BALLUFF

BNI IOL-302-002-E012
IO-Link 1.1 sensor/actuator hub
with extension port
User's Guide

Balluff Network Interface / IO-Link BNI IOL-302-002-E012

Contents

1 General

1.1. Structure of the Manual

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

1.2. 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 numerals are shown without an additional indicator (e.g. 123),
Hexadecimal numerals are shown with the additional indicator $_{hex}$ (e.g. 00$_{hex}$).

Cross-references

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

1.3. Symbols

⚠ **Attention!**
This symbol indicates a security notice which must be observed.

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

1.4. Abbreviations

BNI	Balluff Network Interface
DPP	Direct Parameter Page
I/O port	Digital input/output port
EMC	Electromagnetic compatibility
FE	Function ground
IOL	IO-Link
LSB	Least Significant Bit
MSB	Most Significant Bit
SPDU	Service Protocol Data Unit
US	Sensor supply undervoltage
UA	Actuator supply undervoltage
HF noise	High-frequency noise

1.5. Deviating views

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

1.6. Disposal

This product is covered by WEEE Directive 2012/19/EU on waste electrical and electronic equipment.

Dispose of the product properly and not as part of the regular waste stream. The regulations of the respective country are to be observed. Information is provided by the national authorities.

2.1. Intended use	The BNI IOL-… acts as a decentralized input/output sensor module, which is connected to a higher-level IO-Link master module through an IO-Link interface.

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 Notes

Commissioning and inspection
Before commissioning, carefully read the user's guide.
The system must not be used in applications in which the safety of persons 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. Use only 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 always have good chemical and oil resistance. When used in aggressive media (such as chemicals, oils, lubricants and coolants, each in a high concentration (i.e. too little water content)), the material must first be checked for resistance in the particular application. No defect claims may be asserted in the event of a failure or damage to the BNI modules caused by such aggressive media.

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.

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

3   First Steps

3.1. Connection Overview
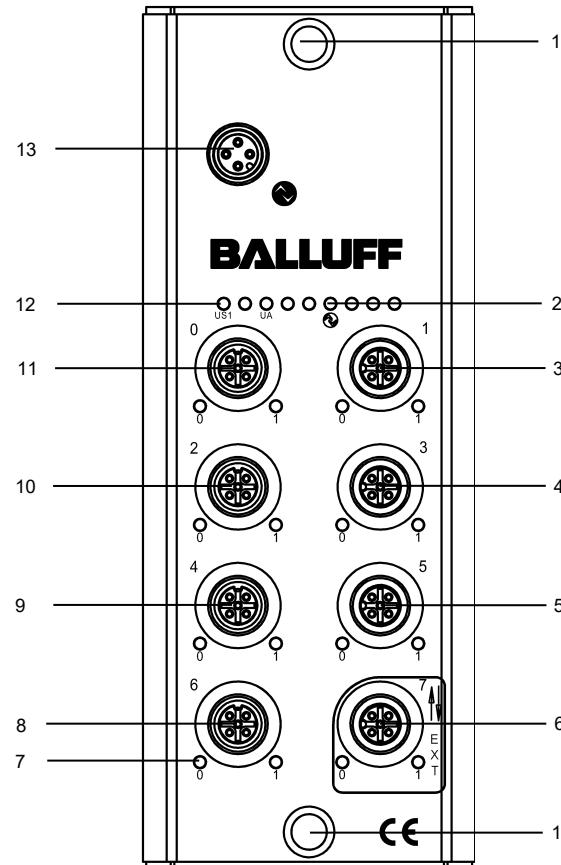
Figure 3-1: Connection overview BNI IOL-302-002-E012

1 Mounting hole/ground	8 Port 6
2 Status LED: communication	9 Port 4
3 Port 1	10 Port 2
4 Port 3	11 Port 0
5 Port 5	12 Status LED: supply module
6 Port 7, extension port	13 IO-Link Interface
7 Pin/Port LED: signal status	

3.2.	**Mechanical Connection**	The BNI IOL modules are attached using 2 M6 screws and 2 washers.

3.3.	**Electrical Connection**	The 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
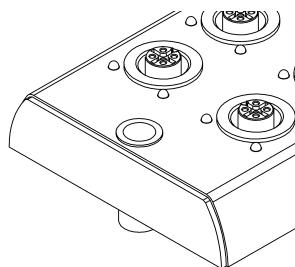
Fig. 3-3: Ground connection using mounting screw

> **Note**
> The function ground connection from the housing to the machine must have low-impedance and is made using the mounting screw.

