I/O Terminal

Installation Manual

Revision 1.1, June 2011

AKT-AT-220-000 2-Channel Analog Output 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

Because Motion Matters™

Record of Document Revisions

Revision	Remarks
1.0	Preliminary edition
1.1	Added dimensions to technical data table and mechanical drawing to Appendix A. For more information, see “Technical Data” page 7 and “Appendix A” page 23.

IMPORTANT NOTICE

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.

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June 2011

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 AKT-AT-220-000 2-Channel Analog Output 0-20mA

The 2-channel analog output terminal generates analog output signals in the range from 0 to 20 mA. The power is supplied to the process level with a resolution of 12 bits and is electrically isolated. Ground potential for the output channels of a Bus Terminal is common with the 24 V DC supply. The output stages are powered by the 24 V supply. This terminal combines two channels in one housing and the run LEDs give an indication of the data exchange with the Bus Coupler. The supply voltage fed in via the power contacts is used for generating the output current.

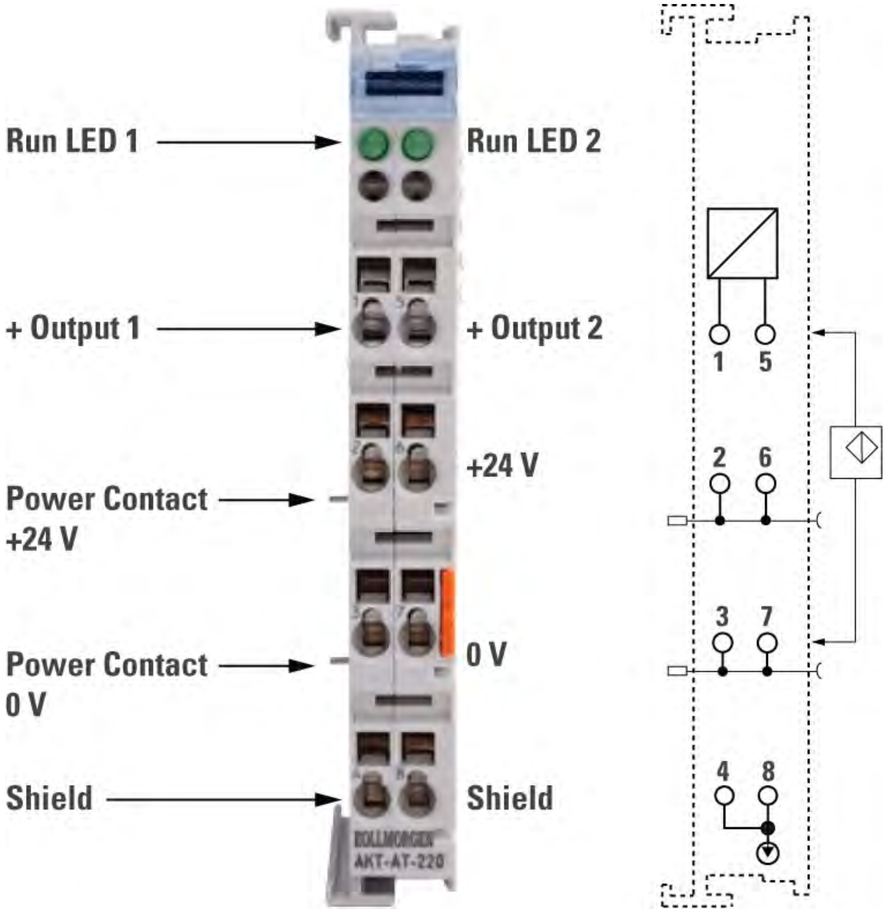


Figure 2.1 Top View and Contact Assembly

2.1.1 Technical Data

This section provides the technical details for the 2-channel thermocouple module.

