Manual

Balluff Network Interface next generation

BNI XG1-505-0A5-R067
BNI XG3-302-0B5-R067
BNI XG3-302-1B5-Z067
BNI XG3-508-0B5-R067
BNI XG5-508-0B5-P067
BNI XG5-508-0B5-R067
BNI XG5-538-0B5-R067
BNI XG5-538-1B5-Z067
BNI XG5-508-1B5-Z067

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CONTENTS

CHAPTER

ONE

ABOUT THIS GUIDE

1.1 Validity

This guide describes the integration and configuration of the product lines BNI XG1-…, BNI XG3-… and BNI XG5-…

The following table describes the product variants covered by this guide:

Table 1: Supported product variants

Type Code	Oder Code	Performance Class	IO Port	Housing	Display
BNI XG1-505-0A5-R067	BNI00L1	Entry	8x IO-Link Class A / 16x DI / 8x DO	Plastic	-
BNI XG3-302-0B5-R067	BNI00L7	Standard	16x DI / 16x DO	Plastic	-
BNI XG3-302-1B5-Z067	BNI00L8	Standard	16x DI / 16x DO	Metal	
BNI XG3-508-0B5-R067	BNI00L3	Standard	8x IO-Link Class A / 16x DI / 16x DO	Plastic	-
BNI XG5-508-0B5-P067	BNI00L9	Advanced	8x IO-Link Class A / 16x DI / 16x DO	Plastic	-
BNI XG5-508-0B5-R067	BNI00KH	Advanced	8x IO-Link Class A / 16x DI / 16x DO	Plastic	-
BNI XG5-538-0B5-R067	BNI00KJ	Advanced	4x IO-Link Class A / 4x Class B / 12x DI / 12x DO	Plastic	-
BNI XG5-508-1B5-Z067	BNI00K6	Advanced	8x IO-Link Class A / 16x DI / 16x DO	Metal	
BNI XG5-538-1B5-Z067	BNI00K7	Advanced	4x IO-Link Class A / 4x Class B / 12x DI / 12x DO	Metal	

Read this guide and the other applicable documents completely before installing and operating the product.

This guide was created in German. Other language versions are translations of this guide.

1.2 Other applicable documents

Additional information about this product can be found at www.balluff.com on the product page, e.g. in the following documents:

- Data sheet
- Declaration of Conformity
- Disposal

1.3 Disclaimer

The following description is provided free of charge and is a general application example. The description should support the programming and planning of PLC applications and illustrate possible solutions. The user has no claim to warranty, error correction or updates. In particular, any claims for compensation that could result from the use of this description are excluded. This liability limitation excludes (a) damages due to loss of life, personal injury or harm to health, (b) liability in accordance with the Product Liability Act and © cases of intent. Prior to implementation in systems and machines, please check whether the description provided here is intended for your application. The use of this free description shall be deemed to imply acceptance of the warranty and liability limitation!

1.4 Explanation of the warnings

Always observe the warnings in this guide and the measures described to avoid hazards.
The warnings used here contain various signal words and are structured as follows:

SIGNAL WORD

Type and source of the hazard
Consequences if not complied with
► Measures to avoid hazards

The individual signal words mean:

NOTICE

Identifies a danger that could **damage or destroy the product.**

CAUTION

The general warning symbol together with the signal word CAUTION indicates a hazard which can lead to **slight or moderate injuries.**

DANGER

The general warning symbol in conjunction with the signal word DANGER identifies a hazard which, if not avoided, will certainly result in **death or serious injury.**

1.5 Symbols and conventions

- Individual instructions are indicated by a preceding triangle.

Action sequences are numbered consecutively:

- Instruction 1
- Instruction 2

Numbers unless otherwise indicated are decimals (e.g. 23). Hexadecimal numbers are represented with a preceding 0x (e.g. 0x12AB).

Buttons or selectable menu entries are described in italic and small caps, e.g.Save.

Menu commands are joined with a greater-than sign, e.g. “Settings>Options” stands for the menu command Options from the Settings menu.

Note

Note, tip
This symbol indicates general notes.

1.6 Technical terms and abbreviations used

C/Q
Switching and communication line

EMC
Electromagnetic compatibility

FE
Functional earth

GND
Electrical ground 0 V

I/O
Standard inputs and outputs

n. c.
Not connected

SIO
Standard input/output

UA
Power supply

US
Sensor supply

ADT
Fieldbus Autodetection

BET
Balluff Engineering Tool

DID
Device ID

I/O
Input/Output

ECT
EtherCAT[1]

EIP
EtherNet/IP

IOL
IO-Link

ISDU
IO-Link-Parameter (Index Service Data Unit)

MBT
Modbus

MQTT
Message Queuing Telemetry Transport

Modbus TCP
Modbus Transmission Control Protocol

PNT
Profinet

SIO
Standard IO-Mode

PLC
Programmable logic controller

VID
Vendor ID

1.7 Pictures

The illustrations mostly show the device variant BNI XG5-538-1B5-Z067. Product views and pictures in these operating instructions may differ from the specified product.

The screenshots shown for the configuration are taken from the following project planning software as an example:

- **EtherCAT**: TwinCAT System Manager for connecting to a Beckhoff TwinCAT control
- **Profinet**: Siemens HW config
- **Ethernet/IP**: Rockwell RSLogix5000 configuration

[1] EtherCAT© is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

CHAPTER

TWO

FIRST STEPS

2.1 Before you begin

WARNING

Before initial operation, please read the *Safety notes*.

2.2 Finding all neccesary information

Before connecting and commissioning the module, please read the safety instructions and guidelines in the manual. Always ensure that all necessary safety precautions are followed.

What's in the box

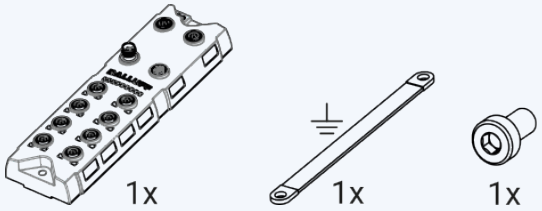
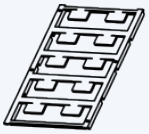


Fig. 1: 1x Balluff network module1x Ground connector1x M4 screw

Accessories (to be ordered separately)



BAM01JT
BAM02K3

BAM01C2

Fig. 2: BAM01JT - Store linkBAM02K3 - Store linkBAM01C2 - Store link

2.3 Mounting the module

First, mount the network module at both mounting holes in its designated position using the specified torque values. Two screws with a maximum diameter of 6mm are required for this. The length can be chosen according to your application location. Next, the grounding cable must be screwed to both the module and a conductive substrate using the specified torque value.

2.3.1 Main steps for installing the module:

To set up your BNI, follow these steps:

1. Prepare the substrate for installation
2. Position the module at the designated location
3. Screw the module in place through the two mounting holes with M6 screws
4. Tighten the screws to a maximum torque of 3 Nm
5. Attach and tighten the grounding cable with a maximum torque of 1.2 Nm
6. Screw the grounding cable to the grounding point in the application

2.3.2 Connecting the module

When connecting the module, please follow the order described below. Always ensure that all cables are securely seated and that the plugs and cable connections are in good condition.

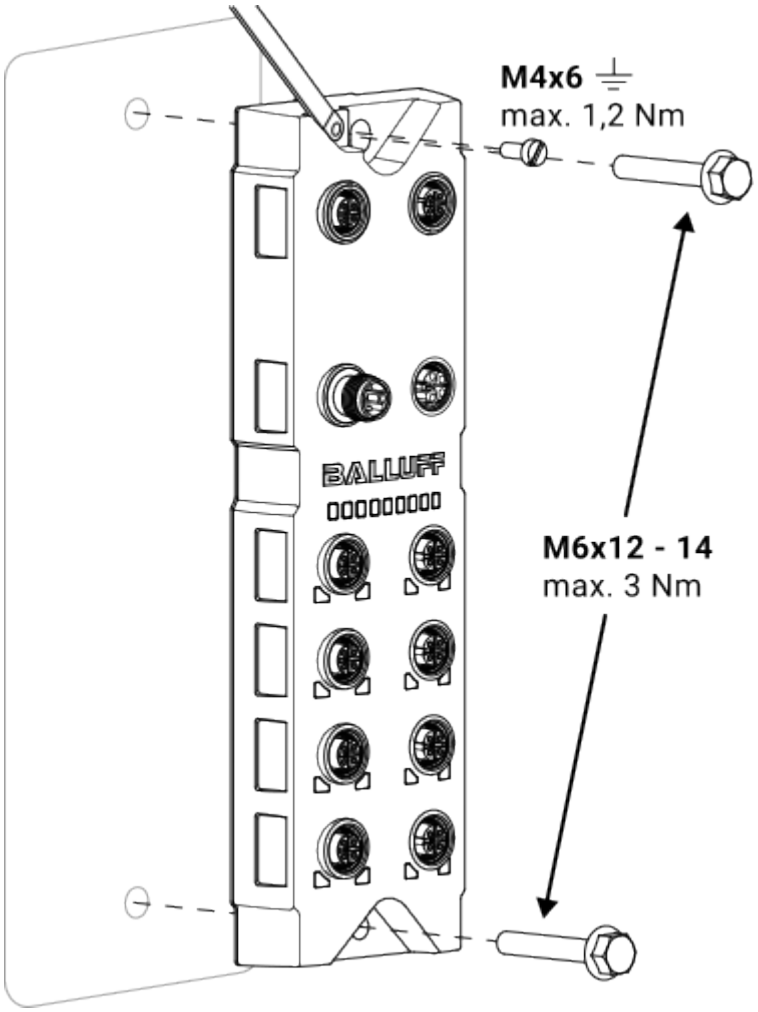
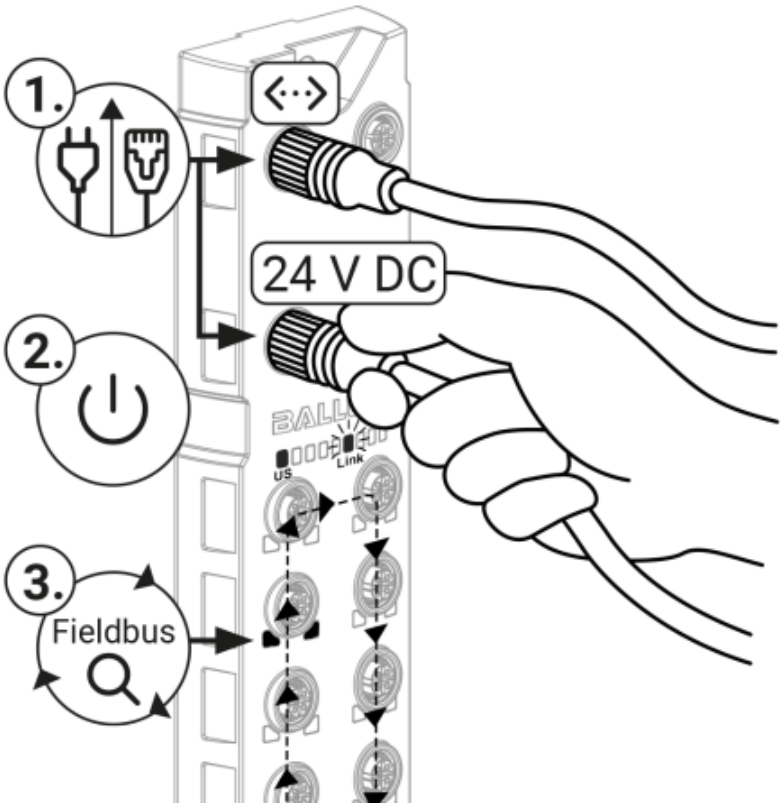


Fig. 3: Suit moments for the installation of module and grounding cable

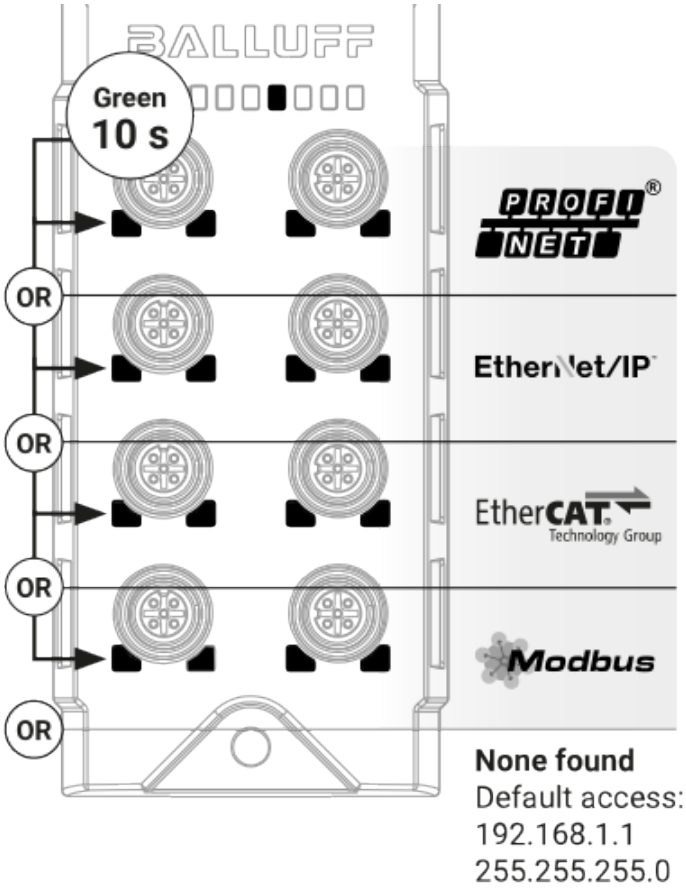


Main steps for connecting the module:

1. Plug in the M12 Ethernet cable and securely tighten the screw connection. Next, connect the unpowered 24V power cable to the module and securely tighten the screw connection. This ensures the IP67 protection class at the connections. The open connections must be covered with caps.
2. Then, activate the 24V power source. The module LEDs US and Link will start to light up.
3. In the area of the device connectors, the LEDs will form a running light in a clockwise direction, indicating the search for an active fieldbus protocol in the connected network.

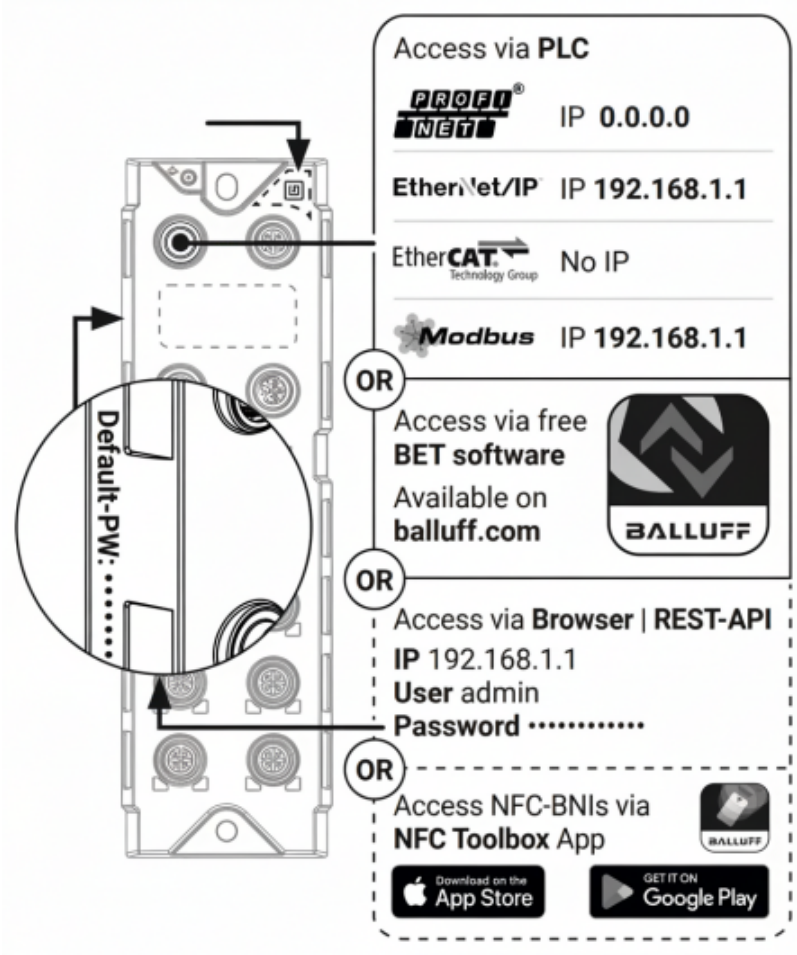
2.3.3 Selecting the fieldbus protocol

If a supported fieldbus protocol is found in the network, the network module selects it automatically. The chosen fieldbus protocol is visualized for 10 seconds by the respective LED line in the device connector area. If no protocol is found, no LEDs will light up, and the default access via the web interface will be activated. There, a fieldbus protocol can be selected manually, and network settings can be adjusted.



2.3.4 Comissioning via network and software

There are different ways to start up the module after connecting it. Accessibility via the various fieldbus protocols and interfaces varies, as shown below.



Access via PLC and fieldbus

There are different ways to put the module into operation after connecting it. The accessibility via the various fieldbus protocols and interfaces varies, as shown below.

Feldbus	Default IP adress	default subnet mask	gateway
Autodetect	192.168.1.1	255.255.255.0	0.0.0.0
Profinet	0.0.0.0	0.0.0.0	0.0.0.0
EtherNet/IP	192.168.1.1	255.255.255.0	0.0.0.0
Modbus/TCP	192.168.1.1	255.255.255.0	0.0.0.0
EtherCAT	IP settings via EoE	IP settings via EoE	IP settings via EoE

Detailed information on integrating the module via fieldbus protocols:

1. *Profinet integration*
2. *Ethernet/IP integration*
3. *EtherCAT integration*
4. *Modbus TCP configuration*

Access via Balluff Engineering Tool (BET)

First, download the free software Balluff Engineering Tool from the Balluff website and install it. Then, open the software and after logging in, click on “Search Devices” on the right side of the bar.

Access via browser with Web UI or the REST API

If EtherCAT was not selected as the fieldbus protocol after powering on, you can access the module via the browser and a REST interface. Use the login credentials found on the side of the module or on the included sticker. Follow these steps:

1. Open the URL 192.168.1.1 in your browser. You may need to change the network settings of your network adapter to the same IP range to gain access.
2. Log in as “admin” with the provided default password.
3. Open the network settings to adjust the fieldbus protocol and network settings.

To access via the REST API, open the REST documentation. There you will find all available endpoints.

Here you will find a detailed documentation of the WebUI chapter *REST API*.

Note

For detailed instructions, refer to the *Installation and connection* and *Startup and operation* sections.

CHAPTER

THREE

PRODUCT INFORMATION

This section provides information about the product features and specifications.

3.1 Product description

3.1.1 Dimensions

BNI XG1-505-0A5-R067 / BNI XG3-302-0B5-R067

BNI XG3-508-0B5-R067 / BNI XG5-508-0B5-P067

BNI XG5-508-0B5-R067 / BNI XG5-538-0B5-R067

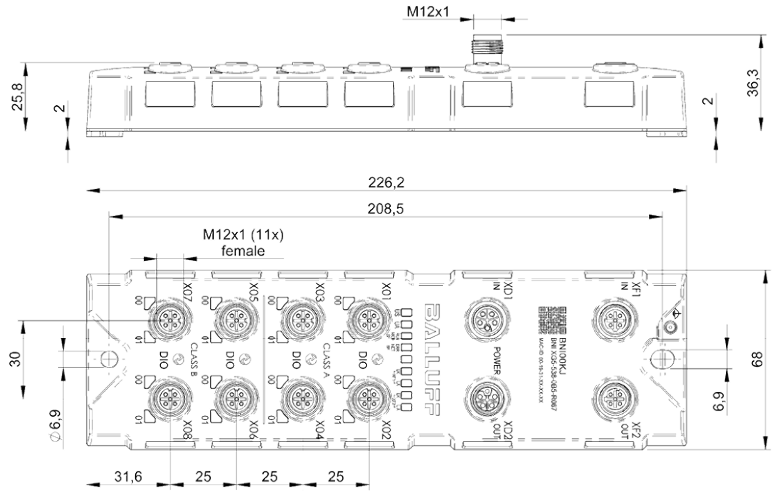


Fig. 1: Dimensions BNI XG1-505-0A5-R067 / BNI-XG3-302-0B5-R067 / BNI-XG3-508-0B5-R067 / BNI XG5-508-0B5-R067 / BNI XG5-538-0B5-R067

BNI XG3-302-1B5-Z067 /

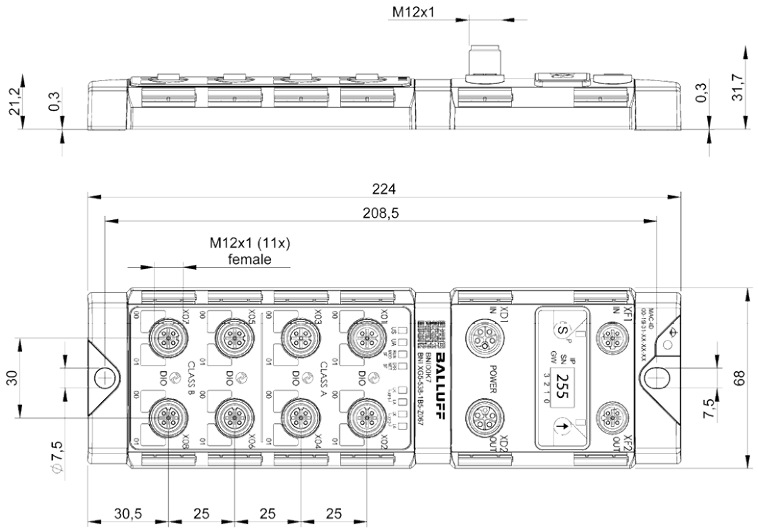


Fig. 2: Dimensions BNI XG3-302-1B5-Z067 / BNI XG5-508-1B5-Z067 / BNI XG5-538-1B5-Z067

BNI XG5-508-1B5-Z067 / BNI XG5-538-1B5-Z067

3.1.2 Construction

Note

1) Only for BNI XG5-…-1B5-… _variants.

3.1.3 Function

The IO-Link multiprotocol master is a decentralized and configurable gateway that processes and evaluates the input and output signals of standard sensors and actuators as well as process data from connected IO-Link devices.

The data is transmitted via an existing fieldbus interface to a higher-level controller set up by the user for further processing.

A web server is available on the IO-Link master for configuration and diagnostics.

Note

For configuration information, see the configuration guide at **www.balluff.com** on the product page.

Variant	I/O-Port	IO-Link Port	
-	-	Class A	Class B
BNI XG1-505-0A5-R067	-	1…8	–
BNI XG3-302-0B5-R067	1…8	–	–
BNI XG3-302-1B5-Z067	1…8	–	–
BNI XG3-508-0B5-R067	–	1…8	–
BNI XG5-508-0B5-P067	–	1…8	–
BNI XG5-508-0B5-R067	–	1…8	–
BNI XG5-538-0B5-R067	–	1…4	5…8
BNI XG5-508-1B5-Z067	–	1…8	–
BNI XG5-538-1B5-Z067	–	1…4	5…8

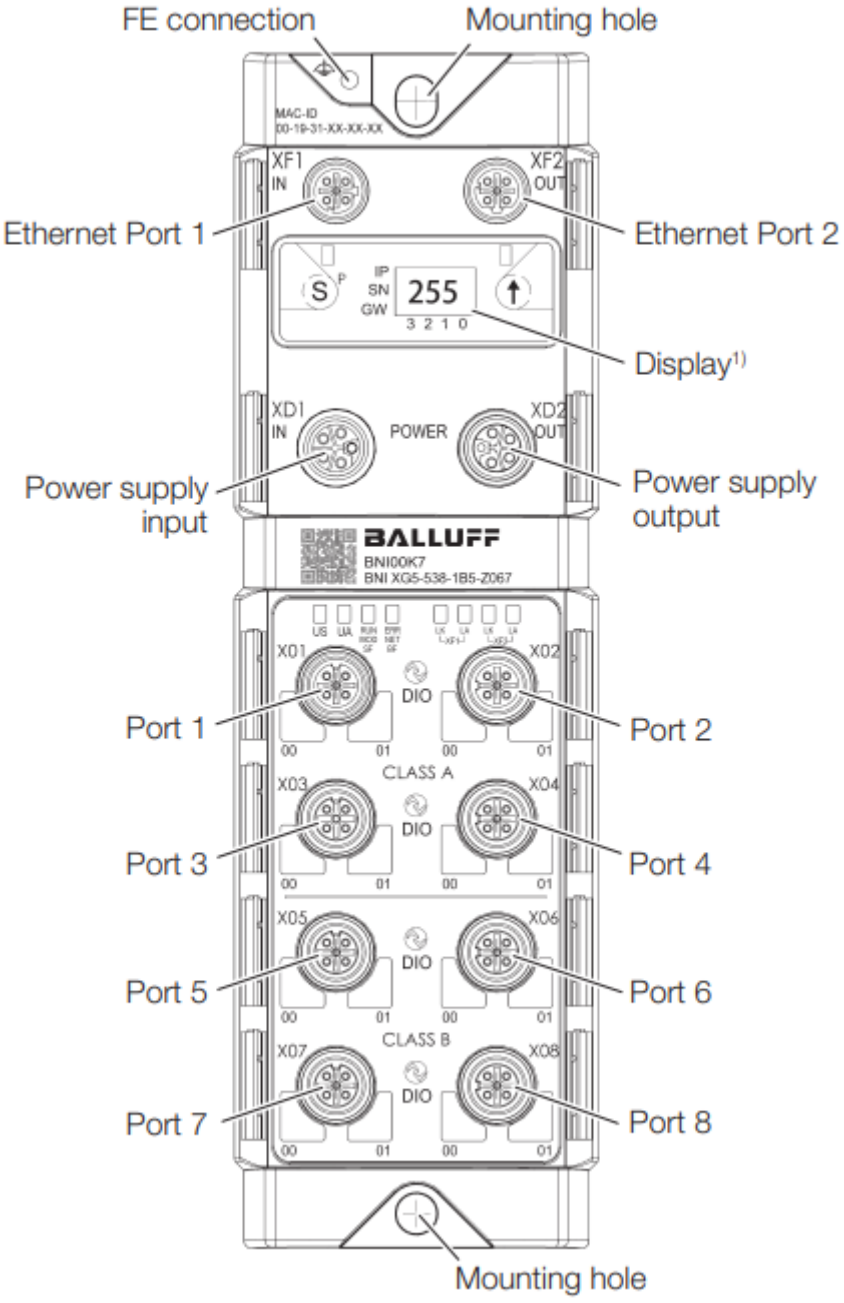


Fig. 3: Device overview

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

3.1.4 Display elements

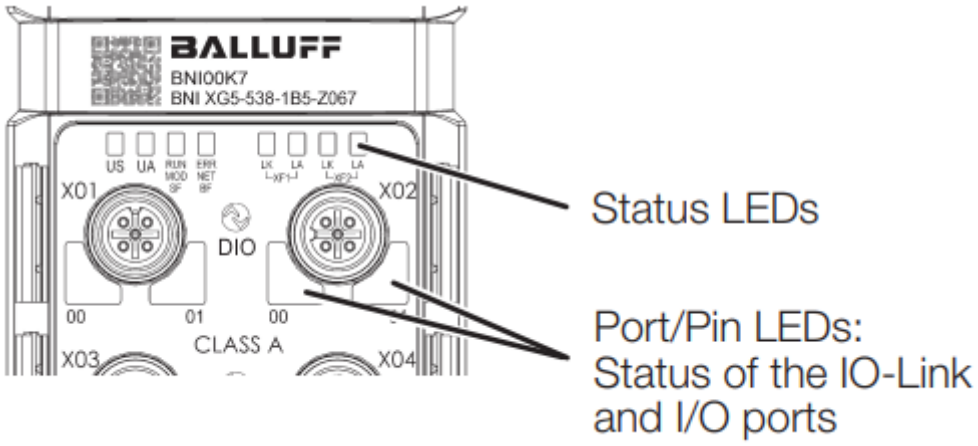


Fig. 4: Display elements

Note

For flashing behavior in autodetect mode, see *Startup*.

Status LEDs

Note

Specified voltage level according to DIN EN 61131.

Power supply

LED	Signal	Meaning
US	Green, static	Input voltage OK
	Red flashing	Input voltage too low (< ~20.5 V DC)
UA	Green, static	Output voltage OK
	Red flashing	Output voltage too low (< ~20.5 V DC) or too high (> ~28.7 V DC)
	Red, static	No output voltage present (< ~10.4 V DC)

Profinet communication

LED	Signal	Meaning
SF	Off	No error
	Red, static	Watchdog timeout; channel, general or extended diagnostics present; system error
	Red flashing	DCP signal service started via bus.
BF	Off	No error
	Red, static	Low speed of physical link; or no physical link
	Red flashing	No data exchange or no configuration

Ethernet/IP communication

LED	Signal	Meaning
MOD	Green flashing	Incorrect or no module configuration
	Green, static	Module in progress.
	Red flashing	Fixed bus cycle not possible
	Red-Green Flashing	Starting sequence
NET	Off	Module has no IP address.
	Green flashing	Module has an IP address, but no connection established.
	Green, static	Connection is established.
	Red flashing	Connection timeout
	Red-Green Flashing	Starting sequence

EtherCAT communication

LED	Signal	Meaning
RUN	Off	Device is in INIT state.
	Green flashing	Device is in PRE-OPERATIONAL state.
	Green slowly flashing	Device is in SAFE-OPERATIONAL state.
	Green, static	Device is in OPERATIONAL state.
ERR	Off	No errors
	Red flashing	Invalid configuration
	Red slowly flashing	Local error
	Red, fast flashing	Application watchdog timeout
	Red, static	Error in application

Modbus TCP communication

LED	Signal	Meaning
RUN	Green slowly flashing	Module is ready to establish a connection.
	Green, static	Connection is established.
	Yellow, fast flashing	Existing connection has been lost.

Ethernet Ports

LED	Signal	Meaning
LA	Off	No data transfer and data reception
	Green, flashing	Send and receive data with connected device.
LK	Off	Ethernet connection is not yet established.
	Green, static	Ethernet connection established with another device.

Port/Pin LEDs

LED number	Assignment
LED 0	Pin 4
LED 1	Pin 2

Port/Pin LEDs Standard Port

Signal	Meaning
Off	State of input or output pins is 0
Yellow, static	State of input or output pins is 1
Both LEDs red flashing	Short circuit of sensor supply between pin 1 and pin 3
Red, static	Short circuit at output on pin 2/4 against pin 3
Red, static	No high signal at diagnostic input
Red, static	24 V input signal on configured output (actuator warning)

Port/Pin LEDs IO-Link Port

Signal	Meaning
Green, static	IO-Link connection active
Green flashing	No IO-Link connection or incorrect IO-Link device
Green, fast flashing	IO-Link: Preoperate during data storage
Red, fast flashing	Validation failed / incorrect configuration of the IO-Link data length
Red, fast flashing	Data storage failed / incorrect device for data storage
Red, static	IO-Link: Short circuit of pin 4 against pin 3

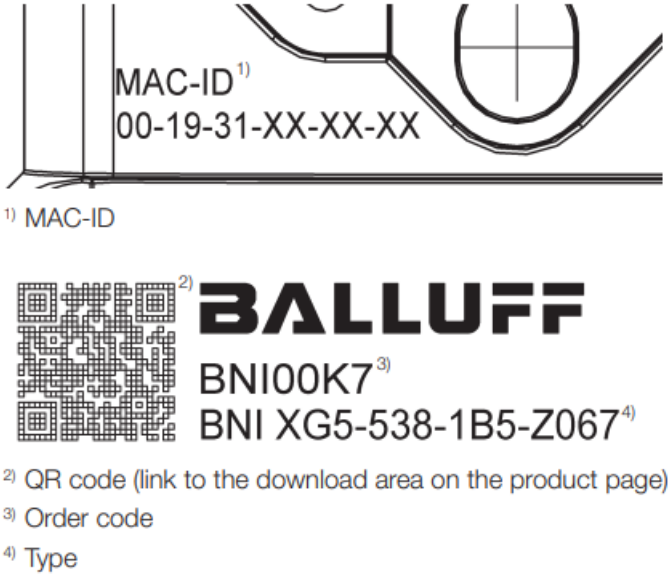


Fig. 5: Labeling (example)

3.1.5 Labeling

Note

Only for BNI XG…-…-Z067 _variants.

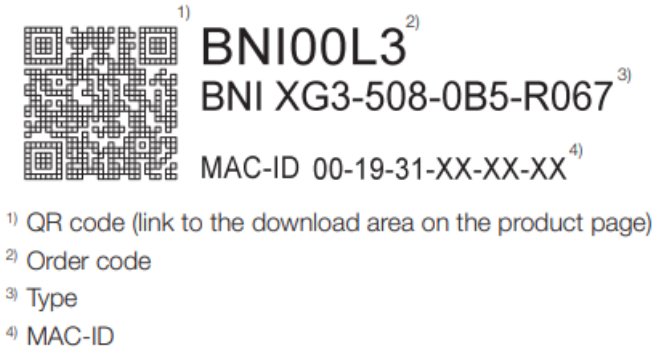


Fig. 6: Labeling (example)

Note

Only for BNI XG…-…-R067 _variants.

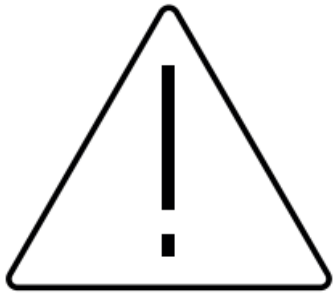


Fig. 7: Symbol

3.1.6 Symbol on product

WARNING

General warning sign ► Observe the additional approval-related and safety-related information in the product documentation.

3.2 Safety notes

3.2.1 Intended use

The IO-Link multiprotocol master serves as decentralized I/O and IO-Link Block for connection to a Profinet, Ethernet/IP or EtherCAT network and is intended for use in industrial applications.

The module may only be operated with an approved power supply. Only approved lines may be connected.

Proper function according to the specifications in the technical data is only assured when the product is used solely as described in the user's guide and the respective documents as well as in compliance with the technical specifications and requirements and only with suitable original Balluff accessories.

Otherwise, there is deemed to be unintended use. Unintended use is not permitted and will result in the loss of warranty and liability claims against the manufacturer.

3.2.2 Reasonably foreseeable misuse

The product is not intended for the following applications and areas and may not be used there:

- In safety-oriented applications in which personal safety depends on the device function (for exception see chapter *Use in combination with safety modules (BNI XG5-538-… only)*)
- In explosive atmospheres

3.2.3 General safety notes

Activities such as **installation, connection** and **startup** may only be carried out by qualified personnel.

Qualified personnel are persons whose technical training, knowledge and experience as well as knowledge of the relevant regulations allows them to assess the work assigned to them, recognize possible hazards and take appropriate safety measures.

The **operator** is responsible for ensuring that local safety regulations are observed.

In particular, the operator must take steps to ensure that a defect in the product will not result in hazards to persons or equipment.

The product must not be opened, modified or changed. If defects and unresolvable faults occur in the product, take it out of service and secure against unauthorized use.

BNI modules generally have good chemical and oil resistance. When used in aggressive media (e.g. chemicals, oils, lubricants and coolants) in high concentrations (e.g. due to low water content), the material resistance must be checked in advance for the specific application. In the event of failure or damage to the BNI modules due to these kinds of aggressive media, claims for defects are ruled out.

If BNI XG5-**538**-… modules are to be used in conjunction with Class B isolation, there must be no galvanic connection between US and UA networks. Example: US must not be used to apply a high level to pin 2 of a Class B port.

BNI XG…-**302/505/508**-… modules connect UA/GND and US/GND internally. If galvanic isolation is to be maintained, no mixed operation of BNI XG…-302/505/508-… and BNI XG5-538-… on the same US-UA networks may take place.

If the Class B ports are not to be used galvanically isolated and the system is to behave like an BNI XG5-**508**-…, UA/GND and US/GND must be connected.

Hot surfaces

The housing heats up under normal operating conditions. There is a risk of burn injuries. Avoid direct skin contact with the surface.

3.3 Scope of delivery, transport and storage

3.3.1 Scope of delivery

- IO-Link master
- Screw M4x6
- Grounding strap

Accessories are not included in the scope of delivery and must be ordered separately.

> **Note**
>
> Recommended accessories can be found at **www.balluff.com** on the product page.

3.3.2 Transport

- Transport product to location of use in original packaging.

3.3.3 Storage conditions

- Store product in original packaging.
- Observe ambient conditions (see *Ambient conditions*).

3.4 Technical data

The specifications are typical values for 24 V DC at room temperature.

The product is immediately ready for use.

Note

For performance data for UL, *UL Requirements*.

Note

Further data can be found at **www.balluff.com** on the product page.

3.4.1 Ambient conditions

Ambient temperature	
BNI XG…-…-P067	–40…+70 °C
BNI XG…-…-R067	–40…+70 °C
BNI XG…-…-Z067	–5…+70 °C (without display function: –25…+70 °C)
Storage temperature	
BNI XG…-…-P067	–40…+70 °C
BNI XG…-…-R067	–40…+70 °C
BNI XG…-…-Z067	–25…+70 °C
Protection class (in screwed state)[1]	
BNI XG…-…-P067	IP68, IP69K
BNI XG…-…-R067	IP68, IP69K
BNI XG…-…-Z067	IP67

3.4.2 Electrical data

Operating voltage Ub	18…30 V DC, as per EN 61131-2
Residual ripple	< 1%
Input current at 24 V	130 mA

3.4.3 Electrical connection

Connection (power supply IN/OUT)	M12, L-coded, 5-pin, plug/socket
Input/output ports[2]	M12, A-coded, 8 × socket

3.4.4 Interface

[1] Not assessed by UL.

[2] Only for BNI XG1-505-0A5-R067:
Design of digital outputs: 24 V DC / 250 mA (general use/resistor operation, Pilot Duty)

Ethernet

Ethernet Port	2 × 10Base/100Base-Tx
Connection for Ethernet Port	M12, D-coded, socket
Cable types as per IEEE 802.3	Shielded twisted pair min. STP CAT 5 / STP CAT 5e
Data transmission rate	10/100 Mbit/s
Max. cable length	100 m
Flow control	Half-duplex/full-duplex (IEEE 802.33x-Pause)

Note

The device may only be connected to internal Ethernet networks, without external connection or influence from TNV.

IO-Link

IO-Link version	1.1.3
Transmission rate	
COM1	4.8 kBaud
COM2	38.4 kBaud
COM3	230.4 kBaud
Port class	
BNI XG1-505-0A5-R067	Ports 1…8: Class A
BNI XG3-302-0B5-R067	Ports 1…8
BNI XG3-302-1B5-Z067	Ports 1…8
BNI XG3-508-0B5-R067	Ports 1…8: Class A
BNI XG5-508-0B5-P067	Ports 1…8: Class A
BNI XG5-508-0B5-P067	Ports 1…8: Class A
BNI XG5-508-0B5-R067	Ports 1…8: Class A
BNI XG5-538-0B5-R067	Ports 1…4: Class A / Ports 5…8: Class B
BNI XG5-508-1B5-Z067	Ports 1…8: Class A
BNI XG5-538-1B5-Z067	Ports 1…4: Class A / Ports 5…8: Class B

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

3.4.5 Materials

Housing material	
BNI XG…-…-P067	Plastic, stainless steel inserts
BNI XG…-…-R067	Plastic, stainless steel inserts
BNI XG…-…-Z067	Zinc die cast, nickel-plated

3.4.6 Mechanical features

Installation	2-hole screw mounting
Ground strap fastening	Screw M4
Dimensions (W × H × D)	
BNI XG…-…-P067	68 × 226.2 × 38.3 mm
BNI XG…-…-R067	68 × 226.2 × 38.3 mm
BNI XG…-…-Z067	68 × 224 × 32 mm
Weight	
BNI XG…-…-P067	approx. 570 g
BNI XG…-…-R067	approx. 570 g
BNI XG…-…-Z067	approx. 660 g

3.4.7 Approvals and designations

Note

Additional information on directives, approvals and standards can be found at **www.balluff.com** on the product page.

EtherCAT	EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

CE

CE	The CE Mark verifies that our products meet the requirements of the current EU Directive.

UL Requirements

Cleaning

Clean the product only with dry cloth or cloth dampened only with water!

