Inline terminal with four analog input channels

R911170542
Edition 02

Data sheet R-IB IL AI 4/EF-PAC

4 analog differential inputs
2-, 3-, 4-conductor technology
0 - 20 mA, 4 - 20 mA, ± 20 mA
0 - 10 V, ± 10 V, 0 - 5 V, ± 5 V

10 / 2022

1 Description

The terminal is designed for use within an Inline station.
It is used to acquire analog voltage and current signals.

Features

- 4 differential signal inputs
- Connection of sensors in 2-, 3-, and 4-conductor technology
- Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
- Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V
- The channels are parameterized independently of one another via the bus system
- Parameterization via process data or PCP
- Measured values can be represented in four different formats
- Resolution depends on the representation format and the measuring range
- Process data update of all channels in max. 1 ms
- Sensor supply with channel-specific integrated short-circuit and overload protection
- Bus-synchronous provision of input values with very low jitter (< 10 µs)

This data sheet is only valid in association with the “Automation terminals of the Inline product range” application description (DOK-CONTRL-ILSYSINS***-AW..-EN-P, MNR R911317021).

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

2 Table of contents

3 Ordering data

Description	Type	MNR	Pcs./Pkt.
Inline terminal with four analog input channels, incl. accessories (connectors and marking fields)	R-IB IL AI 4/EF-PAC	R911170426	1

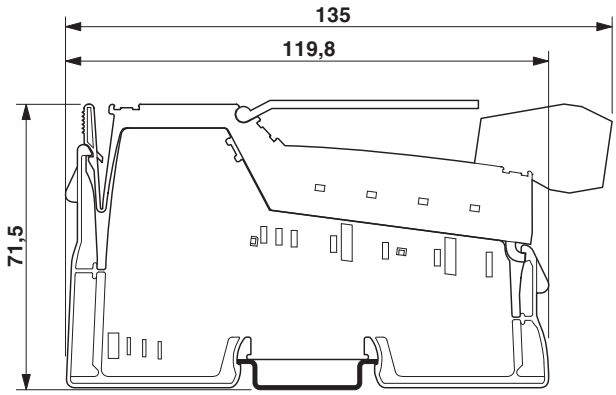
Documentation	Type	MNR	Pcs./Pkt.
Application description Automation terminals of the Inline product range	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317021	1

Additional ordering data

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

4 Technical data

Dimensions (nominal sizes in mm)



Width	48.8 mm
Height	135 mm
Depth	71.5 mm
Note on dimensions	Housing dimensions

General data	
Color	light grey RAL 7035
Weight	210 g (with connectors)
Operating mode	Process data mode with 5 words/1 word PCP
Ambient temperature (operation)	-25 °C ... 55 °C
Ambient temperature (storage/transport)	-25 °C ... 85 °C
Permissible humidity (operation)	10 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	10 % ... 95 % (non-condensing)
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	III (IEC 61140, EN 61140, VDE 0140-1)
Mounting type	DIN rail mounting

Connection data: Inline connector	
Connection method	Spring-cage connection
Conductor cross section, rigid	0.2 mm² ... 1.5 mm²
Conductor cross section, flexible	0.2 mm² ... 1.5 mm²
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm
Interface: Inline local bus	
Number of interfaces	2
Connection method	Inline data jumper
Transmission speed	500 kbps
Communications power (U_L)	
Supply voltage	7.5 V DC (via voltage jumper)
Current consumption	typ. 85 mA max. 100 mA
Supply of analog modules (U_{ANA})	
Supply voltage	24 V DC (via voltage jumper)
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption	typ. 13 mA max. 20 mA
Main circuit supply (U_M)	
Supply voltage	24 V DC (via voltage jumper)
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption	min. 0 mA (No-load) max. 200 mA
Power consumption	
Power consumption	typ. 950 mW (entire device) max. 1.25 W (entire device)
Sensor supply U_{iS}	
Supply voltage	24 V DC (via feed-in from U_M)
Current consumption	max. 50 mA (per channel)
Short-circuit/overload protection	electronic fuse
Analog inputs	
Number of inputs	4
Description of the input	Differential input, including sensor supply (24 V DC)
Connection method	Inline shield connector
Connection technology	2-, 3-, 4-conductor, shielded
Current input signal	0 mA ... 20 mA, 4 mA ... 20 mA, -20 mA ... 20 mA
Voltage input signal	0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V
Permissible voltage	max. -50 V DC ... 50 V DC (Between analog voltage inputs and functional ground) max. -30 V ... 30 V (at the current inputs)
A/D converter resolution	16 bit
A/D conversion time	max. 10 µs
Data formats	IB IL, IB ST, standardized representation, S7 compatible

