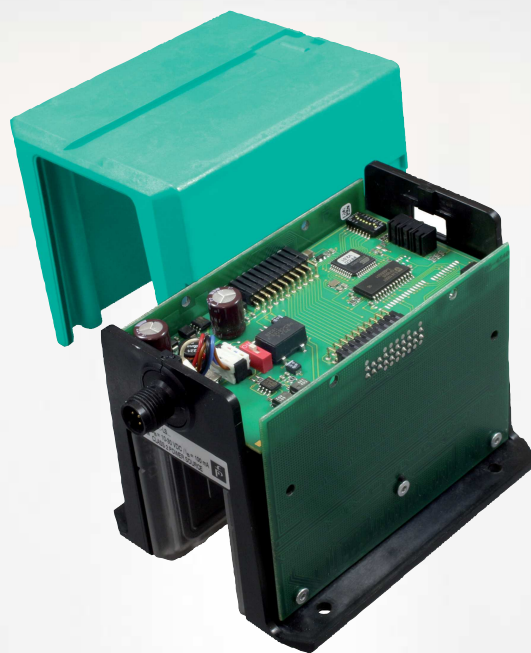


WCS* Read Head Position Encoding System Electrical Data

Manual



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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismantling of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols



Note

This symbol brings important information to your attention.



Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2 Product Description

2.1 Functional Description

The WCS position encoding system consists of two main components:

Code Rail

The code rail carries information for the absolute code. The code rail is routed parallel to the track for the material handling equipment and thus assigns a unique position to every point on the track. It is possible to route the code rail at points only where positioning is required. The system allows the code rail to be routed along curves and allows branches to be created. The code rail is built to order and delivered in a bundle. Unless otherwise ordered, the code rail always starts with position value 0 and ends with a maximum position according to the ordered length in meters. The length of a code rail segment ranges from 0 to a maximum total length of 314.573 m (WCS3) or from 0 to a maximum total length of 327 m (WCS2).

Spacers can also be ordered for repair purposes or specific applications, stating the start or end position of the desired section and the desired length in meters.

For identification applications ID-pads are available as short code rail sections, with a length of between 250 mm and 264 mm and a unique identification number.

Read Head

The U-shaped read head scans the code rail photoelectronically without touching it. The read head detects a new position value every 0.8 mm (WCS3) or 0.833 mm (WCS2).

This results in the following data:

	WCS2B	WCS3B
Resolution	± 0.42 mm 1200 pos./m	± 0.40 mm 1250 pos./m
Movement speed [v_{max}]	12.5 m/s	12.5 m/s
Y axis (tolerance)	± 5 mm	± 15.5 mm
X axis (tolerance)	± 5 mm	± 14 mm

After insertion into the code rail, the read head determines a highly accurate position value without reference or delay. The code rail can be scanned at very high speeds. The scanning can be reproduced, is reliable, and is independent of temperature fluctuations.

The position value, movement speed, and error codes such as the contamination detection or the "OUT" message can be transmitted directly from the read head to the control panel via a communication interface. There are a number of types of interfaces available in the WCS3 read head to achieve this, such as RS-485, SSI, CANopen, PROFINET, and EtherNet/IP.

There is a wide range of interface modules available for connecting to other interfaces:

- PROFINET
- PROFIBUS DP
- EtherNet/IP
- EtherCAT
- DeviceNet
- CANopen

Each interface module can simultaneously accommodate up to four read heads with an RS-485 interface and address each separately. This makes it easy to extend your plant at a later stage.

In addition to automatic contamination detection, there are other optional extensions for the WCS read head. The options are indicated in the type code with the corresponding letter:

WCS2B and WCS3B	
H	Integrated heating element for an extended outside temperature range as low as - 40 °C.

WCS3B	
D	Integrated display with a seven-segment display for position and diagnostic information.
E	Read head with Extended option for long distances of up to 629.146 meters.
O	Outdoor protective enclosure with degree of protection IP69 for outdoor use.
S	Switching output for signaling when a limit speed is exceeded

The variants available can be found in the product selector at <https://www.pepperl-fuchs.com>, as well as in the model overview for read heads, see chapter 10.

Mounting System

There are three different mounting systems available for mounting the code rail. The bracket system, the WCS3 aluminum profile system, and the WCS2 aluminum profile system with fixture for a guide trolley. The three mounting systems can be screwed directly to the surface or mounted on standard C profiles.

The bracket system is the easiest to mount as it features mounting brackets for straight section elements and curved sections (vertical, horizontal). The brackets are screwed directly to the code rail and to the surface and C profile.

As an alternative to the mounting brackets, the WCS3 aluminum profile system provides better stabilization of the code rail and simplified mounting for long, straight sections. In this case, the code rail is inserted into an extruded aluminum profile developed for the WCS and fixed in place with a fixing cord. The aluminum profile rail is clipped to plastic brackets and attached to the surface with a C profile.

The WCS2 aluminum profile rail system with guide trolley is intended for applications with high running tolerances. The aluminum profile accommodates the code rail and the guide trolley. The guide trolley is connected to the vehicle via a free-running tappet and guarantees that the read head is always in the optimal position in relation to the code rail. At the same time, the read head is decoupled from vehicle vibrations. Use of the guide trolley is generally recommended with the WCS2 read head due to the low read head gap. For the WCS3 read head with outdoor protective enclosure, an optional guide trolley can be used in combination with the WCS2 profile rail.

Properties of the WCS

- Absolute position encoding system
- Photoelectric principle (infrared range)
- Proven and robust
- Easy to maintain
- No reference points required
- No calibration and adjustment work necessary
- Resistant to power failure
- Millimeter-precise positioning with absolute repeat accuracy
- Determination of position value in real time and regardless of temperature fluctuations
- Guaranteed reading up to a speed of 12.5 m/s
- High resolution = ± 0.4 mm
- Variable route length:
 - Up to 327 m (WCS2)
 - Up to 314.573 m (WCS3)
 - Up to 629.146 m (WCS Extended)
- The coding system is also suitable for curves with a radius of up to 0.5 m (does not apply to systems with guide trolleys)
- A wide range of areas of application, e.g., automated storage and retrieval systems, moving carriages, monorail conveyors, galvanic plants, automatic and slewing cranes, elevators, as well as outdoors such as in harbors, offshore installations, and ships
- Various mounting systems available for installing the code rail
- Connection to any control panel possible, either directly or via interface module
- Connectivity to many fieldbus systems available
- Support during commissioning and maintenance due to extensive system diagnostics options
- High functional reliability as a result of permanent self-diagnostics
- Contamination warning
- Optional heating for ambient temperatures down to -40 °C
- Digital output of an adjustable limit speed (optional)
- The WCS3-Outdoor has an IP69-compliant protective enclosure

2.2 Areas of Use

The WCS can be used anywhere where material handling equipment has to be positioned precisely. The operating principle of the WCS enables it to be used in a diverse range of applications, including:

- Interruptions in the code rail
- Applications with curves and circular paths
- Use of multiple vehicles in a row

Due to the large tolerance between the read head and code rail, the WCS can be used for most applications. In some cases, however, it is advantageous to use the WCS with a special protective enclosure or a guide trolley in conjunction with the aluminum profile system. Here are some examples from the variety of application options:

Automated Storage and Retrieval Systems (High-Bay Warehouses)

Moving carriages, lifting gear, and transversing carriages are each positioned with one read head. The positioning is independent of the length of the code rail and always absolutely reproducible. For new high-bay warehouses we recommend the WCS3 system. For retrofits in older warehouses, it may be beneficial to use the WCS2 in conjunction with the aluminum profile system:

- Easy to retrofit
- High mechanical tolerances between the measuring system and moving carriages possible
- Decoupling of vehicle vibrations

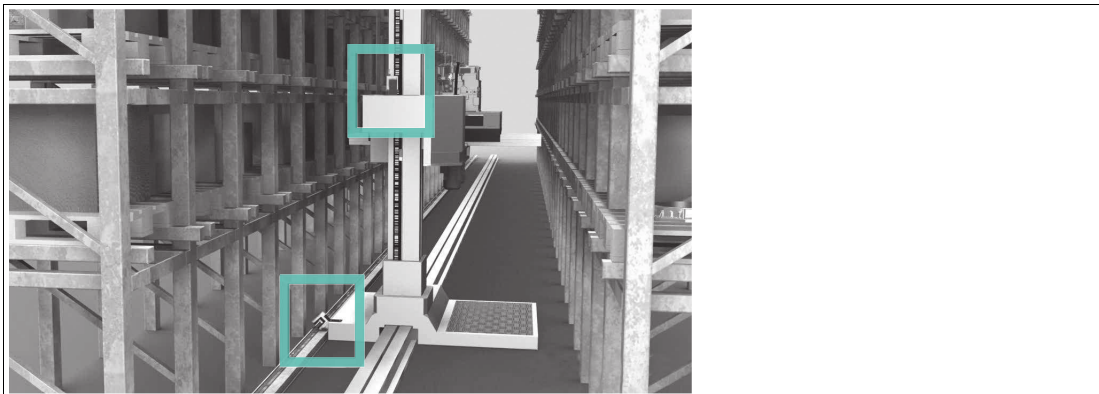


Figure 2.1 Automated storage and retrieval system (high-bay warehouse)

Automatic Cranes

Automatic cranes are a typical application for the WCS2 in conjunction with the aluminum profile system. The crane is positioned using one read head each for the crane and the trolley movement. At each point, the guide trolley ensures the optimal position of the read head in relation to the code rail and decouples any vibrations from the crane track. Optional cleaning brushes for the code rail can be attached to the guide trolley. This means that the WCS can be used in a very dusty environment, such as in cement works or foundries. If the cranes are used outdoors, the WCS3 is used with a special protective enclosure.

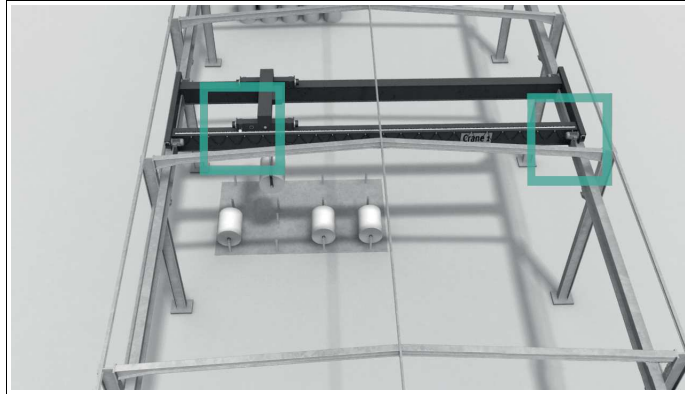


Figure 2.2 Automatic crane

Galvanic Plants

One or more vehicles in succession moving along a straight route. The vehicles automatically bring the material to be galvanized into the corresponding bath. The high and adaptable light output of the read heads has enabled the WCS position encoding system to perform extremely well even under these difficult conditions. The WCS3 with protective enclosure is ideal for galvanic plants. In addition to degree of protection IP69, the enclosure is resistant to acids and alkalis.

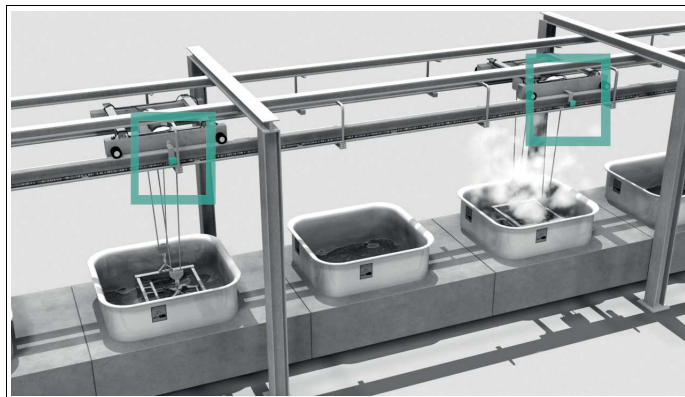


Figure 2.3 Galvanic plant

Overhead Conveyors

Many vehicles have to be positioned on a circular track—the WCS offers the optimal solution for this. Branches (track switches) and curves can be created. The WCS3 is particularly well-suited for this task. After a power failure, the current position of the vehicle is transferred to the control panel immediately; the vehicle does not have to be moved. The WCS can also be used for distances longer than 314.573 m.

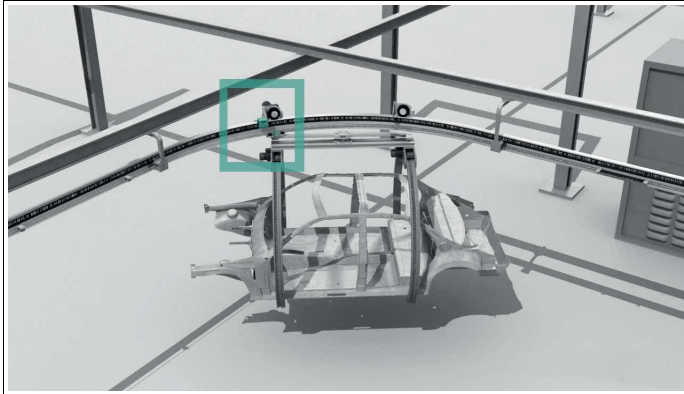


Figure 2.4 Overhead conveyor

Harbor Applications

The WCS with protective enclosure is used for material handling plants in particularly demanding areas such as harbors, offshore installations, and ships. To meet the requirements of these areas, the WCS includes an IP69-compliant protective enclosure that, in addition to protecting against dust and humidity, has been specifically designed for resistance to aggressive substances such as salt water, salty air, acids, and alkalis. It offers increased impact resistance compared to typical outdoor sources of interference such as falling branches and hailstorms. In combination with built-in heating, the WCS can even be used in snow and temperatures as low as $-40\text{ }^{\circ}\text{C}$. The indicator LEDs and the display are always visible through the translucent enclosure material.

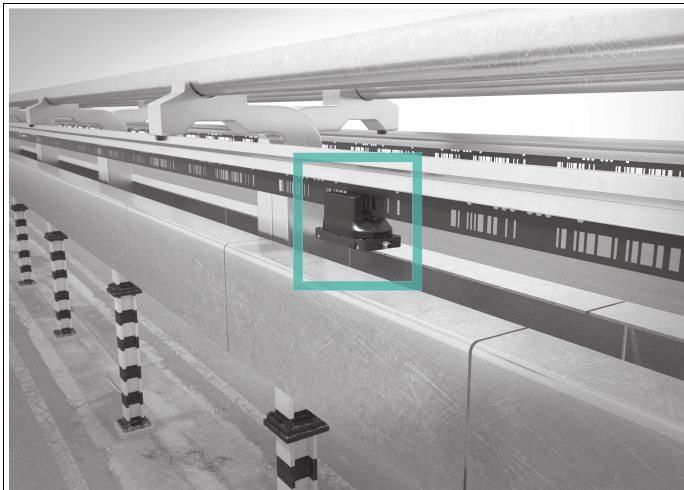


Figure 2.5 Power rail of a gantry crane

3 Data Cables and Mounting/Dismounting the Read Head

3.1 Data cable

A shielded data cable with twisted-pair wires is used for the electrical connection. Pepperl and Fuchs can supply suitable preassembled M12 single-ended female cordsets (see chapter 12.1) or field-attachable M12 single-ended female cordsets and data cables.

Data cable WCS-DC*

There are 2 types of data cable available:

- **WCS-DCS** for stationary cable routing
- **WCS-DCF** for trailing cable and drag chain installations.

The data cables are twisted pairs and have a tinned copper braided shield. The braided shield surrounds all wire pairs. The parameters of the data cables that are suitable for RS-485, SSI, and CANopen data transfer are listed in the table below.

	WCS-DCS	WCS-DCF
Capacitance (core-core)	120 pF/m	60 pF/m
Cross section	0.14 mm ²	0.25 mm ²
Number of wires	6 (3 x 2)	6 (3 x 2)
External diameter	5.8 mm	7.5 mm
Temperature range	-40 ... 80 °C	-40 ... 70 °C

Cable routing

The basic prerequisite for uninterrupted data transfer is that the data cables are routed in such a way that any coupling of electromagnetic fields and interference is excluded. For EMC-compliant cable routing, it is necessary to divide the cables into cable groups and route these groups separately.

Group A

- Shielded data cable (including analog)
- Unshielded cable for DC and AC voltages 0 ... 60 V
- Shielded cable for DC and AC voltages 0 ... 230 V
- Coaxial cables for monitors

Group B

- Unshielded cable for DC and AC voltages 60 ... 400 V

Group C

- Unshielded cable for DC and AC voltages greater than 400 V

Shielding cables

The shielding of cables is required to suppress electromagnetic interference. Establishing a low resistance or low impedance connection with the protective conductor is a particularly important factor in ensuring that these interference currents do not become a source of interference themselves.

The WCSB2B and WCS3B read heads have no connection option for the cable shield. The cable shield is connected to the plant potential in the switch cabinet with low resistance (large area). In the case of high electromagnetic interference, it is advisable to connect the shield of the data cable to the plant potential in the immediate vicinity of the read head with low resistance using a grounding clip.

