BALLUFF

BNI PNT-509-105-Z033

IP67 Module

User´s Guide

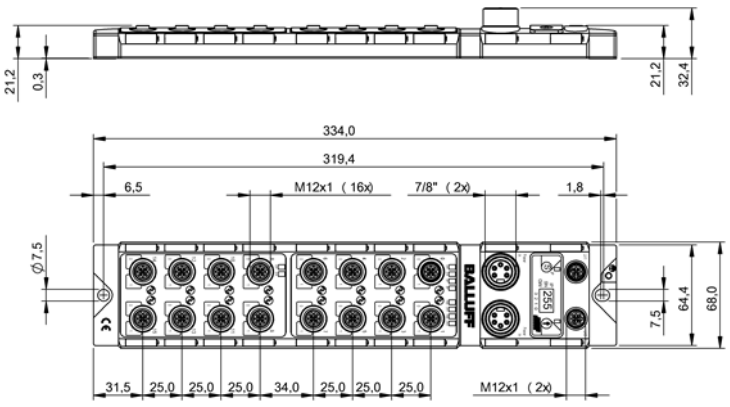


Table of contents

1 General

1.1. Structure of the manual

This manual is structured such that one chapter is builds on the other.
Chapter 1: General
Chapter 2: Basic safety instructions
…….

1.2. Typographical conventions

The following typographical conventions are used in this manual.

Enumerations

Enumeration is shown in the form of lists with bullets.

- Keyword 1
- Keyword 2

Actions

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

➢ Action instruction 1
↳ Result of action
➢ Action instruction 2

Actions can also be indicated as numbers in parentheses.

(1) Step 1
(2) Step 2
(3)

Syntax

Numbers:
Decimal numbers are shown without additional information (e.g., 123),
hexadecimal numbers are shown with the additional indicator hex (e.g., 00_{hex}) or the prefix "0x" (e.g., 0x00).

Cross-references

Cross references indicate where further information on the subject 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

BNI	Balluff Network Interface
EMC	Electromagnetic Compatibility
FE	Functional earth
I	Standard input port
O	Standard output port
PNT	PROFINET ™
UA	Actuator supply
US	Sensor supply

1.5. Deviating views

Product views and illustrations in this user's guide may differ from the actual product. They are intended only as illustrative material.

2 Safety

2.1. Proper use

The BNI PNT-509-105-Z033 is a decentral IO-Link input and output module for connecting to a PROFINET ™ network.

2.2. Installation and startup

Attention!
Installation and startup are to be performed only by trained specialists. Qualified personnel are persons who are familiar with the installation and operation of the product, and who fulfills the qualifications required for this activity. Any damage resulting from unauthorized manipulation or improper use voids the anufacturer's guarantee and warranty. The Operator is responsible for ensuring that applicable of safety and accident prevention regulations are complied with.

2.3. General safety instructions

Commissioning and inspection
Before commissioning, carefully read the operating manual.
The system must not be used in applications in which the safety of persons is dependent on the function of the device.
Authorized Personnel
Installation and commissioning may only be performed by trained specialist personnel.
Intended use
Warranty and liability claims against the manufacturer are rendered void by:

- Unauthorized tampering
- Improper use
- Use, installation or handling contrary to the instructions provided in this operating manual

Obligations of the Operating Company
The device is a piece of equipment from EMC Class A. Such equipment may generate RF noise. The operator must take appropriate precautionary measures. The device may only be used with an approved power supply. Only approved cables may be used.
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.
Intended use is ensured only when the housing is fully installed.

2.4. Resistance to aggressive substances

Attention!
The BNI modules generally have a good chemical and oil resistance. When used in aggressive media (eg chemicals, oils, lubricants and coolants each in high concentration (ie, low water content)) must be checked prior application-related material compatibility. In the event of failure or damage to the BNI modules due to such aggressive media are no claims for defects.

Hazardous voltage

Attention!
Disconnect all power before servicing equipment.

Note
In the interest of product improvement, the Balluff GmbH reserves the right to change the specifications of the product and the contents of this manual at any time without notice.

3 Getting Started

3.1. Module overview

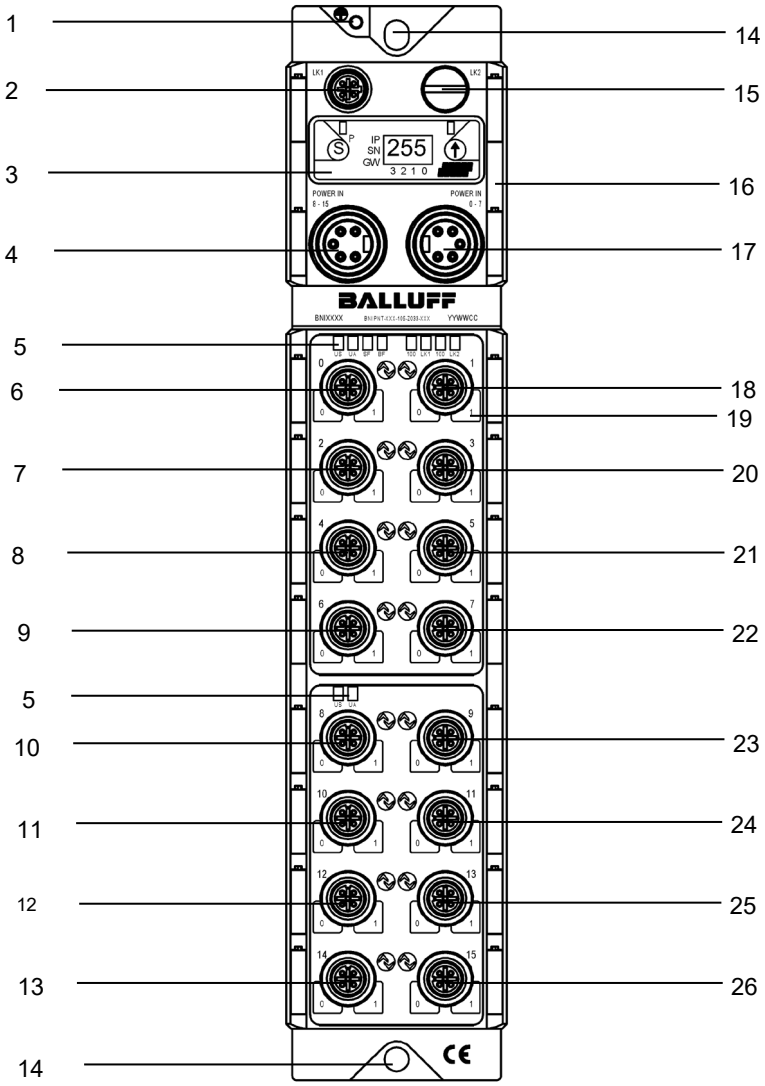


Figure 1 – Overview of BNI PNT-509-105-Z033

1	Function earth	14	Mounting hole
2	PROFINET ™ port 1	15	PROFINET ™ port 2
3	Display	16	Label
4	Power IN 8-15	17	Power IN 0-7
5	Status LEDs	18	Port 1
6	Port 0	19	Pin/Port LEDs
7	Port 2	20	Port 3
8	Port 4	21	Port 5
9	Port 6	22	Port 7
10	Port 8	23	Port 9
11	Port 10	24	Port 11
12	Port 12	25	Port 13
13	Port 14	26	Port 15

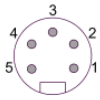
3 Getting Started

3.2. Mechanical connection

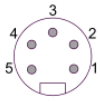
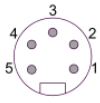
The module is secured by means of two M6 screws and two washers.
Insulation support is available separately.

3.3. Electrical connection

Power supply (from HW 2)

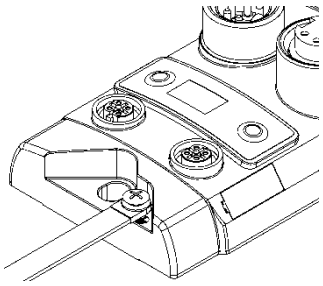
	Pin	Function	Description
Power IN 0-7  7/8", male	1	0 V	GND module- / sensor and actuator power supply
	2		
	3	FE	Function earth
	4	+24 V	Module / sensor power supply port 0-7
	5	+24 V	Actuator power supply port 0-7
Power IN 8-15  7/8", male	1	0 V	GND sensor and actuator power supply
	2		
	3	FE	Function earth
	4	+24 V	Sensor power supply port 8-15
	5	+24 V	Actuator power supply port 8-15

Power supply (to HW 1)

	Pin	Funktion	Beschreibung
Power IN US  7/8", Stecker	1	0 V	GND module- / sensor power supply
	2		
	3	FE	Function earth
	4	+24 V	Module- / sensor power supply port 0-7
	5	+24 V	Sensor power supply port 8-15
Power IN UA  7/8", Stecker	1	0 V	GND actuator power supply
	2		
	3	FE	Function earth
	4	+24 V	Module-/ actuator power supply port 0-7
	5	+24 V	Module-/ actuator power port 8-15

Note
Provide sensor/bus power and actuator power from seperate power sources if possible. Total current < 9 A per Pin. The total current of all modules may not exceed 9A power supply

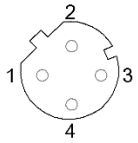
Grounding



Note
The ground connection between housing and machine must have a low impedance and be as short as possible.

PROFINET interface

M12, D-coded, female



Pin	Function	Description
1	Tx+	Transmit Data +
2	Rx+	Receive Datat +
3	Tx-	Transmit Data -
4	Rx-	Receive Datat -

Note
Unused I/O ports must be provided with cover caps in order to ensure enclosure rating IP67.

3 Getting Started

I/O port

M12, A-coded, female

Pin	Function
1	+24 V, 200 mA
2	Input/output 2A
3	GND
4	Input/output 2A
5	FE

Note
For the digital sensor inputs, refer to guideline on inputs EN 61131-2, Type 3.

Note
Each output receives a maximum current of 2.0 A.

Note
Unused I/O ports must be provided with cover caps in order to ensure enclosure rating IP67.

IO-Link port

M12, A-coded, female

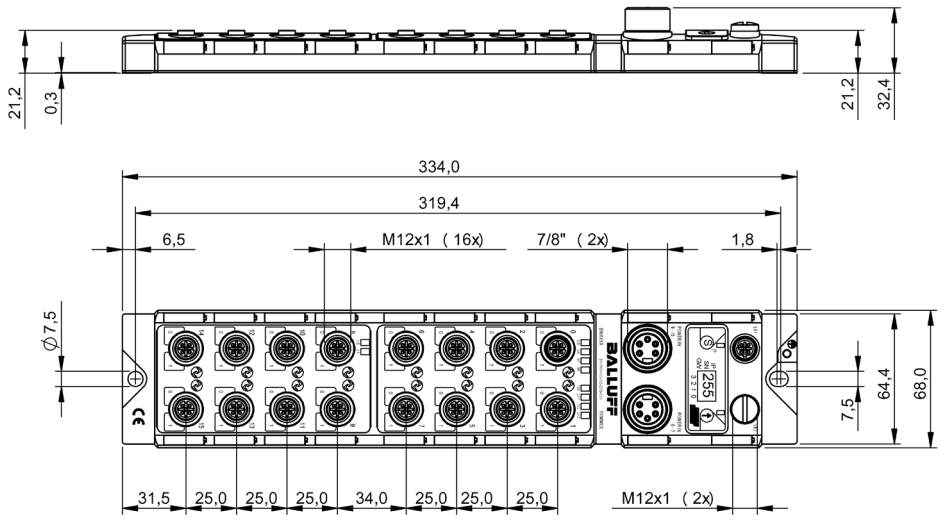
Pin	Function
1	+24 V, 1.6 A
2	Input/output 2A
3	GND
4	IO-Link / input / output 2A
5	n.a.

