Rexroth Inline terminal with two analog input channels

R911170606
Edition 01

R-IB IL AI 2/SF-PAC

2 analog inputs
2 and 3-wire technology
0-20 mA, 4-20 mA, ±20 mA
0-10 V, ±10 V

04/2008

1 Description

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

Features

- Two analog single-ended signal inputs for the connection of either voltage or current signals
- Connection of sensors in 2 and 3-wire technology
- Three current measuring ranges:
  0 mA to 20 mA, ±20 mA, and 4 mA to 20 mA
- Two voltage measuring ranges:
  0 V to 10 V, ±10 V
- Channels are configured independently of one another using the bus
- Measured values can be represented in four different formats
- Resolution depends on the representation format and the measuring range
- Process data update of both channels in 1.5 ms, maximum
- Diagnostic indicators

This data sheet is only valid in association with the application descriptions for the Rexroth Inline system (see "Documentation" on page 3).

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

Table of contents

2 Ordering data

Products

Description	Type	MNR	Pcs./Pkt.
Rexroth Inline terminal with two analog voltage input channels, complete with accessories (connector and labeling field)	R-IB IL AI 2/SF-PAC	R911170784	1

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

Documentation

Description	Type	MNR	Pcs./Pkt.
"Automation Terminals of the Rexroth Inline Product Range" application description	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317021	1
"Configuring and Installing the Rexroth Inline Product Range for INTERBUS" application description	DOK-CONTRL-ILSYSPRO***-AW..-EN-P	R911317023	1

3 Technical data

General data	
Housing dimensions (width x height x depth)	12.2 mm x 136 mm x 72 mm (with connectors)
Weight	69 g (with connector)
Operating mode	Process data mode with 2 words
Connection method for sensors	2 wire and 3-wire technology
Power supply for the sensors	With an external power supply unit or with an additional segment terminal with a fuse R-IB IL 24 SEG/F
Ambient temperatures (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
Class of protection	III, IEC 61140
Connection data for Inline connectors	
Connection type	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 DOK-CONTRL-ILSYSPRO*-AW..-EN-P application description:**	
Noise immunity test according to EN 50082-2	
Electrostatic discharge (ESD) according to EN 61000-4-2; IEC 61000-4-2	Criterion B 6 kV contact discharge 6 kV air discharge
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	Data routing

Transmission speed	
R-IB IL AI 2/SF-PAC	500 kbps

Power consumption	
Communications power U_L	7.5 V DC
Current consumption from U_L	45 mA (typical); 60 mA (maximum)
I/O supply voltage U_{ANA}	24 V DC
Current consumption at U_{ANA}	13 mA (typical); 18 mA (maximum)
Total power consumption	662 mW (typical), 882 mW (maximum)

Supply of the module electronics and I/O through the bus coupler/power terminal	
Connection method	Potential routing

Analog inputs				
Number		2 analog single-ended inputs		
Signals/resolution in the process data word (quantization)				
Voltage	0 to 10 V	0 to 10.837 V	(IB IL format)	0.333 mV/LSB
		0 to 10.000 V	(IB ST format)	2.441 mV/LSB
		0 to 10.000 V	(IB RT format)	0.305 mV/LSB
		0 to 10.837 V	(Standardized representation)	1.000 mV/LSB
	±10 V	±10.837 V	(IB IL format)	0.333 mV/LSB
		±10.000 V	(IB ST format)	2.441 mV/LSB
		±10.000 V	(IB RT format)	0.305 mV/LSB
		±10.837 V	(Standardized representation)	1.000 mV/LSB
Current	0 to 20 mA	0 to 21.6746 mA	(IB IL format)	0.6666 µA/LSB
		0 to 20.000 mA	(IB ST format)	4.8828 µA/LSB
		0 to 20.000 mA	(IB RT format)	0.6105 µA/LSB
		0 to 21.6746 mA	(Standardized representation)	1.000 µA/LSB
	±20 mA	±21.6746 mA	(IB IL format)	0.6666 µA/LSB
		±20.000 mA	(IB ST format)	4.8828 µA/LSB
		±20.000 mA	(IB RT format)	0.6105 µA/LSB
		±21.6746 mA	(Standardized representation)	1.000 µA/LSB
	4 to 20 mA	4 to 21.339 mA	(IB IL format)	0.533 µA/LSB
		4 to 20.000 mA	(IB ST format)	3.906 µA/LSB
		4 to 20.000 mA	(IB RT format)	0.4884 µA/LSB
		4 to 21.339 mA	(Standardized representation)	1.000 µA/LSB
Measured value representation		In the formats		
		IB IL	(15 bits with sign bit)	
		IB ST	(12 bits with sign bit)	
		IB RT	(15 bits with sign bit)	
		Standardized representation	(15 bits with sign bit)	

Please read the notes on page 16 and page 20 on measured value representation in "IB IL" and "standardized representation" format.

