MANUAL

WCS
Position Encoding System
Electrical

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1 Introduction

Congratulations

You have chosen a device manufactured by Pepperl+Fuchs. Pepperl+Fuchs develops, produces and distributes electronic sensors and interface modules for the market of automation technology on a worldwide scale.

Symbols Used

The following symbols are used in this manual:

Note!

This symbol draws your attention to important information.

Handling instructions

You will find handling instructions beside this symbol

Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

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2 Declaration of Conformity

2.1 CE Conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Note!

A declaration of conformity can be requested from the manufacturer.

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3 Safety

3.1 Symbols Relevant to Safety

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.

3.2 General Safety Instructions

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

Installation and commissioning of all devices may be performed only by personnel specially trained for that purpose.

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

Note!

Disposal

Electronic waste is hazardous waste. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

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4   Product Description

4.1   Functional Description

The WCS position encoding system consists of two main components:

1. **The 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 assigns a unique position to every point on the track. It is possible to route the code rail only at points 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 the position value 0. The maximum length of the code rail is 327 m (WCS2) or 314.5 m (WCS3). Brackets are available for mounting the code rail.

2. **The reader**

   The U-shaped reader scans the code rail photoelectronically without touching it. Every 0.833 mm (WCS2) or 0.8 mm (WCS3), the reader detects a new position value. After insertion into the code rail, the reader determines the position value without reference or delay. The code rail can be scanned at very high speeds. The scanning is reproducible, reliable, and independent of temperature fluctuations. The position value can be transferred directly from the reader to the controller via a serial RS485 interface. For connection to standard interfaces, there is a wide range of interface modules available:

   - Parallel
   - SSI
   - PROFIBUS DP
   - DeviceNet
   - CANopen
   - Ethernet
   - InterBus-S
   - PROFINET
   - MODBUS RTU

   Up to four readers can be connected simultaneously to all interface modules with the exception of the SSI interface module.

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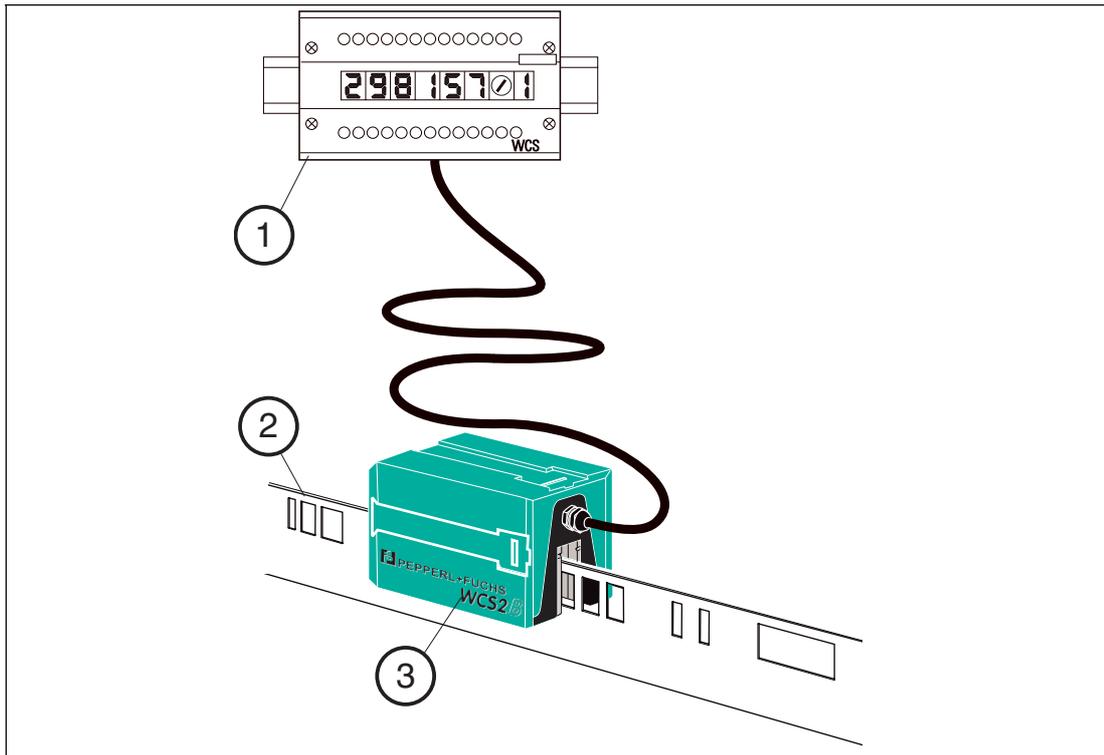
1. Interface module
2. Code rail
3. Reader

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: 0.1 m to 327 m
- Coding system also suitable for curves with up to 0.5 m radius
- A wide variety of applications, such as stock feeders, trolleys, monorail conveyors, galvanic plants, automatic and slewing cranes, as well as elevators
- Various mounting systems available for installing the code rail
- Connection to any controller possible, either directly or via interface module
- Connectivity to many fieldbus systems available
- Support during commissioning and maintenance with extensive system diagnostics options

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■ 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)

4.2 Application Areas

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

■ Interruptions in the code rail (lane changes, track switches)

■ Applications with curves and circular paths

■ Use of multiple vehicles in a row

Due to the larger tolerances of the reader in relation to the code rail, in most applications the WCS3 system can be used. In some circumstances, however, it is advantageous to use the WCS2 in conjunction with the aluminum profile system. Here are some examples from the variety of application options:

Stock Feeders (High-Bay Warehouse)

Trolleys, lifting gear, and transversing carriages are each positioned with one reader. 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
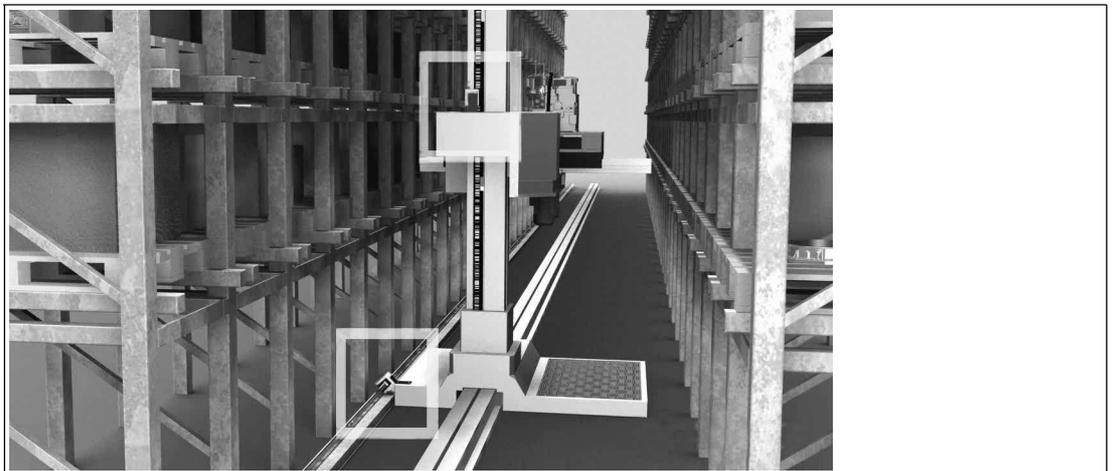
Figure 4.1   Stock feeder (high-bay warehouse)

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Automatic Cranes

Automatic cranes are a typical application for the WCS2 in conjunction with the aluminum profile system. The crane is positioned using one reader each for the crane and the trolley movement. At each point, the guide trolley ensures the optimum position of the reader 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 WCS2 can be used in a very dusty environment, such as in cement works or foundries.
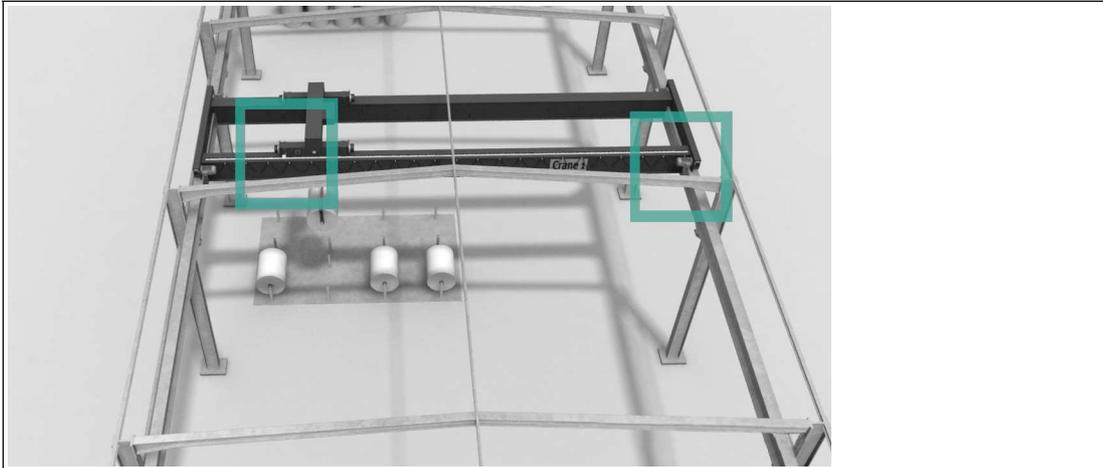
Figure 4.2   Automatic crane

Galvanic Plants

One or more vehicles moving in a line along a straight route. The vehicles bring the material to be galvanized into the corresponding bath automatically. The high and adaptable light output of the readers has enabled the WCS position encoding system to perform extremely well even under these difficult conditions. In addition to the WCS3 system, the WCS2 with the aluminum profile system, which is also available powder-coated, can be used.
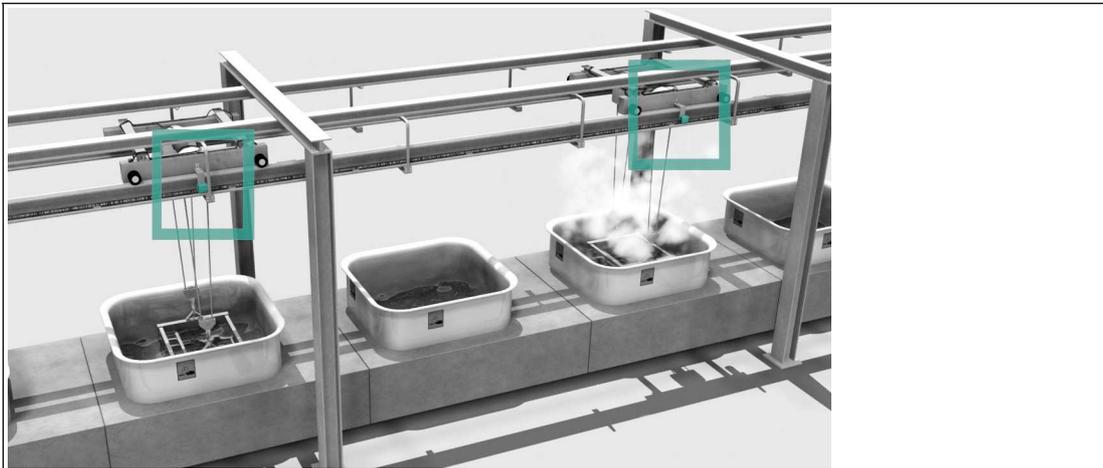
Figure 4.3   Galvanic plant

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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 controller immediately; the vehicle does not have to be moved. The WCS can also be used for distances longer than 314 m.
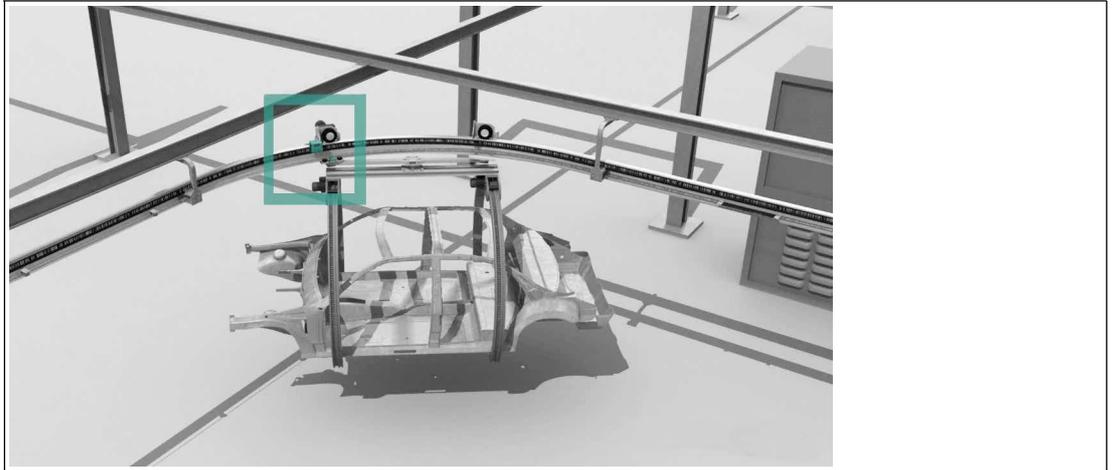
Figure 4.4   Overhead conveyor

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5 Reader Configuration

5.1 Configuration of the WCS2B Readers with RS485 Interface

Configuration Switch in the Reader

You can change the hardware and software configuration of the reader in the reader. In so far as possible, the type of reader is changed using two DIP switches: S1 and S2. S1 is a DIP switch with four switch positions and S2 is a switch with two switch positions. The DIP switches are located in the reader.

Figure 5.1   Position of the DIP switches S1 and S2

Figure 5.2   Right board

Figure 5.3   Horizontal board

Setting the Configuration Switch

To adjust the switch, you need to remove the housing cover.

1. Loosen the four screws on the underside of the housing.
2. Remove the housing cover.

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▶ Assembly after Configuration

When performing the assembly after configuration, tighten the screws with a torque of 1.0 Nm.

Changing the Reader Address

Reader type	S1				Address
	1	2	3	4	
WCS2.-LS***-0	OFF	OFF	X	X	0
WCS2.-LS***1	ON	OFF	X	X	1
WCS2.-LS***-2	OFF	ON	X	X	2
WCS2.-LS***-3	ON	ON	X	X	3

▶ Changing the Terminator

1. Reader **with** RS485 terminator (-LS2..): Set both **S2** switches to the **ON** position.

2. Reader **without** RS485 terminator (-LS1..): Set both **S2** switches to the **OFF** position.

RS485 terminator	S2	
	1	2
ON	ON	ON
OFF	OFF	OFF

Changing the Baud Rate

Base types LS211/LS221:

Reader type (* = 1 or 2)	S1				Baud rate
	1	2	3	4	
WCS2.-LS*11	X	X	OFF	X	187.5 kBaud
WCS2.-LS*21	X	X	ON	X	62.5 kBaud

Tip

To suppress the output of the pollution warning on the diagnostic bit (DB), on S1 set switch 4 to the position **ON**.

Base types LS231/LS261

Reader type (* = 1 or 2)	S1				Baud rate
	1	2	3	4	
WCS2.-LS*61	X	X	OFF	X	38.4 kBaud
WCS2.-LS*31	X	X	ON	X	31.25 kBaud

Base types LS246/LS256

Reader type (* = 1 or 2)	S1				Baud rate
	1	2	3	4	
WCS2.-LS*46	X	X	OFF	OFF	19.2 kBaud even parity
WCS2.-LS*47	X	X	OFF	ON	19.2 kBaud no parity
WCS2.-LS*56	X	X	ON	OFF	9.6 kBaud even parity
WCS2.-LS*57	X	X	ON	ON	9.6 kBaud no parity

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Note!

Changing the Reader Designation

If you have changed the reader address or the baud rate and/or switched the RS485 terminator on/off, you have to change the reader designation on the type label in accordance with the table above.

Examples:

■ You have changed the address from 0 to 1.

Change the reader designation WCS.-LS211(-**0**) $^{*)}$ to WCS.-LS211-**1**.

■ You have switched the RS485 terminator off.

Change the reader designation WCS.-LS**2**11 to WCS.-LS**1**11.

■ You have changed the baud rate from 187.5 kBaud to 62.5 kBaud.

Change the reader designation WCS.-LS2**1**1 to WCS.-2**2**1.

*) If no address is specified explicitly in the reader designation, the default address of 0 is set.

