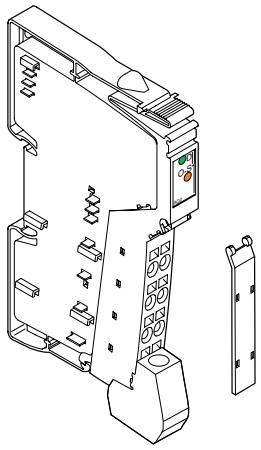
IB IL AO 2/U/BP (-PAC)



Inline Terminal
With Two Analog Voltage Outputs

AUTOMATIONWORX

Data Sheet
5660_en_02

1 Description

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

Features

- Two analog signal outputs
- Actuator connection in 2-wire technology with shield connection
- Voltage ranges:
  -10 V to +10 V (13-bit resolution) and
  0 V to +10 V (12-bit resolution)
- Output value data available in two formats (IB IL and IB ST)
- Parameterizable behavior of the outputs in the event of an error
- Process data update including conversion time of the digital/analog converter < 1 ms
- Very good output driver properties, therefore also suitable for long actuator cables
- Diagnostic indicators

This data sheet is only valid in association with the IL SYS INST UM E user manual or the Inline system manual for your bus system.

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

A conversion table is available on the Internet at
www.download.phoenixcontact.com/general/7000_en_00.pdf.

This data sheet is valid for the products listed on the following page:

Table of Contents

2 Ordering Data

Products

Description	Type	Order No.	Pcs./Pkt.
Inline terminal with two analog voltage outputs, complete with accessories (connector and labeling field)	IB IL AO 2/U/BP-PAC	2861467	1
Inline terminal with two analog voltage outputs, without accessories	IB IL AO 2/U/BP	2732732	1

The connector listed below is needed for the complete fitting of the IB IL AO 2/U/BP terminal.

Accessories

Description	Type	Order No.	Pcs./Pkt.
Connector with six spring-cage connections and shield connection (green, w/o color print)	IB IL SCN-6 SHIELD-TWIN	2740245	5

Documentation

Description	Type	Order No.	Pcs./Pkt.
"Automation Terminals of the Inline Product Range" user manual	IL SYS INST UM E	2698737	1
"Configuring and Installing the INTERBUS Inline Product Range" user manual	IB IL SYS PRO UM E	2743048	1

3 Technical Data

General Data	
Housing dimensions (width x height x depth)	12.2 mm x 120 mm x 71.5 mm
Weight	48 g (without connector), 70 g (with connector)
Operating mode	Process data mode with 2 words
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 3 according to VDE 0106, IEC 60536
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

Interface	
Local bus	Data routing

Transmission Speed	
IB IL AO 2/U/BP, IB IL AO 2/U/BP-PAC	500 kbps

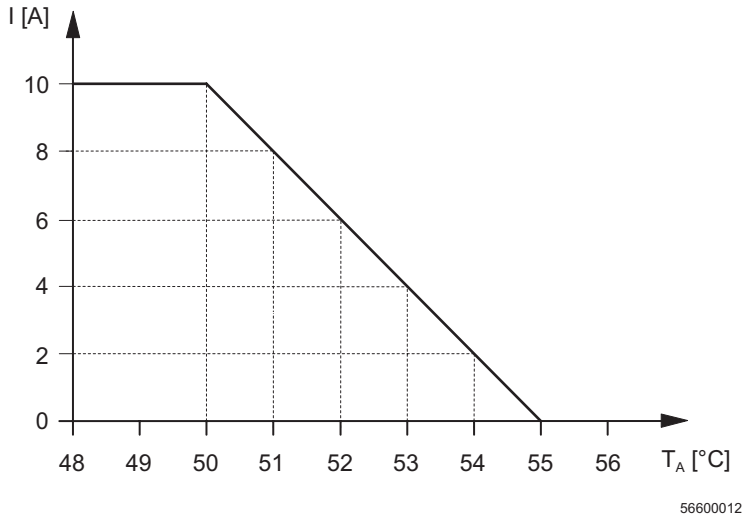
Power Consumption

Communications power U_L	7.5 V
Current consumption at U_L	33 mA, typical; 40 mA, maximum (approximately)
I/O supply voltage U_{ANA}	24 V DC
Current consumption at U_{ANA}	
No-load operation (R_L > 10 MΩ)	18 mA, typical; 28 mA, maximum
Full load operation (R_L = 2 kΩ)	25 mA, typical; 35 mA, maximum
Total power consumption	
No-load operation (R_L > 10 MΩ)	0.68 W, typical
Full load operation (R_L = 2 kΩ)	0.85 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)



Above T_A = +50°C derating is 2 A/K.

