

# I/O Terminal Installation Manual



**Revision 1.1, June 2011**

AKT-AN-420-000 4-Channel Analog Input Terminal (0-20mA)

AKT-AN-820-000 8-Channel Analog Input Terminal (0-20mA)



Keep all manuals as a product component during the life span of the product.  
Pass all manuals to future users / owners of the product.

**KOLLMORGEN**<sup>®</sup>

*Because Motion Matters™*

## Record of Document Revisions

Revision	Remarks
1.0	Preliminary edition
1.1	Added mechanical drawing to Appendix A. For more information, see "Appendix A" page 37.

## IMPORTANT NOTICE

Copyright© Kollmorgen™2010-2011. All rights reserved. Kollmorgen holds the copyright to this manual. All rights are reserved and no part of this publication may be reproduced or transmitted in any form or by any means without prior written consent from Kollmorgen.

### Disclaimer

The information in this manual was accurate and reliable at the time of its release. However, Kollmorgen. reserves the right to change the specifications of the product described in this manual without notice at any time.

This document contains proprietary and confidential information of Kollmorgen. The contents of the document may not be disclosed to third parties, translated, copied or duplicated in any form, in whole or in part, without the express written permission of Kollmorgen.

### Registered Trademarks

Kollmorgen is a registered trademark of Danaher Corp.

Technical changes which improve the performance of the device may be made without prior notice! Printed in the Federal Republic of Germany. All rights reserved. No part of this work may be reproduced in any form (by printing, photocopying, microfilm or any other method) or stored, processed, copied or distributed by electronic means without the written permission of Kollmorgen. All other proprietary names mentioned in this manual are the trademarks of their respective owners.

**June 2011**

<b>1</b>	<b>Safety Precautions</b>	
1.1	Safety Rules.....	5
1.2	State at Delivery.....	5
1.3	Personnel Qualification .....	5
1.4	Description of Notes and Warnings .....	5
<b>2</b>	<b>Overview</b>	
2.1	4-Channel Analog Input Terminal (AKT-AN-420-000).....	6
2.1.1	Technical Data .....	7
2.1.2	Diagnostic LEDs.....	8
2.1.3	LEDs Defined .....	8
2.2	8-Channel Analog Input Terminal (AKT-AN-820-000).....	9
2.2.1	Technical Data .....	10
2.2.2	Diagnostic LEDs.....	11
2.2.3	LEDs Defined .....	11
<b>3</b>	<b>Basic Function Principles</b>	
3.1	Process Data Output Format .....	12
3.2	Process Data Equations .....	12
<b>4</b>	<b>Mounting and Wiring</b>	
4.1	Installation of Bus Terminals on Mounting Rails.....	14
4.1.1	Assembly.....	14
4.1.2	Disassembly.....	14
4.1.3	Connections Within a Bus Terminal Block.....	14
4.1.4	PE Power Contact.....	15
4.1.5	Wiring .....	15
4.2	Connections (4-Channel I/O) .....	16
4.2.1	Terminal Connection Descriptions .....	16
4.3	Connections (8-Channel I/O) .....	17
4.3.1	Terminal Connection Descriptions .....	17
<b>5</b>	<b>Automatic Configuration</b>	
5.1	Scan Device .....	18
5.2	Setting I/O Values .....	18
<b>6</b>	<b>Manual Configuration</b>	
6.1	Process Image .....	19
6.1.1	Process Image (AKT-AN-420-000).....	19
6.1.2	Process Image (AKT-AN-820-000).....	20
6.2	Mapping .....	20
6.2.1	Compact Evaluation.....	21
6.2.2	Complete Evaluation.....	21
6.3	Control and Status Bytes .....	23

- 6.3.1 Channel 1 (Process Data Mode).....24
- 6.4 Register Information.....25
  - 6.4.1 Register Communication.....25
  - 6.4.2 Channel 2, 3, and 4.....26
  - 6.4.3 Register Overview.....26
  - 6.4.4 Register Descriptions.....27
  - 6.4.5 Examples of Register Communication.....32
- Appendix A**
  - A.1 I/O 12.0 mm Mechanical Drawing.....37

# 1 SAFETY PRECAUTIONS

This chapter provides safety information for the I/O terminal.

## 1.1 Safety Rules

The appropriate 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.

## 1.2 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 any liability from Kollmorgen.

## 1.3 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.

## 1.4 Description of Notes and Warnings

The following notes and warnings are used in this manual. They are intended to alert the reader to the associated safety instructions.

**Danger** — This note is intended to highlight risks for the life or health of personnel.

**Warning** — This note is intended to highlight risks for equipment, materials or the environment.

**Note** — Indicates information that contributes to better understanding.

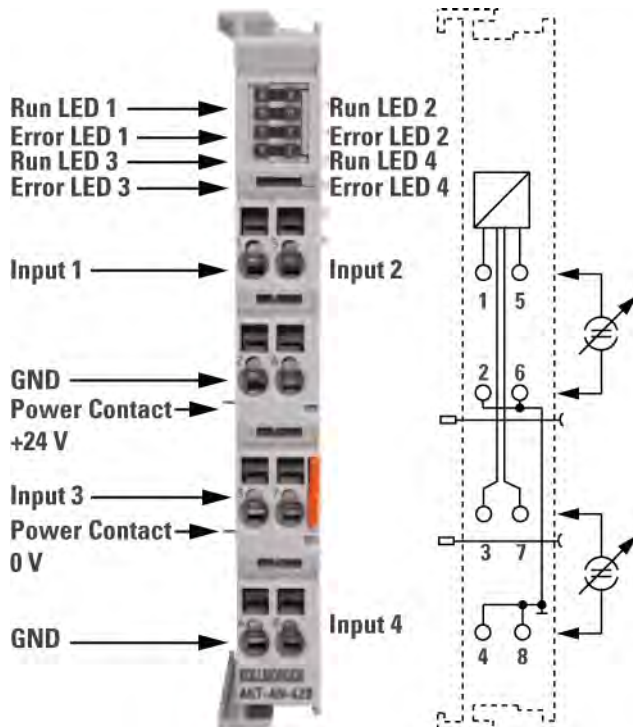
## 2 OVERVIEW

This section provides an overview of the I/O terminal.

**Note:** For information about configuring the I/O terminal, see the Kollmorgen Automation Suite™ IDE software and online help system.

### 2.1 4-Channel Analog Input Terminal (AKT-AN-420-000)

The 4-channel analog input terminal process signals in the range between 0 and 20 mA. The current is digitized to a resolution of 12 bits, and is transmitted, in an electrically isolated form, to the higher-level automation device. The four inputs are 2-wire versions and have a common ground potential. This reference ground for all inputs is separated from the 0 V power contact. The power contacts are connected through. Overload is detected and the terminal status is relayed to the controller via the Standard-bus. The Run-LEDs indicate the data exchange with the Bus Coupler, the Error-LEDs indicate overload.