Parameters	AKT-AT-220-000
Number of outputs	2
Power supply	24 VDC
Signal voltage	0 … 20 mA
Load	< 500 W (short-circuit-proof)
Accuracy	± 0.5 LSB linearity error, ± 0.5 LSB offset error ±0.1% of the full scale value
Resolution	12 bits
Electrical isolation	500 Vrms (Standard-Bus / signal voltage)
Conversion time	~ 1.5 ms
Current consumption from Standard-Bus	Typically 60 mA
Bit width in the process image	Input: 2 x 16 bits of data (2 x 8 bit control/status optional)
Configuration	no address or configuration settings
Weight	~80 g
Dimensions (W x H)	~12mm x 100 mm
Operating temperature	0°C ... +55°C
Storage temperature	-25°C ... +85°C
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
Installation position	Any
Type of protection	IP20

2.1.2 Process Data Input Format

In the delivery state, the process data are entered in two's complement form (integer -1 corresponds to 0xFFFF). Other formats may be selected.

Hexadecimal	Process Data Decimal	Output Current
0x0000	(0)	0 mA
0x3FFF	(16383)	10 mA

Hexadecimal	Process Data Decimal	Output Current
0x7FFF	(32767)	20 mA

2.1.3 LED Display

Both RUN LEDs indicate the operating state of the associated terminal.

Green LED: RUN

- On: normal operation
- Off: Watchdog-timer overflow has occurred.

  If no process data are transmitted by the Bus Coupler for 100 ms, the green LEDs go out. A user-specified voltage will be applied to the output.

2.1.4 Process Data

The process data arriving from the Bus Coupler are output to the process:

X = PLC process data
B_h, A_h = Manufacturer scaling
B_w, A_w = User scaling
Y_dac = output value to the D/A converter

Neither user nor manufacturer scaling are active:

Y_dac = X (1.0)

Manufacturer scaling active:

Y_1 = B_h + A_h * X (1.1)
Y_dac = Y_1

User scaling active:

Y_2 = B_w + A_w * X (1.2)
Y_dac = Y_2

Manufacturer and user scaling active:

Y_1 = B_h + A_h * X (1.3)
Y_dac = B_w + A_w * Y_1 (1.4)

3 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.

3.1 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!

3.1.1 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.

3.1.2 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.

3.1.3 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.

3.1.4 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!

3.1.5 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.

3.2 AKT-AT-220-000 Connections

The section describes the connections for the Counter module.

