

```plaintext
Dim As Integer Ptr foo = New Integer
*foo = 1
Print *foo
Delete foo
```

This will create a new Integer, then destroy it when we call delete. Remember dynamic memory. For simple data types you can also specify a default value after the data type, ie:

```plaintext
Dim As Integer Ptr foo = New Integer(42)
Print *foo
Delete foo
```

This also works for UDT's with just simple data fields:

```plaintext
Type foo
   x As Integer
   y As Integer
End Type

Dim As foo Ptr bar = New foo(1, 2)
Print bar->x, bar->y
```
This initialization won't work for more complex types involving constructors or destructors, however a useful feature is that when using new/delete with objects, it also calls them. The following example:

```
Type foo
    Declare Constructor()
    Declare Destructor()
    x As Integer
    y As Integer
End Type

Constructor foo()
    Print "ctor"
End Constructor

Destructor foo()
    Print "dtor"
End Destructor

Dim As foo Ptr bar = New foo

Delete bar
```

You will see that the constructor and destructor for the object are called.

The second type of new/delete is for creating arrays, this time the number of elements is placed after the datatype in square brackets '[]'. When using the array version, you must use 'delete[]', so that FreeBASIC knows you are deleting an array, here is a simple example:

```
Dim As Integer Ptr foo = New Integer[20]
```
This will create a dynamic array, with 20 Integer elements. It should be noted this is different from Allocate, which takes the number of bytes as its argument; using new, you specify the number of elements. The array method works just the same for objects:

```plaintext
Type foo
    Declare Constructor()
    Declare Destructor()
    x As Integer
    y As Integer
End Type

Constructor foo()
    Print "ctor"
End Constructor

Destructor foo()
    Print "dtor"
End Destructor

Dim As foo Ptr bar = New foo[3]

Delete[] bar
```

When you run this code, you will see that three constructor/destructor pairs are called, because we created an array of three instances of foo.

You must remember to call Delete, or Delete[] for any memory allocated to variables, to prevent a memory leak, just like the way you must remember to call DeAllocate for any memory allocated to variables using the Allocate function.
Name Mangling

Name mangling, also known as name decoration, is something that happens at a lower level, and as such is not essential to know about. The reason for name mangling is to resolve problems that are involved with more than one function sharing the same name, which happens when functions are overloaded, or are part of a type. Take for example the overloaded subs shown below:

```
Sub foo Overload ()
End Sub

Sub foo(ByVal i As Integer)
End Sub
```

If we didn't have name mangling, then both might be known at a lower level as a name clash, so they have to be decorated in order to know which one is used. For the first sub, the compiler actually creates a sub called _Z3FOO, for a sub called _Z3FOOi. The compiler then remembers these, and chooses depending on how you call it, for example 'foo()' will actually call _Z3FOO, _Z3FOOi. We can spot something from this, that the 'v' stands for void (no argument), and 'i' stands for integer. The full details of name mangling are quite complex, and vary between compilers, some use a different name mangling scheme to GNU compilers, and there are different schemes as well. The main thing we need to know, is that FreeBASIC follows the GCC 3.x ABI (Application binary interface), meaning that any overloaded functions, or complex types will only be compatible with other compilers using the same scheme. This is an unfortunate limitation, but it is not really a FreeBASIC problem, it is common of all the compilers that use advanced features, and even if all the compiler authors agreed on a common name mangling scheme, there would cause incompatibility.

Implicit this

This again is not necessary to know about mostly, its something that happens at a lower level. When you call a member function of an object, what actually parameter is passed, so that the function knows which instance of the object.
also true for the property/constructor/destructor/operator members. If we look at a very simple example:

```vbnet
Type foo
    Declare Sub bar(ByVal n As Integer)
        x As Integer
    End Type

Sub foo.bar(ByVal n As Integer)
    x = n
End Sub

Dim baz As foo
baz.bar(5)
```

What actually happens behind the scenes is something essentially equivalent:

```vbnet
Type foo
    x As Integer
End Type

Sub foo_bar(ByRef _this As foo, ByVal n As Integer)
    _this.x = n
End Sub

Dim baz As foo
foo_bar(baz, 5)
```

This method using an explicit ‘this’ is often used in languages that do not have OOP features. OOP is really just a set of concepts, that can be mostly coded in almost any language. Some languages have difficulties implementing certain features, such as constructors, because the compiler does not know how to enforce them. The reason for adding OOP features to a language is to hide a lot of this, and add syntactic sugar to make it simpler to use, such as the way we can use properties as if they were ordinary data members.
functions, which is what they really are.

**Hints for debugging/profiling**

When using GDB or other debuggers, and the gprof profiling tool, the inf syntax, and all your variable names and other symbols are shown in uppercase. Here's an overview to help you understand how these are shown:

Here's an example type:

```vbnet
Type bar
    Declare Constructor()
    Declare Constructor(ByRef obj As bar)
    Declare Constructor(ByVal n As Integer)
    Declare Destructor()
    Declare Operator Cast() As Any Ptr
    Declare Operator Let(ByVal n As Integer)
    Declare Property foo(ByVal n As Integer)
    Declare Property foo() As Integer
    member As Any Ptr
End Type
```

When using GDB, these will be shown as follows (note in C++ they use `::` where we would use `.`, `::` is known as the scope resolution operator):

BAR::BAR() - The default constructor
BAR::BAR(BAR&) - The copy constructor (& in C++ means a reference, `&` in VB is Copy By Reference)
BAR::BAR(int) - The constructor taking an integer argument (note there ByVal, as this is the default passing method in C/C++)
BAR::~BAR() - The destructor
BAR::operator void*() - A cast to Any ptr (void is similar to Any, * means Pointer)
BAR::operator=(int) - The assignment operator (Let), denoted by `=' in C++
BAR::FOO(int) - Property foo setter, taking an integer argument
BAR::FOO() - Property foo getter
Member sub/functions are shown in the same way as properties, indexed also, just with the extra argument for the index.

Here is how the FB data types will be shown:

Any ptr - void *
ZString ptr - char *
String - FBSTRING
byte - signed char
ubyte - bool
short - short
ushort - unsigned short
integer - int
unsigned integer - unsigned int
longint - long long
ulongint - unsigned long long

I hope that helps you get started with understanding how things are disp experimentation will always help.

More reading

http://www.freebasic.net/wiki/wikka.php?wakka=KeyPgOpDelete
http://en.wikipedia.org/wiki/Copy_constructor
http://en.wikipedia.org/wiki/Object_copy
http://en.wikipedia.org/wiki/Name_mangling
Introduction to Variable Scope

Written by rdc

Variable Scope

Scope refers to the visibility of a variable, where you can access a variable within a program. Before you can understand the different levels of scope, you need to understand the structure of a program in FreeBasic.

Program Structure

A complete program is composed of one or more .bas files, called modules. Each module can contain both module level code, and code contained within subroutines and functions. Module level code is code that is not contained within a subroutine or function. The following snippet illustrates the various parts of a module.

```plaintext
Dim aInt As Integer 'Variable declared at module level

Sub DoSomething
    Dim aInt As Integer 'Variable declared at sub level
    ... 'This code is local to sub
End Sub

Function DoSomethingElse() As Integer
    Dim aInt As Integer 'Variable declared at func level
    ... 'This code is local to func
End Function

'Module level code
aInt = 5
DoSomething
aInt = DoSomethingElse()
```
Local Variables

If you define a variable at the module level (and not using `Shared`), the variable will have local module level scope. It is visible to the module level code, but not to subroutine or function within the module. In the example above the module variable `aInt` is only visible to the module level code.

Variables defined within a subroutine or function are local to the subroutine or function and are not visible to module level code or any other subroutine or function.

Variables Defined Within Control Structures

Variables that are defined within If, For-Next, While-Wend and Do-Loop are local to the control structure block code. That is, they are not visible outside the bounds of the begin and end of the control block, just like a variable declared within a subroutine or function.

Shared Variables

In the example, if you wanted `aInt` to be visible within the subroutine or function, you would need to declare the variable as `Shared` and then not declare a variable with the same name within any subroutine, function or control block. Shared variables are visible to module level code, subroutine or function level code and within control structure blocks.

Scope Conflicts

In the code snippet above, if `aInt` were declared as `Shared`, and each subroutine and function declared `aInt`, there would be a scope conflict, since there is one variable name used for different levels of scope.

The compiler resolves this by taking the current scope into account and variable within that scope. Since subroutines and functions have a lower scope than the module, `aInt` would refer to the variable declared within the subroutine or function, and not the one declared at the module level, even though it is declared as a shared variable.

Multiple Modules
Scope is limited to a single module, that is a single .bas file. However, it
necessary to extend the scope from one module to another. You would use a
Common statement when you declare a variable that needs to be shared among
modules.

Each module must have the same Common declaration in order for the compiler
to match up the common variables. If you declare a variable in module1 as an
Integer then module2 must also have Common aInt as Integer. Without a Common
declaration aInt would not be visible within module2.

You can add the Shared attribute to Common, that is Common Shared to not extend the scope to multiple modules, but to extend scope within a module. Common
Shared operates the same as Shared within a single module. As with Common, you
have matching declarations in each module that needs access to the variable.

**Scope...End Scope**

You can create a temporary scope block by using the Scope, End Scope key
words. The scope block is very useful when creating multi-line macros where you
need to create some temporary working variables but do not want to introduce new
variables in the program. The following snippet illustrates how to create a scope block.

```vbnet
Scope
    Dim tmp As Integer
    ... 'Some code
End Scope
```

The scope of any variable created within a scope block is limited to the block. However, the scope block inherits the visibility of the surrounding scope, so variables created at the same scope as the scope block are visible within the scope block.

For example, if you have aInt which is at module level scope, and the scope block is at module level scope, then aInt would be visible inside the scope block. Of course there is a scope conflict, in which case the variable inside the scope block would override the variable with the same name outside the scope block.
**Variable Lifetime**

Not only does scope set the visibility of a variable, it also determines the variable. A variable goes through several stages in its lifetime; creation, access and destruction. When this occurs depends on the scope of a variable, where the variable has been defined within the program.

**Module Level Variables**

Module level variables exist for the life of a program, since they are declared within the main body of the program. Module level code is the main executing code of the program, and terminates when the program ends.

**Subroutine and Function Level Variables**

Variables declared within a subroutine and function exist as long as the subroutine and function exists within the body of the subroutine and function. On entering the sub/func, the variable is created, initialized and can be accessed within the sub/func. Once the subroutine or function exits, the variable is destroyed.

**Static Variables**

One exception to the declared sub/func variable is the Static variable. Static variables maintain their value between calls to the subroutine or function with a module level lifespan.

**Control Block Variables**

Variables declared within a control block, such as a For-Next, exist as long as the control block is executing. Upon leaving the control block, the variables are destroyed.

**Scope...End Scope Variables**

Variables declared within a scope block exist as long as the scope block exists. Once the program leaves the scope block, any variables created within the scope block are destroyed.
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Introduction To Arrays

Written by rdc

Arrays are probably the single most useful programming construct that is available to you in FreeBasic. Many problems that you will try to solve with a programming solution involve data arranged in tabular format, and arrays are perfect for managing this type of data. Understanding arrays is a crucial skill in becoming a competent programmer.

Arrays are contiguous memory segments of a single or composite data type. An array can have one or more rows, and each row can have one or more columns. The number of rows and columns defines the dimensions of the array. FreeBasic uses the row-major scheme for arrays, which means that the first dimension references the row in an array that has more than one dimension. FreeBasic supports up to eight dimensions in an array.

One-Dimensional Arrays

An array with a single row is called a one-dimensional array. If an array is declared as single-dimensional, only the number of columns in the row. Since an array requires a minimum of one row, the row is understood to exist in this case.

The following code snippets create a single-dimension integer array using different array definition schemes available in FreeBasic.

```
Dim myArray(10) As Integer
Dim myArray(1 To 10) As Integer
```

The first method will define an array with a single row and 11 columns, with column indexes (numbers) ranging from 0 to 10. The second method defines the lower and upper bounds using the to keyword. Here the indexes will range from 1 to 10.

One-Dimensional Array Indexes

You access each element of an array using an index value. In the case of a single-dimensional array, the index refers to a column number in the default row. The format is to use the array variable, with the index surrounded by parenthesis.

```
myArray(5) = 7
```
This would set column 5 in the array to 7.

```vbnet
myInt = myArray(5)
```

This will set the value of `myInt` to the current value of column 5 in `myArray`.

**Two-Dimensional Arrays**

A two-dimensional array is an array that has more than one row, along with a defined number of rows, where each row has a defined number of columns. The following code snippet defines an array using the default method.

```vbnet
Dim myArray(2, 10) As Integer
```

The first dimension defines the number of rows in the array, while the second dimension defines the number of columns in each row. In this example, the array has 3 rows, numbered 0 to 2, and each row has 11 columns, numbered 0 to 10.

You can also define the lower and upper bounds of the array.

```vbnet
Dim myArray(1 To 2, 1 To 10) As Integer
```

This definition would set the number of rows to 2, numbered 1 to 2 and the number of columns to 10, numbered 1 to 10.

**Two-Dimensional Array Indexes**

To access the array elements of a two-dimensional array, you would use indexes. The first index selects the row, and the second index selects a column within that row.

```vbnet
myArray(1, 5) = 7
```
This code would set column 5 in row 1 to 7.

```
myInt = myArray(1, 5)
```

This code would set myInt to the current value contained within column 5.

**Multi-Dimensional Arrays**

For arrays of three or more dimensions, you would use the same format as listed above, taking into account the progression of the array dimensions. For a three-dimensional array, the first dimension would be the row, the second the column, the third the z-order, or depth, of each column.

For example, to define a cube in space, you would use the y, x, z format, which defines the depth axis. To create an array in this format you could define:

```
Dim myCube(y, x, z) As Integer.
```

MyCube(10, 10, 10) would create a cube with 11 vertical units, 0 to 10, 11 horizontal units, 0 to 10 and 10 depth units, 0 to 10. To access the center of the cube, you would use `iCenter = myCube(5, 5, 5)`.

You will probably never need to use arrays of more than three dimensions. However, if you need to use higher-dimensional arrays, the same principles apply.

**Dynamic Arrays**

The arrays described above are static arrays; the array size cannot change size during execution. Dynamic arrays are useful for creating data structures such as stacks or queues.

Static arrays, the arrays described above, are kept on the heap, but dynamic arrays are allocated from the computer's pool of memory. The compiler dynamically allocates memory for the array based on the requested dimensions.
You specify a dynamic array by using the `ReDim` keyword.

```
ReDim myArray(1 To 5, 1 To 5) As Integer
```

If you don't know the needed array bounds at the start of the program execution, you can define an array with empty indexes.

```
Dim myArray() As Integer
```

In this case the compiler sets a default value of 0 for the array size. You can use the bounds.

**ReDim and ReDim Preserve**

Dynamic arrays can change sizes during execution. `ReDim` will clear the contents of the array to the default data type values, while `ReDim Preserve` will keep intact the existing contents, unless the array size is smaller than the previous size.

**Array Functions**

There are a number of functions that you can use with arrays.

**Arrays of Composite Types**

Type definitions allow you to group related data into a single entity, and often you will need more than one instance of a type definition. An example of this usage may be an inventory system for your RPG, a series of documents within an editor, and a set of employee records from a random access database.

You can create arrays of types just as you would with any of the intrinsic data types.

```
Type myPoint
```
The code defines a set of 3 lines, with endpoints $p_1$ and $p_2$, where each using a combination of array index and dot operator.

```vbnet
dim myLineSet (1 to 3) as myLine
```

Arrays in Types

Not only can you create an array of a composite type, you can have an array more efficiently by replacing $p_1$ and $p_2$ with an array.

```vbnet
type myPoint
    row as integer
    col as integer
end type

type myLine
    pts(1 to 2) as myPoint
end type
```
Here pts is an array of myPoint. To access this structure you would use an index value.

```plaintext
myLineSet(1).pts(1).row = 1
myLineSet(1).pts(1).col = 1
myLineSet(1).pts(2).row = 10
myLineSet(1).pts(2).col = 10
myLineSet(1).char = Chr(219)
```

myLineSet is an array, so you use an index value. pts is an element of the type, also an array, so you use an index to select each pts array element. Row and col operators are used.

Using an array for the endpoints enables you to easily extend the line definition to support triangles and squares. The following code snippet shows one possible definition.

```plaintext
Type myObj
  objid As Integer
  Union
    myLine(1 To 2) As myPoint
    myTriangle(1 To 3) As myPoint
    mySquare(1 To 4) As myPoint
  End Union
End Type
```

The objid field would indicate which type of object is contained within the object. A 1 may indicate a line, a 2 may indicate a triangle and a 3 may indicate a square. Since the definition defines a single object,
memory usage.

To print the object to the screen, you would examine the objid and then printing the number of lines that correspond to the type of object.

One further enhancement you can make to this program is to add a function to correspond to the type of object being printed. Using this technique will enable you to further extend the usefulness of the code by simplifying the process of adding new objects to the type definition.

For example, if you needed to be able to describe a cube, you would simply add a new array to the union, add a cube print function, and the type definition would be able to print a cube by simply adding a few lines of code.

Array Initialization

You can initialize an array with values when using the Dim statement in a type definition. The following code snippet illustrates the syntax using a one-dimensional array.

```plaintext
Dim aArray(1 To 5) As Integer => {1, 2, 3, 4, 5}
```

This code snippet dimensions an integer array with 5 elements, then sets the elements to the list contained within the curly brackets. The arrow operator, =>, tells the compiler that the list following the Dim statement should be used to initialize the array.

You can also dimension multidimensional arrays in the same manner, by specifying blocks of data enclosed within curly braces as the following code snippet illustrates.

```plaintext
Dim bArray(1 To 2, 1 To 5) As Integer => {{1, 2, 3, 4, 5}, {6, 7, 8, 9, 10}}
```

In this example, the first block, {1, 2, 3, 4, 5}, corresponds to row 1, and the second block, {6, 7, 8, 9, 10}, corresponds to row 2. Remember that FreeBasic arrays are row-major, so the row is specified before the column. When you initialize an array in this manner, you must be sure that the number of elements defined will fit into the array.

Type Array Initialization
Not only can you initialize an array of simple data types, you can also initialize an array with composite types. The following code snippet illustrates a type array that contains an array as an element of the type.

```vbnet
Type aType
    a As Integer
    b As Byte
    c(1 To 2) As String * 10
End Type

Dim As aType myType(1 To 2) => {1234, 12, "Hello"
```

The curly brackets signify that this is an array initialization, while the parenthesis indicate the type initialization. Since the type has an embedded array, you use the curly brackets to load the data into the embedded array, just as you would a stand-alone array. If the embedded array was a multidimensional array, then you would need to wrap each row in { and }

**Using the -exx Compiler Switch**

The `-exx` compiler switch will enable error and bounds checking within your program, the compiler will generate an "out of bounds" error while the program is running.

This is a great help in debugging your program, and finding problems associated with arrays, so it is quite useful when working with pointers as well.

Using `-exx` does add quite a bit of additional code to your program, so once your program is functioning correctly, you will want to compile the program without the `-exx` switch.
Introduction to the Type Def

Written by rdc
There are times when creating a program that you may want to define an aggregate structure such as a personnel record, or an enemy in a game. While you can do this using individual data types, it is hard to manage within a program. Composite data types allow you to group together related data items into a single structure that can be manipulated.

FreeBASIC offers two composite data types, the Type and Union.

Types

FreeBASIC allows you to group several data types into a unified structure definition which you can use to describe these aggregate data structures.

The basic structure of a type definition is:

```basic
Type typename
  Var definition
  Var definition
  ...
End Type
```

The `Type`-End `Type` block defines the scope of the definition. You define the type structure in the same manner as using the `Dim` keyword, without using the `code snippet shows how to build an employee type.`

```basic
Type EmployeeType
  fname As String * 10
  lname As String * 10
  empid As Integer
  dept As Integer
End Type
```
You can use any of the supported data types as data elements, including type definitions. When you create the type definition, such as in the example above, you are just creating a template for the compiler. In order to use the type definition, you need to create a variable of the type, as the following code snippet illustrates.

```
Dim Employee As EmployeeType
```

Once you have created a variable of the type, you can access each element using the dot notation `var_name.field_name`.

Using the above example, to access the `fname` field you would use:

```
Employee.fname = "Susan"
```

### Using With

To access multiple fields at a time, you can use the `With-End With` block. The following code snippet shows how to use the `With` block with the above example.

```
With Employee
    .fname = "Susan"
    .lname = "Jones"
    .empid = 1001
    .dept = 24
End With
```

The compiler will automatically bind the variable `Employee` to the individual within the `With` block. Not only does mean that you don't have as much typing, but the structure is optimized and is a bit faster than using the full dot notation.
Passing Types to Subroutines and Functions

One advantage to using types in your program is that you can pass the structure to subroutine or function and operate on the structure as a whole. The following code fragment shows a partial subroutine definition.

```plaintext
Sub UpdateEmployeeDept(ByRef Emp As EmployeeType)
 .
 .
End Sub
```

Notice that the parameter is qualified with `ByRef`. This is important since the type within the subroutine. There are two parameter passing modes and `ByVal`.

**ByRef and ByVal: A Quick Introduction**

`ByRef` and `ByVal` tell the compiler how to pass a reference to the subroutine. If you use `ByRef`, or *By Reference*, you are passing a pointer reference to the parameter inside the sub or func will be reflected in the actual variable that was passed. In other words, the `ByRef` parameter points to the memory.

`ByVal`, or *By Value*, on the other hand makes a copy of the parameter, and any changes you make inside the sub or func are local and will not be reflected in the actual passed. The `ByVal` parameter points to a copy of the variable not the actual variable.

The default for FreeBASIC .17 is to pass parameters using `ByVal`. In order to update the passed parameter, you need to specify the `ByRef` qualifier. In this example, updates the department id of the employee type, so the parameter is qualified as that the subroutine can update the dept field of the type variable.

On the other hand you may not need to update the type as in the following...
In this sub you are just printing the employee record to the screen or a printer, so you need to change anything in the type variable. Here the default \texttt{Byval} is used to pass a copy of the employee record to the sub rather than a reference to the variable. If you were to do this in this case, you won't accidentally change something in the type variable that you didn't intend to change.

You should only use \texttt{Byref} if you intend to change the parameter data. It is safer to use \texttt{Byval} in cases where you need to have the parameter data, but want to prevent accidental changes to the data. These accidental changes generate hard-to-find bugs in your program.

\textbf{Types Within Types}

In addition to the intrinsic data types, type fields can also be based on another type. Why would you want to do this? One reason is data abstraction. The more general your data structures, the more you can reuse the code in other parts of your program. The less code you have to write, the less chance of errors finding their way into your program.

Using the \textit{Employee} example, suppose for a moment that you needed to track more department information than just the department id. You might need to keep track of the department manager, the location of the department, such as the floor or the building, or the main telephone number of the department. By putting this information into a separate type definition, you could use this information by itself, or as part of another type definition such as the Employee type. By generalizing your data structures, your program will be much more robust.

Using a type within a type is the same as using one of the intrinsic data types. The following code snippets illustrates an expanded department type and an updated employee type.

\begin{verbatim}
Type DepartmentType

End Type
\end{verbatim}
Notice that in the Employee definition the dept field is defined as `DepartmentType` as one of the intrinsic data types. To access the department information type, you use the compound dot notation to access the dept fields.

```
Employee.dept.id = 24
Employee.dept.managerid = 1012
Employee.dept.floor = 13
```

The top level of the type definition is `Employee`, so that reference comes first. Since dept is now a type definition as well, you need to use the dept identifier to access the fields within the `DepartmentType`. `Employee` refers to the `employee` type, `dept` refers to the `department` type and `id`, `managerid` and `floor` are fields within the `department` type.

You can even carry this further, by including a type within a type within a type. You would simply use the dot notation of the additional type level as needed. While there is no limit on the levels of nested type definitions, it gets to be a bit unwieldy when used this way.

**With and Nested Types**

You can also use the `With-End With` block with nested types, by nesting 1
illustrated in the following code snippet.

```vbnet
With Employee
    .fname = "Susan"
    .lname = "Jones"
    .empid = 1001
    With .dept
        .id = 24
        .managerid = 1012
        .floor = 13
    End With
End With
```

Notice that the second `With` uses the dot notation, `.dept`, to specify the type definitions. When using nested `With` blocks, be sure that you match all the statements with their correct `With` statements to avoid a compile error.

**Type Assignments**

Extending the idea of data abstraction further, it would be nice to be able to initialize the department type from the initialization of the employee in the two functions, you can easily add additional department information where you can use type assignments.

Just as you can assign one intrinsic data type to another, you can assign another type variable, providing they share the same type definition.

The following code snippet abstracts the department initialization function and result to the department type within the `Employee` type.

```vbnet
' This function will init the dept type and return it
Function InitDept(deptid As Integer) As DepartmentType
    Dim tmpDpt As DepartmentType
    Select Case deptid
      ```
Case 24 'dept 24
With tmpDpt
   .id = deptid
   .managerid = 1012
   .floor = 13
End With
Case 48 'dept 48
With tmpDpt
   .id = deptid
   .managerid = 1024
   .floor = 12
End With
Case Else 'In case a bad department id was passed
With tmpDpt
   .id = 0
   .managerid = 0
   .floor = 0
End With
End Select
' return the dept info
Return tmpDpt
End Function

' Create an instance of the type
Dim Employee As EmployeeType

' Initialize the Employee type
With Employee
   .fname = "Susan"
   .lname = "Jones"
   .empid = 1001
   .dept = InitDept(24) ' get dept info
End With

As you can see in the snippet, the dept field of the employee type is initialized with a function call. The InitDept function returns a DepartmentType and the compiler will assign that type to
the dept field of the Employee record.

By just adding a simple function to the program, you have made the program easier to maintain. If a new department is created, you can simply update the InitDept the new department information, recompile and the program is ready to go.

**Bit Fields**

There is yet another data type that can be used in type definitions, the bit field. It is defined as `variable_name: bits As DataType`. The variable name must be followed by a colon, the number of bits, followed by the data type. Only integer types (excluding the two floating-point types 'single' and 'double' and excluding the 64-bit types) are allowed within a bit field. Bit fields are useful when you need to keep boolean type information. A bit can be either 0 or 1, which may represent Yes or No, On or Off or even Black and White.

The following code snippet illustrates a bit field definition.

```
Type BitType
    b1: 1 As Integer
    b2: 4 As Integer
End Type
```

`b1` is defined as a single bit, and `b2` is defined as four bits. You initialize the bit fields by passing the individual bits to the type fields.

```
myBitType.b1 = 1
myBitType.b2 = 1101
```

The data type of the bit field determines how many bits you can declare. Since an integer is 32 bits long, you could declare up to 32 bits in the field. However, you would declare a single bit for each field, and use a number of fields to define the masking that you wish to use. Using a single bit simplifies the coding you
determine if a bit is set or cleared and allows you to easily identify what a type definition.

**The Field Property**

When you create a variable of a type definition, the type is padded in memory, which allows for faster access of the type members since the type fields are aligned on a 4 byte or Word boundary. However, this can cause problems when trying to read a type record from a file that is not padded. You can use the use `field` property to change the definition.

The `field` keyword is used right after the type name and can have the values alignment (no padding), 2 for 2 byte alignment and 4 for 4 byte alignment. To define a type with no padding you would use the following syntax.

```basic
Type myType Field = 1
    v1 As Integer
    v2 As Byte
End Type
```

For 2 byte alignment you would use `field = 2`. If no `field = property` is assigned, then the padding will be 4 bytes. If you are reading a type definition created by FreeBASIC using the default alignment, then you do not need to use the `field` property.

**Quick Basic**

**Type Initialization**

You can initialize a type definition when you dimension the type just as you do with intrinsic variables. The following code snippet illustrates the syntax.

```basic
Type aType
    a As Integer
    b As Byte
End Type
```
In the `Dim` statement, the arrow operator `=>` is used to tell the compiler that you are initializing the type variable. The type element values must be enclosed in parenthesis by commas. The order of the value list corresponds to the order of the type elements, and will be set to 12345, b to 12 and c to "Hello".

You cannot initialize a dynamic string within a type definition using this method. The string must be fixed length.

Initializing a type definition in a `Dim` statement is useful when you need to know the values for a type, or values that will not change during program execution. If these values are known at compile time, the compiler doesn't have to spend cycles loading the values during runtime.

**Unions**

Unions look similar to Types in their definition.

```
Union aUnion
  b As Byte
  s As Short
  i As Integer
End Union
```

If this were a `Type`, you could access each field within the definition. For a `Union` can only access one field at any given time; all the fields within a `Union` occupy the same memory segment, and the size of the `Union` is the size of the largest member.

In this case, the `Union` would occupy four bytes, the size of an `Integer`, V
occupying 1 byte, the \( s \) field occupying 2 bytes, and the \( i \) occupying the field starts at the first byte, so the \( s \) field would include the \( b \) field, and thus include both the \( b \) and \( s \) fields.

**Types in Unions**

A good example of using a type definition in a union is the `Large_Integer` from `winnt.bi`. The `Large_Integer` data type is used in a number of Windows Runtime Library. The following code snippet shows the `Large_Integer` definition.

```plaintext
Union LARGE_INTEGER
    Type
        LowPart As DWORD
        HighPart As Long
    End Type
    QuadPart As LONGLONG
End Union
```

The `Dword` data type is defined in `windef.bi` as a FreeBASIC `Uinteger`, and is defined as a `Longint`. A `Long` is just an alias for the integer data type. Each type occupies contiguous memory locations, so the `HighPart` field follows the `LowPart` field in memory. Since this is a union, the type occupies the same memory segment as the `QuadPart` field.

When you set `QuadPart` to a large integer value, you are also setting the `LowPart` and `HighPart` fields, which you can then extract as the `LowPart` and `HighPart`. You can also set the `QuadPart` field that is by setting the `LowPart` and `HighPart` of the type, you are setting the `QuadPart` field.

As you can see, using a type within a union is an easy way to set or retrieve individual values of a component data type without resorting to a lot of conversion code. The layout of the memory segments does the conversion for you, providing that the memory sense within the context of the component type.

In the `Large_Integer` case, the `LowPart` and `HighPart` have been defined to return the appropriate component values. Using values other than `Dword` and `Long` would not return...
correct values for \textit{LowPart} and \textit{HighPart}. You need to make sure when defining a union, you are segmenting the union memory segment correctly within the type.

**Unions in Types**

A union within a type definition is an efficient way to manage data when one field within a type can only one of several values. The most common example of this is the Variant data type found in other programming languages.

FreeBASIC does not have a native Variant data type at this time. However, by using the extended type syntax, you could create a Variant data type for use in your program.

When using a \texttt{Union} within a type it is common practice to create an \textit{id} field that indicates what the union contains at any given moment. The following code illustrates this concept.

```vbscript
'Union field ids
#define vInteger 0
#define vDouble 1

'Define type def with variable data fields
Type vType
    vt_id As Integer
    Union
        d As Double
        i As Integer
    End Union
End Type
```

The union definition here is called an anonymous union since it isn't defined with a name. The \texttt{vt_id} field of the type definition indicates the value of the union. To initialize the type you would use code like the following.
```vbnet
Dim myVarianti As vType
Dim myVariantd As vType

myVarianti.vt_id = vInteger
myVarianti.i = 300

myVariantd.vt_id = vDouble
myVariantd.d = 356.56
```

`myVarianti` contains an integer value so the `id` is set to `vInteger`. `myVariantd` double so the id is set to `vDouble`. If you were to create a subroutine that parameter, you could examine the `vt_type` field to determine whether an had been passed to the subroutine.

You cannot use dynamic strings within a union.

Using a combination of `unions` and `types` within a program allows you to types that have a lot of flexibility, but care must be taken to ensure that y constructs correctly. Improper use of these data types can lead to hard-t benefits however, out-weigh the risks and once mastered, are a powerful
New to Programming?

If you're new to programming in general, you should probably learn what some basic concepts are:

**How Your Program Is Run**
- What a Compiler Is
- Syntax
- Program Flow

**Variables**
- Basic DataTypes

**Input/Output (IO)**

The above being the most important programming concepts for an absolute beginner to learn.

In FreeBASIC, it is also important to learn how to use the manual, located at www.freebasic.net/wiki. It has manuals with both descriptions and demonstrations. ALWAYS refer to the manual before looking else where, as what you want is in the manual, and if it's not, it can be added.

This tutorial's on Version 1.0. Don't care for the revision number ^^;;

**How Your Program is Run**

**What a Compiler Is**

FreeBASIC is a compiled programming language, rather than interpreted. "PRINT" or "SLEEP" and translates that directly into Assembly or Machine Code. In general, you will never code in Machine Code, no matter how "low level" you go.

FreeBASIC is a High Level programming language. FreeBASIC makes it programming, you don't have to worry about the more complex areas of lower level, the programmer has the advantage of manipulating the computer, to know more about internals.

Your compiler of choice will depend on your situation. If you want complete control over every action being taken by your computer, you may wish to code in ASM or C. However, as computers and compilers have progressed, you no longer have to worry as much about the speed and lower level details of your code. In many ways, the entire purpose of higher level programming is to make sure you don't have to worry about those things.
level areas of control if you wish. One problem with this, however, which levels of implicit actions being taken by the compiler. If you want to work explicitly control certain aspects of your code.

**Syntax**

Syntax is how words and commands are grouped together in programs. If you want to work with lower level code in a higher level language, you need to know how to explicitly control certain aspects of your code.

For example, in programming, you will come across the task of calling commands. This tells you how you can call this command, and what is or isn't allowed. The syntax rules for that command could occur in a more "syntax free" (what is essentially impossible in programming)
environment. The syntax for FreeBASIC generally goes as follows: CommandName [Argument,]

While the above may look confusing at first, it's actually very simple. All that says is that you give the compiler a command, and then give your arguments after the command. The comma is what separates the arguments. For example, can assume that Draw will draw something, Circle will be the shape that is drawn, and 10 will be the radius of the circle being drawn.

Syntax rules for that command may look something like this:

```
Draw [Shape,]
```

FreeBASIC is *not* case sensitive. Calling a command 'DRaW' is the same as calling the command 'draw'.

**Program Flow**

FreeBASIC's code is read from the TOP of the code, to the BOTTOM, one line at a time. The code for that line is read by the computer, the command that's on the line will be executed (it will be translatated, it will happen, your computer will do what the code tells it to). Example code can be:

```
Print "HI"
Sleep
```

Since the code PRINT is on the line above SLEEP, PRINT will be run first before executing.

Comments can be made in FreeBASIC, which are ignored, and will not be included in the code. Comments can be made with ' ' or can be multiple line comments if you begin them with '/'.

the code or characters within the comments are even noticed by the compiler.

```
' ABLASHD
' PRINT "HI!" ' This line of code will never even be printed.
Print "This is not a comment. This event will occur.
Sleep ' pause the program until the user hits a key.
```

### Variables

What are variables? They're the most important part of programming, that's what. Variables store information in variables.

Do you recall doing algebra or using letters in math, in school? An example is exactly that. They are words or letters that hold values in programming. For example, your main character in your video game has, or even something as simple as the color of one pixel. Storing the data it holds is a small piece of the computer's memory. In FreeBASIC, and most programming languages, you will work with variables a lot.

To create variables in FreeBASIC, we use the DIM command. What does DIM stand for? Programmers would define the "size" of their variable. DIM is used to tell FreeBASIC what exactly that is. It is described in high detail on This Page, but we're going to explain it in less detail here.

The most simple syntax for DIM is: DIM [VariableName] AS [DataType] [Value]

What this does, is it tells FreeBASIC:
- We're making a variable, because we typed in the command DIM
- We're naming the variable [VariableName] (Where VariableName is the name you want to make, AlexPritchard, BLahblh, Foo, etc.)
- We're specifying the type of variable, because we typed in AS after VariableName
- We're making the variable of the type [DataType] (Datatype can be something that holds numbers, letters, or a whole bunch of stuff!)
- We can also assign the value of the variable by putting EQUALS (=) after our variable creation.

Example:

```
Dim foo As Integer = 5
Print foo
Sleep
```
In our program, we created foo. FOO was created as an INTEGER (A datatyp
cmd command PRINT, which PRINTS information on our screen. We PRINT
which pauses our program until we hit a key.

**Basic DataTypes**

Variables are a tough subject, I think, to begin with in programming. The
'The kind of data that's held in this type of variable', and you wondered vr
these types of variables:

Integer - Hold numbers WITHOUT DECIMAL PLACES. Will generally be
Double - Holds numbers WITH DECIMAL PLACES. Holds very large and
the variable it's actual value will be)
String - A nice feature in FreeBASIC. STRING is a datatype which holds
and cool information to put on the screen, such as cooking directions.

Remember, follow the proper DIM syntax. DIM variablename as INTEGER
program. You can replace INTEGER with DOUBLE, or STRING. BE CAREFUL!
not give a STRING the value of 5! You can however, give it the value of
double equal "5", as "5" is a string, and not a number.

Here is a really cool example, which demonstrates how you can use vari

```自由码
' Create the variable MyName. Assign it's value to
Dim As String MyName = "Alex"

' Print The MyName variable
Print MyName

' pause the program until the user hits a key.
Sleep
```

**Input/Output**
Input is the receiving of information. When your get input on something, (GETTING SOMETHING, Retrieving Something)

Output is the sending of information. When you output to something, you

Input and Output are often put together, and are shortened as I/O, or IO.

FreeBASIC has MANY methods of input and output. For a beginner, most knowledge of variables and more complex forms of programming. We're

You remember the command PRINT in the above examples? That's OUTPUT of output, and it's easy to learn, too! You just call the command PRINT, then enclosed in Double-Quotes. If you want to print variables, you just give FreeBASIC has MANY methods of input and output. For a beginner, most knowledge of variables and more complex forms of programming. We're

PRINT [WhatToPrint]
Example:

'' Print the words, HI! to the screen
Print "HI!"

'' create a new integer and name it foo. Give it the value of 10.
Dim As Integer foo = 10

'' Print the value of foo.
Print foo
Sleep

INPUT isn't much harder, either. However, whenever you input, you have to give the PRINT command something to output. We and the user inputs.

1) We need a variable to store that information in.
2) We need to call a command to get input.
3) We need to print the input to make sure we stored the information cor
I know how to do 1 and 3, but what about 2? We're going to learn a new command, INPUT.

Input's syntax is as follows: INPUT [VariableToInputTo]

You can also use input like so: INPUT [Output String To Tell User What to Input], [VariableToInputTo]

The first version of INPUT will let you get input, and put it right into the variable you're asking for input. This way, the user will know what to input! Alternatively, you can just use the PRINT command before INPUT to send the user a message, but sometimes being able to put related code on one line is a convenience.

Example:

```plaintext
'' Create a string. We will hold the user's name in the string!
Dim As String MyName

'' Get the user's name!
'' The message Please Enter Your Name is posted on the screen, and then the user has a chance to enter in their name!
Input "Please enter your name!", MyName

'' Print the user's name that we just got.
'' Just like input, we can print several messages or execute different types of commands by separating them with commas.
Print "Your Name Is: ", MyName