5.2 Configuration of the WCS2B/WCS3B-LS3** Readers with SSI Interface

Configuration Switch in the Reader

You can change the hardware and software configuration of the reader in the reader. As far as possible, the reader type is changed with DIP switch S1. S1 is a DIP switch with four switch positions. The DIP switch is located in the reader.
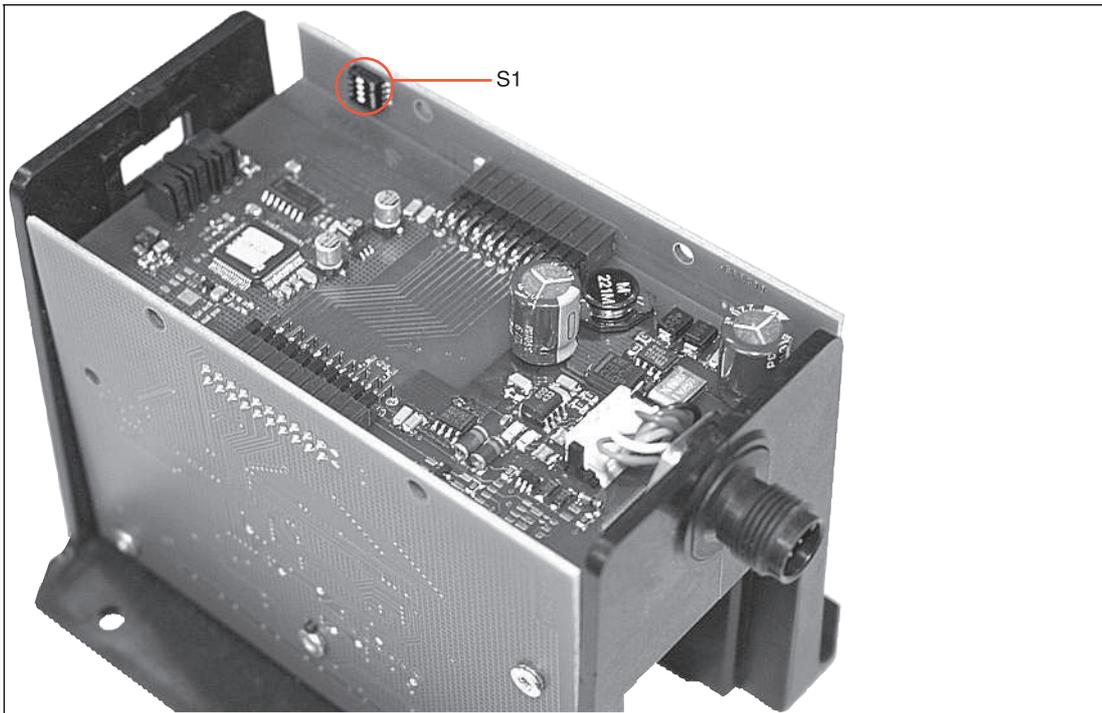
Figure 5.4   Position of the configuration switch S1

▶ Setting the Configuration Switch

To adjust the switch, you need to remove the housing cover.

1. Loosen the four screws on the underside of the housing.

2. Remove the housing cover.

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▶ Assembly after Configuration

When performing the assembly after configuration, tighten the screws with a torque of 1.0 Nm.

Changing the Data Output

Reader type	S1				Code
	1	2	3	4	
WCS2.-LS310	ON	OFF	X	X	Binary
WCS2.-LS311	OFF	OFF	X	X	Gray
WCS3B-LS310	ON	OFF	X	X	Binary
WCS3B-LS311	OFF	OFF	X	X	Gray

Note!

Changing the Reader Designation

If you have changed the switch setting, you must change the reader designation on the type label in accordance with the table above.

Example:

■ You have changed the encryption of Gray to digital.

Change the reader designation WCS.-LS31**1** to WCS.-LS31**0**.

Output of a Warning if the Optics Are Contaminated

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

Reader type (* = 0 or 1)	S1				Diagnostic bit
	1	2	3	4	
WCS2.-LS31*	X	OFF	X	OFF	ON
WCS2.-LS31*	X	OFF	X	ON	OFF
WCS3B-LS31*	X	OFF	X	OFF	ON
WCS3B-LS31*	X	OFF	X	ON	OFF

Note!

Setting the Diagnostic Bit

The setting of the diagnostic bit is not noted on the type label of the reader.

5.3 Configuration of the WCS3B-LS1**/WCS3B-LS2** Readers (Base Types and Option -S)

Configuration Switch in the Reader

You can change the hardware and software configuration of the reader in the reader. In so far as possible, the type of reader is changed using two DIP switches: S1 and S2. S1 is a DIP switch with four switch positions and S2 is a switch with two switch positions. The DIP switches are located in the reader.

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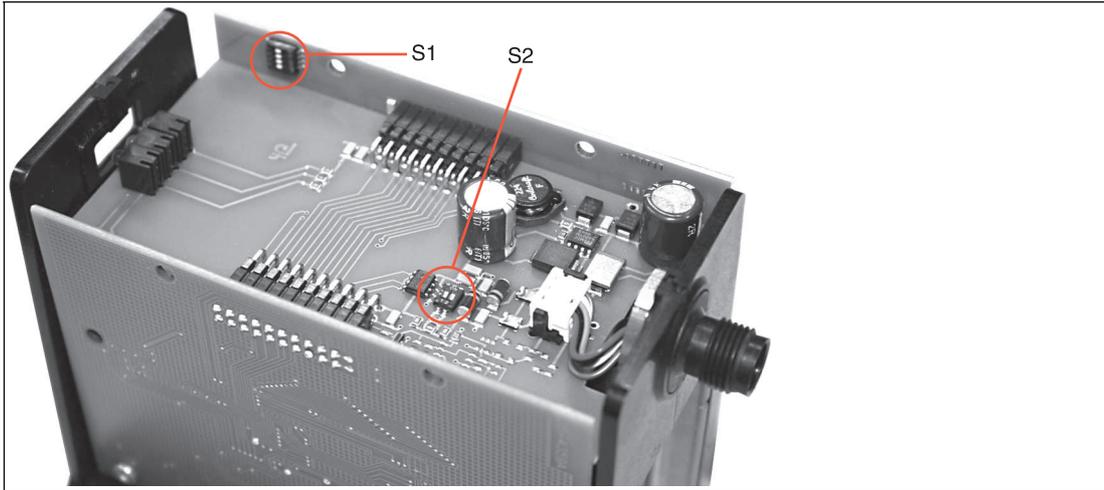
Figure 5.5   Positions of the configuration switches S1 and S2

▶ **Setting the Configuration Switch**

To adjust the switch, you need to remove the housing cover.

1. Loosen the four screws on the underside of the housing.
2. Remove the housing cover.

▶ **Assembly after Configuration**

When performing the assembly after configuration, tighten the screws with a torque of 1.0 Nm.

Changing the Reader Address

Reader type	S1				Address
	1	2	3	4	
WCS3B-LS***-0	OFF	OFF	X	X	0
WCS3B-LS***-1	ON	OFF	X	X	1
WCS3B-LS***-2	OFF	ON	X	X	2
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
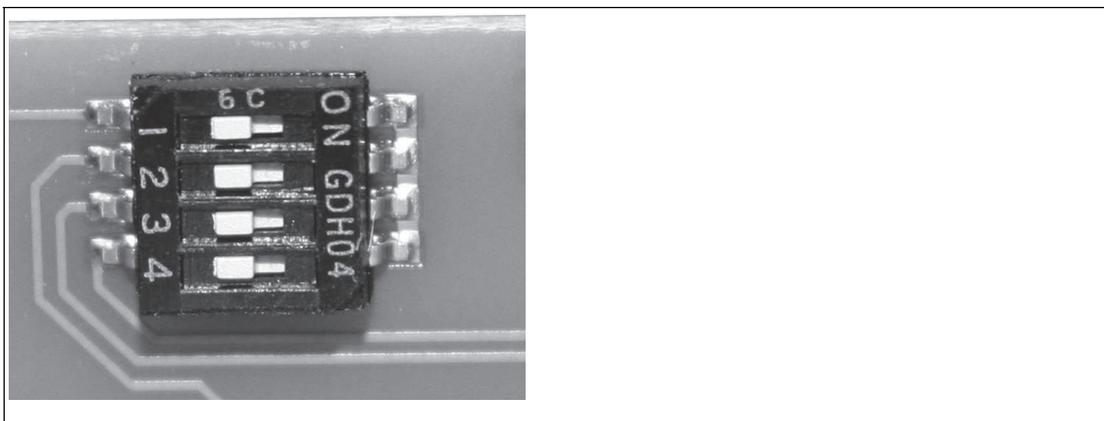
Figure 5.6   DIP switch S1

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▶ Changing the Terminator

1. Reader **with** RS485 terminator (-LS2..): Set both **S2** switches to the **ON** position.

2. Reader **without** RS485 terminator (-LS1..): Set both **S2** switches to the **OFF** position.
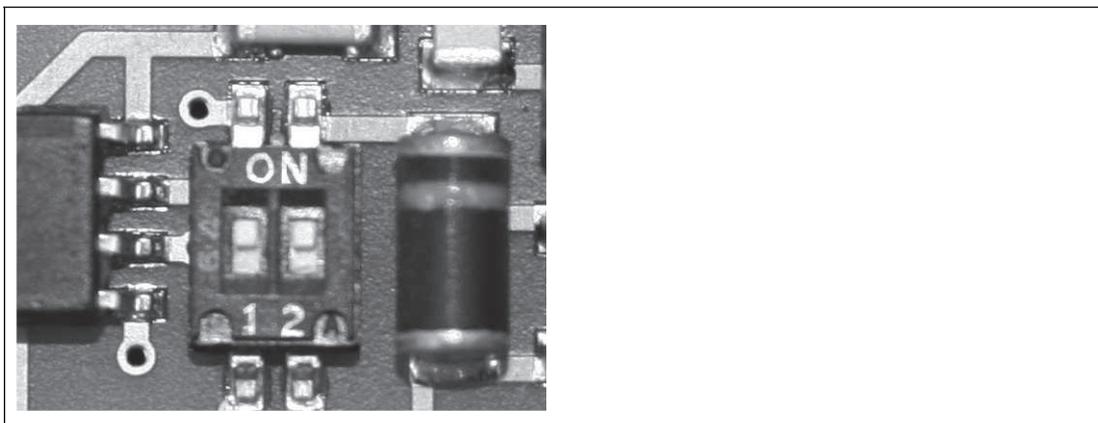
Figure 5.7   DIP switch S2

RS485 terminator	S2	
	1	2
ON	ON	ON
OFF	OFF	OFF

Changing the Baud Rate
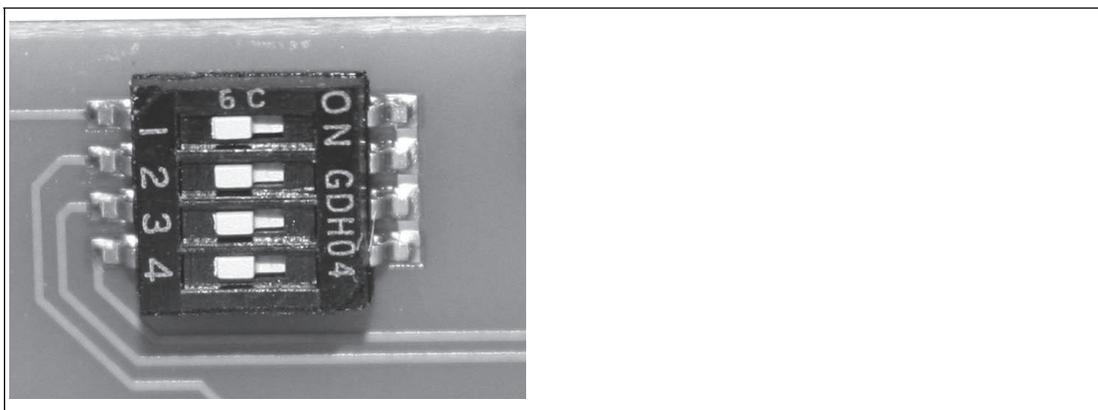
Figure 5.8   DIP switch S1

Base types LS*11/LS*21:

Reader type (* = 1 or 2)	S1				Baud rate
	1	2	3	4	
WCS3B-LS*11	X	X	OFF	X	187.5 kBaud
WCS3B-LS*21	X	X	ON	X	62.5 kBaud

Base types LS*3x/LS*6x

Reader type (* = 1 or 2, x = 1, 6 or 7)	S1				Baud rate
	1	2	3	4	

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WCS3B-LS*61	X	X	OFF	X	38.4 kBaud
WCS3B-LS*31	X	X	ON	X	31.25 kBaud

Base types LS*46/LS*47/LS*56/LS*57

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

Base types LS*1xS/LS*2xS:

Reader type (* = 1 or 2, x = 1, 6 or 7)	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

Reader type (* = 1 or 2, x = 1, 6 or 7)	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*4xS/LS*5xS

Reader type (* = 1 or 2, x = 1, 6 or 7)	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

Note!

Changing the Reader Designation

If you have changed the reader address or the baud rate and/or switched the RS485 terminator on/off, you have to change the reader designation on the type label in accordance with the table above.

Examples:

- You have changed the address from 0 to 1.

  Change the reader designation WCS.-LS211(-**0**) [*)] to WCS.-LS211-**1**.

- You have switched the RS485 terminator off.

  Change the reader designation WCS.-LS**2**11 to WCS.-LS**1**11.

- You have changed the baud rate from 187.5 kBaud to 62.5 kBaud.

  Change the reader designation WCS.-LS2**1**1 to WCS.-2**2**1.

*) If no address is specified explicitly in the reader designation, the default address of 0 is set.

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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 --> $v_{current} < v_{limit}$

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

Note!

The set limit speed is not noted on the type label of the reader.

5.4 Configuration Switches on the Integrated Display Module (Reader with Option -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.
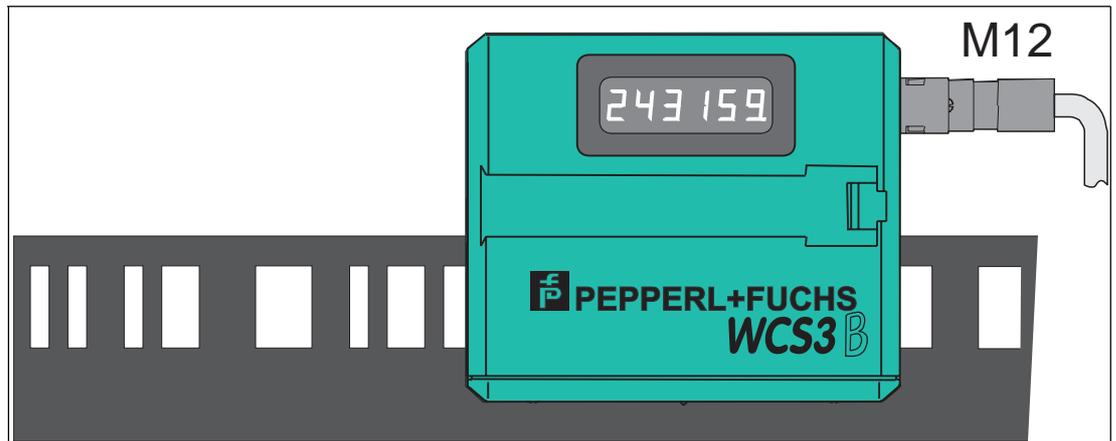
Figure 5.9   Display for a perpendicular code rail (position 0°)

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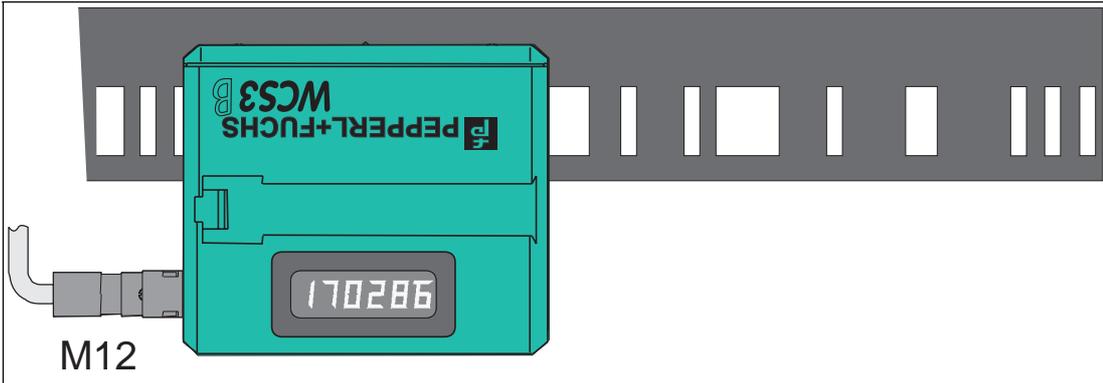
Figure 5.10   Display for a suspended code rail (position 180°)

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.

