BECKHOFF Fieldbus Components

Documentation about KL3361 and KL3362 Dscilloscope Terminals

Version 1.0

Date: 15.02.2005

BECKHOFF Fieldbus Components: Foreword

Notes on the Documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards. It is essential that the following notes and explanations are followed when installing and commissioning these components.

Liability Conditions

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

The documentation has been prepared with care. The products described are, however, constantly under development. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. None of the statements of this manual represents a guarantee (Garantie) in the meaning of § 443 BGB of the German Civil Code or a statement about the contractually expected fitness for a particular purpose in the meaning of § 434 par. 1 sentence 1 BGB. In the event that it

contains technical or editorial errors, we retain the right to make alterations at any time and without warning. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

© This documentation is copyrighted. Any reproduction or third party use of this publication, whether in whole or in part, without the written permission of Elektro BECKHOFF GmbH, is forbidden. BECKHOFF Fieldbus Components: Foreword

Safety Instructions

Safety Rules

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

State at Delivery

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Elektro BECKHOFF GmbH.

Personnel Qualification

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

Description of safety symbols

The following safety symbols are used in this operating manual. They are intended to alert the reader to the associated safety instructions.



This symbol is intended to highlight risks for the life or health of personnel.



This symbol is intended to highlight risks for equipment, materials or the environment.



This symbol indicates information that contributes to better **i** Note understanding.

Jocumentation Issue Status

Version	Comment
1.0	Describes: KL3361with Hardware-Stand* 01, Firmware-Stand* 1D KL3362 with Hardware-Stand* 01, Firmware-Stand* 1F • description of the parameterization of KL336x by KS2000 software corrected (trigger logic in detail)
0.6	description of the parameterization of KL336x by KS2000 software updated (trigger logic in detail)
0.5	description of the process image overworked
0.4	 description of control and status bytes extended register description updated english version available
0.3	 (only german version available) connection notes extended description of the parameterization of KL336x by KS2000 software updated register description updated description of control and status bytes overworked
0.2	 (only german version available) connection notes added description of the parameterization of

	KL336x by KS2000 software extendedregister description overworked
0.1	first preliminary version (only german version available)

*) The hardware and firmware version (delivery state) can be found in the serial number printed at the side of the terminal.

Syntax of the serial number

Structure of the serial number: KK YY FF HH

- KK week of production (CW, calendar week)
- YY year of production
- FF firmware version
- HH hardware version

Example with ser. no.: 35 04 1F 01:

- 35 week of production 35
- 04 year of production 2004
- 1F firmware version 1F
- 01 hardware version 01

BECKHOFF KL3361, KL3362: Product Overview

Product Overview

Seneral

The KL3361 and KL3362 oscilloscope terminals enable decentralized pre-processing of analog input data. The input values are digitized with a 14-bit resolution and written into an internal memory. A powerful pre-processing processor can determine or monitor the following values, among others:

- Maximum value of a recording
- Minimum value of a recording
- RMS value of a recording
- Arithmetic mean of a recording
- Peak-peak value of a recording
- Envelope curve monitoring
- Cycle duration
- Most frequent value of a recording
- etc.

The result or all the measured values are transported to the higher-level automation unit.



Not all bus couplers support the KL3361 and KL3362 oscilloscope terminals. These include BK2000, BK3000, BK3100, BK4000, BK4500, BK5000, BK7500.

<u>(L3361</u>

Single-channel oscilloscope terminal for an input voltage range of -16 mV to +16 mV.

Typical application:

Logging and pre-processing of the differential signal from strain gauges in a <u>bridge circuit</u>.

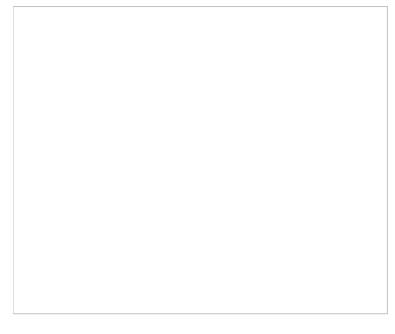
<u>(L3362</u>

Two-channel oscilloscope terminal for an input voltage range of -10 V to +10 V.

Typical application:

Logging and pre-processing of standard analog signals.

(L3361 - Single-channel Oscilloscope Terminal



LED indicators - meanings

LED	No	Indication
No Wire (red)	А	This LED is on if the wire breaks at the trigger input.
Output (green)	В	This LED is on if the digital output is set.
Error (red)	С	in preparation
Trigger (green)	D	This LED is on if a signal is present at the trigger input.

For pin assignment see <u>Connecting the KL3361</u>.

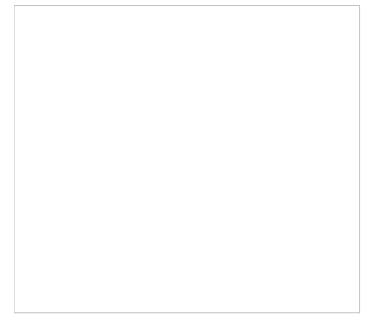
Fechnical Data of the KL3361

KL3361: Single-channel oscilloscope terminal, -16 mV to +16 mV

Technical data	KL3361
Number of inputs	1 analog, 1 trigger
Signal voltage U _B	-16 mV to +16 mV
Input resistance	> 1 MOhm (U _B)
Supply voltage for the measuring bridge ${\rm U}_{\rm V}$	5 V _{DC} , maximum 20 mA
Resolution	14 bit (plus 1 bit sign)
Sampling rate (configurable)	minimum 100 μs, (minimum 10 μs for <u>fast sampling</u>)
Measurement error (complete measuring range)	±1% of the full scale value
Internal memory	32 Kbytes
Bit width in the input process image	2 data words, 1 control byte
Bit width in the output process image	2 data words, 1 status byte
Power supply for the electronics	via the K-Bus
Current input from the K-Bus with external supply of the measuring bridge	typically 120 mA
Current input from the K-Bus with supply of the measuring bridge (4 x 350 Ohm) via KL3361	typically 140 mA
Dielectric strength	500 V _{rms} (shielding, base plate /

	K-Bus)
Permissible ambient temperature range during operation	0°C +55°C
Permissible ambient temperature range during storage	-25 °C +85°C
Permissible relative humidity	95%, no condensation
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Weight	approx. 55 g
Dimensions (W x H x D)	approx. 15mm x 100 mm x 70 mm
Assembly	on 35 mm C mounting rail according to EN 50022
Installation position	variable
Type of protection	IP20
Approval	CE

(L3362 - Two-channel Oscilloscope Terminal



LED indicators - meanings

LED	No	Indication
Error 1 (red)	А	in preparation
Output (green)	В	This LED is on if the digital output is set.
Error 2 (red)	С	in preparation
Trigger (green)	D	This LED is on if a signal is present at the trigger input.

For pin assignment see <u>Connecting the KL3362</u>.

Fechnical Data of the KL3362

KL3362: Two-channel oscilloscope terminal, -10 V to +10 V

Technical data	KL3362
Number of inputs	2 analog, 1 trigger
Signal voltage U _{IN}	-10 V to +10 V
Input resistance (IN1-GND, IN2- GND)	> 500 kOhm
Resolution	14 bit (plus 1 bit sign)
Sampling rate (configurable)	minimum 100 μs, (minimum 10 μs for <u>fast sampling</u>)
Measurement error (complete measuring range)	±0.5% of the full scale value
Internal memory	32 Kbytes
Bit width in the input process image	Per channel: 2 data words, 1 control byte
Bit width in the output process image	Per channel: 2 data words, 1 status byte
Power supply for the electronics	via the K-Bus
Current consumption on the K- Bus	typically 120 mA
Dielectric strength	500 V _{rms} (shielding, base plate / K-Bus)
Permissible ambient temperature range during operation	0°C + 55°C
Permissible ambient temperature range during	-25 °C + 85°C

storage	
Permissible relative humidity	95%, no condensation
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	conforms to EN 61000-6-2 / EN 61000-6-4
Weight	approx. 55 g
Dimensions (W x H x D)	approx. 15mm x 100 mm x 70 mm
Assembly	on 35 mm C mounting rail according to EN 50022
Installation position	variable
Type of protection	IP20
Approval	CE

BECKHOFF KL3361, KL3362: Product Overview

Frigger Units

The oscilloscope terminals have two trigger units per signal channel. They are configured via sets of registers. The first trigger unit is configured via registers R40 to R45, the second one via registers R46 to R51.

Optionally, the following are used as a trigger source:

- an output word of the fieldbus
- a timer
- the analog inputs
- the digital input
- the output of trigger unit 1 for trigger unit 2

The following can be selected as a trigger event:

- rising or falling edge
- a positive or negative pulse that is greater or smaller than a specified pulse width (glitch)

The trigger can be <u>enabled</u> as follows:

- always, i.e. each trigger event is immediately enabled
- via the signal at the analog inputs or the digital input (each with positive or negative logic and associated threshold levels).

Enabling of the trigger evens can prompt various <u>actions</u>:

- start of recording
- start of a timer (chronometer)
- setting of the digital output
- saving of the current timer value

- resetting of the timer
- starting of a further timer, which is associated with the *Valid Trigger Time* register

The trigger units can be cascaded. This enables extremely flexible triggering depending on the cause of events. For cascaded trigger units, the *Valid Trigger Time* register specifies a time window, during which the subsequent trigger event must occur. If this does not happen, everything is reset and the first trigger event is once again awaited.

