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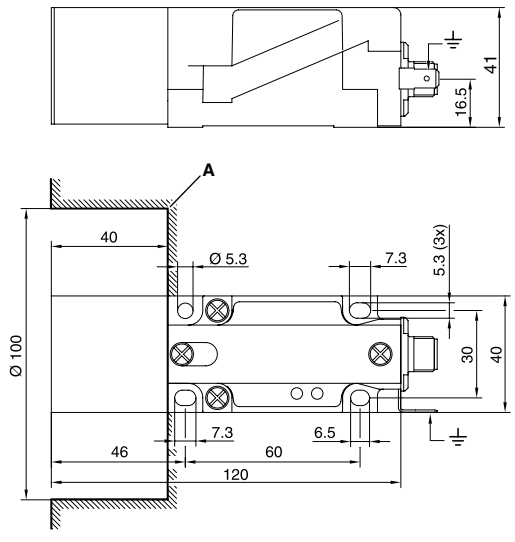
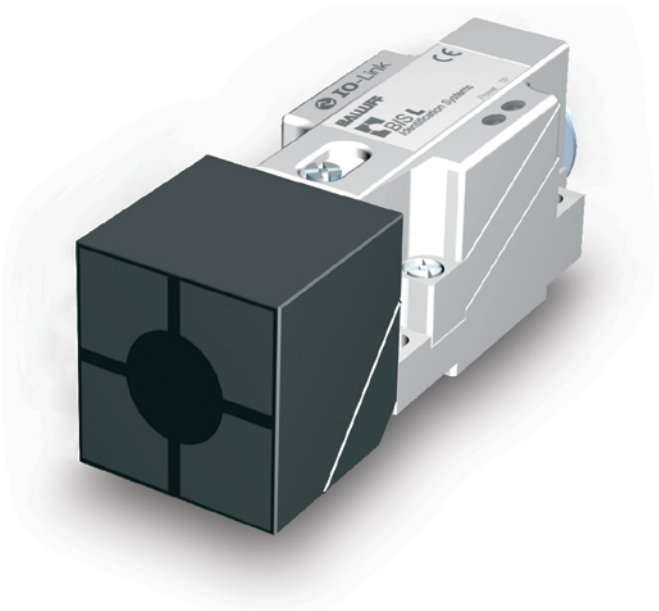
BIS L-409-045-00x-07-S4

Technical Description, User's Guide





English

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1 Notes to the user

1.1 About this manual

This manual describes processors in the series BIS L-409-... identification system as well as startup instructions for immediate operation.

1.2 Structure of the manual

The manual is organized so that the sections build on one another.
Section 2: Basic safety information.
Section 3: The main steps for installing the identification system.
Section 4: Introduction to the material.
Section 5: Technical data for the processor.
Section 6: Mechanical and electrical connection.
Section 7: Basics for the IO-Link communications standard.
Section 8: User-defined processor settings.
Section 9: Integration into a fieldbus system using Profibus as an example.
Section 10: Processor and host system interaction.

1.3 Typographical conventions

The following conventions are used in this manual.

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. 00hex).

Parameters:
Parameters are shown in italics (e.g. *CRC_16).*

Directory paths:
References to paths in which data are stored or are to be saved to are shown in small caps (e.g. Project:\Data Types\User Defined).

Cross-references

Cross-references indicate where additional information on the topic can be found (see “Technical data” starting page 16).

1.4 Symbols

Attention!
This symbol indicates a security notice which most be observed.

Note, tip
This symbol indicates general notes.

1 Notes to the user

1.5 Abbreviations

BIS	Balluff Identification System
CRC	Cyclic Redundancy Code
DPP	Direct Parameter Page
EMC	Electromagnetic Compatibility
LSB	Least Significant Bit
MSB	Most Significant Bit
PC	Personal Computer
SIO	Standard IO
SPDU	Service Protocol Data Unit
PLC	Programmable Logic Controller
TCP	Transmission Control Protocol

2 Safety

2.1 Intended use

BIS L-409-... processors together with the other components of the BIS L system comprise the identification system.
They may be used only for this purpose in an industrial environment corresponding to Class A of the EMC Law.
This description applies to the compact processors in the BIS L-409-... series.

2.2 General safety notes

Installation and startup
Installation and startup are to be performed only by trained specialists. Any damage resulting from unauthorized manipulation or improper use voids the manufacturer's guarantee and warranty.
When connecting the processor to an external controller, observe proper selection and polarity of the connection as well as the power supply (see “Installation” on page 24).
The processor must be powered only using approved power supplies (see “Technical data” starting on page 16).

Attention!
This is a Class A device. This device may cause RF disturbances in residential areas; in such a case the operator may be required to take appropriate countermeasures.

Operation and testing
The operator is responsible for observing local prevailing safety regulations.
When defects and non-clearable faults in the Identification System occur, take it out of service and secure against unauthorized use.

2.3 Meaning of the warnings

Attention!
The pictogram used with the word “Caution” warns of a possible hazardous situation affecting the health of persons or equipment damage. Ignoring these warnings can result in injury or equipment damage.
► Always observe the described measures for preventing this danger.

3 Getting Started

3.1 Mechanical connection

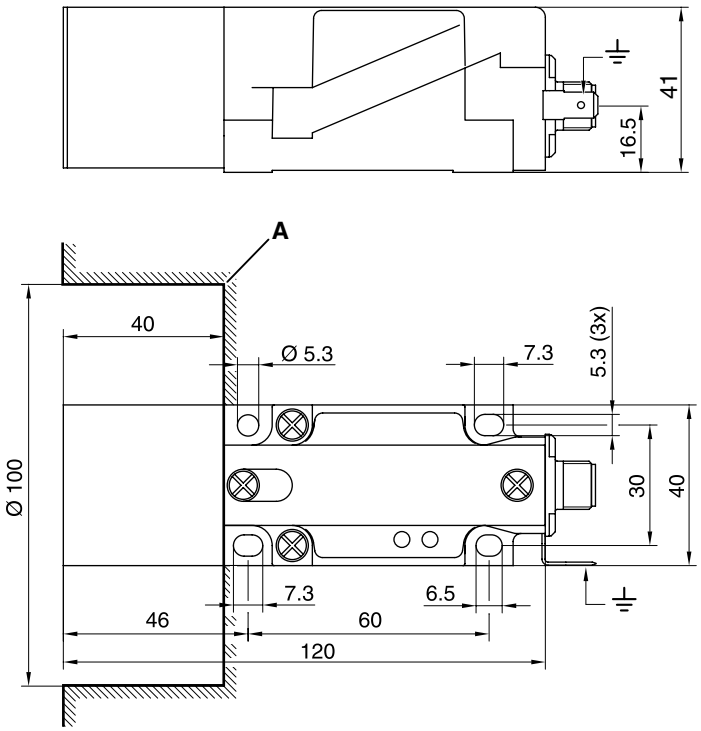


Fig. 1: BIS L-409-045-001-07-S4 with integrated read head, dimensions in mm

A Clear zone

► Attach the processor using 4 M4 screws.
Note maximum tightening torque of 15 Ncm.

In addition to the processor with integrated read head, the following processors with remote read head are available.
The processors with remote read head are also tightened using 4 M4 screws to a max. tightening torque of 15 Ncm:

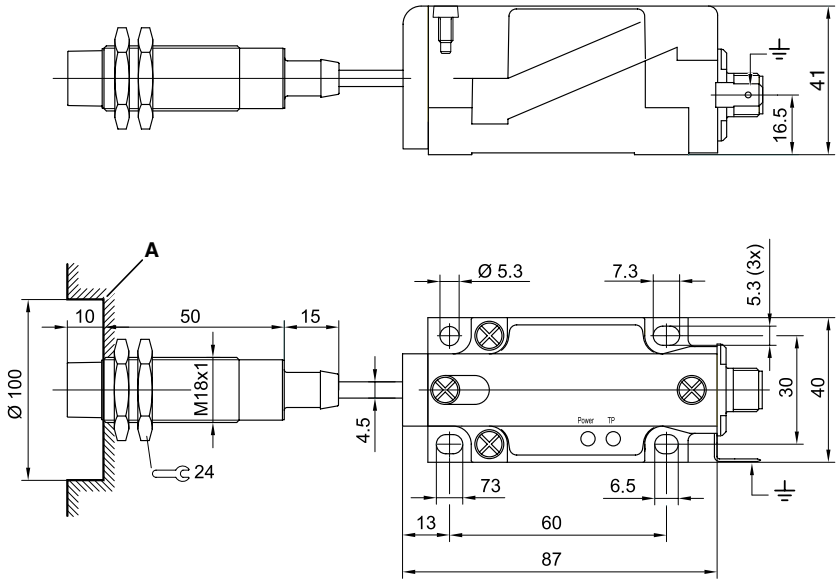


Fig. 2: Processor BIS L-409-045-002-07-S4, dimensions in mm

A Clear zone

3 Getting Started

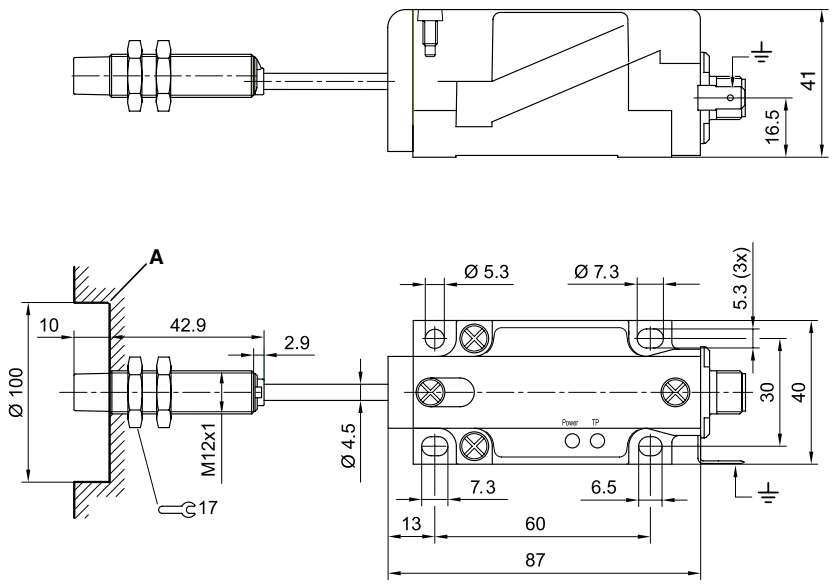


Fig. 3: Processor BIS L-409-045-003-07-S4, dimensions in mm

A Clear zone

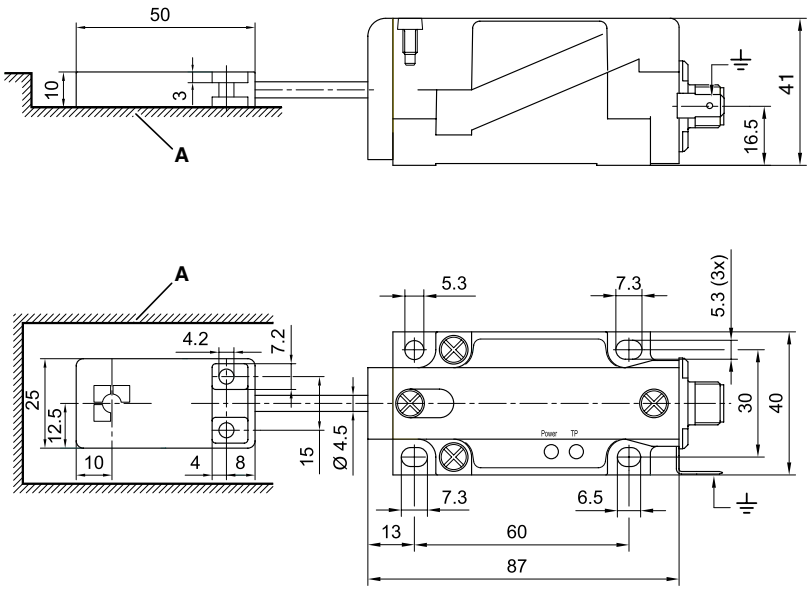


Fig. 4: Processor BIS L-409-045-004-07-S4, dimensions in mm

A Clear zone

3 Getting Started

Distance between data carriers

Data carrier	Distance
BIS L-200-03/L	> 25 cm
BIS L-100-05/L	
BIS L-201-03/L	> 30 cm
BIS L-101-05/L	
BIS L-202-03/L	> 40 cm
BIS L-102-05/L	

Distance between processors

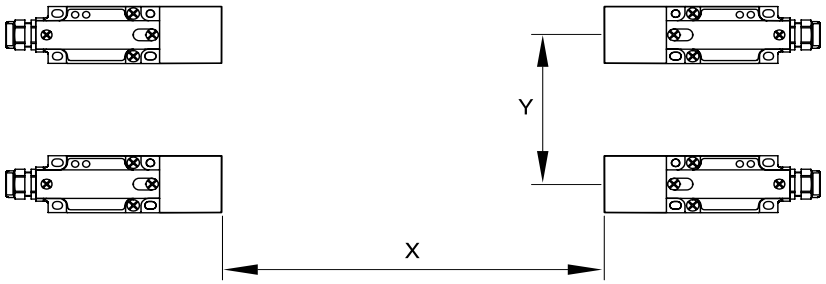


Fig. 5: Distance between two processors, see table for legend

The following distances between individual BIS L-409_... systems must be maintained:

Processor	Distance x	Distance Y
BIS L-409-...-001- ...	1 m	1 m
BIS L-409-...-002- ...	0.5 m	0.3 m
BIS L-409-...-003- ...	0.5 m	0.3 m
BIS L-409-...-004- ...	0.5 m	0.3 m

Note
When installing two BIS L-409-... on metal there is normally no mutual interference.
Unfavorable use of a metal frame can result in problems when reading a data carrier.
In this case the read distance is reduced to 80% of the maximum value.
In critical applications a pre-test is recommended.