**Figure 2.1** Contact Assembly Connection (Top View)

### 2.1.1 Technical Data

This section provides the technical details for the 4-channel analog input terminal.

Parameters	(AKT-AN-420-000)
Number of inputs	4
Signal voltage	0 ... 20 mA
Input resistance	< 85 $\Omega$
Common-mode voltage $U_{CM}$	Maximum 30 V
Resolution	12 Bit
Conversion time	~2 ms
Meas. error (total meas. range)	< $\pm 0,3\%$ of the full scale value
Surge voltage resistance	30 $V_{DC}$
Electrical isolation	500 $V_{rms}$ (Standard-Bus/signal voltage)
Power supply for the electronics	Via the Standard-Bus
Current consumption from the Standard-Bus	Typically 85 mA
Bit width in the process image	Input: 4 x 16 Bit data, 4 x 8 Bit control/status (optional)
Weight	~55 g
Dimensions (W x H x D)	~15mm x 100mm x 70mm
Assembly	35 mm mounting rail according to EN 50022
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	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	according to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	variable
Approval	CE

## 2.1.2 Diagnostic LEDs

Operation status of the channels is shown by four green Run LEDs and four red Error LEDs.

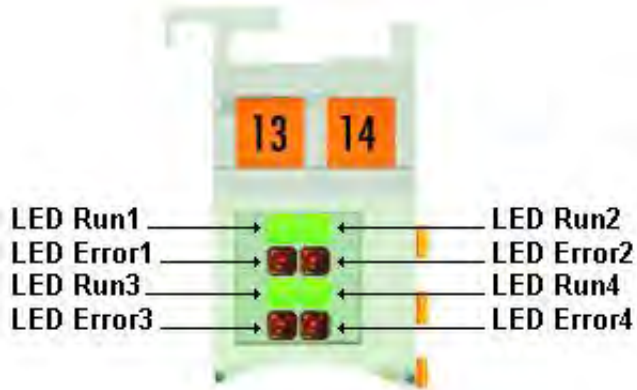


Figure 2.2 LEDs Operation Status

## 2.1.3 LEDs Defined

The following table describes the operation status of the LEDs for the 4-channel analog input terminal.

LED	Color	Channel	Status	
			On	Off
Run 1	Green	1	Regular operation	A watchdog-timer overflow has occurred. If no process data is transmitted between control system and bus coupler for 100 ms, the green LEDs extinguish.
Run 2		2		
Run 3		3		
Run 4		4		
Error 1	Rot	1	Current consumption of the channel higher than 20,8 mA	Regular operation
Error 2		2		
Error 3		3		
Error 4		4		



## 2.2 8-Channel Analog Input Terminal (AKT-AN-820-000)

The 8-channel analog input terminal process signals in the range between 0 and 20 mA. The current is digitized to a resolution of 12 bits and is transmitted in an electrically isolated form to the higher-level automation device. The 8 channels are combined in one housing and is particularly suitable for space-saving installation in control cabinets. The use of single conductor connection technology enables the connection of multi-channel sensor technology with minimum space requirements. In the 8-channel input terminal the power contacts are connected through. The reference ground for all inputs is the 0 V power contact. Overload is detected and the terminal status is relayed to the controller via the Standard-bus. The Run-LEDs indicate the data exchange with the Bus Coupler.

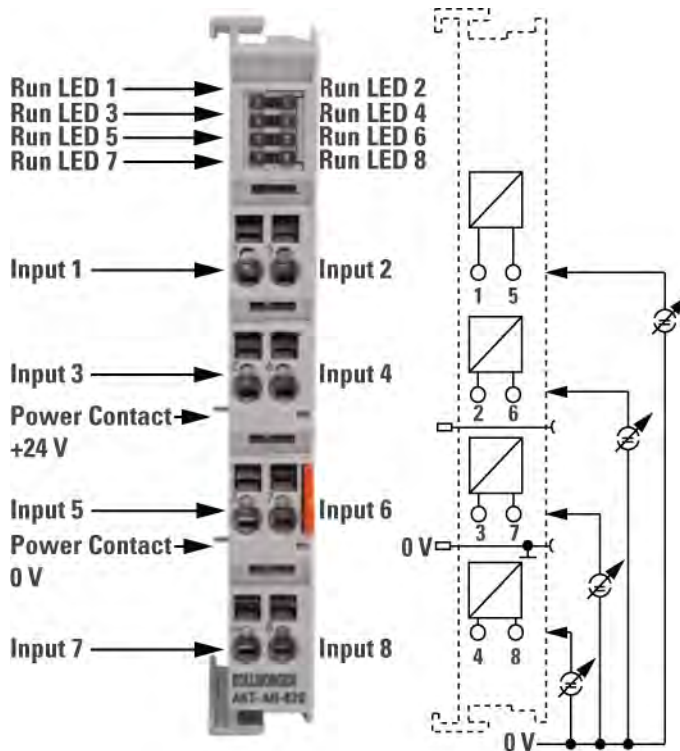


Figure 2.3 Contact Assembly Connection (Top View)

## 2.2.1 Technical Data

This section provides the technical details for the 8-channel analog input terminal.

Parameters	(AKT-AN-820-000)
Number of inputs	8
Signal voltage	0 ... 20 mA
Input resistance	< 85 $\Omega$
Common-mode voltage $U_{CM}$	Maximum 30 V
Resolution	12 Bit
Conversion time	~4 ms
Meas. error (total meas. range)	< $\pm 0,3\%$ of the full scale value
Surge voltage resistance	30 $V_{DC}$
Electrical isolation	500 $V_{rms}$ (Standard-Bus/signal voltage)
Power supply for the electronics	Via the Standard-Bus
Current consumption from the Standard-Bus	Typically 105 mA
Bit width in the process image	Input: 8 x 16 Bit data, 8 x 8 Bit control/status (optional)
Weight	~55 g
Dimensions (W x H x D)	~15mm x 100mm x 70mm
Assembly	35 mm mounting rail according to EN 50022
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	according to EN 60068-2-6 / EN 60068-2-27, EN 60068-2-29
EMC resistance burst / ESD	according to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	variable
Approval	CE

## 2.2.2 Diagnostic LEDs

Operation status of the channels is shown by eight green Run LEDs.

