Use the National Instruments Instrument I/O Assistant to communicate with message-based instruments and graphically parse the response. For example, you can communicate with an instrument that uses a serial, Ethernet, or GPIB interface.

The Instrument I/O Assistant organizes instrument communication into ordered steps. To use the Instrument I/O Assistant, you place steps into a sequence. As you add steps to the sequence, they appear in the step sequence window. Use the view associated with a step to configure instrument I/O. Four steps are available in the Instrument I/O Assistant.

- <u>Select Instrument</u>—Use this step to select the instrument you want to communicate with and to configure basic instrument properties. This step appears in the step sequence window when you launch the Instrument I/O Assistant and must always be the first step in any Instrument I/O Assistant sequence.
- Query and Parse—Use this step to send a command to the instrument, read a response from the instrument, and parse the returned data.
- Write—Use this step to send a command to the instrument.
- <u>Read and Parse</u>—Use this step to read a response from the instrument and parse the returned data.

Once you build a sequence of steps, you then execute the sequence to communicate with the instrument. When execution completes, use the response window in the **Read and Parse** view and **Query and Parse** view to interactively parse data into tokens and assign new data types to the tokens you create.

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Selecting an Instrument



Note Before you begin communicating with the instrument, ensure that the instrument is properly connected and configured. Refer to the documentation for the instrument for information about connection and configuration.

Use a **Select Instrument** step to select the instrument with which you want to communicate and to configure basic instrument properties.

Complete the following steps to select an instrument.

1. The **Select Instrument** step automatically appears in the Step Sequence window when you launch the Instrument I/O Assistant. Select the instrument you want to communicate with or the port the instrument is connected to from the **Select an instrument** pull-down menu.



Note If you are using an Ethernet instrument, you must first configure the instrument through Measurement & Automation Explorer (MAX) for the instrument to appear in the **Select an instrument** pull-down menu. Alternatively, you can enter the VISA instrument resource descriptor directly in the **Select an instrument** text box.



Note If you recently connected a new instrument to the computer and it does not appear in the **Select an instrument** pull-down menu, click the **Refresh instrument list** button.

- 2. Click the **Properties** button ** to configure basic instrument properties.
- 3. In the **Timeout** text box, enter the number of milliseconds you want the Instrument I/O Assistant to wait for each step to complete before the step returns an error.
- 4. From the **Termination character** pull-down menu, select the character that signifies the last character of the command for the instrument. You also can select **<custom>** to enter a termination character in the **Termination character** text box.
- 5. From the **Code generation type** pull-down menu, select the type of code you want the Instrument I/O Assistant to generate.
- 6. (Optional) If you are using a GPIB instrument and you want the Instrument I/O Assistant to check for 488.2 errors, place a checkmark in the **Do 488.2 error checking** checkbox. If the instrument supports error querying, enter the error query command for the instrument in the **Command to retrieve error strings** text box. Refer to the instrument

documentation for more information about valid instrument commands.

After you select the instrument you want to communicate with, add <u>Write</u>, <u>Read and Parse</u>, or <u>Query and Parse</u> steps to the step sequence to send commands to the instrument and read the response.

Writing a Command to an Instrument

Use a **Write** step to send a command to the instrument. You also can use a series of **Write** steps to configure an instrument programmatically.

Complete the following steps to write a command to an instrument.

- 1. <u>Select the instrument</u> with which you want to communicate.
- 2. Click the **Add Step +** button above the Step Sequence window, and select **Write** from the **Add Step** menu that appears.
- 3. In the **Enter a command** text box, enter the command you want to send to the instrument, or right-click the command window and use **Insert Command** from the shortcut menu to select a command you entered previously. You can select **Clear Command History** from the shortcut menu to clear the list of commands. Refer to the instrument documentation for more information about valid instrument commands.
- 4. (Optional) Add a parameter to the command.
- 5. Click the **Run** → button above the Step Sequence window to send the command to the instrument.

Adding a Parameter to a Command

Use a <u>Write</u> step to add an input parameter to an instrument command. The parameter becomes an input to the VI or function.

