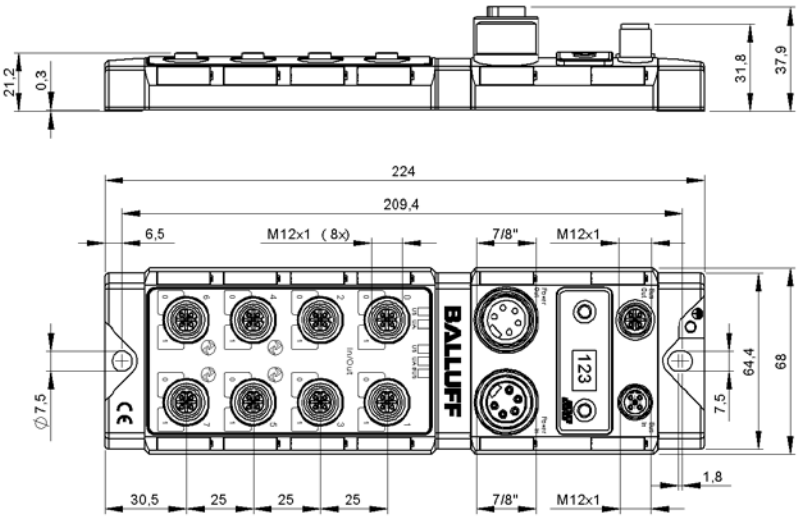
BNI PBS-502-101-Z001

Profibus IO-Link Master

User's Guide



Contents

1 Notes for the user

1.1 Structure of the manual

The manual is organized so that the sections build on each other.
Section 2: Basic safety information.
…..

1.2 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.

1.3 Symbols

Note
This symbol indicates general notes.

Attention!
This symbol indicates a safety instruction that must be followed without exception.

1.4 Abbreviations

BCD	Binary coded switch
BNI	Balluff Network Interface
EMC	Electromagnetic Compatibility
FE	Function ground
GSD file	Generic Station Description
I-port	Digital input port
LSB	Least Significant Bit
MSB	Most Significant Bit
O-port	Digital output port
PELV	Protective Extra Low Voltage
PLC	Programmable Logic Controller
Profibus-DP	Profibus Decentralized Periphery
SELV	Safety Extra Low Voltage

1.5 Divergent views

Product views and images can differ from the specified product in this manual. They serve only as an illustration.

2 Safety

2.1 Intended use

The BNI PBS-... serves as a decentralized input and output module for connecting to a Profibus-DP network. The integrated IO-Link ports enable simple linking of IO-Link capable sensors and actuators. The module may be used only for this purpose in an industrial environment corresponding to Class A of the EMC Law.

1.1. Installation and Startup

Attention!
Installation and startup are to be performed by trained technical personnel only. Skilled specialists are people who are familiar with the work such as installation and the operation of the product and have the necessary qualifications for these tasks. Any damage resulting from unauthorized tampering or improper use shall void warranty and liability claims against the manufacturer. The operator is responsible for ensuring that the valid safety and accident prevention regulations are observed in specific individual cases.

2.2 General safety notes

Commissioning and inspection
Before commissioning, carefully read the User's Guide.
The system must not be used in applications in which the safety of persons depends on the function of the device.
Intended use
Warranty and liability claims against the manufacturer shall be rendered void by damage from:

- Unauthorized tampering
- Improper use
- Use, installation or handling contrary to the instructions provided in this User's Guide.

Obligations of the owner/operator!
The device is a piece of equipment in accordance with EMC Class A. This device can produce RF noise. The owner/operator must take appropriate precautionary measures against this for its use. The device may be used only with a power supply approved for this. Only approved cables may be connected.
Malfunctions
In the event of defects and device malfunctions that cannot be rectified, the device must be taken out of operation and protected against unauthorized use.
Approved use is ensured only when the housing is fully installed.

1.2. Resistance to Aggressive Substances

Attention!
The BNI modules always have good chemical and oil resistance. When used in aggressive media (such as chemicals, oils, lubricants and coolants, each in a high concentration (i.e. too little water content)), the material must first be checked for resistance in the particular application. No defect claims may be asserted in the event of a failure or damage to the BNI modules caused by such aggressive media.

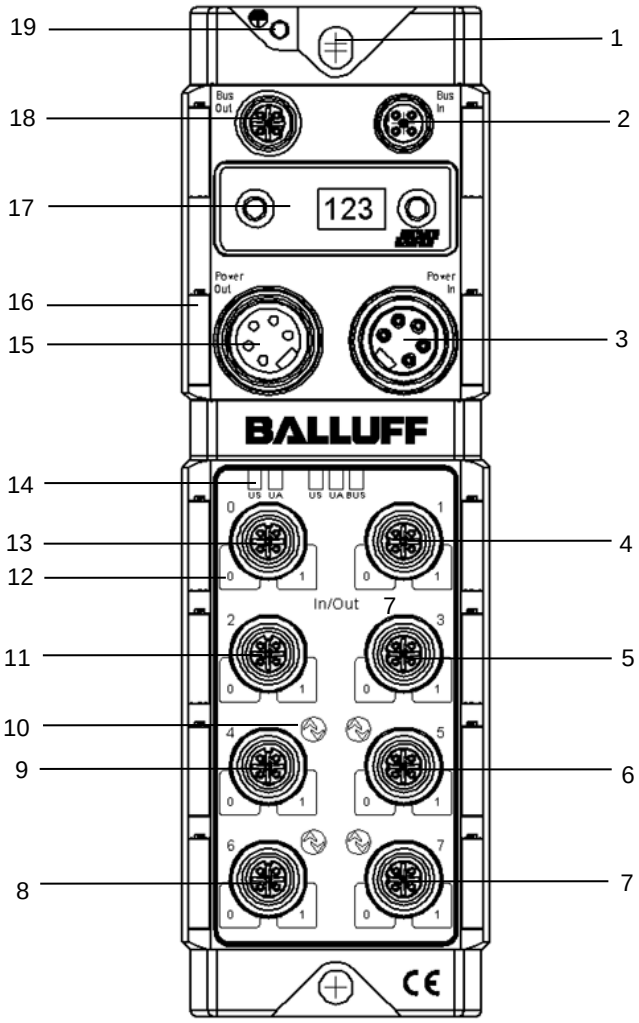
Dangerous Voltage

Attention!
Before working on the device, switch off its power supply.

Note
In the interest of continuous improvement of the product,
Balluff GmbH reserves the right to change the technical data of the product and the content of these instructions at any time without notice.

