BALLUFF

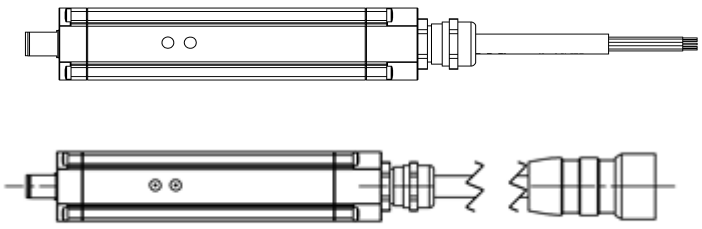
sensors worldwide

BNI IOL-770-000-A027
BNI IOL-770-V06-A027

IO-Link Version 1.1

IO-Link Valve Interface - with broken coil detection

User´s Guide



Content

1 Notes to the User

1.1. About this guide

This guide describes the Balluff IO-link valve block interface BNI IOL-770-… to control valve block devices of different manufacturers.
Connection to the host interface IO-Link master is made through the IO-Link protocol.

1.2. Structure

The chapters in this guide build on one another.
Section 2: Basic safety information.
Section 3: Getting started.
…..

1.3. Typographical conventions

The following typographical conventions are used in this Guide.

Enumerations

Enumerations are shown in list form with bullet points.

- 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

Note tip
This symbol indicates general notes.

Note
This symbol indicates a security notice which most be observed.

1.5. Abbreviations

BNI	Balluff Network Interface
DPP	Direct Parameter Page
EMC	Electromagnetic compatibility
FE	Function ground
IOL	IO-Link
LSB	Least Significant Bit
MSB	Most Significant Bit
SPDU	Service Protocol Data Unit (see IO-Link Specification)

2 Safety

2.1. Intended use

This guide describes the Balluff IO-link valve block interface BNI IOL-770-… to control valve block devices of different manufacturers.
Connection to the host interface IO-Link master is made through the IO-Link protocol.

2.2. Installation and startup

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

2.3. General safety instructions

Commissioning and inspection
The operating company shall be responsible for observance of locally applicable safety instructions.
Before commissioning, carefully read the operating manual.
The system must not be used in applications in which the safety of persons is dependent on the function of the device.
Authorized Personnel
Installation and commissioning may only be performed by trained specialist personnel.
Intended use
Warranty and liability claims against the manufacturer are rendered void by:
- Unauthorized tampering
- Improper use
- Use, installation or handling contrary to the instructions provided in this operating manual

Obligations of the Operating Company
The device is a piece of equipment from EMC Class A. Such equipment may generate RF noise. The operator must take appropriate precautionary measures. The device may only be used with an approved power supply. Only approved cables may be used.
Malfunctions
In the event of defects and device malfunctions that cannot be rectified, the device must be taken out of operation and protected against unauthorized use.

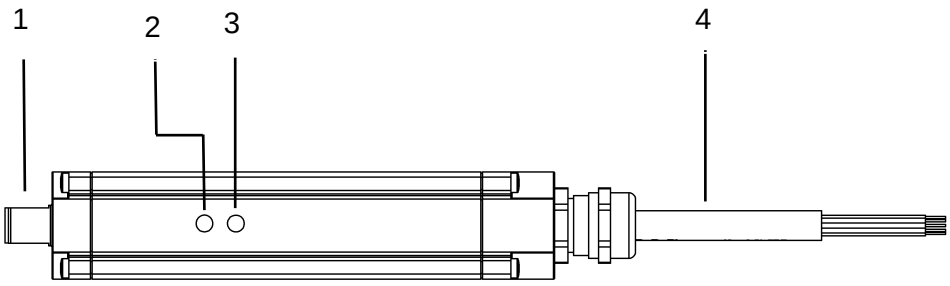
Hazardous voltage

Note
Disconnect all power before servicing equipment.