UL certificate

UL CERTIFIED SAFETY US CA E319845	File: E319845 Enclosure rating: Type 1 Ambient temperature: +50 °C (BNI XG…-…-R067) +45 °C (BNI XG…-…-Z067)

The power supply has to be an isolated type or SELV type.

Power ratings

Power input, nominal rated voltage 24 V DC	130 mA maximum consumption 16 A including all output loads
Power output, nominal rated voltage 24 V DC	max. 16 A
Digital input, nominal rated voltage 24 V DC	max. 30 mA/pin (point)
Digital output, nominal rated voltage 24 V DC	Class A IO-Link Port 0.5 A/port (point) Pilot Duty 4 A/port (point) Resistive /General use 16 A or less per device

Cable sizes

Power supply cable

Listed or R/C cable (CYJV2/8) with M12 female thread and L-coded plug rated 24 V minimum, 16 A minimum for all models. S, SJ, SO, ST, SV, or R/C (AVLV2) listed cable marked or specified on the UL Style Page as suitable for external connections, rated 300 V minimum, 14 AWG minimum, unless marked with the maximum load current and overcurrent protection for the cable in accordance with the table below.

Mains connection cable

Listed or R/C cable (CYJV2/8) with an M12 L-coded threaded plug and a voltage rating of at least 24 V and at least 16 A for all models. Listed S, SJ, SO, ST, SV or R/C cable (AVLV2) marked or specified on the UL Style Page as suitable for external connections, rated 300 V minimum and 14 AWG minimum, unless marked with the maximum load current and overcurrent protection for the cable in accordance with the table below.

Communication cable

Listed or R/C cable (CYJV2) with A, B, or D-coded male or female threads, as applicable, for connection to Article 9, M12 plug rated 24 V minimum and 1 A minimum. R/C (AVLV2), marked or specified on the UL Style Page as suitable for external connections, cable rated 28 AWG minimum and 300 V minimum.

Input/output cable

Listed or R/C (CYJV2) cord assembly with threaded male A-coded M12 connector rated 24 V minimum, 4 A minimum. R/C (AVLV2) marked or specified in UL style page as suitable for external interconnection Cord rated 300 V minimum, 20 AWG minimum unless marked with maximum load current and overcurrent protection for the cord in accordance with table below

Cable conductor size, AWG	14	14	16	18	20	22	24	26	28	30
Overcurrent protection maximum amperage [amps]	16	12	8	5.6	5	3	2	1	0.8	0.5
Maximum load [amps]	16	9	8	5.6	4	2.4	1.6	0.8	0.6	0.4

CHAPTER

FOUR

INSTALLATION AND CONNECTION

4.1 Installation

Note

For dimensions, (see *Dimensions*).

- Fasten the module with 2 M6 screws and a maximum tightening torque of 3 Nm the mounting holes (see *Device overview*).

4.2 Electrical connection

4.2.1 Requirements for complying with the protection classes

For complying with the protection class (see *Ambient conditions*), all plugs and caps must be properly connected and the tightening torque of 0.6 Nm must be observed (see data sheets of connectors and caps).

4.2.2 Power supply

Note

NOTICE
Unwanted voltage dips
Non-separated electric circuits of the power supplies for sensor and actuator can lead to unwanted voltage dips of the sensor supply when switching actuators.

- Fuse the power supplies for sensors and actuators separately.
- Make sure that the power supply of the device is sufficiently dimensioned to cover start-up and peak currents and design the fuse protection concept accordingly.

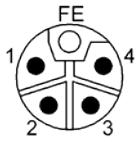
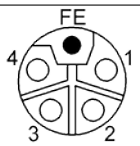
Note

- Power supply of sensor/bus and actuator may only be established via a separate power source.
- The total current for the sensor and actuator supply must not exceed 16 A each.
- The external circuits that are connected to this device must be disconnected from the mains voltage or dangerous voltage by reinforced or double insulation and must satisfy the requirements of SELV/PELV (Class III).
- For UL: Observe cable requirements and power supply requirements (see *UL Requirements*)!

Note

Only for BNI XG1-505-0A5-R067 : Outputs are supplied via US.
The actuator supply UA is only looped through, nothing on the circuit board is supplied by UA (UA diagnostics are nevertheless available).

4.2.3 Top view of M12 plug (left) and socket (right)

Power IN	Power OUT
M12 plug (L-coded, with FE)	M12 socket (L-coded, with FE)
	

4.2.4 Pin assignment

Pin	Signal	BNI XG...-302/505/508-...	BNI XG...-538-...
1	L+ (US+)	Module/sensor supply +24 V	
2	2L– (UA–)	Electrical ground 0 V	Separate power supply (–)
3	L– (US–)		Electrical ground 0 V
4	2L+ (UA+)	Actuator supply +24 V	Separate power supply (+)
5	FE	Functional earth	

Note

Only for BNI XG1-505-0A5-R067 : Outputs are supplied via US.
The actuator supply UA is only looped through, nothing on the circuit board is supplied by UA (UA diagnostics are nevertheless available).

Note

Only for BNI XG5-538-…: Pin 2 and Pin 3 are galvanically separated.

4.2.5 Ethernet interface

Pin	Signal	Description
1	Tx+	Transmit Data +
2	Rx+	Receive Data +
3	Tx–	Transmit Data –
4	Rx–	Receive Data –

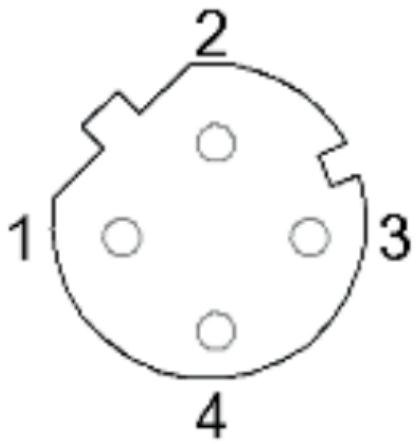


Fig. 1: Top view of M12 socket, D-coded

4.2.6 I/O-Port

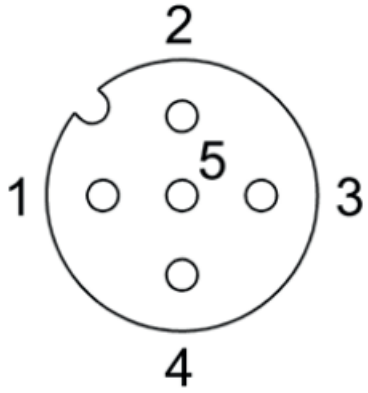


Fig. 2: Top view of M12 socket, A-coded

4.2.7 Pin assignment BNI XG1-505-0A5-R067

Pin	Signal			
	Class A			
1	L+ (US+)	+24 V, 0,5 A		
2	I (DI)	Input		
3	L– (US–)	Electrical ground 0 V		
4	C/Q (SIO/IO-Link)	Input / Output (0,25 A) / IO-Link		
5	n. c.			

4.2.8 Pin assignment BNI XG3-302-...-...

Pin	Signal			
1	L+ (US+)	+24 V, 2 A		
2	I/O (DI/DO)	Input / Output (2 A)		
3	L– (US–)	Electrical ground 0 V		
4	I/O (DI/DO)	Input / Output (2 A)		
5	n. c.			

4.2.9 Pin assignment BNI XG3-508-...-...

Pin	Signal			
	Class A			
1	L+ (US+)	+24 V, 2 A		
2	I/O (DI/DO)	Input / Output (2 A)		
3	L– (US–)	Electrical ground 0 V		
4	C/Q (SIO/IO-Link)	Input / Output (2 A) / IO-Link		
5	n. c.			

4.2.10 Pin assignment BNI XG5-...-...-...

Pin	Signal			
	Class A		Class B	
1	L+ (US+)	+24 V, 2 A	L+ (US+)	+24 V, 2 A
2	I/O (DI/DO)	Input / Output (4 A)[1]	2L+ (UA+)	P24 (4 A)[1],[2]
3	L– (US–)	Electrical ground 0 V	L– (US–)	Electrical ground 0 V
4	C/Q (SIO/IO-Link)	Input / Output (2 A)[3] / IO-Link	C/Q (SIO/IO-Link)	Input/Output (2 A)[3] / IO-Link
5	n. c.		2L– (UA–)	N24 (Electrical ground 0 V)

[1] adjustable to 1 A, 2 A, 3 A and 4 A (from FW 1.2) taking into account the total current of 16 A and the maximum total current of 4 A on the electronic ground of a port <

[2] with switching option

[3] adjustable to 1 A and 2 A (from FW 1.2) taking into account the total current of 16 A and the maximum total current of 4 A on the electronic ground of a port

4.2.11 Overview

Variant	I/O-Port	IO-Link Port	
-	-	Class A	Class B
BNI XG1-505-0A5-R067	-	1…8	–
BNI XG3-302-0B5-R067	1…8	–	–
BNI XG3-302-1B5-Z067	1…8	–	–
BNI XG3-508-0B5-R067	–	1…8	–
BNI XG5-508-0B5-P067	–	1…8	–
BNI XG5-508-0B5-R067	–	1…8	–
BNI XG5-538-0B5-R067	–	1…4	5…8
BNI XG5-508-1B5-Z067	–	1…8	–
BNI XG5-538-1B5-Z067	–	1…4	5…8

Note

- For the digital sensor inputs, see the directive on inputs EN 61131-2, type 3.
- The total current of the outputs must not exceed the total current of the module of 16 A.
- Unused ports must be covered with caps to ensure compliance with the protection class (see *Ambient conditions*).
- Daisy chain: If BNI XG5-538-… master and BNI XG3/XG5-302/508-… or BNI XG1-505-… master are used in a line, it must be ensured that the galvanic isolation is removed. BNI XG3/XG5-302/508-… and BNI XG1-505-… masters connect both earth potentials. A BNI XG5-538-… master in the same line is then no longer galvanically electrically supplied!
- **Only for BNI XG1-505-0A5-R067:** All IO-Link outputs are supplied via the sensor voltage (US).
- **Only for BNI XG…-302/508-…** : All outputs are supplied via the actuator supply (UA).
- **Only for BNI XG5-538-…** :
  - If the separate power supply 2L+ is removed, the Class A outputs (Port 1…4) are deactivated.
  - With a separate galvanic supply, the correct reference potential must be used as the input signal, as inputs on pin 2 have a reference to pin 5. If US is used as the input signal, this results in undefined behavior.
  - All outputs on the upper ports (ports 1…4) and the outputs on pin 4 on the lower ports (ports 5…8) are supplied by US. Only the outputs of pin 2 on the lower ports are supplied via UA. In order to emulate the behavior of the 508 master, there is currently a software switch-off of the pin 2 outputs when UA drops out.
  - The master can also be used without galvanic isolation, in which case it behaves like a 508 master (also due to the software shutdown).

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

4.2.12 Grounding

To counteract EMC interference, the functional earth connection must be used.

- Connect the earth terminal to the functional earth (FE) of the machine.

Note

The FE connection between the housing and the machine must have a low impedance and be as short as possible.
► Use the grounding strap included in the scope of delivery (tightening torque: 1.1…1.2 Nm).

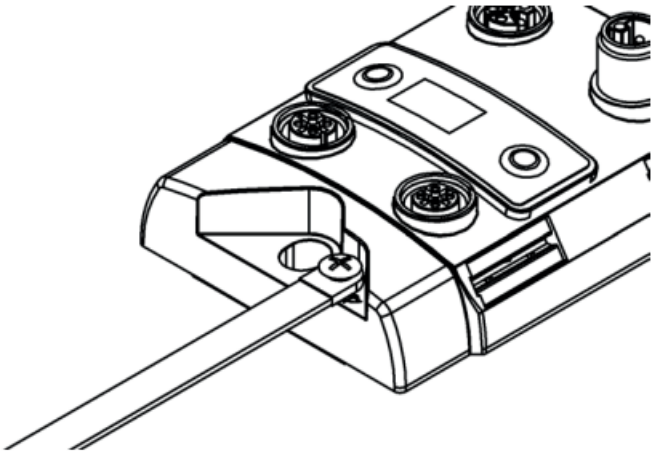


Fig. 3: Ground connection

4.3 Cable routing

4.3.1 Cable length

- The Ethernet cable may be max. 100 meters long.
- The IO-Link cable may be max. 20 meters long.
- The standard IO cable may be max. 30 meters long.

4.4 Use in combination with safety modules (BNI XG5-538-... only)

These products are remote fieldbus modules with four Class A ports and four Class B ports (per IEC 61131-9).

Note

The Class A ports and Pins 1,3 and 4 on the Class B ports are not suitable for use in safety applications.

4.4.1 Product description

Description	Order code	Class A-Ports	Class B-Ports
BNI XG5-538-0B5-R067	BNI00KJ	4	4
BNI XG5-538-1B5-Z067	BNI00K7	4	4

4.4.2 Port overview and pinning

Port type	Connector diagramm	Pinning			Remarks
Class A (Ports 0…4)		1	L+ (US+)	+24 V, 2 A	In this type the functions of Pins 2 and 5 are not specified. Pin 2 is usually connected to another digital channel.
		2	I/O (DI/DO)	Input / Output (4 A)	
		3	L– (US–)	Electrical ground 0 V	
		4	C/Q (SIO/IO-Link)	Input / Output (2 A) / IO-Link	
		5	n. c.		
Class B (Ports 5…7)		1	L+ (US+)	+24 V, 2 A	This type provides an additional supply voltage and is suitable for connecting devices which have a higher current requirement. Here pins 2 and 5 provide an additional (galvanically isolated) supply voltage.
		2	2L+ (UA+)	P24 (4 A)	
		3	L– (US–)	Electrical ground 0 V	
		4	C/Q (SIO/IO-Link)	Input/Output (2 A) / IO-Link	
		5	2L– (UA–)	N24 (Electrical ground 0 V)	

Note

The pin configuration and diagnostics for devices with Class B properties are identical to the configuration described in these instructions.

By maintaining all the specifications in the corresponding user's guide and safety instructions Pins 2 and 5 of the Class B port on these modules can be safety switched off using a higher level safety logic (e.g. safety relay). The devices are therefore suitable for turning off actuators which are powered solely by these pins for use in safety applications.

4.4.3 Safety function

The safe state of the Class B ports is no voltage on Pins 2 and 5. Turn-off must be done by the higher level safety logic (externally).

The fieldbus modules are constructed internally so that because of fault exclusions (see DIN EN ISO 13849-2) no external voltages can reach the galvanically isolated Pins 2 and 5 on the Class B port. This applies both to the IO-Link interface communication and for the external voltage supplies. The modules do not have their own safety logic or safety diagnostics.

Note

- Turning off actuators over the IO-Link interface is not suitable for safety functions within the safety chain.
- The actuators must be suitable for this type of safe turn-off and must if appropriate also habe galvanic isolation.

Accordingly the actuator-voltage supplies must be configured according to the principles of safe (potential-) isolation in order to prevent cross fault (per EN.IEC 60204-1, DIN EN ISO 13849-2). Within the safety chain of the safety application both potentials (24 V and 0 V) of the actuator-voltage supplies must always be isolated using the higher level safety logic.

Note

The use of power supplies other than SELV/PELV can result in a hazard to the user and compromising of the functional safety.

4.4.4 Example of an application description

The safety function of the safe turn-off is implemented for example using the following signal chain: Safe switches/sensors (e.g. E-Stop) – safety logic (e.g. safety relay – fieldbus module with Class B ports – actuator(s). All elements must be suitable for use in the implemented safety function.

When the safe switch/sensor (e.g. E-Stop) is actuated, Pins 2 and 5 on the Class B ports are safely isolated from the supply voltage (two-pin) by the safety logic and switched potential-free.

The voltage supplies US/UA provide power to the Class A and Class B ports of the module galvanically isolated and independent of each other:

4.4.5 Segment assignment for the voltage supplies

Description	Order code	Signal	Class A Port 0, 1, 2, 3	Class B Port 4, 5, 6, 7
BNI XG5-538-0B5-R067 / BNI XG5-538-1B5-Z067	BNI00KJ / BNI00K7	US (24 V/GND)	Pins 1, 3 Pins 2, 4[4]	Pins 1, 3, 4
		UA (P24/N24)		Pins 2, 5

4.4.6 Inspections

The inspection interval for the function test of the safety function to be documented turning off the actuator-voltage(s) depends on the requirements for the safety function of the higher level system, but must be performed no later than every 12 months.

[4] When UA is turned off the Class A outputs are also deactivated via software (not safe).

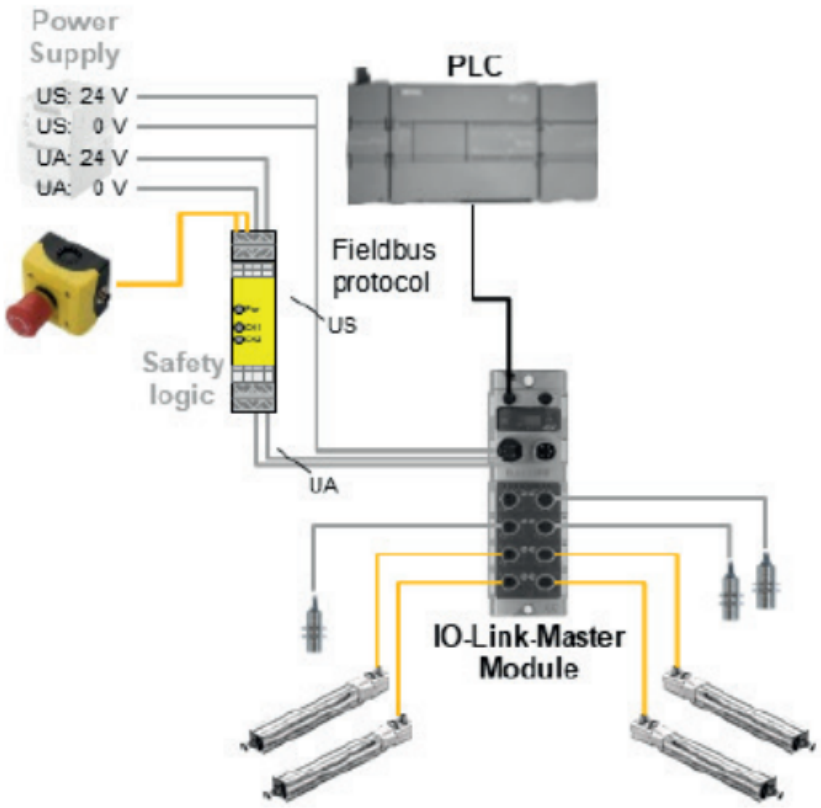


Fig. 4: Schematic diagram of safety chain

Note

It is recommended that the inspection be automatically carried out by the higher level system. If this is not possible, we recommend automatically providing the user with a reminder for the inspection. If this is not possible either, performance of the inspection must be specified in the process instructions for the higher level system.

CHAPTER

FIVE

STARTUP AND OPERATION

5.1 Startup

DANGER

Uncontrolled system movement
When starting up, if the network module is part of a closed loop system whose parameters have not yet been set, the system may perform uncontrolled movements. This could result in personal injury and equipment damage.

- Persons must keep away from the system's hazardous zones.
- Startup must be performed only by trained technical personnel.
- Observe the safety instructions of the equipment or system manufacturer.

1. Check connections for tightness and correct polarity. Replace damaged connections.
2. Turn on the system.

Note

Check for the correct values, especially after replacing the BNI or after repair by the manufacturer.

5.1.1 Autodetect Mode

Note

Default in Fieldbus protocol: Autodetect.

Search fieldbus

As soon as the network module is initialized, it starts in autodetect mode and searches for the connected fieldbus system.

The outer port/pin LEDs light up in sequence.

Fieldbus system detected

If the fieldbus system is detected, the port/pin LEDs in a row light up green for 10 seconds. If no field bus is detected, the default address is used.

Row	Port/Pin-LEDs of the Ports	Meaning
1	1/2	Profinet
2	3/4	Ethernet/IP
3	5/6	EtherCAT
4	7/8	Modbus TCP

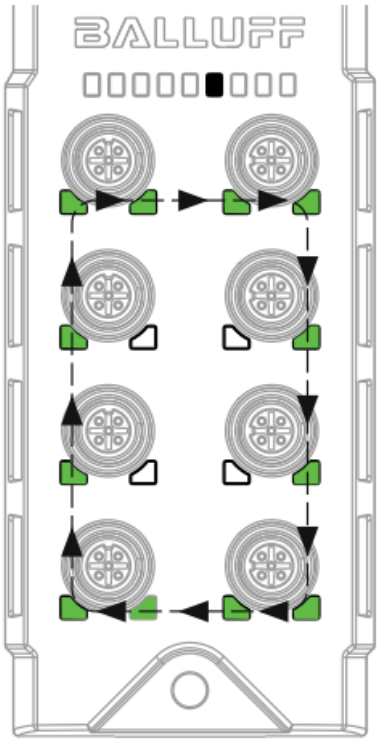


Fig. 1: Search fieldbus

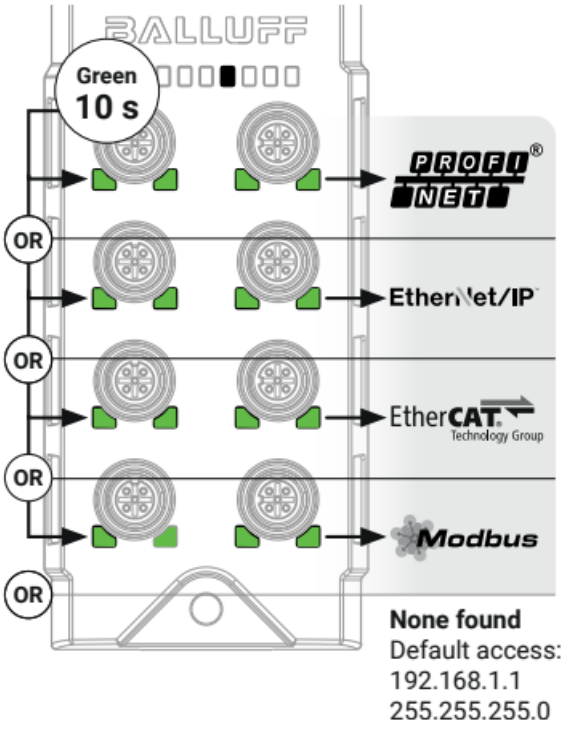


Fig. 2: Fieldbus system detected

Note

For additional information, see Configuration guide at **www.balluff.de** on the product page.

5.2 Operation

CAUTION

Danger of burns from hot surfaces
The housing heats up under normal operating conditions.
There is a risk of burn injuries.
- Avoid direct skin contact with the surface.

5.2.1 Operating notes

- Regularly check function of the BNI and all associated components.
- Take the BNI IO-Link master out of service whenever there is a malfunction.
- Secure the system against unauthorized use.
- Check fasteners and retighten if needed.

5.3 Cleaning

Note

For UL requirements, *UL Requirements*.

The product may only be cleaned when switched off.

Note

Only for BNI XG5-508-0B5-P067:
The product can be cleaned in a washdown process and is resistant to numerous alkaline, neutral and acidic cleaning media based on peroxyacids and amines with and without chlorine for the food and beverage industry.
For further information, see ECOLAB certificate at **www.balluff.com** on the product page.

5.4 Maintenance

The product is maintenance-free.

Depending on the operating conditions, it may be necessary to regularly check and, if necessary, retighten the tightening torques of the plugs and caps to maintain the protection classes (see *Electrical connection*).

CHAPTER

SIX

CONFIGURATION GUIDE

This section describes how to integrate and configure the BNI into your system.

Contents:

6.1 Protocols

6.1.1 Automatic detection of the protocol

On delivery, the network module is in autodetect mode. This mode actively monitors the network to identify the bus type used. A green running light on the IO-Link ports indicates the active detection process.

As soon as the module has successfully identified the network type, the corresponding port LEDs quickly light up green. The assignment of the LEDs to the various fieldbus protocols can be found in *LED assignment to fieldbus protocols*. After successful detection, the device restarts automatically and can then be accessed via the detected fieldbus protocol.

To put the module back into autodetect mode, either the display (see chapter *Select protocol in the display*) or the WebUI (see *Change protocol*) can be used.

In autodetect mode, the device can be reached at any time via the IP address 192.168.1.1 with subnet mask 255.255.255.0.

6.1.2 Manually select protocol

For devices with a display, the protocol is selected manually via the integrated display (see chapter *Select protocol in the display*).

The table below shows other options for manually selecting the protocol for devices without a display.

From Autodetect

To switch from Autodetect (ATD) to PNT, EIP, ECT, MBT, use the following options:

- Automatic detection
  OR

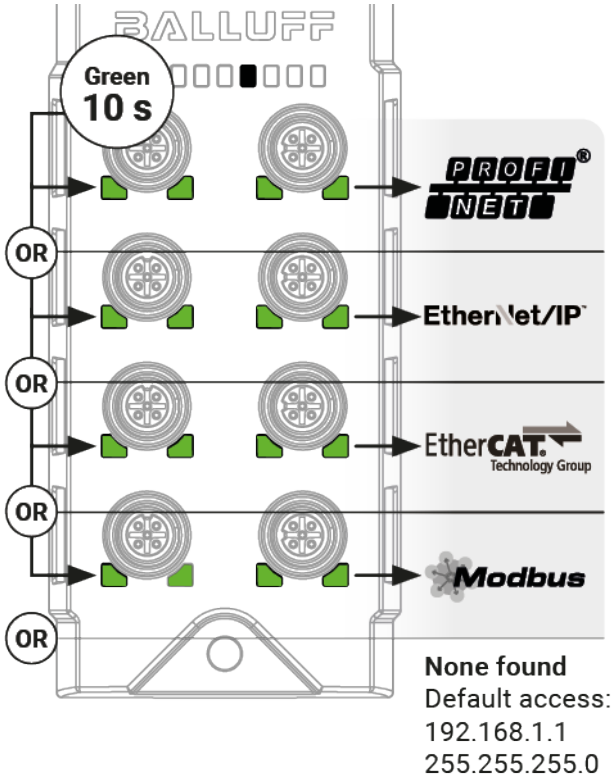


Fig. 1: LED assignment to fieldbus protocols

- Set manually via:
  - IP assignment via WebUI
  - Changeover via WebUI (see *Change protocol*)

From PNT

To switch from Profinet (PNT) to ATD, EIP, ECT, MBT, use the following options:

- IP assignment via DCP (BET, Proneta)
- Changeover via WebUI (see *Change protocol*)

From EIP

To switch from EtherNet/IP (EIP) to ATD, PNT, ECT, MBT, use the following options:

- IP assignment per TCP/IP object or per WebUI (see *Make network settings*)
- Changeover via WebUI (see *Change protocol*)

From ECT

To switch from EtherCAT (ECT) to ATD, PNT, EIP, MBT, use the following options:

- Activate EoE (see *EoE set-up*)
- Changeover via WebUI (see *Change protocol*)
- Changeover via CoE (see *Change protocol for set ECT*)

From MBT

To switch from Modbus/TCP (MBT) to ATD, PNT, EIP, ECT, use the following options:

- IP assignment via WebUI (see *Make network settings*)
- Changeover via WebUI (see *Change protocol*)

6.1.3 WebUI default settings

The protocol can also be selected via the WebUI (see *Change protocol*). By default, the WebUI can be reached via the IP address 192.168.1.1.

Note

The following settings are assigned at the factory:
- Protocol: Autodetect
- IP address: 192.168.1.1
- Subnet mask: 255.255.255.0

If the protocol is changed, the IP parameters are reset to the default value of the respective protocol, as shown in the following table:

Table 1: Default values of the respective protocols

Protocol	Default IP adress	default subnet mask
Autodetect	192.168.1.1	255.255.255.0
Profinet	0.0.0.0	0.0.0.0
EtherNet/IP	192.168.1.1	255.255.255.0
Modbus/TCP	192.168.1.1	255.255.255.0
EtherCAT	IP settings via EoE	IP settings via EoE

6.1.4 Change protocol for set ECT

Proceed as follows if ECT is already set and the protocol should be changed.

1. Select CoE object *Fieldbus Information* (0xF502).

Fig. 2: Select CoE object *Fieldbus Information*

2. Select and set the desired protocol in the object *Protocol After Reboot*.

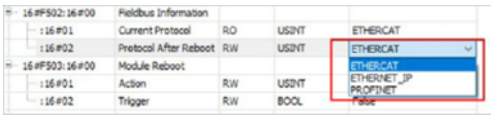


Fig. 3: Select protocol in the object *Protocol After Reboot*

Then the module must be restarted as follows:

1. Select CoE object *Module Reboot* (0xF503).
2. Set object *Action* to *Reboot*.

Fig. 4: Select CoE object *Module Reboot*

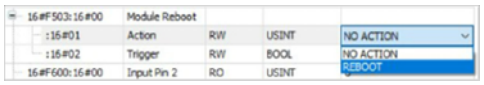


Fig. 5: Object *Action*

3. Set object *Trigger* to *True*.

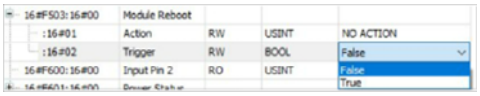


Fig. 6: Object *Trigger*

6.2 Profinet integration

6.2.1 Configuration

When planning Profinet devices, a device is mapped as a modular system, which has a headslot and several data modules.

GSDML file

> **Note**
>
> The GSDML files are available in two languages at www.balluff.com .

The device data required for project planning is stored in Generic Station Description Markup Language (GSDML) files. The data modules of a network module are displayed in the project planning software itemized by subslots.

The GSDML file provides the possible data modules (input or output of different data widths). To configure the network modules, the corresponding data modules are assigned to a subslot.

> **Note**
>
> Outdated GSDML versions may not be compatible with the latest FW version.

Integrating a module

The device can be found in the catalog via the search function and pulled into the Profinet string via drag & drop (see *Integrating a module*).

The BNI PNT… module with the PN-IO, Port 1-M12 and Port 2-M12 sub-modules are used for Profinet communication.

In X1 PN-IO, functions such as prioritized startup or the domains for the ring topology can be selected.

Slot 1 is reserved for IO-Link. The following submodules can be inserted in the eight submodules below:

- IO-Link
- Digital Input (DI)
- Digital Output (DO)

- Port deactivated

Only the IO-Link headslot is plugged in by default. The submodules are free.

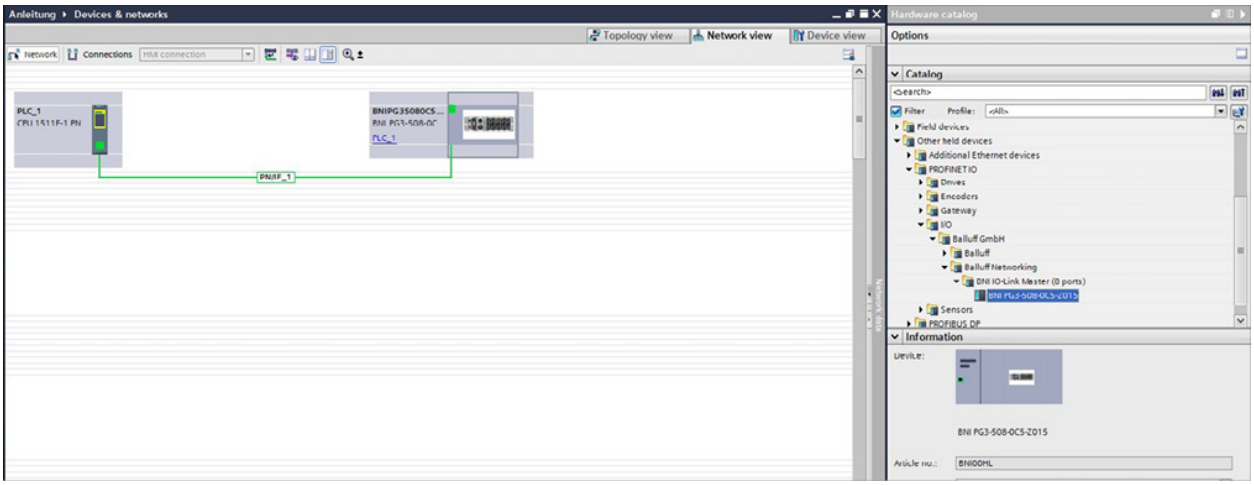


Fig. 7: Integrating a module

Hardware configuration

The remaining submodules can, if necessary, be pulled into the configuration table from the hardware catalog using drag & drop and must be configured in accordance with the configuration of the headslot.

Addressing modules

After double-clicking on the submodules, the addressing can be changed in the *Addresses* window.

Configuring the network module

The ports 1…8 are reserved for the IO-Link Ports.

- In accordance with the process data length of the IO-Link device, select a matching network module in the catalog and drag it to the corresponding slot using drag & drop.

  The process data length required by the device can be found in the manual for the IO-Link device.

Port Qualifier (PQI)

Network modules are available with and without PQI. The PQI is 1 byte long and contains various information about the respective port status. This information can be found at the end of the input data of the submodule of a port for each bit.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Device Process Data validity	Port/Device error indication	Device communication	Port operation (`"1"`)	Reserved (`"0"`)	Reserved (`"0"`)	Reserved (`"0"`)	Reserved (`"0"`)
PQ	DevErr	DevCom	Port active	-	-	-	-

IO-Link submodules without PQI save 1 byte. The information which the PQI contains can currently not be replaced with another submodule. Submodules which contain this information (e.g. *PD Valid*, *Pin2/4*, etc.), will be added in the future.

The flags have the following meaning:

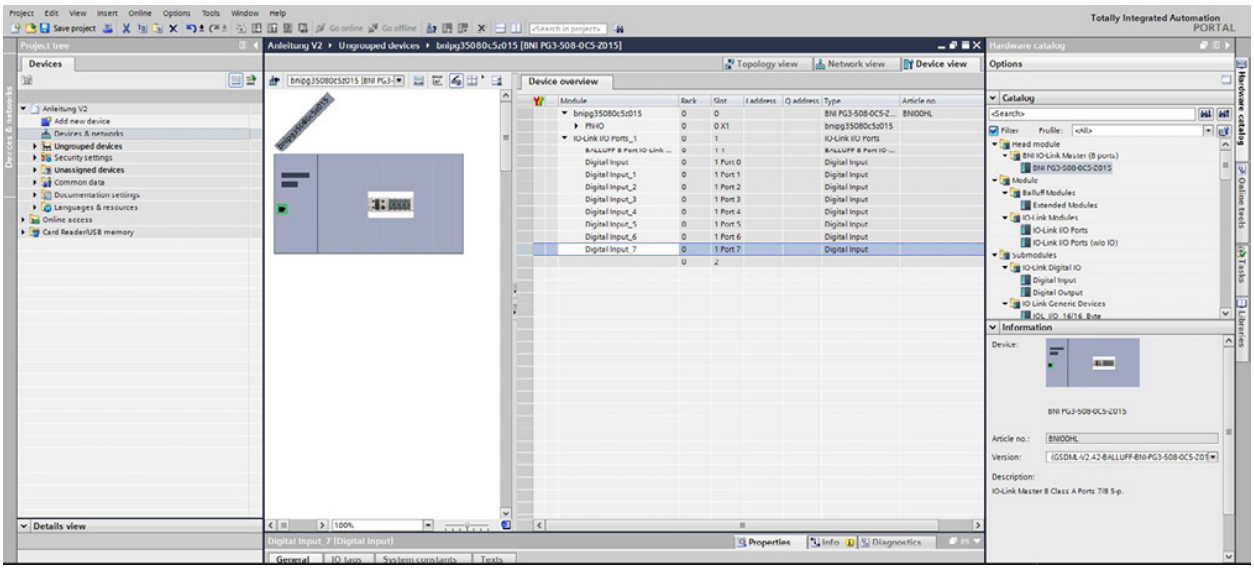


Fig. 8: Hardware configuration

PQ | : | Value | Description | | — | ——————————————– | | 0 | Process data from device invalid | | 1 | Process data from device valid |

DevErr | : | Value | Description | | — | ——————————- | | 0 | No errors/warnings | | 1 | Errors/warnings occurred. |

DevCom | : | Value | Description | | — | ——————- | | 0 | No device available | | 1 | Device available |

PortActive | : | Value | Description | | — | ——————– | | 0 | Port deactivated. | | 1 | Port activated. |

Configuring digital input and digital output

In order to configure the port pins to input or output, the corresponding submodule *Digital Input* or *Digital Output* must be dragged to the port. Input/Output are always configured to Pin 4 of the port. Pin 2 must be manually configured in the module parameters of the port properties.

The inputs and outputs can be mapped either to the network module 1 (see *Network module 1*) or to the submodules Input-Pin 2/4 or Output-Pin 2/4 in slot 3.

Note

XG1 devices have no outputs to Pin 2.

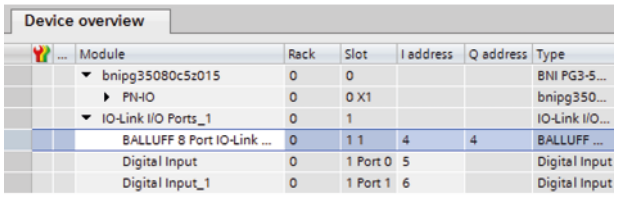


Fig. 9: Network module 1

To save the two bytes in the network module, there is a second network module without IO data. If this is used, the inputs and outputs can be mapped to the corresponding submodules in slot 3.

If the network module has been inserted with IO data, the submodules Input-Pin 2/4 and Output-Pin 2/4 can be inserted in slot 3 but the output module has no function. Only the configuration of the ports in slot 1 is valid. The inputs are also

always displayed at slot 3.

Table 2: IO-Link diagnosis ports

Configuration	Description
Input Pin 2 / 4	Defines the input byte on which each bit maps Pin 2 / 4 of the respective port.
Output Pin 2 / 4	Defines the output byte on which each bit maps pin 2 / 4 of the respective port.
IO-Link communication	Defines the input byte on which each bit represents active IO-Link communication.
IO-Link PD Valid	Defines the input byte on which each bit indicates whether the port's process data is valid.
IO-Link diag.	Suppresses the diagnosis as soon as the corresponding bit is TRUE.

Note

The following modules can only be plugged in if the *Extended Modules* module is plugged into slot 2.

Disable IO-Link diagnosis

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

If this function is configured, the IO-Link diagnosis remains activated for all ports and can be deactivated for the desired ports by setting the bit for the respective port.

IO-Link communication

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Bit status for each IO-Link port, i.e. feedback on whether communication has been established.

IO-Link PD Valid

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Bit status for each IO-Link Port, i.e. feedback whether the process data at the corresponding port are set to Valid.

Note

Bit 0 … 7 corresponds to the port designations Port 1 … 8.

Deactivating diagnostic messages

The *Diagnostics Deactivated* module allows various diagnostic messages sent by the module to be suppressed.

To deactivate the diagnostic messages:

- Plug the *Diagnosis Disable* module into the extended modules (see *Configurations of the Diagnosis Disable module*).

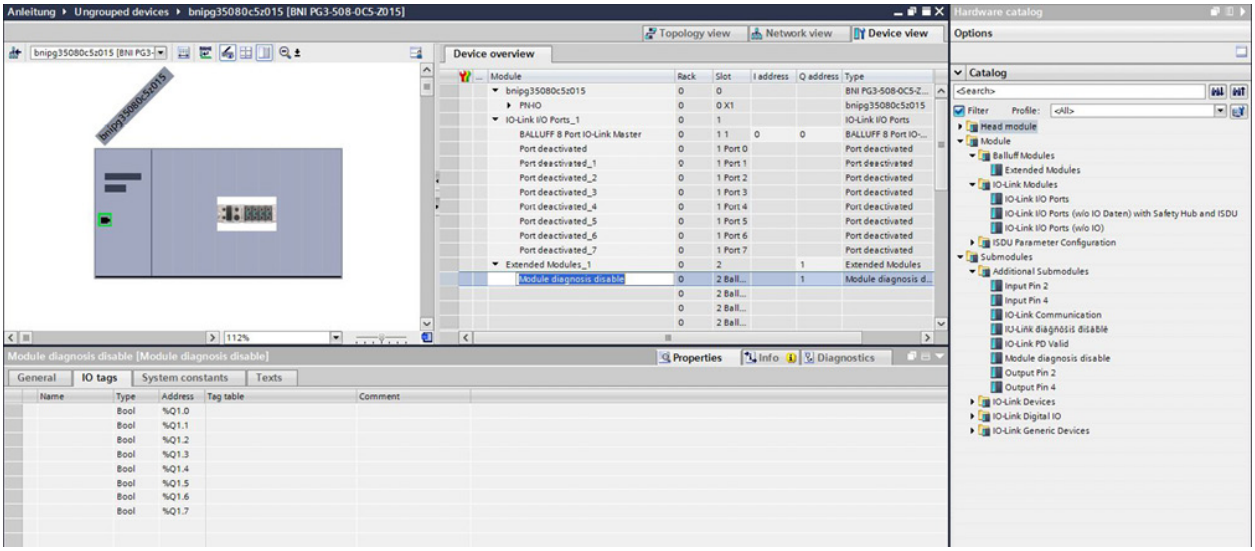


Fig. 10: Plugged-in Diagnosis Disable module

The table below shows the individual bits fields and their possible values.