BECKHOFF Fieldbus Components: Mounting and Wiring

nstallation of Bus Terminals on C mounting rails



Bring the bus system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

ssembly

The Bus Coupler and Bus Terminals are attached to commercially available 35 mm C mounting rails (EN 50022) by applying slight pressure:

- 1. First attach the Fieldbus Coupler to the mounting rail.
- The Bus Terminals are now attached on the right-hand side of the Fieldbus Coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail. If the Terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

During the installation of the Bus Terminals, the locking mechanism of the terminals must not come into conflict with the fixing bolts of the mounting rail.

)isassembly

Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

- 1. Carefully pull the orange-colored lug approximately 1 cm out of the disassembled terminal, until it protrudes loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail without excessive force.
- 2. Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal away from the mounting rail.

connections within a bus terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realised by joining the components:

- The six spring contacts of the K-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler.



During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts. Power Feed Terminals (KL91xx, KL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

'E power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.



Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V).

For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

The PE power contact must not be used for other potentials!

Viring

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The terminals are implemented in spring force technology. Connect the cables as follows:

- 1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
- 2. The wire can now be inserted into the round terminal opening without any force.
- 3. The terminal closes automatically when the pressure is released, holding the wire securely and permanently.

The diagram shows the connection of four strain gauges as a bridge circuit, with supply of the measuring bridge

- through the oscilloscope terminal (left) or
- from an external voltage source U_{ext} (right).

Contact	No	Connection
+24V	1	Supply voltage for digital output
OUT 24V	2	Digital output
UB+	3	Input for differential voltage of the measuring bridge
UV+	4	5 V supply voltage for the strain gauges in a bridge circuit or reference input for the external supply voltage of the measuring bridge

24V Trigger	5	Trigger input
0V	6	Ground for trigger input
UB-	7	Input for differential voltage of the measuring bridge
UV-	8	0 V supply voltage for the strain gauges in a bridge circuit or reference input for the external supply voltage of the measuring bridge

Supply of the measuring bridge via KL3361

The total resistance of the measuring bridge should be dimensioned in such a way that the current to be supplied by the oscilloscope terminal at the terminals UV+ and UV- never exceeds 20 mA.

Supply of the measuring bridge from an external voltage source

Note the following if the measuring bridge is supplied from an external voltage source:

The external supply voltage

- must also be applied to the UV+ and UV- connections for reference;
- must be within the range +5 V to +10 V;
- must not vary by more than ±5% during operation. Fluctuations of the external supply voltage increase the measurement error! After changing the external supply voltage, the oscilloscope terminal has to be restarted for re-balancing!

The internal voltage source switches off automatically, as soon as an external voltage of more than 5 V is applied to the UV+ and UV- terminals of the oscilloscope terminal.

Connecting the KL3362

The diagram shows the connection of two function generators (FG1, FG2) to the channels of the KL3362 oscilloscope terminal.

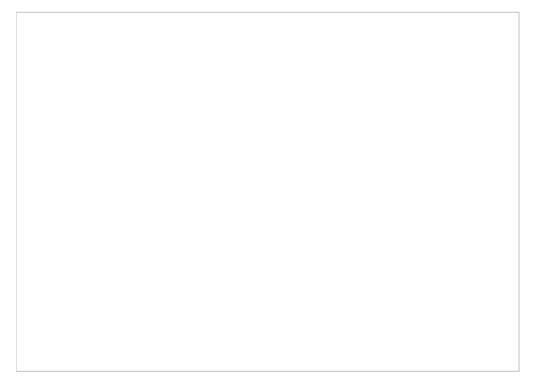
Contact	No	Connection	
+24V	1	Supply voltage for digital output	
OUT 24V	2	Digital output	
IN 1	3	Oscilloscope input channel 1 (-10 V to +10 V)	
GND	4	Ground for oscilloscope input channel 1 (internally connected with terminal no. 8)	
24V Trigger	5	Trigger input Ground for trigger input	
0V	6		
IN 2	7	Oscilloscope input channel 2 (-10 V to +10 V)	

G	SND	8	Ground for oscilloscope input channel 2 (internally connected with terminal no. 4)
P	I)		

BECKHOFF Fieldbus Components: Configuration Software KS2000

Configuration Software KS2000

The KS2000 configuration software permits configuration, commissioning and parameterization of bus couplers, of the affiliated bus terminals and of Fieldbus Box Modules. The connection between bus coupler/Fieldbus Box Module and the PC is established by means of the serial configuration cable or the fieldbus.



Configuration

You can configure the Fieldbus stations with the Configuration Software KS2000 offline. That means, setting up a terminal station with all settings on the couplers and terminals resp. the Fieldbus Box Modules can be prepared before the commissioning phase. Later on, this configuration can be transferred to the terminal station in the commissioning phase by means of a download. For documentation purposes, you are provided with the breakdown of the terminal station, a parts list of modules used and a list of the parameters you have modified. After an upload, existing fieldbus stations are at your disposal for further editing.

varameterization

KS2000 offers simple access to the parameters of a fieldbus station: specific high-level dialogs are available for all bus couplers, all intelligent bus terminals and Fieldbus Box modules with the aid of which settings can be modified easily. Alternatively, you have full access to all internal registers of the bus couplers and intelligent terminals. Refer to the register description for the meanings of the registers.

commissioning

The KS2000 software facilitates commissioning of machine components or their fieldbus stations: Configured settings can be transferred to the fieldbus modules by means of a download. After a *login* to the terminal station, it is possible to define settings in couplers, terminals and Fieldbus Box modules directly *online*. The same high-level dialogs and register access are available for this purpose as in the configuration phase.

The KS2000 offers access to the process images of the bus couplers and Fieldbus Box modules.

- Thus, the coupler's input and output images can be observed by monitoring.
- Process values can be specified in the output image for commissioning of the output modules.

All possibilities in the *online mode* can be used in parallel with the actual fieldbus mode of the terminal station. The fieldbus protocol always has the higher priority in this case.

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

Parameterization with KS2000

Connect the configuration interface of your Fieldbus Coupler with the serial interface of your PC via the configuration cable and start the *KS2000* configuration software.



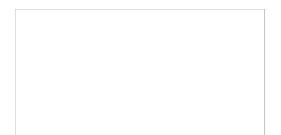
Click on the *Login* button. The configuration software will now load the information for the connected fieldbus station. In the example shown, this is

- a BK9000 Bus coupler for Ethernet
- a KL1xx2 digital input terminal
- a KL3661 oscilloscope terminal
- a KL9010 Bus end terminal

The left-hand KS2000 window displays the terminals of the fieldbus station in a tree structure.

The right-hand KS2000 window contains a graphic display of the fieldbus station terminals.

In the tree structure of the left-hand window, click on the plus-sign next to the terminal whose parameters you wish to change (item 2 in the example).



Click on *Settings*. You can now change the settings of the oscilloscope terminal.

KL3361:

- <u>Trigger logic</u>
- Operating mode and trigger values
- Process data

KL3362:

- Trigger logic
- <u>Trigger values</u>
- Operation mode
- Process data

BECKHOFF KL3361: KS2000 Configuration Software

rigger Logic for KL3361

In the *Trigger Logic* tab, you can specify the trigger behavior of the KL3361 oscilloscope terminal.

Source

Here you can select the trigger source (see <u>Trigger logic in detail</u>).

Event

Here you can specify the trigger event (see Trigger logic in detail).

Enable

Connect the lower input of the And gate with the desired function in order to specify when the And gate should switch through a trigger pulse (see <u>Trigger logic in detail</u>).

Action

Connect the output of the And gate with the desired function in order to specify which task should be triggered (see <u>Trigger logic in detail</u>).

BECKHOFF KL3361: KS2000 Configuration Software

rigger Values for KL3361

In the *Trigger Values* tab, you can set the mode, the scaling and the threshold levels, the pulse width and the valid trigger time for the two trigger units of the KL3361 oscilloscope terminal.

)peration mode

Here you can specify the trigger type (see General settings in detail).

;eneral

Here you can specify the general trigger settings (see <u>General settings in</u> <u>detail</u>).

caling

Here you can specify the scaling (see General settings in detail).

rigger Unit 1

Here you can specify the trigger values for trigger unit 1 (see Trigger

values in detail).

rigger Unit 2

Here you can specify the trigger values for trigger unit 2 (see <u>Trigger</u> values in detail).

BECKHOFF KL3361: KS2000 Configuration Software

Process Data for KL3361

In the *Process Data* tab, you can specify which data are displayed in the process image of the KL3361 oscilloscope terminal.

Dutput process image

Data word 0

For trigger unit 1, select which trigger parameter you wish to specify with data word 0 (<u>DataOUT0</u>) of the KL3361 (see <u>Output process data in</u> <u>detail</u>).

Data word 1

For trigger unit 2, select which trigger parameter you wish to specify with data word 1 (<u>DataOUT1</u>) of the KL3361 (see <u>Output process data in</u> <u>detail</u>).

nput process image

Data word 0

Here you can specify which input value is transferred with data word 0 (DataINO) from the KL3361 to the control (see Input process data in detail).

Data word 1

Here you can specify which input value is transferred with data word 1 (<u>DataIN1</u>) from the KL3361 to the control (see <u>Input process data in</u> <u>detail</u>).