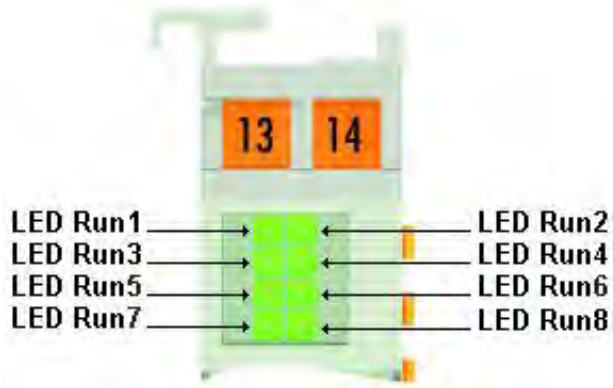


Figure 2.2 LEDs Operation Status

## 2.2.3 LEDs Defined

The following table describes the operation status of the LEDs for the 8-channel analog input terminal.

LED	Color	Channel	Status	
			On	Off
Run 1	Green	1	Regular operation	A watchdog-timer overflow has occurred. If no process data is transmitted between control system and bus coupler for 100 ms, the green LEDs die green LEDs extinguish.
Run 2		2		
Run 3		3		
Run 4		4		
Run 5		5		
Run 6		6		
Run 7		7		
Run 8		8		

### 3 BASIC FUNCTION PRINCIPLES

The analog input terminals processes signals in the range between 0 and 20 mA with a resolution of 12 bits (4095 increments). They can supply the sensors from voltage fed in via the power contacts. The power contacts can optionally be supplied via the standard supply or via a feed terminal with electrical isolation.

#### 3.1 Process Data Output Format

In the delivery state the process data are shown in two's complement form ( -1integer corresponds to 0xFFFF). Other display types can be selected via the feature register (e.g. sign/amount representation, Siemens output format).

Measured Value	Input Data	
	Decimal	Hexadecimal
0 mA	0	0x0000
10 mA	16383	0x3FFF
20 mA	32767	0x7FFF

#### 3.2 Process Data Equations

The process data that are transferred to the Bus Coupler are calculated using the following equations:

Neither user nor manufacturer scaling is active:

$$Y_a = (B_a + X_{ADC}) \times A_a \quad (1.0)$$

$$Y_{out} = Y_a$$

Manufacturer scaling active (default setting):

$$Y_1 = B_h + A_h \times Y_a \quad (1.1)$$

$$Y_{out} = Y_1$$

User scaling active:

$$Y_2 = B_w + A_w \times Y_a \quad (1.2)$$

$$Y_{out} = Y_2$$

Manufacturer and user scaling active:

$$Y_1 = B_h + A_h \times Y_a \quad (1.3)$$

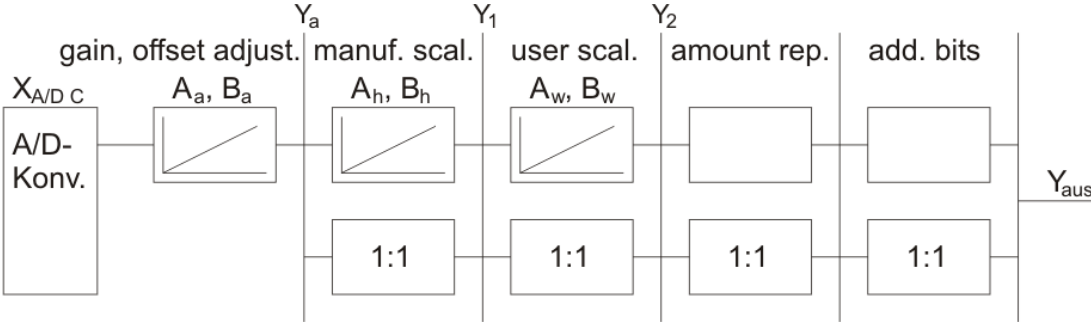
$$Y_2 = B_w + A_w \times Y_1 \quad (1.4)$$

$$Y_{out} = Y_2$$

Key:

- $X_{ADC}$ : Output values of the A/D converter
- $Y_{out}$ : Process data to PLC
- $B_a, A_a$ : Manufacturer gain and offset compensation (R17, R18)
- $B_h, A_h$ : Manufacturer scaling (R19, R20)
- $B_w, A_w$ : User scaling (R33, R34)

The equations of the straight line are activated via register R32.



## 4 MOUNTING AND WIRING

This section provides mounting and wiring information for the operator terminal.

**Note:** For information about configuring the I/O terminal, see the Kollmorgen Automation Suite™ IDE software and online help system.

### 4.1 Installation of Bus Terminals on Mounting Rails

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

#### 4.1.1 Assembly

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

1. First attach the Fieldbus Coupler to the mounting rail.
2. 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.

#### 4.1.2 Disassembly

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.

#### 4.1.3 Connections Within a Bus Terminal Block

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

- The six spring contacts of the Standard Bus/Performance 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.

**Note:** 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 interrupt the power contacts and thus represent the start of a new supply rail.

#### 4.1.4 PE 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.

**WARNING!!** 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.

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

#### 4.1.5 Wiring

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.

**Note:** Analog sensors and actors should always be connected with shielded, twisted paired wires.

## 4.2 Connections (4-Channel I/O)

The section describes the connections for the 4-channel analog input terminal.

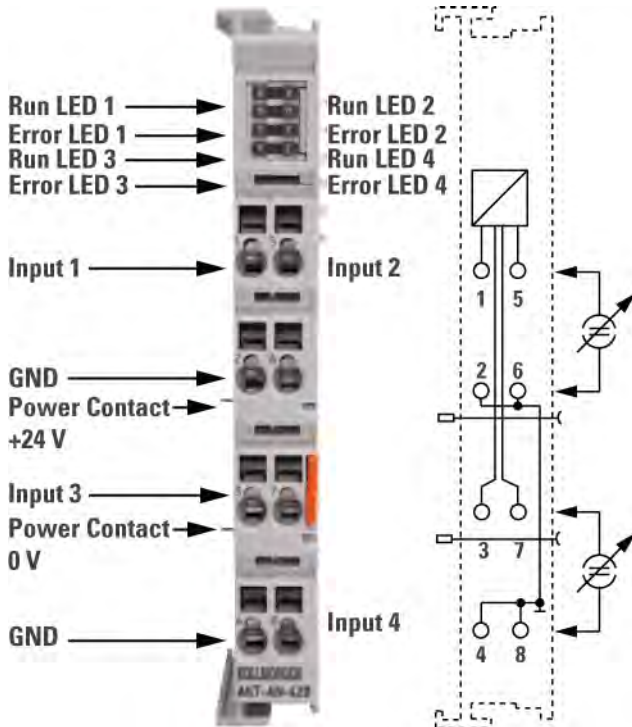


Figure 4.1 Terminal Connections (4-Channel I/O)