Port

	Port
	0 - 15
BNI PNT-509-105-Z033	IN / OUT / IO-Link

4 Technical data

4.1. Dimensions



4.2. Mechanical data

Housing material	Die-cast zinc, matte nickel-plated
Housing protection type in accordance with IEC 60529	IP 67 (only in plugged-in and screwed-down state)
Dimensions (W x H x D in mm)	68 x 334 x 32.4
Type of installation	Screw installation with 2 securing holes (M6)
Ground strap installation	M4
Weight	Approx. 900 g

4.3. Operating conditions

Ambient temperature Storage temperature	-5 °C ... 70 °C -25 C ... 70 °C

4.4. Electrical data

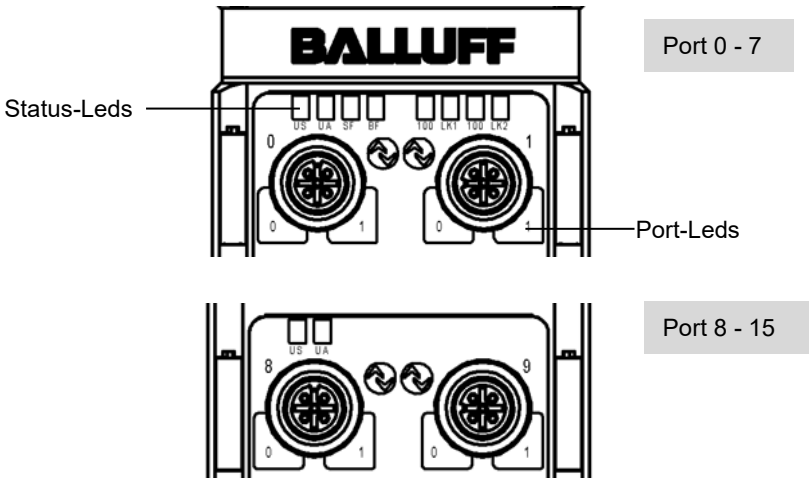
Supply voltage	18...30.2 V DC, in accordance with EN 61131-2
Ripple	<1%
Input current	130 mA @ 24V

4.5. PROFINET

PROFINET port	1 x 100Base-Tx
Cable types in accordance with IEE 802.3	Shielded, twisted pair min. STP CAT 5/ STP CAT 5e
Data transmission rate	100 Mbit/s
Max. cable length	100 m
Flow control	Full-duplex (IEEE 802.33x pause)
Profinet Conformance-Class	B
Netload-Class	3

4 Technical data

4.6. Function indicators



Module status

LED	Display	Function
US	Green	Input voltage OK
	Red	Input voltage low (< 18 V)
UA	Green	Output voltage OK
	Red flashing	Output voltage low (< 18 V)
	Red	Output voltage < 11 V
SF	off	No error
	Red	Diagnosis message; system fault
	Red, flashing	DCP signal service is initiated via the bus
BF	off	No error
	Red	No configuration; or no physical link
	Red, flashing	No data exchange
100	off	Transmission rate: 10 Mbit/s
	Yellow	Transmission rate: 100 Mbit/s
LK	Green	Data transfer

4 Technical data

Port

Standard port

Status	Function
Off	Status of input or output pin is 0
Yellow	Status of input or output pin is 1

IO-Link port

Status	Function
Green	IO-Link – connection active
Green, flashing	No IO-Link – connection
Red, flashing	Validation failed

Status	Port configuration		
	Diagnosis Input	Input	Output
Red	Input low	Short-circuit pin 1 and 3	Short-circuit on output pin
red short flashing	-	-	Short-circuit pin 1 and 3

5 Integration

5.1. Configuration

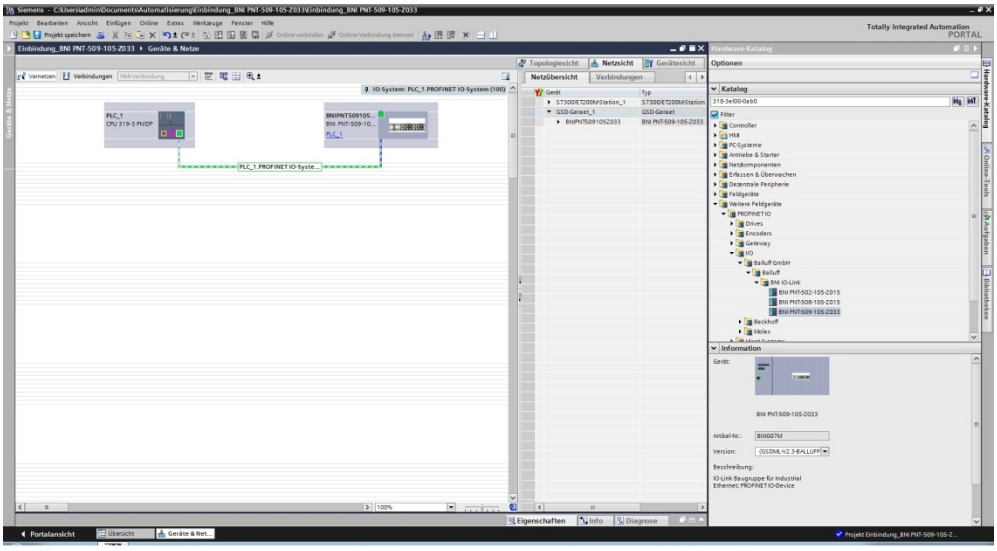
When planning Profibus devices, a device is depicted as a modular system with a header module and several data modules. The screenshots shown here have been taken from the configuration software of the Siemens HW config.

GSDML file

The device data required for project planning is saved in GSDML files (**G**eneric **S**tation **D**escription **M**arkup **L**anguage). The GSDML files are available in two languages as an Internet download (www.balluff.com). The data modules of an IO-Link module are depicted in the project planning software according to the slot.
The GSDML file makes the possible data modules available (input or output of different data ranges). For configuration of the IO-Link modules, the corresponding data modules are assigned to a slot.

Integration of the module

The device can be found by searching in the catalog and inserted in the Profinet section by Drag & Drop.

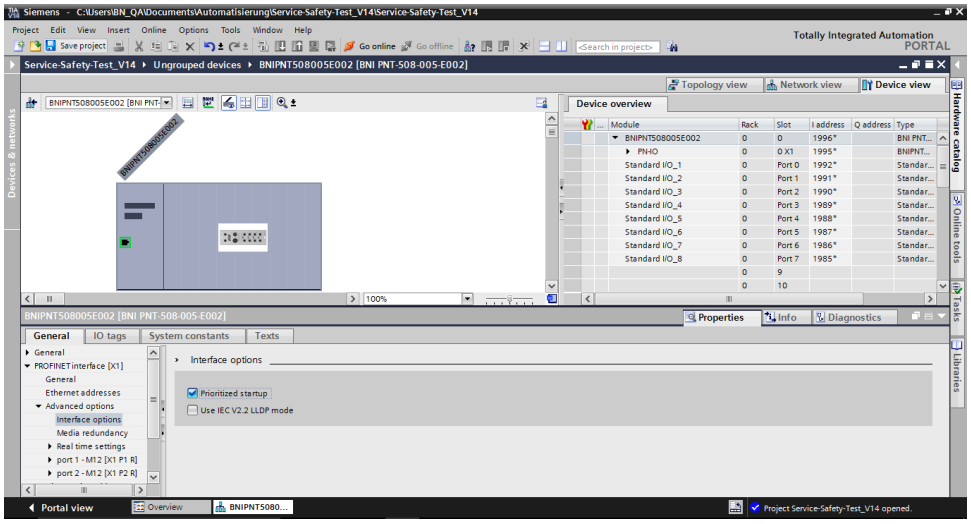


The BNIPNT509105Z033 module with submodules PN-IO, port 1-M12 and port 2-M12 are used for Profinet communication.
In X1 PN-IO, functions such as prioritized run-up or the domains for the ring topology can be selected.
Slot 1 is reserved for the header module; port functions (input, output, diagnostic input, IO-Link) or diagnostic messages can be defined here.
The remaining slots preassigned in the default configuration (2-17) are placeholders for the IO-Link modules or standard I/O modules.
Slot 2 is for the first IO-Link port / standard I/O port (port 0), slot 17 for the last.
If IO-Link communication is planned for a given port, the standard I/O module must be deleted and replaced with an IO-Link module, e.g., IOL_E_2byte.

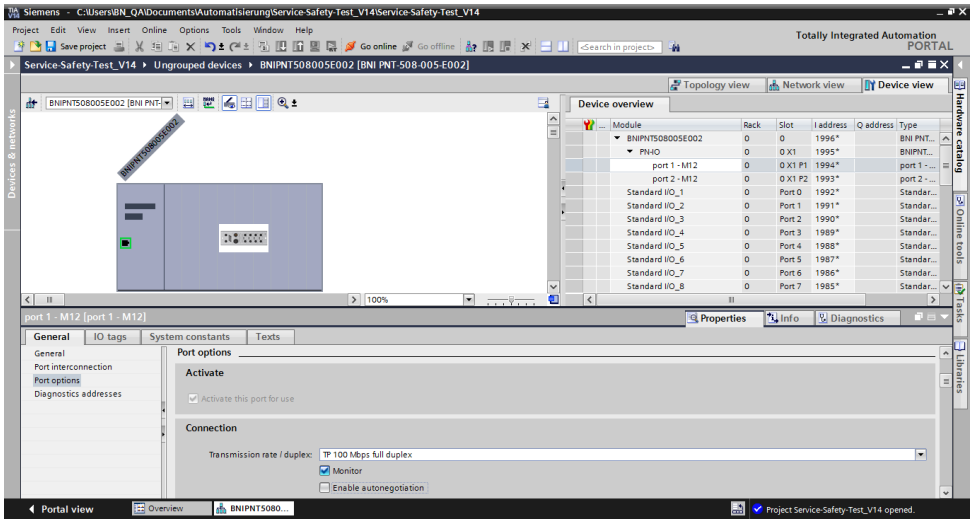
Prioritized acceleration / fast startup

The Balluff modules also have the function "Prioritized acceleration".
If the prioritized acceleration or "fast startup" (FSU) is activated, the modules run within a time of <2s.

To activate the function, several settings must be made in the hardware configuration:



- Hook at prioritized startup



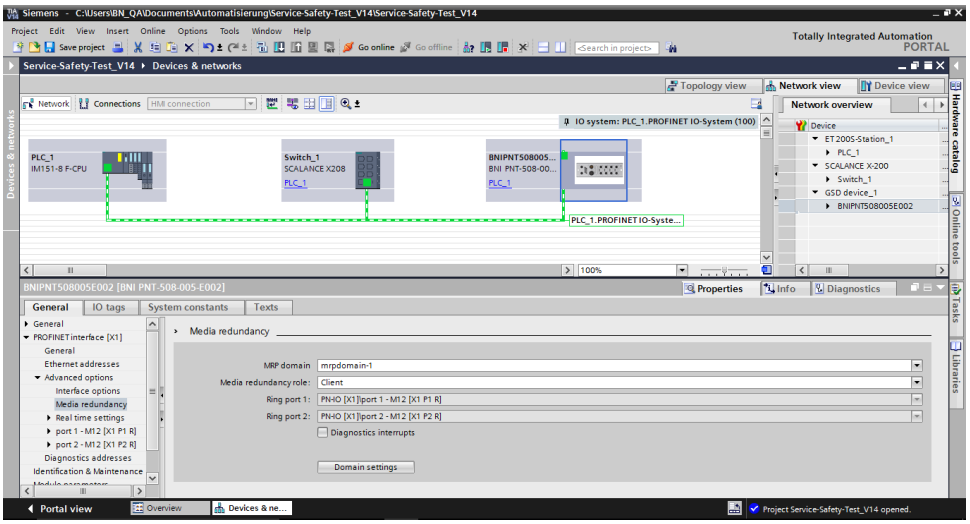
In order to ensure optimum acceleration in <2s:

- The transfer speed at all connected ports must be fixed to 100Mbit.
- Autonegotiation must not be activated.
- Observe port direction → Port 1 IN Port 2 OUT
- Unused PN IO ports (eg last module in the Lino topology) do not have to be changed.

5 Integration

Ring topology / MRP

The Balluff PNT modules support the ring topology with media redundancy, which is enabled by the Media Redundancy Protocol (MRP).
To do this, the module must be in the same topology instance as the MRP master (managed switch, CPU ...).
The instance can be set here:

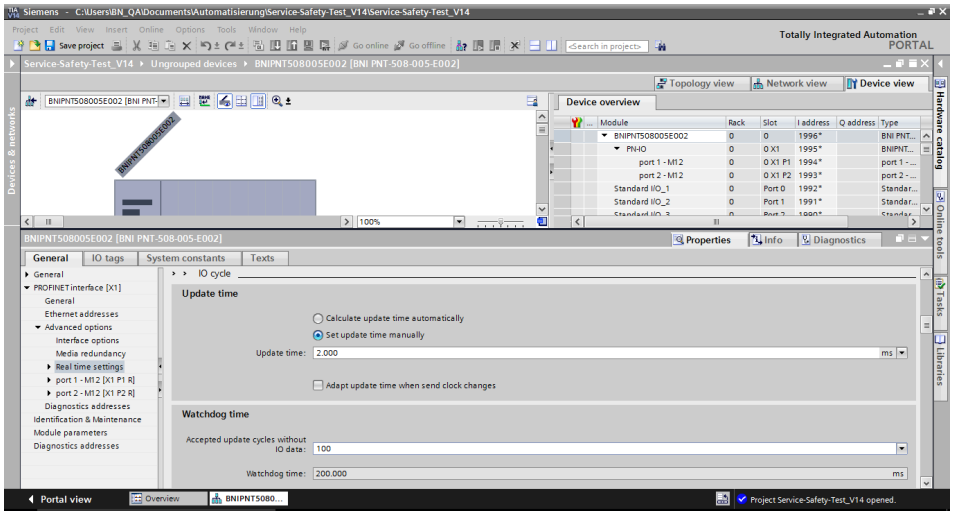


Media redundancy role must be set to "Client". By default, "non-participant" is set.

With the ring topology, it is possible to build up a redundant system. In normal operation, one side of the loop line is deactivated by the MRP master. If the cable is damaged / capped in the ring, the deactivated branch is reactivated and two line topologies are created.

To ensure an uninterrupted operation, the response monitoring time should be> 200ms. Because the MRP master takes some time to activate the second string. If the response monitoring time is less than the switching time of the MRP master, the communication breaks down.

