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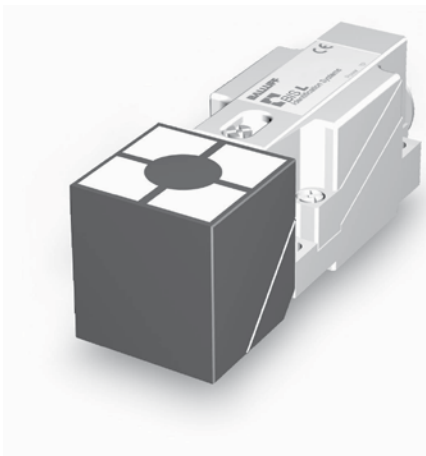
BIS L-400-..., BIS Z-EL-...

Technical Description, User's Guide



English

www.balluff.com

1 User Instructions

1.1 About this manual

This manual describes the Easy Loop connection system with the components BIS Z-EL-001-ETHERNET, BIS Z-EL-002-RS232, BIS L-400-043-0xx-02-S115 as well as startup instructions for immediate use.

1.2 Manual organization

The manual is organized so that the sections build on each other.
Section 2: Basic safety information.
Section 3: The key 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: Logging the processor on to the network.
Section 8: User-defined processor settings.
Section 9: Processor and host system interaction.

1.3 Conventions

The following conventions are used in this manual:

Enumerations

Enumerations are shown as a list with em-dashes.
– 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}).

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

ASCII characters:
– The control characters in ASCII code are set in angle brackets (e.g. <CR>),
– and the other ASCII characters are set in apostrophes (e.g. 'L').

Cross-references

Cross-references indicate where additional information on the topic can be found (see “Technical Data” on page 19).

1.4 Symbols

Attention!
This symbol indicates a safety instruction that must be followed.

Note, tip
This symbol indicates general notes.

1 Notes to the user

1.5 Abbreviations

BCC	Block Check Character
BIS	Balluff Identification System
CRC	Cyclic Redundancy Code
EEPROM	Electrically Erasable and Programmable Read Only Memory
EL	Easy Loop
EMC	Electromagnetic Compatibility
IP	Internet Protocol
MAC-ID	Media Access Control Identifier
PC	Personal Computer
PLC	Programmable Logic Controller
TCP	Transmission Control Protocol

2 Safety

2.1 Intended use

The Easy Loop connection system enables multiple BIS processors to be connected to a host controller (PLC, PC) through just a single port on the communication module. The system is intended only for this use in industrial areas as per Class A of the EMC Law.
This description is valid for communications modules in series BIS Z-EL-… and the compact processor BIS L-400-043-0xx-02-S115

2.2 General safety notes

Installation and Startup
Installation and startup are to be performed only by trained technicians. No warranty is made for damage caused by unauthorized intervention or by improper use.
When connecting the components, ensure proper polarity and assembly of the connections (see “Installation” on page 29).
The processor may be operated only using an approved power supply (see “Technical Data” on page 19).

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

2.3 Meaning of the warning notes

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 may result in personal injury or equipment damage.
► Always take the described measures to prevent hazardous situations.

3 Getting Started

System overview

The Easy Loop connection system consists of a communications module and up to 16 processors.

- Up to eight processors may be connected to each of the two ports on the communications module.
- The Easy Loop connection system forms a ring in which the processors are numbered in sequence, beginning with Line 1.
- The telegrams from the individual processors are strung in this sequence and sent to the controller from the communications module as a data chain. The telegrams can be evaluated separately in the host controller (see “Protocol sequence” on page 42).
- The processors may be interchanged with each other within the connection system, since the processors are not addressed.
- Additional processors may be connected at any point, whereby only the order of the telegrams changes.
- The ring must be closed.

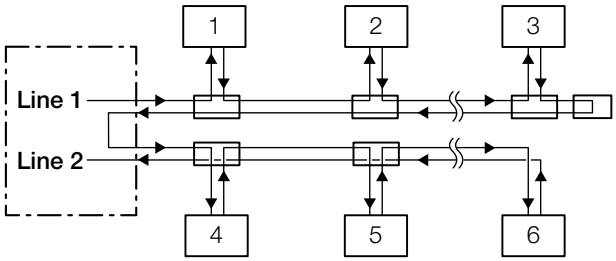


Fig. 1: Schematic representation with 3 processors each on Line 1 and Line 2

Example

In the following example the first processor in Line 1 sends the first telegram (1st read location) and the first processor on Line 2 sends telegram number 5 (5th read location):

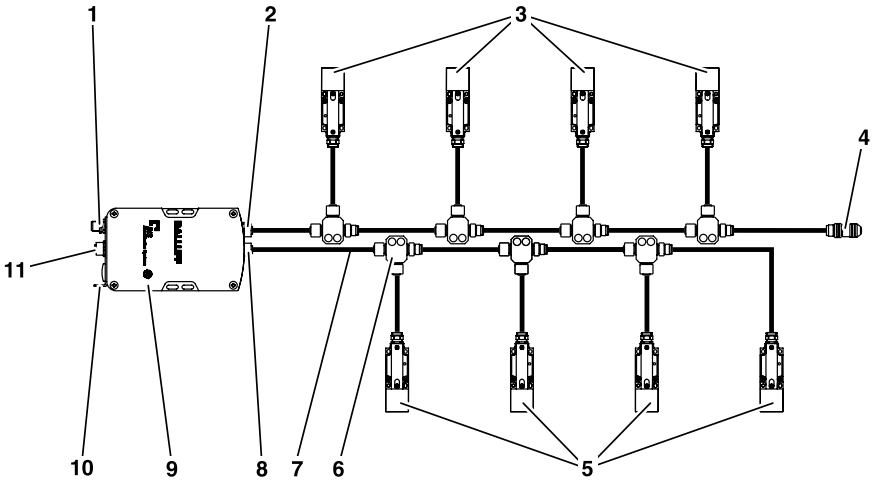


Fig. 2: System structure with 4 processors each on Line 1 and Line 2

1 X1 (24 V DC)
2 Line 1 (Easy Loop)
3 Processors on Line 1
4 Terminating plug BKS-S117-R01
5 Processors on Line 2
6 Tee BKS-S115-TW2-03
7 Connection cable: BIS Z-5xx-…
8 Line 2 (Easy Loop)
9 Communications module
10 Ground
11 X2 (TCP/IP or RS232) BIS Z-EL-…

3 Getting Started

Mechanical connection of the communications-module

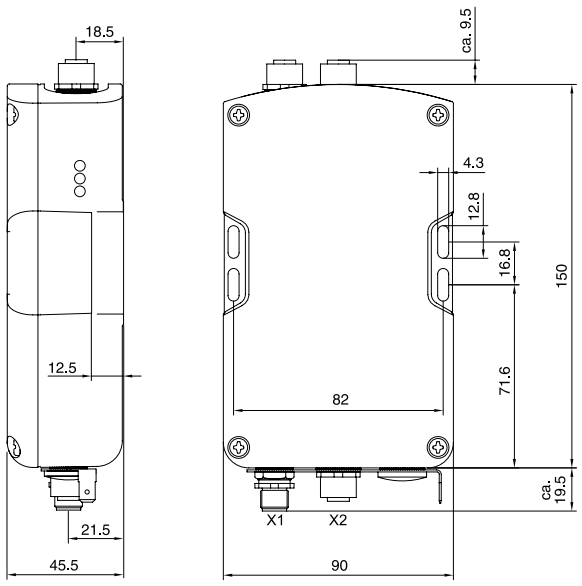


Fig. 3: Communications module dimensions

► Attach communications module using 4 M4 screws.

Mechanical connection of the communications-module

Note
Make the ground connection either directly or using an RC combination to ground. When making your connection to the Ethernet, be sure that the shield is perfectly connected to the connector body.

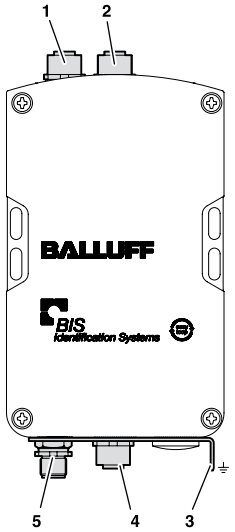


Fig. 4: Communications module, connections

1 Line 1 (Easy Loop)
2 Line 2 (Easy Loop)
3 Ground
4 X2 (TCP/IP or RS232)
5 X1 (24 V DC)

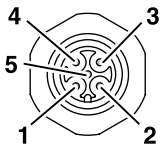
► Connect data line for the tee and processor to ports Line 1 and 2.
⇒ Be sure that the ring is closed at the end of the installation.

3 Getting Started

Ethernet

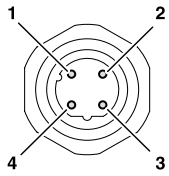
BIS Z-EL-001-Ethernet:

X1 – Panel plug, 5-pin



PIN	Function
1	+Vs
2	n.c.
3	–Vs
4	n.c.
5	n.c.

X2 – Panel socket, 4-pole

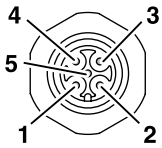


PIN	Function
1	TD+
2	RD+
3	TD–
4	RD–

RS232

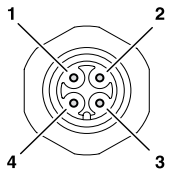
BIZ Z-EL-002-RS232:

X1 – Panel plug, 5-pin



PIN	Function
1	+Vs
2	n.c.
3	–Vs
4	n.c.
5	n.c.

X2 – Panel plug, 4-pin



PIN	Function
1	
2	TxD
3	GND
4	RxD

- ► Connect power supply to port X1.
- ► Connect data line for host system to port X2.

LED indicators

The communications module is equipped with two LEDs.

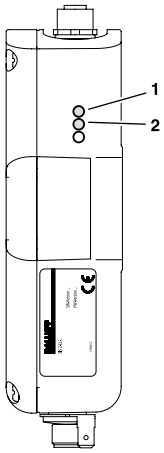


Fig. 5: Communications module, LED indicators

Item	LED	Display	Function
1	LED 1	green	Indicates ready state of the unit
2	LED 2	yellow	Indicates transmission of data to the controller

3 Getting Started

Bus connection

The bus link for the **BIS Z-EL-001-Ethernet Communications Module** is established using the “BIS SetIP” program and a Windows PC with Ethernet connection.

> **Note**
> For the **BIS Z-EL-002-RS232** Communications Module there is no bus connection, since this is a serial point-to-point device.

The application “BIS SetIP” can be found on the included BIS-CD.

- ▶ Start “BIS SetIP”.
  ⇒ The window “BIS_-6027 assign IP Address” is opened.

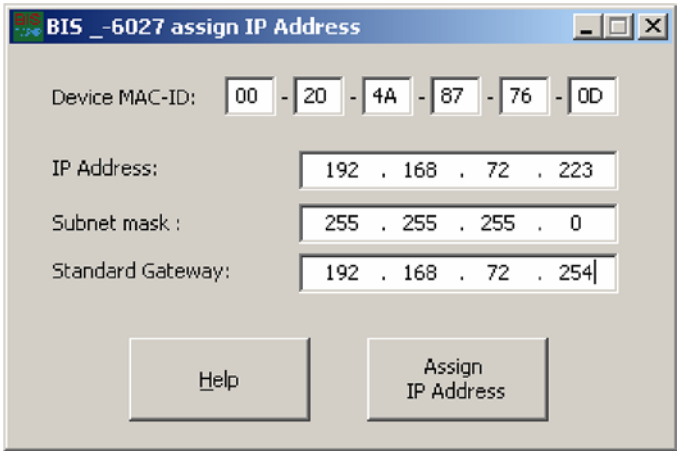


Fig. 6: Screenshot of MAC-ID entry

- ▶ Enter MAC-ID for the device.

> **Note**
> The MAC-ID can be found on the part label of the communications module.

- ▶ Assign IP address, subnet mask and gateway address.
- ▶ Confirm settings by clicking on “Assign IP Address”.