IO-Link connection

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

IO-Link (M12, A-coded, male)
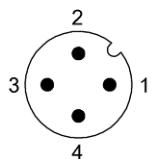
Pin	Requirement
1	Supply voltage for controller/sensors US, +24V
2	Supply voltage for actuators UA, +24V
3	GND, reference potential
4	C/Q, IO-Link data transmission channel

3   First Steps

Connecting the sensor hub	➢ Connect ground conductor to the functional ground connection, 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 to the IO-Link master module. Maximum length of 20 m.

Module variants

Sensor hub variants	Digital port
BNI IOL-302-002-E012	16 inputs/outputs

Sensor interface   Digital input port (M12, A-coded, female)
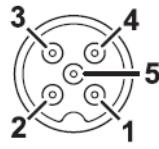
Pin	Requirement
1	+24 V
2	Input / output 2
3	0 V, GND
4	Input / output 1
5	Function GND

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 IP69 degree of protection.

Extension port 55hex   Extension port (M12, A-coded, female)
The port acts like a sensor/actuator interface if the extension function is disabled.
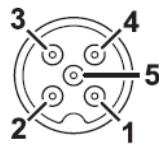
Pin	Requirement
1	+24 V
2	Extension port for actuator power supply
3	0 V, GND
4	Communication
5	FE

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

The modules gives you the ability to use the No. 7 slot in various ways. By default, it is used as a digital input slot, where both pin 2 and 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. This makes it possible to operate one of the following modules using the No. 7 slot.
BNI IOL-302-002-E012
BNI IOL-751-V08-K007
BNI IOL-751-V10-K007
BNI IOL-751-V13-K007

Extension port configuration 55hex

Configuration	Index 55hex value
BNI IOL-302-002-E012	0
BNI IOL-302-002-E012 with BNI IOL-302-002-E012	1
BNI IOL-302-002-E012 with BNI IOL-751-V08-K007	2
BNI IOL-302-002-E012 with BNI IOL-751-V10-K007	3
BNI IOL-302-002-E012 with BNI IOL-751-V13-K007	4

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 parameter 0x55 (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-302-002-E012 extension off	
Transmission rate	COM2 (38.4 kBaud)
Minimum cycle time	4.0 ms
Process data length	2 byte input, 2 byte output

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 7 Pin 2	Input Port 6 Pin 2	Input Port 5 Pin 2	Input Port 4 Pin 2	Input Port 3 Pin 2	Input Port 2 Pin 2	Input Port 1 Pin 2	Input Port 0 Pin 2

5.3. Process Data/ Output Data

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Output Port 7 Pin 4	Output Port 6 Pin 4	Output Port 5 Pin 4	Output Port 4 Pin 4	Output Port 3 Pin 4	Output Port 2 Pin 4	Output Port 1 Pin 4	Output Port 0 Pin 4	Output Port 7 Pin 2	Output Port 6 Pin 2	Output Port 5 Pin 2	Output Port 4 Pin 2	Output Port 3 Pin 2	Output Port 2 Pin 2	Output Port 1 Pin 2	Output Port 0 Pin 2

5.4. Parameter Data / Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default value
	Index	Index	Sub-index				
Identification data	07hex 07			Vendor ID	2 bytes	**Read only**	0378hex
	08hex 08						
	09hex 09			Device ID	3 bytes		0x05 0D 80
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor Name	-		BALLUFF
		11hex 17	0	Vendor text	-		www.balluff.com
		12hex 18	0	Product Name	-		BNI IOL-302-002-E012
		13hex 19	0	Product ID	-		BNI00AR
		14hex 20	0	Product text	-		M12 sensor/actuator hub
		15hex 21	0	Serial number	16 bytes		0hex
		16hex 22	0	Hardware revision			
		17hex 23	0	Firmware revision			
		18hex 24	0	Application-specific tag	32 bytes		0hex

	DPP	SPDU		Parameter	Data width	Access rights	Default Value
	Index	Index	Sub-index				
Parameter data		40hex 64	0 1-16	Inversion of the inputs	2 bytes	Read/write	0hex
		41hex 65	0 1-16	Config. inputs/outputs	2 bytes	Read/write	0hex
		42hex 66	0 1-16	Safe state on Pin 4	4 bytes	Read/write	0hex
		43hex 67	0 1-8	Safe state on Pin 2	2 bytes	Read/write	0hex
		44hex 68	0 1-16	Voltage monitoring	2 bytes	Read	-
		45hex 69	0 1-16	Output monitoring	2 bytes	Read	-
		46hex 70	0 1-16	Actuator warning	2 bytes	Read	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	0hex