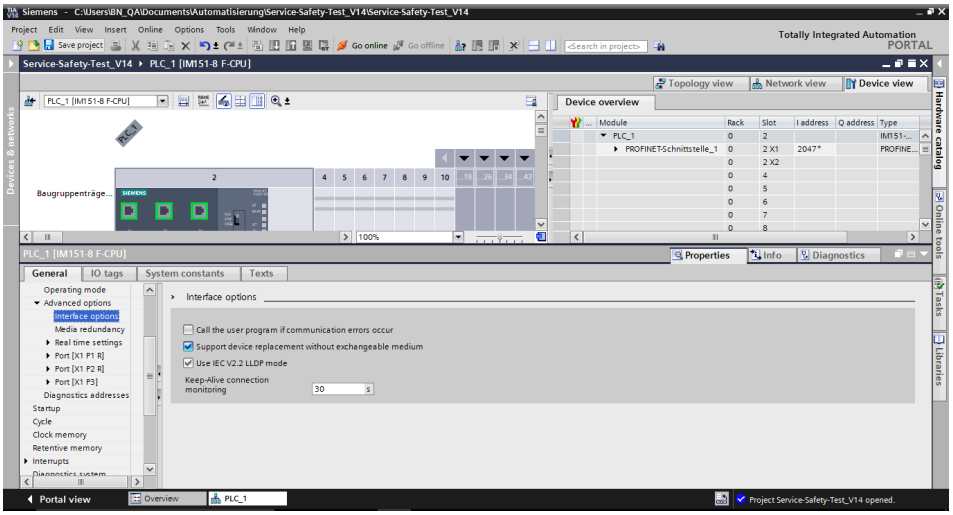
The response monitoring time is calculated from the "update time" and from the factor "Accepted update time without IO data":



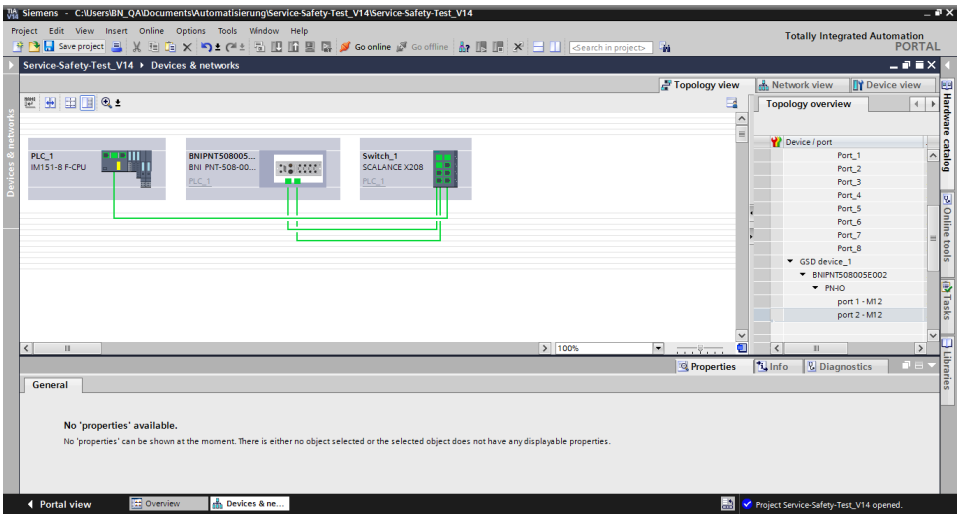
5 Integration

Device replacement without removable media

The Balluff modules also support simple device replacement during operation. LLDP is used for this.
Please follow the below mentioned instructions for an simple device replacement.



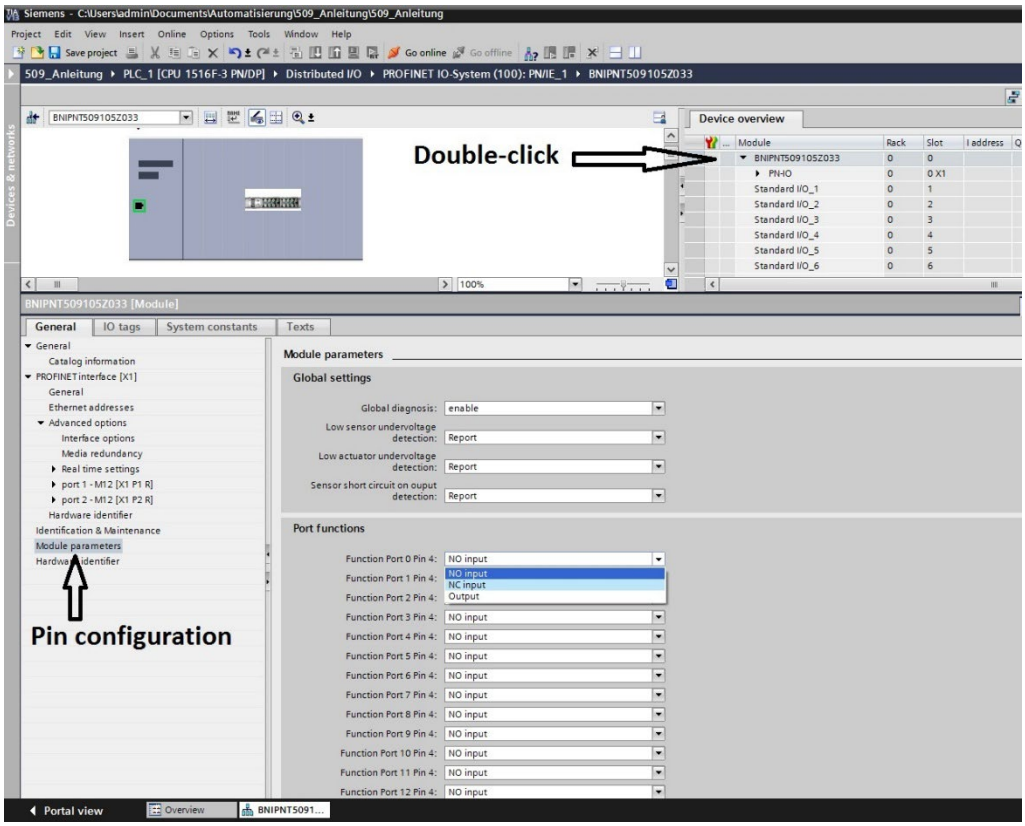
In the HW configuration of the CPU, the "device replacement without removable medium" must be enabled.



The PROFINET topology must be created in the HW configuration. The connections of the individual ports must match the wiring of the hardware. If the topology is not correct in the HW configuration, errors can occur..

Configuration of the header module

Double-click on the header module to open its properties.
Click on the "Parameter" tab to open a menu selection for defining the port functions and diagnostic functions.



Note
IO-Link configuration:
If the connected IO-Link device makes outputs available, pin 2 must be configured to output on the corresponding port.
Standard input and output:
For each port, the function (N.C., N.O., diagnostic input (pin 2)) can be arbitrarily selected for each port at pin 2 and pin 4.

5 Integration

Hardware configuration

The IO-Link / standard I/O modules must now be configured appropriately for the configuration of the header module.
If necessary, these can be taken over into the configuration table from the hardware catalog by means of drag & drop.
By default, all ports are set to Standard I/O.
If the port is to be configured as an IO-Link port, the module must be deleted and replaced with an IO-Link module.

Slot port 0-15 (Slot 1-16) are reserved for the IO-Link ports / standard I/O ports.

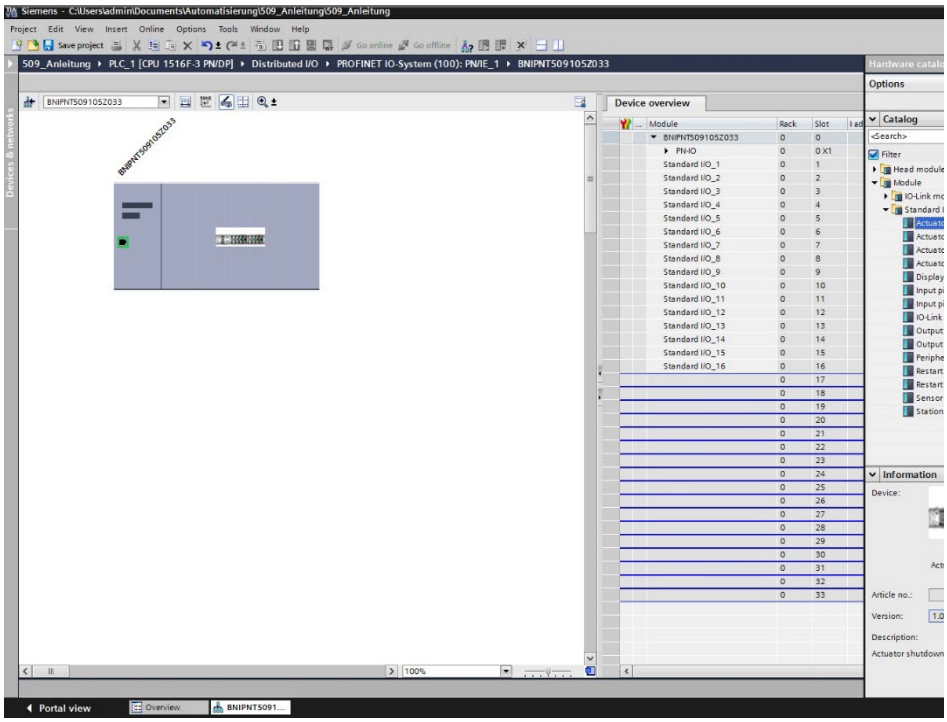
Module addressing:
Double-click on the IO-Link modules and the remaining addressable modules to change the addressing in the "Addresses" window.

Configuring the IO-Link module:
A suitable IO-Link module that corresponds to the process data length of the IO-Link device must be selected in the catalog and dragged to the appropriate slot by means of drag & drop.
The process data length required by the device in each case can be obtained from the manual of the IO-Link device.

Configuring a standard input / output:
If one of the possible port pins (pin 4) is to be configured with a standard function (input, output), the "Standard I/O" placeholder module must be used for the corresponding slot.
To address the inputs and outputs, input pin 2 / 4 and output 2 /4 must be taken over from the catalog and used in the configuration according to the given modules.

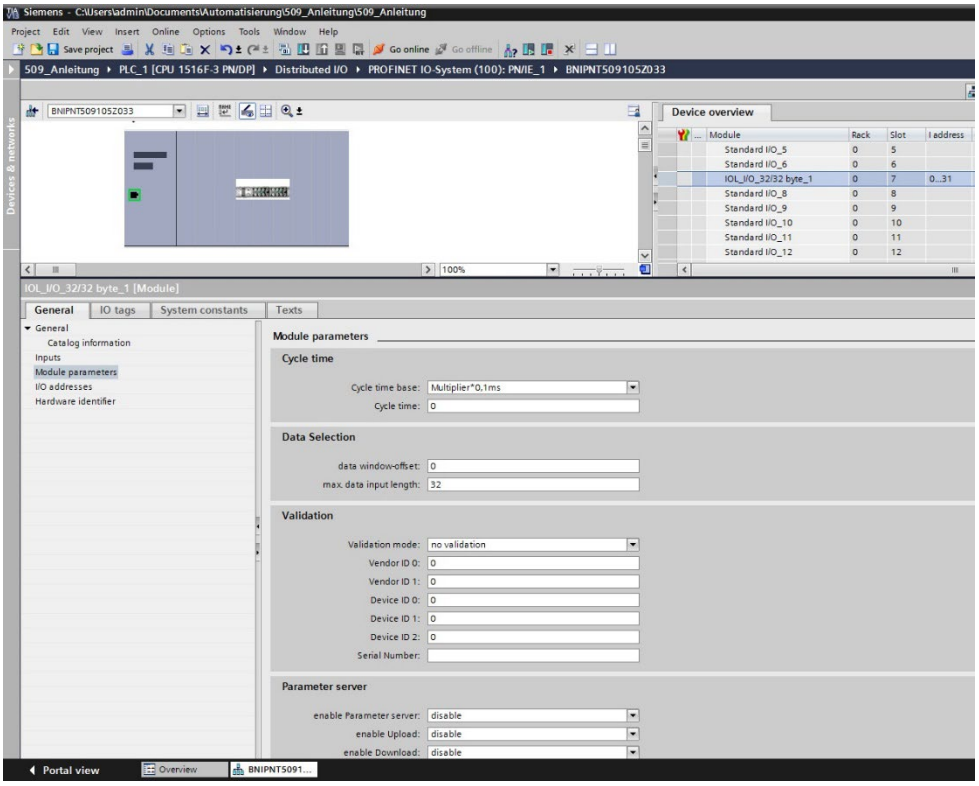
For the SIO function, integrate the "IO-Link input with SIO mode" module.

With the remaining modules, the various functions are mapped into the process data areas.