Serial settings

For the BIS Z-EL-001-Ethernet Communications Module the serial port parameters for sending to the processors need to be set.
For the BIS Z-EL-002-RS232 this is not necessary, since here just a pure level setting is done, and the correct parameters must already have been set in the controller.

Configuring the serial settings

- ▶ Establish the physical connection.
- ▶ Start Internet browser, e.g. Microsoft IE. The latest version of Java Runtime Environment (JRE) must be installed.
- ▶ Enter device IP in the address line (Balluff factory default 192.168.72.223).
  ⇒ The Ethernet CONFIG program is now started.

3 Getting Started

Fig. 7: Screenshot of login

▶ Password prompt: Confirm by clicking on OK with no entry.

Note
The communications module settings can be password protected. Use of a password is not recommended, however, since if the password is lost the communications module will have to be completely replaced.

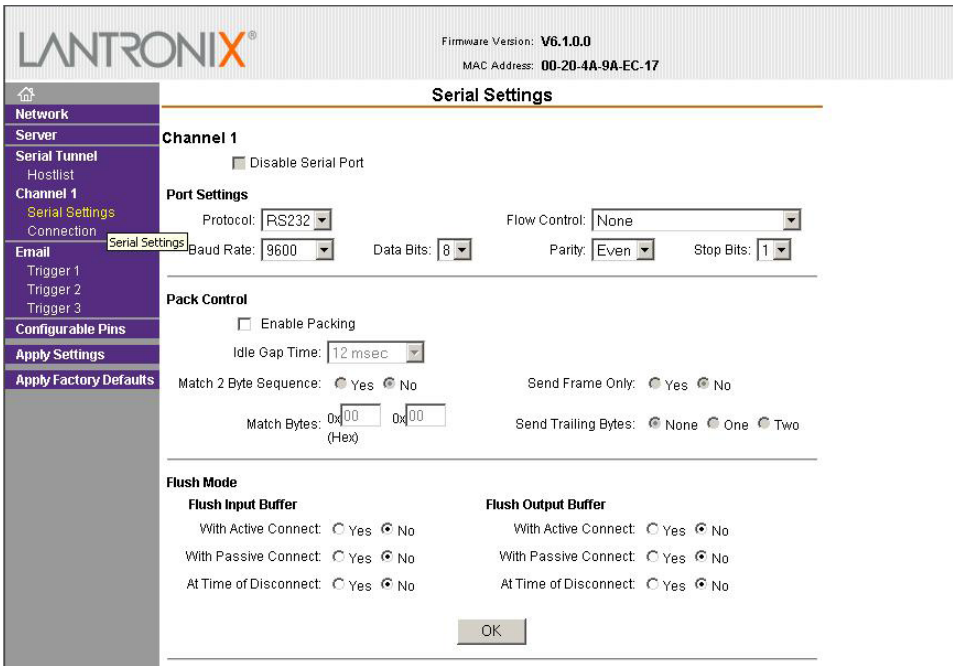


Fig. 8: Screenshot of serial settings

▶ Now make the serial settings for the communications module.

Default settings:

Baud rate: 9600 Data bits: 8 Parity: Even Stop bits: 1

▶ Confirm the settings by clicking on OK and “Apply Settings”.

Note
The serial settings must agree with the parameter configuration in all connected BIS L-400-043-0xx-02-S115 processors.

3 Getting Started

Mechanical connection

Processor with integrated read head

BIS L-400-043-001-02-S115

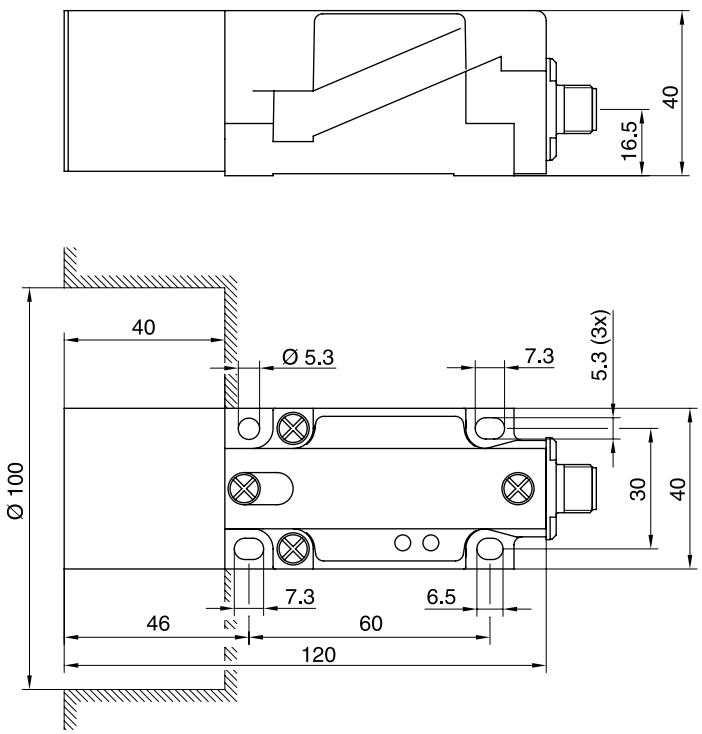


Fig. 9: BIS L-400-043-001-02-S115 processor dimensions

► Attach processor using 4 M4 screws.

Processor with offset read head

BIS L-400-043-002-02-S115

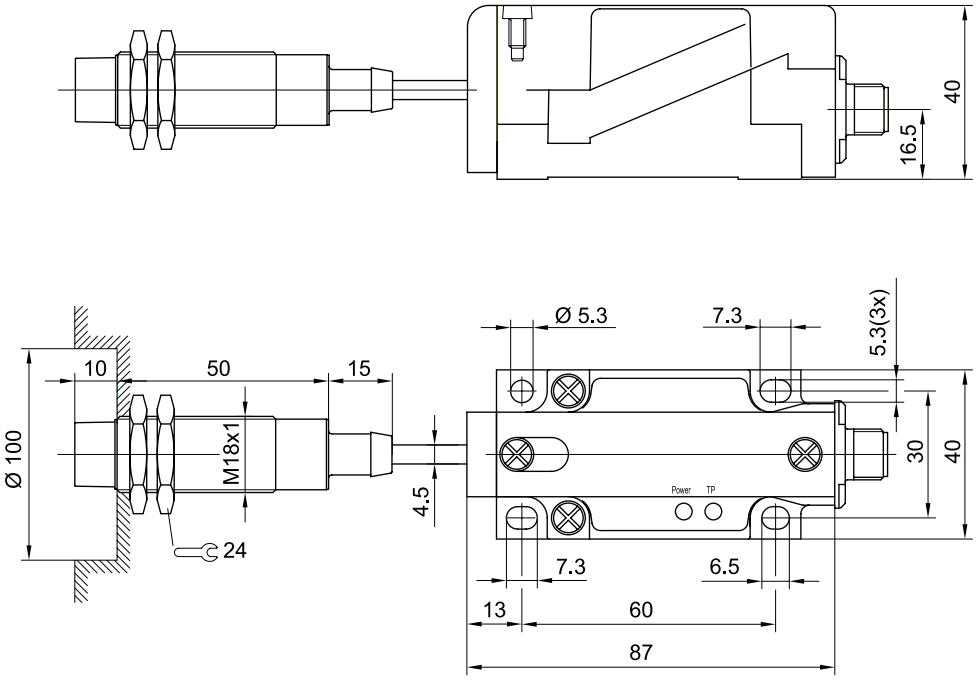


Fig. 10: BIS L-400-043-002-02-S115 processor dimensions

3 Getting Started

BIS L-400-043-003-02-S115

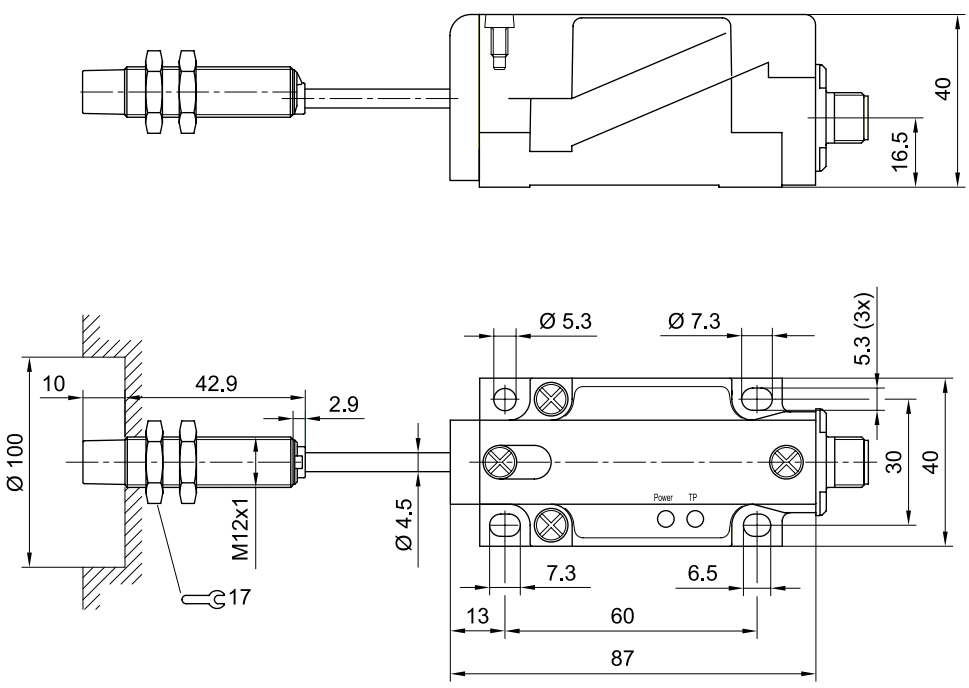


Fig. 11: BIS L-400-043-003-02-S115 processor dimensions

BIS L-400-043-004-02-S115

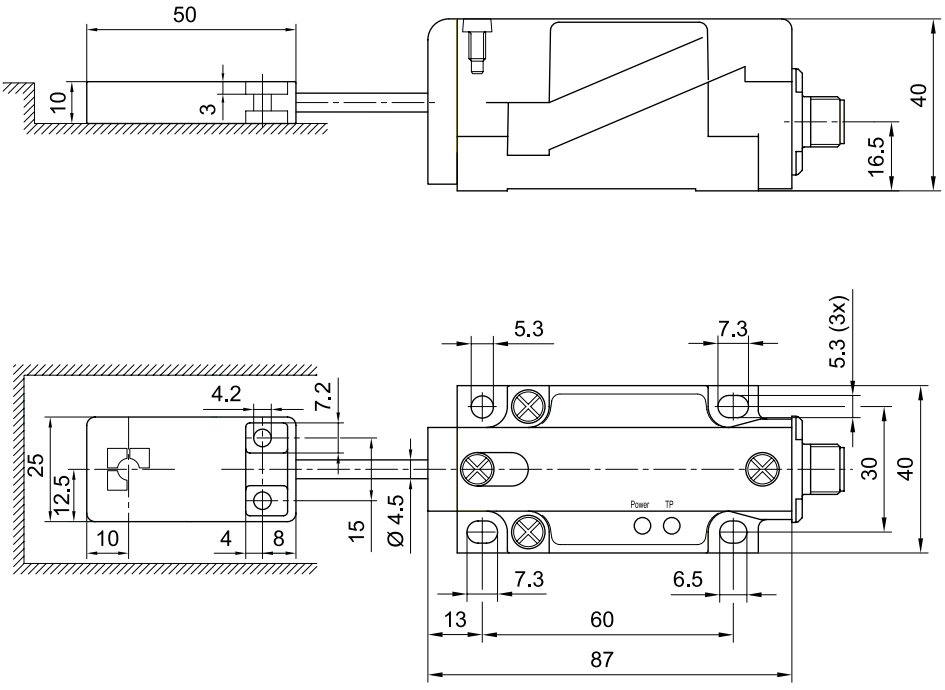


Fig. 12: BIS L-400-043-004-02-S115 processor dimensions

3 Getting Started

Mounting separation

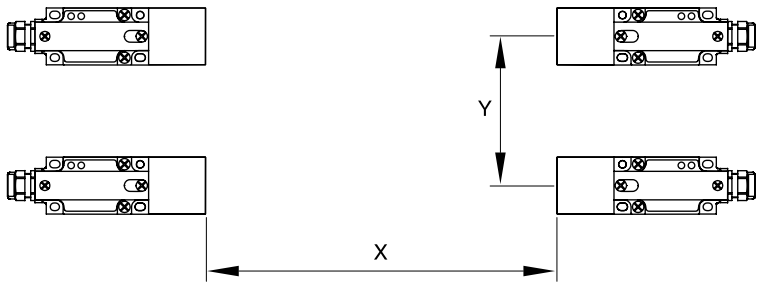


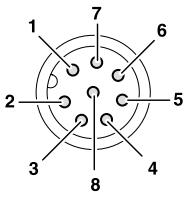
Fig. 13: Distance between processors

The following distances between individual BIS L-400_ systems must be maintained:

	Distance x	Distance Y
BIS L-400-...-001- ...	1 m	1 m
BIS L-400-...-002- ...	0.5 m	0.3 m
BIS L-400-...-003- ...	0.5 m	0.3 m
BIS L-400-...-004- ...	0.5 m	0.3 m

Note
When installing two BIS L-400 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!