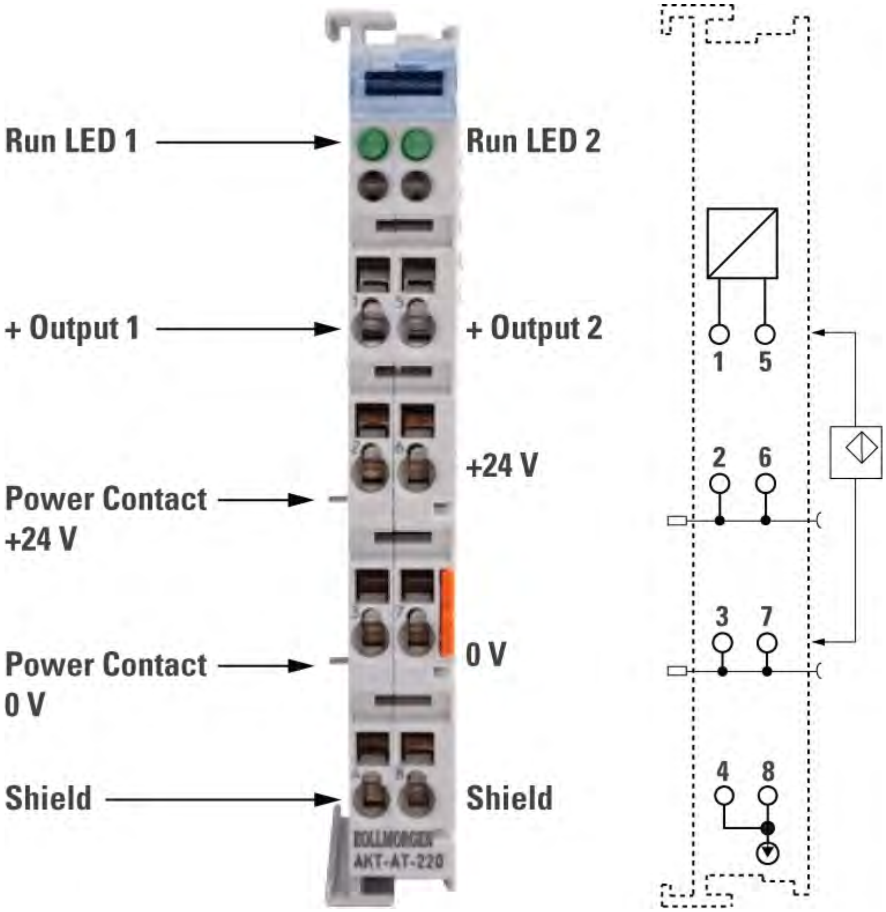


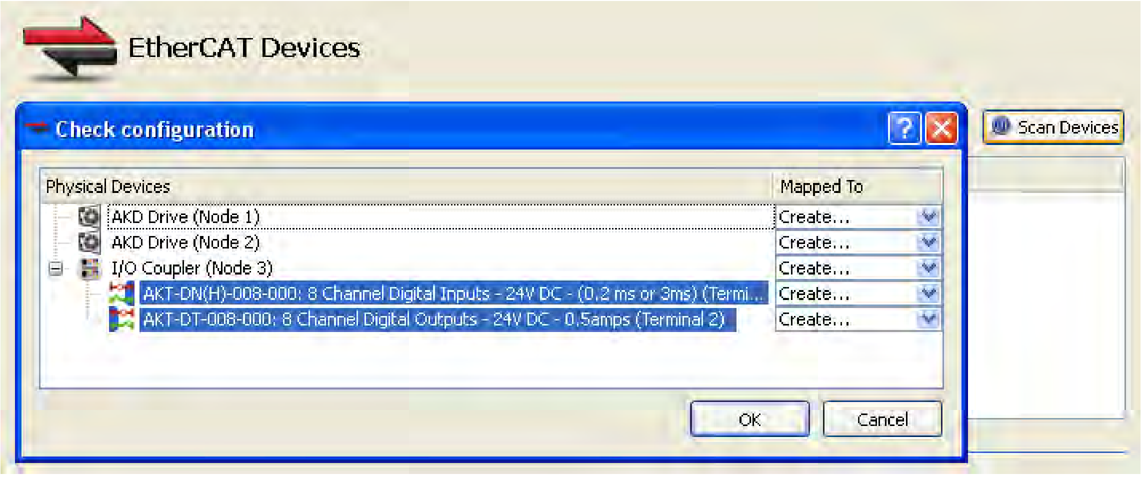
Figure 3.1 Terminal Connections

4 AUTOMATIC CONFIGURATION

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

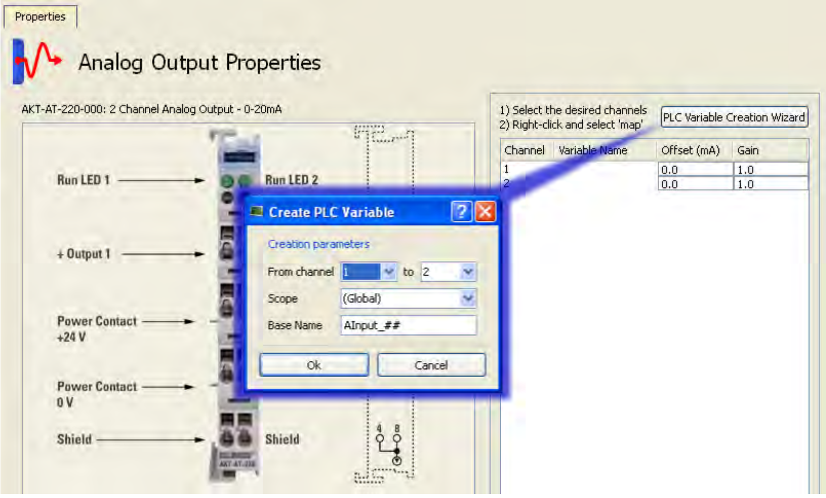
4.1 Scan Device

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:



4.2 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:

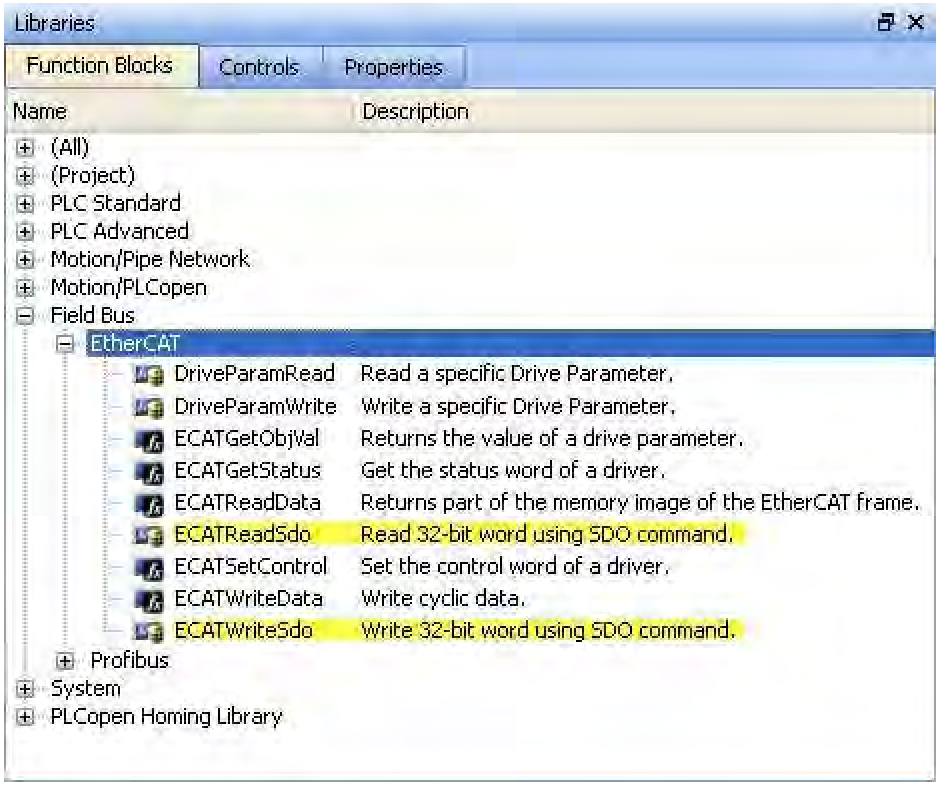


For more detailed information on these procedures refer to the section “EtherCAT Scan Device” in the KAS IDE online help.

5 MANUAL CONFIGURATION

Kollmorgen strongly recommends automatic configuration using the KAS IDE over manual configuration. For automatic configuration refer to chapter 4. 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.

5.1 Mapping

As already described in the Terminal Configuration section, each Bus Terminal is mapped in the Bus Coupler. In the delivery state, this mapping occurs with the default settings of the Bus Coupler for this terminal.

If the terminals are fully evaluated, they occupy memory space in the input and output process image.

The following tables provide information about the terminal mapping, depending on the conditions set in the Bus Coupler.

5.1.1 AKT-AN-220-000

Default mapping for: EtherCAT

Conditions	Word offset	High byte	Low byte
Complete evaluation: yes Motorola format: no Word alignment: yes	0	res.	Ch0 CB/SB
	1	Ch0 D0	Ch0 D1
	2	res.	Ch1 CB/SB
	3	Ch1 D0	Ch1 D1

Conditions	Word offset	High byte	Low byte
Complete evaluation: yes Motorola format: yes Word alignment: yes	0	res.	Ch0 CB/SB
	1	Ch0 D0	Ch0 D1
	2	res.	Ch1 CB/SB
	3	Ch1 D0	Ch1 D1

Legend:

Complete evaluation: The terminal is mapped with control and status byte.

