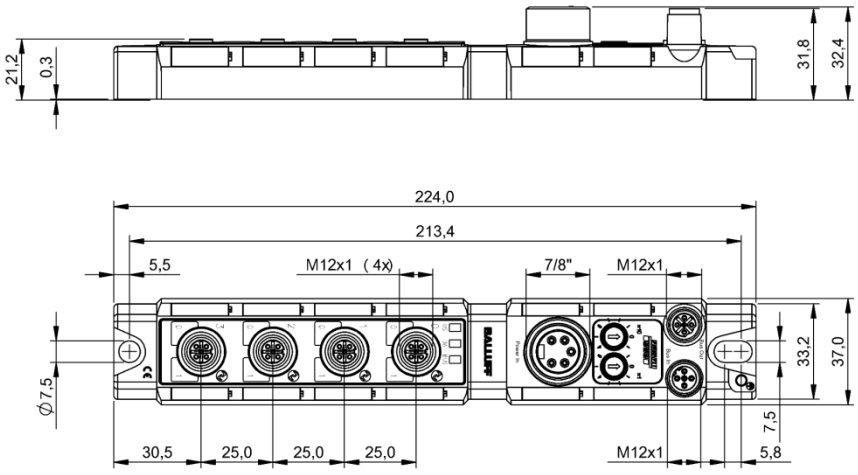
BALLUFF

sensors worldwide

BNI PBS-506-001-Z011
BNI PBS-507-001-Z011

IP67 Module, Profibus IO-Link Master

User´s Guide



Contents

1 Notes for the user

1.1. About this guide

The BNI EIP-… serves as a decentralized input/output module for connecting to a Profibus network.

1.2. Structure of the guide

The guide is organized so that the sections build on one another.
Section 2: Basic safety information.
Section 3: Getting started.
Section 4: Technical data for the Device.
Section 5: Included Material.

1.3. Typographical conventions

The following typographical conventions are used in this Guide.

Enumerations

Enumerations are shown in list form with bullet points.

- Entry 1,
- Entry 2.

Actions

Action instructions are indicated by a preceding triangle. The result of an action is indicated by an arrow.

➢ Action instruction 1,
↳ Action result.
➢ Action instruction 2.

Syntax

Numbers:

- Decimal numbers are shown without additional indicators (e.g. 123)
- Hexadecimal numbers are shown with the additional indicator hex (e.g. 00hex)

Menu commands:
Menu commands are separated by a vertical line. "Tools | Install new GSD…" refers to the menu command "Install new GSD…." From the "Tools" menu.

Buttons:
Buttons are shown in brackets, e.g. [Install]

Cross references

Cross references indicate where additional information on the topic can be found (see „Technical Data").

1.4. Symbols

Note, Tip!
This symbol indicates general notes.

Note!
This symbol indicates a security notice which most be observed.

1.5. Abbreviations

O-Port	Digital output port
BCD	Binär coded switch
BNI	Balluff Network Interface
EMC	Electromagnetic Compatibility
I-Port	Digital input port
FE	Functions earth
GSD file	Generic Station Description
LSB	Least Significant Bit
MSB	Most Significant Bit
SELV	Safety Extra Low Voltage
PLC	Process logic control
PELV	Protective Extra Low Voltage -
Profibus DP	Profibus decentralized peripherie

2 Safety

2.1. Intended use

This guide describes The BNI PBS-… serves as a decentralized input/output module for connecting to a Profibus network.

2.2. General safety notes

Installation and startup
Installation and startup are to be performed only by trained specialists. Any damage resulting from unauthorized manipulation or improper use voids the manufacturer's guarantee and warranty.
The Device is in accordance with EMC Class A. Such equipment may generate RF noise. The operator must take precautionary measures accordingly.
The Device must be powered only using an approved power supply (see section 4 "Technical data"). Only approved cable may be used.

Material resistance
The BNI PBS-…has good chemical and oil resistance.
If aggressive media are used, the material resistance must be tested for this application.

Operating and testing
The operator is responsible for observing local prevailing safety regulations.
When defects and non-clearable faults in the Device occur, take it out of service and secure against unauthorized use.
Approved use in ensured only when the housing is fully installed.

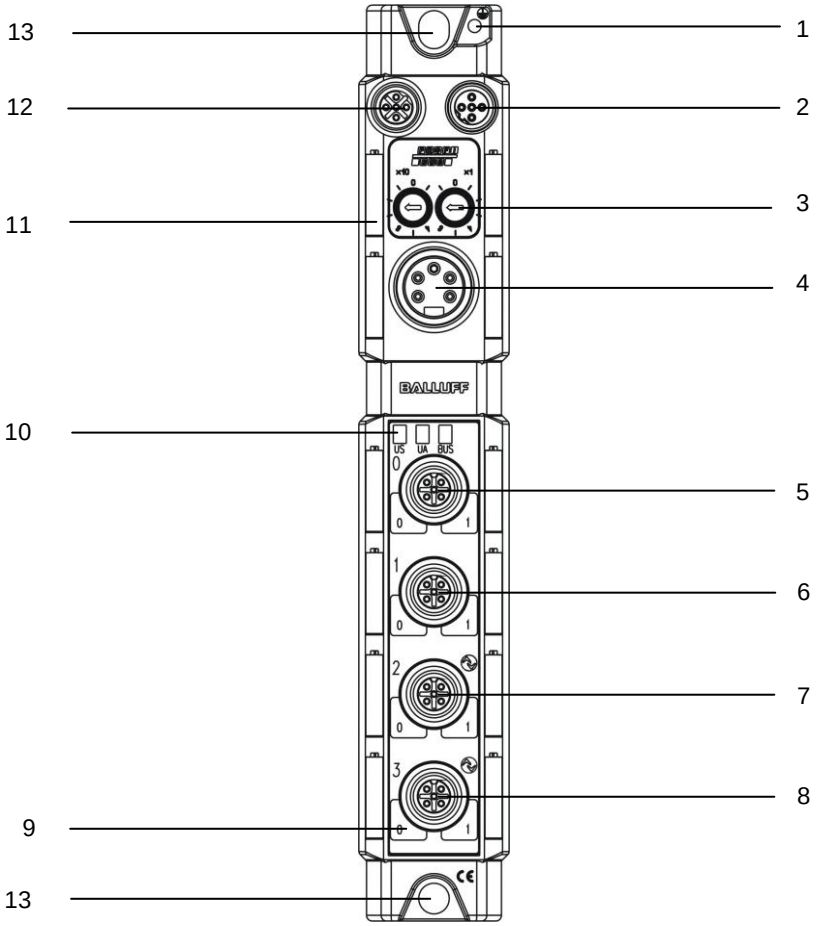
2.3. Meaning of the warnings

⚠ **Note!**
The pictogram used with word "Caution" warns of a possible hazardous situation affecting the health of persons or equipment damage. Ignoring these warnings can result in injury or equipment damage.

- Always observe the described measures for preventing this danger.