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Positions of the Configuration Switches on the Display Board
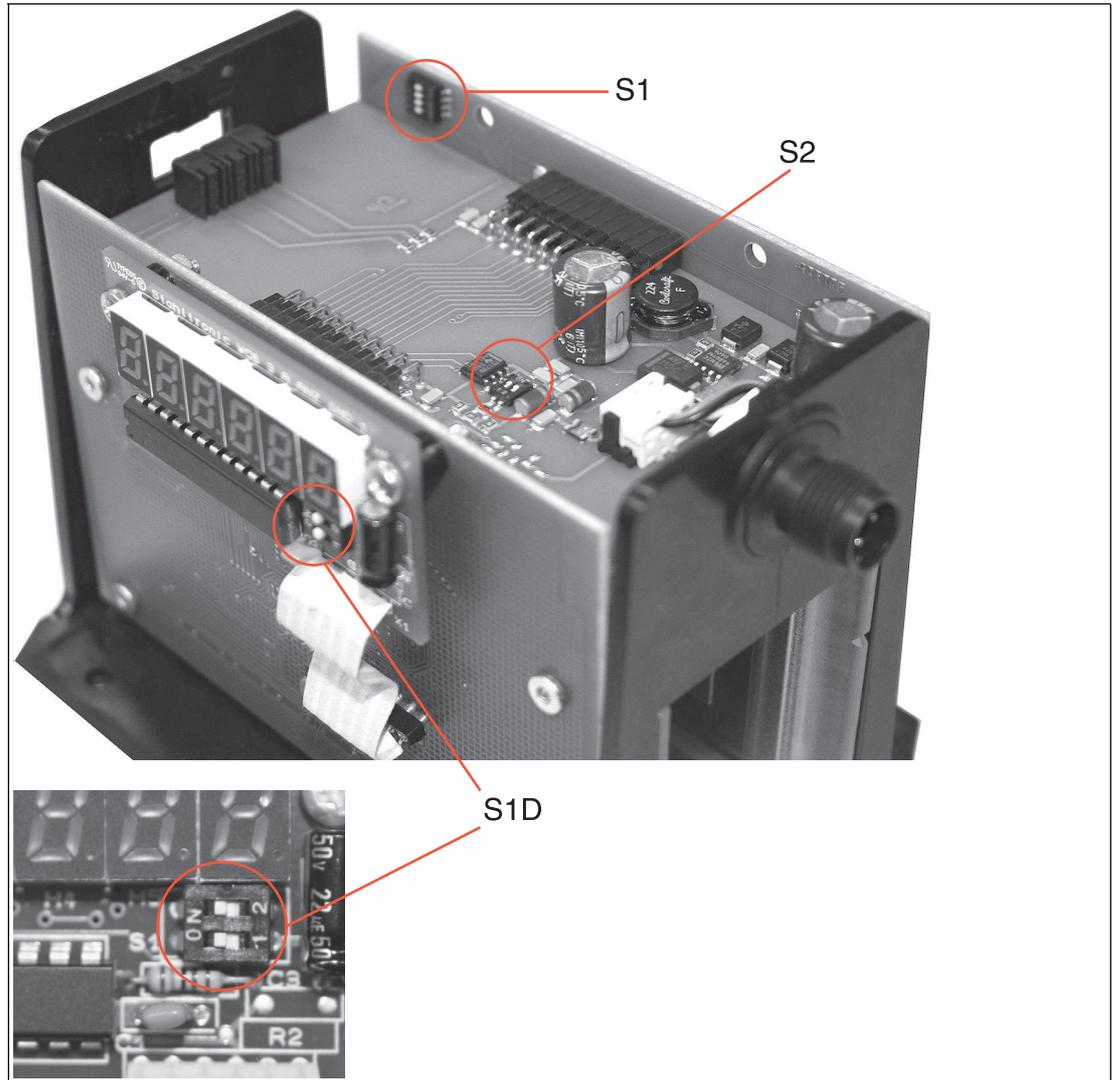
Figure 5.11   Positions of the configuration switches S1, S2, and S1D

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5.5 LED Display on the WCS3B Reader

Reader with SSI, RS-485, and CANopen Interface
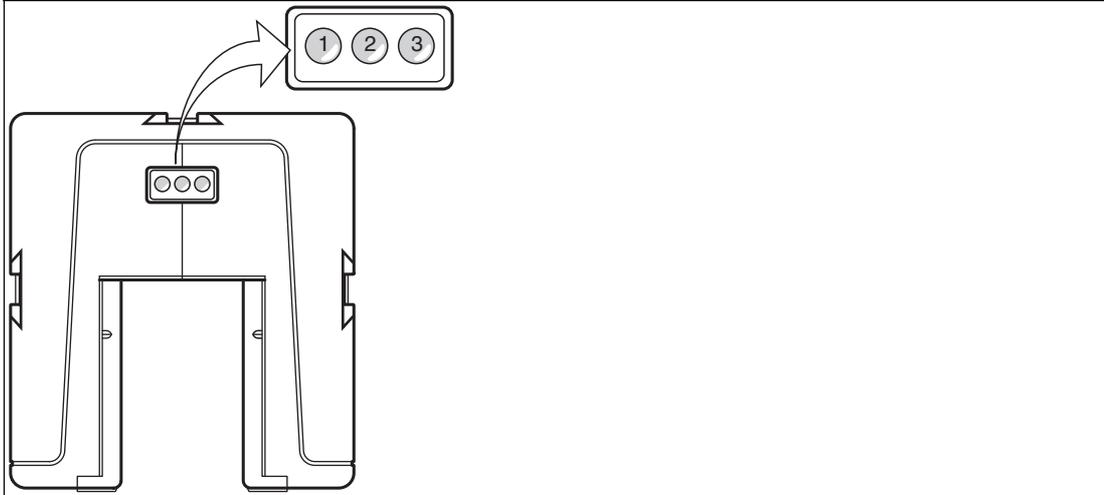
1 Green LED

2 Yellow LED

3 Red LED

Display	Meaning
Operating indicator	Green LED: Power on
Data flow indicator[1]	Yellow LED: Data transfer active
Velocity display[2]	Yellow LED Off if limit speed exceeded
Fault indicator	Red LED Flashing: Reader outside the code rail Permanently lit: Internal diagnostic error
Contamination indicator	Yellow LED and red LED flashing alternately: Reader lens dirty (f=1.5 Hz)
Function indicator	Yellow LED and red LED light up for 2 seconds after power on or reset

1. Only for readers with no velocity output

2. Only for readers with velocity output

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Reader with PROFINET and EtherNet/IP interface
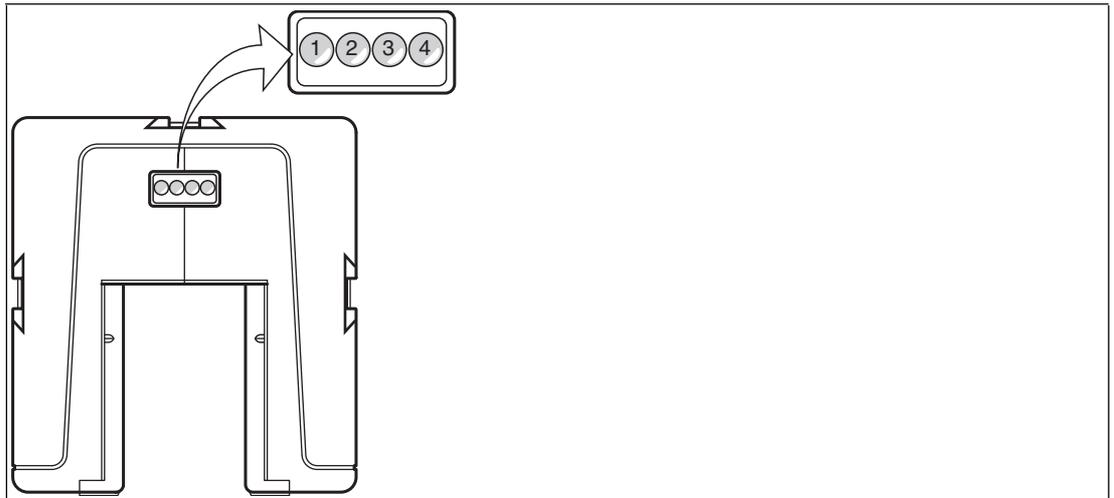
1   Dual red/green LED

2   Green LED

3   Yellow LED

4   Red LED

Display	Meaning
Status indicator	Dual red/green LED Green: Code rail detected, normal function Red: System error Flashing red: No code rail detected
Ethernet link	Green LED On: Fieldbus connection OK
Ethernet RX/TX	Yellow LED Flashing: Data transfer
Ethernet communication	Red LED On: Communication error

5.6   Configuration of the WCS3B Readers with EtherNet/IP Interface

5.6.1   General Information on Communication via EtherNet/IP

The reader 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 management and development of the EtherNet/IP standard are subject to the Open DeviceNet Vendor Association (ODVA). More information on EtherNet/IP will be supplied on request by the Open DeviceNet Vendor Association (ODVA) at the following Internet address:

ODVA, Inc

4220 Varsity Drive, Suite A

Ann Arbor, MI 48108-5006 USA

http://www.odva.org e-mail: mailto:odva@odva.org

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)

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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 reader 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) $\geq$ 2 ms

■ Dynamic Host Configuration Protocol (DHCP)

■ Address Conflict Detection (ACD)

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

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 information about the device (e.g., the product description or the item number) into the search function.

5.6.2 EtherNet/IP Connection

The WCS3B-LS5* reader is connected to EtherNet/IP and the power supply via an 8-pin M12 plug with Y encryption.
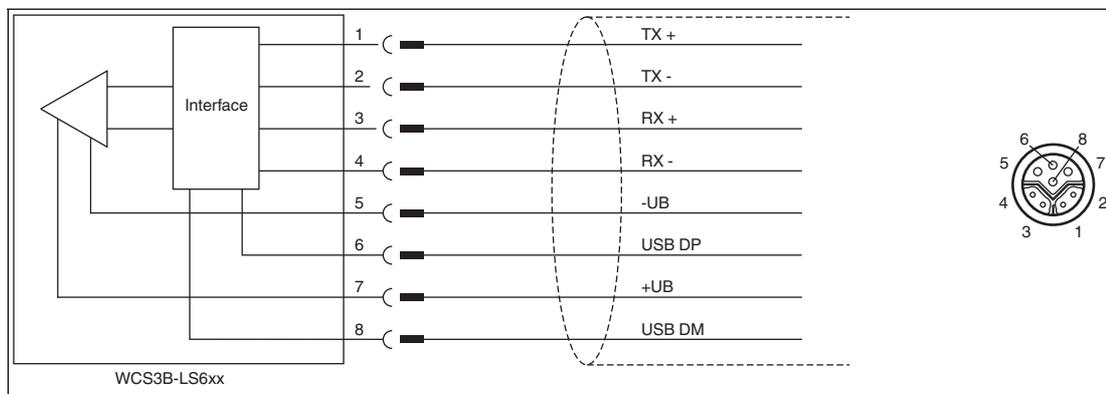
Figure 5.12

⚠ **Caution!**
Cable shielding

Note that all the lines are shielded. This is the only way to ensure the noise immunity of the reader!

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5.6.3 Communication via EtherNet/IP

Setting the IP Address

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

The following section describes the address assignment via the software **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.
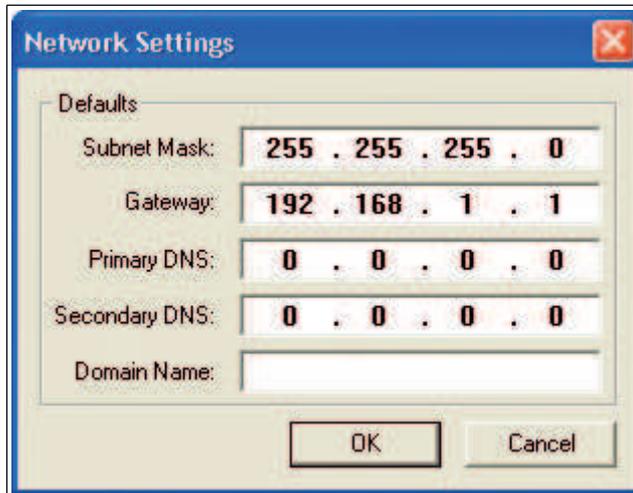
4. Switch on the supply voltage to the read head.

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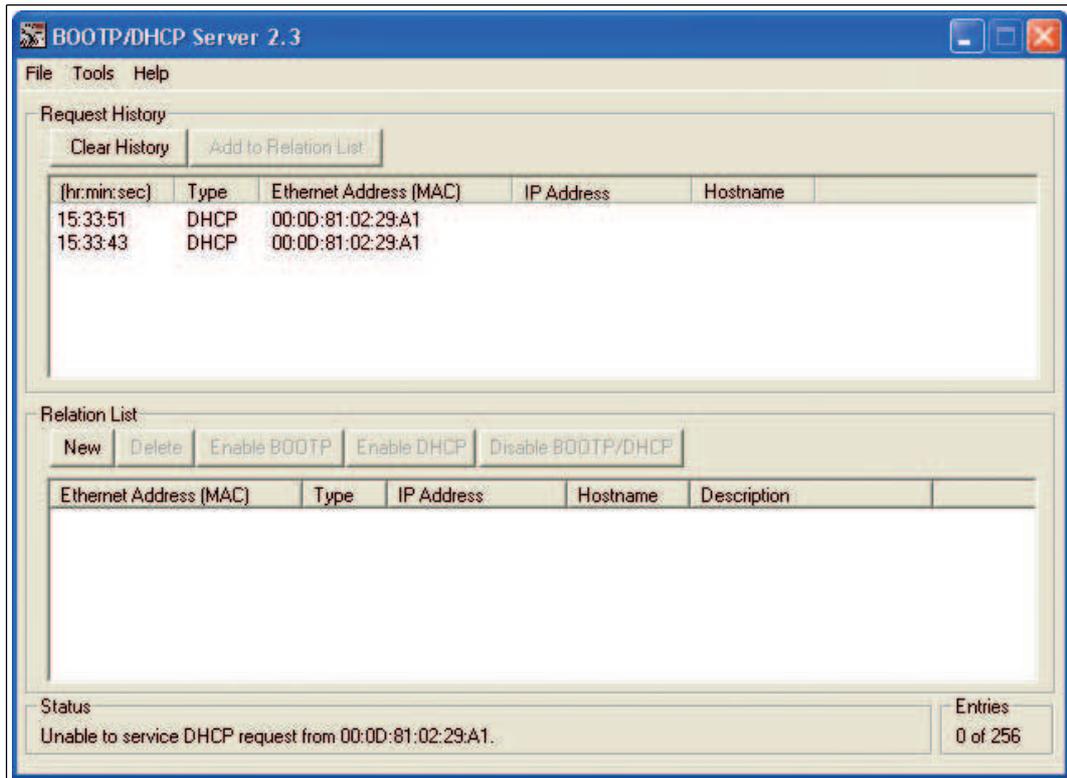
↪ The read head cyclically carries out DHCP requests. This enters the MAC address of the read head in the **Request History** field to the list.

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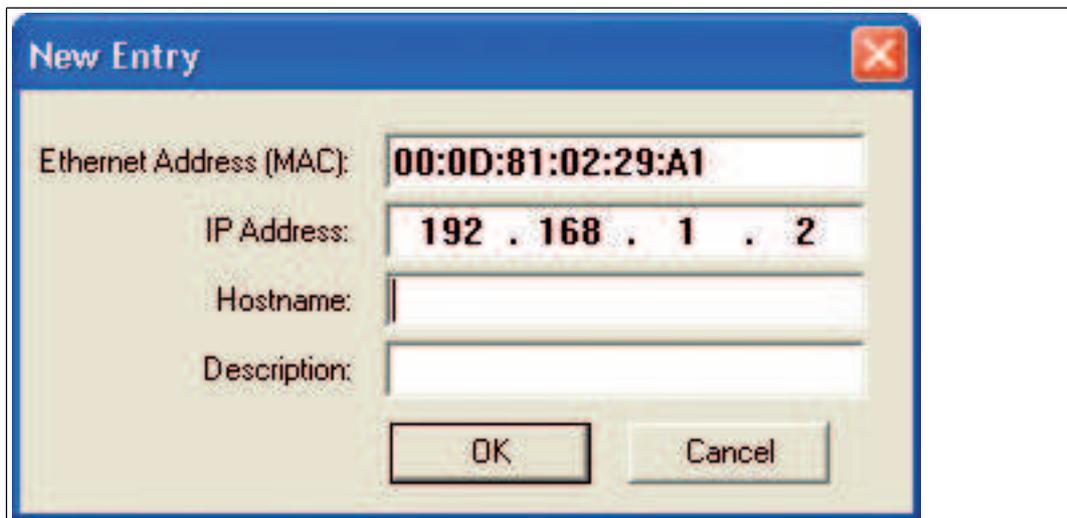
6. Confirm the entries of the address data using **OK**.

   ↪ 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.

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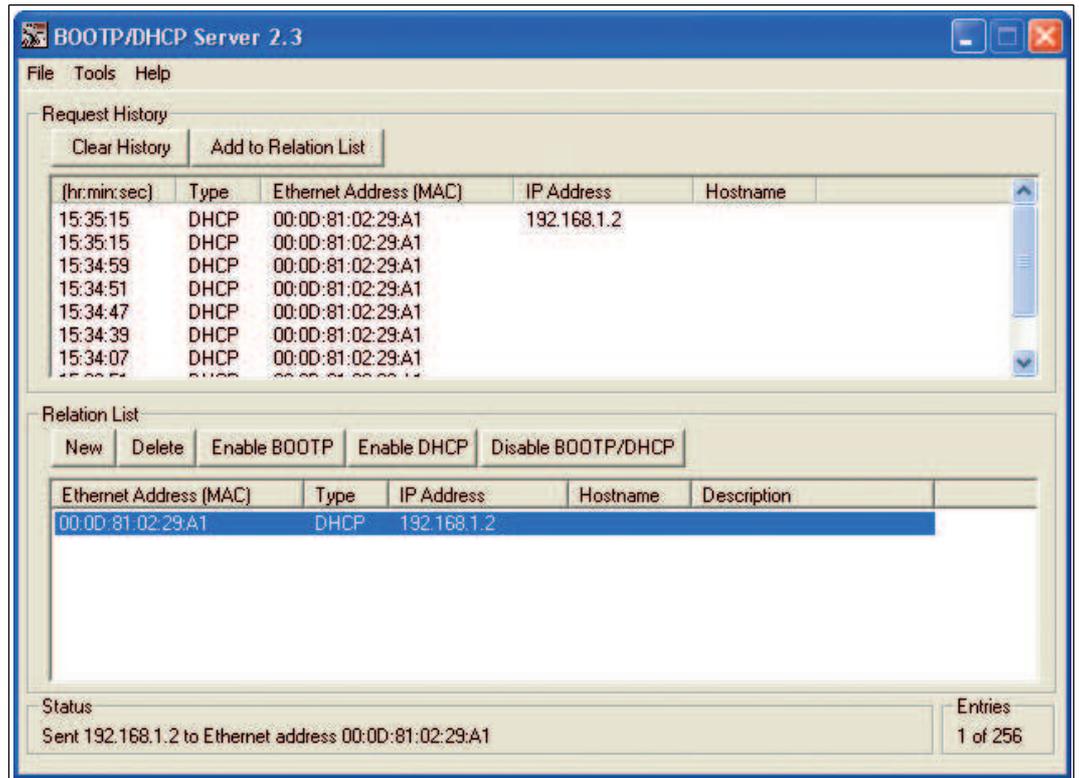
7. Press the **Disable BOOTP/DHCP** key in the **Relation List** field.