3 Getting Started

3.2 Electrical connection

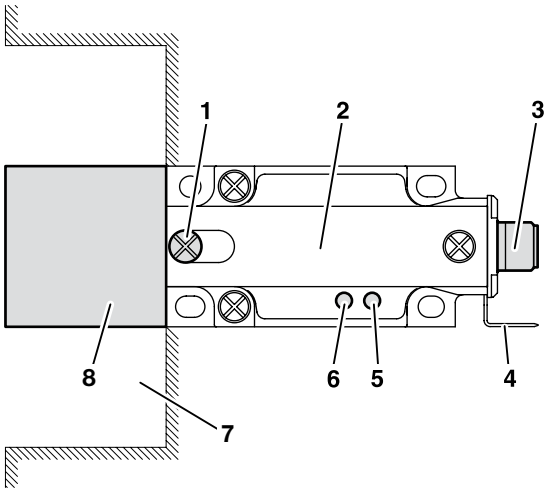


Fig. 6: Overview of processor BIS L-409-045-001-07-S4

1	Locking screw	**5**	LED 1
2	BIS L-409-045-001-07-S4	**6**	LED 2
3	IO-Link connection	**7**	Clear zone
4	Ground connection	**8**	Read head

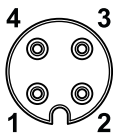
LED indicators

LED indicators on the processor:

Item	LED	Display	Function
3	LED 1	green	Supply voltage present
4	LED 2	yellow	Tag Present

Data line

IO-Link port (M12, A-coded, female)



PIN	Function
1	+24 V
2	NC
3	GND
4	C/Q

► Connect data line to IO-Link Master.
(See Balluff IO-Link catalog for connection cable and accessories)

3 Getting Started

Operating mode/ baud rate

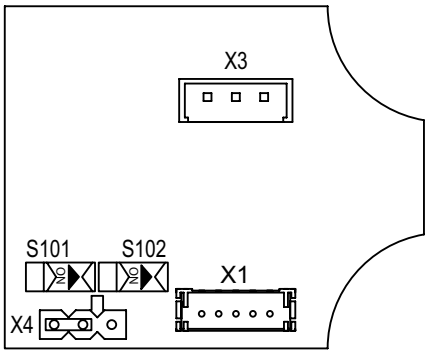


Fig. 7: Overview of BIS L-409-... processor

1 X1 - Device terminal
2 X3 - Read head terminal
3 X4 - Jumper for operating mode
4 S101/S102 - baud rate setting

The operating mode is set using jumpers in the processor (X4):
– IO-Link mode, jumper setting as shown in Fig. 7 (factory default setting)
– Service mode - to be used only by Balluff service

The baud rate is set using two DIP switches S101 and S102:

S102	S101	Baud rate
OFF	OFF	com1 4k8
OFF	ON	com1 4k8
ON	OFF	com2 38k4 *)
ON	ON	com3 230k4

*) Factory default setting

4 Basic knowledge

4.1 Function principle of Identification Systems

The BIS L-409-... Identification System is a non-contact read-only system. The compact processor consists of processing circuitry with a fixed read head.
The system may be used to read information which has been permanently programmed into the data carrier and to send current status messages to the controller.

The main components of the BIS L-409-... Identification System are:
– Processor,
– read head,
– data carriers.
Data transmission to the controlling system is accomplished using an IO-Link Master.

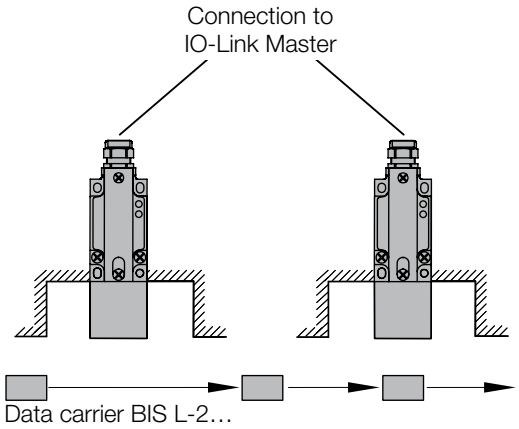


Fig. 8: Schematic representation of an identification system

The data carrier is an autonomous unit which is supplied with power by the read head. The read head continuously sends a carrier signal which is picked up by the data carrier from within a certain distance. As soon as the data carrier is powered up by the carrier signal, a static read operation takes place.

The processor manages the data transfer between read head and data carrier, serves as a buffer storage device, and sends the data to the host controller.
The data are passed to the IO-Link Master using IO-Link protocol, and the Master then passes them to the controlling system.

Host systems may be the following:
– A control computer (e.g. industrial PC),
– a PLC.

The main areas of application are:
– In production for controlling material flow (e.g. in model-specific processes), in workpiece transport with conveying systems, for acquiring safety-relevant data.
– warehousing for monitoring material movement,
– transportation, and
– conveying technology.

4 Basic knowledge

4.2 System topology

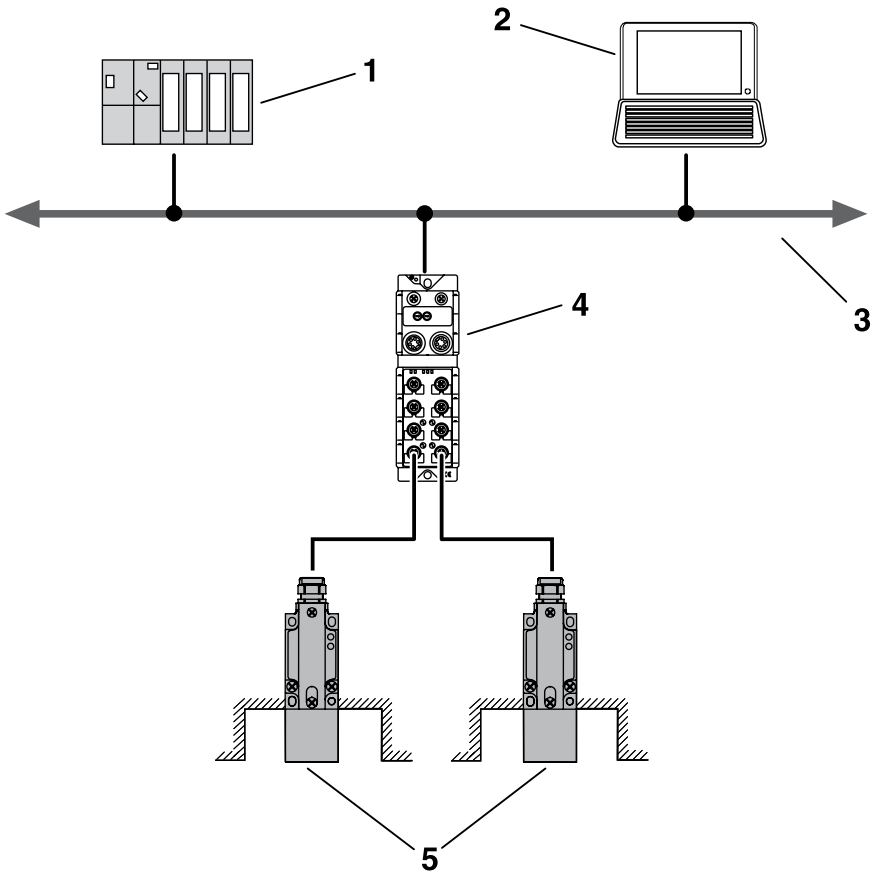


Fig. 9: BIS L-409… topology

1 PLC
2 PC
3 ProfiBus
4 IO-Link Master
5 Processors BIS L-409…

4 Basic knowledge

4.3 Read distance/ offset

To ensure that data carriers are recognized without error and the data can be reliably read, do not exceed a maximum distance and maximum offset between the data carriers and read heads (see “Technical Data” starting page 16).
The “distance” specification refers to the maximum distance from the data carrier to the sensing surface of the read head.
The “offset” specification indicates the maximum offset between the center axis of the data carrier and the center axis of the sensing surface.
Data carriers can only be reliably recognized and the data reliably read within the permissible read distance and offset. In the border area an unstable condition may occur, so that a data carrier is alternately recognized and lost.
Data carrier recognition is indicated by an LED on the device (“TP – Tag Present”, see “Technical Data” starting page 16). At the same time the CP bit is set in the input buffer (“CP – Codetag Present”, see “Process Data” starting page 42).

4.4 Product description

Processor BIS L-409-045-…-07-S4:
– Plastic housing,
– circular connector terminations,
– one read head connected,
– the read head suitable for dynamic or static operation,
– data carrier is powered by the read head using a carrier signal.

4.5 Data security

In order to ensure data integrity, data transmission between the data carrier and processor can be monitored using a check procedure.
In the processor a CRC_16 data check can be configured.
If the CRC check is enabled, the data carrier data are checked using a 2-byte CRC_16 checksum. If the checksum does not agree with the checked data, an error message is sent.

Note
The CRC_16 data check can only be used with data carriers of type BIS L-10X-05/L
The data carriers must be initialized using a BIS L-60_ _ processor and the BISCOMRW.EXE PC software or a portable reader BIS L-81_ (refer to the User's guide for the corresponding device for this procedure).

4.6 IO-Link basic knowledge

The manufacturer-specific standard IO-Link sends not only the actual process signal, but also all relevant parameter and diagnostics data on the process level over a single standard cable. Communication is based on a standard UART protocol with 24V pulse modulation; no separate power supply is required. Connection is possible using a 2-conductor or 3-conductor cable.

Advantages of IO-Link:
– Uniform, simple wiring of different devices
– Controlling system can be used to change the device parameters
– Remote querying of diagnostics information is possible
– Centralized data retention of the device parameters is possible

5 Technical Data

BIS L-409-045-001-07-S4

Dimensions

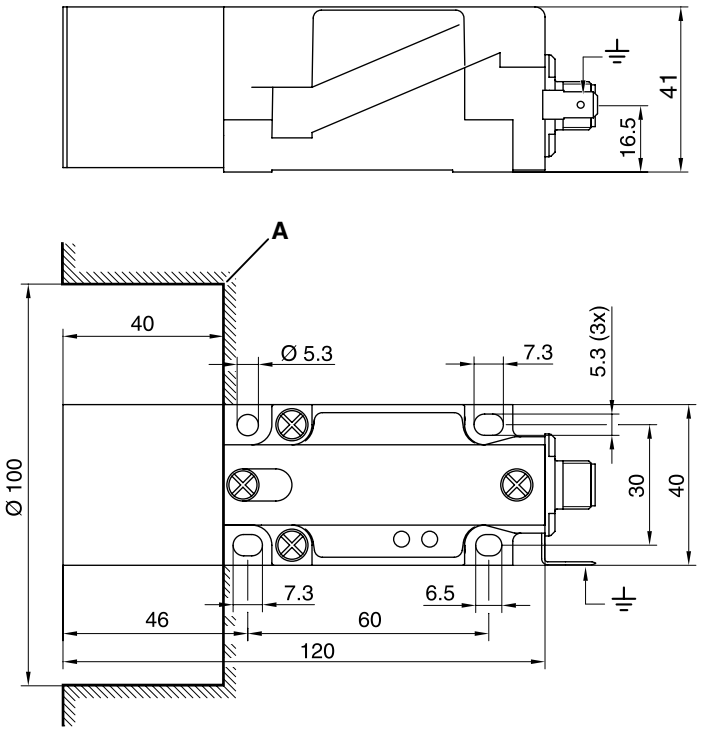


Fig. 10: Dimensions for BIS L-409-045-001-07-S4 processor [mm]