Motorola format: Motorola or Intel format can be set.

Word alignment: The terminal is at word limit in the Bus Coupler.

Ch n SB: status byte for channel n (appears in the input process image).

Ch n CB: control byte for channel n (appears in the output process image).

Ch n D0: channel n, data byte 0 (byte with the lowest value)

Ch n D1: channel n, data byte 1 (byte with the highest value)

"-": This byte is not used or occupied by the terminal.

res.: reserved: This byte occupies process data memory, although it is not used.

5.2 Control and Status Byte

This section provides information on control and status byte.

5.2.1 Control Byte for Process Data Exchange

The control byte is transmitted from the controller to the terminal. It can be used

- in register mode (REG = 1bin) or

- during process data exchange (REG = 0bin).

The control byte can be used to carry out gain and offset compensation for the terminal (process data exchange). This requires the code word to be entered in R31. The gain and offset of the terminal can then be compensated.

The parameter will only be saved permanently once the code word is reset.

Control byte:

Bit 7 = 0bin

Bit 6 = 1bin: Terminal compensation function is activated

Bit 4 = 1bin: Gain compensation

Bit 3 = 1bin: Offset compensation

Bit 2 = 0bin: Slower cycle = 1000 ms,

1bin: Fast cycle = 50 ms

Bit 1 = 1bin: up

Bit 0 = 1bin: down

5.2.2 Status Byte for Process Data Exchange

The status byte is transmitted from the terminal to the controller.

5.3 Register Description

Different operating modes or functionalities may be set for the complex terminals. The General Description of Registers explains those register contents that are the same for all complex terminals.

The terminal-specific registers are explained in the following section.

Access to the internal terminal registers is described in the Register Communication section.

5.4 General Description of Registers

Complex terminals that possess a processor are able to exchange data bi-directionally with the higher-level controller. These terminals are referred to below as intelligent Bus Terminals. These include analog inputs, analog outputs, serial interface terminals (RS485, RS232, TTY etc.), counter terminals, encoder interface, SSI interface, PWM terminal and all other configurable terminals.

The main features of the internal data structure are the same for all the intelligent terminals. This data area is organized as words and comprises 64 registers. The important data and parameters of the terminal can be read and set through this structure. It is also possible for functions to be called by means of corresponding parameters. Each logical channel in an intelligent terminal has such a structure (4-channel analog terminals therefore have 4 sets of registers).

This structure is divided into the following areas: (A detailed list of all registers can be found in the Appendix.)

Register	Application
0 to 7	Process variables
8 to 15	Type register
16 to 30	Manufacturer parameters
31 to 47	User parameters
48 to 63	Extended user area

5.4.1 Process Variables

R0 to R7: **Registers in the internal RAM of the terminal** – The process variables can be used in addition to the actual process image. Their function is specific to the terminal.

R0 to R5: **Terminal-specific registers** – The function of these registers depends on the respective terminal type (see terminal-specific register description).

R6: **Diagnostic register** – The diagnostic register can contain additional diagnostic information. Parity errors, for instance, that occur in serial interface terminals during data transmission are indicated here.

R7: Command register

High-Byte_Write = function parameter

Low-Byte_Write = function number

High-Byte_Read = function result

Low-Byte_Read = function number

5.4.2 Type Register

R8 to R15: Registers in the internal ROM of the terminal – The type and system parameters are hard programmed by the manufacturer, and the user can read them but cannot change them.

R8: Terminal type – The terminal type in register R8 is needed to identify the terminal.

R9: Software version (X.y) – The software version can be read as a string of ASCII characters.

R10: Data length – R10 contains the number of multiplexed shift registers and their length in bits. The Bus Coupler sees this structure.

R11: Signal channels – Related to 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 type register

Data Type Register	Description
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
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

R14: Reserved

R15: Alignment bits (RAM) – The alignment bits are used to place the analog terminal in the Bus Coupler on a byte boundary.