'' pause the program until the user hits a key
Sleep
```

That demonstrates both INPUT and OUTPUT! Both are essential in programs and, as well as INPUT. You might be getting input from a robotic arm's sensors rather than from the user's keyboard. Alternatively, you might be getting input from a power drill rather than a monitor. It really depends on the hardware and programs you're using.

At the time, and in most cases, you don't have to worry so much about where the input is coming from or going to when dealing with your standard I/O functions. More advanced methods of I/O let you decide what you want to do with the input.
Programming Definitions

Argument: See Parameter

ASM: The lowest level code that a human will want to read. This can be compiled directly into machine code.

Compiling: The process of turning text in one language to another. Ex: BASIC in FreeBASIC compiles into ASM.

Machine Code: 0's and 1's. This is *the* code that your computer will understand.

Parameter: Data that you pass to a command you call in programming. It tells commands how to do something, or what they will do. Passing a parameter 'Rectangle' to a command 'Draw', it would make sense if that drew a rectangle onto your screen.

Pixel: One 'dot' on your monitor. Monitors are made up of thousands of tiny dots which are lit up to different colors. The pixel variable that the monitor receives. Believe it or not, even your hardware will use variables, in many ways.

Syntax: How words are grouped together. Your syntax in programming is a set of rules that tell you what code can be placed where so that only logical code is allowed. Ex: Print "Hi". PRINT is the COMMAND, "Hi" is what the command will PRINT.

Variable: A word that holds data in programming. You assign these words values, and with those values, you can save information on your program.
Let's try to compile a big (4000+ lines) graphical QB program in FreeBasic, to see how compatible FB is with QB. As an example I will use Jark's TCRay a great raytracer with quadric, cubic and quadratic shapes, perlin noise programmed in 2004. You can get TCRay.zip from http://www.mandelbrot-dazibao.com/Programs/Programs.htm

Notice TCRay is a QB4.5 interpreted program, Jark never had the patience to compile his work, he just tested it interpreted and went on adding features.

The program is made of has 3 files:

TcRay21C.bas - The Main file.
TcLib17L.bas - The SVGA graphics library.
Tclib17.bi - The include file for the library.

Porting TCLib17.bas

In TCLib17.bas
It is a "pure QB" SVGA library. Most of its functions are obsoleted by FB as they are implemented as QB-style keywords. I had my share in developing that lib so you can trust me for this part ;)

Comment out the contents of the ClearScreen sub and add this
CLS

Comment out the contents of the Point24 sub and add this:

a& = Point(x%, y%)
red% = a& Shr 16
green% = (a& Shr 8) And 255
blue% = a& And 255

Comment out the contents of the Pset24 sub and add this:
PSet (x%, y%), red% Shl 16 Or green Shl 8 Or blue
Comment out the contents of the Screenshot sub and add this:
BSave Name$".bmp"

Comment out the contents of the SelectVga sub, we will work with a fixe size most pc’s will support. Comment out the contents of the SetText sub we are able to output text in HiRes graphics so mode switching is not required.

Comment out the contents of the SetVGA Sub excluding the Powers of two calculation at the end and add these four lines:
```
Screen 20,32 '1024x768, 32 bits
scrheight=768
scrlenwidth=1024
Fullscreen
```

**In TCRay17.bas**
Add a SetSVGA as the first line in the Menu sub (we are not switching modes so mode must be set before outputting text),

**Compiling**
Ok, stop trusting me, now you can start trying to compile. You'll receive some errors.

Compile with: `fbc -s gui -w 1 -lang qb TcRay21C.bas TcLib17L.bas`

I warn you all changes required except two come from a couple of (wise limitations in the FB syntax:
- A variable name can't be a keyword plus a type suffix
- A simple variable can't have the same name as an array

**In TCLib17.bi**
ERROR: Duplicated definition, found 'RGB' (**RGB** is a keyword in FB)
Add:
```cpp
#define RGB
```
Before the line giving the error.

ERROR: Duplicated definition, found 'ScreenRes' (**ScreenRes** is a keyword in FB)
Add:
#undefine ScreenRes
Before the line giving the error.

ERROR: Duplicated definition, found 'Name' (Name is a keyword in QB)
Add
#undefine Name
Before the line giving the error.

In TCRay17.bas
ERROR: Duplicated definition, found 'Acos' (Acos is a keyword in QB)
Add
#undefine Acos
Before the line giving the error.

ERROR: Argument count mismatch Clear (Clear is not required in FB, the keyword has been reused (not a clever decision?))
'comment out CLEAR

ERROR: Illegal specification, at parameter 2 (Type) of Init.Cubic() (Type is a keyword in QB)
We can undefine it so search and replace type$ to _type$

ERROR: Expected 'END IF', found 'END' END FUNCTION
This is an error caused by a quirk introduced in FB. Single line If's havin a colon after THEN require an ENDIF, it has to do with macros... What reason had Jark to put colons past his THEN's escapes me. QB does no require them at all and FB behaves as expected without them. Remove all colons after THEN keywords. Search and Replace THEN : to THEN

ERROR: Array access, index expected, before '=' xn = x * x - y * y + zx0
We have an array names xn, and a variable named xn. Substitute xn wit _xn in the lines which error when you try to compile.

The same error with x0, we have an array called x0.
Substitute xo with _xo in the lines which error when you try to compile.

ERROR: Array access, index expected, before '*' dadY = Amplitude * dAdR * drdY. Same problem with Amplitude.
Substitute Amplitude with _Amplitude in the lines which error when you try to compile.

Ok. At this point all modules compile. We're now going to fix a few linker errors.

**Linker Errors**

After compiling the linker ties together all the modules with a runtime library, finds the final addresses of every sub/function and substitutes the labels in the calls with these addresses. If a sub/function is called in the code and its nowhere to be found, the linker complains and gives us the name of the offending function. It can't give us the line numbers (the linker doesn't work with the source) so we will have to do a text search to find where the problem occurs. Notice the linker gives us "mangled" function names (an ampersand and the size of the parameters passed is added to the end), just ignore the ampersand and what's after.

TcRay21C.o:fake:(.text+0x174d): undefined reference to `LINE24@20'
A call to an undefined Line24 sub is made in the program, you can find this call inside Draw.Axis, in TCRay21.bas, a sub that's it's never called (you can do a search to confirm it)
Probably the QB4.5 compiler would complain too about this. (Remembe this program never compiled in QB4.5) Just comment out the contents of the sub Draw.Axis

TcRay21C.o:fake:(.text+0x181b3): undefined reference to `FFIX@0'
Ffix was that useful v1ctor's floating point patch for QB 4.5. It's not needed in FreeBASIC. Just comment out the line calling it just after the declarations in tcray21c.bas

And that's all, the program compiles and works. Not a lot of changes for 4000+ lines...
Enjoy!
Antoni

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Introduction by Lachie Dazdarian
The objective of this series of lessons is to help newbies who know very little about programming in FreeBASIC necessary to create any computer game. Some knowledge about the word (well, it's an acronym) "BASIC" and not FreeBASIC, because if you know BASIC or any other variant of BASIC, these lessons should be easy to comprehend.

I'm starting this series because I feel that tutorials of this kind were always lacking, even before FreeBASIC. I've corresponded during my programming lifetime with quite few programming newbies, and they all had almost identical problems when trying to program. Beginners need quite well and on what way the stuff needs to be explained to them, and the problems I had with using separated routines that were never meant to be combined and used to create a game. The breaking point for me was the moment when I discovered RelLib (a QuickBASIC graphics library by R.E.Lope) and the scrolling engine that was created with it. That scrolling engine motivated me to explore its mechanics and expand on it (with some help from R.E.Lope). In one single moment I acquired the ability to program most of the stuff (necessary to complete a game) by myself. It's like driving a bike. The moment when you acquire the actual skill lasts for one second.

So that's my goal with this series. To learn you enough so you would be able to write code yourself. The best way to learn new things is to see them applied. Many tutorials fail in this way because they help from more expert programmers, but the point is that you don't need their help all the time. It depends on the type of game you are developing and the graphics library you use.

The example programs and mini-games we'll create will be coded in GFXlib (FreeBASIC's built-in graphics library). Lynn's Legacy, ArKade, Mighty Line and Poxie were coded in it (among many others), and I think those games are good references. But don't worry. Switching from one graphics library to another is relatively easy when you know how to code in at least one.

This tutorial will not deal with raycasting engines (3D programming) or something similar, but for those who are a beginner, you NEED the following lessons FIRST.

Since we are going to code in FreeBASIC you need to get FreeBASIC from http://www.freebasic.net (the examples were compiled with version 0.18). I recommend FBIDE or FBEdit.
**Example #1: A simple program - The circle moves!**

We'll start with some elementary stuff. The first program we'll code will not feature graphics from external files (usually BMP images) is always a dirty business and will confuse you on this. Be patient.

The program we'll create will allow you to move a circle around the screen, making it we'll learn important facts and a lot of elementary statements and methods necessary to create any game with GFXlib.

As we are using GFXlib you need to be aware of the gfxlib.txt file (GFXlib's documentation) placed in the /FreeBASIC/docs directory. That's our Bible and very useful with these lessons since I will not explain every parameter of every statement used in the example programs (most likely). This document is somewhat outdated as FreeBASIC moved on with new versions, so be sure to refer to this online FreeBASIC manual too (part of the FreeBASICWiki).

Open a new program in FBIDE. First thing we'll do is set the graphic mode of the program's graphic resolution and color depth in bits (8-bit, 16-bit, ...). For example, 8-bit color depth is the standard 256 colors mode (8 bits per pixel). The graphic mode is set with

```
Screen 13,8,2,0
```

13 means 320*200 graphic resolution, 8 means 8-bit graphics, 2 means (input 1 for full screen mode). Minimum of 2 work pages is recommended, things will become clearer a little bit later. For more details about the SCREEN statement refer to GFXlib's documentation or FreeBASICWiki (a more "advanced" version of the SCREEN statement is SCREENRES).

The next thing we'll do is set a loop that plays until the user pushes the letter Q on the keyboard. Loops are foundation of any program, not just a computer game. Coding a program on a way it forces the user to type something in is a BAD and WRONG way to program. We'll use loops as places where the program waits for the user to do something and where the program executes some routine according to user's action. Objects not controlled by the player (enemies) are managed/moved. Loops are a must have.

If you are aware of all these things, you can skip to the end of this section (with comments). If there is something in it you don't understand, then get back...
We can set a loop on more ways (with WHILE:WEND statements, using way is to use DO...LOOP. This type of loop simply repeats a block of statements after LOOP with UNTIL. Check the following code:

```
Screen 13,8,2,0  ' Sets the graphic mode 
Do
  ' We'll put our statements here later
Loop Until Inkey$ = "Q" Or Inkey$ = "q"
```

If you compile this code and run it, you'll get a small black empty 320*200 window which you can turn off by pushing the letter Q (you might need to hold it). The program simply loops until you push the lower case "Q" symbol in case Caps Lock is turned on on your keyboard. I will explain later why it shouldn't be used.

To draw a circle we'll use the CIRCLE statement (refer to GFXlib's documentation).

```
Screen 13,8,2,0  ' Sets the graphic mode 
Do
  Circle (150, 90), 10, 15
Loop Until Inkey$ = "Q" Or Inkey$ = "q"
```

The last code draws a small circle on coordinates 150, 90 with a radius of 10 and color 15 (plain white) in a loop, which you can check if you compile the code. So how to move that circle? We need to connect its coordinates with VARIABLES. For this we'll use two variables named circlex and circley.

```
Dim Shared As Single circlex, circley
Screen 13,8,2,0  ' Sets the graphic mode 
circlex = 150  ' Initial circle position
```
```
circley = 90

Do
    Circle (circlex, circley), 10, 15
Loop Until Inkey$ = "Q" Or Inkey$ = "q"
```

This makes no change in the result of our program, but it's a step to what amounts to which circlex and circley equal to change the circle's initial position. In order to move the circle we need to connect circlex and circley variables with keyboard statements.

We declared first two variables in our program. Since FreeBASIC ver.0.1 be declared, although if you use -lang qb command line during compiling compatibility dialect (I don't recommend it as it will keep you deprived of default FB compatibility already provides and will provide). For more info FreeBASIC wiki - Using the command line. Variables are declared (dimen

```
Dim variable_name [As type_of_variable]
```

Or...

```
Dim [As type_of_variable] variable1, variable2,
```

The data inside [ ] is optional and the brackets are not used. Types of variables SHORT, INTEGER, STRING, SINGLE, DOUBLE and few others, but I don't level. What you need to know now is that you should declare variables or graphics data (memory buffers holding graphics) or when they represent (number of lives, points, etc.). Variables that need decimal precision are usually variables used in games which rely on physics formulae like arcade (gravity effect). Simply, the difference between the speed of two pixels per cycle is most often too large, and in those limits you can't emulate effects like...
Also, behind DIM you should put SHARED which makes that the specific variable readable in the entire program (all subroutines). Don't use SHARED only with variables declared inside subroutines. I advise you to replace DIM with REDIM to declare ARRAYS inside a subroutine. If you are going to declare ARRAYS inside a subroutine, I advise you to replace DIM with REDIM. Like YourName = "Dodo", but you need to declare YourName AS STRING first.

Now I will introduce a new statement instead of INKEY$ which can detect multiple keypresses and is much more responsive (perfect response) than INKEY$. The flaw of INKEY$, as we probably were able to detect when trying to shut down the previously compiled examples, is that it can detect only one keypress at any given moment which renders it completely unusable in games.

The substitute we'll use is MULTIKEY (a GFXlib statement) which features the scancode of the key you want to query. You might be lost now. DOS scancode is a code referred by the computer to a certain keyboard key. If you check Appendix A of the GFXlib documentation, you will see what each code stands for. For example, MULTIKEY(\h1C;) queries if you pushed ENTER. DOS scan codes with "easy to read" constants like it's explained in Appendix A (fbgfx.bi) into your source. What's a .bi file? Well, it can be any kind of module you would attach to your source code and which can feature various subroutines (if you don't know what a subroutine is, we'll get on that later) and declarations used in your main module. The code you need to add are the following:

```
#include "fbgfx.bi"
Using FB
```

It's best to put these two lines somewhere on the beginning of your program. You don't need to set a path to fbgfx.bi since it's placed in the /FreeBASIC/inc directory. You only need to set a path to a .bi file if it's not in that directory or not in the directory where the source code is. Using FB tells the program that we will be accessing GFXlib symbols without namespace, meaning, without having to put 'FB.' in front of every GFXlib symbol. Refer to FreeBASIC Wiki on USING.

Now the fun starts.

We will add a new variable named circlespeed which flags (sets) how many pixels the circle will move in one cycle (loop). The movement will be done with the arrows key. Every time the user pushes a certain arrow key, we will tell the program to change either circlex or circley (depends on the pushed key) using the following code:
#include "fbgfx.bi"

Using FB

Dim Shared As Single circlex, circley, circlespeed

Screen 13, 8, 2, 0 ' Sets the graphic mode

circlex = 150 ' Initial circle position
circley = 90
circlespeed = 1 ' Circle's speed => 1 pixel per

Do

  Circle (circlex, circley), 10, 15

  ' According to pushed key we change the circle's
  If MultiKey(SC_RIGHT) Then circlex = circlex + circlespeed
  If MultiKey(SC_LEFT) Then circlex = circlex - circlespeed
  If MultiKey(SC_DOWN) Then circley = circley + circlespeed
  If MultiKey(SC_UP) Then circley = circley - circlespeed

Loop Until MultiKey(SC_Q) Or MultiKey(SC_ESCAPE)

As you see we also changed the condition after UNTIL since we are using program by pressing ESCAPE too (I added one more condition).

If you compile the last version of the code, two things we don't want to happen fast you won't even notice the movement of the circle, and the circle will smear the screen (the circles drawn on different coordinates in previous cycles will remain on the screen). To avoid this statement (clears the screen) in the loop so that in every new cycle the old circle is erased before the new is drawn.

To reduce the speed of the program the quickest fix is the SLEEP command: the amount of time has elapsed (in milliseconds) or a key is pressed. To escape the key press option use that statement any kind of FreeBASIC program with a loop (even the
cycles and make all the other Windows tasks you might be running to crawl with other tasks while that kind of FreeBASIC program is running. Err...the programmers that have released FreeBASIC games so far did not bother this is not a huge problem and a fair amount of programmers that have released FreeBASIC games so far did not bother.

Copy and paste the following code and compile it:

```plaintext
#include "fbgfx.bi"
Using FB

Dim Shared As Single circlex, circley, circlespeed

Screen 13,8,2,0 ' Sets the graphic mode

circlex = 150 ' Initial circle position
circley = 90
circlespeed = 1 ' Circle's speed => 1 pixel per loop

Do

Cls
Circle (circlex, circley), 10, 15

' According to pushed key we change the circle's coordinates.
If MultiKey(SC_RIGHT) Then circlex = circlex + circlespeed
If MultiKey(SC_LEFT) Then circlex = circlex - circlespeed
If MultiKey(SC_DOWN) Then circley = circley + circlespeed
If MultiKey(SC_UP) Then circley = circley - circlespeed

Sleep 10, 1

Loop Until MultiKey(SC_Q) Or MultiKey(SC_ESCAPE)

Viola! Our circle is moving and "slow enough".

The last version of the code does not represent the desirable way of coding, but I had to simplify the code in order to make this lesson easy to understand. What we need to do next is declare our variables on the way they should be.
declared in any "serious" program, and show why we are having two wo

The way variables are declared in the above code is not the most conve
amount of variables usually associated to several objects (an object can
defined with MORE THAN ONE variable).

So first we'll define a user defined data type with the statement TYPE th
with me). We'll name this user data type ObjectType. The code:

```
Type ObjectType
  x As Single
  y As Single
  speed As Single
End Type
```

After this we declare our circle as an object:

```
Dim Shared CircleM As ObjectType
  ' We can't declare this variable with "Circle"
  ' since then FB can't differ it from
  ' the statement CIRCLE, thus "CircleM".
```

How is this method beneficial? It allows us to manage the program varia
Instead of (in this example) having to declare each circle's characteristic
simply use a type:def that includes all these variables and associate a va
CircleM). So now the circle's x position is flagged with CircleM.X, circle's
with CircleM.speed. I hope you see now why this is better. One user defi
variables or arrays. In this example you can add another object with some
ObjectType which would allow us to manage 8 "evil" circles with a specific
the variables from the ObjectType type:def (x, y, speed), and these circles
way. In the next lesson all this will become more clear. Have in mind that
a type:def. This is only for "objects" in your game that are defined (chara
determined by health, money, score, strength, etc.).
After the change the final version of the code looks like this:

```plaintext
#include "fbgfx.bi"
Using FB

' Our user defined type.
Type ObjectType
  x As Single
  y As Single
  speed As Single
End Type

Dim Shared CircleM As ObjectType
' We can't declare this variable with "Circle"
' since then FB can't differ it from
' the statement CIRCLE, thus "CircleM".

Screen 13,8,2,0 ' Sets the graphic mode
SetMouse 0,0,0 ' Hides the mouse cursor

CircleM.x = 150 ' Initial circle's position
CircleM.y = 90
CircleM.speed = 1 ' Circle's speed => 1 pixel per loop

Do

  Cls
  Circle (CircleM.x, CircleM.y), 10, 15

  ' According to pushed key we change the circle's
  If MultiKey(SC_RIGHT) Then CircleM.x = CircleM.x
  If MultiKey(SC_LEFT) Then CircleM.x = CircleM.x
  If MultiKey(SC_DOWN) Then CircleM.y = CircleM.y
  If MultiKey(SC_UP) Then CircleM.y = CircleM.y -
  Sleep 10, 1 ' Wait for 10 milliseconds.

Loop Until MultiKey(SC_Q) Or MultiKey(SC_ESCAPE)
```
You will notice I added one more statement in the code. The SETMOUSE cursor (first two parameters) and shows or hides it (third parameter; 0 hides these parameters in every program AFTER the SCREEN statement (IMPORTANT!) because even if your program is going to feature a mouse controllable interface, you will most likely draw your own cursor. Trust me on this.

Uh, I use that line way too often.

Download the completed example with extra comments inside the source.

Phew, we are done with the first example. Some of you might think I went into too many details, but I feel all this dance was needed to make the next examples and lessons a more enjoyable adventure.

Nevertheless, this example is far from what we want, right? So the next chapter will teach you how to load graphics from external files among other things.

**Example 2: A warrior running around a green field**

In the next example we will be applying all the knowledge from the first example, so don't expect for this example to go into every statement again. I will explain every new statement and just brush off the old ones.

In this section we'll start to code our mini-game which won't be completed in this lesson. In this lesson we will just create a program where a warrior runs around a green field (single screen).

First I'll show you what graphics we'll be using. We are going to work in 8-bit color depth mode, so the images that we are going to use need to be saved in that mode (256 colors mode). For the character I'll use the sprites of the main character from my first game Dark Quest.

![http://hmcsoft.org/fb/htpagl1-sprites.png](http://hmcsoft.org/fb/htpagl1-sprites.png)

As you see this image features 12 sprites of our warrior, each 20*20 pixels large (walk animation) and one sprite for each direction when the warrior is swinging his sword. Sword swinging won't be implemented in the first lesson but will become necessary later.

Second image is the background image which you can check/download if you click there (320*200 pixels large, 8-bit BMP image).

Download both images and place them where you will place the source,
the end of this section.

On the beginning of our program we should include fbgfx.bi, same as in graphic mode. The code:

```c
#include "fbgfx.bi"
Using FB
Screen 13,8,2,0  ' Sets the graphic mode
SetMouse 0,0,0    ' Hides the mouse cursor
```

Now we will declare two memory pointers that will point to memory buffers the sprites and one for the background).

The first pointer we'll name background1 and declare it with the following line:

```pascal
Dim Shared background1 As Any Ptr
```

ANY PTR tells us that background1 will actually be a memory pointer. A compiler checking for the type of data it points to. It is useful as it can point to pointers because we will allocate memory for our graphics using the IMAGECREATE allocates the right amount of memory for a piece of graphics (sprite/image) we would have to do it manually, meaning, calculate the needed amount of depth and variable size. IMAGECREATE does this for use. As IMAGECREATE returns a pointer to it and not a variable. Don't worry if you don't know anything about pointers because we will allocate memory for our graphics using the IMAGECREATE statement. IMAGECREATE allocates the right amount of memory for a piece of graphics (sprite/image) we would have to do it manually, meaning, calculate the needed amount of depth and variable size. IMAGECREATE does this for use. As IMAGECREATE returns a pointer to it and not a variable. Don't worry if you don't know anything about pointers.

The next pointer we'll declare will point to the memory buffer that holds the 12 warrior sprites. We will dimension this pointer as a single dimension array, each element in the array represents:

```pascal
Dim Shared WarriorSprite(12) As Any Ptr
```
Both these lines should be put in the code before the SCREEN statement. Subroutine declarations, then variable declarations, then extra subroutine code. The beginning of our program should now look like this:

```plaintext
#include "fbgfx.bi"
Using FB

Dim Shared background1 As Any Ptr ' A pointer that points to a memory buffer holding the background graphics
Dim Shared WarriorSprite(12) As Any Ptr ' A pointer that points to a memory buffer holding the warrior sprites

Screen 13,8,2,0 ' Sets the graphic mode
SetMouse 0,0,0 ' Hides the mouse cursor
```

After the screen resolution, color depth and number of work pages are set, we will hide our work page before loading graphics onto it since we don't want the user to see all of the program's graphics every time they start the program. To accomplish that we'll use the SCREENSET statement. What it does is set the work page (first parameter) and the visible page (second parameter). In our case we will set page 1 as the work page and page 0 as the visible page. After using 'SCREENSET 1, 0' every time we draw or load something onto the work page and won't be visible to the user until we use SCREENSET with different parameters (SCREENSET 1, 1). This allows us to load graphics onto the screen we don't want for the user to see and delete it before coping the content on the work page to the visible page. This page flipping is also useful in loops with "graphics demanding" programs to avoid flicker or some other unwanted occurrence.
Introduction

On more than one occasion I was inquired by a programming newbie about how to load a new high score properly, and then save the modified high scores table. Using the same set of routines for high scores since the days of Ball Blazing Fantasy, I decided to write a tutorial on them and implement some lacking flexibility (plus few fixes) there, something that was long needed to be done. The tutorial will also point you out to some useful (for high scores table reading) routines, not written by me.

Let’s do it!

It’s fairly obvious we’ll need two separate subroutines, one for loading/reading and one for writing/modifying. We’ll start with loading/reading of a high score table, as that part is easier. The subroutine for reading a high score table should work relatively simply: open a file which contains name and score entries, storing them in appropriate variables and then printing them on the screen, this part being most dependent on the developer’s wishes and needs (the method of printing, position of the high score table, its formatting, etc.).

First, we should create a text file containing our name and score entries.

<table>
<thead>
<tr>
<th>Name</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRED</td>
<td>10000</td>
</tr>
<tr>
<td>BILL</td>
<td>9000</td>
</tr>
<tr>
<td>SARAH</td>
<td>8000</td>
</tr>
<tr>
<td>BOB</td>
<td>7000</td>
</tr>
<tr>
<td>RED</td>
<td>6000</td>
</tr>
<tr>
<td>SUE</td>
<td>5000</td>
</tr>
<tr>
<td>DAVID</td>
<td>4000</td>
</tr>
</tbody>
</table>
It contains 10 high score entries, formatted with name followed by the accompanying score. You can pick one where all the names all listed first, and then followed by the scores, so we'll work with the one I started with.

This file will be used with the following 'ReadHighScore' subroutine.

Let's start our main program with some needed initiation statements:

```
#include "fbgfx.bi"
Using FB

Const num_of_entries = 10
```

'num_of_entries' will flag the number of score entries (names or scores in the 'high_score.dat' file (not lines, but high score ENTRIES!).

We should now declare our subroutine with:

```
Declare Sub ReadHighScore (highscore_file As String)
```

The 'highscore_file' variable will flag the file you want for the 'ReadHighScore' subroutine, this adds some flexibility to it.

After this, we should declare the following variables:
Dim Shared workpage As Integer
Dim Shared hname(num_of_entries) As String
Dim Shared hscore(num_of_entries) As String

'workpage' variable is not related to this tutorial and will be used to swap
'hname' array will hold the name entries, while 'hscore' array will hold the
Finally, let's initialize our screen and work/visible pages with:

ScreenRes 640, 480, 32, 2, GFX_ALPHA_PRIMITIVES + GFX_WINDOWED
ScreenSet 1, 0

Following this code we should place this:

ReadHighScore "high_scores.dat"
End

Sub ReadHighScore (highscore_file As String)
End Sub

You can compile this code, but nothing will happen as the 'ReadHighScore'
We need to start it by opening the 'high_scores.dat' file and reading the
file opening in FreeBASIC if not familiar with it.

As we want to open the file using a FREE file handle, we need to dimen:

Dim free_filehandle As Integer
free_filehandle = FreeFile
We should now open the high score file with:

```
Open highscore_file For Input As #free_filehandle
```

After the file is opened for reading (FOR INPUT), let's use a for loop to retrieve all the data from it and store it in our 'hname' and 'hscore' variables:

```
For count_entry As Integer = 1 To num_of_entries
    Input #free_filehandle, hname(count_entry)
    Input #free_filehandle, hscore(count_entry)
    ' If the end of file is reached, exit the FOR loop.
    If EOF(free_filehandle) Then Exit For
Next count_entry
```

Note how the 'count_entry' variable is used and how for each entry the name is stored FOLLOWED by the accompanying score. 'hname(1)' will flag the name with the top score, while 'hscore(1)' the top score. 'hname(num_of_entries)' will flag the name with the lowest score in the high score table.

Don't forget now to close the file with:

```
Close #free_filehandle
```

All we need now is a loop that will display all these names and scores, n
A simple DO...LOOP that ends when the user pushes ESCAPE. I used Draw String to print the names and the scores. Another FOR loop is used to loop through the name and score entries, and to display them lower down the score under the next higher one (note how the Y position of the text to display is connected with the 'count_entry' variable - increase 12 to get more space between scores vertically). I also used a small trick to display each next score with lower translucency (last parameter in the RGBA function).

After placing all this code in the 'ReadHighScore' subroutine, you can compile it and the desired result will appear on the screen.

Now when we are done with the easy part of the problem, let's move onto writing new entries into our high score table.

I constructed the 'WriteHighScore' subroutine like this:

```
Sub WriteHighScore (highscore_file As String, users
```

Which means it will be called with a high scores table file and a score we want to input. If this score evaluates to be lower than the lowest in the high score table, no code will be executed.
This subroutine should start with the following code:

```vbnet
dim free_filehandle as integer

dim startwrite as integer

free_filehandle = freefile

open highscore_file for input as #free_filehandle

for count_entry as integer = 1 to num_of_entries
  input #free_filehandle, hname(count_entry)
  input #free_filehandle, hscore(count_entry)
  ' If the end of file is reached, exit the FOR loop.
  if eof(free_filehandle) then exit for
next count_entry

close #free_filehandle
```

As you see it starts as the 'ReadHighScore' subroutine. In order to evaluate the file containing our high score entries and store them in appropriated variables, the high score table (on which position).

The code that follows should be opened with an IF clause that will execute the high score table (naturally):

```vbnet
if users_score > hscore(num_of_entries) then

for check_score as integer = 1 to num_of_entries

if users_score > hscore(check_score) then
  inputname
  ' Record the position where the new score is
  ' to placed and exit FOR loop.
  startwrite = check_score
  exit for

next check_score

if users_score > hscore(check_score) then
```
The FOR loop 'goes' through the high score entries from the highest to the lowest (flagged with 'startwrite' and 'check_score') where our new entry will be inserted. It starts with the top score in the high score table. If the user's score ends up being higher than the highest score, it needs to be 1. 'InputName' is a subroutine we'll create later, and inside it the user will be...inputting this name.

What follows is the 'nexus' of our routine, the code that places the new high score entry on the proper position and bumps all the lower ones one position down.

Check the following code:

```vbnet
If startwrite = num_of_entries Then
    hscore(startwrite) = users_score
    hname(startwrite) = playername
Else
    For write_pos As Integer = (num_of_entries - 1) To startwrite
        hscore(write_pos + 1) = hscore(write_pos)
        hname(write_pos + 1) = hname(write_pos)
    Next write_pos
    hscore(startwrite) = users_score
    hname(startwrite) = playername
End If
```

First condition checks if the new entry is the lowest (last) in the high score table. If this is the case, there are no lower score as there are none, but only replace the lowest score entry with the new one. If this is NOT the case, a FOR loop is executed which loops from the lowest to the highest entry, meaning, from bottom to top.

For example, if our high score table has 10 entries and the new entry needs to be placed at position 9, values from 'hscore(9)' and 'hname(9)' are passed to 'hscore(9+1)' and 'hname(9+1)' respectively.
are passed to 'hscore(8+1)' and 'hname(8+1)'. And so on.

After the FOR loop we need to input the new entry on its appropriate position 'playernam', where 'playernam' will be inputted inside the 'InputName'

The last thing in the 'WriteHighScore' sub we need to do is to store the result in the file:

```basic
free_filehandle = FreeFile
Open highscore_file For Output As free_filehandle
For count_entry As Integer = 1 To num_of_entries
Print #free_filehandle, hname(count_entry)
Print #free_filehandle, hscore(count_entry)
Next count_entry
Close free_filehandle
```

Note how FOR OUTPUT is used and PRINT for writing data into external files.

After this I placed a 'ReadHighScore' call and closed with END IF as I find it good that a new high score table should display after a new entry has been inputted in it.

All we need now is to create the 'InputName' sub like this:

```basic
Sub InputName

ScreenSet workpage, workpage Xor 1
ScreenSet 0,0
Line (0,0)-(639,479), RGBA(0, 0, 0, 255), BF
Locate 12, 17
Input ; "Please input your name: ", playernam

End Sub
```

Of course, this will look totally different in your game. Perhaps you'll ask he/she starts a new game). Just have in mind you need one.
To test the routines just place...

```plaintext
ReadHighScore "high_scores.dat"
WriteHighScore "high_scores.dat", 4500
End
```

...after first SCREENSET (outside subroutines). Change the second parameter in the high score table. I'm sure you are aware that when calling 'WriteHighScore' but with a variable in which you'll store player's score, whatever that may be.

**What's next?**

The only other things I wish to share regarding this issue is related to high score encryption and better name inputting routine. As both routines I'm using are not by me, I will only brush off them and provide them in an example program you can easily use for your own needs.

Encryption is done using two functions, 'neoENCpass' and 'neodeENCpass'. One for encryption and one for decryption. They are called with a string (high score entry string in our case) and password, password being any string you choose and the same must be used for encrypting and decrypting (of course).

Just after you retrieve an string entry from a file you decrypt it like this:

```plaintext
Input #free_filehandle, hname(count_entry)
neoENCdepass SAdd(hname(count_entry)), Len(hname(count_entry))
```

With 'hscore' variables, being INTEGER, we need to use a temporary STRING variable which has to be decrypted and then pass its value to 'hscore'.

The only annoying feature of this method is the fact you need a separate project will work only if the high score file is previously encrypted. I provide a small program which does this encrypting for you. It is recommended you keep a backup of your high score file in a separate folder (I also provided this in the zip downloads), even if not encrypting it.

Instead of encryption you can use BINARY files, which I don't know how to use at this moment (don't have time), and which also AREN'T the same as ENCRYPTION. Encryption using a password (well, most people), while BINARIES can be read by anyone having access to the encryption passwords inside it.

Anyway, you might not need or prefer encryption at all. But I personally I can change/read them with Notepad. Unencrypted high scores might kill Name inputting routine I won't go describing as that's irrelevant. You have custom font printing libraries) and allows you to limit the number of charact
to him.
Download the extended example (with encryption and better name input http://lachie.phatcode.net/Downloads/Managing_A_High_Score_Table.zip

And that’s it for this tutorial.
Until next time, have fun!

A tutorial written by Lachie D. (mailto CHR$(58) lachie13 CHR$(64) yahoo CHR$(46) com ; http://lachie.phatcode.net - The Maker Of Stuff)
The IF Statement

Written by rdc

You can think of the If statement block as a question that requires a True or False answer. The answer determines which section of code your program will execute. Since computers only work with numbers, you frame the question as a conditional equation that will result in either 0 for False or non-zero for True.

The If statement has the following formats.

```
If <expression> Then Do something[:Do something]
```

The <expression> is the question that requires a True or False answer. If the answer is True, i.e., not False, then the code following the Then is executed. If the answer is False then the next line of code is executed.

You can execute more than one statement after the Then if you separate the statements with a colon. All statements must be on the same line. An easier format is to use the IF code block, as shown below.

```
If <expression> Then
    Do something 1
    Do something 2
    ...
End If
```

In this format if the answer is True then the code block following the Then is executed, starting with statement 1 and executing all statements until the End If is reached. The program will then start executing code after the End If.

```
If <expression> Then
    Do something
    ...
Else
    Do something Else
```

If the answer is False, the code in the code block is skipped and the code following the End If is executed.
In this format if <expression> is True then the code following the Then is executed. In this format you can address both the True and False answers of the <expression>.

```
If <expression> Then
  Do something
ElseIf <expression> Then
  Do something
End If
```

In this format if <expression> is True then the code following the Then is executed. If the ElseIf is True, the code following the Then (of the ElseIf) is executed. You can have as many ElseIf statements as you need to fully cover the range of questions you need to ask.

```
If <expression> Then
  Do something
ElseIf <expression> Then
  Do something
Else
  Do something Else
End If
```

This format is a combination of all the other formats. If <expression> is True then the code following the Then is executed. If the ElseIf is True, the code following the Then (of the ElseIf) is executed. If the ElseIf is False, then the Else is executed. Otherwise the code following the Else is executed.

This format enables you to ask a series of questions and if the answer is False for all the questions, you can take a default course of action based on the Else block.

As you can see you can frame the question in a number of ways and then execute the code based on the number of answers.
combinations. This gives you a lot of flexibility in how to both frame a qu

The <expression> is the question that needs an answer and you frame t

You can mix arithmetic and logical operators, as well as parenthesis, wit conditional statements from left to right, taking into account the precede
code snippets are legal If statement constructs.

```plaintext
If var1 = 5 Then
If (var1 = 5) And (var2 < 3) Then
If (var1 + 6) > 10 Then
```

You will notice that parenthesis are used to group the different parts of th
d sure that you are executing logical portions of the expressions. The expr even if you are using arithmetic operators within the expression.

**Using Bitwise Operators in an If Statement**

Remember that the operators And, Or and Not are bitwise operators. Th operation that they perform. You should take care when using bitwise op: result will evaluate correctly.

Take the second code snippet listed above.

```plaintext
If (var1 = 5) And (var2 < 3) Then
```

If var1 equals 5, the compiler will return True, or -1 for the expression. If or -1 for this expression. The compiler will then evaluate the And opera True, the code following the Then will be executed.

If either of the statements within the parenthesis evaluate to 0, then And the Then clause will be skipped. When using bitwise operators you should the bitwise operator so that they return either True or False. This will give
The Not Problem

The Not bitwise operator can be a problem in an If statement. You may be used to writing a logical, rather than a bitwise operation. In FreeBasic Not performs a bitwise operation, not a logical operation.

If var were to contain the value of 3, then Not 3 is -4, which will be regarded as a True result and the code following the Then will be executed, which is probably not what you wanted. Instead of writing

Overlapping Conditions

When using compound conditions care must be taken to ensure that the conditions do not overlap. In most cases overlapping conditions will produce unpredictable results. Each condition must produce a unique result, and the combination of the individual results, must itself express a unique result. This is very important in If-ElseIf constructs; an overlapping condition within an If-ElseIf block may execute the wrong code at the wrong time.

Nested If Statements

At times it may become necessary to nest If statements in order to better describe the decision making process of the evaluation. While the If statement can handle multiple arguments within an expression, there are times when incrementally check for certain ranges of values which you can do using

```plaintext
If <expression> Then
    <statement>
    ...
    If <expression> Then
        <statement>
        <statement>
        ...
    End If
End If
```

It is important to close each block properly with an End If when opened to avoid compiler or logical errors. Compiler errors are fairly easy to fix, while logical errors can be tricky to track down.
closing the blocks properly is to indent the nested If statements and then level as the If. In the example above, the indentation tells you at a glance:

**The IIF Function**

The Iif, or "immediate If" function returns one of two numeric values based on an in-line If statement that acts as a function call.

```plaintext
Value = IIf(<expression>, numeric_value_if_true, numeric_value_if_false)
```

Iif can be used as a standalone function or inside other expressions where an If statement. The numeric values can be literal values, variables or numeric function calls. The limitation of the function is that it will only return a numeric value, not a string value, however you can work around this limitation by using pointers.

The Iif statement will evaluate both the True and False conditions so you need to take care that condition, even if that condition is not returned from the function.

**Framing the Question**

The If statement is a powerful tool, but you need to make sure that you are correctly. Each expression must resolve to True or False, with True always

When writing an If statement you must ask yourself, does this expression compound expressions that have a number of terms within the expression sum of the terms must resolve to True or False. If there is any doubt that it into nested If statements.

**Checking For Range Values**

Often times you will need to check for a range of values within an If statement range condition correctly, you must frame the expressions correctly. There are exclusive and inclusive ranges. Exclusive range expressions exclude a ri
range of values. Each has a particular format that must be followed for proper evaluation.

**Excluding a Range of Values**

Suppose that you have a range of values and you want to do something special if the value is less than or equal to 1 or the value is greater than or equal to 10. To put this another way, you want to exclude the numbers 2 through 9 from the special action.

You can frame this as a question that can then be translated into code.

```
Is the value a number less than Or equal To 1 Or a number
If Yes, Then Do special action.
If No, Then Do standard action.
```

The key here is the OR. If the lower bound of the value is equal to or less than 1 or the upper bound of the value is equal to or greater than 10 then do the special action.

```
If (value <= 1) Or (value >= 10) Then
do_special
Else
do_standard
End If
```

Remember that OR will return True if either condition is True. If the value expression will return True and the special action will be performed.

**Including a Range of Values**

Inclusion is the opposite of exclusion. As you might guess, the format is opposite of the OR operator.

Suppose you want to do something special if the value is a 5, 6 or 7. That range expression. Again, you can start by asking a question.
Is the value a number between 5 And 7 (inclusive)?
If Yes, Then Do special action
If No, Then Do standard action

Here you want to include the numbers 5, 6, 7 for consideration. That is if then do something special. This translates to the following code snippet.

If (value >= 5) And (value <= 7) Then
    do_special
Else
    do_standard
End If

Remember that the And operator will only return True if both operands return True. If value is 6, 6 is greater than 5 and 6 is also less than 7, so both statements are True and the expression evaluates to True.
The Select Case Statement

Written by rdc

The Select Case block can be viewed as an optimized If-ElseIf ladder, and works much the same way. The standard Select Case can use any of the standard data types for <expression> and the specialized Select Case As Const format is optimized for integer values.

This code snippet shows the syntax of the standard select case. Expression is a variable which can be of any of the standard data types, or individual elements of a Type or array.

```
Select Case <expression>
  Case <list>
    <statement>
    <statement>
    ...
  Case Else
    <statement>
    <statement>
    ...
End Select
```

The <list> clause of the Case statement can be any of the following forms:

- Case <value>: Value is one of the supported data types or an enumeration.
- Case <value> To <value>: Specifies a range of values.
- Case Is <operator> <value>: Operator is any of the logical operators.
- Case <value>, <value>, ...: List of values separated with commas.
- Case <variable>: A variable that contains a value.

The following snippet illustrates how these different formats may be used:

```
Case 47
```
Case 47 To 59
Case Is > 60
Case 47, 48, 53
Case keycode

The Select Case As Const is a faster version of the Select statement designed to work with integer expressions in the range of 0 to 4097.

```
Select Case As Const <integer_expression>
  Case <list>
    <statement>
    <statement>
    ...
  Case Else
    <statement>
    <statement>
    ...
End Select
```

The <list> statement formats for the Select Case As Const are limited to enumerations of values. That is, the operator expressions are not allowed within a Case As Const.

When a Case block is executed, the statements following the Case key word or the next Case keyword (or End Select) will be executed. Only one block of statements within a Case will execute at any one time. If a Case Else is present, the statements within the Else block will execute if no Case matches the <expression> portion of the Select statement. The following program illustrates using the Case statement block.

'Ascii code of key press
Dim As Integer keycode

'Loop until esc key is pressed
Do
    keycode = Asc(Inkey)
    Select Case As Const keycode
        Case 48 To 57
            Print "You pressed a number key."
        Case 65 To 90
            Print "You pressed an upper case letter."
        Case 97 To 122
            Print "You pressed a lower case key."
    End Select
    Sleep 1
Loop Until keycode = 27 '27 is the ascii code for Escape
End

In the program, when you press a key, the value is translated to a number using the Asc function. Since this will always be an integer value that is less than 4097 (since ascii character codes range from 0 to 255), the Select Case as Const format is used.

The compiler will check the value of keycode against the Case ranges to determine which block should execute. If keycode falls within a particular range, the Print statement will execute, and then the flow of the program will continue with the next line following the End Select. If keycode doesn't match any Case range, then the program will continue with the next line following the End Select.

A Select Case can usually be translated from an If-Elseif ladder. To illustrate this, the previous program is shown below as an If-Elseif ladder.

'Ascii code of key press
Dim As Integer keycode

'Loop until esc key is pressed
Do
keycode = Asc(Inkey)
If (keycode >= 48) And (keycode <= 57) Then
    Print "You pressed a number key."
ElseIf (keycode >= 65) And (keycode <= 90) Then
    Print "You pressed an upper case letter key."
ElseIf (keycode >= 97) And (keycode <= 122) Then
    Print "You pressed a lower case key."
End If
Sleep 1
Loop Until keycode = 27 '27 is the ascii code for Escape
End

If you compare the two programs, you can see that the logic is quite similar, but the Select Case is much more readable and understandable than the If-ElseIf ladder.
Conditional Compilation is one of those parts of programming that sit in the dusty corners of the knowledge banks of programmers world-over, yet is one of the most ingenious additions to any language. Usually something that was reserved for C programmers, with the power of freeBASIC's new preprocessor, you can now use conditional compilation to help your program.

The preprocessor allows you flexibility in changing the way code is generated through the use of conditional compilation. Take this scenario: you are debugging the code in your program, and you want to add some extra code to output a few variables, but remove them in the final version. The code would be something like this:

```
#define DEBUG

#ifdef DEBUG
    Print "Debug Value"
#endif 'DEBUG
```

**Note** you do not need the comment after the `#endif`, but is it good practice.

Basically, the above code checks to see whether `DEBUG` has been defined and if it has, then the code between the `#ifdef...#endif` will be executed. While this may seem silly, the uses this has are amazing. If you simply remove one line at the top of your program (`#define DEBUG`), then all the 'debug code' that you've added won't be sent to the compiler - the preprocessor removes it, reducing the bloat of the final executable.

