BALLUFF

sensors worldwide

BNI IOL-302-S02-R026

IO-Link 1.1 sensor/actuator hub with extension port

User's Guide



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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 and analog 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. 00_{hex}).

Cross-references

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

1.4. Symbols

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

Note, tip
This symbol indicates general notes.

1.5. Abbreviations

BNI	Balluff Network Interface
DPP	Direct Parameter Page
I/O port	Digital input/output port
EMC	Electromagnetic compatibility
FE	Functional Ground
IOL	IO-Link
LSB	Least Significant Bit
MSB	Most Significant Bit
SPDU	Service Protocol Data Unit

2 Safety

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.

1.1 Installation and Startup



Note
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.

2.2. General Safety Notes

Commissioning and inspection
Before commissioning, carefully read the user's guide.
The system must not be used in applications in which the safety of persons 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.

2.3. Resistance to Aggressive Substances



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

Dangerous voltage



Note
Before maintenance, disconnect the device from the power supply.



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

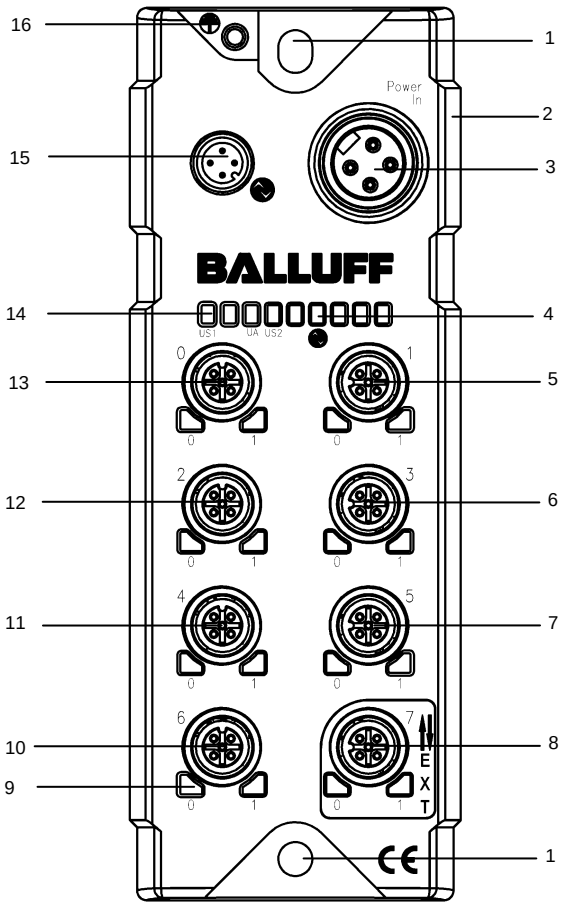


Figure 3-1: Connection overview BNI IOL-302-S02-R026

1 Mounting hole
2 Part label
3 Power supply
4 Status LED: communication
5 Port 1
6 Port 3
7 Port 5
8 Port 7, extension port
9 Pin/Port LED: signal status
10 Port 6
11 Port 4
12 Port 2
13 Port 0
14 Status LED: supply module
15 IO-Link interface
16 Ground connection

3.2. Mechanical Connection

The BNI IOL modules are attached using 3 M4 screws.

3.3. Electrical Connection

The BNI IOL-302-xxx-R026 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.

Functional ground

The modules are equipped with a ground connection.

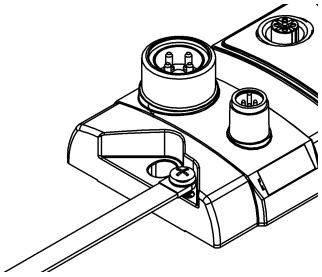


Figure 3-3: BNI ground connection IOL-302...

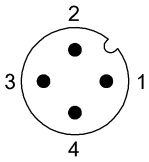
➢ Connect the sensor hub module to the ground connection.

Note!
The functional ground connection from the housing to the machine must have low-impedance and be kept as short as possible.