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

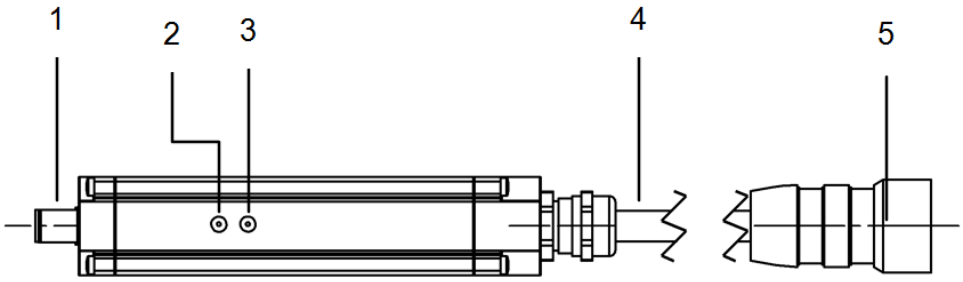
3 Getting Started

3.1. Connection overview BNI IOL-770-000-A027



1	Connector IO-Link	4	Cable 0.5mtr
2	Status LED „UA“		
3	Status LED „COM“		

3.2. Connection overview BNI IOL-770-V06-A027



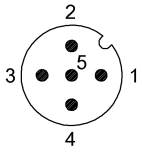
1	Connector IO-Link	4	Cable 0.5mtr
2	Status LED „UA“	5	Connector Valve Block
3	Status LED „COM“		

3.3. Electrical connection

The valve block connector has no separate power supply connection. The supply of the power comes from the IO-Link master unit at pin 1 and pin 2 of the M12 male connector.

IO-Link interface

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

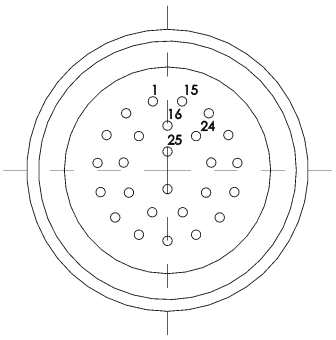


Pin	BNI IOL-770-000-A027 / BNI IOL-770-V06-A027
1	US
2	UA
3	GND US, GND UA
4	C/Q
5	-

US	Power Supply Module, +24V, max.1.2 A
UA	Power Supply Actuators, +24V, max. 1.2 A
GND US	Ground reference to Power Supply Module
GND UA	Ground reference to Power Supply Actuators
C/Q	IO Link communication line

3 Getting Started

Interface Valve Block Unit



26 pin connector M27 female

Versions

Valve Plug	Valve Block
BNI IOL-770-000-A027	open cable
BNI IOL-770-V06-A027	SMC VQC1000/2000/4000

Pin assignment

BNI IOL-770-000-A027		BNI IOL-770-V06-A027	
Color	**Marker**	**Pin**	**Description**
Black	None	Pin 1	Valve 1 Coil A
Brown	None	Pin 2	Valve 1 Coil B
Red	None	Pin 3	Valve 2 Coil A
Orange	None	Pin 4	Valve 2 Coil B
Yellow	None	Pin 5	Valve 3 Coil A
Pink	None	Pin 6	Valve 3 Coil B
Blue	None	Pin 7	Valve 4 Coil A
Purple	White	Pin 8	Valve 4 Coil B
Grey	Black	Pin 9	Valve 5 Coil A
White	Black	Pin 10	Valve 5 Coil B
White	Red	Pin 11	Valve 6 Coil A
Yellow	Red	Pin 12	Valve 6 Coil B
Orange	Red	Pin 13	Valve 7 Coil A
Yellow	Black	Pin 14	Valve 7 Coil B
Pink	Black	Pin 15	Valve 8 Coil A
Blue	White	Pin 16	Valve 8 Coil B
Purple	None	Pin 17	Valve 9 Coil A
Grey	None	Pin 18	Valve 9 Coil B
Orange	Black	Pin 19	Valve 10 Coil A
Red	White	Pin 20	Valve 10 Coil B
Brown	White	Pin 21	Valve 11 Coil A
Pink	Red	Pin 22	Valve 11 Coil B
Grey	Red	Pin 23	Valve 12 Coil A
Black	White	Pin 24	Valve 12 Coil B
White	None	Pin 25	GND
-	-	Pin 26	GND

- Current output per pin: 300mA (max.)
- Total current all output pins 1.2 A (max.)
- The output pins are overcurrent protected.