Table 3: Configurations of the Diagnosis Disable module

Bit position	Value 0	Value 1
Bit 0	Global diagnostics activated.All diagnostics are sent.	Global diagnostics deactivated.All diagnostics from the module to the controller are suppressed. If diagnostics are already pending, they are deleted.
Bit 1	UA diagnostics activated.UA diagnostics are sent.	UA diagnostics deactivated.All UA diagnostics from the module to the controller are suppressed. If UA diagnostics are already pending, they are deleted.
Bit 2	reserved	reserved
Bit 3	reserved	reserved
Bit 4	reserved	reserved
Bit 5	reserved	reserved
Bit 6	reserved	reserved
Bit 7	reserved	reserved

Pending diagnostics can be deleted at runtime by toggling the bit.

Configuring device

After double-clicking on the module in the Profinet string, the communication parameters of the module are displayed.

Assign IP address

The IP address is configured under IP Protocol.

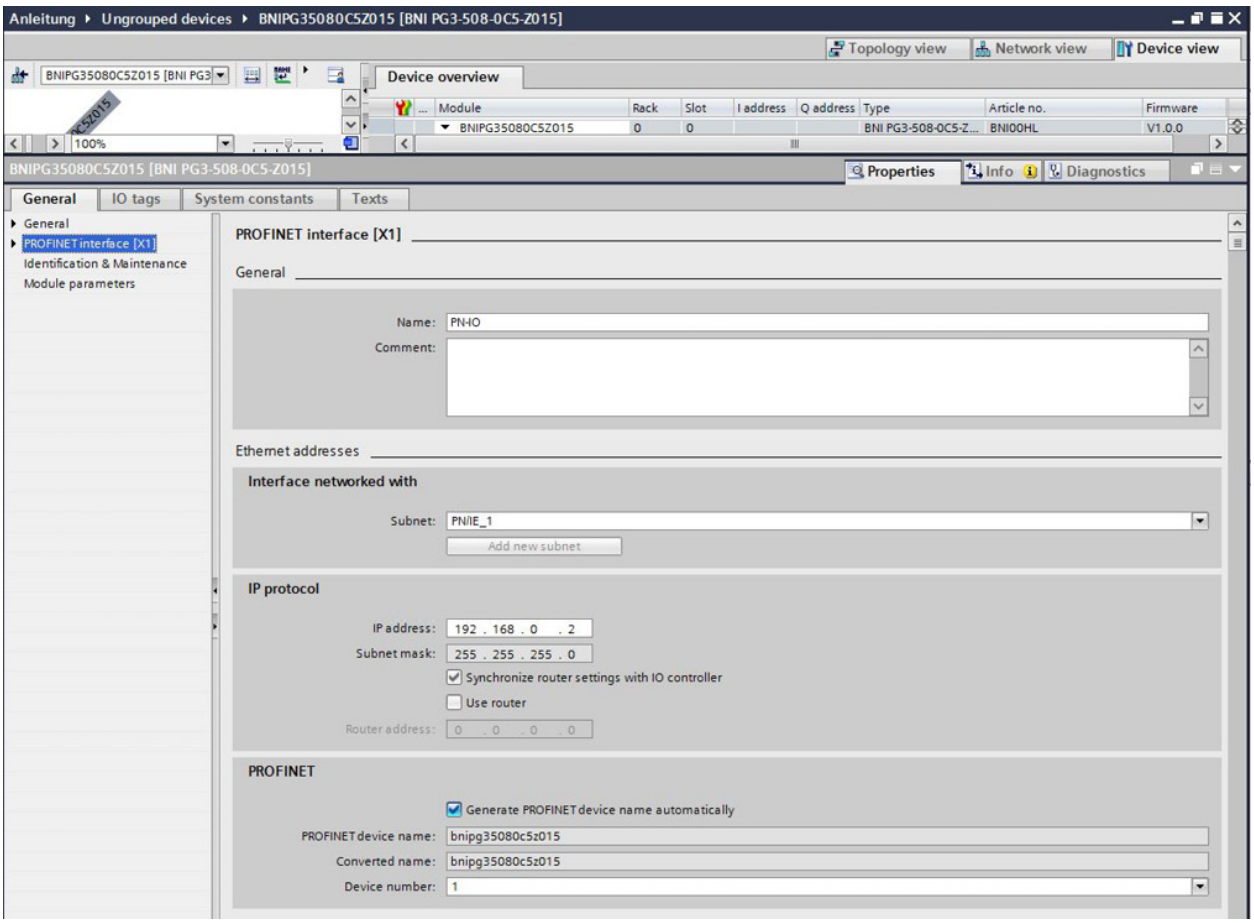


Fig. 11: Profinet address

Establishing a device connection

- In theDevice overview, right-click on the module and select Assign device name.

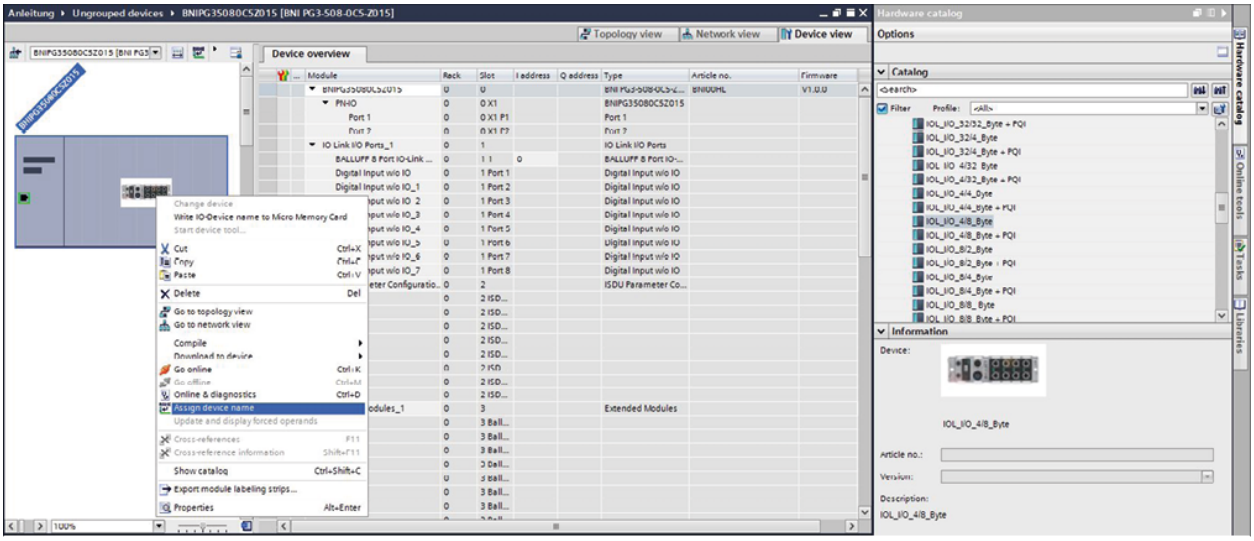


Fig. 12: Establishing the device relationship

The identification takes place via the MAC address or via the *Flash LED* function. This function causes the SF-LED on the module to flash three times at a frequency of 1 Hz.

Assigning the device name

- Assign the desired device name and assign it to the selected, found device by clicking on *Assign name*.

> **Note**
>
> The device name must match the name that was previously configured (see chapter *Configuring device*).

Completing the configuration

- Download the configuration into the module parameterization.
  ⇒ The bus error should be reset at the module.

If the module continues to report a bus error, this could be because the device relationship has not been established. The following remedies are possible:

- Via *Target system* > *Ethernet* > *Ethernet subscriber* > *Browse*, scan the network and check whether the device is reporting under the correct device name and IP address.
- If necessary, change the IP address or the device name.
- Assign the device name to the device again and download the configuration.

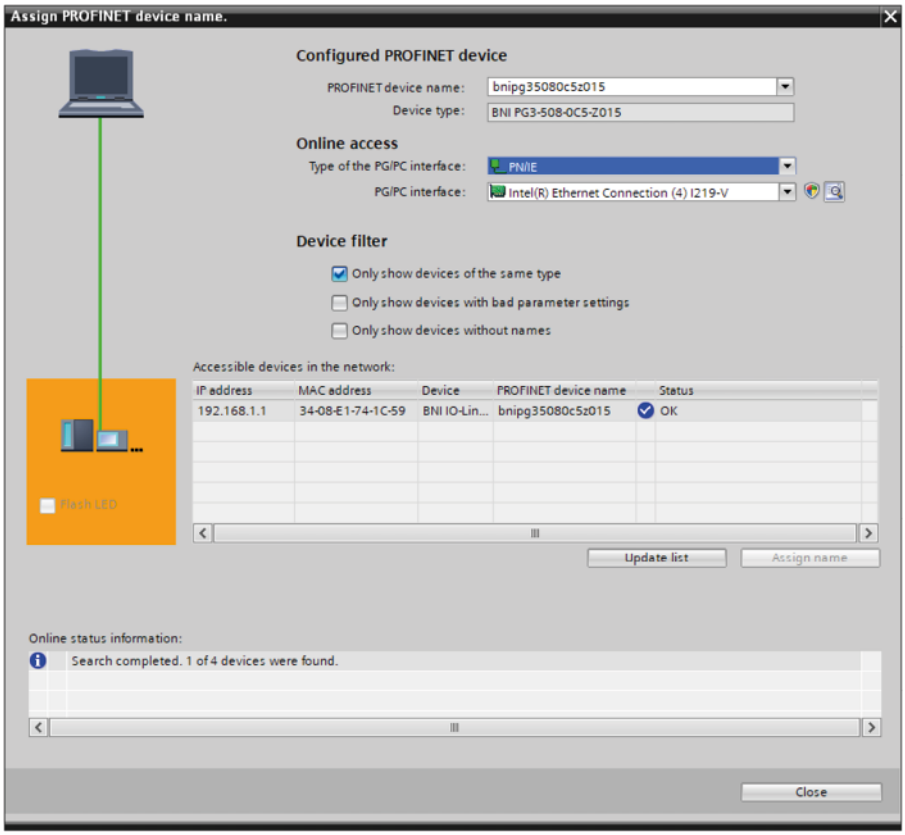


Fig. 13: Assigning the Profinet device name

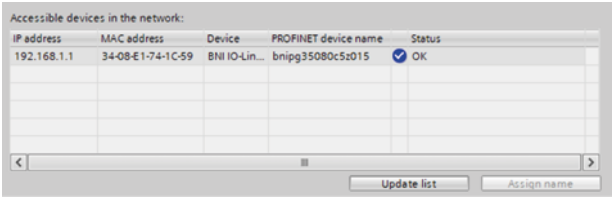


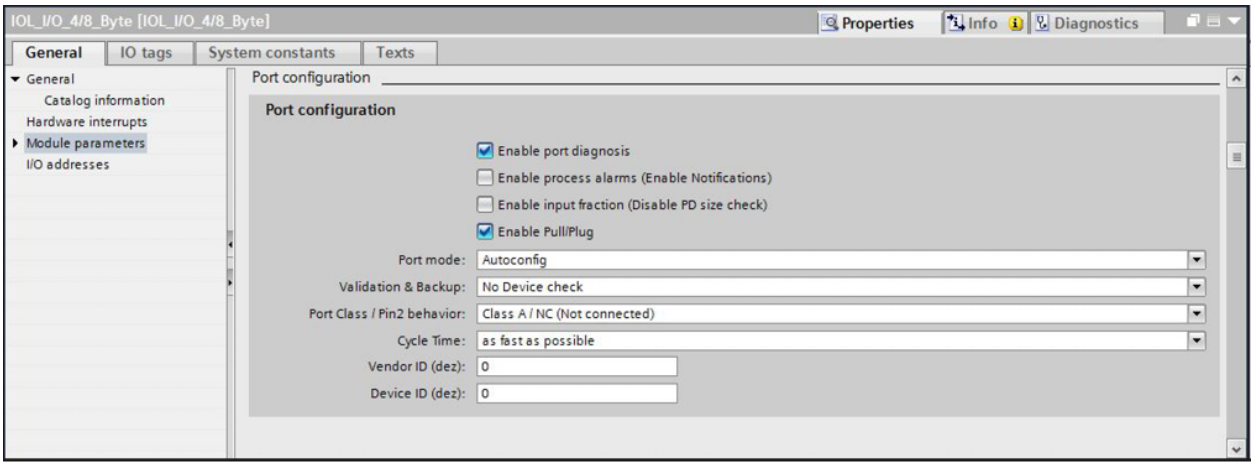
Fig. 14: Assigning the device name

6.2.2 IO-Link Configuration

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Port configuration settings

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



> **Note**
>
> **IO-Link configuration**:
> If the connected IO-Link device provides outputs, Pin 2 at the corresponding port must be configured as an output (see *Port Qualifier (PQI)*). Does not apply to XG1 devices.

The following settings can be made:

Enable port diagnostics
: Activates or deactivates the diagnostic messages of the port (static muting).

Configure process alarms
: Maps single-shot events (notifications) to process alarms.

Activate input fraction
: Checks the PD size of the device against the PD size of the plugged module.

> **Note**
>
> Only affects PD inputs. PD output size is always checked.

Enable Pull/Plug
: Blocks the call of module OB82 (diagnosis alarm) or enables it.

Port mode
: Defines the mode of the port.

  The following settings are possible:

  - Deactivated: Switches the port off.

- Auto Config: Activates IO-Link and the data exchange between master and device.
- Set Port Config: Enables some settings to be changed manually, e.g.Cycle Time.

> **Note**
>
> Set Port Config must be activated to enable validation and back-up (data storage).

Validation and backup

Validation and backup are used to identify specific or individual device types with which a data exchange should take place.

The following settings are possible:

- *No Device Check*: Validation is deactivated and every device is accepted.
- *Compatibility Device V1.0*: Only devices according to IOL specification 1.0 are accepted. No data storage, only validation active.
- *Compatibility Device V1.1*: Only devices according to IOL specification 1.1 are accepted. No data storage, only validation active.
- *Compatibility Device V1.1 Backup and recovery*: Only devices according to IOL specification 1.1 are accepted. Data storage with upload and download, with validation.
- *Compatibility Device V1.1 Recovery*: Only devices according to IOL specification 1.1 are accepted. Data storage only with download (Master to Device), with validation.

Port Class / Pin2 behavior

Defines the behavior of pins.

The following settings are possible:

- *Class A / NC*: Pin 2: Deactivated
- *Class A / DI*: Pin 2: Digital input
- *Class A / DO*: Pin 2: Digital output
- *Class A / Power* = actuator supply/continuous voltage on pin 2
- *Class B / NC*: Pin 2: Deactivated
- *Class B / DI*: Pin 2: Digital input
- *Class B / DO*: Pin 2: Digital output
- *Class B / Power*: actuator supply/continuous voltage on pin 2

> **Note**
>
> The Pin 4 behavior is specified by the plugged submodule.

> **Note**
>
> Class B only available for devices with Class B property.

Cycle Time

Makes it possible to influence the IO-Link communication speed.

The cycle time can be adjusted using the scroll-down menu.

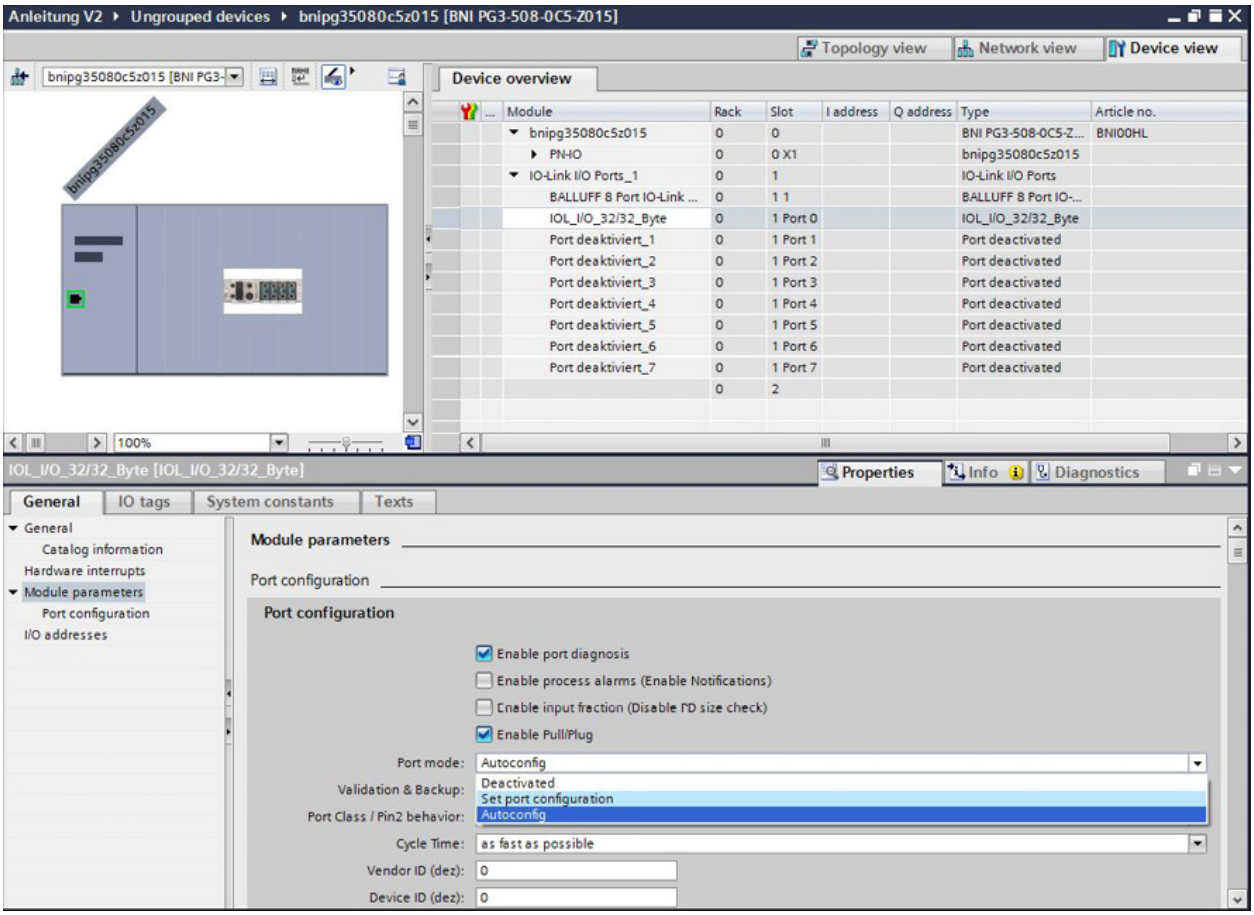


Fig. 15: Port Configuration – Port Mode

Port class

The plugged submodule for Pin 4 / Pin 2 behavior is always the configuration for Pin 4.
In addition, NC (Not connected), DI, DO or Power can be selected for pin 2.

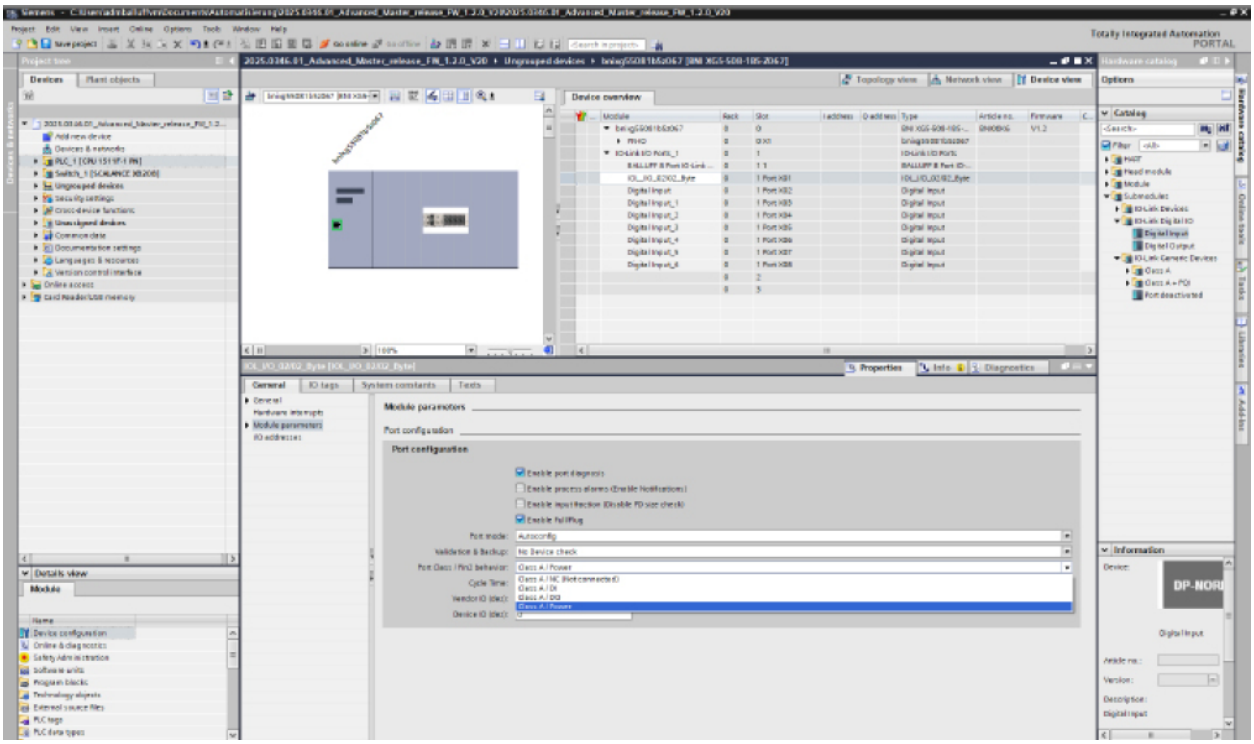


Fig. 16: Port Configuration – Pin 4 / Pin 2 Behavior

Settings for Pin 4 / Pin 2 behavior

The following settings are possible:

- *Class A / NC*: Defines Pin 4 as digital input / disables Pin 2.
- *Class A / DI*: Defines Pin 4 and Pin 2 as digital input.
- *Class A / DO*: Defines Pin 4 as digital input and Pin 2 as digital output.
- *Class A / Power*: Continuous voltage on pin 2.

> **Note**
>
> Configuration using pin 4 digital input as an example.

Function module

To be able to write or read out the ISDU data of connected IO-Link devices during operation, the common programming interfaces of the control manufacturers provide corresponding function modules or libraries.

REQ

Use Request to start the action in order to write or read data.

ID

The ID is permanently declared by the master via the hardware configuration.
This can be found under *System constants* in the hardware identification.

- Select the hardware ID of the module *IO-Link_I_O_Ports_1~BALLUFF*….

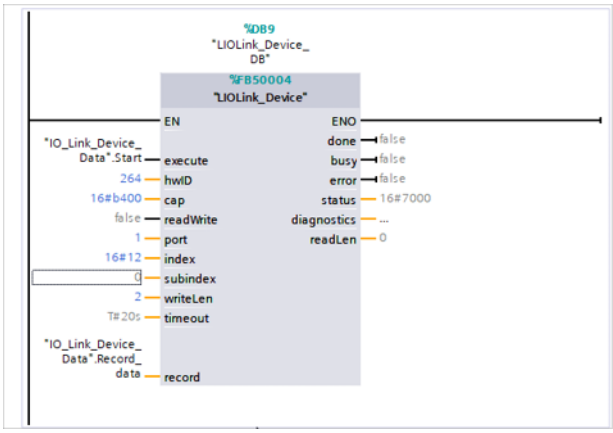


Fig. 17: Function module

CAP Value
This is assigned by the manufacturer. For Balluff products, it is the value 0xB400.

Read/Write
The command is defined here. To read data, it must be a 0; to write data, it must be a 1.

Port
Here you select the port to which the device has been connected. The master counts as 0 and the ports are counted from 1…8.

Index
This is the index of the IO-Link subscriber being read out or written. This can be found in the user's guide for the IO-Link device.

SubIndex
The sub-index is defined by the data to be processed. This can also be found in the operating instructions for the connected IO-Link device.

LEN
This is the length of the data. This can also be found in the parameter data in the user's guide for the IO-Link device.

RECORD_IOL_DATA
A data module is used for communication. The structure must be established in Array of Bytes. The data to be changed is written into this array.

DONE_VALID
Confirms the successful request to read or write data.

BUSY
Shows the working state of the module.

ERROR
If an error occurs in the function, it is reported here.

STATUS
Error status of the function

IOL_STATUS
Describes the current status or an error.

RD_LEN
Shows how many bytes were read by the module.

Fig. 18: Hardware configuration: System constants

The *IOL_Call* function module composes a telegram that is transferred to the master via acyclic services. The following settings are required for this:

Table 4: Telegram settings

Diagnosis address	CAP access
The diagnosis address of module *IO-Link_I_O_Ports_1~BALLUFF…* is used.	0xB400

The telegram set-up is described in the table below.

Range	Size in bytes	Value	Definition
Call – Header	1	0x08	0x08 for Call, fix
	1	0	IOL Master
		1…63	Port number
		64…255	reserved
	2	65098	FI_Index, IO-Link Header is following
IO-Link Header	1	0…255	Task
			2 = Write
			3 = Read
	2	0…32767	IO-Link Index
		65535	Port Function
	1	0…255	IO-Link Subindex
Data range	232		Range of data to be written or read

Read

To be able to read out data, the master must be sent a read task for the corresponding slot/index/subindex.

For this, the telegram must be adapted accordingly (slot, index) and entered at *Task* 0x03 for reading. The telegram can then be sent to the corresponding module via write command.

The module reads the data from the IO-Link device.

The data can be fetched by reading with the same telegram.

Write

To be able to write data, the network module must be sent a write task for the corresponding slot/index/subindex.

For this, the telegram must be adapted accordingly (slot, index) and entered at *Task* 0x02 for *writing*. The telegram can then be sent to the corresponding module via write command.

Ring topology

The network module also supports the ring topology with media redundancy, which is enabled via the Media Redundancy Protocol (MRP). For this, the module and the MRP master (Managed Switch, CPU, etc.) must be in the same topology instance.

With the ring topology, it is possible to establish a redundant system. I.e. in normal operation, one side of the ring line from the MRP master is deactivated. If the

line is damaged or capped at one place in the ring, the deactivated branch is activated again and there are two linear topologies.

Activating ring topology

- Set the media redundancy role to *Client* (the default setting is *Non-subscriber*).

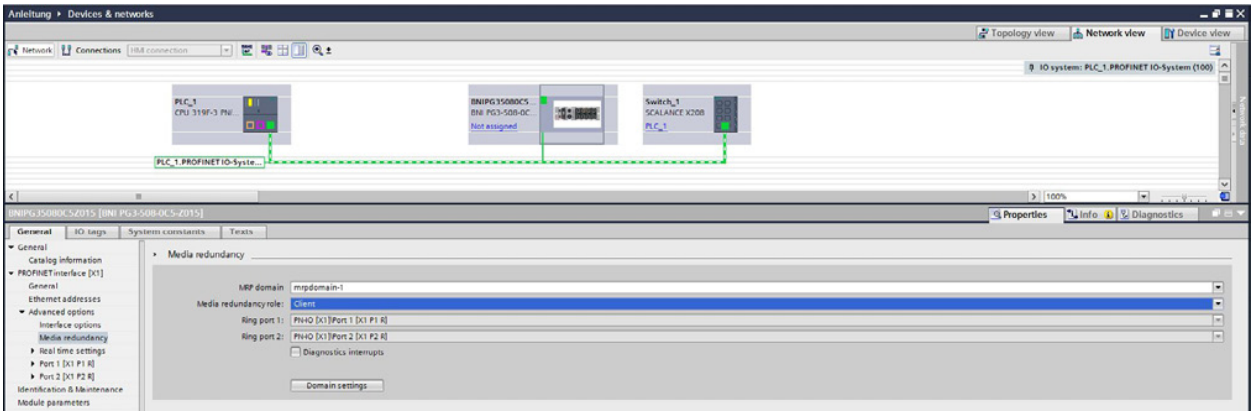


Fig. 19: Ring topology

> To ensure uninterrupted operation, the watchdog time should be greater than 200 milliseconds, as the MRP master requires some time to activate the second line. If the watchdog time is less than the switching time of the MRP master, this will cause a communication breakdown.
>
> The watchdog time is calculated from the “Update time” and the *Accepted update cycles* without *IO data* factor.

Device replacement without exchangeable medium

The modules also support simple device replacement in LLDP mode (Link Layer Discovery Protocol).

Activating device replacement without exchangeable medium

- In the CPU hardware configuration, activate the *Support device replacement without exchangeable medium* checkbox.
- Create the Profinet topology in the hardware configuration.

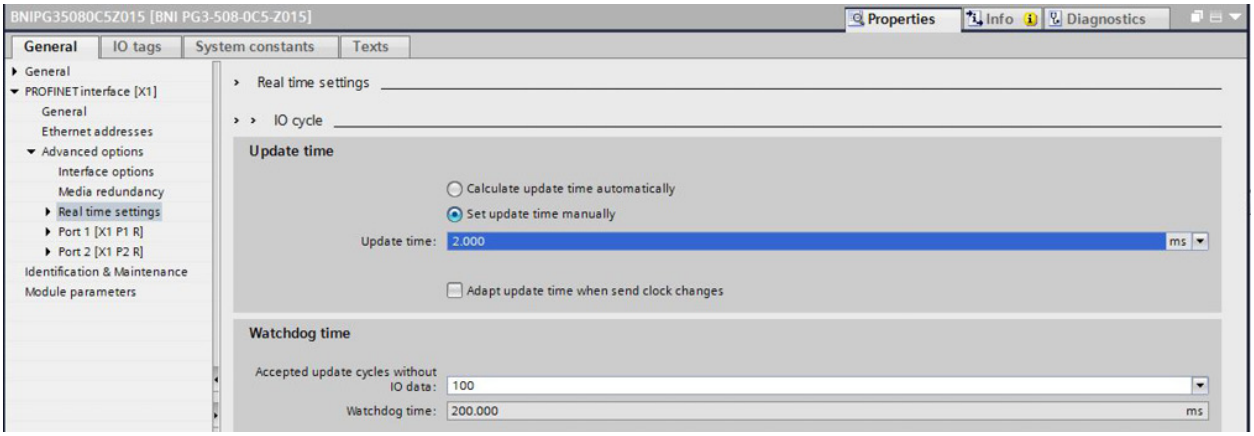


Fig. 20: “Update time” setting

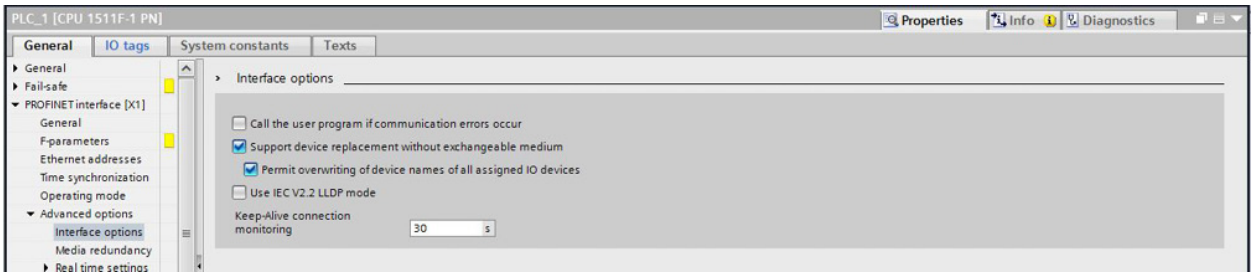


Fig. 21: Support device replacement without exchangeable medium

> **Note**
>
> The connections of the individual ports must match the hardware wiring. If the topology in the hardware configuration is not a match, errors can occur.

6.2.3 ISDU parameterization via GSDML

With ISDU parameterization via GSDML, the connected IO-Link devices can be configured via the parameters of the corresponding submodules when establishing a connection with Profinet.

The parameters are transferred when the BNI establishes the connection with the controller and are then forwarded directly to the corresponding IO-Link devices as ISDU write accesses. When an IO-Link device is unplugged and plugged in, the ISDU parameters configured in advance and transmitted by the controller are written again.

Carry out ISDU parameterization

1. Plug an IOL submodule into slot 1 of the desired port.
2. Insert the *ISDU parameter configuration* module into slot 3.
3. Select the corresponding submodule to define the maximum number of ISDU parameters that can be written to the corresponding port.

   The assignment *position submodule = port number* applies, e.g. slot 3/subslot 3 = Port 2 (see *Assignment position submodule = port number*).
4. Enter the ISDU parameters in the corresponding fields.

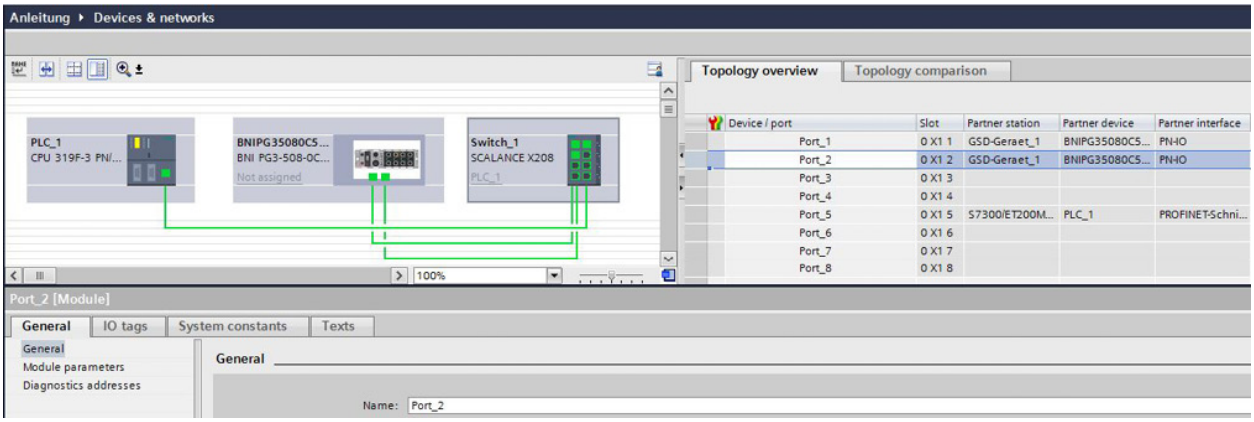


Fig. 22: Device replacement without exchangeable medium: Topology

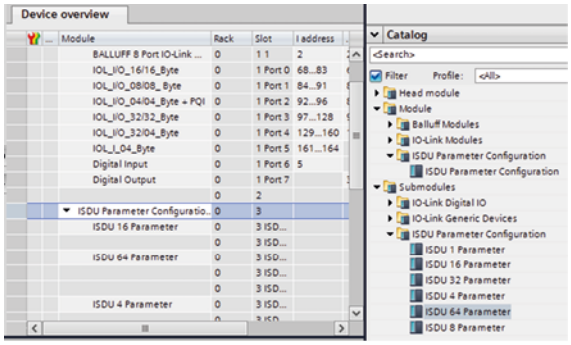


Fig. 23: Select submodule

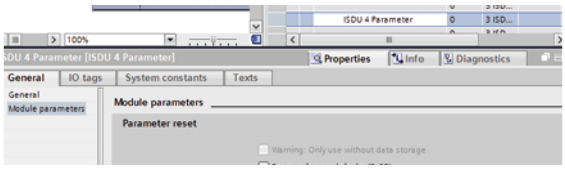


Fig. 24: Assignment position submodule = port number

Note

Regardless of the submodule used, only the parameters that are entered are written to the IO-Link device (condition: length > 0). When the connection is established, all parameters are transferred to the BNI.
Example
ISDU 64 parameter is plugged in and 5 ISDU parameters are described.

- All 64 parameters are transferred when the connection is established.
- Only the 5 described ISDU parameters are transferred to the device.

Set ISDU parameterization

The following settings exist for the ISDU parameterization:

- *Reset to factory defaults*: Resets the ISDU parameters to factory settings. The ISDU parameters can then be reset.
- *Start block parameterization*: Starts the check of several parameters of a device. The parameters are checked for plausibility only at the end of the complete parameterization.
- *End block parameterization*: Ends the check of the parameters of a device. Setting the parameter is mandatory if *Start block parameterization* has been selected.

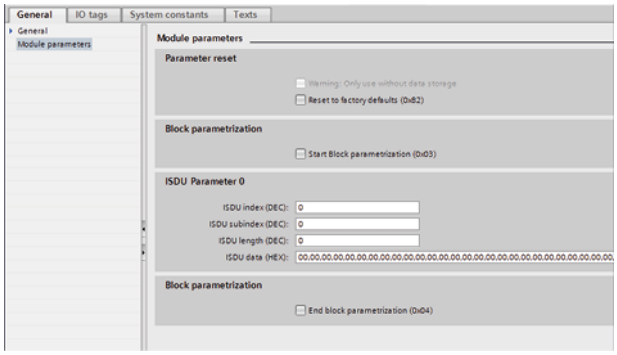


Fig. 25: Set ISDU parameterization

6.2.4 ISDU parameterization via GSDML and device catalog

With the ISDU parameterization via GSDML and device catalog, the connected IO-Link devices can be configured with the parameters taken from the IOOD of the device when establishing a connection with Profinet.

Carry out ISDU parameterization

- Plug the desired devices from the GSDML catalog into the corresponding subslots of the IO-Link ports (slot 1).

  ⇒ The device parameters appear in the module parameters of the corresponding port and can be selected.

The parameters are forwarded to the corresponding devices as ISDU write accesses and written to the device in the following cases:

- each time the IO-Link device is reconnected
- for a new connection with the PLC

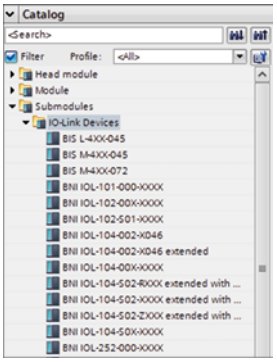


Fig. 26: Select devices

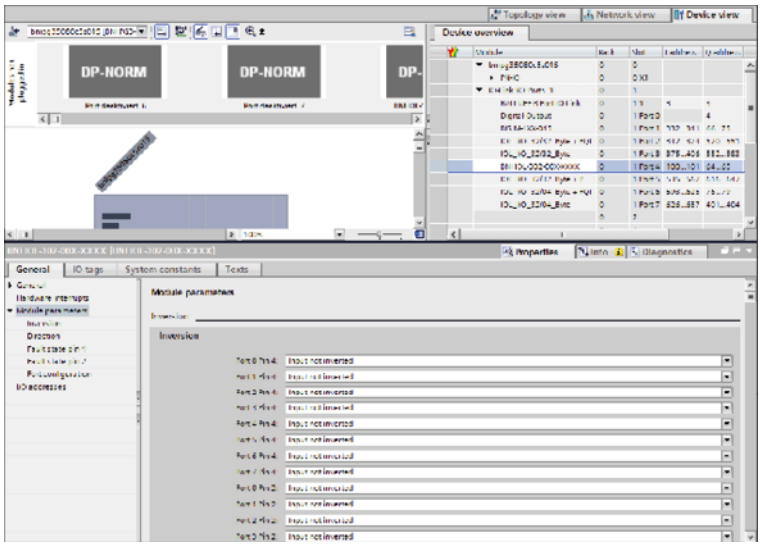


Fig. 27: Parameters of the selected device

6.2.5 Integrating Safety-Hub

> Note
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Connecting the safe I/O module to the network module

When project planning for Profinet devices, a device is mapped as a modular system, which has a headslot and several data modules. The illustrations used here are taken as examples from the *Totally Integrated Automation Portal (TIA Portal)* project planning software and from the SIMTATIC Manager from Siemens AG and are for illustrative purposes only.

