BALLUFF
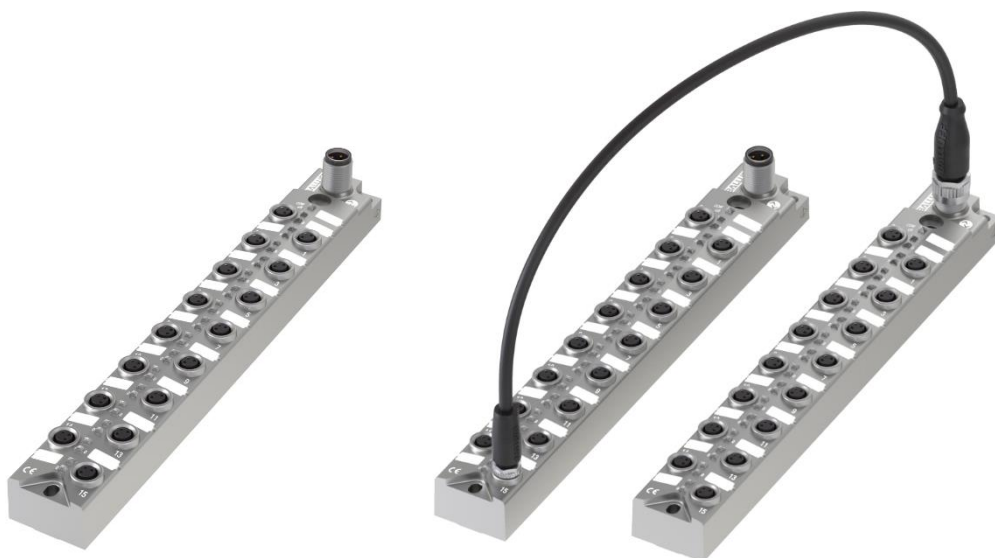
BNI IOL-104-002-Z046

IO-Link 1.1 Sensor hub
with extension port
User´s Guide

Contents

1   User Instructions

1.1. About this Manual

This manual describes the Balluff IO-Link I/O module, also called a sensor/actuator hub. The IO-Link protocol is used to link to the higher-level master module.
In terms of function, this compact, cost-effective module is similar to a passive splitter box; it records digital sensor signals and transmits them over the IO-Link interface. It passes control signals coming over IO-Link to the connected actuators.

1.2. Structure of the Manual

The manual is organized so that the sections build on one another.
Chapter 2: Basic safety information.
……..

1.3. Typographical Conventions

The following typographical conventions are used in this manual.

Enumerations

Enumerations are shown as a list with an en-dash.
  − Entry 1.
  − Entry 2.

Actions

Action instructions are indicated by a preceding triangle. The result of an action is indicated by an arrow.
  ➢ Action instruction 1.
  ↳ Action result.
  ➢ Action instruction 2.

Syntax

Numbers:
Decimal numbers are shown without additional indicators (e.g. 123), hexadecimal numbers are shown with the additional indicator hex (e.g. 3F$_{hex}$).

Cross references

Cross references indicate where additional information on the topic can be found.

1.4. Symbols

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

ℹ **Note**
This symbol indicates general notes.

1.5. Abbreviations

BNI	Balluff Network Interface
DPP	Direct Parameter Page
I port	Digital Input Port
EMC	Electromagnetic compatibility
FE	Function ground
IOL	IO-Link
LSB	Least Significant Bit
MSB	Most Significant Bit
SPDU	Service Protocol Data Unit

1.6. Differing views

Product views and images in this manual may differ from the product described. They are intended to serve only as illustrations.

2   Safety

2.1. Intended use

The BNI IOL-… acts as a decentral sensor input module, which is connected by an IO-Link interface to a higher-level master module.

2.2. Installation and Startup

⚠ **Attention!**
Installation and startup must only be carried out by trained technical personnel. Qualified personnel are people who are familiar with installation and operation of the product and have the necessary qualifications for these tasks. Any damage resulting from unauthorized tampering or improper use voids the manufacturer's guarantee and warranty. The operator must ensure that appropriate safety and accident prevention regulations are observed.