Electrical connection Processor



fixed plug 8-pin

PIN	Function	Color code*)
1	A (R+)	yellow
2	Y (T+)	gray
3	B (R–)	pink
4	n.c.	red
5	Z (T–)	green
6	–VS	blue
7	+VS	brown
8	COM	white

*) When using BIS Z-501-PU1-... or BIS Z-502-PU1-....

3 Getting Started

Cable lengths

The maximum permissible cable length between the communications module and each individual processor is 80 m.

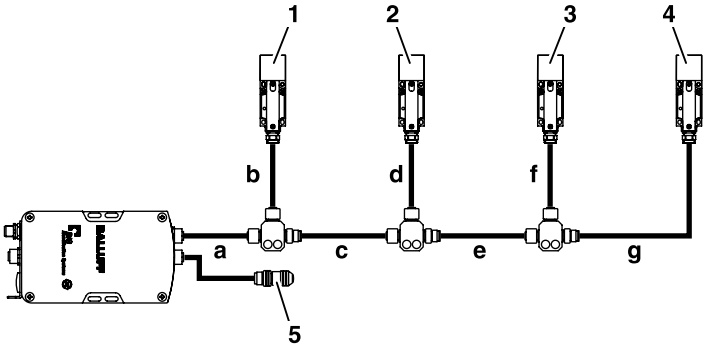


Fig. 14: Cable lengths

The cable length is calculated by adding the sub-sections between the communications module and the processor, e.g.:

Processor **1**: l = a + b
Processor **2**: l = a + c + d
Processor **3**: l = a + c + e + f
Processor **4**: l = a + c + e + g $l_{max} \leq 80$ m

5 Terminating plug

Alternate wiring options

The following illustrations show various connection options. For example, tees and terminating plugs can be connected directly to the Communications Module or processors can be connected directly to a tee.

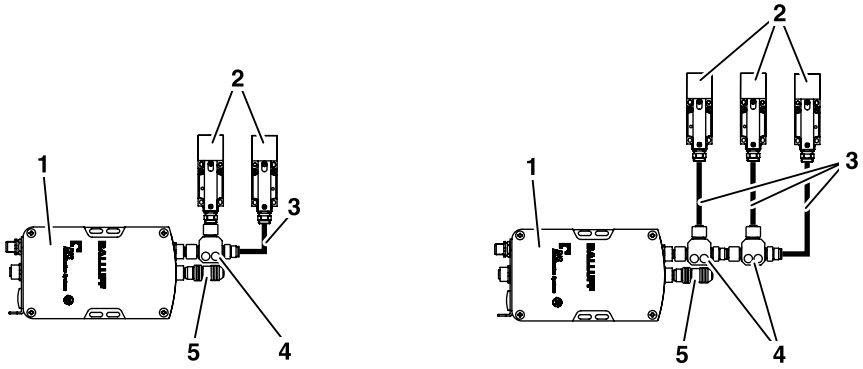


Fig. 15: Tee and terminating plug connected directly to Communications Module, processor directly to tee or tee directly to tee

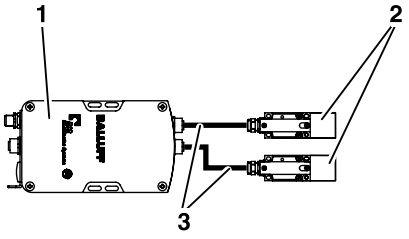


Fig. 16: Connecting processors with no terminating plug

1 Communications module
2 Processors on Line 1 (or Line 2)
3 Connection cable BIS Z-5xx-…
4 Tee BKS-S115-TW2-03
5 Terminating plug BKS-S117-R01 on Line 2

3 Getting Started

LED indicators

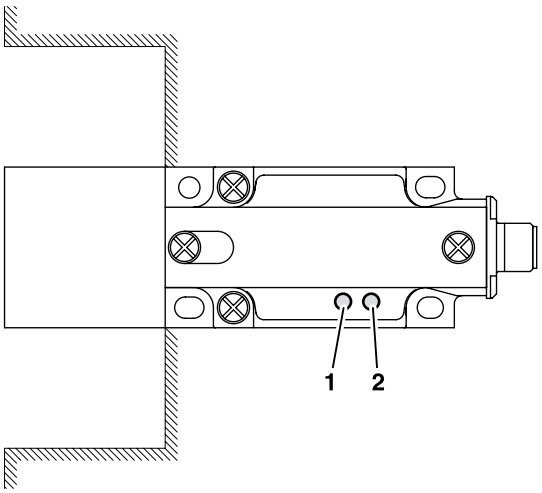


Fig. 17: Processor LEDs

Item	LED	Display	Function
1	LED 1	green flashing green	Power Cable break test
2	LED 2	yellow yellow flashing	Tag Present Parity Error, e.g. wrong baud rate

4 Basic knowledge

4.1 Function principle of the Easy Loop connection system

The Easy Loop connection system makes it possible to connect up to sixteen processors to the host system using just one data line.
The individual stations do not have to be addressed. If the connection system is operated using the standard settings, no parameter configuration is necessary. This makes it an easy to connect system. Within the system the processors can also be easily exchanged (see also “System Overview” on page 7).

The BIS L-400 ... processors used for this system are part of the non-contact read-only systems. Pre-programmed information in the data carrier is read out and forwarded.

Main components of the Easy Loop connection system:
– Communications module,
– processors,
– data carriers.

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,
– transporting and conveying..

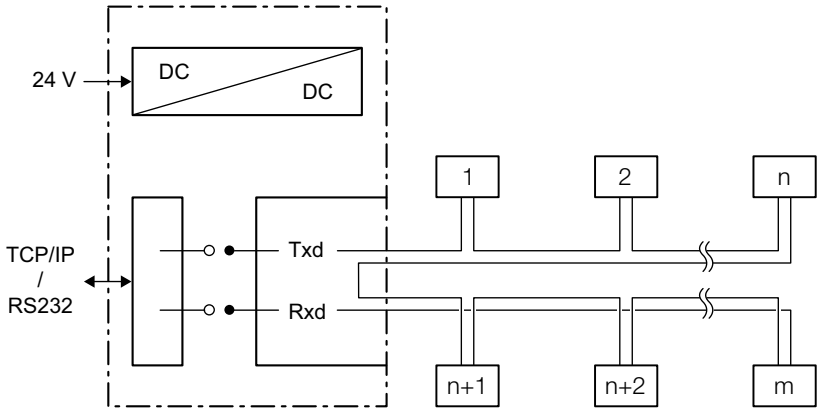


Fig. 18: Block diagram of Easy Loop (number of processors: n ≤ 8; m ≤ 8)

4.2 Product description

Communications module BIS Z-EL-...:
– Plastic housing,
– Connections made using round connectors,
– up to eight processors may be connected to each of the two ports on the communications module.
– Galvanic isolation of the supply voltage and
– galvanic isolation of the interface.

Processor BIS L-400-043-0xx-02-S115:
– Plastic housing,
– round connector terminations,
– integrated or offset read head,
– read head suitable for dynamic or static operation,
– data carrier is powered by the read head using a carrier signal.

The data carrier is a self-contained unit. It receives power from the read head integrated in the BIS L-400... processor. The read head continuously sends out a carrier signal which powers the data carrier as soon as the required distance is achieved. The read operation also takes place during this phase.

4 Basic knowledge

4.3 Data security

In order to ensure data integrity, data transfer between the data carrier and processor can be monitored using a check procedure.

In the processor a CRC_16 data check can be configured. In CRC_16 data checking a check code is implemented on the data carrier which enables the data to be checked for validity at any time. If a correct CRC_16 checksum is recognized, it is output in bytes 1 and 2 of the data record. If an error is detected, instead of the checksum 00_{HEX}, 00_{HEX} is sent.

To be able to use the CRC_16 data check procedure, the data carriers must first be initialized using a BIS L-60_ _ processor and the BISCOMRW.EXE software or a BIS L-81_ portable reader (refer to the user's guide for the equipment used).

The CRC_16 data check can only be used with data carriers of type BIS L-10X-05/L

4.4 Bus connection

The communications connection between Communications Module and the host system can be implemented in serial RS232 (BIS Z-EL 002) or in the physical Ethernet network (BIS Z-EL 001). There Internet Protocol (IP) is used. The Transmission Control Protocol (TCP) ensures complete, errorless and properly sequenced data transmission

5 Technical Data

5.1 Communications module

Dimensions

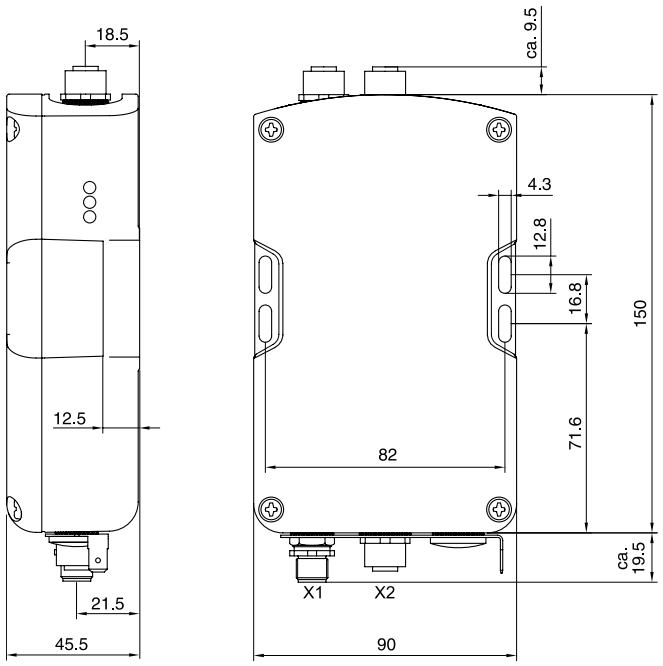


Fig. 19: Communications module, dimensions (in mm)

Mechanical data

	BIS Z-EL-001-Ethernet	BIS Z-EL-002-RS232
Housing material	ABS	ABS
X1	V_S 24 V DC, panel connector, 5-pin	V_S 24 V DC, panel connector, 5-pin
X2	fixed plug 4-pin	fixed socket 4-pin
Read head connections, Line 1, 2 (Easy Loop) for BIS L-400 processors	2x female panel connector, 8-pole	2x female panel connector, 8-pole
Enclosure rating	IP65 (with connectors)	IP65 (with connectors)
Weight	365 g	345 g

Electrical data

Operating voltage VS	24 V DC ±10 %	24 V DC ±10 %
Ripple	≤ 10 %	≤ 10 %
Device interface	Ethernet TCP/IP	RS232
Current draw without load	≤ 350 mA	≤ 200 mA
Current draw $I_{max.}$	≤ 1.25 A	≤ 1.25 A