### 4.2.1 Terminal Connection Descriptions

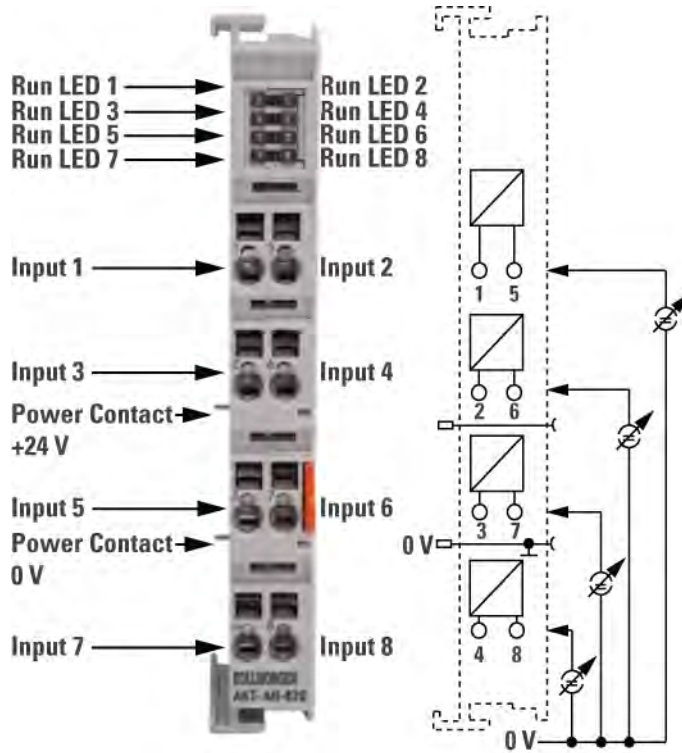
The following table provides the terminal descriptions for the 4-channel analog input terminal.

Terminal	Channel	Name	Connection
1	1	Input 1	Input 1, signal
2		GND	Input 1, ground
3	3	Input 3	Input 3, signal
4		GND	Input 3, ground
5	2	Input 2	Input 2, signal
6		GND	Input 2, ground
7	4	Input 4	Input 4, signal
8		GND	Input 4, ground



### 4.3 Connections (8-Channel I/O)

The section describes the connections for the 8-channel analog input terminal.



**Figure 3.2** Terminal Connections (8-Channel I/O)

#### 4.3.1 Terminal Connection Descriptions

The following table provides the terminal descriptions for the 8-channel analog input terminal.

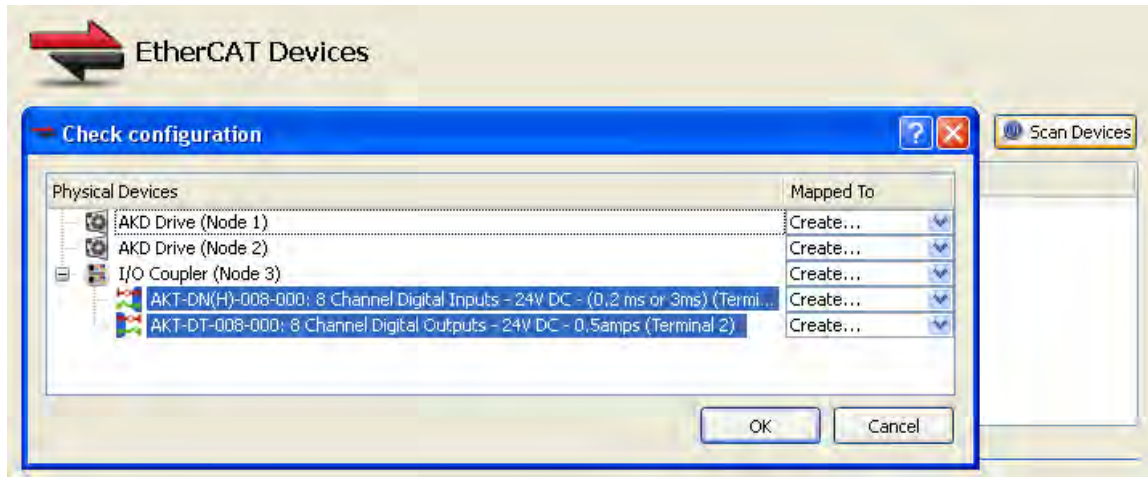
Terminal	Channel	Name	Connection
1	1	Input 1	Input 1, signal
2	3	Input 3	Input 3, signal
3	5	Input 5	Input 5, signal
4	7	Input 7	Input 7, signal
5	2	Input 2	Input 2, signal
6	4	Input 4	Input 4, signal
7	6	Input 6	Input 6, signal
8	8	Input 8	Input 8, signal

## 5 AUTOMATIC CONFIGURATION

This chapter will describe the basics of automatic configuration within the KAS Integrated Development Environment (IDE).

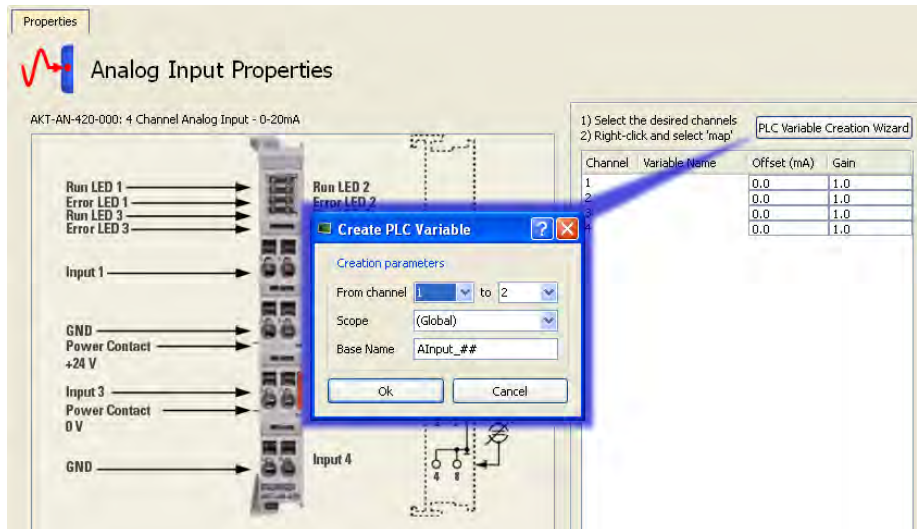
### 5.1 Scan Device

For ease-of-use the KAS IDE Scan Device feature provides automatic integration of I/O devices. This allows you to automatically locate and add I/O terminals to the application project:



### 5.2 Setting I/O Values

After the I/O slice is mapped it can be selected in the application project and the offset and gain values can be set. Additionally, the IDE allows you to map the I/O points to variables in your application:

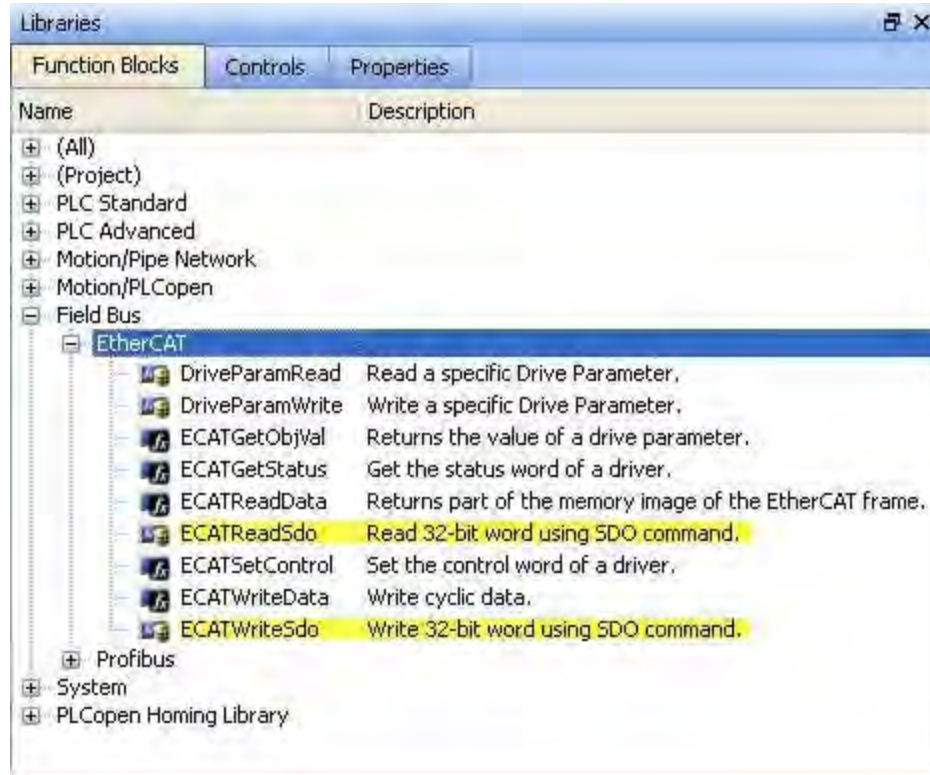


For more detailed information on these procedures refer to the section “EtherCAT Scan Device” in the KAS IDE online help.

## 6 MANUAL CONFIGURATION

Kollmorgen strongly recommends automatic configuration using the KAS IDE over manual configuration. For automatic configuration refer to chapter 5. Manual configuration is for advanced procedures only. The following sections provide information on:

1. Advanced configuration settings that can be made on Registers within this I/O module using EtherCAT Read and Write SDO function blocks in the application project code. These function blocks are located as follows:



2. Manually mapping this I/O block into a KAS project. Manual mapping requires an additional configuration tool. Contact Kollmorgen for more information.

### 6.1 Process Image

This section describes the process image for the I/O terminal.

#### 6.1.1 Process Image (AKT-AN-420-000)

In the process image the AKT-AN-420 is shown with up to 12 byte input and 12 byte output data.

Format	Input Data	Output Data
byte	SB1	CB1
word	DataIN1	DataOUT1

byte	SB2	CB2
word	DataIN2	DataOUT2
Byte	SB3	CB3
Word	DataIN3	DataOUT3
Byte	SB4	CB4
Word	DataIN4	DataOUT4

Key:

SB n: Status byte for channel n

CB n: Control byte for channel n

DataIN n: input data word of channel n

DataOUT n: output data word of channel n

- The mapping of the bytes and words to the addresses of the controlling system can be found on the mapping page.
- The meaning of control and status bytes can be found on the page control and status bytes.
- In process data mode the analog values are transmitted within the input data words DataIN1 to DataIN4 and the output data words DataOUT1 to DataOUT4 are not used.

### 6.1.2 Process Image (AKT-AN-820-000)

The AKT-AN-820-000 is a special case from its process image:

Practically, here are two four channel terminals located in one terminal housing, and they behave like two terminals for the Standard-Bus!

Each of these eight channel analog terminals has the same process image like two four channel terminals of same signal type, plugged next to each other.

**Note:** Consider for the Standard Bus diagnosis of your Bus Coupler (e.g. at blink codes, error codes and error arguments), that these eight channel analog terminals are shown to the Standard-Bus like 2 four channel analog terminals.

If an error occurs and the bus coupler displays the error location, you have to count two terminals for each eight channel analog terminal!

## 6.2 Mapping

The Bus Terminals occupy addresses within the process image of the controller. The assignment of process data (input and output data) and parameterization data (control and status bytes) to the control addresses is called mapping. The type of mapping depends on:

- The fieldbus system used
- The terminal type
- The parameterization of the bus coupler (conditions) such as:

- compact or full evaluation
- Intel or Motorola format
- word alignment switched on or off

The Bus Couplers and Bus Terminal Controllers are supplied with certain default settings. The default setting can be changed with a master configuration software.

The table in the following section shows the mapping depending on different conditions. For information about the contents of the individual bytes please refer to the sections Process image and Control and status byte.

### 6.2.1 Compact Evaluation

For compact evaluation, the analog input terminals only occupy addresses in the input process image. Control and status bytes cannot be accessed.

#### Compact Evaluation in Motorola Format

Default mapping for Profibus.

Conditions	Address	Input Data		Output Data	
	Word Offset	High Byte	Low Byte	High Byte	Low Byte
Complete evaluation: no Motorola format: yes Word alignment: any	0	Ch1 D0	Ch1 D1	–	–
	1	Ch2 D0	Ch2 D1	–	–
	2	Ch3 D0	Ch3 D1	–	–
	3	Ch4 D0	Ch4 D1	–	–

### 6.2.2 Complete Evaluation

For complete evaluation, the analog input terminals occupy addresses in the input and output process image. Control and status bytes can be accessed.

