Rexroth Inline terminal with one analog output

R911170602
Edition 01

R-IB IL AO 1/SF-PAC

1 analog output
2-wire technology
0 - 20 mA, 4 - 20 mA
0 - 10 V

04/2008

Description

The terminal is designed for use within an Inline station. It is used to output analog voltage or current signals. The signals are available with a resolution of 16 bits.

Features

- One analog signal output for the connection of either voltage or current signals
- Actuator connection in 2-wire technology with shield connection
- Two current ranges, one voltage range:
  0 mA to 20 mA, 4 mA to 20 mA, 0 V to 10 V
- Process data update including conversion time of the digital/analog converter <1 ms

CAUTION

Only **one** output may be used on the terminal! Use a connector with shield connection when installing the actuator.

This data sheet is only valid in association with the application description for the Rexroth Inline system (see "Documentation" on page 2).

Make sure you always use the latest documentation.
It can be downloaded at www.boschrexroth.com.

Ordering data

Products

Description	Type	Order No.	Pcs./Pkt.
Rexroth Inline terminal with one analog output for either voltage or current signals; complete with accessories (connectors and labeling fields)	R-IB IL AO 1/SF-PAC	R911170787	1

Documentation

Description	Type	Order No.	Pcs./Pkt.
"Configuring and Installing the INTERBUS Inline Product Range" application description	DOK-CONTRL-ILSYSPRO***-AW..-EN-P	R911317023	1
"Automation Terminals of the Inline Product Range" application description	DOK-CONTRL-^ ILSYSINS***-AW..-EN-P	R911317021	1

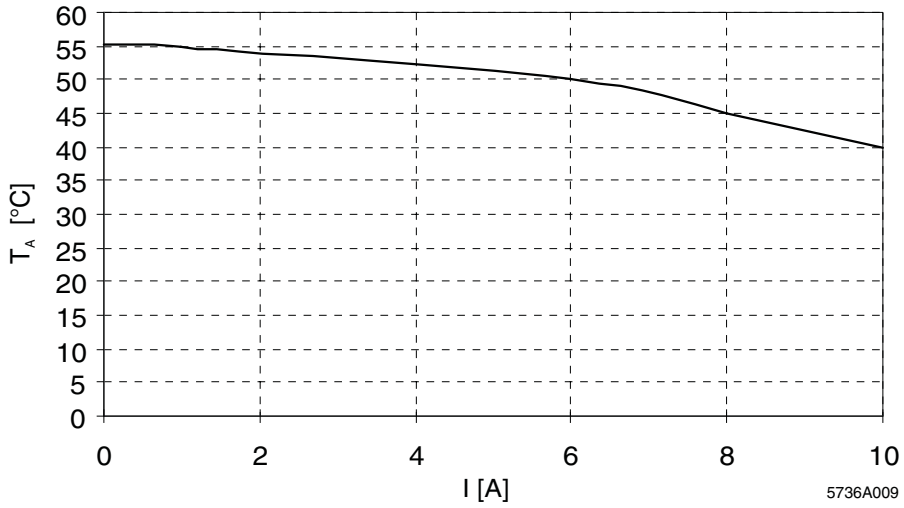
For additional ordering data (accessories), please refer to the product catalog at www.boschrexroth.com.

Technical data

General data	
Housing dimensions (width x height x depth)	24.4 mm x 136 mm x 72 mm (with connector)
Weight	100 g (with connector)
Operating mode	Process data mode with 1 word
Connection method for actuators	2-wire technology
Ambient temperature (operation)	-25°C to +55°C
Ambient temperature (storage/transport)	-25°C to +85°C
Permissible humidity (operation/storage/transport)	10% to 95%, according to DIN EN 61131-2
Permissible air pressure (operation/storage/transport)	70 kPa to 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20 according to IEC 60529
Class of protection	Class III, IEC 61140
Connection data for Inline connector	
Connection method	Spring-cage terminals
Conductor cross-section	0.2 mm^2 to 1.5 mm^2 (solid or stranded), 24 - 16 AWG