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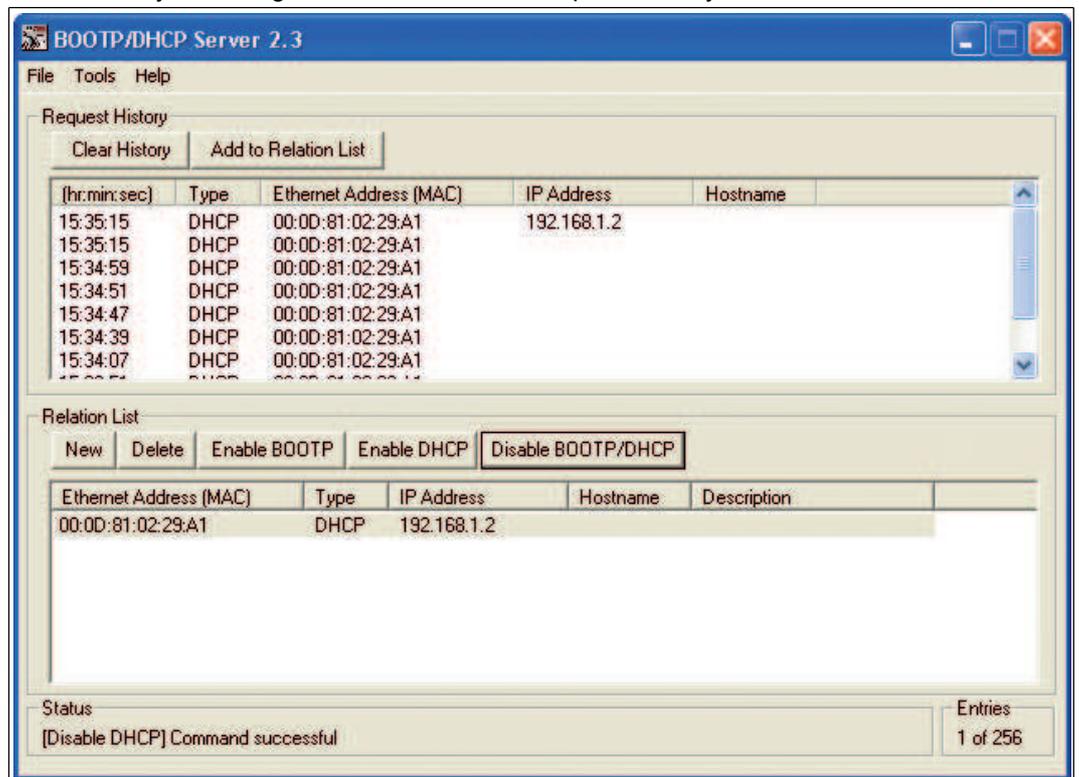
EtherNet/IP Objects

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

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

Standard classes

Class ID	Class description
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 description
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 by means of a connection. The composition of the assemblies in the reader 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 reader. 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

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Attributes of the Reader's EtherNet/IP Objects

Position Sensor Object attributes (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 reader 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	Bbyteyte 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 = **l**east **s**ignificant **b**yte At a resolution of 0.8 mm: $L_{max} = 314.5$ m $= 314,500$ mm

Data of the 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

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

Data of attribute 100

Bit no.	Content	
	Byte 1 Status	Function
1	ERR	Error message, error code in ERR00 – ERR07
2	OUT	Reader partially outside the code rail. No valid position available.
3	OUTALL	Reader completely outside the code rail.
4	DB	Diagnostic bit. Reader 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 of the 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 bytebyte consistent	Input data	8 bit fault data

A set ERR bit in attribute 100 means that the corresponding fault is active.

Data of attribute 102

Bit no.	Content	
	Byte 1 Status	Function
0	ERR00	-
1	ERR01	Current position cannot be determined.
2	ERR02	Current position cannot be determined.

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| Bit no. | Content | Function |
	Byte 1 Status	
3	ERR03	Fault in the RAM working memory.
4	ERR04	Fault in the EPROM memory or in the decoder.
5	ERR05	Fault in the ROM memory.
6	ERR06	-
7	ERR07	-

See chapter 16

5.7 Configuration of the WCS3B Readers with PROFINET Interface

5.7.1 General Information on Communication via PROFINET

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.

The communication concept for setting up decentralized applications within PROFINET is PROFINET IO, i.e. decentralized field devices are integrated by PROFINET IO. The familiar IO view of PROFIBUS DP is used where the usable data of the field devices is transferred to the controller process image in cycles. PROFINET IO is a device model consisting of slots and channels, which is based on the main features of PROFIBUS DP. The field device properties are written in a GSDML (generic station description markup language) based on XML. PROFINET IO is engineered in the same way as has long been the case for system integrators of PROFIBUS DP. The decentralized field devices are assigned in the design of a controller.

PROFINET IO draws a distinction between three device types: IO controller, IO device, and IO supervisor.

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.

5.7.2 PROFINET Connection

The WCS3B-LS6* reader is connected to PROFINET and the power supply via an 8-pin M12 plug with Y encryption.
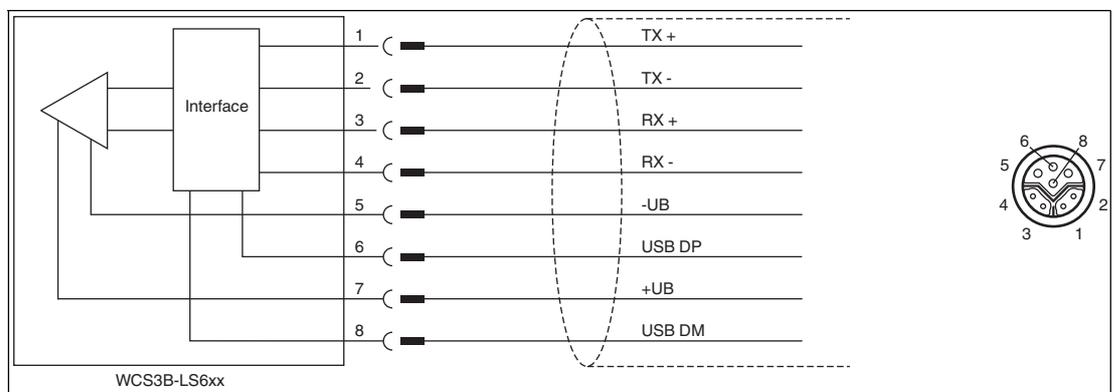
Figure 5.13

> **Caution!**
> Cable shielding
>
> Note that all the lines are shielded. This is the only way to ensure the immunity of the reader.

5.7.3   PROFINET I/O Interface

The WCS3B-LS6** readers are PROFINET I/O devices that communicate cyclically with the assigned PROFINET I/O controller during operation.

The PROFINET interface of the WCS3B-LS6** readers 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

Identification & Maintenance Data

Identification and maintenance data (I&M data) is information stored in a device. I&M data uniquely identifies a device within a system. 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 regarding the device within the system, for example the installation location and installation date. Maintenance data is initially stored in the device during installation; this data can be changed.

Data Input

The Step7 software from Siemens can be used to display and change the I&M data. You can read and write I&M data 1, 2 and 3 in the "Target System" menu of the HW Config hardware configuration using the functions "Download Module Identification" and "Download Module Identification to PG". → see Figure 5.14 on page 37.

I&M Data

I&M data 1	=	system ID location ID
I&M data 2	=	installation date
I&M data 3	=	additional information

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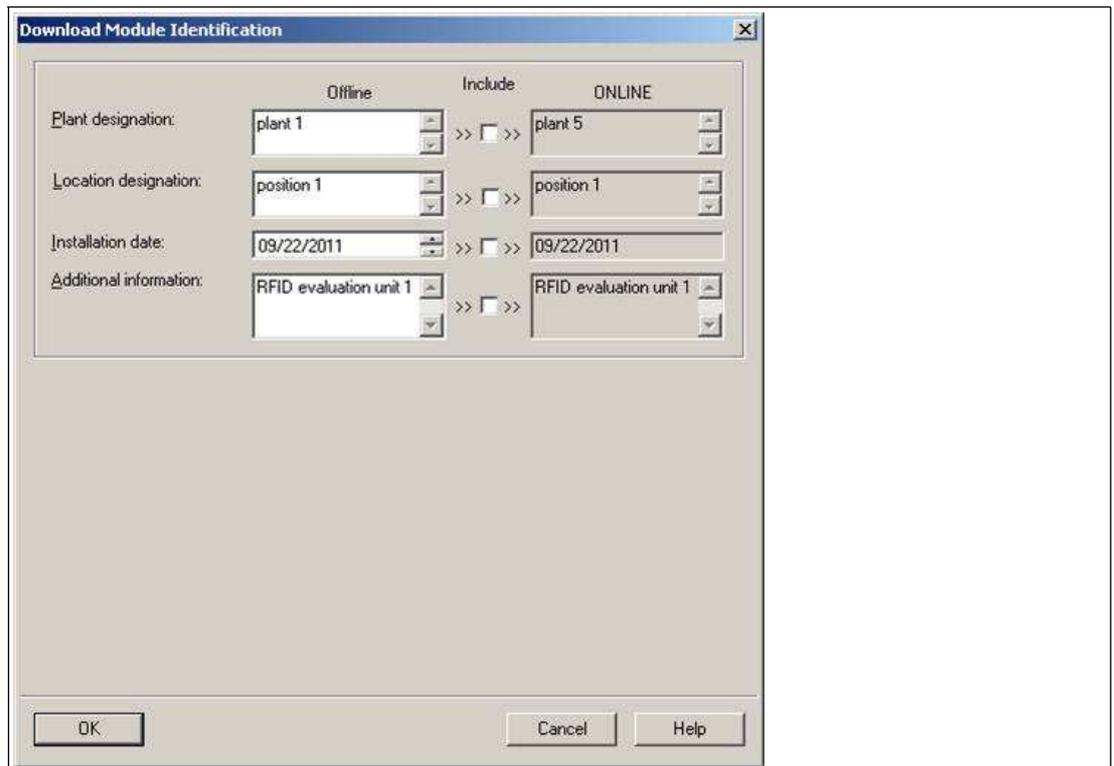
Figure 5.14

5.7.4 Project Planning Using Device Description

As with PROFIBUS DP, a field device is integrated into the project planning tool by way of a device description. The field device properties are described in the GSD file. The GSD file contains the field device data (technical features and information for communication) that you need to operate the device in a PROFINET network.

Import the GSD file into a project planning tool. Peripheral addresses are assigned to the individual channels of the field devices. The peripheral input addresses incorporate the received data. The user program evaluates and processes this data. The user program generates the peripheral output values and sends them to the control interface.

Once project planning is complete, the I/O controller receives the planning and configuration data. The I/O controller parameterizes and configures the field devices automatically.

Downloading the GSD File

You can find the relevant GSD 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 information about the device (e.g., the product description or the item number) into the search function.

5.7.5 PROFINET Address and Identifying a Device

Every PROFINET IO device 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-ls610`.

- An **IP address**. The default IP address is `192.168.2.2`.

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5.7.6   PROFINET Modules

1 word = 16-bit value

1 byte = 8-bit value

Modules with Response Telegram

The following modules enable reader 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 = **m**ost **s**ignificant **b**yte Resolution: 0.8 mm, binary coded $L_{max} = 314.5$ m = 314500 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 from 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

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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 ... 20 **Example:** ERR message = 00001111 = 16 16 corresponds to "Interface module is not set for communication with multiple readers"

Response

Bit no.	Content
	Word 1 ERROR message
1	ERR00
2	ERR01
3	ERR02
4	ERR03
5	ERR04
6	ERR05
7	ERR06
8	ERR07

ERR messages

Fault	Cause	Remedy
1 2	Reader cannot calculate position value because:	
	■ Optical unit is dirty	Ensure that the optical system is cleaned
	■ Plastic lenses scratched	Align reader and code rail correctly. Replace plastic lenses
	■ Position of the reader in relation to the code rail is incorrect	Install reader correctly, see page 10 ff
	■ Light barriers have failed	Send reader for repair
3	RAM error, reader	Send reader for repair
4	EPROM error, reader	Send reader for repair
5	ROM error, reader	Send reader for repair

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Fault	Cause	Remedy
6	Reserved	-
7	No position value available. Reader is located in the initialization routine.	Message only after switching on the reader and/or RESET
8 9 10 11 12	Data transfer error between reader and interface module, data transfer disrupted	Check the cable connection from the reader to the interface module; check the shielding, protective ground, cable routing (EMC)
13	Reader cannot be addressed by the interface module	Check the cable connection from the reader to the interface module; check the operating voltage of the reader
14	Reader 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 readers	Send interface module for correct configuration setting
19	RAM error in interface module	Send module for repair
20	EPROM error in interface module	Send module for repair

Status module

Size	Type	Content
1 byte	Input data	16-bit status

Response

Bit no.	Content	
	Byte 1 Status	Function
1	OUT	Error message, see **Error Codes**
2	OUT ALL	No position information/OUT (XP=0; SP=0)
3	ERR	See table "ERR Messages"
4	DB	Set diagnostics bit
5	0	-
...	...	-
16	0	-

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6   Interface Module

6.1   Mounting the Interface Module

The interface module is mounted on a DIN mounting rail of width 35 mm (EN 50022-35) using the snap-on fixing method.

The devices are grounded via the DIN mounting rail.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

Dimensions of the Interface Modules

Interface module	Dimensions Width x height x depth (in mm)
WCS-CG210	90 x 127 x 55
WCS-DG210	90 x 127 x 55
WCS-EIG210	23 x 111 x 115
WCS-IG110	90 x 127 x 55
WCS-IP110/-IP111	100 x 118 x 74
WCS-IP120/-IP121	100 x 118 x 74
WCS-IS31*/-IS32*	100 x 118 x 74
WCS-MBG110	23 x 100 x 115
WCS-PG210	90 x 127 x 55
WCS-PNG110	23 x 111 x 115

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7 WCS-CG210 Interface Module

7.1 Use and Application

The WCS-CG210 is used as an interface between the WCS reader and the CAN bus. The data between the reader(s) and the WCS-CG210 is transferred via the RS485 interface and from the WCS-CG210 to the controller via the CANopen protocol.

You can connect up to four readers of type LS221 or LS121. If you connect several readers, they must have different addresses. The interface module WCS-CG210 acts as a CANopen slave in the "Predefined Connection Set" and allows data transfer rates of up to 1 MBaud.

7.2 Installation

7.2.1 Electrical Connection

Connecting the interface module to the voltage

1. Connect terminal 1 of the 5-pin plug on the interface module with operating voltage 24 V ± 20 %.

2. Connect terminal 2 of the 5-pin plug on the interface module with the ground 0 V.

   ↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

7.3 Commissioning

7.3.1 Connecting the reader

If you install several WCS readers together on one interface module, the readers must have different addresses. This will allow the PLC to allocate the data to the correct readers. If you connect only one WCS reader to the interface module, this reader is always given the address 0. You can connect up to four WCS readers to the interface module via an RS485 line. When delivered, each reader has the default address 0. For information on how to change the address of the reader, see the configuration instructions for the reader.
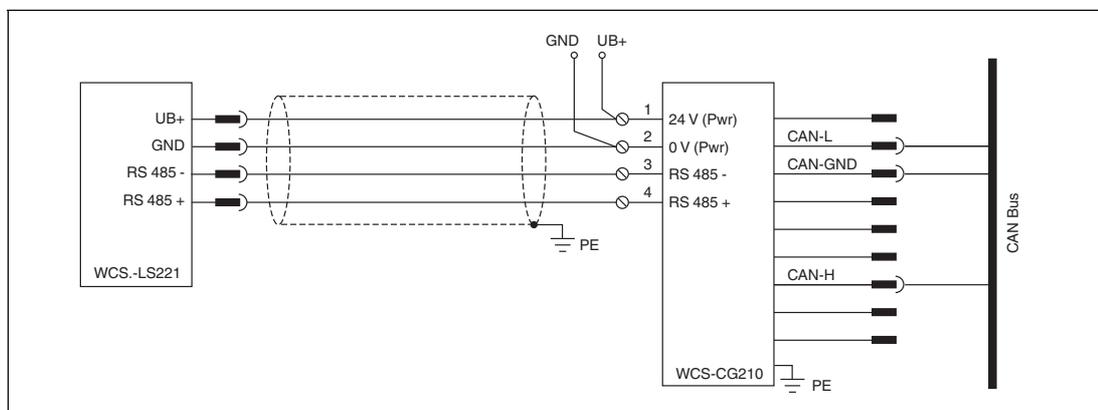
Figure 7.1   Electrical Connection

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Connection of the Reader to the Interface Module

Clamp		Designation
1	24 V (PWR)	Operating voltage interface module/ operating voltage readers
2	0 V (PWR)	Ground interface module/ ground readers
3	RS 485-	RS 485- data line to reader
4	RS 485+	RS 485+ data line to reader
5	n.c.	Not used

Table 7.1   Terminals WCS-CG210

Connecting the Reader to the Interface Module

1. Connect terminals 1 and 2 of the 5-pin plug on the interface module with the supply voltage for the readers. Ensure correct polarity.