3 Connection overview

3.1 Connection overview BNI PBS-502-101...



1	Mounting hole	11	Port 2 (standard I/O)
2	Profibus input	12	Port LEDs
3	Power input	13	Port 0 (standard I/O)
4	Port 1 (standard I/O)	14	Module LEDs
5	Port 3 (standard I/O)	15	Power output
6	Port 5 (IO-Link/standard I/O)	16	Part label
7	Port 7 (IO-Link/standard I/O)	17	Display
8	Port 6 (IO-Link/standard I/O)	18	Profibus output
9	Port 4 (IO-Link/standard I/O)	19	Ground
10	Designation IO-Link port		

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 8 standard I/O ports.
Connection to Profibus using 2 × M12×1 round connectors.
Electrical power 24 V DC using 7/8“ round connector.

Connection options:
A total of 8 ports that can be freely configured are available, each with 2 switching contacts.

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 PLCs, PCs, 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 signals) in addition to the binary process signals over the IO-Link interface.

Compatibility with standard I/O:

- IO-Link sensors 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, 20 m cable length.
- Communication using 24V pulse modulation, standard UART protocol.
- Maximum current draw: per sensor 200 mA/per actuator 1.6 A.

Module developed according to IO-Link specification 1.1

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 2 ms cycle time for 16 bits of process data and 38.4 Kbaud transmission rate.

Service data (diagnostics, parameters):

- Parallel and reactionless process data

Standard IO mode (SIO mode)

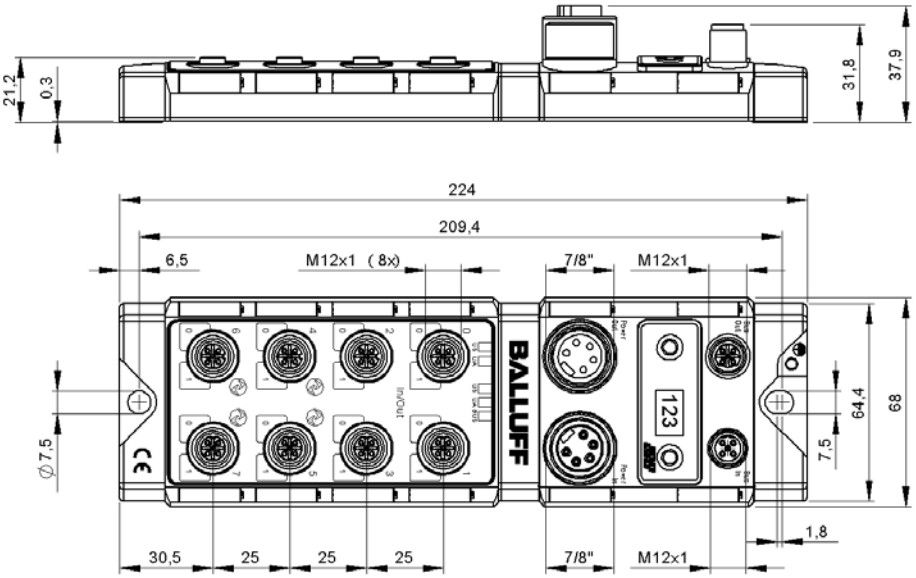
- Startup parameter setting possible using communication, then
- binary switching signal

4.5 Replacing modules

The BNI PBS-... modules are upward compatible. A defective module can be replaced with a module which has a greater or at least the same functionality.

5 Technical data

5.1 Dimensions



5.2 Mechanical data

Housing material	Die-case zinc, matte nickel plated
Fieldbus	Profibus: M12, B-coded (male and female)
Power supply	5-pin, 7/8" (male and female)
I/O ports	M12, A-coded (8x female)
Enclosure rating	IP67 (only when plugged-in and screwed-in)
Weight	approx. 735 g

5.3 Electrical data

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

5.4 IO-Link data

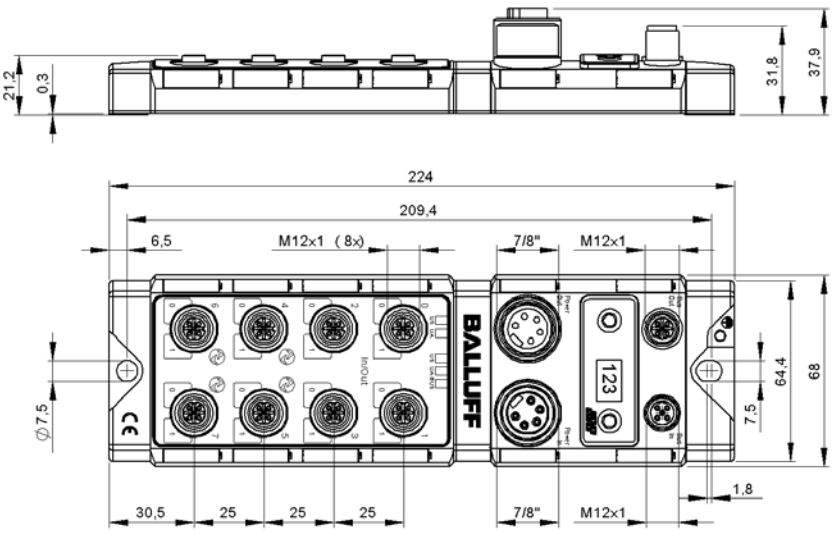
Baudr rate	COM 1, 2, 3
Frame type	1, 2.x, 3
Minimum cycle time	2.3 ms

5.5 Operating conditions

Operating temperature Storage temperature range	-5 C … 70°C -25 C … 70°C

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.

The BNI PBS-... is attached using two max. M6 screws and two washers.

Note

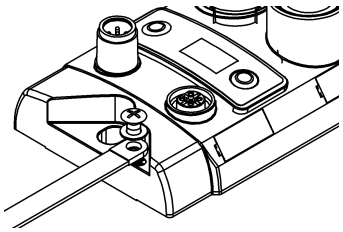
Recommended hole dimension: 210.5 ±0.2 mm **(when using M6 screws!).** All IP67 Profibus/Profinet splitter boxes can be mounted when this hole diameter is used.

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

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

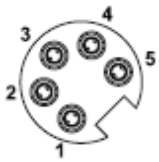
6 Installation

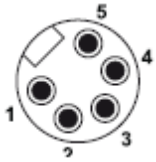
Supply voltage

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.

Attention!
The use of a Profibus hybrid cable is not permitted.

Power IN (7/8", 5-pin, male) Power OUT (7/8", 5-pin, female)





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

- 24 V DC.
- Use different power sources for the sensor/bus and for the actuator if possible to minimize noise susceptibility.
- Total current < 9 A. The total current of all modules may not exceed 9 A even when daisy chaining the actuator supply.

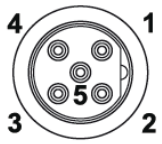
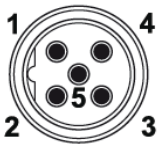
Note
Module and connected sensors are powered by the "module and sensor supply", while the "actuator supply" powers all outputs. The only exception is pin 4 on all IO Link ports. Here the outputs are powered by the sensor supply.