3.2 Mounting/Dismounting the Read Head Enclosure

If required, the factory default setting of the read head can be changed using the respective DIP switches. The DIP switches are located inside the housing on the PCB of the read head. To access the DIP switches, open the enclosure cover of the read head. Proceed as follows:



Mounting/Dismounting

1. Disconnect the device from the power supply.

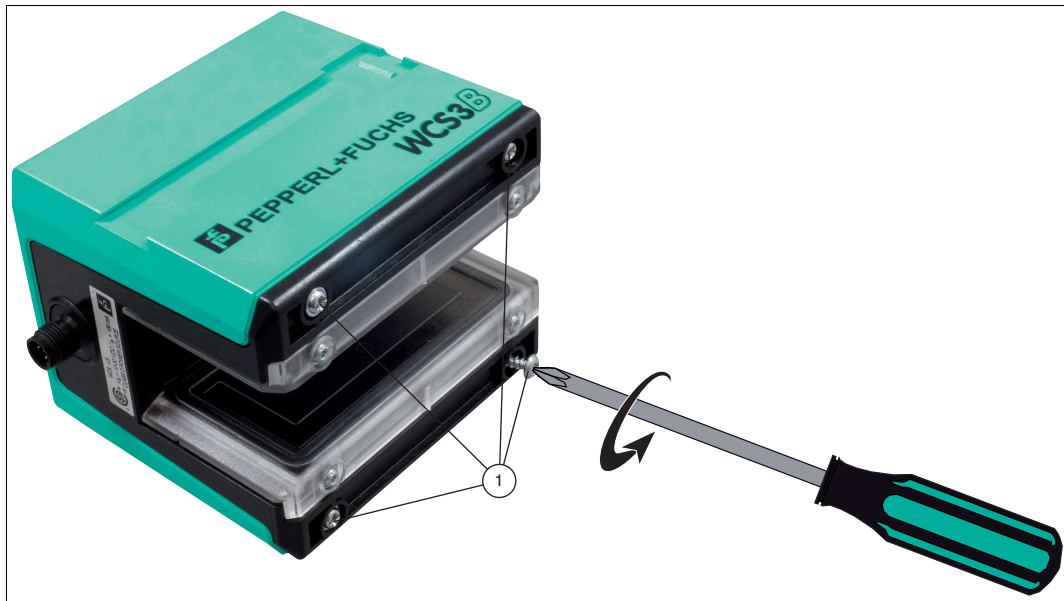


Figure 3.1 Opening the read head

2. Open the read head by removing the four screws (4) on the bottom of the read head.



Warning!

Property damage caused by electrostatic discharge (ESD)

If the housing is opened, the electronics may be damaged by electrostatic discharges.

- Use a wrist grounding strap or other ESD protective measures.

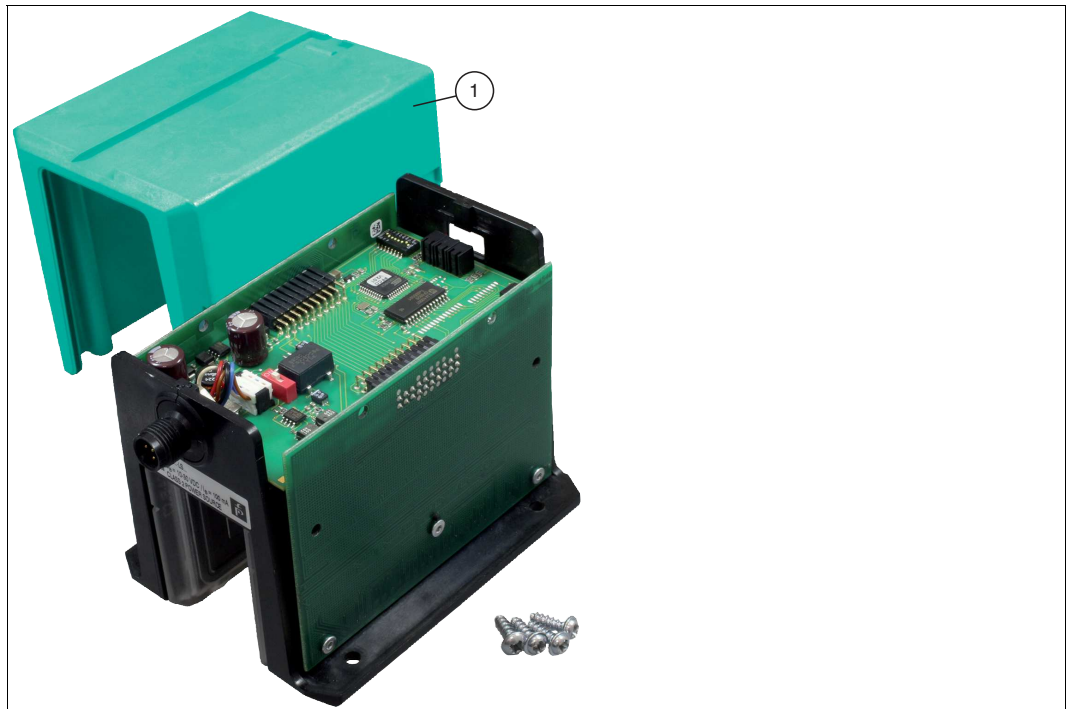


Figure 3.2 Removing the enclosure cover

3. Remove the enclosure cover (1) from the read head. To do this, carefully pull the enclosure cover upward.

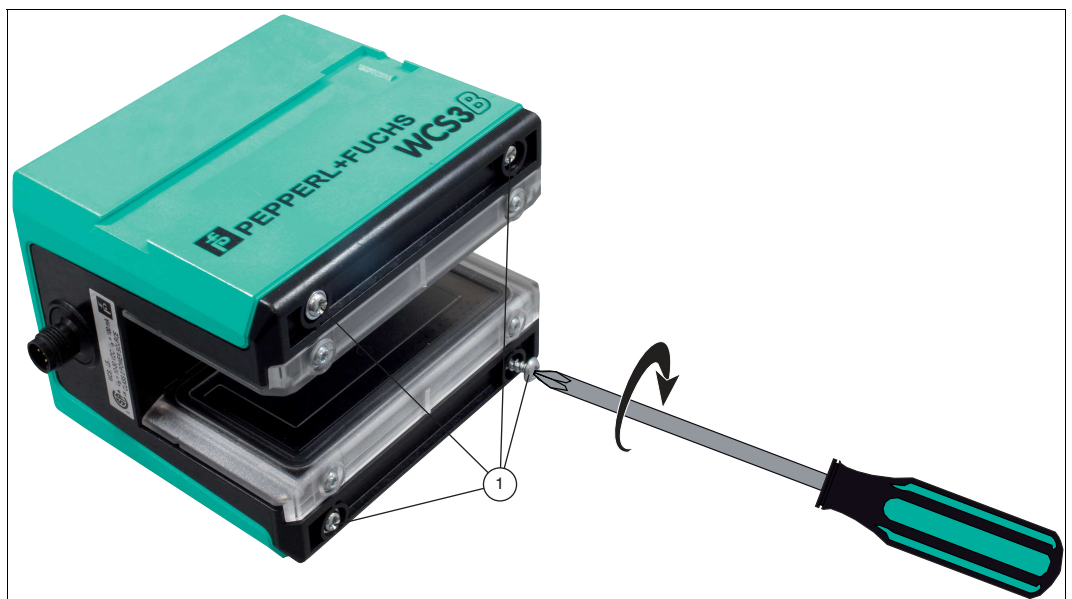


Figure 3.3 Mounting the enclosure cover

4. After making all adjustments, carefully slide the enclosure cover onto the read head and screw it into place with the four screws.



Note

The settings of the DIP switches for the respective interfaces can be found in the following chapters, under the menu item Hardware Configuration.

4 RS-485 Interface (LS1xx*, LS2xx*)

The serial interface of the read head allows the position values and other defined operating data to be read out.

Up to four WCS2B and/or WCS3B read heads can be interconnected in one RS-485 bus line. In this case, the read heads must have different addresses. The read head address must be configured in the read head if it has not already been set. If the read head address is already preset, this is indicated by the type designation of the read head. In the section "Type Overview of WCS Read Head," you will find a detailed breakdown of the read head types, see chapter 10.

4.1 Electrical Connection and Data Cables



Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

Connection diagram for WCS2B read head

The WCS2B read head is connected via a 5-pin M12 plug.

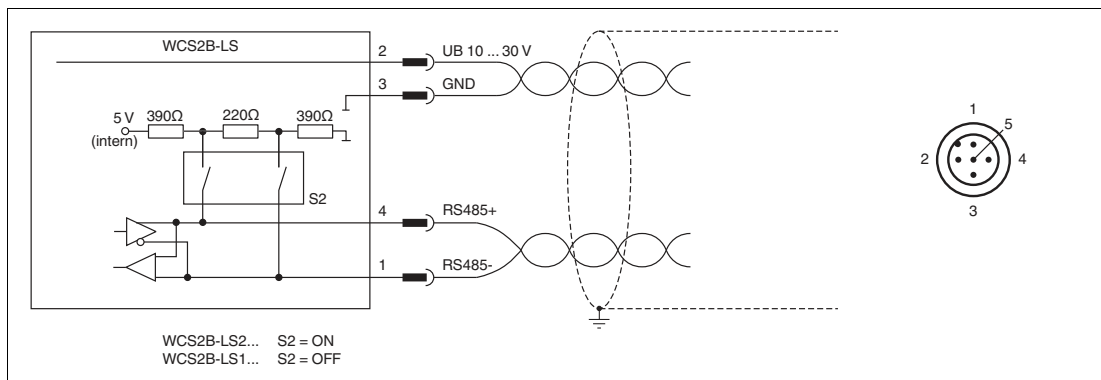


Figure 4.1 WCS2B, RS-485 interface

Connection diagram for WCS3B read head

The WCS3B read head is connected via a 5-pin M12 plug.

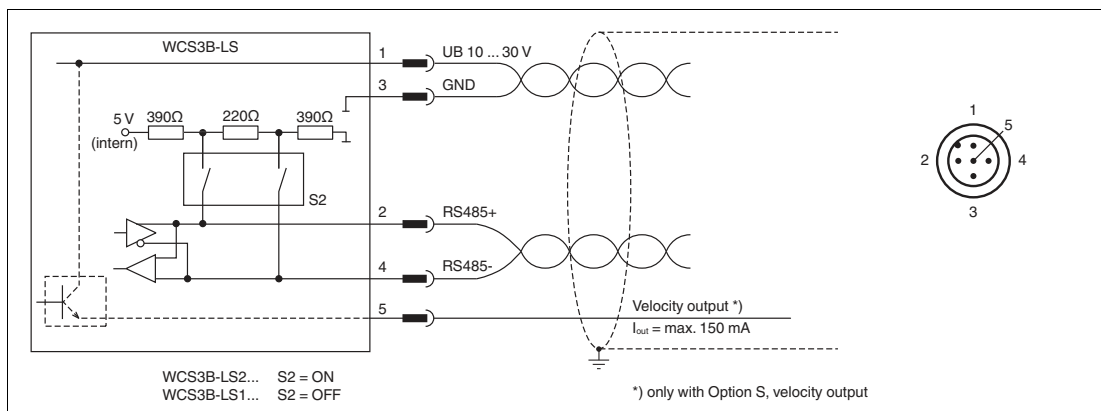


Figure 4.2 WCS3B, RS-485 interface

The counterpart of the plug connections, the 5-pin M12 socket, is not included in the scope of delivery for the read head. You can obtain suitable connectors and cables from Pepperl+Fuchs, see chapter 12.1.

Data cable

For the RS-485 data transfer path, a four-wire, shielded, twisted pair data cable must be used. One wire pair is used for the supply voltage, and one pair for the RS-485 data connection. The maximum length of the cable depends on the capacitance of the data cable—core-core—for data transfer, and on the cross section of the cables for power supply to the read heads. For data transfer, a small core cross section and thus a small cable capacitance is an advantage, whereas for the power supply, the largest possible cross section is required. The table below shows the possible cable lengths depending on the cable cross section.

Cable length

Cable cross section	AWG ¹	Number of read heads without heater				Number of read heads with heater			
		1	2	3	4	1	2	3	4
0.14 mm ²	~ 26	200 m	110 m	70 m	50 m	15 m	10 m	7 m	5 m
0.22 mm ²	~ 24	320 m	170 m	110 m	80 m	30 m	15 m	10 m	7 m
0.25 mm ²	-	350 m	190 m	130 m	90 m	35 m	17 m	12 m	8 m
0.28 mm ²	-	400 m	220 m	150 m	110 m	40 m	20 m	15 m	10 m
0.34 mm ²	~ 22	500 m	250 m	180 m	140 m	50 m	25 m	17 m	12 m
0.50 mm ²	~ 20	500 m	400 m	270 m	200 m	70 m	35 m	25 m	17 m

1. American Wire Gauge, a system commonly used in North America for the specification of wire diameters in electrical engineering.

In the calculations, the worst-case scenario was assumed: All read heads are located at the end of the data line. In the case of large cable lengths, and when connecting multiple WCS2 read heads with a heater, 6-wire data cables (3 x 2) can be used. These data cables use two pairs for the power supply (doubling the cable cross section), and one pair for the RS-485 data line. The table below shows the possible cable lengths depending on the cable capacitance (core-core). The number of connected read heads is of no significance.

Capacitance (core-core)	RS-485 interface		
	19.2 kb	62.5 kb	187.5 kb
60 pF	500 m	500 m	300 m
90 pF	500 m	450 m	275 m
120 pF	500 m	400 m	250 m

4.2 Hardware Configuration

You can change the hardware and software configuration of the read head in the read head. The changes to the read head type are made with two DIP switches or with three if you have a read head with the "Display" option: S1 (1) is a DIP switch with four switch positions, S2 (2) and S1D (3) are switches with two switch positions each.



Figure 4.3 Positions of the DIP switches

1. Configuration switch S1, 4-way (address, baud rate)
2. Configuration switch S2, 2-way (terminator)
3. Configuration switch S1D, 2-way (display)

Changing the read head address

Read head type	Configuration switch "S1"				Address
	1	2	3	4	
WCS2B-LS***-0 WCS3B-LS***-0	OFF	OFF	X	X	0
WCS2B-LS***-1 WCS3B-LS***-1	ON	OFF	X	X	1
WCS2B-LS***-2 WCS3B-LS***-2	OFF	ON	X	X	2
WCS2B-LS***-3 WCS3B-LS***-3	ON	ON	X	X	3
WCS3B-LS***S-0	OFF	X	X	X	0
WCS3B-LS***S-1	ON	X	X	X	1

Changing the terminator

WCS2B and WCS3B		
Terminator	Configuration switch "S2"	
	1	2
ON	ON	ON
OFF	OFF	OFF

Changing the baud rate

Base types LS*11/LS*21:

Read head type (* = 1 or 2)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS2B-LS*11 WCS3B-LS*11	X	X	OFF	X	187.5 kBaud
WCS2B-LS*21 WCS3B-LS*21	X	X	ON	X	62.5 kBaud

Base types LS231/LS261

Read head type (* = 1 or 2)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS2B-LS*61 WCS3B-LS*61	X	X	OFF	X	38.4 kBaud
WCS2B-LS*31 WCS3B-LS*31	X	X	ON	X	31.25 kBaud

Base types LS246/LS256

Read head type (* = 1 or 2)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS2B-LS*46 WCS3B-LS*46	X	X	OFF	OFF	19.2 kBaud even parity
WCS2B-LS*47 WCS3B-LS*47	X	X	OFF	ON	19.2 kBaud no parity
WCS2B-LS*56 WCS3B-LS*56	X	X	ON	OFF	9.6 kBaud even parity
WCS2B-LS*57 WCS3B-LS*57	X	X	ON	ON	9.6 kBaud no parity

Base types LS*1xS/LS*2xS

Read head type (* = 1 or 2, x = 1, 6, or 7)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS3B-LS*1xS	X	OFF	X	X	187.5 kBaud
WCS3B-LS*2xS	X	ON	X	X	62.5 kBaud

Base types LS*3xS/LS*6xS

Read head type (* = 1 or 2, x = 1, 6, or 7)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS3B-LS*6xS	X	OFF	X	X	38.4 kBaud
WCS3B-LS*3xS	X	ON	X	X	31.25 kBaud

Base types LS*3xS/LS*6xS

Read head type (* = 1 or 2, x = 1, 6, or 7)	Configuration switch "S1"				Baud rate
	1	2	3	4	
WCS3B-LS*4xS	X	OFF	X	X	19.2 kBaud
WCS3B-LS*5xS	X	OFF	X	X	9.6 kBaud

Adjusting the Display

You can rotate the character position on the display 180° using the S1D DIP switch. This allows you to read the displayed values easily regardless of the installation position of the read head.

WCS3B			
Display position	Configuration switch "S1D"		Comment
	1	2	
0°	OFF	OFF	The displayed value can be read on a code rail mounted upright.
180°	ON	ON	The displayed value can be read on a code rail mounted suspended.

4.3 Data Protocols

Various data protocols and data transmission speeds are available for direct connection of the read head to the higher-level control panel via a serial communication channel. The data protocols and baud rates are identical for the respective types in the WCS2B and WCS3B read heads.

A byte has the following format:

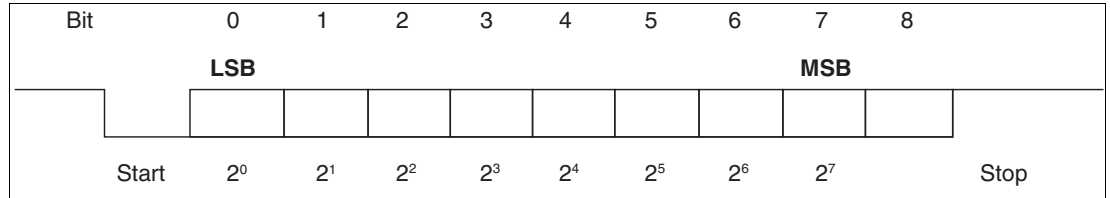


Figure 4.4 Data structure

For data protocols 1 and 2, the eighth data bit is used to distinguish between request bytes and response bytes. For control panels that do not support direction control via the eighth data bit, data protocol 3 is available. Read heads with RS-485 interface and data protocol 3 can be supplied as type:

LSxx6 = data protocol 3 with parity (even parity), 9 bits/byte

LSxx7 = data protocol 3 without parity = 8 bits/byte.