IO-Link configuration

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

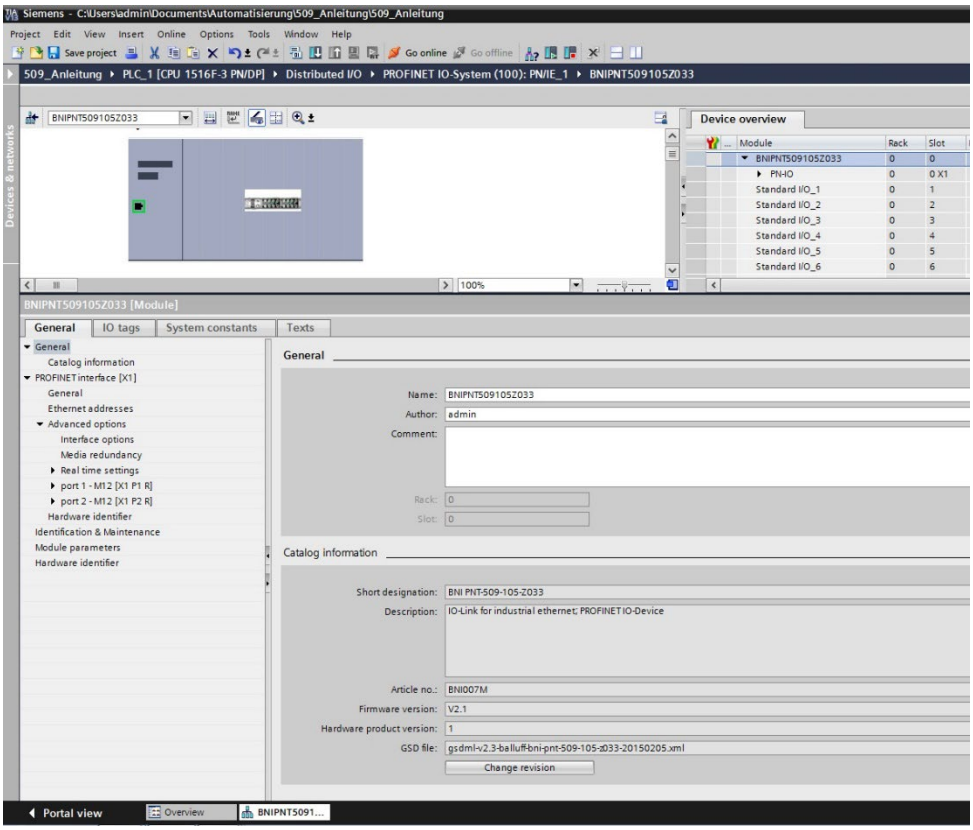


5 Integration

Device name, PROFINET address

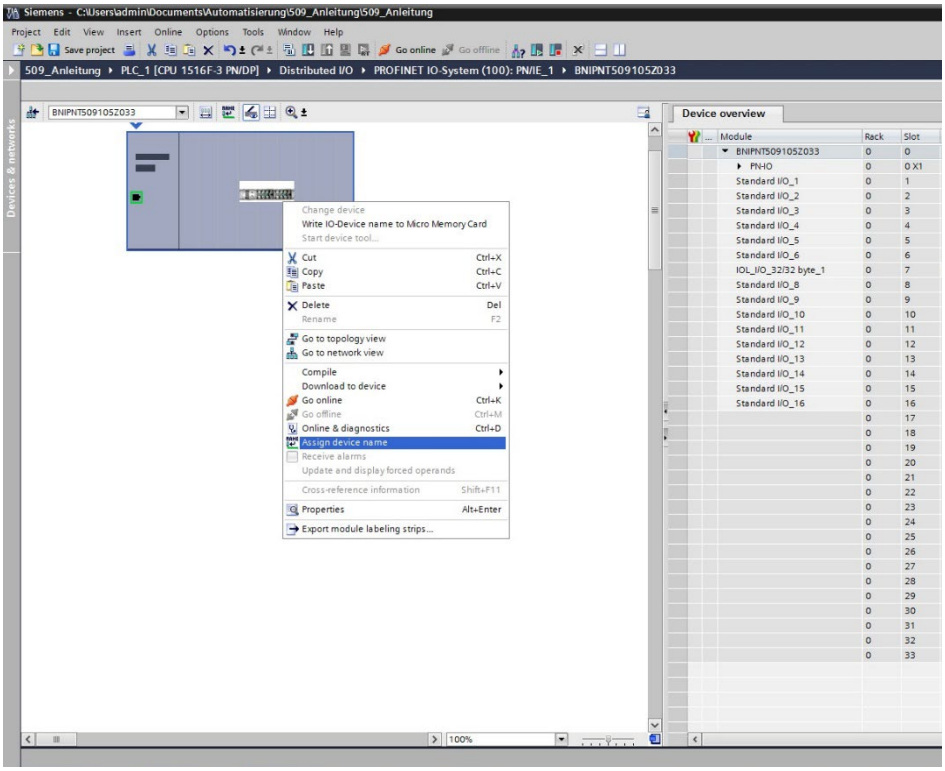
Double-click on the module in the PROFINET line to view the communication parameters of the module.

The device name and the Profinet address (IP) are configured here.



Establishing device relationship

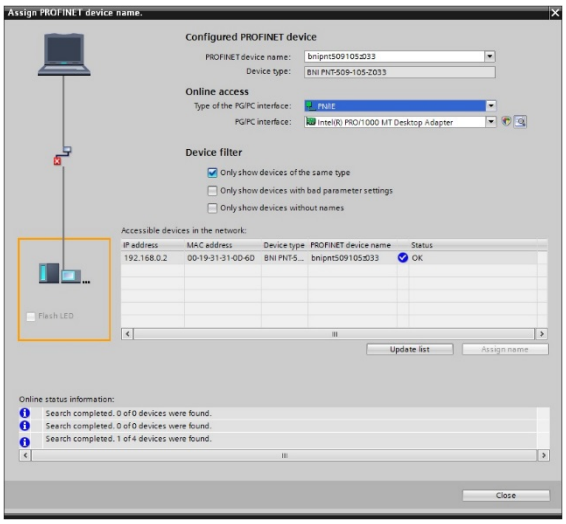
Navigate through "Target system" -> "Ethernet" -> "Assign device name" to start the tool for assigning the module a device name.



Assigning device name

Select the desired name and use "Assign name" to assign the marked device that you found.
The device name must be the same as that previously configured under Device properties (see previous page).

Identification takes place via the MAC address (on the rear of the device) or via the Flashing test.



5 Integration

Concluding the configuration

Download the configuration into HW config.

At this point, the bus error on the module should disappear.
There could still be an active system error, particularly if an IO-Link is used.

Possible causes:

- Line break (no IO-Link device connected)
- IO-Link device fault (e.g., external voltage supply not connected)
- Validation failed

If the module still reports a bus error,
there could be a problem in one of the following areas:

- Device relationship not established.
  Scan the network via "Target system" -> "Ethernet" -> "Ethernet user" -> "Search" and check whether the device is signaling under the correct device name and correct IP address.
  Adapt the Ethernet address or device name if necessary, assign the device name to the device once again and download the configuration.

5.2. Functions in module properties

Description of the functions in module properties

Module settings

Global diagnostics:
This function can be used to permit / suppress all diagnostics messages of the module. (optical diagnostics signals and diagnostics in configured diagnostics modules are not affected)

Sensor supply undervoltage:
This function can be used to permit / suppress the diagnostics message Sensor supply undervoltage. (Optical diagnostics and diagnostics in configured 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 and diagnostics in configured diagnostics modules are not affected)

Sensor connection to output:
This function can be used to permit / suppress the diagnostics message Sensor Short-circuit on the module output. (Visual diagnostics and diagnostics in configured diagnostics modules is not affected) Function applies only to channels/pins which are configured as outputs. Channels/pins configured as inputs are unaffected.

Port functions

The function for every individual port pin can be defined here:
Make contact = input as normally open contact
Break contact = input as normally closed contact
Diagnostic input = Pin 2 as diagnostic input (red at 0)
Output = output function

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 to be assumed in the event of a loss of bus communication.

5 Integration

5.3. Bit mapping and function

Bit mapping and function of the configurable modules

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 "inputs pin 2" module also depicts the diagnostic inputs of the diagnostic input function.

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 shutdown pin 4 / pin 2

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

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Actuator warning pin 4 / pin 2

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

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Restart pin 4 / pin 2

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

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Switching IO-Link diagnostics on / off

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

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

IO-Link communication

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

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Peripheral error, socket

Feedback indicating the port at which an error occurred.

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Short circuit Sensor supply

Feedback indicating the port at which there is a sensor supply short circuit.

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

5 Integration

PD Valid

Indicates if the process data is valid for IO-Link devices.
1 = valid, 0 = not valid

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1	Port 0	Port 15	Port 14	Port 13	Port 12	Port 11	Port 10	Port 9	Port 8

Station diagnostics

Feedback indicating which fault occurred.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IO-Link short circuit	Actuator Warning	Actuator Short circuit	Sensor voltage Short circuit	External error	No UA	UA < 18 V	US < 18 V

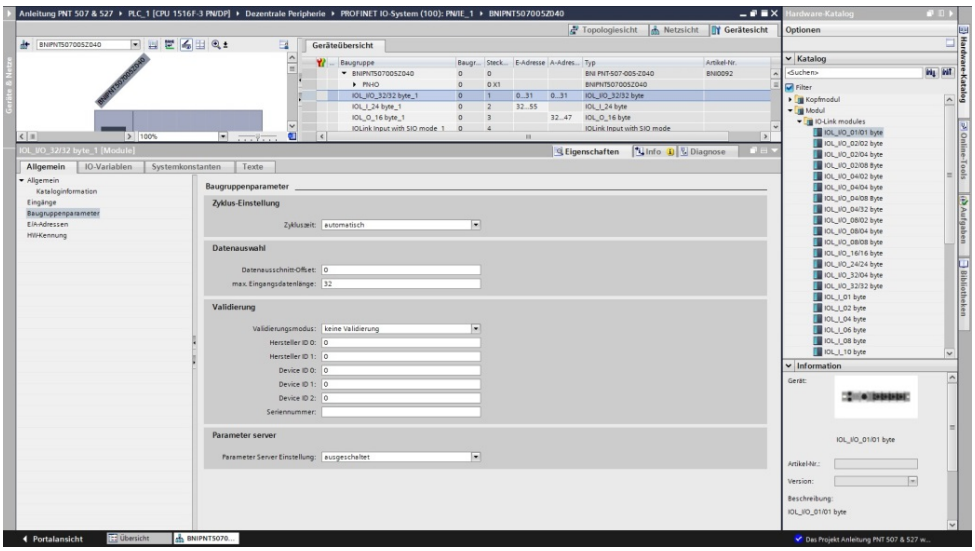
Display LED

Display functions

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

IO-Link configuration

In the properties of the IO-Link module the IO-Link parameters of the respective port can be changed.



IO-Link functions

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

Cycle settings

This parameter is used to reduce the IO-Link communication speed by increasing the IO-Link cycle time. Use the scroll down menu to set the cycle time.

Data selection

The start byte of the process data can be defined with the data section offset. For the max. input data length, the actual process data length of the IO-Link device is entered. These settings are only for the input data.
The visible data window for the input data can now be adjusted via an IO-Link module with appropriate process data length.

Validation

No validation: Validation deactivated, every device will be accepted
Compatibility: Manufacturer ID and device ID are compared to the module data.
The IO-Link communication is only started if there is a match. Manufacturer ID and device ID are entered in decimal format.
Identity: Manufacturer ID and device ID and serial number are compared to the module data. The IO-Link communication is only started if there is a match.
Manufacturer ID and device ID are entered in decimal format, the serial number is entered in ASCII code.

5 Integration

Parameter server

Switched off:
Data management functions disabled, saved data are retained.

Delete:
Data management functions disabled, saved data is deleted.

Restore:
Only a download of the parameter data to the IO-Link device is performed.
As soon as the saved parameter data in the port parameter server differs from the that of the connected IO-Link device a download is performed.
Only exception: The parameter server is empty. Then one upload is performed.

Save/Restore:
An up-/download of the parameter data to the IO-Link device is performed.
As soon as the saved parameter data in the port parameter server differs from the that of the connected IO-Link device and no upload requests from the IO-Link device are present, a download is performed.
As soon as a device requests an upload (upload flag set) or if there is no data saved in the master port (e.g. after data has been deleted or before the first data upload), the master starts an upload of the parameter data from the device.

Note
After the upload of the parameter data, the vendor ID and device ID of the connected IO-Link device are also still saved until the data records are deleted. When the connected IO-Link device is started, a validation takes place. Thus, only an IO-Link device of the same type can be used for the data management.

6 Configuration of IO-Link devices

General

IO-Link devices can be configured via the web server, function modules and the IO-Link device tool.

When using the device tool as well as the web server the read and write accesses are taken over by the software.

Function block

The function block "IOL_Call" constructs a telegram which is sent to the master using DPV1 functions. This requires the following settings:

Diagnostics address	The diagnostics address of Slot 1 is used
CAP access	255

The sample project with the IOL_Call function module of Siemens AG can be downloaded on the Balluff homepage.

The telegram structure is described in the following table:

Area	Size in bytes	Value	Definition
Call header	1	08h	08h for "CALL", fixed
	1	0 1…63 64…255	IOL master Port number Reserved
	2	65098	FI_Index, IO-Link header is following
IO-Link header	1	0…255	Task 2 = write 3 = read
	2	0…3276 7 65535	IO-Link index Port function
	1	0…255	IO-Link subindex
Data range	232		Range of the data to be written or read

Read

To read out data, the master must be given a reading task for the corresponding slot/index/subindex.

The telegram must be adapted accordingly for this purpose (slot, index), and 0x03 for reading must be entered under "Task".
The telegram can then be sent by write instruction to the corresponding module.

The module reads the data from the IO-Link device.
The data can be retrieved by reading with the same telegram.

Write

To write data, the master must be given a writing task for the corresponding slot/index/subindex.

The telegram must be adapted accordingly for this purpose (slot, index), and 0x02 for writing must be entered under "Task".
The telegram can then be sent by write instruction to the corresponding module.

7 Monitoring & Diagnostics

7.1. General

The fieldbus module offers a number of diagnostics interfaces which are described in the following:

- Device diagnostics using the web interface
- Network diagnostics via SNMP
- Fieldbus-specific diagnostics using the PLC

The web interface and the fieldbus-specific diagnostics interface are each described in a separate section.

The monitoring and diagnostics interfaces on the device are accessed via the IP-based management interface over the Ethernet network. Alternately to the procedure for setting IP access described in the "Integration" section, other dedicated configuration tools can also be used together with the DCP protocol of PROFINET. The following parameters must then be set:

- IP address (IP)
- Subnet mask (SN)
- Gateway address (GW)
- Device name

The configuration settings can be reset to their factory defaults through the web interface.

Configuration settings are only possible if the module has no active connection with a controller unit.

7.2. SNMP MIBs

Monitoring and diagnostics of the device network settings can be done over the network using the SNMPv1 protocol. This can be accessed simply from a so-called SNMP browser or common network management applications.