IO-Link connection

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

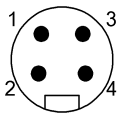
IO-Link (M12, A-coded, male)



Pin	Function
1	Supply voltage for controller Us, +24 V
2	-
3	GND, reference potential
4	C/Q, IO-Link data transmission channel

Power supply

Power IN (7/8", male)



Pin	Function
1	Supply voltage for actuators, +24V
2	Supply voltage for sensors, +24V
3	GND, sensor supply reference potential
4	GND, actuator supply reference potential

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.

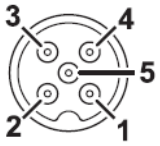
Note!
A standardized sensor cable is used to connect to the higher-level IO-Link master module. Maximum length of 20 m.

Module variants

Sensor hub variants	Digital port
BNI IOL-302-S02-R026	16 inputs/outputs, freely configurable

Sensor/actuator interface

Digital input/output port (M12, A-coded, female)



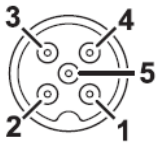
Pin	Function
1	+24 V
2	Input 2/output 2
3	0 V, GND
4	Input 1/output 1
5	FE

Note!
For the digital inputs, the input guideline specified in EN 61131-2, Type 3 applies

Note!
Unused input port sockets must be fitted with blind caps to ensure the IP67 degree of protection.

Extension port

Extension port (M12, A-coded, female)
The port acts like a sensor/actuator interface if the extension function is disabled.



Pin	Function
1	+24 V
2	Extension port for actuator power supply
3	0 V, GND
4	Communication
5	FE

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

The BNI IOL-302-S02-R026 module gives you the ability to use the No. 7 slot in various ways. By default, it is used as a digital I/O slot, where both pin 2 and pin 4 can be used as a digital input or output.
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-S02-R026
BNI IOL-751-V08-K007
BNI IOL-751-V10-K007
BNI IOL-751-V13-K007



Extension port configuration

Configuration	Index 0x55 value
BNI IOL-302-S02-R026	0
BNI IOL-302-S02-R026 with BNI IOL-302-S02-R026	1
BNI IOL-302-S02-R026 with BNI IOL-751-V08-K007	2
BNI IOL-302-S02-R026 with BNI IOL-751-V10-K007	3
BNI IOL-302-S02-R026 with BNI IOL-751-V13-K007	4

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

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.

4 Configuration: "Extension Off"



4.1. IO-Link Data

BNI IOL-302-S02-R026 extension off	
Transmission rate	COM2 (38.4 kbaud)
Minimum cycle time	6 ms
Process data length	6 byte input, 2 byte output

4.2. Process Data/Input Data

BNI IOL-302-S02-R026
Process data length of 6 bytes:

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

Byte	2								3							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Description	Short-circuit Port 7	Short-circuit Port 6	Short-circuit Port 5	Short-circuit Port 4	Short-circuit Port 3	Short-circuit Port 2	Short-circuit Port 1	Short-circuit Port 0	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

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

4.3. Process Data/ Output Data

BNI IOL-302-…

Process data length of 2 bytes

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

4 Configuration: "Extension Off"

4.4. 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 0B 20
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor name	8 bytes		BALLUFF
		11hex 17	0	Vendor text	16 bytes		www.balluff.com
		12hex 18	0	Product name	20/24 bytes		BNI IOL-302-S02-R026
		13hex 19	0	Product ID	7 bytes		BNI0091
		14hex 20	0	Product text	16 bytes		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

Parameter Data/Demand Data

	DPP	SPDU		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
		42hex 66	0 1-8	Safe state on Pin 4	2 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	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	0hex

4 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.