2. Connect terminal 3 of the 5-pin plug on the interface module with the RS485 data line to the readers. Ensure correct polarity.

Reader terminal pin			Interface module terminal
WCS2A	WCS3A	WCS3B	
2	1	1	1
4	2	2	4
1	3	4	3
3	5	3	2

Setting the Number of Connected Readers

Set the number of connected readers with the rotary switch S4 in accordance with the table "Rotary Switch S4". When you set this switch, the baud rate range is simultaneously preset.

Rotary switch S4

Switch setting S4	Number of readers	Addresses	Baud rate range
1	1 reader	Address 0	BD set A
2	2 readers	Address 0, 1	BD set A
3	3 readers	Address 0, 1, 2	BD set A
4	4 readers	Address 0, 1, 2, 3	BD set A
5	1 reader	Address 0	BD set B
6	2 readers	Address 0, 1	BD set B
7	3 readers	Address 0, 1, 2	BD set B
8	4 readers	Address 0, 1, 2, 3	BD set B

Setting Baud Rate

If you have pre-set the baud rate range via the rotary switch S4, you can use DIP switches 1 and 2 to set the baud rate. See the following table:

DIP switches			
7	6	BD set A	BD set B
0	0	1 MBaud	100 kBaud
0	1	500 kBaud	50 kBaud

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DIP switches		BD set A	BD set B
7	6		
1	0	250 kBaud	20 kBaud
1	1	125 kBaud	10 kBaud

Note!

Always set the "Interface" sliding switch to position "485".

If the module is located at the beginning or at the end of the data line to the readers, you have to activate the RS485 terminator. To do this, set the "RS 485 termination" sliding switch to "On".

If you connect only one reader on the WCS-CG210, you must always set the "RS 485 termination" sliding switch to "On".

7.3.2   Connection to the controller

Connect the WCS-DG210 interface module to the CANopen bus via the 9-pin connector. This requires a 9-pin Sub-D socket that is connected to the 9-pin Sub-D plug on the device. This socket is not supplied with the interface module.

Set the module ID of the CANopen address via the 6-pin DIP switch "Node ID". The highest value bit of the 7-digit module ID is "0". Node ID "0" is not allowed.

You can switch the terminator in the CANopen bus on and off via the "Termination" sliding switch.

Pin	Designation
1	-
2	CAN-L
3	CAN-GND
4	-
5	-
6	-
7	CAN-H
8	-
9	-

7.3.3   Meaning of LEDs

Power:

The "Power" LED is green: The WCS-CG210 interface module is correctly connected to the power supply.

BusPower:

The "Power" LED is green: The LED is connected directly to the electrically isolated supply voltage of the CANopen side.

BusState:

| The "BusState" LED is green: | Guarding active |
| The "BusState" LED flashes green: | No guarding active |

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The "BusState" LED is red: Guarding error

The "BusState" LED flashes red: CANopen bus error

State:

The "State" LED is green: Data exchange is taking place with the readers. Using the four "Error No/Select ID" LEDS, the number of the currently polled reader is displayed.

ErrorNo/Select ID				Reader address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1
0	1	0	0	2
1	0	0	0	3

The "State" LED is red: The interface module has detected an error or a warning. The interface module displays the binary coded error and/or warning number via the "Error No/Select ID" LEDs. For a description of the error codes see chapter 16.5.

Error (No. 1...7):   Switch the interface module off and back on. If the error occurs again, the module must be replaced.

Warning (No. 8...15):   The warning provides information. The interface module displays the warning for one minute and then resets automatically.

7.3.4   Transmission Mode

You can configure the "Transmission Type" in the WCS-CG210 in accordance with the CANopen specification. When the power is switched on, the following "Transmission Type" is pre-configured in the WCS-CG210:

S5 = 0 ... B, E, and F: asynchronous

In asynchronous transmission, the WCS-CG210 sends automatically when the reader data changes, but not more than every 3 ms ... 250 ms (configurable via rotary switch S5, see the following table). This prevents an overload of the CANopen bus if there are continuous changes in the WCS data. If the position value does not change (vehicle is stationary), with asynchronous transfer no further data is sent. When the switch is set to position E/F, the position value is sent at most every 5 ms/3 ms, but at least every 50 ms/20 ms. Thus the controller receives data even if the vehicle is stationary.

S5 = D: cyclic, synchronous

The WCS-CG210 sends data after the SYNC command. If one or two readers are connected, PD01 is sent. If more than two readers are connected, PDO1 and PDO2 are sent. The typical delay time after SYNC is 2 ms; the maximum delay time is 5 ms.

S5	Min. pause time
0	3 ms
1	5 ms
2	10 ms
3	15 ms
4	20 ms
5	30 ms
6	40 ms

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S5	Min. pause time
7	50 ms
8	100 ms
9	150 ms
A	200 ms
B	250 ms
C	res.
D	SYNC mode
E	5 ms/50 ms
F	3 ms/20 ms

7.3.5   Data Exchange in the CANopen Bus

The WCS-CG210 works as a CANopen slave in the "Predefined Connection Set". Five objects have been defined for the data of the WCS readers:

Object 0x2000:   1 byte - function byte for addressing the readers

Object 0x2001:   4 bytes of data from reader address 0

Object 0x2002:   4 bytes of data from reader address 1

Object 0x2003:   4 bytes of data from reader address 2

Object 0x2004:   4 bytes of data from reader address 3

The data format of the objects 0x2001...0x2004 is identical. The PDO (process data object) can be used to access the objects. The following applies:

PDO1(tx):   Objects 0x2001 and 0x2002 are sent

PDO2(tx):   Objects 0x2003 and 0x2004 are sent

PDO1(rx):   Object 0x2000 is received

PD02(rx):   Not used

Object 0x2000 - function byte for addressing the reader(s)

	Reader							
	Address 3		Address 2		Address 1		Address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Table 7.2   For notes on function F0, see Section 4.1 to 4.3 .

Object 0x2001 ... 0x2004 - 4 Bytes of Data from the Reader

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	ERR	OUT	A1	A0

Table 7.3   For a description of the data bits see chapter 16.4.

If a reader is not configured, all four data bytes of the corresponding object contain the value 0x00. A reader is not configured if the number of connected readers does not match the set number on rotary switch S4.

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Object 1011h (Restore default parameters) is not supported by WCS-CG210.

7.3.6 Connection to Lenze Servo Inverters, Series 9300

Set the number of readers and the baud rate range via the rotary switch S4. See chapter 7.3.1. In position A..D, the protocol for the Lenze servo inverters of series 9300 is set at the same time.

Rotary switch S4

Switch setting S4	Number of readers	Addresses	Baud rate range
9	1 reader	Address 0	BD set A
A	2 readers	Address 0, 1	BD set A
B	3 readers	Address 0, 1, 2	BD set A
C	4 readers	Address 0, 1, 2, 3	BD set A

Object 0x2001 ... 0x2004 - 4 Bytes of Data from the Reader (Lenze Specification)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	ERR	OUT	A1	A0

Table 7.4   For a description of the data bits, see Section 4.3.

8 WCS-DG210 Interface Module

8.1 Use and Application

The WCS-DG210 is used as an interface between the WCS reader and the DeviceNet bus. The data between the reader(s) and the WCS-DG210 is transferred via the RS485 interface and from the WCS-DG210 to the controller via the DeviceNet protocol.
You can connect up to four readers of type LS221 or LS121. If you connect several readers, they must have different addresses. The WCS-DG210 meets the conditions laid down in "DeviceNet Specification Release V2.0" and works as a DeviceNet "Group 2 only Slave". (Vendor ID:272, device type: 12). The interface module allows data transfer rates up to 500 kBaud in DeviceNet.
The WCS-DG210 is compatible with the predecessor model WCS-DG110.

8.2 Installation

8.2.1 Electrical Connection

Connecting the interface module to the voltage

1. Connect terminal 1 of the 5-pin X1 plug on the interface module with operating voltage 24 V ± 20 %.

2. Connect terminal 2 of the 5-pin X1 plug on the interface module with the ground 0 V.

   ↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

8.3 Commissioning

8.3.1 Connecting the reader

If you install several WCS readers together on one interface module, the readers must have different addresses. This will allow the PLC to allocate the data to the correct readers. If you connect only one WCS reader to the interface module, this reader is always given the address 0. You can connect up to four WCS readers to the interface module via an RS485 line. When delivered, each reader has the default address 0. For information on how to change the address of the reader, see the configuration instructions for the reader.

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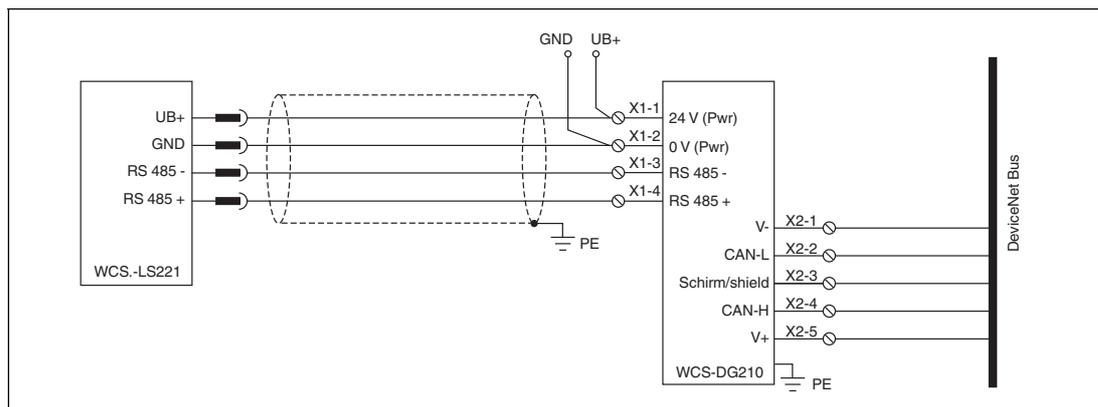
Figure 8.1   Electrical Connection

Connection of the Reader to the Interface Module

X1 terminal		Designation
1	24 V (PWR)	Operating voltage interface module/ operating voltage readers
2	0 V (PWR)	Ground interface module/ ground readers
3	RS 485-	RS 485- data line to reader
4	RS 485+	RS 485+ data line to reader
5	n.c.	Not used

Table 8.1   WCS-DG210 terminals

Connecting the Reader to the Interface Module

1. Connect terminals 1 and 2 of the 5-pin X1 plug on the interface module with the supply voltage for the readers. Ensure correct polarity.

2. Connect terminal 3 of the 5-pin X1 plug on the interface module with the RS485 data line to the readers. Ensure correct polarity.

Reader terminal pin			Interface module terminal
WCS2A	WCS3A	WCS3B	
2	1	1	X1-1
4	2	2	X1-4
1	3	4	X1-3
3	5	3	X1-2

Setting the Number of Connected Readers

Set the number of connected readers with the rotary switch S4 in accordance with the table "Rotary Switch S4".

Rotary switch S4

Switch setting S4	Number of readers	Addresses
1	1 reader	Address 0
2	2 readers	Address 0, 1
3	3 readers	Address 0, 1, 2
4	4 readers	Address 0, 1, 2, 3

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Setting Baud Rate

You can set the baud rate in DeviceNet with two switches on the 8-way DIP switch of the WCS-DG210. The location of the DIP switches is marked on the device label.

DIP switches		Baud rate
7	6	
0	0	125 kBaud
0	1	250 kBaud
1	0	500 kBaud
1	1	125 kBaud

Note!

Always set the "Interface" sliding switch to position "485".

If the module is located at the beginning or at the end of the data line to the readers, you have to activate the RS485 terminator. To do this, set the "RS 485 termination" sliding switch to "On".

If you connect only one reader on the WCS-DG210, you must always set the "RS 485 termination" sliding switch to "On".

8.3.2 Connection to the controller

Connect the WCS-DG210 interface module to DeviceNet via the 5-pin connector with X2 screw terminals.

Set the MAC ID of the DeviceNet address via the 6-pin DIP-switch "Node ID". MAC ID "0" is not allowed.

You can switch the terminator in the DeviceNet bus on and off via the "Termination" sliding switch.

Connection of the Reader to the Interface Module

X2 terminal		Designation
1	V- (PWR)	0 V
2	CAN-L	Dominant low
3	Shielding	Cable shield
4	CAN-H	Dominant high
5	V+	24 V_{DC}

Table 8.2   WCS-DG210 terminals, bus side

8.3.3 Meaning of LEDs

Power:

The "Power" LED is green: The WCS-DG210 interface module is correctly connected to the power supply.

BusPower:

The "Power" LED is green: The LED is connected directly to the electrically isolated supply voltage of the DeviceNet side.

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BusState:

The "BusState" LED is green:	Connected to the DeviceNet master
The "BusState" LED flashes green:	No connection to the DeviceNet master
The "BusState" LED is red:	Serious error on DeviceNet bus (for example, double MAC ID)
The "BusState" LED flashes red:	Recoverable error (e.g., timeout error)
The "BusState" LED flashes red/green:	Communication error

State:

The "State" LED is green: Data exchange is taking place with the readers. Using the four "Error No/Select ID" LEDS, the number of the currently polled reader is displayed.

ErrorNo/Select ID				Reader address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1
0	1	0	0	2
1	0	0	0	3

The "State" LED is red: The interface module has detected an error or a warning. The interface module displays the binary coded error and/or warning number via the "Error No/Select ID" LEDs. For a description of the error codes see chapter 16.5.

Error (No. 1...7):	Switch the interface module off and back on. If the error occurs again, the module must be replaced.
Warning (No. 8...15):	The warning provides information. The interface module displays the warning for one minute and then resets automatically.

8.3.4 Data Exchange in DeviceNet

In DeviceNet, the DG210 works as a "Group 2 Only Slave". The access methods "polling", "bit-strobe", and "change of state" are supported. If you connect more than two readers on the WCS-DG210, you can query the data from the master only via polling access. The sending of a function byte is likewise only possible in polling mode.

Polling

In polling, a function byte is sent from the master to the WCS-DG210. The WCS-DG210 then returns 16 data bytes. The 16 bytes contain the data of the four readers (4 x 4 bytes). If fewer than four readers are configured (via rotary switch S4), the four data bytes for the readers not configured contain the value 0x00.

	Reader address 3		Reader address 2		Reader address 1		Reader address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

Table 8.3   Function byte for addressing the reader(s) during polling

For notes on function F0, see chapter 16.2

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Bit-strobe

With bit-strobe access, the "Bit-Strobe" command is sent from the master without any further data. The master then always receives 8 data bytes from the interface module as a response. The 8 data bytes contain the data of the readers with the address 0 and 1 (2 x 4 bytes). If the reader with address 1 is not connected (rotary switch S4 is in position 1), the 4 data bytes for this reader are 0x00.

Change of State

In this method, the WCS-DG210 sends 8 data bytes to the master without request as soon as the content of the data has changed. The data format corresponds to the data format for bit-strobe access. If the reader data changes constantly, e.g., if the reader is moving quickly, the data is sent every 5 ms. In this case, the pause time is necessary to avoid overloading the DeviceNet bus.

Data Format of the Interface Module for One Reader

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	ERR	OUT	A1	A0

Note!

For some controllers, the position of the bytes in a word are swapped. For a description of the data bits, see chapter 16.4.

8.3.5 EDS Configuration File

To assist with the configuration, you can download the EDS file from the download area of our Internet homepage http://www.pepperl-fuchs.com. Simply enter the product name or item number in the **Product/Keyword** search box and click **Search**.
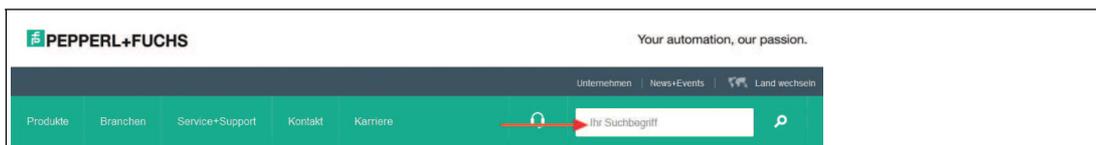
Select your product from the list of search results. Click on the information you require in the product information list, e.g., **Software**.