BECKHOFF KL3362: KS2000 Configuration Software

rigger Logic for KL3362

In the *Trigger Logic* tab, you can specify the trigger behavior of the KL3362 oscilloscope terminal.

Source

Here you can select the trigger source (see <u>Trigger logic in detail</u>).

Event

Here you can specify the trigger event (see Trigger logic in detail).

Enable

Connect the lower input of the And gate with the desired function in order to specify when the And gate should switch through a trigger pulse (see <u>Trigger logic in detail</u>).

Action

Connect the output of the And gate with the desired function in order to specify which task should be triggered (see <u>Trigger logic in detail</u>).

BECKHOFF KL3362: KS2000 Configuration Software

Seneral Settings for KL3362

In the *General Settings* tab, you can specify the operating mode, general settings and the scaling of both channels of the KL3362 oscilloscope terminal.

)peration mode

Here you can specify the trigger type (see General settings in detail).

Seneral

Here you can specify the general trigger settings (see <u>General settings in</u> <u>detail</u>).

cale channel 1

Here you can specify the scaling for channel 1 (see <u>General settings in</u> <u>detail</u>).

cale channel 2

Here you can specify the scaling for channel 2 (see <u>General settings in</u> <u>detail</u>).

BECKHOFF KL3362: KS2000 Configuration Software

rigger Values for KL3362

In the *Trigger Values* tab, you can specify the threshold levels, the pulse width and the valid trigger time for the four trigger units of the KL3362 oscilloscope terminal.

rigger Unit 1

Here you can specify the trigger values for trigger unit 1 (see <u>Trigger</u> values in detail).

rigger Unit 2

Here you can specify the trigger values for trigger unit 2 (see <u>Trigger</u> values in detail).

rigger Unit 3

Here you can specify the trigger values for trigger unit 3 (see <u>Trigger</u> values in detail).

rigger Unit 4

Here you can specify the trigger values for trigger unit 4 (see <u>Trigger</u> <u>values in detail</u>).

BECKHOFF KL3362: KS2000 Configuration Software

Process Data for KL3362

In the *Process Data* tab, you can specify which data are displayed in the process image of the KL3362 oscilloscope terminal.

Dutput process image

Data word 0

For trigger unit 1, select which trigger parameter you wish to specify with data word 0 (<u>DataOUT0, channel 1</u>) of the KL3362 (see <u>Output process data in detail</u>).

Data word 1

For trigger unit 2, select which trigger parameter you wish to specify with data word 1 (<u>DataOUT1, channel 1</u>) of the KL3362 (see <u>Output process data in detail</u>).

Data word 2

For trigger unit 3, select which trigger parameter you wish to specify with

data word 2 (<u>DataOUT0, channel 2</u>) of the KL3362 (see <u>Output process data in detail</u>).

Data word 3

For trigger unit 4, select which trigger parameter you wish to specify with data word 3 (<u>DataOUT1, channel 2</u>) of the KL3362 (see <u>Output process data in detail</u>).

nput process image

Data word 0

Here you can specify which input value is transferred with data word 0 (<u>DataIN0, channel 1</u>) from the KL3362 to the control (see Input process data in detail).

Data word 1

Here you can specify which input value is transferred with data word 1 (<u>DataIN1, channel 1</u>) from the KL3362 to the control (see <u>Input process data in detail</u>).

Data word 2

Here you can specify which input value is transferred with data word 2 (<u>DataIN0, channel 2</u>) from the KL3362 to the control (see <u>Input process data in detail</u>).

Data word 3

Here you can specify which input value is transferred with data word 3 (<u>DataIN1, channel 2</u>) from the KL3362 to the control (see <u>Input process data in detail</u>).

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

rigger Logic

Source

You may select one of the following trigger sources ($\mathbb{R40}$):

	Shot	The trigger pulse is triggered by the fieldbus via a control word.
	Timer	The trigger pulse is triggered at regular intervals by a timer. The frequency of the timer can be specified under <u>General trigger</u> <u>settings</u> .
	Digital input	The trigger pulse is triggered by the trigger input (24V trigger).
	Analog input 1	The trigger pulse is triggered by analog input 1.
(KL3362 only)	Analog input 2	The trigger pulse is triggered by analog input 2.

Event

Here you can specify the event (R40) that triggers the trigger.

Rising edge (default)	The trigger unit responds to the rising edge of the input signal. The associated threshold level can be specified via the <u>Trigger values</u> tab.
Falling edge	The trigger unit responds to the falling edge of the input signal. The associated threshold level can be specified via the <u>Trigger values</u> tab.
Positive pulse longer than set pulse	The trigger unit responds if the positive pulse width is longer than the configured pulse width, which can be specified via the <u>Trigger values</u> tab.

width

Positive The trigger unit responds if the positive pulse width is shorter than the configured pulse width, pulse which can be specified via the Trigger values shorter than set tab. pulse width Negative The trigger unit responds if the negative pulse pulse width is longer than the configured pulse width, longer which can be specified via the Trigger values than set tab. pulse width Negative The trigger unit responds if the negative pulse pulse width is shorter than the configured pulse width, which can be specified via the Trigger values shorter than set tab. pulse width

Enable

Connect the lower input of the And gate with the desired function in order to specify when the And gate should switch through a trigger pulse ($\mathbb{R}40$).

Always enabled	The trigger pulse is always switched through.
Digital input High	The trigger pulse is switched through, if the trigger input (24V trigger) of the oscilloscope terminal is on High potential.
Analog input 1 above threshold level	The trigger pulse is switched through, if the signal at analog input 1 of the oscilloscope terminal increases above the specified threshold level 2. The threshold level can be specified via the <u>Trigger values</u> tab.
Analog	The trigger pulse is switched through, if the

(KL3362 only)	input 2 above threshold level	signal at analog input 2 of the oscilloscope terminal increases above the specified threshold level 2. The threshold level can be specified via the <u>Trigger values</u> tab.
	Digital input Low	The trigger pulse is switched through, if the trigger input (24V trigger) of the oscilloscope terminal is on Low potential.
	Analog input 1 below threshold level	The trigger pulse is switched through, if the signal at analog input 1 of the oscilloscope terminal decreases below the specified threshold level 2. The threshold level can be specified via the Trigger values tab.
(KL3362 only)	Analog input 2 below threshold level	The trigger pulse is switched through, if the signal at analog input 2 of the oscilloscope terminal decreases below the specified threshold level 2. The threshold level can be specified via the <u>Trigger values</u> tab.

Action

Connect the output of the And gate with the desired function in order to specify which task should be triggered.

Reset the timer (chronometer) to zero (<u>R40.2</u>)	Resets the timer back to zero. The timer will start running again automatically immediately.
Save timer (chronometer) (<u>R40. 3</u>)	Saves the current value of the running timer at the trigger instant.
Set digital output (<u>R40.4</u>)	Sets the digital output, e.g. for synchronous triggering of the second oscilloscope channel of a KL3362. This function has to be enabled by bit 2 of the control byte 1 (<u>CB1.2</u>).

	Start recording (<u>R40.5</u>)	Starts the recording
	Enable trigger unit 2 (<u>R40.5</u>)	If the output of the And gate in trigger unit 1 is connected with the function <i>Enable trigger 2</i> , the trigger signal is transferred to trigger unit 2, which can be accessed via the <i>Unit 2</i> button in the <i>Selection</i> field for parameterization.
(KL3362 only)	Enable trigger unit 3 (<u>R40.5</u>)	If the output of the And gate in trigger unit 2 is connected with the function <i>Enable trigger 3</i> , the trigger signal is transferred to trigger unit 3, which can be accessed via the <i>Unit 3</i> button in the <i>Selection</i> field for parameterization.
(KL3362 only)	Enable trigger unit 4 (<u>R40.5</u>)	If the output of the And gate in trigger unit 3 is connected with the function <i>Enable trigger 4</i> , the trigger signal is transferred to trigger unit 4, which can be accessed via the <i>Unit 4</i> button in the <i>Selection</i> field for parameterization.

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

Jeneral Settings

)peration mode

Pre- Trigger (<u>R32.8-</u> <u>10</u>)	Recording ceases as soon a event occurs.
Mid- Trigger (<u>R32.8-</u> <u>10</u>)	The trigger event is the cent recording.
Post- Trigger (<u>R32.8-</u> <u>10</u>) default	Recording commences as s trigger event occurs.
Fast- Sampling (<u>R32.8-</u> <u>10</u>)	Operation with increased sa rate of up to 10µs: • The recording ca started via the tri • The settings of th units are not take account. • Only the first cha recorded, even fi
Trigger delay active (R32.4) default: not	Switches the trigger delay o

activated

Trigger delay (<u>R52</u>) default: 0	A trigger delay (t_{TD}) can be s here. The number of skipped (n_{STD}) is entered as the para The trigger delay thus depensample rate! Example: - Sample rate: $T_s = 200 \ \mu s$ - skipped samples: $n_{STD}=10$ $t_{TD} = T_s \ x \ n_{STD} = 200 \ \mu s \ x \ 10$
Test mode active (<u>R32.5</u>)) default: not activated	Switches the test mode on. mode, a ramp is output inste converted analog values. It i 0 to 0x3FFF and back again
Auto trigger active (<u>R32.6</u>) default: not activated	Switches the auto trigger fur With auto trigger switched o trigger unit is automatically a once the preceding event ha evaluated. To this end, bit 0 in status register 1 (<u>SR1</u>) wi new evaluation.