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	

4 Configuration: "Extension Off"

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

4 Configuration: "Extension Off"

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	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

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

5 Configuration: extended with BNI IOL-302-S02-R026



5.1. IO-Link Data

BNI IOL-302-002-K006 extended with BNI IOL-302-S02-R026	
Transmission rate	COM2 (38.4 kbaud)
Minimum cycle time	8.4 ms
Process data length	12 byte input, 4 byte output

5.2. Process Data/Input Data

Process data length of 12 bytes:

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
Description	Short-circuit Port 7	Short-circuit Port 6	Short-circuit Port 5	Short-circuit Port 4	Short-circuit Port 3	Short-circuit Port 2	Short-circuit Port 1	Short-circuit Port 0	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

5 Configuration: extended with BNI IOL-302-S02-R026

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

Byte	8								9							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Extension port															
Description	Short-circuit Port 7	Short-circuit Port 6	Short-circuit Port 5	Short-circuit Port 4	Short-circuit Port 3	Short-circuit Port 2	Short-circuit Port 1	Short-circuit Port 0	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

Byte	10								11							
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Extension port															
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

5 Configuration: extended with BNI IOL-302-S02-R026

5.3. Process Data/ Output Data

Process data length of 4 bytes

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 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	-

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

5 Configuration: extended with BNI IOL-302-S02-R026

5.4. Parameter Data/Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default value
	Index	Index	Subindex				
Identification data	07hex 07			Vendor ID	2 bytes	Read only	0378hex
	08hex 08						
	09hex 09			Device ID	3 bytes		0x05 0B 21
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor name	8 bytes		BALLUFF
		11hex 17	0	Vendor text	16 bytes		www.balluff.com
		12hex 18	0	Product name	20/24 bytes		BNI IOL-302-S02-R026 with BNI IOL-302-S02-R026
		13hex 19	0	Product ID	7 bytes		BNI0091 with BNI0091
		14hex 20	0	Product text	16 bytes		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

Parameter Data/Demand Data

	DPP	SPDU		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
		42hex 66	0 1-16	Safe state on Pin 4	4 bytes	Read/write	0hex
		43hex 67	0 1-16	Safe state on Pin 2	4 bytes	Read/write	0hex
		44hex 68	0 1-32	Voltage monitoring	4 bytes	Read	-
		45hex 69	0 1-32	Output monitoring	4 bytes	Read	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	1hex

5 Configuration: extended with BNI IOL-302-S02-R026

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

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	

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 6 Pin 4		Safe state Port 5 Pin 4		Safe state Port 4 Pin 4	

5 Configuration: extended with BNI IOL-302-S02-R026

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	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 permitted

5 Configuration: extended with BNI IOL-302-S02-R026

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	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	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	26	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	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

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 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 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

5 Configuration: extended with BNI IOL-302-S02-R026

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	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

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.

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



6.1. IO-Link Data

BNI IOL-302-S02-R026, extended with valve terminal connector with 22/24 valves	
Transmission rate	COM2 (38.4 kbaud)
Minimum cycle time	7.2 ms
Process data length	6 byte input, 6 byte output

6.2. Process Data/Input Data

Process data length of 6 bytes:

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
Description	-	Short-circuit Port 6	Short-circuit Port 5	Short-circuit Port 4	Short-circuit Port 3	Short-circuit Port 2	Short-circuit Port 1	Short-circuit Port 0	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

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

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

6.3. Process Data/ Output Data

Process data length of 6 bytes

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

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

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

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

6.4. Parameter Data/Demand Data

	DPP	SPDU		Parameter	Data width	Access rights	Default value
	Index	Index	Subindex				
Identification data	07hex 07			Vendor ID	2 bytes	Read only	0378hex
	08hex 08						
	09hex 09			Device ID	3 bytes		0x05 0B 22 0x05 0B 23 0x05 0B 24
	0Ahex 10						
	0Bhex 11						
		10hex 16	0	Vendor name	8 bytes		BALLUFF
		11hex 17	0	Vendor text	16 bytes		www.balluff.com
		12hex 18	0	Product name	20/24 bytes		BNI IOL-302-S02-R026 with BNI IOL-751-V08-K007 BNI IOL-302-S02-R026 with BNI IOL-751-V10-K007 BNI IOL-302-S02-R026 with BNI IOL-751-V13-K007
		13hex 19	0	Product ID	7 bytes		BNI0091 with BNI006N with BNI006P with BNI006R
		14hex 20	0	Product text	16 bytes		Sensor/actuator hub M12 with expanded BNI IOL-751-V08-K007 Sensor/actuator hub M12 with expanded BNI IOL-751-V10-K007 Sensor/actuator hub M12 with expanded BNI IOL-751-V13-K007
		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	Subindex				
Parameter data		40hex 64	0 1-16	Inversion of the inputs	2 bytes	Read/write	0hex
		42hex 66	0 1-32	Safe state on Pin 4	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	-
		54hex 84	0	Serial number	16 bytes	Read/write	16x00hex
		55hex 85	0	Extension port	1 byte	Read/write	2, 3, 4hex