Complete the following steps to add a parameter to a command.

1. Select the command in the **Enter a command** text box and click the **Add parameter** button to add a parameter to a command. You also can select and right-click the command, and select **Add parameter** from the shortcut menu.



Note If you want to reuse a parameter from a previous command, you can right-click a command and use **Link to input** from the shortcut menu to create a new instance of a parameter you entered previously. You also can copy a parameter from a previous command by selecting the parameter and pressing the <Ctrl-C> keys. You can paste the parameter into a new command by pressing the <Ctrl-V> keys.

- 2. Enter a default value for the parameter in the **Test value** text box.
- 3. Enter a name for the parameter in the **Parameter name** text box. You use this name to reference the parameter in the application.
- 4. To change the data type of a parameter, click the parameter and select a new data type from the **Data type** pull-down menu.

You can remove a parameter by right-clicking the value and selecting **Remove Parameter** from the shortcut menu. You also can remove all parameters by clicking the **Clear all parameters** button.

Reading Data from an Instrument

Use a **Read and Parse** step to read data from an instrument and parse the returned data.

Complete the following steps to read data from an instrument.

- 1. Select the instrument with which you want to communicate.
- 2. Click the **Add Step +** button above the Step Sequence window, and select **Read and Parse** from the **Add Step** menu that appears.
- 3. Click the **Run** → button above the Step Sequence window to read data from the instrument. The data appears in the response window.
- 4. Parse the data.
- 5. (Optional) Scale tokens you create.

Querying an Instrument

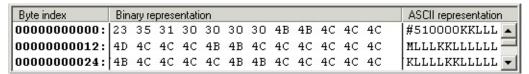
Use a **Query and Parse** step to write a command to an instrument, read the instrument response at once, and parse the returned data. You also can split a **Query and Parse** step into the **Write** and **Read and Parse** steps to use <u>parameterized inputs</u>.

Complete the following steps to query an instrument.

- 1. <u>Select the instrument</u> with which you want to communicate.
- 2. Click the **Add Step +** button above the Step Sequence window, and select **Query and Parse** from the **Add Step** menu that appears.
- 3. In the **Enter a command** text box, enter the command you want to send to the instrument, or use the pull-down menu to select a command you entered previously. Refer to the instrument documentation for more information about valid instrument commands.
- 4. Click the **Run** → button above the Step Sequence window to send a command to the instrument and read the instrument response. The data appears in the response window.
- 5. Parse the data.
- 6. (Optional) Scale tokens you create.
- 7. (Optional) Right-click the **Query and Parse** step in the Step Sequence window and select **Split step into Write and Read steps** from the shortcut menu to split the step into the **Write** and **Read and Parse** steps.

Parsing an Instrument Response

When you use a <u>Query and Parse</u> step or <u>Read and Parse</u> step to read data from an instrument, the response appears in the response window as shown in the following illustration. The Instrument I/O Assistant can <u>automatically parse</u> the entire data set for you, or you can parse the data into tokens manually. Use the response window to manually create data tokens to use in an application.

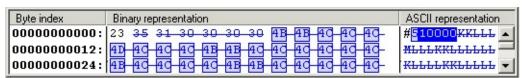


The response window displays data in binary form, ASCII form, or binary form and ASCII form together. Use the pull-down menu below the **Byte index** column of the response window to select the form in which to display data in the response window. Use the **Byte index** column to help you navigate the data set. Use the **Binary representation** column to parse binary numbers and strings or binary number arrays. Use the **ASCII representation** column to parse ASCII numbers and strings or ASCII number arrays.

Manually parsing data into tokens

Complete the following steps to manually parse data into tokens.

1. Move the cursor over the response window and click the data you want to parse. A token appears as a highlighted data selection in the response window, as shown in the following illustration. You can use the response window to parse binary number arrays, ASCII numbers and strings, and ASCII numbers arrays.





- **Tip** You can preview the token value in the **Value** window in the lower section of the Instrument I/O Assistant.
- 2. To change the data type of a token, right-click the token in the response window and select a new data type from the **Data Type** shortcut menu. You also can click the token and select a new data type from the **Type** pull-down menu on the **Data Type** tab.