2.3. General Safety Instructions

Commissioning and inspection
Before commissioning, carefully read the user's guide.
The system must not be used in applications in which the safety of persons is dependent upon proper functioning of the device.
Authorized personnel
Installation and startup must only be carried out by trained technical personnel.
Intended use
Warranty and liability claims against the manufacturer are rendered void by:
- – Unauthorized tampering
- – Improper use
- – Use, installation or handling contrary to the instructions provided in this user's guide

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

2.4. Resistance to aggressive substances

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

Hazardous voltage

⚠ **Attention!**
Before maintenance, disconnect the device from the power supply.

ℹ **Note**
In the interests of product improvement, Balluff GmbH reserves the right to change the technical data of the product and the content of this manual at any time without notice.

3 First Steps

3.1. Connection Overview
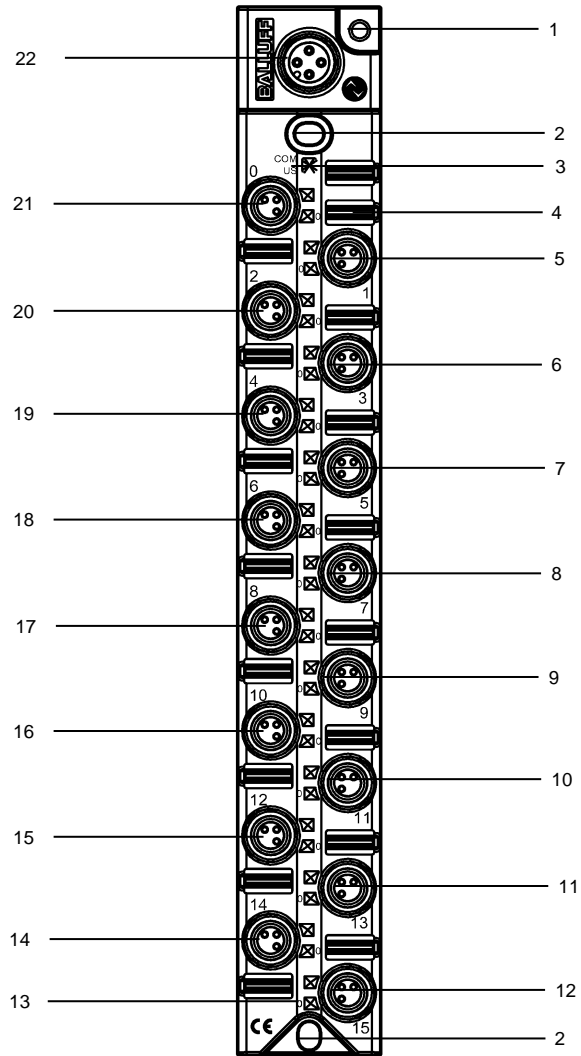
Figure 3-1: Connection overview BNI IOL-104-002-Z046

1 Ground connection	13 Pin/Port LED: signal status
2 Mounting hole	14 Port 14
3 Status LED: communication	15 Port 12
4 Part label	16 Port 10
5 Port 1	17 Port 8
6 Port 3	18 Port 6
7 Port 5	19 Port 4
8 Port 7	20 Port 2
9 Port 9	21 Port 0
10 Port 11	22 IO-Link Interface
11 Port 13	
12 Port 15, extension port	

3	First Steps

3.2.	Mechanical Connection	The BNI IOL modules are attached using 2 max. M4 screws and 2 washers.
3.3.	Electrical Connection	The BNI IOL-xxx-002-Z046 modules do not require a separate supply voltage connection. Supply voltage is provided via the IO-Link interface and the higher-level IO-Link master module.
	Function ground	The modules are equipped with a ground connection.
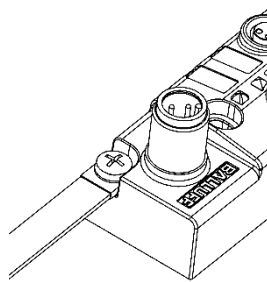
Figure 3-3: BNI ground connection IOL...

➢ Connect the sensor hub module to the ground connection.