Analog inputs	
Averaging	Can be parameterized: None or using 4,16 or 32 measured values; default setting: using 16 measured values
Process data update	< 1 ms (bus-synchronous)
Input resistance of voltage input	typ. 300 kΩ
Input resistance current input	typ. 110 Ω
Limit frequency (3 dB)	500 Hz
Wire-break behavior	goes to 0 V, 0 mA or 4 mA
Transient protection	Yes, via arresters
Overload protection of the current inputs	electronic

Programming data (INTERBUS, local bus)	
ID code (hex)	DF
ID code (dec.)	223
Length code (hex)	05
Length code (dec)	05
Process data channel	80 Bit
Input address area	10 Byte
Output address area	10 Byte
Parameter channel (PCP)	2 Byte
Register length (bus)	96 Bit

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

Configuration and parameter data in a PROFIBUS system	
Required parameter data	28 Byte
Required configuration data	4 Byte

Error messages to the higher level control or computer system	
Failure of the internal I/O supply	I/O error message sent to the bus coupler
Failure of or insufficient communications power U_L	I/O error message sent to the bus coupler
I/O error	Error message in the process data
User error	Error message in the process data

Electrical isolation/isolation of the voltage areas	
Test section	**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 ground	500 V AC, 50 Hz, 1 min.
I/O/functional ground	500 V AC, 50 Hz, 1 min.

Approvals

For the current approvals, please visit www.boschrexroth.com/electrics.

5 Additional technical data

The following data deviates from the specifications in the “Automation terminals of the Inline product range” application description (DOK-CONTRL-ILSYSINS***-AW..-EN-P, MNR R911317021).

Mechanical tests	
Shock in accordance with EN 60068-2-27/IEC 60068-2-27	15g load for 11 ms, half sinusoidal wave, three shocks per space direction and orientation 25g load for 6 ms, half sinusoidal wave, three shocks per space direction and orientation

Immunity test in accordance with EN 61000-6-2/IEC 61000-6-2	
Electrostatic discharge (ESD) EN 61000–4–2 / IEC 61000–4–2	Criterion B, 6 kV contact discharge, 8 kV air discharge

6 Tolerance data

The following applies for tolerance values:

The specifications refer to nominal operation with preferred mounting position (wall mounting on horizontal DIN rail).

All percentage tolerances refer to the relevant measuring range final value.

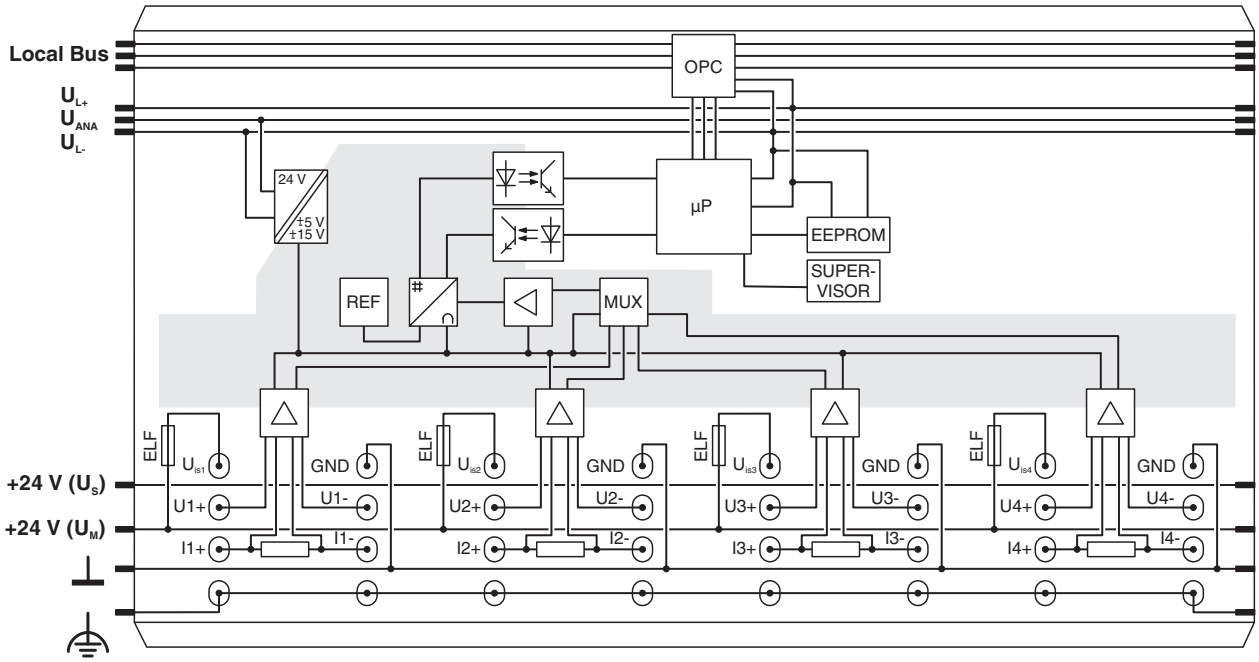
Tolerances at T_A = +25°C				
Measuring range	Absolute		Relative	
	Typical	Maximum	Typical	Maximum
0 V ... 5 V, ±5 V	±2.5 mV	±7.5 mV	±0.05 %	±0.05 %
0 V ... 10 V, ±10 V	±2.5 mV	±10 mV	±0.025 %	±0.10 %
0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA	±14 µA	±40 µA	±0.07%	±0.20 %