'Turn on debugging
The `#undef` directive is a way of 'undefining' something, in this case `DEBUG`. While it is strictly not needed (just commenting out the line `'#define DEBUG'` is enough), it makes the code much clearer, and has other uses:

```c
#ifndef DEBUG
    Print "Production Version"
#endif 'DEBUG
```

While not the most useful example, this demonstrates the use of another directive: `#ifndef`. This directive will cause the code to be compiled if the symbol is not defined.

Much like a normal programming language, the sense of the conditional can be reversed using a variant of `else`, `#else`:

```c
#ifndef DEBUG
    Print "Test Version"
#else
    Print "Production Version"
#endif 'DEBUG
```

Of course, there are many applications to this. Who says you need to do this on debug code only? You could actually check the effect of a new piece of code, or some test routines by simply defining a name like
TESTCODE and using the preprocessor directives to encompass your code for conditional compilation:

```c
#define TESTCODE

#ifdef TESTCODE
    BulletRoutine()
    TestFireRoutine()
#endif
```

The scope of this tutorial is a limited one, but this method is used by professionals. It makes life easy when programming. I have used this method in my own code. To see this code in action, view the source here.

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Introduction to Pointers

Written by rdc

What is a Pointer?

A pointer is a 4-byte data type that holds an address to a memory location. It does not contain data, it points to data once it has been initialized. An uninitialized pointer points to nothing and is undefined.

To understand pointers, think of an egg carton that has numbers 1 through 12 printed on the bottom of each "hole" (where you put the eggs). These holes are like memory locations in a computer; each hole, or memory location, has an address, in this example an egg represents a data item, then an egg in hole 1 has an address of 1.

Normally, you would access the data directly through the use of variables. DIMension a variable of a particular type, you are setting aside storage space for the data. You do not need to know, or care, where the data resides since you can access it directly through the variable. This is like reaching out and picking up the egg (reading the data) or putting an egg in hole 1 (setting the data) without looking at the numbers written on the bottom of the hole.

Using pointers is a bit different. Imagine you have a little scrap of paper that will represent our pointer. Right now it is blank and doesn't point to anything. This undefined pointer can't be used until it is initialized. To initialize the pointer, write a 1 on it. Now our pointer is "pointing" to hole 1 in our egg carton. To put data (an egg) in hole 1, we match our paper, match it to hole 1 and place the egg in the hole. To retrieve the egg, we do the opposite. We match our slip of paper to hole 1 and then grab the egg. All the putting and getting of the egg has to be done through the slip of paper and is called dereferencing the pointer. That is, we get to the data through the reference contained in the pointer, the number 1. The pointer doesn't contain the data; it contains a reference to the data.

In FreeBasic we define a pointer using the Dim and Ptr statements:

```
Dim aptr As Integer Ptr
```
This statement corresponds to our blank piece of paper in the above example. The pointer doesn't point to anything and is undefined. If we tried to use the pointer it is likely the program would crash.

In order for a pointer to be useful, it must be initialized:

```vbnet
Dim aptr As Integer Ptr
aptr = Allocate(SizeOf(Integer))
```

Here we are using `Allocate` to set aside enough space in memory for an integer type and loading the address of that space into `aptr`. The `SizeOf` macro returns the size in bytes of the passed data type. You could use `len` instead of `SizeOf` (since .13b) if you prefer.

Once we have initialized the pointer, we can now use it:

```vbnet
*aptr = 5
Print "aptr: "; *aptr
```

Notice the * prefix on `aptr`. The * is the reference operator. This is like matching the number on the slip of paper to the number on the hole in the egg carton. By using the * operator we are able to get at the data (egg) contained in the hole pointed at by `aptr`.

Here is a complete example program:

```vbnet
Option Explicit

Dim aptr As Integer Ptr
aptr = Allocate(SizeOf(Integer))
*aptr = 5
```
Deallocate aptr
Sleep

The **Deallocate** function frees the memory pointed at by `aptr`, and makes `aptr` undefined once again. This is like erasing the number on our slip of paper. If we were to deallocating it, the program would crash.

**What Good are Pointers?**

A major reason for adding pointers to FreeBasic is that many external libraries require pointers to type structures and pointers to strings. For example, the Win32 API has many structures that must be filled out and then passed to a function through a pointer.

Another use of a pointer is in a **Type** definition. **Type** defs in FreeBasic can only contain fixed length strings, but what if you don't know the length of a string until the program is running? A pointer can serve this purpose.

(It should be stated that the Type definitions can now support variable length strings.)

```freebasic
Option Explicit

Type mytptr
    sptr As ZStringPtr
End Type

'Declare Function pSetString(ByVal s As String) As ZString

' this function will allocate space for the passed string, and load it into a memory location, returning the pointer to the string.

Declare Function pSetString(ByVal s As String) As ZString

'dtype var
Dim mytype As mytptr

'mytype.sptr = pSetString("

' Set a variable string into the type def
mytype.sptr = pSetString("Hello World From FreeBasic")
```
Here we define our type with a field sptr as **ZString Ptr**. Zstrings are null terminated strings and are used by many external libraries and are designed for dynamic allocation. Once we define our type we create an instance of it with the **Dim** statement:

```
Dim mytype As mytptr
```

We then call our function pSetString to get the address of the variable length string we want in our **Type** def.

```
mytype.sptr = pSetString("Hello World From FreeBasic!")
```

Remember sptr is defined as a pointer, not a string variable, so pSetString is returning a pointer (memory address) to the string not the string itself. In other words...
hole #1, pSetString returns 1.

The function pSetString uses a temporary ZString sz, to Allocate space for the string parameter s. Because a ZString is a null terminated string, we must add 1 to the length of s for the null terminator in the Allocate function.

```plaintext
'select some space + 1 for the chr(0)
sz = Allocate(Len(s) + 1)
```

Once we have allocated space for the string, we use the reference operator to load the data into the memory location.

```plaintext
'load the string into the memory location
*sz = s
```

We then return a pointer (the address of the string) back to our type, which is stored in mytype.sptr.

```plaintext
'return the pointer
Return sz
```

We can now reference the string in our type using the reference operator.

```plaintext
Print "aptr: "; *mytype.sptr
```
Pointers can be confusing for the uninitiated, however they need not be that the pointer doesn't contain data, it simply points to some data. The pointer is a memory address, and you manipulate that data through the reference operator *. Different than a normal variable.
If you read the article Introduction to Pointers you know that pointers contain memory location addresses. You can manipulate the data in these memory locations using the reference operator *. Using pointers with single data item isn?t a problem, but what if you need to store multiple data items together and manipulate them using a pointer? It can get a bit tricky unless you understand how data is stored in memory.

A single memory location in a computer is 1 byte long. Big enough to hold a single ANSI character (as opposed to Unicode characters, which are wide characters and are two bytes. We won?t be discussing Unicode characters in this article.) However, all data types are not a single byte in width. Here is a simple program that displays the length in bytes of each data type.

```basic
Dim a As Byte
Dim b As Short
Dim c As Integer
Dim d As LongInt
Dim au As UByte
Dim bu As UShort
Dim cu AsUInteger
Dim du As ULongInt
Dim e As Single
Dim f As Double
Dim g As Integer Ptr
Dim h As Byte Ptr
Dim s1 As String * 10 'fixed string
Dim s2 As String 'variable length string
Dim s3 As ZString Ptr 'zstring

s1 = "Hello World!"

s2 = "Hello World from FreeBasic!"

s3 = Allocate( Len( s2 ) + 1 )
```
*s3 = s2

Print "Byte: ";Len(a)
Print "Short: ";Len(b)
Print "Integer: ";Len(c)
Print "Longint: ";Len(d)
Print "UByte: ";Len(au)
Print "UShort: ";Len(bu)
Print "UInteger: ";Len(cu)
Print "ULongint: ";Len(du)
Print "Single: ";Len(e)
Print "Double: ";Len(f)
Print "Integer Pointer: ";Len(g)
Print "Byte Pointer: ";Len(h)
Print "Fixed String: ";Len(s1)
Print "Variable String: ";Len(s2)
Print "ZString: ";Len(*s3)

Deallocate s3

Sleep

The output is:

Byte:  1
Short:  2
Integer:  4
LongInt:  8
UByte:  1
UShort:  2
UInteger:  4
ULongInt:  8
Single:  4
Double:  8
Integer Pointer:  4
Notice that the length of a pointer is always 4 bytes long (the same as an integer), regardless of the data being pointed to, since a pointer contains a memory address and not data.

Looking at the length of the different data types, you can see that if you were to Allocate enough space for 10 integers, it would take 40 bytes of memory. Each integer takes up 4 bytes. So the question is, how do you access each integer value from the memory buffer? The answer, pointer math. Take a look at the following program.

```
Option Explicit

Dim a As Integer
Dim aptr As Integer Ptr

'Allocate enough space for 2 integers
aptr = Allocate(Len(a) * 2)
'Load our first integer
*aptr = 1
Print "Int #1: ";*aptr
'Move the pointer to the next integer position
*aptr + 4
*(aptr + 4) = 2
Print "Int #2: ";*(aptr + 4)

Deallocate aptr
Sleep
End
```
In this program we dimension two variables, an **Integer** and an **Integer Pointer**, `aptr`. `aptr` will point to our memory buffer that will contain two integers. The **Allocate** function requires the size of the buffer we need, so we multiply the size of an **Integer** by 2 to reserve 8 bytes of memory (each integer will take 4 bytes of space).

After the allocation process, `aptr` contains the address of the first byte of our memory buffer. Storing the first integer is simply a matter of using the reference operator and setting the value to 1. To print out the value, we again just use `*aptr`.

Now, let me ask you a question: How does the compiler know that the value 1 requires 4 bytes and not 1 or 2 bytes? Because we dimensioned `aptr` as an `integer ptr`. The compiler knows that an integer takes 4 bytes and so loads the data into four bytes of memory. This is why when we print out the value we get 1 and not some strange number.

To load the second value into our buffer, we use:

\[ *(aptr + 4) = 2 \]

This may look a little strange at first glance. `aptr` points to the first byte in our memory buffer. An integer is 4 bytes long, so to get to the next integer byte position, we must add 4 to `aptr`. We need the parenthesis around the add operation because the reference operator `*` has a higher precedence than `+`. The parenthesis ensure that we perform the add operation first, and then apply the indirection operator.

Notice that we didn't increment `aptr` directly. If we did, `aptr` would no longer point to the start of the memory buffer and the program would crash when we deallocated the buffer since it would **Deallocate** memory outside the memory buffer. If the need arises to directly increment a pointer, then create a temporary pointer variable and increment that,
rather than the pointer used in the original allocation.

Memory buffers and pointers are a powerful way to store and manipulate data in memory. Care must be taken though to ensure that you are accessing the data correctly according to the type of data being stored in the buffer.
The Pointer Data Type

Written by rdc

The pointer data type is unique among the FreeBasic numeric data types.

On a 32-bit system, the pointer data type is 4 bytes. FreeBasic uses pointers fast, since the compiler can directly access the memory location that a pointer contains.

For many beginning programmers, pointers seem like a strange and mysterious beast. However, if you keep on top of things, you should not have any problems using pointers in your program. The rule is very simple: a pointer contains an address, not data. If you keep this simple rule in mind, you should have no problems using pointers.

Pointers and Memory

You can think of the memory in your computer as a set of post office boxes (P.O. Box) at your local post office. You decide to write the number down on a slip of paper and put it in your wallet. The next day you look in your wallet and find the slip of paper. You locate box 100 and look inside the box and find a nice stack of junk mail. Of course, you want to toss the junk mail, but there isn’t a trash can handy, so you decide to just put the mail in the box and toss it later.

Working with pointers in FreeBasic is very similar to using a P.O. Box. When you declare a pointer, it isn’t pointing to anything which is analogous to the blank slip of paper. Once you have the address, find the right P.O. Box, you can pointers.

Declare a pointer variable.
Initialize the pointer to a memory address.
Dereference the pointer to manipulate the data at the pointed-to memory location.

This isn’t really any different than using a standard variable, and you use directly, and with a pointer you must dereference the pointer to interact with variables. The only real difference between the two is that in a standard variable, you can access the data directly, and with a pointer you must dereference the pointer to interact with the data.

Typed and Untyped Pointers

FreeBasic has two types of pointers, typed and untyped. A typed pointer

Dim myPointer As Integer Ptr
This tells the compiler that this pointer will be used for integer data. Using typed pointers allows the compiler to make sure that you are not using the wrong type of data with the pointer, and simplifies pointer arithmetic.

Untyped pointers are declared using the Any keyword.

```freebasic
Dim myPointer As Any Ptr
```

Untyped pointers have no type checking and default to size of byte. Unless you specifically need an untyped pointer, you should use typed pointers so that the compiler can check the pointer assignments.

**Pointer Operators**

FreeBasic has the following pointer operators.

You will notice that the addressof operator not only returns the memory address of a variable, but it can also be used to specify the memory address of a subroutine or function. You would use the address of a subroutine or function to create a callback function such as used in the CRT QSort function.

**Memory Functions**

FreeBasic also has a number of memory functions that are used with pointers.

These functions are useful for creating a number of dynamic structures such as linked lists, ragged or dynamic arrays and buffers used with third party libraries.

When using the Allocate function you must specify the storage size based on the data type.

```
Allocate(10 * Sizeof(Integer)).
```

An integer is 4 bytes so allocating 10 integers will set aside 40 bytes.

allocate works in the same fashion, except that the calculation is done internally.

```
Callocate(10, Sizeof(Integer)).
```

Unlike Allocate, Callocate will clear the memory segment.

 realloc will change the size of an existing memory segment, making it larger or smaller as needed.

```
Reallocate(myPointer, 10, 4).
```

If the new segment is larger than the existing segment, then the data in the existing segment will be preserved. If the new segment is smaller than the existing segment, the data in the existing segment will be truncated.

 realloc does not clear the added memory or change any existing data.

All of these functions will return a memory address if successful. If the function cannot allocate the memory segment, then a NULL pointer (0) is returned. You should check the return value each time you use these functions to be sure that the memory segment was successfully created. Trying to use a bad pointer will result in undesirable behavior or system crashes.
There is no intrinsic method for determining the size of an allocation. You must keep track of this information yourself.

Be careful not to use the same pointer variable to allocate two or more memory segments. Reusing a pointer variable to allocate two or more memory segments will result in the memory segment being lost causing a memory leak.

**Pointer Arithmetic and Pointer Indexing**

When you create a memory segment using the allocation functions, you can access its contents using the `indirection` operator with pointer arithmetic, and pointer indexing.

Pointer arithmetic, as the name suggests, adds and subtracts values to and from a pointer. For example, if you know that the data being used with this pointer is of size Integer or 4 bytes. This allows you to add or subtract a value from the pointer, which can be expressed as `*(myPtr + 1)`.

Since the compiler knows that the pointer is an Integer pointer, adding 1 to the pointer is valid. However, using untyped pointers. The compiler does much of the work for you in accessing the data in the memory segment.

Notice that the construct is `*(myPtr + 1)` and not `*myPtr + 1`. The `*` operator will evaluate `myPtr` first, which returns the contents of the memory location to which `myPtr` points. Then, the `+ 1` will be evaluated, which increments the pointer address, and then the `*` is applied to the new address.

Pointer indexing works the same way as pointer arithmetic, but the details are handled by the compiler. Using the index operator, you can calculate the correct memory offsets to return the proper values using the index. Which format you use is up to you, but the `indirection` operator typically resembles the standard array access method and is visually easier to understand than the index operator.

**Pointer Functions**

Freebasic has a set of pointer functions to complement the pointer operators.

- **CPtr** Converts expression to a data_type pointer. Expression can be another pointer or an integer.
- **Peek** Returns the contents of memory location pointed to by pointer. Data_type specifies the type of expected data.
- **Poke** Puts the value of expression into the memory location pointed to by pointer.
**SAdd** Returns the location in memory where the string data in a dynamic string is located.

**StrPtr** The same as SAdd.

**ProcPtr** Returns the address of a function. This works the same way as the addressof operator @.

**VarPtr** This function works the same way as the addressof operator @.

The SAdd and Strptr functions work with the string data types to return the address of the string data, just like the address of operator @, but Proptr only works on subroutines and functions.

**Subroutine and Function Pointers**

Subroutines and functions, like variables, reside in memory and have an address associated with their entry point. You can use these addresses to create events in your programs, to create pseudo-objects and are used in callback functions. You create a sub or function pointer just like any other pointer.

Before using a function pointer, it must be initialized to the address of a subroutine or function.

You declare a function pointer using the anonymous declaration syntax.

```plaintext
Dim FuncPtr As Function(x As Integer, y As Integer)
```

You then need to associate this function pointer with an actual subroutine or function.

```plaintext
Function Power(number As Integer, pwr As Integer) As Integer
    Return number^pwr
End Function

FuncPtr = @Power
```

You can then call the function pointer much like you would call the real function.

```plaintext
FuncPtr(2, 4)
```
While this may not be useful at first glance, you can use this technique to implement polymorphic functions where a single variable instance can point to one of several different subroutines or functions.

For example, suppose you have a dog and cat object. Both objects need to make `Speak` either issue a "Woof!" or "Meow!" depending on the object:

```
Creating a Callback Function
```

One of the primary uses for function pointers is to create callback functions. A callback function is a function that is called by another function or subroutine either in your own code space or in an external library. Windows uses callback functions to enumerate through window objects like fonts, printers, and forms.

The `qsort`, function contained within the C Runtime Library sorts the elements of an array using a callback function to determine the sort order. The prototype for the `qsort` function is contained in `stdlib.bi`:

```
Declare Sub qsort cdecl Alias "qsort" (ByVal As Any
```

The following lists the parameter information for the `qsort` subroutine.

- The first parameter is the address to the first element of the array. The easiest way to pass this information to `qsort` is to append the address of operator to the first element index: `@myArray(0)`.
- The second parameter is the number of elements in the array, that is the array count.
- The third parameter is the size of each element in bytes. For an array of integers, the element size would be 4 bytes.
- The fourth parameter is a function pointer to the user created compare function. The function must be declared using the Cdecl passing model, as shown in this parameter.

Using this information, you can see how `qsort` works. By passing the address of the first element, the number of elements, the size of each element, and the compare function, `qsort` can iterate through the array using pointer arithmetic.

`Qsort` will take two array elements, pass them to your user defined compare function, and use the compare function to sort the array elements. It does this repeatedly until each array element is in sorted order.

You need to declare the function prototype as Cdecl which ensures that the parameters are passed in the correct order.

```
Declare Function QCompare cdecl (ByVal e1 As Any Ptr
```

You would then define the function like the following.
'The qsort function expects three numbers 
'from the compare function: 
'-1: if e1 is less than e2 
'0: if e1 is equal to e2 
'1: if e1 is greater than e2

Function QCompare cdecl (ByVal e1 As Any Ptr, _
ByVal e2 As Any Ptr) As Integer
Dim As Integer el1, el2
Static cnt As Integer

'Get the call count and items passed
cnt += 1
'Get the values, must cast to integer ptr
el1 = *(CPtr(Integer Ptr, e1))
el2 = *(CPtr(Integer Ptr, e2))
Print "Qsort called";cnt;" time(s) with";el1;" and";
'Compare the values
If el1 < el2 Then
Return -1
ElseIf el1 > el2 Then
Return 1
Else
    Return 0
End If
End Function

You would then call the QSort function passing the address of the callback

qsort @myArray(0), 10, SizeOf(Integer), @QCompare

**Pointer to Pointer**

In FreeBasic you can create a pointer to any of the supported data types, structures such as linked-lists and ragged arrays. A pointer to a pointer i
One application of a pointer to pointer is the creation of a memory segment that you can resize as needed during runtime.

```
Dim myMemArray As Integer Ptr Ptr
```

You would then initialize the pointer reference by using `Allocate` or `CAllocate`.

```
'Create 10 rows of integer pointers
myMemArray = CAllocate(10, SizeOf(Integer Ptr))
```

Notice that the variable is initialized to an `Integer Ptr` since this list is going to contain another list; this is the pointer that points to another pointer. You can then initialize the individual pointer references just created to point to the needed memory segments.

```
'Add 10 columns of integers to each row
For i = 0 To 9
    myMemArray[i] = CAllocate(10, SizeOf(Integer))
Next
```

In this code snippet, the individual pointers in the list are initialized to 10 memory segments.

```
'Add some data to the memory segment
For i = 0 To 9
    For j = 0 To 9
        myMemArray[i][j] = Int(Rnd * 10)
    Next
Next
```

This code snippet uses the index method to load the actual data into the memory segment.
code to create a dynamic array within a type definition. Since you cannot

One thing you need to be aware of is how to deallocate a structure such as this: these memory segments first and then you can deallocate the base pointer:

```vbnet
'Free memory segment
For i = 0 To 9
Deallocation myMemArray[i]
Next

'Free the pointer to pointer
Deallocation myMemArray
```

You need to be sure that you deallocate in the right order, otherwise you
A linked list is a structure that is easily expandable by using a single function to do something but you have no idea how many. The concept behind a linked list is that each node contains a pointer to the next and previous node structure. This is called a double linked list, as it links to two different nodes. By using a pointer to a structure, you can specify a null pointer if there is no next or previous node, and since the amount of nodes you can store is limited only by memory.

The only downside to using a linked list is that in order to store say an integer, you have to allocate space not only for that integer, but also a structure that contains a pointer to the integer and a pointer to the surrounding nodes. This doesn't make much of a difference on today's computers however, unless you are storing millions of nodes.

The basic structure of the linked list is the node. The declaration is this:

```plaintext
Type listnode
    As Any Ptr pData
    As listnode Ptr pNext
    As listnode Ptr pPrev
End Type
```

As a side note, if whoever has access to these scripts would like to update them to use new (as ptr), feel free to :) Also, LIST doesn't appear to be an FB keyword (correct me if I'm wrong).

This structure contains three pointers. The first is a pointer to anything (Any), characters, even user defined types and unions. But it also means that you have to use the Allocate (or CAllocate) function.

The next two pointers are pointers to listnodes, that is, you are technically allowed to do this:

```plaintext
Print node->pNext->pNext->pNext->pNext...
```

since each node contains a pointer to another node. The problem with the above syntax is that you can access and the code gets hard to understand. You can use the ListGetNext function for this purpose, and loop with a While loop.

Before we go any further, let's see all the declarations for using linked lists:

```plaintext
Declare Function ListCreate() As listnode Ptr
Declare Function ListAdd(list As listnode Ptr, item...
Declare Function ListAddHead(list As listnode Ptr, item...
```
Declare Function ListGetFirst(list As listnode Ptr)
Declare Function ListGetLast(list As listnode Ptr)
Declare Function ListGetNext(list As listnode Ptr)
Declare Function ListGetPrev(list As listnode Ptr)
Declare Function ListGetData(list As listnode Ptr)
Declare Function ListRemove(list As listnode Ptr, bDelete)
Declare Sub ListRemoveAll(list As listnode Ptr, bDelete)

Edit: Hmm, it doesn't seem to like my use of "Rem" in a function. It compiles fine though.

You can see that there is a function to create a linked list, to add an item, to get various nodes, get data, and to remove nodes. Currently we'll focus on the ListCreate function. It takes no parameters and has no data filled out. The whole structure is null, but it is still a structure point to the new item, so it won't stay as a null node, since there would be no point to the new item, so it won't stay as a null node, since there would be no ListCreate won't have any data stored in it and it won't have a previous node.

The function ListCreate looks like this:

```vbnet
' CREATE
Function ListCreate() As listnode Ptr
    Dim As listnode Ptr pTemp
    pTemp = CAAllocate(Len(listnode))
    ' CAAllocate automatically zeroes memory.
    Return pTemp
End Function
```

I prefer to use the Return instruction to return a value from a function, but allowed, although they don't immediately exit the function.

The point of this function is easy to see, a node is allocated and returned. CAAllocate automatically zeroes memory. If you used the Allocate function, the mem have to do that on your own.

The next functions, ListAdd and ListAddHead, add a node to the list. ListAddListAddHead puts a node at the very top (the head).
' ADD, ADDHEAD

Function ListAdd(list As listnode Ptr, item As Any Ptr) As Any
    Dim As listnode Ptr pTemp
    
    If (list = 0) Then Return item
    
    pTemp = ListGetLast(list)
    pTemp->pNext = CAllocate(Len(listnode))
    pTemp->pNext->pPrev = pTemp
    pTemp->pNext->pData = item
    
    Return item
End Function

Function ListAddHead(list As listnode Ptr, item As Any Ptr) As Any
    Dim As listnode Ptr pTemp
    
    If (list = 0) Then Return item
    
    pTemp = list->pNext
    list->pNext = CAllocate(Len(listnode))
    
    list->pNext->pPrev = list
    list->pNext->pData = item
    list->pNext->pNext = pTemp
    
    If (pTemp <> 0) Then
        pTemp->pPrev = list->pNext
    End If
    
    Return item
End Function

You can see that ListAdd makes a reference to a function not shown yet. It returns a pointer to the last node in the list. It will be covered later.
ListAdd retrieves the last node and sets its pNext pointer to a new listnode structure. This won't cause memory loss since the last node has a null pNext value because nothing comes after it. Once our node is added, we can access it using the -> operator. The line `pTemp->pNext->pPrev = pTemp` is the whole basis of linked lists, the linking part. What this says is that we have a reference to a node. That node knows where the next node is, and now we're telling the node after that next one where the previous one is. It may look a little redundant at first, but the compiler doesn't know where the nodes are until you set them. Once you've done this, you can step through the linked list.

The ListAddHead function is a little more complicated, since we're actually inserting a node between the current first node and the null node from ListCreate. What it does basically is allocates space to hold the current first node, creates a new node there, and links them all together. If you study it a little, it should seem a lot clearer. If you're trying to access memory that doesn't exist (NULL->pPrev). If `pTemp` doesn't exist, it won't be assigned. Otherwise, there is no reason to worry about it.

The next functions are ListGetFirst and ListGetLast. I implemented them as a separate function.

```vbnet
' GETFIRST, GETLAST

Function ListGetFirst(list As listnode Ptr) As listnode
    If (list = 0) Then Return 0

    Return list->pNext
End Function

Function ListGetLast(list As listnode Ptr) As listnode
    Dim As listnode Ptr pTemp

    If (list = 0) Then Return 0

    pTemp = list
    While (pTemp->pNext <> 0)
        pTemp = pTemp->pNext
    Wend

    Return pTemp
End Function
```
The first function is probably the shortest and easiest function to understand, although it relies on the fact that you are holding a pointer to the node returned by ListCreate. If you don't do this, it could return any random node. All it does is return a pointer to the first node, or the node that comes right after the null node.

The second function, ListGetLast, loops through the list until it finds a null node of pTemp = 0 is that I don't want to return zero. I want to return the last node, which has its pNext value set to zero. Once that node is found, ListGetLast returns it.

The next 3 functions are just helper functions, and could be easily accomplished with one line of code. They really exist because the original implementation not written by me had a ListGetNext function.

```vbnet
' GETNEXT, GETPREV

Function ListGetNext(list As listnode Ptr) As listnode
    If (list = 0) Then Return 0
    Return list->pNext
End Function

Function ListGetPrev(list As listnode Ptr) As listnode
    ' can't do anything to a null list
    If (list = 0) Then Return 0
    ' this is needed for below
    If (list->pPrev = 0) Then Return 0
    ' since the list starts with a null node (pPrev
    ' the first should be the one right after the re
    If (list->pPrev->pPrev = 0) Then Return 0
    Return list->pPrev
End Function

' GETDATA

Function ListGetData(list As listnode Ptr) As Any Ptr
    If (list = 0) Then Return 0
```

The first function, ListGetNext, is the exact same as ListGetFirst, but the ListGetFirst on a node value in this implementation, it isn't a smart idea I beginning of the list in order to find the first node, in which case you'd be

The ListGetPrev function is a little more complicated, since I don't want the comments) are the ones that are actually needed, but the second one ess, says that if two nodes up is null, we should return zero. That means that previous node that you can do anything with, although there does exist a handles the default case, where there is in fact a previous node, and it s

The ListGetData function is as easy and brief as the ListGetFirst and ListGetNext functions.

The final two functions remove nodes from the list.

' REMOVE, REMOVEALL

Function ListRemove(list As listnode Ptr, bDelete As Integer) As listnode
  Dim As listnode Ptr pPrev
  Dim As listnode Ptr pNext

  If (list = 0) Then Return 0

  pPrev = list->pPrev
  pNext = list->pNext

  If ((list->pData <> 0) And (bDelete <> 0)) Then
    Deallocate list
  End If

  If (pPrev <> 0) Then
    pPrev->pNext = pNext
  End If

  If (pNext <> 0) Then
The ListRemove function has two jobs: To remove the node you specified, you can see that it stores a previous and next pointer to do this. The optional parameter bDelete specifies if the data item should be deleted. If you are just storing integers, or even structures with no pointers, the data item will be deleted for you. But if you have a structure with pointers in it, the best idea is to delete all the data yourself and have ListRemove only handle the list part to ensure that there is no memory loss, whether or not you told it to delete the data.

ListRemoveAll relies on the ListRemove function to delete the nodes. It simply loops and deletes every node. The original code used a For loop, but FB doesn't support For node = list To 0 Step ListRemove(node) so it has been changed.

That's it, here's the whole file that includes a sample at the top of how to use them. This is my first time writing a tutorial, so feel free to leave comments on ways I could improve. Also, if you catch a bug in my code (I found a couple while writing this), please let me know. Feel free to edit the bug out also, but I'd like to know about it too.
As listnode Ptr pNext
As listnode Ptr pPrev
End Type

Declare Function ListCreate() As listnode Ptr
Declare Function ListAdd(list As listnode Ptr, item) As listnode Ptr
Declare Function ListAddHead(list As listnode Ptr, item) As listnode Ptr
Declare Function ListGetFirst(list As listnode Ptr) As listnode Ptr
Declare Function ListGetLast(list As listnode Ptr) As listnode Ptr
Declare Function ListGetNext(list As listnode Ptr) As listnode Ptr
Declare Function ListGetData(list As listnodePtr) As Integer
Declare Function ListRemove(list As listnode Ptr, bDelete) As Boolean
Declare Sub ListRemoveAll(list As listnode Ptr, bDelete)

Dim As listnode Ptr list, node
Dim As Integer Ptr item
list = ListCreate()
item = ListAdd(list, CAllocate(Len(Integer)))
*item = 4
item = ListAdd(list, CAllocate(Len(Integer)))
*item = 44
item = 0 ' just to show it works
node = ListGetFirst(list)

While node <> 0
    Print "found item"
    item = ListGetData(node)
    Print *item
    node = ListRemove(node, 1)
Wend

While Inkey$ = "": Wend

' CREATE
Function ListCreate() As listnode Ptr
    Dim As listnode Ptr pTemp
    pTemp = CAllocate(Len(listnode))
    ' CAllocate automatically zeroes memory.
Return pTemp
End Function

' ADD, ADDHEAD

Function ListAdd(list As listnode Ptr, item As Any Ptr)
    Dim As listnode Ptr pTemp
    If (list = 0) Then Return item

    pTemp = ListGetLast(list)

    pTemp->pNext = CAllocate(Len(listnode))
    pTemp->pNext->pPrev = pTemp
    pTemp->pNext->pData = item

    Return item
End Function

Function ListAddHead(list As listnode Ptr, item As Any Ptr)
    Dim As listnode Ptr pTemp
    If (list = 0) Then Return item

    pTemp = list->pNext
    list->pNext = CAllocate(Len(listnode))

    list->pNext->pPrev = list
    list->pNext->pData = item
    list->pNext->pNext = pTemp

    If (pTemp <> 0) Then
        pTemp->pPrev = list->pNext
    End If

    Return item
End Function
'GETFIRST, GETLAST

Function ListGetFirst(list As listnodePtr) As listnode
   If (list = 0) Then Return 0
   Return list->pNext
End Function

Function ListGetLast(list As listnodePtr) As listnode
   Dim As listnodePtr pTemp
   If (list = 0) Then Return 0
   pTemp = list
   While (pTemp->pNext <> 0)
      pTemp = pTemp->pNext
   Wend
   Return pTemp
End Function

'GETNEXT, GETPREV

Function ListGetNext(list As listnodePtr) As listnode
   If (list = 0) Then Return 0
   Return list->pNext
End Function

Function ListGetPrev(list As listnodePtr) As listnode
   'can't do anything to a null list
   If (list = 0) Then Return 0
   'this is needed for below
   If (list->pPrev = 0) Then Return 0
   'since the list starts with a null node (pPrev)
   'the first should be the one right after the real
   If (list->pPrev->pPrev = 0) Then Return 0
   Return list->pPrev
End Function

' GETDATA

Function ListGetData(list As listnodePtr) As Any Ptr
    If (list = 0) Then Return 0
    Return list->pData
End Function

' REMOVE, REMOVEALL

Function ListRemove(list As listnodePtr, bDelete As Dim As listnodePtr pPrev
    Dim As listnodePtr pNext
    If (list = 0) Then Return 0
    pPrev = list->pPrev
    pNext = list->pNext
    If ((list->pData <> 0) And (bDelete <> 0)) Then
        Deallocate list
        If (pPrev <> 0) Then
            pPrev->pNext = pNext
        End If
        If (pNext <> 0) Then
            pNext->pPrev = pPrev
        End If
        Return pNext
    End If
End Function

Sub ListRemoveAll(list As listnodePtr, bDelete As Dim As listnodePtr node
    node = list
If (list = 0) Then Return

While (node <> 0)
    If ((node->pData <> 0) And (bDelete <> 0)) Then
        node = ListRemove(node)
    Wend
End Sub

If you haven’t noticed already, ListAdd and ListAddHead return a pointer. The sample code (see above) shows how to use this functionality. ListRemove returns a pointer to next node. ListRemoveAll is the only function that doesn't return anything. There is no need, since the whole list will be empty after you have called it.
Dynamic Arrays in Types

Written by rdc

Introduction

A dynamic array in a type definition is a very useful feature, but FreeBasic doesn't support it before version 1.00.0. Or rather, it doesn't support it directly before that version. However, you can create dynamic arrays by using pointers and the associated memory functions.

An array is simply a contiguous block of memory that holds a certain data type. Arrays in FreeBasic use an array descriptor to describe the data contained within the array, and you can use this same technique to build a dynamic array within a type. The two elements you need within your type-def are a pointer to a particular data type, and a size indicator.

You can then use the ptr field to allocate a block of memory to the needed size, and save that size in the size indicator field. The size field is used to tell you how many elements are currently in the array. Once the array has been initialized, you can then use pointer indexing to access each element in the array.

Getting the Point(er) in Code

The following program illustrates the steps in creating, initializing and resizing a dynamic type-def array.

```
'Define type:
'size is current size of array
'darray will contain array data
Type  DType
   size  As  Integer
   darray  As  Integer  Ptr
End  Type

'Create an instance of type
Dim  myType  As  DType
```
Dim As Integer i, tmp

'Create enough space for elements
myType.darray = CAllocate(5, SizeOf(Integer))

'Set the length of the array
'in the array size indicator
myType.size = 5

'Load data into array
For i = 0 To myType.Size - 1
    myType.darray[i] = i
Next

'Print data
For i = 0 To myType.Size - 1
    Print "darray[";i;" ]:";myType.darray[i]
Next

Print "Press any key...
Sleep
Print

'Save the current array size
tmp = myType.size

'Now resize the array
myType.darray = Reallocate(myType.darray, 10)

'Set the length indicator
myType.size = 10

'Load in data into new allocation
For i = tmp To myType.Size - 1
    myType.darray[i] = i
Next

'Print out contents
For i = 0 To myType.Size - 1
    Print "darray[";i;" ]:";myType.darray[i]
Next

Print "Press any key...
Sleep
'Free allocated space
Deallocate myType.darray
End

How it Works

The first step is, of course, to define the type-def:

```
Type DType
    size As Integer
    darray As Integer Ptr
End Type
```

Since this is just an example there are only two elements within the type a size indicator and the array pointer. Notice that the array pointer is defined as an Integer ptr. When you define a pointer to a particular type, you are creating a "typed" pointer. The compiler can use this type information to check to make sure the values being placed into the array are valid, and will also use this information for pointer arithmetic.

The next step is to define the working variables.

```
Dim myType As DType
Dim As Integer i, tmp
```

Here an instance of the type is created, as well as some working variables that are used in the following code. WARNING: You must initialize the array pointer before you can use it; using an uninitialized ptr can cause program crashes, system lockups and all sorts of bad things.

```
myType.darray = CAllocate(5, SizeOf(Integer))
myType.size = 5
```
These two lines of code initialize the array pointer to hold 5 integers. Calllocate is used to allocate the memory segment, since Calllocate will initialize the segment to zeros.

The size field stores the current length of the array. Now, of course, you could calculate the size of the array by simply dividing the number of bytes in the allocation by the size of an integer, but using a size indicator within the type is much cleaner and saves you a calculation in your program.

```bash
For i = 0 To myType.Size - 1
    myType.darray[i] = i
Next
```

This section of code loads the array with some values. You can see why saving the size of the array simplifies the coding process. Since the array is a typed pointer, you can access the array using the pointer indexing method, which is almost like accessing a predefined array.

```bash
For i = 0 To myType.Size - 1
    Print "darray[";i," ]:";myType.darray[i]
Next
```

This section simply prints out the values using the same method that was used to load the array.

Of course, this should be a dynamic array, so you should be able to resize the array, and this is exactly what the next section of code will do.

```bash
tmp = myType.size
myType.darray = Reallocate(myType.darray, 10)
myType.size = 10
```

The first line of code saves the current size of the array so that the new memory segment can be initialized while not overwriting any existing
data. You will see this in a moment.

The second line uses the Reallocate function to resize the memory segment, that is, resize the array. In this case, the array is being made larger; you could of course make the array smaller. If you were to make the array smaller, any data not in the new segment would be lost, as you would expect.

The last line of code above saves the new array size in the size indicator

```
For i = tmp To myType.Size - 1
    myType.darray[i] = i
Next
```

Here, you can see why the old array size was saved. In the For statement, the initialization procedure iterates through the newly added indexes, storing data within the memory segment. This is like using the Redim Preserve statement on a normal array.

```
For i = 0 To myType.Size - 1
    Print "darray[";i;" ]:",myType.darray[i]
Next
```

This code section simply prints out the new values.

```
Deallocate myType.darray
```

This is vitally important. You should always deallocate any allocated memory that you have created in your program to prevent memory leaks.

When you run the program you should see the following output:

```
darray[ 0 ]: 0
darray[ 1 ]: 1
```
The first print out shows the original array. The second print out shows the newly resized array.

**From fbc version 1.00.0, dynamic arrays fields as non-static members are supported inside UDT**

Previous example transposed for fbc version 1.00.0 or greater, by using dynamic array field as non-static member inside the UDT (feature now supported):

```fbc
'Define type (for fbc version >= 1.00.0):
darray will contain array data
Type  DType
   darray(Any) As Integer
End  Type

'Create an instance of type
Dim  myType As DType
Dim As Integer  i, tmp
```
'Create enough space for elements
ReDim myType.darray(4)

'Load data into array
For i = 0 To UBound(myType.darray)
    myType.darray(i) = i
Next

'Print data
For i = 0 To UBound(myType.darray)
    Print "darray(";i;" ):numType.darray(i)
Next
Print "Press any key..."
Sleep
Print

'Save the current array upper bound
tmp = UBound(myType.darray)
'Now resize the array
ReDim Preserve myType.darray(10)

'Load in data into new allocation
For i = tmp + 1 To UBound(myType.darray)
    myType.darray(i) = i
Next

'Print out contents
For i = 0 To UBound(myType.darray)
    Print "darray(";i;" ):numType.darray(i)
Next
Print "Press any key..."
Sleep
Function Overloading

written by :stylin:

What is It?

Function overloading is as close as you can come to generic programming without having templates. In functional (or modular) programming, the emphasis is on value, while in generic programming, the type of the argument passed. Function overloading is a side-step into generic programming, allowing a function identifier to be associated with a variety of functions that work with a variety of different types.

Simply put, function overloading involves defining functions that have the same name, but a combination of all the information needed to correctly reference the function, and includes the function's parameter list and return type. These are what we redefine, or overload. Let's start off with a small representation of a number. We simply write:

```
Option Explicit        '' force explicit declaration of variables
Option ByVal          '' default passing convention as ByVal

'' to declare functions with similar functionality but a different type. These are what we redefine, or overload. Let's start off with a small example.
Say we need functions that output the string representation of a number.
We simply write:

Declare Function print_byte( As Byte )        '' outputs a stringified byte
Declare Function print_short( As Short )       '' outputs a stringified short

Dim As Byte b = 102
Dim As Short s = 10240

print_byte( b )
print_short( s )

Sleep : End 0

'' function definitions squished for brevity - don't constrained tutorial ;}
Function print_byte( n As Byte ) : Print Str( n ) :
```
What Does It Do For Me?

The problem here is that not only do we have two different function signatures, we - not the compiler - have to remember both in order to call the right function. It can be confusing if you decide you want to support INTEGERS, SINGLES and DOUBLES, and we have functions that accept both the signed and unsigned versions of each type. We need a scheme setup to make this easier on yourself. And, of course you'll want to remember that when you're actually writing code that uses these functions. Since, after all, you are the one who will have to actually write the code. And, the compiler will happily let you slip a DOUBLE in to your print_integer function - no problem!

Surely there must be a better way?

There is, and don't call me Shirley. I mentioned before that the compiler uses two primary components to establish a function signature: the parameter list and the return type. I also mentioned that through overloading, we can define multiple functions with different signatures, and still keep the same function name for all of them. And, of course you'll want to remember to support your own unique types, too. So, what we're going to do is to establish a scheme setup to make this easier on ourselves. And, of course you'll want to remember that when you're actually writing code that uses these functions. Since, after all, you are the one who will have to actually write the code. And, the compiler will happily let you slip a DOUBLE in to your print_integer function - no problem!