3 Getting Started

3.1. Connection overview BNI PBS-506-001-..

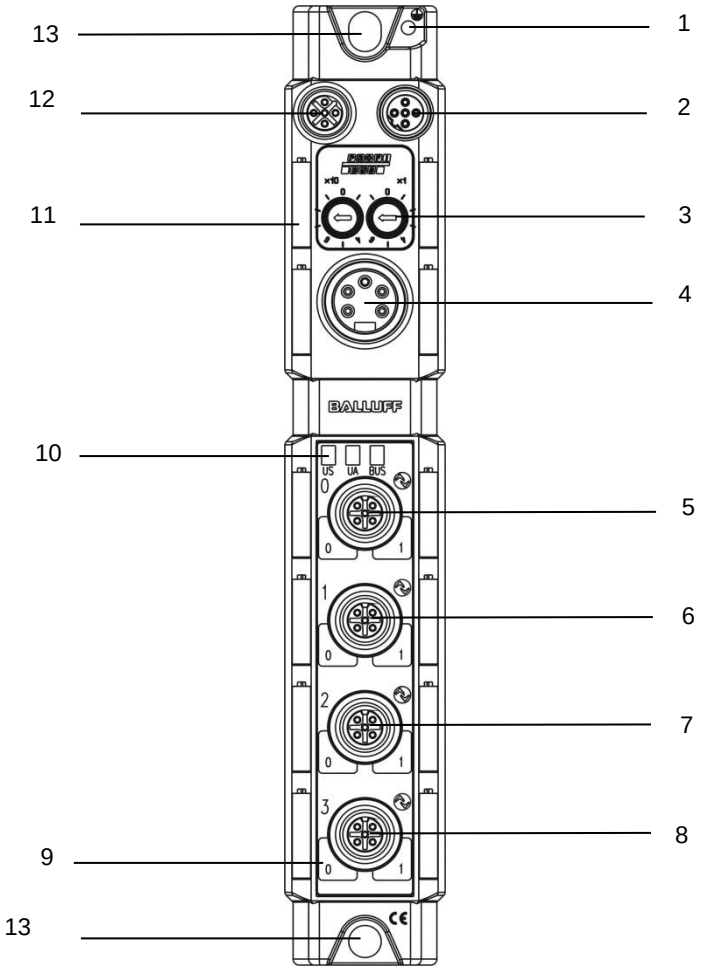


BNI PBS-506-001-Z011

1 Ground connection
2 M12 Profibus IN
3 Address switches
4 Supply POWER
5 I-/O- port 0
6 I-/O- port 1
7 IO-Link port 2
8 IO-Link port 3
9 I-/O-/IO-Link port LED
10 Status LED communication / module
11 Label
12 M12 Profibus OUT
13 Mounting hole

3 Getting Started

3.2. Connection overview BNI PBS-507-001..



BNI PBS-507-001-Z011

1 Ground connection
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9 I-/ O-/ IO-Link port LED
10 Status LED communication / module
11 Label
12 M12 Profibus OUT
13 Mounting hole

4 Basic knowledge

4.1. Product description

Balluff Network Interface BNI PBS-...:

- Used for connecting sensors/actuators to a Profibus-DP network.
- Sensors/actuators can be connected through 4 standard I/O ports.
- Connection to Profibus using 2 × M12×1 round connectors.
- Electrical power 24 V DC using 7/8“ round connector.

The main areas of application are:

- In the industrial area as an interface between sensors/actuators and a Profibus.
- When using "intelligent" sensors and actuators which process information in addition to the actual process signal (e.g. diagnostics information)

4.2. Profibus

Open bus system for process and field communication in cell networks with a low number of stations as well as for data communication per IEC 61158/EN 50170. Automation Devices such as PLC's, PC's, control and monitoring Devices, sensors or actuators can communicate over this bus system.

Variants:

- Profibus DP for fast, cyclical data exchange with field Devices,
- Profibus PA for applications in process automation in the intrinsically safe area,
- Profibus FMS for data communication between automation Devices and field Devices.

4.3. IO-Link

IO-Link is defined as a standardized point-to-point connection between sensors/actuators and the I/O module. An IO-Link sensor/actuator can send additional communication data (e.g. diagnostics signas) in addition to the binary process signas over the IO-Link interface.

Compatibility with standard I/O:

- IO-Link sensors/actuators can be connected to existing I/O modules.
- Sensors/actuators which are not IO-Link capable can be connected to an IO-Link module.
- Standard sensor/actuator cable can be used.

Key technical data:

- Serial point-to-point connection,
- Communication as add-on to standard I/O.
- Standard I/O connection technique, unshielded, 20m cable length.
- Communication using 24V pulse modulation, standard UART protocol.
- Maximum current draw: per sensor 200 mA/per actuator 1,6 A.

4 Basic knowledge

4.4. Communication mode

Process data (cyclical):
The GSD file provides different data modules for representing the sensor map:

- Inputs: 1 byte – 32 bytes
- Outputs: 1 byte – 32 bytes
- Or combined input/output modules

Deterministic time behavior:

- Typically 3 ms cycle time 16 bits of process data and 38.4 Kbaud transmission rate.

Service data (diagnostics, parameters):

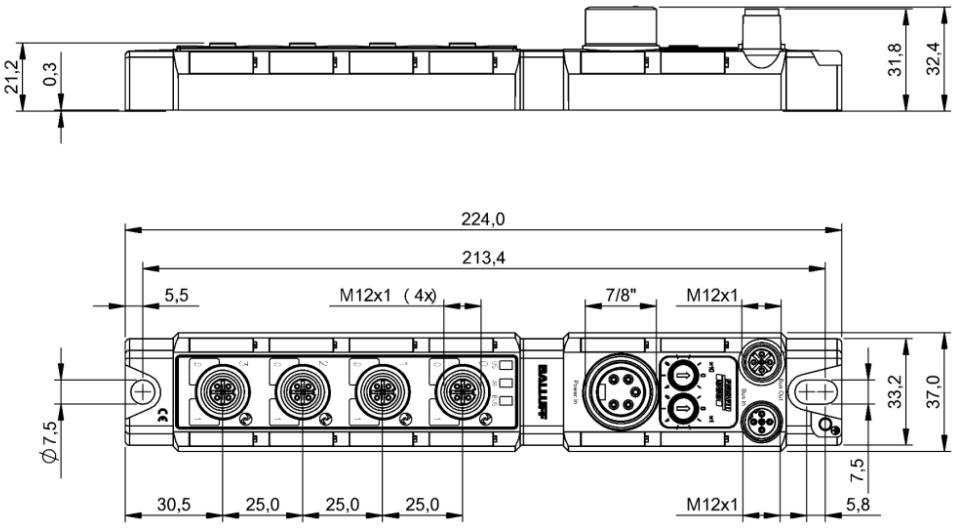
- parallel and reactionless process data

Standard IO-modes (SIO-mode)

- Startup parameter setting possible using communication, then
- binary switching signal

5 Technical Data

5.1. Dimensions



5.2. Mechanical Data

Housing material	Die case zinc, matt nickel plated
Fieldbus	Profibus: M12, B-coded (female and male)
Supply power	5-pin, 7/8“ (male)
I/O Ports	M12, A-coded (4 x female)
Enclosure rating	IP67 (only when plugged-in and threaded-in)
Weight	ca.: 352 g

5.3. Electrical Data

Operating voltage	18 ... 30 V DC
Ripple	< 1 %
Current draw without load	≤ 200 mA

5.4. IO-Link data

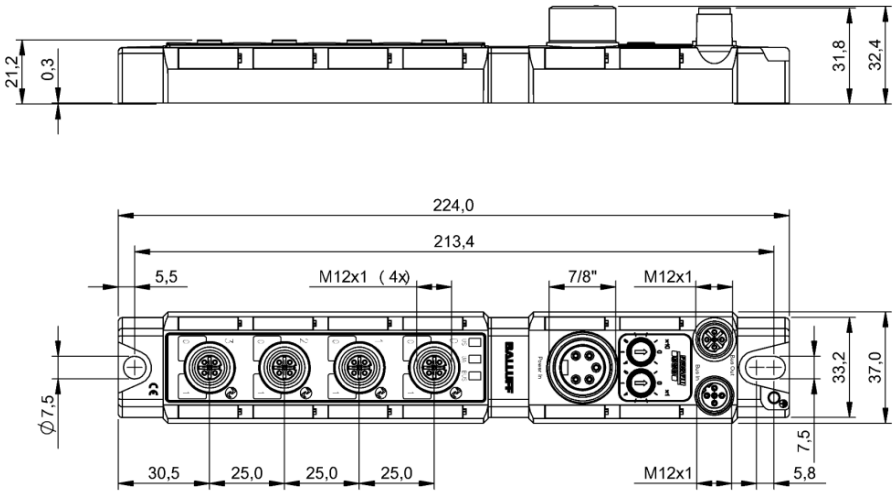
Baud rate	COM 1, 2, 3
Frame typ	1, 2.x, 3