Operating conditions

Ambient temperature range	0 °C…60 °C	0 °C…60 °C
EMC – EN 61000-4-2/3/4/5/6 – EN 55011	– Severity level 4A/3A/3A/2A/3A – Gr. 1, Cl. A	– Severity level 4A/3A/3A/2A/3A – Gr. 1, Cl. A
Vibration/shock	EN 60068 Part 2-6/27/29/64/32	EN 60068 Part 2-6/27/29/64/32

5 Technical Data

LED indicators

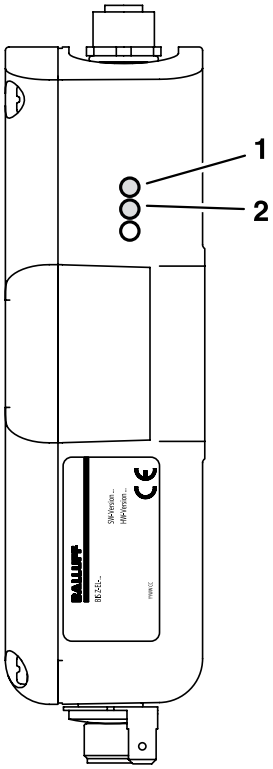


Fig. 20: Communications module, LEDs

Item	LED	Display	Function
1	LED 1	green	Indicates ready state of the unit
2	LED 2	yellow	Indicates transmission of data to the controller

5 Technical Data

5.2 Processor

BIS L-400-043-001-02-S115

Dimensions

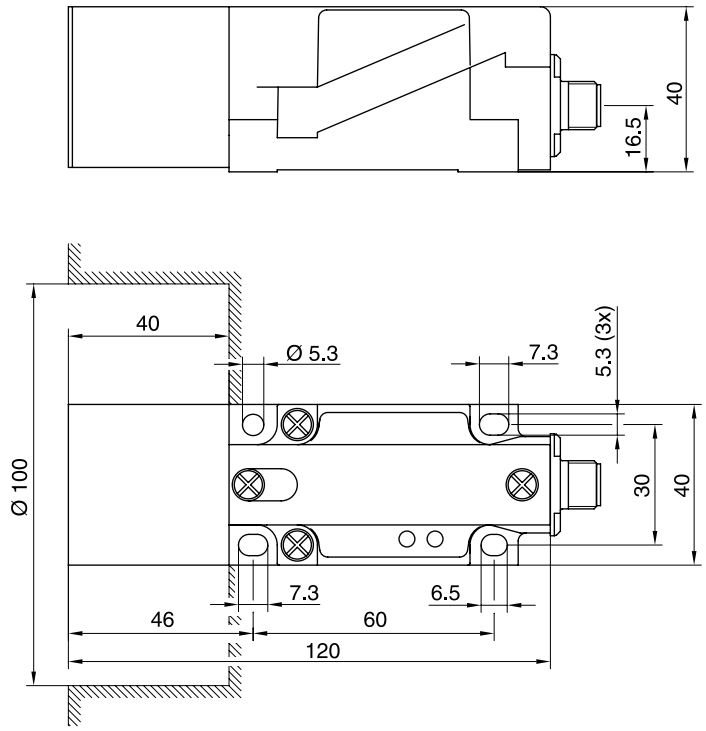


Fig. 21: BIS L-400-043-001-02-S115 processor dimensions

Characteristic data when used with data carrier

BIS L-400-043-001-02-S115					
Characteristic data when used with data carrier (installed in clear zone)	When v = 0 (static)				
	Distance [mm] read	Offset from center axis at distance: [mm]			
		0–25	0–35	0–45	0–15
BIS L-200-03 / L-100-05	0–30	± 15	–	–	–
BIS L-201-03 / L-101-05	0–40	–	± 20	–	–
BIS L-202-03 / L-102-05	0–55	–	–	± 30	–
BIS L-203-03 / L-103-05	0–20	–	–	–	± 10

5 Technical Data

Mechanical data

Housing material	Plastic (PBT)
Input/Output (RS422)	V_S24 V DC, panel connector, 8-pin
Enclosure rating	IP65 (with connectors)
Weight	170 g

Electrical data

Operating voltage VS	24 V DC ± 10 %
Ripple	≤ 10 %
Current draw	≤ 50 mA
Current draw $I_{max.}$	≤ 1.25 A
Device interface	Easy Loop

Operating conditions

Ambient temperature range	0 °C…70 °C
EMC – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-6 – EN 300 330-1	 – Class B – Severity level 4A/2A/3A/2A – Power Class 3A
Vibration/shock	EN 60068 Part 2-6/27/29/64/32

LED indicators

Two LEDs on the communications module indicate the status of the Ethernet connection.

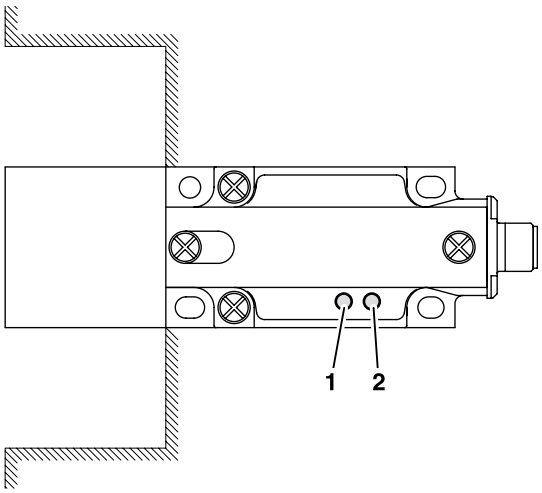


Fig. 22: Processor LEDs

Item	LED	Display	Function
1	LED 1	green flashing green	Power Cable break test
2	LED 2	yellow yellow flashing	Tag Present Parity Error, e.g. wrong baud rate

5 Technical Data

BIS L-400-043-002-02-S115

Dimensions

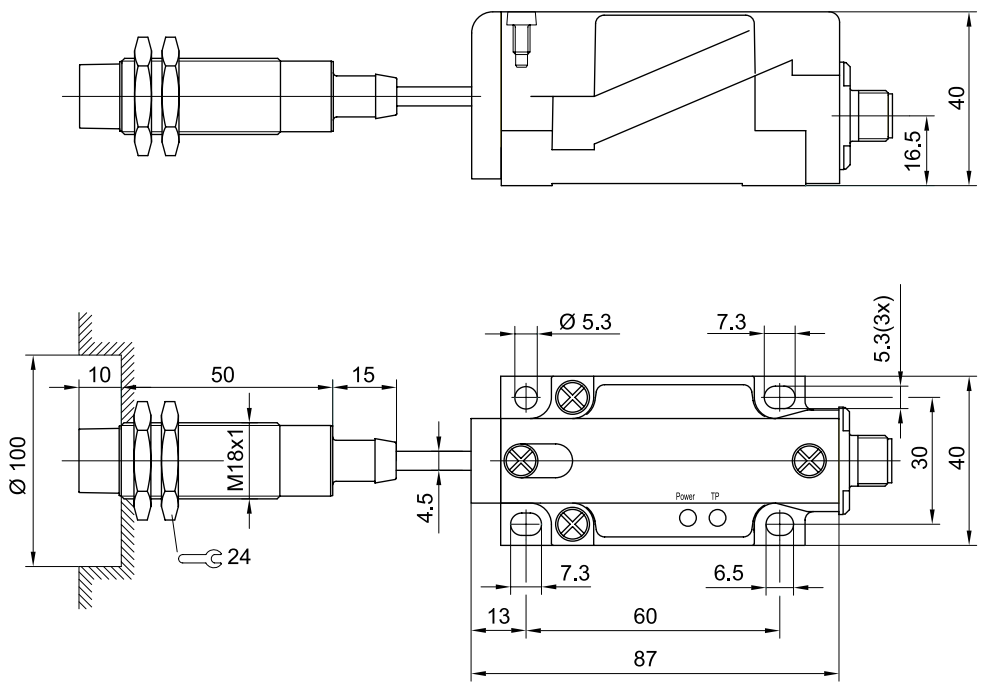


Fig. 23: BIS L-400-043-002-02-S115 processor dimensions

Characteristic data when used with data carrier

BIS L-400-043-002-02-S115					
Characteristic data when used with data carrier (installed in clear zone)	When v = 0 (static)				
	Distance [mm] read	Offset from center axis at distance: [mm]			
		0–10	0–15	0–20	0–25
BIS L-200-03 / L-100-05	0–23	± 12	± 12	± 8	–
BIS L-201-03 / L-101-05	0–27	± 15	± 15	± 15	± 6
BIS L-203-03 / L-103-05	0–16	± 8	± 4	–	–

5 Technical Data

Mechanical data

Housing material	Plastic (PBT)
Read head housing material	CuZn nickel plated
Input/Output (RS422)	V_S24 V DC, panel connector, 8-pin
Enclosure rating	IP67
Weight	170 g

Electrical data

Operating voltage VS	24 V DC ± 10 %
Ripple	≤ 10 %
Current draw	≤ 50 mA
Current draw $I_{max.}$	≤ 1.25 A
Device interface	Easy Loop

Operating conditions

Ambient temperature range	0 °C…70 °C
EMC – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-6 – EN 300 330-1	 – Class B – Severity level 4B/2A/4B/2A – Power Class 3
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

5 Technical Data

BIS L-400-043-003-02-S115

Dimensions

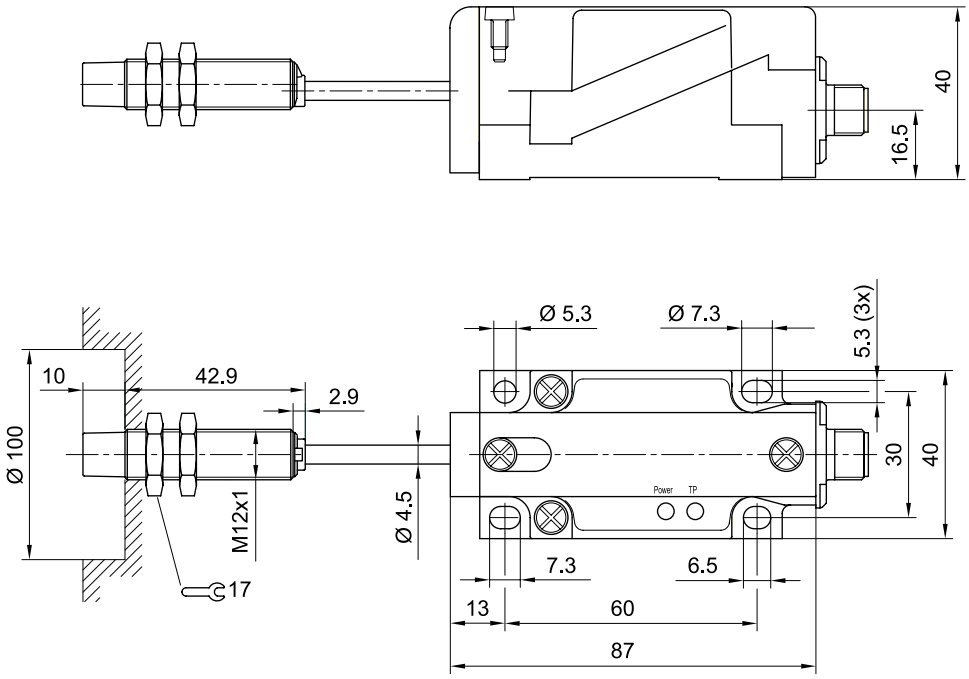


Fig. 24: BIS L-400-043-003-02-S115 processor dimensions

Characteristic data when used with data carrier

BIS L-400-043-003-02-S115				
Characteristic data when used with data carrier (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 / L-103-05	0–11	± 6	± 4	± 2