The following MIBs are supported:

- MIB-2 (RFC 1213)
- LLDP-MIB (IEEE 802.1AB)

Information about the fieldbus module is provided in the module-specific information of the MIB-2:

MIB variable	Description
sysDescr	A textual description of the entity. This value should include the full name and version identification of the system's hardware type, software operating-system, and networking software.
sysObjectID	{1.3.6.1.4.1.44233.1.2.1} For Balluff products with Product Enterprise Number (PEN) = 44233, the product list is defined in **BALLUFF-PRODUCTS-MIB**
sysUpTime	The time (in hundredths of a second) since the network management portion of the system was last re-initialized.
sysContact	The textual identification of the contact person for this managed node, together with information on how to contact this person. (“BALLUFF”)
sysName	An administratively-assigned name for this managed node. By convention, this is the node's fully-qualified domain name. (“BNI PNT ….”)
sysLocation	The physical location of this node (e.g. “73765 Neuhausen a.d.F, Germany”)

The port-specific information of the MIB-2 describes diagnostic data about the network connections, including the IO-Link ports:

MIB variable	Ethernet port	IO-Link Port
ifIndex	A unique value, contiguously starting from 1.	
ifDescr	A textual string containing information about the interface, i.e. "Ethernet X"	”IO-Link X" / “IO-IN X” / ”IO-OUT X”
ifType	IANAifType = 6 (ethernetCsmaCd) when Ethernet	IANAifType = 280 (sdci) when IO-Link-Port = 0 (other) when I/O-Port
ifMTU	length of Ethernet MTU	length of IO-Link process data (typically max. 32 Byte) or 1, when IO-port
ifSpeed	actual Ethernet speed	IO-Link speed (no device = 0 bit/s, Com1 Mode = 4800 bit/s, Com2 Mode 38400 bit/s, Com3 Mode = 230400 bit/s)
ifPhysAddress	MAC address assigned to this port	This object may contain an octet string of zero length, since IO-Link is a serial P2P protocol with no specific addressing.
ifAdminStatus	Up(1), Down(2), depending	Up(1), Down(2), depending if IO-Link capability is configured.
ifOperStatus	Up(1), Down(2), depending if an IO-Link device is connected and operable.	
ifLastChange	The value of sysUpTime at the time the interface entered its current operational state. If the current state was entered prior to the last re-initialization of the local network management subsystem, then this object contains a zero value.	n/a
ifInOctets	The total number of octets received on the interface, including framing characters.	
ifInErrors	n/a	Number of received frames that were rejected as invalid by the IO-Link-Master (Abort).
ifOutOctets	The total number of octets transmitted out of the interface, including framing characters.	
ifOutErrors	n/a	Number of retries by the IO-Link-Master, indicating unsuccessful packet transmissions.

8 Display

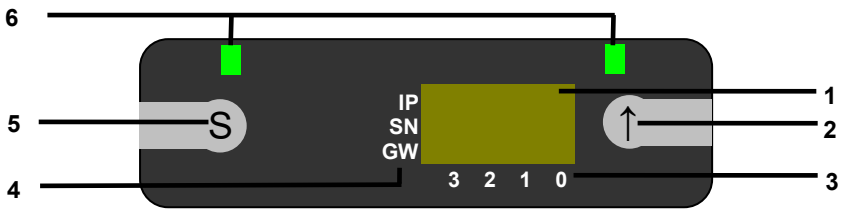
8.1. General

The display element of the BNI PNT-509-105-Z033 consists of two LEDs, two buttons and a LCD display. A backlight is built in to increase readability in low-light environments and is activated if you start going through the menu.
It is possible to display the station name. At delivery status, the letters “no name” show that no station name of the module is set by the control system.
The following address types are implemented and reflect the current configuration of the control system:

- IP address (IP)
- Subnet mask (SN)
- Gateway address (GW)

Each address type consists of 4 octets.
Additionally the display shows information about the device name, the hard- and software version and the MAC-ID.

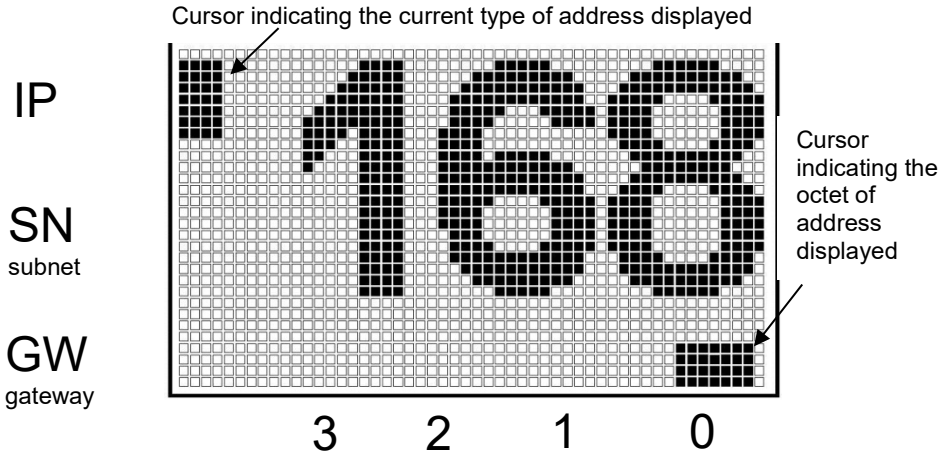
8.2. Controls and visualization



1 Display
2 Arrow-Key
3 Octett-Cursor
4 Address type cursor
5 Set-Key
6 LEDs

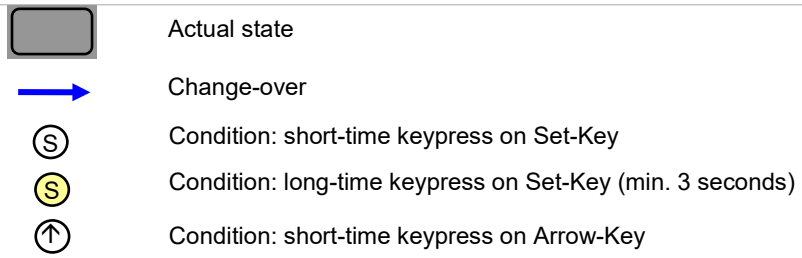
Arrow-Key: This button is used to go through the entries of a menu and is a short-time keypress. The display shows the default screen after 10 seconds of inactivity.
Octett-Cursor: The default location of the Octett-Curser is position 0 indicating the lowest-order octet.
Address type cursor: The default location of the Address type cursor is position IP.
Set-Key: This button is used to start the editing mode and save or confirm a change in the configuration.
LEDs: The LEDs, configured as a single LED, can be set by the control system to indicate a change in a state. Is is required to add the module “Display Leds” to the configuration of the control system in order to utilize this functionality.

8.3. Display information

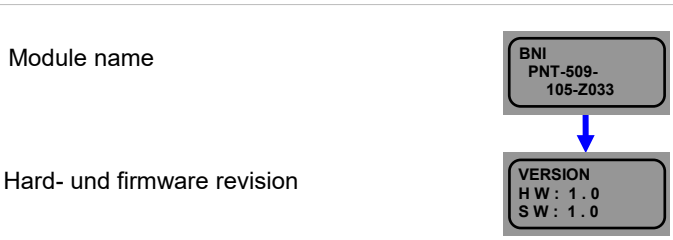


8.4. Design and symbols

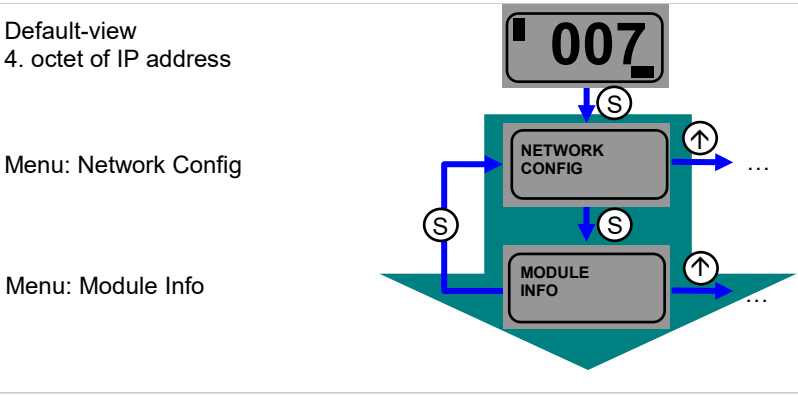
There are some symbols used in the following flow-charts to describe the display-functionality:



8.5. Startup



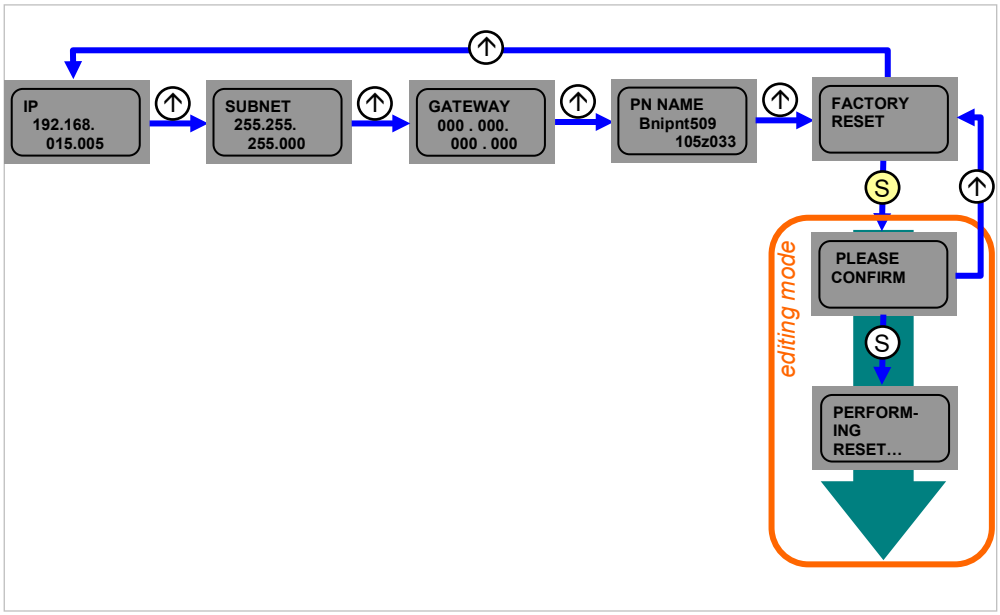
8.6. Main menu



- Go through the main menu with short-time keypress on Set-Key
- Step in a menu with short-time keypress on Arrow-Key

8 Display

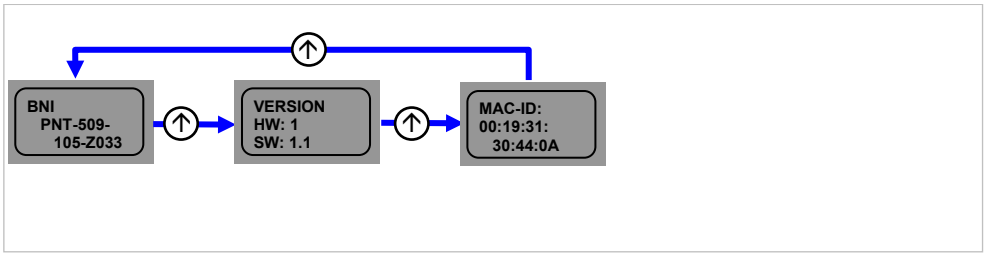
8.7. Factory Reset



- Go through the Network Config menu with short-time keypress on Arrow-Key.
- Reset the module with a long-time keypress on Set-Key at the Factory Reset menu item.
- Confirm the factory reset with a short-time keypress on Set-Key or decline it with a short-time keypress on Arrow-Key. If the factory reset is confirmed, the device performes a restart.

Note
A factory reset can be performed only after a power reset without an attached network cable.

8.8. Module Info



- Go through the Module Info menu with short-time keypress on Arrow-Key.
- You can select between the device name, the hard and software version and the MAC-ID.

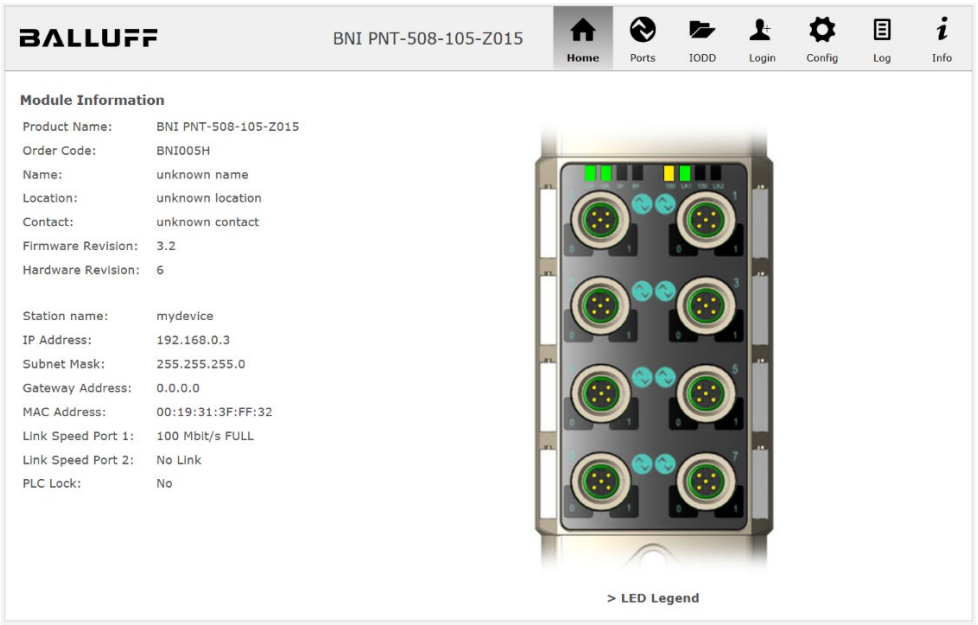
9 Webserver

9.1. General information

The BNI fieldbus module contains an integrated web server for retrieving detailed device information and for configuring the device.