5.5. Operating conditions

Operating temperature Storage temperature	-5 C … 70°C -25 C … 70°C
EMC - EN 61000-4-2/3/4/5/6 - EN 55011	 - Severity level 4A/3A/4B/2A/3A - Gr. 1, Kl. A
Shock / vibration	EN 60068 Part 2-6/27

6 Installation

6.1. Mechanical connection



The BNI PBS-... module can be connected directly to a mounting wall or to a machine. Be sure that the mounting base is flat to prevent any mechanical stress on the Device housing.

Two M6 screws and two washers are required for mounting. The tightening torque is 9 Nm.

Installation:

- Attach module using two M6 screws and 2 washers.
- Keep a distance of at least 3 mm between two modules.

Note, Tip!

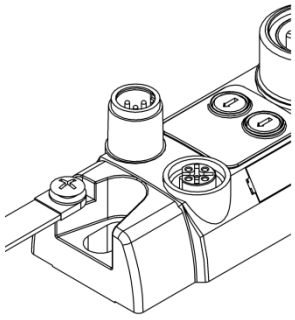
Recommended drilling distance: 210,5 ±0,2 mm **(by using M6-Screws!).**
With these drilling distance all IP67 Profibus/Profinet modules mountable.

6.2. Electrical connection

The ground connection for the BNI PBS… modules is located at upper left next to the mounting hole.

Ground straps are preferred for the ground connection. Alternately a fine-strand PE wire with large cross-section may be used.

Function ground



Note Tip!
The FE connection from the housing to the machine must be low-impedance and kept short as possible.

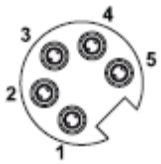
6 Installation

Supply voltage

Profibus modules require a DC voltage of 24 V DC (SELF/PELF) for power.
The power can be provided by regulated and unregulated power supplies.
Regulated power supplies allow the output voltage to be increased above the nominal voltage to compensate for line losses.

Note!
The use of a Profibus hybrid cable is not allowed.

Power (7/8”, 5pol, male)



Pin	Function	
1	Ground	0V
2	Ground	0V
3	Function ground	FE
4	Module- and Sensor supply	+24V
5	Actuator supply	+24V

- 24 V DC.
- Provide sensor/bus power and actuator power from separate power sources if possible.

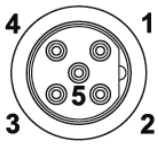
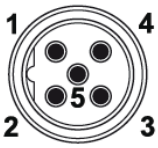
Note, Tip!
Module and connected sensors are supplied by the sensor supply. The output stages are supplied by the actuator supply, except pin 4 of the IO-Link output stage. These are supplied by the sensor supply.

Note, Tip!
Use different power sources for the sensor/bus and actuator if possible.

6 Installation

6.3. Bus connection

The bus connection is made using the M12 sockets Profibus IN and Profibus OUT. The address is set on the address switch.

Profibus OUT (M12, B-coded, female)	Profibus IN (M12, B-coded, male)	PIN	Function
		1	VP
		2	RxD/TxD-N, A line (green)
		3	DGND
		4	RxD/TxD-P, B line (red)
		5	n.c.
		Thread	Shield

Note, Tip!
- Connect ground conductor to FE terminal
- Connect incoming Profibus line to Profibus IN
- Connect continuing Profibus line to Profibus OUT or screw termination resistor to the continuing bus terminal.

Note, Tip!
Each Profibus segment must be terminated with a bus terminator. The termination resistor requires no external voltage.
Unused sockets must be fitted with cover caps to ensure IP 67 protection rating.

6.4. Ports

The sensor supply is fused by a PTC. When an overload or short circuit occurs, the affected output is turned off. The Output remains turned off after the fault is eliminated. The affected output must be turned off from the controller to clear the short circuit memory.

Note, Tip!
For the digital sensor inputs follow the input guideline per EN 61131-2, Typ 2.

IO-Link port

IO-Link port M12, A-coded, female

	PIN	Function
	1	+24 V DC, 1,6A
	2	Input /Output max. 1,6A / Diagnostic-Input
	3	0 V / GND
	4	IO-Link / Input /Output max. 1.6A
	5	n.c.

6.5. Replacing BNI PBS modules

- Turn off power to the Profibus module,
- remove the mounting screws,
- replace the unit.

7 Startup

7.1. Profibus-Address

The Profibus address is set directly on the BNI PBS-... using two BCD-switches.

Adressing

- Permissible address range 0...99.
- Each Profibus node must have a unique address assigned to it.
- The address is read once after power is turned on.
- Any change to the address does not become effective until power is reset on the modules.

A DP Master is generally assigned addresses 0 bis 2. For the PBS modules we recommend using addresses 3 and higher.

7.2. Configuration

When project planning Profibus Devices, a Device is mapped as a modular system which consists of a header module and multiple data modules

GSD file

The Device data required for project planning are stored in GSD files (Generic Station Description). The GSD files are available in 2 languages for downloading over the Internet (www.balluff.com).
The data modules of an IO-Link module are represented in the project planning software by slot. The GSD file provides the possible data modules (inputs or outputs of various data width). To configure the IO-Link module the appropriate data modules are assigned to a particular slot.

Slot	Module	Function
1	Header module	Identification/parameter setting special indentifier format, 1 data bytes
2	Port 0 Pin 4 (1. IO-Link port)	IO-Link data modules of various data width or configurable as standard I/O port
3	Port 1 Pin 4 (2. IO-Link port)	
4	Port 2 Pin 4 (3. IO-Link port)	
5	Port 3 Pin 4 (4. IO-Link port)	
6		Slots for optional additional moduls: Communication state IO-Link diagnosis enable Stations diagnostic Peripherie fault Sensor short circuit Actuator shut down / warning Pin 4 Actuator shut down / warning Pin 2 Restart Pin 4 Restart Pin 2
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

7 Startup

Header module

First the header module is inserted into the configuration. The header module is coded according to the special identification format. Header modules in this coding are used for identification and parameter setting and have a data width of 1 bytes input of 1 bytes input/output data.

Structure of the header module

Header module coding:

Header module	Description	Coding
BNI PBS-506-001-Z001	BNI IO-Link, DI8DO8	30hex
BNI PBS-507-001-Z001	BNI IO-Link, DI8DO8	30hex

Header byte coding

First byte of the header module (Header byte)

Determining the in-and/or outputs of the module.

Bit-Layout Header-Byte							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
		0	0	Number of manufacturer-specific bytes: (0: none, 1…14: number of bytes, 15: 16 bytes or words)			
		Header special format					
0	0	Determining in-/outputs of the module: Empty					
0	1	Ports are inputs, 1 length-byte for input data					
1	0	Ports are outputs,1 length-byte for output data					
1	1	Ports may be in- or outputs, each 1 length-byte for output and input data					

Length byte coding

Second byte of the header module (length byte)

Determining the data width and consistency for process data.