5.4.3 Manufacturer Parameters

R16 to R30: Manufacturer parameter area (SEEROM) – The manufacturer parameters are specific for each type of terminal. They are programmed by the manufacturer, but can also be modified by the controller. The manufacturer parameters are stored in a serial EEPROM in the terminal, and are retained in the event of voltage drop-out. These registers can only be altered after a code-word has been set in R31.

5.4.4 User Parameters

R31 to R47: User parameter area (SEEROM) – The application parameters are specific for each type of terminal. They can be modified by the programmer. The application parameters are stored in a serial EEPROM in the terminal, and are retained in the event of voltage drop-out. The user area is write-protected by a code-word.

R31: Code-word register in RAM – The code-word **0x1235** must be entered here so that parameters in the user area can be modified. If any other value is entered into this register, the write-protection is active. When write protection is not active, the code word is returned when the register is read. If the write protection is active, the register contains a zero value.

R32: Feature register – This register specifies the terminal's operating modes. Thus, for instance, a user-specific scaling can be activated for the analog I/Os.

R33 to R47 Terminal-specific Registers – The function of these registers depends on the respective terminal type (see terminal-specific register description).

5.4.5 Extended Application Region

R47 to R63 – Extended registers with additional functions.

5.5 Terminal-Specific Register Description

This section provides specific register information for this I/O.

5.5.1 Process Variables

R0 to R4 – reserved

R5: Raw DAC value (Y_dac) – The 12-bit value transferred to the D/A converter is called raw DAC value. It is calculated from the process data via the manufacturer and user scaling.

R6 to R7: reserved

5.5.2 Manufacturer Parameters

R17: Hardware compensation – offset

This register is used for hardware offset compensation (8-bit digital potentiometer) of the terminal. The register is transferred to the hardware after each processor reset or with each write access to R17. Note that the transferred offset does not correspond to the DAC values.

High byte: reserved

Low byte: Offset value (0 to 255)

R18: Hardware compensation – gain

This register is used for hardware gain compensation (8-bit digital potentiometer) of the terminal. The register is transferred to the hardware after each processor reset or with each write access to R17.

High byte: reserved

Low byte: Gain value (0 to 255)

R19: Manufacturer scaling - offset (B_h)

16 bit signed integer [0x0000]

This register contains the offset of the manufacturer's equation of the straight line (1.1). The straight-line equation is activated via register R32.

R20: Manufacturer scaling - gain (A_h)

16 bits signed integer *2-8 [0x0020]

This register contains the scale factor of the manufacturer's equation of the straight line (1.1). The straight-line equation is activated via register R32. 1 corresponds to register value 0x0100.

R21: Manufacturer's switch-on value

[0V], 12 bits unsigned integer in X [0x000]

The manufacturer switch-on value is applied to the terminal output after a system reset or a watchdog timer overflow (terminal has not received any process data for 100 ms).

The manufacturer switch-on value is activated via register R32.

5.5.3 User Parameters

R32: Feature register

[0x0006]

The feature register specifies the terminal's operating mode.

Feature bit no.		Description of the operating mode
Bit 0	1	User scaling (1.2) active [0]
Bit 1	1	Manufacturer scaling (1.1) active [1]
Bit 2	1	Watchdog timer active [1] In the delivery state, the watchdog timer is switched on. In the event of a watchdog overflow, either the manufacturer or the user switch-on value is applied to the terminal output.
Bit 3	1	Sign / amount representation [0]
Bit 7…4	-	reserved, do not change
Bit 8	0/1	0: Manufacturer switch-on value [0] 1: User switch-on value
Bit 15…9	-	reserved, do not change

R33: User scaling - offset (B_w)

16 bit signed integer [0x0000]

This register contains the offset of the user straight-line equation (4.1). The straight-line equation is activated via register R32.

R34: User scaling - gain (A_w)

16 bits signed integer * 2-8 [0x0100]

This register contains the scale factor of the user straight-line equation (4.1). The straight-line equation is activated via register R32.