The necessary settings depend on the application and are the responsibility of the user. The BNI IOF-329-P02-Z038 must always be connected via a compatible Balluff network module.

Placing module on slot

The GSDML file provides the data modules available for the respective network module.

- Select module *IO-Link I/O ports (w/o IO data) with Safety Hub and ISDU* and drag and drop to slot 1.

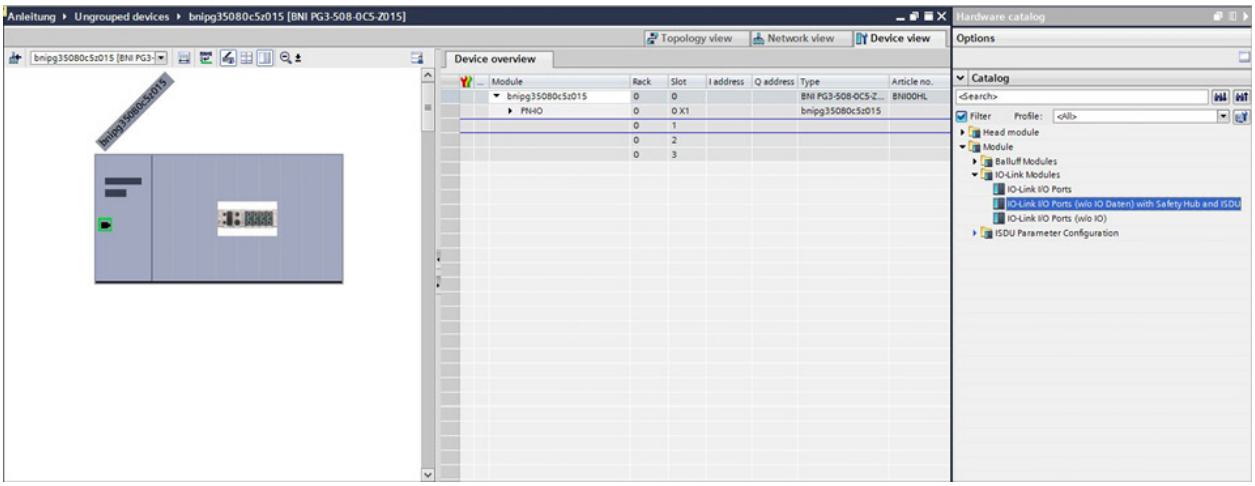


Fig. 28: Select module *IO-Link I/O ports (w/o IO data) with Safety Hub and ISDU*

> Note
>
> The list of module entries is automatically doubled, as the secure IO-Link IO module consists of one sub-module each for secure and standard communication.

Assigning a secure I/O module to a slot

Before assigning to the desired slot, the two default entries *Port deactivated* and *Empty submodule on the network module* must be deleted. The BNI IOF-329-P02-Z038 security module can then be dragged and dropped under the tab *Device view* > *Device overview* to any IO-Link Port of the compatible Balluff network module as a new IO-Link data module.

The device data for the secure I/O module can be found in the Safety Hub submodule of the project planning software.

Configuring slot

1. Delete default setting for the *Port deactivated* and *Empty submodule* entries.
2. Drag and drop the secure I/O module for the secure data from the Safety Hub submodule to the upper free slot. Place the submodule for the standard IO data in the slot below.

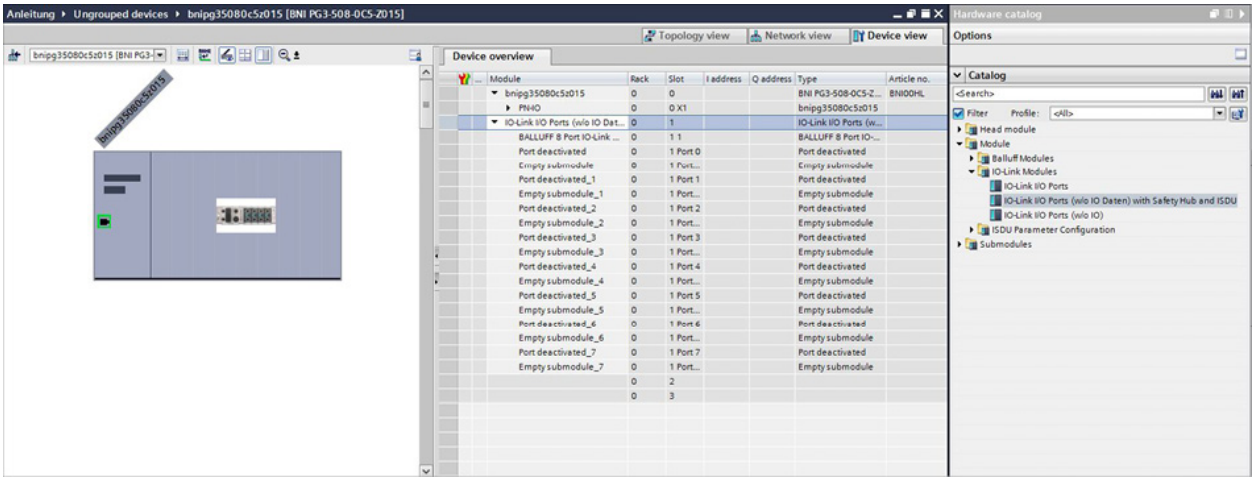


Fig. 29: Module placed on slot 1

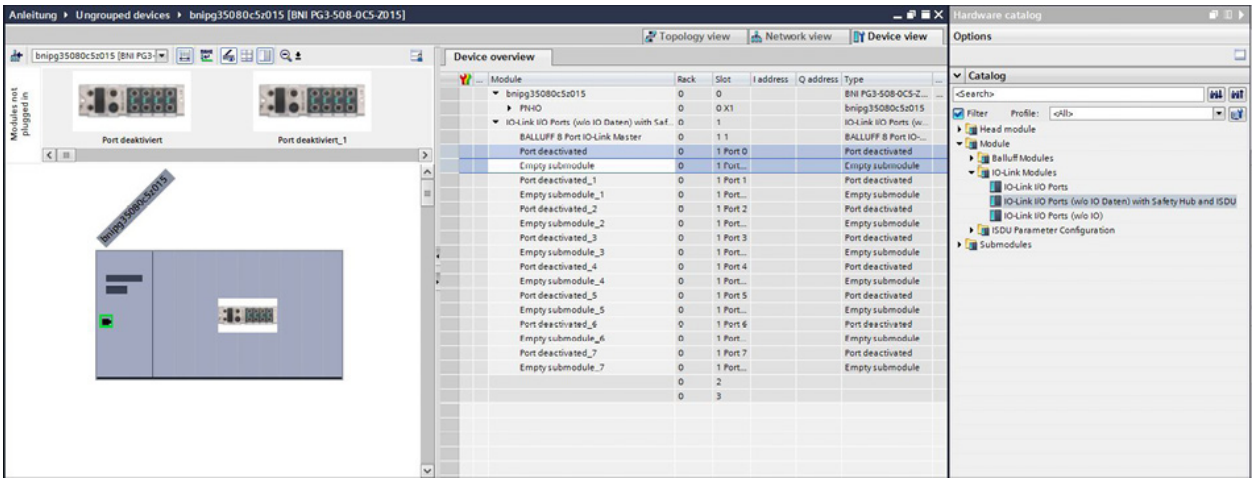


Fig. 30: Delete entries *Port deactivated* and *Empty submodule* on the network module

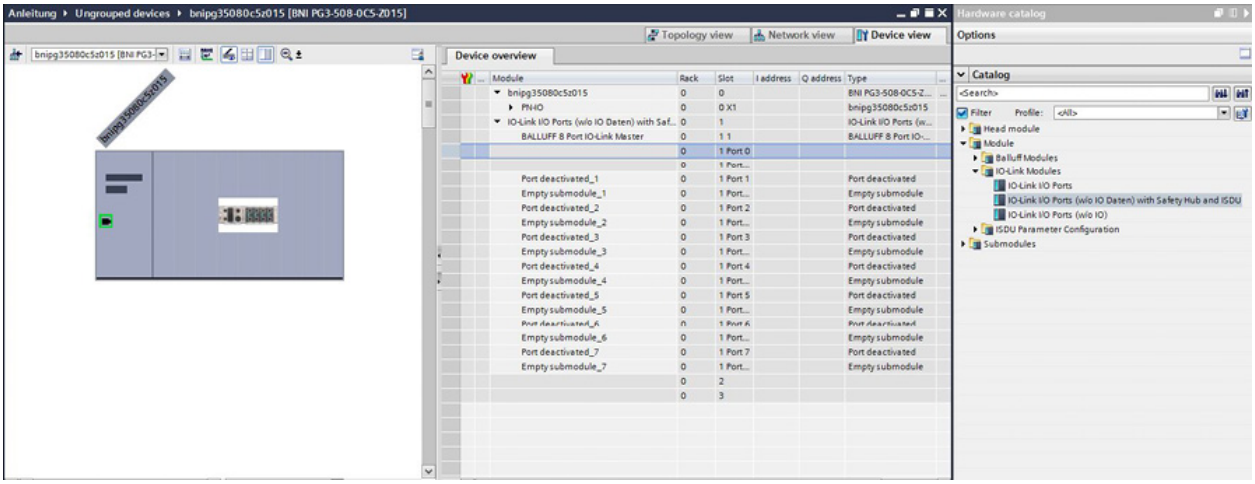


Fig. 31: Deleting default setting

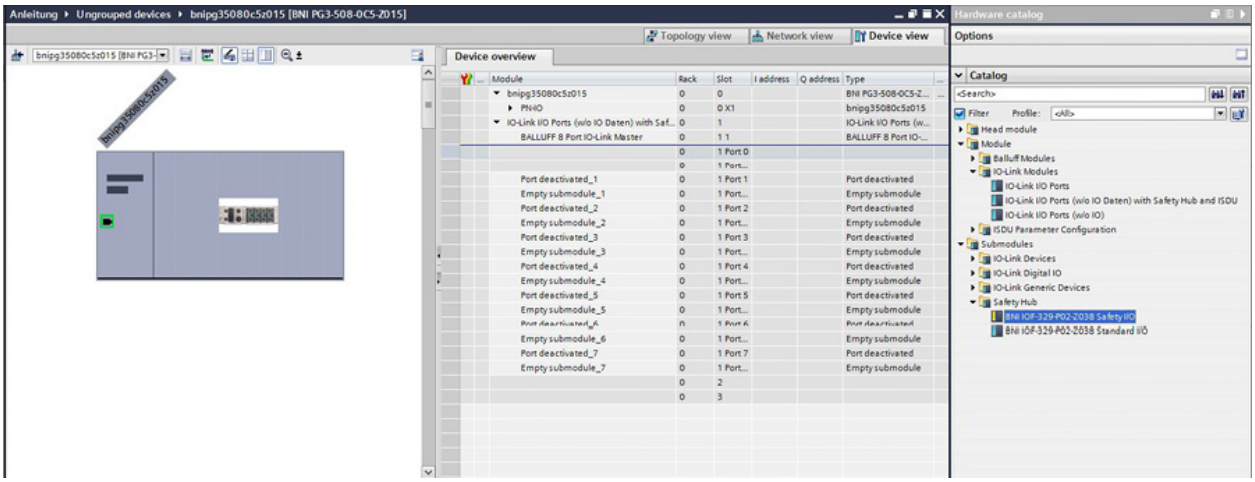


Fig. 32: Placing I/O module

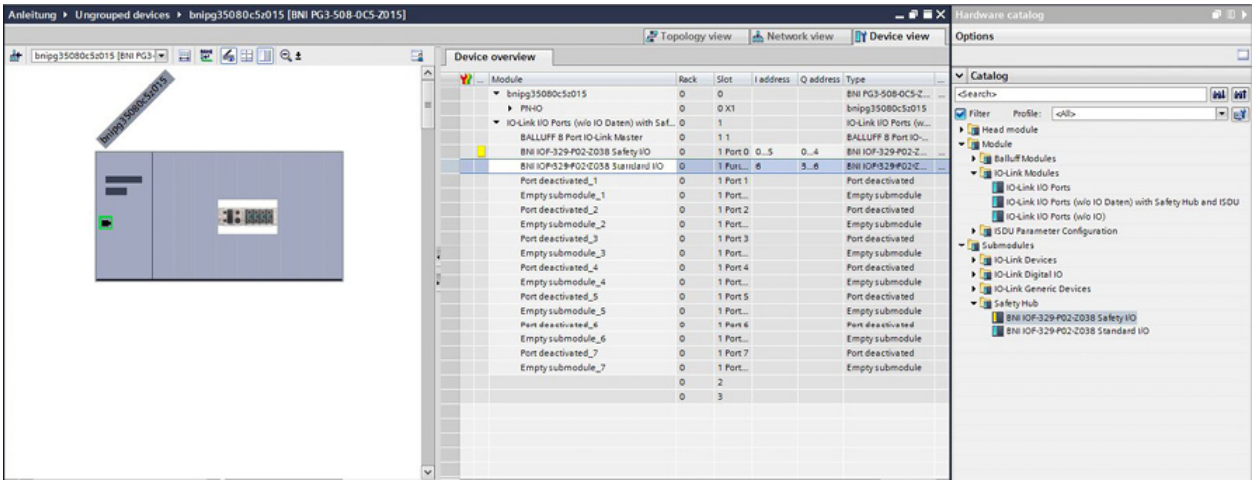


Fig. 33: Placing submodule

Note

For further configurations, see the Safety Hub guide.

Note

After integrating and configuring the module, the master must be restarted!

6.2.6 Diagnosis

Diagnosis message

The diagnosis message that the module generates in the event of an error is usually read out from the PLC and processed. It is also possible for the diagnosis to be read out and evaluated from the module using function modules.

The diagnosis message is 40 bytes long and split into 3 blocks (Block Header, Alarm Header, Alarm Item) (see table below).

Byte	Value	Meaning	Block
0	0x00	Block Type	Block Header
1	0x02		
2	0x00	BlockLength	
3	0x24		
4	0x01	BlockVersion	
5	0x00		
6	0x00	AlarmType	Alarm Header
7	XX		
8	0x00	API (Application Process Identifier)	
9	0x00		
10	0x4E		
11	0x01		
12	0x00	SlotNumber	
13	0x01		
14	0x00	SubslotNumber	
15	XX		
16	0x00	ModuleIdentNumber (module identification)	
17	0x00		
18	XX		
19	XX		
20	XX	SubmoduleIdentNumber (submodule identification)	
21	XX		
22	XX		
23	XX		
24	XX	Alarm Specifier	
25	XX		
26	0x80	User Structure Identifier	Alarm Item
27	0x02		
28	0x80	ChannelNumber	
29	0x00		
30	XX	ChannelProperties	
31	0x00		
32	0x95	ChannelErrorType	

continues on next page

Table 5 – continued from previous page

Byte	Value	Meaning	Block
33	XX		
34	XX	ExtChannelErrorType	
35	XX		
36	0x00	reserved	
37	0x00		
38	0x00		
39	0x00		

Block Header

The first part of the diagnosis is the so-called Block Header, which is 6 bytes long.

BlockType

The first 2 bytes of the Block Header are written by the block type, in order to define the data type.

Table 6: BlockType

Other values	Meaning
0x0002	Alarm Notification Low

BlockLength

2 bytes of data; Information about the length of the following diagnosis message (for the complete diagnosis message, the 2 bytes of the block type and the 2 bytes of the block length must be added together).

BlockVersion

Low Byte fixed at 0x00, High Byte fixed at 0x01.

Alarm Header

The second part of the diagnosis is known as the Alarm Header, which is 20 bytes long.

AlarmType

2 bytes of data; Information on the alarm type.

Table 7: AlarmType

Other values	Meaning
0x0001	Diagnosis
0x0003	Pull
0x0004	Plug
0x000C	Diagnosis disappears

API

4 bytes of data; Application Process Identifier.

Table 8: API

Other values	Meaning
0x00004E01	Administrative number

SlotNumber

2 bytes of data; defines which slot of the module is reporting an error.

Table 9: SlotNumber

Other values	Meaning
0x0001	Slot 1, IO-Link Blocks

SubslotNumber

2 bytes of data; defines which subslot of the slot reports an error.

Network module	Other values	Meaning
IO-Link I/O ports or IO-Link I/O ports (without IO data)	0x0002	Port 1 (Digital Port or IO-Link Port)
	0x0003	Port 2 (Digital Port or IO-Link Port)
	0x0004	Port 3 (Digital Port or IO-Link Port)
	0x0005	Port 4 (Digital Port or IO-Link Port)
	0x0006	Port 5 (Digital Port or IO-Link Port)
	0x0007	Port 6 (Digital Port or IO-Link Port)
	0x0008	Port 7 (Digital Port or IO-Link Port)
	0x0009	Port 8 (Digital Port or IO-Link Port)
IO-Link I/O ports (without IO data) with SafetyHub	0x0002	Port 1 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x0004	Port 2 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x0006	Port 3 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x0008	Port 4 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x000A	Port 5 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x000C	Port 6 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x000E	Port 7 (Digital Port, IO-Link Port or Safety IO-Link Port)
	0x0010	Port 8 (Digital Port, IO-Link Port or Safety IO-Link Port)

ModuleIdentNumber

4 bytes of data; defines which module is plugged in to the respective slot (module identification is saved in the GSDML).

Table 10: ModuleIdentNumber for devices with Class A

Other values	Meaning
0x0000005E	IO-Link I/O ports (without IO data) with Safety-Hub
0x00004E01	IO-Link-I/O-Ports
0x00004E04	IO-Link I/O ports (without IO data)

Table 11: ModuleIdentNumber for devices with Class B

Other values	Meaning
0x0000505E	IO-Link I/O ports (without IO data) with Safety-Hub
0x00005E01	IO-Link-I/O-Ports
0x00005E04	IO-Link I/O ports (without IO data)

SubmoduleIdentNumber

4 bytes of data; defines which submodule is used in the respective module (submodule identification is stored in the GSDML).

Group	Other values	Meaning
IO-Link Digital IO	0x00008100	Digital Output
	0x00000081	Digital Input
	0x00004001	Digital Output w/o IO
	0x00004002	Digital Input w/o IO
IO-Link Generic Devices	0x00000002	IOL_I_01_Byte + PQI
	0x00000003	IOL_I_02_Byte + PQI
	0x00000005	IOL_I_04_Byte + PQI
	0x00000007	IOL_I_06_Byte + PQI
	0x00000009	IOL_I_08_Byte + PQI
	0x0000000B	IOL_I_10_Byte + PQI
	0x00000011	IOL_I_16_Byte + PQI
	0x00000019	IOL_I_24_Byte + PQI
	0x00000021	IOL_I_32_Byte + PQI
	0x00000101	IOL_O_01_Byte + PQI
	0x00000201	IOL_O_02_Byte + PQI
	0x00000401	IOL_O_04_Byte + PQI
	0x00000601	IOL_O_06_Byte + PQI
	0x00000801	IOL_O_08_Byte + PQI
	0x00000A01	IOL_O_10_Byte + PQI
	0x00001001	IOL_O_16_Byte + PQI
	0x00001801	IOL_O_24_Byte + PQI
	0x00002001	IOL_O_32_Byte + PQI
	0x00000102	IOL_I/O_01/01_Byte + PQI
	0x00000203	IOL_I/O_02/02_Byte + PQI
	0x00000403	IOL_I/O_02/04_Byte + PQI
	0x00000205	IOL_I/O_04/02_Byte + PQI
	0x00000405	IOL_I/O_04/04_Byte + PQI
	0x00000803	IOL_I/O_02/08_Byte + PQI

continues on next page

Table 12 – continued from previous page

Group	Other values	Meaning
	0x00000805	IOL_I/O_04/08_Byte + PQI
	0x00000209	IOL_I/O_08/02_Byte + PQI
	0x00000409	IOL_I/O_08/04_Byte + PQI
	0x00000809	IOL_I/O_08/08_Byte + PQI
	0x00000A0B	IOL_I/O_10/10_Byte + PQI
	0x00002005	IOL_I/O_04/32_Byte + PQI
	0x00000421	IOL_I/O_32/04_Byte + PQI
	0x00002021	IOL_I/O_32/32_Byte + PQI
	0x00001011	IOL_I/O_16/16_Byte + PQI
	0x00001819	IOL_I/O_24/24_Byte + PQI
	0x40000001	IOL_I_01_Byte
	0x40000002	IOL_I_02_Byte
	0x40000004	IOL_I_04_Byte
	0x40000006	IOL_I_06_Byte
	0x40000008	IOL_I_08_Byte
	0x4000000A	IOL_I_10_Byte
	0x40000010	IOL_I_16_Byte
	0x40000018	IOL_I_24_Byte
	0x40000020	IOL_I_32_Byte
	0x40000100	IOL_O_01_Byte
	0x40000200	IOL_O_02_Byte
	0x40000400	IOL_O_04_Byte
	0x40000600	IOL_O_06_Byte
	0x40000800	IOL_O_08_Byte
	0x40000A00	IOL_O_10_Byte
	0x40001000	IOL_O_16_Byte
	0x40001800	IOL_O_24_Byte
	0x40002000	IOL_O_32_Byte
	0x40000101	IOL_I/O_01/01_Byte
	0x40000202	IOL_I/O_02/02_Byte
	0x40000402	IOL_I/O_02/04_Byte
	0x40000204	IOL_I/O_04/02_Byte
	0x40000404	IOL_I/O_04/04_Byte
	0x40000802	IOL_I/O_02/08_Byte
	0x40000804	IOL_I/O_04/08_Byte
	0x40000208	IOL_I/O_08/02_Byte
	0x40000408	IOL_I/O_08/04_Byte
	0x40000808	IOL_I/O_08/08_Byte
	0x40000A0A	IOL_I/O_10/10_Byte
	0x40002004	IOL_I/O_04/32_Byte
	0x40000420	IOL_I/O_32/04_Byte
	0x40002020	IOL_I/O_32/32_Byte
	0x40001010	IOL_I/O_16/16_Byte
	0x40001818	IOL_I/O_24/24_Byte
Safety-Hub	0x00000001	BNI IOF-329-P02-Z038 Safety I/O
	0x00020002	BNI IOF-329-P02-Z038 Standard I/O
IO-Link Devices	0xFFFF0001	BNI IOL-101-000-XXXX
	0xFFFF0002	BNI IOL-102-00X-XXXX
	0xFFFF0003	BNI IOL-102-S01-XXXX

continues on next page

Table 12 – continued from previous page

Group	Other values	Meaning
	0xFFFF0FFF	BNI IOL-104-00X-XXXX
	0xFFFF0005	BNI IOL-104-002-X046
	0xFFFF0006	BNI IOL-104-002-X046 extended
	0xFFFF0007	BNI IOL-104-S02-XXXX extended with BNI IOL-104-S02-XXXX
	0xFFFF0008	BNI IOL-104-S02-ZXXX extended with BNI IOL-751-VXX-K007
	0xFFFF0009	BNI IOL-104-S02-RXXX extended with BNI IOL-751-VXX-K007
	0xFFFF000A	BNI IOL-104-S0X-XXXX

Group	Other values	Meaning
	0xFFFF000B	BNI IOL-252-000-XXXX
	0xFFFF000C	BNI IOL-252-S01-XXXX
	0xFFFF000D	BNI IOL-256-000-XXXX
	0xFFFF000E	BNI IOL-256-S01-XXXX
	0xFFFF000F	BNI IOL-302-00X-XXXX
	0xFFFF0010	BNI IOL-302-002-X046
	0xFFFF0011	BNI IOL-302-002-XXXX extended
	0xFFFF0012	BNI IOL-302-002-X046 extended with BNI IOL-104-002-X046
	0xFFFF0013	BNI IOL-302-S01-XXXX
	0xFFFF0014	BNI IOL-302-S01-XXXX only Input and Output
	0xFFFF0015	BNI IOL-302-S01-XXXX only Output
	0xFFFF0016	BNI IOL-302-S01-XXXX-C01
	0xFFFF0017	BNI IOL-302-S02-XXXX
	0xFFFF0018	BNI IOL-302-S02-X026
	0xFFFF0019	BNI IOL-309-00X-XXXX
	0xFFFF001A	BNI IOL-310-000-XXXX
	0xFFFF001B	BNI IOL-355-S02-XXXX
	0xFFFF001C	BNI IOL-719-002-XXXX
	0xFFFF001D	BNI IOL-771-000-XXXX
	0xFFFF001E	BNI IOL-772-000-XXXX
	0xFFFF001F	BNI IOL-800-000-Z036
	0xFFFF0020	BNI IOL-800-000-Z037
	0xFFFF0021	BNI IOL-801-000-Z036
	0xFFFF0022	BNI IOL-801-000-Z037
	0xFFFF0023	BNI IOL-802-000-Z036
	0xFFFF0024	BNI IOL-802-000-Z037
	0xFFFF0025	BIS M-4XX-045
	0xFFFF0026	BIS M-4XX-072
	0xFFFF0027	BIS L-4XX-045
	0xFFFF0028	BNI IOL-709-000-XXXX (10 Byte Input)
	0xFFFF0029	BNI IOL-710-000-XXXX (10 Byte Input)
	0xFFFF002A	BNI IOL-727-S51-XXXX (16 Byte Input and 1 Byte Output)
	0xFFFF002B	BNI IOL-728-S51-XXXX (23 Byte Input and 0 Byte Output)

Alarm Specifier

2 bytes of data; Alarm Specifier is divided as follows:

Sequence Number (Bit 0…10)

This counter is incremented with each new diagnostic message.

Channel Diagnosis (Bit 11)

Table 14: Channel Diagnosis

Other values	Meaning
0x00	No channel-based diagnosis available
0x01	Channel-based diagnosis available

Manufacturer Specific Diagnosis (Bit 12)

Other values	Meaning
0x00	No manufacturer-based diagnosis available
0x01	Manufacturer-based diagnosis available

Submodule Diagnosis State (Bit 13)

Other values	Meaning
0x00	No further diagnosis of the submodule available
0x01	At least one further diagnosis of the submodule available

Reserved (Bit 14)

AR Diagnosis State (Bit 15)

Other values	Meaning
0x00	No further diagnosis of the module available
0x01	At least one further diagnosis of the module available

Alarm Item

The third part of the diagnostics is known as the Alarm Item, which is 14 bytes long.

User Structure Identifier

2 bytes of data; defines the type of diagnostics.

Table 15: User Structure Identifier

Other values	Meaning
0x8002	Extended Channel Diagnosis
0x8100	Alarm Head Maintenance
0x8000	Channel-based diagnosis

ChannelNumber

2 bytes of data; defines the channel number.

Table 16: ChannelNumber

Other values	Meaning
0x8000	Submodule

ChannelProperties

2 bytes of data; Channel Properties are divided as follows:

Type (Bit 0…7)

Other values	Meaning
0x00	Complete submodule

Accumulative (Bit 8)

Other values	Meaning
0x00	Not used.

Maintenance (Bit 9 and 10)

Other values	Meaning
0x00	Not used.

Specifier (Bit 11 and 12)

Other values	Meaning
0x00	Not used.
0x01	Diagnosis occurred.
0x02	Diagnosis done.
0x03	Diagnosis done but another is still active.

Direction (Bit 13…15)

Other values	Meaning
0x00	Not used.

ChannelErrorType

2 bytes of data; Information on the error type.

Table 17: ChannelErrorType

Other values	Meaning
0x9500	IO-Link device events in the lower range (0x0000-0x7FFF)
0x9501	IO-Link device events in the upper range (0x8000-0xFFFF)
0x9502	IO-Link port events in the lower range (0x0000-0x7FFF)
0x9503	IO-Link port events in the upper range (0x8000-0xFFFF)

If *User Structure Identifier* has the value 0x8000, the module-related errors are displayed here:

Table 18: Module-related errors

Error code	Meaning
0x0002	Undervoltage
0x0003	Overvoltage
0x0105	Undervoltage of the actuator supply
0x0104	No actuator supply

ExtChannelErrorType

2 bytes of data; Information on the error type.

ChannelErrorType	ExtChannelErrorType (EventCode)	Error text
IO-Link device events in the lower range (9500)	0x1000	General malfunction
	0x4000	Temperature fault
	0x4210	Device temperature exceeded.
	0x4220	Device temperature undershot.
	0x5000	Fault in the device hardware
	0x5010	Malfunction of a component
	0x5011	Loss of non-volatile memory
	0x5012	Batteries weak
	0x5100	General fault in the power supply
	0x5101	Fuse blown/open.
	0x5110	Primary supply voltage exceeded.
	0x5111	Primary supply voltage undershot.
	0x5112	Fault in the secondary supply voltage (Port C
	0x6000	Fault in the device software
	0x6320	Parameter error
	0x6321	Parameter missing.
	0x6350	Parameters changed.
	0x7700	Wire break of subordinate device
	0x7701	Wire break of subordinate device 1
	0x7702	Wire break of subordinate device 2
	0x7703	Wire break of subordinate device 3
	0x7704	Wire break of subordinate device 4
	0x7705	Wire break of subordinate device 5
	0x7706	Wire break of subordinate device 6
	0x7707	Wire break of subordinate device 7
	0x7708	Wire break of subordinate device 8
	0x7709	Wire break of subordinate device 9
	0x770A	Wire break of subordinate device 10
	0x770B	Wire break of subordinate device 11
	0x770C	Wire break of subordinate device 12
	0x770D	Wire break of subordinate device 13
	0x770E	Wire break of subordinate device 14
	0x770F	Wire break of subordinate device 15
	0x7710	Short circuit
	0x7711	Grounding fault

ChannelErrorType	ExtChannelErrorType (EventCode)	Error text
IO-Link device events in the upper range (9501)	0x0C00	Technology-specific application errors
	0x0C01	Simulation active.
	0x0C10	Process variable range exceeded.
	0x0C20	Measuring range exceeded.
	0x0C30	Process variable range undershot.
	0x0C40	Maintenance required – Cleaning
	0x0C41	Maintenance required – Top up
	0x0C42	Required maintenance – Wear and tear

Table 20 – continued from previous page

ChannelErrorType	ExtChannelErrorType (EventCode)	Error text
IO-Link device events in the lower range (9502)	0x17FF	Process data does not match.
	0x1800	No device
	0x1801	Error during start parameterization
	0x1802	Incorrect Vendor ID
	0x1803	Incorrect device ID
	0x1804	Short circuit at C/Q
	0x1805	IO-Link PHY above temperature
	0x1806	Short circuit at L+
	0x1807	Undervoltage at L+
	0x1808	Overflow of device event
	0x1809	Backup inconsistent
	0x180A	Backup inconsistent
	0x180B	Backup inconsistent
	0x180C	Backup inconsistent
	0x180D	Backup inconsistent
	0x180E	P24 (Class B) missing or undervoltage
	0x180F	Short circuit at P24 (Class B)
	0x1810	Short circuit at I/Q
	0x1811	Short circuit at C/Q (Digital Output)
	0x1812	Overcurrent at I/Q
	0x1813	Overcurrent at C/Q (Digital Output)
	0x1883	S7-PCT configuration error (incorrect or in
	0x1888	Module defective
	0x6000	Invalid cycle time
	0x6001	Version error
	0x6002	ISDU batch failed.

Profinet diagnostic module – Pin 4/2 Actor Ground Short Circuit Detection

If a short circuit is detected at a port on the pin, the corresponding bit is set to 1.

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

Profinet module – Short Circuit and Actor Warning Detection

If an error with the following modules occurs, the corresponding bit is set to *true*:

- Pin 1 Short Circuit Detection
- Pin 4/2 Actor Warning Detection
- Pin 4/2 Actor Ground Short Circuit Detection
- Pin 4 IO-Link Short Circuit Detection

Table 21: Profinet module – Short Circuit and Actor Warning Detection

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 8	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1

Profinet diagnostic module – Pin 4 IO-Link Short Circuit Detection

If an IO-Link short circuit is detected at a port on pin 4, the corresponding bit is set to 1. The port must be configured to IO-Link.

Table 22: Profinet diagnostic module – Pin 4 IO-Link Short Circuit Detection

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 8 Pin 4	Port 7 Pin 4	Port 6 Pin 4	Port 5 Pin 4	Port 4 Pin 4	Port 3 Pin 4	Port 2 Pin 4	Port 1 Pin 4

Profinet module – IO-Link Device Event Pending

If there is a pending IO-Link device event at any connection, the corresponding bit is set to 1.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 8	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1

Profinet diagnostic module – Pin 4/2 Actor Warning Detection

If pin 2/4 of connection x (where x is a number between 1 and 8) is configured to:

- OUTPUT (Pin 2/4)
  - If the voltage is low and an external voltage is applied, the bit is set to true.
  - If high-controlled (UA is missing; therefore the output is physically low) and an external voltage is applied, the bit is set to true.
- POWER (Pin 2)
  - If UA is missing and external voltage is applied, the bit is set to true.

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

Profinet module – Port Event Pending

If an upcoming event is detected, the bit for the port is set to 1. If an outgoing event is sent for this event, the bit is reset to 0.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Port 8	Port 7	Port 6	Port 5	Port 4	Port 3	Port 2	Port 1

6.3 Ethernet/IP integration

6.3.1 Integration in RSLogix EIP development tool

Example of how the module can be integrated into the RSLogix EIP development tool:

1. Go offline.

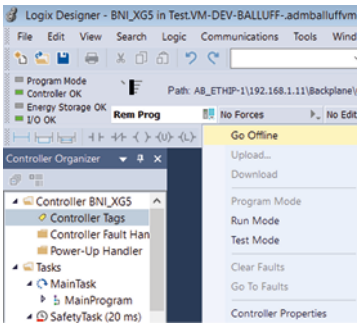


Fig. 34: Go offline

2. Right click on *Ethernet* (the correct scanner card) and select *New Module…*.

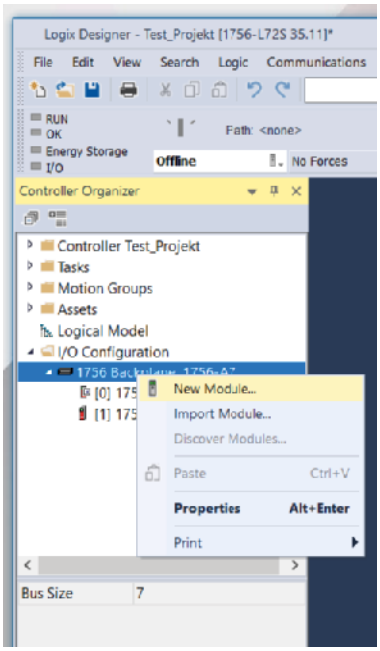


Fig. 35: Select New Module

3. Select the *Generic Ethernet Module* as Ethernet module in the communication path.
4. Enter tag name (user-defined), select the general format *Data SINT*, enter the IP address of the module and the correct connection parameters and confirm with *OK*.

   ⇒ The new module and the corresponding controller tags are automatically generated.
5. Download the configuration with Download.

After the download is completed the tags can be monitored and activated using the Controller tags option.

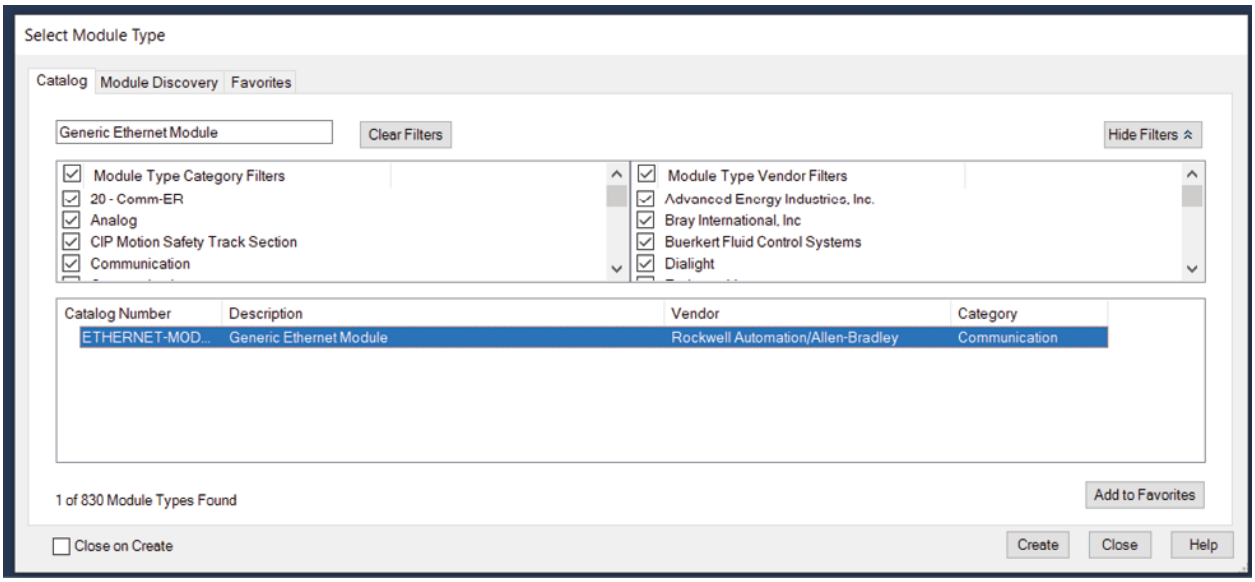


Fig. 36: Select Generic Ethernet Module

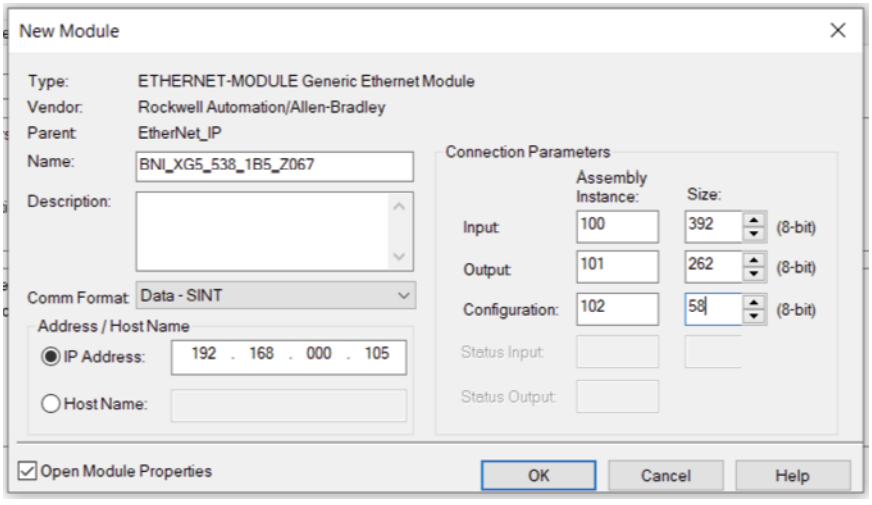


Fig. 37: New Module dialog

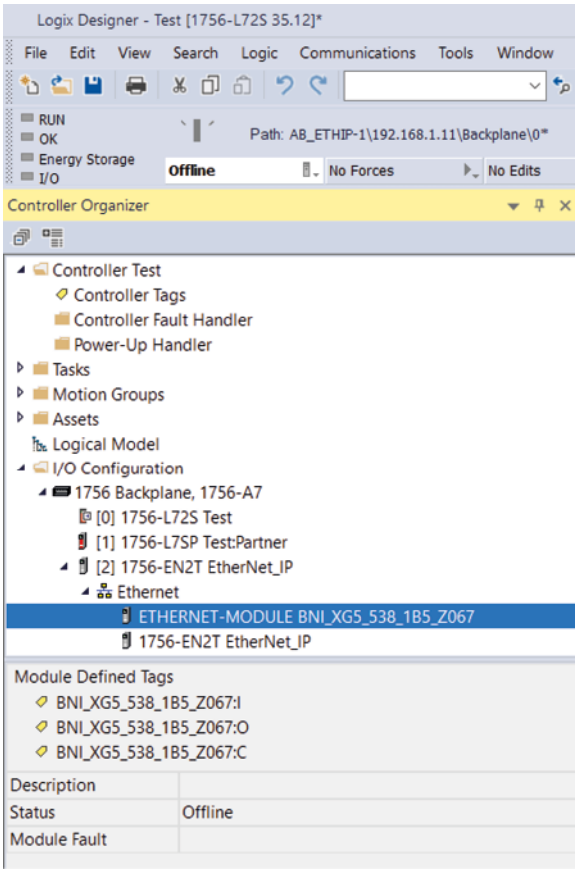


Fig. 38: Controller tags

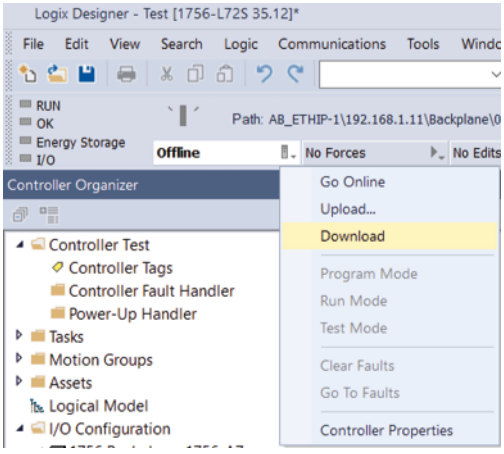


Fig. 39: Download configuration

Note

Make sure to select the previously configured correct tag name.