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

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

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

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 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
Subindex									31		29		27		25	
	Valve terminal on extension port															
Description	-		-		-		-		* 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
Subindex	23		21		19		17		15		13		11		9	
	Valve terminal on extension port															
Description	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	

6 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									32		30		28		26	
	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	24		22		20		18		16		14		12		10	
	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

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

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	-	-	-	-	Outputs off (UA too low)	Undervoltage UA	Undervoltage US2	Undervoltage US1

Byte	2							
Bit	7	6	5	4	3	2	1	0
Sub Index		23				19		17
	Valve terminal on extension port							
Description	-	Overload UA	-	-	-	Undervoltage UA	-	Undervoltage US

6 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					39	37	35	33	31	29	27	25	23	21	19	17
	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					40	38	36	34	32	30	28	26	24	22	20	18
	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.

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

6.5. 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

6.6. Events

IO-Link Revision 1.0	
Event code	**Description**
0x5112	Low sensor voltage (US)
0x5114	Low actuator 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 actuator 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

7 IO-Link Functions

7.1. 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.

7.2. 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.

7.3. Block Configuration

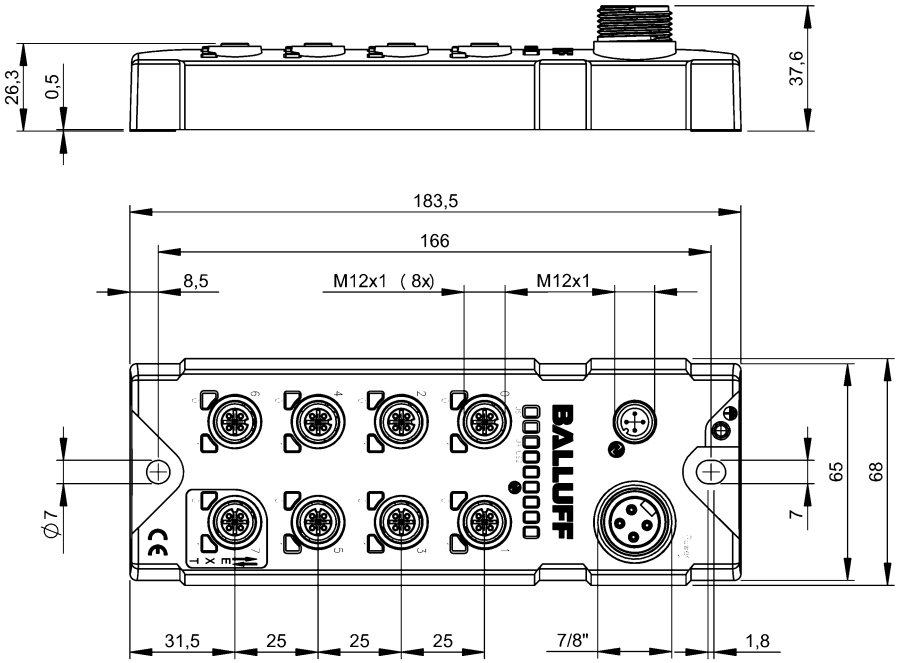
The device supports block configuration. This allows all parameters in a data block to be consistently imported from a controller or a configuration tool into the device.

7.4. 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.