T_A	Ambient temperature in °C
I	Current flowing through the potential jumpers U_M and U_S in A

Analog Outputs		
Number		2
Signal connection method		2-wire technology, single-ended
Signals/resolution in the process data word (quantization)		
Voltage	-10 V to +10 V	333.33 µV/LSB
Voltage	0 V to +10 V	333.33 µV/LSB
Representation of output value		
	-10 V to +10 V	16-bit two's complement
	0 V to +10 V	16-bit two's complement

For the representation of the output value in the different formats, please refer to the notes in "Formats for Representing the Output Values" on page 16.

Smallest DAC quantization step	
-10 V to +10 V	2.667 mV (13 bits)
0 V to +10 V	2.667 mV (12 bits)
Basic error limit	±0.02%, typical, of the output range final value
Output load	2 kΩ, minimum
Process data update time including conversion time of the digital/analog converter	1 INTERBUS cycle (depending on the bus configuration); <1 ms
Signal rise time (slew rate)	
10% to 90% of the final value	15 µs, typical
0% to > 99% of the final value	31 µs, typical
Signal rise time (slew rate) (-9.0 V to + 9.0 V)	
No-load operation	0.35 V/µs, typical
With ohmic load (R_L = 2 kΩ)	0.24 V/µs, typical
With ohmic/capacitive load R_L = 2 kΩ / C_L = 10 nF	0.24 V/µs, typical
With ohmic/capacitive load R_L = 2 kΩ / C_L = 220 nF	0.09 V/µs, typical
Transient protection of analog outputs	Yes
Maximum cable length for the LiYCY (TP) cable type, (shielded twisted power station cable)	500 m
Electrical features of LiYCY (TP) Inductance Effective capacitance	N x 2 x 0.5 (N= number of wire pairs, wire cross-section ≥ 0.5 mm^2 0.67 mH/km, typical 120 nF/km, typical

Tolerance Behavior and Temperature Response (Absolute Tolerance Values) (The tolerance values refer to the output range final value of 10 V.)	Typical	Maximum
Tolerance at 23°C		
Total offset voltage	±0.5 mV	±4.0 mV
Gain error	±2.5 mV	±6.0 mV
Differential non-linearity	±1.3 mV	±3.9 mV
Total tolerance at 23°C	**±4.3 mV**	**±13.9 mV**
Temperature response at -25°C to +55°C		
Offset voltage drift T_{KVO}	±2.1 mV	±5.0 mV
Gain drift T_{KG}	±9.2 mV	±20.0 mV
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	±11.3 mV	±25.0 mV
Total tolerance of the voltage output (-25°C to +55°C) offset error + gain error + linearity error + drift error	**±15.6 mV**	**±38.9 mV**

Tolerance Behavior and Temperature Response (Relative Tolerance Values) (The tolerance values refer to the output range final value of 10 V.)	Typical	Maximum
Tolerance at 23°C		
Total offset voltage	±0.005%	±0.027%
Gain error	±0.025%	±0.060%
Differential non-linearity	±0.013%	±0.027%
Total tolerance at 23°C	**±0.09%**	**±0.14%**
Temperature response at -25°C to +55°C		
Offset voltage drift T_{KVO}	4 ppm/K	10 ppm/K
Gain drift T_{KG}	18 ppm/K	40 ppm/K
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	23 ppm/K	50 ppm/K
Total tolerance of the voltage output (-25°C to +55°C) offset error + gain error + linearity error + drift error	**±0.16%**	**±0.39%**

Additional Tolerances Influenced by Electromagnetic Fields		
Type of Electromagnetic Interference	**Typical Deviation From the Output Range Final Value (Voltage Output)**	
	Relative	**Absolute**
Electromagnetic fields; field strength 10 V/m according to EN 61000-4-3/IEC 61000-4-3	< ±0.2%	< ±20 mV
Conducted interference Class 3 (test voltage 10 V) according to EN 61000-4-6/IEC 61000-4-6	< ±2.8%	< ±280 mV

Safety Equipment	
Transient protection of analog outputs	Yes

Electrical Isolation/Isolation of the Voltage Areas

The values are valid for shielded and unshielded twisted actuator cables.

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

Information on current approvals can be found on the Internet at www.download.phoenixcontact.com.