Seneral

	Sample- Rate (<u>R3</u> default: 200 μs

Sample-
Rate (R35)Interval (T_s) between
two samples (scans)
in microseconds.200 μ sThe sampling speed
is limited to $T_s = 100$
 μ s (10 kHz) by the
evaluation of the
trigger detectors.
Only the Fast

 $\frac{\text{sampling}}{\text{enables sampling at}} \text{ mode}$ $T_{s} = 10 \text{ } \mu \text{s} \text{ (100 kHz)}.$

Sample-	Number of sampling
Amount	values to be
(<u>R36</u>)	recorded. A
default:	maximum of 4,000
100	values can be
	recorded.
Trigger	Here you can specify
frequency	the trigger frequency
(<u>R56</u>)	of the <u>timer</u> .
default: 0	

cale channel 1

	User offset (R33) default: 0	Here you can enter an offset. Scaling: offset = full scale value x parameter / resolution Example for KL3361: 16 mV x 100 / 32767 = 0.049 mV
	User gain (R34) default: 256	Here you can enter the gain factor for scaling the input value by this factor.
caling channel 2 (KL3362 only	()	
	User offset (<u>R33</u>)	Here you can enter an offset. Scaling: offset = full scale value

default: 0

fault: 0 x parameter / resolution Example for KL3361: 16 mV x 100 / 32767 = 0.049 mV

User	Here you can enter the
gain	gain factor for scaling
(<u>R34</u>)	the input value by this
default:	factor.
256	

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

rigger Values

rigger Unit 1

Threshold 1 (R41) default: 1000	Here you can specify the threshold level for the trigger source of trigger unit 1. Scaling: Threshold value = full scale value x parameter / resolution Example for KL3361: 16 mV x 1000 / 32767 = 0,488 mV
Threshold 2 (R42) default: 1000	Here you can specify the threshold level for enabling the trigger of trigger unit 1. Scaling: see Threshold 1.
Pulse width (R43) default: 100	Here you can specify the pulse width (t_P) of trigger unit 1 for the glitch mode. The number of samples (n_{SP}) is entered as the parameter. The pulse width thus depends on the

sample rate! Example: - Sample rate: $T_s = 200 \ \mu s$ Samples: $n_{SP} = 100$ Pulse width : $t_P = T_s$ $x n_{SP} = 200 \ \mu s \ x$ 100 = 20 msHere you can specify the valid trigger time (t_{VT}) for trigger unit 1. The number of valid samples (n_{VS}) is entered as the parameter. The valid trigger time thus depends on the sample rate! Example: - Sample rate: $T_s = 200 \ \mu s$ - Valid samples: n_{VS}=100 Valid trigger time: $t_{VT} = T_s \times n_{VS}$ =200 µs x 100 = 20 ms Here you can switch Time window on the time window active for trigger unit 1. (<u>R40.6</u>)

Valid trigger time (<u>R44</u>)) default: 100

default: not activated

rigger Unit 2

Threshold 1 (R47) default: 1000	Here you can specify the threshold level for the trigger source of trigger unit 2. Scaling: see <u>Trigger</u> <u>Unit 1</u> .
Threshold 2 (R48) default: 1000	Here you can specify the threshold level for enabling the trigger of trigger unit 2. Scaling: see <u>Trigger</u> <u>Unit 1</u> .
Pulse width (R49) default: 100	Here you can specify the pulse width for trigger unit 2. Scaling: see <u>Trigger</u> <u>Unit 1</u> .
Valid trigger time (R50) default: 100	Here you can specify the valid trigger time for trigger unit 2. Scaling: see <u>Trigger</u> <u>Unit 1</u> .
Time window active (<u>R46</u>) default: not	Here you can switch on the time window for trigger unit 2.

activated

rigger unit 3 (KL3362 only)

See <u>Trigger Unit 1</u>.

rigger unit 4 (KL3362 only)

See <u>Trigger Unit 2</u>.

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

Jutput Process Data in Detail

Data word 0

Here you can choose which trigger parameter you wish to specify with data word 0 of the oscilloscope terminal for trigger unit 1.

Threshold 1	Threshold level 1 of trigger unit 1
Threshold 2	Threshold level 2 of trigger unit 1
Pulse width	Pulse width of trigger unit 1
Valid	Valid trigger time of

trigger time trigger unit 1 Not indicated

No parameters set

Data word 1

Here you can choose which trigger parameter you wish to specify with data word 1 of the oscilloscope terminal for trigger unit 2.

Three	shold 1 Threshold level 2 of trigger unit 1
Three	shold 2 Threshold level 2 of trigger unit 2
Pulse	e width Pulse width of trigger unit 2
Valid trigge	Valid trigger time of er time trigger unit 2
Not indica	No parameters set ated

Data word 2 (KL3362 only)

Here you can choose which trigger parameter you wish to specify with data word 2 of the oscilloscope terminal for trigger unit 3 (see <u>Data word</u> <u>0</u> for trigger parameters).

Data word 3 (KL3362 only)

Here you can choose which trigger parameter you wish to specify with data word 3 of the oscilloscope terminal for trigger unit 4 (see <u>Data word</u> <u>1</u> for trigger parameters).

BECKHOFF KL3361, KL3362: KS2000 Configuration Software

nput Process Data in Detail

Data word 0

Here you can specify which input value is transferred with data word 0 from the oscilloscope terminal to the control.

	O a manual de la constance de		
Input value	Comment		
Current measurement reading	Current analog value		
Maximum value	Maximum value of a recording		
Minimum value	Minimum value of a recording		
RMS value	RMS value of a recording: Sqrt((Sum(x _n ²))/n		
Mean value	Arithmetic mean of a recording: (Sum (x _n))/n		
Peak to peak value	Peak to peak value of a recording		
Cycle duration	Cycle duration of a recording		
Pulse width HIGH	 four successive values have to be above the threshold level for activating the start 		
	 four successive values have to be below the threshold level for activating the stop 		
Pulse width LOW	 four successive values have to be above the threshold level for activating the start 		

	 four successive values have to be below the threshold level for activating the stop 			
Mark/space ratio	Duty cycle			
Jitter T _{max}	reserved			
Jitter T _{min}	reserved			
Jitter T _{mean}	reserved			
Histogram Max	Most frequent value of a recording			
Latched value timer 1	stored value of the <u>timer</u> (chronometer) from trigger unit 1*	*) for KL3362		
Online value timer 1	current value of the <u>timer</u> (chronometer) from trigger unit 1*	also trigger unit 3 (via data word 2 or 3)		
Latched value timer 2	stored value of the <u>timer</u> (chronometer) from trigger unit 2**	**) for KL3362 also trigger		
Online value timer 2	current value of the <u>timer</u> (chronometer) from trigger unit 2**	unit 4 (via data word 2 or 3)		
Error counter inner envelope curve	error counter of the inner envelope	curve		
Error counter outer envelope curve	error counter of the outer envelope	curve		
Number of samples up to	Number of measurement points rec the time when the analog value exc	•		

analog value greater than threshold level	threshold level.
Number of samples up to analog value less than threshold level	Number of measurement points recorded up to the time when the analog value was less than the threshold level.

Data word 1

Here you can specify which input value is transferred with data word 1 from the oscilloscope terminal to the control.

(input value see <u>Data word 0</u>).

Data word 2 (KL3362 only)

Here you can specify which input value is transferred with data word 2 from the oscilloscope terminal to the control.

(input value see <u>Data word 0</u>).

Data word 3 (KL3362 only)

Here you can specify which input value is transferred with data word 3 from the oscilloscope terminal to the control.

(input value see <u>Data word 0</u>).

Access from the User Program

The index registers R38 and R39 can be used to specify which process data are cyclically transferred from the oscilloscope terminal

- KL3361 with registers *DATAIN11* and *DATAIN12*
- KL3362 with registers <u>DATAIN11</u> and <u>DATAIN12</u> (channel 1) or <u>DATAIN21</u> and <u>DATAIN22</u> (channel 2)

to the controller. Maximum values, minimum values, RMS values, mean values, individual sampling values (sample n after trigger event), rise times, pulse widths etc. can thus optionally be represented directly in the process data.

The index register $\mathbb{R}37$ can be used to specify which process data are cyclically transferred to oscilloscope terminal

- KL3361 with registers *DataOUT11* and *DataOUT12*
- KL3362 with registers <u>DataOUT11</u> and <u>DataOUT12</u> (channel 1) or <u>DataOUT21</u> and <u>DataOUT22</u> (channel 2)

Threshold levels, pulse widths etc. can thus optionally be specified via the process data channel.

Evaluation of a recording

A recording is requested via the *bEnableTrigger* bit. Current values are present in the memory if the *bTriggerDone* bit appears in the status byte of the terminal. If the memory is to be read or evaluated, the *bEnableTrigger* bit must remain set, otherwise the memory is continuously overwritten.

Evaluation of the memory is activated via the *bEvalBuffer* bit. Current values are present in the process data, as soon as the *bEvalBufferDone* bit appears. Multiple evaluation of the memory is thus possible. Mean value, maximum value, minimum value, RMS value of the recording can thus be read sequentially.

Reading the trace memory

Samples can be read via the *Trace data registers* R60 and R61. To this end, the offset within the memory can be specified via the *Trace index register* (R62).

The Zoom register (R63) can be used to specify a number n_S of samples for which the maximum value, minimum value and mean value is calculated, or the sample interval n_S at which the values are output. After each read access of R60 or R61, the *Trace index register* (R62) is incremented by n_S .