Note
The sensor supply and actuator supply should be powered from different electricity sources wherever 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(+5V)
		2	RxD/TxD-N, A line (green)
		3	DGND
		4	RxD/TxD-P, B line (red)
		5	n.c.
		Thread	Shield/FE

Connection information

- Connect protective ground to FE
- Connect the incoming Profibus line to Profibus IN
- Connect the secondary Profibus line to Profibus OUT and connect to downstream device or use terminating resistor.

Note

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.

Attention!

Pin 1 on the male connector (VP) is only required for the terminating resistor and is coupled via the Profibus. Any voltages connected directly to the pin may damage the module.

6.4 Ports

Eight I/O ports (standard I/O and/or IO-Link) are provided for connecting the actuators/sensors.

I/O ports

Standard I/O port M12, A-coded, female

PIN	Function
1	+ 24 V, max. 200mA
2	Input / output max. 2A / diagnostics input
3	0 V / GND
4	Input / output max. 2A
5	FE

Note
For the digital sensor inputs, read the input guideline specified in EN 61131-2, Type 2.

IO-Link port

IO-Link port M12, A-coded, female

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

Note
Due to limited CPU resources, only a maximum of three IO-Link-devices with COM3 speed can be reliably handled. It is therefore recommended not to use all 4 IO-Link-Ports for COM3 IO-Link Devices simultaneously.

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

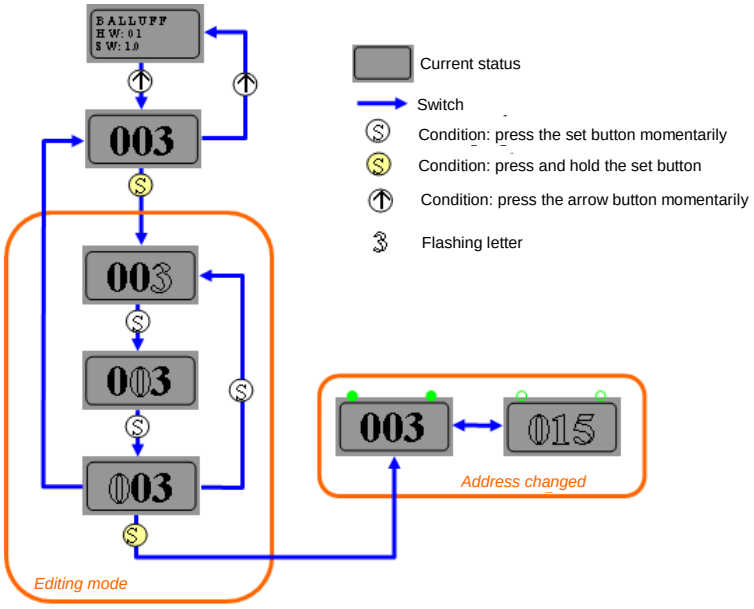
The Profibus address is set directly on the BNI PBS-... using two buttons on the display. Permissible address range 0...125.

Addressing

Each Profibus node must have a unique address assigned to it. The address is loaded once from the hard disk after the power is turned on. Any change to the address is saved immediately but does not become effective until power is reset on the module.

Menu structure

The display on the BNI PBS-xxx-101-Z001 has the following menu structure. You can navigate between the different menu items using the buttons.



Address setting

The bus address is set on the display. Editing mode is activated when the "S" button is pressed for longer than 3s. A flashing status value indicates that editing mode is active. In this case, pressing the " ↑ " button increases the value by one. When the required value is reached, the next status value can be selected by pressing the "S" button again. The value is changed by pressing the " ↑ " button.
Pressing the "S" button in editing mode for more than approx. 10s saves the address currently selected. Although this address is saved, it is not yet active. The display LEDs and address flash to indicate that this status is active. The new address is only adopted after the power is reset.
If no buttons are pressed in editing mode within 10 seconds, the module exits editing mode without saving the address.

The display buttons can be locked by the PLC. A key symbol on the display indicates that this status is active.

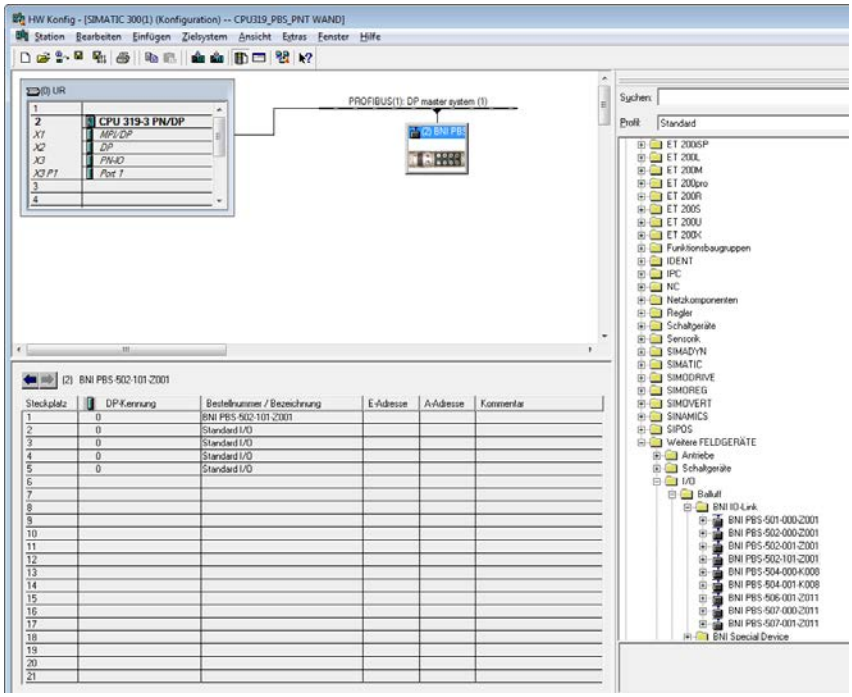
7.2 Integration in project planning software

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 perform 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 product tree and can be integrated in a Profibus network.