To use the web interface you must first ensure that the module has been correctly integrated into your network. In addition the IP subnet of the BNI module must be accessible from the PC on which the browser is running. For the supported web browsers, please refer to the corresponding data sheet.

For open a connection with the web server, enter the IP address of the module in the address line of the browser. The homepage then appears with the essential device information.

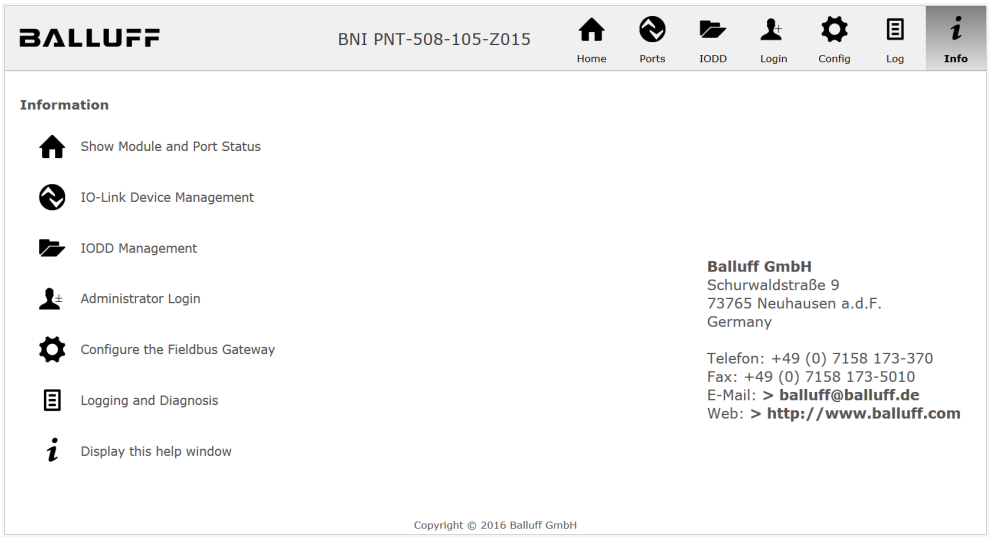


9 Webserver

9.2. Navigation / Info

The navigation bar is located in the upper area of the window, which allows you to switch between the various dialogs of the web interface. To do this click on the corresponding icon.

When the "Info" tab is selected the following overview appears:



The "BALLUFF" logo at upper right links to the international Balluff homepage.

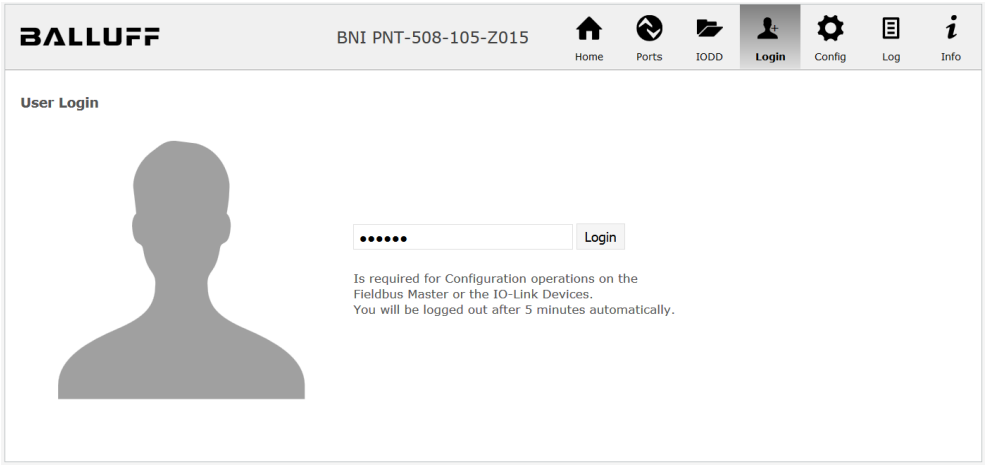
9.3. Login/Logout

To make configuration settings on the fieldbus module using the web interface, you must first log in. Functionalities which cannot be used without logging in are indicated by the grayed out buttons.

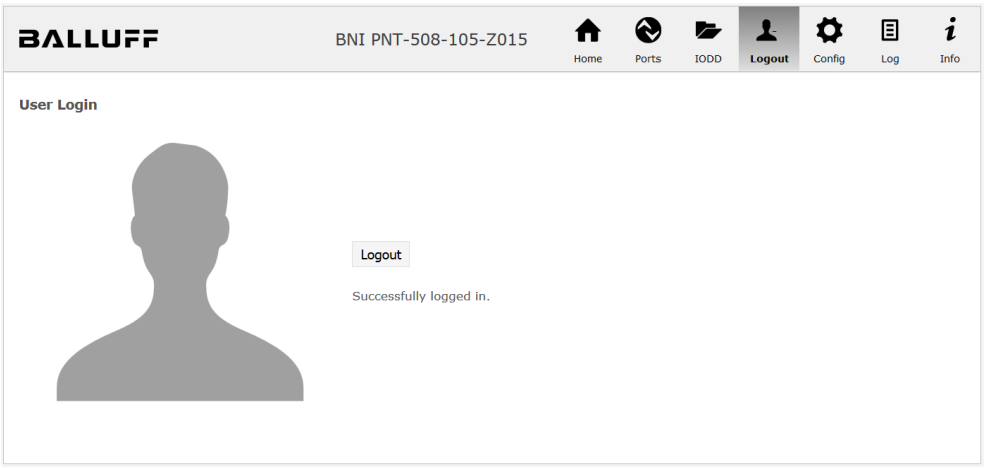
The default password is:

BNI PNT-XXX-XXX-XXXX	"BNIPNT“
BNI EIP-XXX-XXX-XXXX	"BNIEIP“
BNI ECT-XXX-XXX-XXXX	"BNIECT“

The password cannot be changed!



After successfully logging in the dialogs are shown as follows:



Use the "Logout" button to log out again. After 5 minutes of no interaction with the Webserver the user is automatically logged out.

Note
For security reasons the fieldbus module shows only one login at a time with configuration access. Reading (without logging in) is however possible from multiple PCs at the same time on the fieldbus module.

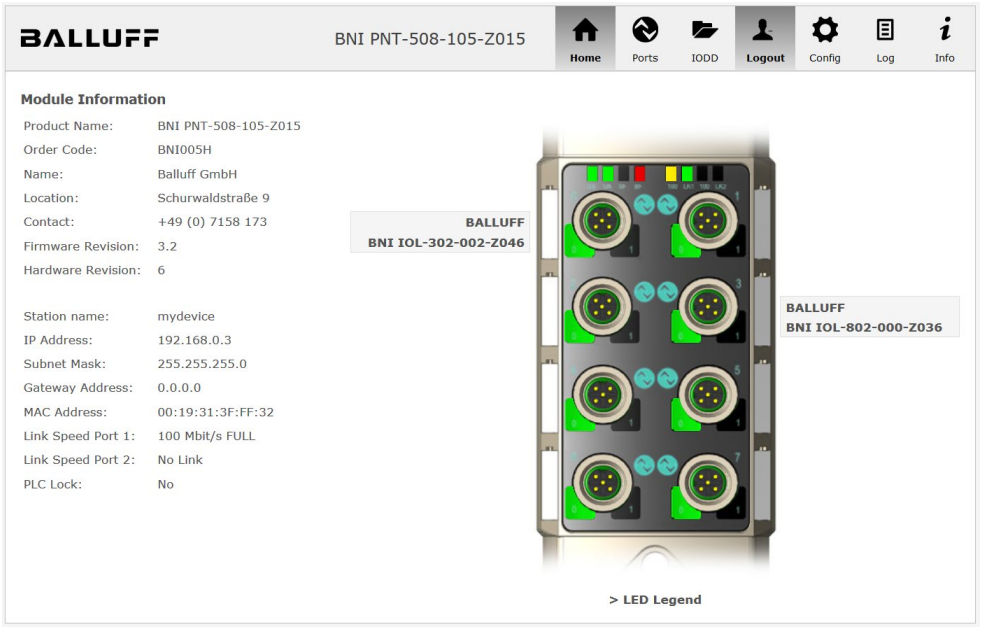
9 Webserver

9.4. "Home" dialog

Under "Home" you are given the essential information about the fieldbus itself and its network activity. You are also shown whether the configuration block was enabled by the controller (PLC).

Information is also shown about the current process data and the status of the module via the corresponding LEDs. After selecting "LED Legend" a Help dialog appears which explains the meaning of the LEDs.

If an IO-Link device is connected to one of the configured IO-Link terminals, some of the device data will be displayed in addition to the module data in the form of a link. After selecting one of these links the corresponding device dialog is opened.



PNT:


Module LED Functions
US UA SF BF 100 LK1 100 LK2
US
UA
SF
BF
100
LK
OK
Low
Error
System error
Bad signal service
No config
No data exchange
100 Mbit/s
10 Mbit/s
Link activity
No link activity
Port LED Functions
IO
0
1
short circuit
> Imax.
IO-Link
n. C.
IO-Link
wrong device
short circuit

EIP:


Module LED Functions
US UA MODNET 100 LK1 100 LK2
US
UA
Mod
Net
100
LK
OK
Low
Error
Bus error
Config Error
No config
No data exchange
Connected
Timeout
100 Mbit/s
10 Mbit/s
Link activity
No link activity
Port LED Functions
IO
0
1
short circuit
> Imax.
IO-Link
n. C.
IO-Link
wrong device
short circuit

9 Webserver

9.5. "Ports" dialog

The "Ports" dialog displays information and process data for the connected IO-Link devices. Select the desired IO-Link Port in the image of the fieldbus module on the right side to see the device data.

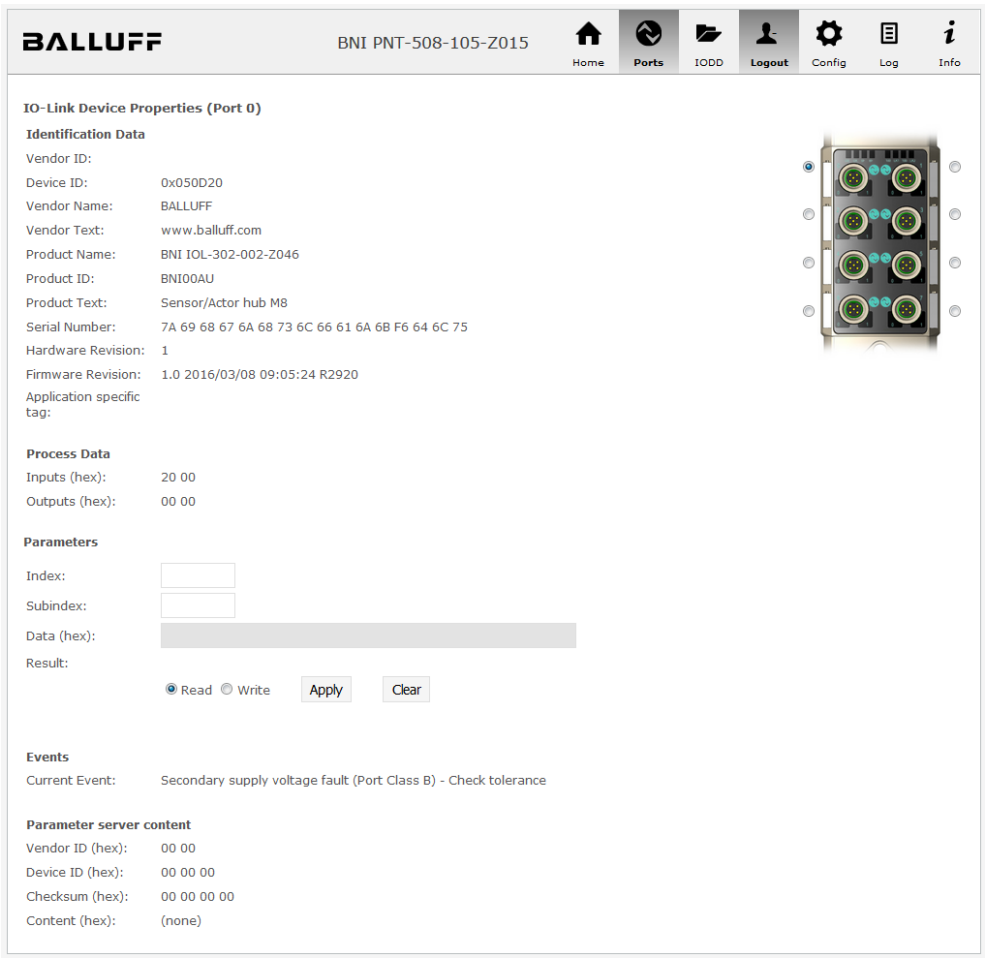
Note
The IO-Link device data are only displayed if the port is also configured as an IO-Link port!

No appropriate IODD uploaded

It is possible to read and write the configuration parameters of the IO-Link device via the "Parameters" option. The parameter indexes and subindexes of the IO-Link device are described in the corresponding separate user's guide (and follow the IO-Link conventions).

Under "Events" you can see whether a diagnostic event from the IO-Link device exists.