Bit-Layout Length byte							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
		Length oft he I/O data (0…63): 00: 1 byte/word 63: 64 byte/word					
	0	Length in bytes					
	1	Length in words (2 bytes each)					
0	Consistency over a word or byte						
1	Consistency over the module						

Data modules

The data modules are arranged onto the header module in order of the slots for ports/PINs. For one IO-Link port there are a total of max. 32 bytes of input and output data available. Each data module has a certain data length which must be selected according to the data width for each input/output. The total of all data modules may not exceed 32 bytes of input/output data.

Data module coding

Data modules for standard I/O ports:

Data module	Data width	Coding
Standard I/O		

Data modules for IO-Link inputs:

Data module	Data width	Coding
IOL_I_1byte	1 Byte	41hex 80hex 05hex
IOL_I_2byte	2 Byte	41hex 81hex 05hex
IOL_I_4byte	4 Byte	41hex 83hex 05hex
IOL_I_6byte	6 Byte	41hex 85hex 05hex
IOL_I_8byte	8 Byte	41hex 87hex 05hex
IOL_I_10byte	10 Byte	41hex 89hex 05hex
IOL_I_16byte	16 Byte	41hex 8Fhex 05hex
IOL_I_24byte	24 Byte	41hex 97hex 05hex
IOL_I_32byte	32 Byte	41hex 9Fhex 05hex

Data modules for IO-Link outputs:

Data module	Data width	Coding
IOL_O_1byte	1 Byte	81hex 80hex 05hex
IOL_O_2byte	2 Byte	81hex 81hex 05hex
IOL_O_4byte	4 Byte	81hex 83hex 05hex
IOL_O_6byte	6 Byte	81hex 85hex 05hex
IOL_O_8byte	8 Byte	81hex 87hex 05hex
IOL_O_10byte	10 Byte	81hex 89hex 05hex
IOL_O_16byte	16 Byte	81hex 8Fhex 05hex
IOL_O_24byte	24 Byte	81hex 97hex 05hex
IOL_O_32byte	32 Byte	81hex 9Fhex 05hex

Data modules for IO-Link inputs and outputs:

Data module	Data width		Coding
	Input	Output	
IOL_I/O 1/_1 byte	1 Byte	1 Byte	C1hex80hex80hex05hex
IOL_I/O 2/_2 byte	2 Byte	2 Byte	C1hex81hex81hex05hex
IOL_I/O 2/_4 Byte	2 Byte	4 Byte	C1hex83hex81hex05hex
IOL_I/O 4/_4 Byte	4 Byte	4 Byte	C1hex83hex83hex05hex
IOL_I/O 4/_2 Byte	4 Byte	2 Byte	C1hex81hex83hex05hex
IOL_I/O 2/_8 Byte	2 Byte	8 Byte	C1hex87hex81hex05hex
IOL_I/O 4/_8 Byte	4 Byte	8 Byte	C1hex87hex83hex05hex
IOL_I/O 8/_2 byte	8 Byte	2 Byte	C1hex81hex87hex05hex
IOL_I/O 8/_4 byte	8 Byte	4 Byte	C1hex83hex87hex05hex
IOL_I/O 8/_8 byte	8 Byte	8 Byte	C1hex87hex87hex05hex
IOL_I/O 4/32 byte	4 Byte	32 Byte	C1hex9Fhex83hex05hex
IOL_I/O_32/_4 byte	32 Byte	4 Byte	C1hex83hex9Fhex05hex
IOL_I/O_16/16 byte	16 Byte	16 Byte	C1hex8Fhex8Fhex05hex
IOL_I/O_24/24 byte	24 Byte	24 Byte	C1hex97hex97hex05hex
IOL_I/O_32/32 byte	32 Byte	32 Byte	C1hex9Fhex9Fhex05hex

Note, Tip!
Project planning software offers mostly graphical assistance in configuration, the configuration string is automatically created.

7 Startup

Additional Module

Additional Module	Data width		Coding
	Input	Output	
Communication state	1 Byte		10hex
IO-Link diagnoses enable		1 Byte	10hex
Stations diagnostic	1 Byte		10hex
Peripherie fault	1 Byte		10hex
Sensor short circuit	1 Byte		10hex
Actuator shut down Pin 4	1 Byte		10hex
Actuator shut down Pin 2	1 Byte		10hex
Actuator warning Pin 4	1 Byte		10hex
Actuator warning Pin 2	1 Byte		10hex
Restart Pin 4		1 Byte	20hex
Restart Pin 2		1 Byte	20hex

Process data coding

Input / Output Pin 2 and Pin 4

Byte 0							
Pin 2				Pin 4			
7	6	5	4	3	2	1	0
Port 3 Channel 7	Port 2 Channel 6	Port 1 Channel 5	Port 0 Channel 4	Port 3 Channel 3	Port 2 Channel 2	Port 1 Channel 1	Port 0 Channel 0

Note, Tip!
The process data for in- and outputs are assigned to the header module.

7.3. Setting parameters

For the BNI PBS modules the parameter telegram is 19 bytes long. The first 7 bytes are defined by the Profibus standard EN 50170. The following 12 bytes are user parameters.

Norm-specific parameters

Structure of the norm-specific parameters (bytes 0 to 6, see below for coding):

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Station status							
1	WD_Fact_1							
2	WD_Fact_2							
3	MinTSDR							
4	Indent_Number_High							
5	Indent_Number_Low							
6	Group_Intend							

Note, Tip!
When coding the parameters:1 = activated, 0 = deactivated.

Station status

Byte 0, station status:

Bit	Parameter	Meaning
0 ... 2	-	reserved
3	WD_On	Activated/deactivate watchdog (access monitoring in the Device)
4	Freeze_req	Operate DP Device in freeze mode
5	Sync_req	Operate DP Device in sync mode
6	Lock_req	(see below for coding)
7	Unlock_req	

Coding of lock and unlock:

Lock	Unlock	
0	0	minTSDR and Device-specific parameters may be overwriten
0	1	Enable DP-Device for other Masters.
1	0	DP-Device blocked for other Masters, all parameters are copied
1	1	DP-Device relesed for other Masters (unlock has priority over lock)

WD_Fact_1 and WD_Fact_2

Byte 1 and 2, Watchdog factor 1 and 2:
Time until access monitoring in DP-Device expires. After a failure of the DP-Master the outputs assume the safe state after this time expires.
Timeout (TWD) = 10 ms x WD_Fact_1 x WD_Fact_2.
Times from 10 ms to 650 s can be set.

WD_Fact_1

Byte 1							
7	6	5	4	3	2	1	0
0 ... 255 (0x00 ... 0xFF)							

WD_Fact_2

Byte 2							
7	6	5	4	3	2	1	0
0 ... 255 (0x00 ... 0xFF)							

7 Startup

MinTSDR

MinTSDR: Minimum time before sending a Device reply (in Tbits).
The standard prescribes a minimum value of 11 Tbits. The value must be less than MaxTSDR

Byte 1							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0, 11 ... 255 (0x00, 0x0B ... 0xFF)							

Ident_Number-_High

Ident_Number_High: Identnummer High-Byte

Byte 1							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 ... 255 (0x00 ... 0xFF)							

Ident_Number-_Low

Ident_Number_Low: Identnummer Low-Byte

Byte 1							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 ... 255 (0x00 ... 0xFF)							

Group_Ident

Group_Ident: Group number of the BNI PBS-Module.
Each bit represents a group. Is only applied for Lock-Req.

Byte 1							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Group 8	Group 7	Group 6	Group 5	Group 4	Group 3	Group 2	Group 1

User parameters

The BNI PBS modules differ in how the functions are set for the ports. The user parameters have the same structure for all modules. Parameters which are not supported by a module are indicated as reserved. Reserved parameters must be written with the value 0.
Bytes 7 to 9 of the user parameters are reserved and can be ignored. The required settings are made using the user parameters beginning with byte 10.