Mean value generation	Over 16 measured values (can be switched off)
Conversion time of the A/D converter	120 µs, approximately

Analog input stages	
Voltage inputs	
Input resistance	> 220 kΩ
Limit frequency (-3 dB) of the input filters	40 Hz
Internal process data update of both channels	< 1.5 ms
Behavior on sensor failure	Goes to 0 V
Maximum permissible voltage between analog voltage inputs and analog reference potential	±32 V
Common mode rejection (CMR)	90 dB, minimum
Reference: Voltage input signal, valid for permissible DC common mode voltage range	110 dB (typical)
Permissible DC common mode voltage for CMR	40 V between voltage input and FE
Current inputs	
Input resistance	50 Ω (shunt)
Limit frequency (-3 dB) of the input filters	40 Hz
Internal process data update of both channels	< 1.5 ms
Behavior on sensor failure	Goes to 0 mA or 4 mA
Maximum permissible voltage between analog current inputs and analog reference potential	±5 V (corresponds to 100 mA across the sensor resistances)
Common mode rejection (CMR)	90 dB, minimum
Reference: Current input signal, valid for permissible DC common mode voltage range	110 dB (typical)
Permissible DC common mode voltage for CMR	40 V between current input and FE
Maximum permissible current	±100 mA

Note on the internal process data update:
The time given includes the internal firmware runtime and the time for the analog digital conversion of the module. For system considerations (e.g., for the step response determination of sensors), please take into account additional times for latching and bus transmission as well as the status of mean-value generation.

Tolerance behavior and temperature response of the voltage inputs (The tolerance values refer to the measuring range final value of 10 V.)		
	Typical	**Maximum**
Tolerance at 23°C		
Tolerance through offset	±0.03%	±0.06%
Tolerance through gain	±0.05%	±0.10%
Differential non-linearity	±0.10%	±0.20%
Total tolerance of the voltage inputs at 23 °C Tolerance through offset, gain, and linearity	±0.15%	±0.30%
Temperature response at -25°C to +55°C		
Offset drift T_{KVO}	±6 ppm/K	±12 ppm/K
Gain drift T_{KG}	±30 ppm/K	±50 ppm/K
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	±36 ppm/K	±62 ppm/K
Total tolerance of the voltage inputs (-25°C to +55°C) Tolerance through offset, gain, linearity, and drift	±0.30%	±0.50%
Tolerance behavior and temperature response of the current inputs (The tolerance indications refer to the measuring range final value of 20 mA.)		
	Typical	**Maximum**
Tolerance at 23°C		
Tolerance through offset	±0.03%	±0.06%
Tolerance through gain	±0.10%	±0.10%
Differential non-linearity	±0.10%	±0.30%
Total tolerance of the current inputs at 23 °C Tolerance through offset, gain, and linearity	±0.20%	±0.40%
Temperature response at -25°C to +55°C		
Offset drift T_{KIO}	±6 ppm/K	±12 ppm/K
Gain drift T_{KG}	±30 ppm/K	±50 ppm/K
Total drift $T_{Ktot} = T_{KIO} + T_{KG}$	±36 ppm/K	±62 ppm/K
Total tolerance of the current inputs (-25°C to +55°C) Tolerance through offset, gain, linearity, and drift	±0.35%	±0.60%

Additional tolerances influenced by electromagnetic fields				
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	**Absolute**	**Relative**	**Absolute**
Electromagnetic fields; Field strength 10 V/m according to EN 61000-4-3/IEC 61000-4-3	< ±2%	< ±200 mV	< ±2%	< ±400 µA
Conducted interference Class 3 (test voltage 10 V) according to EN 61000-4-6/IEC 61000-4-6	< ±1%	< ±100 mV	< ±1%	< ±100 µA
Fast transients (burst) 4 kV supply, 2 kV input according to EN 61000-4-4/IEC 61000-4-4	< ±1%	< ±100 mV	< ±1%	< ±100 µA