3.4. Current sense / Broken coil detection

The valve plug can monitor the current of each coil in high state separately. It will be discern between the current of the coil and the lower current of the valve state LED. This discrimination allows detecting a broken wire in the coil.

If the current of a coil in high state is below 25mA ±20% a broken wire will detect. See capture 4.3 and capture 4.5 for signalizing the broken coil error.

4 IO-Link interface

4.1. Communication parameters

	BNI IOL-770-000-A027 / BNI IOL-770-V06-A027	
Transmission rate	COM2 (38.4 kBaud)	
Minimum cycle time	5.5 ms	
IO-Link Revision	**1.1**	**1.0**
Frame type	2.V	1
Process data cycle *	5.5 ms	77 ms

*at min cycle time

4.2. Process data

The BNI IOL-770-xxx-A027 has four bytes of output and 9 bytes of input data. The direction of the data transmission for output data is IO-Link Master to IO-Link device, the direction of the data transmission for input data is IO-Link device to IO-Link Master.

Process Data Inputs

The process data inputs contents some diagnosis information such as actuator short circuit state, broken coil error state and power supply state.

Process data inputs		
4 bytes	**4 bytes**	**1 byte**
Actuator short circuit state	Broken coil error state	Supply state

The content of process data inputs is also mapped in the parameter data. For exact structure have a look at the parameter description.

Process Data Outputs

The process data outputs contents the Valve control information. Every output can be set by one bit in the outputs.

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

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

4.3. Parameter data / On-request data

	DPP	SPDU		Object name	Remark	Default Value
	Index	Index	Sub-index			
Identification Data	07hex			Vendor ID	Read only	0378hex
	08hex					
	09hex			Device ID		050421hex 050420hex
	0Ahex					
	0Bhex					
		10hex	0	Vendor Name		BALLUFF
		11hex	0	Vendor text		www.balluff.com
		12hex	0	Product name		BNI IOL-770-000-A027 BNI IOL-770-V06-A027
		13hex	0	Product ID		BNI007E / BNI004W
		14hex	0	Product text		Valve Connector with current sense
		15hex	0	Serial number		16*00hex
		16hex	0	Hardware Revision		
		17hex	0	Firmware Revision		
		18hex	0	Application Tag	Read / write	32 Byte String settable by user

	DPP	SPDU		Object name	Remark	Default Value
	Index	Index	Sub-index			
Parameter Data		42hex	0 1-24	Fault State	Read / write	00000000 00000000hex
		44hex	0 1,3	Supply Status	Read only	-
		45hex	0 1-24	Actuator Short Circuit	Read only	-
		48hex	0 1-24	Open coil Error	Read only	-
		51hex	0,1	Event Configuration	Read / write	0x00hex
		54hex	0	Serial number	Read / write	16*00hex

4 IO-Link interface

Fault State 42hex

With “Fault State” – parameter you are able to program the outputs for fail situation. If there is no IO-Link communication or the Process data outputs valid flag is not set by the IO-Link master the outputs will be set to the programmed values. Each Pin can be programmed to following states:

Value		Output State
bin	dec	
00	0	Output is 0V
01	1	Output is 24V
10	2	Output holds current state
11	3	Reserved

Byte	0								1							
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 12 – Coil A		Valve 11 – Coil A		Valve 10 – Coil A		Valve 09 – Coil A	

Byte	2								3							
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 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	

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	
Description	-		-		-		-		Valve 12 – Coil B		Valve 11 – Coil B		Valve 10 – Coil B		Valve 09 – Coil B	

Byte	6								7							
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	
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	

4 IO-Link interface

Supply Status 44hex

“Supply State” parameter gives you information about the current power supply status at the device.