Global settings for a standard I/O port:

Decimal	Binary	Meaning
08	00001000	Digital input (NO)
09	00001001	Digital input (NC)
10	00001010	Digital output
11	00001011	Diagnostic input

IO-Link Port:

Configuration of an IO-Link port always consists of 13 bytes and is in 2 parts:

- Global settings of the IO-Link port: 1 byte
- IO-Link parameters: 9 bytes

Global settings for a standard I/O port:

Decimal	Binary	Meaning
04	00000100	IO-Link-Port

IO parameters for an IO-Link port:

Byte	Meaning
1	Module Identifier / Validation type
2	Cycle Time
3	Process data offset
4	Process data window length
5	Vendor ID 0
6	Vendor ID 1
7	Device ID 0
8	Device ID 1
9	Device ID 2

7 Startup

Configuration examples

The structure of the user parameters depends on the port configuration of the Profibus IO-Link Master module.
The following examples show the structure of the user parameters for various port configurations

Example 1

Profibus IO-Link Master
Port 0 – 7 Pin 4: Configured as a standard I/O port
Port 0 – 7 Pin 2: Configured as a standard I/O port
„Minimal configuration“

Byte	Value	Meaning	Module
0		Station status	Norm parameters
1		WD_Fact_1	
2		WD_Fact_2	
3		MinTSDR	
4		Indent_Number_High	
5		Indent_Number_Low	
6		Group_Intend	
7	0x80	DPV1 Status 1	DPV1 parameters
8	0x00	DPV1 Status 2	
9	0x00	DPV1 Status 3	
10	0x0F	Global diagnostic Channel related diagnostic Low voltage bus/sensor supply Low voltage actuator supply	Head module
11	0x00	Function Port 0 … 3 Pin 4	
12	0x00	Function Port 4 … 5 Pin 4	
13	0x00	Function Port 6 … 7 Pin 4	
14	0x00	Function Port 0 … 3 Pin 2	
15	0x00	Function Port 4 … 7 Pin 2	
16	0x00	Safe state Port 0 … 3 Pin 4	
17	0x00	Safe state Port 4 … 5 Pin 4	
18	0x00	Safe state Port 0 … 3 Pin 2	
19	0x00	Safe state Port 4 … 7 Pin 2	
20	0x00	Parameter Server Conflict Resolution Download Enable Upload Enable	
21	0x0E		Standard I/O
22	0x0E		Standard I/O
23	0x0E		Standard I/O
24	0x0E		Standard I/O

Example 2

Profibus IO-Link Master
Port 0 – 3 Pin 4: Configured as a standard I/O port
Port 0 – 3 Pin 2: Configured as a standard I/O port
Port 4 – 7 Pin 4: Configured as a IO-Link port
Port 4 – 7 Pin 2: Configured as a standard I/O port
„Maximal configuration“

Byte	Value	Meaning	Module
0		Station status	Norm parameters
1		WD_Fact_1	
2		WD_Fact_2	
3		MinTSDR	
4		Indent_Number_High	
5		Indent_Number_Low	
6		Group_Intend	
7	0x80	DPV1 Status 1	DPV1 parameters
8	0x00	DPV1 Status 2	
9	0x00	DPV1 Status 3	
10	0x0F	Global diagnostic Channel related diagnostic Low voltage bus/sensor supply Low voltage actuator supply	Head module
11	0x00	Function Port 0 … 3 Pin 4	
12	0x04	Function Port 4 … 5 Pin 4	
13	0x04	Function Port 6 … 7 Pin 4	
14	0x00	Function Port 0 … 3 Pin 2	
15	0x00	Function Port 4 … 7 Pin 2	
16	0x00	Safe state Port 0 … 3 Pin 4	
17	0x00	Safe state Port 4 … 5 Pin 4	
18	0x00	Safe state Port 0 … 3 Pin 2	
19	0x00	Safe state Port 4 … 7 Pin 2	
20	0x00	Parameter Server Conflict Resolution Download Enable Upload Enable	
21	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
22	0x00	Cycle Time	
23	0x00	Process data offset	
24	0x10	Process data window length	
25	0x00	Vendor ID 0	
26	0x00	Vendor ID 1	
27	0x00	Device ID 0	
28	0x00	Device ID 1	
29	0x00	Device ID 2	
30	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
31	0x00	Cycle Time	
32	0x00	Process data offset	
33	0x10	Process data window length	
34	0x00	Vendor ID 0	
35	0x00	Vendor ID 1	
36	0x00	Device ID 0	
37	0x00	Device ID 1	
38	0x00	Device ID 2	
39	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
40	0x00	Cycle Time	
41	0x00	Process data offset	
42	0x10	Process data window length	
43	0x00	Vendor ID 0	
44	0x00	Vendor ID 1	
45	0x00	Device ID 0	
46	0x00	Device ID 1	
47	0x00	Device ID 2	
48	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
49	0x00	Cycle Time	
50	0x00	Process data offset	
51	0x10	Process data window length	
52	0x00	Vendor ID 0	
53	0x00	Vendor ID 1	
54	0x00	Device ID 0	
55	0x00	Device ID 1	
56	0x00	Device ID 2	

7 Startup

Example 3

Profibus IO-Link Master
Port 0 – 3 Pin 4: Configured as standard I/O port
Port 0 – 3 Pin 2: Configured as standard I/O port
Port 4 Pin 4: Configured as IO-Link port
Port 4 Pin 2: Configured as standard I/O port
Port 5 Pin 2+4: Configured as standard I/O port
Port 6 Pin 4: Configured as IO-Link port
Port 6 Pin 2: Configured as standard I/O port
Port 7 Pin 2+4: Configured as standard I/O port
Example of „mixed configuration“

Byte	Value	Meaning	Module
0		Station status	Norm parameters
1		WD_Fact_1	
2		WD_Fact_2	
3		MinTSDR	
4		Indent_Number_High	
5		Indent_Number_Low	
6		Group_Intend	
7	0x80	DPV1 Status 1	DPV1 parameters
8	0x00	DPV1 Status 2	
9	0x00	DPV1 Status 3	
10	0x0F	Global diagnostic Channel related diagnostic Low voltage bus/sensor supply Low voltage actuator supply	Head modules
11	0x00	Function Port 0 … 3 Pin 4	
12	0x44	Function Port 4 … 5 Pin 4	
13	0x44	Function Port 6 … 7 Pin 4	
14	0x00	Function Port 0 … 3 Pin 2	
15	0x00	Function Port 4 … 7 Pin 2	
16	0x00	Safe state Port 0 … 3 Pin 4	
17	0x00	Safe state Port 4 … 5 Pin 4	
18	0x00	Safe state Port 0 … 3 Pin 2	
19	0x00	Safe state Port 4 … 7 Pin 2	
20	0x00	Parameter Server Conflict Resolution Download Enable Upload Enable	
21	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
22	0x00	Cycle Time	
23	0x00	Process data offset	
24	0x10	Process data window length	
25	0x00	Vendor ID 0	
26	0x00	Vendor ID 1	
27	0x00	Device ID 0	
28	0x00	Device ID 1	
29	0x00	Device ID 2	
30	0xE0		Standard I/O
31	0x10	Module Identifier / Validation type	IO-Link module 16 byte IN/16 byte Out
32	0x00	Cycle Time	
33	0x00	Process data offset	
34	0x10	Process data window length	
35	0x00	Vendor ID 0	
36	0x00	Vendor ID 1	
37	0x00	Device ID 0	
38	0x00	Device ID 1	
39	0x00	Device ID 2	
40	0xE0		Standard I/O