R35: User's switch-on value (Y_2)

16 bit signed integer [0x0000]

If the user switch-on value is activated in register R32, this value is applied to the terminal output after a system reset or a watchdog timer overflow (terminal has not received any process data for 100 ms).

5.6 Register Communication

Register access via process data exchange | Bit 7 = 1bin: Register mode

If bit 7 of the control byte is set, then the first two bytes of the user data are not used for exchanging process data, but are written into or read from the terminal's register set.

Bit 6 = 0bin: read | Bit 6 = 1bin: write

Bit 6 of the control byte specifies whether a register should be read or written. If bit 6 is not set, then a register is read out without modifying it. The value can then be taken from the input process image.

If bit 6 is set, then the user data is written into a register. As soon as the status byte has supplied an acknowledgement in the input process image, the procedure is completed (see example).

Bit 0 to 5: Address

The address of the register that is to be addressed is entered into bits 0 to 5 of the control byte.

5.6.1 Control Byte in Register Mode

MSB							
Reg = 1	W/R	A5	A4	A3	A2	A1	A0

REG = 0_{bin}: Process data exchange

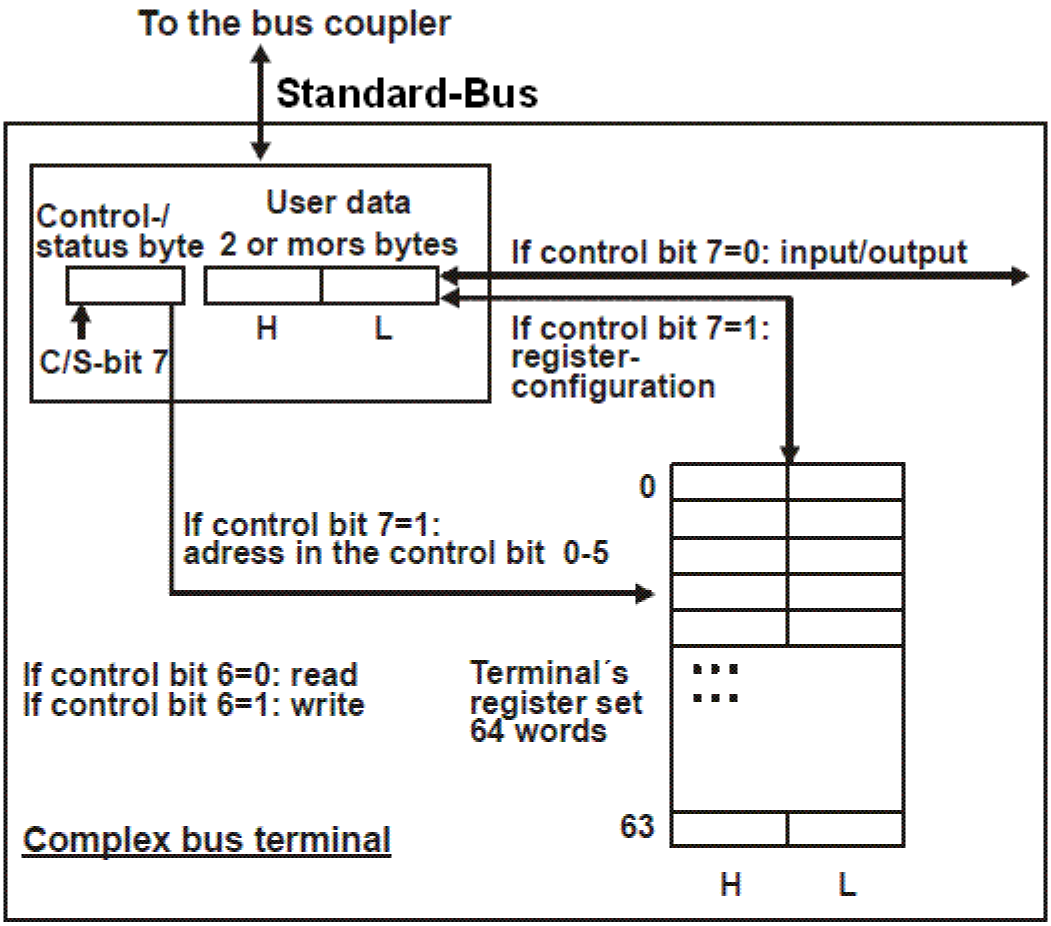
REG = 1_{bin}: Access to register structure