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
Sub-Index	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 7 Pin 2	Inversion of Port 6 Pin 2	Inversion of Port 5 Pin 2	Inversion of Port 4 Pin 2	Inversion of Port 3 Pin 2	Inversion of Port 2 Pin 2	Inversion of Port 1 Pin 2	Inversion of Port 0 Pin 2

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

Configuration of inputs/outputs 41hex

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	Direction Port 7 Pin 4	Direction Port 6 Pin 4	Direction Port 5 Pin 4	Direction Port 4 Pin 4	Direction Port 3 Pin 4	Direction Port 2 Pin 4	Direction Port 1 Pin 4	Direction Port 0 Pin 4	Direction Port 15 Pin 4	Direction Port 14 Pin 4	Direction Port 13 Pin 4	Direction Port 12 Pin 4	Direction Port 11 Pin 4	Direction Port 10 Pin 4	Direction Port 9 Pin 4	Direction Port 8 Pin 4

Direction of port (x):
0 – Input
1 – Output

Safe state of Outputs 42hex

The safe state parameter makes it possible to configure the outputs in case of a fault. If no IO-Link communication is possible or the "valid flag" of the output process data has not been set by the master, then each output adopts the configured status. The following statuses can be configured for each pin.

Safe state of the outputs on Pin 4 42hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index		4		3		2		1		8		7		6		5
Description	Safe state Port 3 Pin 4		Safe state Port 2 Pin 4		Safe state Port 1 Pin 4		Safe state Port 0 Pin 4		Safe state Port 7 Pin 4		Safe state Port 6 Pin 4		Safe state Port 5 Pin 4		Safe state Port 4 Pin 4	

Safe state of the outputs on Pin 2 43hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	4		3		2		1		8		7		6		5	
Description	Safe state Port 3 Pin 2		Safe state Port 2 Pin 2		Safe state Port 1 Pin 2		Safe state Port 0 Pin 2		Safe state Port 7 Pin 2		Safe state Port 6 Pin 2		Safe state Port 5 Pin 2		Safe state Port 4 Pin 2	

Value		Output state
bin	**dec**	
00	0	Output is 0V
01	1	Output is 24V
10	2	Current status is maintained
11	3	Not defined

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					12	11		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	-	-	-	-	Output off (UA too low)	Undervoltage UA	-	Undervoltage US1

5   Configuration: "Extension Off"

Monitoring the outputs 45hex

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 4	Short-circuit Port 6 Pin 4	Short-circuit Port 5 Pin 4	Short-circuit Port 4 Pin 4	Short-circuit Port 3 Pin 4	Short-circuit Port 2 Pin 4	Short-circuit Port 1 Pin 4	Short-circuit Port 0 Pin 4	Short-circuit Port 7 Pin 2	Short-circuit Port 6 Pin 2	Short-circuit Port 5 Pin 2	Short-circuit Port 4 Pin 2	Short-circuit Port 3 Pin 2	Short-circuit Port 2 Pin 2	Short-circuit Port 1 Pin 2	Short-circuit Port 0 Pin 2

Monitoring the outputs 46hex

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	Warning Port 7 Pin 4	Warning Port 6 Pin 4	Warning Port 5 Pin 4	Warning Port 4 Pin 4	Warning Port 3 Pin 4	Warning Port 2 Pin 4	Warning Port 1 Pin 4	Warning Port 0 Pin 4	Warning Port 7 Pin 2	Warning Port 6 Pin 2	Warning Port 5 Pin 2	Warning Port 4 Pin 2	Warning Port 3 Pin 2	Warning Port 2 Pin 2	Warning Port 1 Pin 2	Warning Port 0 Pin 2

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.