Safety equipment	
Surge voltage	Suppressor diodes in the analog inputs

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

4 Local diagnostic and status indicators and terminal point assignment

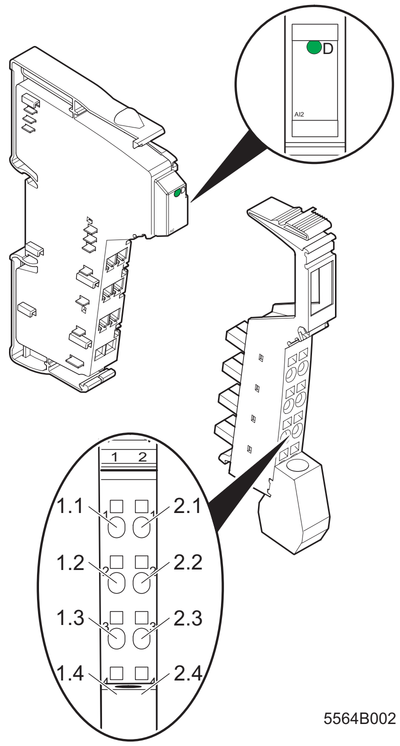


Fig. 1 Terminal with appropriate connector

4.1 Local diagnostic and status indicators

Des.	Color	Meaning
D	**Green**	Diagnostics

4.2 Function identification

Green

4.3 Terminal point assignment

Terminal points	Signal	Assignment
1.1	**+U1**	Voltage input channel 1
2.1	**+U2**	Voltage input channel 2
1.2	**+I1**	Current input channel 1
2.2	**+I2**	Current input channel 2
1.3	**-1**	Minus input for channel 1 (for both current and voltage)
2.3	**-2**	Minus input for channel 2 (for both current and voltage)
1.4, 2.4	**Shield**	Shield connection

5 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 the analog terminals.

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

6 Internal circuit diagram

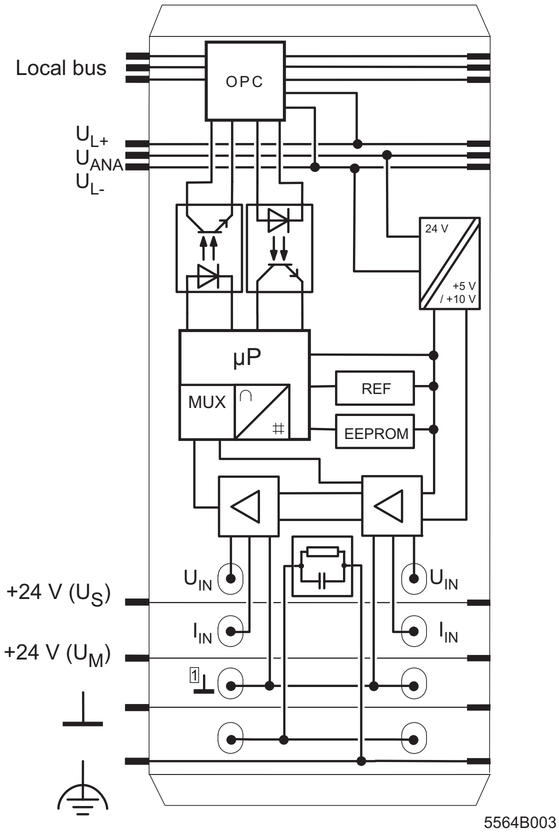
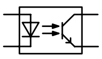


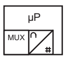
Fig. 2 Internal wiring of the terminal points

Key:

Protocol chip


Optocoupler


Supply unit with electrical isolation

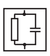


Microprocessor with multiplexer and analog/digital converter

Reference voltage

Electrically erasable programmable read-only memory


Amplifier


Coupling network

Other symbols used are explained in the DOK-CONTRL-ILSYSPRO***-AW..-EN-P application description or the application description for your bus system.

7 Electrical isolation

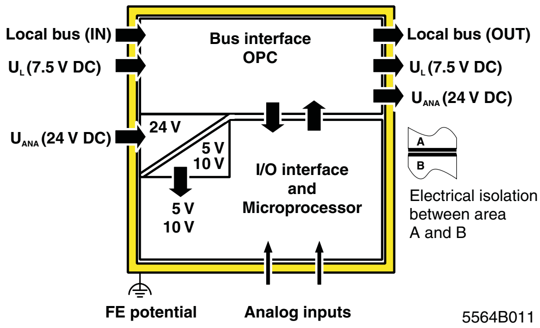


Fig. 3 Electrical isolation of the individual function areas

8 Connection notes

CAUTION

Do not connect voltages above ±5 V to a current input. The module electronics will be damaged, as the maximum permissible current of ±100 mA will be exceeded.