Tolerances at T_A = -25°C ... +55°C				
Measuring range	Absolute		Relative	
	Typical	Maximum	Typical	Maximum
0 V ... 5 V, ±5 V	±9 mV	±20 mV	±0.18 %	±0.40 %
0 V ... 10 V, ±10 V	±13 mV	±30 mV	±0.13 %	±0.30 %
0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA	±22 µA	±80 µA	±0.11 %	±0.40 %

Additional tolerances influenced by electromagnetic interference			
Type of electromagnetic interference		Typical deviation from the measuring range final value (voltage input)	Typical deviation of the measuring range final value (current input)
		Relative	Relative
Electromagnetic fields	EN 61000-4-3/ IEC 61000-4-3	< ±1.0 %	< ±1.0 %
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	< ±1.0 %	< ±1.0 %
Conducted interference	EN 61000-4-6/ IEC 61000-4-6	< ±1.0 %	< ±1.0 %

7 Internal circuit diagram

Fig. 1 Internal wiring of the terminal points



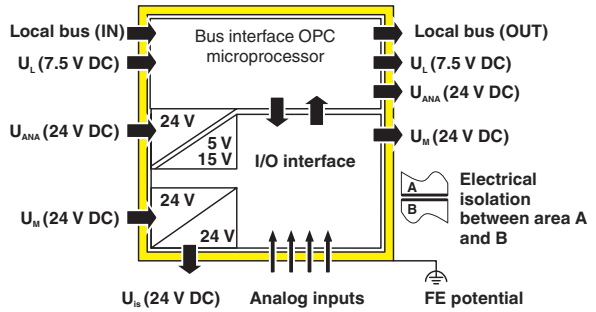
Key:

OPC	Protocol chip
	Electrical isolation (optocoupler or isolator)
	Power supply unit with electrical isolation
µP	Microprocessor
REF	Reference voltage source
EEPROM	Electrically erasable programmable read-only memory
△	Input amplifier
MUX	Multiplexer
# ∩	Analog/digital converter
	Electronic fuse
Supervisor	Microprocessor monitoring

For an explanation of the other symbols used, please refer to the “Automation terminals of the Inline product range” application description (DOK-CONTRL-ILSYSINS***-AW..-EN-P, MNR R911317021).

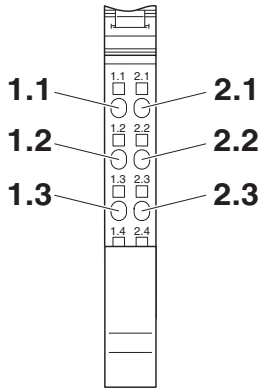
8 Electrical isolation

Fig. 2 Electrical isolation of the individual function areas



9 Terminal point assignment

Fig. 3 Terminal point assignment



Terminal point assignment for each connector		
Terminal point	**Signal**	**Meaning**
1.1	+24 V, U_{iS}x	Initiator supply for channel x
2.1	GND	Ground of U_{iS}x
1.2	+Ux	Positive voltage connection for channel x
2.2	-Ux	Negative voltage connection for channel x
1.3	+Ix	Positive current connection for channel x
2.3	-Ix	Negative current connection for channel x
1.4, 2.4	Shield	Shield connection

x = 1 ... 4

10 Connection notes

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

Connect the shielding to the terminal using the shield connection clamp. The clamp connects the shield to FE on the module side.

Insulate the shielding at the sensor or connect it with a high resistance and a capacitor to the FE potential.

11 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. To keep the current flowing through the potential jumpers of the analog terminals as low as possible, always place the analog terminals after all the other terminals at the end of the main circuit (for the sequence of the Inline terminals: see also “Automation terminals of the Inline product range” application description (DOK-CONTRL-ILSYSINS***-AW..-EN-P, MNR R911317021).

12 Connection examples

Use a connector with shield connection when installing the sensors. The image illustrates the connection schematically (without shield connection).