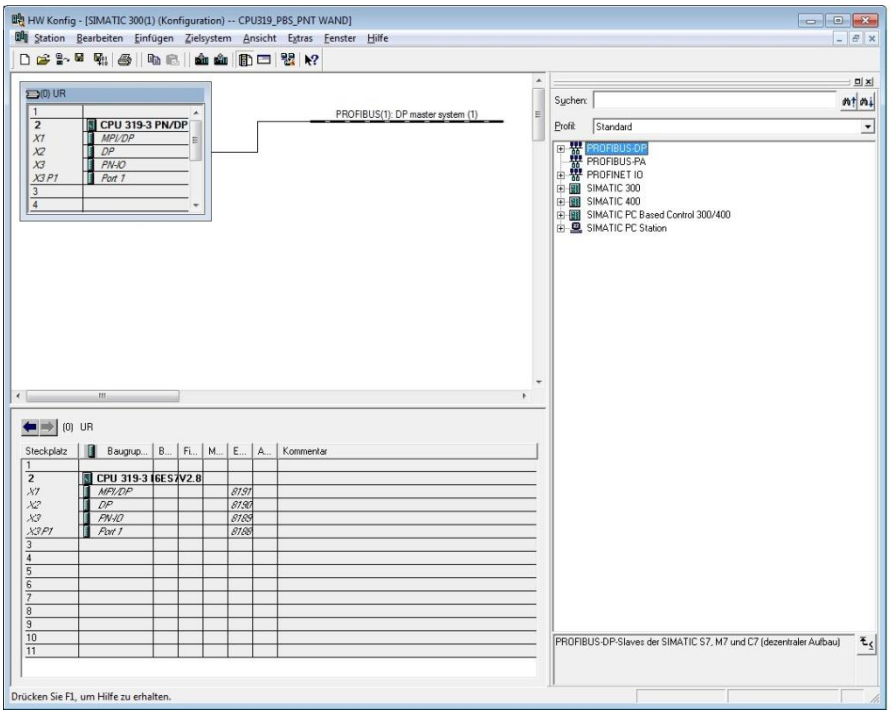
7.4. Integration in project planning software

The example shows the connection of the BNI PBS modules to a Siemens S7 controller with "SIMATIC Manager". The exact procedure depends on the project planning software used.

Installing the GSD file

To do the project planning on the PC, the GSD file for the module must be installed:

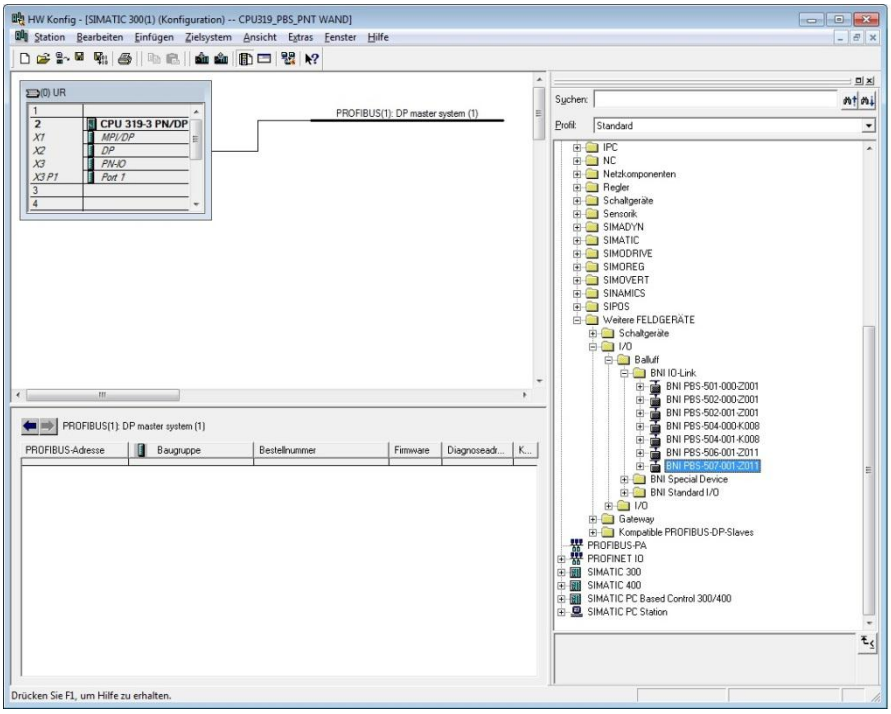
- Open a new project.
- Open hardware configurator.
- Select menu command "Tools| Install new GSD…".
  - The window "Install new GSD" opens.
- Select directory and GSD file.
  - The [Install] button only becomes active if a GSD file is selected.
- Click on [Install].
  - The GSD file is installed.
  - When the process is finished, a message appears.
- Confirm the message and close the window.
- Select the menu command „Tools | Update catalog“.
  - The modules are displayed in the project tree.



7 Startup

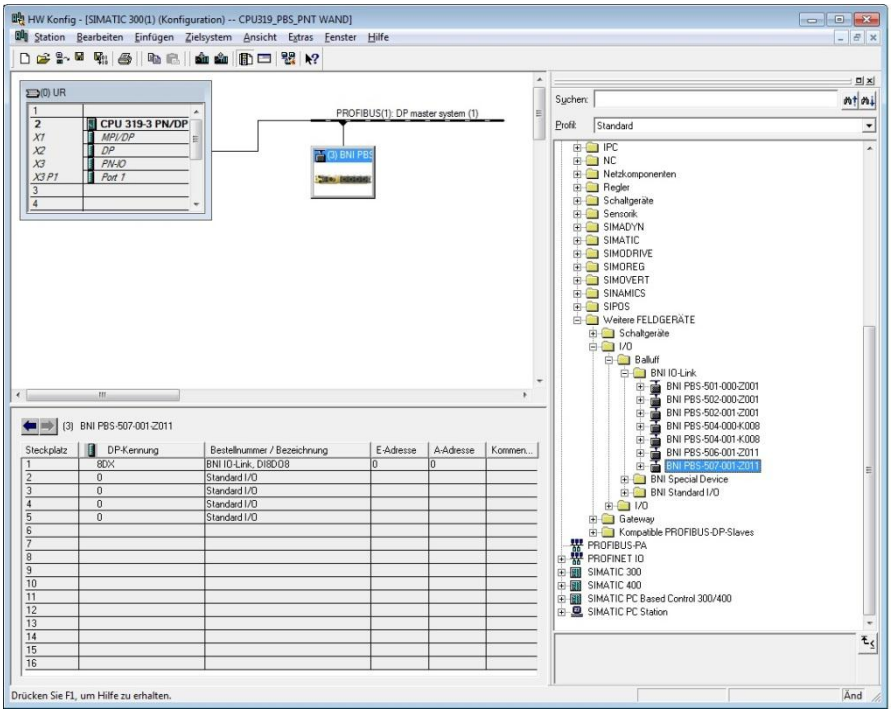
Requirements

For the integration of a Profibus Device a configuration at the PLC and the DP interface is required.