Always connect the analog sensors using shielded, twisted pair cables.
Connect the shield to the terminal using the shield connection clamp. The clamp connects the shield with high resistance and with a capacitor to FE on the module side. Additional wiring is not necessary.
Connect the shield of the sensor with PE potential.

Within the terminal, ground is connected to FE via an RC element.

If you want to use **both** channels of the terminal, you can connect the shield in various ways depending on the cable feed.

Connection of sensors using a multi-wire bus cable

- Strip the outer sheath of the bus cable where required and connect the shield to the Inline terminal using the shield connection clamp of the shield connector (see A in Fig. 4).
- Lead the bus cable to the sensors (see B in Fig. 4).

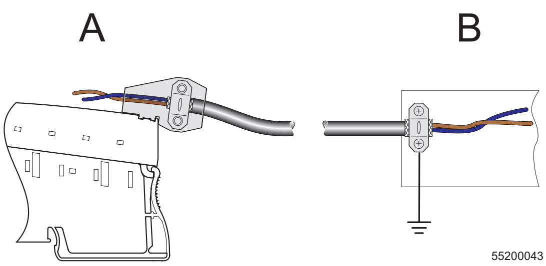


Fig. 4 Connection of sensors using a multi-wire bus cable

Connection of sensors using separate cables

Connect the sensors with separate sensor cables to protect them against ground loops as follows (see Fig. 5).

- Install a busbar with a connection to the ground potential in front of the Inline terminal (detail B in Fig. 5).
- Strip the outer sheath of the bus cable where required and connect the shield using an appropriate shield clamp.
- Please note that the busbar must be the only point in the wiring at which the shield is connected with ground potential.
- Lead the sensor cables to the Inline terminals and connect the shield using the shield connection clamp of the shield connector (see A in 1).
- Lead the sensor cable into the sensor making sure to **maintain the cable insulation** (detail C in Fig. 5).
- Repeat this procedure for the second sensor cable.

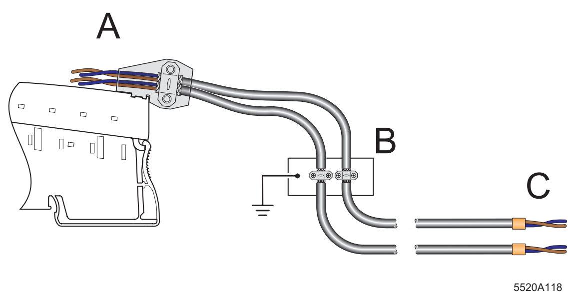


Fig. 5 Connection of two analog sensors with separate cables

9 Connection examples

Use a connector with shield connection when installing the sensors. Fig. 6 and Fig. 7 show the connection schematically (without shield connection).

9.1 Connection of active sensors

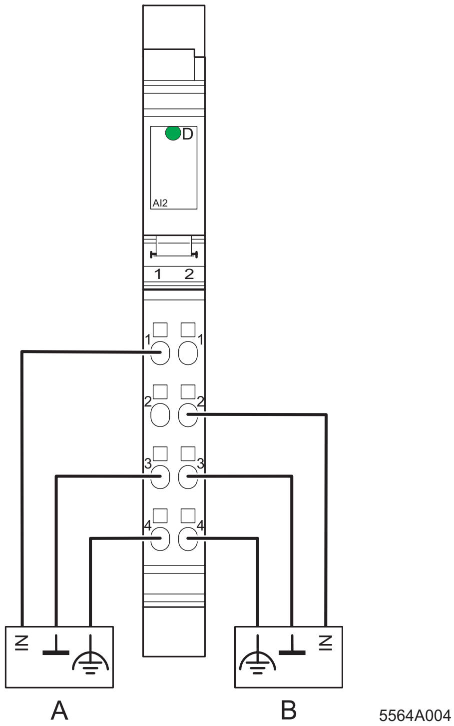


Fig. 6 *Connection of active sensors in 2-wire technology with shield connection*

A Active sensor with voltage output (channel 1)

B Active sensor with current output (channel 2)