A Clear zone

Characteristic data

BIS L-409-045-001-07-S4					
Characteristic data when used with data carriers (installed in clear zone)	When v = 0 (static)				
	Distance [mm] read	Offset from center axis at distance: [mm]			
		0 - 20	0 - 35	0 - 45	0 - 15
BIS L-200-03 / BIS L-100-05	25	15	–	–	–
BIS L-201-03 / BIS L-101-05	35	–	20	–	–
BIS L-202-03 / BIS L-102-05	48	–	–	25	–
BIS L-203-03 / BIS L-103-05	16	–	–	–	10

Mechanical data

Housing material	Plastic (PBT)
Wiring	Connector, M12 4-pin, A-coded
Enclosure rating	IP65 (with connectors)
Weight	220 g

5 Technical data

Electrical data

Operating voltage VS	24 V DC +10/-20 %
Ripple	≤ 10 %
Current draw	≤ 150 mA
Load current capacity in SIO mode	max. 50 mA
Output C/Q	Short circuit protected
Device interface	IO-Link

Operating conditions

Ambient temperature range	0 °C … +70 °C
EMV – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-5/-6 – EN 300 330-1	 – Class A – Level 3A/3A/4A/2A/3A – Power class 5
Vibration/shock	EN 60068 Part 2-6/27/29/64/32

Function indicators

Two LEDs on the communications module indicate the status:

LED indicator	Function
LED green	Supply voltage present
LED yellow	Data carrier within read range (Tag Present)

5 Technical data

BIS L-409-045-002-07-S4

Dimensions

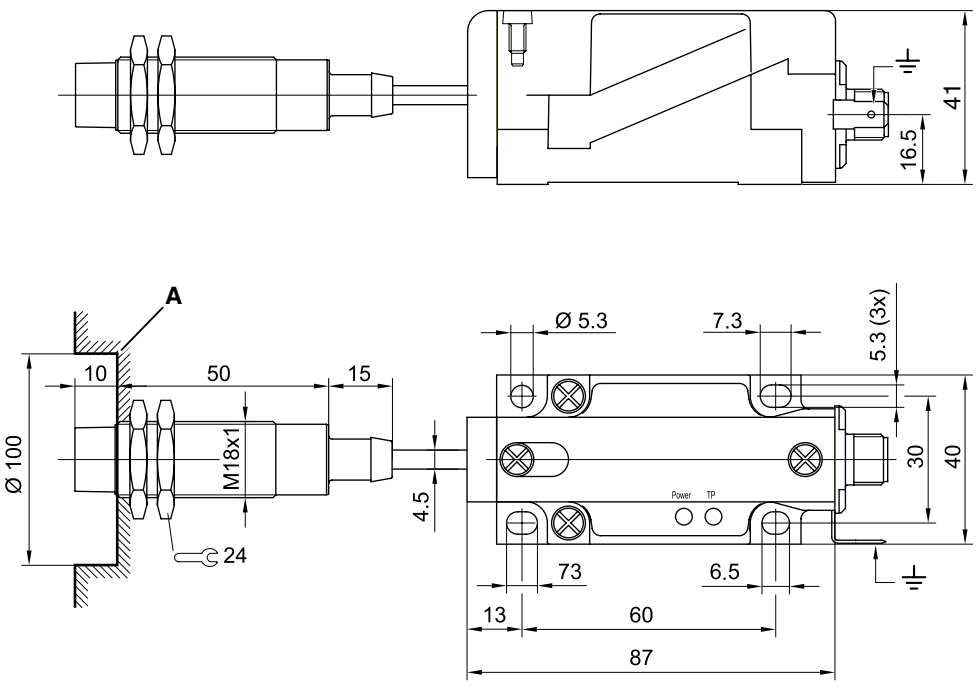


Fig. 11: Dimensions for BIS L-409-045-002-07-S4 processor [mm]

A Clear zone

Characteristic data

BIS L-409-045-002-07-S4				
Characteristic data when used with data carriers (installed in clear zone)	When v = 0 (static)			
	Distance [mm] read	Offset from center axis at distance: [mm]		
		0 - 10	0 - 15	0 - 20
BIS L-200-03 / BIS L-100-05	15	10	–	–
BIS L-201-03 / BIS L-101-05	18	12	12	–
BIS L-203-03 / BIS L-103-05	10	4	–	–

Mechanical data

Housing material	Plastic (PBT)
Read head housing material	CuZn nickel plated
Wiring	Connector, M12 4-pin, A-coded
Enclosure rating	IP67
Weight	200 g

5 Technical data

Electrical Data

Operating voltage VS	24 V DC +10/-20 %
Ripple	≤ 10 %
Current draw	≤ 150 mA
Load current capacity in SIO mode	max. 50 mA
Output C/Q	Short circuit protected
Device interface	IO-Link

Operating conditions

Ambient temperature range	0 °C … +70 °C
EMV – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-5/-6 – EN 300 330-1	 – Class A – Level 3A/3A/4A/2A/3A – Power class 5
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

Function indicators

Two LEDs on the communications module indicate the status:

LED indicator	Function
LED green	Supply voltage present
LED yellow	Data carrier within read range (Tag Present)

5 Technical data

BIS L-409-045-003-07-S4

Dimensions

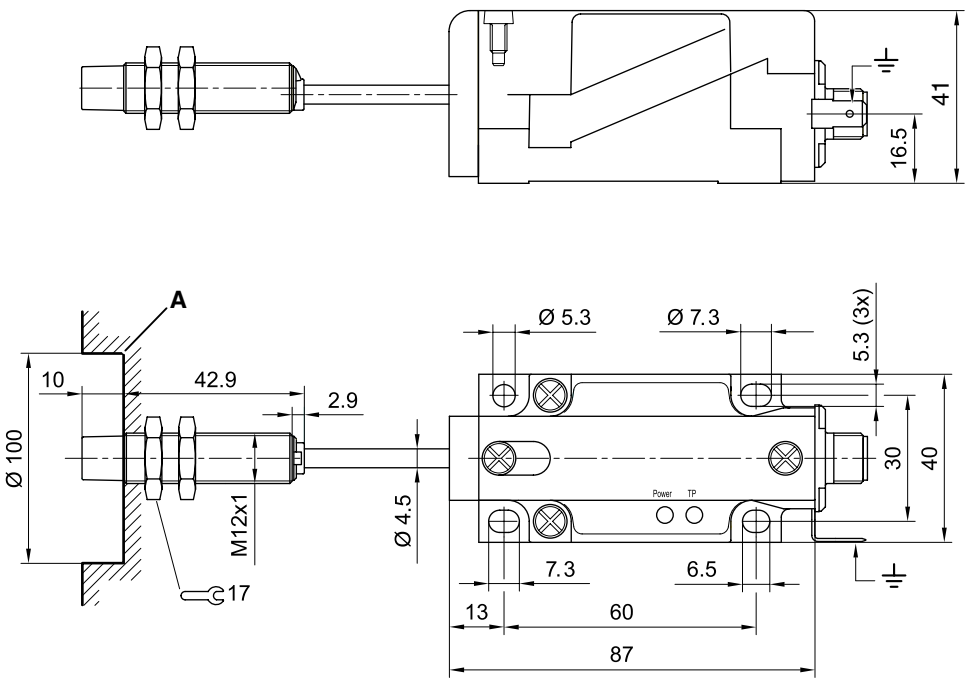


Fig. 12: Dimensions for BIS L-409-045-003-07-S4 processor [mm]

A Clear zone

Characteristic data

BIS L-409-045-003-07-S4				
Characteristic data when used with data carriers (installed in clear zone)	When v = 0 (static)			
	Distance [mm] read	Offset from center axis at distance: [mm]		
		0 - 5	0 - 8	0 - 11
BIS L-203-03 / BIS L-103-05	7	4	–	–

Mechanical data

Housing material	Plastic (PBT)
Read head housing material*)	CuZn nickel plated
Wiring	Connector, M12 4-pin, A-coded
Enclosure rating	IP67
Weight	170 g

5 Technical data

Electrical Data

Operating voltage VS	24 V DC +10/-20 %
Ripple	≤ 10 %
Current draw	≤ 150 mA
Load current capacity in SIO mode	max. 50 mA
Output C/Q	Short circuit protected
Device interface	IO-Link

Operating conditions

Ambient temperature range	0 °C … +70 °C
EMV – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-5/-6 – EN 300 330-1	 – Class A – Level 3A/3A/4A/2A/3A – Power class 5
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

Function indicators

Two LEDs on the communications module indicate the status:

LED indicator	Function
LED green	Supply voltage present
LED yellow	Data carrier within read range (Tag Present)

5 Technical data

BIS L-409-045-004-07-S4 Dimensions

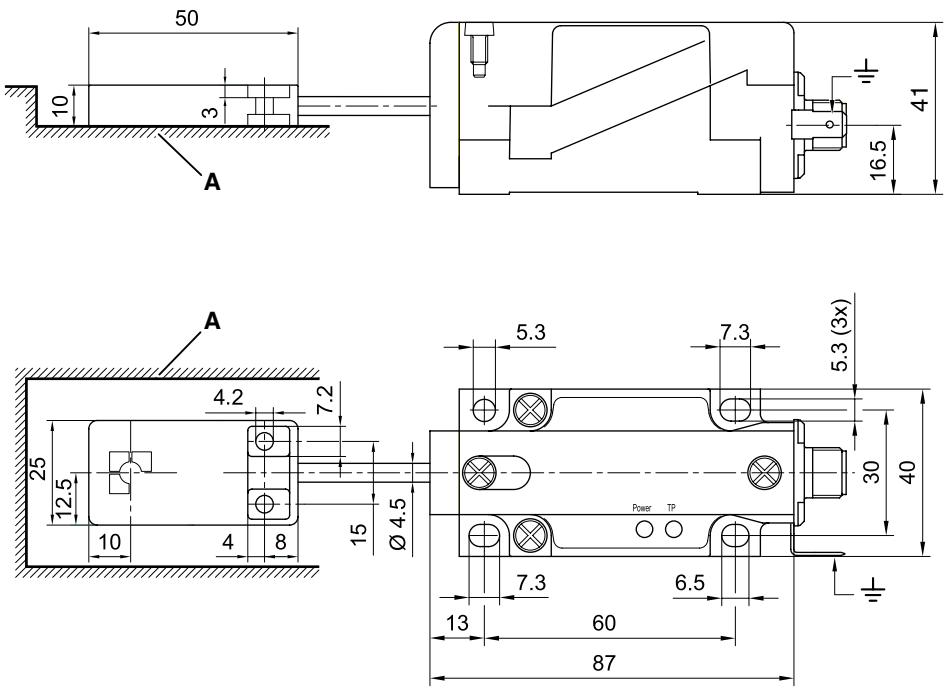


Fig. 13: Dimensions for BIS L-409-045-004-07-S4 processor [mm]

A Clear zone

Characteristic data

BIS L-409-045-004-07-S4				
Characteristic data when used with data carriers (installed in clear zone)	When v = 0 (static)			
	Distance [mm] read	Offset from center axis at distance: [mm]		
		0 - 10	0 - 15	0 - 20
BIS L-200-03 / BIS L-100-05	15	10	–	–
BIS L-201-03 / BIS L-101-05	18	12	12	–
BIS L-203-03 / BIS L-103-05	10	4	–	–

Mechanical data

Housing material	Plastic (PBT)
Read head housing material	CuZn nickel plated
Wiring	Connector, M12 4-pin, A-coded
Enclosure rating	IP67
Weight	170 g

5 Technical data

Electrical Data

Operating voltage VS	24 V DC +10/-20 %
Ripple	≤ 10 %
Current draw	≤ 150 mA
Load current capacity in SIO mode	max. 50 mA
Output C/Q	Short circuit protected
Device interface	IO-Link

Operating conditions

Ambient temperature range	0 °C … +70 °C
EMV – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-5/-6 – EN 300 330-1	 – Class A – Level 3A/3A/4A/2A/3A – Power class 5
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

Function indicators

Two LEDs on the communications module indicate the status:

LED indicator	Function
LED green	Supply voltage present
LED yellow	Data carrier within read range (Tag Present)

6 Installation

6.1 Installation

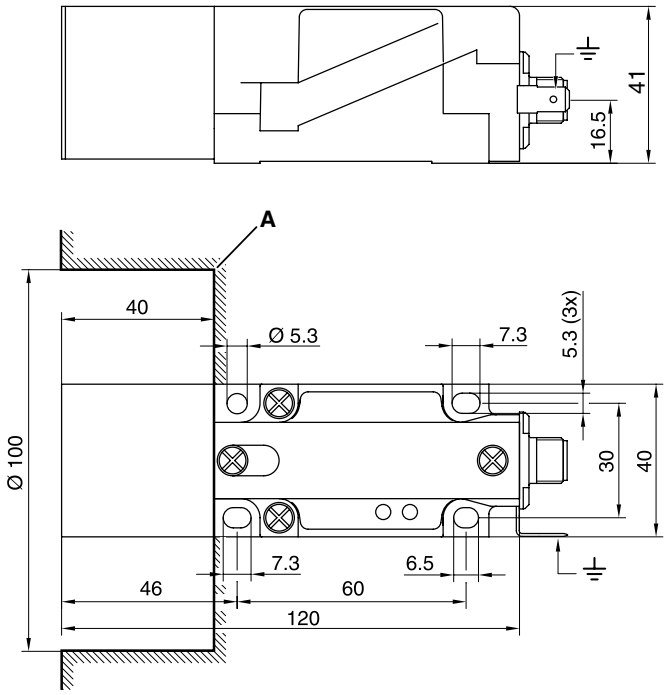


Fig. 14: Processor with integrated read head BIS L-409-045-001-07-S4 (dimensions in mm)

A Clear zone

► Attach processor using four M4 screws
Note maximum tightening torque of 15 Ncm.