5 Technical Data

Mechanical data

Housing material	Plastic (PBT)
Read head housing material	CuZn nickel plated
Input/Output (RS422)	V_S24 V DC, panel connector, 8-pin
Enclosure rating	IP67
Weight	170 g

Electrical data

Operating voltage VS	24 V DC ± 10 %
Ripple	≤ 10 %
Current draw	≤ 50 mA
Current draw $I_{max.}$	≤ 1.25 A
Device interface	Easy Loop

Operating conditions

Ambient temperature range	0 °C…70 °C
EMC – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-6 – EN 300 330-1	 – Class B – Severity level 2A/2A/4A/2A – Power Class 3
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

5 Technical Data

BIS L-400-043-004-02-S115

Dimensions

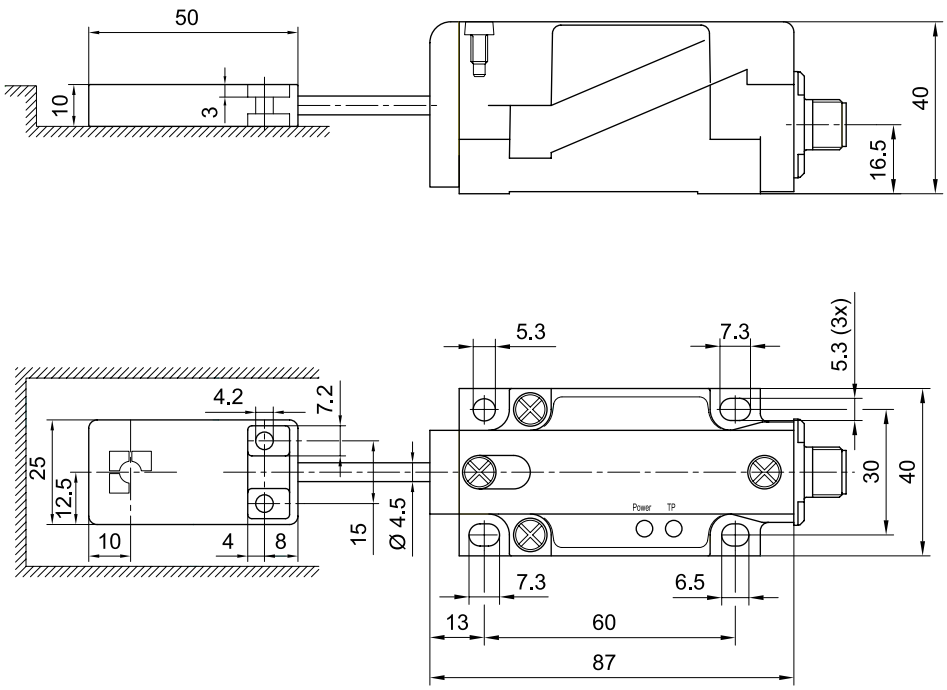


Fig. 25: BIS L-400-043-004-02-S115 processor dimensions

Characteristic data when used with data carrier

BIS L-400-043-004-02-S115					
Characteristic data when used with data carrier (installed in clear zone)	When v = 0 (static)				
	Distance [mm] read	Offset from center axis at distance: [mm]			
		0–10	0–15	0–20	0–25
BIS L-200-03 / L-100-05	0–23	± 12	± 12	± 8	–
BIS L-201-03 / L-101-05	0–27	± 15	± 15	± 15	± 6
BIS L-203-03 / L-103-05	0–16	± 8	± 4	–	–

5 Technical Data

Mechanical data

Housing material	Plastic (PBT)
Read head housing material	CuZn nickel plated
Input/Output (RS422)	V_S24 V DC, panel connector, 8-pin
Enclosure rating	IP67
Weight	170 g

Electrical data

Operating voltage VS	24 V DC ± 10 %
Ripple	≤ 10 %
Current draw	≤ 50 mA
Current draw $I_{max.}$	≤ 1.25 A
Device interface	Easy Loop

Operating conditions

Ambient temperature range	0 °C…70 °C
EMC – EN 301 489-1/-3 – EN 61000-4-2/-3/-4/-6 – EN 300 330-1	 – Class B – Severity level 4B/2A/4B/2A – Power Class 3
Vibration/shock	EN 60068 Part 2-6/27/29/32/64

6 Installation

6.1 Installation

Communications module

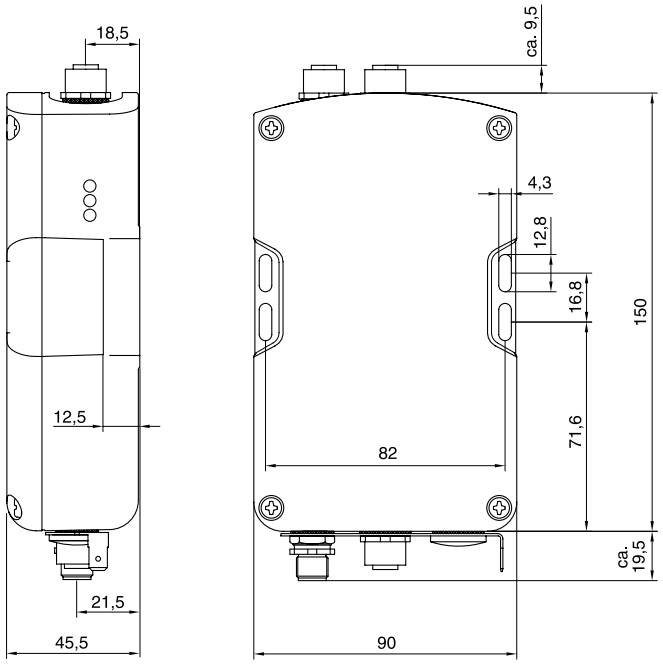


Fig. 26: Communications module dimensions

► Attach communications module using 4 M4 screws.

Processor

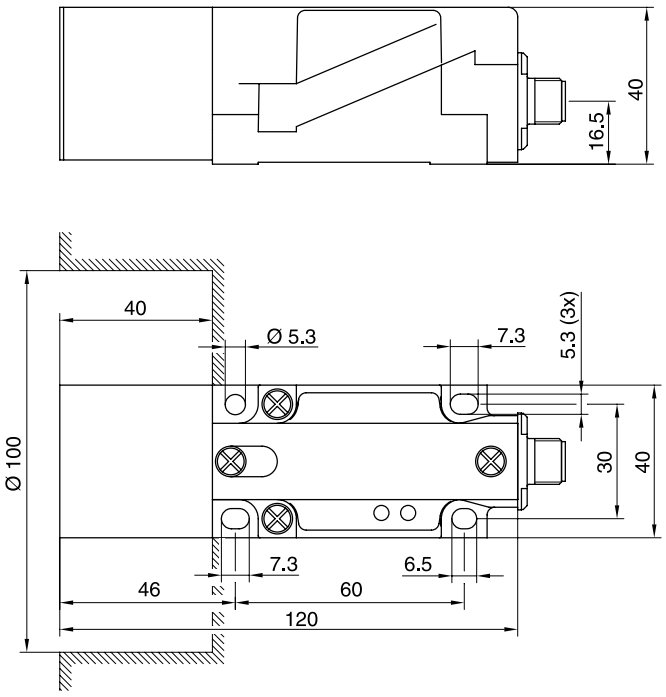


Fig. 27: BIS L-400-043-001-02-S115 processor dimensions

► Attach processor using 4 M4 screws.

6 Installation

Mounting separation

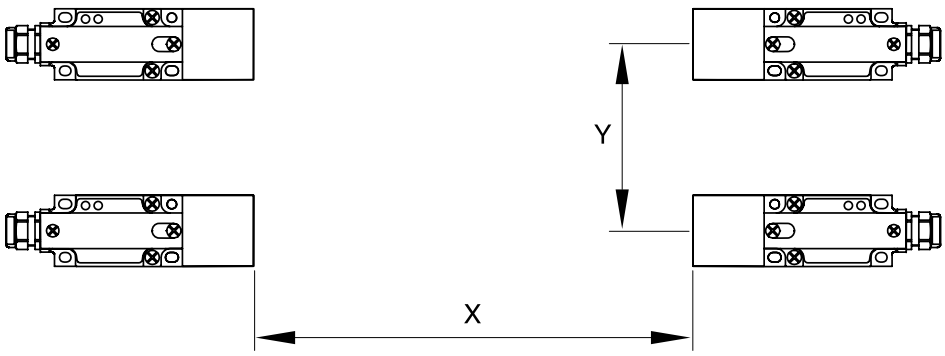


Fig. 28: Mounting separation

The following distances between individual BIS L-400_ systems must be maintained:

Type	Distance x	Distance Y
BIS L-400-...-001- ...	1 m	1 m
BIS L-400-...-002- ...	0.5 m	0.3 m
BIS L-400-...-003- ...	0.5 m	0.3 m
BIS L-400-...-004- ...	0.5 m	0.3 m

Note
When installing two BIS L-400 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

The read head for the BIS L-400-043-001-02-S115 processor consists of read head module and read head carrier.

Positions of the active surface

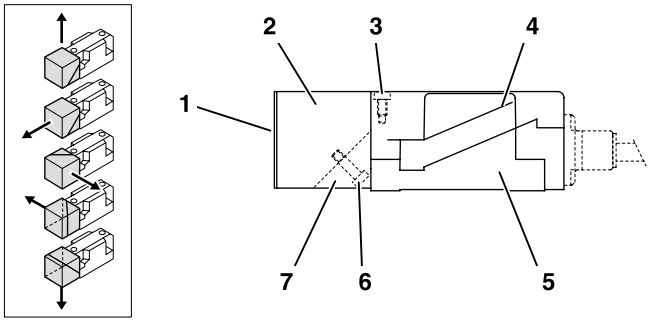


Fig. 29: Active surface positions

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

The read head for the BIS L-400-043-001-02-S115 processor can be relocated and rotated as needed.

Rotating the read head

- ► Loosen both screws on the read head carrier.
- ► Rotate read head module 180°.
- ► Tighten both screws.

Rotating the read head

- ► Loosen locking screw.
- ► Turn read head to the desired position.
  ⇒ The read head can be turned steplessly over a range of 270°.
- ► Tighten locking screw.

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

6 Installation

6.2 Processor connection

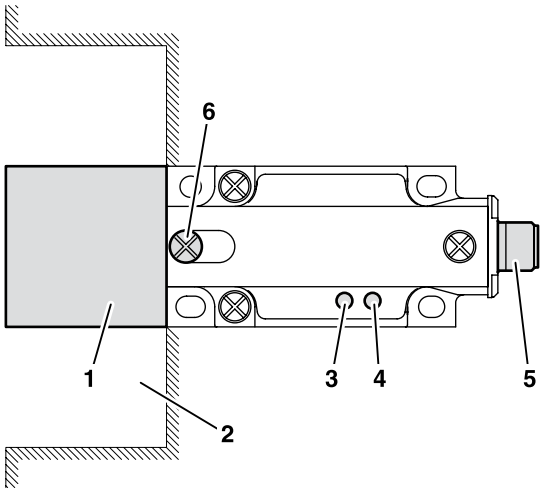
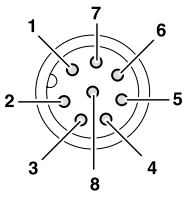


Fig. 30: Overview of processor BIS L-400-043-001-02-S115

1 Read head
2 Clear zone
3 LED 1
4 LED 2
5 RS422 connection
6 Locking screw



Fixed plug 8-pin

PIN	Function	Color code*)	
1	A (R+)	yellow	
2	Y (T+)	gray	
3	B (R–)	pink	
4	n.c.	red	
5	Z (T–)	green	
6	–VS	blue	
7	+VS	brown	
8	COM	white	
*) When using BIS Z-501-PU1-... or BIS Z-502-PU1-....			