The entry, output and configuration data are described on the following pages.

Note

These tags can also be used for programming.

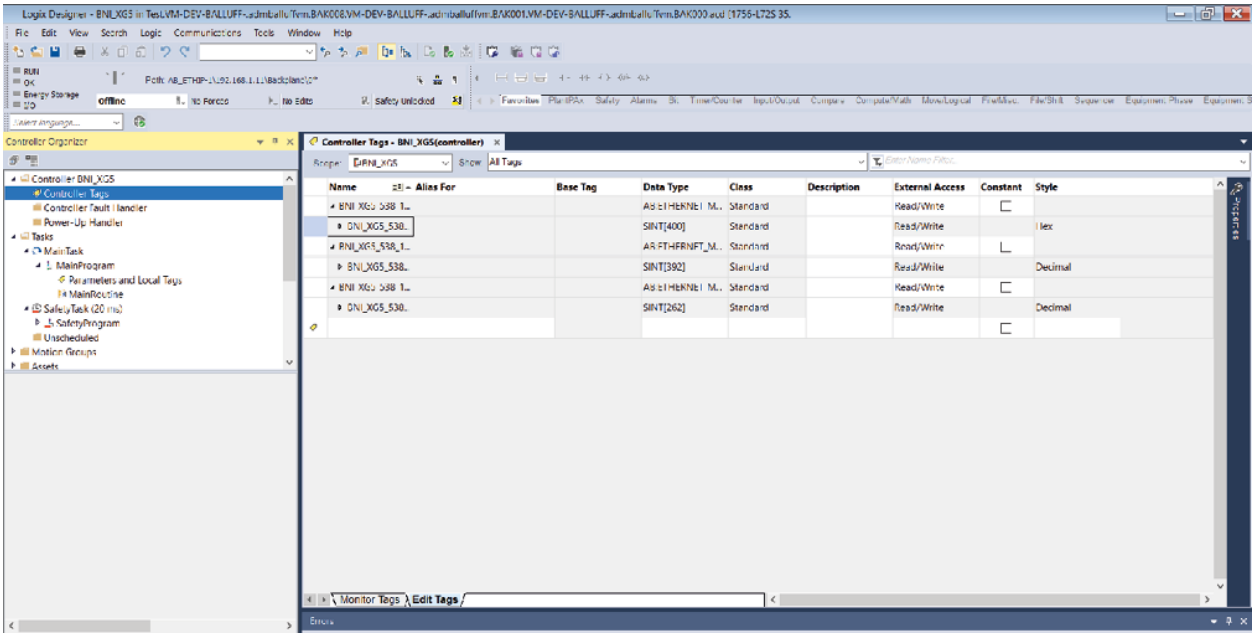


Fig. 40: Tag creation completed

6.3.2 Integration

Data configuration

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Enter the values from *Data configuration* in the control system. They describe the data sizes of the entry, output and configuration data.

Table 23: Data configuration

Data size	Instance ID	Length of data
Input with 32 bytes of IO-Link process data	100	392
Output with 32 bytes of IO-Link process data	101	262
Configuration	102	58/0
Automatic IO-Link	103	0 (adjustable, see Automatic IO-Link – Adjustable IO-Link process data length)
Input with 24 bytes of IO-Link process data	110	328
Output with 24 bytes of IO-Link process data	111	198
Input with 16 bytes of IO-Link process data	112	264
Output with 16 bytes of IO-Link process data	113	134
Input with 10 bytes of IO-Link process data	114	216
Output with 10 bytes of IO-Link process data	115	86
Input with 8 bytes of IO-Link process data	116	200
Output with 8 bytes of IO-Link process data	117	70
Input with 6 bytes of IO-Link process data	118	184
Output with 6 bytes of IO-Link process data	119	54
Input with 4 bytes of IO-Link process data	120	168
Output with 4 bytes of IO-Link process data	121	38
Input with 2 bytes of IO-Link process data	122	152
Output with 2 bytes of IO-Link process data	123	22
Input with 1 byte of IO-Link process data	124	144
Output with 1 byte of IO-Link process data	125	14
Input with 0 bytes of IO-Link process data	126	8
Output with 0 bytes of IO-Link process data	127	6

Automatic IO-Link – Adjustable IO-Link process data length

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The Ethernet/IP master offers a variety of configurations for IO-Link process data lengths, ranging from 0 to 32 bytes. The EDS file (Electronic Data Sheet) contains several predefined connections under the Connection *Manager section*. One of these connections is, for example, *Connection2* with the name *Exclusive Owner Connections – 32 IOL Data*. A connection is a compilation of a configuration. Part of this is the definition of the data from the control unit to the device (O->T), the data from the device to the control unit (T->O) and the device configuration. These definitions can be found in the EDS file under the *Assembly* section. *Assem101* (a consuming module with 32 bytes of IO-Link output process data) is used for *Connection2* and the direction _O->T. *Assem100* (a producing module with 32 bytes of IO-Link input process data) is used for the direction *T->O* and *Assem102* is used for the configuration.

For example, if 10 bytes of IO-Link input and output data are required, the path *20 04 2C 73 2C 72 (hex)* can be used, where the assembly sizes are *T->O 216*, *O->T 86* and the configuration assembly is 0 or 58 bytes.

Configuration modules

The Ethernet/IP master contains two configuration assemblies for managing the IO-Link settings. These are *Assem102* and *Assem103*, which each serve different purposes:

- **Assem102**: The assignment of this module is described in detail in the EDS file and can be configured to a size of either 58 bytes or 0 bytes. If it is set to 0 bytes, the existing configuration is retained and is not overwritten.
- **Assem103**: This module is set to a length of 0 bytes and was specially developed to automatically set all ports to IO-Link mode.

If the configuration module is not included in the connection path, the device operates as if module 103 is being used. This means that all ports are automatically set to IO-Link mode.

Configuration data

Assignment of configuration data sequence shows an assignment of the configuration data sequence. The stated standard values describe a configuration with the IO-Link function on Pin 4 and standard I/O functions on Pin 2 and 4 of every port. The input and output functions of the configured standard I/O ports are set using the process data.

Table 24: Assignment of configuration data sequence

Byte	Module part	Description
0…1	Module	Configuration of the pin functions for ports X01 to X08 (pin 4 and pin 2 functions for each port)
2…8	IO-Link Port X01	Configuration of the IO-Link Port X01
9…15	IO-Link Port X02	Configuration of the IO-Link Port X02
16…22	IO-Link Port X03	Configuration of the IO-Link Port X03
23…29	IO-Link Port X04	Configuration of the IO-Link Port X04
30…36	IO-Link Port X05	Configuration of the IO-Link Port X05
37…43	IO-Link Port X06	Configuration of the IO-Link Port X06
44…50	IO-Link Port X07	Configuration of the IO-Link Port X07
51…57	IO-Link Port X08	Configuration of the IO-Link Port X08

Module configuration

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Table 25: Module configuration

Bit	Description
0	Port X01 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
1	Port X01 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
2	Port X02 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
3	Port X02 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
4	Port X03 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
5	Port X03 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
6	Port X04 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
7	Port X04 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
8	Port X05 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
9	Port X05 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
10	Port X06 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
11	Port X06 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
12	Port X07 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
13	Port X07 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)
14	Port X08 Pin 4 function (0x00: Standard-I/O, 0x01: IO-Link)
15	Port X08 Pin 2 function (0x00: Standard-I/O, 0x01: IO-Link)

IO-Link Port configuration

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Table 26: IO-Link Port configuration

Byte	Description
2	Port X01 Cycle time
3	Port X01 Validation type and parameter server
4, 5	Port X01 Vendor ID
6…8	Port X01 Device ID
…	

Cycle settings

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

With this parameter, the IO-Link communication speed can be set. The IO-Link cycle time can be increased calculated by the multiplier and the time base.

The time base is described in the table below, the multiplier is entered as a decimal number from 0…63.

The cycle-time byte is structured as follows:

- **Bits 0…5 (Multiplier):** These bits contain a 6-bit multiplier for calculating *MasterCycleTime* or *MinCycleTime*. The valid range is 0…63.
- **Bits 6…7 (Time base):** These bits define the time base used to calculate *MasterCycleTime* or *MinCycleTime*.

Bit position	Description
7	Time base bit 1
6	Time base bit 0
5	Multiplier bit 5
4	Multiplier bit 4
3	Multiplier bit 3
2	Multiplier bit 2
1	Multiplier bit 1
0	Multiplier bit 0

Possible values for *MasterCycleTime* and *MinCycleTime*:

Table 27: Possible values for MasterCycleTime and MinCycleTime

Time base coding	Time base value	Calculation	Cycle Time
00	0.1 ms	Multiplier x time base	0.41[1] …6.3 ms
01	0.4 ms[Page 85, 1]	6.4 ms + multiplier x time base	6.4…31.6 ms
10	1.6 ms	32 ms + multiplier x time base	32…132.8 ms
11	reserved	reserved	reserved

Validation settings

No validation : Validation deactivated, every device is accepted.

Compatibility : Manufacturer ID and Device ID are compared with the data of the IO-Link device.

Parameter server

Switched on : Data retention functions active, parameter data and identification data of the IO-Link device are saved in a remanent memory.

Switched off : Data retention functions deactivated, saved parameter data and identification data of the IO-Link devices remain in the memory.

Enable download : If only the download is enabled, in each case the master starts a download of the parameter data. In this case the download is also performed irrespective of the upload flag of the IO-Link device. If there are no data in the master port, an upload takes place first (e.g. after deletion of the data or before the first data upload). Upload and download enabled: If the upload and download are enabled, a distinction is made for different parameter records depending on the upload flag of the IO-Link device. If there are no data in the IO-Link master port, an initial upload takes place (e.g. after deletion of the data or before the first data upload). If the upload flag is set at the IO-Link device, the parameter data are uploaded in each case. If no upload flag is set and parameter data have already been stored, a download of the parameter data takes place in each case.

Note

After uploading the parameter data, the Vendor ID and Device ID of the connected IO-Link device remain stored until the data records are deleted.
When the connected IO-Link device is started a validation takes place and then only an IO-Link device of the same type can be used for the data retention.
If a different type of IO-Link device should be used, the content of the parameter server must be deleted.
The data storage is only supported by IO-Link devices with IO-Link Revision 1.1.

Values for validation type and parameter server

Table 28: IO-Link Port configuration

Value	Description
0	No device check
1	Type-compatible device V1.0
2	Type-compatible device V1.1
3	Type-compatible device V1.1+ Backup + Restore
4	Type-compatible device V1.1, Restore

Upload flag at IO-Link device

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The upload flag is required in order to overwrite data already saved in the parameter server with new parameter data of the same IO-Link device.

In order to activate the upload flag of an IO-Link device, the data value 0x05 must be entered in the index 0x02, subindex 0.

[1] The value 0.4 is the result of the minimum possible transmission time according to the IO-Link Interface and System Specification|

(For information on setting parameters via IO-Link, see *I/O ports* or *IO-Link device parameterization*.

6.3.3 Configuration via Explicit Messages

PLC program

> **Note**
>
> Information about the PLC program and *Add Application Logic* , see Allen Bradley Ethernet/IP QuickConnect Application Technique.

Fault State

For each output at the port pins, a safe state can be predefined, which should be adopted in the case of a loss of bus communication.

The *Fault State* settings can be implemented via the following Class Instance Attribute of the *Explicit Messages*.

Activate / deactivate Fault State

Class	Instance	Attribute	Value
9 (0x09)	1 – m[2]	6	`"0"`: Fault State disabled `"1"`: Fault State enabled

Fault State Action

Class	Instance	Attribute	Value
9 (0x09)	1 – m[2]	5	`"0"`: Output on`"1"`: Hold last state

> **Note**
>
> The *Fault State* settings are only stored temporarily in the module. They are deleted again after a power reset. In order to ensure a permanent *Fault State* configuration, the configuration must be programmed via the PLC so that it can be transferred to the module again when the system is restarted.

IO-Link device parameterization

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

There are two ways to parameterize an IO-Link device connected to the IO-Link Port.

- Parameterization via the web server (see *I/O ports*)
- Parameterization via *Explicit Messages*

The following section describes, for example, how via Rockwell RSLogix 5000 an IO-Link device can be parameterized via *Explicit Messages*.

The *MSG* modules are used in the PLC program (see *MSG modules*).

[2] m Number of outputs

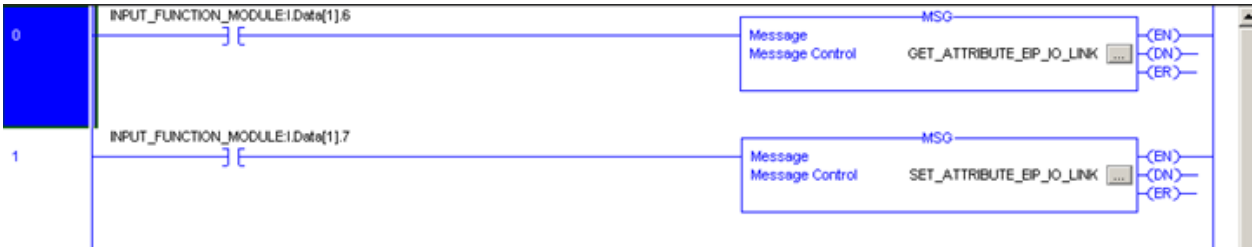


Fig. 41: MSG modules

Read IO-Link parameters

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Table 29: Values for read IO-Link parameters

Service code	Class	Instance	Attribute
0x32	0x96	1…n[3]	0x03 (Read parameters)

Source Length must at least correspond to the read parameters, but can also be bigger (in this example 100 bytes).

1. As a *Source Element* (Write) and as a *Destination Element* (Read), create a SINT[100] Array and select the first row [0].

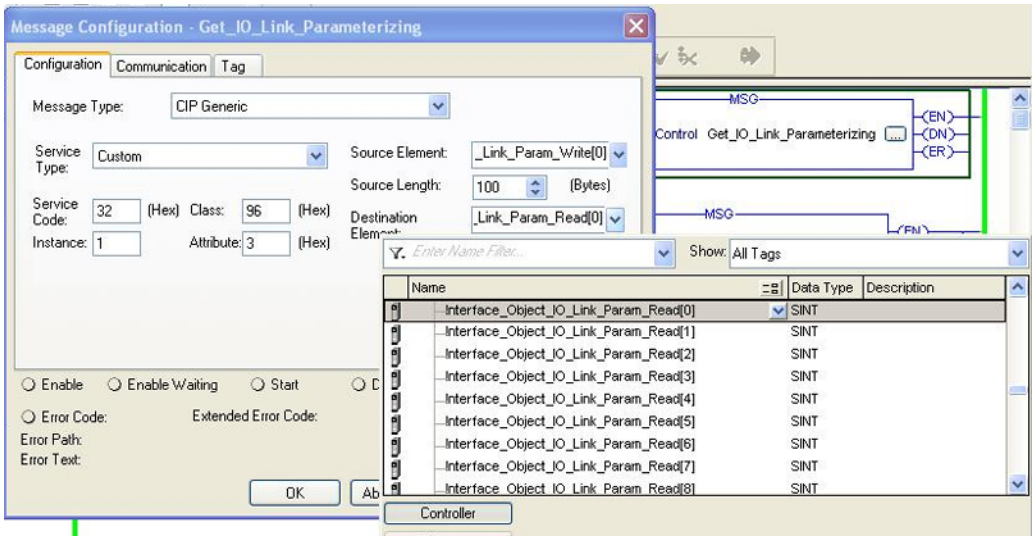


Fig. 42: Create SINT[100] Arrays

2. In the *Source Element* Array (Write) enter which index should be read (in this example Index 0x4E).

   ⇒ The read value is displayed in the *Destination Element* Array (Read).
   ⇒ The error code is also displayed there in the event of a parameterization error.

3. In the *Communication* window select the Ethernet module for which parameters should be set.

[3] n: Number of ports

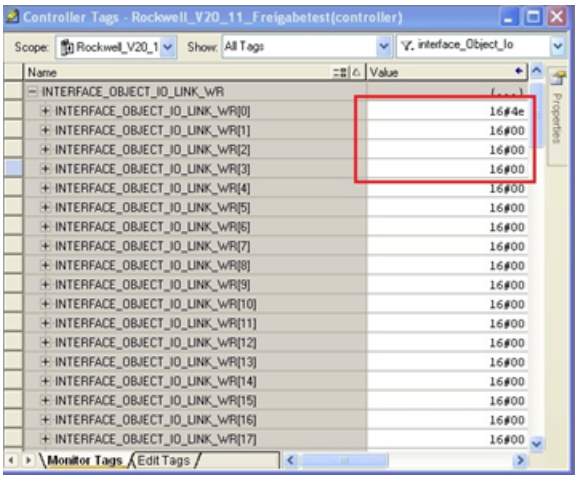


Fig. 43: Enter Source Element Array

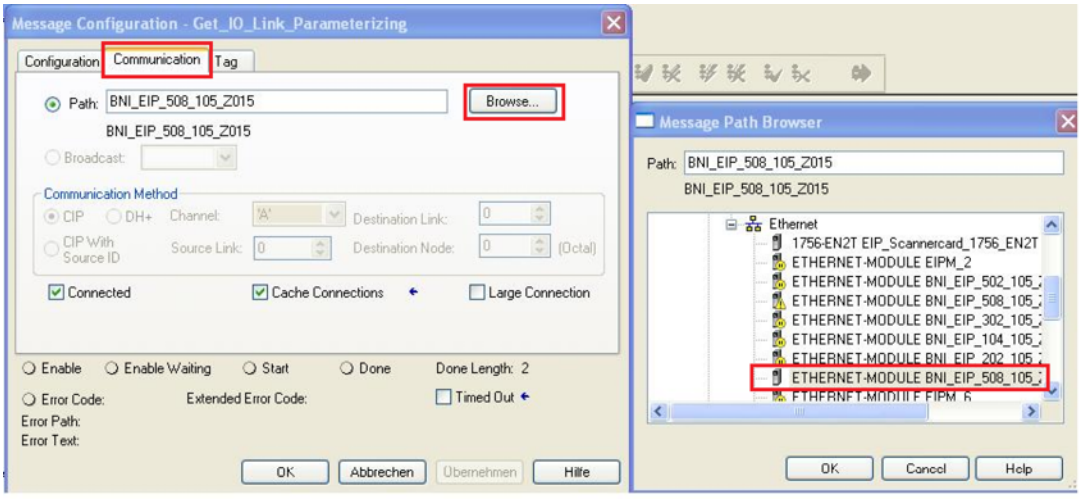


Fig. 44: Select Ethernet module

Write IO-Link parameters

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Table 30: Values for write IO-Link parameters

Service code	Class	Instance	Attribute
0x32	0x96	1 - n[Page 87, 3]	0x02 (Write parameters)

1. Select *Source Element* and *Destination Element* as described in the example *Values for read IO-Link parameters*.

   The *Source Length* must be the same length as the parameter data to be written. In this example the index 0x4E, subindex 0, value 0x02 are written in the *Source Element Array* (Write).

   In the event of a parameterization error an error code is displayed in the *Destination Element Array* (Read).

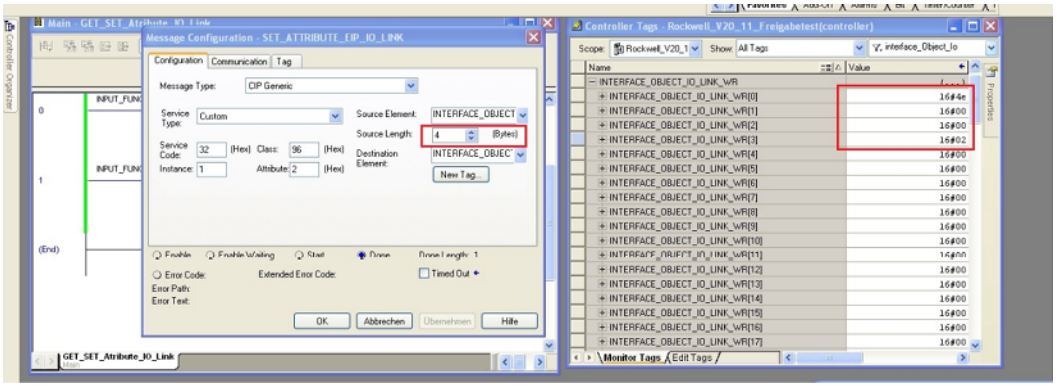


Fig. 45: Configuration

2. In the *Communication* tab select the Ethernet module for which parameters should be set.

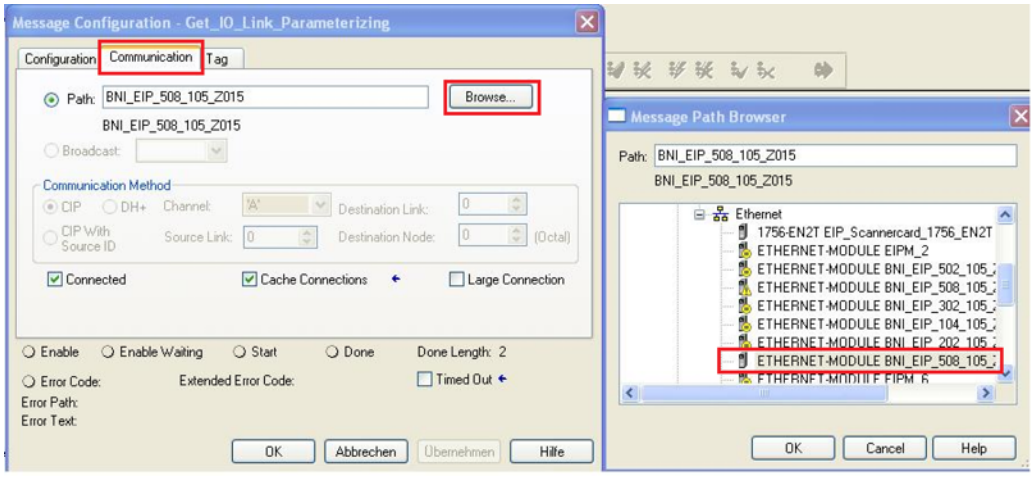


Fig. 46: Select Ethernet module

Note

The Explicit Messages functions are implemented according to Volume 1: Common Industrial Protocol Specification and Volume 2: Ethernet/IP Adaption of CIP.

6.3.4 Process data

Process data inputs

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The input data have a size of 392 bytes. The table below shows the assignment of the process data inputs.

Table 31: Process data inputs

Byte	Module part	Description
0…7	Standard I/O ports	Process data inputs for the standard inputs
8…55	IO-Link Port 0	Process data inputs for the IO-Link Port 0
56…103	IO-Link Port 1	Process data inputs for the IO-Link Port 1
104…151	IO-Link Port 2	Process data inputs for the IO-Link Port 2
152…199	IO-Link Port 3	Process data inputs for the IO-Link Port 3
200…247	IO-Link Port 4	Process data inputs for the IO-Link Port 4
248…295	IO-Link Port 5	Process data inputs for the IO-Link Port 5
296…343	IO-Link Port 6	Process data inputs for the IO-Link Port 6
344…391	IO-Link Port 7	Process data inputs for the IO-Link Port 7

Standard input data

Input data I04: Input for Port 0, Pin 4 The result is only 0 when the port is configured as an IO-Link Port.

Short circuit status Short circuit between Pin 1 and 3 at reported port

Overload status O04: Overload at Port 0, Pin 4 Only if the port is configured as an output.[4]

PA[4]

Status of power supply NA: No actuator supply PS: Power supply of sensor PA: Power supply of actuator

IO-Link input data

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

IO-Link status IOL: Port in IO-Link mode DC: Device connected 0: reserved

41 SC 0 0 0 0 PDI DF VF

IO-Link error VF: Validation failed SC: IO-Link short-circuit DF: Data storage validation failed PDI: Process data invalid

[4] not available for BNI XG1-…

Process data outputs

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The output data have a size of 262 bytes. The table below shows the assignment of the process data outputs.

Byte	Module part	Description
0…5	Standard I/O ports	Process data outputs for the standard inputs
6…37	IO-Link Port 0	Process data output for the IO-Link Port 0
38…69	IO-Link Port 1	Process data output for the IO-Link Port 1
70…101	IO-Link Port 2	Process data output for the IO-Link Port 2
102…133	IO-Link Port 3	Process data output for the IO-Link Port 3
134…165	IO-Link Port 4	Process data output for the IO-Link Port 4
166…197	IO-Link Port 5	Process data output for the IO-Link Port 5
198…229	IO-Link Port 6	Process data output for the IO-Link Port 6
230…261	IO-Link Port 7	Process data output for the IO-Link Port 7

Standard output data

Byte	Bit								Description
	7	6	5	4	3	2	1	0	
0	O32	O34	O22	O24	O12	O14	O02	O04	Output data O04: Output at Port 0, Pin 4 The port must be configured as an output in order to use this function at an IO-Link Port.[5]
1	O72	O74	O62	O64	O52	O54	O42	O44	*see above*
2	R32	R34	R22	R24	R12	R14	R02	R04	Restart Restart of output after identified short-circuit
3	R72	R74	R62	R64	R52	R54	R42	R44	*see above*
4	0	0	0	0	0	0	0	0	reserved
5	0	0	0	0	0	DL	GO	RO	Display control[6] **DL**: Display locked / PLC lock **GO**: Green display LED lights up **RO**: Red display LED lights up

IO-Link output data

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

[5] not available for BNI XG1-…
[6] only valid for devices with display

Byte	Bit								Description
	7	6	5	4	3	2	1	0	
6…37									IO-Link Port 0 output data
…	The data of the other IO-Link Ports are structured identically and described below.								

6.3.5 Quick Connect mode

The following points must be observed in *Quick Connect* operating mode:

- **Ethernet port settings**
  - Ethernet port 1: The connection must be set to a fixed speed of 100 Mbit/s in full duplex mode.
  - Ethernet port 2: The connection must be set to a fixed speed of 100 Mbit/s in full duplex mode.
- **Device configuration**: Quick Connect mode must be activated.

Auto-MDIX is not available in Quick Connect mode. Therefore, the automatic configuration of the ports at fixed speed and activated Quick Connect is as follows:

- Port 1: MDI
- Port 2: MDIX

This configuration is crucial, as port 2 can be connected to port 1 of another device with a non-crossover cable, but not to port 2. If the connection is incorrect, no Ethernet connection (link) can be established.

For more information, see *Ethernet/IP Specification Volume 2: EtherNet/IP Adaption of CIP, Appendix E: EtherNet/IP Quick Connect™*.

6.4 EtherCAT integration

With the EtherCAT integration, the system is made up of the following components:

- Bus master
- Bus modules/slaves (here the bus module BNI)

6.4.1 Device data

In order to properly parameterize the bus master, device data in the form of three ESI files is enclosed with the bus module BNI.

6.4.2 Input/output buffer

The data exchange with the controlling system takes place in the input and output buffer. The size of this buffer must be configured by the master.

6.4.3 Configuration

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

During the project planning the BNI bus module is displayed as a modular device. The device data required for the project planning is stored in the ESI files. The data modules of the inputs/outputs, the IO-Link Port and any additional modules are shown in the project planning software in relation to the slot.

The ESI files make available the possible data modules (inputs/outputs, IO-Link Ports of varying data width and other additional modules).

The appropriate data modules are assigned to a certain slot for the configuration of the BNI. Unused slots can be released.

6.4.4 Integration in project planning software

As an example, the connection of the BNI to a Beckhoff TwinCAT control is shown with the TwinCAT System Manager. The exact procedure depends on the project planning software used.

Installing ESI files

The device description has the following name: Balluff BNI XG5-538-1B5-Z067 ECS V.x.x.x.xml

- Copy the file to the corresponding TwinCAT directory (in the standard: `C:\TwinCAT\3.1\Config\Io\EtherCAT`).

  ⇒ Installed devices are available when the TwinCAT System Manager starts again.

Automatic scanning

Prerequisite

Before connecting devices to the EtherCAT network, the EtherCAT system must be in a secure, de-energized state.

1. Switch on the operating voltage and start the TwinCAT System Manager in Config mode.
2. Scan BNI as a box.

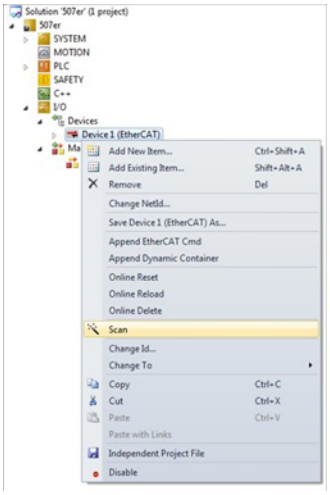


Fig. 47: Automatic scanning

Manually adding a device

Prerequisite

Before connecting devices to the EtherCAT network, the EtherCAT system must be in a secure, de-energized state.

1. Switch on the operating voltage and start the TwinCAT System Manager in Config mode.
2. Attach a box.

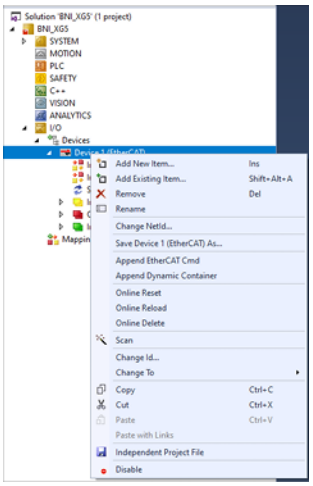


Fig. 48: Manually adding a device

3. Select a box.

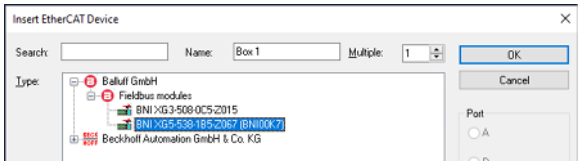


Fig. 49: Select a box

Necessary configuration of device

After automatic scanning or manual adding of the device, the device appears in the tree structure of TwinCAT.

The BNI supports EoE (Ethernet over Ethercat). In order to configure TwinCAT, in the EtherCAT tab select *Advanced settings*.

A valid DNS name and then a valid IP address must be entered.

Configuring Station Alias

The Station Alias can be selected under the EtherCAT tabAdvanced settings.

1. Open ESC Access.
2. Open E^{2}PROM.
3. Select *Configured Station*.

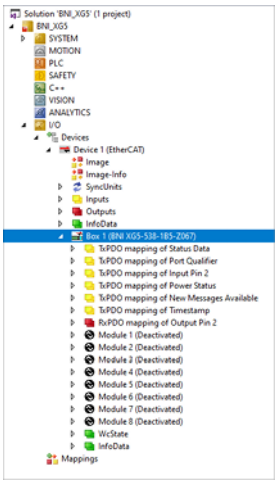


Fig. 50: Device in tree structure

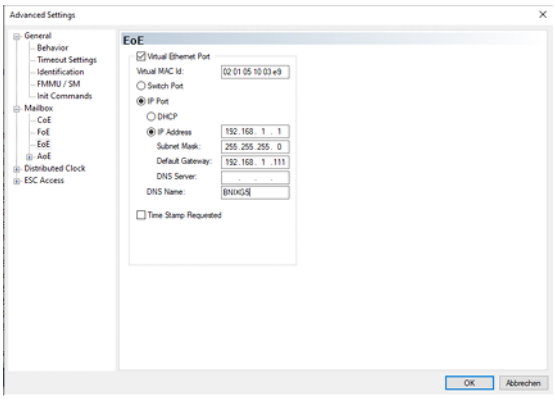


Fig. 51: EoE configuration

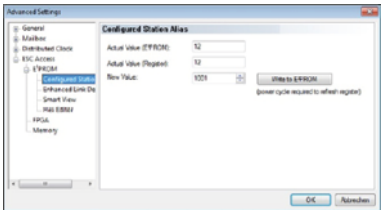


Fig. 52: Configuring Station Alias

Note

The new value is only valid after a reset.

Configuring the network module

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The BNI is a modular EtherCAT device. The device has the following slot structure:

Table 32: Data configuration

Slot number	Meaning
1-8	IO-Link Ports

Note

The sum of the output data may not exceed 256 bytes.

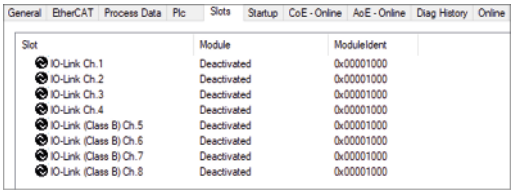


Fig. 53: Configuring the network module

In order to configure the IO-Link Ports, a defined number of process data (buffer size) must be assigned to the EtherCAT slots. In the TwinCAT System Manager this works as follows:

1. Delete assignment of IO-Link channel (or port) with *x*.
2. Place the channel selected on the left side with with **<** the module configuration selected on the right.
3. Transfer configuration to the EtherCAT slave with r*estart of TwinCAT in Config mode*.

Bitmapping and function

Signals from configured inputs or outputs are displayed in the modulesSTD_IN_1bit(inputs Pin 4), Input Pin 2 (inputs Pin 2), as well asSTD_OUT_1bit(outputs Pin 4) and Output Pin 2 (outputs Pin 2).

Note

XG1 devices have no outputs to Pin 2.

Network modules

The IO-Link modules are always established according to the same schema:

IOL*I/O*x/xBytes

- Quantity of process data used (should be greater than or equal to the process data length of the O-Link device)

- I = Input data
- O = Output data
- I/O = Input and output data

Short circuits and restart bits

The BNI restarts automatically if a short circuit occurs at one of the IO-Link Ports. No restart bits are required.

IO-Link state

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

In the IO-Link state the current status of each port is displayed.

Table 33: IO-Link state

Value	Status
0x_0	Port disabled
0x_3	Port in communication OP
0x_4	Port in communication COMSTOP
0x1_	Watchdog detected
0x2_	Internal Error
0x3_	Invalid Device ID
0x4_	Invalid Vendor ID
0x5_	Invalid IO-Link Version
0x7_	Invalid Cycle Time
0x8_	Invalid PD in length
0x9_	Invalid PD out length
0xA_	No device detected
0x0_	No error
0xD_	Voltage low
0xE_	Short circuit
0xF_	Unspecific error

6.4.5 Start-up

In the start-up the IO-Link Ports and outputs can be preconfigured. For more information, see *Configuration without ESI*.

The entries are transferred during the transfer of the configuration.

Configuration of modules

Validation

No validation: Validation deactivated, every device is accepted.

Compatibility: Manufacturer ID and device ID are compared with the module data. IO-Link communication is only started if they match.

The following values are possible for the validation setting:

Fig. 54: Start-up

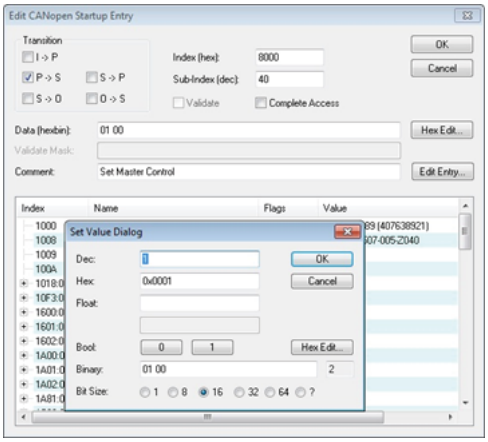


Fig. 55: Configuration of modules

Table 34: Values for the validation

Value	Validation
0	No validation
1	Compatible (VID + DID)

The validation can be activated via the CoE object *additional IO-Link Configuration Data* for each port with subindex 1 (validation and backup). The values used for the validation must be configured in the CoE object *IO-Link Configuration Data* for each port.

Parameter server

Switched on : Data retention functions active, parameter data and identification data of the IO-Link device are saved in a remanent memory.

Disabled : Data storage function disabled, stored data remains stored.

Deleted : Data storage function disabled, stored data is deleted.

Upload enabled : Can be used to select whether an upload of the parameter data to the data storage of the network module port should be performed or not. If the upload is enabled, as soon as a device has requested an upload (Upload flag set) or if no data is saved in the master port (e.g. after deletion of the data or before the first data upload), the master starts uploading the parameter data.

Block upload : No data upload is started if the upload is blocked. For an upload request from the IO-Link device, a download (if activated) is started in the case of different parameter sets as no upload may be carried out.

Enable download : Can be used to select whether a download of the parameter data to the IO-Link device should be performed or not. As soon as the stored parameter data in the port's parameter server differs from the connected IO-Link device and there are no upload requests from the IO-Link device, a download is performed.

Block download : If the download is blocked, an upload (if activated) of the parameter data takes place, irrespective of the upload flag of the IO-Link device.

Block upload and download : There is no exchange of parameter data if both upload and download are blocked. The IO-Link device communicates then with the IO-Link Port.

The following values are possible for the settings:

Value	Function
`0x8X`	switch on
`0x0X`	switch off
`0x40`	delete
`0xX1`	Switch on upload
`0xX2`	Switch on download

The data memory can be activated via the CoE object *additional IO-Link Configuration* Datafor each port with subindex 1 (validation and backup). There is no read or write access to the content of the data memory via EtherCat.

Note

After uploading the parameter data, the Vendor ID and Device ID of the connected IO-Link device remain stored until the data records are deleted.
Validation takes place when the connected IO-Link device is started up. Only an IO-Link device of the same type can be used for data storage.
In order to use a different type of IO-Link device, the content of the parameter server must be deleted.

Upload flag at IO-Link device

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The upload flag is required in order to overwrite data already saved in the parameter server with new parameter data of the same IO-Link device.

In order to activate the upload flag of an IO-Link device, the value `0x05` must be entered in the parameterIndex `0x02`, Subindex `0`.

Failsafe values

If the EtherCAT connection fails or if the EtherCAT status is notOperate, the IO-Link Ports use these values:

- If a port is in the IO-Link stateOperate, the process data displayed is switched to invalid.
- If Pin 2 or Pin 4 are in the digital output mode, zero (low level) is displayed.

6.4.6 IO-Link parameterization

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Via the object `0x4000` (IO-Link Service Data Ch. X), IO-Link ISDU parameters can be read or written from the IO-Link device. For this purpose, the corresponding index and subindex must be entered and for writing the corresponding length and data must be entered. The read or write operation is started via the control object. The result is displayed in the status object.

Values for the control

Table 35: Values for the control

Value	Function
`0x00`	No function
`0x02`	Write
`0x03`	Read

Values for the status

Table 36: Values for the status

Value	Status
`0x00`	No status
`0x01`	Active/Busy
`0x02`	Access
`0x04`	Error
`0xFF`	Fail

Example of CoE setting

This example shows how the index 0x40 of Smartlight (mode) is changed by reading and writing.

1. Select module.
2. Open CoE - Online.
3. Activate the setting *Auto Update*.
4. Under *Advanced* select the setting *Online - via SDO Information*.

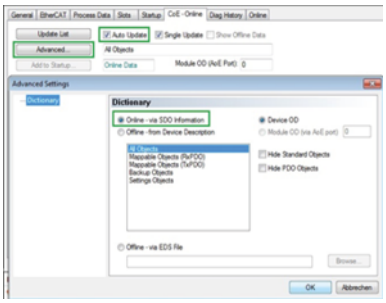


Fig. 56: Activate settings

5. In port, select 4030:0(here channel 4).
6. Read index by double clicking 4030:0 and specifying the respective index (here 0x0040 64).
7. In control write the command 0x03.