Processors with remote read head are also tightened using 4 M4 screws to a max. tightening torque of 15 Ncm:

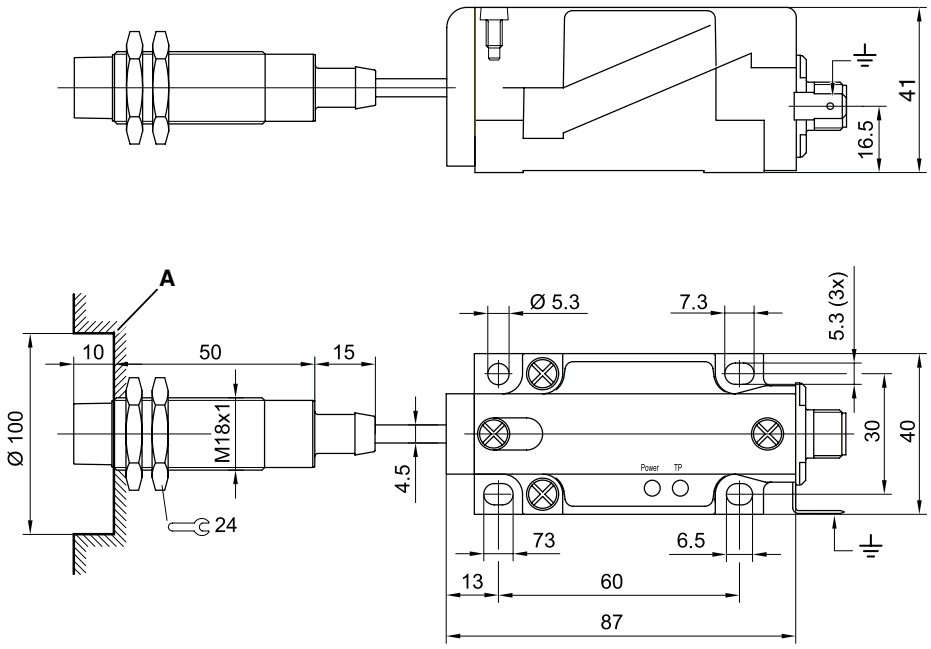


Fig. 15: Processor BIS L-409-045-002-07-S4 (dimensions in mm)

A Clear zone

6 Installation

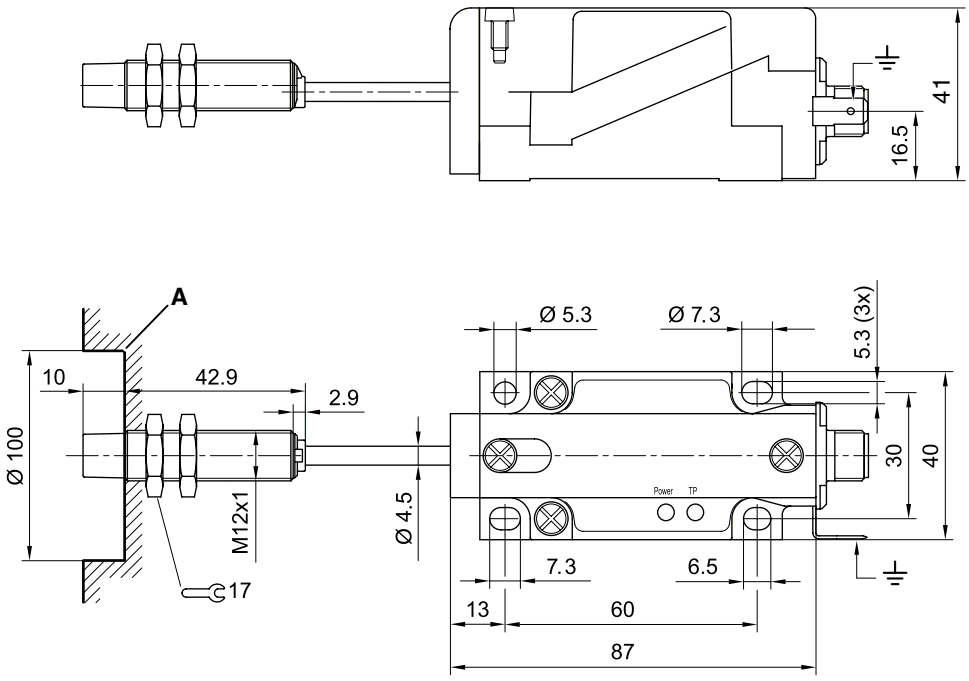


Fig. 16: Processor BIS L-409-045-003-07-S4 (dimensions in mm)

A Clear zone

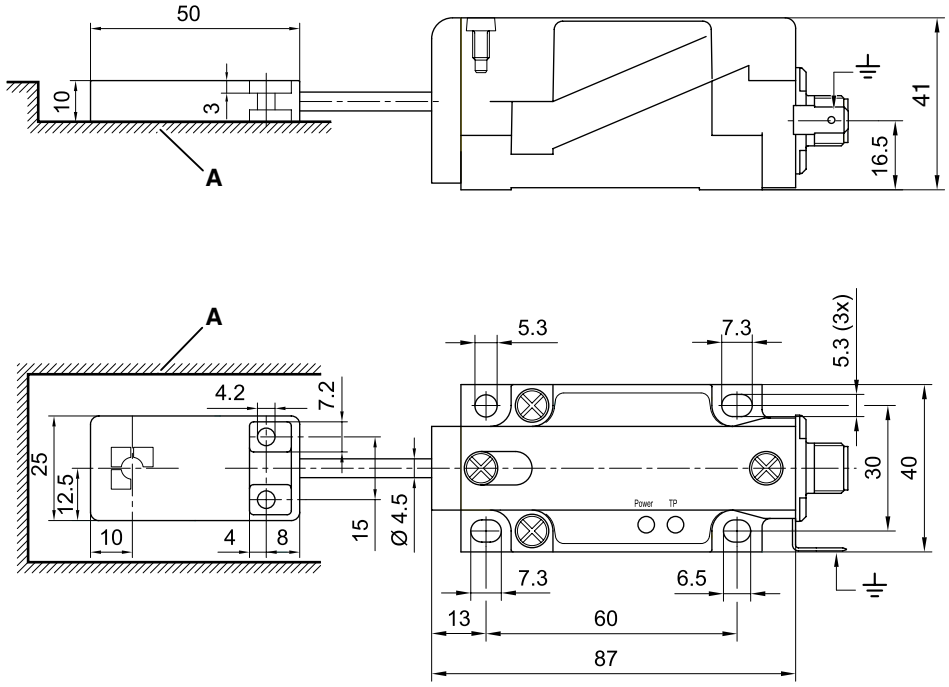


Fig. 17: Processor BIS L-409-045-004-07-S4 (dimensions in mm)

A Clear zone

6 Installation

Distance between processors

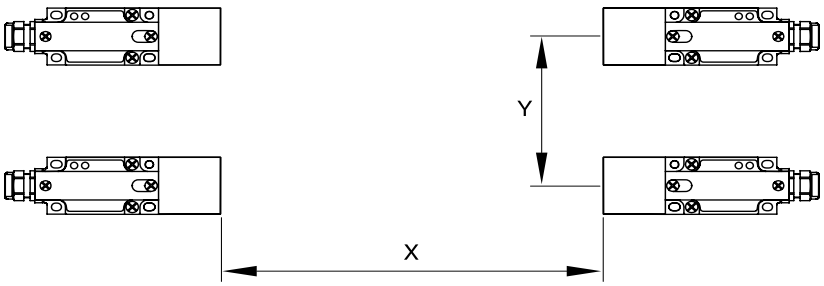


Fig. 18: Distance between processors

The following distances between individual BIS L-409_... systems must be maintained:

Processor	Distance x	Distance Y
BIS L-409-...-001- ...	1 m	1 m
BIS L-409-...-002- ...	0.5 m	0.3 m
BIS L-409-...-003- ...	0.5 m	0.3 m
BIS L-409-...-004- ...	0.5 m	0.3 m

Note
When installing two BIS L-409-... on metal there is normally no mutual interference. Unfavorable use of a metal frame can result in problems when reading a data carrier. In this case the read distance is reduced to 80% of the maximum value. In critical applications a pre-test is recommended!

6 Installation

Orienting the read head

The read head of the processor consists of a read head module and read head carrier. The sensing face of the read head can be positioned as desired (see Fig. 19).

Rotating the sensing face from front to up or to the side:
- ▶ Unscrew both screws (6) on the read head carrier (7).
- ▶ Rotate read head module (2) by 180°.
- ▶ Tighten both screws (6).

Rotating the read head:
- ▶ Loosen locking screw (3).
- ▶ Turn read head to the desired position.
  ⇒ The read head can be rotated steplessly by 270°.
- ▶ Tighten locking screw (3).

Note
The read head module is protected against overtightening.
The read head modules are not interchangeable.

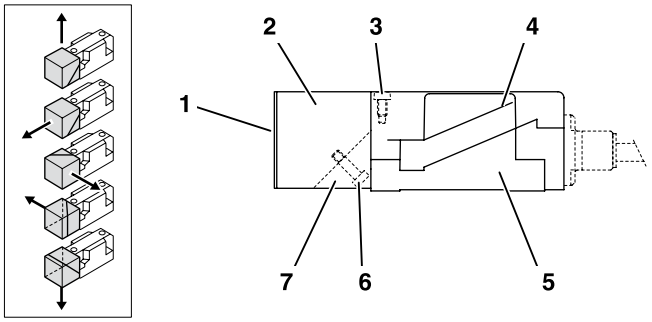


Fig. 19: Sensing face positions

1 Sensing face
2 Read head module
3 Locking screw
4 Module BIS L-400
5 Mounting base
6 Screw
7 Read head carrier

6.2 Electrical connection

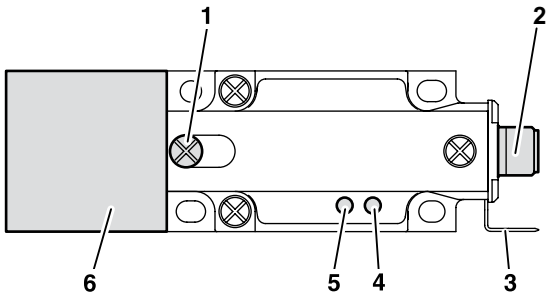


Fig. 20: Processor BIS L-409-... overview

1 Locking screw
2 IO-Link connection
3 **Ground**
4 LED 1
5 LED 2
6 Read head

6 Installation

IO-Link connection

Note
Make the ground connection, depending on the system, either directly or using an RC combination to ground.

IO-Link port (M12, A-coded, female)

PIN	Function
1	+24 V
2	NC
3	GND
4	C/Q

► Connect data line to IO-Link Master.
(See Balluff IO-Link catalog for connection cable and accessories)

6.3 Hardware settings

The operating mode and the baud rate are set in the processor using jumpers and DIP switches.

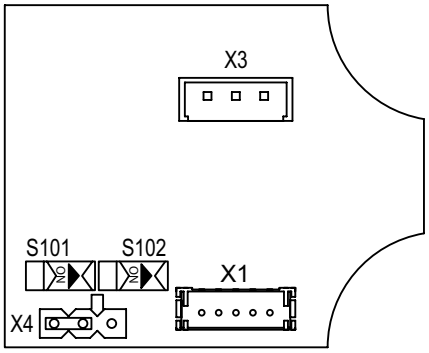


Fig. 21: Processor BIS L-409-... overview

1 X1 - Device terminal
2 X 3 - Read head terminal
3 X4 - Jumper for operating mode
4 S101/S102 - baud rate setting

The operating mode is set using jumpers in the processor (X4):
– IO-Link mode, jumper setting as shown in Fig. 21 (factory default setting)
– Service mode - to be used only by Balluff service

The baud rate is set using two DIP switches S101 and S102:

S102	S101	Baud rate
OFF	OFF	com1 4k8
OFF	ON	com1 4k8
ON	OFF	com2 38k4 *)
ON	ON	com3 230k4

*) Factory default setting

7 IO-Link Basics

7.1 Digital point-to-point connection

IO-Link integrates conventional and intelligent actuators and sensors into automation systems. Mixed use of traditional and intelligent devices is possible with no additional effort.
IO-Link is intended as a communications standard below the traditional fieldbus level. Fieldbus-neutral IO-Link transmission uses existing communications systems (fieldbuses or Ethernet-based systems).
The actuators and sensors are connected in point-to-point using conventional unshielded cables.
IO-Link devices can send application-specific parameters and data (e.g. diagnostics data) using a serial communications procedure. Flexible telegrams are possible for sending larger quantities of data. Communication is based on a standard UART protocol with 24V pulse modulation. Only one data line is used, which carries both the controller as well as the device telegram. This means that conventional 3-conductor physics is possible.