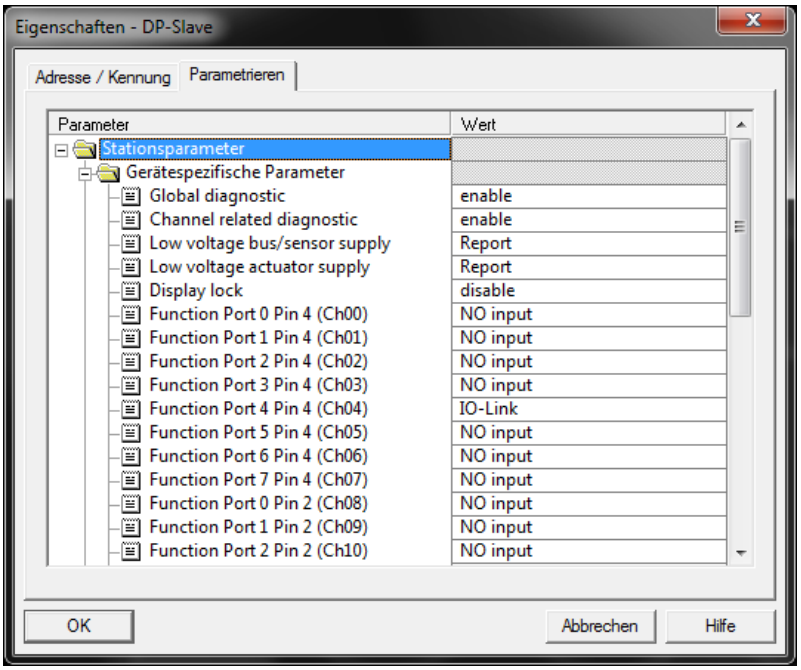


The header module (BNI PBS-502-101-Z001) must always be assigned to slot 1.
In the default configuration, the placeholder "Module standard I/O" is assigned to slots 2 to 5. The structure shown here [header module + 4x standard I/O] must always be maintained, whereby standard I/O can be replaced with IO-Link_X/X.

7 Startup

Specifying the properties

- Double-click the module in slot 1 (header module)
  - The "Properties - PROFIBUS Interface DP" window opens.
- The functions of the respective pin can be configured under "Parameterize".



Module settings

Global diagnostics:

- This function can be used to permit / suppress all diagnostics messages of the module. (optical diagnostics signals / diagnostic modules are not affected)
- Sensor supply undervoltage:
- This function can be used to permit / suppress the diagnostics message Sensor supply undervoltage. (optical diagnostics signals / diagnostics modules are not affected)
- Actuator supply undervoltage:
- This function can be used to permit / suppress the diagnostics message Actuator supply undervoltage. (optical diagnostics signals / diagnostics modules are not affected)
- Display lock:
- The address in the display can be locked to prevent manual access.

Port functions

NO contact	Input as NO contact
NC contact	Input as NC contact
Outputs	Output
Diagnostics input	Desina function
IO-Link	IO-Link function
NO contact after parameterization	Parameterization via IO-Link, followed by standard I/O function (NO contact)
NC contact after parameterization	Parameterization via IO-Link, followed by standard I/O function (NC contact)

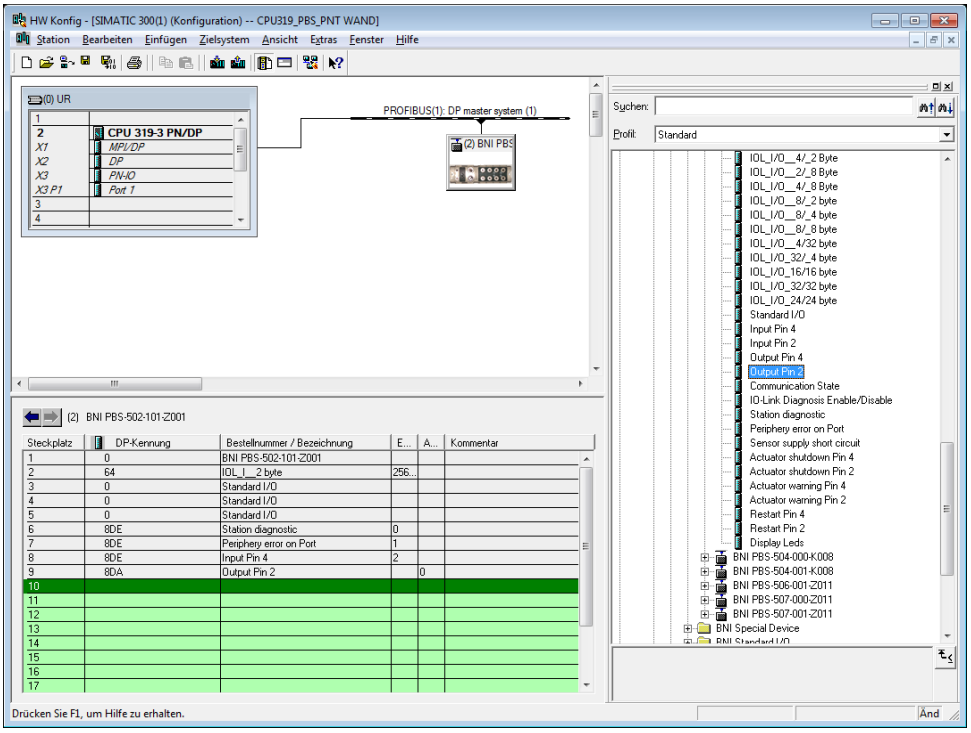
Safe state

- This function is a supplement to an output configuration of the respective port pin.
- For each port pin, a safe status can be predefined which is assumed in the event of a failure in bus communication.

Configuring the slots

When an IO- Link interface is activated, the IO-Link module from the catalog, which corresponds to the process data of the IO-Link device must be integrated in the slots (2…5).

For example, IO-Link is the function selected for port 4 pin 4 in the header module on the previous page. Now the placeholder module (slot 2) related to the port must be deleted and an IO-Link module integrated.
In this example, the IO-Link module IOL_I_2byte was selected, which is suitable for an IO-Link device with a maximum of 2 bytes of input process data.



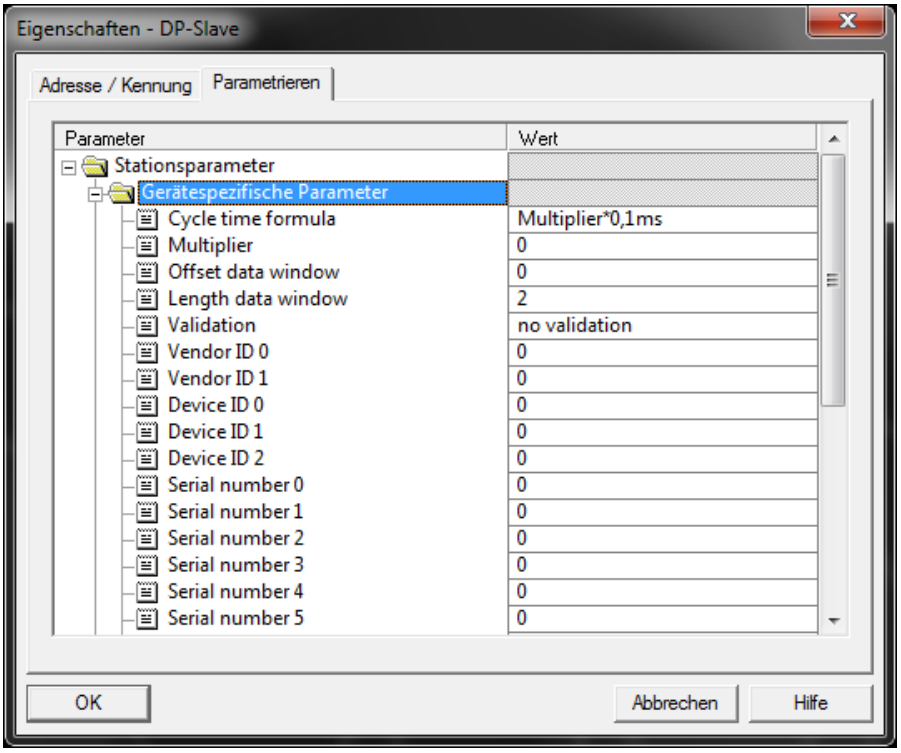
Auxiliary modules

Finally, additional modules such as input pin 4, output pin 2 (for process data) or the "Station diagnostics" module (for simplified diagnostics evaluation) can be configured