The following technical data differs from the IB IL SYS PRO UM E user manual:	
Mechanical requirements	
Shock test according to EN 60068-2-27; IEC 60068-2-27	15g load for 11 ms, half sinusoidal wave, three shocks in each direction and orientation 25g load for 6 ms, half sinusoidal wave, three shocks in each direction and orientation
Interface	
Local bus	Through data routing
Transmission speed	
R-IB IL AO 1/SF-PAC	500 kbps
Power consumption	
Communications power U_L	7.5 V
Current consumption from U_L	30 mA, typical; 40 mA, maximum
I/O supply voltage U_{ANA}	24 V DC
Current consumption at U_{ANA}	50 mA, typical; 65 mA, maximum
Total power consumption	1.425 W, typical
Supply of the module electronics and I/O through the bus coupler/power terminal	
Connection method	Potential routing

Derating: Permissible ambient temperature depending on the current of the potential jumpers U_M and U_S (total current)



T_A [°C] Ambient temperature in °C

I [A] Current flowing through the potential jumpers U_M and U_S in A

Analog output			
Number		1; configures itself depending on the terminal point used	
Signals/resolution in the process data word (quantization)			
Voltage	0 to 10 V	0 to 9.99985 V	0.153 mV/LSB
Current	0 to 20 mA	0 to 19.9997 mA	0.305 µA/LSB
	4 to 20 mA	4 to 19.99976 mA	0.244 µA/LSB
Measured value representation		16-bit, straight binary	
Basic error limit in the current range		±0.05%, typical	
Output load			
Voltage output		2 kΩ, minimum	
Current output		500 Ω, maximum	
Process data update including conversion time of the digital/analog converter		1 bus cycle (depending on the bus configuration); <1 ms	
Slew rate (>99% of the final value)		<10 µs	

Tolerance behavior and temperature response of the voltage output (The tolerance values refer to the output range final value of 10 V.)		
	Typical	**Maximum**
Tolerance at 23°C		
Total offset voltage	±0.03%	±0.05%
Tolerance due to gain	±0.10%	±0.15%
Differential non-linearity	±0.0012%	±0.003%
Total tolerance at 23°C	**±0.15%**	**±0.25%**
Temperature response at -25°C to +55°C		
Offset voltage drift T_{KVO}	±10 ppm/K	±65 ppm/K
Gain drift T_{KG}	±30 ppm/K	±35 ppm/K
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	±40 ppm/K	±100 ppm/K
Total tolerance of the voltage outputs (-25°C to +55°C) Tolerance due to offset, gain, linearity, and drift	**±0.30%**	**±0.60%**

Tolerance behavior and temperature response of the current output (0 mA to +20 mA) (The tolerance values refer to the output range final value of 20 mA.)		
	Typical	**Maximum**
Tolerance due to offset at 23°C		
Offset current I_{oc}	±0.05%	±0.15%
Tolerance due to gain	±0.09%	±0.25%
Differential non-linearity	±0.0012%	±0.003%
Total tolerance at 23°C	**±0.15%**	**±0.25%**
Temperature response at -25°C to +55°C		
Offset current drift T_{KIO}	±25 ppm/K	±65 ppm/K
Gain drift T_{KG}	±10 ppm/K	±35 ppm/K
Total current drift TKtot = TKIO + TKG	**±35 ppm/K**	**±100 ppm/K**

Tolerance behavior and temperature response of the current output (4 mA to +20 mA) (The tolerance values refer to the output range final value of 20 mA.)		
	Typical	**Maximum**
Tolerance due to offset at 23°C		
Offset current I_{oc}	±0.15%	±0.45%
Tolerance due to gain	±0.25%	±0.45%
Differential non-linearity	±0.003%	±0.005%
Total tolerance at 23°C	**±0.25%**	**±0.46%**
Temperature response at -25°C to +55°C		
Offset current drift T_{KIO}	±28 ppm/K	±70 ppm/K
Gain drift T_{KG}	±15 ppm/K	±40 ppm/K
Total current drift TKtot = TKIO + TKG	**±43 ppm/K**	**±110 ppm/K**

Note:
The specified data refers to operation under nominal conditions on a R-IBS IL 24 BK-T/U bus coupler in the recommended mounting position.