Response time

The minimum response time of the read head (start sending the first data bytes from the response telegram) depends on the internal time sequence of the read head and is 10 ... 180 µsec for data protocol 1 and 2.

For data protocol 3, the response time is a byte time + 10 ... 100 µsec. The byte time depends on the baud rate and is calculated from **1/baud rate * 11,000 in µsec.**

Example: **38.4 kBaud**

Byte time = 1/38.4 * 11,000 = **286.5 µsec.**



Note

Note the different data protocols for extended read head, see chapter 9.2.

Data protocol 1

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	0	0	0	F0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 5	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 6	0	P07	P06	P05	P04	P03	P02	P01	P00

Data protocol 1 with position and velocity output

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	1	0	0	0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 6	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 7	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 8	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0

Data protocol 2

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	0	1	1	F0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	Exclusive or link, byte 1 ... Byte 3							

Data protocol 2 with position and velocity output

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	1	1	1	0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	Exclusive or link, byte 1 ... Byte 4							

Data protocol 3

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	PAR	1	0	0	F0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	PAR	0	0	A1	A0	0	DB	OUT	ERR
Byte 2	PAR	0	0	0	P18	P17	P16	P15	P14
Byte 3	PAR	0	P13	P12	P11	P10	P09	P08	P07
Byte 4	PAR	0	P06	P05	P04	P03	P02	P01	P00
Byte 5	PAR	Exclusive or link, byte 1 ... Byte 4							

Data protocol 3 with position and velocity output

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	PAR	1	1	1	0	0	0	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	PAR	0	SST	A1	A0	0	DB	OUT	ERR
Byte 2	PAR	0	0	0	P18	P17	P16	P15	P14
Byte 3	PAR	0	P13	P12	P11	P10	P09	P08	P07
Byte 4	PAR	0	P06	P05	P04	P03	P02	P01	P00
Byte 5	PAR	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 6	PAR	Exclusive or link, byte 1 ... Byte 5							

Description of the protocol data

Activation of the read head

F0	A1	A0	Read head address
x	0	0	Read head address 0
x	0	1	Read head address 1
x	1	0	Read head address 2
x	1	1	Read head address 3
0	x	x	Send position value
1	x	x	Send diagnosis result

Data from read head

Function number for read head F0=0 (send position value)					
ERR	DB	OUT	SST	Description	State of the read head lens
0	0	0	x	Current position value in P00 ... P18, binary coded	Good
0	0	1	x	Read head outside the code rail, no position value (see OUT message)	Good
0	1	0	x	Current position value in P00 ... P18, binary coded	Poor
0	1	1	x	No position value, read head outside the code rail (see OUT message)	Poor
1	x	x	x	No position value, error message from read head, error number in P00 ... P04, binary coded	-
x	x	x	1	Current speed unknown, last speed in SP0 ... SP6 *)	-
x	x	x	0	Current speed in SP0 ... SP6 *)	-

*) Speed information

The speed is binary coded in bits SP0 to SP6.

SP0...SP6...	Speed in 0.1 m/s, binary coded
0:	Speed less than 0.1 m/s
126:	Speed more than 12.5 m/s
127:	Speed unknown

Example:

SP0...SP6...	1:	Speed 0.1 m/s
	37:	Speed 3.7 m/s
	112:	Speed 11.2 m/s

Diagnostic function F0=1

The read head can be requested to perform a diagnosis of the photoelectrics via the request byte to the read head. For this purpose, the read head must be located outside of the code rail. On the WCS2B and WCS3B read heads, the degree of dirt accumulation on the photoelectrics is monitored automatically during operation and the diagnostic bit (DB) set if dirt accumulation is too high. Thus the request for diagnosis to the read head via F0 in the request byte is no longer necessary. However, for reasons of downward compatibility, this function is also supported by the new read heads.

Diagnostic bit (DB)

Diagnostic bit DB displays the result of the integrated diagnostics of the read head.

Function number for read head F0 = 1 (send diagnosis result)				
ERR	DB	OUT	Description	State of the read head lens
0	1	0	Diagnosis invalid, read head not outside of the code rail	-
0	1	1	Diagnosis result in P16 ... P18	-
			P16 ... P18 = 0	Good
			P16 ... P18 > 0	Poor
1	x	x	Error message from read head, error message in P00 ... P04, binary coded	-

Contamination detection

Read heads WCS2B and WCS3B continually monitor the condition of the lenses. If a drop in light output is detected on the infrared transmitter, e.g., as a result of contamination of the clear protective lenses, the read head automatically increases the light intensity. If the level of contamination is too high, a warning message is sent to the higher-level control panel (diagnostic bit DB=1). The automatic light adjustment in the read head allows you sufficient time to clean the read head as part of the next servicing procedure. The WCS3B read head emits a visual signal for the "contamination detected" state: the yellow and red LEDs on the front of the read head flash alternately. To clean the lenses, the read head must be removed from the code rail (removed from the mounting base). After cleaning the transparent protective lenses, the contamination message is automatically deleted from the read head. If the message is not reset despite careful cleaning or replacement of the plastic protective lenses, there may be an error. In this case, the read head must be sent for inspection.

OUT message

Function number for read head F0 = 0 (send position value)					
ERR	DB	OUT	SST	Description	State
0	x	1	x	P00...P18 = 0 -> read head is partially outside the code rail	OUT
				P00 = 1, P02...P18 = 0 -> read head is completely outside the code rail	OUT A

OUT means that the position value cannot be determined because the position of the code rail in the read head gap is incorrect.

OUT A (A=All) means that there is no code rail in the read head gap; all light barriers of the read head report a signal.

The "OUT" message may be desirable and correct, e.g., if the code rail is interrupted and the read head sends this information between the individual rail pieces to the control panel. If the "OUT" message must not occur, the following test steps must be performed:

Result of the check	Remedy
The upper edge of the code rail is outside the tolerance range of the read head	<ul style="list-style-type: none"> Align the code rail precisely Align the read head Use the guide system for the read head
The plastic protective lenses on the optical unit are dirty or scratched	<ul style="list-style-type: none"> Clean optical unit Ensure the read head is cleaned Change the protective lenses
Incidence of extraneous light	<ul style="list-style-type: none"> Protect the read head against any incidence of extraneous light

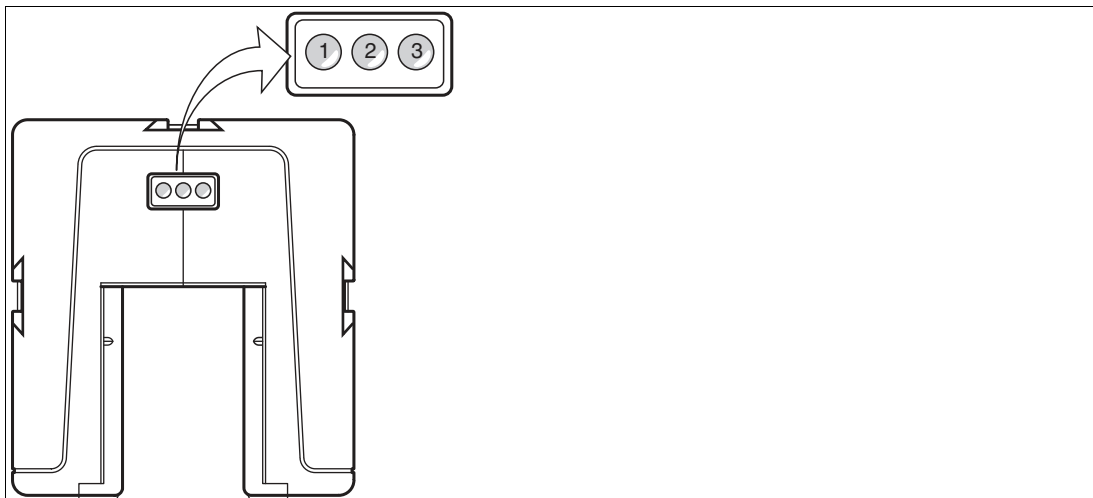
If these measures do not solve the problem, the read head must be sent for inspection.

4.4 Status and Error Messages

Error number	Cause	Remedy
1 2	WCS read head cannot calculate position value because:	
	Optical unit is dirty	Clean optical unit
	Plastic protective lenses are scratched	Align WCS read head and code rail correctly; replace scratched plastic protective lenses
	Position of the read head in relation to the code rail is incorrect	Check the position of the WCS read head in relation to the code rail; install WCS read head correctly
	Light barriers have failed	Check light barriers; if necessary send for repair
3	RAM error, WCS read head	Send WCS read head for repair
4	EPROM error, WCS read head	Send WCS read head for repair
5	ROM error, WCS read head	Send WCS read head for repair
6	Reserved	
7	No position value available	Message only after switching on the WCS read head and/or after a RESET
8 9 10 11 12	Data transfer error between WCS read head and interface module, data transfer disrupted	Check the cable connection from the WCS read head to the interface module; check the shielding, protective earth, cable routing (EMC)
13	WCS read head cannot be addressed by the interface module	Check the cable connection from the WCS read head to the interface module; check the operating voltage of the read head
14	Read head is located in the initialize or diagnostic routine	Wait for initialization; exit diagnostics (set the selector switch on the interface module to 0 ... 7)
15	Interface module is not set for communication with multiple WCS read heads	Send interface module for correct configuration setting
19	RAM error in interface module	Send interface module for repair
20	EPROM error in interface module	Send interface module for repair

4.5 LED Status Indication

WCS3B-LS1xx*/ WCS3B-LS2xx*



- 1 Green LED
- 2 Yellow LED
- 3 Red LED

Display

Operating indicator

Data flow indicator¹

Velocity display²

Fault indicator

Contamination indicator

Function indicator

Meaning

Green LED: Power on

Yellow LED: Data transfer active

Yellow LED
Off if limit speed exceeded

Red LED
Flashing: Read head outside the code rail
Permanently lit: Internal diagnostic error

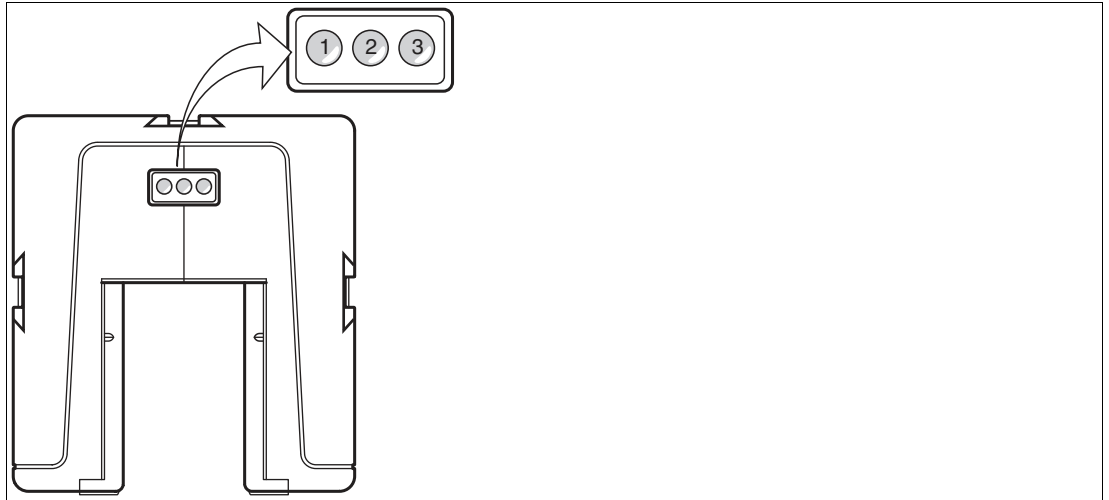
Yellow LED and red LED flashing alternately: Read head lens dirty (f=1.5 Hz)

Yellow LED and red LED light up for 2 seconds after power on or reset

1. Only for read heads with no velocity output

2. Only for read heads with velocity output

WCS3B-LS*E* (option—extended)



- 1 Yellow LED
- 2 Yellow LED
- 3 Dual LED green/red

Display

Data flow indicator

Velocity display

Status indicator

Meaning

LED 1 yellow
 Flashing: Data transfer active
 Off: No data transfer

LED 2 yellow
 On: Supply voltage applied
 Off: Limit speed exceeded

Dual LED 3 green/red
 Green on: Code rail detected, normal function
 Flashing green: Position invalid; code rail area is not clear after the supply voltage has been connected
 Red on: Internal diagnostic error
 Flashing red: Read head partially or completely outside the code rail

5 SSI Interface (LS3xx*)

The read head with SSI interface supports data formats in gray code (LS311) or binary code (LS310). Data transfer is carried out on the SSI read head at the request of the control panel.

5.1 Electrical Connection and Data Cables



Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

Connection diagram for WCS2B read head

The WCS2B read head with SSI interface is electrically connected via an 8-pin M12 plug.

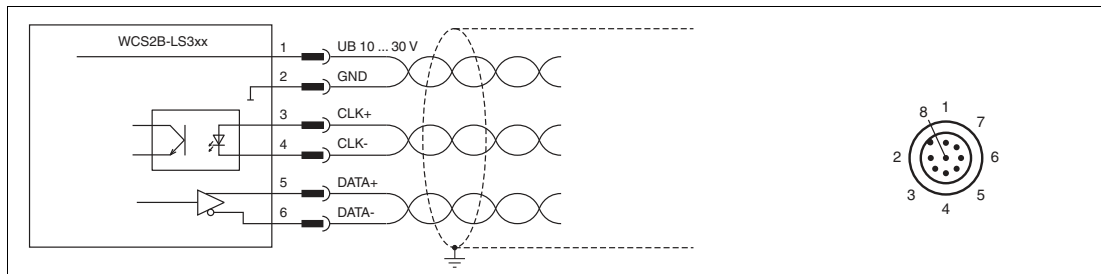


Figure 5.1 WCS2B, SSI interface

Connection diagram for WCS3B read head

The WCS3B read head with SSI interface is electrically connected via an 8-pin M12 plug.

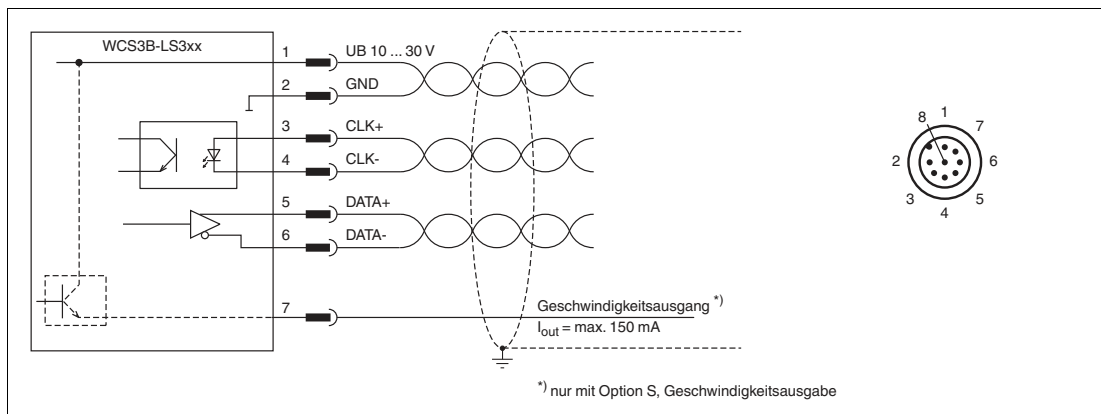


Figure 5.2 WCS3B, SSI interface

The counterpart of the plug connections, the 8-pin M12 socket, is not included in the scope of delivery for the respective read head. You can obtain suitable connectors and cables from Pepperl+Fuchs, see chapter 12.1.

Data cable

For SSI data transfer, a 6-wire, shielded, twisted pair data cable (3 x 2) is used. One wire pair is used for the supply voltage, one pair for the CLK line, and one pair for the DATA line. The cable lengths that are technically possible can be determined from the tables. For large cable lengths (longer than 12 m) between the SSI read head and control panel, we recommend using the SSI interface module. In this case, the data is transferred asynchronously from the read head to the interface module via the RS-485 interface. The data is converted to SSI protocol immediately next to the control panel. The table below shows the possible cable lengths depending on the cable capacitance (core-core). The number of connected read heads is of no significance.

Capacitance (core-core)	SSI Interface		
	125 kHz	250 kHz	500 kHz
60 pF	200 m	100 m	30 m
90 pF	150 m	80 m	25 m
120 pF	100 m	60 m	20 m

5.2 Hardware Configuration

You can change the hardware and software configuration of the read head in the read head. The changes to the read head type are made with a DIP switch or with two if you have a read head with the "Display" option: S1 (1) is a DIP switch with four switch positions and S1D (2) is a DIP switch with two switch positions.