Configuration of the extension port 55hex

Configuration	Index 55hex value
BNI IOL-302-002-E012	0
BNI IOL-302-002-E012 with BNI IOL-302-002-E012	1
BNI IOL-302-002-E012 with BNI IOL-751-V08-K007	2
BNI IOL-302-002-E012 with BNI IOL-751-V10-K007	3
BNI IOL-302-002-E012 with BNI IOL-751-V13-K007	4

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

6.1. IO-Link data

BNI IOL-302-002-E012 extended with BNI IOL-302-002-E012	
Transmission rate	COM2 (38.4 kBaud)
Minimum cycle time	5.0 ms
Process data length	4 bytes input, 4 bytes output

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 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 6 Pin 2	Input Port 5 Pin 2	Input Port 4 Pin 2	Input Port 3 Pin 2	Input Port 2 Pin 2	Input Port 1 Pin 2	Input Port 0 Pin 2

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 7 Pin 2	Input Port 6 Pin 2	Input Port 5 Pin 2	Input Port 4 Pin 2	Input Port 3 Pin 2	Input Port 2 Pin 2	Input Port 1 Pin 2	Input Port 0 Pin 2

6 Configuration: Extended with BNI IOL-302-002-E012

6.3. Process Data/ Output Data

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	-	Output Port 6 Pin 4	Output Port 5 Pin 4	Output Port 4 Pin 4	Output Port 3 Pin 4	Output Port 2 Pin 4	Output Port 1 Pin 4	Output Port 0 Pin 4	-	Output Port 6 Pin 2	Output Port 5 Pin 2	Output Port 4 Pin 2	Output Port 3 Pin 2	Output Port 2 Pin 2	Output Port 1 Pin 2	Output Port 0 Pin 2

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Extension port															
Description	Output Port 7 Pin 4	Output Port 6 Pin 4	Output Port 5 Pin 4	Output Port 4 Pin 4	Output Port 3 Pin 4	Output Port 2 Pin 4	Output Port 1 Pin 4	Output Port 0 Pin 4	Output Port 7 Pin 2	Output Port 6 Pin 2	Output Port 5 Pin 2	Output Port 4 Pin 2	Output Port 3 Pin 2	Output Port 2 Pin 2	Output Port 1 Pin 2	Output Port 0 Pin 2

6.4. Parameter Data / Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default value
	Index	Index	Sub-index				
Identification data	07hex 7			Vendor ID	2 bytes	Read only	0378hex
	08hex 8						
	09hex 9			Device ID	3 bytes		0x05 0D 81
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor Name	-		BALLUFF
		11hex 17	0	Vendor text	-		www.balluff.com
		12hex 18	0	Product Name	-		BNI IOL-302-002-E012 with BNI IOL-302-002-E012
		13hex 19	0	Product ID	-		BNI00AR with BNI00AR
		14hex 20	0	Product text	-		Sensor hub M12 extended with sensor hub M12
		15hex 21	0	Serial number	16 bytes		0hex
		16hex 22	0	Hardware revision			
		17hex 23	0	Firmware revision			
		18hex 24	0	Application-specific tag	32 bytes		0hex

Parameter Data / Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default Value
	Index	Index	Sub-index				
Parameter data		40hex 64	0 1-32	Inversion of the inputs	4 bytes	Read/write	0hex
		41hex 65	0 1-16	Config. inputs/outputs	2 bytes	Read/write	0hex
		42hex 66	0 1-16	Safe state on Pin 4	4 bytes	Read/write	0hex
		43hex 67	0 1-8	Safe state on Pin 2	2 bytes	Read/write	0hex
		44hex 68	0 1-32	Voltage monitoring	4 bytes	Read	-
		45hex 69	0 1-16	Output monitoring	2 bytes	Read	-
		46hex 70	0 1-16	Actuator warning	2 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-302-002-E012

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	16	15	14	13	12	11	10	9
Description	-	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 6 Pin 2	Inversion of Port 5 Pin 2	Inversion of Port 4 Pin 2	Inversion of Port 3 Pin 2	Inversion of Port 2 Pin 2	Inversion of Port 1 Pin 2	Inversion of Port 0 Pin 2

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 7 Pin 2	Inversion of Port 6 Pin 2	Inversion of Port 5 Pin 2	Inversion of Port 4 Pin 2	Inversion of Port 3 Pin 2	Inversion of Port 2 Pin 2	Inversion of Port 1 Pin 2	Inversion of Port 0 Pin 2

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

Configuration of inputs/outputs 41$_{hex}$

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

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	Direction Port 7 Pin 4	Direction Port 6 Pin 4	Direction Port 5 Pin 4	Direction Port 4 Pin 4	Direction Port 3 Pin 4	Direction Port 2 Pin 4	Direction Port 1 Pin 4	Direction Port 0 Pin 4	Direction Port 7 Pin 2	Direction Port 6 Pin 2	Direction Port 5 Pin 2	Direction Port 4 Pin 2	Direction Port 3 Pin 2	Direction Port 2 Pin 2	Direction Port 1 Pin 2	Direction Port 0 Pin 2

Direction of port (x):
0 – Input
1 – Output

Safe state of Outputs 42$_{hex}$

The safe state parameter makes it possible to configure the outputs in case of a fault. If no IO-Link communication is possible or the "valid flag" of the output process data has not been set by the master, then each output adopts the configured status. The following statuses can be configured for each pin.