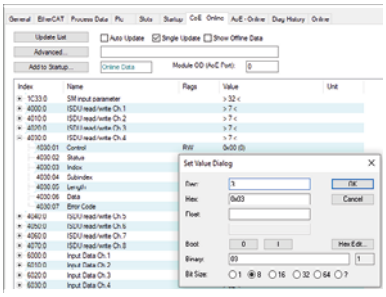
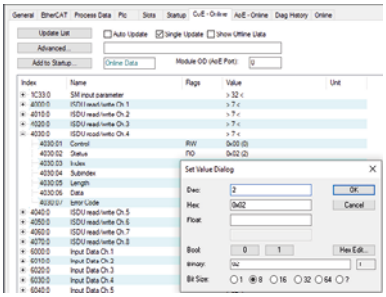


Fig. 57: Read

⇒ Content of the index is read and displayed in data.

8. Change data, specify length and use the command `0x02`.



⇒ The data is written and the parameter is changed in the device.

Acyclic access via AoE

The ETG5001.6220 describes AoE instead of CoE for the ISDU read/write access to IO-Link device parameters. Details on ADS can be found in the Beckhoff TwinCAT documentation and in ETG.1020. In contrast to CoE, AoE permits non-blocking processing.

AoE ISDU access uses these definitions (all are 32 bit):

- AoE IndexGroup = `0x0000F302`
- AoE PortNumber = `0x00001000` + IO-Link port number, starting with 0.
- AoE IndexOffset
  - 16 Bit IO-Link Index
  - 8 Bit always zero
  - 8 Bit IO-Link Subindex
- Return error code
  - 16 Bit additional information about the error code, which is 0x0700 (ADS device error).
  - 16 Bit error code via IO-Link

Function blocks ADSREAD and ADSWRITE

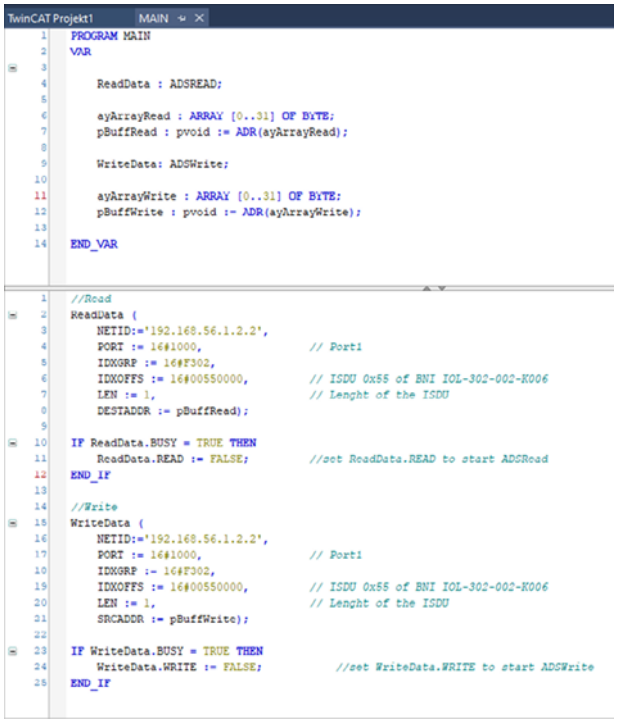


Fig. 58: Function blocks ADSREAD and ADSWRITE

Function block ADSREAD in TwinCat

ADSREAD commands

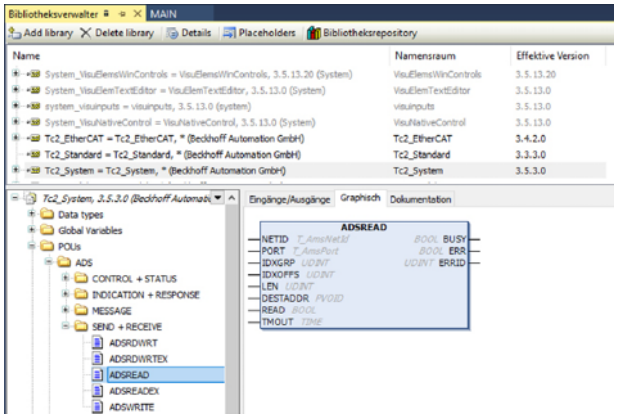


Fig. 59: TwinCat – ADSREAD

Name	Type	Inherited from	Address	Initial	Comment
NETID	T_AmsNetId	–	–	–	Ams net id
PORT	T_AmsPort	–	–	–	ADS communication port
IDXGRP	UDINT	–	–	–	Index group
IDXOFFS	UDINT	–	–	–	IndexOffset
LEN	UDINT	–	–	–	Maximum number of the data bytes to be read (LEN ≤ maximum size of target buffer)
DESTADDR	PVOID	–	–	–	Indicator of target buffer
READ	BOOL	–	–	–	Rising edge starts command execution.
TMOUT	TIME	–	–	DEFAULT_ADS_TIMEOUT	Maximum permissible time for the execution of this ADS command
BUSY	BOOL	–	–	–	Busy-Flag
ERR	BOOL	–	–	–	Error-Flag
ERRID	UDINT	–	–	–	ADS error code

Function block ADSWRITE in TwinCat

ADSWRITE commands

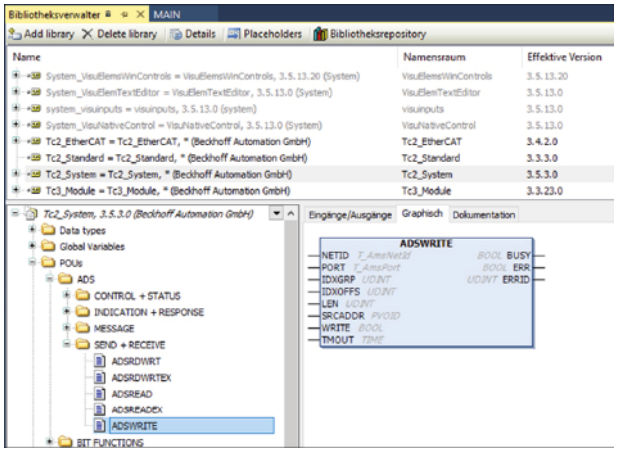


Fig. 60: TwinCat – ADSWRITE

Name	Type	Inherited from	Address	Initial	Comment
NETID	T_AmsNetId	–	–	–	Ams net id
PORT	T_AmsPort	–	–	–	ADS communication port
IDXGRP	UDINT	–	–	–	Index group
IDXOFFS	UDINT	–	–	–	IndexOffset
LEN	UDINT	–	–	–	Maximum number of the data bytes to be written (LEN ≤ maximum size of source buffer)
SRCADDR	PVOID	–	–	–	Indicator of source buffer
WRITE	BOOL	–	–	–	Rising edge starts command execution.
TMOUT	TIME	–	–	DEFAULT_ADS_TIMEOUT	Maximum permissible time for the execution of this ADS command
BUSY	BOOL	–	–	–	Busy-Flag
ERR	BOOL	–	–	–	Error-Flag
ERRID	UDINT	–	–	–	ADS error code

6.4.7 Preparation for the web server

EoE set-up

In order to be able to access the web server of the BNI module, access via EoE (Ethernet over EtherCAT) must be configured first.

1. Select the *Advanced Settings…* button.
2. Enter valid DNS name and valid IP address.

6.4.8 Preparing network

Before the web server can be reached via EoE, the network of the Beckhoff control must be configured.

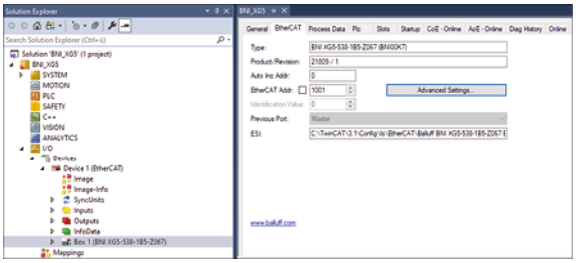


Fig. 61: *Advanced Settings…* button

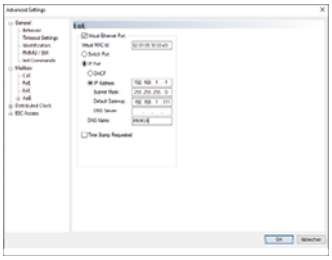


Fig. 62: Enter valid DNS name and valid IP address

Configuring Beckhoff control

A static IP address must be assigned to both network cards.

1. On the Beckhoff control select *Start* > *Control panel Network and dial-up connections* > *PCI…Settings*.
2. Assign IP address.

Fig. 63: *Advanced Settings…* button

3. Under *Start* > *Control Panel* > *Beckhoff CX Configuration Tool* > *Miscellaneous* activate the setting *IP Routing*.

EoE and PC networks

For the EoE settings in the Twincat, the IP address of the second network card of the Beckhoff control must be entered as a default gateway.

As a default gateway for the network configuration of the PC, the IP address of the first network card of the Beckhoff control must be entered.

6.4.9 Object directory

Map TxPDO input pin 2 (`0x1A90`)

Map TxPDO pin 4 (`0x1A0n`)

- 0x6xxx is a module-specific input range for TxPDO data.

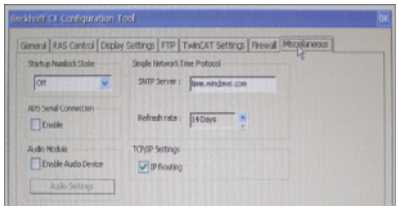


Fig. 64: Advanced Settings… button

- 0x7xxx is a module-specific output range for RxPDO data.

IO-Link data is up to 32 bytes for input and output.

If a connection is configured as aDigital InputorDigital Output, the value of pin 4 is mapped to data byte 0, bit 0.

Map TxPDO PowerStatus (0x1A91)

Index	Subindex	Name	DataType
0xF601	0x01	Global status, see *Global status values (Subindex 0x01)*	UINT8
	0x02	Short circuit in the sensor supply; one bit for each port	UINT8
	0x03	Short circuit at pin 4 of the actuator supply, one bit for each port	UINT8
	0x04	Short circuit at pin 2 of the actuator supply, one bit for each port	UINT8

Global status values (Subindex 0x01)

Bit	Description
0	Sensor supply low (1 = low, 0 = OK)
1	Actuator supply low (1 = low, 0 = OK)

IO-Link Service Data Ch. x (0x4000 – 0x4FFF)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Sub-index	Name	DataType	Access
0x40n0	0x01	Control	UINT8	RW
	0x02	Status	UINT8	RO
	0x03	Index	UINT16	RW
	0x04	Subindex	UINT8	RW
	0x05	Length	UINT8	RW
	0x06	Data	UINT32	RW
n = 0…7	0x07	Error code	UINT16	RO

Control values (Subindex 0x01)

Value (UINT8)	Function
0	no control action
2	write
3	read

Status values (Subindex 0x02)

Value (UINT8)	Status
0	no activity
1	busy
2	success
4	error
0xFF	failure

IO-Link Configuration Data Ch. x (0x8000 – 0x8FFF)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Sub-index	Name	Value	DataType
0x8nn0 n = 0…7	0x04	Device ID	24-Bit-ID	UINT32
	0x05	Vendor ID	16-Bit-ID	UINT32
	0x32	IO-Link revision	0x10 or 0x11	UINT8
	0x33	Frame Capability	not in use	UINT8
	0x34	Desired Cycle Time	Cycle Time	UINT8
	0x35	Offset Time	not in use	UINT8
	0x36	Max. PD In Length	Max. length	UINT8
	0x37	Max. PD Out Length	Max. length	UINT8
	0x38	Compatible ID	not in use	UINT16
	0x40	Master Control	see *Configuration without ESI*.	UINT16

IO-Link Information Data Ch. x (0x9000 – 0x9FFF)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Subindex	Name	DataType	Access
0x90n0, n = 0…7	0x04	Device ID	UINT32	RO
	0x05	Vendor ID	UINT32	RO
	0x20	IO-Link revision	UINT8	RO
	0x22	Min Cycle Time	UINT8	RO
	0x24	Process Data In Length	UINT8	RO
	0x25	Process Data Out Length	UINT8	RO

IO-Link Diagnosis Data Ch. x (0xA000 – 0xAFFF)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Subindex	Name	DataType	Access
0xa0n0 n = 0…7	0x01	IO-Link state	UINT8	RO
	0x02	Lost Frames	UINT8	RO

Values for IO-Link state (Subindex 0x01)

Value	Name	Status of IO-Link Port
0	INACTIVE	Deactivated
1	DIGINPUT	Digital Input
2	DIGOUTPUT	Digital Output
3	ESTABLISHCOMM	not in use
4	INITMASTER	not in use
5	INITDEVICE	not in use
6, 7	Unused	not in use
8	OPERATE	IO-Link, in status Operate
9	STOP	IO-Link, not in status Operate state (error or no device)

Values for Lost Frames (Subindex 0x02)

Two repeat attempts are generally added when changing the device. This value is only reset to zero during the start. The value is updated regularly, e.g. once a second.

IO-Link Status Data Ch. x (0xF100)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Subindex	Name	DataType	Access
0xF100	0x01	Status of IO-Link Port 1	UINT8	RO
	0x02	Status of IO-Link Port 2	UINT8	RO
	0x03	Status of IO-Link Port 3	UINT8	RO
	0x04	Status of IO-Link Port 4	UINT8	RO
	0x05	Status of IO-Link Port 5	UINT8	RO
	0x06	Status of IO-Link Port 6	UINT8	RO
	0x07	Status of IO-Link Port 7	UINT8	RO
	0x08	Status of IO-Link Port 8	UINT8	RO

The CoE objectDevice Status(0xF100) is mapped asTxPDO-Mapping of Status Datato the Process Data.

IO-Link Port Qualifier Ch. x (0xF101)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Subindex	Name	DataType	Access
0xF101	0x01	Port Qualifier Port 1	UINT8	RO
	0x02	Port Qualifier Port 2	UINT8	RO
	0x03	Port Qualifier Port 3	UINT8	RO
	0x04	Port Qualifier Port 4	UINT8	RO
	0x05	Port Qualifier Port 5	UINT8	RO
	0x06	Port Qualifier Port 6	UINT8	RO
	0x07	Port Qualifier Port 7	UINT8	RO
	0x08	Port Qualifier Port 8	UINT8	RO

The CoE objectPort Qualifier(0xF101) is mapped asTxPDO-Mapping of Port Qualifierto the Process Data.

Port Qualifier Bits

Bit	Description
4	PortActive / Port activated 1 = Port can be used. 2 = Port deactivated.
5	DevCom / device is ready for operation 1 = Device detected and in status Operate 0 = everything else
6	DevErr / device error 1 = Error occurred (validation error, short circuit, etc.) 0 = OK
7	PQ / validity of input data of IO-Link device 1 = valid 0 = invalid

Configuration without ESI

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The ports can also be configured without integration of an ESI. For this, the master control and the respective length of the process data must be set in the object 0x8000.

Values for the master control (80X0:28)

Value	Function
0x0000	Deactivated
0x0001	Port in Standard Input
0x0002	Port in Standard Output
0x0003	Port in IO-Link mode
0x0005	Power

Process data length

IO-Link Ports

Byte	Length of data
1 Byte	0x08
2 Byte	0x16
4 Byte	0x83
6 Byte	0x85
8 Byte	0x87
10 Byte	0x89
16 Byte	0x8F
24 Byte	0x97
32 Byte	0x9F

Standard input/output ports

0x01

Example

MasterControl = 3 –> IO-Link				
IO-Link size	Process Data In Length		Process Data Out Length	
	Hex	Dec	Hex	Dec
IOL_1_1byte	0x08	8	0x00	0
IOL_1_2byte	0x16	22	0x00	0
IOL_1_4byte	0x83	131	0x00	0
IOL_1_6byte	0x85	133	0x00	0
IOL_1_8byte	0x87	135	0x00	0
IOL_1_10byte	0x89	137	0x00	0
IOL_1_16byte	0x8F	143	0x00	0
IOL_1_24byte	0x97	151	0x00	0
IOL_1_32byte	0x9F	159	0x00	0
IOL_1_1byte/0_1bytes	0x08	8	0x08	8
IOL_1_2byte/0_2bytes	0x16	22	0x16	22
IOL_1_2byte/0_4bytes	0x16	22	0x83	131
IOL_1_4byte/0_4bytes	0x83	131	0x83	131
IOL_1_4byte/0_2bytes	0x83	131	0x16	22
IOL_1_2byte/0_8bytes	0x16	22	0x87	135

In the start-up the configuration for Port 6 in IO-Link mode with 32 Byte process data length for input and output looks as follows:

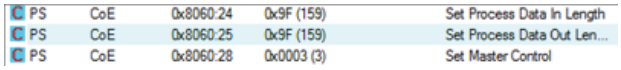


Fig. 65: Sample configuration in the start-up for Port 6

6.5 Modbus TCP configuration

6.5.1 Description

Modbus is available in masters as an interface with the following features:

- Read/write process data
- Port configuration
- Port/device diagnostics
- Read/write ISDU data

Access is via the TCP/IP interface using the IP address of the device and Port 502 (example: 192.168.1.1:502). The response time depends on the data written/read.

6.5.2 Structure of a Modbus TCP message

A Modbus TCP message is structured as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte x
Transaction ID		Protocol ID		Unit ID	Function Code		Data
MBAP header					PDU		
Modbus TCP message							

The protocol ID must be 0, as it indicates that the message is a Modbus message.

The unit ID can be arbitrary. It is not used because the IP address already identifies a device.

6.5.3 General

- All numbers are decimal numbers, unless they are specified with 0x = hexadecimal, e.g.: 0x1B.
- All data is organized as UINT16 unless otherwise specified.
- The length is organized in UINT16 by default, unless otherwise specified, e.g. length in [bytes] or bit length.
- The mapping of the byte sequence uses Big Endianness, see example in Index 10.

6.5.4 The Profile ID

Note

The Register Mapping Version (list of registers and their content) is identified with the **Profile ID** which is a similar version number to HW or FW version number. Due to the content of the registers may be subject to change in the future, with keeping the compatibility and consistency, this Profile ID should be checked first when a new application is developed.

6.5.5 Index overview

- Profile ID = 2
- Available from Firmware 1.3.1

Index (dec.)	Description	Access
0	Profile ID (Register Mapping Version)	RO
1…99	Device (Module) Identification	RO
100	IO-Link ISDU Command Request	RW
300	IO-Link ISDU Command Response	RO
1100…1800	IO-Link Process Data Input/Output	RO/RW
2000	SIO Digital Input State	RO
2001	SIO Digital Output State	RW
2047	Digital Input State (Mirrored to 2000)	RO
2048	Digital Output State (Mirrored to 2001)	RW
3000	Device (Module&Port) Diagnostic	RO
3100…3800	IO-Link Port Diagnostic	RO
9100…9800	Port Configuration	RW
11000	Variable Processdata Register	RW
20000	Module Settings	RW

Identification

Index	Length	Description	Access	Default (example)
0	1	Register Mapping Version (ProfileID)	RO	0x0001
1…9	-	reserved	-	-
10…13	4	Product Order Code (ASCII, 7 chars)	RO	BNI00KH
14…29	16	Product Name (TEXT)	RO	BNI XG5-508-0B5-R067
30…99	-	reserved	-	-

The byte array from/to IO-Link is converted as follows in the MODBUS index:

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

UINT16	LSB	Bit(0…7)	= IO-Link Byte[n]
UINT16	MSB	Bit(8…15)	= IO-Link Byte[n+1]

Example

The ASCII coded text of the manufacturer nameBalluff(length = 7) is converted into four (4) Word UINT16 indices as follows:

Index	0	1	2	3	4	5	6
Byte [0…6]	42h,	41h,	4Ch,	4Ch,	55h,	46h,	46h

Word[0…3]	4142h,	4C4Ch,	4655h,	0046h
Index	0	1	2	3

6.5.6 Read ISDU data

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

1. Write the port number, index and subindex to the corresponding registers (30,31,32).
2. Write the selected command to the upper byte of register 33.

6.5.7 Write ISDU data

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

1. Write the port number, index and subindex to the corresponding registers (30,31,32).
2. Write data to registers 35…51 and the desired data length.
3. Write the selected command to the upper byte of register 33.

6.5.8 Function Codes

The following function codes are implemented:

- Read holding register (0x03)
- Write several registers (0x10)

6.5.9 Error Responses

The following responses are reported in the event of an error:

Error Code	Description
0x00	No error. Last command successful.
0x01	Bad Function Code
0x02	Wrong Register Address
0x03	Invalid value
0x04	Slave error (IO-Link fails)

Even if the start register is valid, reading too many registers leads to Bad Register Address.

Slave errors occur when the IO-Link interface triggers errors.

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

6.5.10 Modbus TCP configurations

Digital Input / Output State

When a port (X01…X08) is configured as SIO mode (Standard Input or Output) following Digital Input / Output State can be accessed.

Registers 2000, 2001 and 2047, 2048 – Digital Input / Output State

There are two register locations which can be used for Digital Input and Output. Those are working completly the same and are just mirrored location for compatibility.

Index	Byte	Bit	Name	Data Type	Access	Value
2000 (2047)	-	0…7	Digital Input Port n Pin 4	BOOL	RO	0 = off, 1 = on
		8…13	Digital Input Port n Pin 2	BOOL	RO	0 = off, 1 = on
2001 (2048)	-	0…7	Digital Output Port n Pin 4	BOOL	R/W	0 = off, 1 = on
		8…13	Digital Output Port n Pin 2	BOOL	R/W	0 = off, 1 = on

The digital output works if the port is configured as an *output*.

Values – Digital Input / Output State (data)

Value	Description
0	off, de-energized, 0 V
1	on, under power, 24 V

Bits – Digital Input / Output State (data)

Bit	Port n
0, 8	X01
1, 9	X02
2, 10	X03
3, 11	X04
4, 12	X05
5, 13	X06
6, 14	X07
7, 15	X08

Detailed view – Digital Input / Output State (data)

Index	Byte	Bit	Name	Data Type	Access	Value
2000 (2047)	0	0	X01 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		1	X02 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		2	X03 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		3	X04 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		4	X05 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		5	X06 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on

continues on next page

Table 37 – continued from previous page

Index	Byte	Bit	Name	Data Type	Access	Value
		6	X07 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
		7	X08 Pin4 Digital Input State	BOOL	RO	0 = off, 1 = on
	1	0	X01 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		1	X02 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		2	X03 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		3	X04 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		4	X05 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		5	X06 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		6	X07 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
		7	X08 Pin2 Digital Input State	BOOL	RO	0 = off, 1 = on
2001 (2048)	0	0	X01 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		1	X02 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		2	X03 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		3	X04 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		4	X05 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		5	X06 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		6	X07 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
		7	X08 Pin4 Digital Output State	BOOL	RW	0 = off, 1 = on
	1	0	X01 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		1	X02 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		2	X03 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		3	X04 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		4	X05 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		5	X06 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		6	X07 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on
		7	X08 Pin2 Digital Output State	BOOL	RW	0 = off, 1 = on

IO-Link Process Data

When a port (X01…X08) is configured as IO-Link mode following Process Data Input and Output can be accessed.

There are two ways of handling the Process Data

- Using **fixed length** 32 Bytes, accessing port-by-port allows simple, port organized access, however it requires multiple commands to perform
- Using customizable **variable lenght** provides accessing content in one step, but pre-configuration is required

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Registers 1100...1800 - IO-Link Process Data (fixed length)

Read out an IO-Link port once.

Reading back the process data output is used for feedback (control).

Index	Length	Description	Access
1100	34	Port X01 IO-Link Process Data Input/Output	RO
1200	34	Port X02 IO-Link Process Data Input/Output	RO
1300	34	Port X03 IO-Link Process Data Input/Output	RO
1400	34	Port X04 IO-Link Process Data Input/Output	RO
1500	34	Port X05 IO-Link Process Data Input/Output	RO
1600	34	Port X06 IO-Link Process Data Input/Output	RO
1700	34	Port X07 IO-Link Process Data Input/Output	RO
1800	34	Port X08 IO-Link Process Data Input/Output	RO

Details – IO-Link Process Data 1100...1800

Index	Length	Description	Access	Value
1n01[5]	1	Port n IO-Link Process Data Input Valid	RO	0 = invalid, 1 = valid
1n01…1n16[5]	16	Port n IO-Link Process Data Input (Byte 1…32)	RO	–
1n17[5]	1	Port n IO-Link Process Data Output Valid	RW	0 = invalid, 1 = valid
1n18…1n33[5]	16	Port n IO-Link Process Data Output (Byte 1…32)	RW	–

Port numbers – IO-Link Process Data 1100...1800

n[5]	Port
1	X01
2	X02
3	X03
4	X04
5	X05
6	X06
7	X07
8	X08

Registers 11000...11257 - Variable Processdata Registers

The registers mirror the registers 1100…1800. While the standard processdata registers are always 32-Bytes long for input and output processdata the variable processdata register adapt to the configured length.

Index	Byte	Name	DataType	Access	Value / Description	Note
11000	0	IO-Link Process Data Input Valid	UINT16	RO	Each bit represents a port (Bit 0 → Port 1, etc.)	
	1	Reserved	UINT16	RO	Always zero	
11001	0	IO-Link Process Data Output Valid	UINT16	RW	Each bit represents a port (Bit 0 → Port 1, etc.)	
	1	Reserved	UINT16	RW	Write zero	
11002…11257		Variable Processdata Input/Output		RW	See port configuration for size and layout	See blow for Layout

[5] n = Port number

- The variable processdata registers mirror the standard processdata registers (1100…1800), but adapt to the configured input/output length per port.
- Input and output data lengths are defined by the port configuration.
- Reserved bytes must be zero when written and will always read as zero.
- If a port is not configured to IO-Link the complete processdata will be omitted in this registers (see example).

Variable Processdata Layout

The variable processdata registers are organized as follows:

1. **Input Processdata for Ports 1–8** (read-only)
2. **Output Processdata for Ports 1–8** (read/write)

If the configured processdata length for a port does not align to a full word (2 bytes), a padding byte is added to ensure the next port's processdata starts at the correct word boundary.

Note:

- The Input Processdata section is read-only. Any write attempt will result in an error.

Section	Port Number	Access
Input Processdata	1	Read-only
Input Processdata	2	Read-only
Input Processdata	3	Read-only
Input Processdata	4	Read-only
Input Processdata	5	Read-only
Input Processdata	6	Read-only
Input Processdata	7	Read-only
Input Processdata	8	Read-only
Output Processdata	1	Read/Write
Output Processdata	2	Read/Write
Output Processdata	3	Read/Write
Output Processdata	4	Read/Write
Output Processdata	5	Read/Write
Output Processdata	6	Read/Write
Output Processdata	7	Read/Write
Output Processdata	8	Read/Write

Example

Suppose the following configuration:

- Port 1 Input: 3 bytes
- Port 3 Input: 2 bytes
- Port 4 Input: 5 bytes
- Port 1 Output: 4 bytes
- Port 3 Output: 1 byte

The layout will be:

Address	Section	Port	Data Length	Padding	Word Boundary
11002 + 0	Input Processdata	1	3 bytes	1 byte	2 words
11002 + 2	Input Processdata	3	2 bytes	0	1 word
11002 + 3	Input Processdata	4	5 bytes	1 byte	3 words
11002 + 6	Output Processdata	1	4 bytes	0	2 words
11002 + 8	Output Processdata	3	1 byte	1 byte	1 word

This ensures each port's processdata starts at a word boundary, with padding bytes added as needed. Ports which have zero length configured or are not in IO-Link mode will not reserve space in the register.

IO-Link ISDU Data

Registers 100, 300 – Acyclic Command Channel (including ISDU Read/Write Request)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Length	Description	Access	Default
100	4…121	IO-Link ISDU Command Request	RW	-
300	5…122	IO-Link ISDU Command Response	RO	-

Details – Registers 100...220 Command Request Channel = ISDU Read/Write Request

Index	Byte	Name	Data Type	Access	Needed?	Value
100	-	Command	UINT16	RW	M[1]	1 = read, 2 = write
101	-	Port No.	UINT16	RW	M[1]	1…8
102	-	Index	UINT16	RW	M[1]	0…0xFFFF
103	-	Subindex	UINT16	RW	M[1]	0…255
104[3]	-	Data Length [Byte]	UINT16	RW	O[2]	1…232
105…220[4]	0	Data Byte n	UINT8	RW	O[2]	-
105…220[4]	1	Data byte n1	UINT8	RW	O[2]	-

[1] M = mandatory
[3] optional, only required for Write Request
[2] O = optional
[4] optional, only required for Write Request, depending on the desired length of the data to be written

Details - Registers 300...421 Command Response Channel = ISDU Read/Write Response

Index	Byte	Bit	Name	Data Type	Access	Value
300	-	-	Command (last sent)	UINT16	RO	1 = read, 2 = write
301	-	-	Port No.	UINT16	RO	1…8
302	-	-	Index	UINT16	RO	0…0xFFFF
303	-	-	Subindex	UINT16	RO	0…255
304	-	-	Error Code	UINT16	RO	0 = no error other values = see Tab. 6-15
305		-	Data Length [Bytes]	UINT16	RO	1…232
306…421	0	-	Data Byte n	UINT8	RO	-
306…421	1	-	Data Byte n+1	UINT8	RO	-

Error codes

Error Code	Description
0x0000	No error, command was successful
0x4001	ARGBLOCK_NOT_SUPPORTED
0x4002	ARGBLOCK_INCONSISTENT
0x4003	DEVICE_NOT_SUPPORTED
0x4004	SERVICE_NOT_AVAILABLE
0x4005	DEVICE_NOT_IN_OPERATE
0x4006	MEMORY_OVERRUN
0x4011	PORT_NUM_INVALID
0x4034	ARGBLOCK_LENGTH_INVALID
0x4036	SERVICE_TEMP_UNAVAILABLE
0x8000…0x80FF	IO-Link error code from the connected device, see IO-Link specification

Diagnostic

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Length	Description	Access
3000	10	Module and Port Diagnostic	RO
3100	10	X01 IO-Link Info & Events	RO
3200	10	X02 IO-Link Info & Events	RO
3300	10	X03 IO-Link Info & Events	RO
3400	10	X04 IO-Link Info & Events	RO
3500	10	X05 IO-Link Info & Events	RO
3600	10	X06 IO-Link Info & Events	RO
3700	10	X07 IO-Link Info & Events	RO
3800	10	X08 IO-Link Info & Events	RO

Details – Diagnostic

Registers 3000...3009 – Module and Port Diagnostic

Index	Byte	Bit	Name	Data Type	Access	Value
3000	0	0…3	reserved	–	RO	–
3000	0	4	Sensor Voltage Short Circuit	BOOL	RO	–
3000	0	5	Actuator Short Circuit	BOOL	RO	–
3000	0	6	Actuator Warning	BOOL	RO	–
3000	0	7	IO-Link Short Circuit	BOOL	RO	–
3001	0	0…7	Port n: IO-Link Communication Established	BOOL	RO	–
3001	1	8…15	Port n: IO-Link PD Input Valid	BOOL	RO	–
3002	0	0…7	Port n: IO-Link Valid Device Connected	–	–	–
3002	1	8…15	reserved	–	–	–
3003	–	–	reserved	–	–	–
3004	0	0…7	Port n: Actuator shutdown (Pin 2)	BOOL	RO	–
3004	1	8…15	Port n: Actuator shutdown (Pin 4)	BOOL	R	–
3005	0	0…7	Port n: Actuator Warning (Pin 2)	BOOL	RO	–
3005	1	8…15	Port n: Actuator Warning (Pin 4)	BOOL	RO	–
3006	–	–	reserved	–	–	–
3007	–	–	reserved	–	–	–
3008	–	–	reserved	–	–	–
3009	–	–	reserved	–	–	–

BOOL value	Meaning
0	false, status not available
1	true, status available

Bit	Port n
0, 8	X01
1, 9	X02
2, 10	X03
3, 11	X04
4, 12	X05
5, 13	X06
6, 14	X07
7, 15	X08

Registers 3010...3080 – IO-Link Port Diagnostic

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Detailed information about the connected IO-Link device.

Index	Byte	Bit	Name	Data Type	Access	Value
3n00[6]	0	0	IO-Link Mode	BOOL	RO	–
		1	Device Connected	BOOL	RO	–
		2	Valid PD IN Data	BOOL	RO	–
		3	Wrong Vendor ID or Device ID	BOOL	RO	–
		4	Wrong Cycle Time	BOOL	RO	–
		5	Wrong Length PD IN	BOOL	RO	–
		6	Wrong Length PD OUT	BOOL	RO	–
		7	reserved	–	RO	–
	1	–	reserved	–	RO	–
3n01[6]	–	–	Vendor ID	UINT16	RO	–
3n02[6]	0	–	Device ID (MSB)	UINT8	RO	–
	1	–	reserved	–	RO	–
3n03[6]	–	–	Device ID (LSB)	UINT16	RO	–
3n04[6]	0	–	Entry #1 Event Qualifier	IOL coded	RO	IOL coded
	1	–	reserved	–	RO	–
3n05[6]	–	–	Entry #1 Event Code	UINT16	RO	IOL coded
3n06[6]	0	–	Entry #2 Event Qualifier	Enum	RO	IOL coded
	1	–	reserved	–	RO	–
3n07[6]	–	–	Entry #2 Event Code	UINT16	RO	IOL coded
3n08[6]	0	–	Entry #3 Event Qualifier	Enum	RO	IOL coded
	1	–	reserved	–	RO	–
3n09[6]	–	–	Entry #3 Event Code	UINT16	RO	IOL coded

Port numbers – Registers 3010...3080

n[Page 117, 5]	Port
1	X01
2	X02
3	X03
4	X04
5	X05
6	X06
7	X07
8	X08

[6] "n" = Port number

IOL coded Event Qualifier – Registers 3010...3080

Bit	Description
0…2	Instance
3	Source
4…5	Type
6, 7	Mode

Configuration

Registers 9100...9800 – Port Configuration

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Index	Length	Name
9100	7	X01 Port Configuration
9200	7	X02 Port Configuration
9300	7	X03 Port Configuration
9400	7	X04 Port Configuration
9500	7	X05 Port Configuration
9600	7	X06 Port Configuration
9700	7	X07 Port Configuration
9800	7	X08 Port Configuration

Please see the following tables for information on the structure of the port configuration.

Index	Byte	Bit	Name	Data Type	Access	Value
9n00 Page 117	0	-	Master Cycle Time	UINT8	RW	IO-Link coded
	1	-	reserved		-	-
9n01 Page 117	0	-	Pin 2 Port Mode	UINT8	RW	0 = deactivated 1 = Digital Input 2 = Digital Output
	1	-	Pin 4 Port Mode	UINT8	RW	0 = deactivated 1 = IOL Manual 2 = IOL Autostart 3 = Digital input 4 = Digital Output
9n02 Page 117	0	-	Validation ID	UINT8	RW	0 = No device check 1 = Compatible V1.0 2 = Compatible V1.1 3 = Backup Restore 4 = Restore
	1	-	reserved	-	-	-
9n03 Page 117	-	-	Vendor ID	UINT16	RW	-
9n04 Page 117	0	-	Device ID (MSB)	UINT8	RW	-
	1	-	reserved	-	-	-
9n05 Page 117	-	-	Device ID (LSB)	UINT16	RW	-

Port numbers – Registers 9100…9800

n[Page 117, 5]	Port
1	X01
2	X02
3	X03
4	X04
5	X05
6	X06
7	X07
8	X08

Coding of the master cycle time of the IO-Link specification

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Time Base Encoding	Time Base Value	Calculation	Cycle Time
0	0.1 ms	Multiplier × Time base	0.4…6.3 ms
1	0.4 ms	6.4 ms + Multiplier × Time Base	6.4…31.6 ms
10	1.6 ms	32.0 ms + Multiplier × Time Base	32.0…132.8 ms
11	reserved	reserved	reserved

Register 20000 - Module Settings

Global configuration registers for the Module (Device).

Index	Byte	Bit	Name	DataType	Access	Value	Note
20000			Output Powerloss Behavior	UINT16	RW	See table below	(1)

(1) Only available for the XG5-538 Variants

Value	Description
0	Default. The Network Module will imitate the behavior of a XGx-508 master.
	If UA is lost/ not connected also the US powered outputs will be deactivated by software
1	No Software Handling enabled. Powerloss behavior is defined by the hardware.

6.6 Display

6.6.1 General

With the installed display the address is displayed directly on the devices.

Note

This chapter applies solely to device variants with display.

The following address types are possible:

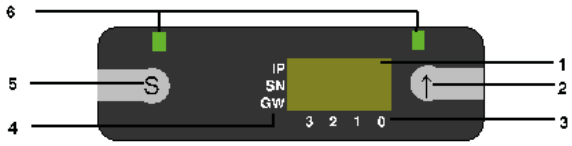
- IP address
- Subnet mask
- Gateway address

Each address consists of 4 octets.

The display also shows information about the update of the hardware and firmware.

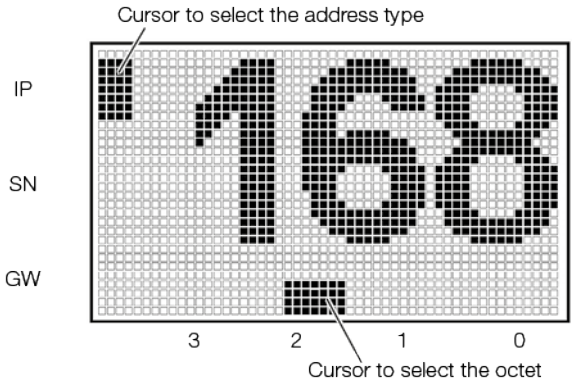
The display has a lock function which can be activated from the system control. Editing is no longer possible if the lock is set.

6.6.2 Control and display



1	Display
2	Arrow button
3	Octet cursor
4	Address type cursor
5	Set button
6	LEDs

6.6.3 Display information



IP:	IP address	3	First octet
SN:	Subnet address	2	Second octet
GW:	Gateway address	1	Third octet
		0	Fourth octet

6.6.4 Design and symbols

In the following diagrams, a number of symbols are used to describe the display functionality:

Table 38: Explanation of symbols

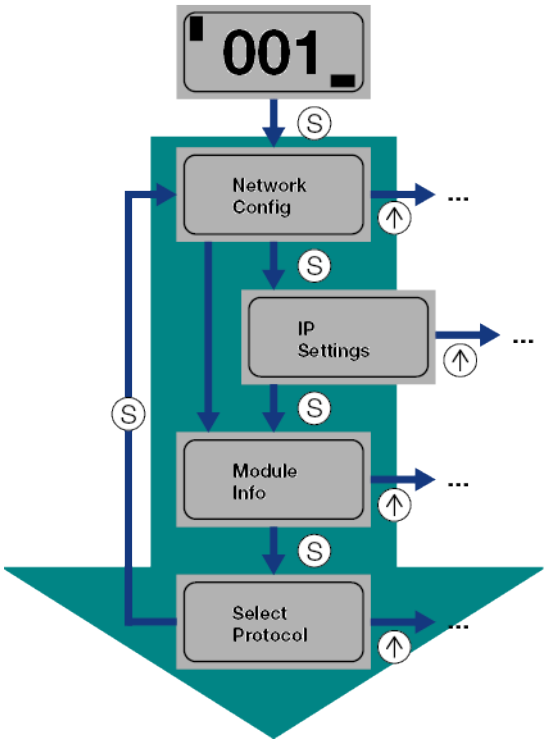
Symbol	Meaning
	Current state
	Switch
	Press the Set button briefly
	Press the Set button for several seconds (≥ 3 s)
	Press the arrow button briefly

6.6.5 Startup sequence

Sequence step	Displayed information	Description
1	Module Name	
2	Hardware Version	
3	Firmware Version	
4	Selected Protocol	
5	4th octet of IP address (for ECT: Station Alias)	

6.6.6 Main menu

Standard view 4th octet of the IP address



Menu: Network Config

Menu: IP Settings[1]

Menu: Module İnformation

To navigate the main menu:

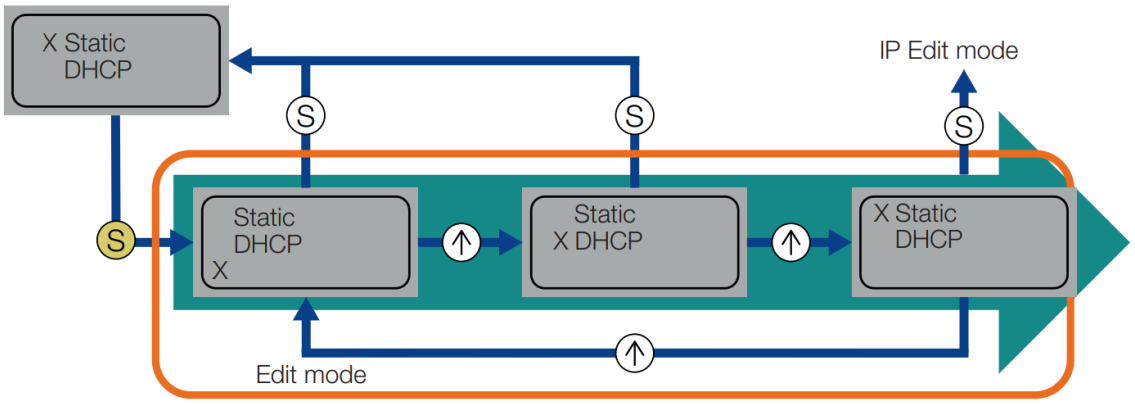
- Press the Set button briefly to scroll through the main menu.
- Press the arrow button to bring up the menu.