4 Local Diagnostic and Status Indicators and Terminal Point Assignment

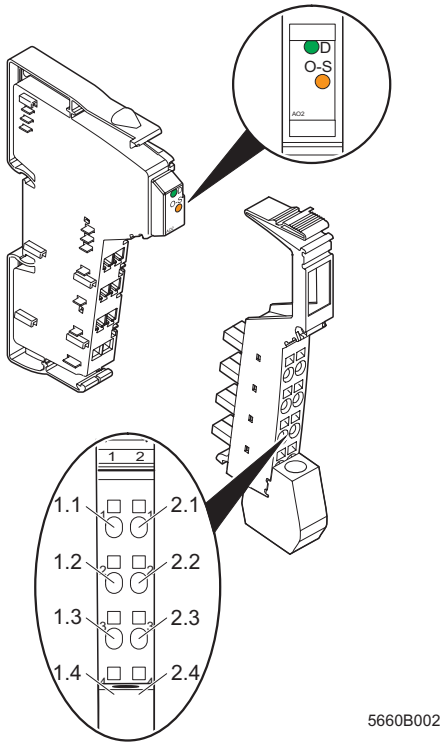


Figure 1 Terminal with appropriate connector

4.1 Local Diagnostic and Status Indicators

Desig.	Color	Meaning
D	Green	Diagnostics
O-S	Orange	Original default state parameterized

4.2 Function Identification

Yellow

4.3 Terminal Point Assignment

Terminal Point	Signal	Assignment
1.1	**U1**	Voltage output 1
2.1	**U2**	Voltage output 2
1.2, 2.2	**–**	Not used
1.3, 2.3	**AGND**	Voltage output ground
1.4, 2.4	**Shield**	Shield connection

4.4 Parameterized Default Upon Delivery

By default upon delivery, the parameters are set as follows:

Data format:	IB IL
Behavior of the outputs in the event of an error:	Outputs hold the last value (Hold)
Output range:	-10 V to +10 V

The following terminal parameters can be configured according to your conditions using the process data:

Data format:	IB ST
Behavior of the outputs in the event of an error:	Outputs are reset to 0 V (Reset)
Output range:	0 V to +10 V

For parameterization you must switch to parameterization mode. The procedure is described in "Parameterization" on page 22.

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 instruction to keep the current flowing through the potential jumpers of the analog terminals as low as possible:

Create a separate main circuit for each analog terminal.

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 behind all the other terminals at the end of the main circuit.

Please note the derating curve shown on page 4.

6 Internal Circuit Diagram

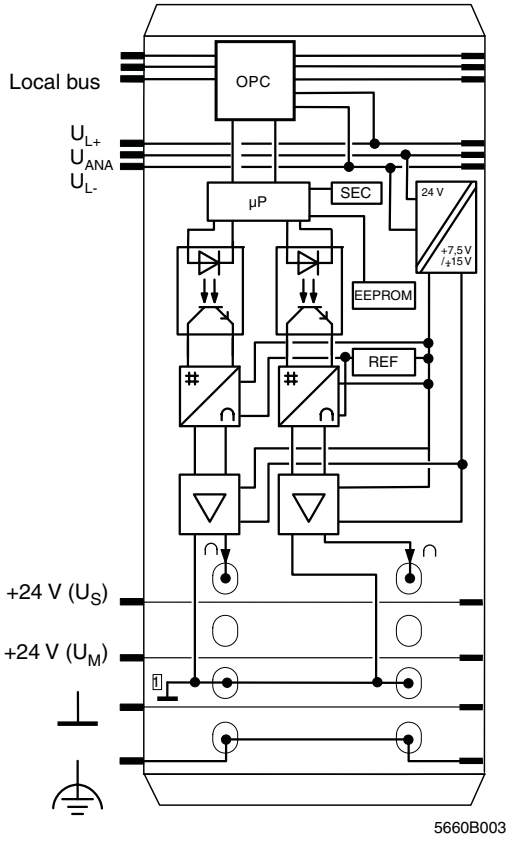


Figure 2 Internal wiring of the terminal points

Key:

OPC	Protocol chip
	Optocoupler
µP	Microprocessor
SEC	Safety circuit
EEPROM	Electrically erasable programmable read-only memory
	DC/DC converter with electrical isolation
REF	Reference voltage
	Amplifier
	Digital/analog converter
	Analog output
1	Analog ground, electrically isolated from ground of the potential jumper

Other symbols used are explained in the IL SYS INST UM E user manual or in the system manual for your bus system.