Note You can configure the Instrument I/O Assistant to parse all data in a token until you have no data

left to parse. To configure the Instrument I/O Assistant to parse until the end of the data, select the **To end of data** item from the **Count** pull-down menu in the **Query and Parse** step, or click the **To end of data** button below the **Count** pull-down menu. The Instrument I/O Assistant also parses to the end of the data if you click the **Auto parse** button. The **To end of data** item and behavior are available only if the token you configure is the last token.

Automatically Parsing Instrument Response Data

Complete the following steps to automatically parse instrument response data.

- 1. Click the **Auto parse** button to automatically parse binary block data or ASCII text. Automatically parsing data parses adjacent numeric values as a single array value.
- 2. Enter a name for the token in the **Token name** text box. You use this name to reference the token in the application.
- 3. (Optional) If the array token contains less than five elements, you can right-click the token in the response window and select **Split array into elements** from the shortcut menu to split the array elements into separate values.



Note If you already parsed some of the data manually, the Instrument I/O Assistant stops parsing at the first token. It does *not* reparse data you already parsed.

Parsing a Binary Number or String

The response window displays data in binary form, ASCII form, or binary form and ASCII form together. Use the pull-down menu below the **Byte index** column of the response window to select the form in which to display data in the response window.

Use the Instrument I/O Assistant to parse a single binary number or string or an <u>array of binary numbers</u>. Complete the following steps to parse a single binary number or string.

- 1. In the **Binary representation** column of the response window, click the first byte of the binary data that you want to parse. Selections appear on the **Data Type** tab.
- 2. Select the type of token array you want to create. The token appears as a highlighted data selection in the response window.
- 3. Enter a name for the token in the **Token name** text box. You use this name to reference the token in the application.
- 4. To change the data type of a token, right-click the token and select a new data type from the **Data Type** shortcut menu. You also can click the token and select a new data type from the **Type** pull-down menu on the Data Type tab.

Parsing an Array of Binary Numbers

The response window displays data in binary form, ASCII form, or binary form and ASCII form together. Use the pull-down menu below the **Byte index** column of the response window to select the form in which to display data in the response window.

Use the Instrument I/O Assistant to parse a <u>single binary number or string</u> or an array of binary numbers. Complete the following steps to parse an array of binary numbers.

- 1. In the **Binary representation** column of the response window, click the first binary value of the array you want to parse. Selections appear on the **Data Type** tab.
- 2. Select the type of token you want to create. The token appears as a highlighted data selection in the response window.
- 3. Place a checkmark in the **Array** checkbox on the **Data Type** tab.
- 4. Enter the length of the array in the **Array Size** text box, or use the pull-down menu to select a value you entered previously.



Note You can enter an array size in elements or bytes. If you want to enter the array size in elements, select **element(s)** from the **element(s)/byte(s)** pull-down menu. If you want to enter the array size in bytes, select **byte(s)**.



Tip Double-click an array to collapse or expand it for easier viewing.

- 5. Enter a name for the token in the **Token name** text box. You use this name to reference the token in the application.
- 6. To change the data type of a token, right-click the token and select a new data type from the **Data Type** shortcut menu. You also can click the token and select a new data type from the **Type** pull-down menu on the **Data Type** tab.

Parsing an ASCII Number or String

The response window displays data in binary form, ASCII form, or binary form and ASCII form together. Use the pull-down menu below the **Byte index** column of the response window to select the form in which to display data in the response window.

Use the Instrument I/O Assistant to parse a single ASCII number or string or an <u>array of ASCII numbers</u>. Complete the following steps to parse a single ASCII number or string.

- 1. In the **ASCII representation** column of the response window, click the value you want to parse.
- 2. Enter the number of characters to include in the token in the **Character Count** text box, or use the pull-down menu to select a value you already have entered.
- 3. Enter a name for the token in the **Token name** text box. You use this name to reference the token in the application.
- 4. To interpret a token as a string, right-click the token and select **Data Type»String** from the shortcut menu. To interpret a token as a number, right-click the token and select **Data Type»Number** from the shortcut menu.