6.6.7 IP Setup

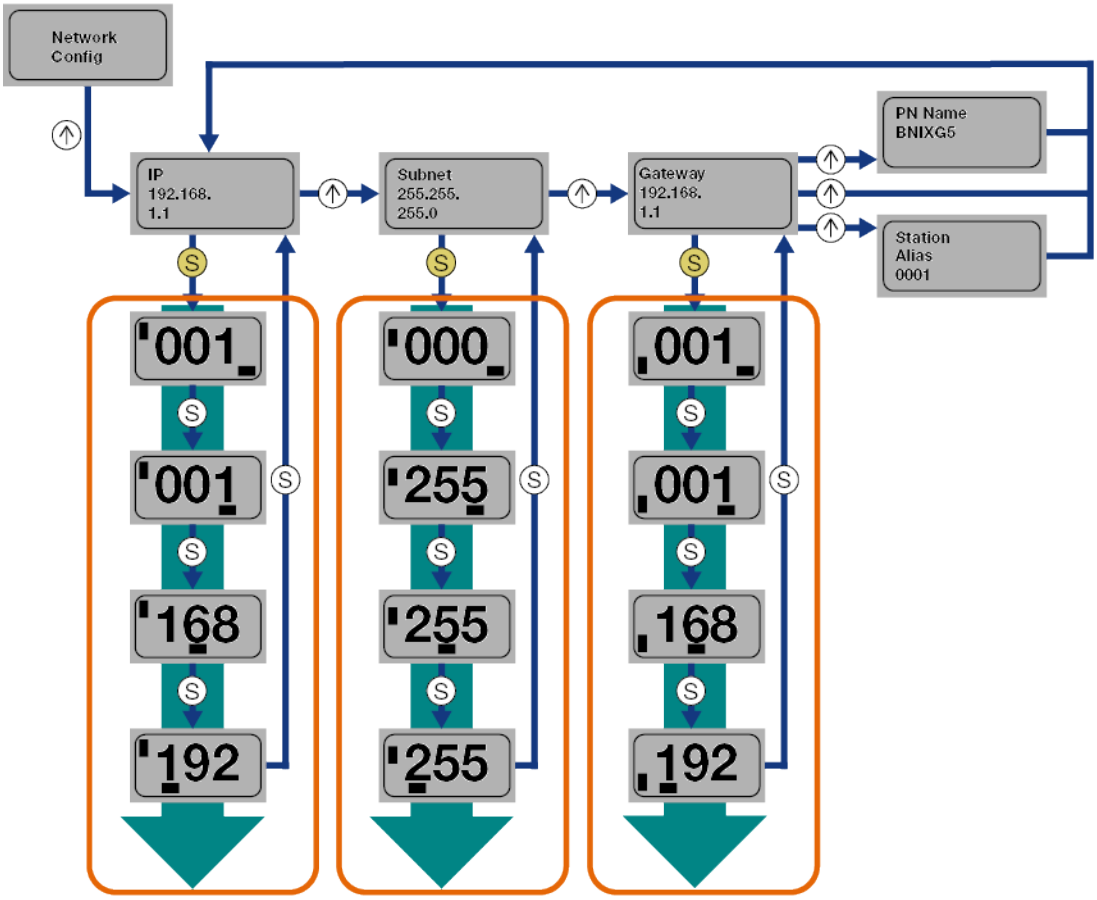
To navigate the IP Setup menu:

- Press the Set button for several seconds to bring up Edit mode.
- Press the arrow button briefly to configure the preferred value.

[1] only available for Ethernet/IP



6.6.8 Network Config



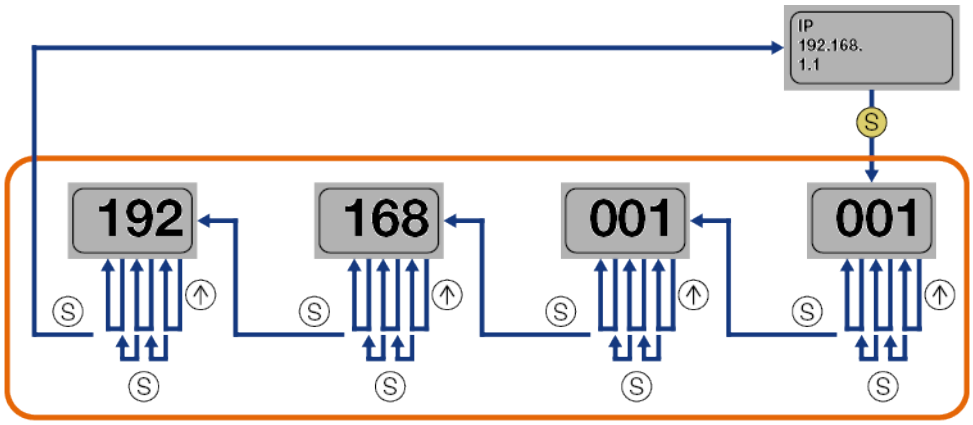
Note

- The *PN Name* setting is only available for Profinet.
- The *Station Alias* setting is only available for EtherCAT.

To navigate the Network Config menu:

- Press the Set button for several seconds to bring up Edit mode.
- Press the arrow button briefly to configure the preferred value.
- Press the arrow button for several seconds to bring up the Quick Program mode.
- Press the Set button briefly to save the value entered and scroll to the next octet. The 4th octet marks the start of the editing process.
- Press the Set button briefly to save the full address entered when editing the first octet. The entered value appears immediately on the IP overview display.
- Manual changes to IP, subnet or gateway lead to an automatic change of the IP Setup to static.

6.6.9 Edit mode



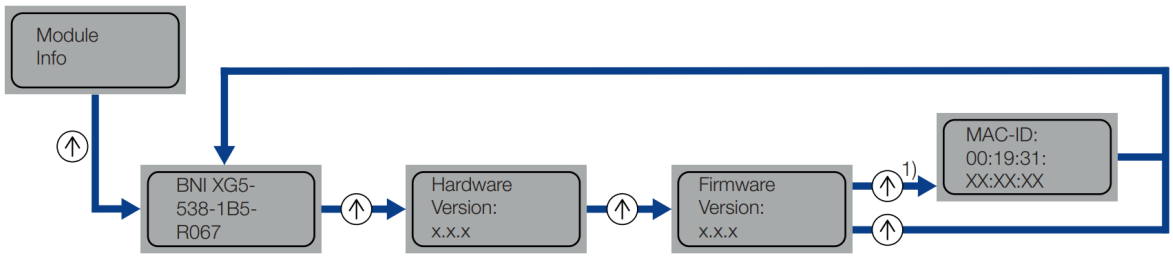
To navigate in Edit mode:

- In the Network Config menu select IP/subnet or gateway address.
- Hold down the Set button to change to Edit mode.
- Press the arrow button briefly to change the number.
- Briefly press the Set button to go to the next position.
- After the last position briefly press the Set button to go to the next octet of the address or to apply the new number after the last octet.

Note

The module must be restarted to work with the new configuration.

6.6.10 Module information



Note

The *MAC-ID* information is not available for EtherCAT.

To navigate the Module Information menu:

- Press the arrow button briefly to scroll through the *Module Information* menu.

The information displayed is the product name, module updates and MacID.

6.6.11 Select protocol in the display

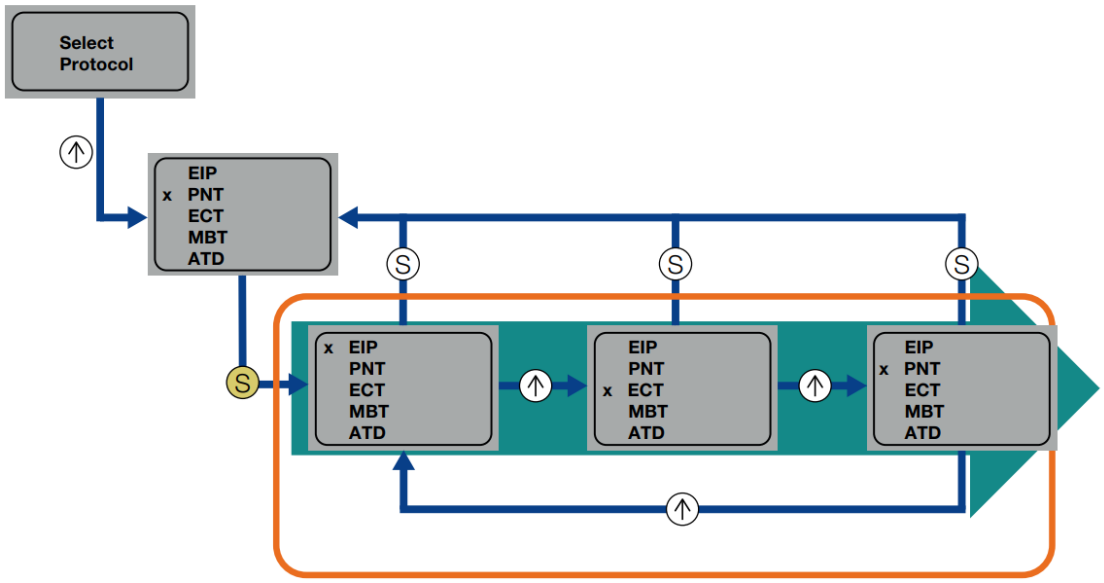


Fig. 66: Select protocol in the display

- Press the Set button for several seconds to activate Edit mode.
- Press the arrow button to adjust the selection.
- Press the Set button briefly to confirm the current selection.

The current network protocol set is displayed for information.

6.6.12 General information

- Hold down the arrow button to scroll quickly in Edit mode.
- If no button is pressed for more than 10 seconds, the display returns to the standard display (4th octet of the IP address). Unsaved changes may be lost.
- Differences between the new configuration and the configuration with which the module works are displayed with an unequal symbol. In this case the display returns to the standard display after 5 seconds.
- The display flashes in Edit mode. The display flickers in Fast Scroll mode.
- The LED function of the display LEDs can be defined specific to the user by setting several bits in the process data outputs (see bit layout in *Standard output data*).
- The plc-lock function can also be used by setting a bit in the process data outputs (see bit layout in *Standard output data*).

> **Note**
>
> Edit mode cannot be selected in the display if in the process data inputs the plc-lock is set by a bit (see bit layout in Standard output data).

6.7 WebUI/web interface

6.7.1 General

The network module includes an integrated web interface for accessing detailed device information and for configuration.

Prerequisites

To use this web interface, it must be ensured that the module has been integrated in the network correctly. To do this, the IP subnet of the network module must be accessible from the PC on which the browser is being operated.

Browser

The web interface is compatible with newer versions of Google Chrome, Firefox or MS Edge.

> **Note**
>
> For more detailed version information, see the data sheet at www.balluff.com on the product page.

Connection setup

- To establish a connection with the web interface, enter the IP address of the BNI module in the browser's address bar.
  ⇒ WebUI starts with the homepage, which displays the most important device information (see *Homepage*).

6.7.2 Navigation bar

In the top window area, there is a navigation bar which enables you to switch between the different dialogs of the web interface by clicking on the corresponding icons:

- Homepage (see *Homepage*)
- Condition monitoring (see *Condition Monitoring*)

- Diagnosis (see *Diagnosis*)
- Settings (see *Settings*)
- Notifications (see *Notifications*)
- User menu (see *User profile*)

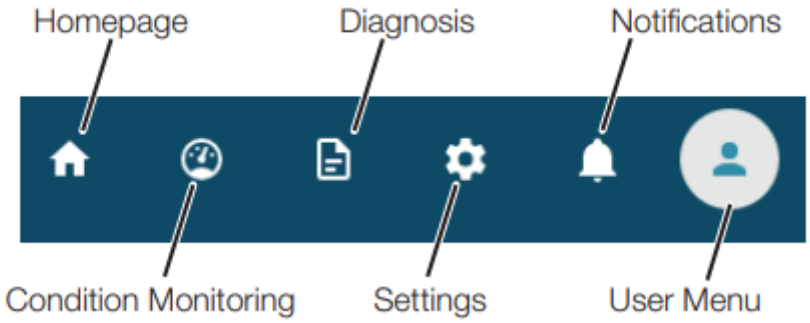


Fig. 67: Navigation bar

Note

Hover the mouse over the different icons to see the corresponding names.

6.7.3 User profile

Click on the user icon to open a user menu:

- Select *Help* to view device-specific information and documents (see chapter *Information/documents*).
- Select the national flag/language to make a language selection (see chapter *Language selection*).
- With *Login* a user logs in (see *Logging in and logging out*).

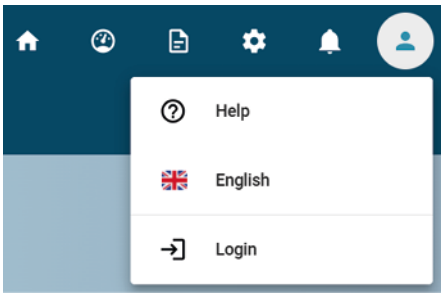


Fig. 68: User menu (not logged in)

When logged in, users with the *ADMIN* role can also see the user management (see *User menu (logged in)*).

Users with the *EXPERT* or *USER* role will see the entry *Edit profile* here instead, through which the respective profile can be viewed and, if relevant, edited.

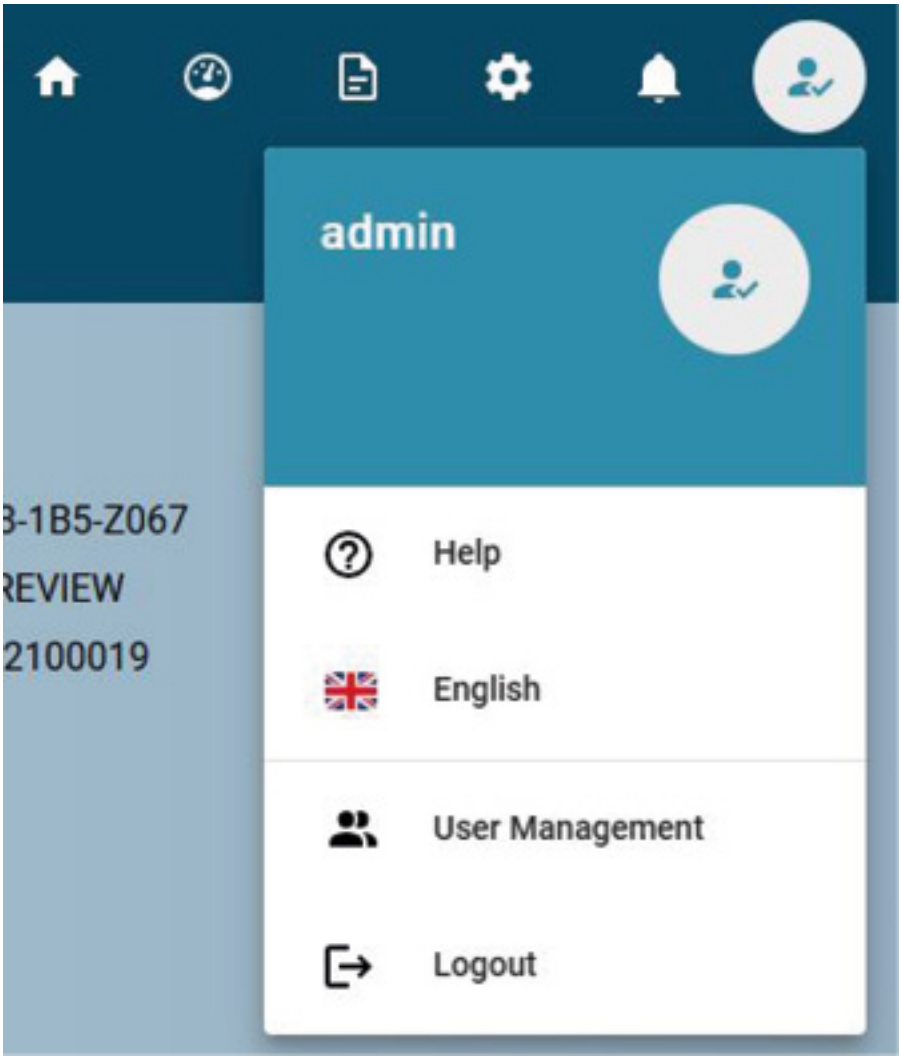


Fig. 69: User menu (logged in)

Information/documents

Click on *Help* > *About* to view device-specific information and documents.

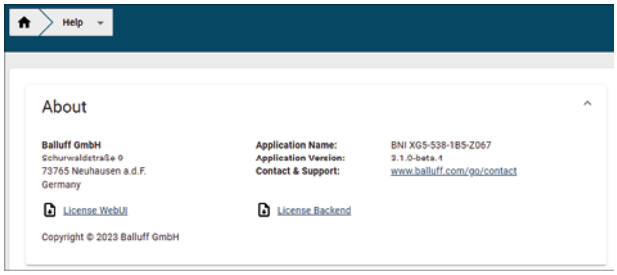


Fig. 70: User menu: *Help* > *About*

Use the dropdown menu under *Online documents* to select different online documents, such as manuals, and click on them to open in a new window.

Language selection

The languages German and English are supported. Click on the language German or English to select the language.

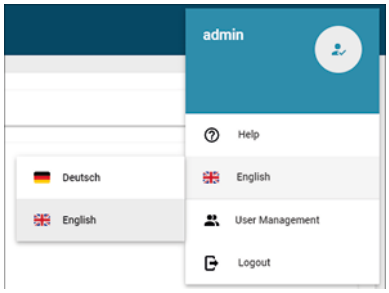


Fig. 71: User menu: *Language selection*

User Management (ADMIN)

Select *User Management* to open a view of the stored users. Information on the user status (*active/inactive*), the user name, user information, password and its confirmation in hidden view, as well as the user's role is specified.

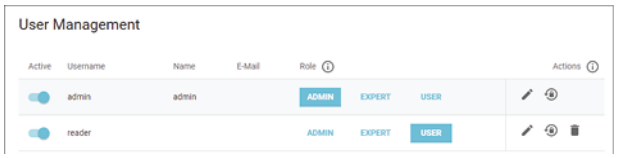


Fig. 72: User Management

Authorizations are role-dependent:

Table 39: User rights

Authorization	ADMIN	EXPERT	USER
Read device parameters	X	X	X
Write device parameters	X	X	–
Adding users	X	–	–
Deleting users	X	–	–

Click on the pen icon to edit fields and buttons.

Fig. 73: Pen icon

Click on the information icon in the password field to open a dialog box and view the requirements for a secure password.

A user with the *ADMIN* role can delete users with the *EXPERT* or *USER* role by clicking on the recycle bin icon.

Note

The default user *admin* can only be deleted if another user with *admin* rights exists.

Click on + (*Add new user*) to add new users and confirm with after entering the corresponding information.

Edit profile (EXPERT/USER)

Users with the *EXPERT* or *USER* role can view and, if relevant, change their profile via *Edit profile*. Only the relevant profile is displayed. *EXPERTs* and *USERs* can only change their own user information as well as their own password, but not their role or name. *EXPERTs* and *USERs* cannot make any profile deletions.

Logging in and logging out

Note

Several PCs can access the network module with read access at the same time (without login). However, parallel accesses can result in response delays.

To make configuration settings on the network module via the web interface, you must first log in with the *EXPERT* or *ADMIN* role. Logging in with the *USER* role activates further dialogs in view-only mode. The user icon indicates the current status.

Table 40: User icon

Not logged in	Logged in
	

Login

1. Login (see *User menu (not logged in)*) opens the login dialog.
2. Enter the login details and click on *LOGIN*.

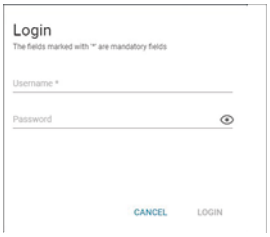


Fig. 74: Login dialog

> **Note**
>
> Logging in is required when notifications request it or when selecting functionalities that cannot be used without logging in.

Each device has its own default password for the *admin* user. It is printed on the side of the device and is only used for the first login, or it is required when the network module is reset to factory settings.

As soon as the password for the *admin* user is changed, it is no longer possible to log in with the printed default password.

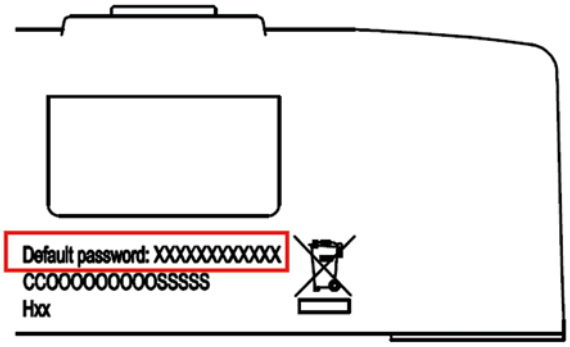


Fig. 75: Default password on the side of the device (example)

> **Note**
>
> On a new device it is possible to log on within 60 minutes after the device starts with the *admin* user and a random or blank password if no login has already been carried out on the new device.

Log out

- Log out with *Logout* (see *User menu: Language selection*).

  > **Note**
  >
  > If there is no interaction with the WebUI for more than five minutes, the user will be logged out automatically.

6.7.4 Homepage

The homepage shows information about the network module itself and its network activity. It also shows whether the configuration lock has been activated via the control unit (PLC).

Fig. 76: WebUI – Homepage

Port overview/configuration

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

If an IO-Link device is connected to one of the configured IO-Link ports, the module data at the ports and the device data are displayed in buttons on the left-hand side of the figure. After one of these buttons is selected, the corresponding port dialog opens. The default value of the displayed DeviceAlias is adapted to the labeling on the front.
The port numbering always starts at 1, even if the labeling on the front has a different port designation depending on the product variant. This is due to the relevant definition of port numbering in the IO-Link specification and the IO-Link/JSON specification (JSON Integration for IO-Link, Karlsruhe, 2020). The designation of the front label is reflected in the process data layout as well as in the description file (GSD).

Device Status

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Some devices (including from external providers) supply the device status defined in the IO-Link Spec. In this case, it is displayed on the home screen. On the homepage, details can be called up by clicking on the icon in the port (see Fig. 8-13). Products that do not supply the device status show a gray control box here.

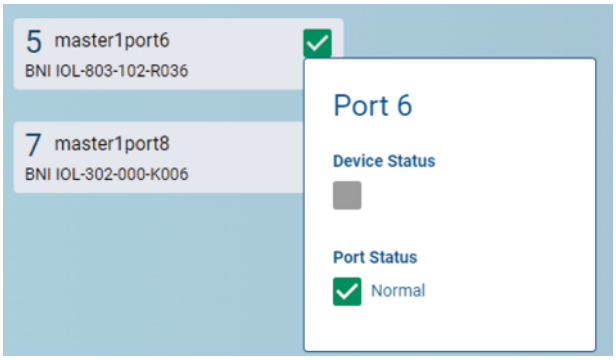


Fig. 77: Device Status

Opening the port dialog

- Click on the corresponding port field to select the desired IO-Link Port.

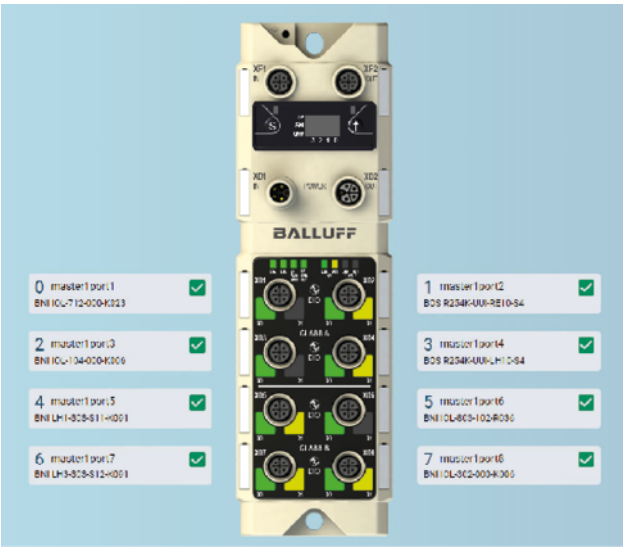


Fig. 78: Selecting the IO-Link port in the breadcrumb

- Alternatively, select the target port via the breadcrumb navigation in the header.

Note

The IO-Link device data is only displayed if the port is configured as an IO-Link port (can be identified by the green port LED).

Ports dialog

Click on the expand symbol ⌄ of a closed tab page to view e.g. information on relevant ISDU parameters. Information that is not currently required can be hidden by clicking on the collapse symbol ⌃.

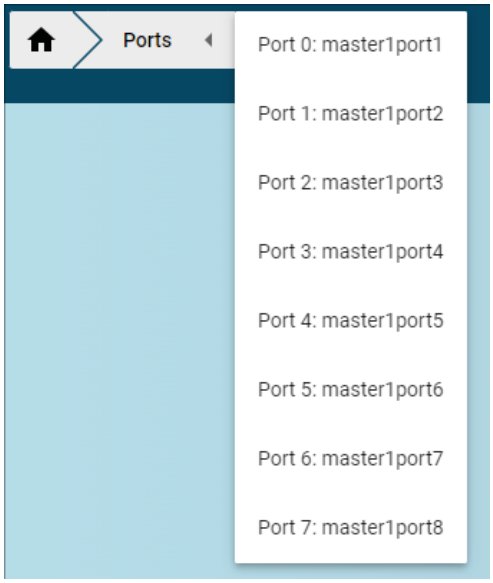


Fig. 79: Selecting the IO-Link port in the breadcrumb navigation

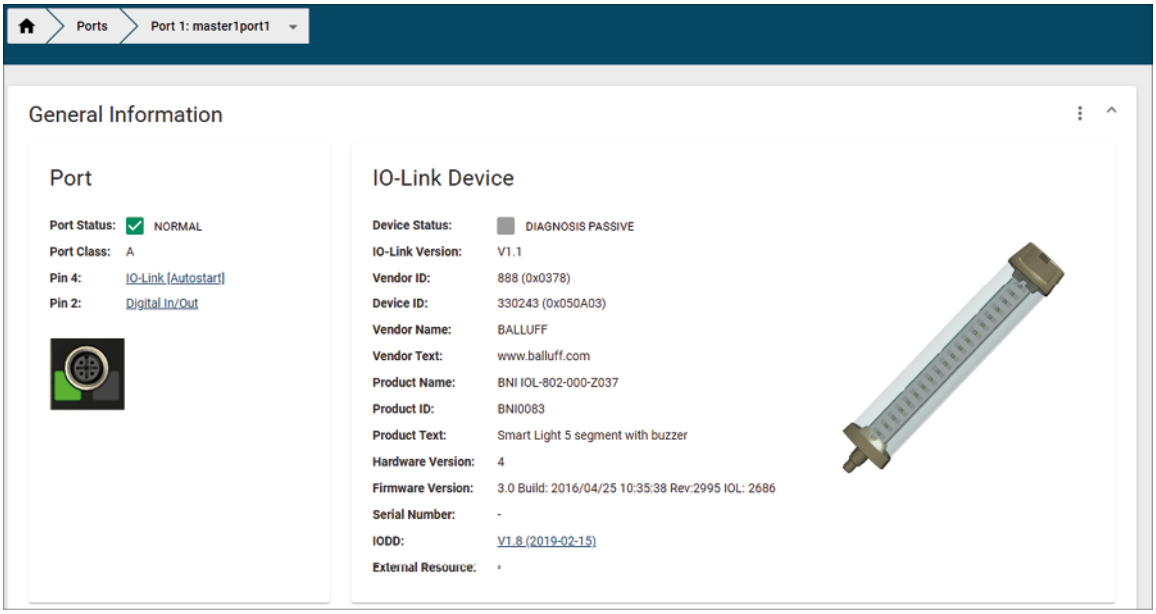


Fig. 80: Ports dialog

General Information

Under *General Information*, you can find manufacturer information as well as other general information on the current module. Under *IODD*, you can see whether a suitable IODD for the IO-Link device connected to this port is uploaded to the network module.

Fig. 81: IODD

If this is not the case, click on *Upload IODD* to access the *Settings* tab page. Based on the connected IO-Link devices, the corresponding device description can be selected for upload.

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Process data

Under *Process Data*, interpreted data is only shown if a suitable IODD is saved. To display the data more clearly, information from the device's IODD is used here. So, in *IODD Interpretation*, you can see not only the input data of the example sensor as a hexadecimal number, but also interpreted under *Input* and provided with corresponding labels from the IODD.

In the *Set process data area*, the output process data of an IO-Link device can be set manually. The *Validity Qualifier* can be used to specify whether the process data should be marked as valid or invalid (PD valid).

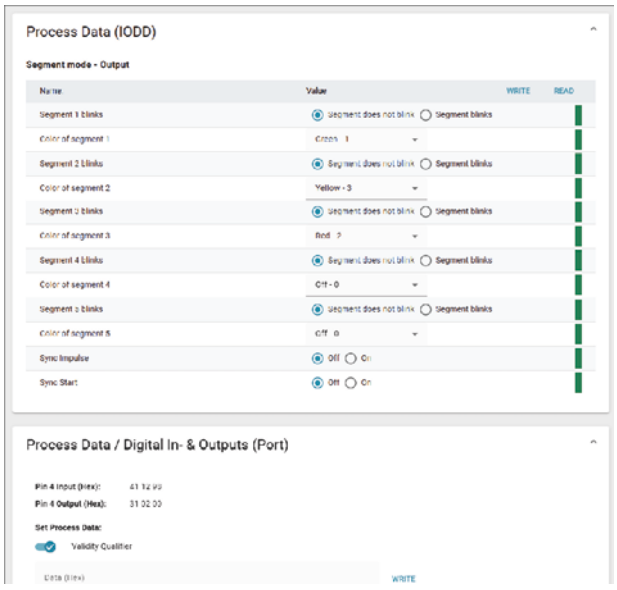


Fig. 82: IODD Interpretation

Parameter (IODD)

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Note

The Parameter (ISDU) tab page is only displayed if a suitable IODD is uploaded for the IO-Link device connected to the selected port. *Upload IODD* , see *General Information*.

Under *Parameter (IODD)*, the device identification data of the IO-Link device is displayed in a table when the *Identification* tab page is selected (e.g. *Dialog view after clicking on Read all or, for each subindex, on Read*). The corresponding texts are saved in the IODD.

The input values can either be read out from the IO-Link device individually for a subindex by clicking on *Read* or for the entire tab page via *Read all*. A successful request is indicated by a green bar on the right-hand edge of the relevant table row.

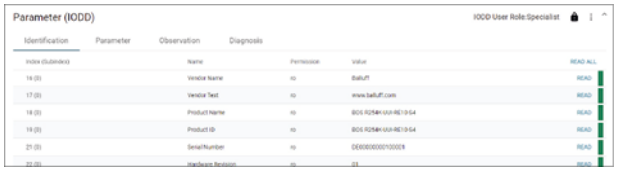


Fig. 83: Dialog view after clicking on Read all or, for each subindex, on Read

The *Application Specific Tag* is an application-specific field in IO-Link devices and, in the current example (see *Application Specific Tag*), can either be read out from the IO-Link device with *Read* or can be individually configured by clicking on the gray input field with the same name and described with *Write* (provided the required write authorization exists). It is also possible to enter a company-internal device name in this field.

Fig. 84: Application Specific Tag

If the IODD of the IO-Link device at the currently selected port also has parameters, these are also displayed in the form of a table (see *Ports dialog figure*). Similarly to the process for device identification data, parameter values and associated texts from the saved IODD can be configured, depending on the parameter, via *Read* or *Read all*.

If available, click on the ▼ icon to open a dropdown list and select a value or select a value within a specific range and confirm with *Write*.

If there is no *Read* button next to subindices, these indices cannot be processed individually, but only as a complete index.

Note

Each changed value must be written individually by clicking on Write !

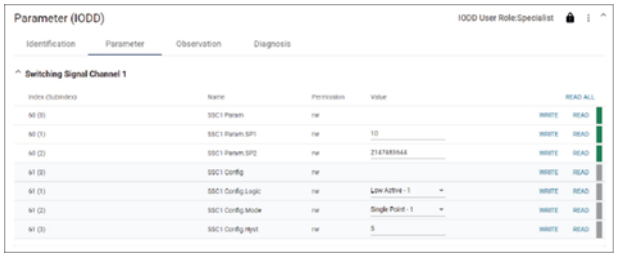


Fig. 85: *Ports* dialog: Extract from the parameter list of an IO-Link device with uploaded IODD after clicking on *Read all* or *Read* for individual subindices

ISDU Parameter

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Configuration parameters of the IO-Link device can be read and written via the *ISDU Parameter* option. The parameter indices and subindices of the IO-Link device follow the IO-Link conventions and are described in the corresponding user's guide.

Parameter indices and subindices can be entered both in decimal and hexadecimal format, while data can only be entered in hexadecimal format.

An input is confirmed with *Set* or can be rejected with *Delete*.

Events

Under *Events*, you can see whether there is a diagnosis event from the IO-Link device.

The events can be displayed in ascending or descending order. The list of events can be updated via further options of the *Events* card or can be downloaded in CSV format.

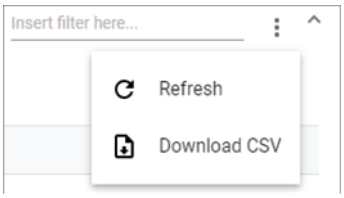


Fig. 86: Further options of the *Events* tab page

LEDs

The LEDs of the network module display information on the current process data and the module status. The meanings of the LEDs can be viewed in a legend.

Opening the LED legend

- At the *LED legend*, click on *OPEN*.

  ⇒ The legend appears.

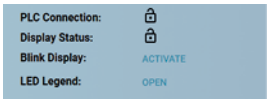


Fig. 87: Opening the LED legend

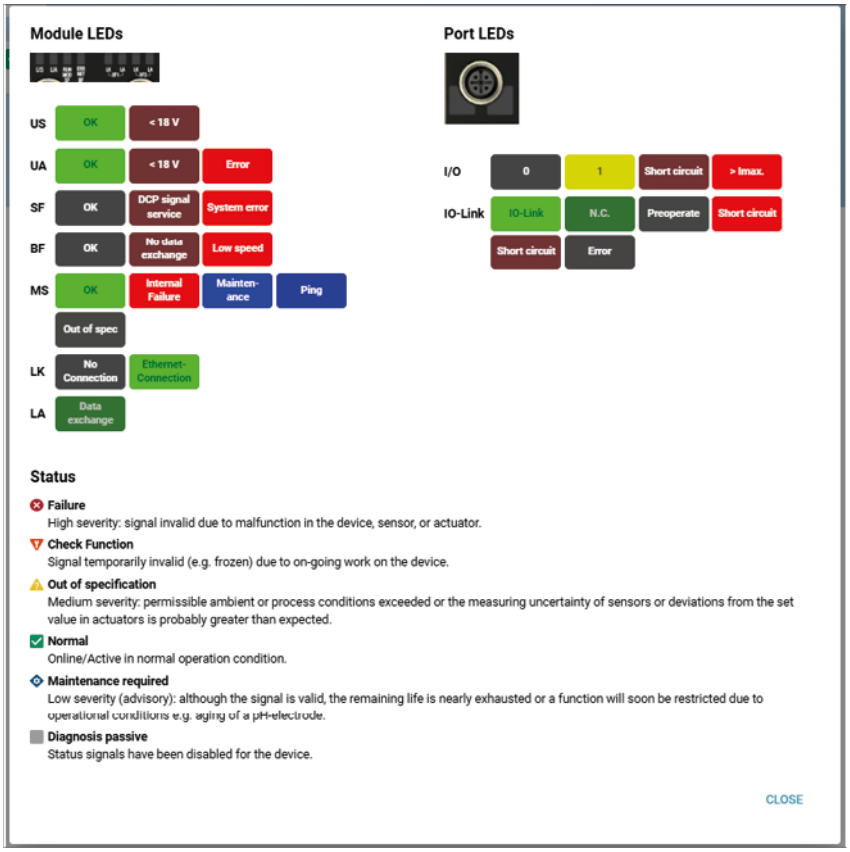


Fig. 88: LED legend

6.7.5 Condition Monitoring

Note

This function is only available for XG5 devices.

Fig. 89: Condition Monitoring

Click on the corresponding icon in the navigation bar (see *Navigation bar*) to open the *Condition Monitoring* dialog.

Module values

In the top section, you can see the condition monitoring values of the module that are not specific. These relate to the entire module. The values in the top area are refreshed automatically every 10 seconds.

Electrical values

The table on theElectrical Valuestab page shows the available values for current consumption and power draw at the individual pins of the different ports.

6.7.6 Diagnosis

Click on the corresponding icon in the navigation bar (see *Navigation bar*) to open the *Diagnosis* dialog. The *Diagnosis* dialog provides general service information about the device and a logging function.

The *Status* tab page contains information for all service requests, while the *Activity Log* tab page contains a table view of the log information. The information can be printed as a PDF by clicking on the printer icon (e.g. for a service request).

Note

If you have a specific question about a specific case, save or print this website as a PDF file and send it to us for technical support. You can find the corresponding contact details at www.balluff.com.

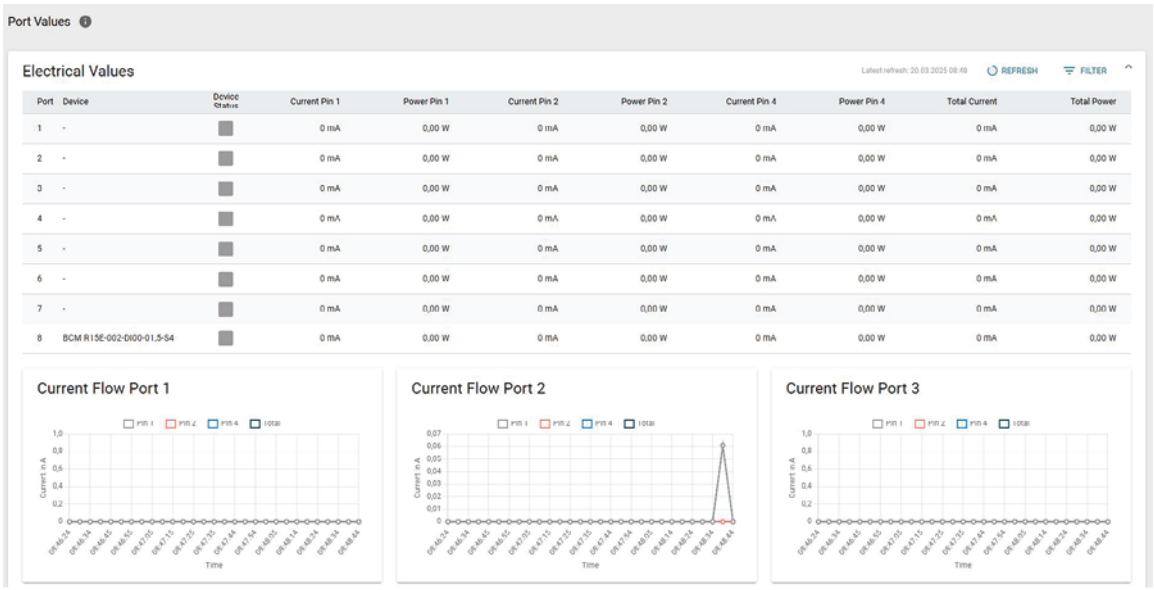


Fig. 90: Electrical Values

Information

Via the *Information* item, you can view information about the device, such as the browser version used or the system operating time.