Byte	0							
Bit	7	6	5	4	3	2	1	0
Sub Index						3		1
Description	-	-	-	-	-	UA status	-	US status

Actuator Short Circuit 45hex

Byte	0								1							
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
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

Byte	2								3							
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
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

Broken coil error 48hex

Broken coil error shows the current open coil error state. The structure is the same as actuator short circuit.

Event Configuration 51hex

Turns the event for the broken coil error on or off.
0 - off
1 - on

Byte	0							
Bit	7	6	5	4	3	2	1	0
Sub Index								1
Description								Broken coil error

Serial number 54hex

The serial number has the default value 16*0x00hex. To use the master validation mode "Identity", with this Parameter are set a serial number. This prevents that a Device will be connected to a wrong master.

4 IO-Link interface

4.4. Errors

Error Code	Description
0x8011	Index not available.
0x8012	Subindex not available.
0x8023	Access Denied.
0x8030	Parameter Value out of Range
0x8031	Parameter Value above limit
0x8032	Parameter Value below limit
0x8033	Parameter length overrun
0x8034	Parameter length underrun
0x8035	Function not available

4.5. Events

IO-Link Revision 1.0	
Event Code	**Description**
0x5112	Low sensor voltage (US)
0x5114	Low actuator voltage (UA)
0x5151	Short circuit output stages
0x9000	Broken coil error
IO-Link Revision 1.1	
Event Code	**Description**
0x5111	Low sensor voltage (US)
0x5112	Low actuator voltage (UA)
0x7710	Short circuit output stages
0x7700	Broken coil error

5 IO-Link functions

5.1. IO-Link Version 1.0 / 1.1

This Device is compatible to IO-Link Master version 1.0 and 1.1 version specific functions like Data Storage will be supported only in combination with an IO-Link Master accordant to the IO-Link Version of the function.

5.2. Data Storage

Each IO-Link Master of the IO-Link Version 1.1 supports data storage. This can be used to save the device parameter in the IO-Link Master. In case of a device swap, the saved device parameter will be transferred to the new device.

5.3. Block parameter

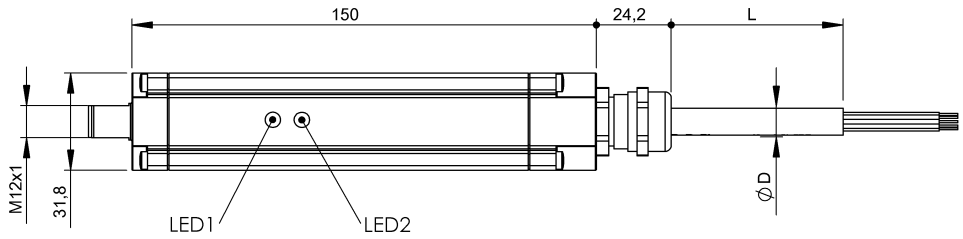
This feature allows writing parameters in one block. It´s necessary of one parameter depends on the other.

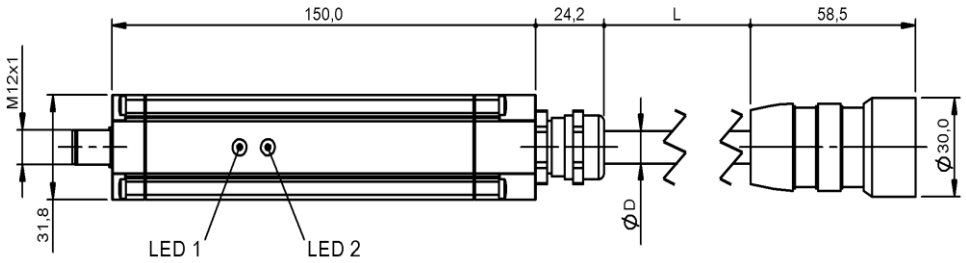
5.4. Reset factory setting

The System Command "reset factory settings", resets the device to factory settings. It can be executed by writing 0x82 to Index 2 subindex 0.