Three-conductor physics

IO-Link supports both communication mode as well as standard IO mode (SIO). Standard IO provides a switching signal on the communication line such as used by normal binary switching sensors. This mode is only possible with devices using 3-conductor connection technology.

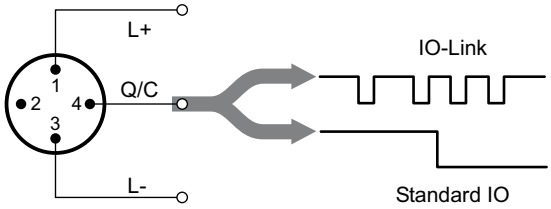


Fig. 22: 3-conductor physics of IO-Link

The BIS L-409-... supports both modes. In SIO mode the signal “Data carrier in range” (24V) and “No data carrier in range” (0 V) is made available to the host system as a switching signal.
If the BIS L-409… is not used with an IO-Link Master and without triggering IO-Link communication, it works in SIO mode and can be operated on a digital input.

Communications mode

The BIS L-409-... works in communication mode with Frame Type 1. In this transmission type 2 bytes of process data or required data are sent per frame (data block). This can take place either from IO-Link Master to device or vice-versa. Process data are the application-specific data, and required data may contain parameters, service or diagnostic data.

Interleave mode

So-called “Interleave Mode” makes it possible to send larger quantities of data. There multiple Type 1 frames must be combined into a sequencer. One frame with process data and one with required data are sent in alternation.
With the BIS L-409 a sequence consists of 32 individual frames. 8 bytes of process data are sent in each direction per sequence. These process data are shown in greater detail in Section 10.4 “Protocol sequence” on page 42.

7 IO-Link Basics

7.2 Process data container

The IO-Link protocol provides a process data container 32 bytes in size. Addressing is done in the command byte which the IO-Link Master sends. When process data are sent, addressing is directly to the sub-indices 00_{hex} … $1F_{hex}$.
The BIS L-409-… processes 8 bytes of input and 8 bytes of output data (input buffer/output buffer). The process data are mapped to the first 8 bytes of the process data container (sub-indices 00_{hex}…07_{hex}).

IO-Link protocol Subaddress		BIS L-409 IO-Link Device Subaddress
00_{hex}	⇒	00_{hex}
⋮	⋮	⋮
07_{hex}	⇒	07_{hex}
08_{hex}		
⋮		
$1F_{hex}$		

7.3 Direct parameter page

The Direct Parameter Page (DPP) contains 32 bytes of application-specific parameters and parameters for setting IO-Link communication. This corresponds to the first two pages of the Service Protocol Data Unit (SPDU) with 16 bytes each. Although the SPDU of the BIS L-409 devices is not supported, access to the DPP is made via Index, Subindex and length (in bytes) of the SPDU.
With Subindex 0 all 16 bytes of the Index can be accessed; the length determines how many parameters are read or written. With a Subindex > 0 a particular element of the Index is accessed, and the length specification is not used. Specification of these values depends on the IO-Link Master and the controller.

The most important parameters are summarized in the following table. Each parameter has a data width of 1 byte.

DPP	SPDU		Parameter	Access	BIS L-409	Meaning
Address	Index	Sub-index				
00_{hex}	0	1	Master Command	R/W	-	Determines the mode: $5A_{hex}$: Standard-IO mode 97_{hex}: Restart communication 98_{hex}: Communication running, output data valid[1)] 99_{hex}: Communication running, output data invalid[2)]
01_{hex}	0	2	Master Cycle Time	R/W	-	Used cycle time, specified by IO-Link master
02_{hex}	0	3	Min. Cycle Time	R	[3)]	Minimum cycle time achievable by the device
03_{hex}	0	4	Frame Capability	R	02_{hex}	The device supports Frame Type 1

Legend:
W: Write
R: Read

1) Device accepts output data from the master.
2) Device does not accept output data from the master and uses the last valid output data.
3) 25_{hex} at 230.4 kbaud
35_{hex} at 38.4 kbaud
62_{hex} at 4.8 kbaud

7 IO-Link Basics

Direct parameter page (cont.)

DPP	SPDU		Parameter	Access	BIS L-409	Meaning
Address	Index	Sub-index				
04hex	0	5	IO Link Revision	R	10hex	Version of the IO-Link spec matching the device: 10hex = V1.0
05hex	0	6	Process Data In	R	07hex	8 bytes of process data (Device to Master, SIO mode is supported)
06hex	0	7	Process Data Out	R	87hex	8 bytes of process data (Master to device, SIO mode is not supported)
07hex	0	8	Vendor ID 1	R	03hex	Vendor-ID: 0378hex = Balluff GmbH
08hex	0	9	Vendor ID 2	R	78hex	
09hex	0	10	Device ID 1	R	06hex	Device-ID: 060101hex = BIS L-409-045-…-07-S4
0Ahex	0	11	Device ID 2	R	01hex	
0Bhex	0	12	Device ID 3	R	01hex	
10hex ... 1Bhex	1	1)	Device Specific Parameters	R/W	-	1)

Legend: W: Write R: Read

1) See “Parameterizing the processor” starting page 32

Note
The output buffer process data are only valid if the device is using “Master Command” 98hex.

8 Setting the processor parameters

8.1 Required data

The device-specific parameters for the identification system application are in addresses 10_{hex} ... 12_{hex}. The parameter data are described in greater detail in the following.

	DPP	SPDU		Parameter	Data width	Value range	Default value
	Address	Index	Subindex				
Identification data	07_{hex}	0	8	Vendor ID	2 bytes	Read only	0378_{hex}
	08_{hex}	0	9				
	09_{hex}	0	10	Device ID	3 Byte		060101_{hex}
	$0A_{hex}$	0	11				
	$0B_{hex}$	0	12				
Parameter data	10_{hex}	1	1	CRC_16 check	1 byte	0/1	0
	11_{hex}	1	2	BIS L-10x-05	1 byte	0/1	0
	12_{hex}	1	3	Data comparison counter	1 byte	1...10	2

The parameters can be accessed on the parameter data channel using Index, Subindex and length (in bytes). With Subindex 0 all 16 bytes of the Index can be accessed; the length determines how many parameters are read or written. With a Subindex > 0 a particular element of the Index is accessed, and the length specification is not used. Specification of these values depends on the IO-Link Master and the controller.
There are parameters which can only be read, while others can be read and written (see “Direct Parameter Page” on page 30).

Note
The values of the unused device-specific parameters 13_{hex} to $1B_{hex}$ must be set to “0”.

Saving the parameters

The configured parameters are immediately valid as soon as they are set. However, if there is a power loss the user-defined settings will be lost. The device is restarted with the factory settings, and any other parameter setting needs to be made again.

8 Setting the processor parameters

8.2 Parameterization data mapping

Address 10hex, CRC_16 check

The CRC check is a procedure for determining a check value in order to be able to recognize data transmission errors. If the CRC check is activated, an error message is sent when a CRC error is detected.

CRC check

(If the parameter CRC_16 data check is set, then in addition to the data carrier data, a 2-byte CRC_16 checksum is checked (see “Data integrity” on page 15). The data compare counter is automatically set to one-time reading. Detection of a data carrier arriving in the read zone then takes a maximum of 70 ms.

Note
The CRC_16 data check can only be used with data carriers of type BIS L-10X-05/L. The data carriers must be initialized using a BIS L-60_ _ processor and the BISCOMRW.EXE PC software or a portable reader BIS L-81_ (refer to the User's guide for the corresponding device for this procedure).

Checksum

The checksum is written to the data carrier as 2 bytes of information. This means 2 bytes of user data per block are sacrificed.

1 byte, Address 10hex							
MSB	6	5	4	3	2	1	LSB
(not relevant)							1/0

Bit 0 (LSB) = 0: no CRC check (default setting)
Bit 0 (LSB) = 1: CRC Check

Data carrier

Address 11hex, BIS L-10x-05

Note
If type BIS L-10X-05 data carriers are used, parameter “BIS L-10x-05” must be activated.

1 byte, Address 11hex							
MSB	6	5	4	3	2	1	LSB
(not relevant)							1/0

Bit 0 (LSB) = 0: No type BIS L-10x-05 data carrier is used (default setting)
Bit 0 (LSB) = 1: A type BIS L-10x-05 data carrier is used

8 Setting the processor parameters

Data comparison counter

Address 12hex, data comparison counter

Using this parameter you can increase data integrity if the CRC_16 checksum is not used. The processor reads the data carrier data multiple times within a read operation. The processor stores and compares the data. Once the data carrier is recognized, the processor releases the data. From 1 to 10 read repetitions can be set in the “Data comparison counter” field.

1 byte, Address 12hex							
MSB	6	5	4	3	2	1	LSB
(not relevant)				Value range: 01hex…0Ahex			

Bit 0 … 3: Permissible value range 01hex … 0Ahex (decimal 1 … 10)
Default setting: 02hex (decimal: 2)

The decimal value is copied directly to the program. If an input value lies outside the permitted value range, the default setting of 2 comparisons is used.

9 Startup

9.1 Project administration

In project administration of fieldbus devices, a physical device is mapped as a modular system consisting of a head module and multiple data modules. The device data required for project planning are stored in GSD files (**G**eneric **S**tation **D**escription).

GSD file

The GSD files are made available by the vendors of the IO-Link Masters. The GSD files for Balluff IO-Link Masters are available on the Internet at “www.balluff.com/software” for downloading.
The data modules for an IO-Link device are shown in the project administration software by port. The GSD file provides the possible data modules (inputs or outputs of various data width). For configuring the IO-Link device the appropriate data modules are assigned to a particular port.

Head module

First the head module is inserted into the configuration. The head module is coded according to the special identification format. head modules in this coding are used for identification and parameter setting and have a data width of 2 bytes input of 2 bytes input/output data.

Data modules

The data modules are arranged onto the head module in order of the slots for ports/PINs.

9.2 Integration into project administration software

To integrate a BIS L-409 IO-Link device the following steps a generally required:

1. Load the GSD file for the IO-Link Master into the hardware configuration of the host system.
2. Insert the data module “Input 8 bytes/Output 8 bytes” (IOL_I/O_8/8_Byte) for the used IO-Link port (Port X, Pin 4).
   ⇒ This assigns the start addresses of the input and output data. The input and output data can, as described in Section 10, be used for operating the BIS L-409-....

9.3 Integration example

Integration of a BIS L-409-IO-Link-Device is shown using the example of a BNI-PBS-IO-Link-Master. In the example a Siemens S7 with “SIMATIC-MANAGER” program and project administration software is used. The exact procedure will vary from case to case depending on the software used and may differ from this example.

Installing the GSD file

To do the project planning on the PC, the GSD file for the module must be installed:

- ▶ Open new or existing project.
- ▶ Open hardware configurator.
- ▶ Select menu command “Tools| Install new GSD...”.
  ⇒ The “Install new GSD” window opens.
- ▶ Select directory and GSD file.
  ⇒ The [Install] button only becomes active if a GSD file is selected.
- ▶ Click on [Install].
  ⇒ The GSD file is installed.
  ⇒ Once the operation is finished, a message appears.
- ▶ Confirm the message and close the window.
- ▶ Select menu command “Tools | Update catalog”.
  ⇒ The modules are displayed in the project tree.