9.2 Connection of passive sensors

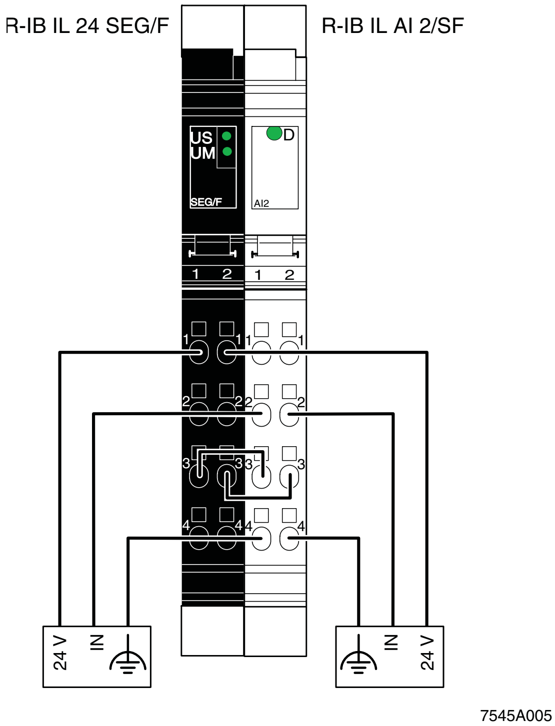


Fig. 7 *Connection of two passive sensors in 2-wire technology with shield connection*

Fig. 7 shows the passive sensor supply. The sensors are supplied through a pre-connected segment terminal with a fuse. The sensors can also be supplied from an external power supply unit.

9.3 Connection for battery monitoring

CAUTION

Both reference inputs (minus inputs) of each terminal are connected to each other. If signal sources are connected in series, wrong connections can lead to a short circuit of individual signal sources.

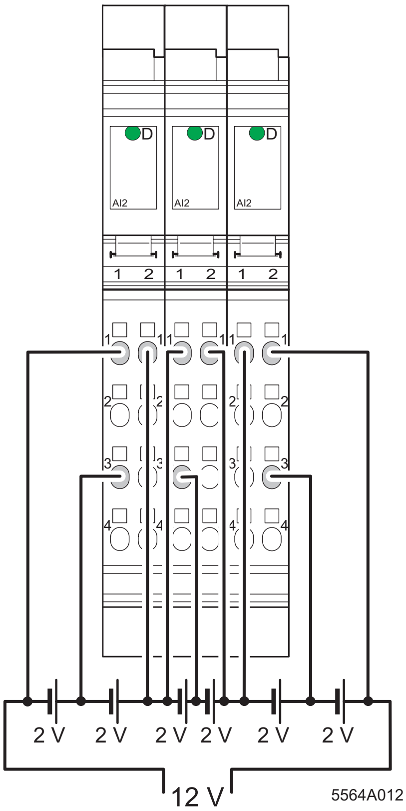


Fig. 8 Connection for battery monitoring

Because of the single-ended inputs, the following connections are necessary:

Connect the reference input of a terminal between two voltage sources.

Channel 1 measures the first voltage source with opposite polarity. The measured value must be adapted in the control system to the polarity.

Channel 2 measures the second voltage source with correct polarity.

Configure the terminal to bipolar (±10 V).

10 Programming data/ configuration data

10.1 Local bus

ID code	$7F_{hex}$ (127_{dec})
Length code	02_{hex}
Input address area	2 words
Output address area	2 words
Parameter channel (PCP)	0 bytes
Register length (bus)	2 words

10.2 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).

11 Process data

11.1 OUT process data for configuring the terminal (see page 14)

(Word.bit) view	Byte	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Channel 1	Assignment	1	0	0	0	0	0	Filter		0	0	Format		Measuring range			
Channel 2	Assignment	1	0	0	0	0	0	Filter		0	0	Format		Measuring range			

11.2 Assignment of the terminal points to the IN process data words (see page 15)

(Word.bit) view	Byte	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Channel 1	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		Terminal point 1.1: Voltage input Terminal point 1.2: Current input															
	Signal reference	Terminal point 1.3															
	Shield (FE)	Terminal point 1.4															
Channel 2	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		Terminal point 2.1: Voltage input Terminal point 2.2: Current input															
	Signal reference	Terminal point 2.3															
	Shield	Terminal point 2.4															

11.3 OUT process data

With the two OUT process data words you can configure each channel of the terminal independently. The following configurations are possible:

- Selecting a measuring range according to the input signal
- Switching off mean-value generation
- Switching between the measured value representation formats

The configuration setting is not stored. It must be transmitted in each bus cycle.

After applying voltage (power up) to the Inline station, the "Measured value invalid" message (error code 8004_{hex}) appears in the IN process data. After a maximum of 1 second, the preset configuration is accepted and the first measured value is available. If you change the configuration the corresponding channel is re-initialized. The "Measured value invalid" message (error code 8004_{hex}) appears in the IN process data for a maximum of 100 ms.

Default:

Measuring range:	0 V to 10 V
Mean-value generation:	Switched on
Output format:	IL format

Mean-value generation should be switched off for the analysis of dynamic signals.