Additional tolerances influenced by electromagnetic fields		
Type of electromagnetic interference	**Criterion**	**Typical relative deviation of the measuring range final value**
Electromagnetic fields Field strength 10 V/m According to EN 61000-4-3/IEC 61000-4-3	A	<1%
Fast transients (burst) 2 kV supply, 1 kV output According to EN 61000-4-4/IEC 61000-4-4	B	<1%
Conducted interference Class 3 (test voltage 10 V) According to EN 61000-4-6/IEC 61000-4-6	A	<6%

Safety equipment

None

Electrical isolation/isolation of the voltage areas

The electrical isolation of the logic level from the I/O area is ensured by the DC/DC converter.

Common potentials

24 V I/O voltage, 24 V segment voltage, and GND have the same potential. FE is a separate potential area.

Separate potentials in the system consisting of bus coupler/power terminal and I/O terminal

- Test distance	**- Test voltage**
7.5 V supply (bus logic), 24 V supply U_{ANA} / I/O	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logic), 24 V supply U_{ANA} / functional earth ground	500 V AC, 50 Hz, 1 min.
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min.

Error messages to the higher-level control or computer system

Failure of or insufficient communications power U_L	Yes, I/O error message sent to the bus coupler

Approvals

For the latest approvals, please visit www.boschrexroth.com.

Local diagnostic and status indicators and terminal point assignment

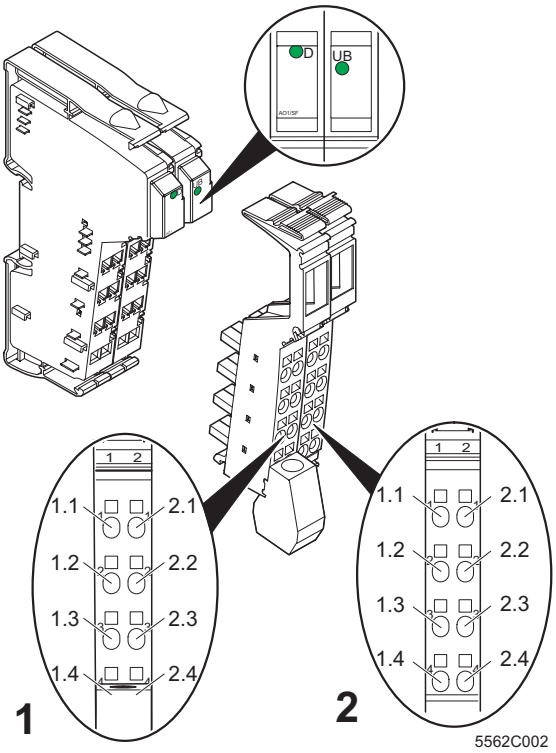


Fig. 1 Terminal with appropriate connectors

Local diagnostic and status indicators

Des.	Color	Meaning
D	Green	Diagnostics
UB	Green	I/O voltage for analog terminals present (current level)

Function identification

Yellow

Terminal point assignment

Connector	Terminal point	Signal	Assignment
1	**1.1**	**U**	Voltage output 0 V to 10 V
	2.1	**–**	Not used
2	**1.1**	**I**	Current output 0 mA to 20 mA
	2.1	**I**	Current output 4 mA to 20 mA
1 and 2	**1.2, 2.2**	**–**	Not used
	1.3, 2.3	**GND**	Ground
	1.4, 2.4	**Shield**	Shield connection

Installation instructions

High current flowing through potential jumpers U_M and U_S leads to a temperature rise in the potential jumpers and inside the terminal. Observe the following instructions to keep the current flowing through the potential jumpers of the analog terminals as low as possible:

CAUTION

Create a separate main circuit for all analog terminals!

If this is not possible in your application and you are using analog terminals in a main circuit together with other terminals, place the analog terminals behind all the other terminals at the end of the main circuit.

Please note the derating curve shown on page 3.