9 Startup

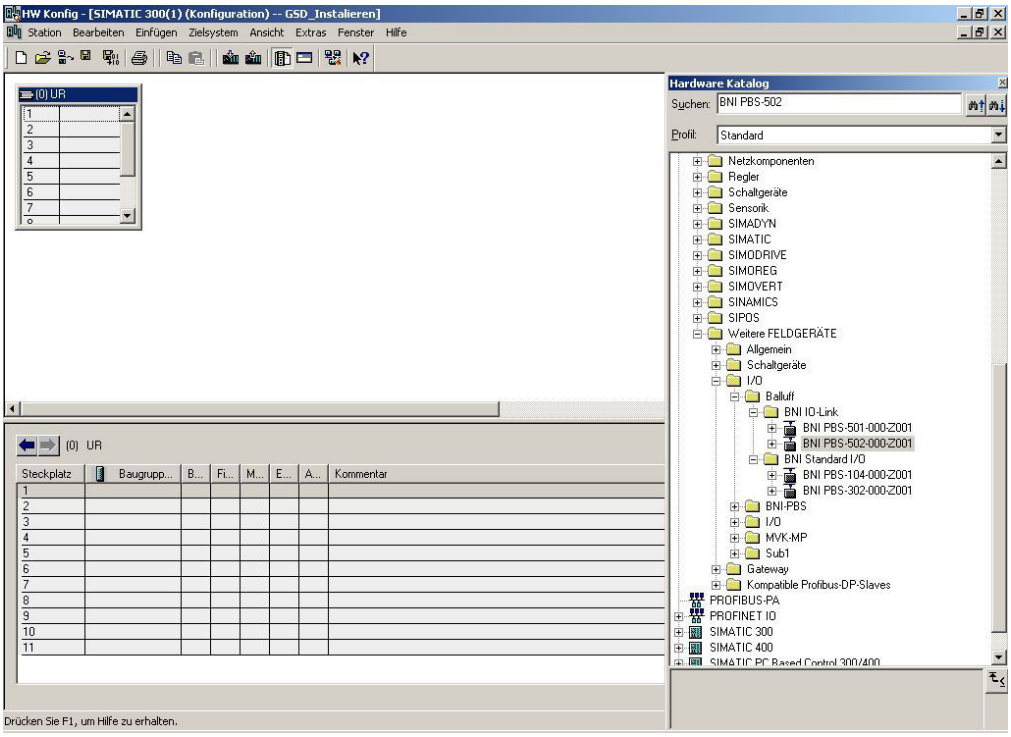


Fig. 23: The modules are shown in the product tree.

Selecting the module

To be able to select a CPU, you must first have selected a module carrier, here for example “RACK-300”.

► In the hardware catalog under “SIMATIC 300” select | “RACK-300 | Rail”.

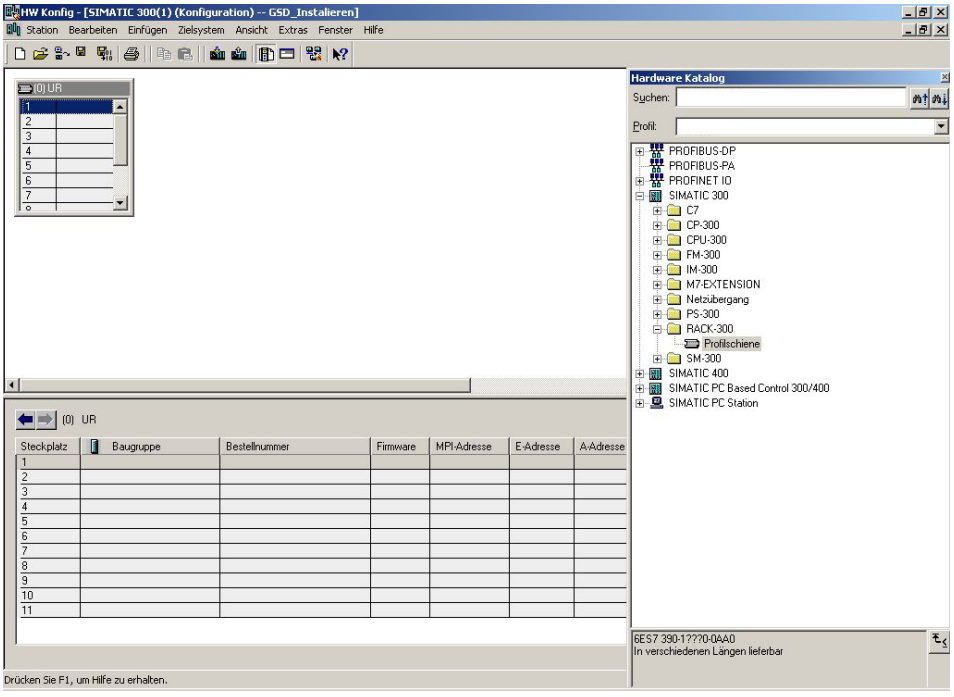


Fig. 24: Selecting a module

9 Startup

Selecting the CPU

► Select CPU from the hardware catalog.

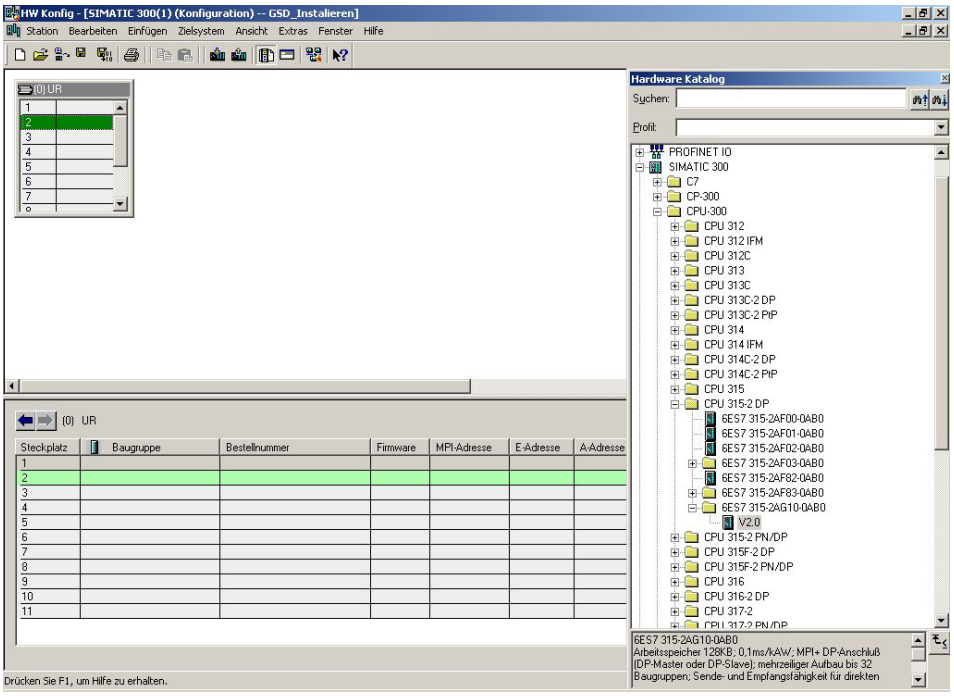


Fig. 25: Selecting CPU

Specifying the properties

► Double-click to open the properties.
⇒ The “Properties - PROFIBUS Interface DP” opens.
► Specify the Profibus address of the CPU and select subnet “PROFIBUS”.

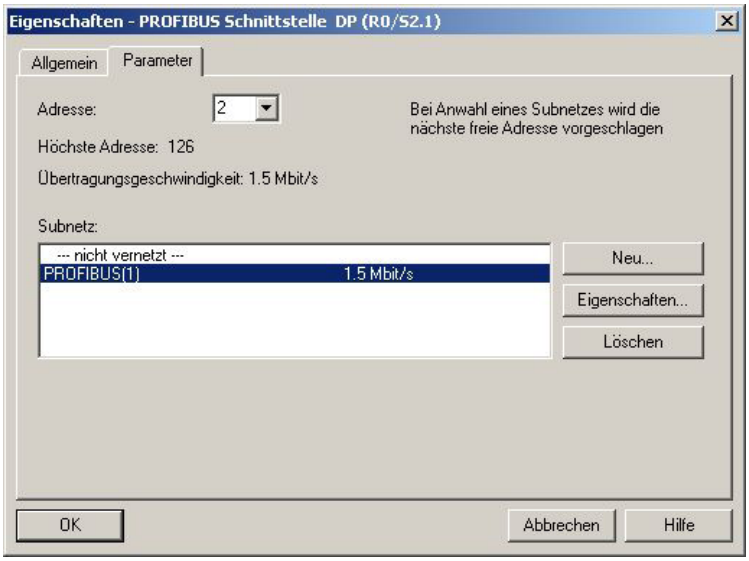


Fig. 26: Specifying CPU properties

9 Startup

Add DP slave (IO-Link Master)

The modules are located in the hardware catalog under “Other field devices”.
The IO-Link Master is added as a DP slave:

- ► Select Profibus rail.
- ► Add IO-Link Master as DP-Slave by double-clicking.
  ⇒ The slots are assigned the default settings.

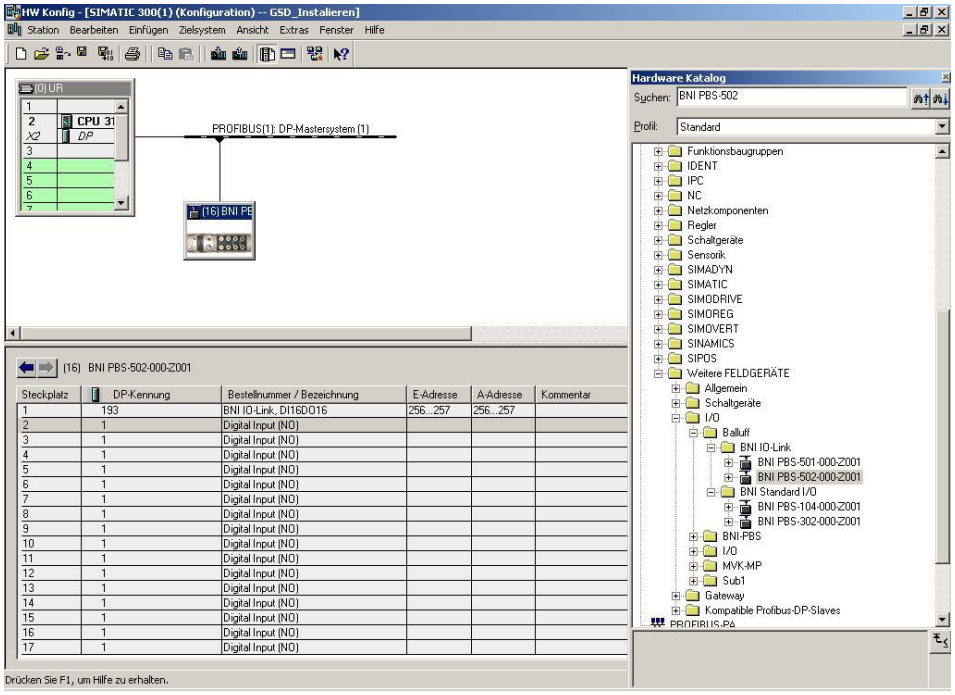


Fig. 27: Adding a module as a DP slave

Specifying the address

- ► Double-click on the head module to open the properties.
  ⇒ The “Properties - DP-Slave” window opens.
- ► Specify addressing of the head module.

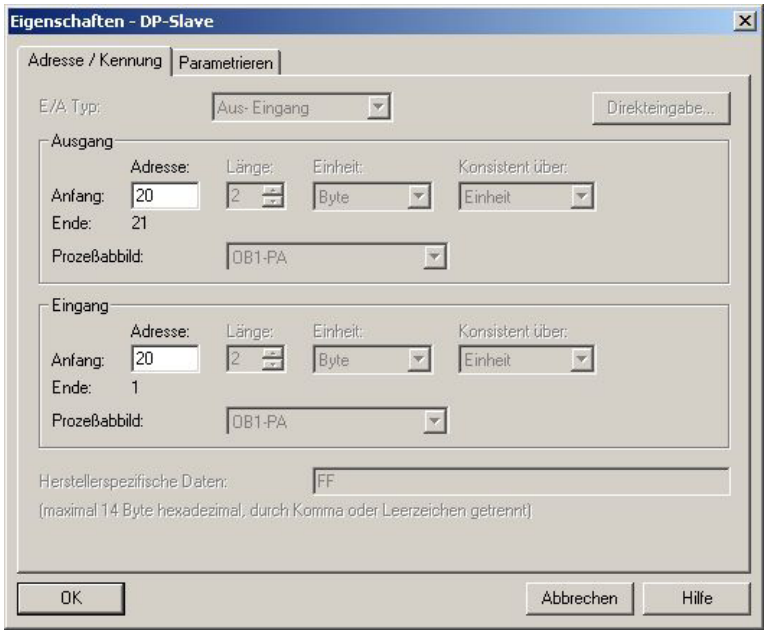


Fig. 28: Specifying addressing of the head module

9 Startup

Configuring inputs or outputs

The ports and PINs are represented by the slots.
In the example an IO-Link port is configured.

- ► Select Slot 6.
- ► Select the menu command “Edit | Delete”.