7 Startup

IO-Link configuration

Double-click on the IO-Link module to change the IO-Link parameters of the respective port pins.



Parameter server

Parameter server switched on:

Switched on: Data management functions active, data is saved remanently
Switched off: Data management functions deactivated, saved data is deleted.

Enable upload:
Select whether an upload of parameter data to the data management of the IO-Link master is to be carried out or not.
An upload is carried out:
if the configuration allows and a compatible device with an active upload request flag is connected.

If a device requests an upload and the configuration prevents it, a download (if activated) will be started if the parameter checksum is different.

Note
If no data or no valid data is stored on the parameter server and uploading is activated, an upload always starts when communication is established.

Enable download:
Select whether a download of parameter data to the data management of the IO-Link devices is to be carried out or not.

A download is carried out when:
- different parameter data is available (device data compared with data management data for this port)
- no uploads are requested
- downloads are permitted.

7 Startup

7.3 Configuration via hex string

Normally the configuration is carried out via a graphic interface that compiles the configuration string automatically. The module is configured in 2 steps: configuration and then parameterization.

7.4 Example

Sample configuration for

- Port 4-6 to the IO-Link (device with 2 bytes of input process data)
- The remaining switching contacts are configured to the input (NO contact).

BNI PBS-502-101-Z001	Header module	0x0
IOL_I__2 bytes	Port 4	0x40, 0x81
IOL_I__2 bytes	Port 5	0x40, 0x81
IOL_I__2 bytes	Port 6	0x40, 0x81
IOL_I__2 bytes	Port 7	0x40, 0x81

(Ports 4-7 are configured specially as modules because if an IO-Link configuration is made, the process data must be displayed. The switching contacts are configured in the parameters of the header module.)

The required hex parameters are arranged one after the other in a configuration string (all values in HEX)
00, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81.

If modules such as input pin 4 / input pin 2 (0x10) are configured, the corresponding hex parameters must be attached
00, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81, 10, 10

Note
If modules such as input pin 4 / input pin 2 (0x10) are configured, the corresponding hex parameters must be attached, e.g. 00, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81, 0x40, 0x81, 10, 10

The following hex parameters are required to parameterize the modules:

C0 00 00	DPV1 statuses
2F 00 44 44 00 00 00 00 00 00	Header module
10 00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	IO-Link port 4
10 00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	IO-Link port 5
10 00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	IO-Link port 6
10 00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	IO-Link port 7

Hex parameters for the modules

BNI PBS-502-101-Z001	0x0	0x00* , 0x00, 0x00
Standard I/O	0x0	0xE0
SIO mode after param	0x0	0x20
IOL_I__1 byte	0x40, 0x80	0x10
IOL_I__2 bytes	0x40, 0x81	0x10
IOL_I__4 bytes	0x40, 0x83	0x10
IOL_I__6 bytes	0x40, 0x85	0x10
IOL_I__8 bytes	0x40, 0x87	0x10
IOL_I__10 bytes	0x40, 0x89	0x10
IOL_I__16 bytes	0x40, 0x8f	0x10
IOL_I__24 bytes	0x40, 0x97	0x10
IOL_I__32 bytes	0x40, 0x9F	0x10
IOL_O__1 byte	0x80, 0x80	0x10
IOL_O__2 bytes	0x80, 0x81	0x10
IOL_O__4 bytes	0x80, 0x83	0x10
IOL_O__6 bytes	0x80, 0x85	0x10
IOL_O__8 bytes	0x80, 0x87	0x10
IOL_O__10 bytes	0x80, 0x89	0x10
IOL_O__16 bytes	0x80, 0x8F	0x10
IOL_O__24 bytes	0x80, 0x97	0x10
IOL_O__32 bytes	0x80, 0x9F	0x10
IOL_I/O__1/_1 byte	0xC0, 0x80, 0x80	0x10
IOL_I/O_2/2 bytes	0xC0, 0x81, 0x81	0x10
IOL_I/O__2/_4 bytes	0xC0, 0x83, 0x81	0x10
IOL_I/O__4/_4 bytes	0xC0, 0x83, 0x83	0x10
IOL_I/O__4/_2 bytes	0xC0, 0x81, 0x83	0x10
IOL_I/O__2/_8 bytes	0xC0, 0x87, 0x81	0x10
IOL_I/O__4/_8 bytes	0xC0, 0x87, 0x83	0x10
IOL_I/O__8/_2 bytes	0xC0, 0x81, 0x87	0x10
IOL_I/O__8/_4 bytes	0xC0, 0x83, 0x87	0x10
IOL_I/O__8/_8 bytes	0xC0, 0x87, 0x87	0x10
IOL_I/O__4/32 bytes	0xC0, 0x9F, 0x83	0x10
IOL_I/O_32/_4 bytes	0xC0, 0x83, 0x9F	0x10
IOL_I/O_16/16 bytes	0xC0, 0x8F, 0x8F	0x10
IOL_I/O_32/32 bytes	0xC0, 0x9F, 0x9F	0x10
IOL_I/O_24/24 bytes	0xC0, 0x97, 0x97	0x10

7 Startup

Hex parameters for the modules

Input pin 4	0x10	0xE1
Input pin 2	0x10	0xE2
Output pin 4	0x20	0xE3
Output pin 2	0x20	0xE4
Communication state	0x10	0x30
IO-Link diagnosis enable/disable	0x20	0x40
Station diagnostic	0x10	0x50
Periphery error on port	0x10	0x60
Sensor supply short circuit	0x10	0x70
Actuator shutdown pin 4	0x10	0x80
Actuator shutdown pin 2	0x10	0x90
Actuator warning pin 4	0x10	0xA0
Actuator warning pin 2	0x10	0xB0
Restart pin 4	0x20	0xC0
Restart pin 2	0x20	0xD0
Display LEDs	0x20	0xE5