W/R = 0_{bin}: Read register

W/R = 1_{bin}: Write register

A5...A0 = register address

Address bits A5 to A0 can be used to address a total of 64 registers.



The control or status byte occupies the lowest address of a logical channel. The corresponding register values are located in the following 2 data bytes.

5.7 Register Table

These registers exist once for each channel.

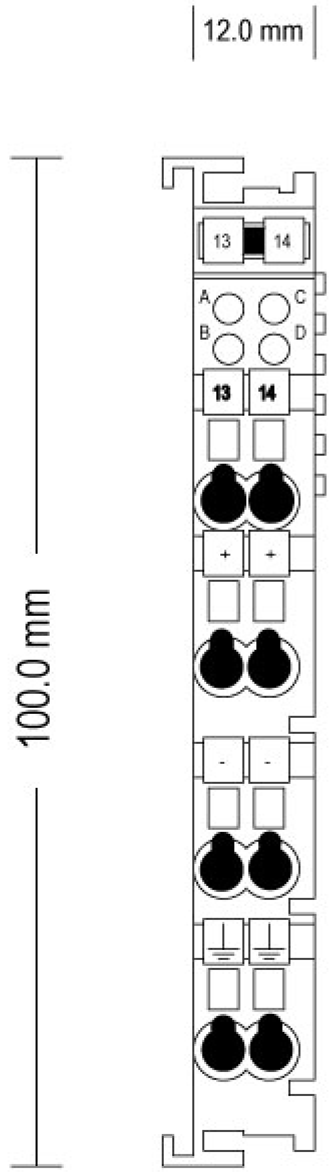
Address	Denomination	Default value	R/W	Storage medium
R0	reserved	0x0000	R	
…	…	…	…	…
R4	reserved	0x0000	R	
R5	Raw DAC value	variable	R	RAM
R6	Diagnostic register not used	0x0000	R	
R7	Command register not used	0x0000	R	
R8	Terminal type	e.g. 4012	R	ROM

Address	Denomination	Default value	R/W	Storage medium
R9	Software version number	0x????	R	ROM
R10	Multiplex shift register	0x0218/0130	R	ROM
R11	Signal channels	0x0218	R	ROM
R12	Minimum data length	0x9800	R	ROM
R13	Data structure	0x0000	R	ROM
R14	Reserved	0x0000	R	
R15	Alignment register	variable	R/W	RAM
R16	Hardware version number	0x????	R/W	SEEROM
R17	Hardware compensation: Offset	specific	R/W	SEEROM
R18	Hardware compensation: Gain	Specific	R/W	SEEROM
R19	Manufacturer scaling: Offset	0x0000	R/W	SEEROM
R20	Manufacturer scaling: Gain	0x0020	R/W	SEEROM
R21	Manufacturer’s switch-on value	0x0000	R/W	SEEROM
R22	reserved	0x0000	R/W	SEEROM
…	…	…	…	…
R30	reserved	0x0000	R/W	SEEROM
R31	Code word register	variable	R/W	RAM
R32	Feature register	0x0006	R/W	SEEROM
R33	User scaling: Offset	0x0000	R/W	SEEROM
R34	User scaling: Gain	0x0100	R/W	SEEROM
R35	User switch-on value	0x0000	R/W	SEEROM
R36	reserved	0x0000	R/W	SEEROM
…	…	…	…	…
R63	reserved	0x0000	R/W	SEEROM

APPENDIX A

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

A.1 I/O 12.0mm 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 or visit www.kollmorgen.com

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