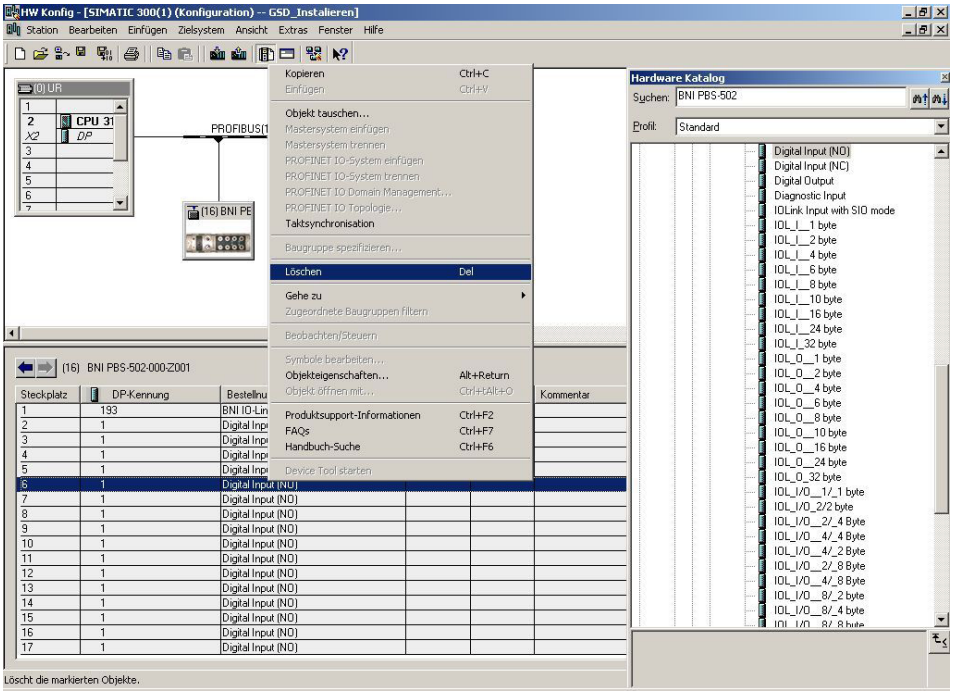


Fig. 29: Slot 6 selected, deleting default setting

9 Startup

After deleting the default setting:
⇒ Port and PIN are displayed.

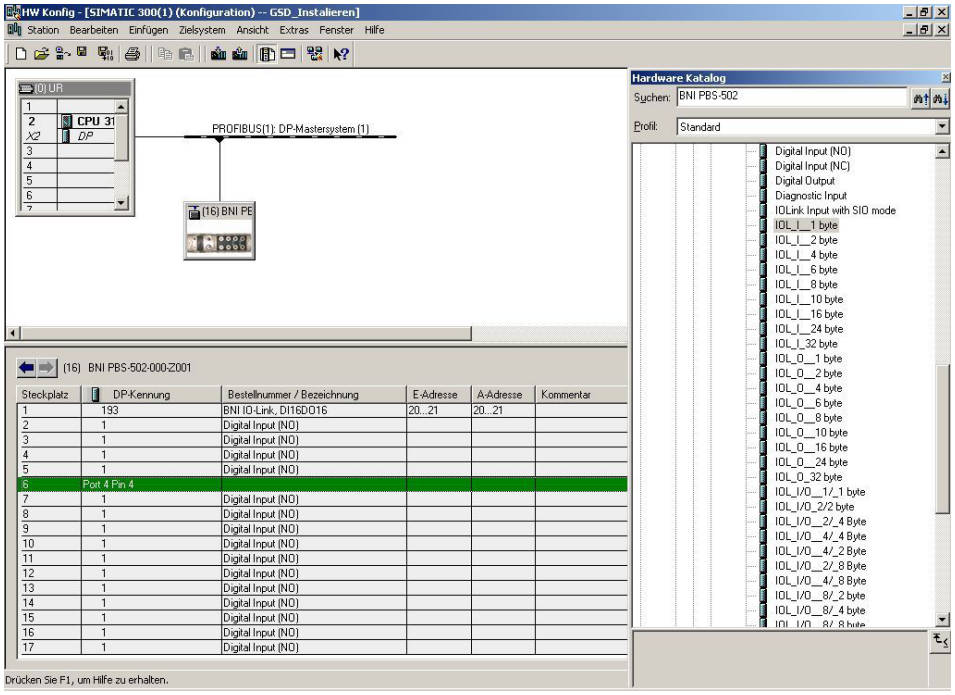


Fig. 30: Slot for port and PIN is free

Add device

The IO-Link slot can now be assigned the data module “IOL_I/O_8/8_Byte”, which is used for the BIS L-409-....

► Use drag and drop to assign the data module to the free slot.

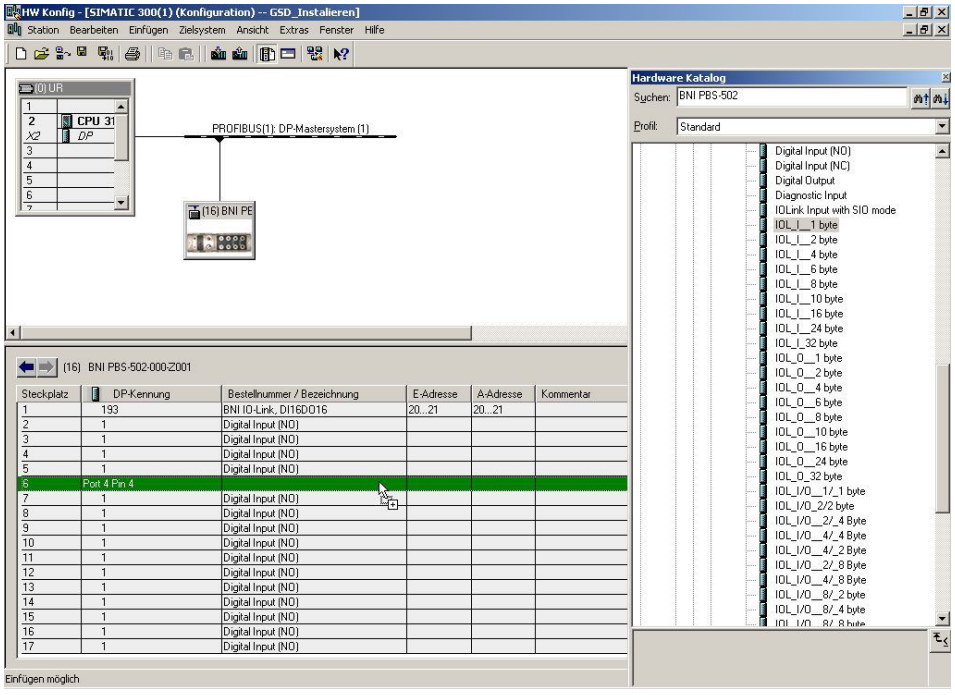


Fig. 31: Using drag and drop to assign the data module to the free slot.

10 Device Function

10.1 Function principle

The BIS L-409-... Identification System is a non-contact read-only system. The compact processor consists of processing circuitry with a fixed read head.
The system may be used to read information which has been permanently programmed into the data carrier and to send current status messages to the controller.

The main components of the BIS L-409-... Identification System are:
– Processor,
– read head,
– data carriers.

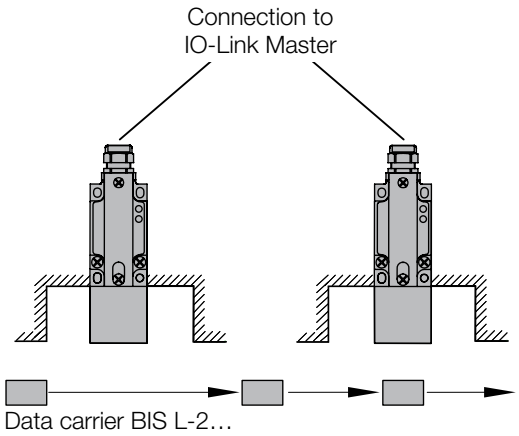


Fig. 32: Schematic representation of an identification system

The data carrier is an autonomous unit which is supplied with power by the read head. The read head continuously sends a carrier signal which is picked up by the data carrier from within a certain distance. Once the data carrier is powered, a static read operation takes place.

The processor manages the data transfer between read head and data carrier, serves as a buffer storage device, and sends the data to the host controller.
The data are passed to the IO-Link Master using IO-Link protocol, and the Master then passes them to the controlling system.

Host systems may be the following:
– A control computer (e.g. industrial PC),
– a PLC.

10.2 Operating mode

The BIS L-409-... supports cyclical data exchange via IO-Link protocol and standard IO mode.
Recognition of a data carrier (Codetag Present, 24 V) or no data carrier (0 V) is sent on the data line C/Q as a digital switching signal.
In cyclical data exchange the BIS L-409-... cyclically sends read data to the controller. It is also possible to read or enter parameter data in this mode.

10 Device Function

10.3 Process data

The start addresses of the input and output data are assigned in the hardware configuration for the host system. The BIS L-409-... uses 8 bytes of input and 8 bytes of output data, with assignment as described in the following. Subaddress 00_{hex} corresponds to the respective start address of the hardware configuration.

Output/Input buffer

The BIS L-409-... provides two fields for sending commands and data between the BIS L-409… and the host system:
– Output buffer
– Input buffer

These fields are embedded into the process data transmission via the IO-Link Master. As described above, 8 bytes of process data are sent in each direction.
The map of this process data is described below:

Output buffer:

Bit-No. / Subaddress	7	6	5	4	3	2	1	0
00_{hex} - 1st bit header			KA			GR		
01_{hex}								
02_{hex}								
03_{hex}								
04_{hex}								
05_{hex}								
06_{hex}								
07_{hex} - 2nd bit header			KA			GR		

Explanations for output buffer:

Subaddress	Bit name	Meaning	Function description
00_{hex}	1st bit header		
	KA	Head on/off	1 = Head off (read head turned off) 0 = Head on (read head operating)
	GR	Ground state	1 = Software-Reset - causes the BIS to go to the ground state 0 = Normal operation
07_{hex}	2. bit header		
	KA, GR		If 1st and 2nd bit headers agree, there are valid commands

10 Device Function

Input buffer:

Bit-No. / Subaddress	7	6	5	4	3	2	1	0
00_{hex} - 1st bit header	BB	HF			AF			CP
01_{hex}	Error code or data (LOWBYTE)							
02_{hex}	Data							
03_{hex}	Data							
04_{hex}	Data or CRC_16							
05_{hex}	Data (HIGHBYTE) or CRC_16							
06_{hex}	not used							
07_{hex} - 2nd bit header	BB	HF			AF			CP

Explanations for input buffer:

Subaddress	Bit name	Meaning	Function description
00_{hex}	1st bit header		
	BB	Power	1 = Device is ready 0 = Device is in ground state
	HF	Head Failure	1 = Head is turned off 0 = Head is turned on
	AF	Job error	1 = Job incorrectly processed 0 = Job processed without error
	CP	Codetag Present	1 = Data carrier is within range of the head 0 = No data carrier in range
01_{hex}		Error code	Error number is entered if the job was incorrectly processed or canceled. Only valid with AF bit! $0E_{hex}$ = *The CRC on the data carrier does not agree with the calculated CRC for the read data.* $0F_{hex}$ = 1st and 2nd bit header of the output buffer do not agree.
		or: Data	Data which were read from the data carrier
02_{hex}		Data	Data which were read from the data carrier
03_{hex}		Data	Data which were read from the data carrier
04_{hex}		Data	Data which were read from the data carrier
		or: CRC	CRC read from the data carrier
05_{hex}		Data	Data which were read from the data carrier
		or: CRC	CRC read from the data carrier
06_{hex}		-	not used
07_{hex}	2. bit header		
	BB, HF, AF, CP		If 1st and 2nd bit headers agree, there are valid data

Note
The 1st and 2nd header must be compared by the user (host system) in order to query the validity of the sent data.

10 Device Function

10.4 Protocol sequence

When communication is initiated by the IO-Link Master, transmission of the current process data begins. Reading is automatic and does not have to be initiated.
The bit headers of the output buffer offer the possibility of having the device go into the ground state or to turn off a head. For this the corresponding control commands in the two bit headers need to be set (see “Process data” on page 42). If the bits are cleared again, the module resumes operation.

The processor sends the current process data in each cycle. The data are only valid if the two bit headers agree. The bit headers show the status of the device and the subaddress 01_{hex} ... 05_{hex} contains data.
If an error occurs (AF bit =1), an error code is sent in subaddress 01_{hex} (see “Process data” on page 42).
If no data carrier is present (CP bit = 0), the stored data from the last data carrier are displayed until a new data carrier enters the active zone of the head. The stored data can be deleted with a reset by setting the GR bit.

10.5 Protocol examples

The following examples show the protocol sequence in various situations.