**Complete Evaluation in Intel Format**

Conditions	Address	Input Data		Output Data	
	Word Offset	High Byte	Low Byte	High Byte	Low Byte
Complete evaluation: yes Motorola format: no Word alignment: no	0	Ch1 D0	SB1	Ch1 D0	CB1
	1	SB2	Ch1 D1	CB2	Ch1 D1
	2	Ch2 D1	Ch2 D0	Ch2 D1	Ch2 D0
	3	Ch3 D0	SB3	Ch3 D0	CB3
	4	SB4	Ch3 D1	CB4	Ch3 D1
	5	Ch4 D1	Ch4 D0	Ch4 D1	Ch4 D0

**Complete Evaluation in Motorola Format**

Conditions	Address	Input Data		Output Data	
	Word Offset	High Byte	Low Byte	High Byte	Low Byte
Complete evaluation: yes Motorola format: yes Word alignment: no	0	Ch1 D1	SB1	Ch1 D1	CB1
	1	SB2	Ch1 D0	CB2	Ch1 D0
	2	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1
	3	Ch3 D1	SB3	Ch3 D1	CB3
	4	SB4	Ch3 D0	CB4	Ch3 D0
	5	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1

**Complete Evaluation in Motorola Format with Word Alignment**

Conditions	Address		Input Data		Output Data	
	Word Offset	High Byte	Low Byte	High Byte	Low Byte	
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	Reserved	SB1	Reserved	CB1	
	1	Ch1 D0	Ch1 D1	Ch1 D0	Ch1 D1	
	2	Reserved	SB2	Reserved	CB2	
	3	Ch2 D0	Ch2 D1	Ch2 D0	Ch2 D1	
	4	Reserved	SB3	Reserved	CB3	
	5	Ch3 D0	Ch3 D1	Ch3 D0	Ch3 D1	
	6	Reserved	SB4	Reserved	CB4	
	7	Ch4 D0	Ch4 D1	Ch4 D0	Ch4 D1	

**Key:**

Complete evaluation: In addition to the process data, the control and status bytes are also mapped in the address space.

Motorola format: Motorola or Intel format can be set.

Word alignment: In order for the channel address range to commence at a word boundary, empty bytes are inserted into the process image as appropriate.

SB n = Status byte for channel n (appears in the input process image).

CB n = Control byte for channel n (appears in the output process image).

Ch n D0 = Channel n, lower-value data byte.

Ch n D1 = Channel n, higher-value data byte.

Reserved = This byte occupies process data memory, although it has no function.

“-“ = This byte is not assigned or used by the terminal/module.

**6.3 Control and Status Bytes**

This section describes the control and status bytes for the I/O terminal.

**6.3.1 Channel 1 (Process Data Mode)****Control byte 1 in process data mode:**

Control byte 1 (CB1) is located in the output image, and is transmitted from the controller to the terminal. In process data mode it has no function.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2	CB1.1	CB1.0
Name	RegAccess	–	–	–	–	–	–	–

**Legend**

Bit	Name	Description
CB1.7	RegAccess	0 <sub>bin</sub> Register communication off (process data mode)
CB1.6 – CB1.0	–	0 <sub>bin</sub> Reserved

**Status byte 1 in process data mode:**

The status byte 1 (SB1) is located in the input image, and is transmitted from terminal to the controller.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.1	SB1.0
Name	RegAccess	Error	LimitValue 2 State		LimitValue 1 State		Over range	Under range

**Legend:**

Bit	Name	Description
SB1.7	RegAccess	0 <sub>bin</sub> Acknowledgement for process data mode
SB1.6	Error	1 <sub>bin</sub> General error bit
SB1.5 – SB1.4	LimitValue 2 State	00 <sub>bin</sub> Limit value 2 not activated
		01 <sub>bin</sub> Process data less than limit value 2
		10 <sub>bin</sub> Process data greater than limit value 2
		11 <sub>bin</sub> Process data equal limit value 2
SB1.3 – SB1.2	LimitValue 1 State	00 <sub>bin</sub> Limit value 1 not activated
		01 <sub>bin</sub> Process data less than limit value 1
		10 <sub>bin</sub> Process data greater than limit value 1



Bit	Name	Description	
		1 <sub>bin</sub>	Process data equal limit value 1
SB1.1	Over range	1 <sub>bin</sub>	Permissible measuring range exceeded
SB1.0	Under range	1 <sub>bin</sub>	Lower measuring range limit violated

## 6.4 Register Information

The following section includes all the register information necessary for mapping the I/O device.

### 6.4.1 Register Communication

#### Control byte 1 in register communication:

Control byte 1 (CB1) is located in the output image, and is transmitted from the controller to the terminal.

Bit	CB1.7	CB1.6	CB1.5	CB1.4	CB1.3	CB1.2	CB1.1	CB1.0
Name	RegAccess	R/W	Register number					

#### Legend:

Bit	Name	Description	
CB1.7	RegAccess	1 <sub>bin</sub>	Register communication switched on
CB1.6	R/W	0 <sub>bin</sub>	Read access
		1 <sub>bin</sub>	Write access
CB1.5 – CB1.0	Reg. no.	Register number: Enter the number of the register to – Read with input data word DataIN1 or – Write with output data word DataOUT1.	

#### Status byte 1 in register communication:

The status byte 1 (SB1) is located in the input image, and is transmitted from terminal to the controller.

Bit	SB1.7	SB1.6	SB1.5	SB1.4	SB1.3	SB1.2	SB1.1	SB1.0
Name	RegAccess	R/W	Reg. no.					

**Legend:**

Bit	Name	Description	
SB1.7	RegAccess	1 <sub>bin</sub>	Acknowledgement for register access
SB1.6	R	0 <sub>bin</sub>	Read access
SB1.5 – SB1.0	Reg. no.	Number of the register that was read or written.	

**6.4.2 Channel 2, 3, and 4**

The control and status bytes of channels 2, 3 and 4 are structured like the control and status byte of channel 1.

**6.4.3 Register Overview**

The following registers are used to parameterize the I/O terminal. They exist once for each channel of a terminal and can be read or written by register communication using control, status, and data bytes.

Register Number	Comment		Default Value		R/W	Memory
R0	Raw value of A/D converter (X <sub>R</sub> )		-	-	R	RAM
R1	Reserved		-	-	-	-
...	...		...	...	...	...
R5	Reserved		-	-	-	-
R6	Diagnostic register		-	-	R	RAM
R7	Command register		0x0000	0 <sub>dec</sub>	R/W	RAM
R8	Terminal type	AKT-AN-420	0x0D88	3444 <sub>dec</sub>	R	ROM
		AKT-AN-820	0x0D8C	3448 <sub>dec</sub>		
R9	Firmware revision level		e.g. 0x3141	e.g. 1A <sub>ASCI</sub>	R	ROM
R10	Data length (Multiplex shift register)		0x0230	560 <sub>dec</sub>	R	ROM
R11	Signal channels		0x0418	1048 <sub>dec</sub>	R	ROM
R12	Minimum data length		0x0098	152 <sub>dec</sub>	R	ROM
R13	Data structure (Data type register)		0x0004	4 <sub>dec</sub>	R	ROM
R14	Reserved		-	-	-	-
R15	Alignment register		e.g. 0x7F80	e.g. 32640 <sub>dec</sub>	R/W	RAM