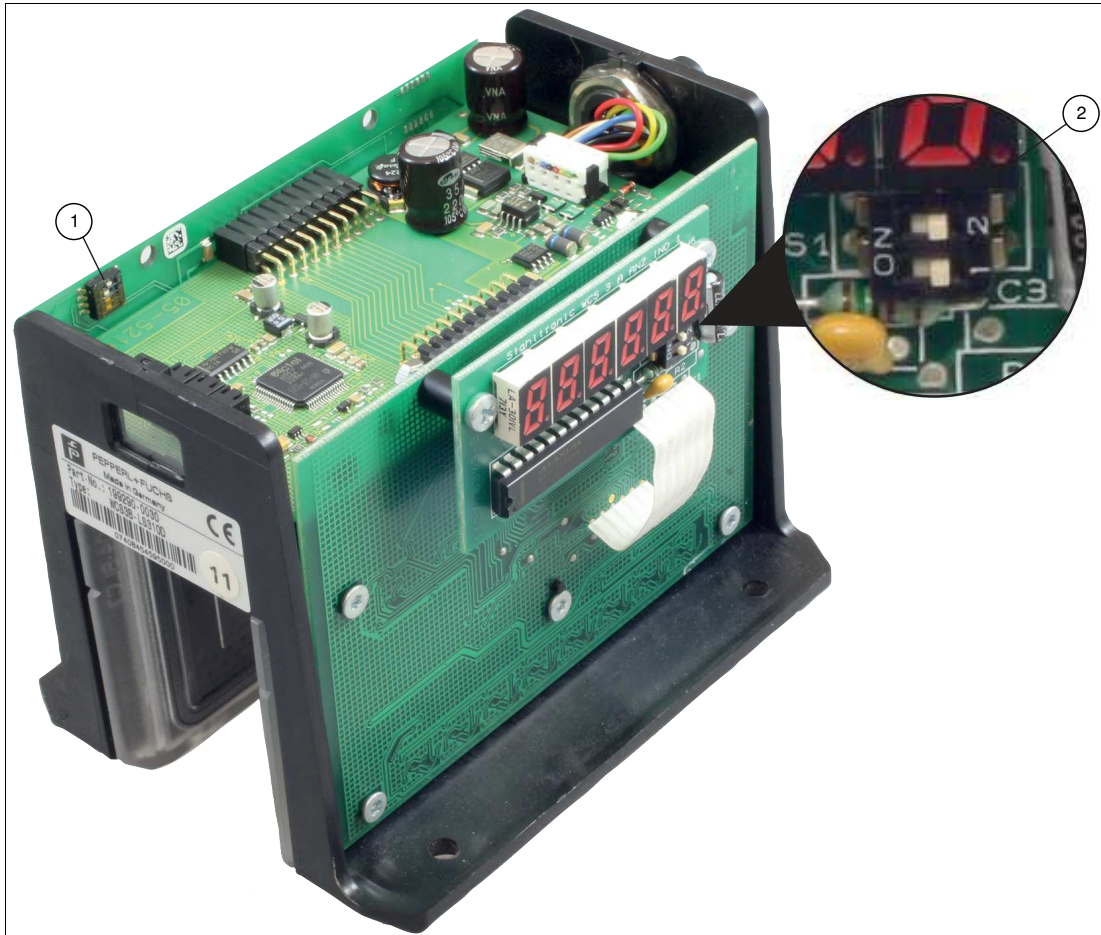


Figure 5.3 Configuration switch positions

1. Configuration switch S1, 4-way (data format, contamination detection)
2. Configuration switch S1D, 2-way (display)

Changing the data format

Read head type	Configuration switch "S1"				Code
	1	2	3	4	
WCS2B-LS310 WCS3B-LS310	ON	OFF	X	X	Binary
WCS2B-LS311 WCS3B-LS311	OFF	OFF	X	X	Gray

Output of a warning if the lenses are contaminated

Read head type	Configuration switch "S1"				Code
	1	2	3	4	
WCS2B-LS31* WCS3B-LS31*	X	OFF	X	OFF	ON
WCS2B-LS31* WCS3B-LS31*	X	OFF	X	ON	OFF

Adjusting the Display

You can rotate the character position on the display 180° using the S1D DIP switch. This allows you to read the displayed values easily regardless of the installation position of the read head.

WCS3B			
Display position	Configuration switch "S1D"		Comment
	1	2	
0°	OFF	OFF	The displayed value can be read on a code rail mounted upright.
180°	ON	ON	The displayed value can be read on a code rail mounted suspended.

5.3 Data Protocols

The read head with SSI interface supports data formats in gray code (LS311) or binary code (LS310). Data transfer for the SSI read head is carried out on request from the control panel.

SSI interface

The clock signal (CLK) generated by the control panel is used for the transfer. If no data transfer begins, the serial data output of the read head remains at 1. The data transfer begins with a falling edge of the clock signal. With each rising edge of the clock signal, the read head transmits one bit of the current position. The transfer begins with the most significant bit (MSB) and ends with the least significant bit (LSB).

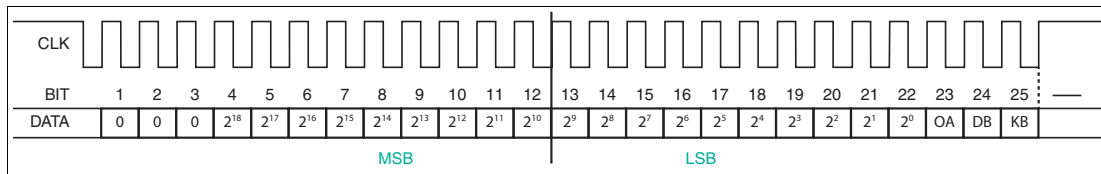


Figure 5.4 SSI data format

The read head with SSI interface corresponds to a 19-bit absolute encoder in the data format. Effectively, the WCS read head delivers up to 512 revolutions and 1024 increments/revolution. The clock rate between the control panel and the read head may be 100 ... 1000 kHz. The recommended value is 250 kHz.

Bit 1 ... 3

The first three bits are always 0.

Bit 4 ... 22 (2^{18} ... 2^0 position values)

The position values are transferred to bits 4 to 22 of the SSI protocol. For LS311 read heads the position values are gray encoded, and for LS310 read heads the position values are binary encoded.

Bit 23 (OA read head outside the code rail)

A distinction is made between two different states:

1. The code rail is located in the read head gap, but outside the possible tolerances. In this case, the control panel receives the following bit pattern:
 KB = 0
 OA = 0
 POS 2^0 ... $2^{18} = 1$ (position value 524287)
2. There is no code rail in the read head gap. In this case, bit OA = 1 (Out All) is set in addition to the above bit pattern.

Note

Position data (bit 4 ... 22) are output for LS311 read heads in gray code. Status and error bits (bit 23 ... 25) are not output in gray code.



Bit 24 (DB output of a prewarning if the lenses are contaminated)

The contamination warning is transferred in bit 24 of the SSI protocol and can be evaluated. The diagnostic bit DB is always switched on by default.

Read heads WCS2B and WCS3B continually monitor the condition of the lenses. If a drop in light output is detected on the infrared transmitter, e.g., as a result of contamination of the clear protective lenses, the read head automatically increases the light intensity. If the level of contamination is too high, a warning message is sent to the higher-level control panel (diagnostic bit DB=1). The automatic light adjustment in the read head allows you sufficient time to clean the read head as part of the next servicing procedure. The WCS3B read head emits a visual signal for the "contamination detected" state: the yellow and red LEDs on the front of the read head flash alternately. To clean the lenses, the read head must be removed from the code rail (removed from the mounting base). After cleaning the transparent protective lenses, the contamination message is automatically deleted from the read head. If the message is not reset despite careful cleaning or replacement of the plastic protective lenses, there may be an error. In this case, the read head must be sent for inspection.

Read head type (* = 0 or 1)	S1				Diagnostic bit
	1	2	3	4	
WCS2B-LS31*	X	OFF	X	OFF	ON
WCS2B-LS31*	X	OFF	X	ON	OFF
WCS3B-LS31*	X	OFF	X	OFF	ON
WCS3B-LS31*	X	OFF	X	ON	OFF

Bit 25 (KB error message)

If the read head detects an error, the KB error bit is set and the error code is output to the control panel:

KB = 1

POS $2^0 \dots 2^2$ = error number

POS $2^3 \dots 2^{18}$ = 0

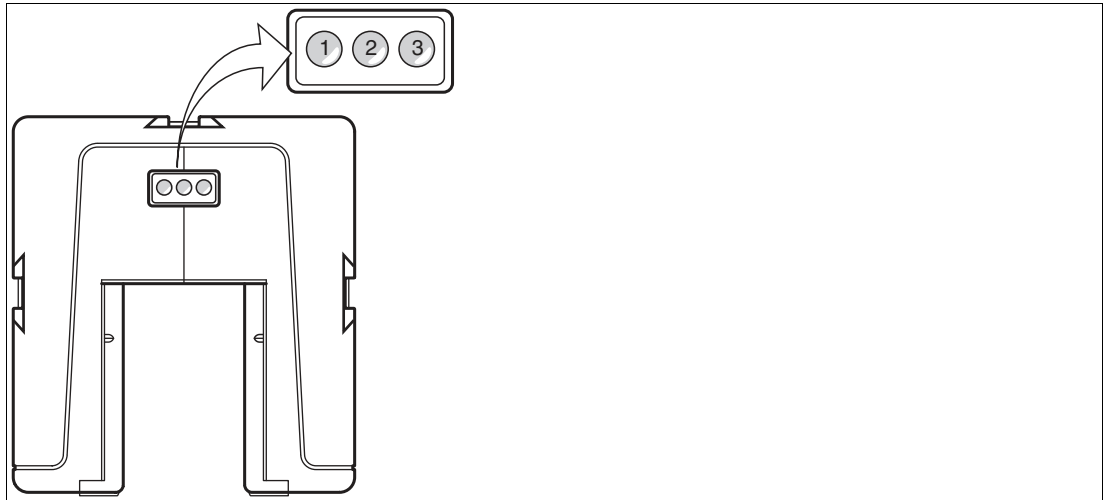
Information on the error messages see chapter 5.4.

5.4 Status and Error Messages

Error number	Cause	Remedy
1 2	WCS read head cannot calculate position value because:	
	Optical unit is dirty	Clean optical unit
	Plastic protective lenses are scratched	Align WCS read head and code rail correctly; replace scratched plastic protective lenses
	Position of the read head in relation to the code rail is incorrect	Check the position of the WCS read head in relation to the code rail; install WCS read head correctly
	Light barriers have failed	Check light barriers; if necessary send for repair
3	RAM error, WCS read head	Send WCS read head for repair
4	EPROM error, WCS read head	Send WCS read head for repair
5	ROM error, WCS read head	Send WCS read head for repair
6	Reserved	
7	No position value available	Message only after switching on the WCS read head and/or after a RESET

5.5 LED Status Indication

WCS3B-LS3xx*



- 1 Green LED
- 2 Yellow LED
- 3 Red LED

Display

Operating indicator

Data flow indicator¹

Velocity display²

Fault indicator

Contamination indicator

Function indicator

Meaning

Green LED: Power on

Yellow LED: Data transfer active

Yellow LED
Off if limit speed exceeded

Red LED
Flashing: Read head outside the code rail
Permanently lit: Internal diagnostic error

Yellow LED and red LED flashing alternately: Read head lens dirty (f=1.5 Hz)

Yellow LED and red LED light up for 2 seconds after power on or reset

1. Only for read heads with no velocity output

2. Only for read heads with velocity output

6 CANopen Interface (LS4xx*)

The WCS3B read head with CANopen interface can be connected directly to a CANopen bus after configuration. The configuration is made via DIP switches in the read head in a de-energized state.

The CAN interface is galvanically isolated. The read head works as a CANopen slave in the "Predefined Connection Set" and sends the data in the TxPDO1.

6.1 Electrical Connection



Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

Connection diagram for WCS3B read head

The connection is made via a 5-pin M12 plug. The counterpart to the connector is not included in the scope of delivery for the read head.

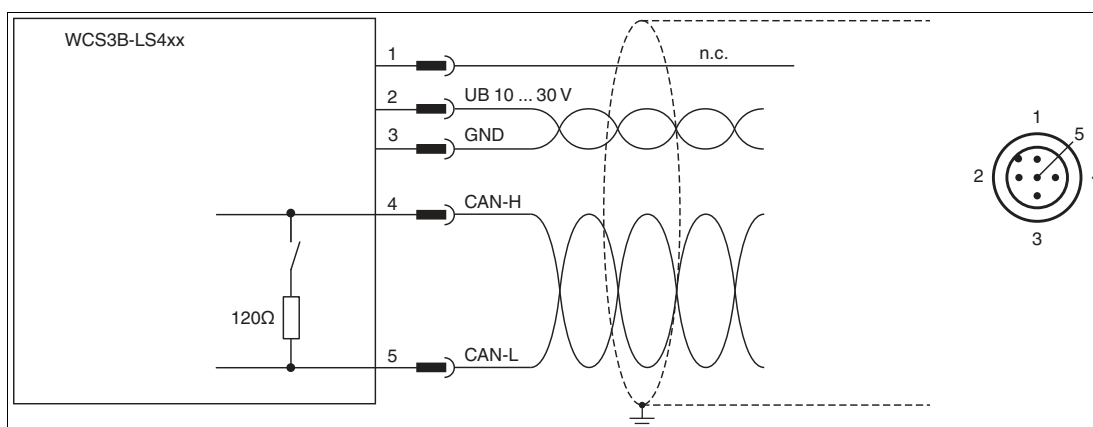


Figure 6.1 WCS3B, CANopen interface

You can obtain suitable connectors and cables from Pepperl+Fuchs, see chapter 12.1.

Data cable

For CANopen data transfer, a four-wire, shielded, twisted pair data cable must be used. One wire pair is used for the supply voltage, and one wire pair is used for the CANopen data transfer.

The maximum length of the cable depends on the speed of the data transfer. The table below shows the possible cable lengths depending on the bit rate.

Maximum cable length

Bit rate	Cable length
125 kbits/s	500 m
250 kbits/s	250 m
500 kbits/s	100 m
1 Mbits/s	30 m

6.2 Hardware Configuration

You can change the hardware and software configuration of the read head in the read head. The read head type is changed using three DIP switches.



Figure 6.2 Configuration switch positions

1. 4-way configuration switch (transfer mode, data protocols)
2. 1-way configuration switch (CAN terminator)
3. 8-way configuration switch (baud rate, node ID)

CAN terminator

On the middle PCB in the read head there is a 1-way DIP switch (2). This switch can be used to switch the CAN terminator, 120 ohms, off or on. The terminator is switched on by default.

Baud rate

The baud rate can be changed using two switches of the 8-way DIP switch (3) on the central PCB in the read head. The baud rate is 250 kBaud by default.

DIP 8-8	DIP 8-7	Baud rate
OFF	OFF	125 kBaud
OFF	ON	250 kBaud
ON	OFF	500 kBaud
ON	ON	1 MBaud

Node ID

The address in the CANopen bus, the node ID, can be changed using switches 1 to 6 of the 8-way DIP switch (3) on the central PCB in the read head. The node ID is encoded in binary form. The smallest possible node ID is 1, the highest possible node ID is 63. Node ID 0 is not permitted. Node ID 1 is applied by default.

Transfer mode in the CANopen bus

The transfer mode and the "inhibit time" can be configured using switches 1 to 3 of the 4-way DIP switch (1) on the PCB on the side of the read head.

Asynchronous

Switch position 0 ... 3, see table below.

The read head automatically sends the data to the CAN bus as soon as this has changed in the read head. However, a wait time of at least x ms must have passed since the last data packet. This can prevent bus overload. If x = 0 ms, no waiting time is taken into account. In this case, the maximum data rate to the CAN bus is approx. 1.5 ... 2 ms.

If the data in the read head does not change, it is sent to the CAN bus every y ms. Thus the control panel receives data even if the vehicle is stationary.

Synchronous

Switch position 7, see table below.

The read head sends data after the SYNC command from the control panel. The typical delay time after SYNC is 2 ms; the maximum delay time is 5 ms. By default, switch 1 - 3 = OFF, i.e., asynchronous data transfer 0 ms/10 ms.

Switch setting	DIP4-3	DIP4-2	DIP4-1	x ms/y ms
0	OFF	OFF	OFF	0 ms/10 ms
1	OFF	OFF	ON	5 ms/20 ms
2	OFF	ON	OFF	10 ms/50 ms
3	OFF	ON	ON	20 ms/50 ms
4	ON	OFF	OFF	Reserved
5	ON	OFF	ON	Reserved
6	ON	ON	OFF	Reserved
7	ON	ON	ON	SYNC mode

Data Protocols

Two data protocols are supported: CAN data protocol 1 and CAN data protocol 2.

The data protocols always have a length of 8 bytes. The data protocol is selected via the fourth switch of the 4-way DIP switch (1) on the PCB on the side of the read head.

DIP4-4 = OFF ... Can data protocol 1

DIP4-4 = ON ... CAN data protocol 2

6.3 Software Configuration

The read head is integrated into the network via an EDS file (electronic datasheet) with a project planning tool such as RSLogix 5000. The EDS file contains all information about device-specific parameters and operating modes.



Note

Downloading the EDS file

You can find the relevant EDS file in the **Software** section of the product detail page for the device.

To access the product detail page for the device, go to <http://www.pepperl-fuchs.com> and type e.g., the product description or the item number into the search function.

6.4 Data Protocols

Two data protocols are supported: data protocol 1 and data protocol 2.

The data protocols always have a length of 8 bytes. The data protocol is selected via the fourth switch of the 4-way DIP switch on the PCB on the side of the read head (see chapter 6.2).