6　Configuration: Extended with BNI IOL-302-002-E012

Safe state of the outputs on Pin 4 42hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	4		3		2		1				7		6		5	
Description	Safe state Port 3 Pin 4		Safe state Port 2 Pin 4		Safe state Port 1 Pin 4		Safe state Port 0 Pin 4		-		Safe state Port 6 Pin 4		Safe state Port 5 Pin 4		Safe state Port 4 Pin 4	

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	12		11		10		9		16		15		14		13	
	Extension port															
Description	Safe state Port 3 Pin 4		Safe state Port 2 Pin 4		Safe state Port 1 Pin 4		Safe state Port 0 Pin 4		Safe state Port 7 Pin 4		Safe state Port 6 Pin 4		Safe state Port 5 Pin 4		Safe state Port 4 Pin 4	

Safe state of the outputs on Pin 2 43hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	4		3		2		1		8		7		6		5	
Description	Safe state Port 3 Pin 2		Safe state Port 2 Pin 2		Safe state Port 1 Pin 2		Safe state Port 0 Pin 2		Safe state Port 7 Pin 2		Safe state Port 6 Pin 2		Safe state Port 5 Pin 2		Safe state Port 4 Pin 2	

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	12		11		10		9		16		15		14		13	
Description	Extension port															
	Safe state Port 3 Pin 2		Safe state Port 2 Pin 2		Safe state Port 1 Pin 2		Safe state Port 0 Pin 2		Safe state Port 7 Pin 2		Safe state Port 6 Pin 2		Safe state Port 5 Pin 2		Safe state Port 4 Pin 2	

Value		Output state
bin	**dec**	
00	0	Output is 0V
01	1	Output is 24V
10	2	Current status is maintained
11	3	Not permitted

6   Configuration: Extended with BNI IOL-302-002-E012

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					12	11		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	'	'	'	'	Output off (UA too low)	Undervoltage UA	'	Undervoltage US1

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		25
	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	'	'	'	'	Output off (UA too low)	Undervoltage UA	'	Undervoltage US1

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.

7.1. IO-Link data

BNI IOL-302-002-E012, extended with valve terminal connector with 22/24 valves	
Transmission rate	COM2 (38.4 kBaud)
Minimum cycle time	5.1 ms
Process data length	2 byte input, 6 byte output

7.2. 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 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 6 Pin 2	Input Port 5 Pin 2	Input Port 4 Pin 2	Input Port 3 Pin 2	Input Port 2 Pin 2	Input Port 1 Pin 2	Input Port 0 Pin 2

7 Configuration Extended with Valve Terminal Connector with 22/24 Valves

7.3. Process Data/ Output Data

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Output Port 7 Pin 4	Output Port 6 Pin 4	Output Port 5 Pin 4	Output Port 4 Pin 4	Output Port 3 Pin 4	Output Port 2 Pin 4	Output Port 1 Pin 4	Output Port 0 Pin 4	Output Port 7 Pin 2	Output Port 6 Pin 2	Output Port 5 Pin 2	Output Port 4 Pin 2	Output Port 3 Pin 2	Output Port 2 Pin 2	Output Port 1 Pin 2	Output Port 0 Pin 2

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Valve terminal on extension port															
Description	-	-	-	-	* Valve 12 – Coil A	Valve 11 – Coil A	Valve 10 – Coil A	Valve 09 – Coil A	Valve 08 – Coil A	Valve 07 – Coil A	Valve 06 – Coil A	Valve 05 – Coil A	Valve 04 – Coil A	Valve 03 – Coil A	Valve 02 – Coil A	Valve 01 – Coil A

* No function for V013

Byte	4								5							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Valve terminal on extension port															
Description	-	-	-	-	* Valve 12 – Coil B	Valve 11 – Coil B	Valve 10 – Coil B	Valve 09 – Coil B	Valve 08 – Coil B	Valve 07 – Coil B	Valve 06 – Coil B	Valve 05 – Coil B	Valve 04 – Coil B	Valve 03 – Coil B	Valve 02 – Coil B	Valve 01 – Coil B