ℹ **Note**
The FE-connection from the housing to the machine must have low impedance and be as short as possible.

IO-Link connection

The IO-Link connection is established via an M12 connector (A-coded, male).

IO-Link (M12, A-coded, male)
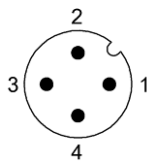
Pin	Requirement
1	Supply voltage controller US, +24V
2	Not used
3	GND, reference potential
4	C/Q, IO-Link data transmission channel

⚠ **Attention!**
Overcurrent. Defective or absent fusing of the supply voltage for the sensor and actuator will result in their damage or destruction.
Use a fuse or an intelligent power supply (current monitoring designed for maximum 4 A) which turns off power when overcurrent is present.

3	**First Steps**

Connecting the sensor hub

➢ Connect ground conductor to the FE terminal, if available.
➢ Connect the incoming IO-Link cable to the sensor hub.
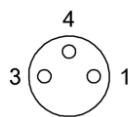
i **Note**
A standardized sensor cable is used to connect to the higher-level IO-Link master module. Maximum length of 20 m.

Module variants

Sensor hub variants	Digital port
BNI IOL-104-002-Z046	IN

Sensor interface

Port

Pin	Function
	IN
1	+24V
4	In
3	0V

i **Note**
For the digital inputs, the input guideline specified in EN 61131-2, Type 3 applies
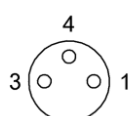
i **Note**
Unused input port sockets must be fitted with blind caps to ensure the IP67 degree of protection.

Extension port

Extension port (M8, female)
The port acts like a sensor interface if the extension function is deactivated.

Pin	Function
	IN
1	+24V
4	Communication
3	0V

i **Note**
A standardized sensor cable is used to connect to the device/sensor to be extended. Maximum length of 20 m.

| 4 | **General Configuration** |

4.1. Extension port

The BNI IOL-104-002-Z046 module gives you the ability to use the No. 15 slot in various ways. By default it is used as a digital input slot, where Pin 4 can be used as a digital input. This slot can be used as an extension port by making a corresponding entry in the parameter with an index of 55hex. It is thus possible to run of the following modules via Slot No. 15:

- BNI IOL-104-002-Z046
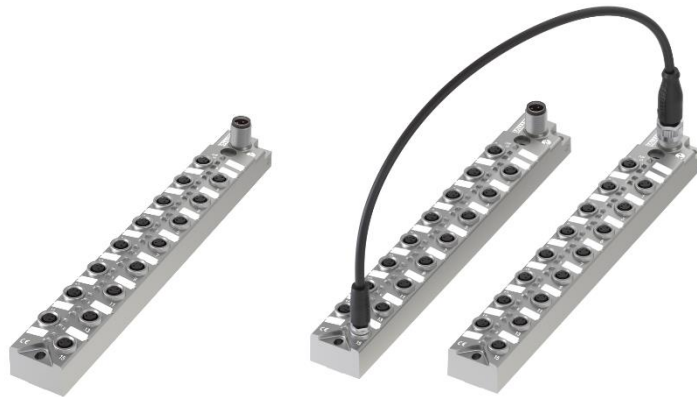
Extension port configuration

Configuration	Value Index 55hex
BNI IOL-104-002-Z046	0
BNI IOL-104-002-Z046 with BNI IOL-104-002-Z046	1

i **Note**
The "Factory reset" command does not affect the configuration of the extension port in any way.

i **Note**
The process data length depends on the configuration.

The extension port can be configured using the parameter 55hex (see table). If data storage or validation is used, validation (identical) must be used for configuring. Depending on the system, the Device ID has to be entered (parameter data table) or the Device ID is read out from the IODD.

Setting the serial number 54hex

The serial number has a default value of 16x00hex.
In order to use the "Identity" master validation mode, a serial number can be set using this parameter.
This prevents a device from connecting to the wrong master port.