6 Technical Data

6.1. Dimensions





6.2. Mechanical data

Housing material	aluminium housing
IO-Link port	M12, A-coded, male
Port valve block connector	26 pin connector M27 female = BNI IOL-770-V06-A027 Open cable = BNI IOL-770-000-A027
Enclosure rating per IEC 60529	IP 67 (only when mounted an threaded-in)
Dimensions (W x H x D in mm)	185 x 31.8 x 31.8 without cable
Cable length	0.5 mtr.
Weight BNI IOL-770-000-A027	352 gr
Weight BNI IOL-770-V06-A027	424 gr

6.3. Elektrical data

Operating voltage	18...30.2 V DC, per EN 61131-2
Ripple	< 1%
Current draw without load	50 mA

6.4. Operating conditions

Operating temperature	-5° C……70° C **Note:** Installed in cable channel
Storage temperature	-25 C ... 70 °C
EMC Immunity tests: Emission tests:	EMC-directive 2004/108/EEC EN 61000-6-2:2005 AC:2005 EN 61000-6-4:2007 A1:2011
Vibration / Shock	EN 60068-2-6, EN 60068-2-27 EN 60068-2-29

6 Technical Data

6.5. Indicators / LEDs

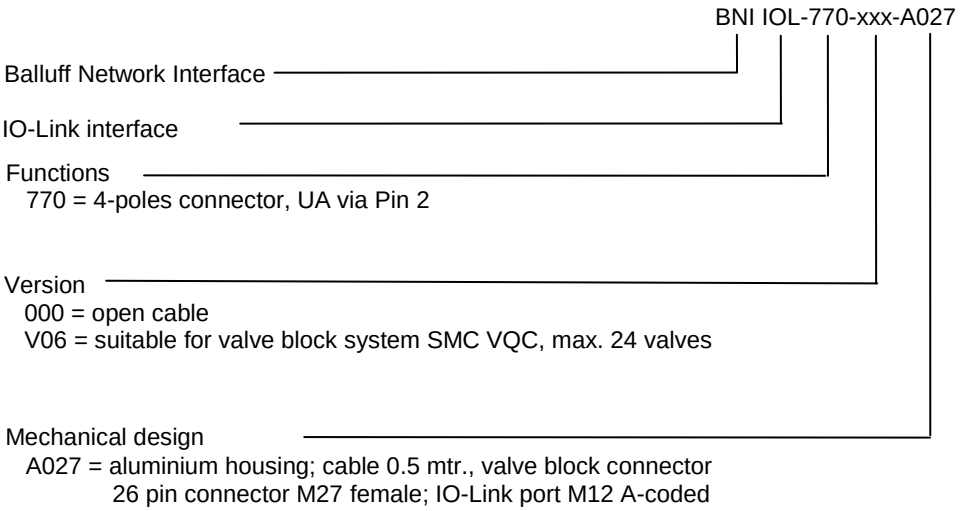
See “Dimensions”

LED 1 – Status of Actuator Power Supply	
Green	Actuator Power Supply OK
Green, pulsed	Short Circuit on output
off	Actuator power supply <18V

LED 2 – Communication Status	
Green, static on	No communikation
Green, negative pulsed	Communikation OK
Green, flashing	Sensor Power supply <18V

7 Appendix

7.1. Type designation code



7.2. Order information

Type	Order code
BNI IOL-770-000-A027	BNI007E
BNI IOL-770-V06-A027	BNI004W

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