Internal circuit diagram

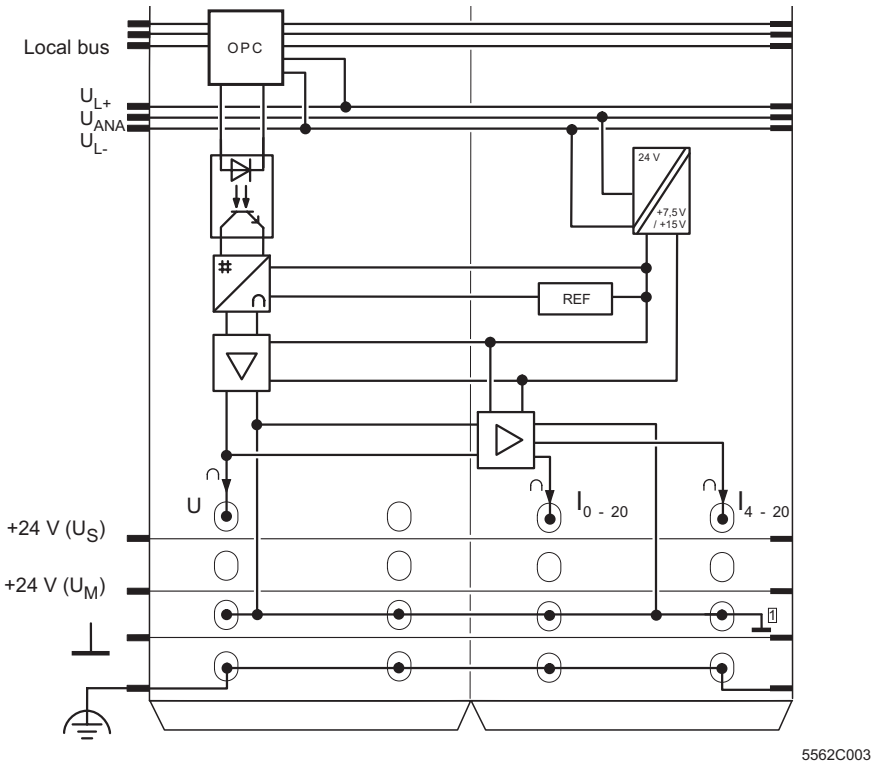


Fig. 2 Internal wiring of the terminal points

Key:

OPC	Protocol chip		Amplifier
	Optocoupler		Digital/analog converter
	DC/DC converter with electrical isolation		Analog output
REF	Reference voltage	1	Analog ground, electrically isolated from ground of the potential jumper

Other symbols used are explained in the application descriptions for the Rexroth Inline system (see "Documentation" on page 2) or in the application description for your bus system.

Electrical isolation

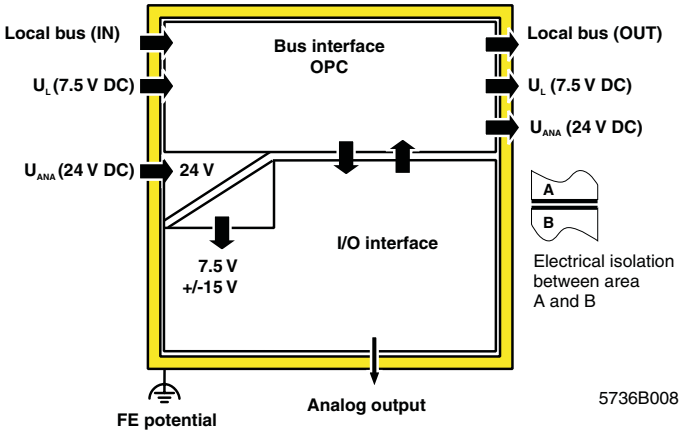


Fig. 3 Electrical isolation of the individual function areas

Connection notes

CAUTION

Always connect the analog actuator using shielded, twisted pair cables.

At the terminal, connect one end of the shielding to PE. At the module, fold the outer cable sheath back and connect the shield to the terminal via the shield connection clamp. The clamp connects the shield directly to FE on the module side.

When using cables longer than 10 m in environments prone to interference, we recommend additionally connecting the shield on the actuator to the FE potential via an RC element. The capacitor C should typically have values of 1 nF to 15 nF. The resistor R should have a resistance of at least 10 MΩ.

Use an I/O connector with shield connection when installing the actuator. Insert the connector without shield connection into the unused base side. The appearance of the module differs depending on the output used. This is shown in Fig. 4 and Fig. 5 in the top left corner.

Connection examples

Use a connector with shield connection when installing the actuator. Fig. 4 and Fig. 5 show the connection schematically (without shield connector).