* No function for V013

7.4. Parameter Data / Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default value
	Index	Index	Sub-index				
Identification data	07hex 07			Vendor ID	2 bytes	Read only	0378hex
	08hex 08						
	09hex 09			Device ID	3 bytes		0x05 0D 82 0x05 0D 83 0x05 0D 84
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor Name	-		BALLUFF
		11hex 17	0	Vendor text	-		www.balluff.com
		12hex 18	0	Product Name	-		BNI IOL-302-002-E012 with BNI IOL-751-V08-K007 BNI IOL-302-002-E012 with BNI IOL-751-V10-K007 BNI IOL-302-002-E012 with BNI IOL-751-V13-K007
		13hex 19	0	Product ID	-		BNI00AR with BNI006N BNI006P BNI006R
		14hex 20	0	Product text	-		Sensor hub M12 extended with valve plug CG25 24 2-5 Sensor hub M12 extended with Valve plug CG13 24 2-3 Sensor hub M12 extended with Valve plug CG23-24 22 2-3
		15hex 21	0	Serial number	16 bytes		0hex
		16hex 22	0	Hardware revision			
		17hex 23	0	Firmware revision			
		18hex 24	0	Application-specific tag	32 bytes		0hex

	DPP	SPDU		Parameter	Data width	Access rights	Default Value
	Index	Index	Sub-index				
Parameter data		40hex 64	0 1-16	Inversion of the inputs	2 bytes	Read/write	0hex
		41hex 65	0 1-16	Config. inputs/outputs	2 bytes	Read/write	0hex
		42hex 66	0 1-38,40	Safe state output	10 bytes	Read/write	0hex
		43hex 67	0 1-8	Safe state on Pin 2	2 bytes	Read/write	0hex
		44hex 68	0 1-23	Voltage monitoring	3 bytes	Read	-
		45hex 69	0 1-40	Output monitoring	6 bytes	Read	-
		46hex 70	0 1-16	Actuator warning	2 bytes	Read	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	2, 3, 4hex

7 Configuration Extended with Valve Terminal Connector with 22/24 Valves

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

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

Configuration of inputs/outputs 41hex

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

Direction of port (x):
0 – Input
1 – Output

Safe state of Outputs 42hex

The safe state parameter makes it possible to configure the outputs in case of a fault. If no IO-Link communication is possible or the "valid flag" of the output process data has not been set by the master, then each output adopts the configured status. The following statuses can be configured for each pin.

Safe state of the outputs on Pin 4 42hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	4		3		2		1		8		7		6		5	
Description	Safe state Port 3 Pin 4		Safe state Port 2 Pin 4		Safe state Port 1 Pin 4		Safe state Port 0 Pin 4		-		Safe state Port 6 Pin 4		Safe state Port 5 Pin 4		Safe state Port 4 Pin 4	

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-index									23		21		19		17	
Description	Valve terminal on extension port															
	-		-		-		-		* Valve 12 – Coil A		Valve 11 – Coil A		Valve 10 – Coil A		Valve 09 – Coil A	

* No function for V013

Byte	4								5							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-index	15		13		11		9		7		5		3		1	
Description	Valve terminal on extension port															
	Valve 08 – Coil A		Valve 07 – Coil A		Valve 06 – Coil A		Valve 05 – Coil A		Valve 04 – Coil A		Valve 03 – Coil A		Valve 02 – Coil A		Valve 01 – Coil A	

7   Configuration Extended with Valve Terminal Connector with 22/24 Valves

Byte	6								7							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index									24		22		20		18	
	Valve terminal on extension port															
Description	-	-	-	-					* Valve 12 – Coil B		Valve 11 – Coil B		Valve 10 – Coil B		Valve 09 – Coil B	

* No function for V013

Byte	8								9							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	16		14		12		10		8		6		4		2	
	Valve terminal on extension port															
Description	Valve 08 – Coil B		Valve 07 – Coil B		Valve 06 – Coil B		Valve 05 – Coil B		Valve 04 – Coil B		Valve 03 – Coil B		Valve 02 – Coil B		Valve 01 – Coil B	