Example:

For calling up all values from the memory, enter the value 0x0000 in R62 and 0x0001 in R63. Then read R60 and R61 alternatively. If only every second value is to be read, enter the value 0x0002 in R63.

Invelope curve monitoring

Each recording can be monitored with a tight or a wide interval. The tight interval is subsequently referred to as inner envelope curve, the wide interval as outer envelope curve.

Application example:

- Monitoring of an ageing process via the inner envelope curve
- Monitoring of malfunctions via the outer envelope curve

A reference curve can be placed in the flash memory of the terminal, which is copied to the RAM after a terminal reset.

If evaluation of the inner or outer error counter is activated, i.e. if the index register for process data (R38 or R39) contains the value 18 or 19, the difference between the respective actual value and the target value is compared with parameter x of the envelope curve (R53, R54). If the difference is greater, the respective counter is incremented.

The RAM area can be overwritten with current trace data (Teach-in) via the command register (R7) using the instruction *WriteEnvCurvToRAM* (0x0201), or it can be directly written and read from offset 0x8000. The command *WriteEnvCurvToFLASH* (0x0202) can then be used to place data in the flash memory, and are retained even if the voltage supply fails.

Process Image of the KL3361

The following 5 bytes are transferred bi-directionally between KL3361 and control:

Oscilloscope Channel No.	Byte offset (without word alignment*)	Byte offset (with word alignment*)	Format	Input data	Outpı data
1	0	0	byte	Status byte 1 (<u>SB1</u>)	Contro byte 1 (<u>CB1</u>)
	1	2	word	DataIN0	DataC
	3	4	word	DatalN1	DataC

*) Word-Alignment: the Bus Coupler maps words to even byte addresses

Analog voltages are represented by the oscilloscope terminal KL3361 as follows:

Tension	Decimal	Hexadecimal
+20 mV	32767	0x7FFF
0 mV	0	0x0000
-20 mV	-32767	0x8001

Process Image of the KL3362

The following 10 bytes are transferred bi-directionally between KL3362 and control:

Oscilloscope Channel No.	Byte offset (without word alignment*)	Byte offset (with word alignment*)	Format	Input data	Outpi data
1	0	0	byte	Status byte 1 (<u>SB1</u>)	Contr byte 1 (<u>CB1</u>)
	1	2	word	DataIN0 (channel 1)	DataC (chan 1)
	3	4	word	DatalN1 (channel 1)	DataC (chan 1)
2	5	8	byte	Status byte 2 (<u>SB2</u>)	Contr byte 2 (<u>CB2</u>)
	6	10	word	DataIN0 (channel 2)	DataC (chan 2)
	8	12	word	DatalN1 (channel 2)	DataC (chan 2)

*) Word-Alignment: the Bus Coupler maps words to even byte addresses

Analog voltages are represented by the oscilloscope terminal KL3362 as follows:

-		

Tension	Decimal	Hexadecimal
+10 V	32767	0x7FFF
0 V	0	0x0000
-10 V	-32767	0x8001

Control and Status Bytes

[:]irst channel

Process data mode

control byte 1 (CB1) in process data mode

The control byte of the first channel is in the output image of the oscilloscope terminal and is transmitted from the PLC to the terminal.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2
Name	bRegAccess	-	-	-	bSetDigitalOut	bEnat

Key

Bit	Name	Desc	cription
CB1.7	bRegAccess	0 _{bin}	Register communication off (process data mode):
			 Process data word <u>DataIN0</u> is used to transfer the date specified with index register 1 for input data (<u>R38</u>)* from the terminal to the control.
			 Process data word <u>DataIN1</u> is used to transfer the date specified with index register 2 for input data (<u>R39</u>)* from the terminal to the control.
			 Process data word <u>DataOUT0</u> is used to

			 transfer the parameter specified with the Low byte of the index register for output data (R37)* from the control to the terminal. Process data word DataOUT1 is used to transfer the parameter specified with the High byte of the index register for output data (R37)* from the control to the terminal. *) The Registers can be set by Register communication or by configuration software KS2000. 	
CB1.6	-	reserved		
CB1.5	-	reserved		
CB1.4	-	reserved		
CB1.3	bSetDigitalOut	Setting the digital output.		
CB1.2	bEnabIntFkt		bles the trigger unit to set the digital ut directly.	
		0 _{bin}	The trigger unit must not set the digital output when triggered (default).	
		1 _{bin}	The trigger unit may set the digital output directly when triggered (<u>SET DOUT</u>).	
CB1.1	bEvalBuffer	The	recorded memory is to be	

		evaluated.
CB1.0	bEnableTrigger	The rising edge of this bit activates the trigger in trigger mode <u>Shot</u> .

status byte 1 (SB1) in process data mode

The status byte of the first channel is in the input image of the oscilloscope terminal and is transmitted from the terminal to the PLC.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3
Name	bRegAccessQ	bError	-	-	bDigitalOutputStatus

Key

Bit	Name	Description		
SB1.7	bRegAccessQ	0 _{bin}	Process data mode acknowledgement	
SB1.6	bError	reserved		
SB1.5	-	rese	rved	
SB1.4	-	reserved		
SB1.3	bDigitalOutputStatus	State of the digital output		
SB1.2	bExtTriggerInput	State of the trigger input		
SB1.1	bEvalBufferDone	Evaluation of the memory is complete. There are valid current process data present.		
SB1.0	bTriggerDone	Acknowledgement for trigger event, values were recorded.		

Register communication

control byte 1 (CB1) in register communication

The control byte of the first channel is in the output image of the

oscilloscope terminal and is transmitted from the PLC to the terminal.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2	CB1.1
Name	bRegAccess	R/W	Registe	er numbe	r		

Кеу

Bit	Name	Desc	cription
CB1.7	bRegAccess	1 _{bin}	Register communication switched on
CB1.6	R/W	O _{bin}	 Read access Process data word <u>DataINO</u> is used to read the register specified by the Register number (CB1.5-CB1.0). Process data word <u>DataIN1</u> is not used in register communication, but is also not available for process data! Marger Process data that might be shown are not valid.
		1 _{bin}	Write access • Process data word <u>DataOUT0</u> is used to write to the register specified by the Register number (CB1.5-CB1.0).

		 Process data word <u>DataOUT1</u> is not used in register communication, but is also not available for process data!
CB1.5- CB1.0	Register number	Number of the register that is to be read or written.

status byte 1 (SB1) in register communication

The status byte of the first channel is in the input image of the oscilloscope terminal and is transmitted from the terminal to the PLC.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.
Name	bRegAccessQ	R	Registernummer				

Bit	Name	Description		
SB1.7	bRegAccessQ	1 _{bin} Register access acknowledgeme		
SB1.6	R	0 _{bin}	Read access	
	Register number	Number of the register that was read or written.		

Second channel (KL3362 only)

Process data mode

control byte 2 (CB2) in process data mode

The control byte of the second channel currently has no function in process data mode.

Bit	SB2.7	SB2.6	SB2.5	SB2.4	SB2.3	SB2.2	SB2.1
Name	bRegAccess	-	-	-	-	-	-

Key

Bit	Name	Description			
SB2.7	bRegAccess	0 _{bin}	Register communication off (process data mode)		
SB2.6- SB2.0	-	rese	rved		

itatus byte 2 (SB2) in process data mode

The status byte of the second channel currently has no function in process data mode.

Bit	SB2.7	SB2.6	SB2.5	SB2.4	SB2.3	SB2.2	SB2
Name	bRegAccessQ	-	-	-	-	-	-

Bit	Name	Description			
SB2.7	bRegAccessQ	0 _{bin}	Process data mode acknowledgement		
SB2.6-	-	rese	rved		

Register communication

control byte 2 (CB2) in register communication

The control byte of the second channel is in the output image of the oscilloscope terminal and is transmitted from the PLC to the terminal.

Bit	CB2.7	CB2.6	CB2.5	CB2.4	CB2.3	CB2.2	CB2.1
Name	bRegAccess	R/W	Register number				

Bit	Name	Dese	cription
CB2.7	bRegAccess	1 _{bin}	Register communication switched on
CB2.6	R/W	O _{bin}	Read accessProcess data word DataIN2 is used to read the register specified by the Register number (CB2.5-CB2.0).CB2.5-CB2.0).Process data word DataIN3 is not used in register communication, but is also not available for process data!Mathematical Colspan="2">Process data that might be shown are not valid.

		 1_{bin} Write access Process data word <u>DataOUT2</u> is used to write to the register specified by the Register number (CB2.5-CB2.0). Process data word <u>DataOUT3</u> is not used in register communication, but is also not available for process data! 			
CB2.5- CB2.0	Register number	Number of the register that is to be read or written.			

status byte 2 (SB2) in register communication

The status byte of the second channel is in the input image of the oscilloscope terminal and is transmitted from the terminal to the PLC.

Bit	SB2.7	SB2.6	SB2.5	SB2.4	SB2.3	SB2.2	SB2.
Name	bRegAccessQ	R	Register number				

Bit	Name	Description			
SB2.7	bRegAccessQ	1 _{bin}	Register access acknowledgement		
SB2.6	R	0 _{bin}	Read access		
SB2.5- SB2.0	Register number	Number of the register that was read or written.			

Register Overview

The following registers exist for each signal channel of the oscilloscope terminal. This means these registers exist

- once on the KL3601;
- twice on the KL3602.