7.5 Parameterizing the modules

A string is generated, similar to when the modules are configured.
The string consists of the following blocks:
DPV1 status 1, DPV1 status 2, DPV1 status 3, header module,
IO-Link port 4, IO-Link port 5, IO-Link port 6, IO-Link port 7

DPV1 statuses

DPV1 status 1

7	6	5	4	3	2	1	0	
								reserved
								reserved
								Time base of the watchdog is 1ms
								reserved
								reserved
								The slave operates as a publisher
							E	The slave operates in Fail_Safe mode
							E	The slave opens the MS1 channel (DPV1)

DPV1 status 2

7	6	5	4	3	2	1	0	
								Reduced configuration control
								reserved
								Switch on update alarm
								Switch on status alarm
								Switch on manufacturer-specific alarm
								Switch on diagnostics alarm
								Switch on process alarm
								Switch on insert alarm (pull-plug)

DPV1 status 2

7	6	5	4	3	2	1	0	
							0	1 Every type of alarm possible
							1	2 Every type of alarm possible
							2	4 Every type of alarm possible
							3	8 Every type of alarm possible
							4	12 Every type of alarm possible
							5	16 Every type of alarm possible
							6	24 Every type of alarm possible
							7	32 Every type of alarm possible
								Isochronous mode supported
								Structured parameters possible
								reserved
								reserved
								Parameter command switched on

7 Startup

7.6 Header module

Diagnostics

Byte 0		
7		
6		
5		
4		
3		
2		
1		
0		
	E	Activate global diagnostics
	E	Activate channel-dependent diagnostics
	E	Activate undervoltage diagnostics US
	E	Activate undervoltage diagnostics UA
		Activate display lock
	E	Sensor short circuit evaluation for outputs
		reserved
		reserved

Port configuration

Byte 1	
7	
6	
5	
4	
3	
2	
1	
0	
	Function(1) port 0 pin 4
	Function(1) port 1 pin 4
	Function(1) port 2 pin 4
	Function(1) port 3 pin 4

Byte 2	
7	
6	
5	
4	
3	
2	
1	
0	
	Function(2) port 4 pin 4
	Function(2) port 5 pin 4

Byte 3	
7	
6	
5	
4	
3	
2	
1	
0	
	Function(2) port 6 pin 4
	Function(2) port 7 pin 4

Byte 4	
7	
6	
5	
4	
3	
2	
1	
0	
	Function(3) port 0 pin 2
	Function(3) port 1 pin 2
	Function(3) port 2 pin 2
	Function(3) port 3 pin 2

Byte 5	
7	
6	
5	
4	
3	
2	
1	
0	
	Function(3) port 4 pin 2
	Function(3) port 5 pin 2
	Function(3) port 6 pin 2
	Function(3) port 7 pin 2

Safe state

Byte 6								
7	6	5	4	3	2	1	0	
								Function(4) port 0 pin 4
								Function(4) port 1 pin 4
								Function(4) port 2 pin 4
								Function(4) port 3 pin 4

Byte 7								
7	6	5	4	3	2	1	0	
								Function(4) port 4 pin 4
								Function(4) port 5 pin 4
								Function(4) port 6 pin 4
								Function(4) port 7 pin 4

Byte 8								
7	6	5	4	3	2	1	0	
								Function(4) port 0 pin 2
								Function(4) port 1 pin 2
								Function(4) port 2 pin 2
								Function(4) port 3 pin 2

Byte 9								
7	6	5	4	3	2	1	0	
								Function(4) port 4 pin 2
								Function(4) port 5 pin 2
								Function(4) port 6 pin 2
								Function(4) port 7 pin 2

7 Startup

Bit mapping functions

	Function (1)
0	Input (NO contact)
1	Input (NC contact)
2	reserved
3	Output

	Function (2)
0	Input (NO contact)
1	Input (NC contact)
2	reserved
3	Output
4	IO-Link
5	IO-Link mode (NO contact)
6	IO-Link mode (NC contact)
7 - 16	reserved

	Function (3)
0	Input (NO contact)
1	Input (NC contact)
2	Diagnostics input
3	Output

	Function (4) in event of fault
0	Output inactive
1	Output active
2	Maintain last status
3	reserved

IO-Link port x The same parameters are always required to parameterize the IO-Link module

Byte 0									
7	6	5	4	3	2	1	0		
10 hex								E	Identifier for IO-Link modules

Byte 1								
7	6	5	4	3	2	1	0	
0 .. 3F hex								Multiplier
								Time base (1)

Byte 2									
7	6	5	4	3	2	1	0		
0 .. 1F hex									Offset

Byte 3									
7	6	5	4	3	2	1	0		
0 .. 20hex								E	Data window length

Byte 4								
7	6	5	4	3	2	1	0	
0 hex								No validation
40 hex								Validation compatibility
80 hex								Validation identity

Byte 5	
0 .. FF hex	Vendor ID 0
Byte 6	
0 .. FF hex	Vendor ID 1
Byte 7	
0 .. FF hex	Device ID 0
Byte 8	
0 .. FF hex	Device ID 1
Byte 9	
0 .. FF hex	Device ID 2

7 Startup

Byte 10	
0 .. FF hex	Serial number byte 1
Byte 11	
0 .. FF hex	Serial number byte 2
Byte 12	
0 .. FF hex	Serial number byte 3
Byte 13	
0 .. FF hex	Serial number byte 4
Byte 14	
0 .. FF hex	Serial number byte 5
Byte 15	
0 .. FF hex	Serial number byte 6
Byte 16	
0 .. FF hex	Serial number byte 7
Byte 17	
0 .. FF hex	Serial number byte 8
Byte 18	
0 .. FF hex	Serial number byte 9
Byte 19	
0 .. FF hex	Serial number byte 10
Byte 20	
0 .. FF hex	Serial number byte 11
Byte 21	
0 .. FF hex	Serial number byte 12
Byte 22	
0 .. FF hex	Serial number byte 13
Byte 23	
0 .. FF hex	Serial number byte 14
Byte 24	
0 .. FF hex	Serial number byte 15
Byte 25	
0 .. FF hex	Serial number byte 16

Byte 26									
7	6	5	4	3	2	1	0		
							1		Allow upload
						1			Allow download
	1	1	1	1	1				reserved
1									Activate parameter server

7.7 Bit mapping and function

Bit mapping and function of the configurable modules in the catalog

Inputs pin 4
Inputs pin 2
Outputs pin 4
Outputs pin 2

Signal from configured inputs or outputs are depicted in the modules inputs pin 4 / inputs pin 2 and outputs pin 4, outputs pin 2.

The module "Inputs pin 2" also depicts the diagnostics inputs of the Desina function.