- DIP4-4 = OFF ... CAN data protocol 1
- DIP4-4 = ON ... CAN data protocol 2

Data protocol 1

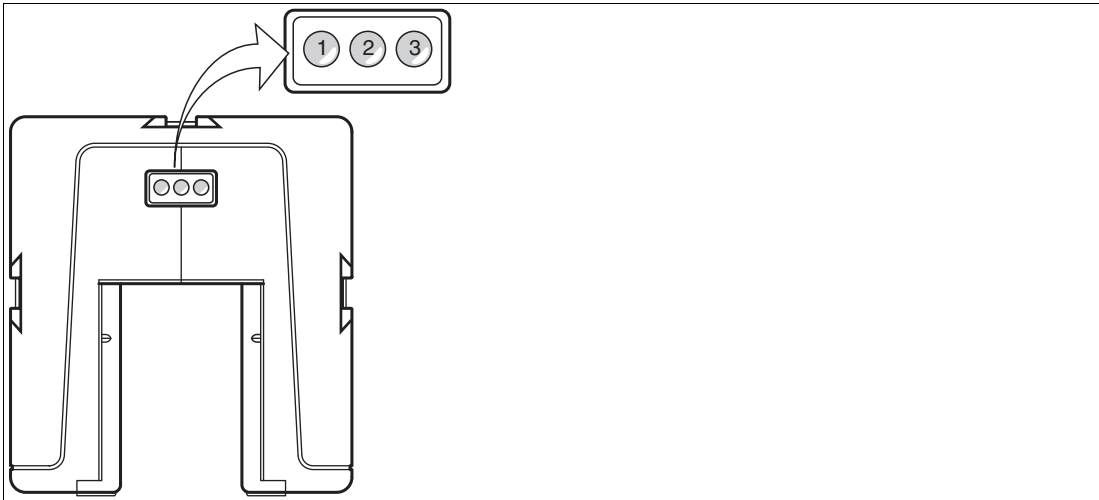
Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	0	0	0	0	0	P18	P17	P16
Byte 1	P15	P14	P13	P12	P11	P10	P09	P08
Byte 2	P07	P06	P05	P04	P03	P02	P01	P00
Byte 3	0	0	SST	DB	ERR	OUT	0	0
Byte 4	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	0	0	0	0	0	0	0
Byte 6	0	0	0	0	0	0	0	0
Byte 7	0	0	0	0	0	0	0	0

Data protocol 2

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	0	0	SST	DB	ERR	OUT	0	0
Byte 1	P07	P06	P05	P04	P03	P02	P01	P00
Byte 2	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	0	0	0	0	P18	P17	P16
Byte 4	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	0	0	0	0	0	0	0
Byte 6	0	0	0	0	0	0	0	0
Byte 7	0	0	0	0	0	0	0	0

6.5 LED Status Indication

WCS3B-LS4xx*



- 1 Green LED
- 2 Yellow LED
- 3 Red LED

Display

Operating indicator

Data flow indicator

Fault indicator

Contamination indicator

Function indicator

Meaning

Green LED: Power on

Yellow LED: Data transfer active

Red LED

Flashing: Read head outside the code rail
Permanently lit: Internal diagnostic error

Yellow LED and red LED flashing alternately: Read head lens dirty (f=1.5 Hz)

Yellow LED and red LED light up for 2 seconds after power on or reset

7 EtherNet/IP Interface (LS5xx*)

The read head communicates with the controller (e.g., PLC) via EtherNet/IP. An object-oriented fieldbus system for exchanging data between nodes based on Ethernet communications.

The basic properties of the interface are:

- Transfer rate 10 Mbit/s or 100 Mbit/s, half or full duplex operation
- Automatic negotiation of the transfer rate and the duplex method (auto negotiation)
- Automatic setting for crossed lines (auto crossover)

EtherNet/IP protocol works according to the CIP protocol (Common Industrial Protocol) and is used to control, configure, monitor, and collect data. Time-sensitive data exchange (implicit messaging) takes place using the UDP/IP protocol and non-time-sensitive data exchange (explicit messaging) using the TCP/IP protocol.

The read head supports the following features:

- "Listen only," "Input only," and "Exclusive Owner" connection types
- Message transmission as "Multipoint data transfer" (Multicast) and "Point-to-point data transfer" (Unicast)
- Cycle time (request packet interval) ≥ 2 ms
- Dynamic Host Configuration Protocol (DHCP)
- Address Conflict Detection (ACD)

7.1 Electrical Connection



Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

Connection diagram for WCS3B read head

The WCS3B-LS5* read head is connected to EtherNet/IP and the power supply via an 8-pin M12 socket with Y encryption.

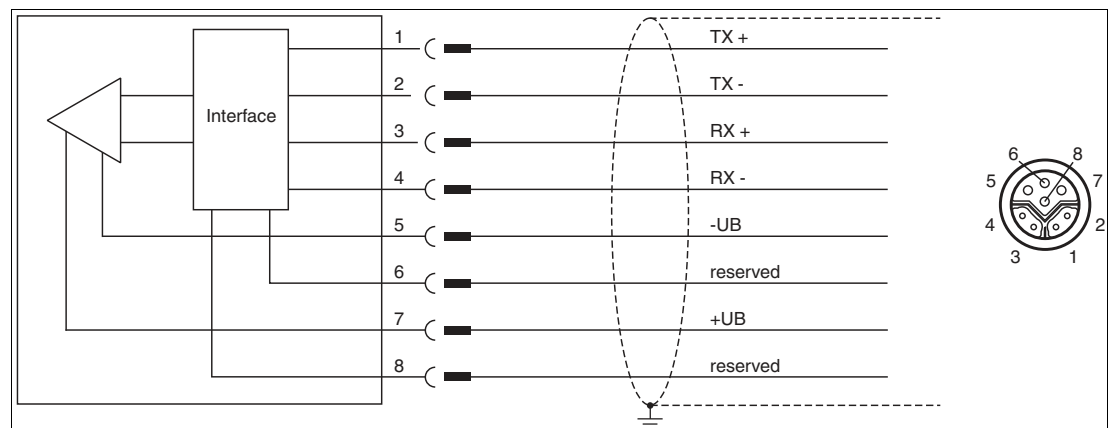


Figure 7.1 WCS3B, EtherNet/IP interface

Pins 6 and 8 are reserved for an internal interface and are connected to ground (-UB).



Note

A shielded twisted pair cable that meets at least the CAT 5e/CAT 6 specification is used to connect the read head to the control panel. The maximum recommended cable length is 75 m for CAT 5e and 55 m for CAT 6. Longer distances are possible provided that the respective specifications are observed. The connection can be implemented with various cable types available from Pepperl+Fuchs.

Y-splitter

There are various options available for the electrical connection. A hybrid cable (see chapter 12.1) with a common data and supply line can be connected directly to the read head. Alternatively, data and supply lines can be routed separately with the Y-splitter.

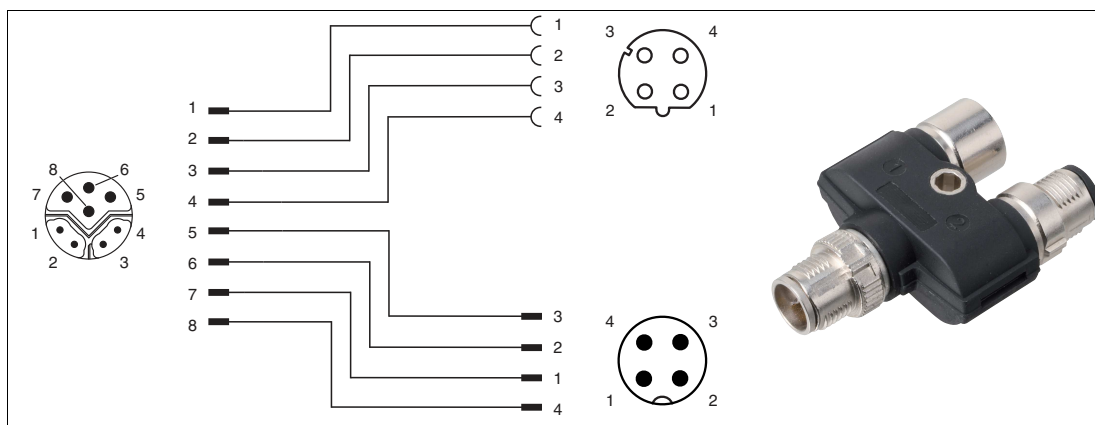


Figure 7.2 V19SY-Y-V1D/V1: Y-splitter, M12 plug Y-encoded to M12 plug A-encoded and M12 socket D-encoded

You can obtain the appropriate connectors and cables from Pepperl+Fuchs, see chapter 12.1.

7.2 Hardware Configuration

If you have a read head with the "Display" option, a DIP switch with two switches S1D (2) is installed. This DIP switch allows you to change the display. The 4-way DIP switch (1) in the figure below does not work. The firmware parameters of the read head are set via the corresponding project planning software.

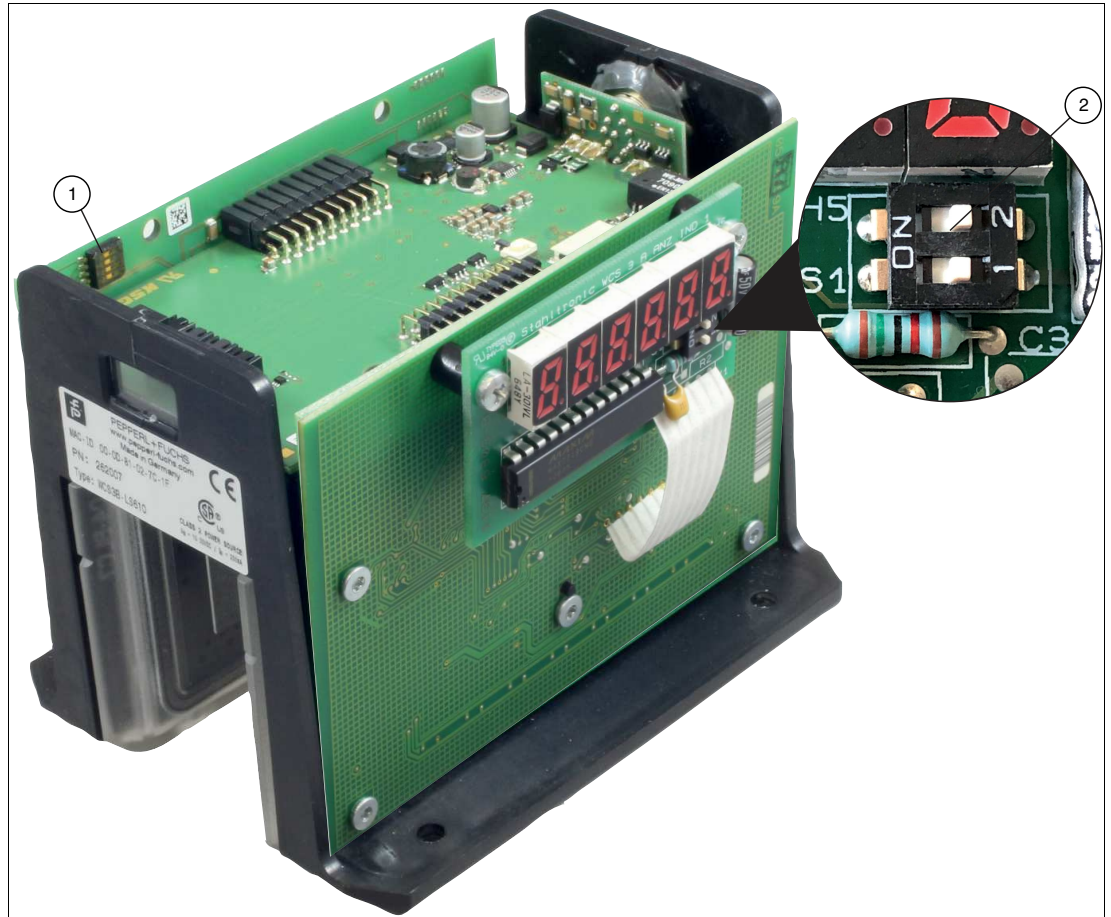


Figure 7.3 Configuration switch positions
 1. Configuration switch S1, 4-way (no function)
 2. Configuration switch S1D, 2-way (display)

Adjusting the Display

You can rotate the character position on the display 180° using the S1D DIP switch. This allows you to read the displayed values easily regardless of the installation position of the read head.

WCS3B			
Display position	Configuration switch "S1D"		Comment
	1	2	
0°	OFF	OFF	The displayed value can be read on a code rail mounted upright.
180°	ON	ON	The displayed value can be read on a code rail mounted suspended.

7.3 Software Configuration

The read head communicates with the control panel (e.g., PLC) via EtherNet/IP, an object-oriented fieldbus system for exchanging data between nodes based on Ethernet communications.

The read head is integrated into the network via an EDS file (electronic datasheet) with a project planning tool such as RSLOGIX5000. The EDS file contains all information about device-specific parameters and operating modes.

Note

Downloading the EDS file

You can find the relevant EDS file in the **Software** section of the product detail page for the device.

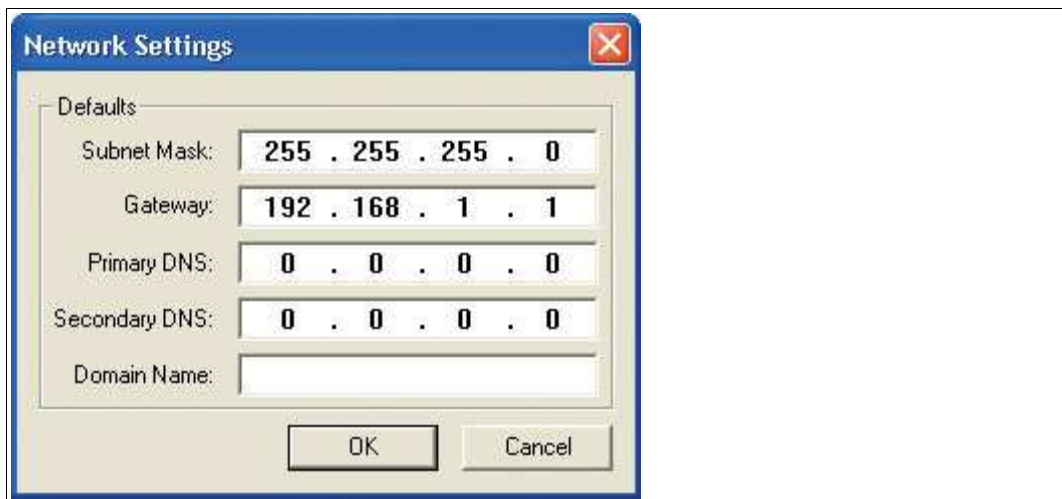
To access the product detail page for the device, go to <http://www.pepperl-fuchs.com> and type e.g., the product description or the item number into the search function.

Setting the IP address

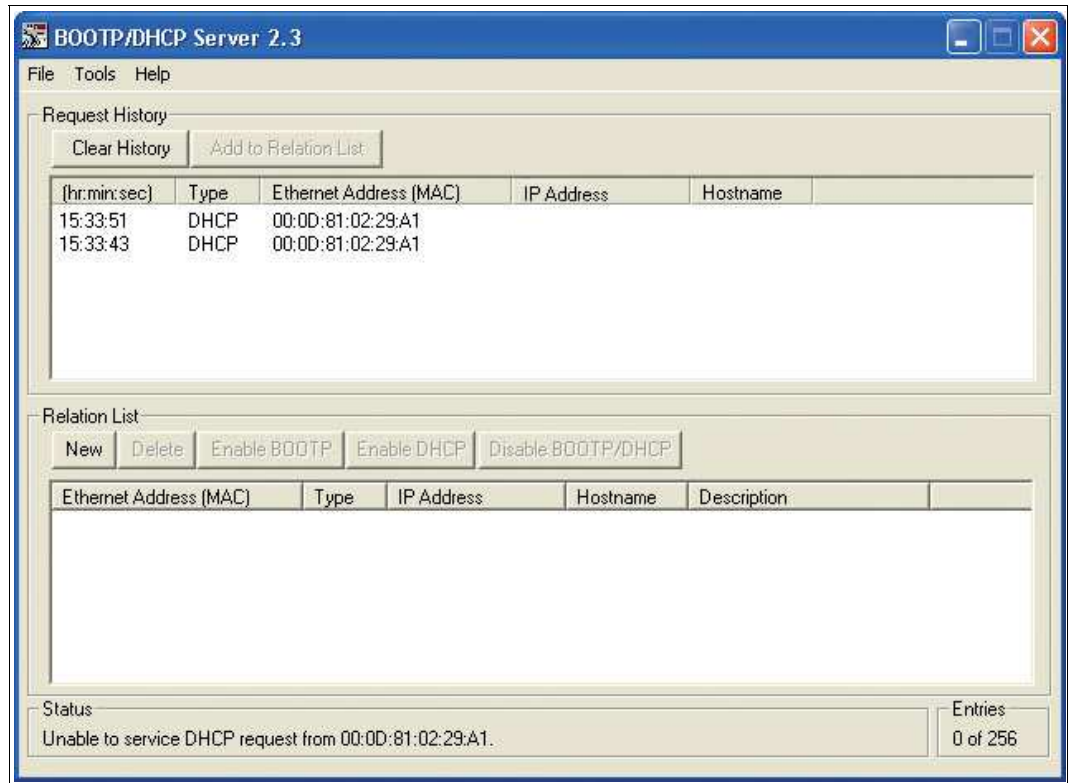
The read head is delivered in DHCP mode and waits for an address assignment from the control panel.

The following section describes the process of assigning an address via the **BOOT/DHCP Server** from Rockwell Automation as an example.

1. Connect the read head with the DHCP server.
2. Start the **BOOT/DHCP server** software.
3. Enter the following data in the **Network Settings** menu:
 - Subnet Mask "255.255.255.0"
 - Gateway "192.168.1.1"
 - The remaining fields are not filled in.