Do not apply current and voltage signals to an input channel simultaneously as you will not receive valid measured values.

CAUTION

You cannot change the signal input type through the OUT process data. Current or voltage measurement is selected by applying the measured signal to the current or voltage input.

In addition, select the corresponding measuring range through the OUT process data.

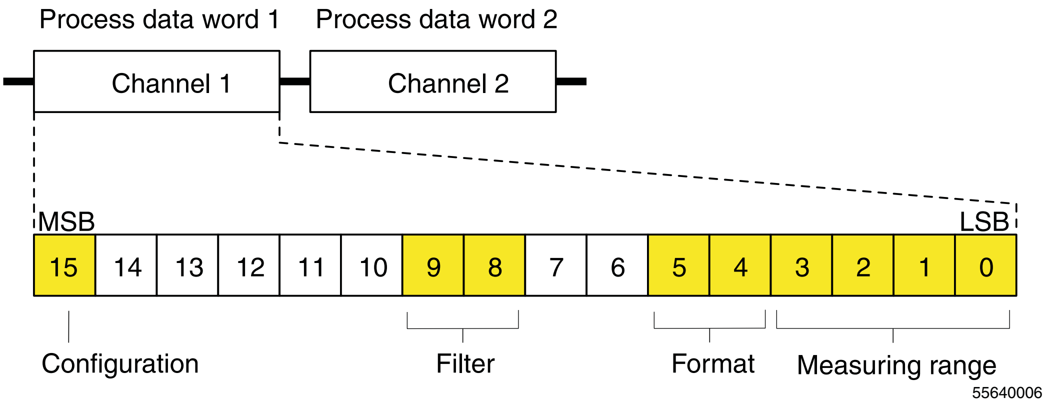


Fig. 9 OUT process data

MSB Most significant bit LSB Least significant bit

One OUT process data word is available for the configuration of each channel.

In order to configure the terminal, set bit 15 of the corresponding output word to 1. If bit 15 = 0, the preset configuration is active.

Bit 15:

Code	**Configuration**
0	**Default**
1	Configuration data

Bit 9 and bit 8:

Code	**Filter**
00	**16-sample average value (default)**
01	No filter
10, 11	Reserved

Bit 5 and bit 4:

Code	**Format**
00	**IB IL (15 bits) (default)**
01	IB ST (12 bits)
10	IB RT (15 bits)
11	Standardized representation

Bit 3 to bit 0:

Code	**Measuring range (voltage)**
0000	**0 V to 10 V (default)**
0001	±10 V
0010 to 0111	Reserved
1000	0 mA to 20 mA
1001	±20 mA
1010	4 mA to 20 mA
1011 to 1111	Reserved

Set all reserved bits to 0.

11.4 IN process data

The measured values are transmitted per channel to the controller board or the computer by means of the IN process data.

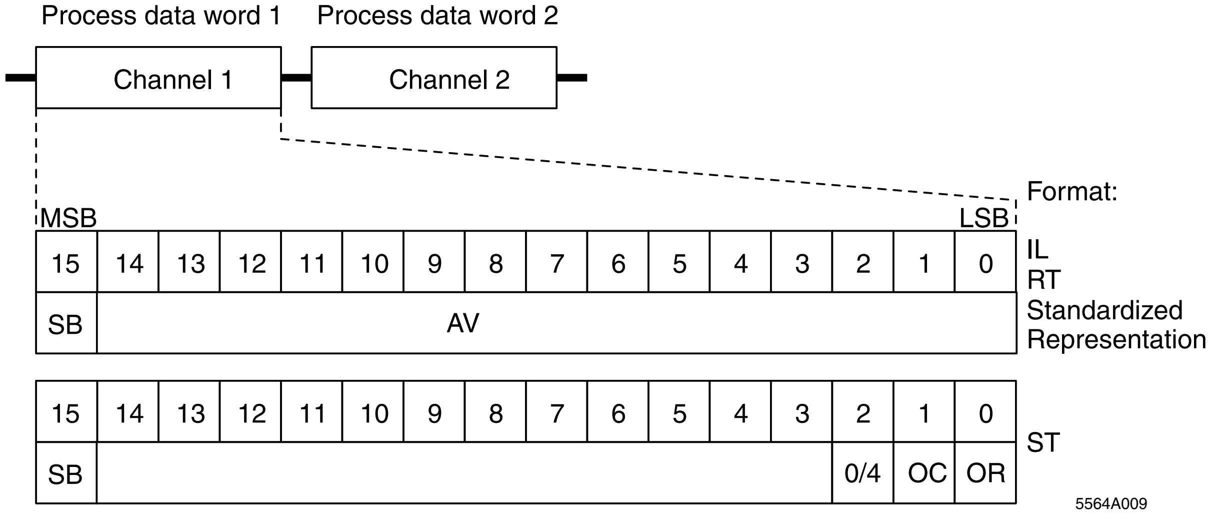


Fig. 10 *Sequence of the IN process data and representation of the bits of the first process data word in the different formats*