Voltage output

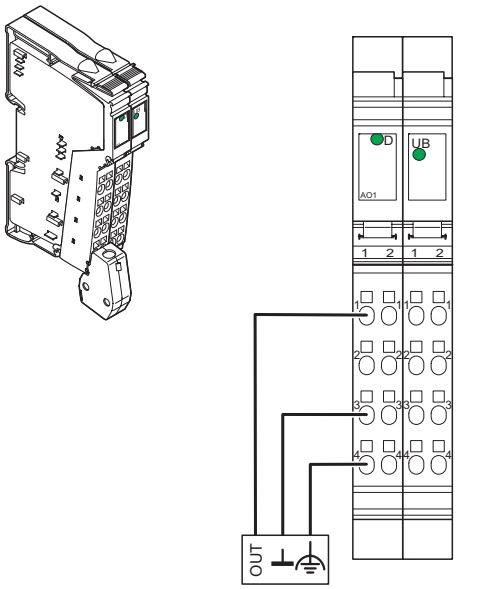


Fig. 4 Actuator connected to the voltage output 0 V to 10 V in 2-wire technology with shield connection

Current output

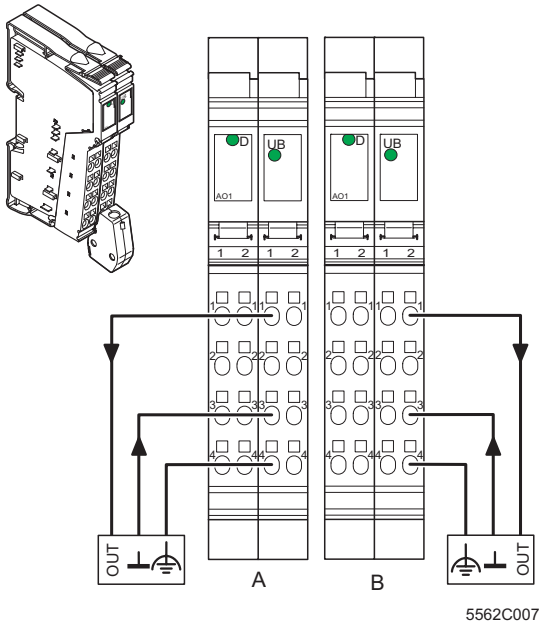


Fig. 5 Actuator connected to the current outputs in 2-wire technology with shield connection

A Signals for actuator at the current output 0 mA to 20 mA

B Signals for actuator at the current output 4 mA to 20 mA

Programming data/configuration data

Local bus

ID code	$7D_{hex}$ (125_{dec})
Length code	01_{hex}
Input address area	0 byte
Output address area	1 word
Parameter channel (PCP)	0 byte
Register length (bus)	1 word

Other bus systems

For the programming data/configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g., GSD, EDS).

Process data

Assignment of the terminal points to the process data output word

(Word.bit) view	Word	Process data output word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Terminal points Slot 1	Signal	Terminal point 1.1: voltage output															
	Signal reference	Terminal point 1.3, 2.3															
	Shielding (FE)	Terminal point 1.4, 2.4															
Terminal points Slot 2	Signal	Terminal point 1.1: current output 0 to 20 mA Terminal point 2.1: Current output 4 to 20 mA															
	Signal reference	Terminal point 1.3, 2.3															
	Shielding (FE)	Terminal point 1.4, 2.4															

Process data output word

The **process data output word** specifies the output value in each cycle.