A list of all available downloads is displayed.

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9 WCS-EIG310 Interface Module

9.1 Use and Application

The WCS-EIG310 interface module acts as an interface between the WCS reader and the EtherNet/IP. Data is transferred between the reader and the interface module via an RS485 interface. The data from the interface module to the PLC is transferred using the EtherNet/IP protocol. The data is converted in the WCS-EIG310 interface via a script.

You can connect a maximum of four WCS readers of type LS221 (and/or LS121) to one WCS-EIG310 interface module. If you connect several readers, they must have different addresses. The number of connected readers is configured in the hardware project settings.

9.2 Installation

9.2.1 Electrical Connection

Connector X1 is located on the top side of the interface module, connector X2 on the underside.

Note!

To use with an RS485 interface, terminal "Rx 422+" on connector X1 must be connected to terminal "Tx 422+", and terminal "Rx 422-" must be connected to terminal "Tx 422-".
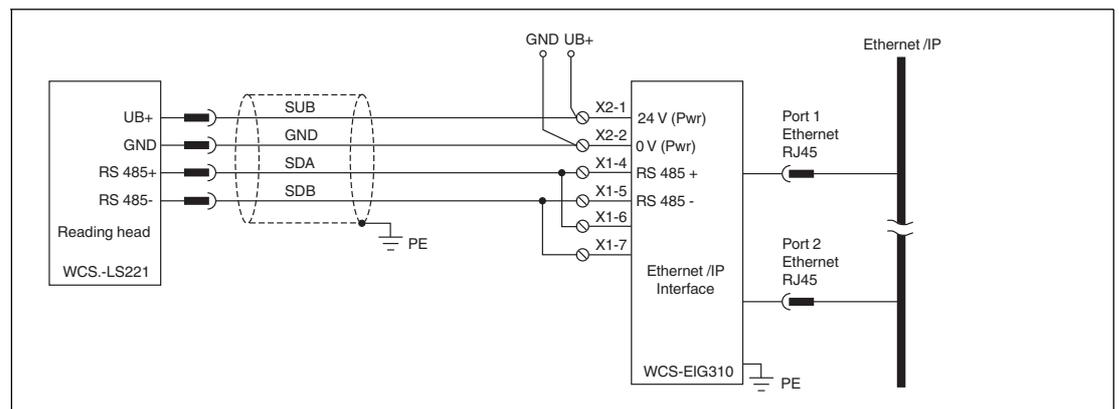
Figure 9.1   Electrical connection

Clamp		Designation
4	Rx 422+	Data line RS 485+ to reader
5	Rx 422-	Data line RS 485- to reader
6	Tx 422+	
7	Tx 422-	

Table 9.1   Terminal X1

Preparing to use the RS485 interface

1. Connect terminal 4 "Rx 422+" to terminal 6 "Tx 422+".

2. Connect terminal 5 "Rx 422-" to terminal 7 "Tx 422-".

Clamp		Designation
1	UB (Pwr)	Operating voltage interface module/ operating voltage reader
2	0 V (Pwr)	Ground interface module/ground reader

Table 9.2   Terminal X2

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

Connecting the interface module to the voltage

Connect the operating voltage (10 VDC ... 30 VDC) to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

9.3   Commissioning

9.3.1   Connecting the readers

If you install several WCS readers together on one interface module, the readers must have different addresses. This will allow the PLC to allocate the data to the correct readers. If you connect only one WCS reader to the interface module, this reader is always given the address 0. You can connect up to four WCS readers to the interface module via an RS485 line. When delivered, each reader has the default address 0. For information on how to change the address of the reader, see the configuration instructions for the reader.

The number of connected readers and their operating mode is configured in the hardware project settings. For hardware planning, use the EDS file which can be downloaded from our website: http://www.pepperl-fuchs.com (see chapter 15.3.4).

Reader terminal pin		Interface module terminal
WCS2B	WCS3B	
2	1	X2-1
4	2	X1-4
1	4	X1-5
3	3	X2-2

Table 9.3   Connection of WCS readers

Connecting the reader

1. Connect the power supply for the reader to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

2. Connect the RS485 data line to the reader on terminals 4 and 5 of connector X1.

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If you operate the WCS-EIG310 interface module at the beginning or end of the RS485 bus, you must activate the RS485 terminator.

Activating the RS485 terminator

1. To use with an RS485 interface, slide the "Rx 422" switch to OFF.

2. To activate the RS485 terminator, slide the "Tx 422" switch to ON.

3. To deactivate the RS485 terminator, slide the "Tx 422" switch to OFF.

4. If only one reader is connected, you must always activate the RS485 terminator. Slide the "Tx 422" switch to ON.

9.3.2 Cable Routing in the Network

On the network side, the interface is connected via two 8-pin RJ-45 sockets "RJ45 EtherNet/IP" on the underside of the device. The front socket is labeled "X3 P1", and the rear socket is labeled "X3 P2".

Pin assignment X3 P1 & X3 P2

Clamp		Designation
1	TD+	Transmission line +
2	TD-	Transmission line -
3	RD+	Receive line +
4		
5		
6	RD-	Receive line -
7		
8		

Table 9.4   Assignment of the 8-pin RJ-45 sockets "RJ45 EtherNet/IP"

Note!

The cable to the surrounding modules on the Ethernet line must be at least 0.6 m long.

Connecting the device to the controller

Plug the EtherNet connector into the RJ45 socket. Use a Cat. 5 data cable.

Setting data exchange mode

Set the "S4" and "S5" rotary switches to position 0.

9.3.3 Setting the rotary switch

On the front of the device there are two rotary switches "S4" and "S5". The rotary switch "S5" must always be in position 0.

The position of the rotary switch "S4" depends on the number of read heads and the desired data output.

Setting rotay switch "S4"

Configuration	Switch position "S4"
1 read head	0
2 read heads	1
3 read heads	2
4 read heads	3

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Configuration	Switch position "S4"
1 read head with velocity output	4
2 read heads with velocity output	5
3 read heads with velocity output	6
4 read heads with velocity output	7

Example:

You have connected three read heads to the interface module and want to use the velocity output. Turn the rotary switch "S4" to the sixth position.

9.3.4 Integrating WCS-EIG310 into the Network

Caution!

Device not configured or configured incorrectly

System failure caused by incorrectly configured device

Configure the device prior to commissioning.

Note!

You can use any project planning tool to configure the interface module.

The device properties are held in an EDS file. The EDS file can be downloaded from our website: http://www.pepperl-fuchs.com.

Downloading EDS File from the Internet

On our home page (http://www.pepperl-fuchs.com), select the product selector and look for the product designation (WCS-EIG310). Click on **Technical Documents**.

↪ This will take you to the EDS file, which has been compressed ready to download.

Every node within an EtherNet/IP network must have a unique name. Every node is identified by its device name and IP address.

When delivered, the WCS-EIG310 interface module has the following configuration:
IP address: 10. 10. 10. 10
Device name: WCS_EthernetIP
During the project planning phase you can change the IP address and the device name. If you are using more than one interface module in the network, you must assign each interface module a name that will enable the PLC to uniquely identify the device, e.g., WCS-EIG310A, WCS-EIG310B, etc. Each name may appear only once in the network.

9.3.5 Setting the IP Address and Subnet Screen

To set the device IP address, the subnet screen, and the gateway IP address, you need the WCS configuration tool UGC_PF.

Downloading the Software Tool from the Internet

On our home page (http://www.pepperl-fuchs.com), select the product selector and look for the product designation (WCS-EIG310). Click on **Technical Documents**.

↪ This will take you to the file, which has been compressed ready to download.

WCS configuration tool UGC_PF

Unzip the files contained in the ZIP file in a directory of your choice on your computer. Start UGC_PF.exe and then select "Help" from the menu bar. Select "Readme" in the drop-down menu. Here you will find a brief functional description of the WCS configuration tool UGC_PF.

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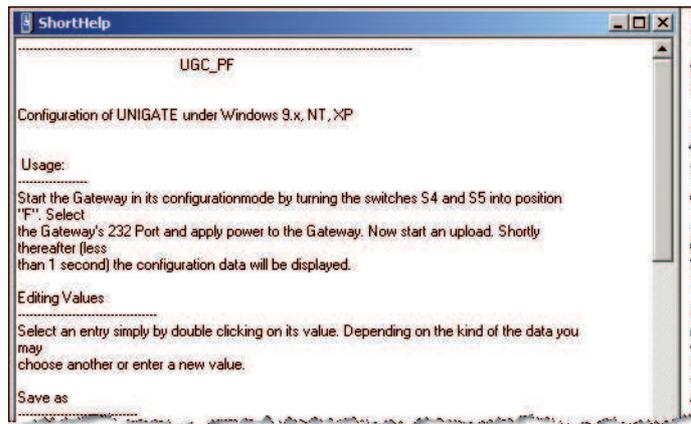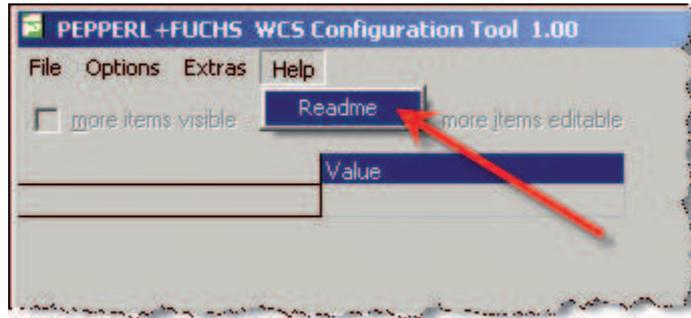
1. Set the two rotary switches S4 and S5 on the front panel of the interface module to position F.

2. Establish a connection between the RS232 interface of the interface module and your PC.

3. Using "Upload", load the configuration of the interface module to the software screen.

4. Select the entry to be edited by double-clicking and then edit it. Proceed in the same way with all entries to be changed until the configuration matches your specifications.

5. Save the configuration via "Save" or "Save as".

6. Write the changed configuration to the interface module via "Download".

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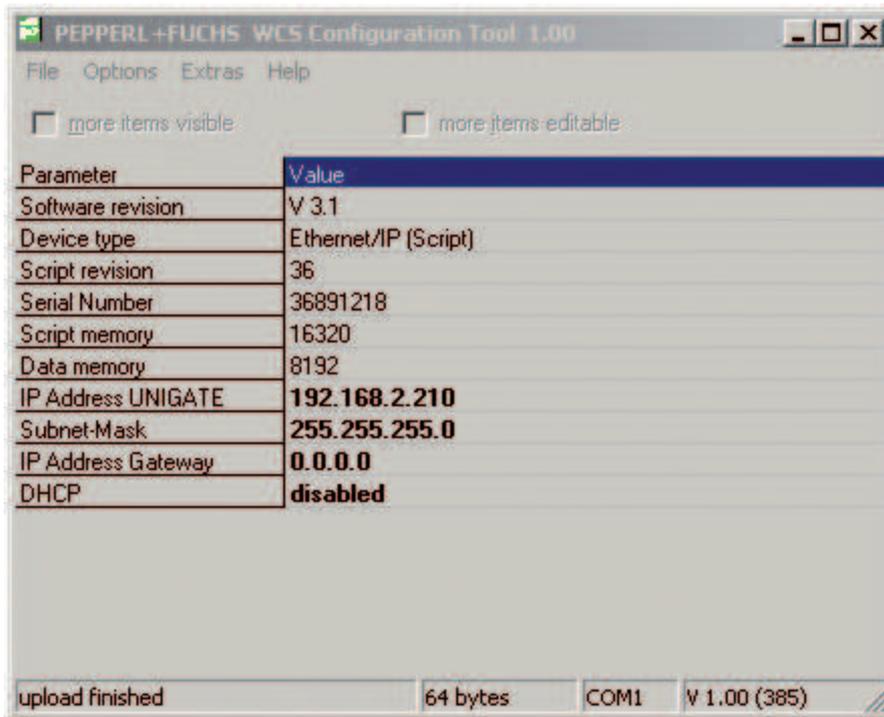
The configuration has now been changed according to your requirements and saved in the nonvolatile memory of the interface module.

► Setting Rotary Switches S4 and S5

1. Switch off the interface module.

2. Close the WCS configuration tool UGC_PF.

3. Disconnect the RS232 connection between the interface module and the PC.

4. Set rotary switch S5 to position 0.

5. Set rotary switch S4 to the correct position in accordance with your hardware configuration see chapter 9.3.3

↳ The interface module is now ready.

9.3.6 WCS-EIG310 Network Settings

The WCS-EIG310 interface uses implicit messaging. Therefore, any position and speed data is mapped directly in the controller. The following figure shows the correct setting for integrating the interface module into the network.

Parameters	Value
Input assembly	101
Output assembly	100
Configuration assembly	4
Minimum RPI	20 ms

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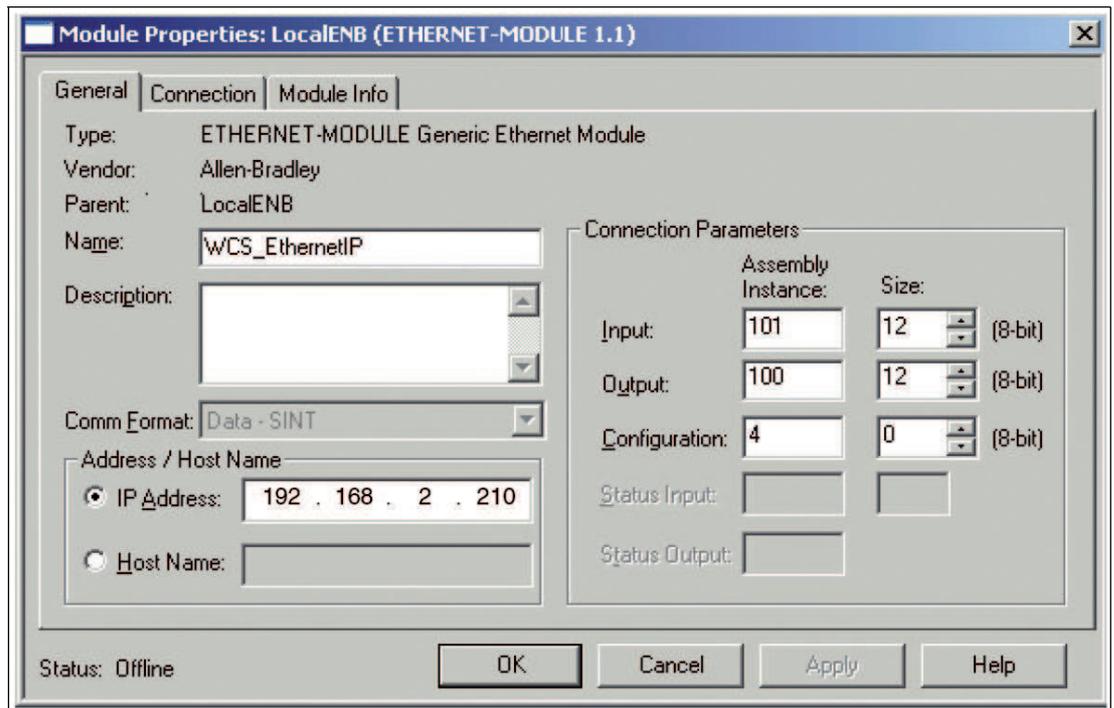
Figure 9.2   Network settings

You can enter all values with the exception of the values for "Input Size" and "Output Size" on the input screen of your project planning tool. The values for "Input Size" and "Output Size" depend on the number of readers and the desired data output. You have to adjust these according to your hardware configuration.

Values for "Input Size" and "Output Size"

Hardware configuration	"Input Size" and "Output Size"
1 reader	4 bytes
2 readers	8 bytes
3 readers	12 bytes
4 readers	16 bytes
1 reader with velocity output	6 bytes
2 readers with velocity output	12 bytes
3 readers with velocity output	18 bytes
4 readers with velocity output	24 bytes

Example:

You have connected three readers to the interface module and want to use the velocity output. Enter the value 18 in both fields "Input Size" and "Output Size".

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9.4 Communication with WCS read heads

9.4.1 Request byte for read heads

	read head address 3		read head address 2		read head address 1		read head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

F0=0: The read head sends the position data to the interface module. This standard function is automatically active after commissioning.

F0=1: The read head sends the result of the diagnostic function.

For more information on the function of F0 .