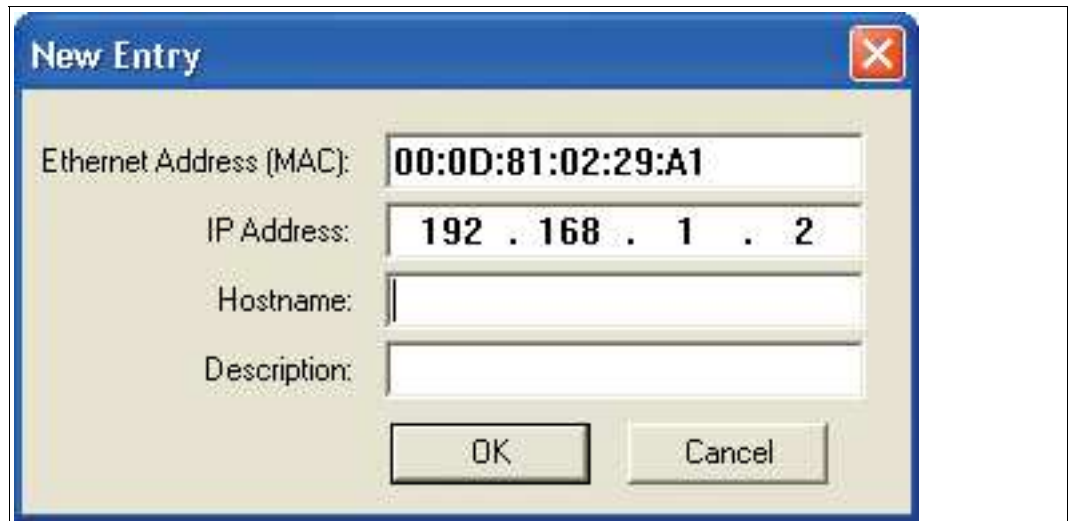


4. Switch on the supply voltage to the read head.



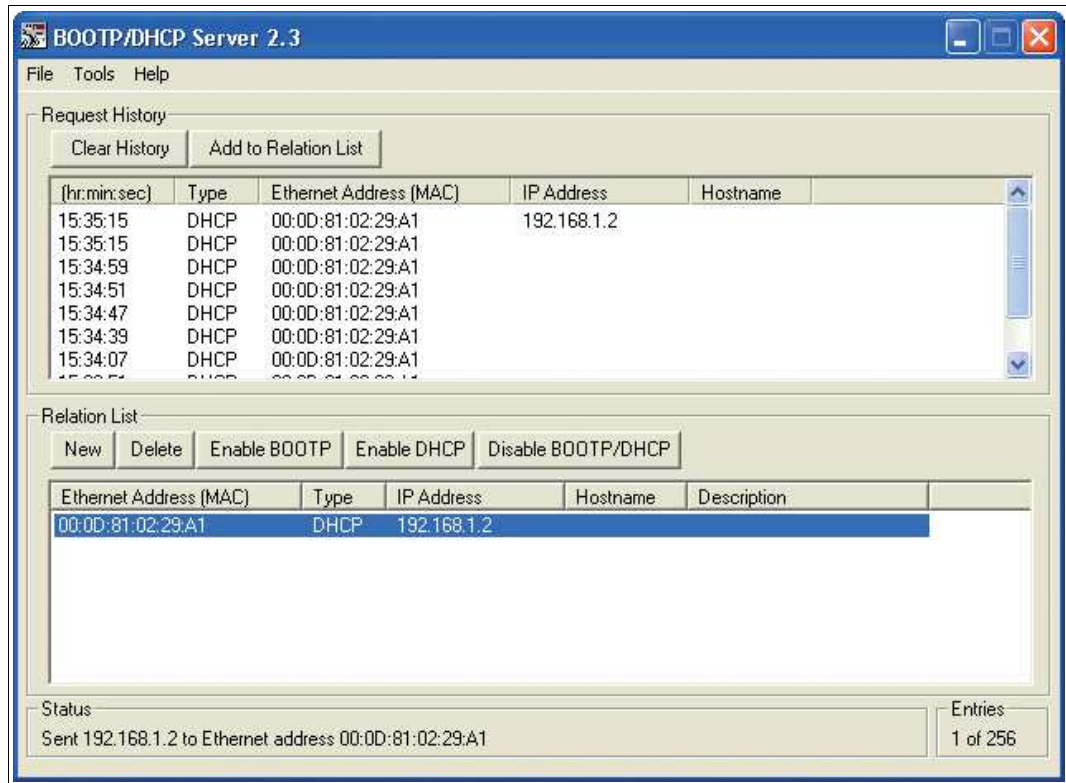
↳ The read head cyclically carries out DHCP requests. The MAC address of the read head is entered in the list in the **Request History** field.

5. Enter the desired IP address in the **New Entry** menu.
 - The software automatically adopts the MAC address of the read head.
 - The "hostname" function is not supported.
 - You may enter text under "Description."



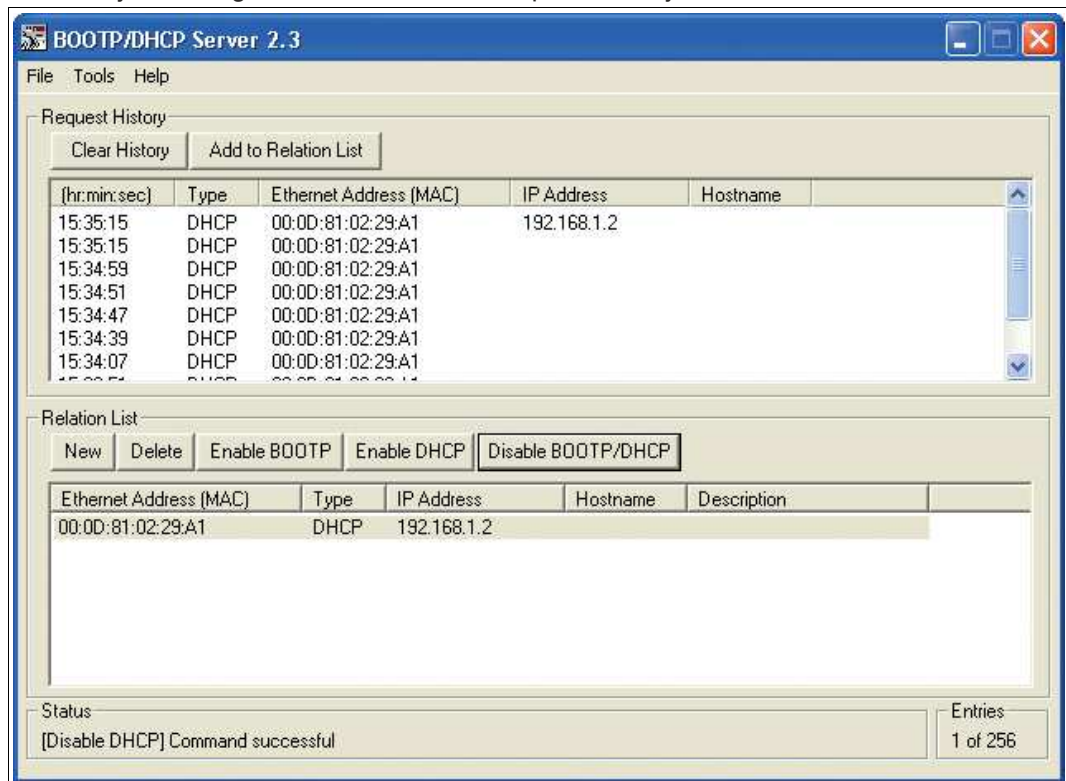
6. Confirm the entries of the address data using **OK**.

↳ The IP address is assigned to the read head on the next DHCP request. The new address data will be displayed in the **Relation List** field.



7. Press the **Disable BOOTP/DHCP** key in the **Relation List** field.

↳ In this way, the assigned IP address is saved permanently in the read head.



7.4 Data Protocols

EtherNet/IP objects

All the data and functions of the read head are defined via objects in accordance with the EtherNet/IP standards. The read head corresponds to the "Encoder Device Type 0x22" device profile.

The read head supports the following listed standard and product-specific classes.

Standard classes

Class ID	Class name
0x01	Identity Object
0x02	Message Router Object
0x04	Assembly Object
0x06	Connection Manager Object
0xF5	TCP/IP Interface Object
0xF6	Ethernet Link Object
0x48	Quality of Service

Product-specific class

Class ID	Class name
0x23	Position Sensor Object

The parameters are not directly addressable from the network with the "Set" or "Get" attribute services. Access is via assembly objects (Class Code 0x04)

Cyclic data communication with assembly objects (Class Code 0x04)

Assemblies are special CIP objects used for cyclic data communication (implicit messaging). These are composed of one or more attributes of various objects. These objects allow you to send or receive data from multiple objects via a connection. The composition of the assemblies in the read head is fixed and cannot be modified by the user.

Input assemblies

Instance no.	Description	Size [byte]	Attribute	Attribute ID	Data type
1	Position	4	Position Value Signed	10	DINT
100	Status, position, velocity, faults	7	Position Value Signed	10	DINT
			Status Word	100	USINT
			Velocity Value	101	USINT
			Error Value	102	USINT

Addresses required for the various connection types

The connection type defines the connection between the control system (originator), in this case the controls, and the target device (target), in this case the read head. The following options are available for data traffic.

Data from the control system to the target device

Instance no. (dec.)	Size [byte]	Connection type
192	0	Listen only
193	0	Input only

Data from the target device to the control system

Instance no. (dec.)	Size [byte]	Assemblies
1	4	Position
100	7	Status, position, velocity, faults

Attributes of the Position Sensor Object (Class ID 0x23)**Class attributes**

ID	Name	Access	Data type	Size [byte]	Description
1	Revision	-	UINT	2	Object inspection

Standard instance attributes for object 0x23

ID	Attribute	Access	Data type	Size [byte]	Description
10	Position Value Signed	-	DINT	4	Position value signed

The parameters are not directly addressable from the network with the "Set" or "Get" attribute services. You can change the parameters by using assemblies.

Specific read head attributes

ID	Attribute	Access	Data type	Size [byte]	Description
100	Status Word	-	USINT	1	Status information
101	Velocity	-	USINT	1	Velocity in dm/s
102	Error	-	USINT	1	Fault if content \neq 0

Basic data structure

1 byte = 8 bit value

Byte 4	Byte 3	Byte 2	Byte 1
Example: XP31 ... XP24 MSB (most significant byte)	Example: XP23 ... XP16	Example: XP15 ... XP08	Example: XP07 ... XP00 LSB (least significant byte)

Position data X: Position Value Signed (ID 10)

Size	Type	Content
4 byte consistent	Input data	32-bit X data LSB first LSB = least significant byte At a resolution of 0.8 mm: $L_{\max} = 314.5 \text{ m} = 314,500 \text{ mm}$

Data for attribute 10

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	XP07	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 2	XP15	XP14	XP13	XP12	XP11	XP10	XP09	XP08
Byte 3	XP23	XP22	XP21	XP20	XP19	XP18	XP17	XP16
Byte 4	XP31	XP30	XP29	XP28	XP27	XP26	XP25	XP24

Status: Status word (ID 100)

Size	Type	Content
1 byte	Input data	8 bit status

If the ERR bit is set, there is an error. The error number is transmitted to the "Error value (ID 102)" attribute.

Data for attribute 100

Bit no.	Content	Function
	Byte 1 Status	
1	ERR	Error message, error code in ERR00 – ERR07
2	OUT	Read head partially outside the code rail. No valid position available.
3	OUTALL	Read head completely outside the code rail.
4	DB	Diagnostic bit. Read head dirty.
5	SST	Speed status. If the speed status = 1 then the current velocity is unknown. The specified velocity value is invalid.
6	Reserved	-
7	Reserved	-
8	Reserved	-

Speed: velocity value (ID 101)

Size	Type	Content
1 byte consistent	Input data	8 bit speed data LSB first Information in dm/s

Data for attribute 101

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	SP07	SP06	SP05	SP04	SP03	SP02	SP01	SP00

Faults: error value (ID 102)

Size	Type	Content
1 byte consistent	Input data	8 bit fault data

Data for attribute 102

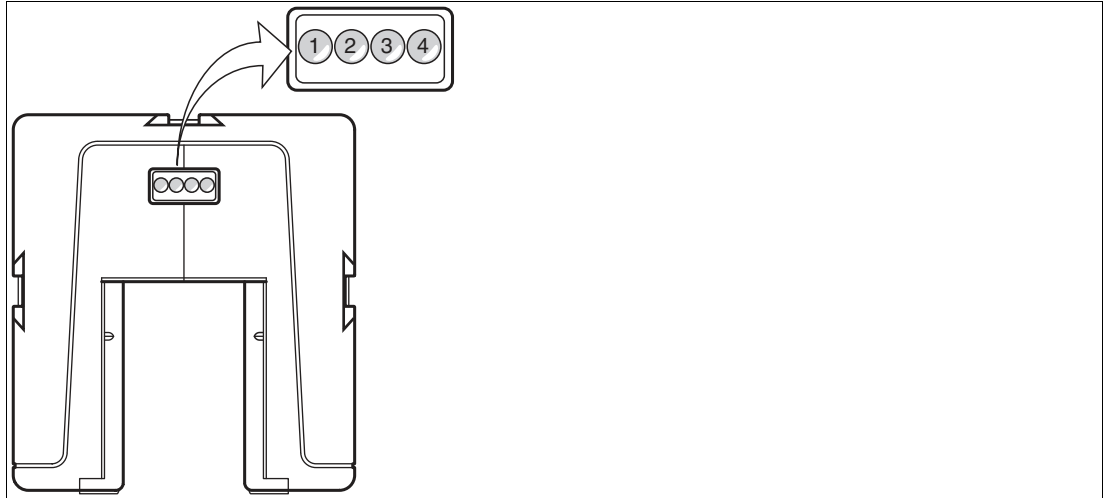
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	ERR7	ERR6	ERR5	ERR4	ERR3	ERR2	ERR1	ERR0

A binary encoded value in attribute 100 means that the corresponding fault is active.

Value	Content	Function
	Byte 1 Status	
0	Error 0	-
1	Error 1	Current position cannot be determined.
2	Error 2	Current position cannot be determined.
3	Error 3	Fault in the RAM working memory.
4	Error 4	Fault in the EPROM memory or in the decoder.
5	Error 5	Fault in the ROM memory.
6	Error 6	-
7	Error 7	-

7.5 LED Status Indication

WCS3B-LS5xx*



- 1 Dual red/green LED
- 2 Green LED
- 3 Yellow LED
- 4 Red LED

Display

Status indicator

Ethernet link

Ethernet RX/TX

Ethernet communication

Meaning

Dual red/green LED
 Green: Code rail detected, normal function
 Red: System error
 Flashing red: No code rail detected

Green LED
 On: Fieldbus connection OK

Yellow LED
 Flashing: Data transfer

Red LED
 On: Communication error

8 PROFINET Interface (LS6xx*)

The WCS3B-LS6xx* read heads are PROFINET I/O devices that communicate cyclically with the assigned PROFINET I/O controller during operation.

The PROFINET interface of the WCS3B-LS6xx* read heads supports:

- A transfer rate of 100 Mbit/s
- The real-time category RT
- The range of functions in accordance with **Conformance Class B**
- The identification and maintenance functions (I&M) IM0 – IM4

8.1 Electrical Connection



Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

Connection diagram for WCS3B read head

The WCS3B-LS6* read head is connected to PROFINET and the power supply via an 8-pin M12 socket with Y encryption.

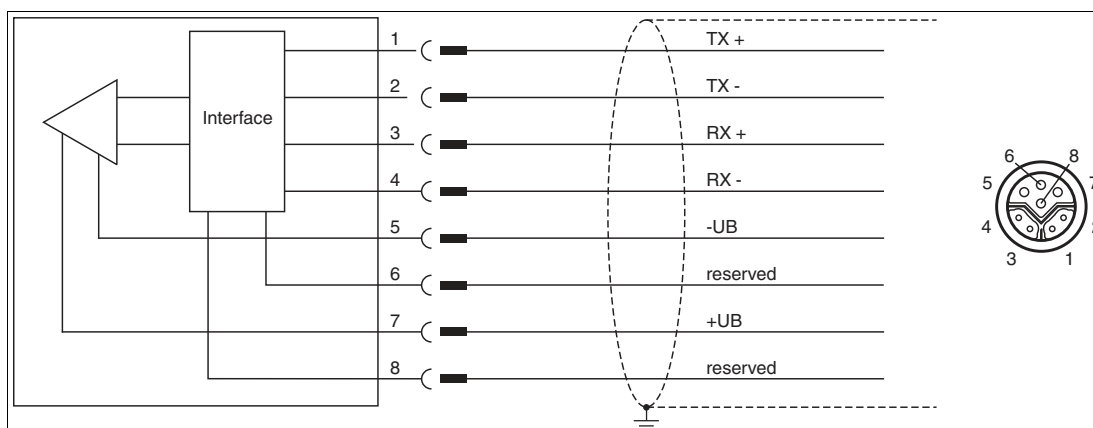


Figure 8.1 WCS3B, PROFINET interface

Pins 6 and 8 are reserved for an internal interface and are connected to ground (-UB).

Note

A shielded twisted pair cable that meets at least the CAT 5e/CAT 6 specification is used to connect the read head to the control panel. The maximum recommended cable length is 75 m for CAT 5e and 55 m for CAT 6. Longer distances are possible provided that the respective specifications are observed. The connection can be implemented with various cable connections available from Pepperl+Fuchs.

Y-splitter

There are various options available for the electrical connection. A hybrid cable (see chapter 12.1) with a common data and supply line can be connected directly to the read head. Alternatively, data and supply lines can be routed separately with the Y-splitter.

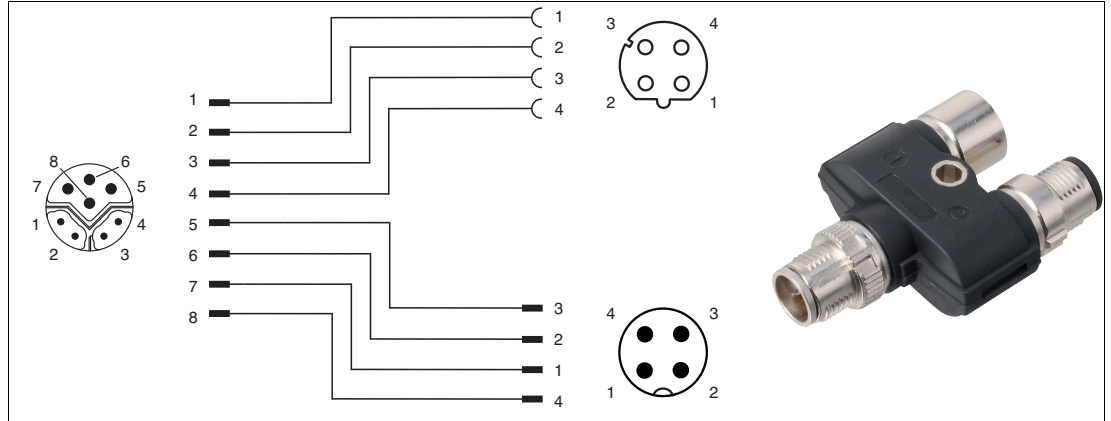


Figure 8.2 V19SY-Y-V1D/V1: Y-splitter, M12 plug Y-encoded to M12 plug A-encoded and M12 socket D-encoded

You can obtain the appropriate connectors and cables from Pepperl+Fuchs, see chapter 12.1.