Fig. 4 Connection of active sensors in 4-conductor technology with shield connection

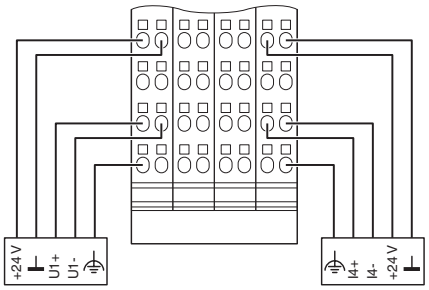


Fig. 5 Passive pressure sensor at a differential current input

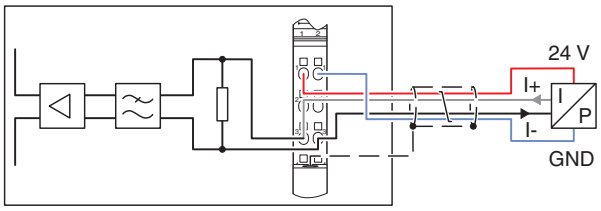


Fig. 6 Active pressure sensor at a differential current input

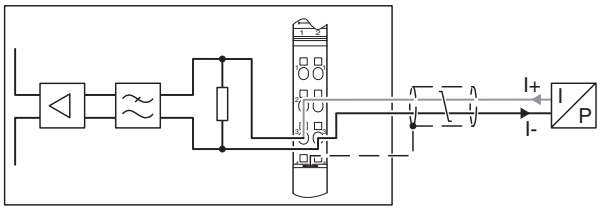
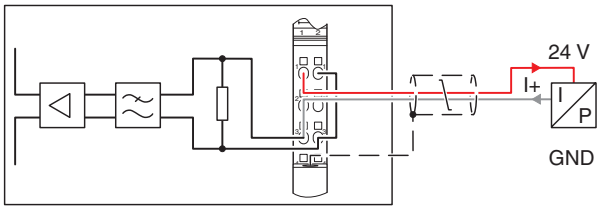
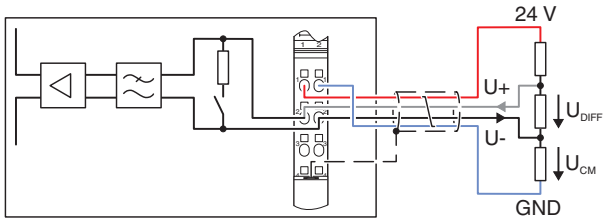


Fig. 7 Passive 2-conductor transmitter at a differential current input



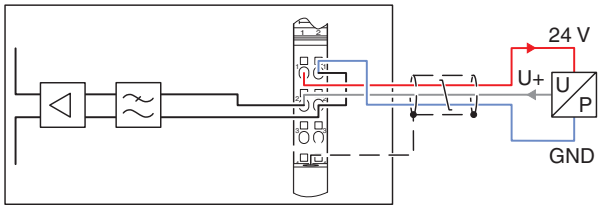
Set the bridge on the connector or alternatively in the sensor for 4-conductor technology.

Fig. 8 Passive voltage divider at a differential voltage input



Make sure that the U_{CM} voltage does not exceed the specified range, see “Analog differential voltage inputs”.

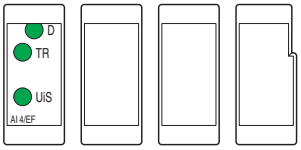
Fig. 9 Active 3-conductor transmitter differential voltage input



Set the jumper on the connector.

13 Local diagnostic and status indicators

Fig. 10 Local diagnostic and status indicators



Designation	Color	Meaning
D	Green	Diagnostics (bus and logic voltage)
TR	Green	PCP communication is active.
UiS	Green/red	Sensor supply
	Green on	Sensor supply is OK.
	Red on	Short circuit/overload of the sensor supply or U_M supply voltage is not present.

If the UiS LED is red, please also check the UM LED on the previous power terminal.

UiS red on/UM off: overload/short circuit of the U_{iS} sensor supply;
UiS red on/UM off: U_M supply voltage not present

For more detailed information on diagnostics, please refer to the “Automation terminals of the Inline product range” application description (DOK-CONTRL-ILSYSINS***-AW..-EN-P, MNR R911317021).

Function identification

Green

14 Parameterization and analog values

You can either parameterize the terminal via process data or via PCP and transmit the analog values accordingly.

If you have parameterized the terminal via PCP, the parameterization can no longer be modified via the process data.

15 Process data

The terminal uses five input process data words and five output process data words.

The terminal also has one PCP word.

Order of the process data words:

OUT0	OUT1	OUT2	OUT3	OUT4
Control word				

IN0	IN1	IN2	IN3	IN4
Status word				

16 OUT process data words

Five OUT process data words are available.

Parameterize the terminal using the process data output words.