SB Sign bit

AV Analog value

0/4 Measuring range 4 to 20 mA

OC Open circuit

OR Overrange

MSB Most significant bit

LSB Least significant bit

The "IB IL" and "standardized representation" process data formats support extended diagnostics. The following error codes are possible:

Code (hex)	Error
8001	Overrange
8002	Open circuit
8004	Measured value invalid/ no valid measured value available
8010	Invalid configuration
8040	Module faulty
8080	Underrange

12 Formats for the representation of measured values

12.1 "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} indicate an error. The error codes are listed on page 15.

Measured value representation in "IB IL" format (15 bits)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	AV														

SB Sign bit

AV Analog value

This format is preset (default). To ensure that the terminal can be operated in previously used data formats, the measured value representation can be switched to different formats.

12.2 Significant measured values

Some codes are used for diagnostic functions. Therefore, the resolution is not 15 bits but exactly 14.9886847 bits.

Measuring range 0 mA through 20 mA / 0 V through 10 V

Input data word (Two's complement)		0 mA to 20 mA I_{Input}	0 V to 10 V U_{Input}
hex	**dec**	**mA**	**V**
8001	Overrange	> +21.6746	> +10.837
7F00	32512	+21.6746	+10.837
7530	30000	+20.0	+10.0
0001	1	+0.66667 µA	+333.33 µV
0000	0	0	0
0000	0	< 0	< 0

Measuring range -20 mA through +20 mA / -10 V through +10 V

Input data word (Two's complement)		-20 mA to +20 mA I_{Input}	-10 V to +10 V U_{Input}
hex	**dec**	**mA**	**V**
8001	Overrange	> +21.6746	> +10.837
7F00	32512	+21.6746	+10.837
7530	30000	+20.0	+10.0
0001	1	+0.66667 μA	+333.33 μV
0000	-1	0	0
FFFF	0	-0.66667 μA	-333.33 μV
8AD0	-30000	-20.0	-10.0
8100	-32000	-21.6746	-10.837
8080	Underrange	< -21.6746	< -10.837

Measuring range 4 mA through 20 mA

Input data word (Two's complement)		4 mA to 20 mA I_{Input}
hex	**dec**	**mA**
8001	Overrange	> +21.339733
7F00	32512	+21.339733
7530	30000	+20.0
0001	1	+4.00053333
0000	0	+4.0 to 3.2
8002	Open circuit	< +3.2

12.3 "IB ST" format

The measured value is represented in bits 14 to 3. The remaining 4 bits are available as sign, measuring range and error bits.

This format corresponds to the data format used on INTERBUS ST modules.

Measured value representation in "IB ST" format (12 bits)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	AV												0/4	OC	OR

SB Sign bit

AV Analog value

0/4 Measuring range 4 to 20 mA

OC Open circuit

OR Overrange

12.4 Significant measured values

Measuring range 0 mA through 20 mA / 0 V through 10 V

Input data word (Two's complement)	0 mA to 20 mA I_{Input}	0 V to 10 V U_{Input}
hex	**mA**	**V**
7FF9	> 21.5	> 10.75
7FF8	20.0 to 21.5	10.00 to 10.75
7FF8	19.9951	9.9975
4000	10.0	5.0
0008	0.0048828	0.002441
0000	0	0

Measuring range -20 mA through +20 mA / -10 V through +10 V

Input data word (Two's complement)	-20 mA to +20 mA I_{Input}	-10 V to +10 V U_{Input}
hex	**mA**	**V**
7FF9	> 21.5	> 10.75
7FF8	20.0 to 21.5	10.00 to 10.75
7FF8	19.9951	9.9975
0008	0.0048828	0.002441
0000	0	0
FFF8	-0.0048828	-0.002441
8000	-20.0 to -21.5	-10.00 to -10.75
8001	< -21.5	< -10.75

Measuring range 4 mA through 20 mA

Input data word (Two's complement)	4 mA to 20 mA I_{Input}
hex	**mA**
7FFD	> 21.5
7FFC	20.0 to 21.5
7FFC	19.9961
000C	4.003906
0004	3.2 to 4.0
0006	< 3.2

12.5 "IB RT" format

The measured value is represented in bits 14 to 0. An additional bit (bit 15) is available as a sign bit.