8.2 Hardware Configuration

If you have a read head with the "Display" option, a DIP switch with two switches S1D (2) is installed. This DIP switch allows you to change the display. The 4-way DIP switch (1) in the figure below does not work. The firmware parameters of the read head are set via the corresponding project planning software.

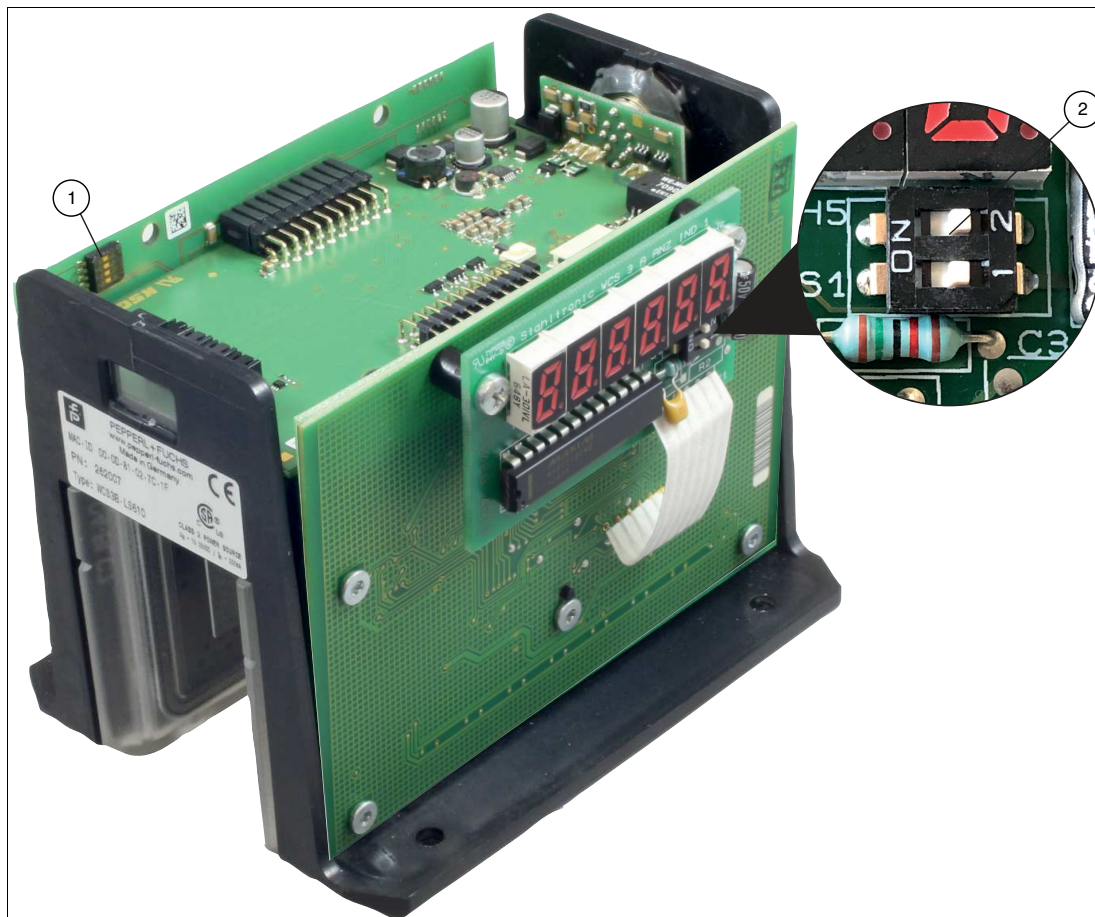


Figure 8.3 Configuration switch positions
 1. Configuration switch S1, 4-way (no function)
 2. Configuration switch S1D, 2-way (display)

Adjusting the Display

You can rotate the character position on the display 180° using the S1D DIP switch. This allows you to read the displayed values easily regardless of the installation position of the read head.

WCS3B			
Display position	Configuration switch "S1D"		Comment
	1	2	
0°	OFF	OFF	The displayed value can be read on a code rail mounted upright.
180°	ON	ON	The displayed value can be read on a code rail mounted suspended.

8.3 Software Configuration

PROFINET is an open standard for industrial automation based on industrial Ethernet. PROFINET integrates information technology with established standards such as TCP/IP and XML in automation technology.

Within PROFINET, PROFINET IO is the communication concept for the construction of decentralized applications. This means that read heads are integrated through PROFINET IO. The familiar IO view of PROFIBUS DP is used where the usable data of the read heads is transferred to the process image of the control panel in cycles. PROFINET IO is a device model consisting of slots and channels, which is based on the main features of PROFIBUS DP. The properties of the read heads are written in a Generic Station Description Markup Language (GSDML) based on XML. PROFINET IO is engineered in such a way that the read heads are assigned to a control panel in project planning.

PROFINET IO distinguishes between the following three device types:

- IO controller: Controller that executes the automation program.
- IO device: Decentrally assigned field device that is assigned to an IO controller.
- IO supervisor: Programming unit/PC with commissioning and diagnostic functions.

The read head functions as a PROFINET I/O device that communicates cyclically with the assigned PROFINET I/O controller during operation.

Project planning using device description

The read head is integrated into the project planning tool by way of a device description. The field device properties are described in the GSDML file. The GSDML file contains the data of the field device that you need to operate the device in a PROFINET network. You import the GSDML file into a project planning tool that you use to configure the read head settings. Once project planning is complete, the control panel receives the project planning data and configuration data.

Downloading the GSDML file

You can find the relevant GSDML file in the **Software** section of the product detail page for the device.

To access the product detail page for the device, go to <http://www.pepperl-fuchs.com> and type e.g., the product description or the item number into the search function.

PROFINET address and identifying a device

Every read head has a unique device identification. This device identification consists of the following:

- A unique **MAC address**. This MAC address is printed on the back of the device.
- A **device name**. The default device name is `wcs3b-1s610`.
- An **IP address**. The default IP address is `192.168.2.2`.



Identification & maintenance—calling up and editing data

Identification & maintenance data (I&M data) is information stored in a device. I&M data uniquely identifies a device within a plant. The identification data (I data) includes information about the device, for example the item number and device name. Identification data cannot be changed.

Maintenance data (M data) includes information about the device within the plant, for example the installation location and installation date. Maintenance data is initially stored in the device during installation. Maintenance data can be changed.

The Step7 software from Siemens can be used to display and change the I&M data.

1. To do so, open the hardware configuration **HW Config** and call up the "Target system" menu.
2. Open one of the following functions:
 - "Download module identification"
 - "Download module identification in PG"

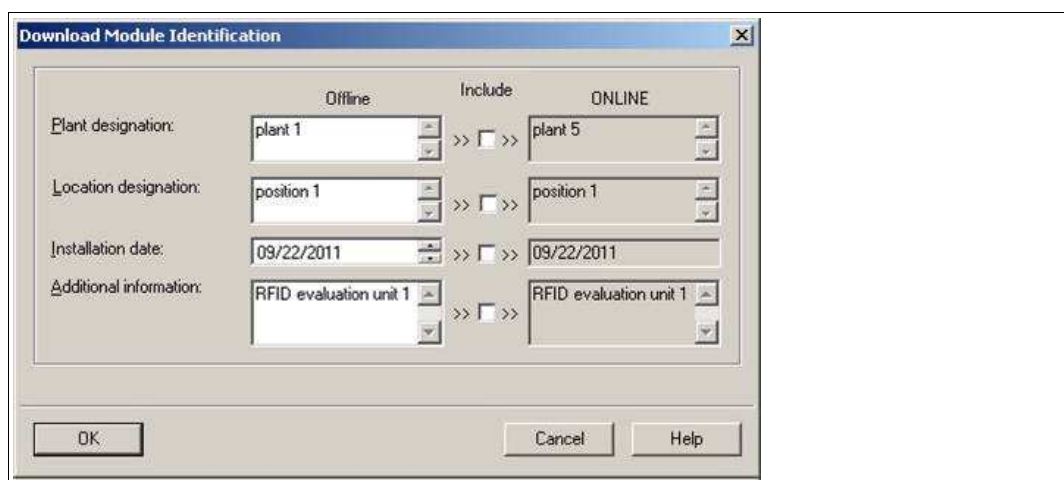


Figure 8.4

3. Depending on the requirement, read or edit the following I&M data:
 - I&M data 1: plant designation, location designation
 - I&M data 2: installation date
 - I&M data 3: additional information

8.4 Data Protocols

The WCS3B-LS6xx* read heads are PROFINET I/O devices that communicate cyclically with the assigned PROFINET I/O controller during operation.

The PROFINET interface of the WCS3B-LS6xx* read heads supports:

- A transfer rate of 100 Mbit/s
- The real-time category RT
- The range of functions in accordance with **Conformance Class B**
- The identification and maintenance functions (I&M) IM0 – IM4

Modules with response telegram

The following modules enable read head data to be retrieved using PROFINET.

Position Data X Module

Size	Type	Content
2 words, consistent	Input data	32-bit X data MSB first MSB = most significant byte Resolution: 0.8 mm, binary coded $L_{\max} = 314.5 \text{ m} = 314500 \text{ mm}$

Response

Bit no.	Content	
	Word 1 X data	Word 2 X data
1	XP16	XP00
2	XP17	XP01
3	XP18	XP02
4	0	XP03
5	0	XP04
6	0	XP05
7	0	XP06
8	0	XP07
9	0	XP08
10	0	XP09
11	0	XP10
12	0	XP11
13	0	XP12
14	0	XP13
15	0	XP14
16	0	XP15

Speed data module

Size	Type	Content
1 byte	Input data	8 bit speed data Resolution: 0.1 m/s, binary coded Speed of 0 ... 12.5 m/s Example: Speed = 4.7 m/s --> speed output = 47 with resolution 0.1 m/s 126 for speed > 12.5 m/s 127 for unknown speed

Response

Bit no.	Content
	Word 1 Speed
1	SP00
2	SP01
3	SP02
4	SP03
5	SP04
6	SP05
7	SP06
8	SP07

Error message module

Size	Type	Content
1 byte	Input data	8 bit numerical value ERR message from 0 ... 7 Example: ERR message = 00000001 = Error 1 Error 1 corresponds to "Current position cannot be determined"

ERR messages

Error	Content	Function
	Byte 1 Status	
0	ERR00	-
1	ERR01	Current position cannot be determined
2	ERR02	Current position cannot be determined
3	ERR03	Fault in the working memory (RAM)
4	ERR04	Fault in the EPROM memory or in the decoder
5	ERR05	Fault in the ROM memory
6	ERR06	-
7	ERR07	-

Status module

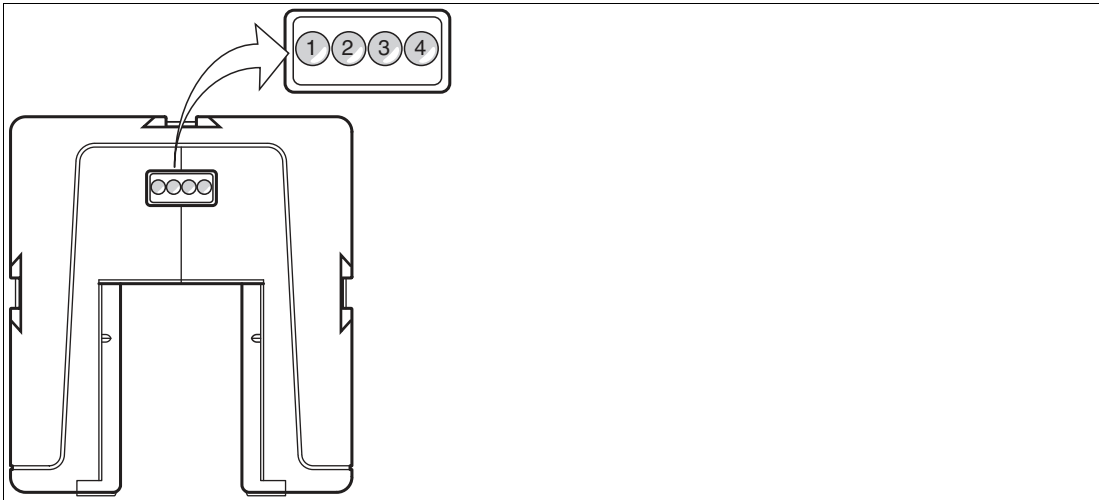
Size	Type	Content
1 byte	Input data	8 bit status

Response

Bit no.	Content	Function
	Byte 1 Status	
1	ERR	Error message, see error codes ERR00 – ERR07
2	OUT	Read head partially outside the code rail. No valid position available.
3	OUTALL	Read head completely outside the code rail.
4	DB	Diagnostic bit. Read head dirty.
5	SST	Speed status
6	Reserved	-
7	Reserved	-
8	Reserved	-

8.5 LED Status Indication

WCS3B-LS6xx*



- 1 Dual red/green LED
- 2 Green LED
- 3 Yellow LED
- 4 Red LED

Display

Status indicator

Ethernet link

Ethernet RX/TX

Ethernet communication

Meaning

Dual red/green LED
 Green: Code rail detected, normal function
 Red: System error
 Flashing red: No code rail detected

Green LED
 On: Fieldbus connection OK

Yellow LED
 Flashing: Data transfer

Red LED
 On: Communication error

9 Options and Special Functions

9.1 Option D—Integrated Display in the Read Head, Type LS...D

Integrated Display Module

The WCS3B reader can be equipped with an optional display module or can be retrofitted at the factory. During the reader's movements, the display module reports the current position value and any error messages. If the reader has been stationary for more than 15 seconds, the display module issues additional diagnostics data alternately with the position value in a rotating cycle. (See the WCS catalog).

You can rotate the character position on the display 180° using the S1D DIP switch. This allows you to read the displayed values easily regardless of the installation position of the reader.

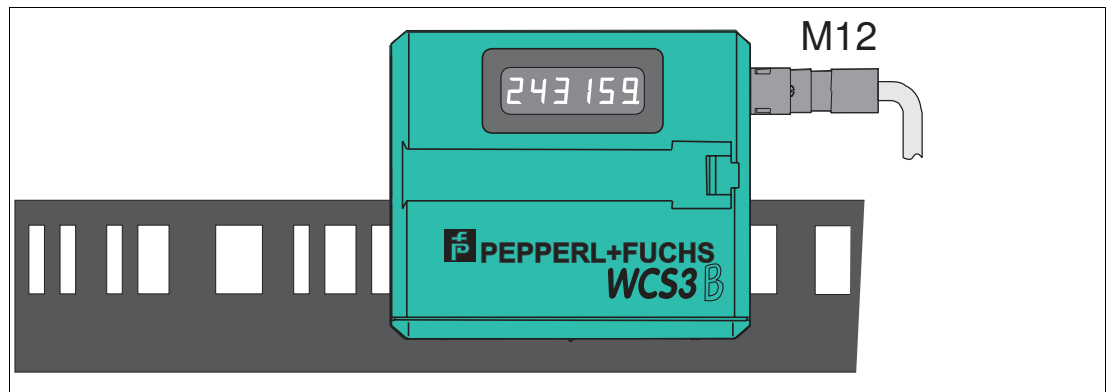


Figure 9.1 Display for a perpendicular code rail (position 0°)

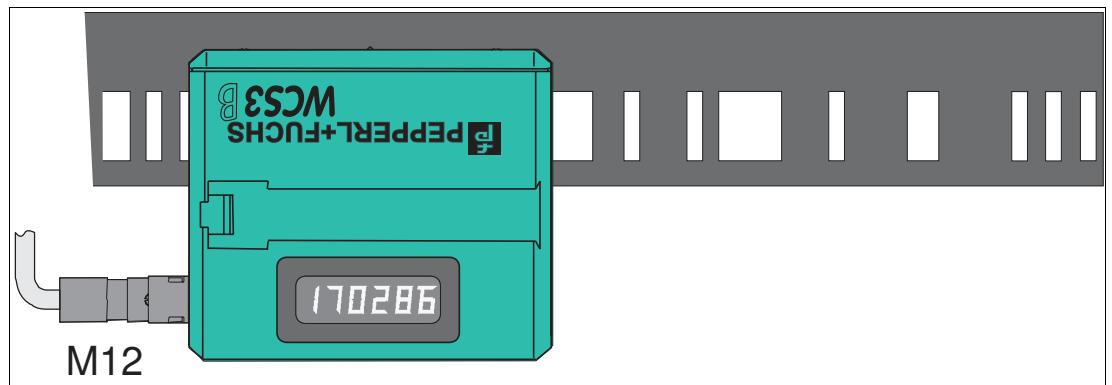


Figure 9.2 Display for a suspended code rail (position 180°)

Adjusting the display with configuration switch S1D

Display position	S1D		Comment
	1	2	
0°	OFF	OFF	The displayed value can be read on a code rail mounted upright.
180°	ON	ON	The displayed value can be read on a code rail mounted suspended.

Note

The set display position is not noted on the nameplate of the read head.