9.5 Software Tool for RSLogix 5000, V15, and V17

This small tool divides the 4- or 6-byte-long telegrams of each reader into the position values, the speed values, and diagnostic information.
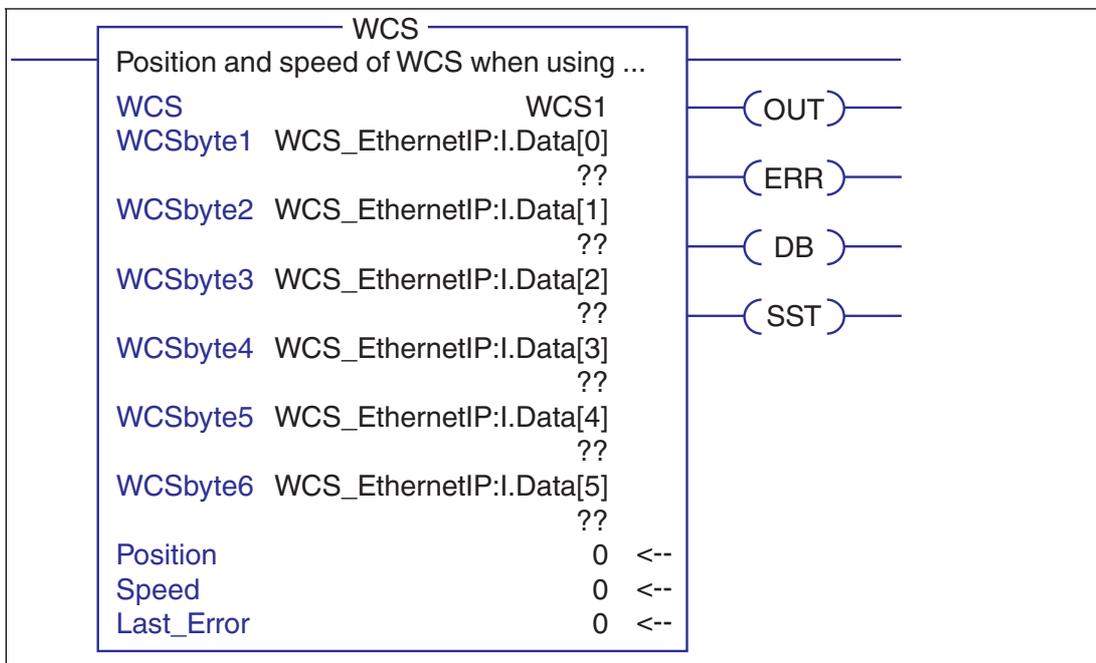
- Position: position data of the read head

- Speed: speed of the read head = speed value x 0.1 m/s

- Last Error: If an error bit is active, it will appear here. It can be reset by the user.

- SST: Status bit speed, usually "0". "1" when an invalid speed value occurs.

- Out: Code rail outside of read head range.

- ERR: An error has occurred. Check "Last Error" for details

- DB: dirty lens system. Please clean the scanning system with a soft, damp cloth without cleaning additives.

Downloading the Software Tool from the Internet

On our home page (http://www.pepperl-fuchs.com), select the product selector and look for the product designation (WCS-EIG310). Click on **Technical Documents**.

↳ This will take you to the file, which has been compressed ready to download.

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10 WCS-IG110 Interface Module

10.1 Use and Application

The WCS-IG110 interface module serves as an interface between the WCS reading head and the Interbus-S. Data is transferred between the reading head and the interface module via an RS 485 interface. The data from the interface module to the controller is transferred via the Interbus-S protocol.

The WCS-IG110 interface module transmits the data in binary code or gray code. The data is transferred to the Interbus-S at a rate of 500 kbaud or 2 Mbaud.

You can connect one or two WCS reading heads Type LS221 (and/or LS121) to a WCS-IG110 interface module. If you connect two reading heads, they must have different addresses. The number of connected reading heads is set using a rotary switch. If you wish to connect up to four reading heads to the interface module, please contact Pepperl+Fuchs.

You can replace type WCS-IS2xx interface modules with interface module WCS-IG110.

10.2 Installation

10.2.1 Electrical Connection

The interface module has two terminal lugs for the connection to the protective ground. For the connection to the protective ground, use cable with a core cross-section of at least 1.5 mm^2.
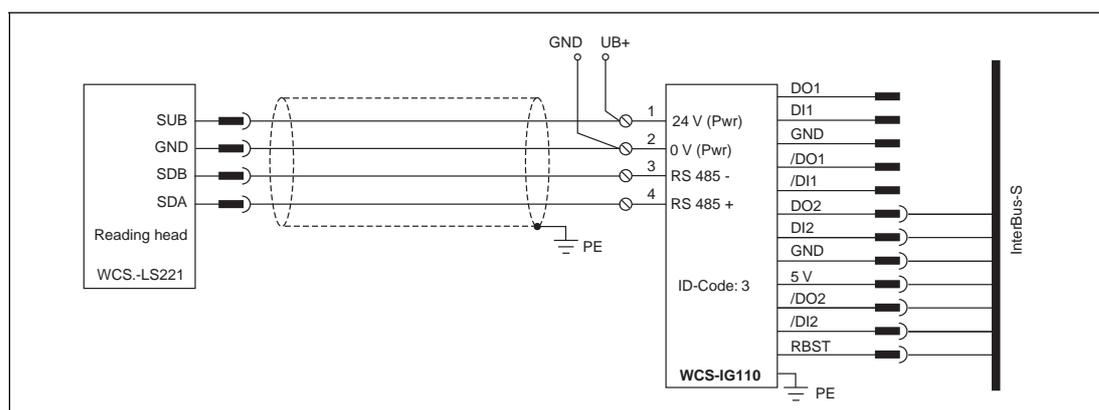
Figure 10.1   Electrical connection

Clamp		Designation
1	24 V (Pwr)	Operating voltage interface module/operating voltage reader
2	0 V (Pwr)	Ground interface module/ground reader
3	RS 485-	Data line RS 485- to reader
4	RS 485+	Data line RS 485+ to reader
5		Not used

Table 10.1   Terminals, WCS-IG110 interface module

⚠ **Caution!**
Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

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▶ Connecting the interface module to the voltage

Connect the operating voltage (24 V ±DC 20 %) to terminals 1 and 2 of the 5-pin plug on the interface module.

↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

10.3 Commissioning

10.3.1 Connection of the reading head(s)

If you install several WCS reading heads together on one bus (maximum of 4 reading heads), the reading heads must have different addresses. In this way, the controller can assign each one individually. If you connect only one WCS reading head to the interface module, this reading head always receives the address 0. You can connect one or two WCS reading heads via an RS 485 line on the interface module. The address of the reading heads is contained in the type designation, e.g. LS221-0: reading head with the address 0, LS221-1: reading head with the address 1. If no address has been noted, the WCS reading head has the address 0.

Use rotary switch S5 to select the number of connected reading heads. Regardless of the number of reading heads, 1 byte is reserved for activating the reading head(s) in the master. For the response data, 4 bytes are reserved per reading head. The WCS-IG110 interface module sends the reading head data to the master. The data is transferred without a delay because the interface module continuously queries the reading heads independently of the Interbus-S.

Terminal pin reading head		Terminal interface module
WCS2B	WCS3B	
2	1	1
4	2	4
1	4	3
3	3	2

Table 10.2   Connection of WCS reading heads

▶ Connect reading head

1. Connect the power supply for the reading head to terminals 1 and 2 of the 5-pin connector on the interface module.

2. Connect the RS 485 data line to the reading head to terminals 3 and 4 of the 5-pin connector on the interface module.

3. Always set the rotary switch "Interface" to position "485".

If you operate the WCS-IG110 interface module at the beginning or end of the RS 485 bus, you must activate the RS 485 terminator.

▶ Activate RS 485 terminator

1. To activate the RS 485 terminator, switch the "RS 485 Termination" sliding switch to "On".

2. To deactivate the RS 485 terminator, switch the "RS 485 Termination" sliding switch to "Off".

3. If only one reading head is connected, you must always activate the RS 485 terminator. To do so, switch the "RS 485 Termination" sliding switch to "On".

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S5 position	Code	Description
0	Gray code	1 reading head connected, 4 bytes in the Interbus-S
1	Gray code	2 reading heads connected, 8 bytes in the Interbus-S
2	Binary code	1 reading head connected, 4 bytes in the Interbus-S
3	Binary code	2 reading heads connected, 8 bytes in the Interbus-S
4	-	Reserved
5	-	Reserved
6	-	Reserved
7	-	Reserved
8...F	-	Reserved for substitute mode

Table 10.3   Adjustment options on rotary switch S5

Selecting the number of connected reading heads and codes

1. Use rotary switch S5 to set the number of connected reading heads and the code. The positions for S5 can be found in the table.

2. Rotary switch S4 is not used. Set rotary switch S4 to position "0".

10.3.2   Connection to the controller

There are two 9-pin Sub-D connectors on the front of the WCS-IG110 interface module for connecting the Interbus-S cable. The 9-pin socket and the 9-pin mating connector for attaching the 9-pin connectors are not included in the delivery package.

Terminal	Description
1	DO1
2	DI1
3	GNDI
6	/ DO2
7	/ DI1

Table 10.4   Terminal assignment of the 9-pin Sub-D mating connector for an incoming Interbus-S cable (IBS-IN)

Terminal	Description
1	DO2
2	DI2
3	GND
5	5 V
6	/ DO2
7	/ DI2
9	RBST

Table 10.5   Terminal assignment of the 9-pin Sub-D socket for intermediate Interbus-S cable (IBS-OUT)

Connect interface module to controller

1. Plug the socket on the incoming Interbus-S cable to the 9-pin Sub-D mating connector.

2. Plug the connector on the intermediate Interbus-S cable into the 9-pin Sub-D socket.

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3. If you are operating other devices downstream of the interface module via the Interbus-S, solder a bridge between terminal 5 (5 V) and terminal 9 (RBST) on the intermediate cable connector.

10.3.3   LED meaning

Power:

The "Power" LED lights up green: The WCS-IG110 interface module is correctly connected with the power supply.

State:

The "State" LED lights up green: Data exchange takes place with the reading heads. Using the four "Error No/Select ID" LEDs, the number of the currently polled reading head is displayed.

ErrorNo/Select ID				Reading head address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1

The "State" LED lights up red: The interface module has recognized an error or a warning. The interface module displays the binary coded error and/or warning number via the "Error No/Select ID" LEDs. For a description of the error codes .

Error (No. 1...7):	Switch the interface module off and back on. If the error occurs again, the module must be replaced.
Warning (No. 8...15):	The warning provides information. The interface module displays the warning for one minute and then resets automatically.

Bus state:

The "Bus state" LED lights up green:	Data exchange in the Interbus-S active
The "Bus state" LED flashes red and green:	No data exchange in the Interbus-S for more than 0.5 s
The "Bus state" LED lights up red:	Interbus-S reset

UL, RC/CC, RD, BA:

The four LEDs allow a diagnosis of the interface module.

The "UL" LED lights up green:	Interbus-S connected with the power supply
The "RC/CC" LED lights up green:	Incoming cable connection is in order, Interbus-S master not resetting (remote bus check)
The "RD" LED lights up red:	Intermediate Interbus-S interface deactivated
The "BA" LED lights up green:	Data exchange in the Interbus-S active

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10.3.4 Data exchange between the WCS-IG110 interface module and master

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Word n+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.6   Activation of the interface module by the master

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	DB	ERR	OUT	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0
Word n+1	P15	P14	P13	P12	P11	P10	P9	P8	0	0	0	0	0	P18	P17	P16

Table 10.7   Response from the interface module

To see what the data bit means .

If the code you selected was gray code, the position value and error code (ERR=1) are included in the gray code.

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11 WCS-IP110, WCS-IP111, WCSIP120, WCS-IP121 Interface Modules

11.1 Use and Application

For an interface module with a parallel interface, the data is transferred in series between the reader(s) and the serial interface module via the RS485 interface and from the interface module to the controller in parallel. The control data can be output in binary code (IP110) or Gray code (IP111). The interface module can be supplied with and without an RS485 terminator.

You can connect up to four readers of type LS221 or LS121. If you connect more than two readers, you have to specify the number of connected readers when ordering the interface module.

11.2 Installation

11.2.1 Electrical Connection

Connecting the interface module to the voltage

1. Connect the UB+ terminal on the interface module with the operating voltage 24 V ± 10%.

2. Connect the GND terminal on the interface module with the ground 0 V.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

Wire Connection

- 30 box terminals with captive plus minus screws

- Box terminal strips removable separately via plug-in technology

- Per box terminal:

  - 1 x 4 mm^2 solid; or

  - 1 x 2.5 mm^2 stranded wire with DIN 46 228 sleeve; or

  - 2 x 1.5 mm^2 stranded wire with DIN 46 228 sleeve

11.3 Commissioning

11.3.1 Connecting the reader

Connect the power supply for the readers to the SUB and GND terminals on a terminal block. The output for the power supply to the readers matches the operating voltage but is protected in the device via a fuse (short-circuit protection for reader). The microfuse (5 mm x 20 mm, 1 A Quick) is designed for a power rating of up to max. 20 VA. When connecting more than two WCS2 readers with the additional heating option (9 VA output), the supply voltage for the readers must be picked up at the operating voltage connection of the interface module. At terminals SDA and SDB, the RS485 data cable is connected to the readers.

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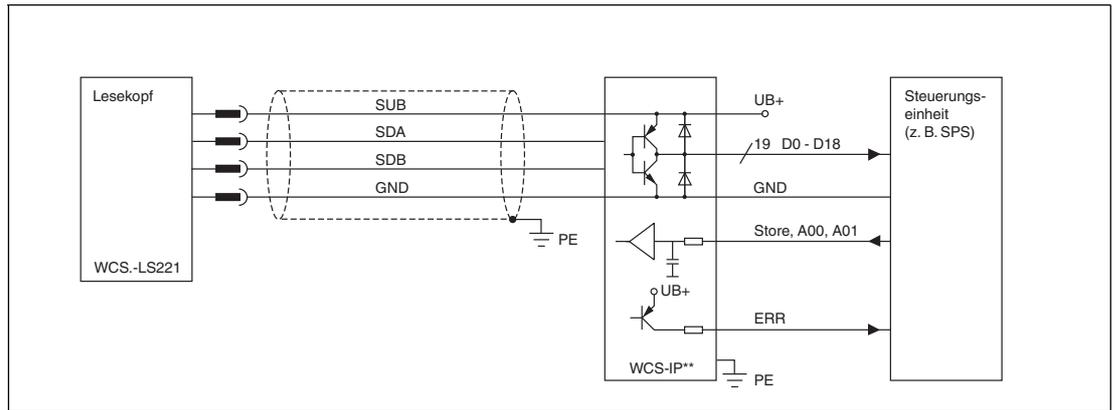
Figure 11.1   Electrical Connection

Interface module terminal

Terminal	Designation
UB+	Interface module operating voltage
GND	Interface module ground
SUB	Reader operating voltage
SDA	RS 485+ data line to reader
SDB	RS 485- data line to reader
GND	Reader ground
A00, A01	Input: address for selecting reader
STO	Input: store bit
ERR	Output: error bit
P00 ... P18	Output: 19-bit position value
PE	Ground wire connection

Table 11.1   Terminal WCS-IP1*

▶ Connecting the Reader to the Interface Module

1. Connect the SUB and GND terminals of the terminal block with the power supply for the readers. Ensure correct polarity.

2. Connect the SDA and SDB terminals of the terminal block with the RS485 data line to the readers. Ensure correct polarity.

Note!

The output for the power supply to the readers matches the operating voltage. The supply voltage of the readers is protected in the device by a fuse to protect the readers in the event of a short circuit. The microfuse (5 mm x 20 mm, 1 A Quick) is designed for a power rating of up to max. 20 VA.

If you want to connect more than two WCS2 readers with the additional heating option (9 VA output), you have to pick up the supply voltage for the readers at the operating voltage connection of the interface module.

Reader terminal pin			Interface module terminal
WCS2A	WCS3A	WCS3B	
2	1	1	SUB
4	2	2	SDA
1	3	4	SDB
3	5	3	GND

Address lines A00 and A01

If you want to operate multiple readers on an interface module, you have to select the reader whose data is to be output at the outputs via the two address inputs. If only one reader with the address 0 is connected on the interface module, the address inputs are not connected. After switching the address lines, the interface module requires a maximum of 1.5 ms until the position value for the selected reader is available on the interface.

A00	A01	Reader address
0	0	0
0	1	1
1	0	2
1	1	3

11.3.2   Connection to the controller

The position value is transferred to the controller via 19 digital outputs P00 ... P18. The 24 $_{VDC}$ outputs of the interface module work as push-pull output with a driver performance of 15 mA and are connected directly to a corresponding I/O module of the controller.

P00 is the lowest value bit (LSB) and P18 the highest value bit (MSB) of the output word. The maximum position value in the respective application is dependent on the length and coding of the code rail.

Example!

The code rail starts at the default position 0 and has a length of 50 m. The highest position value is:

WCS2: 50 m x 1200 pos./m = 60,000

WCS3: 50 m x 1250 pos./m = 62,500

In this example, only 16 outputs P00 ... P15 (= max. 65535) are required

Error Bit (ERR)

If an error is detected in the WCS system, it is passed to the controller as follows:

ERR = 1

P00 ... P04 = error code (see chapter 16.5)

This error remains pending at the outputs for at least 50 ms. If there is a module with a set Gray code (WCS-IP1.1), the error code is also output in the Gray code.

Reader Outside the Code Rail

If the reader leaves the code rail, the controller receives a defined bit pattern.

ERR = 0

P00 ... P18 = 1 (position value = 524287)

If there is a module with a set Gray code, this position value is also output in the Gray code.

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Store bit (STO)

Input for saving the outputs of the interface module. A value "1" means that the outputs are no longer changed; "0" means that the outputs are updated in a 1-ms cycle. The Store signal is active immediately. After the interface module has detected the signal at the input, the outputs are no longer updated. The data exchange with the higher level control system can be synchronized by the Store signal.