5 Configuration: "Extension Off"

5.1. IO-Link data

BNI IOL-104-002-Z046 Extension port	
Transmission rate	COM2 (38.4 kBaud)
Minimum cycle time	3.5 ms
Process data length	2-byte input

5.2. Process Data/Input Data

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

5   Configuration: "Extension Off"

5.3. Parameter Data / Demand Data

	DPP	ISDU		Parameter	Data width	Access rights	Default value
	Index	Index	Subindex				
Identification data	07hex			Vendor ID	2 bytes	Read only	0378hex
	08hex						
	09hex			Device ID	3 bytes		005 0D 40hex
	0Ahex						
	0Bhex						
		10hex	0	Vendor Name	-		BALLUFF
		11hex	0	Vendor text	-		www.balluff.com
		12hex	0	Product Name	-		BNI IOL-104-002-Z046
		13hex	0	Product ID	-		BNI00AY
		14hex	0	Product text	-		Sensor hub M8
		15hex	0	Serial number	16 bytes		0hex
		16hex	0	Hardware revision			
		17hex	0	Firmware revision			
		18hex	0	Application-specific tag	32 bytes		0hex

Parameter Data / Demand Data

	DPP	ISDU		Parameter	Data width	Access rights	Default Value
	Index	Index	Subindex				
Parameter data		40hex 64	0 1-16	Inversion of the inputs	2 bytes	Read/write	0hex
		44hex 68	0 1-24	Voltage monitoring	3 bytes	Read	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00 hex
		55hex 85	0	Extension port	1 byte	Read/write	-

5   Configuration: "Extension Off"

Inversion of the inputs (40hex)

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Subindex	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
Description	Inversion of Port 7 Pin 4	Inversion of Port 6 Pin 4	Inversion of Port 5 Pin 4	Inversion of Port 4 Pin 4	Inversion of Port 3 Pin 4	Inversion of Port 2 Pin 4	Inversion of Port 1 Pin 4	Inversion of Port 0 Pin 4	Inversion of Port 15 Pin 4	Inversion of Port 14 Pin 4	Inversion of Port 13 Pin 4	Inversion of Port 12 Pin 4	Inversion of Port 11 Pin 4	Inversion of Port 10 Pin 4	Inversion of Port 9 Pin 4	Inversion of Port 8 Pin 4

Inversion of port (x):
0 – Normal
1 - Inverted.

Voltage monitoring 44hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
Description	Short-circuit Port 7 Pin 1	Short-circuit Port 6 Pin 1	Short-circuit Port 5 Pin 1	Short-circuit Port 4 Pin 1	Short-circuit Port 3 Pin 1	Short-circuit Port 2 Pin 1	Short-circuit Port 1 Pin 1	Short-circuit Port 0 Pin 1	Short-circuit Port 15 Pin 1	Short-circuit Port 14 Pin 1	Short-circuit Port 13 Pin 1	Short-circuit Port 12 Pin 1	Short-circuit Port 11 Pin 1	Short-circuit Port 10 Pin 1	Short-circuit Port 9 Pin 1	Short-circuit Port 8 Pin 1

Byte	2							
Bit	7	6	5	4	3	2	1	0
Sub-Index								17
Description	-	-	-	-	-	-	-	Undervoltage US

6 Configuration: Extended with BNI IOL-104-002-Z046

6.1. IO-Link data

BNI IOL-104-002-Z046 extended with BNI IOL-104-002-Z046	
Transmission rate	COM2 (38.4 kBaud)
Minimum cycle time	4.1 ms
Process data length	4-byte input

6.2. Process Data/Input Data

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

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

6 Configuration: Extended with BNI IOL-104-002-Z046

6.3. Parameter Data / Demand Data

	DPP	ISDU		Parameter	Data width	Access rights	Default value
	Index	Index	Subindex				
Identification data	07hex			Vendor ID	2 bytes	Read only	0378hex
	08hex						
	09hex			Device ID	3 bytes		05 0D 41hex
	0Ahex						
	0Bhex						
		10hex	0	Vendor Name	-		BALLUFF
		11hex	0	Vendor text	-		www.balluff.com
		12hex	0	Product Name	-		BNI IOL-104-002-Z046 with BNI IOL-104-002-Z046
		13hex	0	Product ID	-		BNI00AY with BNI00AY
		14hex	0	Product text	-		Sensor Hub M8 with Sensor Hub M8
		15hex	0	Serial number	16 bytes		0hex
		16hex	0	Hardware revision			
		17hex	0	Firmware revision			
		18hex	0	Application-specific tag	32 bytes		0hex