Surely there must be a better way?

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Surely there must be a better way?
Dim As Integer i = 1024000000
Dim As LongInt li = 1024000000000000000

' enter the wonderful world of function overloading
print_numeric( b )
print_numeric( s )
print_numeric( i )
print_numeric( li )

Sleep : End 0

' define our function overloads
Function print_numeric( n As Byte ) : Print Str( n )
Function print_numeric( n As Short ) : Print Str( n )
Function print_numeric( n As Integer ) : Print Str( n )
Function print_numeric( n As LongInt ) : Print Str( n )

What does It Mean?

One thing that should stand out right away is how incredibly easy it is to add flexibility and type-safety if offers you, but then again most higher-level constructs are like that. In a nutshell, using methods like this will not only make your life a whole lot easier, but you'll be spending less time debugging, and that's a good thing no matter what kind of code you write.

It means flexibility. Function overloading offers the ability to add more features to your current code intact. Your code doesn't break because you want to support armor, or whatever else. You may now be thinking that the above code is not so simple anymore, and that what seems really simple - because it is - is really the foundation of writing better code. You'd be right.

It means maintainability: So you've got your 80 functions of:
print_some_long_name_you_need_to_look_up_everytime_you_want_to
in a torturous, self-loathing world. What happens when something needs to change? BAM! A maintenance nightmare. You're going to have to search the entire
function here or there; sad way to spend a Saturday night, my friend.

It means safety: You may notice that I utilize two OPTIONs in these exam
and I'm even bigger on having the compiler watch my back for me. I use
get. Function overloading also affords you safety - safety against evil (re
actually returning a value from these functions that was dependent on the
allowed to get truncated without our knowledge, that spells many pills of
It's all about the type-safety, something which cause many to scoff at C

**Wrapping Up**

I hope you have learned at least the basics of function overloading (sinc
themes I've brought up, if you haven't before. Next time I'll discuss overl
different return types, as well as the joys and pitfalls of both. Stay tuned.
Laanan Fisher

(a.k.a. stylin)

FreeBASIC
I regularly use and recommend FreeBASIC to anyone needing a language that provides ease-of-use, low development times, portability and support for a variety of programming paradigms. I log on occasionally at the official FreeBASIC site [www.freebasic.net] and read about what's new with FreeBASIC and its great community at the forums there [www.freebasic.net/forum].

contact
Reach me via email at gmail.com with a username of "laananfisher".
Historically, programming languages have been categorized as procedural and message-based (or event-driven) language. For example, QuickBasic could be categorized as a procedural language and Visual Basic could be categorized as a message-based language. In a procedural language you generally start at the top, do some things and exit in a somewhat linear manner. In a message-based language, you generally initialize the system and then the program sits in an idle loop and waits for something to happen. When something happens, you handle it and then the program returns to the idle loop, eventually exiting the loop when the user closes the program.

In a procedural language you have full control over what the user sees and does. You work in cooperation with the operating system and user, handling only the messages that you are interested in and letting the operating system handle the rest. The real stumbling block for programmers coming to a message-based language from a procedural language is the concept of responding only to messages. However, we are really talking about shades of gray, rather than black and white. Messages play an important role.

If you have ever used a language that supports subroutine and function calls, then you have used message-based programming. For example, say you have written a game in QuickBasic that sits in a loop waiting for one of the arrow keys to be pressed. If the up arrow key is pressed, you call a subroutine that updates the position of a sprite on the screen. If the A key is pressed, you ignore it, since you don't care about the A key. This is message-based programming. The message is the key press and the sprite update subroutine is the message handler.

Any structured programming language could be categorized as a message-based programming language. Message-based programming is a concept, a way to handle user input and output, more of a methodology than it is a type of language. It became the dominant feature of operating systems when operating systems evolved from the command line to graphical user interfaces.

In a GUI based operating system, such as Windows, the OS manages all of the graphical elements and receiving of messages has been formalized into what is called the Windows Software Development Kit, or more commonly, the Windows SDK.

The Windows SDK is a collection of application programming interfaces (APIs) in a set of dynamic link libraries (DLLs) that form the majority of the operating system. Any GUI based program running under Windows uses the SDK, even if it isn't readily apparent. In Rapid Application Development...
Basic or Real Basic, the languages hide the details of the SDK by using properties and events, but they are using the SDK.

While RAD languages enable the programmer to quickly build GUI-based programs, the details of the SDK are not accessible. For example, it is quite difficult to subclass a control using VB, but it is quite straightforward using the SDK. However, the SDK is huge, and the sheer size of the API is enough to make many programmers give up on the idea of SDK programming. The common thought is that it is too complicated and hard to use, but the opposite is true. Because the operating system handles all the graphical elements for the programmer, the programmer can concentrate on the most important aspect of program design: user interaction. After all, a GUI program is all about user interaction.

FreeBasic doesn't have a RAD system for Windows programming. To create a Windows program, you will have to use the SDK, as this is the only option. While the SDK is massive, it is not as complicated as it may seem. For 99% of all Windows programs, only a small subset of the SDK needs to be used. The reality is that Windows SDK programming is no harder than any other type of programming, and for GUI-based programs, it is actually easier than a language where you would have to create all the GUI elements yourself.

Putting aside all the gritty details of the Windows API for the moment, it is important to understand the mechanism of messages in an SDK program. This is best accomplished by looking at an example. In the examples\Windows\gui folder of the FreeBasic .15b distribution (which is required for the code in this article), there is a nice Hello World program that I am going to steal--I mean borrow.

```basic
Option Explicit
Option Private

#include once "windows.bi"

Declare Function WinMain ( ByVal hInstance As Long, ByVal hPrevInstance As Long, szCmdLine As String, ByVal iCmdShow As Integer ) As Long

;' Entry point
;' End WinMain( GetModuleHandle( null ), null, Command$ )
```
Function WndProc ( ByVal hWnd As HWND, _
    ByVal message As UINT, _
    ByVal wParam As WPARAM, _
    ByVal lParam As LPARAM ) As LRESULT

Function = 0

''
'' Process messages
''

Select Case( message )
''
'' Window was created
''
Case WM_CREATE
    Exit Function

'' User clicked the form
Case WM_LBUTTONDOWN
    MessageBox NULL, "Hello world from FreeBasic!"

'' Windows is being repainted

Case WM_PAINT
    Dim rct As RECT
    Dim pnt As PAINTSTRUCT
    Dim hDC As HDC

    hDC = BeginPaint( hWnd, @pnt )
    GetClientRect( hWnd, @rct )

    DrawText( hDC, _
        "Hello Windows from FreeBasic!"
    -1, _
EndPaint( hWnd, @pnt )

Exit Function

;' Key pressed
;
Case WM_KEYDOWN
   'Close if esc key pressed
   If( LoByte( wParam ) = 27 ) Then
      PostMessage( hWnd, WM_CLOSE, 0, 0 )
      End If
;
End Select

;' Message doesn't concern us, send it to the default handler and get result
;
Function = DefWindowProc( hWnd, message, wParam, lParam )
End Function

............
' name: WinMain
' desc: A win2 gui program entry point
'
............
Function WinMain ( ByVal hInstance As HINSTANCE, ByVal hPrevInstance As HINSTANCE,
szCmdLine As String, _
ByVal iCmdShow As Integer) As Integer

Dim wMsg As MSG
Dim wcls As WNDCLASS
Dim szAppName As String
Dim hWnd As HWND

Function = 0

'' Setup window class
''
szAppName = "HelloWin"

With wcls
  .style = CS_HREDRAW Or CS_VREDRAW
  .lpfnWndProc = @WndProc
  .cbClsExtra = 0
  .cbWndExtra = 0
  .hInstance = hInstance
  .hIcon = LoadIcon( NULL, IDI_APPLICATION)
  .hCursor = LoadCursor( NULL, IDC_ARROW)
  .hbrBackground = GetStockObject( WHITE_BRUSH)
  .lpszMenuName = NULL
  .lpszClassName = StrPtr( szAppName )
End With

'' Register the window class
''
If( RegisterClass( @wcls ) = FALSE ) Then
  MessageBox( null, "Failed to register wcls!", Exit Function
End If

'' Create the window and show it
''
hWnd = CreateWindowEx( 0, _
    szAppName, _
    "The Hello Program", _
    WS_OVERLAPPEDWINDOW, _
    CW_USEDEFAULT, _
    CW_USEDEFAULT, _
    CW_USEDEFAULT, _
    CW_USEDEFAULT, _
    NULL, _
    NULL, _
    hInstance, _
    NULL )

ShowWindow( hWnd, iCmdShow )
UpdateWindow( hWnd )

' '
' ' Process windows messages
' ' 
While( GetMessage( @wMsg, NULL, 0, 0 ) <> FALSE 
    TranslateMessage( @wMsg )
    DispatchMessage( @wMsg )
Wend

' '
' ' Program has ended
' ' 
Function = wMsg.wParam

End Function

If you have successfully compiled and run the program, you will see a standard window with a message printed on the form. If you click the form, a message box will be displayed, and if you press the Escape key, the program will close.
Take a moment to examine the window. You will see that the form has the menu and can be resized. Now look at the code above. There isn't any code needed to handle the mentioned window properties, the OS handles all that for you. It also only takes a single messagebox, which in itself, is a rather complex object. The ratio of result to amount of code, is quite remarkable. If you were to try and recreate this simple program using FreeBasic's standard graphical commands, the program would be a hundred times larger.

The first thing you should notice about the code listed above is the format of a Windows program. Every Windows program, no matter how simple or complex, will follow this same basic format. The two key ingredients of this program are the WinMain and WinProc procedures.

The WinMain procedure is the procedure Windows calls when a program is started. It is the entry point of a Windows program. In WinMain, you build and register the main program window and then enter into the message loop to process messages. Once the program enters the message loop, it will start processing messages with the WinProc procedure. Since this article is about the message model in a Windows program, we will only discuss the message loop in WinMain and the WinProc procedure.

When the Windows operating system is running, there are messages being generated all the time. When a Windows program is running, the OS will send messages to the program that it thinks the program should know about. Some of these program specific messages are sent directly to the WinProc procedure, and others, primarily user-generated messages, are placed into a message queue. Since most of a program is concerned with user interaction, it is important to understand the message queue.

A queue is a data structure where data is added to the "back" of the queue and removed from the "front". This is called a First-In-First-Out, or FIFO stack. If you have ever stood in line to buy movie tickets, you have experienced a queue.

For a program, the message queue will hold one or more messages, lined up like the folks in a movie ticket line. The idle loop of a Windows program sits and waits for messages to arrive and then translates and dispatches the messages to the program. This message loop is contained within the following code excerpt from WinMain.

```
''
'' Process windows messages
''

While GetMessage( @wMsg, NULL, 0, 0 ) <> FALSE
  TranslateMessage( @wMsg )
  DispatchMessage( @wMsg )
```
The **GetMessage** procedure retrieves a message from the queue via the MSG type-def that contains the necessary information related to a particular message. Here is the definition of the MSG type-def.

```plaintext
Type MSG
    hwnd As HWND
    message As UINT
    wParam As WPARAM
    lParam As LPARAM
    Time As DWORD
    pt As Point
End Type
```

**hwnd** is the handle of the window that needs to process the message. This window's WinProc procedure.

**Message** is the message identifier. This could be, for example, WM_CREATE, which signals that a window has been created, but not yet shown.

**wParam** and **lParam** both specify additional information based on the message. For example, when a key is pressed, you can retrieve the key code by using the lobyte of wParam.

**Time** specifies the time that the message was posted and **pt** is a structure that contains the position of the cursor when the message was posted.

**TranslateMessage** converts virtual key messages to character messages so that the key can be processed if desired. Any program that uses the keyboard will need this procedure. The **DispatchMethod** then sends a message to the window's WinProc (or similar) procedure associated with the window identified by the hwnd parameter.
To summarize the actions here, a user generated message will be placed into the message queue. GetMessage retrieves the first waiting message, passes it to TranslateMessage if necessary, and puts it back into the queue. The message is then passed to the message to see which window should get the message, and then passed onto DispatchMessage, which in our example, is WinProc.

Before we discuss the WinProc procedure however, we need to ask a question: How does WinMain know what procedure to use for one window in a program? The answer is contained within the WNDCLASS structure. In our example, wcls is defined as WNDCLASS:

```
With wcls
  .style               = CS_HREDRAW Or CS_VREDRAW
  .lpfnWndProc         = @WndProc
  .cbClsExtra          = 0
  .cbWndExtra          = 0
  .hInstance           = hInstance
  .hIcon               = LoadIcon( NULL, IDI_APPLICATION )
  .hCursor             = LoadCursor( NULL, IDC_ARROW )
  .hbrBackground       = GetStockObject( WHITE_BRUSH )
  .lpszMenuName        = NULL
  .lpszClassName       = StrPtr( szAppName )
End With
```

As you can see, the WNDCLASS structure holds all of the information pertinent to messages, the important item is the .lpfnWndProc field. This field holds the address of the message handler procedure. Once this window is registered using the RegisterClass method, Windows will know what procedure to use to process messages.

As you can see, there is no special significance to the name WinProc. WinMain could call it WinHandler. The actual SDK name is WindowProc, which is just a placeholder for the user defined message handler name. The important piece of information is that whatever you call it, the message handler has to have the same parameters as we have defined in our WinProc, and the address of this procedure has to be stored in .lpfnWndProc.
All messages, whether user generated or system generated pass through our example, is WinProc. Looking at the parameter list of WinProc we see the message structure retrieved by GetMessage. The hwnd is the window, wParam and lParam hold additional message information. Once a message must decide if we are interested in the message.

This is usually done with a select case where we examine the message parameter. For example, if the message were WM_PAINT, then we would want to WM_PAINT message so that our window would be updated each time a WM_PAINT message, then we simply pass the message on to the default message handler.

The action here is quite straightforward. WinMain or Windows sends us messages of interest. As messages come into the message queue, they may be further processed, and then passed along to DefWindowProc system. This loop continues for the life of program, until the WM_QUIT message, at which point the window is destroyed and the program is terminated.

In our example, program we are only concerned with the three messages, WM_KEYDOWN. The WM_CREATE and WM_DESTROY are basically boilerplate that you would find any windows program. Since we are only interested in these three messages, we only need to write code for these three messages. The rest of the messages we might receive do not concern us, so we don’t bother looking for them.

In a message-based language, you are writing code to handle an event that has taken place because we received a message describing the event. Instead of writing huge amounts of code to handle everything else, we only need to write code for certain events, and we let the operating system handle everything else.

Now of course, you have to write code to create a window and controls, You simply follow the API and pass along the appropriate parameters to understand the boilerplate, it is simply a matter of plugging that code into action occurs in the WinProc function when you interact with the window.

Message-based programming requires a different mind-set than procedural language, the user must respond to the program; the programmer is in charge. To write effective GUI programs, the programmer must respond to the user and the user is in charge. To write effective GUI programs, the programmer must respond to the user and the user is in charge. To write effective GUI programs, the programmer must respond to the user and the user is in charge. To write effective GUI programs, the programmer must respond to the user and the user is in charge.
When you design a GUI program, you have to ask yourself, "How do I want my program to respond to the user?" For example, when the application is minimized, should the program ignore the event or should it do something like put itself in the system tray? This is the essence of message-based programming. Defining what events are important, and then writing individual routines that handle each event. A collection of specific routines written in response to specific messages.

Despite the reputation of the SDK, the basic concept of message-based programming is quite simple. You are writing a collection of routines to handle messages. This is the core task. All the other stuff like creating a window, or when to repaint the window is done by the operating system. It is the scope of the SDK that gets to most people. There is a lot in there. However, like the cliché says, the best way to eat an elephant is one bite at a time. The best way to master the SDK is to simply understand the concept of message-based programming and learn the boilerplate code. Once that is done, creating sophisticated Windows pro
NOTE! Have to do some spell checking, verify text, code and filenames.

Foreword
This is a tiny basic tutorial on how to write a simple library in C and then knowledge of C or FreeBASIC. After doing this tutorial you should be ab header files to FreeBASIC header files and understand how to use the li

What is a library

Prerequisite
This tutorial was written and tested with FreeBASIC 0.16b and the latest compiler tool chain. You also get code::blocks with a mingw32 bundle.

Formal description of the task at hand
To demonstrate usage of a C library in FreeBASIC we need to create the library works as intended. Then we have to translate the library header file.

Creating the files
So our file list will look like this:
myClib.c: C file implementing our library.
myClib.h: C header file describing the libraries interface.
myClibCTest.c: C file implementing our test program in C.
myClib.bi: FreeBASIC header file. A translation of myClib.h.
myClibFBTest.bas: FreeBASIC
make.cmd: A sample shell script compiling the library and test files.

The C file to become a static library. myClib.c

(C)
/* A function adding two integers and returning the result */
#include "myClib.h"
int SampleAddInt(int i1, int i2)
{
    return i1 + i2;
}

/* A function doing nothing ;) */
void SampleFunction1()
{
    /* insert code here */
}

/* A function always returning zero */
int SampleFunction2()
{
    /* insert code here */
    return 10;
}

The header file myClib.h

(C)
int SampleAddInt(int i1, int i2);
void SampleFunction1();
int SampleFunction2();

A C test project to verify that the static lib is C compatible. myClibC

(C)
#include
#include
#include "myClib.h"
int main(int argc, char *argv[])
{
    printf("SampleAddInt(5, 5):=%d\n", SampleAddInt(5, 5));
    system("PAUSE");
    return 0;
}
Translating the C header file to a FreeBASIC header file
myClib.bi: To interface the static library and automatically include it (#inclib "myClib"

```
''include file for libmyClib.a
#ifndef __myClib_bi__
define __myClib_bi__
#inclib "myClib"

Declare Function SampleAddInt cdecl Alias "SampleAddInt"
Declare Sub SampleFunction1 cdecl Alias "SampleFunction1"
Declare Function SampleFunction2 cdecl Alias "SampleFunction2"
#endif
```

And finally the FreeBASIC file using the library
myClibFBTest.bas:

```
''Testing functions in myClib.bi
#include "myClib.bi"
''
Print "SampleAddInt(10, 10):=" , SampleAddInt(10, 10)
'' Just a dummy call
SampleFunction1()
''
Print "SampleFunction2():=" , SampleFunction2()
```

The make file: make.cmd
I have created a batch file to compile all the files. Including a sample in C to suite your setup.

```
(cmd)
@REM TODO: Set PATH's for this session.
SET PATH=C:\mingw32\bin;c:\mingw32\mingw32\bin
SET MINGW_INCLUDE="C:\MinGW32\include"
SET MINGW_LIB="C:\MinGW32\lib"
```
REM FBC testing
SET fbc="C:\portableapps\FreeBASIC\fbc.exe"
SET fbc="C:\FreeBasic16b\fbc.exe"
@echo *** Verify pat's to compilers
@pause
@echo off

REM
REM Remove old files
DEL /F *.o *.a myClibFBTest.exe

REM
REM Create static lib from c source
gcc.exe -c myClib.c -o myClib.o -I%MINGW_INCLUDE%

REM
REM ar: creating libstatictest.a
ar r libmyClib.a myClib.o

REM
REM No need for ranlib anymore? ar is supposed to take care of:
ranlib libmyClib.a

REM
REM Create a test with a C file

gcc.exe -c myClibCTest.c -o myClibCTest.o -I%MINGW_INCLUDE%
gcc.exe myClibCTest.o -o "myClibCTest.exe" -L%MINGW_LIB% libmyClib.a

echo ====================
echo Running C sample
echo ====================
myClibCTest.exe

echo ====================
echo Creating FreeBASIC sample
echo ====================
REM I thought this explicit reference is unnecessary as I use #include
SET fbcop=-I myClib
SET fbcfl="myClibFBTest.bas"
%fbc% %fbcop% %fbcfl%

echo ====================
echo Running FreeBASIC sample
echo ====================
myClibFBTest.exe
@pause
Encountered error messages and their solutions

undefined reference to
Trying to link against the static C library without using the cdecl alias "functionname" in the FreeBASIC header file results in errors like this:

(cmd)
C:\code"C:\FreeBasic16b\fbc.exe" "myClibFBTest.bas"
myClibFBTest.o:fake:(.text+0x3d): undefined reference to `SAMPLEADDINT@8'
myClibFBTest.o:fake:(.text+0x4a): undefined reference to `SAMPLEFUNCTION1@0'
myClibFBTest.o:fake:(.text+0x67): undefined reference to `SAMPLEFUNCTION2@0'
Press any key to continue . . .

To resolve this you will have to locate function declarations in a *.bi file that look like this:

```
Declare Function SampleAddInt(ByVal i1 As Integer, ....
```

And change it to something like this:

```
Declare Function SampleAddInt cdecl Alias "SampleAddInt"
```

Appendix A: links

The basis for this tutorial is several threads in the forum. When it evolves and can stand alone the links to the threads might be removed. Some interesting links containing information on interfacing libraries created in FreeBASIC and used by other languages or visa versa.

How do I compile a C project as a static lib for inclusion..
SDL_Net: Getting Started

A complete Step by step guide of getting your program from hello world to hello world over a TCP/IP connection, using the SDL_Net SDL library. This tutorial will list all components required and where to download them at the time of writing followed by how to get each component in the proper place to perform the proper functions and finally how to write the actual code. I will assume you have zero previous knowledge and because of that some readers may want to skip the first few bits of the tutorial.

Written by GregF (Paragon)

Step 1: What you need.

Ok, let's pretend that you just sat down and installed the compiler and an IDE. This list takes it from there.

- SDL_Net.bi - Installed with the compiler.
- SDL.dll runtime library - http://www.libsdl.org/download-1.2.php

Step 2: Where you put it.

The .bi file can be put pretty much where ever you want to put it, you will tell the compiler where to find it in the `$include` command. The .dll however need to be placed in specific places. The easiest way to make sure that the program will be able to use these files is to have the .dll in the same folder as the compiled executable. You can also put them in any folder that is listed in your Environment variable, but I don't recommend that because it will be easier to find and remember that you need the .dlls if you just put them in the same folder as the executable, which will probably be the same folder as your .bas file for the main program.

Tutorial in progress...
Using FreeBASIC Built Libraries with GCC

by Jeff Marshall
Shows how to create a static library with FreeBASIC and then call it from a C program using GCC as the compiler.

- Minimum fbc version tested is v0.18.2b

This article shows Windows usage throughout, but application to FreeBASIC on other platforms is similar.

In this tutorial:
A Simple Test
FreeBASIC Library With Dependencies
Using FreeBASIC as a Smart Linker

A Simple Test

For this simple test we are going to create a FreeBASIC static library, or mylib1, and will allow us to check that the basics are working:

First we need a library, and for this it will be just a single trivial function for the use of cdecl and Alias in our procedure definition. By default, C uses declaration makes matching case sensitivity between FreeBASIC and C.

```bas
' mylib1.bas

Function Add2Numbers cdecl Alias "Add2Numbers" _
    ( _
        ByVal x As Integer, _
        ByVal y As Integer _
    ) As Integer

    Return x + y

End Function
```
Create a file called `mylib1.bas` as above and compile it with:

```
fbc -lib mylib1.bas.
```

This will create our static library `libmylib1.a`. Next we need a C program that exactly matches the function we have in the FreeBASIC library. We will prototype that function and use it in our C program. We will call a couple of variables to call `Add2Numbers()`, and print the results.

```c
#include <stdio.h>

/* Prototype from libmylib.a */

Int Add2Numbers( Int x, Int y );

Int main ()
{
    Int a = 5;
    Int b = 7;
    Int c = Add2Numbers( a, b );

    printf( "a = %d\n", a );
    printf( "c = %d\n", b );
    printf( "a + b = %d\n", c );

    Return 0;
}
```

To compile this C program using the FreeBASIC library we just made we need to specify which libraries are needed. In our case, it is `libmylib1.a`.

```
gcc test1.c -L . -l mylib1 -o test1.exe
```

The `-L .` option tells the linker to search in the current directory for libraries. This is the simplest case because the `libmylib1.a` library has no dependencies.
for example the FreeBASIC run-time library libfb.a, we would need to sp

**FreeBASIC Library With Dependencies**

Here we create a FreeBASIC library that uses some features from the FreeBASIC run-time and graphics library. To specify any additional needed libraries to GCC.

Create a file called `mylib2.bas` with the listing above and compile it with:

```
fbc -lib mylib2.bas
```

This will create our static library `libmylib2.a`. Next we need a C program that has a prototype that exactly matches the function we have in the FreeBASIC library `TestGfx()` before terminating.

```
/* test2.c */

void TestGfx();

Int main()
{
```
TestGfx();

    Return 0;
}

To compile and link test2.c directly with gcc, not only do we need to tell library that libmylib2.a needs:

gcc test2.c -L -lmylib2 -L"C:\FreeBASIC\lib\win32" "C:\FreeBASIC\lib\win32\fbrt0.o" -lfbgfx -lfb -lgdi32 -o test2.exe

Depending on what our FreeBASIC library uses, it we may use several additional libraries on the gcc command line. In this example, FreeBASIC is located in "C:\FreeBASIC", which is installed FreeBASIC to. "C:\"FreeBASIC\lib\win32\fbrt0.o" is a special startup file that will initialize the FreeBASIC runtime library. Specifically, it is initialized after the C runtime library, but before any of our program code is called, which are the additional libraries needed to complete linking. The actual libraries can vary depending on which FreeBASIC runtime functions are used, and which platform, for DOS or Linux, the program is being compiled for.

**Using FreeBASIC as a Smart Linker**

FreeBASIC has a neat built-in feature that stores a little bit of extra information in the library indicating what compile time options were used, and which dependent libraries are needed. This is a FreeBASIC only feature, so this kind of capability won't be found when using gcc as the main compiler and linker.

If we reuse the examples from the previous section, mylib2.bas and test2.c, we can save ourselves a bunch of typing. Plus we usually won't have to know what our libraries are. Compile mylib2.bas as before in to a static library.

fbc -lib mytest2.bas

Next we compile our C test program. Notice the '-c' option for the gcc command line, source, but not link it yet. test2.o will still have the entry point, but we are not executable right away.
gcc -c test2.c -o test2.o

Lastly, we use fbc to perform the link step. We are not compiling any basic capabilities of FreeBASIC such that the command line is fairly simple:

fbc test2.o -l mylib2

This will create an executable named test2.exe because test2.o was specified first on the command line. This information stored in libmylib2.a and automatically know which additional libraries to link with, especially when many extra FreeBASIC built libraries are needed.

See also

- Static Libraries
Introduction to the Extended Type

Written by rdc

Introduction

FreeBASIC is moving towards implementing Object Oriented programming. While classes have not yet been added to the language, the Type definition has been extended to include first step towards full class support. This article introduces some of the concepts and explains some of the extended type constructs.

Object Oriented Programming

Object Oriented Programming, usually shortened to OOP, is a methodology that enables the programmer to build code units called objects. An object is a thing; it is a unit of code that can be manipulated in a program. You can think of an object as a noun: a person, a sprite, a drawing primitive or something more elaborate like a tank in a game. Any concrete entity that has a set of characteristics and actions can be represented as an object.

An object contains both the data needed by the object, and the methods that manipulate the data. This grouping of data and methods into a single entity is called encapsulation. Encapsulation allows you to create modular units that can be reused in multiple programs. This idea of code reuse was the main motivation in the creation of the OOP paradigm.

Another beneficial consequence of encapsulation is information hiding. The data inside the object is shielded from the outside world so that unwanted changes to the data cannot occur directly. The object has a public interface that the external program should use to access and change data members. By using an interface, you can control how the object behaves and ensure that its operation is consistent across many programs.

The interface also allows you to make internal changes to the code, without affecting external access. As long as you don't change the published interface, that is change any existing public methods, you can improve the object without breaking any existing code that relies on it. If a program needs an improved method, you can leave the old method in place and just add a new method with the improved functionality. New programs can use the new method, while old programs can still use the old method.

Another advantage of using a public interface is so that other programmers...
worrying about the internal details of the object. As long as the published interface is stable and well documented, anyone should be able to use your object, even beginners.

**The Published Contract**

As already stated, OOP was designed to enable code reuse among programmers. For code reuse to be helpful, the published interface must remain stable. That is, once an object is used in programs, the published interface should not change so that programs that use the object continue to work correctly. There is an implicit contract between you as the author of an object that you will maintain the published interface across changes that may need to be made to the object. This implicit contract between author and user is the main strength of the OOP paradigm and is the main reason that OOP has become such a powerful programming methodology.

**The Characteristics of an Object**

As already mentioned, an object contains both data and methods. The data describes the object, while the methods describe what the object can do. A simple, and not really useful, example will illustrate this concept.

Suppose you want to create an object that draws a rectangle on the screen. Properties that would be contained within the data members of the object include an origin on the screen, normally the top left corner, which can be represented by an x and y data member. The object also has width and a height, so the object would have width and height data members. The object can be outlined or filled, so a filled flag data member can be added to the object. To draw the rectangle, you will want to draw it in a particular color, so the object will need to have a color data member for the fill. Of course you will need a method to actually draw the rectangle in the object definition.

So our rectangle object has the following preliminary properties and methods:

- **Property:** x and y origin
- **Property:** width
- **Property:** height
- **Property:** filled
- **Property:** outline color
- **Property:** fill color
Method: DrawRect

This list is called the object definition. In FreeBASIC you define an object definition in the extended Type definition. The extended Type is similar to the standard Type, with some added language constructs that implement a subset of OOP features.

A Rectangle Type Definition

The following code snippet is a partial rectangle definition:

```
Type myRect
Private:
    X_ As Integer
    Y_ As Integer
    Width_ As Integer
    Height_ As Integer
    Filled_ As Integer
    OutColor_ As Integer
    FillColor_ As Integer
Public:
    Declare Sub DrawRect()
End Type
```

As you can see, the extended Type looks much like a standard Type except for the Private: and Public: keywords and the sub declaration. The Private: keyword tells the compiler that the data members that follow are private to the type, that is cannot be accessed outside of the type. These data members are hidden from the outside world and can only be accessed within the scope of the Type, a process called information hiding. The underscore appended to the private variables is the common way to define private variables.

Information hiding is a way to maintain the integrity of the object. You should never allow an outside process to directly access a data member. All data access should be through the use of Property members so that you can control what is being passed to your object. Strict control over your object's data will help prevent many errors that may occur when a programmer uses your object.
The Declare statements following the Public: qualifier comprises the public interface to your object. Since the variables of the type are defined with the Private: keyword, the only way to access the variables is through the Property members maintaining the integrity of the object. Since you define the code in each Property member, you have full control over what is being put into your object. A common example of code in your property members so that the object does not contain invalid data.

In this example, the variables can be both written and read. The compiler distinguishes between a read Property and a write Property by the type of the method. A subroutine-formatted Property is a write property since you are passing a value that will be saved in a private variable. A function-formatted Property is a read property since a private variable will be returned to the caller. You can create just a function-formatted Property or write-only Properties by just adding

Creating Well-Behaved Objects
The definition looks complete at this point, but there is a problem. What if some or all of the variables were not initialized? The object would not perform correctly and potentially generate a runtime error. It would be better to have a set of default values for the object variables just in case one or more variables did not get initialized. You can initialize the object at the moment of creation by using a Constructor.

A Constructor is a subroutine that is called when the object is created using the Dim (or New) statement. Constructors are useful for initializing an object, either with default values or values you pass to the Constructor. The updated type definition now looks like the following:

```plaintext
Type myRect
    Private:
        X_ As Integer
        Y_ As Integer
        Width_ As Integer
        Height_ As Integer
        Filled_ As Integer
        Otlncolor_ As Integer
        Fillcolor_ As Integer
    Public:
        Declare Sub DrawRect()
        Declare Property X(ByVal xx_ As Integer)
        Declare Property X() As Integer
        Declare Property Y(ByVal yy_ As Integer)
        Declare Property Y() As Integer
        Declare Property Width(ByVal w_ As Integer)
        Declare Property Width() As Integer
        Declare Property Height(ByVal h_ As Integer)
        Declare Property Height() As Integer
        Declare Property Filled(ByVal f_ As Integer)
        Declare Property Filled() As Integer
        Declare Property Otlncolor(ByVal oc_ As Integer)
        Declare Property Otlncolor() As Integer
        Declare Property FillColor(ByVal fc_ As Integer)
        Declare Property FillColor() As Integer
        Declare Constructor()
        Declare Constructor(xx_ As Integer, yy_ As Integer, w_ As Integer, h_ As Integer, f_ As Integer, oc_ As Integer, fc_ As Integer)
```

You will notice in the definition that we have two Constructors, one that takes parameters and one that doesn't. This is called overloading and can be used not only with Constructors and functions. Overloading is useful for situations where you need to handle different types of data with a single method call. The compiler will determine which method to call based on the parameters passed to the method. You can overload as many methods as you want, as long as the number and type of parameters for each method is unique.

In this instance, if the Constructor is not passed any parameter values, it will use the default values. If the Constructor is called with parameters, then it will use the values passed to initialize the object's variables.

There is also a Destructor method that is called when the object is destroyed. This is used to perform any cleanup tasks that must be carried out before the object is released from memory. If the object created any pointer references, or opened any files, then you would clean up those references in the Destructor. Since the Rectangle object doesn't create any outside references, a Destructor is not needed.

**Filling in the Object Methods**

The type definition is a template for the object type and tells the compiler how to set up the object in memory. However, in order to actually use the object, you need to create the actual method calls, which is shown in the next listing.

```vbnet
Type myRect
    Private:
        X_ As Integer
        Y_ As Integer
        Width_ As Integer
        Height_ As Integer
        Filled_ As Integer
        Ot1ncolor_ As Integer
        Fillcolor_ As Integer
    Public:
        Declare Sub DrawRect()
End Type
```
Declare Property X(ByVal xx_ As Integer)
Declare Property X() As Integer
Declare Property Y(ByVal yy_ As Integer)
Declare Property Y() As Integer
Declare Property Width(ByVal w_ As Integer)
Declare Property Width() As Integer
Declare Property Height(ByVal h_ As Integer)
Declare Property Height() As Integer
Declare Property Filled(ByVal f_ As Integer)
Declare Property Filled() As Integer
Declare Property Otlncolor(ByVal oc_ As Integer)
Declare Property Otlncolor() As Integer
Declare Property FillColor(ByVal fc_ As Integer)
Declare Property FillColor() As Integer
Declare Constructor()
Declare Constructor(xx_ As Integer, yy_ As Integer, w_ As Integer, h_ As Integer, f_ As Integer, fc_ As Integer)
End Type

Sub myRect.DrawRect()
    Line (this.x_, this.y_)-(this.x_ + Width - 1, this.y_ + this.height_ - 1), this.Otlncolor_
    If this.Filled_ <> 0 Then
        Paint (this.x_ + 1, this.y_ + 1), this.FillColor
    End If
End Sub

Property myRect.x(ByVal xx_ As Integer)
    this.X_ = xx_
End Property

Property myRect.x() As Integer
    Return this.X_
End Property

Property myRect.y(ByVal yy_ As Integer)
    this.Y_ = yy_
End Property
Property myRect.y() As Integer
    Return this.y_
End Property

Property myRect.Width(ByVal w_ As Integer)
    this.Width_ = w_
End Property

Property myRect.Width() As Integer
    Return this.Width_
End Property

Property myRect.Height(ByVal h_ As Integer)
    this.Height_ = h_
End Property

Property myRect.Height() As Integer
    Return this.Height_
End Property

Property myRect.Filled(ByVal f_ As Integer)
    this.Filled_ = f_
End Property

Property myRect.Filled() As Integer
    Return this.Filled_
End Property

Property myRect.Otlncolor(ByVal oc_ As Integer)
    this.Otlncolor_ = oc_
End Property

Property myRect.Otlncolor() As Integer
    Return this.Otlncolor_
End Property

Property myRect.FillColor(ByVal fc_ As Integer)
    this.Fillcolor_ = fc_
End Property
End Property

Property myRect.FillColor() As Integer
    Return this.Fillcolor_
End Property

Constructor myRect
    this.X_ = 0
    this.Y_ = 0
    this.Width_ = 10
    this.Height_ = 10
    this.Filled_ = 0
    this.Otlncolor_ = 15
    this.Fillcolor_ = 7
End Constructor

Constructor MyRect (xx_ As Integer, yy_ As Integer,
                  h_ As Integer, f_ As Integer,
                  oc_ As Integer,
                  fc_ As Integer)
    this.X_ = xx_
    this.Y_ = yy_
    this.Width_ = w_
    this.Height_ = h_
    this.Filled_ = f_
    this.Otlncolor_ = oc_
    this.Fillcolor_ = fc_
End Constructor

The Methods and Properties are defined using the Sub/Function/Property	typeName.TypeName syntax. This tells the compiler how to match up methods with the proper type definition with the type name for the same reason. The this identifier is a hidden parameter that refers to the defined type. You use the this identifier to specify that you

Using Your Object

The object is now complete can be used in a program which is listed bel
Type myRect
Private:
    X_ As Integer
    Y_ As Integer
    Width_ As Integer
    Height_ As Integer
    Filled_ As Integer
    Otlncolor_ As Integer
    Fillcolor_ As Integer
Public:
Declare Sub DrawRect()
Declare Property X(ByVal xx_ As Integer)
Declare Property X() As Integer
Declare Property Y(ByVal yy_ As Integer)
Declare Property Y() As Integer
Declare Property Width(ByVal w_ As Integer)
Declare Property Width() As Integer
Declare Property Height(ByVal h_ As Integer)
Declare Property Height() As Integer
Declare Property Filled(ByVal f_ As Integer)
Declare Property Filled() As Integer
Declare Property Otlncolor(ByVal oc_ As Integer)
Declare Property Otlncolor() As Integer
Declare Property FillColor(ByVal fc_ As Integer)
Declare Property FillColor() As Integer
Declare Constructor()
Declare Constructor(ByVal xx_ As Integer, ByVal yy_ As Integer, ByVal w_ As Integer, ByVal h_ As Integer, ByVal f_ As Integer, ByVal fc_ As Integer)
End Type

Sub myRect.DrawRect()
    Line (this.x_, this.y_)-(this.x_ + this.Width_ - 1, this.y_ + this.Height_ - 1)
    If this.Filled_ <> 0 Then
        Paint (this.x_ + 1, this.y_ + 1), this.Fillcolor
    End If
End Sub
Property myRect.x(ByName xx As Integer)
    this.X_ = xx_
End Property

Property myRect.x() As Integer
    Return this.X_
End Property

Property myRect.y(ByName yy As Integer)
    this.Y_ = yy_
End Property

Property myRect.y() As Integer
    Return this.y_
End Property

Property myRect.Width(ByName w As Integer)
    this.Width_ = w_
End Property

Property myRect.Width() As Integer
    Return this.Width_
End Property

Property myRect.Height(ByName h As Integer)
    this.Height_ = h_
End Property

Property myRect.Height() As Integer
    Return this.Height_
End Property

Property myRect.Filled(ByName f As Integer)
    this.Filled_ = f_
End Property

Property myRect.Filled() As Integer
    Return this.Filled_
End Property
Property myRect.OTlncolor(ByVal oc_ As Integer)
    this.OTlncolor_ = oc_
End Property

Property myRect.OTlncolor() As Integer
    Return this.OTlncolor_
End Property

Property myRect.FillColor(ByVal fc_ As Integer)
    this.Fillcolor_ = fc_
End Property

Property myRect.FillColor() As Integer
    Return this.Fillcolor_
End Property

Constructor myRect
    this.X_ = 0
    this.Y_ = 0
    this.Width_ = 10
    this.Height_ = 10
    this.Filled_ = 0
    this.OTlncolor_ = 15
    this.Fillcolor_ = 7
End Constructor

Constructor MyRect (xx_ As Integer, yy_ As Integer,
    h_ As Integer, f_ As Integer,
    fc_ As Integer)
    this.X_ = xx_
    this.Y_ = yy_
    this.Width_ = w_
    this.Height_ = h_
    this.Filled_ = f_
    this.OTlncolor_ = oc_
    this.Fillcolor_ = fc_
End Constructor
'Create a graphic screen
Screen 18

Create an object using the default constructor
Dim aRect As myRect

Create an object by explicitly setting the constructor values
Dim bRect As myRect = myRect(200, 200, 200, 100, 1,

'Draw the rectangles on the screen
aRect.DrawRect
bRect.DrawRect

Update aRect properties
aRect.X = 90
aRect.Y = 20
aRect.Filled = 1
aRect.FillColor = 15

'Draw new rect
aRect.DrawRect
Sleep
End

To initialize the object using the default Constructor, you simply Dim the standard type. If the Constructor only takes a single value then you can use the Dim var as Typename = value syntax. To initialize the object with a set of values, you Dim the type and = typename(parm1... ...) syntax. You can see that accessing the members of the object is just like accessing the members of a standard type.

Thanks to cha0s at the FreeBASIC forums for the information regarding
Simulating Polymorphism

Written by rdc

Introduction

Polymorphism is a powerful tool in object-oriented program. A polymorphic method (Sub or Function) behaves differently depending on the definition of the object. For instance, an animal object may have a speak method that will issue a bark for a dog and a meow for a cat. FreeBasic doesn't support true polymorphism before version 0.90.0. However, you can simulate polymorphic methods using method pointers.

Polymorphism

Polymorphic methods are subroutines or functions that have the same type and parameter list, but behave differently when bound to different objects. An animal object may have a Speak method that will issue a bark for a dog and a meow for a cat. Since FreeBasic doesn't yet have classes, you cannot implement true polymorphic methods, but you can simulate their behavior by using method pointers.