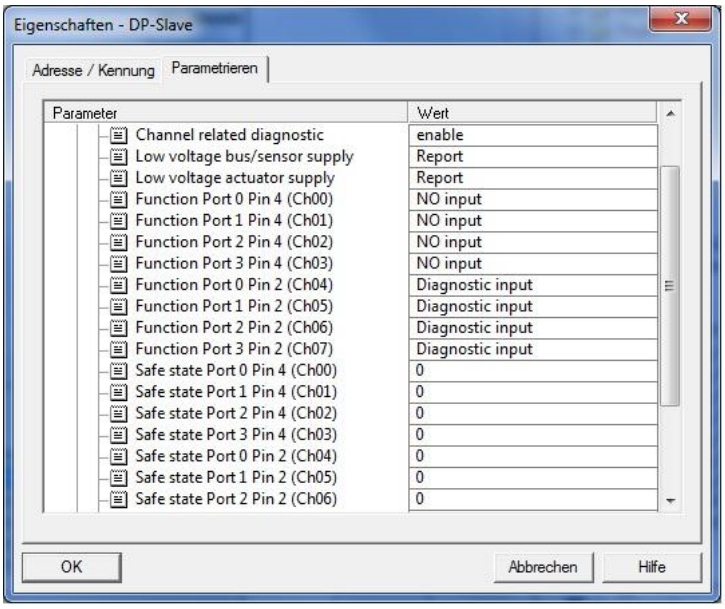
Integration of the module

Select the Profibus Device from the catalogue and integrate it into the Profibus system.



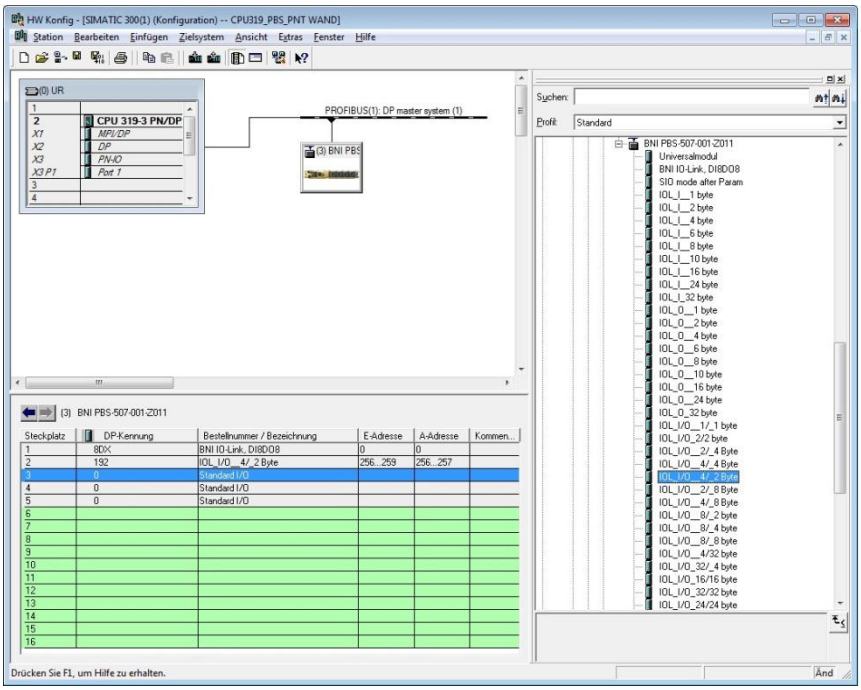
Define properties

➢ Double-click on the module in Slot 1.
↳ The dialogue „Properties DP-slave" appears.
The function of the single pins can be defined



Slot configuration

When the IO-Link interface is activated, in the slots (2…5) the corresponding IO-Link module has to be placed with the right process date length. Additional modules can be placed in slot 6.

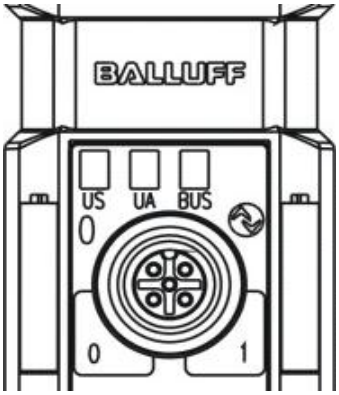


8 Diagnostics

8.1. Function indicators

The status of the supply voltages is indicated by the status LED´s 1 to 5.

LED indicators



Status LEDs

LED	Indicator	Function
US	Green	US power supply sensor ok
UA	Green	UA power supply actuator ok
US	Red	US power supply sensor under voltage
UA	Red	UA power supply actuator under voltage
BUS	Green Grün, blinking	BUS data transmission Profibus ok BUS data transmission Profibus inactive

IO-Link Port LEDs

Each IO-Link-port is assigned two LEDs which indicate the operating states.

LED “0” - PIN 4, LED “1” - PIN 2

Indicator	Function			
	IO-Link	Output	Input	Diagnostic-Input
Off	-	Signal = 0	Signal = 0	Diagnostics = 0
Yellow	-	Signal = 1	Signal = 1	
Red	SC >Imax	I Output > Imax	SC*	Diagnostics = 1 or SC*
Green	IO-Link Commu-nication active	-	-	-
Green blinking	No IO-Link Communication	-	-	-

* SC = Short circuit detection on Pin 1. In this case both LEDs are red.

Diagnostics input

Pin 2 of the I/O port can be configured as a diagnostics channel It behaves like an inverted input. The 0 V signal is interpreted as 1, the corresponding port LED comes n red and a diagnostics message is sent over DP-diagnostics.
The optical indicator on the corresponding I/O port allows defective sensors/actuators to be more easily and quickly localized.

8 Diagnostics

8.2. Diagnostics telegram

The diagnostics telegram is comprised of various blocks. The first 6 bytes are defined by the Profibus standard EN 50170. The following 4 bytes are Device-specific and ID-specific diagnostics information (2 bytes each). For each channel-specific diagnostic 3 bytes of diagnostics information are added (min. 6 and max. 244 bytes).

8.3. Norm diagnostics

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Status 1							
1	Status 2							
2	Status 3							
3	Master address							
4	Ident_Number_High_Byte: 0Bhex							
5	Ident_Number_Low_Byte: 1Ahex							

Note, Tip!
When coding the norm-specific diagnostics: 1 = activated, 0 = deactivated

Norm diagnostics coding

In the following the coding of bytes 0 to 3 of the norm diagnostics is described.
Byte 4 and Byte 5 (Identnumber) are fixed.

Status 1

Byte 0, Status 1

Bit	Meaning
0	**Station_non_existent** The DP-Device always sets the bit to 0. The DP-Master sets it to 1 if the DP-Device cannot be reached.
1	**Station_not_ready** The DP Device sets the bit to 1 if it is not yet ready for data exchange.
2	**Cfg_Fault** The DP Device sets the bit to 1 if the configuration data last received from the Master do not agree with those which the DP Device determined.
3	**Ext_diag** If the bit is set to 1, there is a diagnostics entry in the Device specific diagnostics area (Ext_Diag_Data). A further diagnostic follows in the telegram.
4	**Not supported** The DP Device sets the bit to 1 if a function was requested which is not supported
5	**Invalid_Device-Response** The DP-Device always sets the bit to 0. The DP-Master sets it to 1 if it receives an implausible response from the DP Device.
6	**Prm_fault** The Device sets the bit to 1 if the last parameter telegram was defective (e.g. wrong length, wrong ID number, invalid parameters).
7	**Master_lock** The DP Device always sets the bit to 0. The DP Master sets it to 1 if the DP Device was parameterized by a different Master (Lock from another Master, here: Address in byte 3 not equal to FFhex and not equal to its own address).