This format corresponds to the data format used on INTERBUS RT modules.

In this data format error codes or error bits are not defined. An open circuit is indicated by the positive final value $7FFF_{hex}$.

Measured value representation in "IB RT" format (15 bits)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	AV														

SB Sign bit

AV Analog value

12.6 Significant measured values

Measuring range 0 mA through 20 mA / 0 V through 10 V

Input data word (Two's complement)	0 mA to 20 mA I_{Input}	0 V to 10 V U_{Input}
hex	**mA**	**V**
7FFF	≥ 19.999385	≥ 9.999695
7FFE	19.9987745	9.999939
4000	10.0	5.0
0001	0.6105 µA	305.0 µV
0000	≤ 0	≤ 0

Measuring range -20 mA through +20 mA / -10 V through +10 V

Input data word (Two's complement)	-20 mA to +20 mA I_{Input}	-10 V to +10 V U_{Input}
hex	**mA**	**V**
7FFF	≥ +19.999389	≥ +9.999939
7FF7	+19.998779	+9.99939
4000	+10.0	+5.0
0001	+0.61035 µA	+305.0 µV
0000	0	0
FFFF	-0.61035 µA	-305.0 µV
8001	-19.999389	-9.99939
8000	≤ -20.0	≤ -10.0

Measuring range 4 mA through 20 mA

Input data word (Two's complement)	4 mA to 20 mA I_{Input}
hex	**mA**
7FFF	≥ 19.9995116
7FFE	19.9990232
4000	12.0
0001	4.0004884
0000	4.0
0000	3.2 to 4.0
7FFF	< 3.2

12.7 "Standardized representation" format

The data 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} indicate an error. The error codes are listed on page 15.

Measured value representation in "standardized representation" format (15 bits)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	AV														

SB Sign bit

AV Analog value

12.8 Significant measured values

Some codes are used for diagnostic functions. Therefore, the resolution is not 15 bits but exactly 13.287713 bits.

Measuring range 0 V through 10 V

Input data word (Two's complement)		**0 V to 10 V U_{Input}**
hex	**dec**	**V**
8001	Overrange	> +10.837
2A55	10837	+10.837
2710	10000	+10.0
0001	1	+0.001
0000	0	≤ 0

Measuring range 0 mA through 20 mA

Input data word (Two's complement)		**0 mA to 20 mA I_{Input}**
hex	**dec**	**mA**
8001	Overrange	> +21.674
54AA	21674	+21.674
4E20	20000	+20.0
0001	1	+0.001
0000	0	≤ 0

Measuring range -10 V through +10 V

Input data word (Two's complement)		**-10 V to +10 V U_{Input}**
hex	**dec**	**V**
8001	Overrange	> +10.837
2A55	10837	+10.837
2710	10000	+10.0
0001	1	+0.001
0000	0	0
FFFF	-1	-0.001
D8F0	-10000	-10.0
D5A6	-10837	-10.837
8080	Underrange	< -10.837

Measuring range 4 mA through 20 mA

Input data word (Two's complement)		**4 mA to 20 mA I_{Input}**
hex	**dec**	**mA**
8001	Overrange	> 21.339
43BB	17339	21.339
3E80	16000	20.0
0001	1	4.001
0000	0	4.0 to 3.2
8002	Open circuit	< 3.2

Measuring range -20 mA through +20 mA

Input data word (Two's complement)		**-20 mA to +20 mA I_{Input}**
hex	**dec**	**mA**
8001	Overrange	> +21.674
54AA	21674	+21.674
4E20	20000	+20.0
0001	1	+0.001
0000	0	0
FFFF	-1	-0.001
B1E0	-20000	-20.0
A656	-21674	-21.674
8080	Underrange	< -21.674

Example

Measured value representation in different data formats.

Measuring range: 0 mA to 20 mA

Measured value: 10 mA

Input data word:

Format	Hexadecimal value	Decimal value	Measured value
IB IL	3A98	15 000	10 mA
IB ST	4000	16 384	10 mA
IB RT	4000	16 384	10 mA
Standardized representation	2710	10 000	10 mA

Bosch Rexroth AG
Electric Drives and Controls
P.O.Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Tel. +49-(0) 93 52 - 40-50 60
Fax. +49-(0) 93 52 - 40-49 41
service.svc@boschrexroth.de
www.boschrexroth.com