Register	Comment	Default v	alue	R/W	Memory
<u>R0</u>	Unprocessed ADC value	-	-	R	RAM
R1	reserved	0x0000	0 _{dec}	R	RAM
R5	reserved	0x0000	0 _{dec}	R	RAM
<u>R6</u>	Diagnostic register	-	-	R	RAM
<u>R7</u>	Command register	0x0000	0 _{dec}	R/W	RAM
<u>R8</u>	Terminal description	KL3361: 0x0D21 KL3362: 0x0D22	KL3361: 3361 _{dec} KL3362: 3362 _{dec}	R	ROM
<u>R9</u>	Firmware revision level	e.g. 0x3143	e.g. 12611 _{dec}	R	ROM
<u>R10</u>	Multiplex shift register	KL3361: 0x0128 KL3362: 0x0228	KL3361: 296 _{dec} KL3362: 552 _{dec}	R	ROM
<u>R11</u>	Signal channels	KL3362: 0x0128 KL3362:	KL3361: 296 _{dec} KL3362:	R	ROM

		0x0228	552 _{dec}		
<u>R12</u>	Minimum data length	0x2828	10280 _{dec}	R	ROM
<u>R13</u>	Data structure	0x0004	4 _{dec}	R	ROM
R14	reserved	0x0000	0 _{dec}	R	ROM
<u>R15</u>	Alignment register	-	-	R/W	RAM
<u>R16</u>	Hardware version number	e.g. 0x0000	e.g. O _{dec}	R/W	SEEROM/RAM
R17	Hardware compensation: Offset	typically 0x1FFF	typically 8191 _{dec}	R/W	SEEROM/RAM
R18	Hardware compensation: Gain	typically 0x1000	typically 4096 _{dec}	R/W	SEEROM/RAM
R19	Manufacturer scaling: Offset	typically 0x0000	typically 0 _{dec}	R/W	SEEROM/RAM
R20	Manufacturer scaling: Gain	typically 0x0100	typically 256 _{dec}	R/W	SEEROM/RAM
R21	reserved	-	-	R/W	SEEROM/RAM
R30	reserved	-	-	R/W	SEEROM/RAM
<u>R31</u>	Code word register	0x0000	0 _{dec}	R/W	RAM
<u>R32</u>	Feature register	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R33</u>	User offset	0x0000	0 _{dec}	R/W	SEEROM/RAM

<u>R34</u>	User gain	0x0100	256 _{dec}	R/W	SEEROM/RAM
<u>R35</u>	Sample rate	0x00C8	200 _{dec}	R/W	SEEROM/RAM
<u>R36</u>	Sample amount	0x0064	100 _{dec}	R/W	SEEROM/RAM
<u>R37</u>	Index register for output data	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R38</u>	Index register 1 for input data	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R39</u>	Index register 2 for input data	0x8010	32784 _{dec}	R/W	SEEROM/RAM
<u>R40</u>	Trigger unit 1, trigger logic	0x0D21	3361 _{dec}	R/W	SEEROM/RAM
<u>R41</u>	Trigger unit 1, threshold value 1	0x03E8	1000 _{dec}	R/W	SEEROM/RAM
<u>R42</u>	Trigger unit 2, threshold value 1	0x03E8	1000 _{dec}	R/W	SEEROM/RAM
<u>R43</u>	Trigger unit 1, pulse width	0x0064	100 _{dec}	R/W	SEEROM/RAM
<u>R44</u>	Trigger unit 1, valid trigger time	0x0064	100 _{dec}	R/W	SEEROM/RAM
R45	reserved	-	-	R/W	SEEROM/RAM
<u>R46</u>	Trigger unit 2, trigger logic	0x0D21	3361 _{dec}	R/W	SEEROM/RAM
<u>R47</u>	Trigger unit 2, threshold	0x03E8	1000 _{dec}	R/W	SEEROM/RAM

	value 1				
<u>R48</u>	Trigger unit 2, threshold value 2	0x03E8	1000 _{dec}	R/W	SEEROM/RAM
<u>R49</u>	Trigger unit 2, pulse width	0x0064	100 _{dec}	R/W	SEEROM/RAM
<u>R50</u>	Trigger unit 2, valid trigger time	0x0064	100 _{dec}	R/W	SEEROM/RAM
R51	reserved	-	-	R/W	SEEROM/RAM
<u>R52</u>	Trigger delay	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R53</u>	Parameter 1 envelope curve	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R54</u>	Parameter 2 envelope curve	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R55</u>	Samples envelope curve	0x0000	0 _{dec}	R/W	SEEROM/RAM
<u>R56</u>	Trigger frequency	0x0000	0 _{dec}	R/W	SEEROM/RAM
R57	reserved	-	-	R/W	SEEROM/RAM
R58	reserved	-	-	R/W	SEEROM/RAM
R59	reserved	-	-	R/W	SEEROM/RAM
<u>R60</u>	Trace data register 1	0x0000	0 _{dec}	R/W	RAM
<u>R61</u>	Trace data register 2	0x0000	0 _{dec}	R/W	RAM

	Trace index register	0x0000	0 _{dec}	R/W	RAM
<u>R63</u>	Zoom register	0x0000	0 _{dec}	R/W	RAM

Register Description

The following registers exist for each signal channel of the oscilloscope terminal. This means these registers exist

- once on the single-channel KL3361
- twice on the two-channel KL3362

X0: Unprocessed ADC value

Raw value of the analog/digital converter.

Contraction 16: Contractio 16: Contraction 16: Contraction 16: Contraction

In a later firmware version, the diagnostic register will be used to provide diagnostic information about the state of the oscilloscope terminal.

?: Command register

This register can be used to transfer commands to the oscilloscope terminal.

commands

Command 0x0201: WriteEnvCurvToRAM

Writes the sampling values into the RAM envelope curve (Teach-in method).

Return value. 0x201

Command 0x0202: WriteEnvCurvToFLASH

Writes the sampling values into the RAM envelope curve and the flash envelope curve (Teach-in method). Return value. 0x202

≀OM register

The terminal uses two channels for assigning a byte/word/word data structure. This structure is not supported by couplers that do not have the BK200 switch functionality. In this case, read access to the second register set is not available.

The terminal always reports with a shift register length of 5 bytes (see general terminal documentation).

18: Terminal description

Register R8 contains the terminal identifier in hexadecimal coding: KL3361: $0x0D21 (3361_{dec})$ KL3362: $0x0D22 (3362_{dec})$

89: Firmware revision level

Register R9 contains the firmware revision level of the terminal in hexadecimal coding, e. g. 0x3144 (12612 _{dec}).

₹10: Shift register length

KL3361: 0x0128 KL3362: 0x0228

11: Number of signal channels

KL3361: 0x0128 KL3362: 0x0228

12: Minimum data length

KL3361: 0x2828 KL3362: 0x2828

13: Data type

Register R13 contains the data type of the Bus Terminal. 0x0004 means

analog input.

15: Alignment Register

16: Hardware version number

Register R16 contains the hardware revision level of the terminal in hexadecimal coding, e.g. $0x0000 (0_{dec})$.

Jser register

The user registers of the oscilloscope terminal can be written by the user program in order to change the characteristics of the oscilloscope terminal at run-time.

X31: Code word register

- If you write values into the user registers without previously having entered the user code word (0x1235) in the code word register, these values are only stored in the RAM registers, but not in the EPROM registers and are therefore lost if the terminal is restarted.
- If you write values into the user registers and have previously entered the user code word (0x1235) in the code word register, these values are stored in the RAM registers and in the EPROM registers and are therefore retained if the terminal is restarted.

A restart will reset the code word.

32: Feature register

The feature register specifies the terminal's operating mode.

Bit	Operation mode	Value	Explanation	Default
R32.15	-	-	reserved	0 _{bin}
	-	-	reserved	0 _{bin}
R32.11	-	-	reserved	0 _{bin}
R32.10 R32.9 R32.8	Trigger type	000 _{bin}	Post-trigger. Recording commences as soon as a trigger event occurs.	000 _{bin}
			Pre-trigger. Recording	

		001 _{bin}	ceases as soon as a trigger event occurs.	
		010 _{bin}	Mid-trigger: The trigger event is the centre of the recording.	
		011 _{bin}	 FastSampling (from firmware version 1B'): Operation with increased sampling rate of up to 10μs. The recording can only be started via the trigger input. The settings of the trigger units are not taken into account. Only the first channel is recorded, even for 	
			KL3362.	
R32.7	-	-	reserved	0 _{bin}
R32.6	<u>Auto</u>	0 _{bin}	not active	0 _{bin}
	<u>trigger</u>	1 _{bin}	active: The trigger unit is automatically activated once the preceding event has been evaluated. To this end, bit 0 is toggled in status byte 1 (<u>SB1</u>)	

			with each new evaluation.	
R32.5	Test mode	0 _{bin}	not active	0 _{bin}
		1 _{bin}	active: The oscilloscope terminal simulates a ramp of sampling values. The sampling value is incremented after each reading. The ramp thus runs from 0x0000 to 0x3FFF. From 0x3FFF, the sampling value after each reading is decremented, so that the ramp returns to 0x0000. The process is repeated cyclically.	
R32.4	<u>Trigger</u>	0 _{bin}	not active	0 _{bin}
	<u>delay</u>	1 _{bin}	active: Samples skipped after the trigger event. The number of samples that are skipped is specified in the <i>Trigger</i> <i>delay</i> register (R52).	
R32.3	-	-	reserved	0 _{bin}
	-	-	reserved	0 _{bin}
R32.0	-	-	reserved	0 _{bin}

≀33: User offset

Offset, can be changed by the user. Scaling: offset = full scale value x parameter / resolution Example for KL3361: 16 mV x 100 / 32767 = 0.049 mV

34: User gain

Gain factor, can be changed by the user.