1st example

Device started, no data carrier yet present:

Command from controller			Response from BIS L-409	
1. Process output buffer:			2. Process input buffer:	
00hex	GR bit = 0, KA bit = 0		00hex	Set BB bit
07hex	GR bit = 0, KA bit = 0		01 ... 02_{hex}	Software Revision e.g. $01_{hex}00_{hex}$ = V 1.00
			07hex	Set BB bit

2nd example

Device start if data carrier present or
Read a data carrier in the active zone:

Command from controller			Response from BIS L-409	
1. Process output buffer:			2. Process input buffer:	
00_{hex}	GR bit = 0, KA bit = 0		00_{hex}	Set CP bit
07_{hex}	GR bit = 0, KA bit = 0		01 ... 05_{hex}	5 bytes of data
			07_{hex}	Set CP bit

3rd example

No data carrier in range:

Command from controller			Response from BIS L-409	
1. Process output buffer:			2. Process input buffer:	
00_{hex}	GR bit = 0, KA bit = 0		00_{hex}	Clear CP bit
07_{hex}	GR bit = 0, KA bit = 0		01 ... 05_{hex}	5 bytes of data (stored, last current data)
			07_{hex}	Clear CP bit

10 Device Function

4th example

Job incorrectly processed:

Command from controller		Response from BIS L-409	
		Process input buffer:	
		00_{hex}	Set AF bit
		01_{hex}	Error code (1 byte)
		$02 \ldots 05_{hex}$	4 bytes of data (stored, last current data)
		07_{hex}	Set AF bit

5th example

Turn off read head:

Command from controller		Response from BIS L-409	
1. Process output buffer:		2. Process input buffer:	
00_{hex}	KA bit = 1	00_{hex}	Set HF bit and clear CP bit
07_{hex}	KA bit = 1	$01 \ldots 05_{hex}$	5 bytes of data (stored, last current data)
		07_{hex}	Set HF bit and clear CP bit

New data carrier in range:

3. Process output buffer:		4. Turn off head and process input buffer:	
00_{hex}	KA bit = 1	00_{hex}	Set HF bit and clear CP bit
07_{hex}	KA bit = 1	$01 \ldots 05_{hex}$	5 bytes of data (stored, last current data)
		07_{hex}	Set HF bit and clear CP bit

Turn on read head:

5. Process output buffer:		6. Turn on head and process input buffer:	
00_{hex}	KA bit = 0	00_{hex}	Clear HF bit
07_{hex}	KA bit = 0	$01 \ldots 05_{hex}$	5 bytes of data (updated data for the new data carrier)
		07_{hex}	Clear HF bit

10 Device Function

6th example

Place device in ground state:

Command from controller			Response from BIS L-409	
1. Process output buffer:			2. Go to ground state and process input buffer:	
00hex	GR bit = 1		00hex	Clear BB bit
07hex	GR bit = 1		01...05hex	each 00hex
			07hex	Clear BB bit
3. Process output buffer:			4. Start running and process input buffer:[1)]	
00hex	GR bit = 0		00hex	Set BB bit
07hex	GR bit = 0		01...05hex	5 bytes of data
			07hex	Set BB bit

1) If there is no data carrier in range, the input buffer is filled with 00hex.

10.6 Error codes

Error code	Meaning	Remedy
0Ehex	CRC error	Data carrier was not successfully read. Possible causes: – Data carrier defective – Transmission failed – Data carrier not CRC capable
0Fhex	Format error	The two headers in the output buffer and in the host system do not agree. The headers must be matched (see “Output buffer” page 42).

10 Device Function

10.7 Data transmission timing

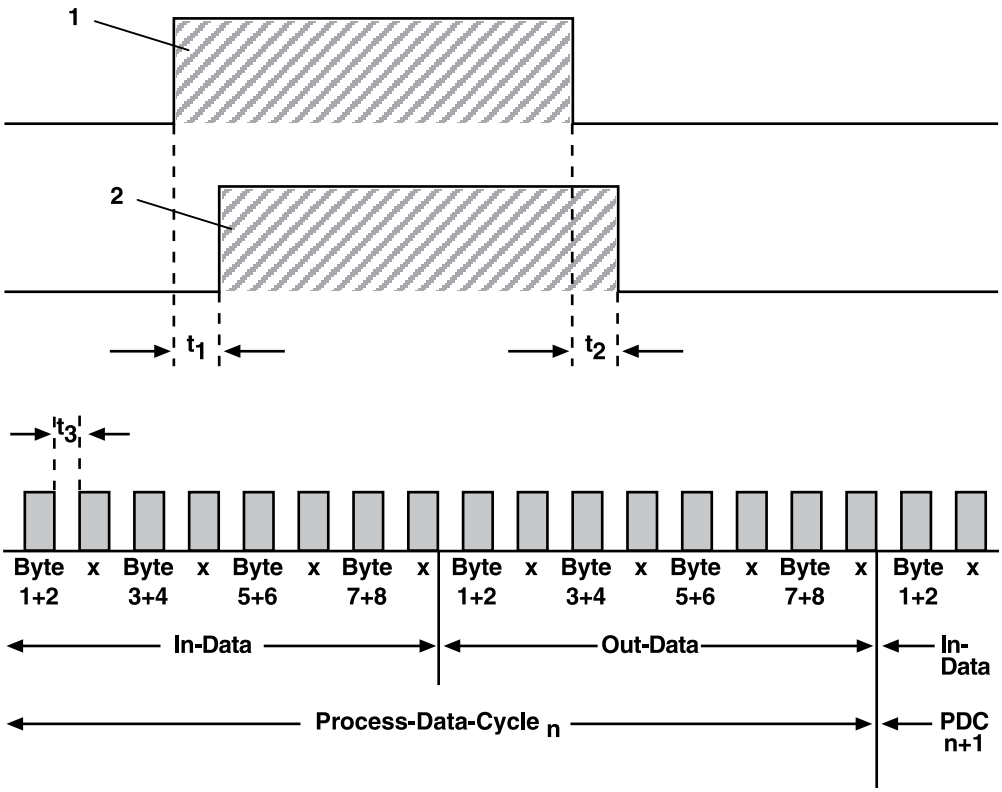


Fig. 33: Timing of data carrier recognition and data transmission

1 Data carrier in range
2 Data carrier recognized (Tag-Present LED, Codetag-Present bit)
t1 Data read time
t2 Polling time
t3 Cycle time

In-Data: Input data
Out-Data: Output data
Process-Data-Cycle: Process data cycle
Byte a+b: Process data
x: Data required

Data read time t1:
Time until the data from a data carrier entering the read range are actually read. The read time is: 70 ms × number of parameterized data compare counts, Default = 2 (see “Map of parameterizing data” on page 33).

Polling time t2:
Time until it is recognized that the data carrier is no longer in the read range (polling time). The polling time is 50 ms.

Cycle time t3:
Time between the sending of two frames. The cycle time depends on the set baud rate and the respective Master (see “Direct Parameter Page” on page 30)

In-Data/Out-Data:
Sending of the input data and output data. 8 frames of 2 bytes each are sent, alternating process data and required data (x).

Process Data Cycle:
A process data cycle consists of the complete sending of the input and output data. At the beginning of each process data cycle the current data are polled and immediately sent.

10 Device Function

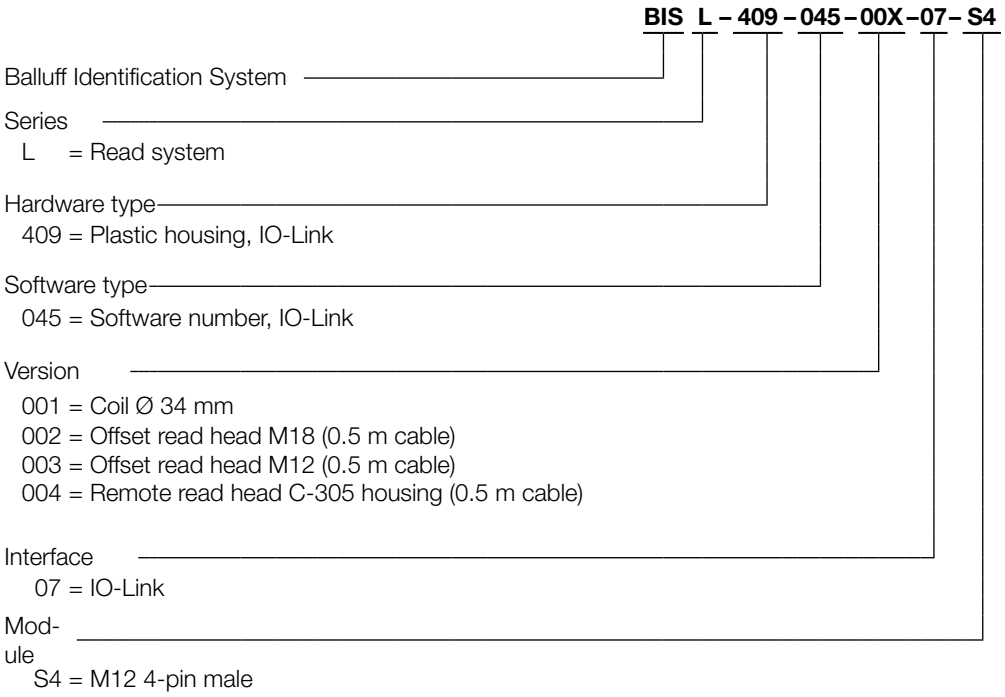
Updating the IO-Link Master data

When a data carrier enters the read range, its data are read and stored within time t_1. The data are sent at the next start of a process data cycle (In-Data).
The data carrier should be located within the read range at the start of a process data cycle so that the CP bit is set when the current data are polled. If the data carrier leaves the read range before polling, the data are sent but the CP bit is not set. If the dwell time of a data carrier in the read range is very short and if another data carrier immediately arrives, loss of data may result in the worst case.

The minimum time until the most current data are available on the IO-Link Master is $16 \times t_3$. The time corresponds to the sending time of 16 frames or one process data cycle with the parameterized cycle time (depending on the set baud rate and the host Master, see also “Direct Parameter Page” on page 30).

Appendix

Ordering code



Accessories (optional, not included)

Accessories for the BIS L-409-... can be found in the Balluff IO-Link catalog.

The catalog can be downloaded on the Internet at “www.balluff.de”.

Appendix

ASCII table

Decimal	Hex	Control Code	ASCII	Decimal	Hex	ASCII	Decimal	Hex	ASCII
0	00	Ctrl @	NUL	43	2B	+	86	56	V
1	01	Ctrl A	SOH	44	2C	,	87	57	W
2	02	Ctrl B	STX	45	2D	-	88	58	X
3	03	Ctrl C	ETX	46	2E	.	89	59	Y
4	04	Ctrl D	EOT	47	2F	/	90	5 A	Z
5	05	Ctrl E	ENQ	48	30	0	91	5B	[
6	06	Ctrl F	ACK	49	31	1	92	5C	\
7	07	Ctrl G	BEL	50	32	2	93	5D	[
8	08	Ctrl H	BS	51	33	3	94	5E	^
9	09	Ctrl I	HT	52	34	4	95	5F	_
10	0 A	Ctrl J	LF	53	35	5	96	60	`
11	0B	Ctrl K	VT	54	36	6	97	61	A
12	0C	Ctrl L	FF	55	37	7	98	62	B
13	0D	Ctrl M	CR	56	38	8	99	63	c
14	0E	Ctrl N	SO	57	39	9	100	64	d
15	0F	Ctrl O	SI	58	3 A	:	101	65	e
16	10	Ctrl P	DLE	59	3B	;	102	66	f
17	11	Ctrl Q	DC1	60	3C	<	103	67	g
18	12	Ctrl R	DC2	61	3D	=	104	68	h
19	13	Ctrl S	DC3	62	3E	>	105	69	i
20	14	Ctrl T	DC4	63	3F	?	106	6 A	j
21	15	Ctrl U	NAK	64	40	@	107	6B	k
22	16	Ctrl V	SYN	65	41	A	108	6C	L
23	17	Ctrl W	ETB	66	42	B	109	6D	m
24	18	Ctrl X	CAN	67	43	C	110	6E	n
25	19	Ctrl Y	EM	68	44	D	111	6F	o
26	1 A	Ctrl Z	SUB	69	45	E	112	70	p
27	1B	Ctrl [	ESC	70	46	F	113	71	q
28	1C	Ctrl \	FS	71	47	G	114	72	r
29	1D	Ctrl]	GS	72	48	H	115	73	s
30	1E	Ctrl ^	RS	73	49	I	116	74	t
31	1F	Ctrl _	US	74	4 A	J	117	75	u
32	20		SP	75	4B	K	118	76	V
33	21		!	76	4C	L	119	77	W
34	22		"	77	4D	M	120	78	X
35	23		#	78	4E	N	121	79	Y
36	24		$	79	4F	O	122	7 A	Z
37	25		%	80	50	P	123	7B	{
38	26		&	81	51	Q	124	7C	|
39	27		‘	82	52	R	125	7D	}
40	28		(	83	53	S	126	7E	~
41	29		)	84	54	T	127	7F	DEL
42	2 A		*	85	55	U			

Appendix

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No. 858282 · 00.000000 · Edition 0804; Subject to modification.