Bit mapping is the same for all 4 module types:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

IO–Link modules

The IO-Link modules always have the same structure:

IOL_I/O_x/xbytes
- number of process data items used (should be equal to or greater than the process data length of the IO-Link device)
- I = Input data
- O = Output data
- I/O = Both input and output data

Actuator deactivate pin 4
Actuator deactivate pin 2

Depicts a short circuit between a set output to ground at the respective port pin.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

Actuator warning pin 4
Actuator warning pin 2

Feedback if a voltage is being fed at an output that is not set.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

Restart pin 4
Restart pin 2

If this function is configured, after an actuator short-circuit no automatic restart is carried out, but rather the port must be activated by inserting the corresponding bit.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

7 Startup

Switching IO-Link diagnostics on / off

If this function is configured, the IO-Link diagnostics are deactivated for all ports and can be reactivated for the desired ports.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

IO-Link communication

Bit status for each IO-Link port; feedback as to whether communication is established.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

Peripheral error, socket

Feedback as to at which port an error occurred.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

Sensor supply Short circuit

Feedback as to at which port a sensor supply short circuit is pending.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0

Station diagnostics

Feedback as to which fault occurred.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Res.	Actuator Warning	Actuator Short circuit	Sensor voltage Short circuit	External error	Res.	US actuator	US sensor

Display LED

Display functions

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Res.	Res.	Res.	Res.	Res.	Res.	Green LED	Red LED

7.8 IO-Link functions

Explanation of the possible settings in the properties of the IO-Link port

Cycle settings

This parameter can be used to influence the IO-Link communication speed
The basic cycle time can be adjusted via the scroll-down menu; the multiplicator can be adjusted decimally from 0..63.

Time base		Calculation	Cycle time
00	0.1ms	Multiplier * time base	0.4ms ... 6.4 ms
01	0.4ms	6.4 ms + Multiplier * time base	6.4ms … 31.6ms
10	1.6 ms	32.0 ms + Multiplier * time base	32.0 ms … 132.8 ms
11	reserved	reserved	reserved

Data section

The Offset can be used by the start byte with length to define the end byte of the process data. This setting is only for the input data, has no influence on the actual process data length and is for visual purposes only.

Validation

No validation: Validation deactivated, IO-Link devices not tested
Compatibility: Manufacturer ID and device ID are compared to the module data.
IO-Link communication only starts if there is a match.
Identity: Check the manufacturer ID, device ID and serial number and compare with the IO-Link device data. IO-Link communication only starts if there is a match.

Read the operating manual accompanying the device to locate the vendor ID, device ID and the serial numbers. This information must be entered decimally and byte by byte.

Parameter server

Parameter server switched on:
Switched on: Data management functions active, data is saved remanently
Switched off: Data management functions deactivated, saved data is deleted.

Enable upload:
Select whether an upload of parameter data to the data management of the IO-Link master is to be carried out or not.
An upload starts as soon as it is allowed in the configuration and requested by the device via the upload request flag.

If the upload is disabled, no data upload will be started. If a device requests an upload, as an upload is not permitted but there is a different parameter checksum, a download (if activated) will be started.

Enable download:
Select whether a download of parameter data to the data management of the IO-Link devices is to be carried out or not.

If the download is activated, as soon as there is different parameter data (device in comparison to the saved data in the master) and an upload is not requested or permitted, a download of the parameter data is carried out.

8 Configuration of IO-Link devices

Telegram structure

In order to parameterize an IO-Link device, a telegram must be compiled and sent to the IO-Link master via Profibus.

The following structure must be maintained:

IOL_Call

DP-V1 header	Function number	1Byte	5F hex 5E hex	Fix "Write" Fix "Read"
	reserved	1Byte	00 hex	
	CAP	1Byte	FF hex	CAP for Balluff IO-Link master
	Length	1Byte	0…F1 hex	Length of the following header + number of data records to be written

Call header	Extend function number	1Byte	08 hex	Fix "Call"
	Port	1Byte	05…08 hex	Master port +1 (e.g. Port 4 = "5")
	FI_Index	2Byte	FE 4A hex	I&M Index

IOL header	Control byte	1Byte	00..03hex	00 = Reserved 01 = Reserved 02 = write 03 = read
	IOL Index	2Byte	00 00 - FF FF	IO-Link index See also manual of the IO-Link device
	IOL subindex	1Byte	00..FF	Subindex of the IO-Link device

Object	Data	232 bytes Max.		Data

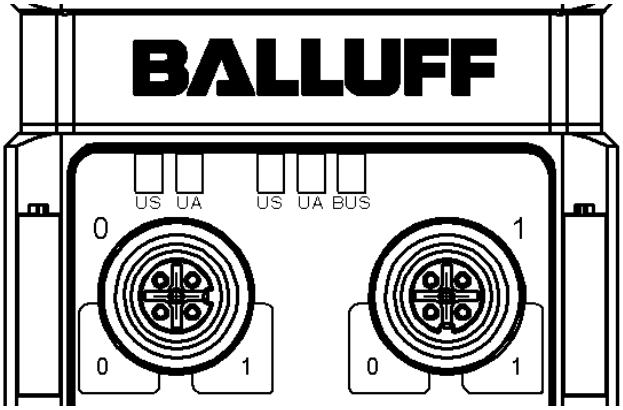
A sample project with the IO_Call function module from Siemens AG can be downloaded on the Balluff homepage.

9 Diagnostics

9.1 Function Indicators

The status of the supply voltages is indicated by the Status LEDs 1 to 5.

LED indicators



Module LEDs

LED	Display	Function
US	Green, illuminated and stays on	US "sensors" power supply on
UA	Green, static	UA "actuators" power supply on
US	Red, static	US "sensors" power supply undervoltage
UA	Red, static	UA "actuators" power supply undervoltage
Bus	Green, static Green, flashing	BUS, data transmission with master active BUS, data transmission with master inactive

I/O port LEDs

Channel-dependent diagnostics are indicated by the Port LEDs.
Each M12 port (I/O interface) is assigned two 2-color LEDs which indicate the configuration or operating states.

LED "0" - PIN 4, LED "1" - PIN 2

Display	Function		
	Output	Input	Diagnostics input
Off	Signal = 0	Signal = 0	Diagnostics 0
Yellow	Signal = 1	Signal = 1	
Red	I Output > Imax	SS*	Diagnostics = 1 or SC

*SS= Short circuit on PIN 1. In this case both LEDs are red**.**

IO-Link port LEDs

Two LEDs are assigned to each IO-Link port to display the operating states.

LED "0" - PIN 4, LED "1" - PIN 2

Display	Function			
	IO-Link	Output	Input	Diagnostics input
Off	-	Signal = 0	Signal = 0	Diagnostics 0
Yellow	-	Signal = 1	Signal = 1	
Red	-	I Output > Imax	SS*	Diagnostics = 1 or SC
Green	IO-Link communication active	-	-	-
Green, flashing	No IO-Link communication	-	-	-

*SS= 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.