Parameter Data / Demand Data

	DPP	ISDU		Parameter	Data width	Access rights	Default Value
	Index	Index	Subindex				
Parameter data		40hex 64	0 1-32	Inversion of the inputs	4 bytes	Read/write	0hex
		44hex 68	0 1-48	Voltage monitoring	6 bytes	Read	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	1hex

6   Configuration: Extended with BNI IOL-104-002-Z046

Inversion of the inputs (40hex)

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	8	7	6	5	4	3	2	1		15	14	13	12	11	10	9
Description	Inversion of Port 7 Pin 4	Inversion of Port 6 Pin 4	Inversion of Port 5 Pin 4	Inversion of Port 4 Pin 4	Inversion of Port 3 Pin 4	Inversion of Port 2 Pin 4	Inversion of Port 1 Pin 4	Inversion of Port 0 Pin 4	-	Inversion of Port 14 Pin 4	Inversion of Port 13 Pin 4	Inversion of Port 12 Pin 4	Inversion of Port 11 Pin 4	Inversion of Port 10 Pin 4	Inversion of Port 9 Pin 4	Inversion of Port 8 Pin 4

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	24	23	22	21	20	19	18	17	32	31	30	29	28	27	26	25
	Extension port															
Description	Inversion of Port 7 Pin 4	Inversion of Port 6 Pin 4	Inversion of Port 5 Pin 4	Inversion of Port 4 Pin 4	Inversion of Port 3 Pin 4	Inversion of Port 2 Pin 4	Inversion of Port 1 Pin 4	Inversion of Port 0 Pin 4	Inversion of Port 15 Pin 4	Inversion of Port 14 Pin 4	Inversion of Port 13 Pin 4	Inversion of Port 12 Pin 4	Inversion of Port 11 Pin 4	Inversion of Port 10 Pin 4	Inversion of Port 9 Pin 4	Inversion of Port 8 Pin 4

Inversion of port (x):
0 - Normal
1 - Inverted

6   Configuration: Extended with BNI IOL-104-002-Z046

Voltage monitoring 44hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
Description	Short-circuit Port 7 Pin 1	Short-circuit Port 6 Pin 1	Short-circuit Port 5 Pin 1	Short-circuit Port 4 Pin 1	Short-circuit Port 3 Pin 1	Short-circuit Port 2 Pin 1	Short-circuit Port 1 Pin 1	Short-circuit Port 0 Pin 1	Short-circuit Port 15 Pin 1	Short-circuit Port 14 Pin 1	Short-circuit Port 13 Pin 1	Short-circuit Port 12 Pin 1	Short-circuit Port 11 Pin 1	Short-circuit Port 10 Pin 1	Short-circuit Port 9 Pin 1	Short-circuit Port 8 Pin 1

Byte	2							
Bit	7	6	5	4	3	2	1	0
Sub-Index								17
Description	-	-	-	-	-	-	-	Undervoltage US

Byte	3								4							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	32	31	30	29	28	27	26	25	40	39	38	37	36	35	34	33
	Extension port															
Description	Short-circuit Port 7 Pin 1	Short-circuit Port 6 Pin 1	Short-circuit Port 5 Pin 1	Short-circuit Port 4 Pin 1	Short-circuit Port 3 Pin 1	Short-circuit Port 2 Pin 1	Short-circuit Port 1 Pin 1	Short-circuit Port 0 Pin 1	Short-circuit Port 15 Pin 1	Short-circuit Port 14 Pin 1	Short-circuit Port 13 Pin 1	Short-circuit Port 12 Pin 1	Short-circuit Port 11 Pin 1	Short-circuit Port 10 Pin 1	Short-circuit Port 9 Pin 1	Short-circuit Port 8 Pin 1

6   Configuration: Extended with BNI IOL-104-002-Z046

Byte	5							
Bit	7	6	5	4	3	2	1	0
Sub-Index								41
	Extension port							
Description	'	'	'	'	'	'	'	Undervoltage US

Setting the serial number 54hex

The serial number has a default value of 16x00hex.
In order to use the "Identity" master validation mode, a serial number can be set using this parameter.
This prevents a device from connecting to the wrong master port.