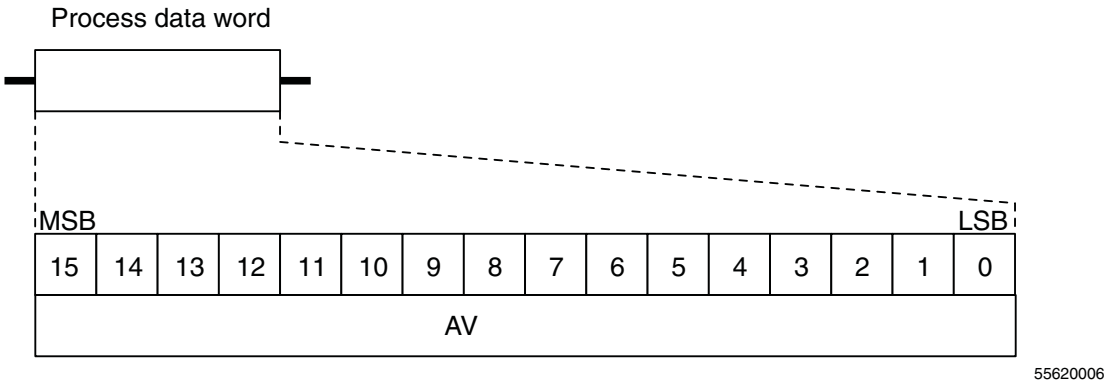


Fig. 6 Process data output word

AV Analog value

MSB Most significant bit

LSB Least significant bit

All output values are represented in 16 bits.

For significant values in the process data word, refer to the following tables.

Abbreviations used in the following tables:

QS Quantization step(s)

MSB Most significant bit

ORF Output range final value

LSB Least significant bit

Process data output word for the voltage output 0 V to 10 V (example)																		
Voltage output **0 V to 10 V**	Analog value (V)	Process data output word																
		Hex	Binary (two's complement) MSB LSB															
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10 V minus 1 QS	9.99985	FFFF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10 V minus 2 QS	9.99969	FFFE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Half ORF	5.0000	8000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 QS	0.153 mV	0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Zero	0.0000	0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Process data output word for the current output 0 mA to 20 mA (example)																	
Current output **0 mA to 20 mA**	Analog value (mA)	Process data output word															
		Hex	Binary (two's complement) MSB LSB														
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
20 mA minus 1 QS	19.9997	FFFF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20 mA minus 2 QS	19.9994	FFFE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Half ORF	10.000	8000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 QS	0.305 µA	0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Zero	0.0000	0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Process data output word for the current output 4 mA to 20 mA (example)																	
Current output **4 mA to 20 mA**	Analog value (mA)	Process data output word															
		Hex	Binary (two's complement) MSB LSB														
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
20 mA minus 1 QS	19.99998	FFFF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20 mA minus 2 QS	19.99995	FFFE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Half ORF	12.0000	8000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 mA plus 1 QS	4,000244	0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Output range start	4.0000	0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Output behavior of the voltage or current output

When configuring your system, take into account output behavior in the event of an error.

Switching operation/status of the supply voltage	**Marginal condition**	**OUT process data word (hex)**	**Behavior/status of the analog output**		
			0 V to 10 V	**0 mA to 20 mA**	**4 mA to 20 mA**
U_{ANA} from 0 V to 24 V	U_L = 0 V	xxxx	0 V	0 mA	4 mA
U_{ANA} from 24 V to 0 V	U_L = 7.5 V	xxxx	0 V	0 mA	0 mA
Bus in STOP state	U_{ANA} = 0 V	xxxx	0 V	0 mA	0 mA
Bus in STOP state	U_{ANA} = 24 V	xxxx	Retain last value		

U_{ANA} Analog supply voltage of the terminal

U_L Supply voltage for module electronics (communications power)

xxxx Any value in the range from 0000_{hex} to $FFFF_{hex}$.

The output behavior and status depend upon which output is used.

Response of the control system or computer to a hardware signal for different control or computer systems

Signal	Control or computer system	Status after switching operation		
		Process data output word OUT	Analog output	
			U_{out}	I_{out}
NORM*	AEG Schneider Automation	0000	0 V	0 mA/4 mA
BASP	Siemens S5	0000	0 V	0 mA/4 mA
CLAB	Bosch	0000	0 V	0 mA/4 mA
SYSFAIL	VME	0000	0 V	0 mA/4 mA
SYSFAIL	PC	0000	0 V	0 mA/4 mA
CLEAR OUT	Moeller IPC	0000	0 V	0 mA/4 mA

*The controller boards for AEG Schneider Automation control systems allow the setting of the NORM signal in such a way that enables the process data output word OUT and the analog output to retain the last value.

The status of the current output depends upon which range is selected.

Response of the voltage and current output to a control command of the controller board

Command	Status after switching operation		
	Process data output word OUT	Analog output	
		U_{out}	I_{out}
STOP	Retain last value	Retain last value	Retain last value
ALARM STOP (reset)	Retain last value	Retain last value	Retain last value

DOK-CONTRL-ILAO1/SF***-KB01-EN-P

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