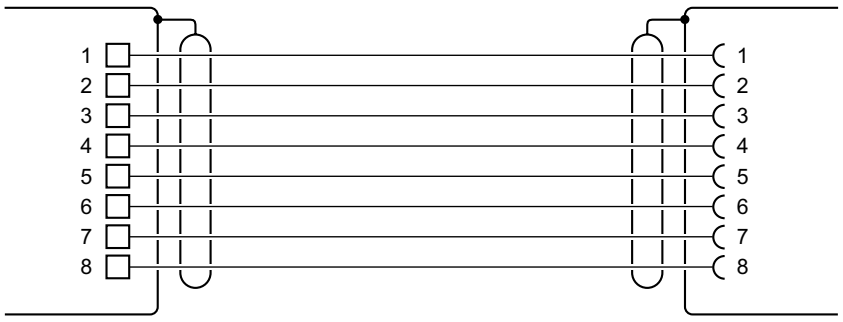


Fig. 31: The cable shield is connected to the housing

6 Installation

6.3 Cabling

The processor is connected to the communications module or other processors by means of a Tee, part number BKS-S115-TW2-03. The tee is internally wired such that two processors can be directly connected at the last tee in a ring (see also “System Overview” starting page 7).

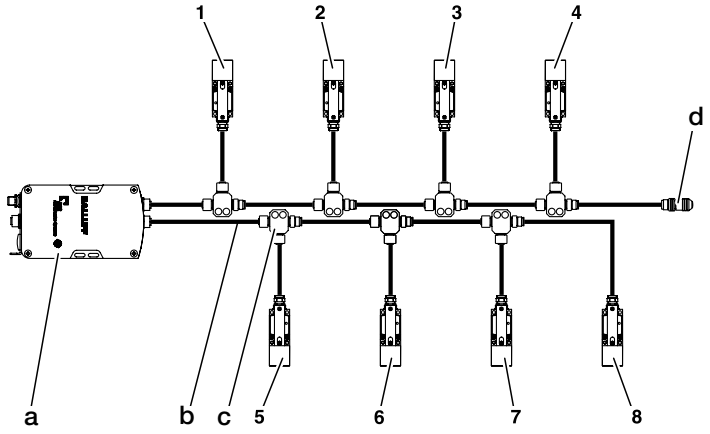


Fig. 32: Easy Loop cabling

a Communications Module
b Connection cable BIS Z-5xx-…
c Tee
d Terminating plug

1–4 Processors on Line 1
5–8 Processors on Line 2

> **Note**
> Alternately the termination plug BKS-S117-R01 can be used to close the ring.

Cable lengths

The maximum permissible cable length between the communications module and each individual processor is 80 m.

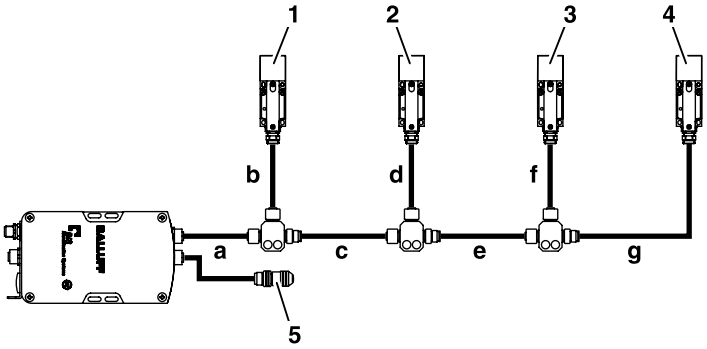


Fig. 33: Cable lengths

The cable length is calculated by adding the sub-sections between the communications module and the processor, e.g.:

Processor **1**: l = a + b
Processor **2**: l = a + c + d
Processor **3**: l = a + c + e + f
Processor **4**: l = a + c + e + g $l_{max} \leq 80$ m

5 Terminating plug

6 Installation

Alternate wiring options

The following illustrations show various connection options. For example, tees and terminating plugs can be connected directly to the Communications Module or processors can be connected directly to a tee.

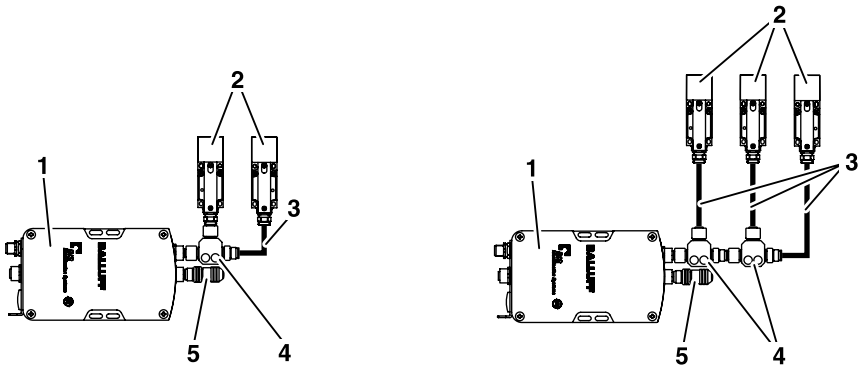


Fig. 34: Tee and terminating plug connected directly to Communications Module, processor directly to tee or tee directly to tee

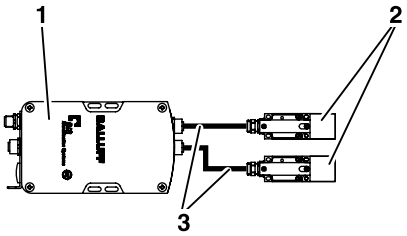


Fig. 35: Connecting processors with no terminating plug

1 Communications module
2 Processors on Line 1 (or Line 2)
3 Connection cable BIS Z-5xx-…
4 Tee BKS-S115-TW2-03
5 Terminating plug BKS-S117-R01 on Line 2

7 Bus connection

7.1 IP address

The BIS Z EL-001-Ethernet Communications Module and the host system communicate over the physical Ethernet network.
Assigning a unique IP address associates the Module within the network.
The bus connection is made using the BIS SetIP program and a Windows PC with Ethernet connection.

Note
For the **BIS Z-EL-002-RS232** Communications Module there is no bus connection, since this is a serial point-to-point device.

7.2 BIS SetIP

The basis for incorporating the processor into the network is the MAC address. This hardware address is unique and identifies network devices such as the processor.

"BIS SetIP" is a software program which enables you to address the hardware for the corresponding subnet before installation.

The application "BIS SetIP" can be found on the included BIS-CD.

- ▶ Start "BIS SetIP".
  ⇒ The window "BIS_-6027 assign IP Address" is opened.

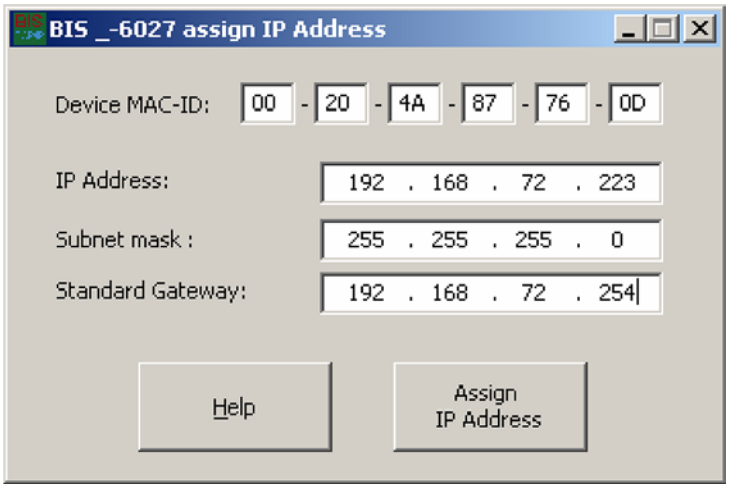


Fig. 36: Screenshot of MAC-ID entry

- ▶ Enter MAC-ID for the device.

Note
The MAC-ID can be found on the part label of the communications module.

- ▶ Assign IP address, subnet mask and gateway address.
- ▶ Confirm settings by clicking on "Assign IP Address".

7 Bus connection

7.3 Serial settings

BIS Z-EL-001-Ethernet communications module:
For the BIS Z-EL-001-Ethernet Communications Module the serial port parameters for sending to the processors need to be set.
For the BIS Z-EL-002-RS232 this is not necessary, since here just a pure level setting is done, and the correct parameters must already have been set in the controller.

Configuring the serial settings:
- ► Establish the physical connection.
- ► Start Internet browser, e.g. Microsoft IE. The latest version of Java Runtime Environment (JRE) must be installed.
- ► Enter device IP in the address line (Balluff factory default 192.168.72.223).
  ⇒ The Ethernet CONFIG program is now started.

Fig. 37: Screenshot of login

- ► Password prompt: Confirm by clicking on OK with no entry.

Note
The communications module settings can be password protected. Use of a password is not recommended, however, since if the password is lost the communications module will have to be completely replaced.
The communications module can only be saved by unsoldering.

7 Bus connection

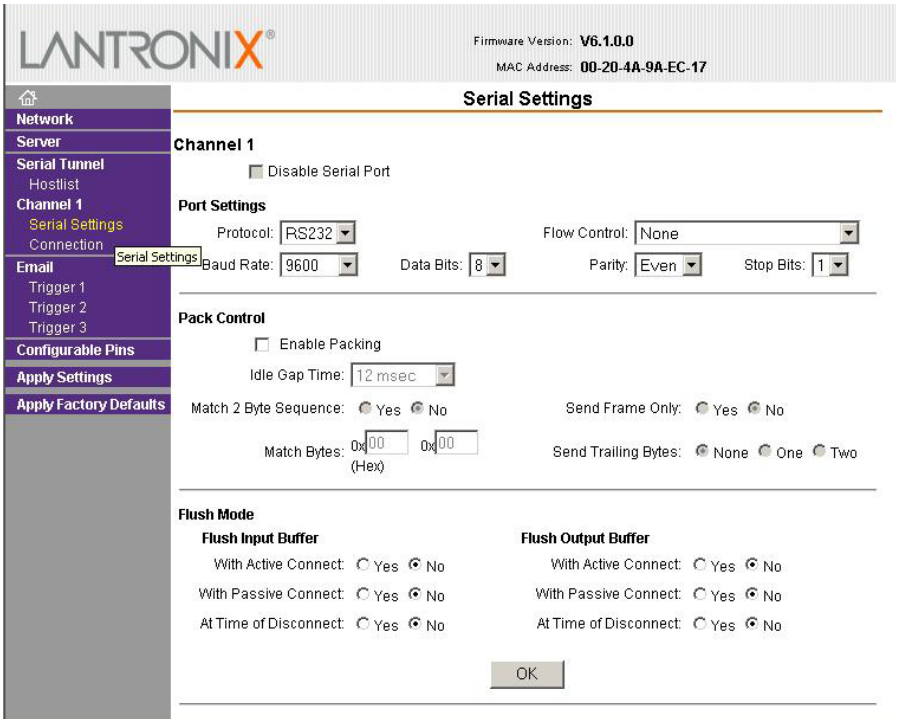


Fig. 38: Screenshot of serial settings

► Now make the serial settings for the communications module.

Default settings:

Baud rate: 9600 Data bits: 8 Parity: Even Stop bits: 1

► Confirm the settings by clicking on OK and “Apply Settings”.

Note
The serial settings must agree with the parameter configuration in all connected BIS L-400-043-0xx-02-S115 processors.

8 Setting the processor parameters

8.1 Basic knowledge

CRC check

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

Checksum
The checksum is written to the data carrier as 2 bytes of information. This means 2 bytes of user data are sacrificed. 3 bytes remain for user data. The CRC data check can only be used with data carriers of type BIS L-10X-05/L.

8.2 Setting parameters

The processors must be configured on their serial port using a point-to-point connection. This uses a BIS Z-EL-002-RS232, which for Line 2 is fitted with a terminating plug.

Note
For setting the parameters only one processor can be connected to the **BIS Z-EL-002-RS232 communications module! The unused Line terminal must be closed using the BKS-S117-R01 terminating plug.**

Note
When configuring the parameters for the processors through the Ethernet Communications Module **BIS Z-EL-001-Ethernet** there will be communication errors, since the interface settings in the module themselves cannot be changed. This is why a serial port must be used to configure the parameters.