Output word OUT0 contains the command.

Output words OUT1 to OUT4 contain the parameters for channels 1 to 4.

16.1 Output word OUT0 (control word)

	OUT0								
Bit	15 ... 8	7	6	5	4	3	2	1	0
Assignment	Command code	0	0	0	0	0	0	0	x

Set all reserved bits to 0.

Bit 15 to bit 8 (command code):

Bit 15 ... bit 8	OUT0 (hex)	Command function
00000000	0000	Read analog value The analog value of the four input channels is represented in IN1 to IN4.
000100KK	1x00	Read parameterization in IN1 channel-by-channel K = channel number; 00 = channel 1, 01 = channel 2, 10 = channel 3, 11 = channel 4
00111100	3C00	Read firmware version and module ID in IN1.
01000000	400x	Parameterizing the device Channels 1 to 4 are parameterized in OUT1 to OUT4.
01010000	500x	Parameterize the device and read analog value Channels 1 to 4 are parameterized in OUT1 to OUT4. The analog values of channels 1 to 4 are displayed in IN1 to IN4.

Bit 0 is only significant for the command codes $400x_{hex}$ and $500x_{hex}$.

Bit 0	PF (Peripheral fault in the event of sensor errors)
0	**Do not permit (default)**
1	Permit

16.2 Output words OUT1 to OUT4

You can parameterize each channel independently of the other channels. You parameterize the first channel via the second output word (OUT1), the second channel via the third output word (OUT2) etc.

If the parameterization is changed, the corresponding channel is re-initialized. If IB IL format is set, the error code “Measured value invalid” is output.

If the parameterization is invalid, a corresponding error message is output in the status word.

A final parameterization is stored in volatile memory.

For commands $400x_{hex}$ and $500x_{hex}$, specify the parameters for channels 1 to 4 in OUT1 to OUT4. The parameter words are only evaluated for these commands.

	OUTx (x = 01 ... 04)															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assignment	0	0	0	0	0	0	Filter		0	0	Format		Measuring range			

Set all unused bits to 0.

If invalid parameters are specified in the parameter word, the command will not be executed. The command is acknowledged in the input words with the set error bit.

Parameter value ranges and presets

The values displayed in bold are pre-settings.

Bit 9 and Bit 8:

Code		**Filter**
bin	**dec**	
00	**0**	**Mean value over 16 measured values (default)**
01	1	No mean-value
10	2	Mean value via 4 measured values
11	3	Mean value via 32 measured values

Bit 5 and Bit 4:

Code		**Format**
bin	**dec**	
00	**0**	**IB IL (15 bits) (default)**
01	1	IB ST (12 bits)
10	2	S7-compatible
11	3	Standardized representation

Bit 3 ... bit 0:

Code		**Measuring range**
bin	**hex**	
0000	**0**	**0 V ... 10 V (default)**
0001	1	-10 V ... +10 V
0010	2	0 V ... 5 V
0011	3	-5 V ... +5 V
1000	8	0 mA ... 20 mA
1001	9	-20 mA ... +20 mA
1010	A	4 mA ... 20 mA
Other		Reserved

17 Process data input words IN

17.1 Input word IN0 (status word)

Input word IN0 performs the task of a status word.

	IN0								
Bit	15	14 ... 8	7	6	5	4	3	2	1	0
Assign-ment	EB	SP	0	0	0	0	0	0	0	0

EB: Error Bit

EB = 0	No error has occurred.
EB = 1	An error has occurred.

The error bit indicates whether a command could be executed without errors or not.

Possible errors and their effects are listed in Section “Diagnostics”.

SP: Mirrored command code

A command code mirrored from the control word. Here, the MSB is suppressed.

17.2 Input words IN1 to IN4

The measured values, parameterization or firmware version are transmitted to the controller board or the computer via process data input words IN1 to IN4 according to the parameterization.

For control words 0000_{hex} and 5000_{hex} (error-free standard operation) the measured values are transmitted in IN1 to IN4.

For control word $1x00_{hex}$, the parameterization of the selected channel is indicated in IN2.

For control word $3C00_{hex}$, word IN1 supplies the firmware version and the module ID.

For control word 4000_{hex} (parameterize device), the parameter data is mirrored in the input words after acceptance.

Example: Firmware version 1.23

	IN1															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assignment (hex)	1				2				3				E			
Meaning	Firmware version 1.23												Module ID			

18 Formats for representing measured values

Bosch Rexroth recommends format IB IL for all controllers, as this format contains the most comprehensive diagnostic codes.

The other formats are only intended for simplifying reconfiguration on IB IL analog modules in existing projects.

18.1 IB IL format

The measured value is represented in bits 14 to 0.

An additional bit (bit 15) is available as a sign bit.