Register Number	Comment	Default Value		R/W	Memory
R16	Hardware revision number	e.g. 0x0000	e.g. 0 <sub>dec</sub>	R/W	SEEPROM
R17	Hardware compensation: Offset (B <sub>a</sub> )	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R18	Hardware compensation: Gain (A <sub>a</sub> )	app. 0x1350	app. 4944 <sub>dec</sub>	R/W	SEEPROM
R19	manufacturer scaling: Offset (B <sub>h</sub> )	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R20	manufacturer scaling: Gain (A <sub>h</sub> )	typ. 0x2000	typ. 8192 <sub>dec</sub>	R/W	SEEPROM
R21	Over range limit	0x0FFF	4095 <sub>dec</sub>	R/W	SEEPROM
R22	Under range limit	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R23	Reserved	-	-	-	-
...	...	...	...	...	...
R30	Reserved	-	-	-	-
R31	Code word register	0x0000	0 <sub>dec</sub>	R/W	RAM
R32	Feature register	0x0906	2310 <sub>dec</sub>	R/W	SEEPROM
R33	User scaling: Offset (B <sub>w</sub> )	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R34	User scaling: Gain (A <sub>w</sub> )	0x0400	1024 <sub>dec</sub>	R/W	SEEPROM
R35	Threshold 1 in (Y <sub>2</sub> )	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R36	Threshold 2 in (Y <sub>2</sub> )	0x0000	0 <sub>dec</sub>	R/W	SEEPROM
R37	Cut-off frequency of digital IIR filter	0x0100	256 <sub>dec</sub>	R/W	SEEPROM
R38	Reserved	-	-	-	-
...	Reserved	...	...	...	...
R63	Reserved	-	-	-	-

#### 6.4.4 Register Descriptions

The following registers are used to parameterize the I/O terminal. They exist once for each channel of a terminal and can be read or written by register communication using control, status, and data bytes.

##### **R0: Raw Value A/DC**

Raw value of the A/D converter (XR)

**R6: Diagnostic Register**

The status byte is mapped to the lower-value byte (bit 7 to bit 0) of register R6.

The higher-value byte (bit 15 to bit 8) of register R6 is reserved.

**R7: Command Register**

The command register of AKT-AN-420 is currently not used.

**R8: Terminal Description**

Register R8 contains the terminal identifier. e.g.:

AKT-AN-420: 0x0D74 (3444<sub>dec</sub>)

**R9: Firmware Revision Level**

Register R9 contains the ASCII coding of the terminal's firmware revision level, e.g. 0x3141 (1AASCII). '0x31' corresponds to the ASCII character '1' and '0x41' to the ASCII character 'A'. This value can not be changed.

**R10: Data Length (Multiplex Shift Register)**

R10 contains the number of multiplexed shift registers and their length in bits.

**R11: Signal Channels**

Unlike R10, this contains the number of channels that are logically present. Thus for example a shift register that is physically present can perfectly well consist of several signal channels.

**R12: Minimum Data Length**

The particular byte contains the minimum data length for a channel that is to be transferred. If the MSB is set, the control and status byte is not necessarily required for the terminal function and is not transferred to the control, if the Bus Coupler is configured accordingly.

**R13: Data structure (Data Type Register)**

<b>Data Type Register</b>	<b>Description</b>
0x00	Terminal with no valid data type
0x01	Byte array
0x02	Structure: 1 byte, n bytes
0x03	Word array
0x04	Structure: 1 byte, n words
0x05	Double word array
0x06	Structure: 1 byte, n double words
0x07	Structure: 1 byte, 1 double word

<b>Data Type Register</b>	<b>Description</b>
0x08	Structure: 1 byte, 1 double word
0x11	Byte array with variable logical channel length
0x12	Structure: 1 byte, n bytes with variable logical channel length (e.g. 60xx)
0x13	Word array with variable logical channel length
0x14	Structure: 1 byte, n words with variable logical channel length
0x15	Double word array with variable logical channel length
0x16	Structure: 1 byte, n double words with variable logical channel length

**R15: Alignment Register**

Via the alignment register bits, the Bus Coupler arranges the address range of an analog terminal such that it starts at a byte boundary.

**R16: Hardware Version Number**

Register R16 contains the hardware revision level of the terminal; this value can not be changed.

**R17: Hardware Compensation - Offset ( $B_a$ )**

This register is used for the offset compensation of the terminal (see equation 1.1). Register value (16 bit signed integer): 0x0000 (0dec).

**R18: Hardware Compensation - Gain ( $A_a$ )**

This register is used for the gain compensation of the terminal (see equation 1.1). Register value (16 bit signed integer x 2<sup>-12</sup>):

AKT-AN-420: approx. 0x13A6 (5030dec)

**R19: Manufacturer Scaling - offset ( $B_h$ )**

This register contains the offset for the manufacturer scaling (see equation 1.3). Register value (16 bit signed integer): 0x0000 (0dec)

Manufacturer scaling can be activated via bit R32.1 of the feature register.

**R20: Manufacturer Scaling - gain ( $A_h$ )**

This register contains the gain for manufacturer scaling (see equation 1.3). Register value (16 bit signed integer x 2<sup>-10</sup>): typically 0x2000 (8192dec)

Manufacturer scaling can be activated via bit R32.1 of the feature register.

**R21 Over-Range Limit - OvRL (Y<sub>a</sub>)**

This limit value limits the maximum measuring range of the input terminal (see equation 1.0). If it is exceeded, the associated status bit is set, and the maximum value is displayed. Register value (16 bit signed integer)

AKT-AN-420: 0x0FFF (4095dec)

**R22 under-Range Limit - UnRL (Y<sub>a</sub>)**

If the value falls below this limit, the associated status bit is set, and the minimum value is displayed (see equation 1.0). Register value (16 bit signed integer)

AKT-AN-420: 0x0000 (0dec)

**R31: Code Word Register**

If you write into the user registers without first entering the user code word (0x1235) into the code word register, the terminal will not accept the supplied data.

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 SEEPROM registers and are therefore retained if the terminal is restarted.

The code word is reset with each restart of the terminal.