The following listing shows a couple of defines and an extended type definition:

```bas
#define isdog 1
#define iscat 2

Type animal
    Public:
        speak As Sub()
    Declare Constructor (anid As Integer)
End Type
```

The #defines are passed to the Constructor to signal what type of object is being created. The `speak As Sub()` definition defines the method pointer. As you will see, two different subroutines will be passed to the speak method pointer. The following listing shows the different speak subroutines and the Constructor method:

```bas
'Speak method for dog object
Sub Bark()
```
Print "Woof!"
End Sub

'Speak method for cat object
Sub Meow()
    Print "Meow!"
End Sub

'Set the proper method pointer based on animal id
Constructor animal(anid As Integer)
    If anid = isdog Then
        this.speak = @Bark
    ElseIf anid = iscat Then
        this.speak = @Meow
    End If
End Constructor

The Bark subroutine will be called if the object is a dog and the Meow subroutine will be called if the object is a cat. You may be wondering why you can't just overload the method? For overloaded methods, the type and parameter list must be unique, while for a polymorphic method, the type and parameter list must be the same. Since Bark and Meow both have the same parameter list, that is no parameters, you cannot overload the method.

The Constructor code is where the program decides what method call to use. If anid is equal to isdog, then the Speak method pointer will be set to the address of the Bark subroutine. If anid is equal to iscat then Speak will be set to the address of the Meow subroutine. The addressof operator @ is used to pass the address of Bark and Meow to the Speak method.

The this object reference is a hidden parameter that is passed to the Constructor and references the type, which in this case is animal. You can use this to reference the internal variables within the type.

The only thing left to do is to create and initialize the object:

'Create a dog and cat object
Dim myDog As animal = isdog
Dim mycat As animal = iscat
Here myDog and myCat are created with the appropriate flags passed to the Constructor so that the proper references can be set up. Once the object are created you can call the speak method of each object.

```
'Have the animals speak
Print "My dog says ";
myDog.speak()
Print "My cat says ";
myCat.speak()
```

Notice that you are calling the same speak method, yet the output is different:

```
My dog says Woof!
My cat says Meow!
```

This is the essence of polymorphic methods.

Here is the complete program listing:

```
'Simulated Polymorphism Using Method Pointers
'Richard D. Clark
'Requires the CVS version of FreeBasic
'******************************************************************************

#define isdog 1
#define iscat 2

Type animal
    Public:
        speak As Sub()
    Declare Constructor (anid As Integer)
End Type

'Speak method for dog object
Sub Bark()
    Print "Woof!"
```
End Sub

'Speak method for cat object
Sub Meow()
    Print "Meow!"
End Sub

'Set the proper method pointer based on animal id
Constructor animal(anid As Integer)
    If anid = isdog Then
        this.speak = @Bark
    ElseIf anid = iscat Then
        this.speak = @Meow
    End If
End Constructor

'Create a dog and cat object
Dim myDog As animal = isdog
Dim mycat As animal = iscat

'Have the animals speak
Print "My dog says ";
myDog.speak()
Print "My cat says ";
myCat.speak()
Sleep
End

From fbc version 0.90.0, polymorphism through inheritance and vir

Previous example transposed for fbc version 0.90.0 or greater, by using through inheritance with abstract/virtual methods (feature now supported)
'Base-type animal
Type animal Extends Object
  Declare Abstract Sub speak ()
End Type

'Derived-type dog
Type dog Extends animal
  Declare Virtual Sub speak () Override
End Type

'Speak method for dog object
Virtual Sub dog.speak ()
  Print "Woof!"
End Sub

'Derived-type cat
Type cat Extends animal
  Declare Virtual Sub speak () Override
End Type

'Speak method for cat object
Virtual Sub cat.speak ()
  Print "Meow!"
End Sub

'Create a dog and cat as dynamic object through animal
Dim myDog As animal Ptr = New dog
Dim mycat As animal Ptr = New cat

'Have the animals speak
Print "My dog says ";
myDog->speak()
Print "My cat says ";
myCat->speak()

Sleep

'Delete the dynamic objects
Delete myDog
Delete myCat
Contrary to popular belief object oriented programming does not require
an specifically OO language. What you get with an OO language is a set of built in constructs that assist you in writing OO programs but in many cases they are unnecessary and sometimes they are counterproductive.

Anyway, this isn't a rant against OO languages but rather a rant against the idea that a specifically OO language is necessary to write object oriented programs. In order to demonstrate that it is not necessary to have an OO language this example presents a technique that is usually presented as an example of class based programming; and so it is presented.

The code was tested using FB 0.16 for win32.

If you have to concatenate a lot of strings in most Basics you usually find that it is a time consuming process. FreeBasic string operations are remarkably quick but you can still do better.

A string builder is simply a class that maintains a string buffer in such a way as to avoid repeated calls to the memory allocation function because this is a relatively expensive operation. The methods of the class provide ways of manipulating the buffer and converting between it and the native string type.

The trick that makes it faster than the built type for large strings and large numbers of appends is that the string is held in a heap allocated buffer that is always larger than the actual length of the string. The end of the string usually simply means copying the contents of the new string to the memory location following the last character of the current string. In this implementation the buffer is a ZString dynamic string.

The FreeBasic module encapsulates a type definition for a struct. Instances of this struct hold the attributes of the object. The methods are simply normal FreeBasic public functions and subs. If you want to call a method you use the normal FreeBasic syntax:

```plaintext
s = StringB_ToString(AStringBInstance)
```

By convention all methods names begin with the name of the class and always the instance of the type. This argument should always be passed by reference to the methods because changes to the instance should persist into the original string.
state are permanent and also to avoid unnecessary, time-consuming, copy.

To add a new method you simply add a new function or sub following the rules.

You can easily implement composition of objects but inheritance in the usual way can't be done. extend classes simply by defining new functions elsewhere that take arguments of the class type. defines all of its methods as overloaded you can even create new methods of the same name so long as they have different signatures.

Here is the example code:

```
'----------------------------------------------------------------------------
' Classes without built in oop.
'
' Define a struct for the properties and a sub or function for method. Pass the struct as the first argument in a call.
'
' By convention the argument will be Me as in VB Classic.
'
' Strings in FB are so fast that a string builder class is not needed most of the time but if you are concatenating thousands of strings to build web pages for instance this might be useful.
'
' And please don't start complaining about the lack of inheritance; that is not a requirement for the use of objects. There is no legal definition of Object Oriented Programming but the most important part is the close association between the data and the code that manipulates it.
'
'You can easily extend this class to provide more methods.
'----------------------------------------------------------------------------

Type StringB
    Len As Integer ' used length
    allocated As Integer
    s As ZString Ptr ' buffer of at least len characters
End Type
```
' Create a new StringB by calling one of these constructors.

Public Function StringB_New Overload (ByVal InitialSize As StringB)
    Dim sb As StringB
    sb.allocated = InitialSize
    sb.s = Allocate(InitialSize)
    *sb.s = ""
    StringB_New = sb
End Function

Public Function StringB_New (ByRef InitialValue As String) As StringB
    Dim sb As StringB
    sb = StringB_New(Len(InitialValue))
    *sb.s = InitialValue
    sb.len = Len(InitialValue)
    StringB_New = sb
End Function

Public Sub StringB_Dispose (ByRef Me As StringB)
    Deallocate Me.s
End Sub

Public Function StringB_ToString (ByRef Me As StringB) As String
    StringB_ToString = *Me.s
End Function

Sub StringB_Append Overload (ByRef Me As StringB, ByVal s As String)
    Dim i As Integer = Me.len
    Me.len += Len(s)
    If Me.len >= Me.allocated Then
        Me.allocated = 2*Me.len
        Dim As ZString Ptr p = Reallocate(Me.s, Me.allocated)
        If p=0 Then
            ' handle allocation failure
        End If
    End If
    *Me.s = s
End Sub
' failed to reallocate
Print "StringB_Append failed to reallocate", Me.
Return
End If
Me.s = p
End If
*(Me.s + i) = s

End Sub

Sub StringB_Append(ByRef Me As StringB, ByRef other
    StringB_Append Me, StringB_ToString(other)
End Sub
Note: As with all things regarding scope, Const qualifiers may be a bit difficult attempting to understand Const qualfiers.

Also note my cliche title, which I chose because of it's clicheness.

What the heck are Const qualifiers? Const qualifiers are a feature recently added to FreeBasic too. Const qualifiers are yet another form of protection - they allow some parts of the program to access (read) them but not modify them. They are very useful in OO situations, but you can probably benefit from them to some degree even if you aren't interested in OOP.

The Const qualifier in FreeBasic is essentially an extension to data type declarations. Generally you put it right after the "As" part of the variables's data type declaration:

```
Dim As Const Integer my_const_int = 5
```

(By the way, throughout this tutorial I use only Integers and Integer Ptrs as examples - however, Const qualifiers types, including Types, Enums, and anything else that declares something.

Note in this case we are allowed to change it once - when we create it. But give an error if you don't (interestingly, you are allowed to set it equal to "Any", in which the contents are not guaranteed and could be anything) anything that modifies it after that. It will actually give you an error if, for example:

```
my_const_int = 3
```

Yet, since this doesn't change the variable any, you can do

```
Print my_const_int
```

Now this is all very good, but it doesn't seem much different from the normal
purposes, the same thing:

```vbnet
Dim As Const Integer my_const_int = 5
Const my_int As Integer = 5
```

Do they? Not quite. You see, the Const qualifier allows you to create constants inside Types and other places. What's more, you can put them inside Sub/Function declarations — and this is a very key reason for their existence:

```vbnet
Sub my_sub (some_num As Integer)
End Sub
```

Normally functions are allowed to modify the variables you send to them, but this depends on whether you use ByVal or ByRef (and of course pointers is a whole different things altogether), but they normally are allowed to modify a variable. This may be undesirable, for whatever reason, and the Const qualifier exists to prevent that. Normally it would only be a local copy that is modified, which is fine, since:

```vbnet
Sub my_sub (ByRef some_num As Integer)
End Sub
```

Now my_sub has direct access to whatever variable you pass to it, and if:

```vbnet
my_sub(my_const_int)
```

Why? Simply because the function may modify the variable. We don't know for sure that it will, of course, but it might, so we can't do that.

If you try to compile that is "Invalid assignment/conversion." It's almost as if it acts like trying to pass a string to an integer argument (or vice-versa). Yet, it possibly modify the variable!

And of course, if we did something like this:
Then it compiles just fine, but if you try to do the following within the function,

```vbnet
some_num = 3
```

Why? Once again, the original variable has been passed ByRef to the sub, and you cannot modify the original, which cannot be done. Once again, it’s entirely possible to create a copy of the variable and modify it all you want:

```vbnet
Dim As Integer copy_of_some_num = some_num
copy_of_some_num = 3
```

But you can't modify `some_num` itself!

Now we come to pointers. What about them? For pointers it's a bit more complicated; or even BOTH! So all of the following are valid:

```vbnet
Declare Sub my_sub_a (ByRef ptr_A As Const Byte Ptr)
Declare Sub my_sub_b (ByRef ptr_B As Byte Const Ptr)
Declare Sub my_sub_c (ByRef ptr_C As Const Byte Const)
```

The first one makes it so you can change the pointer itself all you want, but you can't change the data that the pointer points to! The second allows you to change what the pointer points to, but you can't change the pointer itself! In all cases you can make a copy of the pointer - but it's impossible to change the contents of whatever the original pointer points to! This is
In case the behaviour of the Const qualifier seems a bit strange to you, I summed up pretty quickly: The Const qualifier aims to protect the original data from you to be able to change the original data. Remembering this will help you. There's pointers involved there are so many different places to put the Const qualifier (and there are!) So long as you remember what the Const qualifier is for, you'll never need to not use it.

You can also use the Const qualifier in UDTs. In fact, it's actually a very important thing to OOP (in a similar fashion to Namespaces, which while not a direct part of OOP nevertheless are very much related) - but even if you don't use OOP, it's pretty obvious by now how it works, but here's an example:

```vba
Type my_type
  As Const Integer t_int= 5
End Type

Dim As my_type t

t.t_int = 3
```

And obviously this won't compile, since the member t_int is Const. Further:

The following will not compile either, since ALL members of t are Const:

```vba
Type my_type
  As Integer t_int= 5
End Type

Dim As Const my_type t

t.t_int = 3
```

As for the OOP side of things (and if you aren't interested in OOP you can skip this when called. Is there a way to create constant objects? Of course! Is there a distinction? The answer is yes. As of November 23, 2007, we now have Const procs.
Type my_object
    Public:
        Declare Sub modifier_sub ()

        'Subs that do not modify the object are declared
        Declare Const Sub non_modifier_sub ()

    Private:
        some_num As Integer = 3
    End Type

Sub my_object.modifier_sub ()
    this.some_num = 3
End Sub

Sub my_object.non_modifier_sub()
    Print this.some_num
End Sub

'Note that only Const objects must be initialized (though in
'just like variables. Thus, you must either have a
'default initial values (as I did here), in which case
Dim As Const my_object t = my_object
Dim As my_object u

'Both of these will compile:
t.non_modifier_sub()
u.non_modifier_sub()

'...but the first of these will not compile, since no
't.modifier_sub()
u.modifier_sub()

'Sleep so we can see the results
Sleep
Once again, the way this works is based on the simple rule. Since the implementation of the object - and if the object is declared As Const, that's not given names in the C++ documentation page (listed below in the references). Thus, for objects declared As Const, only the inspector methods for those inspector methods are, of course, the ones declared as Const methods.

This is all very good, but some of you may be asking - Why do I need this? do we need scope at all? The reason for Const qualifiers (and the future Const methods) is the same reason for hiding of variables in objects: because we want to be certain that something won't unexpectedly change in the middle of the program, when we least expect it. Sometimes we want things to change, and that's when we don't want Const qualifier, and you can be certain it will not change (and the compiler won't let you do it anyway). One very important thing to remember is that there are SVN releases for them to work (if the compiler gives an error about one of the examples given there that I told you will compile, then you'll know you need a newer version).

If you have any other difficulties with Const qualifiers, remember that even though there's no documentation for them there are plenty of people on the forum who know about and understand them, and can help you with any questions you may have.

If you still don't understand Const qualifiers, you probably are a newbie who doesn't know much about scope yet - and that's fine! You'll learn as you go.

Eventually some decent documentation for this feature will be created, but probably won't need them. I for one have written fine programs long before they were around, and I'll probably continue to do so without using them anywhere they aren't needed. There are specific instances when they're useful, and if you understand those instances then you may as well use them when those instances arise. But if you don't understand, that's fine!

Finally, here are some links that should be helpful. The first is a C++ documentation page about Const qualifiers - of course, it only makes sense if you understand C++, and they also talk about things we don't have yet (i.e., Const methods). There is also a link to a forum topic in which I asked about FreeBSD development (and learned about Const qualifiers), and a link to the original SourceForge Feature Request page in which Const qualifiers were originally requested as a feature:

http://www.freebasic.net/forum/viewtopic.php?t=9975&postdays=0&postorder=asc&start=0
FBgfx Image and Font Buffers

Creating and understanding your FBgfx image and font buffers

The FBgfx Image Buffer
Creating Buffers
Buffer Format
Getting Pixels
The FBgfx Font Header
Header Details
Creating a Font Buffer
Assigning Font Characters
Tips & Tricks
Coloring your Custom Fonts
ScrPtr vs ImgBuf

Download Accompanying Tutorial Files: FreeBASIC Font Tutorial.7z

The FBgfx Image Buffer

FBgfx has a new data type in .17 and above. This type is called IMAGE. You can use it by including the FBgfx Header in your program (#include "fbgfx.bi") and then accessing the namespace for FBgfx, via going to be using the fb.Image Ptr type. A pointer, because it's dynamic memory which we can resize.

To use an image in the FBgfx Library, you have to create it via image buffer (made available) for your image. You have to deallocate (free, make available) it at the end of your program. FBgfx has its own internal pixel format, as created. The image header contains information about your image. This header contains the actual colors for each individual pixel in RGB (red, blue, green).

Creating Buffers

The size of the buffer you create will vary depending on screen depth. Your individual pixels. Thus, a 32-bit pixel depth screen will need 4 bytes per pixel, however, as using the fb.Image Ptr setup to create your buffer makes it easier. You only need to know this information to understand how much size a buffer will take up total, for memory usage information.
Actually creating the buffer is very simple. It's just a simple creation of a

```
#include "fbgfx.bi"

' Our image width/height
Const ImgW = 64
Const ImgH = 64

' Screens have to be created before a call to imagecreate
ScreenRes 640, 480, 32

' Create our buffer
Dim As FB.Image Ptr myBuf = ImageCreate(ImgW, ImgH)

' Print the address of our buffer.
Print "Buffer created at: " & myBuf
Sleep

' Destroy our buffer. Always DESTROY buffers you create.
ImageDestroy( myBuf )
Print "Our buffer was destroyed."
Sleep
```

**Code Dissection**

```
#include "fbgfx.bi"

This includes the header file which contains the definition for the fb.Image

' Our image width/height
Const ImgW = 64
Const ImgH = 64
```
This creates constants which will be used to decide the size of our image to \texttt{ImageCreate} when we use it.

\begin{verbatim}
' Screens have to be created before a call to \texttt{ImageCreate} 
ScreenRes 640, 480, 32
\end{verbatim}

This creates our FBgfx screen. \texttt{ImageCreate} needs to know our bit depth parameter allowing you to set the depth yourself.

\begin{verbatim}
' Create our buffer 
Dim As FB.Image Ptr myBuf = \texttt{ImageCreate}(ImgW, ImgH)
\end{verbatim}

This first of all creates a pointer that is of the \texttt{fb.Image} type. It's just a local fact, right now it equals zero, and could not be used. That's considered to

The \texttt{ImageCreate} call returns the address of an area in memory of a new size of this buffer depends on the bit depth, but the width/height of the image earlier. \texttt{ImageCreate} can also take a fill color and depth as the third and fourth arguments, respectively; if not specified, the image will be created filled with the transparent color and match the current screen

We now have allocated a space in memory. It's enough space to hold an image of its \texttt{fb.Image} type. We'll need to destroy it later for proper memory management.

\begin{verbatim}
' Print the address of our buffer.
Print "Buffer created at: " & myBuf 
Sleep
\end{verbatim}

This is just there to let you know what we've done. We print the address worked.
Here we destroy our buffer with a call to \texttt{ImageDestroy}. We don't have to use it for consistency and clarity.

**Buffer Format**

Now that we know how to create buffers, we might want to know more information about what's being held inside of them. Open up the \texttt{fbgfx.bi} header file and find the \texttt{fb.Image} type, and you can see all of this cool stuff inside of it.

We actually don't need to know much about the format itself. The reason is because we used the \texttt{fb.Image \_Ptr}. All you have to know is what you want to look for.

**FB.IMAGE Data Type**

```
'' Image buffer header, new style (incorporates old)
Type IMAGE Field = 1
Union
  old As _OLD_HEADER
  Type As UInteger
End Union
bpp As Integer
Width As UInteger
height As UInteger
pitch As UInteger
_reserved(1 To 12) As UByte
End Type
```

This same information can be found in \texttt{fbgfx.bi}. As you can see, this data type integrates the old header into the new style.
The Width, Height, Pitch (bytes per row), and Bit Depth (bytes per pixel) and the old header itself within the same space. The new header format is not used in the default dialect in the newer versions of FB, so we're not going to cover it here.

How do we access that information within the header? If you're familiar with pointers (which you should be, we used a pointer for our buffer in the first example), then all you have to do is access your buffer. This will leave you to believe that all that's contained in your buffer is the `fb.Image` allows the compiler to think that's what's contained in the buffer, even though...

### Getting Pixels

The first section of our buffer which FreeBASIC helps us out with contains the header information, address, and the rest of our buffer contains pixels (Example2.bas).

```vbnet
' We have to include this to use our FB.IMAGE datatype, remember.
#include "fbgfx.bi"
```

Remember to include our `fb.Image` data type!

```vbnet
' This one is very important.
' We cast to a ubyte ptr first off, to get the exact byte our pixels begin.
' We then cast to a uLong ptr, simply to avoid "suspicious assignment" warnings.
Dim As uLong Ptr myPix = Cast( uLong Ptr, ( Cast( UByte Ptr ) ) + sizeof(fb.Image) )
```

Phew. Alright. We have to make sure we get the exact address of our pixels, RGB, and the extra is generally used for alpha when you need it (some people even use channel - to store all kinds of data). If we're even ONE BYTE off, your Red can become Green, and your Blue into Red! So we have to cast to a `UByte Ptr` first.

You probably also noticed that we simply added `sizeof(fb.Image)` to our buffer's start address. We have just skipped all the memory addresses to get to the pixels.

Finally, we cast it all to a `Ulong Ptr`, mainly for safety. We're in 32 bit depth...
Here's a small line if you still don't understand how this works. Here is our buffer:

If what's contained in the first section of our buffer is the `fb.Image Header`, our address for the pixels, simply by adding the size of the `fb.Image` data type onto our original address.

One problem though! If we add that size to our buffer address, to try and get a new one, we end up with strange results because our datatype isn't one byte long. We have to cast to a `UByte Ptr` we'll get the exact byte we need in memory to work with.

Finally, we're in 32-bits. We just casted to a `UByte Ptr`. Although we *can* just assign the `uLong` ptr the address to our buffer address!

We finally have the address of our pixels directly now, if we'd like.

```
'' Print information stored in our buffer.
Print "Image Width: " & myBuf->Width
Print "Image Height: " & myBuf->Height
Print "Image Bit Depth: " & myBuf->BPP
Print "Image Pitch: " & myBuf->Pitch
Print ""
```

This is what I was talking about earlier. FB will treat your pointer as if it's directly. Since we have the size of the image as well as its pixels address pointer to our screen buffer! See ScrPtr vs ImgBuf.bas for an example of...

**FBGfx Font Header**

**Header Details**

The first row of an image buffer that will be used as a font contains the header (remember that the first row of pixels are going to be the first bytes since...

The very first byte tells us what version of the header we're using. Current version has been released. The second byte tells us the first character supported in
0; Byte; Header Version
1; Byte; First Character Supported
2; Byte; Last Character Supported
3 to (3 + LastChar - FirstChar); Byte; Width of each Character in our font.

**Creating a Font Buffer**

If you had a font that supported character 37 as the first, and character 200 as the last, your bytes would contain:

- 0 for the header version. It's the current only version supported.
- 37 for the first character supported.
- 200 for the last character supported.
- 94 bytes containing the widths of each character.

Since the first row is taken up for header data, the font buffer will be an image buffer whose height is the font height plus one. if you have a font height of 8, you need a buffer height of 9. You'll be putting the font in the second row of your buffer, rather than the first as you usually would.

Here's an example (Example3.bas), which creates a font buffer. It only creates the font:

```vbnet
' The first supported character
Const FirstChar = 32
' Last supported character
Const LastChar = 190
' Number of characters total.
Const NumChar = (LastChar - FirstChar) + 1

These constants help us. It makes the code cleaner and faster.

' Create a font buffer large enough to hold 96 characters, with widths of 8.
' Remember to make our buffer one height larger than font height.
Dim As FB.Image Ptr myFont = ImageCreate( (NumChar, 9)
```
Create our font buffer. Remember, we need to add horizontal space for each character in the font (8 pixels wide). Add an extra row for our font header information.

```
' Our font header information.
' Cast to uByte ptr for safety and consistency, remember.
Dim As UByte Ptr myHeader = Cast(UByte Ptr, myFont)
```

Get the exact, casted, and having no warnings address of our font buffer on this with an fb.Image type.

```
' Assign font buffer header.
' Header version
myHeader[0] = 0
' First supported character
myHeader[1] = FirstChar
' Last supported character
myHeader[2] = LastChar
```

Assign the header information described above, into the first three bytes last supported character.

```
' Assign the widths of each character in the font
For DoVar As Integer = 0 To NumChar - 1
' Skip the header, if you recall
    myHeader[3 + DoVar] = 8
Next
```
Each character in our font can have its own width, so we have to assign starts at 0, so the first time it runs through that code, we'll be at index 3.

```
  ' Remember to destroy our image buffer.
  ImageDestroy( myFont )
```

Just reminding you :D

**Assigning Font Characters**

This is fairly simple. We'll use FreeBASIC's default font to draw onto our column 0, as the very first column is reserved for header data. Start the and give it the color you want. Be warned, you can't have custom colors buffer, it's stuck the color you draw it as! See the tips & tricks section on

Here's the modified code (Example4.bas), where we'll add the font drawin

```
  ' NEW!!!
  ' Our current font character.
  Dim As UByte CurChar
```

Just to have a quick index of the current ASCII character we're drawing

```
  Draw String myFont, ( DoVar * 8, 1 ), Chr(CurChar),
```

Skip the first row of our image buffer, as that contains font buffer inform it with a random color. You should note that we're drawing right into our I
Just for clarity, so you can see the characters we're drawing into the buffer.

```
' Use our font buffer to draw some text!
Draw String (0, 80), "Hello!", myFont
Draw String (0, 88), "HOW ARE ya DOIN Today?! YA DO
Sleep
```

Test out our new font. Of course, it's the same one we're used to. You can test it somewhere.

**Tips & Tricks**

**Coloring Your Custom Fonts**

Alright, so by now you have realized that once you color a custom font, you can't use it anymore. We can get around that (CustFontCol.bas). It might be a bit slow, however.

We can create a font object, which has a function to return a font buffer. We can change color, and returns the font buffer stored in the object. This *could* speed up the drawing process, so we could only redraw from the lowest to the highest. Figuring out that range in itself, could also be slow.

```
#include "fbgfx.bi"

Type Font
   '' Our font buffer.
   Buf   As FB.Image Ptr
   '' Font header.
   Hdr   As UByte Ptr
   '' Current font color.
```
Col   As UInteger

' Make our font buffer.
Declare Sub Make( ByVal _Col_ As UInteger = RGB(255, 255, 255) )
' Change the font color and edit the font buffer.
' Return the new font.
Declare Function myFont( ByVal _Col_ As UInteger = RGB(255, 255, 255) )

' Create/Destroy our font.
' Set a default color to it if you like.
Declare Constructor( ByVal _Col_ As UInteger = RGB(255, 255, 255) )
Declare Destructor()
End Type

' Create our font's buffer.
Constructor Font( ByVal _Col_ As UInteger = RGB(255, 255, 255) )
   This.Make( _Col_ )
End Constructor

' Destroy font buffer.
Destructor Font()
   ImageDestroy( Buf )
End Destructor

' Assign the FBgfx font into our font buffer.
Sub Font.Make( ByVal _Col_ As UInteger = RGB(255, 255, 255) )
   ' No image buffer data. Create it.
   If This.Buf = 0 Then
      ' No screen created yet.
      If ScreenPtr = 0 Then Exit Sub

      ' Support 256 characters, 8 in width.
      ' Add the extra row for the font header.
      This.Buf = ImageCreate( 256 * 8, 9 )

      ' Get the address of the font header,
      ' which is the same as getting our pixel addr.
      ' Except that we always will use a ubyte.
This.Hdr = Cast(UByte Ptr, This.Buf) + SizeOf(FB.Image)

    '' Assign header information.
    This.Hdr[0] = 0
        '' First supported character
    This.Hdr[1] = 0
        '' Last supported character
    This.Hdr[2] = 255
Else
    If This.Col = _Col_ Then Exit Sub
End If

    '' Draw our font.
    For DoVar As Integer = 0 To 255
        '' Set font width information.
        This.Hdr[3 + DoVar] = 8

        Draw String This.Buf, (DoVar * 8, 1), Chr(DoVar)
    Next

        '' Remember our font color.
    This.Col = _Col_
End Sub

    '' Get the buffer for our font.
    '' Remake the font if the color's different.
Function Font.myFont( ByVal _Col_ As UInteger = RGB())
    '' If our colors match, just return the current
    If _Col_ = Col Then
        Return Buf
    End If

        '' Make the font with a new color.
    This.Make( _Col_ )
    '' Return out buffer.
    Return This.Buf
End Function
' MAIN CODE HERE!
ScreenRes 640, 480, 32

' Create our font.
Dim As Font myFont = RGB(255, 255, 255)

' Draw a string using our custom font.
Draw String (0,0), "Hello. I am the custom font.",
' Gasp. A new color!
Draw String (0,8), "Hello. I am the custom font.",
Sleep

' Speed test. Turns out it's quite slow.
Scope
  Randomize Timer
  ' Our timer.
  Dim As Double T = Timer

  ' Time how long it takes to make a new font this way.
  For DoVar As Integer = 0 To 499
    myFont.Make( RGB(Rnd * 255, Rnd * 255, Rnd * 255)
  Next

  ' And we're all done. Print important data.
  Locate 3, 1
  Print "Time to Re-Draw font 499 times: " & (Timer - T) / 500
Sleep
End Scope

ScrPtr vs ImgBuf

Comparison of how to draw onto image buffer pixels, versus how to draw on the screen's buffer:

#include "fbgfx.bi"
ScreenRes 640, 480, 32

' Create a buffer the size of our screen.
Dim As FB.IMAGEPtr myBuf = ImageCreate(640, 480)

' Get the address of our screen's buffer.
Dim As uLongPtr myScrPix = ScreenPtr
' Get the address of our pixel's buffer.
Dim As uLongPtr myBufPix = Cast(uLongPtr, Cast(UBytePtr, myBuf))

' Lock our page. Fill the entire page with white.
ScreenLock

' Alternatively, if the screen resolution's unknown, make this more secure

' Note: this code assumes no padding between rows.
' You need to use ScreenInfo to get the screen's row offsets using that instead.
For xVar As Integer = 0 To 639
    For yVar As Integer = 0 To 479
        myScrPix[(yVar * 640) + xVar] = RGB(255, 255, 255)
    Next
Next
ScreenUnlock
Sleep

' Draw onto our image buffer all red.
For xVar As Integer = 0 To myBuf->Width - 1
    For yVar As Integer = 0 To myBuf->Height - 1
        myBufPix[(yVar * (myBuf->Pitch \ SizeOf(*myBuf))) + xVar] = RGB(255, 0, 0)
    Next
Next
' Put the red buffer on the screen.
Put (0, 0), myBuf, PSet
Sleep

/ ScreenPtr:
1) Get address of screen buffer
   (remember that FBgfx uses a dummy buffer that it
2) Lock page
3) Draw onto screen address
4) Unlock page to show buffer

Image Buffer:
1) Create an image buffer
2) Get the address of image pixels
3) Draw onto image pixels
   (you can use neat stuff like the buffer information)
4) Put down Image where you please
   (another big plus!)

About Drawing:
cast(ubyte ptr, mybuff) + Y * Pitch + X * Bpp

Every Y contains PITCH number of bytes. In order to reach
have to skip an entire row.

It should be safe to do the pointer arithmetic in case
the type is not one byte long, so you may find it easier to
match your bit depth.
In these cases you should divide the Pitch and BPP
Conveniently, in this case the Pitch should always
size. And, obviously, so will the BPP, which will

'
Each fbc supports all targets

Since fbc version 0.24, the FreeBASIC compiler always supports all compilation targets. There no longer is any configuration necessary to enable support for additional targets at fbc compile-time, like it used to exist in older fbc versions. This means you only need to install one fbc per host system and it can be used to compile native programs as well as non-native programs.

- default: compile for native system
- -target and -arch compiler options allow cross-compiling

Requirements for cross-compiling

The official FB release packages include an fbc capable of cross-compiling, but fbc alone is not enough.

1. Besides fbc, FreeBASIC consists of the FB runtime library (rtlib/libfb) and the FB graphics library (gfxlib2/libfbgfx). Additionally, FreeBASIC uses libraries from the MinGW, DJGPP or Linux GCC toolchains. All these libraries are precompiled for a certain target. You need a copy of the proper libraries for every compilation target you want to use.

2. FreeBASIC uses the assembler and linker (and sometimes even more tools) from the GNU binutils project to create binaries, and these may only support one target at a time. Depending on how they were built, they can support multiple targets. Either way, you need the proper binutils for every compilation target you want to use.

To keep the official FB release packages small, they only include the libraries and tools needed for native development, but not for cross-compiling.

Example: Cross-compiling from Ubuntu GNU/Linux to Win32

Ubuntu offers official MinGW cross-compiling packages, which we can use for FreeBASIC. The following describes the steps needed to set this up.
1. gcc/binutils cross-compiler toolchain

Install the gcc-mingw-w64 package and its dependencies. The exact package name could be different for different versions of Ubuntu. This should give the gcc cross-compiler toolchain for targetting Win32 (and Win64 -- you install the exact packages manually if you prefer to avoid installing the whole gcc-mingw-w64 and all of its dependencies.).

That includes the binutils and MinGW libraries, both of which fbc definite needs for cross-compiling. It also includes the cross-compiling gcc, which uses to look up the installation locations of the MinGW libraries. Besides gcc is obviously also needed if you want to use -gen gcc (such as when targetting 64bit which is currently only supported via -gen gcc).

The installed tools are called i686-w64-mingw32-as (MinGW cross assembler), i686-w64-mingw32-ld (MinGW cross linker), i686-w64-mingw32-gcc (MinGW cross gcc), etc. You can use them with fbc by specifying the common target prefix to the fbc -target option:

```
fbc foo.bas -target i686-w64-mingw32
```

This tells fbc to cross-compile using the system's i686-w64-mingw32 gcc/binutils toolchain and libraries.

2. Win32 FB libraries

Install Win32 FB libraries such that fbc can find them. For the -target i686-w64-mingw32 example from above, the directory where the Win32 FB libraries need to be is /usr/local/lib/freebasic/win32/, assuming fbc is installed in /usr/local/bin/fbc. You have two options to get them.

a) Copy the libraries from the official Win32 FB release package (or some other existing Win32 build of FB). Create the /usr/local/lib/freebasic/win32/ directory and copy the libraries into it. This should be safe as long as the Win32 FB libraries are from the same FB version.
version as the FB-linux setup you have installed. However, if the Win32 libraries were created with a MinGW toolchain that is incompatible with the one from Ubuntu, then there can be errors.

b) Compile the Win32 FB libraries manually using Ubuntu's toolchain. Assuming you have the FB source code in fbc/, you can do:

```bash
cd fbc
make rtlib gfxlib2 TARGET=i686-w64-mingw32
sudo make install-rtlib install-gfxlib2 TARGET=i686-w64-mingw32
```

This should cross-compile the Win32 FB libraries using the i686-w64-mingw32 toolchain and install them into the proper directory in /usr/local. Again, it is important to ensure that the used source code matches the version of the installed FB-linux setup.

To be completely safe and avoid FB version incompatibilities, you can build an entire FB setup from sources, including the Win32 cross-compiling libraries:

```bash
cd fbc
make
make rtlib gfxlib2 TARGET=i686-w64-mingw32
sudo make install
sudo make install-rtlib install-gfxlib2 TARGET=i686-w64-mingw32
```
Installing gcc for `-gen gcc`

**Windows 32bit**

If you are using the FreeBASIC-x.xx.x-win32 package, you can use our pre-made gcc package. Download gcc-x.x.x-for-FB-win32-gengcc.zip from the Binaries - Windows/More/ directory at the fbc downloads area and extract it into the FreeBASIC installation directory (where fbc.exe is) such that gcc.exe and cc1.exe will be placed in these locations:

- bin\win32\gcc.exe
- bin\libexec\gcc\i686-w64-mingw32\x.x.x\cc1.exe

You can also download Win32 versions of gcc directly from the MinGW.org or MinGW-w64 projects.

**Windows 64bit**

The FreeBASIC-x.xx.x-win64 package already comes with gcc included, and uses `-gen gcc` by default (because `-gen gas` does not support 64bit).

**DOS**

It requires a (minimal) DJGPP installation. DJGPP can be downloaded from the DJGPP website. At least the djdev*.zip and gcc*b.zip are needed. In order to run the DJGPP gcc, the DJGPP environment variable must be set to point to the djgpp.env file.

To use the DJGPP gcc with the FreeBASIC-x.xx.x-dos package, copy gcc.exe and cc1.exe into the FreeBASIC installation directory, such that they will be placed in these locations:

- bin\dos\gcc.exe
- bin\libexec\gcc\djgpp\x.xx\cc1.exe

**Linux**
Typically the gcc package is already installed, or it can be installed by doing something like:

```bash
sudo apt-get install gcc
```
(the exact command depends on your GNU/Linux distribution)

**Non-standalone fbc installed into DJGPP/MinGW toolchains**

If you are using a non-standalone version of fbc (e.g. from one of the fbc-x.xx.x-win32 packages), and have it installed inside a DJGPP or MinGW toolchain, then `-gen gcc` should already work, as the DJGPP or MinGW toolchains provide gcc.

As long as gcc.exe is in the same directory as fbc.exe (typically C:\DJGPP\bin\ or C:\MinGW\bin\), or available in the PATH environment variable, fbc.exe should be able to find and use it.

**See also**

- `-gen <backend>`
Normal vs. Standalone FreeBASIC

When built from source, FreeBASIC can be configured for and installed in one of these two different setups:

<table>
<thead>
<tr>
<th>Normal build (default)</th>
<th>Standalone build</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal directory layout:</strong></td>
<td><strong>Standalone directory layout:</strong></td>
</tr>
<tr>
<td>- bin/</td>
<td>- bin/</td>
</tr>
<tr>
<td>- fbc.exe</td>
<td>- &lt;target&gt;/</td>
</tr>
<tr>
<td>- [&lt;target&gt;-]ld.exe</td>
<td>- ld.exe</td>
</tr>
<tr>
<td>- other tools for native/cross compilation...</td>
<td>- other tools...</td>
</tr>
<tr>
<td>- include/</td>
<td>- inc/</td>
</tr>
<tr>
<td>- freebasic/</td>
<td>- fbgfx.bi</td>
</tr>
<tr>
<td>- fbgfx.bi</td>
<td>- other headers...</td>
</tr>
<tr>
<td>- lib/</td>
<td>- lib/</td>
</tr>
<tr>
<td>- freebasic/</td>
<td>- &lt;target&gt;/</td>
</tr>
<tr>
<td>- &lt;target&gt;/</td>
<td>- libfb.a</td>
</tr>
<tr>
<td>- libfb.a</td>
<td>- other libraries...</td>
</tr>
<tr>
<td>- other headers...</td>
<td>- fbc.exe</td>
</tr>
<tr>
<td>- other tools for native/cross compilation...</td>
<td></td>
</tr>
</tbody>
</table>

**Differences to the standalone build:**
- fbc is located in `bin/`, like other programs
- looks for includes in `include/freebasic/`, instead

**Differences to the normal build:**
- the fbc binary is located at the toplevel, not inside `bin/`
- looks for tools inside `bin/<target>/`, i.e. it uses

of inc/, to cleanly separate FB headers from system headers

- looks for its own libraries in lib/freebasic/ instead of lib/, to cleanly separate FB libraries from system libraries

- looks for binutils/gcc 1) in bin/ and 2) by relying on PATH

- looks for crt/gcc libraries 1) in lib/freebasic/ and 2) by running "gcc -print-file-name=..."

- **-target** option accepts system triplets such as "i686-pc-linux-gnu" or "x86_64-w64-mingw32"

- the target name given to the **-target** option is prepended to the gcc/binutils program names when cross-compiling

- compatible with the standard /usr or /usr/local directories

- typically used for the FB-linux release

- uses windres from binutils to compile win32 resource scripts

This makes the normal FB build integrate with GNU/Linux distributions and other Unix-like systems pretty well, allows fbc to be

bin/<target>/ld.exe instead of bin/[^<target>-]ld.exe

- looks for FB includes in inc/ not in include/freebasic

- looks for libraries in lib/ in lib/freebasic/

- does not try to rely on PATH and use system tools

- does not try to query gcc to find files

- **-target** only accepts simple FB target names, no system triplets

- typically used for the FB-win32 and FB-dos releases

- uses GoRC to compile win32 resource scripts

The standalone build is intended to be used for self-contained installations such as the traditional FB-win32 and FB-dos releases. It also allows adding fbc to the PATH without having to add the whole bin/ directory.
installed into MinGW or DJGPP trees next to gcc, and allows fbc to work with binutils/gcc cross-compiling toolchains.
A BASIC compiler, interpreter and IDE

QuickBASIC is a twenty year old interpreter/compiler upon which FreeBASIC is modeled. It runs in 16-bit MS-DOS.

More information from Wikipedia:

Microsoft QuickBASIC (often shortened, correctly, to QB, or incorrectly, to "QBasic", which is a different system) is a descendant of the BASIC programming language that was developed by the Microsoft Corporation for use with the MS-DOS Operating System. It was loosely based on GW-BASIC but in addition provided user-defined types, improved programming structures, better graphics and disk support and a compiler in addition to the interpreter. Microsoft sold QuickBASIC as a commercial development suite.

Microsoft released the first version of QuickBASIC on August 18, 1985 stored on a single 5.25" floppy disk. QuickBASIC came with a markedly different Integrated Design Environment (IDE) from the one supplied with previous versions of BASIC. Line numbers were no longer needed since users could insert and remove lines directly via an onscreen text editor.

Microsoft's "PC BASIC Compiler" was included which could be used to compile programs into DOS executables. The editor also had an interpreter built in which would run the program without leaving the editor at all, and could be used to debug the program before creating an executable file. Unfortunately there were some small, subtle differences between the interpreter and the compiler, so that sometimes programs running perfectly well in the interpreter would fail after compilation, or even not compile at all.

The last version of QuickBASIC was 4.5 (1988) although there was continued development of the Microsoft Basic Professional Development System (PDS), the last release of which was version 7.1 (June 1990). The PDS version of the IDE was called QuickBASIC Extended (QBX). The successor to QuickBASIC and PDS was Visual Basic for MSDOS
1.0 provided in Standard and Professional versions. Later versions of Visual Basic did not include DOS versions as Microsoft wanted developers to concentrate on Windows applications.

A replacement for GW-BASIC, based on QuickBASIC 4.5 was included with MS-DOS 5 and later versions. This is called QBASIC. Compared to QuickBASIC, it is limited as it lacks a few functions, can only handle programs of a limited size, lacks support for separate modules, and is an interpreter only. It cannot be used to produce executable files directly although programs developed using it can still be compiled by a QuickBASIC 4.5, PDS 7.1 or VBDOS 1.0 compiler, if one is available.

To learn more about the language, history, and community of QuickBASIC and its free interpreter-only counterpart, you should see also en.wikipedia.org/wiki/QBasic. There are more links, and more information, including a barebones tutorial for Quick/QBasic programming.