7	Diagnostics

7.1. Error Codes/ Errors

| Error Code	Description
0x8011	Index not available
0x8012	Subindex not available
0x8023	Access Denied
0x8033	Parameter length overrun
0x8034	Parameter length underrun
0x8035	Function not available

7.2. Events

IO-Link Revision 1.0	
Event Code	**Description**
0x5112	Low sensor voltage (US)
0x5114	Low actor voltage (UA)
0x5410	Output Stages
0x8DF0	Retry at the extension port
0x8DF1	Device lost at the extension port
0x8DF2	Wrong device at the extension port
IO-Link Revision 1.1	
Event Code	**Description**
0x5111	Low sensor voltage (US)
0x5112	Low actor voltage (UA)
0x7710	Short circuit
0x8DF0	Retry at the extension port
0x8DF1	Device lost at the extension port
0x8DF2	Wrong device at the extension port

8   IO-Link functions

8.1. IO-Link Version 1.0 / 1.1

This device can be operated with an IO-Link master according to IO-Link version 1.0 and version 1.1. Version-specific functions such as data storage (version 1.1) are only supported in combination with a suitable IO-Link master.

8.2. Data Storage

Each IO-Link master of IO-Link version 1.1 features data storage in which an image of the IO-Link device configuration can be stored. When a device is replaced, the stored configuration is automatically transferred to the new device. This guarantees minimal downtime. Validation must be switched on in order to use the data storage. For information about the configuration of data storage and validation, please refer to the user's guide of the respective IO-Link master.

8.3. Block Configuration

The device supports block configuration. This allows all parameters in a data block to be consistently imported from a controller or a configuration tool into the device.

8.4. Resetting to Factory Settings

The factory settings on the device can be restored by running the "restore factory settings" system command.
0x82 must be written to Index 2 Subindex 0 for the command.
The extension port setting is not reset in this process.

9	Technical Data

9.1. Dimensions
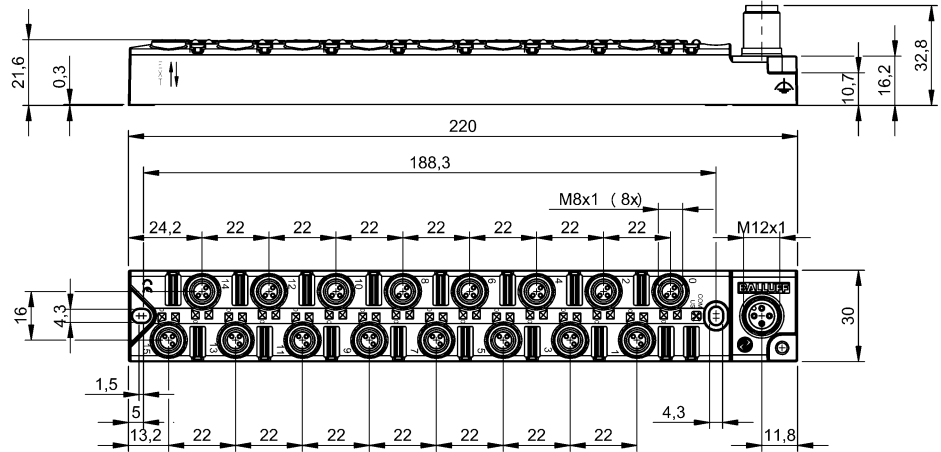
9.2. Mechanical Data

Housing material	die-cast zinc, matte nickel-plated
IO-Link port	M12, A-coded, plug
Inputs port	16xM8, jack
Weight	402 g
Dimensions (L×W×H)	30 x 220 x 32.8 (mm)