7 Electrical Isolation

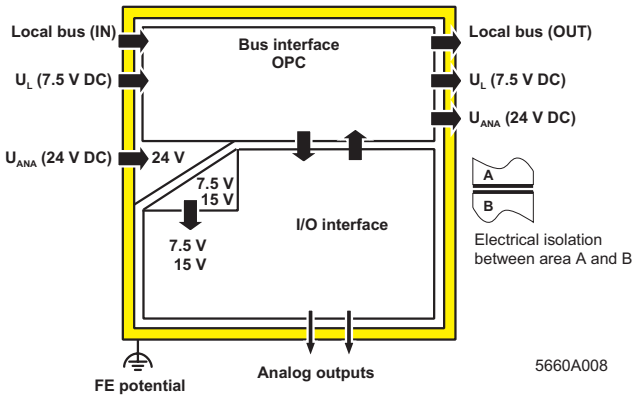


Figure 3 Electrical isolation of the individual function areas

8 Connection Notes

Analog actuators with a cable length of **< 10 m** can be connected using unshielded twisted-pair cables.

Connect analog actuators with a cable length of **> 10 m** using shielded twisted-pair cables.

Connect one end of the shielding to PE. Fold the outer cable sheath back and connect the shield to the terminal via the shield connector clamp (with strain relief). The clamp connects the shield directly to FE on the terminal side.

Ensure that the braided shield is 15 mm longer than the strain relief, when connecting a shielded actuator cable to the I/O connector. Connect the actuator cable as described in "Connecting Shielded Cables Using the Shield Connector" on page 10.

9 Connection Example

Use a connector with shield connection when installing the actuators. Figure 4 shows the connection schematically (without shield connector).

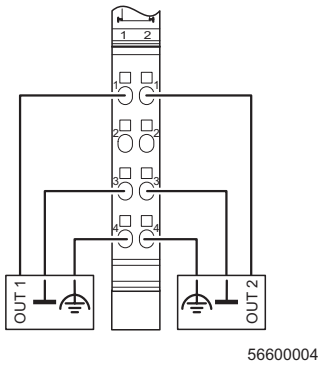


Figure 4 Connection of two voltage actuators with shield connection using 2-wire technology

10 Connecting Shielded Cables Using the Shield Connector

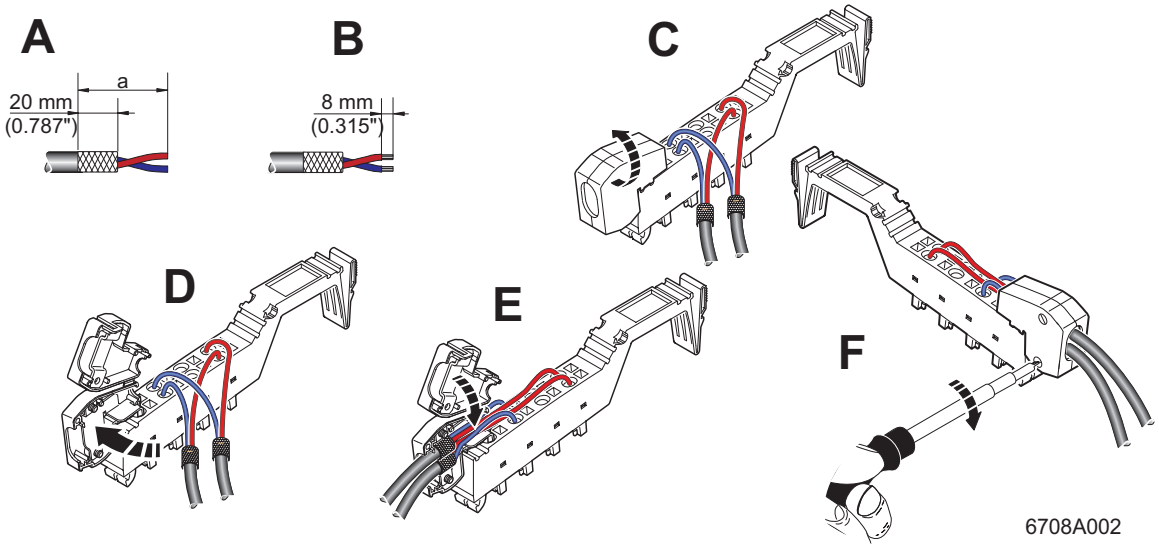


Figure 5 Connecting the shield using the shield connector

The diameter of the actuator cable is usually too large to allow the cable to be installed into the strain relief of the shield connector with sheathed and folded shield. The connection procedure for this cable therefore differs from the connection procedure described in the IB IL SYS PRO UM E user manual. The comparative differences with the user manual are marked in bold text.

Connection of the cables according to Figure 5 should be carried out as follows:

Stripping Cables

- Strip the outer cable sheaths to the desired length (a). (A)
  The desired length (a) depends on the connection position of the wires and whether the wires should have a large or small amount of space between the connection point and the shield connection.
- Shorten the braided shield to **20 mm**. (A)
- **Do not** fold the braided shield back over the outer sheath. (B)
- Remove the protective foil.
- Strip 8 mm off the wires. (B)

Inline wiring is normally without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

Wiring Connectors (According to the User Manual)

- Push a screwdriver into the slot of the appropriate terminal point, so that you can insert the wire into the spring opening.
  Phoenix Contact recommends using an SZF 1-0,6X3,5 screwdriver (Order No. 1204517).
- Insert the wire. Remove the screwdriver from the opening. The wire is now clamped.