9 Diagnostics

9.2 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 specifier-related diagnostics information (2 bytes each). For each channel-dependent diagnostic, 3 bytes of diagnostics information are added (min. 6 and max. 244 bytes).

9.3 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	Indent_Number_High_Byte: 0Bhex							
5	Indent_Number_Low_Byte: 1Ahex							

Note
The following applies for the coding of 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-Slave always sets the bit to 0. The DP-Master sets it to 1 if the DP-Slave cannot be reached.
1	Station_not_ready The DP Slave sets the bit to 1 if it is not yet ready for data exchange.
2	Cfg_Fault The DP Slave sets the bit to 1 if the configuration data last received from the Master do not agree with those which the DP Slave determined.
3	Ext_diag If the bit is set to 1, there is a diagnostics entry in the slave-specific diagnostics area (Ext_Diag_Data). A further diagnostic follows in the telegram.
4	Not supported The DP Slave sets the bit to 1 if a function was requested which is not supported.
5	Invalid_Slave-Response The DP slave always sets the bit to 0. The DP master sets it to 1 if the DP slave sends an implausible response.
6	Prm_fault The DP slave sets the bit to 1 if the last parameter telegram was incorrect (e.g. incorrect length, incorrect identification number, invalid parameters).
7	Master_lock The DP Slave always sets the bit to 0. The DP Master sets it to 1 if the DP Slave 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).

Status 2

Byte 1, status 2

Bit	Meaning
0	Prm_req The DP Slave 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 (static diagnostic) The Slave 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 Slave sets the bit to 1 if it has received the Freeze command.
5	Sync_Mode The Slave sets the bit to 1 if it has received the Sync command.
6	Not_Present The DP slave always sets the bit to 0. The DP master sets it to 1 for the DP slaves that are not included in the master parameter set.
7	Deactivated The DP-Slave always sets the bit to 0. The DP-Master sets it to 1 if the DP-Slave 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 slave sets the bit to 1 if there is more channel-dependent diagnostics information than the DP slave can enter in its send buffer. A DP Master sets the bit to 1 if the DP Slave 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 Slave is entered. If the DP Slave 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-501-.../502-...: 0Bhex

Ident_Number_ Low_Byte

Byte 5, Ident Low

Bit	Meaning
0 ... 7	BNI PBS 502-...: 0Ahex

9 Diagnostics

9.4 Device-specific diagnostics

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

Note
The following applies for the coding of device-specific diagnostics:
1 = activated, 0 = deactivated

Coding for devicespecific diagnostics

Header

Byte 0, header

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

Status type

Byte 1, status type

Bit	Meaning		
7	1=Status block, 0= Alarm block		
0 - 6	Status code	30	Acknowledgment for a parameter command
	0 Reserved	31	Status read
	1 Status message	32..126	Manufacturer-specific
	2 Module status	127	Reserved
	3 DXB Link status		
	4.29 Reserved		

Slot number

Byte 2, slot number

Bit	Meaning
0 … 7	Number of the slot

Status specifier

Byte 3, status specifier

Bit	Meaning
0 ... 7	Status specifier is always 0.

Status message 1

Byte 4, status message 1

Bit	Meaning
0 ... 7	Status of modules 0-3: 0: Valid data from this module 1: Invalid data, defect in module 2: Invalid data, incorrect module 3: Invalid data, missing module

Status message 2

Byte 5, status message 2

Bit	Meaning
0 ... 7	Status of modules 4-7: 0: Valid data from this module 1: Invalid data, defect in module 2: Invalid data, incorrect module 3: Invalid data, missing module

9.5 ID-specific diagnostics

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

Note
The following applies for the coding of identifier-specific diagnostics:
1 = activated, 0 = deactivated

Coding for identifierspecific diagnostics

Header

Byte 0, header

Bit	Meaning
6…7	Header 01: Identifier-specific diagnostics
0…5	Number of bytes

Modules

Byte 1, modules

Bit	Meaning
0 … 7	Modules with diagnostics: 0: Header module 1..7: Reserved

9 Diagnostics

9.6 Channel-dependent diagnostics

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

Note
The following applies for the coding of channel-dependent diagnostics:
1 = activated, 0 = deactivated

Coding for devicespecific diagnostics

Header

Byte 0, header

Bit	Meaning
6...7	Header 10: Channel-dependent diagnostics
0…5	Affected module: 0: Header module 1..7: Reserved

Channel

Byte 1, channel

Bit	Meaning			
6…7	Type: 1: Input 2: Output 3: Input and output			
0…5	Number of affected channels in the module			
	Header module and short circuit module		IO-Link ports	
	00: Port 0 pin 4	08: Port 0 pin 2	16: Reserved	24..30: Reserved
	01: Port 1 pin 4	09: Port 1 pin 2	17: Reserved	31: Undervoltage
	02: Port 2 pin 4	10: Port 2 pin 2	18: Reserved	
	03: Port 3 pin 4	11: Port 3 pin 2	19: Reserved	
	04: Port 4 pin 4	12: Port 4 pin 2	20: IO-Link device port 4	
	05: Port 5 pin 4	13: Port 5 pin 2	21: IO-Link device port 5	
	06: Port 6 pin 4	14: Port 6 pin 2	22: IO-Link device port 6	
	07: Port 7 pin 4	15: Port 7 pin 2	23: IO-Link device port 7	

Error

Byte 2, error

Bit	Meaning	
0 … 4	Error code:	
	1: Short-circuit	10–15: Reserved
	2: Undervoltage	16–22: Manufacturer-specific
	3: Overvoltage	23: Actuator warning
	4: Overload	24: Actuator short circuit
	5: Overtemperature	25: Low voltage bus/sensor supply
	6: Cable break	26: External diagnostic
	7: Upper limit exceeded	27: Sensor has wrong configuration
	8: Lower limit not reached	28: Low voltage actuator supply
	9: Error	29–31: Manufacturer-specific
5 … 7	Format:	
	1: Bit	4: Byte
	2: 2 bits	5: Word
	3: 4 bits	6: 2 words

10 Appendix

10.1 Scope of delivery

The following accessories accompany the BNI PBS:

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

10.2 Order code

BNI PBS-502-101-Z001

Balluff Network Interface

Profibus

Function
502 = IP67 IO modules, 4 x IO-Link ports, 4 x standard I/O ports

Variants
101 = with display, software release 001

Mechanical configuration
Z001 = Material: die-cast zinc, matte nickel plated
Bus termination: 1 x M12x1 internal thread, 1x M12 external thread
Supply voltage: 7/8" male thread
IO ports: 8 x M12 internal thread

10.3 Ordering information

Type code	Ordering code
BNI PBS-502-101-Z001	BNI005R

10 Appendix

10.4 ASCII table

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	0 A	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	1 A	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	2 A		*

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	3 A	:
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	4 A	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	5 A	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	6 A	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	7 A	Z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	DEL

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