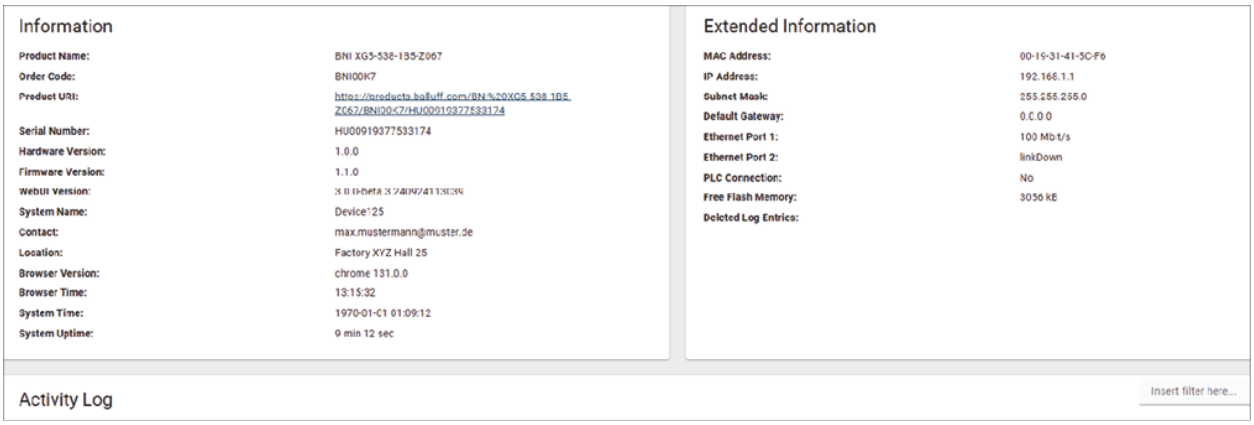


Fig. 91: Information

Activity log

The *Activity log* displays events in their time dependency and is an important tool for detailed troubleshooting in plants.

The expanded *Activity Log* tab page provides a table view of the log information, which can be sorted by numbers. The log information consists of a note regarding the severity, a date stamp, information on the origin and the log message itself.

Events are classified via the *Severity* column:

- Internal error (Emergency, Alert, Critical)

  The network module has found an internal defect (hardware or software), which should not normally occur. If this

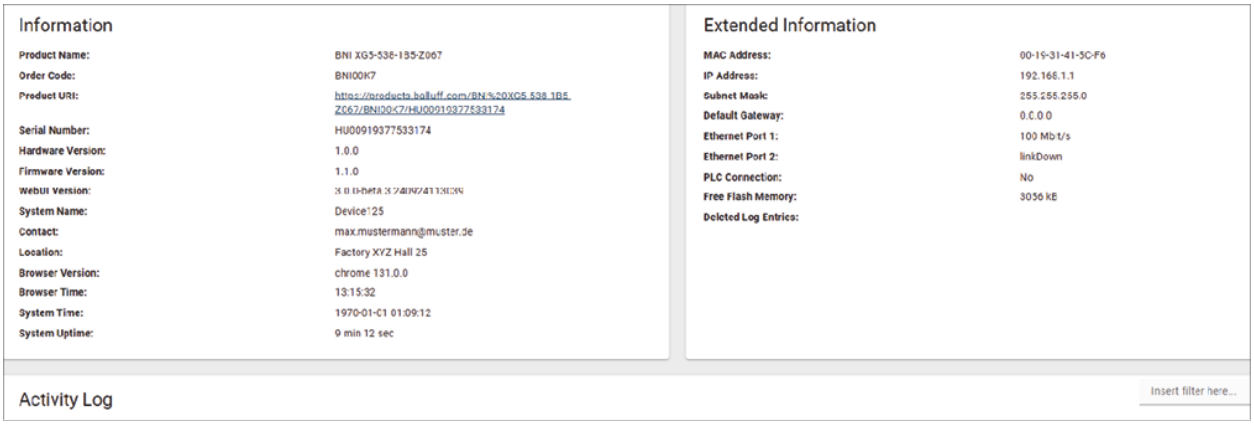


Fig. 92: Activity log

occurs, the module must be maintained or replaced.

- External error (Error, Warning)

  The network module has found a potentially impermissible event, which is affecting the module from outside. Troubleshooting in the system might be necessary.

- Event (Informational, Notice)

  The network module has found an important normal operating event (such as configuration actions via the web interface and other configuration interfaces, which are recorded) and reports it.

Under additional options ( ) you can access more actions for the log (the log entries are saved in a ring buffer):

- *Refresh*
- *Download CSV*
- *Clear*

6.7.7 Settings

The *Settings* dialog enables the configuration of connected modules and IO-Link devices. Click on the corresponding icon in the navigation bar (see *Navigation bar*) to open the *Settings* dialog.

Note

Changing and saving settings as well as implementing restarts and resetting to factory defaults can only be performed by users with corresponding authorizations (*ADMIN* , *EXPERT*).

General settings

General settings such as the name of the module, the module time and security configurations can be made under *General*.

Settings can be applied by clicking on *SAVE* and permanently stored in the device.

RESTART restarts the module (like switching the power supply off and on).

RESET TO FACTORY SETTING completely deletes the configuration saved in the device and them performs a reboot. The device is reset to the delivery state.

Fig. 93: *General* tab

Manually setting the module time

1. Under *General* > *Module time*, either click on the calendar icon or use the *Set from PC* dialog to transfer the current browser time to the network module.
2. Apply the settings with *SAVE*.

> **Note**
>
> The module time is not permanently stored. After a reset, reboot or power, the time will be reset to the factory setting.

Retrieve module time automatically

An NTP server can be configured from which the time is automatically retrieved.

- Under *General* > *Module time*, select the option *NTP server activated*.
- Under *Synchronization interval*, select how often the time is retrieved from the NTP server.
- Enter the IP address of the NTP server under *NTP server address* (internal URLs are not supported).
- Apply the settings with *SAVE*.

Making security configurations

The following security settings for the REST API interface can be made using the security configurations.

Soft Session Timeout
: Defines the time in seconds after which a user is logged out in the event of inactivity.

Hard Session Timeout
: Defines the time in seconds after which a user is logged out, even if they are active.

Minimum Password Length
: Defines the minimum required password length for newly created users.

Rest API Security
: Activates or deactivates authentication when using the REST API directly. If deactivated, it is no longer necessary to log in and send the session token and cookies with a request. All requests have the rights of the *ADMIN* user.

Make network settings

Under *Network*, the *IP Address*, *Subnet Mask* and *Gateway Address* fields can be reset separately via the *FACTORY DEFAULT* button (see *HTTP server settings*).

The *Storage* setting can be used to select how long the new network configuration should be valid.

Permanent
Saves the settings after a restart.

Temporary
Saves the settings until the next restart (factory setting).

The factory settings then apply.

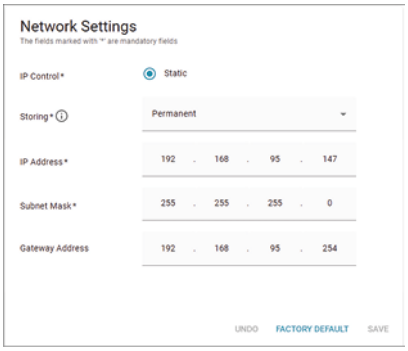


Fig. 94: Network settings

HTTP server settings

HTTP server settings can be used to enable or disable unencrypted and encrypted communication with the web server using HTTP(S).

Fig. 95: HTTP server settings

Note

If the connection between the web browser and the BNI is made via a HTTPS connection, the BNI provides a self-signed certificate that must be imported into the web browser. When the connection is opened, a warning appears in the web browser which must be accepted. After accepting, the certificate is imported.
If the IP address changes, the old certificate may have to be deleted and the new one imported. Once the certificate has been imported, the WebUI opens. A warning symbol appears in the URL bar, but this can be ignored.

Change protocol

The active fieldbus protocol can be viewed and changed in the section Fieldbus Protocol.

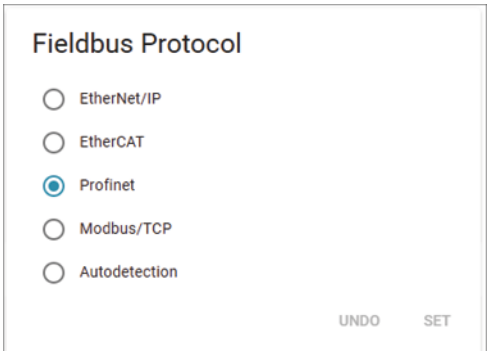


Fig. 96: Change protocol

I/O ports

Via the *I/O Ports* dialog, the ports of a module can be displayed and configured.

Select *Set configuration for all ports* to set the IO-Link *[Autostart]*, *Digital In* and *Digital Out* configuration modes to the desired mode for all ports.

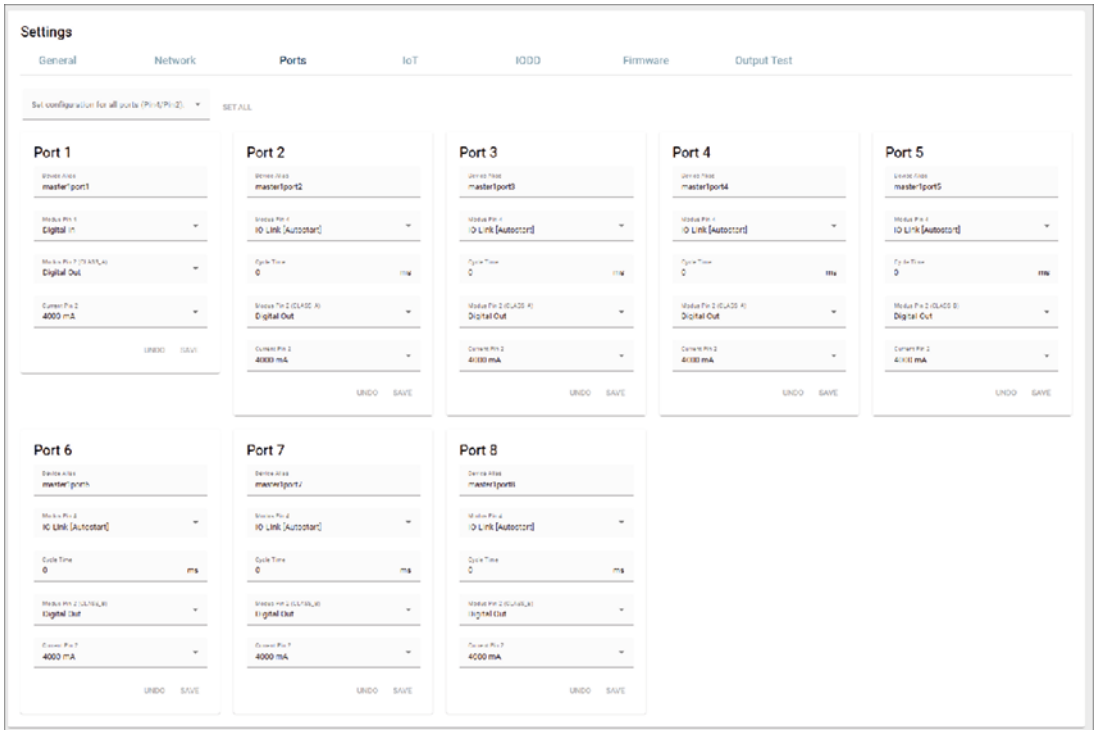


Fig. 97: IO Ports settings

Click on *SET ALL* to open a dialog window in which the action can be confirmed or canceled. With a corresponding selection, the message *I/O port configuration(s) successfully saved* appears in the bottom part of the website.

The ports can also be configured individually. The inputs are confirmed with SAVE or reset with UNDO.

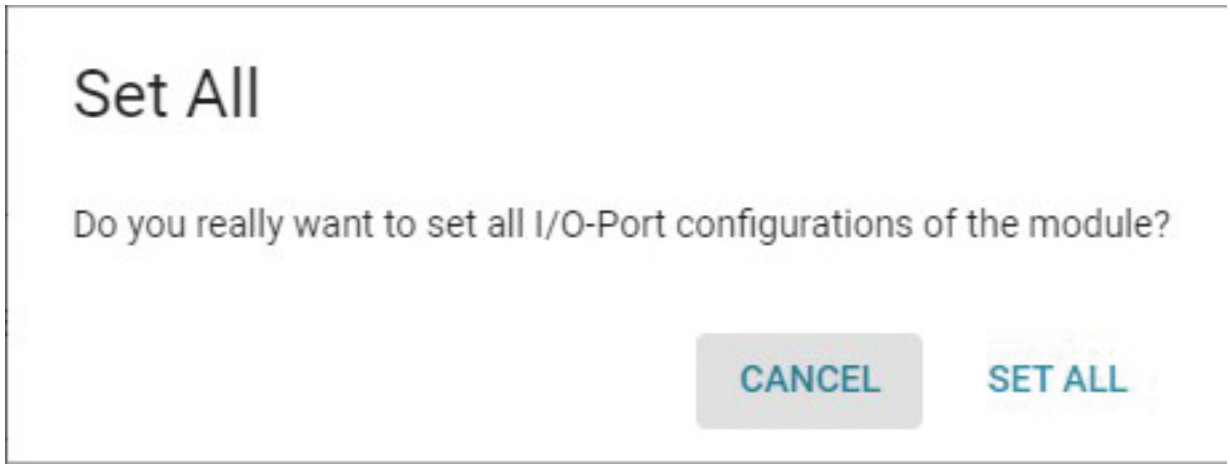


Fig. 98: Set All dialog

The following parameters can be configured (see *IoT*):

Device Alias
name of the device that shows what function the sensor executes (e.g. *rear left end switch*, *temperature at boiler floor*, etc.)

Modus Pin 4
selection of the actuation (e.g. *Deactivated*, *IO-Link [Manual]*, *IO-Link [Autostart]*, *Digital in* or *Digital out*. Depending on the selection, further dialog fields open, which require an input (e.g. when the *IO-Link [Manual]* option is selected).

Validation and Backup
Settings see *Validation and backup*.

Cycle Time
if the *IO-Link [Manual]* or *IO-Link [Autostart]* options are selected for point Modus Pin 4, the desired communication cycle can be set by selecting the corresponding value from the dropdown list.

Modus Pin 2 (CLASS_A)
selection of the options *Digital in* or *Digital out*.

Current pin 2
Maximum current at which the pin switches off. Can only be configured if the pin is configured as an output.

Current pin 4
Maximum current at which the pin switches off. Can only be configured if the pin is configured as an output.

IoT

The IoT settings of the device can be made via the IoT dialog.

MQTT client settings

The BNI features a MQTT interface that allows parameters and product information to be called up. The BNI acts as a MQTT client whose messages are sent cyclically. For events, the BNI sends messages to a MQTT broker (PUBLISH). Other MQTT clients, e.g. applications that store data in an external database, can subscribe to topics provided via the MQTT broker (SUBSCRIBE). Communication is unencrypted and takes place via Port 1883 as standard.

The data sent via MQTT can be used, for example:

- for Condition Monitoring

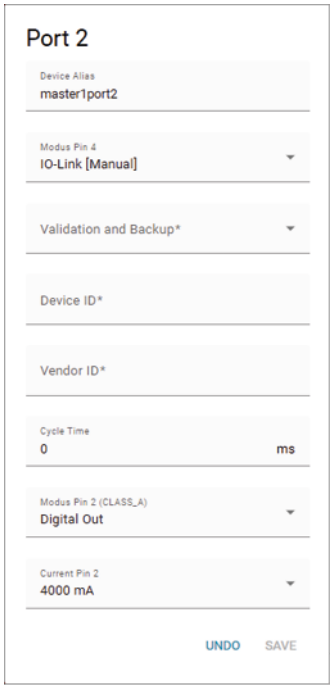


Fig. 99: Modus Pin 4 selection options dialog and Port 2: Configuration dialog of the IO-Link [Manual] option

- as an interface to Track&Trace applications
- for further processing in the cloud

Connection status
The following information can be viewed:

- *Status*: Indicates whether the client is connected or there is an error.
- *Address*: Displays the address of the broker to which the client is currently connected.
- *Uptime*: Displays the elapsed time in seconds since the connection was established.

IODD status messages
Indicates whether the correct IODD could be found and loaded for each device and which value is used for any condition variable. The correct IODD is required to send parsed IO-Link data.

In addition, the IODD can be reloaded manually if a change to one of the ports or the condition variable is not detected.

Client configuration
The following settings can be made:

- *Enable Client* Enables or disables the client.
- *MQTT Client ID* Defines the client ID that will be used for the connection.
- *MQTT Broker URL* Defines the address of the broker. In addition, an individual port can be specified separated by a colon, e.g. 192.168.1.42:1234. If no port is specified, port *1883* is used by default when TLS is deactivated and port *8883* is used when TLS is activated.
- *MQTT Prefix* Defines a prefix to be placed in front of each MQTT topic (e.g. *{prefix}/identification*).
- *Keep Alive* Defines the keep alive time of the MQTT in seconds.
- *Enable encryption (TLS)* Defines whether TSL should be used for MQTT communication.

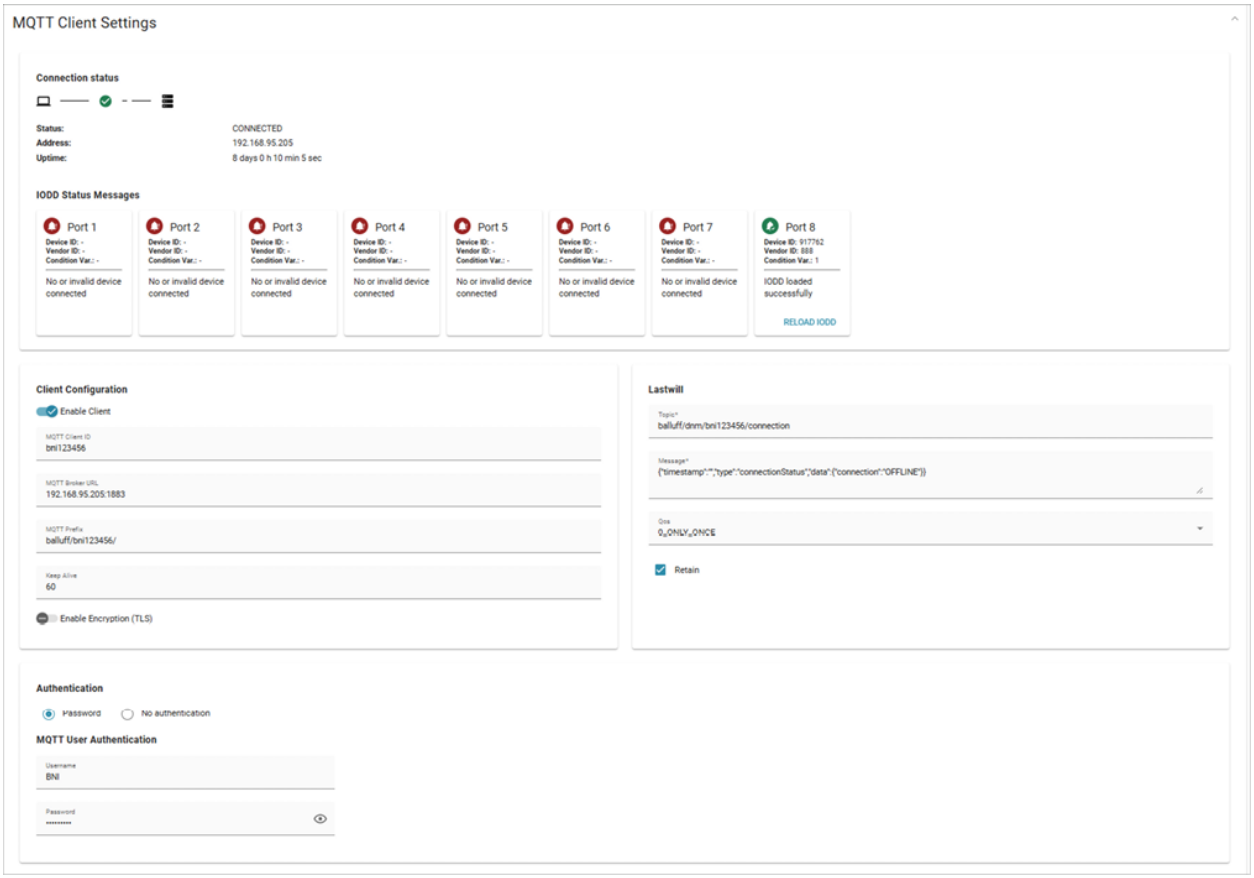


Fig. 100: MQTT client settings

Lastwill
Allows a message to be configured that is to be sent automatically when the client disconnects from the broker. The following settings can be made:

- *Topic*: Defines the topic of the message.
- *Message*: Defines the content of the message.
- *QoS*: Defines the QoS (Quality of Service) level at which the message is sent.
- *Retain*: Sends the message with or without the retain flag.

Note

All available topics and the content of the individual messages can be found in the MQTT AsyncApi specification (see downloads at www.balluff.com on the product page).

Authentication
The following settings can be made:

- *Password*: Authentication is done with password and username.
- *No authentication*: The client logs on to the broker anonymously.

MQTT Message Configuration

Among other things, the process data of the connected sensors or the status of the digital inputs and outputs can be sent via MQTT.

In the delivery state all message formats described in the *AsyncApi* specification are sent cyclically.

This behavior can be adjusted via the *Mqtt Message Configuration* dialog, e.g. that messages should only be sent in the event of a change or in a fixed cycle.

The following settings can be made:

General
Enables general, port-independent messages to be configured, e.g. the sender of the master's identification data.

Port 1…8
Enables port-specific messages to be configured, e.g. sending the identification data of a connected IO-Link device or its process data.

The following can be configured for each message to be sent:

Topic
Defines the topic under which the message is published. If the *Generate topic automatically* option is activated, a user input is ignored and the default path specified in the *AsyncApi* is used.

DataType
Defines the type of message. The individual types are described in the *AsyncApi* specification, the *operation ID* listed there corresponds to the data type to be selected here.

Description
Defines a description text for the configured message. Only serves as an overview and has no other function.

Interval
Defines the fixed interval for sending a message. Either an interval and or the *Trigger on change* option must be set.

Min. interval
Defines a minimum interval for sending between two messages.

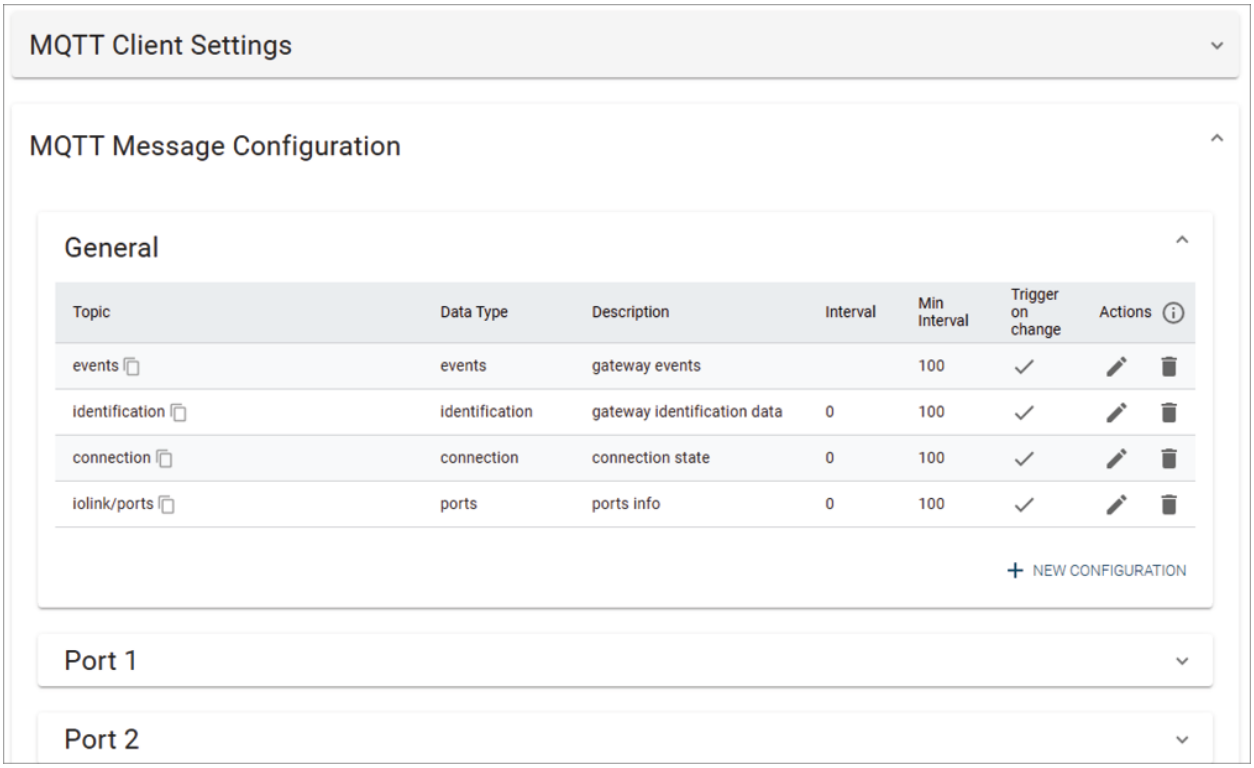


Fig. 101: MQTT Message Configuration

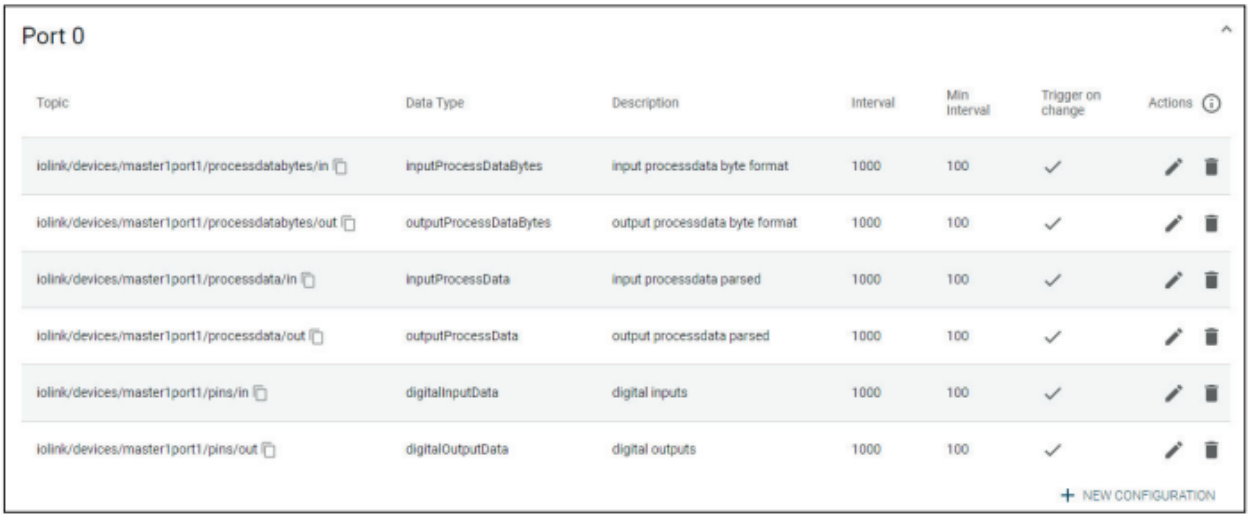


Fig. 102: configure port-specific messages

Example:

The measured value of a connected sensor changes every millisecond. A minimum interval of 100 milliseconds is configured. This means that a message is sent every 100 milliseconds, although the value changes more frequently.

Trigger on change
If active, a message is sent each time a change is made. Either this option or an interval must be set.

Note

- Each message type can only be configured once per port.
- The message types deviceEvents and events cannot be configured with a fixed interval.

IODD

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Via the *IODD* dialog, device description files for IO-Link devices (IODDs) and the associated device images can be uploaded to the network module so that a more detailed illustration of the connected IO-Link devices can be provided in the *Ports* dialog.

Connected IO-Link devices

Note

Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

When IO-Link devices are connected and IO-Link ports are activated, the dialog shows a table with information on the IO-Link devices. The table can be updated by clicking on the refresh icon .

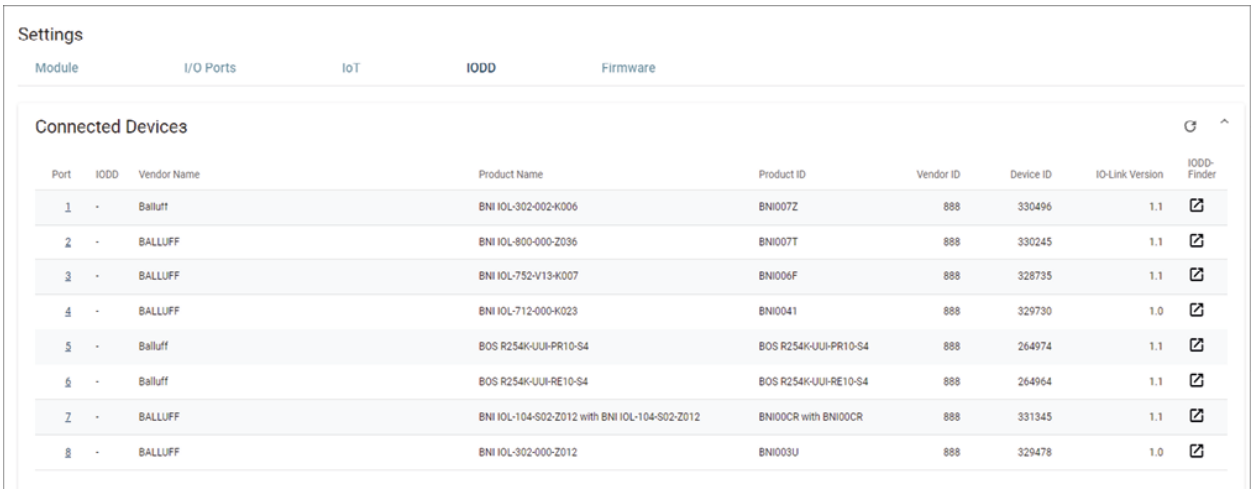


Fig. 103: Connected IO-Link devices

Available IODDs

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

The available IODDs are listed under *Available IODDs* and can be removed by clicking on the recycle bin icon, if necessary.

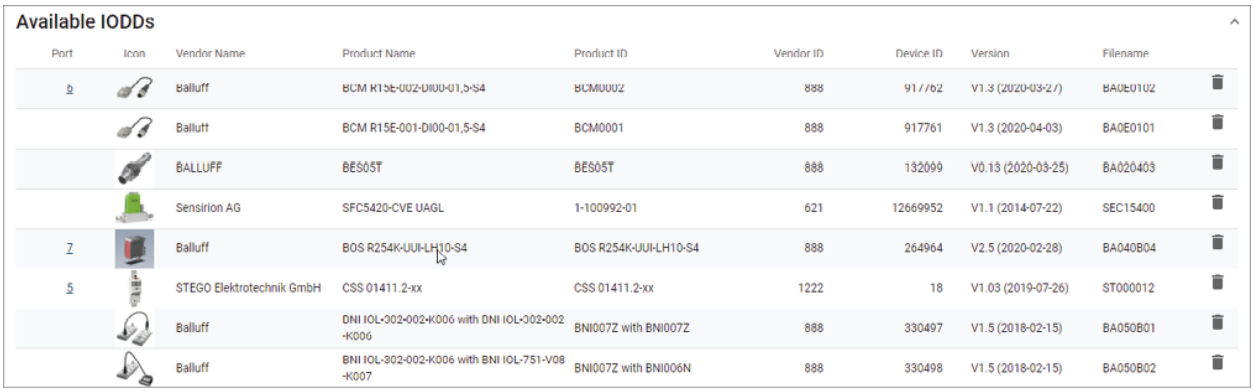


Fig. 104: Available IODDs

An IODD can be uploaded via the *Choose an IODD to upload dialog* between the two tab pages.

Fig. 105: Upload IODD

In order for the automatic assignment of IODDs to connected IO-Link devices to work, the files must be named according to a specific scheme. This is done automatically in the background for IODD files. If an individual image file is selected for upload via *UPLOAD FILE*, which does not meet the naming requirements, a dialog will open with a corresponding message.

The *Connected IO-Link devices* bar also displays help in the form of a list of currently connected IO-Link devices as well as the associated, required IODD file name (column *IODD Filename*).

> **Note**
>
> Always upload ZIP files with the IODD contents as provided by the IODD Finder so that all images are automatically renamed.

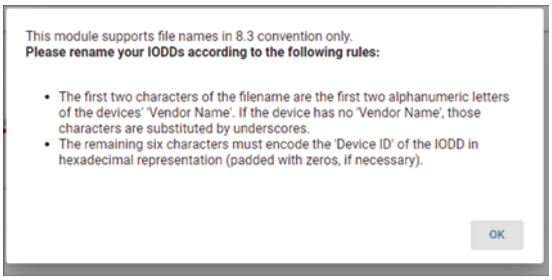


Fig. 106: Info message

Firmware

Under *Firmware* you can see which version of the firmware is being used and when it was uploaded. Via *Firmware Upload*, you can upload a different firmware version. The installation starts after uploading the firmware file. Only files in bff format are supported.

You can check for firmware updates online via *CHECK FOR A NEW VERSION* and install an update directly.

Fig. 107: Firmware view

6.7.8 Notifications

Clicking on the corresponding icon in the navigation bar (see chapter *Navigation bar*) opens the notifications.

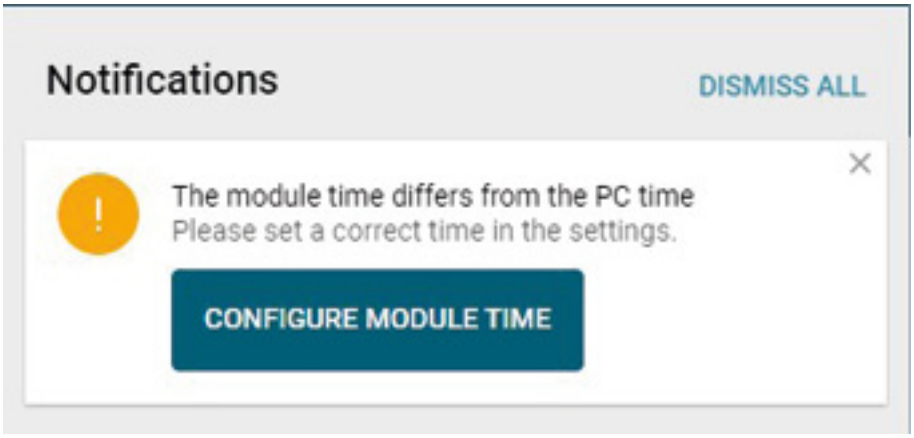


Fig. 108: Notification: Module time

The notification history can be deleted with *Dismiss all*.

6.7.9 REST API

Via the REST API interface, identification data, process data and configuration settings of the network module and other connected devices can be requested and modified. The REST API interface is used by the user interface of the web interface for communication with the module.

The specification of the REST API implemented in the module is stored in YAML files in the device and can be downloaded via *Help* > *Documents* or viewed and tested via *Help* > *Api documentation*.

The present module supports the following REST APIs:

- Generic REST API for Balluff devices and applications. Base path of the REST API in the module: **http://[ip-address]/api/balluff/v1/**
- The REST API *(JSON for IO-Link)* standardized by the IO-Link community.

  Link to the official documentation (JSON for IO-Link) in the IO-Link Integration area. *JSON Integration for IO-Link* (ZIP file).

  Base path of the REST API in the module: **http://[ip-address]/iolink/v1/**

> **Note**
>
> The specification JSON for IO-Link REST API describes a functionality for process data and parameters, which requires IODD support. This functionality is also not fully implemented in the current version.
> The module only supports uploading of IODDs. Writing/reading process data or parameters with their names is not supported.

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Some examples below explain how REST-API is applied.

Registration and authentication are required for some calls.

REST Login

Login is possible by entering the following address: **http://[ip-address]/api/balluff/v1/users/login**.

A JSON object is also specified, in which, as shown below, a user name and password are specified (see *Logging in and logging out*):

```
{
  "username": "[username]",
  "password": "[password]"
}
```

If the login was successful, a bearer token is returned, e.g.:

```
{
  "bearer": " 7euh07tdfawjej"
}
```

In addition, a cookie is set that must be sent with each request, e.g.:

```
{
  "JSESSIONID": "fgaa74a4fa2xdfg"
}
```

This token can now be used to perform methods that require authentication. For this, a corresponding request must be equipped with the following headers:

- `Authorization: Bearer 7euh07tdfawjej`
- `Cookie: JSESSIONID fgaa74a4fa2xdfg`

Requesting the device identification of the module

The device identification data of a network module can be requested via the following address:

- http://[ip-address]/api/balluff/v1/identification
- http://[ip-address]/iolink/v1/masters/1/identification

In the event of a successful request, an answer is supplied in the form of a JSON object with properties such as thevendorID, theserialNumberor thefirmwareRevisionof the respective network module.

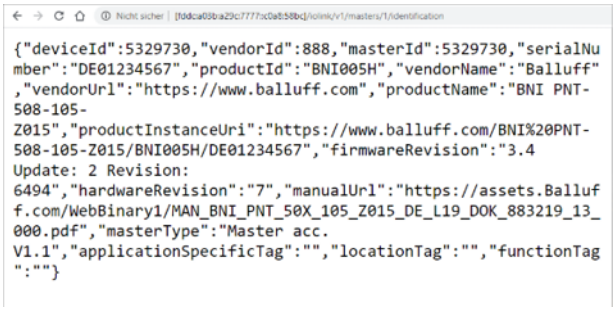


Fig. 109: Requesting the device identification

Requesting port information

All relevant configuration and status data for all IO ports of a module can be requested via:

http://[ip-address]/api/balluff/v1/ports/information

Fig. 110: Requesting the port identification

Requesting an IO-Link device parameter (applicationSpecificTag)

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

Device-specific parameters can be requested via the following addresses:

- http://[ip-address]/api/balluff/v1/devices/identification
- http://[ip-address]/iolink/v1/devices/[deviceAlias]/identification

A request via the generic REST API is the bulk version of the identical request via *JSON for IO-Link*.

In the case of a request via *JSON for IO-Link*, a *deviceAlias* is also specified. This corresponds to the device designation that must be configured previously. The standard device designation is *Port_Xyz*, with *yz* representing the port number (e.g. *Port_X00*).

In the case of successful execution, a JSON object with parameters such as *vendorID*, *productName* and *applicationSpecificTag* is supplied as a response.

Setting an IO-Link device parameter (applicationSpecificTag)

> **Note**
>
> Please check whether IO-Link is supported by your module before using this function. For more information on product variants that support IO-Link, see *Supported product variants*

> **Note**
>
> A login is required to use this call (see *REST Login*).

Device-specific parameters for connected IO-Link devices can be set via the following address:

http://[ip-address]/iolink/v1/devices/{deviceAlias}/parameters/{index}/value

The *deviceAlias* corresponds to the device designation of the IO-Link device (e.g. *Port_X00*). The *index* reflects the ISDU parameter variable to be set in the IO-Link device. In the case of the *applicationSpecificTag*, this would be the value 24.

To set values, a JSON object must also be specified, in which corresponding parameters and values are specified as in the following example:

```
{ "value": [
49,
50,
51,
52,
53,
54
]}
```

In the case above, parameter 24 (*applicationSpecificTag*) was described with the ASCII string `"123456"`.

Successful execution is not confirmed in the form of a JSON object, but with a Code 204 (*Successful operation*).

Setting a master parameter (sysName)

> **Note**
>
> A login is required to use this call (see *REST Login*).

A master parameter, such as *SysName*, can be set via the following address: http://[ip-address]/api/balluff/v1/

A JSON object with the corresponding information must also be specified:

```
{
  "sysName": "[SysName]"
}
```

Successful execution is not confirmed in the form of a JSON object, but with a Code 204 (*Successful operation*).

> **Note**
>
> If you are unable to implement your application case with the examples listed below and the information from the specifications for the REST APIs, please contact Balluff with a description of your application case.
> You can find the contact details at www.balluff.com.

CHAPTER

SEVEN

REPAIR, DISASSEMBLY AND DISPOSAL

7.1 Repair

Repairs to the product may only be performed by Balluff.

If the product is defective, contact our Service Center.

7.2 Disassembly

- Only disassemble the device when it is de-energized!

7.3 Disposal

- Observe the national regulations for disposal.

Note

Additional information can be found at **www.balluff.com** on the product page.

CHAPTER

EIGHT

LEGACY GUIDES

To see the legacy guides, visit the online versions of this documentation.

Headquarters and Technical Service Hubs

www.balluff.com/go/contact

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