For the connector pin assignment, please refer to the table on page 7.

Connecting the Shield

- Open the shield connector (see user manual). (C)
- Place the shield connection clamp in the shield connector corresponding to the cable width (see user manual).

- Place the cables in the shield connection. (D)
  Push the outer cable sheaths up to the shield connection clamp. The wires with the braided shield must be underneath the shield connection clamp. The braided shield must project approximately 15 mm over the shield connection clamp.
- Close the shield connector. (E)
- Fasten the screws for the shield connector using a screwdriver. (F)

11 Programming Data

11.1 Local Bus (INTERBUS)

ID code	$5B_{hex}$ (91_{dec})
Length code	02_{hex}
Process data channel	32 bits
Input address area	4 bytes
Output address area	4 bytes
Parameter channel (PCP)	0 bytes
Register length (bus)	4 bytes

11.2 Other Bus Systems

For the programming data of other bus systems, please refer to the appropriate electronic device data sheet (GSD, EDS).

12 Process Data

12.1 Assignment of the Terminal Points to the OUT Process Data Words

(Word.bit) view	Byte	Word 0															
	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	IB IL format	SB	Channel 1 output value														
Assignment	IB ST format	SB	Channel 1 output value												0	0	0
Terminal points	Signal	Terminal point 1.1: voltage output 1															
	Signal reference	Terminal point 1.3															
	Shielding (FE)	Terminal point 1.4															

(Word.bit) view	Byte	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(Byte.bit) view	Byte	Byte 2								Byte 3							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Assignment	IB IL format	SB	Channel 2 output value														
Assignment	IB ST format	SB	Channel 2 output value												0	0	0
Terminal points	Signal	Terminal point 2.1: voltage output 2															
	Signal reference	Terminal point 2.3															
	Shielding (FE)	Terminal point 2.4															

SB Sign bit

0 In "IB ST" format bits 2 through 0 are irrelevant. Set these bits to "0".

12.2 Assignment of the IN Process Data Words

(Word.bit) view	Byte	Word 0															
	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		SB	Mirrored channel 1 output value												F	R	H

(Word.bit) view	Byte	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(Byte.bit) view	Byte	Byte 2								Byte 3							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Assignment		SB	Mirrored channel 2 output value												F	R	H

SB Sign bit
F Output data format
R Voltage range
H Hold/reset

12.3 OUT Process Data

The OUT process data words specify the output values in each cycle.

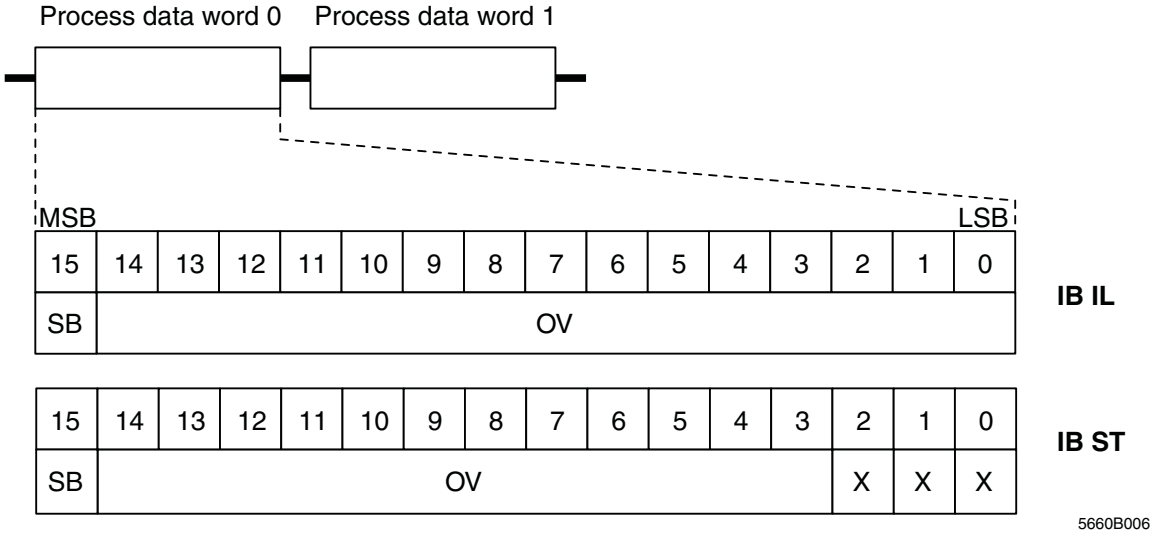


Figure 6 OUT Process data words in IB IL and IB ST formats

SB Sign bit
OV Output value
X Irrelevant bit
MSB Most significant bit
LSB Least significant bit

Set the irrelevant bits to 0.