Parsing an Array of ASCII Numbers

The response window displays data in binary form, ASCII form, or binary form and ASCII form together. Use the pull-down menu below the **Byte index** column of the response window to select the form in which to display data in the response window.

Use the Instrument I/O Assistant to parse a <u>single ASCII number or string</u> or an array of ASCII numbers. Complete the following steps to parse an array of ASCII numbers.



Note You can parse ASCII data as an array of numbers only if separators delimit the data elements.

- 1. Enter the separator(s) that delimit the ASCII data in the **Separator(s)** text box.
- 2. In the **ASCII representation** column of the response window, click the first number of the array. If the token is currently parsed as a string, right-click the token and select **Data Type»Number** from the shortcut menu.
- 3. Place a checkmark in the **Array** checkbox on the **Data Type** tab.
- 4. Enter the length of the array in the **Array Size** text box, or use the pull-down menu to select a value you entered previously.



 ${f Tip}\,$ Place the cursor over any item in the Instrument I/O Assistant to display the description of the item in this window.

488.2 error checking

Place a checkmark in the **Do 488.2 error checking** checkbox if you want the Instrument I/O Assistant to check for GPIB errors as you communicate with an instrument. If the instrument supports error querying, enter the error query command for the instrument in the **Command to retrieve error strings** text box. Refer to the instrument documentation for information about valid instrument commands.

Add parameter

Click the **Add parameter** button to add a parameter to a command.

Array

Place a checkmark in the **Array** checkbox to format or parse data as an array.

ASCII

Click the ${f ASCII}$ option button to interpret the parameter in ASCII form.

ASCII representation

Use the **ASCII representation** column of the response window to parse data as ASCII text.

ASCII representation

Use the **ASCII representation** column of the command window to format data as ASCII text.

Auto parse

Click the **Auto parse** button to automatically parse all of the instrument response data.

Binary

Click the **Binary** button to interpret the parameter in binary form.

Binary representation

Use the **Binary representation** column of the response window to parse data as binary values.

Binary representation

Use the **Binary representation** column of the command window to format data as binary values.

Byte index

Use the **Byte index** column of the response window to navigate the data set.

Byte order

Select the byte order of the binary data from the **Byte order** pull-down menu. Byte order, or *endianness*, indicates whether integers are represented in memory from most-significant byte to least-significant byte, or vice versa. Select **Big Endian** if you want the most-significant byte in the token or parameter to occupy the lowest memory address. Select **Little Endian** if you want the least-significant byte in the token or parameter to occupy the lowest memory address.

Clear all parameters

Click the **Clear all parameters** button to remove all parameters.

Clear parsing

Click the **Clear parsing** button to remove all tokens.

Code generation type

Select the type of code you want the Instrument I/O Assistant to generate from the **Code generation type** pull-down menu.

Count

Enter the number of bytes, elements, or characters you want to include in the array. If you want to enter a binary array size in bytes, select byte(s) from the element(s)/byte(s) pull-down menu and enter the array size in the Byte Count text box. If you want to enter a binary array size in elements, select element(s) from the element(s)/byte(s) pull-down menu and enter the array size in the Array Size text box. Enter the size of an ASCII string in the Character Count text box. Enter the size of an ASCII array in the Array Size text box.

To end of data

Click the **To end of data** button to parse all data in a token until you have no data left to parse.

Data type

Select a new data type for the parameter from the **Data type** pull-down menu.

Element(s)/byte(s) (Count)

You can enter an array size in either elements or bytes. If you want to enter the array size in elements, select **element(s)** from the pull-down menu. If you want to enter the array size in bytes, select **byte(s)**.

Enter a command

Enter a command to send to the instrument. Refer to the instrument documentation for information about available commands.

Insert byte count

Place a checkmark in the **Insert byte count** checkbox to calculate the definite length of the data in bytes and insert the number before the data.

Instrument Driver Finder

Click the **Instrument Driver Finder** button to launch the Instrument Driver Finder and exit the Instrument I/O Assistant dialog.