**External links**

- [Pete's QB Site](http://www.pete-es.co.uk/qb/index.html). One of the oldest remaining QB sites (since Oct 1998).
- [QQN/QBN: QBasic/QuickBasic News](http://www.qbn.com/). Details.
- [QQN's Newbies Section](http://www.qbn.com/qbn/newbie.html) which includes a link for downloading QBasic.
**Credits (in alphabetical order)**

**Project Members**

- **Andre Victor T. Vicentini** (av1ctor[at]yahoo.com.br):
  Founder, main compiler developer, author of many parts of the runtime, FB headers (FBSWIG)

- **Angelo Mottola** (a.mottola[at]libero.it):
  Author of the FB graphics library, built-in threads, thread-safe, runtime, ports I/O, dynamic library loading, Linux port.

- **Bryan Stoeblerl** (b_stoeberl[at]yahoo.com):
  SSE/SSE2 floating point math, AST vectorization.

- **Daniel C. Klauer** (daniel.c.klauer[at]web.de):
  FB releases since 0.21, C & LLVM backends, 64bit port, dynamic arrays in UDTs, virtual methods, preprocessor-only mode, miscellaneous fixes and improvements.

- **Daniel R. Verkamp** (i_am_drv[at]yahoo.com):
  DOS, XBox, Darwin, *BSD ports, DLL and static library automation, VB-compatible runtime functions, compiler optimizations, miscellaneous fixes and improvements.

  FB headers, C emitter

- **Jeff Marshall** (coder[at]execulink.com):
  FB releases since 0.17, FB documentation (wiki maintenance, fbdocs, offline-docs generator), Gosub/Return, profiling support, dialect, specifics, DOS serial driver, miscellaneous fixes and improvements.

- **Mark Junker** (mjscod[at]gmx.de):
  Author of huge parts of the runtime (printing support, date/time, function: SCR/LPTx/COM(console/keyboard I/O), Cygwin port, first FB installer scripts.

- **Matthew Fearnley** (matthew.w.fearnley[at]gmail.com):
  Print Using & Co, ImageInfo, and others, dialect specifics, optimization improvements in the compiler, many fixes and improvements.

- **Ruben Rodriguez** (rubentbstk[at]gmail.com):
  Var keyword, const specifier, placement new, operator overloading and, other OOP-related work, C BFD wrapper, many fixes and improvements.
- **Simon Nash:**
  AndAlso/OrElse operators, ellipsis for array initializers, miscellaneous fixes and improvements.

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  - **Claudio Tinivella** (tinycla[at]yahoo.it):
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- **Dinosaur:**
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    PostgreSQL headers & examples
  - **Edmond Leung** (leung.edmond[at]gmail.com):
    SDL headers & examples
- **Eric Lope** (vic_viperph[at]yahoo.com):
  OpenGL & GLU headers & examples, examples/gfx/rel-*.*bas demos
- **Florent Heyworth** (florent.heyworth[at]swissonline.ch):
  Win32 API sql/obdc headers
- **fsw** (fsw.fb[at]comcast.net):
  Win32 API headers, Gtk/Glade/wx-c examples
- **Garvan O'Keefee** (sisophon2001[at]yahoo.com):
  FB ports of many NeHe OpenGL lessons, PDFlib examples
- **Hans L. Nemeschkal** (Hans.Leo.Nemeschkal[at]univie.ac.at):
DISLIN headers
- Jofers (spam[at]betterwebber.com):
  ThreadCall keyword, libffi/libjit headers, FreeType examples
- Jose Manuel Postigo (postigo[at]uma.es):
  Linux serial devices support
- Laanan Fisher (laananfisher[at]gmail.com):
  FB test suite using CUnit
- Matthew Riley (pestery):
  OpenGL, GLFW, glex, FreeGLUT, cryptlib headers
- Matthias Faust (matthias_faust[at]web.de):
  SDL_ttf headers & examples
- Marzec:
  SDL headers, SDL_bassgl, SDL_opengl and SDL_key examples, First file routines for FB's rtlib
- MJK:
  big_int header fixes
- MOD:
  wx-c, BASS headers; -lang qb support for built-in macros, "real" Rnd() algorithm
  - Nek (dave[at]noldtveidt.net):
  Win32 API headers
- Plasma:
  FMOD and BASS headers & examples
  - Randy Keeling (randy[at]keeling.com):
  GSL matrix example
  - Saga Musix (Jojo):
  BASS examples with sounds
  - Sisophon2001:
    gfxlib2 fixes, Nehe OpenGL lesson ports
  - Sterling Christensen (sterling[at]engineer.com):
    Ex-project-member, author of FB's initial QB-like graphics library
  - TeeEmCee:
    gfxlib2 fixes
  - TJF (Thomas.Freiherr[at]gmx.net):
    ARM port, GTK+, glib, Cairo, Pango headers & examples,
SQLiteExtensions headers
  - zydon:
  Win32 API examples

Greetings

  - Plasma:
    Owner of the freebasic.net domain and main site hoster, many thanks to him.
  - VonGodric:
    Author of the first FreeBASIC IDE: FBIDE.
  - Everybody that helped writing the documentation (and in special Nexinarus who started it):
  - All users that reported bugs, requested features and as such helped improving the compiler, language and run-time libraries.
These functions allow you to use BSAVE and BLOAD in a text mode.

```basic
Sub _bsave( file As String, p As Any Ptr, sz As Integer)
    Dim As Integer ff
    ff = FreeFile

    Open file For Binary As ff
    fb_fileput( ff, 0, ByVal p, sz )

    Close
End Sub

Sub _bload( file As String, p As Any Ptr )
    Dim As Integer ff
    ff = FreeFile

    Open file For Binary As ff
    fb_fileget( ff, 0, ByVal p, LOF( ff ) )

    Close
End Sub
```
DrV

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http://drv.nu/
Part of the FreeBASIC Development team; DOS port maintainer
Creating FB bindings for C libraries

This page aims to document the problems and solutions commonly encountered when creating FB bindings for C libraries.

In general, FB and C/C++ are very similar. FB follows the same ABI as GCC where applicable, in order to be binary-compatible as much as possible. The language syntax is also similar to C/C++. As a result, a lot of type and procedure declarations can be translated 1:1 between C and FB. However, there also are constructs which cannot be translated directly. FB has function pointer types, but not plain function types.

- The good news: We have tools (fbfrog and h_2_bi) which can do most of the translation automatically.
- The bad news: There always are some problems which cannot be solved automatically, and thus need to be fixed manually.

**Data types**

<table>
<thead>
<tr>
<th>C/C++ type</th>
<th>Size in bytes (GCC on Linux/Windows)</th>
<th>Corresponding FB type</th>
</tr>
</thead>
<tbody>
<tr>
<td>char</td>
<td>1 Byte</td>
<td>Byte</td>
</tr>
<tr>
<td>short [int]</td>
<td>2 Short</td>
<td></td>
</tr>
<tr>
<td>int</td>
<td>4 Long</td>
<td></td>
</tr>
<tr>
<td>enum (underlying type int)</td>
<td>4 Long</td>
<td></td>
</tr>
<tr>
<td>long long [int]</td>
<td>8 LongInt</td>
<td></td>
</tr>
<tr>
<td>float</td>
<td>4 Single</td>
<td></td>
</tr>
<tr>
<td>double</td>
<td>8 Double</td>
<td></td>
</tr>
<tr>
<td>long double</td>
<td>12 on 32bit, 16 on 64bit</td>
<td>CLongDouble</td>
</tr>
<tr>
<td>_Bool/bool</td>
<td>1 Byte / Boolean</td>
<td></td>
</tr>
<tr>
<td>* (pointer)</td>
<td>4 on 32bit, 8 on 64bit</td>
<td>Ptr / Pointer</td>
</tr>
<tr>
<td>ssize_t, intptr_t</td>
<td>4 on 32bit, 8 on 64bit</td>
<td>Integer</td>
</tr>
<tr>
<td>size_t, uintptr_t</td>
<td>4 on 32bit, 8 on 64bit</td>
<td>Uinteger</td>
</tr>
<tr>
<td>long [int]</td>
<td>4 on 32bit systems and Win64 (!), 8 on 64bit Linux/BSD</td>
<td>CLong from crt/long.bi</td>
</tr>
</tbody>
</table>

- **Caveat:** int/long is not Integer/Long. In FB, Integer corresponds to systems). Long stays 32bit everywhere. In C, int stays 32bit everywhere, but not on Win64, where long is still 32bit. On Win64, int nor C's long are compatible to FB's Integer.
- **Caveat:** long int is not LongInt. FB's LongInt corresponds to C's
- `int` can be translated to `Long`, as both are 32bit consistently.
- `ssize_t` or `intptr_t` can be translated to `Integer` because they typically have the same size as pointers.
- `long` cannot be translated directly, but we have `crt/long.bi` which provides the target-specific translation.
- `long double` cannot be translated directly, but we have `crt/longdouble.bi` for that.
- `enum` is a special case. Typically their underlying type is `int` (32bit), but we can change that. Thus `enums` (used as data type in declarations) cannot be translated directly.

For example:

```plaintext
Enum MyEnum {
    A,
    B
}
```

has to be translated as:

```plaintext
Type MyEnum As Long
Enum
    A
    B
End Enum
```

- `BOOL` from `windows.h` is just a typedef for `int`, and should not be confused.

**Symbol name conflicts**

- C/C++ is case-sensitive, with ~50 keywords
- FreeBASIC is case-insensitive, with ~400 keywords
- C code sometimes uses FB keywords as symbol identifiers, for example:
- C code often contains identifiers which differ only in case, for example:
- In C, a macro can have the same identifier as a function. This is not allowed in FB:

**Examples**
C code using FB keywords as identifiers:

typedef Int Int;
void Open(void);

Type INT_ As Long
Declare Sub open_ cdecl Alias "open()"

C code relying on case-sensitivity:

void foo(void);
void Foo(void);
void FOO(void);

'Wrong translation:
Extern "C"
  Declare Sub foo() '' error: duplicate definition
  Declare Sub Foo() '' error: duplicate definition
End Extern

'Correct translation:
Extern "C"
  Declare Sub foo()
  Declare Sub Foo_ Alias "Foo()"
  Declare Sub F00__ Alias "F00()"
End Extern

Another classic example where this kind of conflict happens:

#define GET_VERSION_NUMBER 123
Int get_version_number(void);
extern "C"
#define GET_VERSION_NUMBER_ 123 "' renamed to avoid conflict

Declare Function get_version_number() As Long
End Extern

Conflict between procedure and macro:

```
void f(Int);
define f(i) f(i + 1)
```

extern "C"
Declare Sub f(ByVal As Long)
define f_(i) f(i + 1) "' renamed to avoid conflict
End Extern

Solutions

- Symbols should be renamed by appending _ underscores. API.
- Renaming a symbol should not cause further renames (for foo should be renamed to foo__ instead)
- A list of renamed symbols should be available in the binding or in the binding’s documentation such differences to the original API.
- Fields inside structures do not need to be renamed just because Name" syntax they can be use FB keywords as identifiers. They not a class.

```
type UdtWithKeywordFields
    As ZString Ptr String "' Field "String" of type
    As Long Type "' Field "Type" of type "Long"
    As Long As "' Field "As" of type "Long"
End Type
```
Function types

In C it's possible to have typedefs with function types. Dereferencing a function pointer results in a function type.

FB only has function pointer types, but not function types.

```
// A Function typedef (Function result = void, no parameters)
typedef void F(void);

// Using it To Declare a Function called f1
F f1;

// Usually f1 would be declared like This (use of Function void)
void f1(void);

// A more Common use For Function typedefs Is To Declare
Extern F *pf1;
```

Since FB does not have function types, such typedefs have to be solved out, or turned into a function pointer:

```
Extern "C"

Type F As Sub() " Function pointer type

" Declaring procedures is only possible with Declare
Declare Sub f1()

" But at least FB has function pointer types.
" Since F already is the function pointer in the FB
Extern pf1 As F

EndExtern
```
Compiling a Development Version of FreeBASIC

The source code of FreeBASIC is maintained on Sourceforge using the Git version control system, which allows different developers to work on the source code at the same time and later combine their work. It is possible for users to download the FreeBASIC source code using anonymous read access and compile it using GNU development tools.

Compiling the development version is not recommended for most users. FreeBASIC is a self-hosting compiler, still in active development, so there will be times when the current development version cannot be compiled by the last official release. Note also that the procedures for building the compiler described here may change with future versions of FreeBASIC.

Essentially, FreeBASIC consists of two parts:
- The FreeBASIC compiler, written in FreeBASIC (self-hosting). Compiling this requires a working FreeBASIC installation.
- The FreeBASIC runtime libraries, written in C. Compiling this requires a C compiler such as gcc, the GNU C compiler (Native gcc on Linux, MinGW on Windows, DJGPP for DOS).

Generally, when compiling FB, care should be taken to never mix compiler and rtlib of different versions, because they will not necessarily be compatible. fbc's code generation expects a specific libfb version. Thus, an FB setup should always have the proper libfb version in its lib directory, matching the version of the fbc.exe. When building a new compiler, just like any other FB program, it will be compiled by an existing fbc and thus it must also be linked against the existing fbc's libfb, not against the new libfb. The new libfb belongs into the new compiler's lib directory, not in that of the existing fbc. Typically this means that the compiler should be built first, before rtlib/gfxlib2, which is also how the FB makefile works by default.

There are two ways to build FB: normal or standalone. The normal version is intended for integration with an existing gcc toolchain, while the standalone version makes fbc act more like a self-contained tool. Most importantly, the two use slightly different directory layouts. For example, in the normal version the fbc program is located at bin/fbc[.exe], while
in the standalone version, fbc[.exe] is put into the toplevel directory, instead of the bin/ directory. Furthermore, the directory layout for include files and libraries differs. Traditionally, the FB-linux release is a normal build, while the FB-win32 and FB-dos builds are standalone versions.

Getting the source code
Compiling FB for DOS
Compiling FB on Linux
Compiling FB on Windows
Getting source code updates and recompiling FB
Debugging FB
FB build configuration options
Known problems when compiling FB
GCC toolchain choice
Getting the source code

From Git

The FreeBASIC source code is maintained using the Git version control system. The code is available from these Git repositories:

- Main repository at SourceForge:
  Git clone URL: git://git.code.sf.net/p/fbc/code
  Web view: http://sourceforge.net/p/fbc/code/
- Mirror repository at GitHub:
  Git clone URL: https://github.com/freebasic/fbc.git
  Web view: https://github.com/freebasic/fbc

In order to access a Git repository, you first need to install a Git client.

- Linux:
  - The standard Git command line client is available in form of packages for many GNU/Linux distributions. For example, on Debian/Ubuntu, you can install the `git` and `git-gui` packages. File explorer integration: Some tools such as RabbitVCS act as graphical frontend for the Git command line client. It can integrate into the Nautilus file explorer much like TortoiseSVN on Windows. Install the `rabbitvcs-nautilus` package on Debian.

- Windows:
  - The standard Git command line client is made available for Windows. Download the latest installer from their website, and install it. The recommended setting for `core.autocrlf` is true, so that the FB source code in the working tree will have CRLF line endings. By default MsysGit will add some useful context-menu (right-click menu) entries for directories in the Windows Explorer.
  - There are other Git clients available, for example TortoiseGit.

Check out http://git-scm.com/downloads for more information.

After installing a Git client, you can download ("clone") the fbc repository:

- Using the Git command line in a terminal on Linux:
Clone fbc's SourceForge repository into a new fbc/ directory

```
git clone git://git.code.sf.net/p/fbc/code fbc
```

Open graphical commit history browser:
```
gitk --all &
```

Open graphical commit tool:
```
git gui &
```

- Using the Git command line in the *Git Bash* terminal that comes with MsysGit on Windows:

```
The Git Bash is an MSYS shell providing a Linux-like command line. It should have mapped the ~ home directory to your C:\Documents and Settings\username or C:\Users\name directory. It is ok to work there, but if you want to work there, but if you want to change directories and clone the fbc repository to somewhere else, you can do so as follows:
Change directory to C:\foo\bar

```
cd /c/foo/bar
```

Clone fbc's SourceForge repository into a new fbc directory
```
git clone git://git.code.sf.net/p/fbc/code fbc
```

Open graphical commit history browser:
```
gitk --all &
```

Open graphical commit tool:
```
git gui &
```

- Using MsysGit's graphical user interface on Windows: Right click on Explorer and select "Git Gui" to bring up the Git Clone window. Here you can enter the URL of the fbc repository and the directory into which the clone should go. Note: Right-clicking and selecting directories that already are Git repositories will bring up the git-gui commit tool.

- Other: Please check out your Git client's documentation. No matter which Git client you are using, you probably have to enter the Git clone URL somewhere. Then it should download the fbc repository to somewhere on your system.

As a result you should have an *fbc/* directory containing the FreeBASIC
You can regularly update it to the latest version by synchronizing it to the fbc repository. Go into your fbc/ directory and run a Git Pull. When using the Git command line, this should do the trick:

```
  cd fbc/
  git pull
```

**From Git but without using a Git client**

Both SourceForge and GitHub allow you to download snapshots of the source code. This way you can download the latest fbc source code without having to use a Git client. Using a Git client is generally more efficient though.

- GitHub: Visit https://github.com/freebasic/fbc in a web browser and click Download ZIP.

**Source code for releases**

Besides the source code in Git which corresponds to the development version, you can download the source code for the latest official stable release of FreeBASIC in the fbc downloads area on SourceForge:

http://sourceforge.net/projects/fbc/files/

The Source Code directory will always contain downloads for the source code of previous releases can be found in the Older versions directory.
Compiling FB for DOS

The DOS version of FB is typically compiled on a 32bit Windows system with DJGPP and a DOS version of FB installed.

Preparations

Getting the FB source code

To compile a new version of FB, you first need to get the FB source code. The following assumes that you have a directory called fbcdos, containing the latest FB source code. Naming it fbcdos is convenient as it avoids conflicts in case you also have an fbc directory for building the Windows version of FB.

Installing DJGPP

To install DJGPP, we need to download several packages which can be found on the DJGPP homepage. FB needs djdev204.zip from the beta/v2/ directory, and several others from the beta/v2gnu/ directory. If anything is missing from there, you can also look into the current/v2gnu/ directory. The following packages are needed:

- binutils (bnu*b.zip)
- bash (bsh*.zip)
- djdev (djdev*.zip) - pick up djdev204.zip or later from the beta/ directory
- fileutils (fil*.zip)
- gcc (gcc*b.zip)
- g++ (gpp*b.zip)
- make (mak*b.zip)
- shellutils (shl*b.zip)
- textutils (txt*b.zip)

Setup DJGPP by extracting everything into C:\DJGPP and adding an environment variable named "DJGPP", set to C:\DJGPP\djgpp.env.
It can be useful (especially when working in parallel with MinGW) to use a batch script to launch a terminal with the DJGPP tools in its PATH environment variable, instead of modifying the system's global PATH environment variable:

```bash
set DJGPP=C:\DJGPP\djgpp.env
set PATH=C:\DJGPP\bin;%PATH%
cd C:\
cmd
```

In the end, you should be able to open a command prompt with C:\DJGPP\bin in its PATH, such that running the gcc command runs the DJGPP's gcc (and not MinGW's gcc).

**Standalone build (self-contained FB)**

**Getting an existing FB setup for bootstrapping**

We will need a working FB-dos installation to bootstrap the new FB compiler. If you do not have FB-dos installed yet, download the latest FreeBASIC-X.XX.X-dos release from FB's download site. It should be extracted somewhere like C:\FreeBASIC-X.XX.X-dos.

**Building the new FB setup**

If you want to create a traditional standalone FB-dos setup like the one from the FreeBASIC-X.XX.X-dos release package, you need to tell FB's makefile by setting the ENABLE_STANDALONE variable. Assuming the FB sources are located at C:\fbcdos, create a C:\fbcdos\config.mk file containing the following:

```
ENABLE_STANDALONE = 1
```

Then, open a command prompt with C:\DJGPP\bin in its PATH, go to the
directory with the FB source code, run "make" with the \texttt{FBC=}\ldots variable set to point to the existing fbc.exe to use for bootstrapping, and let it compile:

\begin{verbatim}
> cd C:\fbcdos
> make FBC=C:/FreeBASIC-X.XX.X-dos/fbc.exe
\end{verbatim}

This should have produced the fbc.exe compiler and the libraries in \texttt{lib\dos\}. To complete this new FB setup, you need to add the binutils (\texttt{as.exe, ar.exe, ld.exe}) into \texttt{bin\dos\} and copy in some DJGPP libraries into \texttt{lib\dos\}.

- Copy these files to \texttt{C:\fbcdos\bin\dos\}:
  - \texttt{C:\DJGPP\bin\{ar,as,ld}\exe}

- Copy these files to \texttt{C:\fbcdos\lib\dos\}:
  - \texttt{C:\DJGPP\lib\{crt0,gcrt0\}o}
  - \texttt{C:\DJGPP\lib\lib\{emu,m\}a}
  - \texttt{C:\DJGPP\lib\gcc\djgpp\[version]\libgcc.a}

You can copy more libraries if you need them, for example the \texttt{C:\DJGPP\lib\gcc\djgpp\[version]\libsupcxx.a} \texttt{C++ support library}, or others from the \texttt{C:\DJGPP\lib\} directory.

A note on \texttt{libc.a}: FB needs a modified version of DJGPP's \texttt{libc.a} because DJGPP's \texttt{libc.a} contains a bug (see \texttt{contrib/djgpp/readme.txt} from the fbc source code for more information). The FB makefile should have taken care of this and produced the modified version of \texttt{libc.a} at \texttt{lib\dos\libc.a}. This should not be overwritten with DJGPP's original \texttt{libc.a}.

Now, the new FB setup should be ready for use. You can use it right from the source tree or copy it somewhere else. The following are the relevant files and directories:

- \texttt{fbc.exe}
If you rebuild it in the future (e.g. after updates to the FB source code from Git), you can let it rebuild itself by just running "make" without specifying an external FBC. It will then use the default, FBC=fbc, which in this case corresponds to the fbc.exe in the same directory.

```
> cd C:\fbcdos
> make
```

**Normal build (like Linux)**

**Getting an existing FB setup for bootstrapping**

We will need a working fbc installation to bootstrap the new FB compiler. If you do not have fbc installed yet, download the latest fbcXXXXb package from FB's download site, and extract it into the DJGPP directory (C:\DJGPP) like a DJGPP package. This will add a working fbc to your DJGPP installation.

**Building the new FB setup**

In order to create a normal (non-standalone) build like the one from the fbcXXXXb release package, just compile FB without specifying ENABLE_STANDALONE. Open a command prompt with C:\DJGPP\bin in its PATH, go to the directory with the FB source code, run "make" and let it compile.

```
> cd C:\fbcdos
> make
```

This should have produced the bin/fbc.exe compiler and the libraries in
lib\freebas\dos\.

Optionally, you can copy this setup into the C:\DJGPP tree by running "make install":

```bash
> make install prefix=C:/DJGPP
```

It can be useful to store the prefix variable in config.mk, so you can run make install in the future without having to set it manually again:

```plaintext
# config.mk:
prefix = C:/DJGPP
```

Installing fbc into the DJGPP tree this way means that it acts as if it was part of DJGPP. However, it is also possible to use fbc from the source tree, without installing it elsewhere. It will invoke gcc -print-file-name=... in order to locate the DJGPP binutils and libraries.
Compiling FB on Linux

Building FB on Linux is fairly easy because usually the GNU/Linux distributions provide all the needed development packages and they can be installed easily, at least for native builds. Since 64bit support was added to FB, a native build should always be possible, no matter whether you have a 32bit x86 or 64bit x86_64 system. Cross-compiling the 32bit x86 version of FB on a 64bit x86_64 system (or vice-versa) and building for other architectures such as ARM is also possible.

Generally, compiling FB-linux requires the following packages:

- an existing, working FreeBASIC setup for bootstrapping the new compiler
- gcc
- make
- ncurses development headers & libraries (actually only its libtinfo part)
- gpm development headers & libraries (general purpose mouse)
- X11 development headers & libraries (including X11, Xext, Xpm, Xrandr, Xrender)
- OpenGL development headers & libraries (typically from the Mesa project)
- libffi development headers & libraries

Native build

Getting the FB source code

To compile a new version of FB, you first need to get the FB source code. The following assumes that you have a directory called fbc, containing the latest FB source code.

Getting an existing FB-linux setup for bootstrapping

We will need a working FB-linux installation to bootstrap the new FB
compiler. If you do not have a native version of FB installed yet, download the latest FreeBASIC-X.XX.X-linux release for your system (32bit x86, 64bit x86_64, ARM, etc.) from FB's download site, then extract and install it:

```
$ tar xf FreeBASIC-X.XX.X-linux.tar.gz
$ cd FreeBASIC-X.XX.X-linux
$ sudo ./install.sh -i
```

It is possible that you can get working FB setups from other sources besides the fbc project. For example, some distros may provide freebasic packages out-of-the-box.

**Installing development packages**

The following lists show the packages you have to install for some common GNU/Linux distributions. The exact package names can be different depending on which distro (or which version of it) you use.

**Debian-based systems** (including Ubuntu, Mint etc.):

- gcc
- make
- libncurses5-dev
- libgpm-dev
- libx11-dev
- libxext-dev
- libxpm-dev
- libxrandr-dev
- libxrender-dev
- libgles-mesa-dev
- libffi-dev

**OpenSUSE**:

- gcc
Fedora:
- gcc
- make
- ncurses-devel
- gpm-devel
- libX11-devel
- libXext-devel
- libXpm-devel
- libXrandr-devel
- libXrender-devel
- Mesa-libGL-devel
- libffi48-devel

Compiling FB

Compiling FB natively is as simple as running "make" in the fbc source code directory. This will build a native FB setup matching the system architecture, assuming that the existing fbc installed on the system produces native programs.

```sh
$ cd fbc
$ make
```
This should have produced the bin/fbc compiler and the libraries in lib\freebasic\linux-[architecture]\.

Afterwards, you can install the new fbc build into /usr/local by running "make install", and overwrite the old FB installation:

```
$ sudo make install
```

**Compiling 32bit FB on a 64bit system with existing 32bit FB**

Besides native builds, you can also make non-native builds, such as compiling the 32bit version of FB on a 64bit system, using an existing 32bit FB build to bootstrap. This was very common before 64bit support was added to FB. It requires a slightly different procedure than a native build.

- Get the FB source code.
- Install a 32bit version of FB for bootstrapping (instead of a native 64bit version).
- Install 32bit development packages (not just the native 64bit ones).

64bit Debian/Ubuntu example:

- gcc-multilib
- make
- lib32ncurses5-dev
- libx11-dev:i386
- libxext-dev:i386
- libxpm-dev:i386
- libxrandr-dev:i386
- libxrender-dev:i386
- libgl1-mesa-dev
- libgpm-dev
- lib32ffi-dev

64bit OpenSUSE example:
- gcc-32bit
- make
- ncurses-devel-32bit
- gpm-devel
- libX11-devel-32bit
- libXext-devel-32bit
- libXpm-devel-32bit
- libXrandr-devel-32bit
- libXrender-devel-32bit
- Mesa-libGL-devel-32bit
- libffi48-devel-32bit

- Add the following config.mk file to the fbc source tree (next to the FB makefile):

```bash
CC = gcc -m32
TARGET_ARCH = x86
```

This tells the FB makefile to build for 32bit instead of the 64bit default.

Setting CC to gcc -m32 instead of gcc causes all C code to be compiled for 32bit rather than the default 64bit.

Assuming that the existing installed fbc is a 32bit one, it will already default to compiling to 32bit, so setting FBC to fbc -arch 32 instead of fbc is not needed (and older 32bit-only fbc versions did not even have the -arch 32 option anyways).

Setting the TARGET_ARCH to x86 is necessary to override the FB makefile's uname -m check (because that returns x86_64 on 64bit). This allows the FB makefile to select the proper x86 rtlib/gfxlib2 modules and to use the correct directory layout for x86.

- Run "make" and let it compile FB:
$ cd ~/fbc
$ make

- Optionally, install the newly built 32bit FB setup into /usr/local:

$ sudo make install
Compiling FB on Windows

Preparations

Getting the FB source code

To compile a new version of FB, you first need to get the FB source code. It assumes that you have a directory called `fbc`, containing the latest FB source code.

Installing a MinGW-w64 toolchain

In this guide we will use a 32bit or 64bit MinGW-w64 toolchain to build the version of FB, respectively. Visit http://sourceforge.net/projects/mingw-w64/files/ Toolchains targetting Win64 or Toolchains targetting Win32 directory, depending on whether you want to compile a 32bit or 64bit version of FB. Enter the `Personal Builds/subdirectory, choose the latest gcc version, then enter the threads subdirectory and download the toolchain package from there.

Extract the toolchain into a new `C:\MinGW-w64` directory, such that you end in `w64\bin\gcc.exe`.

If you know what you are doing, you can also use a different MinGW-w64 one from different projects such as MinGW.org or TDM-GCC. We have some more information on the MinGW toolchain choices on the DevGccToolchainChoice page.

Installing MSYS

MSYS (originally a Cygwin fork) brings a Unix-like shell environment to Windows, including GNU make, the bash shell and Unix command line tools such as `cp` and `mv` to run the FB makefile and the FB test suite.

The needed MSYS packages can be downloaded and extracted by using the mingw-get setup from the MinGW.org project.

Run the installer and choose `C:\MinGW` as installation directory. This way `C:\MinGW-w64`, avoiding potential conflicts. The MinGW Installation Manager (`C:\MinGW\bin\mingw-get.exe`) should be opened automatically afterward, and the mingw-developer-toolkit package from the Basic Setup section by clicking...
package name and selecting "Mark for Installation", then selecting Install Changes from the application's menu.

This should install the commonly needed MSYS components. We do not mingw32-base or mingw32-gcc-* packages here, because we are using an toolchain instead of the MinGW.org one. If you do not wish to use the Min can also download the MinGW/MSYS packages manually from the MinGW download site.

Ultimately, MSYS should be installed at C:\MinGW\msys\1.0\. Now there directories: C:\MinGW-w64\bin, C:\MinGW\bin and C:\MinGW\msys\1.0\bin added to the PATH environment variable (in the given order), so that the programs will be found when invoked from a command prompt or from the FB makefile.

In order to avoid modifying the system-wide PATH, you can use a open-ms following to open an MSYS bash with the needed PATH settings, everytime:

```plaintext
set PATH=C:\MinGW\msys\1.0\bin;%PATH%
set PATH=C:\MinGW\bin;%PATH%
set PATH=C:\MinGW-w64\bin;%PATH%
C:\MinGW\msys\1.0\msys.bat
```

**Getting libffi**

The FB rtlib source code depends on libffi headers (ffi.h and ffitag the gcc toolchains include directory (C:\MinGW-w64\i686-w64-mingw32\inci w64 and C:\MinGW-w64\x86_64-w64-mingw32\include for 64bit MinGW-w6 libffi.a library will be needed later when compiling FB programs that use

Prebuilt versions of libffi are available from the fbc downloads area.

If you do not want to use a prebuilt version, but prefer to compile libffi may fairly simple. libffi uses the autotools (autoconf, automake, libtool) build of the corresponding packages have to be installed for MinGW/MSYS. Open the FB makefile and 32bit:
$ ./configure
$ make

- 64bit: This requires working around MSYS' `uname` which still returns 32bit even on 64bit:

$ ./configure --build=x86_64-w64-mingw32 --host=x86_64-w64-mingw32
$ make

This should produce the libffi headers in an `include/` subdirectory and the `libs/` subdirectory. You can then copy them into the corresponding directories of the MinGW-w64 toolchain such that gcc will find them.

**Standalone build (self-contained FB)**

**Getting an existing FB setup for bootstrapping**

We will need a working FB-win32 installation to bootstrap the new FB cc have FB-win32 installed yet, download the latest FreeBASIC-X.X.X-win32 download site. It should be extracted somewhere like `C:\FreeBASIC-X.X.X-win32`

**Building the new FB setup**

If you want to create a **traditional standalone** FB-win32 setup like the `C:\FreeBASIC-X.X.X-win32` release package, you need to tell FB's makefile by setting the `ENABLE_STANDALONE` variable. Furthermore, in order to compile for 64bit it is necessary to set the `TARGET_ARCH` variable manually, because MSYS' `uname -m` command does not support 64bit and thus the FB makefile would mis-detect the system as 32bit. As the sources are located at `C:\fbc`, create a `C:\fbc\config.mk` file containing the following:

- **32bit:**

```make
ENABLE_STANDALONE = 1
```

- **64bit:**

```make
ENABLE_STANDALONE = 1
```
# Manually set TARGET_ARCH to override uname check for 64bit
TARGET_ARCH = x86_64

Then, open the MSYS bash using the .bat script mentioned above (with settings), go to the directory with the FB source code, run "make" with the path to point to the existing fbc.exe to use for bootstrapping, and let it compile:

```
$ cd /c/fbc
$ make FBC=C:/FreeBASIC-X.XX.X-win32/fbc.exe
```

This should have produced the fbc.exe compiler and the libraries in lib\respectively. To complete this new FB setup, you need to add the binutils (as.exe, ar.exe, ld.exe, dlltool.exe) into bin\win32\ and copy in some MinGW libraries into:

- **Copy to c:\fbc\bin\win32 (32bit) or c:\fbc\bin\win64 (64bit):**
  - C:\MinGW-w64\bin\{ar, as, ld, dlltool\}.exe
  - GoRC.exe from http://www.godevtool.com/
- **For 64bit, or for using -gen gcc on 32bit, gcc.exe and cc1.exe are**
  - Copy C:\MinGW-w64\bin\gcc.exe to C:\fbc\bin\win{32|64}
  - **Copy C:\MinGW-w64\libexec\gcc\[target]\[version]\cc1.**
    C:\fbc\bin\libexec\gcc\[target]\[version]\cc1.exe
- **Copy to c:\fbc\lib\win32 (32bit) or c:\fbc\lib\win64 (64bit):**
  - C:\MinGW-w64\[target]\lib\{crt2, dllcrt2, gcrt2\}.o
  - C:\MinGW-w64\[target]\lib\lib\{gmon, mingw32, mingwex, mo:\n  - C:\MinGW-w64\[target]\lib\lib\{advapi32, gdi32, kernel32, msvcrt, user3:\n    *(rename to lib*.dll.a if wanted)*
  - C:\MinGW-w64\lib\gcc\[target]\[version]\{crtbegin, crtno\n  - C:\MinGW-w64\lib\gcc\[target]\[version]\libgcc.a
  - libffi.a (from the prebuilt libffi package or your own build)
([target] refers to i686-w64-mingw32 for 32bit MinGW-w64 or x86_64-w64- MinGW-w64, and [version] is the gcc version number)
You can copy more libraries if you need them, for example the `C:\MinGW-[version]\libsupc++.a` C++ support library, or other Win32 API DLL impor

Now, the new FB setup should be ready for use. You can use it right from or copy it somewhere else. The following are the relevant files and director

- `fbc.exe`
- `bin/win32/` (32bit) or `bin/win64/` (64bit)
- `inc/`
- `lib/win32/` (32bit) or `lib/win64/` (64bit)

**Normal build (like Linux)**

**Getting an existing FB setup for bootstrapping**

We will need a working fbc installation to bootstrap the new FB compiler installed yet, download the latest `fbc-X.XX.X-mingw-w64-i686` (32bit) or `w64-x86_64` (64bit) package from FB's download site, and extract it into the `MinGW-w64` directory like a MinGW package. This will add a working fbc installation.

**Building the new FB setup**

In order to create a normal (non-standalone) build, just compile FB without `ENABLE_STANDALONE`. However, in order to compile for 64bit it is necessary to set the variable manually, because MSYS' `uname -m` command does not support 64bit and thus the FB makefile would mis-detect the system as 32bit.

- 32bit: no `config.mk` needed.
- 64bit: Create a `config.mk` containing the following:

```bash
# Manually set TARGET_ARCH to override uname check for 64bit
TARGET_ARCH = x86_64
```

Then, open the MSYS bash using the .bat script mentioned above (with
settings), go to the directory with the FB source code, run "make" and let

```
$ cd /c/fbc
$ make
```

This should have produced the `bin/fbc.exe` compiler and the libraries in `lib\freebasic\win64\` respectively.

Optionally, you can copy this setup into the `c:\MinGW-w64` tree by running

```
$ make install prefix=C:/MinGW-w64
```

It can be useful to store the prefix variable in `config.mk`, so you can run `make install` in the future without having to worry about it:

```
# config.mk:
prefix = C:/MinGW-w64
```

Installing `fbc` into the MinGW tree this way means that it acts as if it was part of MinGW. However, it is also possible to use `fbc` from the source tree, without installing it elsewhere. It will invoke `gcc -print-file-name=...` in order to locate the MinGW binutils a
Getting source code updates and recompiling FB

To download updates made available in the fbc Git repository, you can do this, either using a graphical Git tool, or in a terminal:

```
git pull
```

To take a look at incoming changes before applying them, do this:

```
# Update remote branches
git fetch

# Take a look
gitk --all

# Everything looks ok? Then merge the remote branch into the current branch
git merge origin/master
```

Rebuilding is, most of the time, as easy as running "make" again. Often you used compilation options (like ENABLE_STANDALONE) for the build, you have to specify them again.