Overview of the display module

The display shows the current position value. After switching on the read head, the following information is displayed in sequence:

read head type, e.g., "LS-221"

read head address, e.g., "Addr 0"

software version, e.g., "Pr. 1.01"

When at a standstill, the read head switches to the "information display" mode. The following data is displayed cyclically:

"12.34.56," internal clock (hh.mm.ss)

"Good" or "bad"

Condition of the lens/photoelectrics:

"LE - - -," No error message

"LE 1," Read head has detected error 1

"Lo ---," Read head was not outside the code rail

"Lo 34," Read head was outside the code rail 34 times

"LS ---," Limit speed has not been exceeded

"LS 128," Limit speed was exceeded 128 times (only for read head with option "velocity output")



Note

All values are reset after the voltage is switched on. The maximum time is 99:59:59, then the time starts again at 00:00:00. The maximum counter values for Lo and LS are 255.

9.2 Option-E—Extended, Type WCS3B-LS2*E*, RS-485

The read head **WCS3-Extended: WCS3B-LS*E*** with RS-485 interface is used for routes of more than 314.573 m. In this case, the additional "E" in the type code identifies the extended version for the extending code rail. Two standard code rail segments with a length of 0 ... 314.573 m are connected to each other with the WCS3-CS70-E code rail extender to achieve a maximum code rail length of up to 629.146 m. The first code rail segment must always be complete, or end with the position at 314.573 m. The second code rail segment can have a shorter length of 314.573 m to X m, but must be used in descending position, starting at 314.573 m.

Extended data protocol with position output

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	0	1	1	0	0	1	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	A1	A0	OVL	/VAL	DB	OUT ALL	OUT	ERR
Byte 2	0	0	0	0	0	XP19	XP18	XP17	XP16
Byte 3	0	XP15	XP14	XP13	XP12	XP11	XP10	XP09	XP08
Byte 4	0	XP07	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 5	0	xor B1.7..B4 .7	xor B1.6..B4 .6	xor B1.5..B4 .5	xor B1.4..B4 .4	xor B1.3..B4 .3	xor B1.2..B4 .2	xor B1.1..B4 .1	xor B1.0..B4 .0

Data protocol with position and velocity output

Request byte for read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	1	1	1	1	0	0	1	A1	A0

Response telegram from the read head									
Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	0	A1	A0	OVL	/VAL	DB	OUT ALL	OUT	ERR
Byte 2	0	0	0	0	0	XP19	XP18	XP17	XP16
Byte 3	0	XP15	XP14	XP13	XP12	XP11	XP10	XP09	XP08
Byte 4	0	XP07	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 5	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 6	0	B1.7..B5 .7	B1.6..B5 .6	1.5..B5.5 .5	B1.4..B5 .4	B1.3..B5 .3	B1.2..B5 .2	B1.1..B5 .1	B1.0..B5 .0

Description of the protocol data

Byte 1

A1, A0		Address bits of the read head. Addresses 0 ... 3, binary coding
OVL	0	The read head is located in the readable area of the code rail
	1	The read head is located on WCS3 code rail extender (overlapping area of the code rail segments)
VAL	0:	Position valid
	1	Position invalid; code rail area is not unique after the supply voltage has been connected
DB	0	By default, the diagnostic bit is not set
	1	Diagnostic bit, read head dirty
OUT ALL	0	Read head in code rail
	1	Read head completely outside of the code rail
OUT	0	Read head in code rail
	1	Read head partially outside the code rail. No valid position available
ERR	0	No error
	1	Error message (possible errors in XP00 ... XP01 binary coding)

Byte 2 ... 4

XP00 ... XP19 Current position value, binary coding

Byte 5 ¹

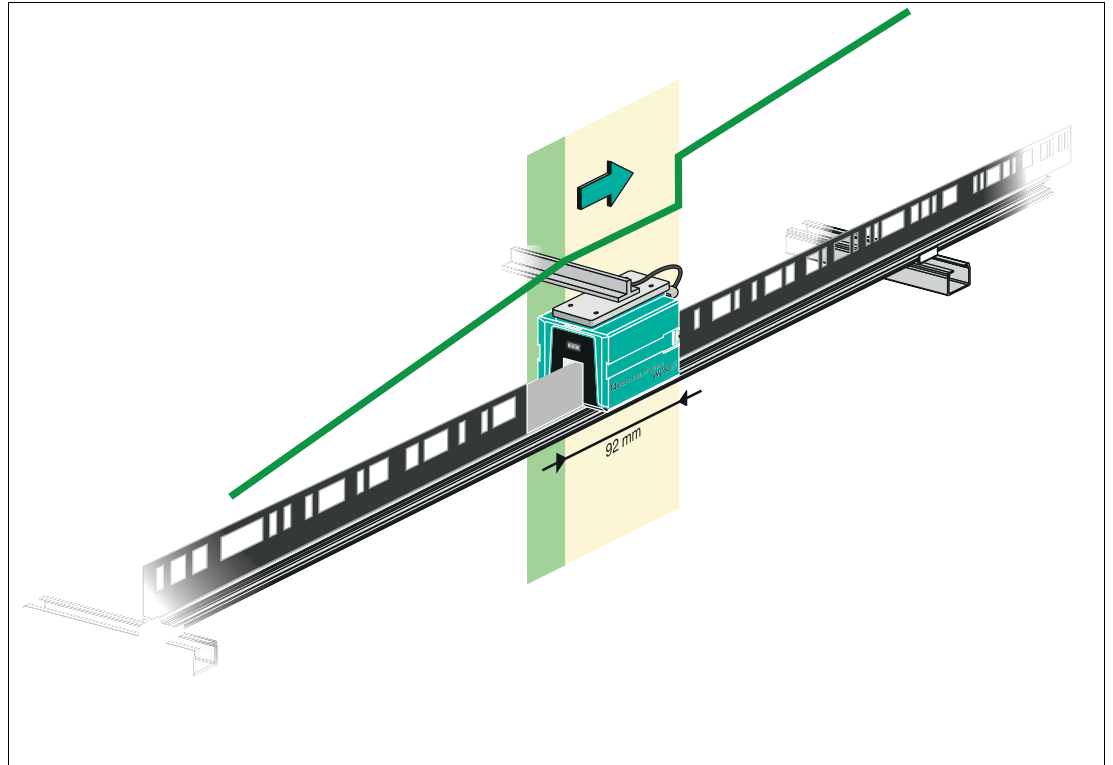
SP0 ... SP6		Current speed in 0.1 m/s, binary coding Example: <ul style="list-style-type: none"> • 1: Speed = 0.1 m/s • 37: Speed = 3.7 m/s • 112: Speed = 11.2 m/s
SST	0	Speed valid
	1	Current speed unknown. Last valid speed in SP0 ... SP6 saved

Byte 5/6 Exclusive or link, byte 1 ... Byte 4/5

1. For data protocol with velocity output

Behavior of the read head in the area of the WCS3 code rail extender (WCS3-CS70-E)

The read head retains the last measured end position of the first code rail segment (position = 393203) when traversing the WCS3 code rail extender. The OVL bit is set at the same time. As soon as the first valid position of the second code rail segment is read, the read head switches to the first valid position of the second code rail segment (position = 393318). The first valid position of the second code rail segment is dimensioned with an offset of approx. + 92 mm (see area highlighted in yellow in the figure below).



Caution!

Impermissible state

If you mount the WCS3 code rail extender in the wrong position, e.g., at an intermediate position of the code rail, the OUT bit is set when this code rail segment is crossed.



Note

Cycle time

Note that the cycle time for the extended variant differs from the standard variant by $t = 10$ ms.

Start-up behavior of the read head

After the supply voltage has been connected, the X position is set to the last valid X position and the VAL bit is set to 1.

The speed value is 127 and the SST bit is set to 1.

After the read head moves by approx. 5 mm, the VAL bit is set to 0 and the X position is assigned a new calculated X position. The last valid X position is stored in a non-volatile memory if it is detected that the voltage is switched off ($+U_b < 9.9$ VDC).

9.3 Option-H—Heating in Read Head, Type LS...H

For applications with a risk of condensation (quick temperature change from cold to hot, high relative humidity), the WCS read head can be equipped with an optional **heater**. The heating is supplied via the read head, i.e., no additional electrical connection is required for the heating. Ensure that the cross section of the supply line to the read head is sufficiently dimensioned.

The **heater** is switched on immediately after the voltage is connected to the read head. The power consumption is 7 VA for the WCS2B and 9 VA for the WCS3B. The WCS3B heater uses a regulator that automatically switches off the heater at a temperature above 60 °C, measured at the transparent protective lenses of the read head.

With the **heater** option, the read head can be used in the temperature range of -40 °C ... 60 °C.

9.4 Option-S—Velocity Output, Type LS...S

The WCS3B read head with velocity output features an additional 24 VDC output, which transmits a signal in the event that a limit speed is exceeded. The limit speed can be configured on the 4-way DIP switch in the read head. The limit speed is set to 0.7 m/s on delivery.

Setting the limit speed (option -S only)

Limit speed v_{limit}	S1			
	1	2	3	4
0.7 m/s	X	X	OFF	OFF
2.0 m/s	X	X	OFF	ON
3.0 m/s	X	X	ON	OFF
4.0 m/s	X	X	ON	ON

The limit speed is output digitally via pin 5 of the 5-pin M12 connector:

U_v (pin 5) = operating voltage U_B --> $v_{\text{current}} < v_{\text{limit}}$

U_v (pin 5) = floating (high impedance) --> $v_{\text{current}} \geq v_{\text{limit}}$



Note

LED status indicator on the WCS3B read head with velocity output

The WCS3B read head has three LEDs on the front. The meaning of the yellow LED is changed according to the speed setting.

Illuminated yellow: Limit speed not exceeded

Not illuminated yellow: Limit speed exceeded

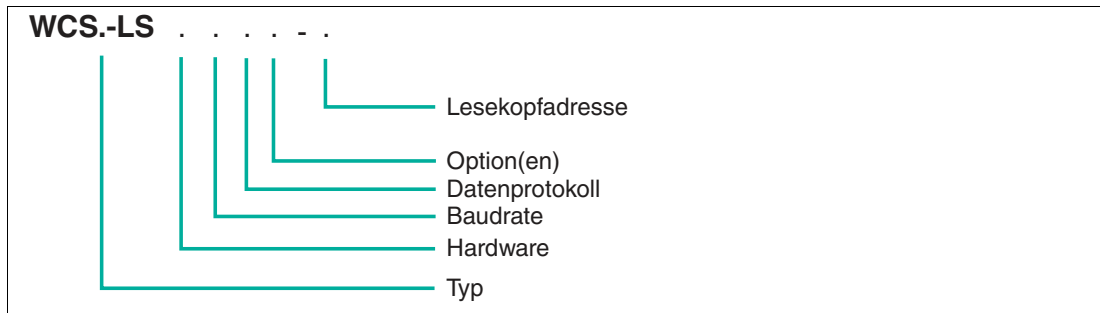
Flashing red: Read head outside the code rail or read head dirty



Note

The set limit speed is not noted on the nameplate of the read head.

10 Model Overview for WCS Read Heads



Type	2B	WCS2B read head (smaller enclosure, 1200 pos./m with a maximum of 327 m)
	3B	WCS3B read head (1250 pos./m with a maximum of 314.573 m)
	3R	WCS3R read head (833 pos./m with a maximum of 39.3 m)
	3T	WCS3T read head (416 pos./m with a maximum of 78.6 m)

Hardware	1	Read head with RS-485 interface, no RS-485 terminator
	2	Read head with RS-485 interface, with RS-485 terminator
	3	Read head with SSI interface
	4	Read head with CANopen interface
	5	Read head with EtherNet/IP interface
	6	Read head with PROFINET Interface

Baud rate	Read head with RS-485 interface	
	1	187.50 kBaud
	2	62.50 kBaud
	3	31.25 kBaud
	4	19.20 kBaud
	5	9.60 kBaud
	6	38.40 kBaud
	Read head with SSI interface	
	1	100 kHz – 1000 kHz
	Read head with CANopen interface	
	1	125 kBaud, 250 kBaud, 500 kBaud, 1 MBaud
	Read head with EtherNet/IP interface	
	1	100 Mbit/s
	Read head with PROFINET Interface	
	1	100 Mbit/s

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Data log	Read head with RS-485 interface	
	1	Data log 1, data log 2 ¹
	6	Data log 3 with even parity (9 bit/byte)
	7	Data log 3 without parity (8 bit/byte)
	Read head with SSI interface	
	0	Data output in binary code
	1	Data output in Gray code
	Read head with a CANopen, EtherNet/IP, and PROFINET interface	
	0	Data output in binary code

1. Data log depends on read head request byte

Option	D	Read head with optional integrated display
	E	Read head with "Extended" option
	H	Read head with optional heating
	S	Read head with optional velocity output
	OM	Read head with "Outdoor" option (IP69K) and central cable outlet
	OL	Read head with "Outdoor" option (IP69K) and left-hand-side cable outlet
	OR	Read head with "Outdoor" option (IP69K), and right-hand-side cable outlet

Read head address	Read head with RS-485 interface	
	0	Read head address 0
	1	Read head address 1
	2	Read head address 2
	3	Read head address 3
	-	Read head address 0

11 Disposal

The device, built-in components, packaging, and any batteries contained within must be disposed in compliance with the applicable laws and guidelines of the respective country.

12 Appendix

12.1 Cable Overview

The cable types listed below represent a selection of the types offered by Pepperl+Fuchs. Further cable types can be found on our website.



Note

For cables that you can assemble yourself, observe the cable length restrictions specified by the interface specification. In the respective interface chapters you will find recommendations for the maximum cable length.

RS-485 (LS1xx*, LS2xx*)

Cable	Description
Pre-configured cable	
V15-G-2M-PUR-ABG	M12 single-ended female cordset, five-pins, straight, 2 m PUR cable, shielded,
V15-G-5M-PUR-ABG	M12 single-ended female cordset, five-pins, straight, 5 m PUR cable, shielded,
V15-G-10M-PUR-ABG	M12 single-ended female cordset, five-pins, straight, 10 m PUR cable, shielded,
Configurable female cordset and meter goods	
V15-G-ABG-PG9	Five-pin single-ended female cordset, field attachable, shielded
V15-G-ABG-PG9-FE	Five-pin single-ended female cordset, field attachable, shielded with grounding terminal
WCS-DCS	Available by the meter, six-pin data cable + shield, 0.14 mm ² 3 x 2 twisted wire pair
WCS-DCF	Available by the meter, six-pin data cable + shield, 0.25 mm ² 3 x 2 twisted wire pair, suitable for drag chains

SSI (LS3xx*)

Cable	Description
Pre-configured cable	
V19-G-2M-PUR-ABG	M12 single-ended female cordset, eight-pin, straight, 2 m PUR cable, shielded,
V19-G-5M-PUR-ABG	M12 single-ended female cordset, eight-pin, straight, 5 m PUR cable, shielded,
V19-G-10M-PUR-ABG	M12 single-ended female cordset, eight-pin, straight, 10 m PUR cable, shielded,
V19-G-2M-PVC-TP	Female cordset, M12, eight-pin, shielded, 2 m PVC cable Shielded twisted pair
V19-G-5M-PVC-TP	Female cordset, M12, eight-pin, shielded, 5 m PVC cable Shielded twisted pair
V19-G-10M-PVC-TP	Female cordset, M12, eight-pin, shielded, 10 m PVC cable Shielded twisted pair
Configurable female cordset and meter goods	
V19-G-ABG-PG9	Eight-pin single-ended female cordset, field attachable, shielded
V19-G-ABG-PG9-FE	Eight-pin single-ended female cordset, field attachable, shielded with grounding terminal
WCS-DCS	Available by the meter, six-pin data cable + shield, 0.14 mm ² 3 x 2 twisted wire pair
WCS-DCF	Available by the meter, six-pin data cable + shield, 0.25 mm ² 3 x 2 twisted wire pair, suitable for drag chains

CANopen (LS4xx*)

Cable	Description
Pre-configured cable	
V15-G-2M-PUR-CAN	CANopen bus cable, M12, 2 m PUR cable, five-pin
V15-G-2M-PUR-CAN-V15-G	CANopen bus cable, M12 to M12, 2 m PUR cable, five-pin
V15-G-5M-PUR-CAN-V15-G	CANopen bus cable, M12 to M12, 5 m PUR cable, five-pin
V15-G-10M-PUR-CAN-V15-G	CANopen bus cable, M12 to M12, 10 m PUR cable, five-pin
Configurable female cordset and meter goods	
V15-G-ABG-PG9-FE	Female connector, M12, five-pin, shielded, field attachable
WCS-DCS	Available by the meter, six-pin data cable + shield, 0.14 mm ² 3 x 2 twisted wire pair
WCS-DCF	Available by the meter, six-pin data cable + shield, 0.25 mm ² 3 x 2 twisted wire pair, suitable for drag chains

EtherNet/IP (LS5xx*) & PROFINET (LS6xx*)

Cable	Description
Hybrid cable with common data line and supply voltage	
V19SY-G-BK2M-PUR-ABG	Single-ended male cordset, M12, 8-pin, Y coding, 2 m PUR cable, shielded
V19SY-G-BK5M-PUR-ABG	Single-ended male cordset, M12, 8-pin, Y coding, 5 m PUR cable, shielded
V19SY-G-BK10M-PUR-ABG	Single-ended male cordset, M12, 8-pin, Y coding, 10 m PUR cable, shielded
Y-splitter and cable (data cable and supply voltage separated)	
V19SY-Y-V1D/V1S	Y-splitter, M12 plug Y-coded to A-coded M12 plug/D-coded socket
V1SD-G-*M-PUR-ABG-V45-G ¹	Cordset, M12 to four-pin RJ-45 PUR cable, CAT5e, in conjunction with Y-plug (data cable)
V1-G-BK10M-PUR-U	Single-ended female cordset, M12, four pins, PUR cable, in conjunction with Y-plug (supply voltage)

1. This cable type is available in various lengths 2 ... 45 m.

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- Wireless Solutions
- Level Measurement

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- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
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