8 Diagnostics

Status 2

Byte 1, Status 2

Bit	Meaning
0	**Prm_req** The DP Device always sets the bit to 1 if it needs to be reconfigured and parameterized. The bit remains set until parameterizing is done.
1	**Stat_Diag** (statistic diagnostic) The Device sets the bit to 1 if for example it can not send valid data. In this case the DP Master retrieves diagnostic data until the bit is reset to 0.
2	**Fixed at 1**
3	**WD_On** Monitoring activated/deactivated (Watchdog on).
4	**Freeze_Mode** The Device sets the bit to 1 if it has received the Freeze command.
5	**Sync_Mode** The Device sets the bit to 1 if it has received the Sync command
6	**Not_Present** The DP Device always sets the bit to 0. The DP Master sets it to 1 for the DP Device which are not contained in the Master parameter set.
7	**Deactivated** The DP-Device always sets the bit to 0. The DP-Master sets it to 1 if the DP-Device is removed from the Master parameter set.

Status 3

Byte 2, Status 3

Bit	Meaning
0 ... 6	reserved
7	**Ext_Diag_Overflow** If this bit is set, there is more diagnostics information than indicated in **Ext_Diag_Data.** For example the DP Device sets the bit to 1 if there is more channel-specific diagnostics information than the DP Device can enter in its send buffer. A DP Master sets the bit to 1 if the DP Device sends more diagnostics information than the Master can hold in its diagnostics buffer.

Address

Byte 3, Address of the Master

Bit	Meaning
0 ... 7	**Master_Add** After parameterizing the address of the DP Master which has parameterized the DP Device is entered. If the DP Device has not be parameterized by a Master, it sets address FFhex.

Ident_Number-_High_Byte

Byte 4, Ident High

Bit	Meaning
0 ... 7	BNI PBS-506-.....: 0Chex
0 ... 7	BNI PBS-507-.....: 0Chex

Ident_Number-_Low_Byte

Byte 5, Ident Low

Bit	Meaning
0 ... 7	BNI PBS 506-...: 65hex
0 ... 7	BNI PBS 507-...: 64hex

8 Diagnostics

8.4. Device-specific diagnostics

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Header							
1	Status Typ							
2	Slot number							
3	Status specifier							
4	Status message 1							
5	Status message 2							

Note, Tip!
When coding the device-specific diagnostics:
1 = activated, 0 = deactivated

Coding of the device-specific diagnostics

Header

Byte 0, Header

Bit	Meaning
6 … 7	Header 00: Device-specific diagnostics
0 … 5	Number of the bytes

Status Typ

Byte 1, Status Typ

Bit	Meaning
7	Status Block
6-2	Not used
1	Module status
0	Not used

Slotnummer

Byte 2, Slotnummer

Bit	Meaning
0 … 7	0-254 Number of the “Slot”

Status specifier

Byte 3, Status specifier

Bit	Meaning
0 ... 7	Not used

Status message

Byte	Bit7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Module
4	3		2		1		0		Module 0-3
5	7		6		5		4		Module 4-7

Status module

00	Valid data from this module
01	Invalid data, error in the module
10	Invalid data, wrong module
11	Invalid data, missing module

8 Diagnostics

8.5. Module-specific Diagnostics

Byte	Bit 7	6	5	4	3	2	1	0
0	Header							
1	Module							

Note, Tip!
When coding the module-specific diagnostics:
1 = activated, 0 = deactivated

Coding of the module-specific Diagnostic

Header

Byte 0, Header

Bit	Meaning
6 … 7	Header 01: modulespecific diagnostic
0 … 5	Number of the bytes

Module

Byte 1, Module

Bit	Meaning
0 … 7	Module with diagnostic: 0: Head module 1: 1. IO-Link Port 2: 2. IO-Link Port 3: 3. IO-Link Port 4: 4. IO-Link Port 5..6: Reserved 7: Undervoltage

8 Diagnostics

8.6. Channel-specific diagnostics

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Header							
1	Channel							
2	Error							

Note, Tip!
When coding the channel-specific diagnostics:
1 = activated, 0 = deactivated

Mapping of the channel-specific diagnostic

Header

Byte 0, Header

Bit	Meaning
6 … 7	Header: channel-related diagnostic
0 … 5	Affected module (0-63): „decimal“ 0: Head Module 1: 1. IO-Link port 2: 2. IO-Link port 3: 3. IO-Link port 4: 4. IO-Link port 5..6: Reserved 7: Undervoltage

Channel

Byte 1, Channel

Bit	Meaning		
6 … 7	Typ: 1: Input 2: Output 3: Input and Output		
0 … 5	Number of affected channels in module (0-63) „decimal“		
	Head module		**IO-Link ports**
	00: Port 0 Pin 4 01: Port 1 Pin 4 02: Port 2 Pin 4 03: Port 3 Pin 4	04: Port 0 Pin 2 05: Port 1 Pin 2 06: Port 2 Pin 2 07: Port 3 Pin 2	00: for all errors

Error

Byte 2, Error

Bit	Meaning	
0 … 4	Errorcode (0-31): 1: Short circuit 2: Under-voltage 3: Over-voltage 4: Overload 5: Over-temperature 6: Wire break 7: Upper limit execded 8: Lower limit undershot 9: Fault	10-15: Reserved 16-22: Vendor specific 23: Actuator warning 24: Actuator short circuit 25: Low voltage bus/sensor supply 26: External diagnostic 27: Sensor has wrong configuration 28: Low voltage actuator supply 29-31: Vendor specific
5 … 7	Format (Decimal): 1: Bit 2: 2 Bit 3: 4 Bit 4: Byte 5: Word 6: 2 Words	

9 Appendix

9.1. Included material

The BNI PBS consists of the following components:

- IO-block
- 4 blind plugs M12
- Ground strap
- Screw M4x6
- 20 labels

9.2. Ordercode

BNI PBS-50x-001-Z011

Balluff Network Interface

Profibus

Functions
- 506 = IP67 IO Module, 2 x IO-Link ports
- 507 = IP67 IO Module, 4 x IO-Link ports

Variants
- 001 = Standard version

Mechanical version
- Z011 = Material:Die-cast zinc, matt nickel plated
  Profibus ports: 1 x M12x1 internal thread, 1x M12 external thread
  Power: 7/8“ external thread
  IO-Ports: 4 x M12 internal thread

9.3. Order information

Product ordering code	Order code
BNI PBS-506-001-Z011	BNI003M
BNI PBS-507-001-Z011	BNI003P

9 Appendix

9.4. ASCII-Tabelle

Decimal	Hex	Control Code	ASCII
0	00	Ctrl @	NUL
1	01	Ctrl A	SOH
2	02	Ctrl B	STX
3	03	Ctrl C	ETX
4	04	Ctrl D	EOT
5	05	Ctrl E	ENQ
6	06	Ctrl F	ACK
7	07	Ctrl G	BEL
8	08	Ctrl H	BS
9	09	Ctrl I	HT
10	0A	Ctrl J	LF
11	0B	Ctrl K	VT
12	0C	Ctrl L	FF
13	0D	Ctrl M	CR
14	0E	Ctrl N	SO
15	0F	Ctrl O	SI
16	10	Ctrl P	DLE
17	11	Ctrl Q	DC1
18	12	Ctrl R	DC2
19	13	Ctrl S	DC3
20	14	Ctrl T	DC4
21	15	Ctrl U	NAK
22	16	Ctrl V	SYN
23	17	Ctrl W	ETB
24	18	Ctrl X	CAN
25	19	Ctrl Y	EM
26	1A	Ctrl Z	SUB
27	1B	Ctrl [	ESC
28	1C	Ctrl \	FS
29	1D	Ctrl]	GS
30	1E	Ctrl ^	RS
31	1F	Ctrl _	US
32	20		SP
33	21		!
34	22		„
35	23		#
36	24		$
37	25		%
38	26		&
39	27		‘
40	28		(
41	29		)
42	2A		*

Decimal	Hex	ASCII
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U

Decimal	Hex	ASCII
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	[
94	5E	^
95	5F	_
96	60	`
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	DEL

10 Notes

10 Notes

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