Under "Parameter Server Content" you can view the content of the parameter server if parameter data is stored on the parameter server.

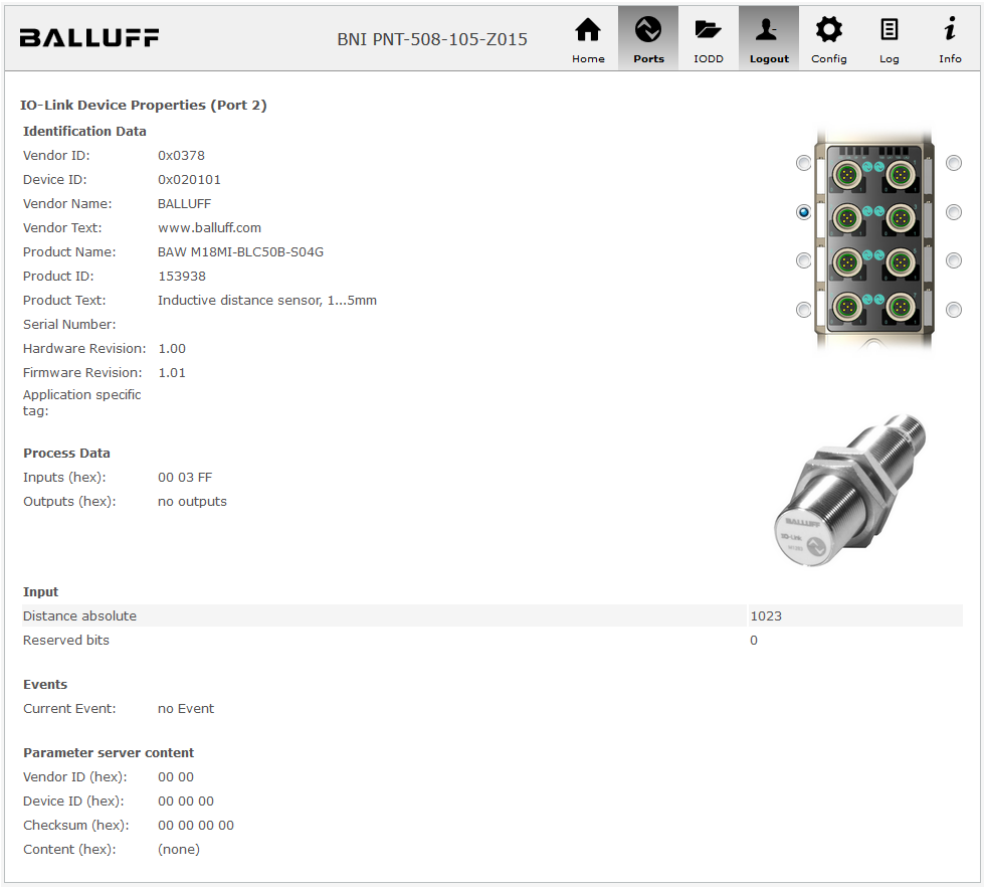


"Ports" dialog with direct parameter access

Appropriate IODD uploaded

If an IODD appropriate to the IO-Link device connected to the currently selected port has been uploaded (see "Dialog "IODD"), the normal dialog for "Process Data" and "Parameters" is not displayed, but rather an expanded dialog.
Information from the IODD of the device is used so that the data can be better understood.

Thus in the following screenshot not only are the input data of the distance sensor displayed as a hex number, but also interpreted and labeled under "Input".
Since the sensor has no parameters, none are displayed.



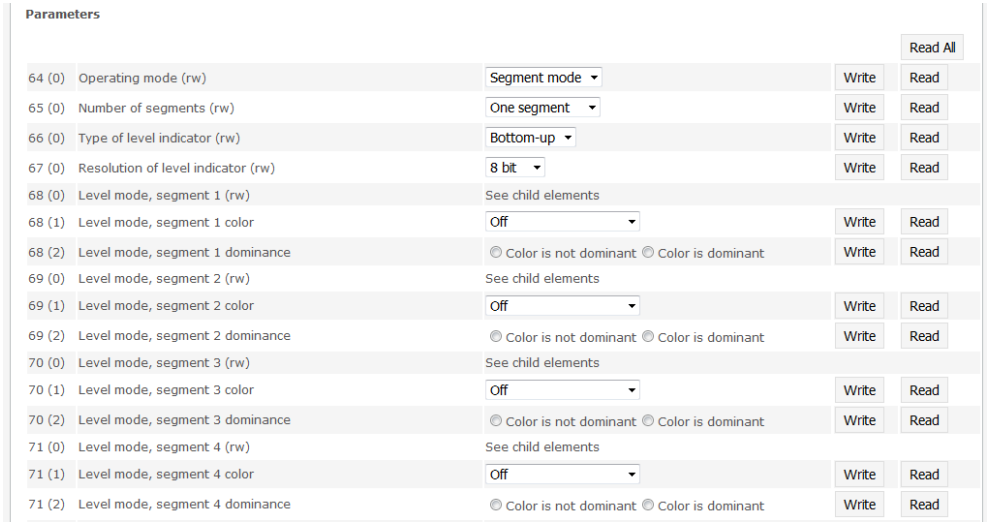
Dialog "Ports“: IODD interpretation and device image

9 Webserver

If the IODD of the IO-Link device on the currently selected port has parameters, these are shown in table format (see following screenshot). In this example the parameters for the Balluff Smart Light are shown.
The Smart Light is a signal light which can be used in three different modes. These modes can be set using an IO-Link parameter. The parameter values and associated texts are stored in the IODD.
This means "Operation Mode" can be read out and displayed ("Read" and "Read All" buttons) or written to the device ("Write" button).

If subindexes have no buttons they cannot be individually processed but rather only the entire index at once.

Note
Each changed value must be individually written by clicking on the "Write" button!



"Ports" dialog: Parameter list of an IO-Link device with uploaded IODD

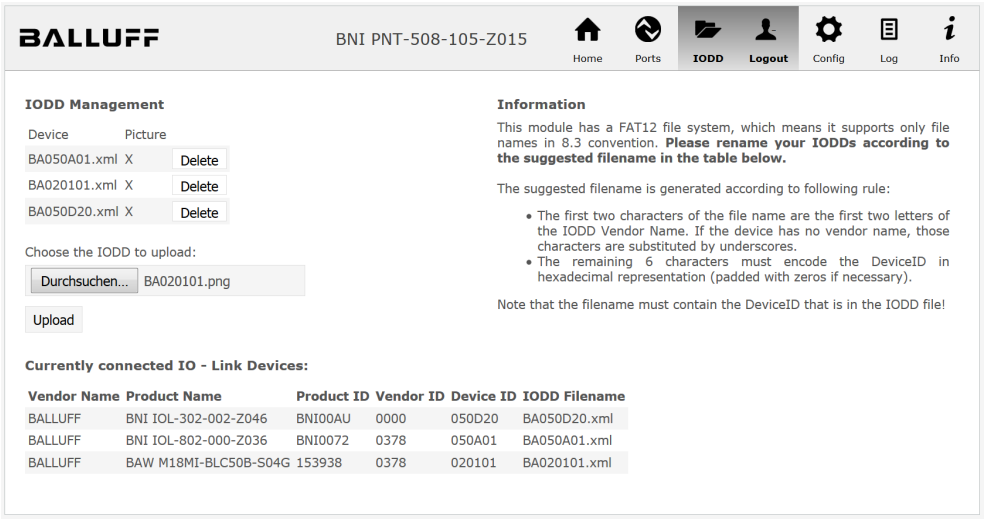
9.6. "IODD" dialog

Using this dialog you can transfer IODDs (device description files for IO-Link devices) and the associated device images to the fieldbus module, so that a detailed representation of the connected IO-Link devices in the "Ports" dialog is possible.

When IO-Link devices are connected and IO-Link ports are activated, the dialog shows a table with information about the IO-Link devices.

The fieldbus module file system supports only device names in "8+3" format, i.e. with a restricted name length. Since IODD files are generally published with a long file name, these must be renamed and given a shorter naming scheme on the PC before uploading to the fieldbus module.
For this a help setting is provided in the dialog, with the associated required IODD file name for the currently connected IO-Link devices shown in the bottom section of the list (column IODD Filename).

Image files without IODD can also be uploaded; the images are still displayed in the "Ports" dialog.



Using the "Delete" button you can delete IODDs and device images from the fieldbus when needed.

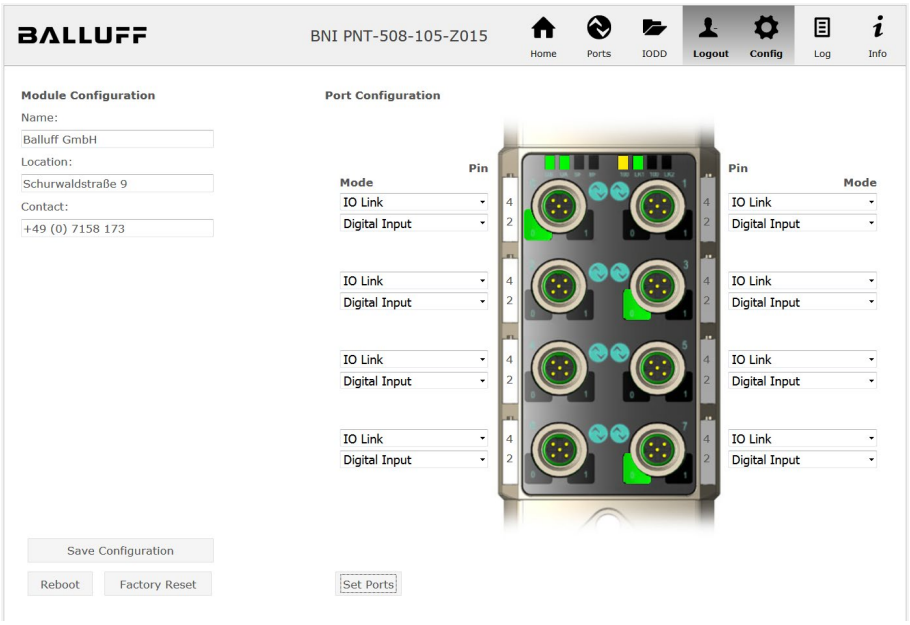
Note
Before selecting the IODD it must be renamed on the PC to the file name which is shown in the table in the "IODD Filename" column!

9 Webserver

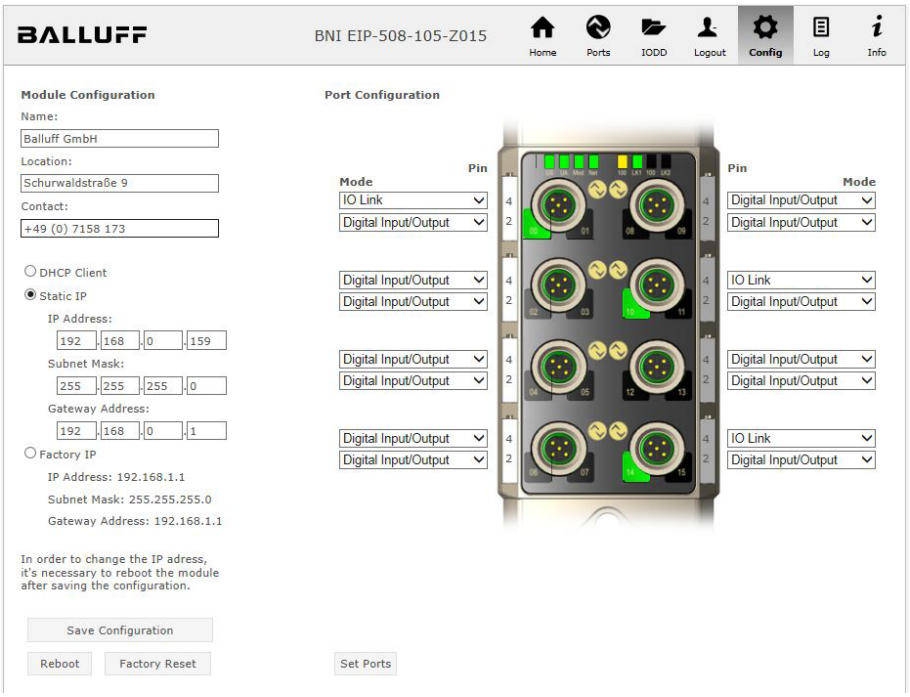
9.7. "Config" dialog

The configuration page enables configuration of the module. You can change both the module information texts and the port configuration.
The "Set Ports" action is not permanently stored in the device and is lost after the next reboot or reset.

PNT / ECT:



EIP:



The parameter set “Module Configuration” on the left side is used by clicking "Save Configuration" and permanently stored in the device.
The "Reboot" button reboots the device as if the power to the module had been turned off and on again.
Clicking on "Factory Reset" deletes the configuration and log files saved in the device and then performs a reboot, so that the device is restored to the default factory configuration as on delivery.