9.3. Electrical Data

Operating voltage	18–30.2 V DC, corresponding to EN 61131-2
Ripple	< 1%
Current consumption without load (extension off)	≤ 90 mA
Load current (PIN 1)	Max. 200 mA (temperature-dependent)
Total current US	3.5 A
Inputs	PNP, type 3

9.4. Operating conditions

Ambient temperature	–5 °C … +70 °C
Storage temperature	–25 °C … +70 °C
Degree of protection	IP67 (only when plugged-in and screwed together using Balluff cable)
Vibration/shock	EN 60068-2-6, EN 60068-2-27 EN 60068-2-29, EN 60068-2-64

Balluff Network Interface / IO-Link

10   Function indicators

10.1. Function indicators

COM/
US
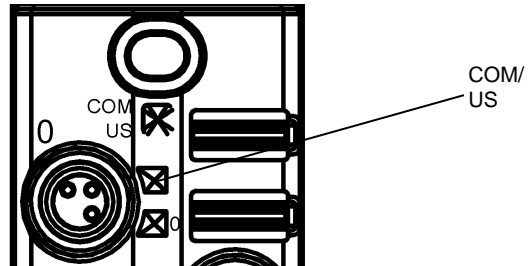
LED indicator module status

LED	Status	Function
COM US	Green	Communication error, US OK
	Green, flashing	Communication OK and US OK
	Red, flashing quickly	Undervoltage module

10 Function indicators

Digital LED indicators for inputs/outputs

LED 2, Input Pin 4

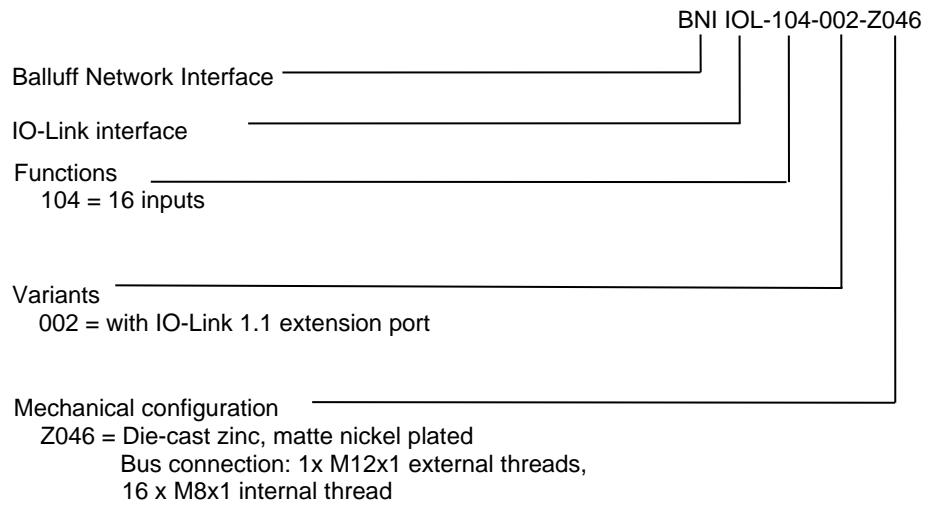| Status	Function
off	Input signal = 0
Yellow	Input signal = 1
Red	Sensor supply short-circuit

Extension port

The table is valid if the extension port is active. If the extension port is used as a standard I, then the description from "Digital LED indicators for inputs" can be used.

Status	Function
Green	IO-Link – connection active
Green, flashing	No IO-Link connection or faulty IO-Link device
Red, flashing	Incorrect IO-Link device or incorrect configuration (0x55)
Red	IO-Link short-circuit on Pin 4

11   Appendix

11.1. Type code

BNI IOL-104-002-Z046

Balluff Network Interface

IO-Link interface

Functions
    104 = 16 inputs

Variants
    002 = with IO-Link 1.1 extension port

Mechanical configuration
    Z046 = Die-cast zinc, matte nickel plated
            Bus connection: 1x M12x1 external threads,
            16 x M8x1 internal thread

11.2. Ordering information

Type code	Order code
BNI IOL-104-002-Z046	BNI00AY

www.balluff.com