Parameter setting of the processors is done using the Windows software “Configuration software BIS”.
Parameters are set online. The parameter settings can be overwritten at any time. The parameter setting can be saved in a file so that it can be used whenever needed.

The application “Configuration software BIS” can be found on the included BIS-CD.

- ▶ Start Configuration software BIS.
- ▶ Select “Device selection” menu.
- ▶ Select “**BIS L-400-043...**”.

Fig. 39: Start BIS screen

- ▶ Select “Online --> Initialize” menu.
  ⇒ “Parameters” dialog window opens.

8 Setting the processor parameters

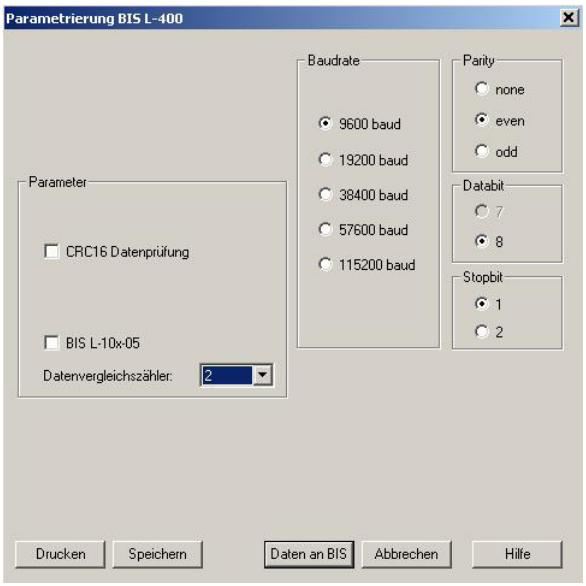


Fig. 40: Screenshot of Parameters dialog window

Default settings

Default settings:

Baud rate: 9600 Data bits: 8 Parity: Even Stop bits: 1

- ► Set the parameters Baud rate, number of data and stop bits as well as the parity type for the serial interface.

CRC_16 data check

If the CRC_16-data check is set, then the data carrier data are also checked using a 2-byte CRC_16 checksum (see “Data integrity” on page 17).

To be able to use the CRC_16 data check procedure, the data carriers must first be initialized using a BIS L-60_ _ processor and the BISCOMRW.EXE software or a BIS L-81_ portable reader (refer to the user's guide for the equipment used).

The CRC_16 data check can only be used with data carriers of type BIS L-10X-05/L

Data comparison counter

If the CRC_16 data check parameter is **not** set, data integrity can still be enhanced by having the processor read the data carrier data multiple times within a read cycle. 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.

The number of reads can be set in the “Data comparison counter” field.

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

9 Function of the system

9.1 Function principle of the Easy Loop connection system

The Easy Loop connection system consists of a communications module and up to sixteen processors. Up to eight processors can be connected on each line. The processors are connected using Tees and if necessary a termination plug. The Tees and termination plugs are wired such that a ring is formed.

When the first processor in the connection system receives the read command 'DLE', it sends its telegram to Processor 2 in the system. Processor 2 sends the individual telegrams from Processors 1 and 2 as a data chain to Processor 3 etc. From the last processor in the system the data chain is sent to the host controller through the Communications Module (see also “System Overview” on page 7).

The host system can split the data chain into individual telegrams and assign the data records in order to the individual processors.

Note
The rings with the processors must be physically closed. This cable ring is used to “push” the data through serially.

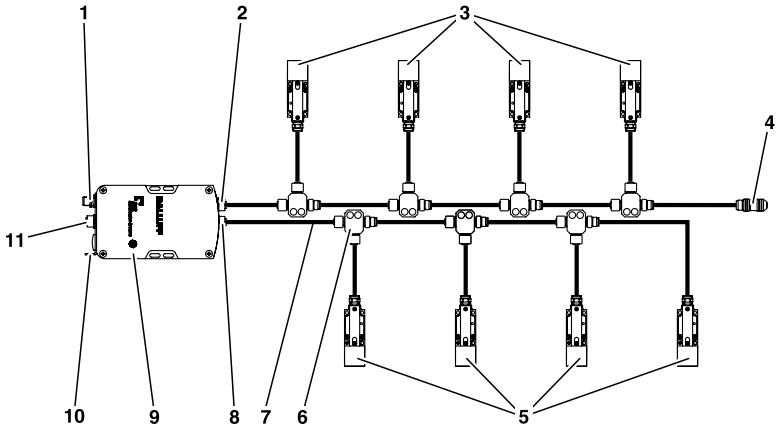


Fig. 41: Schematic block diagram

1 X1 (24 **V DC)**
2 Line 1 (Easy Loop)
3 Processors on Line 1
4 Termination plug BKS-S117-R01
5 Processors on Line 2
6 Tee BKS-S115-TW2-03
7 Connection cable: BIS Z-5xx-…
8 Line 2 (Easy Loop)
9 Communications module
10 **Ground**
11 X2 (TCP/IP or RS232) BIS Z-EL-…

The communications module assumes the following functions in the system:
– Supply voltage for the connected processors
– Interface converter, RS232 to Easy Loop or TCP/IP to Easy Loop,
– Galvanic isolation of the supply voltage and the ports for greater operating security,
– The system works in acyclical mode, meaning the host system can send a read command at any time.

9 Function of the system

The processor is the link between data carrier and host system.
It has the following functions:
– Reading and preparing the data carrier data,
– buffer storage,
– processing the data and command characters in telegrams,
– passing the data on to the host system
  Host systems can be:
  ⇒ A control computer (e.g. industrial PC),
  ⇒ a PLC.

9.2 Communication

A serial transmission protocol is used between the host system and the processor.
All processors integrated in the system are read at the same time. The individual telegrams from the connected processors are combined one after the other into a data chain. The sequence of the individual telegrams within the data chain depends on the position of the processor in the system.

Note
The command character output from the host system to the connection system is always at the end of the received data chain.
This indicates to the host system that the last processor in the system has been read.

Control characters

The following control characters are used:

ASCII	Hex	Meaning
<DLE>	10hex	Reads the current status of the processors
<DC2>	12hex	Start character for the cable break test
<SYN>	16hex	Software reset for the processor
<STX>	02hex	Comes at the beginning of the data
<ETX>	03hex	Comes at the end of the data
<SP>	20hex	Space, used as a placeholder in the telegram
<CR>	0Dhex	Carriage Return, used for PC display
Variable characters in the data record:		
'SB'		Status byte – indicates the status of the respective processor, (see “Status byte” on page 44)
'BCC'		Calculated block check – sent as two separate ASCII characters in the telegram

Note
A new read command cannot be sent until all processors have been read and the <DLE> command at the end of the data chain has been received (see “Data chain” on page 42).

9 Function of the system

9.3 Protocol sequence

Example 1:
Easy Loop connection system with a connected processor (individual telegram)

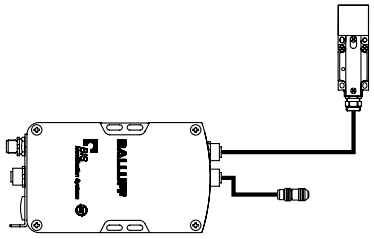


Fig. 42: Communication module with one processor

Telegram

Data carrier data: 01_{hex} 23_{hex} 45_{hex} 67_{hex} 89_{hex}

Query the system with control character <DLE>
Reply:
<STX> <CR> '0' '1' '2' '3' '4' '5' '6' '7' '8' '9' 'SB' <ETX> '0' '0' <SP> 'BCC' 'BCC' <DLE>

20 characters are sent in the individual telegram:

1st character	Start of Text (<STX>)
2nd character	Line Break (<CR>)
3rd–12th character	Data carrier data
13th character	Status byte ('SB')
14th character	End of Text (<ETX>)
15th–17th character	00 (placeholder)
18th–19th character	Block Check Character (BCC)
20th character	Read command <DLE>)

Example 2:
Easy Loop connection system with two processors (data chain made up of two telegrams)

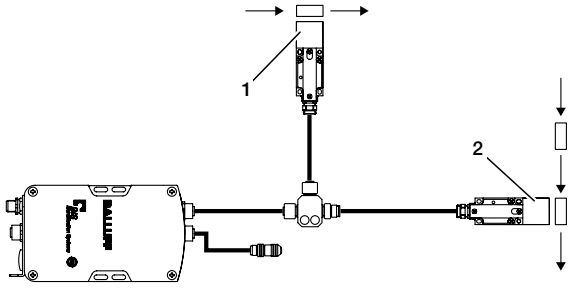


Fig. 43: Communications module with two processors

Data chain

Data carrier data 1: 01_{hex} 23_{hex} 45_{hex} 67_{hex} 89_{hex}
Data carrier data 2: AB_{hex} AB_{hex} AB_{hex} AB_{hex} AB_{hex}

Query the system with control character <DLE>
Reply:
<STX> <CR> '0' '1' '2' '3' '4' '5' '6' '7' '8' '9' 'SB' <ETX> '0' '0' <SP>
<STX> <CR> 'A' 'B' 'A' 'B' 'A' 'B' 'A' 'B' 'A' 'B' 'SB' <ETX> '0' '0' <SP> 'BCC' 'BCC' <DLE>

Explanation:
The processors string the individual telegrams together into a data chain. Which of the telegrams are current can be read from the status byte ('SB') (CT-Present bit, see “Status byte” on page 44). At the end of the data chain is a calculated BCC, consisting of two ASCII characters. This BCC is used to check for correct transmission of the telegrams (see “Calculating the block check (BCC)”).

9 Function of the system

The data chain is terminated with the control character <DLE>. This control character is used to start reading. When the control character <DLE> is received by the host system, reading of all processors is finished and all individual telegrams have been received. The telegrams can be processed and a new read command can be issued.

Note
The next read command cannot be started until all processors have been read and the host system has received the control character <DLE>. Errors may occur if a new read takes place too soon.

Calculating the block check (BCC)

The BCC is always calculated using the entire received data chain (all control characters and data). Each character is included in the calculations using an EXOR operation. The result is a hex value whose high byte and low byte are sent separately as ASCII characters in order to prevent mixing up with control characters.

Formation of the BCC using example with data carrier data:
01_{hex} 23_{hex} 45_{hex} 67_{hex} 89_{hex}:

	ASCII	Hex	Binary	
	<STX>	02_{hex}	0000 0010	EXOR
	<CR>	0Dhex	0000 1101	EXOR
Data	'0'	30_{hex}	0011 0000	EXOR
	'1'	31_{hex}	0011 0001	EXOR
	'2'	32_{hex}	0011 0010	EXOR
	'3'	33_{hex}	0011 0011	EXOR
	'4'	34_{hex}	0011 0100	EXOR
	'5'	35_{hex}	0011 0101	EXOR
	'6'	36_{hex}	0011 0110	EXOR
	'7'	37_{hex}	0011 0111	EXOR
	'8'	38_{hex}	0011 1000	EXOR
	'9'	39_{hex}	0011 1001	EXOR
SB	'0'	30_{hex}	0011 0000	EXOR
	<ETX>	03_{hex}	0000 0011	EXOR
	'0'	30_{hex}	0011 0000	EXOR
	'0'	30_{hex}	0011 0000	EXOR
	<SP>	20_{hex}	0010 0000	EXOR
BCC (calculated)		$1D_{hex}$	0001 1101	
BCC	'1'	31_{hex}	0011 0001	
BCC	'D'	44_{hex}	0100 0100	

When the data are sent, the processor (n) uses the EXOR operations for all characters and the error number to calculate a BCC value. The calculated value is sent to the next processor in the form of a BCC character at the end of the data chain.

In the next processor (n+1) the sent BCC value is checked. If any discrepancy is detected, a BCC error is output in the status byte. The BCC value is recalculated and passed along to the next processor. The status byte can be used to localize errors in the system. If the error occurs at the beginning of the data chain, this implies that the following data records are OK.