9 Webserver

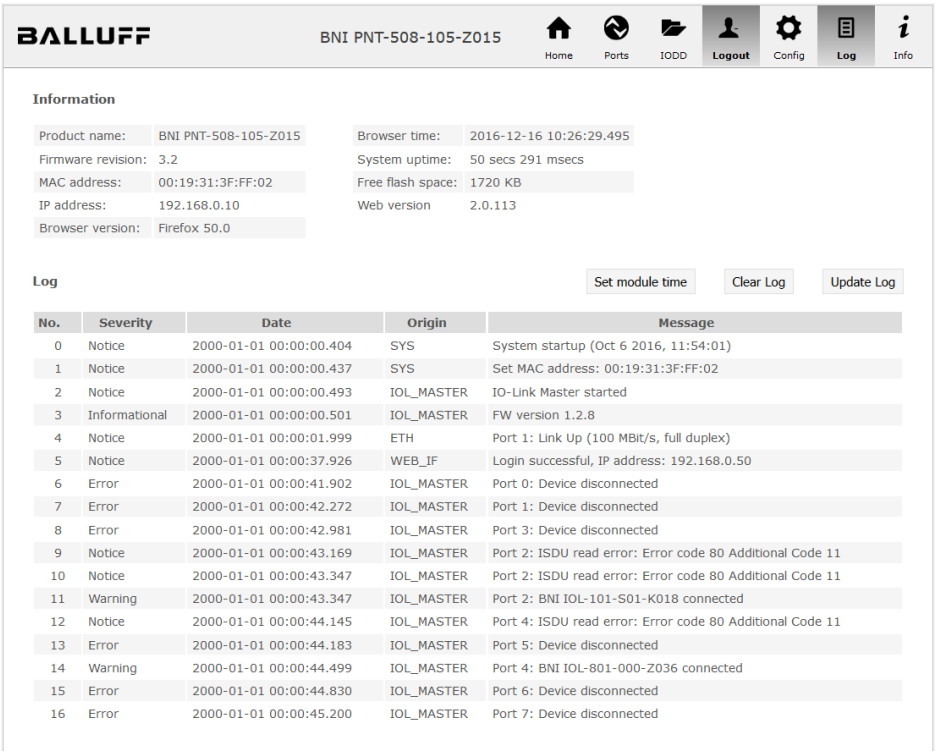
9.8. "Log" dialog

This dialog provides general service information about the device as well as a logging function.

The upper table (see screenshot below) contains important information for all service inquiries.

Note
If you have a detailed question about a specific situation, send us a screenshot of this Web site or print the site as a PDF.

Logging shows events which have occurred in chronological order. This provides a tool for detailed troubleshooting in equipment.



No.	Severity	Date	Origin	Message
0	Notice	2000-01-01 00:00:00.404	SYS	System startup (Oct 6 2016, 11:54:01)
1	Notice	2000-01-01 00:00:00.437	SYS	Set MAC address: 00:19:31:3F:FF:02
2	Notice	2000-01-01 00:00:00.493	IOL_MASTER	IO-Link Master started
3	Informational	2000-01-01 00:00:00.501	IOL_MASTER	FW version 1.2.8
4	Notice	2000-01-01 00:00:01.999	ETH	Port 1: Link Up (100 MBit/s, full duplex)
5	Notice	2000-01-01 00:00:37.926	WEB_IF	Login successful, IP address: 192.168.0.50
6	Error	2000-01-01 00:00:41.902	IOL_MASTER	Port 0: Device disconnected
7	Error	2000-01-01 00:00:42.272	IOL_MASTER	Port 1: Device disconnected
8	Error	2000-01-01 00:00:42.981	IOL_MASTER	Port 3: Device disconnected
9	Notice	2000-01-01 00:00:43.169	IOL_MASTER	Port 2: ISDU read error: Error code 80 Additional Code 11
10	Notice	2000-01-01 00:00:43.347	IOL_MASTER	Port 2: ISDU read error: Error code 80 Additional Code 11
11	Warning	2000-01-01 00:00:43.347	IOL_MASTER	Port 2: BNI IOL-101-S01-K018 connected
12	Notice	2000-01-01 00:00:44.145	IOL_MASTER	Port 4: ISDU read error: Error code 80 Additional Code 11
13	Error	2000-01-01 00:00:44.183	IOL_MASTER	Port 5: Device disconnected
14	Warning	2000-01-01 00:00:44.499	IOL_MASTER	Port 4: BNI IOL-801-000-Z036 connected
15	Error	2000-01-01 00:00:44.830	IOL_MASTER	Port 6: Device disconnected
16	Error	2000-01-01 00:00:45.200	IOL_MASTER	Port 7: Device disconnected

Events are classified using the "**Severity**“ column:

Internal Error (Emergency, Alert, Critical)
→ The fieldbus module has detected a fault in itself (hardware or software) which should not occur during normal operation. If this happens, the module must be serviced or replaced.

External Error (Error, Warning)
→ The fieldbus module has detected what may be a non-permissible event which is affecting the module from the outside. The system may require troubleshooting.

Event (Informational, Notice)
The fieldbus module has detected an important normal operating event and reports it. These may include for example configuration actions over the web interface and other configuration interfaces which are also recorded.

Clicking on "Set Module Time” sends the current browser time to the fieldbus module but does not permanently store it. After a reset, reboot or loss of power the time begins to run again from the year 2000.

Clicking on "Update Log” refreshes the display, and "Clear Log” deletes all entries. The log entries are stored in a ring buffer.

10 Diagnostics

10.1. Diagnostics message

The diagnostics message that is generated by the module in the event of an error is usually read out by the PLC and processed. It is also possible to read out the diagnosis from the module by means of function modules and evaluate it.

The diagnostics message is 34 bytes long and divided into 3 blocks:
Block Header, Alarm Specifier, Channel Properties

Byte	Value	Meaning	Block
0	00	Block Type	Block Header
1	02		
2	00	Block Length	
3	1E		
4	01	Block Version High	
5	00	Block Version Low	
6	00	Alarm type	
7	01		
8	00	API	
9	00		
10	00		
11	00		
12	00	Slot number	
13	XX		
14	00	Subslot number	
15	01		
16	00	Module ID	
17	00		
18	00		
19	XX		
20	00	Submodule ID	
21	00		
22	00		
23	01		
24	XX	AlarmSpecifier	AlarmSpecifier
25	36		
26	80	User Structure ID	
27	00		
28	XX	Channel number	
29	XX		
30	08	ChannelProperties	ChannelProperties
31	00		
32	00	ChannelErrorType	
33	1 A		

10.2. Block Header

The first part of the diagnosis is the so-called Block Header, which is 24 bytes long.

Block Type

The first 2 bytes of the Block Header are described by the Block Type to define the data type.

Possible values	Meaning
0x0002	Alarm Notification Low

Block Length

2 bytes of data that define the length of the following diagnostics message.
(For the complete diagnostics message, the 2 bytes from the Block Type and the 2 bytes from the Block Length must be added.)

Block Version High

1 byte, preset to 0x01

Block Version Low

1 byte, preset to 0x00

Alarm Type

2 bytes; the information on the type of alarm is provided here

Possible values	Meaning
0x0001	Diagnostics

API

4 bytes, default is 0.

Possible values	Meaning
0x00000000	Default value

Slot

2 bytes of data that describe which slot of the module reports an error

Possible values	Meaning
0x0001 - 0x0010	Slot 1-16 (IO-Link ports 0 – 15)
0x0011 - 0x0018	Slot 17-32 (Standard IO-module)

Subslot

2 bytes of data that describe which subslot of the slot reports an error

Possible values	Meaning
0x0001	Subslot 1

10 Diagnostics

Module ID

4 bytes of data that describe which module is inserted in the respective slot.
(The module ID is saved in the GSDML)

Possible values	Meaning
0x00000025	IOL IN 1 OUT 0
0x00000026	IOL IN 2 OUT 0
0x0000003A	IOL IN 4 OUT 0
0x0000003B	IOL IN 6 OUT 0
0x00000027	IOL IN 8 OUT 0
0x00000035	IOL IN 10 OUT 0
0x00000037	IOL IN 16 OUT 0
0x0000003C	IOL IN 24 OUT 0
0x00000028	IOL IN 32 OUT 0
0x00000029	IOL IN 0 OUT 1
0x0000002A	IOL IN 0 OUT 2
0x0000003D	IOL IN 0 OUT 4
0x0000003E	IOL IN 0 OUT 6
0x0000002B	IOL IN 0 OUT 8
0x00000036	IOL IN 0 OUT 10
0x00000038	IOL IN 0 OUT 16
0x0000003F	IOL IN 0 OUT 24
0x0000002C	IOL IN 0 OUT 32
0x0000002D	IOL IN 1 OUT 1
0x0000002E	IOL IN 2 OUT 2
0x00000040	IOL IN 2 OUT 4
0x00000041	IOL IN 4 OUT 2
0x00000042	IOL IN 4 OUT 4
0x0000002F	IOL IN 2 OUT 8
0x00000043	IOL IN 4 OUT 8
0x00000030	IOL IN 8 OUT 2
0x00000044	IOL IN 8 OUT 4
0x00000045	IOL IN 8 OUT 8
0x00000031	IOL IN 4 OUT 32
0x00000032	IOL IN 32 OUT 4
0x00000039	IOL IN 16 OUT 16
0x00000046	IOL IN 24 OUT 24
0x00000033	IOL IN 32 OUT 32
0x00000059	Output pin 4
0x0000005A	Output pin 2
0x0000005B	Input pin 4
0x0000005C	Input pin 2

Submodule ID

4 bytes of data that describe which submodule is used with the respective module.
(The submodule ID is saved in the GSDML.)

Possible values	Meaning
0x00000001	BNI PNT-509-105-Z033 (header module)

10.3. AlarmSpecifier 2 bytes, subdivided as follows:

Sequence Number Bit 0-10, this counter is incremented with every new diagnostic message.

Channel Diagnostic Bit 11

Possible values	Meaning
0x00	No diagnosis related to channel is pending
0x01	Diagnosis related to channel is pending

Manufacturer-Specific Diagnosis Bit 12

Possible values	Meaning
0x00	No diagnosis related to manufacturer is pending
0x01	Diagnosis related to channel is pending

Submodules Diagnostic State Bit 13

Possible values	Meaning
0x00	No further diagnosis of submodule present
0x01	At least one further diagnosis of the submodule present

Bit 14 reserved

ARDiagnosis State Bit 15

Possible values	Meaning
0x00	No further diagnosis of module is present
0x01	At least one further diagnosis of the module is present

User Structure ID 2 bytes, describes the type of diagnosis

Possible values	Meaning
0x8000	Channel-related diagnosis

10 Diagnostics

10.4. Channel Number

Configuration as standard I/O

Error Type	Channel Number
Undervoltage US	8000
Undervoltage UA	8000
No UA	8000
Sensor Short circuit Pin 1 - 3	0…..n
Actor Short circuit Pin 2 - 3	0…..n
Actor Short circuit Pin 4 - 3	0…..n

n = Number of IOL-Ports

Configuration as IO-Link

Error Type	Channel Number
Line break	0
Short circuit IOL Pin 4 - 3	0
Sensor short circuit Pin 1 - 3	0
IOL Device wrong configuration	0

Diagnostics of IO-Link devices

Error Type	Channel Number
Short circuit	1
Undervoltage	1
Upper threshold exceeded	1
Lower threshold undershot	1

10.5. Channel Properties

2 bytes, subdivided as follows:

Type

Possible values	Meaning
0x00	Used if the channel number is 0x8000 or none of the types defined below is relevant.
0x01	1 bit
0x02	2 bit
0x03	4 bit
0x04	8 bit
0x05	16 bit
0x06	32 bit
0x07	64 bit
0x08 – 0xFF	Reserved

Bit 0-7

Accumulative

Bit 8 not used, always 0.

Maintenance

Possible values		Meaning
Bit 9	Bit 10	
0x00	0x00	Diagnostics

Bit 9-10

Specifier

Possible values	Meaning
0x00	Not used
0x01	Diagnosis appeared
0x02	Diagnosis left
0x03	Diagnosis left, but another is still active

Bit 11-12

Direction

Possible values	Meaning
0x00	Manufacturer-specific
0x01	Channel used as input
0x02	Channel used as output
0x03	Channel used as input and output

Bit 13-15

10 Diagnostics

10.6. Channel Error Type

Error code in hex	Description
0x0000	Unknown error
0x0001	Short circuit
0x0002	Undervoltage Bus-/sensor supply port 0-7
0x0003	Overvoltage
0x0004	Overload
0x0005	Temperature limit exceeded
0x0006	Cable break
0x0007	Upper threshold exceeded
0x0008	Lower threshold undershot
0x0009	Error
0x001A	External error
0x001B	Sensor has incorrect configuration (IO-Link device)
0x001C	Data storage error
0x0100	Short circuit of the sensor supply
0x0101	Actuator warning
0x0102	Actuator short circuit
0x0104	No actuator supply port 0-7
0x0105	Undervoltage actuator supply port 0-7
0x0108	Undervoltage Bus-/sensor supply port 8-15
0x0109	No Bus-/sensor supply port 8-15
0x010A	Undervoltage actuator supply port 8-15
0x010B	No actuator supply port 8-15

11 Appendix

11.1. Scope of delivery

The BNI PNT comprises the following elements:

- IO-Link block
- 4x M12 dummy plugs
- Ground strap
- M4x6 screw
- 20 information signs

11.2. Order number

BNI PNT-xxx-105-Z033

Balluff network interface

ProfiNet

Functions
509 = IP 67 IO-Link master module, 16 IO-Link ports

Versions
105 = Display version, 2-port switch

Mechanical version
Z033 = Die-cast zinc housing
Data transmission: 2 x M12x1 female thread
Power connection: 2 x 7/8" male thread
Sensor connections: 16 x M12x1 female thread

11.3. Order information

Product ordering code	Ordering code
BNI PNT-509-105-Z033	BNI007M

www.balluff.com

Balluff GmbH
Schurwaldstrasse 9
73765 Neuhausen a.d.F.
Germany
Tel. +49 7158 173-0
Fax +49 7158 5010
balluff@balluff.de

No. 898328-726 E •06.129078 •Edition J19 •Replaces Edition F17 •Subject to modifications.