This format supports extended diagnostics. Values > 8000_{hex} and < 8100_{hex} indicate an error.

The error codes are specified in Section “Supported diagnostic codes”.

Measured value representation in IB IL format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V	Analog value														

V Sign bit

Significant measured values

Input data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	±20 mA	4 mA ... 20 mA
hex	dec	V	V	V	V	mA	mA	mA
8001	Overrange	> +10.837	> +10.837	> +5.419	> +5.419	>+21.6746	>+21.6746	> +21.3397
7F00	32512	+10.837	+10.837	+5.419	+5.419	+21.6746	+21.6746	+21.3397
7530	30000	+10.0	+10.0	+5.0	+5.0	+20.0	+20.0	+20.0
0001	1	+333.33 µV	+333.33 µV	+166.67 µV	+166.67 µV	+0.66667 µA	+0.66667 µA	+4.0005333
0000	0	≤ 0	0	≤ 0	0	≤ 0	0	+4.0 ... +3.2
FFFF	-1		-333.33 µV		-166.67 µV		-0.66667 µA	
8AD0	-30000		-10.0		-5.0		-20.0	
8100	-32512		-10.837		-5.419		-21.6746	
8080	Underrange		< -10.837		< -5.419		< -21.6746	
8002	Wire break							< +3.2

18.2 IB ST format

The measured value is represented in bits 14 to 3.

An additional bit (bit 15) is available as a sign bit.

Measured value representation in IB ST format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V	Analog value												0	OC	BÜ

V	Sign bit
OC	Wire break
BÜ	Overrange
0	Reserved

Significant measured values

Input data		**0 V ... 10 V**	**±10 V**	**0 V ... 5 V**	**±5 V**	**0 mA ... 20 mA**	**±20 mA**	**4 mA ... 20 mA**
hex	**dec**	**V**	**V**	**V**	**V**	**mA**	**mA**	**mA**
7FF9	Overrange	> +10.75	> +10.75	> +5.375	> +5.375	> +21.5	> +21.5	> +21.5
7FF8	32760	+10.0 ... 10.75	+10.0 ... 10.75	+5.0 ... 5.375	+5.0 ... 5.375	+20.0 ... +21.5	+20.0 ... +21.5	+20.0 ... +21.5
7FF8	32760	+9.9975	+9.9975	+4.9988	+4.9988	+19.9951	+19.9951	+19.9961
4000	16384	+5.0	+5.0	+2.5	+2.5	+10.0	+10.0	+12.0
0008	8	+0.002441	+0.002441	+0.001221	+0.001221	+0.0048828	+0.0048828	+4.003906
0000	0	≤ 0	0	≤ 0	0	≤ 0	0	+4.0 ... +3.2
FFF8	-8		-0.002441		-0.001221		-0.0048828	
8000	-32768		-10.0 ... -10.75		-5.0 ... -5.375		-20.0 ... -21.5	
8001	-32767		> -10.75		< -5.375		> -10.75	
8002	Wire break							< +3.2

18.3 Format S7 compatible

The measured value is represented in bits 14 to 0.

An additional bit (bit 15) is available as a sign bit.

Measured value representation in S7-compatible format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V	Analog value														

V Sign bit

Significant measured values

Input data		**0 V ... 10 V**	**±10 V**	**0 V ... 5 V**	**±5 V**	**0 mA ... 20 mA**	**±20 mA**	**4 mA ... 20 mA**
hex	**dec**	**V**	**V**	**V**	**V**	**mA**	**mA**	**mA**
7FFF	Overrange	> +11.759	> +11.759	> +5.879	> +5.879	> +23.5157	> +23.5157	> +22.8142
7EFF	32511	+11.759	+11.759	+5.879	+5.879	+23.5157	+23.5157	+22.8142
6C00	27648	+10.0	+10.0	+5.0	+5.0	+20.0	+20.0	+20.0
0001	1	+361.69 µV	+361.69 µV	+180.85 µV	+180.85 µV	+0.7234 µA	+0.7234 µA	+4.0005787
0000	0	≤ 0	0	≤ 0	0	≤ 0	0	+4.0
FFFF	-1		-361.69 µV		-180.85 µV		-0.7234 µA	+3.9994
9400	-27648		-10.0		-5.0		-20.0	
8100	-32512		-11.759		-5.879		-23.5157	
8000	Under-range/wire break		< -11.759		< -5.879		< -23.5157	< +1.1852

18.4 Calculation of the measured value from the process data input value

The following examples explain the calculation of the measured value from the process data input value for the measuring range 4 mA to 20 mA.