```
make
# or if needed:
make ENABLE_STANDALONE=1
```

As a special exception, for the DOS build it is necessary to run make clean if source modules have been renamed or deleted. The reason for this is that *.o wildcards to link fbc and archive libfb.a etc., instead of passing the explicit .o file names, because it has to obey the command line length limitation. If make clean is not run, it may use old left-over object files from previous build. Luckily, we do not rename or delete source files often.
For debugging and development it's a good idea to build the compiler with -g and -exx to enable assertions and NULL pointer/array boundary checks. For the rtlbf/gfxlib2 code, -DDEBUG enables the assertions. Just update config.mk and (re)build. Example config.mk settings:

```plaintext
FBFLAGS := -g -exx
CFLAGS := -g -O0 -DDEBUG
```

Running `fbc` inside `gdb` typically looks like this:

```
gdb --args fbc foo.bas
```

Running `fbc` inside `valgrind` typically looks like this:

```
valgrind fbc foo.bas
```

Also note that `fbc` can be tested right from inside the build tree, without having to be "installed" somewhere else, which also is a great debugging and development help.
FB build configuration options

The FB makefile as well as the compiler/rtlib/gfxlib2 source code offers some configuration options. If you build FB by using the FB makefile, then it makes sense to use the FB makefile's configuration options. If you build FB by compiling the sources manually (without using the FB makefile), then of course you can only use the source code configuration options, and you are responsible for putting the FB setup together properly yourself.

The compiler and rtlib/gfxlib2 source code both handle some `#defines` which allow for some configuration. For example, `#defining ENABLE_STANDALONE` when building the compiler (by specifying `-d ENABLE_STANDALONE` on the `fbc` command line) will adjust the compiler for standalone setup. As another example, `#defining DISABLE_FFI` when building the rtlib (by specifying `-DDISABLE_FFI` on the `gcc` command line) will cause the rtlib to be built without using the libffi headers (`ffi.h`). This disables Threadcall support in the rtlib, but can be useful if you do not have libffi.

When using the FB makefile, you can set some variables on the make command line or inside `config.mk` that affect how the makefile will invoke the `fbc/gcc` compilers and what directory layout it will use for the FB setup. This includes cases where the makefile will automatically pass the configuration options on to the compiler/rtlib/gfxlib2 source code. For example, specifying `ENABLE_STANDALONE=1` to the FB makefile causes it to use `-d ENABLE_STANDALONE` when building the new compiler (to make it standalone) and to put the newly built compiler and libraries into the standalone directory layout.

**FB makefile commands**

- none or all
The default - builds everything that needs to be built
- compiler, rtlib, gfxlib2
Used to build a specific component only. For example, this can be used to build an rtlib for a specific target, in order to be able to cross-compile FB programs (such as the compiler) for that target.
**clean[[-component]]**

Used to remove built files. `make clean` removes all built files, while for example `make clean-compiler` removes only the files built for the compiler, allowing the compiler to be recompiled more quickly, without the need to rebuild the whole rtlib/gfxlib2 code.

**install[[-component]], uninstall[[-component]]**

Used to copy the built files into the directory specified by the `prefix` variable, or remove them from there. This is most useful to install the normal build into `/usr/local` on Linux/BSD systems. For the standalone build, `make install` will also work and copy over or remove the files.

However, the standalone build uses an incompatible directory layout and should not be installed into `/usr/local` or similar directories because of this.

Note that it is fine to run the newly built FB setup right from the directory where it was compiled; `make install` is not necessary to make it work (unless the `prefix` path was hard-coded into the compiler via `ENABLE_PREFIX`).

Additionally there are `install-includes` and `uninstall-includes` commands, which copy/remove just the FB includes (header files). Note that there is no `make includes` or similar command, as the includes do not need to be built.

**FB makefile configuration**

The following variables are intended to be set on the make command line or inside a file called `config.mk` next to the FB makefile which is read in by the FB makefile. `config.mk` is useful for setting variables in a permanent way such that you do not have to specify them manually everytime when invoking make.

Make command line example:

```
$ make CFLAGS=' -O2 -g'
```
config.mk example:

```
CFLAGS = -O2 -g
```

- FBFLAGS, FBCFLAGS, FBLFLAGS
  Extra fbc flags to be used when compiling and/or linking the compiler. The default is -maxerr 1 (check the FB makefile for more details). Typically this is used to add options such as -g -exx to build a debug version of the compiler.

- CFLAGS
  Extra gcc flags to be used when compiling rtlib and gfxlib2. The default is -O2 (check the FB makefile for more details). Typically this is overridden for debugging purposes by doing CFLAGS=-g.

- prefix
  The FB installation path. The default is /usr/local. Note: MSYS maps /usr/local to C:\msys\1.0\local.

This is only used...

- by the makefile's install and uninstall commands
- in the compiler (hard-coded) if ENABLE_PREFIX was used

Note that in combination with bash on Win32 (e.g. from DJGPP or MSYS) it's necessary to use forward slashes instead of backslashes in directory paths, for example: prefix=C:/MinGW

- TARGET
  This variable can be set to a gcc toolchain triplet such as i686-pc-linux-gnu or x86_64-w64-mingw32 in order to cross-compile using that GCC cross-compiler toolchain. The makefile will use fbc -target $(TARGET) instead of fbc, and $(TARGET)-gcc instead of gcc.

For example, on a Debian GNU/Linux system with the i686-w64-mingw32 GCC cross/compiler installed, you can build the win32 rtlib like this:

```
# Build the win32 rtlib/gfxlib2
```
It will supplement the existing fbc installation in /usr/local, like a plugin, and from now on you can cross-compile FB programs for win32 by doing:

```
fbc -target i686-w64-mingw32 ...
```

- **FBC, CC, AR**
  These variables specify the fbc, gcc and ar programs used during the build. You can specify them to override the defaults, for example:

```make
make FBC=~/FreeBASIC-0.90.1-linux/fbc CC="gcc -m32"
```

FBC affects the compiler source code only, while CC and AR are used for rtlib and gfxlib2.

- **V=1**
  This variable controls verbosity. By default, the makefile does not display the full command lines used during compilation, but just prints out the latest tool and file name combination to give a better visual indication of the build progress. It also makes warnings and errors stand out more in the console window. If the variable is set, the echoing tricks are disabled and full command lines will be shown, as GNU make normally does.

- **ENABLE_STANDALONE=1**
  Build a standalone FB setup instead of the normal Unix-style setup, see also: the standalone vs. normal comparison. This causes the makefile to use the standalone directory layout and to use `-d ENABLE_STANDALONE` when building the compiler.

- **ENABLE_PREFIX=1**
  This causes the makefile to use `-d ENABLE_PREFIX=$(prefix)` when building the compiler.

- **ENABLE_SUFFIX=foo**
  This causes the makefile to use `-d ENABLE_SUFFIX=$(ENABLE_SUFFIX)` when building the compiler, and to append the given suffix string to the `fbc` executable's and `lib/` directories' names.
For example, using `ENABLE_PREFIX=-0.24` will give you `bin/fbc-0.24.exe` and a `lib/freebasic-0.24/` directory, instead of the default `bin/fbc.exe` and `lib/freebasic/`. This allows installing multiple versions of compiler and runtime in parallel.

Note: The `include/freebasic/` directory name is not affected, and the `FB` headers are always shared by all installed `FB` versions (`FB`'s headers and their directory layouts are designed to be able to do that).

This is only supported for the normal (non-standalone) build. It is not needed for the standalone build, because everyone of those can be in a separate installation directory anyways, while normal (non-standalone) builds may have to share a common installation directory such as `/usr/local` or `C:\MinGW`.

- `ENABLE_LIB64=1`

This causes the makefile to use `-d ENABLE_LIB64` when building the compiler. 64bit libraries are placed into `lib64/freebasic/` instead of `lib/freebasic/`.

**Compiler source code configuration (FBFLAGS)**

- `-d ENABLE_STANDALONE`

This makes the compiler behave as a standalone tool that cannot rely on the system to have certain programs or libraries. See the normal vs. standalone comparison for more information.

- `-d ENABLE_SUFFIX=foo`

This makes the compiler append the given suffix to the `lib/freebasic/` directory name when searching for its own `lib/freebasic/` directory. For example, `-d ENABLE_SUFFIX=-0.24` causes it to look for `lib/freebasic-0.24/` instead of `lib/freebasic/`. Corresponding the `ENABLE_SUFFIX=foo` makefile option, this adjust the compiler to work in the new directory layout.

- `-d ENABLE_PREFIX=/some/path`

This causes the given prefix path to be hard-coded into the compiler, disabling the use of `Exepath()`. Thus it will no longer be relocatable. This is useful if its known that the compiler does not need to be relocatable, or if `exepath()` does not work properly (for example, in `FB 0.90.1`, this is the
case for FreeBSD).

- `ENABLE_LIB64`

This makes the compiler search 64bit libraries in `lib64/freebasic/` instead of `lib/freebasic/`. This only affects the normal (non-standalone) build. 32bit libraries are still searched in `lib/freebasic/`.

**rtlib and gfxlib2 source code configuration (CFLAGS)**

- `-DDISABLE_X11`

With this, the Unix rtlib/gfxlib2 will not use X11 headers, disabling gfxlib2's X11 graphics driver and some of the rtlib's Linux console functionality (affects multikey() and console mouse handling).

- `-DDISABLE_GPM`

With this, the Linux rtlib will not use General Purpose Mouse headers (gpm.h), disabling the Linux *GetMouse* functionality.

- `-DDISABLE_FFI`

With this, the rtlib will not use libffi headers (ffi.h), disabling the *Threadcall* functionality.

- `-DDISABLE_OPENGL`

With this, the gfxlib2 will not use OpenGL headers, disabling the OpenG graphics drivers.
Known problems when compiling FB

Win32 rtlib compilation error: wchar.h: unknown type name 'dev_t'

http://sourceforge.net/p/mingw/bugs/2039/

The wchar.h header file from MinGW.org contains a struct _stat64 declaration that does not compile when _NO_OLDNAMES is defined, because it uses dev_t, ino_t, mode_t which are only available with an _ prefix. For the FB rtlib we define _NO_OLDNAMES when compiling.

To work around this issue, adjust wchar.h and add _ underscore prefixes.

Win32 rtlib compilation error: _controlfp, _PC_64 undeclared

Both the MinGW.org runtime and GCC have a float.h header, and in some setups the GCC one is found before the MinGW one, causing the above errors.

Easiest temporary fix: Append #include_next <float.h> to gcc's float.h

See also:
- The comments at the top of C:\MinGW\include\float.h
- http://sourceforge.net/p/mingw/bugs/1580/
- http://sourceforge.net/p/mingw/bugs/1809/

MinGW binutils ld versions 2.18 to 2.21

fbc triggers a bug (binutils ld bug 12614) in the mentioned linker version in binutils 2.21.1 and up.

MinGW.org runtime's globbing code changes case of command line
MinGW.org's runtime (mingwrt-4.0.3) changed the case of command line arguments given to the program. If the argument matched an existing file/directory name and only differed in case, it was adjusted to match the exact spelling. This can cause problems with programs whose command line parsing is not case-insensitive. For example, gui became fbc.exe's \texttt{-s gui} option, making it impossible to use, as fbc.exe refused to accept this.

**-lXpm not found on Debian x86_64**

The ia32-libs-dev package (for example on Debian 6) for some reason does not contain those for the other X11 development libraries. This apparently can be fixed by creating the symlink manually:

```
ln -s /usr/lib32/libXpm.so.4 /usr/lib32/libXpm.so
```

**DJGPP: Too many open files**

If a DJGPP program fails with a too many open files error on Windows, try:

- Use msconfig to add \texttt{PerVMFiles=255} to the \texttt{[386Enh]} section.
- Edit the \texttt{files=} setting in \texttt{C:\WINDOWS\system32\CONFIG.NT}.
- Also see http://www.delorie.com/djgpp/v2faq/faq9_7.html
FB is based on GCC toolchains and corresponding libraries. However, there is not a single GCC toolchain per platform, but often multiple slightly different toolchains are used, depending on the toolchain chosen to build and use FB. Here we document some of the issues to consider when building FB and/or making FB releases.

**Windows (MinGW)**

MinGW toolchains:

- **MinGW.org** - also provides MSYS, Besides a MinGW GCC toolchain, Win64 support (yet).
- **MinGW-w64** - 32bit and 64bit. Different runtime libraries than MinGW.org.
- **TDM-GCC** - 32bit based on MinGW.org, 64bit based on MinGW-w64, with modifications.
- MinGW cross-compilers on various GNU/Linux distributions - for example MinGW-w64 on Debian/Ubuntu and Fedora (i686-w64-mingw32, x86_64-w64-mingw32)

**Notes:**

- GCC exception handling mechanism: SJLJ setjump/longjump (slow but safe), DWARF-2 (fast but does not always work). The MinGW.org toolchain uses DWARF2, while for MinGW-w64, both types are available. FB does not support exceptions anyways, so in theory the exception handling mechanism used by the underlying GCC toolchain does not matter.

In practice though, DWARF-2 GCC generates static data for stack unwinding which is put into .eh_frame sections. The problem is that .eh_frame data is generated also for C code (not just C++ code) like all the FB/GCC/MinGW runtime libraries, and it increases .exe size noticeably. This can be avoided in multiple ways:

- Use gcc flags to disable the generation of the .eh_frame data. FB is using this in its makefile and for -gen gcc
however obviously it does not affect the prebuilt MinGW/GCC libraries (unless the entire toolchain is recompiled)

-\fno-exceptions -fno-unwind-tables -fno-asynchronous-unwind-tables

- Discard/strip the .eh_frame section when linking (by custom ldscript)
- Use an SJLJ toolchain (i.e. MinGW-w64 built for SJ instead of MinGW.org)

Furthermore, the exception handling method may be an important detail (even if you do not care about .exe size) if you want to use C++ libraries in case the C++ library uses exceptions.

- GCC threading model: Win32 threads (native), POSIX threads (based on winpthreads library). The MinGW.org toolchain uses Win32 threads for MinGW-w64, both types are available.

GCC needs POSIX threads to implement certain new C++ features, which is possible with native Win32 threading functions. Thus, MinGW-w64 uses winpthreads library which provides POSIX threading functions for Windows. However, winpthreads is not part of the main MinGW-w64 runtime, and it has a different license, which may have to be considered.

Since FB does not care about these C++ features, we can just use MinGW toolchains with Win32 threads, and avoid winpthreads.

- Globbing (command line wildcard expansion etc.) behaviour is different between MinGW.org and MinGW-w64 because they have different runtime libraries/startup code implementations.
  - Globbing is enabled by default in the MinGW.org runtime, MinGW-w64 runtime turns globbing off by default and has enable-wildcard configure option. Thus, whether globbing off by default, depends on how MinGW-w64 was built.
  - The way to disable globbing is different:
    - MinGW.org:

```
Extern _CRT_glob Alias "_CRT_glob" As Long
Dim Shared _CRT_glob As Long = 0
```
MinGW-w64:

```vbscript
Extern _dowildcard Alias "_dowildcard" As Long
Dim Shared _dowildcard As Long = 0
```

- MinGW-w64 includes DirectX headers needed to compile FB's graphics library. MinGW.org does not contain them; they have to be added manually.
- MinGW.org provides a common installer for their MinGW toolchain and the MSYS shell environment. This makes installing easier than with other toolchains, if MSYS is needed too.

**DOS (DJGPP)**

FB needs the DJGPP 2.04 beta runtime (does DJGPP 2.03 not work?). Either way, this version of DJGPP is extremely old. On the other hand, there has been any more recent DJGPP releases, and updates can only be found in DJGPP's CVS. The recommendation is to only use DJGPP CVS if really needed though.

**Linux**

GNU/Linux distros usually provide native gcc + glibc toolchains out-of-the-box, and FB is intended to work with them out-of-the-box.

Executables (such as fbc itself) produced on one GNU/Linux distro are not necessarily portable to other GNU/Linux distros, due to differences in system libraries and/or versions, such as glibc version differences, or ncurses/libtinfo differences. The most common problem with fbc is mismatching glibc version differences. i.e. the fbc binary is run on a system with older glibc than the one it was built on, and some form of "glibc too old" error is encountered. The ncurses library is not always exactly the same either, as shown by the "\`ospeed' has different size, consider re-linking" warnings when running fbc. Also, some distros have separated libncurses and libtinfo, some just have libncurses, which can cause errors due to the libtinfo shared library not being found.
In theory, it is possible to use static linking to avoid the problems with shared libraries:

- The fbc -static command line option tells the linker to prefer static libraries instead of shared ones. This can (in theory) also be used when building fbc itself. It relies on the Linux distro to provide static versions of the system libraries. Linking statically on GNU/Linux is typically discouraged though, in particular with glibc (some of its components are not designed for static linking), but also in general (shared libraries are preferred to avoid redundancy).

- FB can (in theory) also be used with a different libc (instead of glibc) that explicitly supports static linking, for example musl-libc. In this context, you will typically use a custom gcc toolchain, which also requires FB to be built specifically for that toolchain. This approach in general works well, but it can be a lot of work.

Besides that, other libc's may not be ABI-compatible with glibc, which can cause problems for FB programs if they are written for glibc. Most noticably, the Linux CRT headers are based on glibc. An example of an ABI difference between musl-libc (0.9) and glibc was the jmp_buf structure size (used with setjmp()/longjmp() functions). As the FB CRT headers defined the glibc they were incompatible to musl-libc which used a smaller jmp_buf structure.

Another headache when using a different libc than the Linux distro default is that you also need to build a lot of libraries such as ncurses, X11 and Mesa/OpenGL in order to satisfy FB’s dependencies, not to mention any other third-party libraries you want to use in your program. Existing libraries precompiled can probably not be used (at least not safely) due to the two libc’s being incompatible.

See also

- Known problems when compiling FB
Compiling the test suite

The FreeBASIC project has a suite of tests which ensure that bugs stay dead and that new bugs have a harder time of gaining a foothold. The test suite is written with the FreeBASIC port of the CUnit library (Thanks stylin!).

Invocation

The tests are located in the tests subdirectory within the main FreeBASIC directory. Invoking with make will present the following help text:

```
$ make
usage: make target [options]

Targets: (using cunit):
cunit-tests
log-tests
failed-tests
check
mostlyclean
clean

Targets: (bypassing cunit)
log-tests ALLOW_CUNIT=1
failed-tests ALLOW_CUNIT=1
mostlyclean ALLOW_CUNIT=1
clean ALLOW_CUNIT=1

Options:
FBC=/path/fbc
FB_LANG=fb | fblite | qb | deprecated
DEBUG=1
EXTRAERR=1
ARCH=arch (default is 486)
OS=DOS
FPU=fpu | sse

Targets: Configuration and Checks
check

Example: make all available tests
make cunit-tests
make log-tests
```
Example: make obj -lang qb tests
make log-tests FB_LANG=qb

When you make an invocation, such as:

make cunit-tests && make log-tests

Some initial generation of index files will take place, followed by the compilation of hundreds of tests. Be patient, it can take a while to run all of the tests...

If you get an error message like: FreeBASIC/bin/linux/ld: cannot find ltcunit

This means you need to install the cunit library. On Ubuntu this looks like:

$ sudo apt-get install libcunit1-dev

**Known Failures**

As of the writing of this document, the following tests are expected to fail on some platforms:

Suite fbc_tests.string_.format_, Test number format test had failures:
1. string/format.bas:168 - CU_ASSERT_EQUAL(sWanted,sResult)
2. string/format.bas:168 - CU_ASSERT_EQUAL(sWanted,sResult)
3. string/format.bas:168 - CU_ASSERT_EQUAL(sWanted,sResult)
4. string/format.bas:168 - CU_ASSERT_EQUAL(sWanted,sResult)

So if you get these failures, everything is normal. No other tests should ever fail, including log tests.

Thank you for running the tests and contributing to make FreeBASIC a healthy compiler! Please report any other failures to http://www.freebasic.net/forum so we can investigate.
Glossary - common terms used in fbc development

arg, argument
An expression passed to a parameter in a procedure call.

cast
A type cast changes the compile-time data type of an expression and either causes a conversion (e.g. float <-> int) or a reinterpretation of the expression value's bit representation (e.g. integer <-> uinteger).

comp, compound
- Compound blocks in the language: Any code block that allows nested code such as IF blocks, SCOPE blocks, NAMESPACE blocks, etc. is called a compound.
- Compound symbols: UDTs, sometimes also namespaces, because both may contain nested (namespaced) symbols and they share some common code.

conv, conversion
A conversion is an operation that translates between two different representations of the same value (e.g. float <-> int, or 32bit <-> 64bit).

cast and conv are often used interchangeably in the compiler sources. For example, the AST's CONV nodes represent type casts, no matter whether they perform conversions or not.

Some (but not all) casts require run-time conversions, for example:
- short <-> integer
- single <-> integer
- single <-> double

Simple casts between types of equal class and size do not require a run time conversion, because the bit representation wouldn't change anyways. For example:
- short <-> ushort
- integer <-> uinteger

These are also called noconv casts.
ctor, constructor
- UDT constructor
- module constructor

cxt, context
UDTs/"classes" in the fbc sources for holding global information shared amongst multiple procedures or modules.

desc, descriptor
- Dynamic string descriptor
- Dynamic array descriptor

dtor, destructor
- UDT destructor
- module destructor

fbc
- The FreeBASIC compiler project as a whole, the Git repository, the project registered on Sourceforge
- The compiler program binary/executable (fbc or fbc.exe), as built from the compiler sources
- The compiler's main module/frontend/driver

fbctinf
FB compile-time information, also see objinfo.

fbgfx
FB graphics, usually referring to the use of FB's built-in graphics keywords, implemented in gfxlib2

frontend stage 1
Compilation of the .bas input files into the next intermediate format: .asm (-gen gas), .c (-gen gcc) or .ll (-gen llvm)

frontend stage 2
Compilation of the .c (-gen gcc) or .ll (-gen llvm) intermediate files into .asm files. (doesn't apply to -gen gas because there the FB compiler
generates .asm itself directly)

function
A procedure with result value; sometimes also used in place of procedure, as in C.

gfxlib2
The FB graphics runtime library implementation from the fbc project.

hashtb
A hash table, often used together with a symbol table to allow fast lookup of the symbols in that symbol table.

libfb, libfbfmt, libfbgfx, libfbgfxmt
Names of the libraries built from the rtl/lib/gfxlib2 sources. Libraries named lib*mt are the thread-safe versions of their lib* counterparts. They are built with the ENABLE_MT #define.

local
- Sometimes: A variable allocated on stack
- Any symbol in a nested scope, not the global/toplevel namespace
  Scoped static variables also have the FB_SYMBATTRIB_LOCAL attribute, even though they are not allocated on stack.

method
- A member-procedure with THIS parameter. Static member-procedures (those without the THIS parameter) do not have FB_SYMBATTRIB_METHOD.
- Sometimes: Any member-procedure, with or without THIS parameter

noconv cast
A cast that does not require a conversion.

normal build
Described here: Normal vs. Standalone

objinfo
See DevObjinfo

param, parameter
Procedure parameters as declared in procedure DECLARE statements or bodies.

paramvar
For each parameter, the compiler will create a corresponding local variable in the procedure's scope, allowing the parameters to be accessed by user code.

proc, procedure
Any sub or function, including constructors/destructors, operator overloads, property setters/getters.

standalone build
Described here: Normal vs. Standalone

static
- static variable allocation: on the heap instead of the stack, but still scoped -- also see local.
- static member variables: are actually externs.
- static member procedures: member-procedures without a THIS parameter, also see method.
- "static array" is often used in place of "fixed-size array" (QB language)

struct, structure
TYPE OR UNION, also known as struct/union in C.

sub
A procedure without result (with VOID result).

symtb
A symbol table: owns a linked list of FBSYMBOL in a specific scope. This is where FBSYMBOLS live.

rtlib
The FB runtime library implementation from the fbc project

UDT, user-defined type
TYPES/UNIONs/ENUMs, sometimes just TYPES/UNIONs.

vreg
Virtual registers are used when emitting the AST. The AST creates a vre for the operands and results of all operations that make up the input program. Each backend emits them differently:

- The ASM backend actually maps the vregs to real register and also re-uses them as they become free again. The vregs then also let the x86 code emitter know which exact registers are used.
- The C backend sometimes emits vregs as temporary variables, sometimes simply inserts the expression whose result is represented by a vreg in place of that vreg's first use.
- The LLVM backend simply emits each vreg as a numbered intermediate value.

Since the C/LLVM backends don't re-use vregs, the vregs are almost in static-single-assignment form; although not quite because there still are self-operations etc. produced by the AST which don't take SSA form into account.
Notes on making FB releases

In general
Packaging and Manifests
Toolchain/build environment
Release making script
FB manual/documentation

Summary: currently the easiest way to build a release

In general

Making an FB release means:

- Ensuring that the development version is in reasonable/usable state.
- Updating the documentation (Wiki and man page) for language/compiler changes and new features, if not yet done.
- Choosing and preparing gcc toolchains/build environments for DOS, Linux x86, Linux x86_64, Win32, Win64.
- Compiling the development version of FB for all of them.
- Building the Win32 installer (contrib/nsis-installer/).
- Testing the builds to ensure they are basically working.
- Synchronizing the online Wiki with the Wiki files in the fbc Git repository.
- Regenerating the PrintToc and CompilerErrMsg pages.
- Regenerating the examples/manual/ directory (code examples from the Wiki).
- Compiling the offline documentation (CHM, HTML, text).
- Creating the release packages (source code, binary builds, documentation).
- Uploading them and source code of dependencies (binutils, gcc, MinGW, DJGPP, ...) to fbc's download site on SourceForge.
- Announcing the new release on freebasic.net, in freebasic.net/forum News, and in SourceForge fbc project News.

The new release should be compilable with the previous version, so
others can bootstrap it if wanted. Ideally it is compilable with even older versions.

FB releases in form of prebuilt binaries should be made at least for DOS Linux, and Win32. The DOS and Win32 packages traditionally are standalone builds coming with prebuilt binutils and MinGW/DJGPP libraries. The Linux package traditionally is a normal build intended to be installed into /usr or /usr/local and uses the system's binutils/libraries.

All the binary packages must effectively be built from the same source revision. All the to-be-released fbc binaries should be built with the same date, preferably on the same day the release is published. It's confusing to have multiple fbc's each with the same version number but different dates; are they the same version or not?

The sources must be packaged and uploaded in parallel to the binary packages. That includes sources for third-party binaries included in the FB binary packages, e.g. binutils, gdb, gcc, DJGPP/MinGW libs, etc.

To test the releases, it can be useful to
- run the test suite (for every target system)
- test all compilation modes (exe, dll, profiling, ...)
- run every .exe (binutils etc.) included in the packages to ensure that no DLLs are missing
- check that globbing works ok for Windows builds (all included .exe's and new generated ones too), because it might depend on the configuration of the MinGW-w64 runtime.

Linux packages must be .tar.gz, Windows/DOS packages must be .zip. Other formats such as .tar.xz or .7z should be offered additionally, but note that there are people with e.g. older GNU/Linux systems that don't know .tar.lzma or .tar.xz, or with Windows systems that don't have 7-zip installed.

**Packaging and Manifests**

The FB makefile offers the gitdist command for packaging the source code via git archive, and the bindist command for packaging
previously built binaries. Example workflow:

```
# Go to fbc Git clone
cd fbc

# Compile FB
make

# Package the source code
make gitdist

# Package the binaries, regenerate the manifest
make bindist

# Check the manifest
git diff
```

gitdist creates source tarballs in multiple formats. It assumes that all changes to the fbc source code used for building the release have been committed to Git.

bindist creates the needed binary archive(s), potentially in multiple formats, with the proper package name and directory layout depending on the target platform and whether it’s a normal or standalone build, and it (re)generates the corresponding manifest (list of all files included in the archive) in the contrib/manifest/ directory in the fbc source tree.

By checking the manifest differences via Git (git diff, git gui, etc.) you can check whether any files are missing in comparison to the previous release, or whether files were added that should not be included. Should there be any such issues, they may need to be fixed manually (possible the makefile’s bindist implementation needs updating, or you simply need to copy in missing files), after which `make bindist` can be run again to recreate the package and update the manifest again.

bindist configuration options:

- **TARGET_OS/TARGET_ARCH** makefile variables: You can set `TARGET_OS` and/or `TARGET_ARCH` on the make command line to override the
makefile's default uname check. This is useful if you want to package for a different system than what the uname command returns. For example, packaging the FB-dos release from a MinGW/MSYS shell (with MSYS tools instead of DJGPP tools):

```
make bindist TARGET_OS=dos
```

- **FBPACKAGE** makefile variable: Package/archive file name without path or extension. Defaults:
  - Linux/BSD normal, Windows/DOS standalone: `FreeBASIC-x.xx.x-target`
  - Linux/BSD standalone: `FreeBASIC-x.xx.x-target-standalone`
  - Windows/DOS normal (MinGW/DJGPP-style packages): `fbc-x.xx.x-target`

- **FBPACKSUFFIX** makefile variable: Suffix string that will be appended to the package name (and the toplevel directory in the archive).

- **FBMANIFEST** makefile variable: Manifest file name without path or extension. The defaults are the same as for FBPACKAGE, except without the `-x.xx.x` version number part.

- **FBVERSION** makefile variable: Is already set in the makefile, but you can override it if you want to (e.g. when making testing releases instead of "official" releases). For example: `FBVERSION=0.90.1` or `FBVERSION=0.90.1rc1`

- **DISABLE_DOCS=1** makefile variable: If this variable is set, bindist will exclude documentation (readme, changelog, man page) and examples from the package. This is useful when creating small binary-only fbc packages such as those for installation into DJGPP/MinGW trees.

**Toolchain/build environment**

When making an FB release, the GCC toolchain used to build FB has a huge impact, because FB itself will basically become a modified/extended version of that toolchain. The FB-dos and FB-win32 releases include libraries from the used DJGPP/MinGW toolchains, and
they will be used for any FB programs made with those FB builds. Even the FB-linux release will depend on the gcc/glibc version it was built with because of the precompiled rtlib/gfxlib2 libraries, and because of fbc which will have been linked against shared libraries that may not exist on other systems.

Additionally, different GCC toolchains and runtime libraries (e.g. MinGW.org vs. MinGW-w64, or DJGPP 2.03 vs. 2.04 vs. CVS) can be more or less different in terms of ABI compatibility or runtime behaviour. As such any FB program can behave differently depending on the GCC toolchain, including fbc itself.

More information:

**Known problems when compiling FB**

**GCC toolchain choice**

**Release making script**

The FB sources contain a release-making script at contrib/release/build.sh.

This script downloads & extracts DJGPP/MinGW.org/MinGW-w64 toolchains, FB packages for bootstrapping, fbc sources, etc., then builds normal and standalone versions of fbc, and finally creates the complete packages ready to be released.

- Downloaded archives are cached in the contrib/release/input/ dir
- Output packages & manifests are put in the contrib/release/output/ dir
- Toolchain source packages are downloaded too
- fbc sources are retrieved from Git; you can specify the exact commit to build, the default is "master".

**Usage:**

```
cd contrib/release
./build.sh
```
<target> can be one of:
- dos: DOS build: must run on Win32. Uses Win32 MSYS, but switches to DJGPP for building FB.
- linux-x86, linux-x86_64: native builds on GNU/Linux x86/x64_64 relying on the host toolchains; no gcc toolchain is downloaded; no standalone version of FB is built.
- win32: 32bit MinGW-w64 build: must run on Win32. Uses MSYS.
- win32-mingworg: 32bit MinGW.org build: must run on Win32. Uses MSYS.
- win64: 64bit MinGW-w64 build: must run on Win64. Uses Win32 MSYS, but overrides the FB makefile's uname check in order to build for 64bit instead of 32bit.

Requirements:
- MSYS environment on Windows with: bash, wget/curl, zip, unzip, patch, make, findutils (win32/win64 builds need to be able to run ./configure scripts, to build libffi)
- 7z (7-zip) in the PATH (win32/win64)
- makensis (NSIS) in the PATH (FB-win32 installer)
- git in the PATH
- internet access for downloading input packages and fbc via git

Some of the ideas behind this script:
- Automating the build process for FB releases => less room for mistakes
- Starting from scratch everytime => clean builds
- Specifying the exact DJGPP/MinGW packages to use => reproducible builds
- Only work locally, e.g. don't touch existing DJGPP/MinGW setups on the host

FB manual/documentation
- See also doc/fbchkdoc/readme.txt and doc/manual/readme.txt
- Get MySQL, libcurl, libaspell, libpcre
- Build the wiki tools:
  
  ```
  cd doc/libfbdoc
  make
  cd ../fbdoc
  make
  cd ../fbchkdoc
  make
  cd ../makefbhelp
  make
  ```
  
  - Update the wiki cache (the offline copy of the *.wakka files)
  
  ```
  cd doc/manual
  rm -f cache/*
  make refresh
  ```
  
  - Regenerate the PrintToc page:
  
  ```
  cd doc/fbchkdoc
  ./mkprntoc -web
  ```
  
  - Regenerate the CompilerErrMsg page:
  
  ```
  cd doc/fbchkdoc
  ./mkerrlst
  fbc mkerrtxt.bas -exx
  ./mkerrtxt > errors.wakka
  ```
  Then copy the error list from errors.wakka into
  doc/manual/cache/CompilerErrMsg.wakka, and update the online wiki too.
  
  - Update the wiki samples in examples/manual/ (may want to clear
    out the old ones first, to delete those removed from the wiki)
  
  ```
  cd doc/fbchkdoc
  ./getindex -web
  ./samps extract @PageIndex.txt
  ```

**Summary: currently the easiest way to build a release**

- Update the wiki snapshot in the fbc sources
- Regenerate PrintToc and CompilerErrMsg
- If needed, update wiki samples in examples/manual/
- Build documentation packages (CHM on Windows, rest can be done on Linux)

- Check whether toolchains used in the contrib/release/build.sh
  script need updating
- Have target systems ready (installations of Linux and Windows, 32bit and 64bit -- virtual machines are useful for this)

- For each system, update fbc sources (to have the latest version of the release script)

- On win32:

  ```
  cd contrib/release
  ./build.sh win32
  ./build.sh win32-mingworg
  ./build.sh dos
  ```

- On win64:

  ```
  cd contrib/release
  ./build.sh win64
  ```

- On linux-x86:

  ```
  cd contrib/release
  ./build.sh linux-x86
  ```

- On linux-x86_64:

  ```
  cd contrib/release
  ./build.sh linux-x86_64
  ```

- Collect all the archives and manifests from the contrib/release/input and contrib/release/output directories

- Review the manifests to check for missing files etc.

- If ok, commit the new manifests

- Create the release tag

- Upload the packages

- Post announcements
**Bootstrapping fbc on a new system**

fbc is written in FB itself, so you need a working fbc to build a new fbc. To do this, you can bootstrapping to the target system, or full cross-compiling using a gcc cross-compiler to the target system.

**Bootstrapping using the FreeBASIC-x.xx.x-source-bootstrap package**

The FreeBASIC-x.xx.x-source-bootstrap package contains the FB sources plus precompiled compiler sources, for multiple targets. After extracting, this can be built without requiring an existing fbc:

```
make bootstrap
```

(as long as the package contains the precompiled sources for the target system)

This package can be created by running:

```
make bootstrap-dist
```

Doing `make bootstrap-dist`, taking the package to the target system, and then:

**Bootstrapping by precompiling the compiler sources**

- On Linux or Win32 (or another system where you have a working fbc):

```
fbc -e -m fbc src/compiler/*.bas -r -target -arch
```

Some random examples:
- x86 Win32 -> x86 OpenBSD: `-target openbsd [-arch 486]`
- x86 Win32 -> x86_64 FreeBSD: `-target freebsd -arch x86_64`
- x86 Linux -> ARM Linux: `-target arm-linux-gnueabihf, or just -arch`

- On the target system, compile FB's rlib/gfxlib2 using the native C compiler:

```
make rlib gfxlib2
```
- Take the `.asm` or `.c` files (produced in the first step) to the target system,

- If you produced `.asm` files, take them to the target system, and use the target system's native tools to build the final fbc executable:

  ```bash
  for i in src/compiler/*.asm; do
    as $i -o `echo $i | sed -e 's/asm$/o/g'`
  done
  gcc -o fbc lib/freebasic//fbrt0.o src/compiler/*.o -Llib/freebasic/
  ```

- If you produced `.c` files, take them to the target system, and compile them into a new fbc executable:

  ```bash
  ```

**Additional notes & tips**

- The new fbc and the new rtlib/gfxlib2 must be built from the same FB source code, otherwise there can be incompatibility issues.
- The compiler version should always match the version of rtlib/gfxlib2 in its build.
- When linking fbc for a Unix-like system, you need to link it against `libncurses` or `libtinfo`, and also link against `libncurses` or `libtinfo`, and also link against `libncurses` if you are in a Unix-like system where you need to link against these libraries and `gcc` does not link them by default.
- When linking fbc for Win32/Win64 that's not needed.

An alternative to linking with `gcc` is to invoke `ld` manually, like fbc itself would normally do it. You can look at fbc -v output to see what it does. However this is more complicated.

**Bootstrapping by cross-compiling everything**

If you're on Linux or Win32 or another system where you already have a cross-compile an FB setup like so:

- Build a native FB setup with additional libraries for cross-compiling:

  ```bash
  # Get a directory with the fbc sources, e.g. "fbc"
  cd fbc
  make
  make rtlib gfxlib2 TARGET=
  # Optionally, you can install everything into /usr/local:
  make install
  make install-rtlib install-gfxlib2 TARGET=
  ```
Use the native FB setup built above to cross-compile the new FB

```bash
cd ..
mkdir crosscompiled-fbc && cd crosscompiled-fbc
make -f ../fbc/makefile FBC='../fbc/bin/fbc -i ../fbc/inc' TARGET=
# (Specifying FBC=... is only needed if you did not install it globally)
```

**Cross-compiling the 64bit version on a 32bit system with gcc -m64**

If you have a gcc multilib toolchain with -m64 support on a 32bit system, the MinGW-w64 project also have support for cross-compiling to 64bit via

```bash
# Get FB sources into fbc/ (must be 0.91+ because earlier versions didn't support multilib/64bit at all),
# and build a native (32bit) FB first
cd fbc
make

# Then add the 64bit rtlib/gfxlib2 to that. Specifying MULTILIB=64
make rtlib gfxlib2 MULTILIB=64

# Now we have a new 32bit FB with 64bit libraries for cross-compiling:
# This can now be used to build a full 64bit FB:
cd..
mkdir fbc64
cd fbc64
make -f ../fbc/makefile MULTILIB=64 FBC='../fbc/bin/fbc -i ../fbc/inc'
```

This does not only work with gcc -m64 on 32bit, but also with gcc -m32 on
About This Guide

This guide is not a **C tutorial** or a **step by step guide** for converting headers. This is a style guide which represents the ideal header we would like to maintain. Currently not all of the headers under our control conform to this guide 100%, but work is in progress to do this and all new contributions should attempt to use these standards.

**General**

- Translations should be very close to the original, so they look familiar and can be updated easily.
- Identifiers (including any #defines) should not be changed unless absolutely necessary.
- Smaller files may be combined into one bigger header, if they would be #included anyways and all belong to the same library.
- Original license should be retained.

**Coding style**

- Headers need to work with the latest FreeBASIC version.
- Naming conflicts between multiple identifiers (due to FreeBASIC's case insensitivity) or an identifier and a FreeBASIC keyword should be resolved by appending an underscore to one identifier.
- extern "c" blocks should be used instead of cdecl alias "..." for function declarations or function pointer types.
- Preprocessor directives (including #defines) should be preserved
  Exception: Remove if they serve only to select options for different C compilers, i.e. extern differences, then these can be removed unless they provide support for further code. When choosing compilers the choice should favor GNU C.
- FreeBASIC keywords should be lower-case.
Dealing with constructs not supported by FreeBASIC

- Inline functions should be converted to a macro if appropriate.
- Preprocessor directives inside structure declarations, function bodies, or similar may need to be moved outside because in FreeBASIC they'd be scoped.
- Declarations spread across multiple lines with preprocessor directives in between them (for example function declarations, or array initializers) will need to be manually rewritten.
Quick overview of all modules

(Only somewhat sorted)

fbc
Frontend: main module, entry point, command-line handling, assembling/linking/etc.

objinfo
Object/library information section reader/writer, used by fbc. Includes tiny ELF/COFF object file format readers.

fb
FB parser interface, starts the parser for every input/include file.

parser
Recursive parser, asks lex for tokens, builds up the ast.

lex, pp
Lexer/tokenizer and preprocessor directive parsing.

error
Error reporting functions, used by many parts of fbc, mostly the parser though.

rtl
Helper functions to build up the ast nodes for rtlib/gfxlib function calls. Declarations must match the actual functions in the rtlib/gfxlib2 source code.

symb
Symbols lookup and storage (information on variables/functions), scope/namespace handling, name mangling; used by parser/ast/emitter:

ast
Abstract syntax tree: per-function code-flow + expressions.
astNew*(): Node creation/tree building, used by the parser.
astLoad*(): First step in emitting, calls ir, called after each function is parsed.
ir, ir-hlc, ir-llvm, ir-tac
Intermediate representation interface (using virtual registers) used to emit the ast.
hlc: High level C emitter (high level in comparison to the ASM backend anyways)
llvm: LLVM IR emitter
tac: Three-address-codes module (asm backend), calls emit. Responsible for register allocation, reusing, spilling.

reg
Register allocator for ir-tac.

emit, emit_SSE, emit_x86
Assembler emitter abstraction and SSE/x86 emitters.

edbg_stab
Stabs debug format emitting for emit_x86.

dstr
Dynamic z/wstrings, used mostly by lex.

hash
Generic hash table, used by symb/fbc.

hlp, hlp-str
Helper functions for all parts of the compiler, plus another implementation of dynamic z/wstrings.

list
Generic linked list with built-in memory pool, used a lot. This is often used as pure pooled allocator, for example for AST nodes or symbols.

flist
list-based without deletions.

pool
list-based allocator using multiple lists with node sizes ranging from small to large, allowing it to store away strings into the next best fitting chunk t
waste as less memory as possible. Used to store away symbol identifiers.

stack
Generic list-based stack.
fbc stores extra information into the object files (.o) it generates, in order to read it out again at link-time. The information that is stored currently consists of the -lang/-mt settings and all libraries/search paths (-l, #inclib, -p, #libpath) that were specified when compiling that object file. This way fbc can show a warning when mixing object files that were compiled with different options, because they may be incompatible, and fbc can automatically link in libraries that were specified via #inclib, even if the user compiles and links in separate steps.

This is accomplished by emitting an extra section called "fbctinf" (FreeBASIC compile time information?) when compiling, and reading it back in at link-time. Furthermore, when building a static library, fbc creates an extra object file (called __fb_ct.inf) containing just that extra information and adds it to the library. At link-time fbc looks at each library to figure out whether it has such an __fb_ct.inf file or not.

In order to do this fbc has a custom COFF, ELF32 and also archive file format readers that can extract the .fbctinf section content. Previously, fbc used libbfd from binutils to do this, however depending on libbfd is problematic especially because of its highly unstable ABI.
**Memory management**

fbc tries to avoid memory allocations as much as possible, since they are pretty slow generally. The linked list implemented in list.bas comes with a builtin memory pool, so pretty much every list is pooled. The memory pool pre-allocates large chunks and can then quickly hand out many small nodes. Those lists are used for simple things like the list of libraries to link into an executable, but also for heavier things like AST nodes. The memory pool is supposed to speed things up (no idea if this was ever verified though).

In many places the compiler simply uses global/static variables, for example fixed-length strings, in order to avoid memory allocations. Tokens are a nice example: lex.bas parses input characters into tokens, and stores the token text in static buffers. Token text, that could be: variable names, string literals, and so on. All tokens are stored here though, so the preprocessor can correctly record macros. Now take into account the huge number of tokens the parser has to deal with: For example, FB's current Windows headers result in ~100k tokens. Dynamically allocating a buffer for every token would quickly become inefficient.

Of course the token length is limited by using a static buffer, but fbc's default of 1024 bytes should be enough for everyone. Similar length limitations apply to many things in the compiler because of the use of fixed-length buffers. In most situations, the buffers in the compiler are not used to their full potential, i.e. they are bigger than they need to be.

All that does not mean the compiler does not use dynamic memory allocations at all. It does, in situations when allocating is easier than using a list/pool and speed is not critical. FB's builtin string type is used in many places too. As long as the string's are kept allocated, they are very efficient. Expansion of macro parameter stringifying in the pre-processor uses a strReplace() based on string's, and it is fast (enough). Besides that, dynamic strings, which are basically the same as string's, are used everywhere in the pre-processor, from macro recording to macro expansion.
Out-of-memory situations/allocation failures are not seriously handled. There are NULL checks in some places where allocate() is called, but these checks are pointless, since the rest of fbc does not check for NULL. NULL is sometimes used to indicate an error, for example by some astNew*() functions. Also, the compiler does not deallocate() everything, but lets the OS do the cleanup.
Lexer & preprocessor

lex*.bas: File input, tokenization, macro expansion buffer, token queue, tokenization, macro expansion buffer, token queue, token queue, #includes, contexts.

pp*.bas: Preprocessor directive parsing, macro expansion text construction.

The lexer reads the source code from the .bas files and translates it into tokens, so the FB parser sees this:

```plaintext
dim as integer i = 5
print i
```

as:

```
Top-level parser retrieves the first token:
DIM keyword (Go to variable declaration parser)
AS keyword (Go to datatype parser)
INTEGER keyword (Data type)
"i" symbol (Back to variable declaration, variable identifier)
"=" operator (Go to initializer parser)
"5" number literal (Expression)
EOL statement end (Variable declaration parser is done, the variable is added to the AST, back to toplevel parser)