12.4 IN Process Data

Bits 15 through 3 of the OUT process data words are mirrored in the IN process data words. Bit 15 is the sign bit. Bits 2 through 0 are available as status bits. They contain information about the parameterized behavior of the terminal.

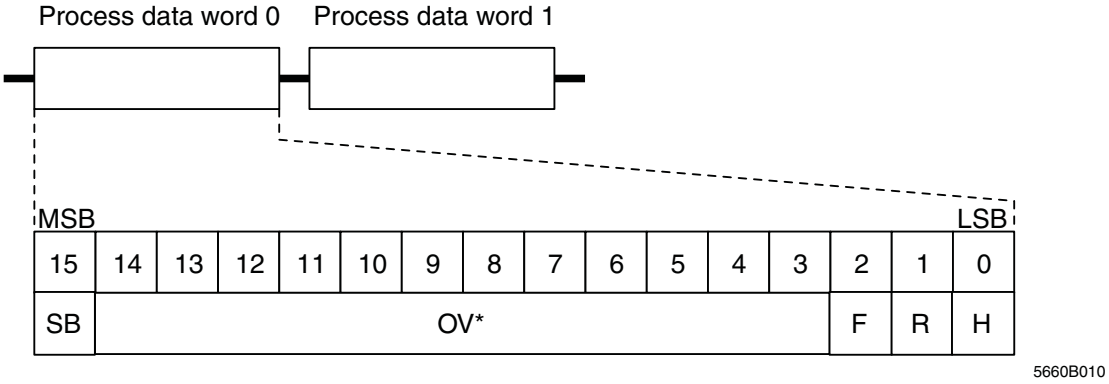


Figure 7 IN process data words

SB	Sign bit
OV*	Mirrored output value
F	Output data format
R	Voltage range
H	Hold/reset
MSB	Most significant bit
LSB	Least significant bit

Bits 2 through 0 have the following meaning:

Bit	Designation	Meaning	Bit x = 0	Bit x = 1
2	F	Output data format	IL	ST
1	R	Voltage range	-10 V to +10 V	0 V to +10 V
0	H	Hold/reset	Hold	0

13 Formats for Representing the Output Values

The IB IL AO 2/U/BP terminal has format compatibility with the IB IL AI 2/SF input terminal. This means that it is possible to use these terminals in multiplexer systems (e.g., IB IL MUX).

"IB IL" is the default format on the terminal. To ensure that the terminal can be operated in previously used ST data formats, the output value representation can be switched to "IB ST" format.

13.1 "IB IL" Format

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

Output value representation in "IB IL" format (15 bits + sign bit)

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

SB Sign bit
OV Output value

Significant Output Values in "IB IL" Format

The terminal has two analog output channels that can supply voltages from -10 V to +10 V with a 13-bit resolution.

Output range -10 V to +10 V

Output Data Word (Two's Complement)		-10 V to +10 V U_{Output}	Remark
hex	dec	V	
<7FFF	32767	+10.837	
>7F00	32512	+10.837	
7F00	32512	+10.837	
7530	30000	+10.0	
0008	8	+2.667 mV	Smallest DAC quantization step
0001	1	+333.33 µV	Process data resolution
0000	0	0	
FFF8	-8	-2.667 mV	
8AD0	-30000	-10.0	
8100	-32512	-10.837	
<8100	*Processed separately:*		
8001	-32767	+10.837	(Overrange)
8080	-32640	-10.837	(Underrange)
80xx	(Other)	Hold last value	

For the 0 V to 10 V output range only the upper range is used (see Figure 6). The resolution for this range is thus limited to 12 bits.

Bits 2 through 0 are not always considered as "irrelevant bits". For use as a field multiplexer, error messages as well as overrange or underrange information must be evaluated appropriately. Overrange (8001_{hex}) outputs 10.837 V, underrange (8080_{hex}) 0 V. With an error code (1000 0000 0xxx $xxx0_{bin}$) the last valid value from the digital/analog converter is output.