PD IW = Process data input word = input data

IB IL format

Resolution = (20 mA - 4 mA) / 30000 = 0.0005333

Measured value = PD-EW x 0.0005333 mA +4 mA

Example 1	
PD IW	$493F_{hex} = 18751_{dec}$
Value x resolution	18751 x 0.000533 mA = 10 mA
+4 mA	10 mA + 4 mA = 14 mA
Measured value	14 mA

S7-compatible format

Resolution = (20 mA - 4 mA) / 27648 = 0.0005787

Measured value = PD IW x 0.0005787 mA + 4 mA

Example 1	
PD IW	$6C00_{hex} = 27648_{dec}$
Value x resolution	27648 x 0.0005787 mA = 16 mA
+4 mA	16 mA + 4 mA = 20 mA
Measured value	20 mA

Example 2	
PD IW	$F940_{hex}$ -> $FFFF_{hex}$ - $F940_{hex}$ +1 = -1728_{dec}
Value x resolution	-1728 x 0.0005787 mA = -1 mA
+4 mA	-1 mA + 4 mA = 3 mA
Measured value	3 mA

18.5 Standardized representation format

The measured value is represented in bits 14 to 0.

An additional bit (bit 15) is available as a sign bit.

In this format, data is standardized to the measuring range and represented in such a way that it indicates the corresponding value without conversion. In this format, one bit has the value of 1 mV or 1 µA.

This format supports extended diagnostics. Values > 8000_{hex} and < 8100_{hex} indicate an error.

The error codes are specified in Section “Supported diagnostic codes”.

Measured value representation in standardized representation format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
V	Analog value														

V Sign bit

Significant measured values

Input data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	±20 mA	4 mA ... 20 mA
hex	**dec**	**V**	**V**	**V**	**V**	**mA**	**mA**	**mA**
8001	Overrange	> +10.837	> +10.837	> +5.419	> +5.419	> +21.6747	> +21.6747	> +21.3397
4E20	20000	-	-	-	-	+20.0	+20.0	-
2710	10000	+10.0	+10.0	-	-	+10.0	+10.0	+14.0
1388	5000	+5.0	+5.0	+5.0	+5.0	+5.0	+5.0	+9.0
0001	1	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+4.001
0000	0	≤ 0	0	≤ 0	0	≤ 0	0	+4.0 ... +3.2
FFFF	-1		-0.001		-0.001		-0.001	
EC78	-5000		-5.0		-5.0		-5.0	
D8F0	-10000		-10.0		-		-10.0	
B1E0	-20000		-		-		-20.0	
8080	Underrange		< -10.837		< -5.419		< -21.6747	
8002	Wire break							< +3.2

18.6 Supported diagnostic codes

In IB IL and standardized representation formats, a diagnostics code is mapped in the event of an error.

Code (hex)	Cause
8001	Measuring range exceeded (overrange)
8002	Wire break
8004	Measured value is invalid
8020	Sensor and/or analog supply not present
8040	Device faulty
8080	Below measuring range (underrange)

18.7 Assignment of the terminal points to IN process data

Assignment also applies to command codes 0000_{hex} “Read analog value” and $500x_{hex}$ “Parameterize the device and read analog value”.

(Word.bit) view	Word	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(Byte.Bit) view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Assignment	24 V	Terminal point 1.1: Power supply for sensors															
	GND	Terminal point 2.1: Ground															
	Signal	Terminal point 1.2: positive voltage output Terminal point 1.3: positive current input															
	Signal reference	Terminal point 2.2: negative voltage input Terminal point 2.3: negative current input															
	Shielding	Terminal point 1.4, 2.4															

Word x	Channel	Connector
IN1	1	1
IN2	2	2
IN3	3	3
IN4	4	4

19 PCP communication

PCP Compact is implemented on the terminal.

19.1 General information

On delivery, the terminal is parameterized according to the default settings (see “OUT process data output words”). The terminal can be parameterized to suit your application using process data or PCP.

During PCP operation you can parameterize the terminal using the “Config Table” object.

19.2 Object dictionary for PCP communication

Index	Data type	A	L	Meaning	Object name	Rights
0080_{hex}	Array of UINT16	5	2	Terminal parameterization	Config Table	rd/wr
0081_{hex}	Array of UINT16	4	2	Analog values of the channels	Analog Values	rd
0018_{hex}	Record	6		Diagnostic status	Diag State	rd

A	Number of elements	rd	Read access permitted
L	Length of an element in bytes	wr	Write access permitted

20 PCP object description

20.1 "Config Table" object

Parameterize the terminal using this object.

If you parameterize the terminal via PCP and the “Parameterization via process data” bit in the “System bit” element equals 0, parameterization via process data is disabled.

Set the bit to 1 in order to enable parameterization via process data in addition to parameterization via PCP.