35: Sample rate

Interval (T_s) between two samples (scans) in microseconds.

The sampling speed is limited to T_s =100 μ s (10 kHz) by the evaluation of the trigger detectors.

Only the <u>Fast sampling</u> mode enables sampling at $T_s = 10 \ \mu s$ (100 kHz).



The sample rate influences the transmission speed with **i** Note which the oscilloscope terminal can be addressed by the K-Bus:

- A sample rate of 100 µs can only accommodate bus cycles with a minimum duration of 3 ms!
- A sample rate of 150 µs can only accommodate bus cycles with a minimum duration of 2 ms!
- The Fast sampling mode can only accommodate K-bus cycles with a minimum duration of 2 ms!

This must be taken into account when considering your PLC cycle time.

₹36: Sample amount

Number of sampling values to be recorded. A maximum of 4,000 values can be recorded (default 100).

37: Index register for output data (terminal parameters)

Low Byte:

The content of the Low byte of this register determines which parameter

of the oscilloscope terminal

- KL3361 is assigned process data register <u>DataOUT0</u>
- KL3362 is assigned process data register <u>DataOUT0 (channel</u> <u>1)</u> or process data register <u>DataOUT0 (channel 2)</u>

The decimal value of the index corresponds to the register number of the parameter to be written.

Index	Decimal	Parameters
0x00	00	Default value
0x29	<u>41</u>	Trigger Unit 1, Threshold 1
0x2A	<u>42</u>	Trigger Unit 1, Threshold 2
0x2B	<u>43</u>	Trigger Unit 1, Pulse width
0x2C	<u>44</u>	Trigger Unit 1, Valid Trigger Time
0x2F	<u>47</u>	Trigger Unit 2, Threshold 1
0x30	<u>48</u>	Trigger Unit 2, Threshold 2
0x31	<u>49</u>	Trigger Unit 2, Pulsewith
0x32	<u>50</u>	Trigger Unit 2, Valid Trigger Time

The following indices are supported:

High Byte:

The content of the High byte of this register determines which parameter of the oscilloscope terminal

- KL3361 is assigned process data register <u>DataOUT1</u>
- KL3362 is assigned process data register <u>DataOUT1 (channel</u> <u>1</u>) or process data register <u>DataOUT1 (channel 2)</u>

(see <u>Low byte</u> for indices).

X38: Index register 1 for input data

The content of this register (default value: 0x0000) determines which date is shown in the process data register

- DataINO of oscilloscope terminal KL3361
- <u>DataIN0 (channel 1)</u> or <u>DataIN0 (channel 2)</u> of oscilloscope terminal KL3362

The following indices are supported:

Index	Decimal	Date
0x0000	0	Current analog value
0x0001	1	Maximum value of a recording
0x0002	2	Minimum value of a recording
0x0003	3	RMS value of the recording: Sqrt((Sum(x _n ²))/n
0x0004	4	Mean value of the recording: (Sum (x _n))/n
0x0005	5	Peak-peak value of the recording
0x0006	6	Cycle duration
0x0007	7	 Pulse width - high: threshold level is trigger level 1 The trigger starts as soon as four successive values are above the threshold level
		 The trigger is stopped as soon as four successive values are below the threshold level
0x0008	8	 Pulse width - low: threshold level is trigger level 1 The trigger starts as soon as four successive values are below the

		 threshold level The trigger is stopped as soon as four successive values are above the threshold level
0x0009	9	Mark/space ratio
0x000A	10	reserved for jitter T _{max}
0x000B	11	reserved for jitter T _{min}
0x000C	12	reserved for jitter T _{mean}
0x000D	13	Histogram max, i.e. the value that has occurred most frequently.
0x000E	14	Timer1LatchValue
0x000F	15	Timer1Run (read/write)
0x0010	16	Timer2LatchValue
0x0011	17	Timer2Run (read/write)
0x0012	18	Error counter inner envelope curve
0x0013	19	Error counter outer envelope curve
0x0014	20	Number of samples up to analog value greater than threshold level 1
0x0015	21	Number of samples up to analog value less than threshold level 1
0x8000		First sampling value. The recorded sampling values are available from here. The MSB has to be set to zero in order to determine the trace offset.
0x8001		Second sampling value.
0x8002		Third sampling value.

0x8063	Hundredth sampling value (in the delivery state, 100 values are stored).
0x8F9F	Four thousandth sampling value (a maximum of 4,000 values can be stored).

X39: Index register 2 for input data

The content of this register (default value: 0x8010) determines which date is shown in the process data register

- <u>DataIN1</u> of oscilloscope terminal KL3361
- <u>DataIN1 (channel 1)</u> or <u>DataIN1 (channel 2)</u> of oscilloscope terminal KL3362

(See Index register 1 for process input data for indices.)

240: Trigger unit 1, trigger logic

Bit	Operation mode	Value	Explanatio	n
R40.15	-	-	reserved	
R40.14,	enableSource	000 _{bin}	Trigger alwa	ays enabled
R40.13, R40.12		001 _{bin}	Trigger enabled if signal at first analog input above <u>threshold</u> <u>level 2</u>	First analog input is fc • KL3361 th Input for differential voltage of the measuring bridge (UB+/UB-)

		010 _{bin}	Trigger enabled if signal at first analog input below <u>threshold</u> <u>level 2</u>	 KL3362 the Oscilloscol input channel 1 (IN 1).
		011 _{bin}	Trigger enabled if signal at second analog input above <u>threshold</u> <u>level 2</u>	Second analog input i for • KL3361no existent • KL3362 th Oscillosco input channel 2 (IN 2).
		100 _{bin}	Trigger enabled if signal at second analog input below threshold level 2	(<u>IIV</u> 2).
		101 _{bin}		bled if trigger input (24\ high potential.
		110 _{bin}		bled if trigger input (24\ ow potential.
R40.11,	TriggerSource	00 _{bin}	Timer with t	hreshold level 1
R40.10		01 _{bin}	First analog threshold le	input (IN1), with vel 1

		10 _{bin}	Second analog input (IN2), with threshold level 1 (KL3362 only)
		11 _{bin}	Digital input
R40.9, TriggerMode R40.8		00 _{bin}	Shot: The trigger is triggered with a edge of the <i>bEnableTrigger</i> bit of th control byte (<u>CB1.0</u>), if it is enabled via enableSource.
		01 _{bin}	Edge: The trigger is triggered via the dge selected via TriggerSource and bLogic, if it is enabled via enableSource.
		10 _{bin}	Glitch: The trigger is triggered via tl pulse selected via TriggerSource, bLogic and bLarger, if it is enabled via enableSource.
R40.7	-	-	reserved
R40.6	bTriggerWinEn	1 _{bin}	The trigger condition for the followin trigger unit must arrive within the valid trigger time for trigger unit 1. Otherwise everything is reset
R40.5	bStartScopeRec	0 _{bin}	The trigger event causes the downstream trigger unit to be enabled
		1 _{bin}	The trigger event causes the recording to be started
R40.4	bTriggerOutEn	1 _{bin}	The trigger event causes the digital output to be set, if this is enabled b bit 2 of the Control Byte 1 (<u>CB1.2</u>).
R40.3	bLatchtimer	1 _{bin}	The trigger event causes the currer value of the running timer to be stored.

R40.2	bResetTimer	1 _{bin}	be reset to z	event causes the timer zero. The timer will star in automatically
R40.1	bLarger	0 _{bin}	in glitch mode: pulse width lest the <u>pulse width</u> <u>specified for tri</u> <u>unit 1</u>	
		1 _{bin}		de: pulse width greater <u>se width</u> <u>specified for</u> L
R40.0	bLogic	0 _{bin}	in edge mode (edge triggering): falling edge	in glitch mode: negativ pulse
		1 _{bin}	in edge mode (edge triggering): rising edge	in glitch mode: positiv pulse

₹41: Trigger unit 1, threshold level 1

Threshold level for the trigger source (TriggerSource) of trigger unit 1

22: Trigger unit 1, threshold level 2

Threshold level for enabling the trigger (EnableSource) of trigger unit 1

₹43: Trigger unit 1, pulse width

Here you can specify the <u>pulse width</u> (t_P) of trigger unit 1 for the glitch mode. The number of samples (n_{SP}) is entered as the parameter. The

pulse width thus depends on the sample rate! Example:

- Sample rate: $T_s = 200 \ \mu s$
- Samples: n_{SP} = 100

Pulse width: $t_P = T_s \times n_{SP} = 200 \ \mu s \times 100 = 20 \ ms$

244: Trigger unit 1, valid trigger time

Here you can specify the <u>valid trigger time</u> (t_{VT}) for trigger unit 1. The number of valid samples (n_{VS}) is entered as the parameter. The valid trigger time thus depends on the sample rate! Example:

- - Sample rate: $T_s = 200 \ \mu s$
- - Valid samples: n_{VS}=100

Valid Trigger Time: $t_{VT} = T_s \times n_{VS} = 200 \ \mu s \times 100 = 20 \ ms$

₹45:

reserved

246: Trigger unit 2, trigger logic

see Trigger detector 1

247: Trigger unit 2, threshold level 1

Threshold level for the trigger source (TriggerSource) of trigger unit 2

248: Trigger unit 2, threshold level 2

Threshold level for enabling the trigger (EnableSource) of trigger unit 2

₹49: Trigger unit 2, pulse width

Here you can specify the pulse width (t_P) of trigger unit 2 for the glitch

mode (see Trigger unit 1, pulse width).