Output range 0 V to 10 V

Output Data Word (Two's Complement)		0 V to 10 V U_{Output}	Remark
hex	**dec**	**V**	
≤7FFF	32512	+10.837	
> 7500	32512	+10.837	
7F00	32512	+10.837	
7530	30000	+10.0	
0008	8	+2.667 mV	Smallest DAC quantization step
0001	1	+333.33 µV	Process data resolution
< 0000	0	0	
< 8100	*Processed separately:*		
8001	-32767	+10.837	(Overrange)
8080	-32640	0	(Underrange)
80xx	(Other)	Hold last value	

The $80xx_{hex}$ range is reserved exclusively for error and message codes.

13.2 "IB ST" Format

The output value is represented in bits 14 through 3. Bit 15 is available as sign bit. Bits 2 through 0 are irrelevant.

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

Output value representation in "IB ST" format (12 bits + sign bit)

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

SB Sign bit
OV Output value
X Irrelevant bit (Set this bit to 0.)

Bits 2 through 0 are not always considered as "irrelevant bits". Values $7FF9_{hex}$ and 8001_{hex} are recognized as overrange or underrange and interpreted as $7FF8_{hex}$ or 8008_{hex} and further processed as normal process data. In this way MUX-compatibility is ensured. The only exceptions are error codes (with ST only an open circuit). With this error code (xxxx xxxx xxxx $xx1x_{bin}$) the last value is maintained.

Significant Output Values in "IB ST" Format

Output range 0 V to 10 V

Output Data Word (Two's Complement)	0 V to 10 V U_{Output}
hex	V
>7FF8	9.9975
7FF8	9.9975
4000	5.0
0008	0.002441
< 0000	0

Output range -10 V to +10 V

Output Data Word (Two's Complement)	-10 V to +10 V U_{Output}
hex	V
>7FF8	9.9975
7FF8	9.9975
0008	0.002441
0000	0
FFF8	-0.002441
8008	-9.9975
< 8008	-9.9975

14 Output Behavior

14.1 Output Behavior During Error-Free Operation (Normal Operation)

On power up during normal operation, the output range and the data format are read using the terminal EEPROM (non-volatile).

Volatile parameterization is also possible for these settings as well as for the behavior of the terminal in the event of an error. This parameterization can be carried out during runtime by a process data sequence.

14.2 Output Behavior in the Event of an Error

In the event of an error the outputs behave as set in the EEPROM (non-volatile) or as subsequently parameterized (volatile). This means that the outputs hold the last value (HOLD, default setting) or are reset to 0 (RESET, can be parameterized).

14.3 Output Behavior of the Voltage Output

Take output behavior (in the event of an error) into account when configuring your system!

Switching Operation/State of the Supply Voltage	Marginal Condition	OUT Process Data Word (Hexadecimal)	Behavior/Status of the Analog Output
U_{ANA} from 0 V to 24 V	U_L = 0 V	xxxx	0 V
U_{ANA} from 24 V to 0 V	U_L = 7.5 V	xxxx	0 V
Bus in stop state	U_{ANA} = 0 V	xxxx	0 V
Bus in stop state	U_{ANA} = 24 V	xxxx	Hold last value
Bus reset (e.g., remote bus cable break)		xxxx	Hold last value (default setting) or 0 V (can be parameterized)

U_{ANA} Analog supply voltage of the terminal

U_L Supply voltage for module electronics (communications power)

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

14.4 Response of the Control System or Computer to a Hardware Signal for Different Control or Computer Systems

Signal	Control or Computer System	State After Switching Operation	
		OUT Process Data Word (Hexadecimal)	Analog Output
			U_{out}
NORM*	AEG Schneider Automation	0000	0 V
BASP	Siemens S5	0000	0 V
CLAB	Bosch	0000	0 V
SYSFAIL	VME	0000	0 V
SYSFAIL	PC	0000	0 V
CLEAR OUT	Moeller IPC	0000	0 V

* On controller boards for AEG Schneider Automation control systems it is possible to set the NORM signal so that the OUT process data word and the analog output hold the last value.

14.5 Response of the Voltage Output to a Control Command of the INTERBUS Controller Board

Command	State After Switching Operation	
	OUT Process Data Word (Hexadecimal)	Analog Output
		U_{out}
STOP	xxxx	Hold last value
ALARM STOP (reset)	xxxx	Hold last value (default setting) or 0 V (can be parameterized)

15 Input Behavior

When analyzing the input behavior, a distinction is made between normal operation and parameterization mode. Input behavior in parameterization mode is described in Section "Parameterization" on page 22.

During **error-free normal operation,** the output data is mirrored in the input words as "acknowledgment" in bits 15 through 3 as soon as it is transmitted to the DAC.

Bits 2 through 0 are available as status bits and are used to display and read the set behavior of the terminal.