**R32: Feature Register**

The feature register specifies the terminal's configuration. Default: 0x0906 (2310<sub>dec</sub>)

Bit	R32.15	R32.14	R32.13	R32.12	R32.11	R32.10	R32.9	R32.8
Name	-	-	-	-	enIIR	enLimit2	enLimit1	enOvRP

Bit	R32.7	R32.6	R32.5	R32.4	R32.3	R32.2	R32.1	R32.0
Name	-	-	-	enSiemens	enSignRepr	enWdTimer	enManScal	enUsrScal

**Key**

Bit	Name	Description	Default
R32.15	-	Reserved	0 <sub>bin</sub>
...	...	...	...
R32.12	-	Reserved	0 <sub>bin</sub>
R32.11	enIIR	0 <sub>bin</sub>	digital IIR Filter not active
		1 <sub>bin</sub>	digital IIR Filter active
R32.10	emLimit2	0 <sub>bin</sub>	Threshold 2 is not active
		1 <sub>bin</sub>	Threshold 2 is active

Bit	Name	Description	Default
R32.9	emLimit1	0 <sub>bin</sub>	Threshold 1 is not active
		1 <sub>bin</sub>	Threshold 1 is active
R32.8	enOvRP	0 <sub>bin</sub>	Over-range protection is not active
		1 <sub>bin</sub>	Over-range protection is active: If the limit values of registers OvRL (R21) and UnRL (R22) are exceeded, the associated status bits are set and the measuring range is restricted accordingly.
R32.7	-	Reserved	0 <sub>bin</sub>
R32.6	-	Reserved	0 <sub>bin</sub>
R32.5	-	Reserved	0 <sub>bin</sub>
R32.4	enSiemens	0 <sub>bin</sub>	Standard output format
		1 <sub>bin</sub>	Siemens output format The three bits with the lowest value are used for displaying status information (see below).
R32.3	enSignRepr	0 <sub>bin</sub>	Two's complement representation is active
		1 <sub>bin</sub>	The arithmetic sign of numerical quantities is active (-1 <sub>dec</sub> = 0x8001)
R32.2	enWdTimer	0 <sub>bin</sub>	Watchdog timer is not active
		1 <sub>bin</sub>	Watchdog timer is active (the watchdog is triggered if no process data are received for 100 ms)
R32.1	enManScal	0 <sub>bin</sub>	Manufacturer scaling is active
		1 <sub>bin</sub>	Manufacturer scaling is not active
R32.0	enUsrScal	0 <sub>bin</sub>	User scaling is not active
		1 <sub>bin</sub>	User scaling is active

**R33: User Scaling - Offset (B<sub>w</sub>)**

This register contains the offset of the user scaling.

User scaling can be activated through bit R32.0 in the feature register.

**R34: User Scaling - Gain ( $A_w$ )**

This register contains the user scaling gain; 0x0400 (1024dec) corresponds to 1.

User scaling can be activated through bit R32.0 in the feature register.

**R35: Threshold 1 in  $Y_2$** 

If the process data are outside this threshold, the appropriate bits are set in the status byte.

**R36: Threshold 2 in  $Y_2$** 

If the process data are outside this limit value, the appropriate bits are set in the status byte.

**R37: Cut-off Frequency of Digital IIR Filter**

This register specifies the digital IIR filter's (first order) cut-off frequency. The IIR filter can be deactivated by bit R32.11 of the feature register.

Value	Cut-off Frequency	
	AKT-AN-420	AKT-AN-820
0x0100 (default)	app. 200 Hz	app. 100 Hz
0x0200	app. 100 Hz	app. 50 Hz
0x0300	app. 50 Hz	app. 25 Hz
0x0400	app. 20 Hz	app. 10 Hz
other	no Filter active	

**6.4.5 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**

Byte 0: Control Byte	Byte 1: DataOUT1, High Byte	Byte 2: DataOUT1, Low Byte
0x89 (1000 1001 <sub>bin</sub> )	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<sub>bin</sub> 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 Register**

**Note:** At normal operation all user registers other than register 31 are 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 (power-off/power-on) of the terminal.

**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 <sub>bin</sub> )	0x12	0x35

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 01 1111<sub>bin</sub> the register number 31.
- The output data word (Byte 1 and 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 <sub>bin</sub> )	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 writing access. Values that might be shown are not valid!

**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 <sub>bin</sub> )	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 01 1111<sub>bin</sub> 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 <sub>bin</sub> )	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).

**Writing into Register 32 (changing the content of the feature register)****Output Data**

Byte 0: Control Byte	Byte 1: DataOUT1, High Byte	Byte 2: DataOUT1, Low Byte
0xE0 (1110 0000 <sub>bin</sub> )	0x00	0x02

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  $10\ 0000_{\text{bin}}$  the register number 32.
- The output data word (Byte 1 and Byte 2) contains the new value for the feature register.

**Attention!**

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 ( $1010\ 0000_{\text{bin}}$ )	0xFF	0xFF

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 writing access. Values that might be shown are not valid!

**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 ( $1010\ 0000_{\text{bin}}$ )	0xFF	0xFF

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  $10\ 0000_{\text{bin}}$  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 ( $1010\ 0000_{\text{bin}}$ )	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).

### 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 <sub>bin</sub> )	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 01 1111<sub>bin</sub> 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 <sub>bin</sub> )	0xFF	0xFF

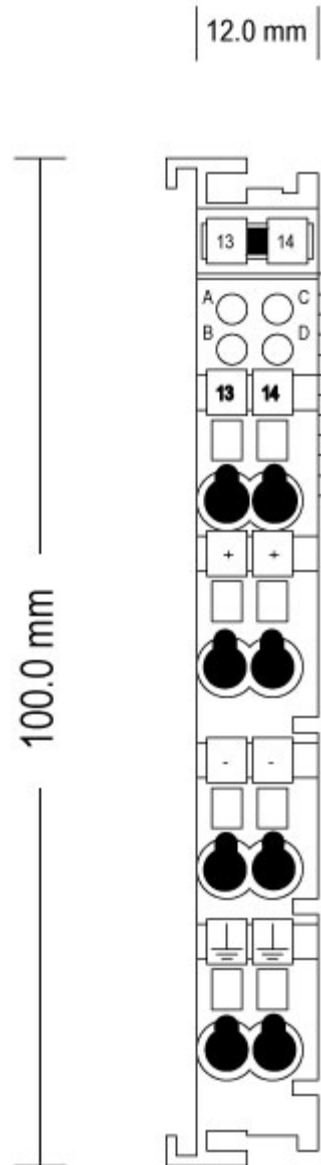
Explanation:

- 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 writing access. Values that might be shown are not valid.

## APPENDIX A

This section provides the mechanical drawing of the I/O Terminal.

### A.1 I/O 12.0 mm Mechanical Drawing



### **About Kollmorgen**

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For assistance with your application needs, contact us at: 540-633-3545, [contactus@kollmorgen.com](mailto:contactus@kollmorgen.com) or visit [www.kollmorgen.com](http://www.kollmorgen.com)

#### **North America**

##### **Kollmorgen**

203A West Rock Road  
Radford, VA 24141 USA  
Phone: 1-540-633-3545  
Fax: 1-540-639-4162

#### **Europe**

##### **Kollmorgen**

Wacholderstraße 40 – 42  
40489 Düsseldorf Germany  
Phone: + 49 (0) 203-9979-235  
Fax: + 49 (0) 203-9979-3314

**KOLLMORGEN**®

*Because Motion Matters™*