₹50: Trigger unit 2, valid trigger time

see Trigger unit 1, valid trigger time

₹51:

reserved

≀52: Trigger delay

A <u>trigger delay</u> (t_{TD}) can be specified here. The number of skipped samples (n_{STD}) is entered as the parameter. The trigger delay thus depends on the sample rate! Example: Sample rate: $T_s = 200 \ \mu s$, skipped samples: n_{STD} =100 $t_{TD} = T_s \ x \ n_{STD} = 200 \ \mu s \ x \ 100 = 20 \ ms$

₹53: Parameter 1 envelope curve

e.g. distance of the inner envelope curve After the trace recording, the envelope curve is evaluated.

₹54: Parameter 2 envelope curve

e.g. distance of the outer envelope curve After the trace recording, the envelope curve is evaluated.

₹55: Samples envelope curve

Number of samples to be evaluated (512 max.).

₹56: Trigger frequency

Frequency of the <u>timer</u> that can be used for triggering.

≀60: Trace data register 1

Contains the sampling value from the register specified in the trace index

register (R62).

After the end of the read access (change of register address), the trace index (R62) is incremented by the zoom distance n_Z (see R63).

161: Trace data register 2

Contains the sampling value from the register following the register specified in the trace index register (R62).

After the end of the read access (change of register address), the trace index (R62) is incremented by the zoom distance n_Z (see R63).

Context Context Conte

Writing: Sets the trace index to offset Reading: Current value of the trace index.

The index is reset to zero at the start of a recording. Offset zero to 0x3FFF contains the trace data. From 0x8000, the envelope curve is given

₹63: Zoom register

With the zoom register you can specify that

- only certain values or
- pre-processed values (maximum value , minimum value or arithmetic mean value)

are transferred to the control.

Bit	Name	Value	Explanation	Default
R63.15 R63.14	Zoom mode	00 _{bin}	Sample zoom - the trace index register is increased automatically after each reading by the zoom distance n _Z . Therefore, only every n _Z th value is read.	-

		01 _{bin}	Max zoom - the highest of the read values is output	
		10 _{bin}	Min zoom - the lowest of the read values is output	
		11 _{bin}	Mean value zoom - the arithmetic mean of the read values is output	
R63.13 R63.12	-	-	reserved	-
R63.11 R63.0	Zoom distance n _Z	Numbe which tl is increa <i>zoom</i> a	-	
		0x000	The same value is always read.	
		0x001	All values are read.	
		0x002	Only every second value is read.	
		0x00A	Only every tenth value is read.	

BECKHOFF Fieldbus Components: Access from the User Program

Examples of Register Communication

In the examples, the numbering of the bytes is according to the description without Word-Alignment.

Example 1: Reading the Firmware Issue Status from Register 9 of a Terminal

Output Data

Byte 0: Control Byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x89 (1000 1001 _{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set indicates register communication active.
- Bit 0.6 not set indicates reading the register.
- Bit 0.5 to Bit 0.0 indicates with 00 1001_{bin} the register number 9.
- The output data word (Byte 1 and Byte 2) has no function at the reading access. If you want to change a register, you have to write the desired value into the output data word.

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x89	0x33	0x41

Explanation:

- The terminal returns the value of the Control Byte in the Status Byte, as an acknowledgement.
- The terminal returns the Firmware Issue Status 0x3341 in ASCII code, in the input data word (Byte 1 and Byte 2). This has to be interpreted as ASCII code:
 - ASCII code 0x33 stands for the cipher 3
 - ASCII code 0x41 stands for the letter A

Therefore the firmware version is 3A.

Example 2: Writing to an user registers

At normal operation all user registers other than register 31are write protected.



In order to deactivate write protection, you have to write the password (0x1235) into register 31. Write protection is

activated again by writing any value other than 0x1235 Note that some of the settings that can be made in registers only become active after the next power restart (poweroff/power-on) of the terminal.

I. Writing the code word (0x1235) to Register 31

Output Data

Byte 0: Control Byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111 _{bin})	0x12	0x35

- Bit 0.7 set indicates: register communication active.
- Bit 0.6 set indicates: writing to the register.
- Bit 0.5 to Bit 0.0 indicates with 00 1111_{bin} the register number 31.
- The output data word (Byte 1 und Byte 2) contains the code word (0x1235) to deactivate the write protection.

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111 _{bin})	0xXX	0xXX

Explanation:

- In the Status Byte, the terminal returns a value, that differs only at bit 0.6 from the value of the of the Control Byte.
- The input data word (Byte 1 and Byte 2) has no function after the the writing access. Values that might be shown are not valid!

II. Reading Register 31 (verifying the set code word)

Output Data

Byte 0: Control Byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0x9F (1001 1111 _{bin})	0xXX	0xXX

- Bit 0.7 set indicates register communication active.
- Bit 0.6 not set indicates reading the register.
- Bit 0.5 to Bit 0.0 indicates with 00 1111_{bin} the register

number 31.

• The output data word (Byte 1 and Byte 2) has no function at the reading access.

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111 _{bin})	0x12	0x35

Explanation:

- The terminal returns the value of the Control Byte in the Status Byte, as an acknowledgement.
- The terminal returns the current value of the code word register in the input data word (Byte 1 and Byte 2).

III. Writing into Register 32 (changing the content of the feature register)

Output Data

Byte 0: Control Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xE0 (1110 0000 _{bin})	0x00	0x02

- Bit 0.7 set indicates register communication active.
- Bit 0.6 set indicates: writing to the register
- Bit 0.5 to Bit 0.0 indicates with 10 0000_{bin} the register number 32.
- The output data word (Byte 1 and Byte 2) contains the new value for the feature register.

The given value 0x0002 is only an example!



The bits of the feature register change the properties of the terminal und and have different meanings, depending on the terminal type. Please check the description of the feature register of your terminal type (chapter *register description*) about the meanings of the bits in detail, before changing the values!

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000 _{bin})	0xXX	0xXX

- In the Status Byte, the terminal returns a value, that differs only at bit 0.6 from the value of the of the Control Byte.
- The input data word (Byte 1 and Byte 2) has no function after the the writing access. Values that might be shown are not valid!

IV. Reading Register 32 (verifying the changed feature register)

Output Data

Byte 0: Control Byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xA0 (1010 0000 _{bin})	0xXX	0xXX

Explanation:

- Bit 0.7 set indicates register communication active.
- Bit 0.6 not set indicates reading the register.
- Bit 0.5 to Bit 0.0 indicates with 10 0000_{bin} the register number 32.
- The output data word (Byte 1 and Byte 2) has no function at the reading access.

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0xA0 (1010 0000 _{bin})	0x00	0x02

Explanation:

• The terminal returns the value of the Control Byte in the Status Byte, as an acknowledgement.

• The terminal returns the current value of the feature register in the input data word (Byte 1 and Byte 2).

V. Writing to Register 31 (setting the code word back)

Output Data

Byte 0: Control Byte	Byte 1: DataOUT1, high byte	Byte 2: DataOUT1, low byte
0xDF (1101 1111 _{bin})	0x00	0x00

Explanation:

- Bit 0.7 set indicates register communication active.
- Bit 0.6 set indicates: writing to the register.
- Bit 0.5 to Bit 0.0 indicates with 00 1111_{bin} the register number 31.
- The output data word (Byte 1 und Byte 2) contains 0x0000 to activate the write protection again.

Input Data (answer of the bus terminal)

Byte 0: Status Byte	Byte 1: DataIN1, high byte	Byte 2: DataIN1, low byte
0x9F (1001 1111 _{bin})	0xXX	0xXX

- In the Status Byte, the terminal returns a value, that differs only at bit 0.6 from the value of the of the Control Byte.
- The input data word (Byte 1 and Byte 2) has no function after the the writing access. Values that might be shown are not valid!

BECKHOFF Fieldbus Components: Appendix

Support and Service

BECKHOFF and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to BECKHOFF products and system solutions.

BECKHOFF Support

Support offers you comprehensive technical assistance, helping you no only with the application of individual BECKHOFF products, but also with other, wide-ranging services:

- world-wide support
- design, programming and commissioning of complex automation systems
- and extensive training program for BECKHOFF system components

Hotline:+49(0)5246/963-157Fax:+49(0)5246/963-199e-mail:support@beckhoff.com

BECKHOFF Service

The BECKHOFF Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:+49(0)5246/963-460Fax:+49(0)5246/963-479e-mail:service@beckhoff.com

You will find further support and service addresses on our Internet pages under <u>http://www.beckhoff.com</u>.

BECKHOFF Headquaters

BECKHOFF Industrie Elektronik

Eiserstr. 5

33415 Verl

Germany

Phone:+49(0)5246/963-0Fax:+49(0)5246/963-198e-mail:info@beckhoff.com

The addresses of BECKHOFF's branch offices and representatives round the world can be found on her internet pages:

http://www.beckhoff.com

You will also find further documentation for BECKHOFF components there.