As the IB IL AO 2/U/BP terminal only evaluates bits 15 through 3 as data bits in both the IB IL and IB ST format, only these 13 bits are mirrored in the input data word (see notes on error codes, overrange and underrange).

Input data in "IB IL" and "IB ST" formats

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	OV*												F	R	H

SB	Sign bit		
OV*	Mirrored output value		
F	Data format	0: IB IL	1: IB ST
R	Output range	0: -10 V to +10 V	1: 0 V to 10 V
H	Hold/reset	0: Hold	1: Reset

If an **error** is detected by the terminal, it is indicated by an error code in the first IN process data word. Possible error codes can be found in the following table.

Error Codes:

Input Data Word (Two's Complement) hex	Cause	Remedy
8010	This code can only appear in parameterization mode and can have two causes:	
	1 Configuration is carried out	Continue configuration
	In step 2 of parameterization, this code appears after sending the code 8055_{hex} in the first input word. **It does not indicate an error at this point.**	
	2 Invalid configuration	Check parameterization
8020	DAC voltage falls below the permissible value I/O error occurs	Check the bus coupler voltage supply; Check that the potential jumpers are connecting safely; Replace the terminal
8040	Terminal faulty	Replace the terminal

The error codes overwrite the status bits (bits 2 through 0) with "0". This means that in IB ST data format, it is also possible to clearly distinguish the data from valid process data.

16 Parameterization

By default upon delivery, the terminal parameters are set as follows:

Data format:	IB IL
Behavior of the outputs in the event of an error:	Outputs hold the last value (Hold)
Output range:	-10 V to +10 V

You can configure the following terminal parameters according to your conditions, using the process data:

Data format:	IB ST
Behavior of the outputs in the event of an error:	Outputs are reset to 0 (Reset)
Output range:	0 V to +10 V

In order to parameterize the terminal you must change to parameterization mode. In the first process data output word, transmit codes 8033_{hex} and 8055_{hex} one after the other.

In order not to change accidentally to parameterization mode, you should set bits 2 through 0 to 0 in normal operation when transmitting process data.

The parameterization is valid for both channels.

Parameterizing the Terminal:

Step 1:	**Transmission of code 8033_{hex} in the first OUT process data word.** In bits 15 through 3 of the first IN process data word this code is acknowledged as a normal process data item.  For every subsequent code which is not equal to 8055_{hex} in the first process data word, normal operation continues and the code is interpreted as a process data item.
Step 2:	**Transmission of code 8055_{hex} in the first OUT process data word.** Acknowledgment takes place via code 8010_{hex} in the first input word. In this case, this code does not indicate an error, but shows that a configuration word is eventually expected (in step 3).  For every subsequent code that is not equal to $80xx_{hex}$ in the first process data word, parameterization mode is quit.

Step 3:	**Transmission of parameterization code 1000 0000 1000 $p_3p_2p_1 1_{bin}$.** Where p_x are the terminal parameters: p_3: Data format (0: IB IL; 1: IB ST) p_2: Output range (0: -10 V to 0 V; 1: 0 V to 10 V) p_1: Reset behavior (0: Hold; 1: Reset) Acceptance of the value is confirmed in bits 15 through 0 of the first input word by mirroring the code. If an invalid configuration is displayed, code 8010_{hex} appears in the first input data word, which indicates the error "Invalid Configuration". This step can be repeated as often as you like. If a code that is not equal to $80xx_{hex}$ is transmitted in the first process data word, parameterization mode is quit without the parameterization taking effect.
Step 4:	In this step you specify whether the parameterization stored in the EEPROM is volatile (dynamic) or non-volatile (static).
	Volatile parameterization: After a power up this setting is no longer available. Subsequent operation uses the settings stored in the EEPROM. Transmission of code 8077_{hex}.
	Non-volatile parameterization: The parameterization is stored in the EEPROM. After a power up this parameterization from the EEPROM is used. Transmission of code 8099_{hex}.
	After writing 8077_{hex} or 8099_{hex} the parameterization takes effect and parameterization mode is quit. This is displayed in the first input word through mirroring of code 8077_{hex} or 8099_{hex}. These values have a dedicated acknowledgment function. Only the next process data item is processed as normal.

If parameterization was aborted, it is possible to switch to parameterization mode by restarting with step 1. The orange "O-S" LED on the terminal indicates whether the original configuration is present or if the active configuration differs from the default configuration of the terminal upon delivery. The LED is on if the default state has been parameterized.

PHOENIX CONTACT GmbH & Co. KG • 32823 Blomberg • Germany
Phone: +49-(0) 5235-3-00 • Fax: +49-(0) 5235-3-4 12 00
www.phoenixcontact.com