Next line, next statement)
PRINT keyword (Go to QB print quirk function call parser)
"i" symbol (Expression, lookup "i" symbol, it's an integer variable, create a CALL to fb_PrintInt(), the expression is the argument)
EOL (Print parser is done, back to toplevel)
EOF (Top-level parser is done)
```

The lexer is an abstraction hiding the ugly details of user input (indentation, comments, keyword capitalization, #includes) from the parser. Additionally it does preprocessing, consisting of macro expansion text construction. The general idea is to handle all preprocessing in the lexer, so the parser never sees it. The parser never calls preprocessor functions, the lexer does.

**Tokens**

Macro storage and expansion
Preprocessor directive parsing
File contexts
Quick overview of the call graph
Purpose

fb.bas: Main module for the compiler, parent module for parser/lexer/AST/IR/emitters, toplevel file & include file handling
parser*.bas: Parsing/compilation functions: lexer tokens -> AST nodes.
symb*.bas: Symbol tables and lookup, namespace/scope handling.
rtl*.bas: Helpers to build AST calls to rtlib/gfxlib functions.

The structure of the parser has a very close relation to the FreeBASIC grammar. Basically there is a parsing function for every element of the grammar.

The parser retrieves tokens from the lexer and validates the input source code. Most error messages (besides command line and file access errors) come from here. Additionally the parser functions build up the corresponding AST. This is the heart of the compilation process.

Many of the parser's (or rather compiler's) functions (prefixed with a 'c') parse and skip the grammar element they represent, or show an error if they don't find it. The parser is fairly recursive, mostly because of the expression parser and the #include parsing.

From parsing to emitting

When parsing code a corresponding AST is built up to represent the program. The AST is used to represent executable code, but also to hold temporary expressions, for example the values of constants or the initializers found while parsing type or procedure declarations. The AST does not contain nodes for code flow constructs like IF, DO/LOOP, GOTO, RETURN, EXIT DO, etc., but it contains labels and branches. Likewise, several operations (like IIF(), ANDALSO, ORELSE, field dereference, member access) are replaced by the corresponding set of lower-level operations in the AST.

After parsing a function, the AST for this function is optimized, and then emitted recursively via astLoad*() calls on each node, from the top down. Note that each AST node has its own implementation of astLoad().
Top level parsing process

fb.bas:fbCompile() is called from the fbc frontend for every input file. Parsing (and compiling) of the file begins here.

fb.bas:fbCompile()
- Open the input .bas
- Start the emitter (ir) (Open the output .asm)
- fbMainBegin() (Build the AST for the implicit main() or static constructor for module-level code)
- fbPreIncludes()
  - fbIncludeFile() for every preinclude (found on the fbc command line)
- cProgram()
- fbMainEnd() (Close the implicit main())
- Finish emitting (ir) (Finish generating the .asm and close it)
- Close the input .bas

fb.bas:fbIncludeFile()
- Include file search
- lexPush() (Push a new lexer context to parse this #include file without disturbing the lexer's state in the parent file)
- Open the include file
- cProgram()
- Close the include file
- lexPop() (Restore the lexer state to the parent file)

parser-toplevel.bas:cProgram() is the root of the FB grammar, and parses a file. Here's a short & quick run down of what is done:
- cLine() repeatedly until EOF
  - cLabel()
  - cStatement()
    - Declarations
      - UDT declarations, typedefs
- Variables (DIM, VAR, ...)
- Procedure declarations (DECLARE)
- Procedure bodies (SUB, FUNCTION, ...)

(Procs temporarily replace the implicit module level procedure, so any AST nodes go into them instead of the implicit main())

- Compounds statements (IF/ELSE, DO/LOOP, EXIT/CONTINUE DO, ...)
- Procedure calls
- Function result assignments
- Quirk statements (special QB rtlib/gfxlib statements
- ASM blocks
- Assignments
- Procedure pointer calls

and most of them use cExpression() at some point.
In order to be able to make the transition from tokens to AST, the parser needs to be able to recognize functions, variables, types, etc. The `symb` module keeps track of all these symbols and their namespaces and scopes. The parser can do lookups in the current scope, or in just specific namespaces. Many AST nodes have a corresponding symbol (e.g. variables and functions).
Almost all parts of the compiler deal with data types in one way or another. Types the most, this is what most of the compile-time type checks are based on. Data types, that takes care of expressions (including casting/conversions).

A data type is represented as a combination of:

- **dtype** integer
  - 5 bits: raw type:
    - void (unknown type, e.g. any ptr, type t as t)
    - byte, ubyte
    - char (zstring pointers and their deref expressions)
    - short, ushort
    - wchar (wstring pointers and their deref expressions)
    - integer, uinteger
    - enum (integer)
    - long, ulong
    - longint, ulongint
    - single, double
    - string (variable length)
    - fixstr (fixed length strings, string * N, N is t)
    - struct (UDT, -> subtype is used)
    - namespace (used during name mangling?)
    - function (used for function pointers, -> subtype is declaration)
    - forward reference (will be changed to actual subtype is used)
    - pointer (this value is only used temporarily as macro)
    - xmmword (used by SSE emitter)
  - 4 bits: PTR count

How many PTR's there are on the type, maximum 8. If > 0, then the data
- 9 bits: CONST mask (8 PTR's + 1 "base")

<table>
<thead>
<tr>
<th>Example</th>
<th>CONST mask</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>const integer</td>
<td>000000001</td>
<td>(first CONST</td>
</tr>
<tr>
<td>integer const ptr</td>
<td>000000001</td>
<td>(ditto)</td>
</tr>
<tr>
<td>const integer ptr</td>
<td>000000010</td>
<td>(pointer to</td>
</tr>
<tr>
<td>const integer ptr const ptr</td>
<td>000000101</td>
<td>(const pointer</td>
</tr>
</tbody>
</table>

- **subtype**, which for some types points to symbol:
  - For UDTs types (structs/classes, enums) this points to a symbol
  - For forward-referencing typedefs this points to a special forward reference symbol which will eventually be replaced by the actual subtype symbol
  - For procedure pointers, this points to an anonymous calling convention etc. and most importantly the type

- **length integer**
  This is used in places that have to calculate sizes (e.g. structure size calculations, stack offsets).
Select Case

Basic implementation

```basic
dim i as integer

scope
select case i + 123
  case 1
    temp = i + 123
    if temp = 1 then goto cmplabel1
  case 2
    temp = i + 123
    if temp = 2 then goto cmplabel2
  case else
    end select
cmplabel1:
  end select
  end scope
  print "1"
goto endlabel

cmplabel2:
  end select
  end scope
  print "2"
goto endlabel

cmplabel3:

end label:
end scope
```

- **SELECT CASE**
  - opens the implicit outer scope
  - declares the temp var
    - when inside a procedure with STATIC, the temp var
    - the FB_SYMBATTRIB_TEMP is removed from the
- emits the assignment
- declares the end label
- each CASE
  - if there was a previous CASE
    - closes the previous CASE's scope
    - emits a jump to the end label
  - emits the label for this CASE
  - emits a conditional branch that jumps to the next CASE if the CASE condition is not met
  - opens the CASE's scope
  - CASE ELSE does not emit a conditional branch
  - once CASE ELSE was used, no further CASE blocks are allowed

- END SELECT
  - closes the previous CASE's scope
  - emits an extra CASE label at the end (There is no CASE coming anymore, but this allows the last CASE to jump to the SELECT's end label. It is a conditional CASE. The last CASE could jump to the SELECT's end label instead, but that would require some special case handling code.)
  - emits the end label
  - any EXIT SELECTs jump immediately to the end label

**SELECT CASE on strings/zstrings/fixstrs**

```plaintext
dim s as string
scope
dim temp as string
fb_StrAssign( temp, s )
fb_StrConcatAssign( temp, "1"

case "1"
  if( fb_StrCompare( temp, 0 )
    goto cmplabel1
  end scope

print "1"

print "1"

end scope
```
SELECT CASE on string/zstring/fixstr expressions uses a string temp var probably because that's easiest
■ knowing the string length will potentially speed up the following comparisons
■ the dynamic memory allocation can be a slow down too
■ the string temp var is destroyed at scope end or scope breaks (e.g. block)

**SELECT CASE on wstrings**

dim w as wstring * 10
dim w as wstring * 10

select case w + wstr( "1" )

• case wstr( "1" )
  1) if( fb_WstrCompare( temp, wstr("1") )
  then goto cmplabel1

print "1"

go to endlabel

cmplabel1:
end label:
fb_StrDelete( temp )

end select

fb_StrDelete( s )
- similar to SELECT CASE on zstrings, for wstring expressions a wstring is dynamically allocated the temp wstring is treated much like a dynamic wstring object when:
  - it is a VAR symbol with type WCHAR PTR
  - marked with FB_SYMBSTATS_WSTRING
  - this allows ctor/dtor checks to recognize it and give it the right treatment this way, the temp wstring is destroyed at scope end or scope break

**SELECT CASE without temp var**

When the expression given to the select statement is just a simple variable case, the given variable itself will be used in the comparisons at each case:

```plaintext
dim i as integer
scope
select case i
  case 1
    if( i > 1 ) then goto cmplabel1
    print "1"
  scope
  print "1"
end scope
end select
scope
endlabel:
```

```plaintext
goto endlabel
```

```plaintext
cmplabel1:
endlabel:
end scope
```
Keyboard Input

Basics

Using FB's built-in functionality, there are four ways of getting keyboard input:

- **Inkey()** returns a string containing an ASCII char corresponding to the key pressed by the user, or a 2-byte FB extended keycode for some special keys, such as the Arrow keys or Page Up/Down. It works pretty much like it did in QB.

- **Getkey()** returns the same information as `inkey()`, but in form of an integer instead of a string. `inkey()` and `getkey()` belong together: They use the same code and they are located in the same modules.

- **Multikey()** takes an FB scancode (SC_*) and checks whether that key is pressed at this moment.

- **Screenevent()** returns key presses in form of EVENT_KEY_PRESS events (and others for key release or repeat). It returns the FB scancode in the Event.Scancode Field, and the ASCII char value or 0 in the EVENT.ascii field. EVENT.ascii does not use FB extended keycodes; the EVENT.scancode field can be checked instead in order to handle extended keys.

"scancode" refers to the SC_* #defines which are more or less matching the DOS keyboard scancodes. The values are not made up, they themselves correspond to certain ASCII chars, for example: SC_HOME = &h47.; They're also the same values that you get under DOS/DJGPP or from the Linux kernel as part of extended key code sequences. Besides their use in `multikey()` or `screenevent()`, scancode are used in various places internally, for example when translating between different kinds of key codes, as an easy-to-use and portable representation of keycodes.

"key" refers to an ASCII char, or a 2-byte extended keycode string for other keys as returned by `inkey()`. The rtlib has several KEY_* #defines
for the available 2-byte extended keycodes, in form of integers. These are used internally and also match the values returned by getkey().

FB's 2-byte extended keycodes consist of a &hFF; byte followed by a byte containing the SC_* scancode value corresponding to the keypress. Checking for SC_HOME returned by inkey() could look like:

```
if( inkey( ) = chr( 255 ) + "G" ) then ...
```

Checking for SC_HOME returned by getkey():

```
if( getkey() = &h47FF; ) then ...
if( getkey() = ((SC_HOME shl 8) or &hFF;) ) then ...
```

inkey(), getkey() and multikey() use wrapper functions that call ...

- the console-mode versions fb_ConsoleInkey(), fb_ConsoleGetkey(), fb_ConsoleMultikey() by default,
- or the gfxlib versions fb_GfxInkey(), fb_GfxGetkey(), fb_GfxMultikey() if a graphics SCREEN is active,

by using function pointer hooks.

**rtlib**

The rtlib has separate console-mode implementations of the above functions, for each platform:

- **DOS**

  fb_ConsoleInkey() and fb_ConsoleGetkey() use DJGPP's getch() function to retrieve input characters anytime they're called. getch() returns ASCII chars, but also 2-byte sequences for special keys, which are easy to handle because they match the SC_* scancodes.

  fb_ConsoleMultikey() installs an interrupt handler that uses port I/O to read keyboard information and updates a key state table which is checked by multikey().

- **Win32**

  fb_ConsoleInkey() and fb_ConsoleGetkey() (indirectly) use the Win32 API functions PeekConsoleInput() and ReadConsoleInput() to get queued key press/release events whenever needed. All currently pending events are handled during a call, and after very complex internal translation involving MapVirtualKey(), the keys are put into a buffer, from where

  fb_ConsoleInkey() and fb_ConsoleGetkey() read the keys they return.
SetConsoleCtrlHandler() is used to listen for console close/system shutdown events to provide SC_CLOSE events for console-mode (the win3 port of the rtlib might be the only one going this far).

fb_ConsoleMultikey() uses a FindWindow()/GetForegroundWindow() hack to determine whether the console window is focused, and if yes, simply uses GetAsyncKeyState().

- Linux, *BSD

The Unix port of the rtlib runs a console keyboard handler (and a console mouse handler) in a background thread, in order to provide input for multikey() (and getmouse()).

fb_ConsoleInkey() and fb_ConsoleGetkey() read input bytes through the __fb_con.keyboard_getch() hook. By default, __fb_con.keyboard_getch() points to a simple function that just uses fgetc() on /dev/tty (indirectly; the Unix rtlib initialization code opens the handle, and changes I/O settings etc., not only for the purpose of keyboard input, but mostly).

The terminal returns ASCII chars for simple key presses, and special escape sequences for extended keys. On the first call, various termcap lookups (via tgetstr()) are done to determine these terminal-specific escape sequences for certain key press events, and they are put into a lookup tree to allow easy & fast translation to the corresponding FB extended keycodes. By doing the termcap query the Unix rtlib can support all the different terminals (e.g. xterm vs. linux) quite well, although there still are some keys not working here and there.

Only one "event" (ASCII char or escape sequence) is read at a time, the resulting key is added to a key buffer, from where fb_ConsoleInkey() and fb_ConsoleGetkey() can read it.

fb_ConsoleMultikey() is currently implemented for the Linux port only, not under *BSD though. In console-input mode (used under 'console'/linux terminals), it dup()icates the rtlib's /dev/tty handle, and switches it over into medium raw mode. Then it overrides the background thread's __fb_con.keyboard_handler() hook to a function that read()s kernel key codes from the duplicated /dev/tty handle. Called from the background thread, it reads a fixed amount of input at
once, whenever it arrives. After somewhat complex translation, a key
state table is updated to reflect the state of pressed/released keys, to be
checked by fb_ConsoleMultikey() at any time, and the keys are added to
a key buffer from where an overridden _fb_con.keyboard_getch() reads
them, whenever called by fb_ConsoleInkey() or fb_ConsoleGetkey() [why
is this done?]. Furthermore, the keys are sent to the Linux fbdev gfxlib2
driver, if it's active.
In X11 mode (used under 'xterm' terminal), fb_ConsoleMultikey() sets the
background thread's __fb_con.keyboard_handler() to a function that
checks whether the xterm has input focus (XGetInputFocus()) and if yes,
simply uses XQueryKeymap() to update the key state table for
fb_ConsoleMultikey().

**gfxlib2**

In the gfxlib, fb_GfxInkey() and fb_GfxGetkey() use one key buffer (sam
code on all platforms), to which the different/platform-specific gfx drivers
post keys to. Similar to that, there is a single key state table for
fb_GfxMultikey(), and it is also updated by the gfx drivers. Whether or
not the gfx drivers actually do post keys or update key states is up to
them though.

- **DOS**
The DOS gfxlib2 port (for all DOS gfx drivers) sets a hook/callback that's
called by the same keyboard interrupt handler used by the DOS
fb_ConsoleMultikey().
- **Win32 driver**
The gfx window thread listens to WM_KEYDOWN, WM_CHAR and WM_CLOSE,
translates the keys, and then updates the key state table, posts them to
the fb_GfxInkey()/fb_GfxGetkey() buffer, and fills in & posts the
_corresponding EVENT for screeevent().
- **X11 driver**
The gfx window thread listens to_KeyPress and other XEvent's, translates
the keys, then posts them etc., just like the Win32 driver.
- **Linux fbdev driver**
As mentioned above, the fbdev driver gets its input from the same
keyboard handler code that's used by the Linux fb_ConsoleMultikey().
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Tokens

Interface

The basic public interface of the lexer is from `lex.bas`:

- `lexGetToken()`: Retrieve current token's id, an FB_TK_* value.
- `lexGetLookAhead(N)`: Look ahead N tokens
- `lexSkipToken()`: Go to next token
- `lexGetText()`: Returns a zstring ptr to the text of the current token, e.g. string/number literals (their values are retrieved like this), or the text representation of other tokens (e.g. operators).
- some more `lexGet*()` accessors to data of the current token
- `lexPeekLine()`: Used by error reporting to retrieve the current line of code.

Current token + look ahead tokens

Tokens are a pretty short-living thing. There only is the current token and a few look ahead tokens in the token queue. That's all the parser needs to decipher FB code. The usual pattern is to check the current token, decide what to do next based on what it is, then skip it and move on. Backward movement is not possible. The file name, line number and token position shown during error reporting also comes from the current lexer state.

The token queue is a static array of tokens, containing space for the current token plus the few look ahead tokens. The token structures contain fairly huge (static) buffers for token text. Each token has a pointer to the next one, so they form a circular list. This is a cheap way to move forward and skip tokens, without having to take care of an array index. Copying around the tokens themselves is out of question, because of the huge text buffers. The "head" points to the current token; the next "k" tokens are look ahead tokens; the rest is unused. When skipping we simply do "head = head->next". Unless the new head already contains a
token (from some look ahead done before), we load a new token into the new current token struct (via lexNextToken()). Look ahead works by loading the following tokens in the queue (but without skipping the current one).

**Tokenization**

`lex.bas:lexNextToken()`

The lexer breaks down the file input into tokens. A token conceptually is an identifier, a keyword, a string literal, a number literal, an operator, EOL or EOF, or other characters like parentheses and commas. Each token has an unique value assigned to it that the parser will use to identify it, instead of doing string comparisons (which would be too slow).

`lexNextToken()` uses the current char, and if needed also the look ahead char, to parse the input. Number and string literals are handled here too. Alphanumeric identifiers are looked up in the `symb` hash table, which will tell whether it's a keyword, a macro, or another FB symbol (type, procedure, variable, ...).

Identifiers containing dots (QB compatibility) and identifier type suffixes (as in stringvar$) are handled here too (but not namespace/structure member access). Tokens can have a data type associated with them. That is also used with number literals, which can have type suffixes (as in `&hFFFFFFFFFFFFFFFu11`).

**Side note on single-line comments**

Quite unusual, single-line comments are handled by the parser instead of being skipped in the lexer. This is done so that usage of `REM` can easily be restricted as in QB, afterall `REM` is more like a statement than a comment. Besides that, comments can contain QB meta statements, so comments cannot just be ignored. Note that the parser will still skip the rest of a comment (without tokenizing it), if it does not find a QB meta statement.

(Multi-line comments are completely handled during tokenization though)

**File input**
lex.bas:hReadChar()

The input file is opened in fb.bas:fbCompile(); the file number is stored in the global env context (similar for #includes in fb.bas:fbIncludeFile()). The lexer uses the file number from the env context to read input from. It has a static zstring buffer that is used to stream the file contents (instead of reading character per character), and for Unicode input, the lexer uses a wstring buffer and decodes UTF32 or UTF8 to UTF16. The lexer advances through the chars in the buffer and then reads in the next chunk from the file. EOF is represented by returning a NULL character.
**Macros**

Some terms used in the source code (Note the double meanings):
- **macro**: The `#defined/#macroed` object that will be expanded to its replacement text
- **macro**: a function-like macro, e.g. `#define m(a, b)`
- **define**: an object-like macro, e.g. `#define simple`
- **argless define** (should be called parameter-less): a function-like macro without parameters, e.g. `#define f()`

**How macros are stored**

Macros are basically stored as raw text, not as token runs (as in GCC's libcpp for example). The body of simple `#defines` without parameters is stored as one string. Macros with parameters are stored as sequence of "macro tokens". There are three types of macro tokens:
- **text("")**
  Raw text, but spaces and empty lines trimmed (like in a `#define` without parameters)
- **textw("")**
  Same as above, just for Unicode input.
- **parameter(index)**
  A macro parameter was used here in the declaration. The index specifies which one. During expansion, the text of argument(index) is inserted where the parameter was in the declaration.
- **stringify_parameter(index)**
  Same as above, except the argument will be stringified during expansion.

Note: macro tokens are actually `symb.bi:FB_DEFTOK` structures, and they contain an id field holding on of the `FB_DEFTOK_TYPE_*` values to tell what they contain.

For example:

```
#define add(x, y) x + y
```

becomes:
And the expansion text will be:

\[
\text{argument(0)} + " + " + \text{argument(1)}
\]

Storing macros as text is a fairly easy implementation, but it requires to re-parse the macro body over and over again. For example, since GCC works with preprocessing tokens and tokenruns, macros are stored as tokens, making expansion very fast, because there is no need to tokenize the macro body again and again. fbc's implementation is not as flexible and maybe not as efficient, but is less complex (regarding code and memory management) and has an upside too: Implementation of `##` (PP token merge) is trivial. `##` simply is omitted while recording the macro's body, where as in token runs the tokens need to be merged explicitly.

**When are macros expanded?**

Because of token look ahead, macros must be expanded during tokenization, otherwise the wrong tokens might be loaded into the token queue. After all the parser should only get to see the final tokens, even during look ahead.

In `lexNextToken()`, each alphanumeric identifier is looked up in the symbol module to check whether it is a keyword or a macro. Macros and keywords are kept in the same hash table. Note that macros cannot have the name of keywords; "#define integer" causes an error. If a macro is detected, it is immediately expanded, a process also called "loading" the macro (`pp-define.bas:ppDefineLoad()`).

**Macro call parsing**

If the macro takes arguments, the macro "call" must be parsed, much like a function call, syntax-wise. Since macro expansion already happens in `lexNextToken()`, the source of tokens, the parsing here is a little tricky. Forward movement is only possible by replacing (and losing) the current token. The token queue and token look ahead cannot be relied upon. Instead it can only replace the current token to move forward while parsing the macro's arguments.
Since `lexNextToken()` is used to parse the arguments, macros in the arguments themselves are recursively macro-expanded while the arguments are being parsed and recorded in text form. The argument texts are stored for use during the expansion.

So, a macro's arguments are expanded before that macro itself is expanded, which could be seen as both good and bad feature:

```c
#define stringify(s) #s
stringify(__LINE__)
```

results in 2 in FB, but `__LINE__` in C, because in C, macro parameters are not expanded when used with `#` or `##`. In C, two macros have to be used to get the 2:

```c
#define stringize(s) #s
#define stringify(s) stringize(s)
stringify(__LINE__)
```

**Putting together the macro expansion text**

The expansion text is a string build up from the macro's body tokens. For macro parameters, the argument text is retrieved from the argument array created by the macro call parser, using the indices stored in the parameter tokens. Parameter stringification is done here.

There is a specialty for the built-in defines (`__LINE__`, `__FUNCTION__`, `__FB_DEBUG__`, etc.):

A callback is used to retrieve their "value". For example: `__LINE__`'s callback simply returns a string containing the lexer's current line number.

**Expansion**

The macro expansion text (`deftext`) is stored by the lexer, and now it will read characters from there for a while, instead of reading from the file
input buffer. Skipping chars in the macro text is like skipping chars in the file input: Once skipped it's lost, there is no going back. So, there never is "old" (parsed) macro text, only the current char and to-be-parsed text. New macro text is prepended to the front of existing macro text. That way macros inside macros are expanded.

This implementation does not (easily) allow to detect macro recursion. It would be hard to keep track of which characters in the macro text buffer belong to which macro, but that would be needed to be able to push and pop macros properly. It could be done more easily with a token run implementation as seen in GCC's libc++p. However C doesn't allow recursive macros in the first place: In C, a macro's identifier is undefined (does not trigger expansion) inside that macro's body. That is not the case in fbc, because (again) a way to detect when a macro body ends is not implemented.

Currently fbc only keeps track of the first (toplevel) macro expanded, because it's easy to detect when that specific macro's end is reached: as soon as there is no more macro text.

That's why the recursion is detected here:

```c
#define a a
#define a
```

and here too:

```c
#define a b
#define b a
#define a
```

but not here: (Note that fbc will run an infinite loop)

```c
#define a a
#define a
#define m a
#define m
```
Directive parsing

Preprocessor directives (#if, #define, #include, etc.) are parsed during pp.bas:ppCheck(). After moving to the next token (or loading a new token), if the current token is a '#'. If so it will also check whether the previous token is a begin, and directly parses the PP directive, using the same lexGetToken() parser. This is necessary because some PP directives result in parser functions being called, for example identifier.bas:cIdentifier() is used by the #ifdef parser, to recognize

```
dim as integer i
#ifdef i
#endif
```

So, lexSkipToken() is recursive because of the PP. ppCheck() will only call lexSkipToken(), but not if it was called recursively from the PP. This lets #macro ... #endmacro or skip #if ... #endif blocks without "executing" the macro, Note that unlike C, FB allows macros to contain PP directives.

As a result, every time the FB parser skips an EOL, lexSkipToken() might then call the PP to let it parse that directive. It may "silently" parse more that the PP directives are even there. The PP parsing launched from lex #include and call fb.bas:fbIncludeFile() to parse it immediately, recursively, toplevel.bas:cProgram() for that #include file. The parser has to be able to happen during every lexSkipToken() at EOL, but luckily that is not a big deal to keep track of compound statements anyways.

Note that PP directives are not handled during token look ahead (lex.bas:lexGetLookAhead() to look ahead across EOL, it could very well see a PP directive. Luckily this is not necessary.

**Macro expansion in PP directives**

The beginning of directives, the keyword following the '#', is parsed without redefining PP keywords (intentionally) has no effect on the PP directives
will not intermediated be seen as:

```
#define define foo
#define bar baz
```

Directives like `#if` & co. make use of the PP expression parser, which does point of PP expressions. For example:

```
#define foo 1
#if foo = 1
#endif
```

The `#define` and `#macro` directives don't do macro expansion at all. A macro's body is recorded as-is. A macro's body is recorded as-is.

**#define/#macro parsing**

`pp.bas:ppDefine()` first parses the macro's identifier. If there is a `('` followed, then the parameter list is parsed too.

Then the macro body is parsed. For each token, its text representation is appended to the macro body text. Space is preserved (but trimmed); comments are left out; in multi-line `#macro`s, empty lines are removed.

If the macro has parameters, the `macro` tokens will be created (as discussed: macro parameters are added to a temporary hash table, which associates parameter names to their indices. Then, identifiers in the macro body are looked up, and when a parameter is recognized, a `parameter(index)` macro token is created, instead of appending the token to the previous `text()` for it). After that `parameter(index)`, if there is other text again, a new `text()` macro token is created.

Using `#` on a parameter results in the creation of a `stringify_parameter(index)` macro token. The `PP` merge operator `##` is simply omitted from the macro body, so `a##b` becomes `ab` before/after/between parameters goes into `text()` macro tokens.

For example:
#define add(x, y) foo bar x + y

And the actions of the `#define`/#macro parser will be:

'add' - The macro's name
'(' following the name, without space in between: Parse the parameter list.
'x' - Parameter 0.
',' - Next parameter.
'y' - Parameter 1.
')' - End of parameter list.

Create the macro body in form of macro tokens.
' ' - Create new text(" ").
'foo' - Append "foo".
' ' - Append " ".
'bar' - Append "bar".
' ' - Append " ".
'x' - Is parameter 0, create new param(0).
' ' - Create new text(" ").
'+' - Append "+".
' ' - Append " ".
'y' - Is parameter 1, create new param(1).
EOL - End of macro body.

Resulting in this macro body:

`text(" foo bar "), param(0), text(" + "), param(1)`

The `#define` parser allows macros to be redefined, if the body is the same.

```
#define a 1
#define a 1
```

does not result in a duplicated definition. However this would:

```
#define a 1
#define a 2
```

Since those are pure text `#defines`, the comparison is the bodies is a simple string comparison. This feature is not implemented for macros with parameters currently.

**PP expressions**
The preprocessor has its own (but fairly small and simple) expression parser, which works much like parser-expression.bas:cExpression(), except instead of creating AST nodes, it immediately evaluates the expressions.

**PP skipping**

The preprocessor uses a simple stack to manage #if/#endif blocks. The preprocessor processes #includes in them, but they cannot go across files. False blocks (#if 0, or the #else of an #if 1) are immediately skipped when parsing the #if 0 or the #else (pp-cond.bas:ppSkip()), before returning to lexSkipToken().

For example:

```
#if 1
  (push to stack: is_true = TRUE, #else not visited)
...
  (will be parsed)
#else
  1) Set the #else visited flag for the current stack node, so further #else's are not allowed.
     2) Since the current stack node has is_true = TRUE, that means the #else block must be skipped, -> call ppSkip()...
     (skipped in ppSkip())
#endif
  (parsed from ppSkip(), skipping ends, ppSkip() returns to #else parser, which returns to lexSkipToken())
```

Note that there are a few tricky bits about PP skipping. Since macros are allowed to contain PP directives, macro expansion must be done even during PP skipping, because an #else or #endif could be inside a multi-line macro. Also, multi-line #macro declarations are not handled during PP skipping.

```
#if 0
  #macro test()
#endif
#endmacro
```

will be seen as:

```
#if 0
  #macro test()
```
Resulting in an error (#endmacro without #macro).

So, this:

```c
#if 0
#macro test()
  #endif
#endmacro
#endif
```

will not work as suggested by the indentation.
Because `#`includes can occur in the middle of input files, the lexer needs to push file contexts to a stack. File input buffer, macro expansion buffer and the token queue form a so-called "context". It is file specific and thus it must be pushed onto a stack, so that the lexer can return to the parent (after parsing an `#include`), without losing any tokens or macro text. Note that macros can contain `#`includes too.

```
fb.bas:fbIncludeFile() basically just consists of:
  lexPush()
  cProgram()
  lexPop()
```
Quick overview of the call graph

Showing the recursion between the FB parser, the PP parser, and the lexer:

- `fbCompile()` leads to `cProgram()`, which in turn leads to `lexSkipToken()`.
- `fbPreIncludes()` leads to `ppCheck()`.
- `fbIncludeFile()` leads to `ppParse()`.

Symbols:
- `v` and `>:` for function calls and return values.
- `|` and `^` for recursion points.
- `#include` and `('include)` for include directives.
- `(directives)` for directive processing.
FreeBASIC grammar

**Grammar Notation**

**Format of a production**

_left hand side_: right hand side;

: should be read as 'is defined as'.

The right hand side of a production is terminated by a ;.

A word in _italics_ represent the name of a production (the left hand side of the production).

Few operators are used to describe the FreeBASIC grammar.

<table>
<thead>
<tr>
<th>operator</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>.</td>
<td>any character</td>
</tr>
<tr>
<td>*</td>
<td>0 or more (repetition)</td>
</tr>
<tr>
<td>+</td>
<td>1 or more (repetition)</td>
</tr>
<tr>
<td>?</td>
<td>optional (choice)</td>
</tr>
<tr>
<td>()</td>
<td>grouping</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>;</td>
<td>end of production</td>
</tr>
</tbody>
</table>

Any symbol that appears on the right hand side of a production that is not an operator and does not appear in _italics_ represents itself and appears **bold**.

A symbol at the right hand side of a rule can refer to a production. Such references are in _italics_.

For navigational purposes a reference is a link to the production being referenced.

When reading the grammar be aware that FreeBASIC is a case insensit language.
The grammar presented is not an exact statement of the FreeBASIC lan

Go straight to:

```
program
expression
```

**Tokens**

- **white**: \t | \n
- **any_char**: any valid character;

- **eol**: \n|\r|\n\r;

- **statement_separator**: ( : | eol )+

- **dot**: .

- **sign**: +|-;

- **alpha**: a|b|c|d|e|f|g|h|i|j|k|m|n|p|q|r|s|t|v|w|x|y|z;

- **digit**: 0|1|2|3|4|5|6|7|8|9;

- **hexdigit**: a|b|c|d|e|f|digit;

- **octdigit**: 0|1|2|3|4|5|6|7;

- **bindigit**: 0|1;

- **alphadigit**: alpha|digit;

- **integer_suffix**: %&|\u|ll|lull;

- **floating_point_suffix**: !|#|f;

- **suffix**: integer_suffix|floating_point_suffix|$

- **expchar**: d|e;

- **operator**
  
  `: = | < | > |<> |+ | - | * | @

  & | -> | / | \ | ^ | andalso

  orelse | and | or | xor | eqv | imp

  += | -= | *= | /= | //= | ^= | &= |

  and= | or= | xor= | eqv= | imp=

  new | delete | delete[] | cast | proctrl

  varptr | strptr | sizeof | [] | ()

```

- **binary_operator**

  `: = | < | > |<> |+ | - |

  & | -> | / | \ | ^

  += | -= | *= | /= | //= | ^= | &= |
and= | or= | xor= | eqv= | imp= andalso | orelse ;

identifier :	(alpha)(alphadigit|_)* nbsp _(alphadigit|_)+
;

literal :	sign integer_literal integer_suffix
nbsp sign floating_literal floating_point_suffix
nbsp string_literal
;

integer_literal :	decimal_integer hexadecimal_integer octal_integer binary_integer
;

decimal_integer: digit+;
hexadecimal_integer: &hhexdigit+;
octal_integer: &ooctdigit+;
binary_integer: &bbindigit+;

floating_literal :	digit+(dot(digit+))?\(exp_char?(sign?digit+)?\)\suffix? nbsp(dot(digit+))?\(exp_char?(sign?digit+)?\)\suffix? ;

string_literal :	(!|$)?\escape_sequence\"\"\any_char\"\(white\*string_literal\)* ;

escape_sequence :	simple_escape_sequence unicode_escape_sequence
decimal_escape_sequence
hexadecimal_escape_sequence
octal_escape_sequence
binary_escape_sequence
;

simple_escape_sequence:
:\a|\b|\f|\l|\n|\r|\t|\v|\\|'
;

unicode_escape_sequence:
:\u;hexdigit hexdigit hexdigit hexdigit
;

decimal_escape_sequence:
:\d;digit digit digit
;

hexadecimal_escape_sequence:
:\&h;hexdigit hexdigit
;

octal_escape_sequence:
:\&o;octdigit octdigit octdigit
;

binary_escape_sequence:
:\&b;bindigit bindigit bindigit bindigit bindigit bindigit bindigit bindigit bindigit
;

Comment

colornt:
:\.

multiline_nested_comment:
:l' ( ( . | multiline_nested_comment)* 'l
;
**Toplevel**

program
 : line* EOF? ;

line
 : label (statement|namespace_statement)? comment? eol ;

label
 : identifier :
   
statement
 : statement_separator?
   (declaration | procedure_call_or_assign | compound_statement | quiz assignment )?
   (statement_separator statement)* ;

declaration
 :(public|private)?
   (static
   ( function_definition
     sub_definition
     operator_definition
     constructor_definition
     destructor_definition
     property_definition
     variable_declaration
   )
   )
   function_definition
   sub_definition
   destructor_definition
   property_definition
   constructor_definition
   operator_definition


const_declaration

type_or_union_declaration

variable_declaration

enumeration_declaration

auto_variable_declaration

) declare procedure_declaration

;

procedure_call_or_assign

: call identifier ((procedure_parameter_list))?

identifier procedure_parameter_list?

(identifier | function | operator | property) = expression

;

compound_statement

: namespace_statement

scope_statement

if_statement

for_statement

do_statement

while_statement

select_statement

;

namespace_statement

: namespace identifier (alias string_literal)? (declaration | namespace)

;

scope_statement: scope statement_separator statement* end scope

;

if_statement

: short_if_statement | long_if_statement

;

short_if_statement

: if expression then statement_separator statement
else  

statement_separator statement*  
(eol| end if | endif)  
;

long_if_statement  
: if expression then statement_separator  
statement statement*  
elseif_block*  
(else statement_separator statement*)?  
(end if|endif)  
;

elseif_block  
: elseif expression then statement_separator statement*  
;

for_statement  
: for identifier (as scalar)? = expression to expression (step expression) statement|exit for(, for)* | continue for (, for)*) next identifier (, identifier)*  
;

do_statement  
: do (until|while) expression (statement|exit do (, do)* | continue do (, do)*) loop (until|while)  
;

while_statement  
: while expression statement_separator  
(statement | exit while (, while)* | continue while (, while)*)* wend  
;

select_statement  
: select case (as const) expression case_statement* case else statement*  
;

case_statement  
: case case_expression (, case_expression)*  
;

case_expression
expression | expression to expression | is (> | < | >= | <= | = | <> | e)

assembler_block
: asm comment? (asm_code comment? eol)+ end asm

assignment
: let? variable binary_operator = expression
variable variable (procedure_parameter_list)

variable
: highest_precedence_expression;

const_declaration
: const (as symbol_type)? const_assign (, const_assign)*

; type_or_union_declaration
: type_declaration | union_declaration

; type_declaration
: type identifier (alias string_literal)? (field = expression)? (comment
type_member_declaration+ end type

; union_declaration
: union identifier (alias string_literal)? (field = expression)? (comme
union_member_declaration+ end union

; type_member_declaration
: ( (union|type) comment? statement_separator element_declaration
del (union|type)
)
element_declaration
as as_element_declaration
;

variable_declaration :
(redim preserve?|dim|common) shared? symbol_type
extern import? symbol_type alias string_literal
static symbol_type
;
symbol_type :
const? unsigned?
(scalar string (* integer_literal)?
wstring (* integer_literal)?
user_defined_type
function ((parameters)) (as symbol_type)
sub ((parameters))
)const? (ptr|pointer))*
;
scalar :
byte
ubyte
short
ushort
integer
uinteger
longint
ulongint
long
ulong
single
double
;

parameters :
parameter (, parameter)*
parameter : (byval|byref)? (identifier ( ))? as symbol_type (= literal)?

user_defined_type : identifier

procedure_declaration : static?
(sub_declaration|function_declaration|constructor_declaration|destructor_declaration)

procedure_parameter_list : procedure_parameter (, procedure_parameter)*

procedure_parameter : byval? (identifier( ))? | expression

expressions

expression : boolean_expression

boolean_expression : logical_expression( ( andalso | orelse ) logical_expression)*

logical_expression
logical_or_expression : (xor | eqv | imp) logical_or_expression *

logical_or_expression : logical_and_expression (or logical_and_expression)*

logical_and_expression : relational_expression (and relational_expression)*

relational_expression : concatenation_expression (|=|>|<|<|<|=|<|<=|>=) concatenation_expression

concatenation_expression : add_expression (& add_expression)*

add_expression : shift_expression ( + | - ) shift_expression*

shift_expression : mod_expression (shl | shr) mod_expression*

mod_expression : = integer_division_expression (mod integer_division_expression)*

integer_division_expression : multiplication_expression (\ multiplication_expression)*
multiplication_expression
: exponentiation_expression ( (* | /) exponentiation_expression )* 
;

exponentiation_expression
: prefix_expression ( ^ prefix_expression )* 
;

prefix_expression
: (-|+) exponentiation_expression
not relational_expression
highest_precedence_expression 
;

highest_precedence_expression
: address_of_expression 
( dereference_expression | casting_expression | 
pointer_type_casting_expression | parenthesised_expression ) 
anonymous_udt 
atom 
;

address_of_expression
: varptr ( highest_precedence_expression )
procptr ( identifier ()? )
@ (identifier ()? | highest_precedence_expression)
sadd|strptr ( expression )
;

dereference_expression
: *+ highest_precedence_expression 
;

casting_expression
: cast ( symbol_type , expression ) 
;

quirk_function
: quirk_function_name procedure_parameter_list
;

quirk_function_name
: mkd | mki | mkl | mklongint | mkshort
  cvd | cvi | cvl | cvlongint | cvs | cvshort
  asc | chr | instr | instrev | lcase | left | len | lset | ltrim | mid | right |
  rset | rtrim | space | string | ucase | wchr | wstr | wstring
  abs | sgn | fix | frac | len | sizeof | sin | asin | cos | acos | tan | atn | sqr |
  log | exp | atan2 | int
  peek
  lbound | ubound
  seek | input | open | close | get | put | name
  err
  iif
  va_first
  cbyte | cshort | cint | clng | clngint | cubyte | cushort | cuint | culng |
  culngint | csng | cdbl | csign | cunsg
  type
  view | width | color | screen
;

quirk_statement
: jump_statement
print_statement
data_statement
array_statement
line_input_statement
input_statement
poke_statement
file_statement
write_statement
error_statement
on_statement
view_statement
mid_statement
lrset_statement
width_statement
color_statement
gfx_statement
;

jump_statement
: goto identifier
;

print_statement
: (print | ?) (# expression ,)? (using expression ;)? (expression? ; | , )*

data_statement
: restore identifier
data literal (, literal)*
;

array_statement
: erase variable (, variable)*
swap variable , variable
;

line_input_statement
: line input ;? (# expression| expression?) (, | ;)? variable?
;

input_statement
: input ;? ((# expression| string_literal) (, | ;))? variable (, variable)*
;

poke_statement
: poke expression , expression
;

file_statement
: close (#? expression) (, #? expression)*
seek #? expression , expression
put # expression , expression? , expression
get # expression , expression? , variable
(lock|unlock) #? expression , expression (to expression)?
name expression as expression
;

write_statement
: write (# expression)? (expression? , )*  
;

error_statement
: error expression
err = expression
;

on_statement
: on local? (error | expression) goto identifier 
;

view_statement
: view (print (expression to expression)?) 
;

mid_statement
: mid ( expression , expression (, expression) = expression 
;

lset_statement
: lset|rset highest_precedence_expression ,
highest_precedence_expression
;

width_statement
: width expression , expression
width lprint expression
width (# expression| expression), expression
;

color_statement
: color expression , expression
;

gfx_statement
: pset ( expression , )? step? ( expression , expression ) (,
expression )?
line ( expression , )? step? (( expression , expression ) )? - step? ( expression , expression ) (, expression? (, string_literal? (, expression )?)?)?
circle ( expression , )? step? ( expression , expression ) , expression ((, expression? (, expression? (, expression? (, expression (,
expression )?)?)?)?)?
paint ( expression , )? step? ( expression , expression ) (,
expression? (, expression? ) )
draw ( expression , )? expression
view (screen? ( expression , expression ) - ( expression , expression ) (, expression? (, expression?)? )?
palette get? ((using variable) | (expression , expression (,
expression , expression)?)?)
put ( expression , )? step? ( expression , expression ) ( ( expression , expression ) - ( expression , expression ), )? variable (,
expression (, expression)?)
get ( expression , )? step? ( expression , expression ) - step? ( expression , expression ) , variable
screen (integer_literal | ((expression (((, expression)? , expression)? expression)? , expression))
screenres expression , expression (((, expression)? , expression)? , expression)?
;
;}