8 Technical Data

8.1. Dimensions



8.2. Mechanical Data

Housing material	Plastic, resistant, Fortron 6165 A6
IO-Link Port	IO-Link port M12, A-coded, male
I/O ports	M12x1, A-coded, female (8 piece)
Weight	90 g
Dimension (L × W × H, without connector)	115 × 50 × 30.8 mm

8.3. Electrical Data

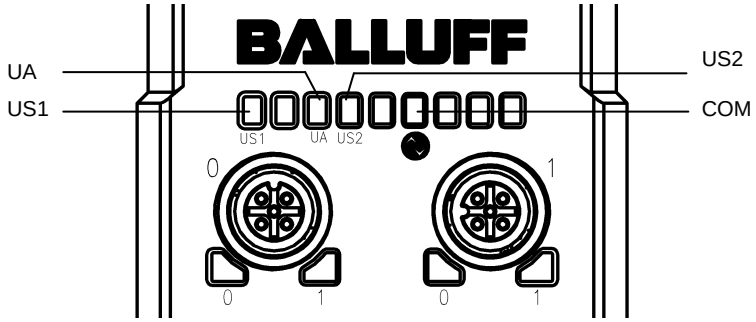
Supply voltage	18–30.2 V DC, corresponding to EN 61131-2
Ripple	< 1%
Current consumption without load	≤ 65 mA
Load current (PIN 1)	Max. 200 mA (temperature-dependent)
Load current per output (PIN 2.4)	max. 2 A (temperature-dependent)
Inputs	PNP, type 3

8.4. Operating conditions

Operating temperature	–5 °C … +55 °C
Storage temperature	–25 °C … +70 °C
EMC Immunity tests: Emission tests:	 EN 61000-6-2:2005 AC:2005 EN 61000-6-4:2007 A1:2011
Degree of protection	IP67 (only in plugged-in and screwed state)
Vibration/shock	EN 60068 Part 2-6/27

9 Function Indicators

9.1. Function Indicators



LED indicator module status

	Indicator	Function
COM	Green	No communication
	Green, negatively pulsed	Communication OK
US1 LED	Green	Sensor power supply is OK
	Red	Undervoltage < 18 V
UA LED	Green	Actuator power supply is OK
	Red	Undervoltage < 18 V
US2 LED	-	-

9 Function Indicators

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 power supply short-circuit, Actuator warning Actuator short-circuit
Off	Input/output signal = 0

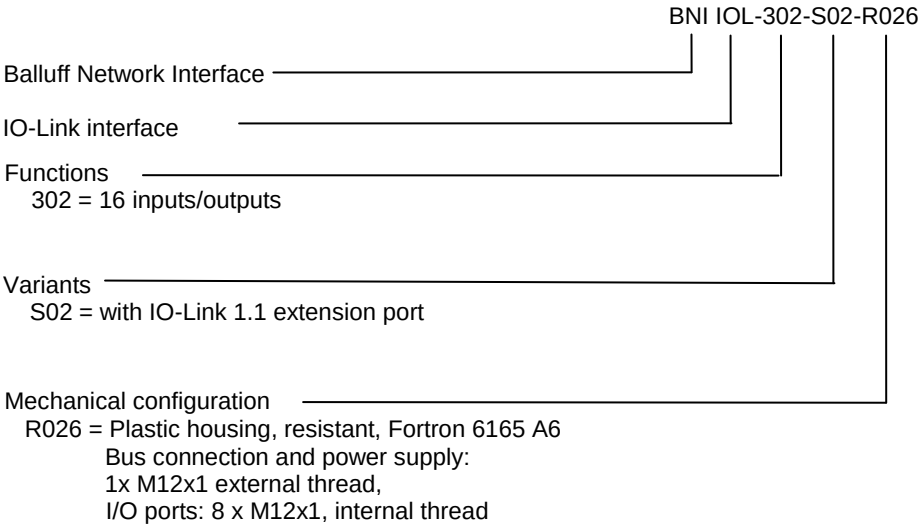
Extension port

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
Quick, red flashing	Incorrect IO-Link device or incorrect configuration
Red	IO-Link short-circuit on Pin 4

10 Appendix

10.1. Type Code



10.2. Ordering Information

Type code	Order code
BNI IOL-302-S02-R026	BNI0091

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No. 924292 E • Edition H15 • Subject to modification

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