Safe state of the outputs on Pin 2 43hex

Byte	0								1							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index	4		3		2		1		8		7		6		5	
Description	Safe state Port 3 Pin 2		Safe state Port 2 Pin 2		Safe state Port 1 Pin 2		Safe state Port 0 Pin 2		-		Safe state Port 6 Pin 2		Safe state Port 5 Pin 2		Safe state Port 4 Pin 2	

Value		Output state
bin	**dec**	
00	0	Output is 0V
01	1	Output is 24V
10	2	Current status is maintained
11	3	Not defined

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					12	11		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	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	-	Undervoltage US1

Byte	2							
Bit	7	6	5	4	3	2	1	0
Sub-Index		23			20	19		17
	Valve terminal on extension port							
Description	-	Overload UA	-	-	Outputs off (UA too low)	Undervoltage UA	-	Undervoltage US

7 Configuration Extended with Valve Terminal Connector with 22/24 Valves

Monitoring the outputs 45hex

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 4	Short-circuit Port 6 Pin 4	Short-circuit Port 5 Pin 4	Short-circuit Port 4 Pin 4	Short-circuit Port 3 Pin 4	Short-circuit Port 2 Pin 4	Short-circuit Port 1 Pin 4	Short-circuit Port 0 Pin 4	Short-circuit Port 7 Pin 2	Short-circuit Port 6 Pin 2	Short-circuit Port 5 Pin 2	Short-circuit Port 4 Pin 2	Short-circuit Port 3 Pin 2	Short-circuit Port 2 Pin 2	Short-circuit Port 1 Pin 2	Short-circuit Port 0 Pin 2

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-Index					23	21	19	17	15	13	11	9	7	5	3	1
	Extension port															
Description	·	·	·	·	* Valve 12 – Coil A	Valve 11 – Coil A	Valve 10 – Coil A	Valve 09 – Coil A	Valve 08 – Coil A	Valve 07 – Coil A	Valve 06 – Coil A	Valve 05 – Coil A	Valve 04 – Coil A	Valve 03 – Coil A	Valve 02 – Coil A	Valve 01 – Coil A

* No function for V013

Byte	4								5							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Sub-index					24	22	20	18	16	14	12	10	8	6	4	2
	Extension port															
Description	·	·	·	·	* Valve 12 – Coil B	Valve 11 – Coil B	Valve 10 – Coil B	Valve 09 – Coil B	Valve 08 – Coil B	Valve 07 – Coil B	Valve 06 – Coil B	Valve 05 – Coil B	Valve 04 – Coil B	Valve 03 – Coil B	Valve 02 – Coil B	Valve 01 – Coil B

* No function for V013

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.

7.5. 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
0x8036	Function temporarily unavailable

7.6. 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.

9.1. Dimensions
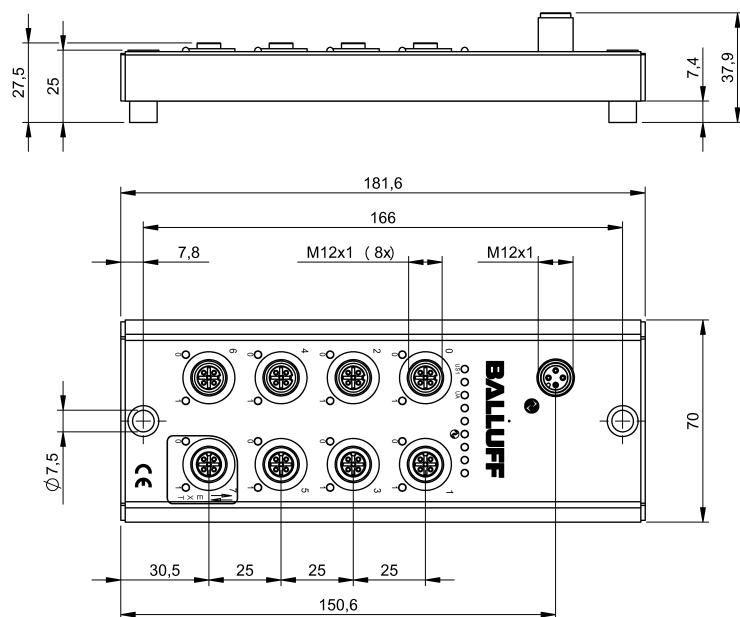
9.2. Mechanical Data

Housing material	Stainless steel (V4A)
IO-Link Port	IO-Link port M12, A-coded, male
I/O ports	M12x1, A-coded, female (8 piece)
Weight	ca 530 g
Dimensions (L×W×H)	181.6 × 70 × 37.9 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)	≤ 40 mA
Load current (PIN 1)	Max. 200 mA (temperature-dependent)
Total current US	4 A
Inputs	PNP, type 3
Load current per output (Pin 2, Pin 4)	max. 2 A
Load current per extension port (Pin2)	max. 2 A