Object description:

Object	Config Table	
Access	Read, write	
Data type	Array of UINT16	5 x 2 bytes
Index	0080_{hex}	
Subindex	00_{hex}	Write all elements
	01_{hex}	Parameterization of channel 1
	02_{hex}	Parameterization of channel 2
	03_{hex}	Parameterization of channel 3
	04_{hex}	Parameterization of channel 4
	05_{hex}	System bits
Length (bytes)	$0A_{hex}$	Subindex 00_{hex}
	02_{hex}	Subindex 01_{hex} to 05_{hex}
Data	Terminal parameterization	

Element value range

Parameterization of channel x

The “Parameterization of channel x” elements have the following structure:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assign-ment	0	0	0	0	0	0	Fil-ter		0	0	For-mat		Output range			

For value ranges and default values, refer to section “Output words OUT1 to OUT4”.

If you specify invalid parameters, a negative confirmation is generated with error message 08_{hex}, 00_{hex} or $xx30_{hex}$. The low byte of the Additional_Error_Code is 30_{hex} (value is out of range), the high byte contains the number of the element in question.

Example: Config Table is completely written with data (subindex 00) and the entry for channel 2 is invalid. In this case, the Additional_Error_Code is equal to 0230_{hex}.

System bit

The “System bit” element has the following structure:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Assign-ment	0	0	0	0	0	0	0	0	0	0	0	0	0	PF	0	P

PF: Peripheral fault

Bit 2 = 0 In the event of a sensor problem (overrange, underrange, wire break), the terminal does not generate a peripheral fault (I/O error).

= 1 In the event of a sensor problem (overrange, underrange, wire break), the terminal generates a peripheral fault (I/O error).

P: parameterization via process data

Bit 0 = 0 If the terminal is parameterized via PCP, parameterization via process data is disabled (default).

= 1 The terminal can always be parameterized via process data.

20.2 "Analog Values" object

The elements of this object contain the analog values of the channels in the format that was parameterized for this channel.

Object description:

Object	Analog Values		
Access	Read		
Data type	Array of UINT16		4 x 2 bytes
Index	0081_{hex}		
Subindex	00_{hex}	Read all elements	
	01_{hex}	Analog value of channel 1	
	02_{hex}	Analog value of channel 2	
	03_{hex}	Analog value of channel 3	
	04_{hex}	Analog value of channel 4	
Length (bytes)	08_{hex}	Subindex 00_{hex}	
	02_{hex}	Subindex 01_{hex} to 04_{hex}	
Data	Analog values of the channels		

20.3 "Diag State" object

This object is used for a structured message of an error.

Object description:

Object	Diag State		
Access	Read		
Data type	Record		
Index	0018_{hex}		
Subindex	00_{hex}	Read all elements	
	01_{hex}	Error Number	UINT16
	02_{hex}	Priority	UINT8
	03_{hex}	Channel	UINT8
	04_{hex}	Error code	UINT16
	05_{hex}	More follows	UINT8
	06_{hex}	Text (10 characters)	Visible String
Length (bytes)	11_{hex}	Subindex 00_{hex}	
	02_{hex}	Subindex 01_{hex}	
	01_{hex}	Subindex 02_{hex}	
	01_{hex}	Subindex 03_{hex}	
	02_{hex}	Subindex 04_{hex}	
	01_{hex}	Subindex 05_{hex}	
	$0A_{hex}$	Subindex 06_{hex}	
Data	Diagnostic state		

Value range:

Error Number	$0 ... 65535_{dec}$	
Priority	Error code = 0000_{hex}	Prio: 00_{hex}
	other	Prio: 02_{hex}
Channel	Error code = 0000_{hex}	Channel: 00_{hex}
	other	$01_{hex} ... 04_{hex}$
Error code	0000_{hex}	OK
	8910_{hex}	Overrange
	8920_{hex}	Underrange
	7710_{hex}	Line break
	5160_{hex}	Power fail
	5010_{hex}	Hardware fault
More follows	00_{hex}	None
Text (10 characters)	Error code = 0000_{hex}	Text: Status OK
	Other	Error-specific

21 Diagnostics

The following events are monitored and indicated:

Event	Response
Wire break, overrange or under-range	Error bit is set.
	In IB IL or standardized representation format: an error code is displayed.
	If this was permitted during parameterization, a peripheral error is generated.
Voltage failure of the sensor supply	Error bit is set.
	Device error
	In IB IL or standardized representation format: an error code is displayed.
	If this was permitted during parameterization, a peripheral error is generated.
Voltage failure of the device-internal analog supply (5 V and 15 V)	Error bit is set.
	In IB IL or standardized representation format: an error code is displayed.
	If this was permitted during parameterization, a peripheral error is generated.
Faulty parameterization	Error bit is set.

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