9 Function of the system

If an error occurs at the end of the data chain, the error in the data chain cannot be definitely located. This means that the data are not “reliable”, and a new read must take place. The error can however be physically associated with a processor, and that processor can be replaced if necessary.
At the end of the ring the entire BCC value for all telegrams is sent to the host control by the last processor in the system.
The controller again calculates and compares this value. If both characters are identical, the transmitted data are correct.

Note
Within a ring all BCC values for all data records are added together. This enables errors to be localized.
To ensure that the BCC does not take on the value of a control character, the calculated BCC is sent as two ASCII characters.

Fragmenting

Telegram fragmenting can result in the Ethernet/TCP protocol. If the controller wait time is too long, the data are divided up into multiple TCP blocks.

Note
When using many read heads, the strong can become so long that the receive buffer on the controller is no longer large enough. The telegrams must be fragmented. The controller must be programmed so that the fragments can be reassembled.

9.4 Status byte

The status byte is structured like a bit header.

The meanings of the bits are shown here:

0	0	1	1	0	BCC error	CRC error	CT Present	Meaning
							1	There is no data carrier currently within range of the read head
							0	There is a data carrier currently in range of the read head
						1		A CRC error occurred when reading the data carrier data
						0		No CRC error detected
					1			A BCC error was detected in the transmission from the last processor to this processor
					0			Transmission from the last processor to this processor is correct

Note
The data record from the last data carrier remains stored in the processor until a new data carrier is recognized.
The CT Present bit indicates whether the data record is updated.

9 Function of the system

9.5 Response times

The response times for the Communications Modules vary according to the interface, protocol and baud rate.

Easy Loop with BIS Z-EL-001-TCP/IP

Times in [ms]:

Baud rate	Time per head (t_1)	Time TCP/IP ($t_2 \leq$)	Following time ($t_3 \geq$)
9600	25.2	20.0	0
19200	12.6	20.0	0
38400	6.3	20.0	0
57600	4.2	20.0	0
115200	2.1	20.0	0

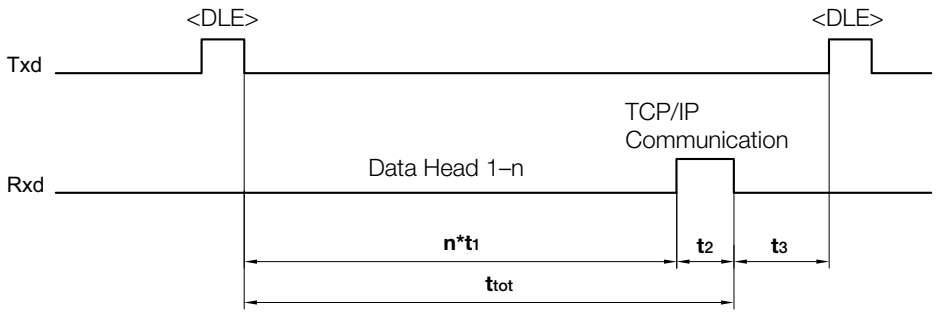


Fig. 44: Timing diagram for Easy Loop with BIS Z-EL-001-TCP/IP

To calculate total time: $t_{tot} = n * t_1 + t_2$
Total time from start of the request to end of the character string, in [ms]:

Baud rate / No. of heads n	9600	19200	38400	57600	115200
1	45.2	32.6	26.3	24.2	22.1
2	70.4	45.2	32.6	28.4	24.2
3	95.6	57.8	38.9	32.6	26.3
4	120.8	70.4	45.2	36.8	28.4
5	146.0	83.0	51.5	41.0	30.5
6	171.2	95.6	57.8	45.2	32.6
7	196.4	108.2	64.1	49.4	34.7
8	221.6	120.8	70.4	53.6	36.8
9	246.8	133.4	76.7	57.8	38.9
10	272.0	146.0	83.0	62.00	41.0
11	297.2	158.6	89.3	66.2	43.1
12	322.4	171.2	95.6	70.4	45.2
13	347.6	183.8	101.9	74.6	47.3
14	372.8	196.4	108.2	78.8	49.4
15	398.0	209.0	114.5	83.0	51.5
16	423.2	221.6	120.8	87.2	53.6

9 Function of the system

Easy Loop with BIS Z-EL-002-RS232

Times in [ms]:

Baud rate	Response time (t_1)	Transmission time (t_2)	Transmission time (t_3)	Following time ($t_3 \geq$)
9600	1.80	22.80	3.60	0
19200	0.90	11.40	1.80	0
38400	0.45	5.70	0.90	0
57600	0.30	3.80	0.60	0
115200	0.15	1.90	0.30	0

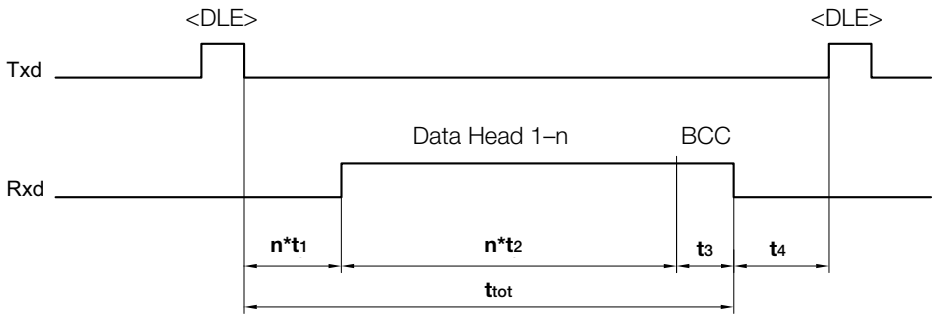


Fig. 45: Timing diagram for Easy Loop with BIS Z-EL-002-RS232

Calculating the total time: $t_{tot} = n * (t_1 + t_2) + t_3$
Total time from start of the request to end of the character string, in [ms]:

Baud rate / No. of heads n	9600	19200	38400	57600	115200
1	28.20	14.10	7.05	4.70	2.35
2	52.80	26.40	13.20	8.80	4.40
3	77.40	38.70	19.35	12.90	6.45
4	102.00	51.00	25.50	17.00	8.5
5	126.60	63.30	31.65	21.10	10.55
6	151.20	75.60	37.80	25.20	12.60
7	175.80	87.90	43.95	29.30	14.65
8	200.40	100.20	50.10	33.40	16.70
9	225.00	112.50	56.25	37.50	18.75
10	249.60	124.80	62.40	41.60	20.80
11	274.20	137.10	68.55	45.70	22.85
12	298.80	149.40	74.70	49.80	24.90
13	323.40	161.70	80.85	53.90	26.95
14	348.00	174.00	87.00	58.00	29.00
15	372.60	186.30	93.15	62.10	31.05
16	397.20	198.60	99.30	66.20	33.10

9 Function of the system

9.6 LED indicators

The communications module is equipped with two LEDs.

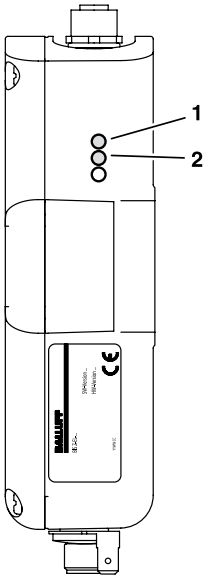


Fig. 46: Communications module, LEDs

Item	LED	Display	Function
1	LED 1	green	Indicates ready state of the unit
2	LED 2	yellow	Indicates transmission of data to the controller

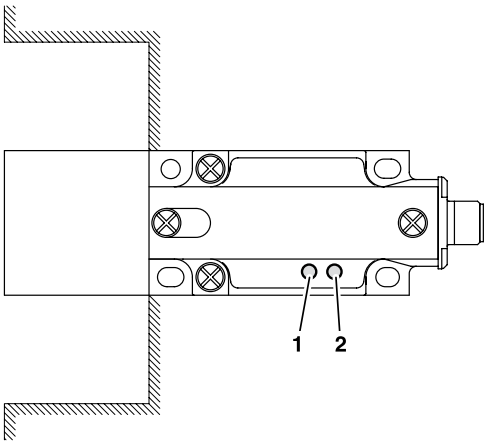


Fig. 47: Processor

Two LEDs on the communications module indicate the status of the Ethernet connection

Item	LED	Display	Function
1	LED 1	green flashing green	Power Cable break test
2	LED 2	yellow yellow flashing	Tag Present Parity Error, e.g. wrong baud rate

9 Function of the system

9.7 Diagnostics

LED	Display	Function
LED 1	flashing green	Cable break test
LED 2	yellow flashing	Parity Error

Cable break test

The cable break test checks the cable connections in the connection system.

There are two variants:

1. When starting up the system:
   Power is on, LED 1 flashes green. If a proper read command is detected by the processor, LED 1 changes to continuous green.
   The first processor which does not correctly recognize the read command continues to flash its LED 1. Likewise the processors following in the ring.
   A possible interruption or cable break can be localized based on the position of the first flashing processor in the ring.

2. During operation:
   While the system is running, the command <DC2> (0x12) can be used to start the cable break test. All the LED 1's on the processors connected in the Easy Loop system begin to flash green one after the other.
   If there is an interruption or cable break in the Easy Loop system, LED 1 on the first processor after the interruption comes on continuous. This enables the source of the error to be localized and eliminated in the system.

   When the next read command “DLE” is issued, LED 1 on the processors stops flashing.

Parity check

If LED 2 on a processor flashes yellow, the processor has detected a UART error. This indicates incorrect parameterization of the serial setting in this processor (see “Setting parameters” on page 36).

Note
If the first processor in the system flashes, there may also be an incorrect setting in the host system, or the serial settings were incorrectly set when using the BIS Z EL-001-Ethernet Communications Module
(see “Serial settings” on page 11)

Appendix

Ordering code

BIS Z – EL –00X– xxx

Balluff Identification System

Series Z

Hardware type

EL = Plastic housing, Easy Loop

Type

001 = Ethernet with TCP/IP protocol
002 = RS232

Information text

BIS L – 400 – 043 – 00X – 02 – S115

Balluff Identification System

Series L Read-Only System

Hardware type

400 = Plastic housing, Ethernet

Software type

043 = Easy Loop

Type

001 = Coil Ø 34 mm
002 = Offset read head M18 (0.5 m cable)
003 = Offset read head M12 (0.5 m cable)
004 = Offset read head C-305 in housing (0.5 m cab;e)

Interface

02 = RS422/Easy Loop

Module

S115 = M12, 8-pin male

Accessories (optional, not included in scope of delivery)

Type		Ordering code
Connection cable: One straight connector, 8-pin molded, other end pigtailed, length can be trimmed, connector included	For connecting the processor, Available in cable lengths: 5, 10, 15, 20, 25, or 50 m	BIS Z-501-PU1-.../E
Connection cable 8-conductor. shielded, female M12 straight, male M12 straight, molded-on both ends	Available in cable lengths: 0.5, 1, 2, or 5 m	BIS Z-501-PU1-…/M
Connection cable: One straight angled connector, 8-pin molded, other end pigtailed, length can be trimmed, connector included	For connecting the processor, Available in cable lengths: 5, 10, 15, 20, 25, or 50 m	BIS Z-502-PU1-.../E
Connection cable 8-conductor. shielded, female M12 straight, male M12 straight, molded-on both ends	Available in cable lengths: 0.5, 1, 2, or 5 m	BIS Z-502-PU1-…/M
Easy Loop Tee	Connecting piece for processors	BKS-S115-TW2-03
Easy Loop termination plug	Connector with jumper	BKS-S117-R01
Ethernet connection cable RJ45, male 4-pin D-coded	Connection for communications module (Ethernet)	BIS C-526-PVC-005
RS232 connection cable 9-pin SUB D, 4-pole female	Communications Module (RS232) connection Cable lengths: 2 or 3 m	BIS C- 522-PVC-…
RS232 and supply voltage: 5-pole female connector	(for user assembly)	BKS-S 79-00
TCP/IP connector, D-coded, 4-pin male	(for user assembly)	BKS-S182-00

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			

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