9.4. Operating conditions

Ambient temperature	-5 °C … +70 °C
Storage temperature	-25 °C … +70 °C
Degree of protection	IP69 (only when plugged-in and screwed together)

10   Function indicators

10.1. Function indicators
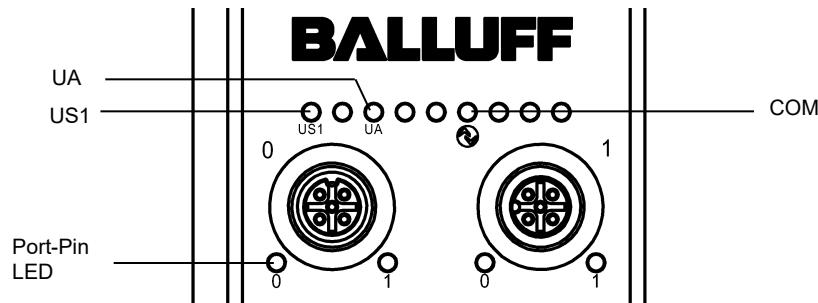
LED indicator module status

	Indicator	Function
COM	Green	No communication
	Green, negative pulsed	Communication OK
US1 LED	Green	Module supply OK
	Red	Undervoltage < 18 V
UA LED	Green	Actuator supply OK
	Red	Undervoltage < 18 V

Port-Pin LEDs

LED "0" – Port Pin 4
LED "1" – Port Pin 2

Digital LED indicators for inputs/outputs

**LED 2, input/output on Pin 4 and LED 1, input/output on Pin 2**

Indicator	Request / Signal
Yellow	Input/output signal = 1
Red	Sensor supply short-circuit
Off	Input/output signal = 0

Extension port

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

Status	Function
Green	IO-Link – connection active
Green, flashing	No IO-Link connection or faulty IO-Link device
Flashing red rapidly	Incorrect IO-Link device or incorrect configuration (0x55)
Red	Short circuit

11.1. Type code

BNI IOL-302-002-E012

Balluff Network Interface

IO-Link interface

Functions
   302 = 16 inputs/outputs

Variants
   002 = with IO-Link 1.1 extension port

Mechanical configuration
   E012 = Stainless steel V4A
          Bus connection: 1x M12x1 external threads,
          I/O ports: 8 x M12x1, internal thread
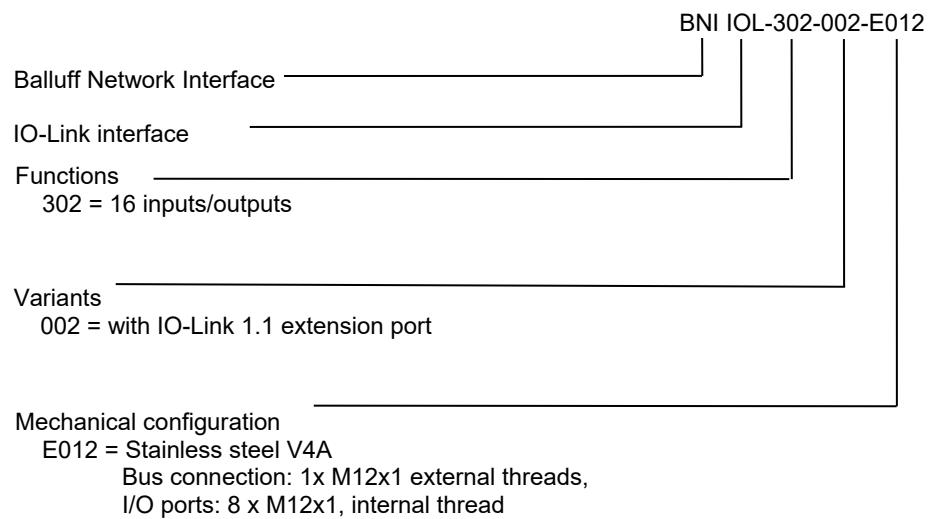
11.2. Ordering information

Type code	Order code
BNI IOL-302-002-E012	BNI00AR

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