Normalize

Place a checkmark in the **Normalize** checkbox to scale the input data in the graph to the maximum and minimum you specify. The graph compares the original input data with the normalized data.

Maximum

Enter the maximum value for the data in the **Maximum** text box.

Minimum

Enter the minimum value for the data in the **Minimum** text box.

Numeric format

Select a numeric format for the parameter from the **Numeric format** pull-down menu.

Parameter name

Enter the name you want to assign to the parameter in the **Parameter name** text box. You use this name to reference the parameter in the application. Parameters appear by name in the Step Sequence window of the Instrument I/O Assistant.

Parameter value and Command string

Use the **Parameter value** column to assign values to parameters.

Use the **Command string** column to assign names to parameters.

Parsing help

Click the **Parsing help** button to display or hide help for the Instrument I/O Assistant. You also can click the **Show Help/Hide Help** button to display or hide help.

Properties

Click the **Properties** button to view and edit the selected instrument's alias and serial port settings.

Refresh instrument list

Click the **Refresh instrument list** button to scan the computer for connected message-based instruments.

Run this step

Click the **Run this step** button to run only the current step in the sequence.

Scaling

Use the scaling option buttons to apply one of the following scaling formulas to the token. Select **None** if you do not want to scale the token.

Linear y=mx+b

Exponential

$$y=Ae^{Bx}+C$$

Enter values for the variables in the text boxes.

Scaling a Token

Use the **Scaling** tab in the lower section of the Instrument I/O Assistant to scale a token using the linear formula y=mx+b or the exponential formula $y=Ae^{Bx}+C$. Complete the following steps to scale a token.

- 1. Click the **Scaling** tab.
- 2. Select the **Linear** button to apply the linear formula y=mx+b to the token. Select the **Exponential** button to apply the exponential formula $y=Ae^{Bx}+C$.
- 3. Enter values for the variables in the text boxes of the formula you selected. The scaled token value appears in the **Value** window in the lower section of the Instrument I/O Assistant.

Scientific notation

Place a checkmark in the **Scientific notation** checkbox to display the parameter in scientific notation.

Select an instrument

Select the instrument you want to communicate with from the **Select an instrument** pull-down menu. If you are using a serial instrument, select the port to which the instrument is connected. If you are using an Ethernet instrument, either enter the VISA resource descriptor for the instrument, or use Measurement & Automation Explorer to configure the instrument. If no instruments or ports appear in the list, or if you recently connected an instrument to the computer, click the **Refresh instrument list** button.

Separator

Enter the character that separates data in the command string in the **Separator** text box.

Separator(s)

Enter the character that separates data in the instrument response in the **Separator(s)** text box. If more than one character separates the data, enter all possible characters. For example, if periods and commas separate the data, enter ., in the text box.



Note The Instrument I/O Assistant automatically includes tabs, carriage returns, and line feeds as possible separators.

Termination character

Enter the character that signifies the last character of the command for the instrument in the **Termination character** text box. For serial instruments, the corresponding read operation terminates when the instrument receives the termination character. Refer to the VISA documentation for more information about serial termination characters.

Test count

Enter a test value for the parameter in the **Test count** text box to send a simulated input to the instrument.

Test value

Enter the default value you want to assign to the parameter in the **Test value** text box.

Timeout

Enter the number of milliseconds you want the Instrument I/O Assistant to wait for a response from the instrument in the **Timeout** text box. If the instrument does not return a response within the period of time that you specify, a timeout error message appears.

Token name

Enter the name you want to assign to the token in the **Token name** text box. You use this name to reference the token in the application. Tokens appear by name in the Step Sequence window of the Instrument I/O Assistant.

Type

Select a new data type for the token from the **Type** pull-down menu. You also can right-click the token in the response window and select a new data type from the **Data Type** shortcut menu.

Value

Preview the token value or view a graph of the data set in the **Value** window.

View type

Select the form in which you want to display data in the response window. The response window displays data in binary form, ASCII form, or binary form and ASCII form together.