Note!

Notes on PLC Programming

To ensure an error-free import of the WCS position values, note the following:

1. Release Store signal (="0")

2. Activate address lines (only necessary if multiple readers are connected)

3. Wait: 1.5 ms

4. Activate Store signal (="1")

5. Wait: 0.1 ms

6. Read position value

7. Release Store signal (="0") etc.

In a PLC program with a cycle time > 1.5 ms, this would look as follows:

1. Cycle: Release Store signal and activate address lines

2. Cycle: Activate Store signal

3. Cycle: Read position value, release Store signal, and activate address lines

4. Cycle: Activate Store signal

5. Cycle: Read position value etc.

11.3.3 Display and Diagnostics Function

The interface module is equipped with a 6-digit, 7-segment LED display for a visual display of the reader data. Using the 16-position rotary switch to the right of the display, you can select the connected reader that you want to display the data for. The output via the interface is independent of this. A further 7-segment display to the right of the switch shows the current switch position as a function number. In the case of unknown functions, " ----" appears in the left-hand display.

Switch setting	Designation
0	Position of or error message from reader with address 0
1	Position of or error message from reader with address 1
2	Position of or error message from reader with address 2
3	Position of or error message from reader with address 3
5	Display configuration of the interface module
6	Time (mm:ss) For a device restart (RESET) time is 00.00
8	Diagnostic result for reader with address 0
9	Diagnostic result for reader with address 1
A	Diagnostic result for reader with address 2
B	Diagnostic result for reader with address 3

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Error code

If the interface module detects a malfunction in the reader or an internal error, an error code is output on the display and simultaneously transferred to the controller via the interface. Using the error code, the cause of the fault can be identified and eliminated. (see chapter 16.5).

Reader Diagnostics

The WCSA readers perform continuous self-diagnostics of optics. If dirt is detected on the reader, "-bad-" appears periodically on the display. The corresponding reader address (0 ... 3) is shown on the display to the right of the rotary switch. In addition, the reader can be requested via the rotary switch for diagnostics (see table above). The reader must be located outside of the code rail during the diagnostics process. An error message is output on the parallel interface for the corresponding reader during this time. The result of the diagnostics process is shown on the display.

Display	Description
----	Waiting for diagnostic result
–Good–	Reader is OK
-Bad-	Reader is dirty or defective
-No out-	Reader is not outside the code rail

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12   WCS-IS31*, WCS-IS32* Interface Modules

12.1   Use and Application

For an interface module with an SSI interface, the data is transferred in series between the reader and the interface module via the RS485 interface and from the interface module to the controller with SSI protocol (synchronous serial interface).

For an interface module of type WCS-IS310/320, the data is transferred to the controller in binary code. For an interface module of type WCS-IS311/321 the data is transferred to the controller in Gray code.

A reader of type LS211-0 is connected to the interface module type WCS-IS310/311. A reader of type LS221-0 is connected to the WCS-IS320/321. The interface module is always supplied with an RS485 terminator.

12.2   Installation

12.2.1   Electrical Connection

Connecting the interface module to the voltage

1. Connect the UB+ terminal on the interface module with the operating voltage 24 V ± 10 %.

2. Connect the GND terminal on the interface module with the ground 0 V.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

Wire Connection

- ■ 30 box terminals with captive plus minus screws
- ■ Box terminal strips removable separately via plug-in technology
- ■ Per box terminal:

    - • 1 x 4 mm^2 solid; or
    - • 1 x 2.5 mm^2 stranded wire with DIN 46 228 sleeve; or
    - • 2 x 1.5 mm^2 stranded wire with DIN 46 228 sleeve

12.3   Commissioning

12.3.1   Connecting the reader

Connect the power supply for the readers to the SUB and GND terminals on a terminal block. The output for the power supply of the readers matches the operating voltage but is protected in the device via a fuse (short-circuit protection for reader). The microfuse (5 mm x 20 mm, 1 A Quick) is designed for a power rating of up to max. 20 VA. When connecting more than two WCS2 readers with the additional heating option (power 9 VA), the supply voltage for the readers must be picked up at the operating voltage connection of the interface module. At terminals SDA and SDB, the RS485 data cable is connected to the readers.
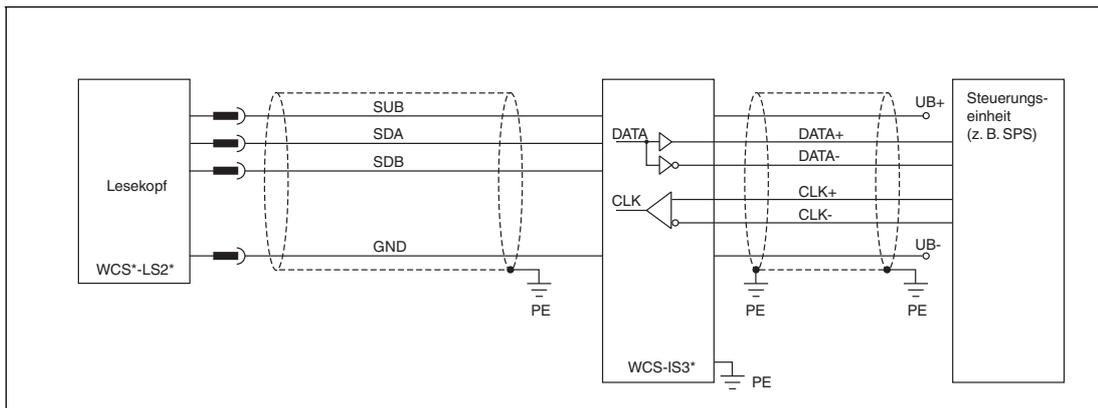
Figure 12.1   Electrical Connection

Interface module terminal

Terminal	Designation
UB+	Interface module operating voltage
GND	Interface module ground
SUB	Reader operating voltage
SDA	RS 485+ data line to reader
SDB	RS 485- data line to reader
GND	Reader ground
DATA+	Data +
DATA-	Data -
CLK+	Clock +
CLK-	Clock -
PE	Ground wire connection

Table 12.1   Terminal WCS-IS3*

Connecting the Reader to the Interface Module

1. Connect the SUB and GND terminals of the terminal block with the power supply for the readers. Ensure correct polarity.

2. Connect the SDA and SDB terminals of the terminal block with the RS485 data line to the readers. Ensure correct polarity.

Reader terminal pin			Interface module terminal
WCS2A	WCS3A	WCS3B	
2	1	1	SUB
4	2	2	SDA
1	3	4	SDB
3	5	3	GND

RS485 Reader Connection to the Interface Module/Controller

In the WCS system, the RS485 interface is used for the data communication between reader and controller. Even when the Stahltronic interface module is used, the data is transferred between the readers and the interface module via an RS485 interface.

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Reader Addresses

If you connect multiple readers in one bus, the nodes must have different addresses. The data in the bus can then be assigned uniquely using the respective bus address. The WCS bus is designed so that the controller or the interface module acts as a master. The WCS readers are slave nodes and are queried (polled) cyclically by the master.

If you connect only one reader to the controller or the interface module, this reader always receives the address 0. You can connect a maximum of four WCS readers with the addresses 0 ... 3 to an interface module or an RS485 interface of the control system via an RS485 bus line. The reader is available with four different addresses. The reader address is contained in the model designation. You can connect WCS2 and WCS3 readers in one bus line.

Example!

LS221-0: Reader with address 0

LS221-1: Reader with address 1

If the address is not clearly noted, e.g., LS221, this is synonymous with address 0. The master does not need its own address but must know the number of connected readers. See the description for the corresponding interface module.

You can request information and notes on configuring the reader address or download information from the Internet at www.pepperl-fuchs.com.

12.3.2 Connection to the controller

The interface module is connected to the controller via four lines:

- 2 cycle lines Clock + and Clock -
- 2 data lines Data + and Data -

The interface module with SSI interface corresponds to the data format of a 25-bit absolute rotary encoder with 4096 revolutions and 4096 increments/revolution. Effectively, the WCS interface module delivers up to 512 revolutions and 1024 increments/revolution. The cycle rate between the controller and the reader can be 100 kHz ... 500 kHz. The recommended value is 125 kHz ... 250 kHz.

CLK																										—
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
DATA	0	0	0	2^{18}	2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	OA	DB	KB	
						MSB											**LSB**									
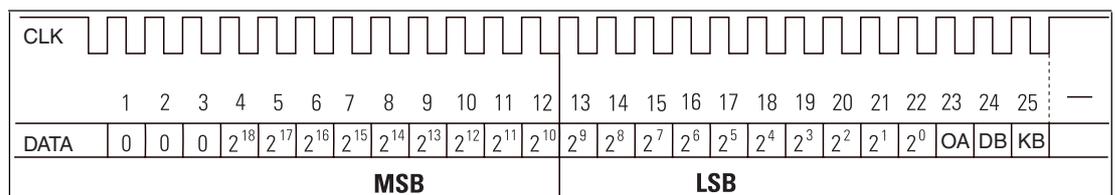
Figure 12.2   Reader/controller data format

Example!

The code rail starts at the default position 0 and has a length of 50 m. The highest position value is:

WCS2: 50 m x 1200 pos./m = 60,000

WCS3: 50 m x 1250 pos./m = 62,500

In this example, only 16 outputs P00 ... P15 (= max. 65535) are required

Fault message

If a fault exists, the error bit is set. The error bit is designated KB. In angle coders, the designation PFB—Power Fail Bit— is used.
The error code is output to the controller:

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KB $\quad$ = $\quad$ 1

POS 2^0 = $\quad$ Error number
... 2^4

POS 2^5 = $\quad$ 0
... 2^{18}

A description of the fault

Error number	Cause	Remedy
1 2	Reader cannot calculate position value	Clean optical unit. Align reader and code rail correctly; replace scratched plastic lenses Check the position of the reader in relation to the code rail; install reader correctly Check light barriers; if necessary send for repair
3	RAM error, reader	Send reader for repair
4	EPROM error, reader	Send reader for repair
5	ROM error, reader	Send reader for repair
6	Reserved	
7	No position value available	Message only after switching on the reader and/or after a RESET
8 9 10 11 12	Data transfer error between reader and interface module, data transfer disrupted	Check the cable connection from the reader to the interface module; check the shielding, protective ground, cable routing (EMC)
13	Reader cannot be addressed by the interface module	Check the cable connection from the reader to the interface module; check the operating voltage of the reader
14	Reader 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 readers	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

Reader Outside the Code Rail

The controller receives the following bit pattern if the reader is outside the code rail:

KB $\quad$ = $\quad$ 0

POS 2^0 = $\quad$ 1, (= position value 524287)
... 2^{18}

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12.3.3 Display and Diagnostics Function

The interface module is equipped with a 6-digit, 7-segment LED display for a visual display of the reader data. Using the 16-position rotary switch to the right of the display, you can select the connected reader that you want to display the data for. The output via the interface is independent of this. A further 7-segment display to the right of the switch shows the current switch position as a function number. In the case of unknown functions, " ----" appears in the left-hand display.

Switch setting	Designation
0	Position of or error message from reader with address 0
1	Position of or error message from reader with address 1
2	Position of or error message from reader with address 2
3	Position of or error message from reader with address 3
5	Display configuration of the interface module
6	Time (mm:ss) For a device restart (RESET) time is 00.00
8	Diagnostic result for reader with address 0
9	Diagnostic result for reader with address 1
A	Diagnostic result for reader with address 2
B	Diagnostic result for reader with address 3

Error code

If the interface module detects a malfunction in the reader or an internal error, an error code is output on the display and simultaneously transferred to the controller via the interface. Using the error code, the cause of the fault can be identified and eliminated. (see chapter 16.5).

Reader Diagnostics

The WCSA readers perform continuous self-diagnostics of optics. If dirt is detected on the reader, "-bad-" appears periodically on the display. The corresponding reader address (0 ... 3) is shown on the display to the right of the rotary switch. In addition, the reader can be requested via the rotary switch for diagnostics (see table above). The reader must be located outside of the code rail during the diagnostics process. An error message is output on the parallel interface for the corresponding reader during this time. The result of the diagnostics process is shown on the display.

Display	Description
----	Waiting for diagnostic result
–Good–	Reader is OK
-Bad-	Reader is dirty or defective
-No out-	Reader is not outside the code rail

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13 WCS-MBG110 Interface Module

13.1 Use and Application

The WCS-MBG110 interface module serves as an interface between the WCS read head and the Modbus RTU. Data is transferred between the read head and the interface module via an RS 485 interface. The data from the interface module to the controller is transferred via the Modbus RTU protocol. You can connect a maximum of four WCS read heads, type LS221 (and/or LS121), to one WCS-MBG110 interface module. If you connect several read heads, they must have different addresses. The number of connected read heads is set using the rotary switches.

13.2 Installation

13.2.1 Electrical Connection

Connector X1 (interface to the reader) is located on the top of the interface module. Connector X2 for the power supply to the interface module and the reader is located on the bottom, at the rear. Connector X3 (interface to the Modbus) is located on the bottom of the interface module.
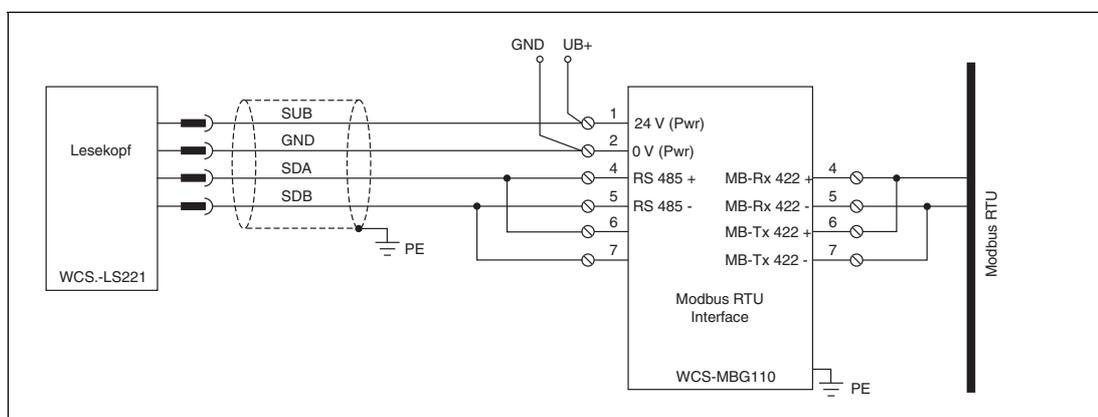
Figure 13.1   Electrical connection

Note!

To operate an RS485 interface, the terminal with the designation "Rx 422+" on connector X1 must be connected to the "Tx 422+" terminal, and the terminal with the designation "Rx 422-" must be connected to the "Tx 422-" terminal.

On connector X3, the terminal with the designation "Rx 422+" must be connected to the "Tx 422+" terminal, and the terminal with the designation "Rx 422-" must be connected to the "Tx 422-" terminal.

Clamp		Designation
4	Rx 422+	Data line RS 485+ to reader
5	Rx 422-	Data line RS 485- to reader
6	Tx 422+	
7	Tx 422-	

Table 13.1   Terminal X1

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Clamp		Designation
4	Rx 422+	Data line RS 485+ to the Modbus RTU
5	Rx 422-	Data line RS 485- to the Modbus RTU
6	Tx 422+	
7	Tx 422-	

Table 13.2   Terminal X3

▶ **Preparing to use the RS485 interface**

1. On connector X1, connect terminal 4 "Rx 422+" to terminal 6 "Tx 422+".

2. On connector X1, connect terminal 5 "Rx 422-" to terminal 7 "Tx 422-".

3. On connector X3, connect terminal 4 "Rx 422+" to terminal 6 "Tx 422+".

4. On connector X3, connect terminal 5 "Rx 422-" to terminal 7 "Tx 422-".

Clamp		Designation
1	UB (Pwr)	Operating voltage interface module/operating voltage reader
2	0 V (Pwr)	Ground interface module/ground reader

Table 13.3   Terminal X2

⚠ ***Caution!***
Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

▶ **Connecting the interface module to the voltage**

Connect the operating voltage (11 VDC ... 30 VDC) to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

↳ The "Power" LED lights up green.

○
ⵊ ***Note!***
Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

13.3   Commissioning

13.3.1   Connection of the read head(s)

If you install several WCS read heads together on one bus (maximum of 4 read heads), the read heads must have different addresses. In this way, the controller can assign each one individually. If you connect only one WCS read head to the interface module, this read head always receives the address 0. You can connect up to four read heads to the interface module via one RS 485 line. The address of the read heads is contained in the model number, e.g. LS221-0: read head with the address 0, LS221-1: read head with the address 1. If no address has been noted, the read head has the address 0.

The number of connected read heads is set using rotary switch S4.

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With rotary switch S4, you can choose one, two, three, or four connected read heads. Regardless of the number of read heads, 1 byte is reserved for activating the read head(s) in the master. For the response data, 4 bytes are reserved per read head (configuration data for 4 read heads: 0x20, 0xD1, 0xD1, 0xD1, 0xD1).

read head terminal		Interface module terminal
WCS2B	WCS3B	
2	1	X2-1
4	2	X1-4
1	4	X1-5
3	3	X2-2

Table 13.4   Connection of WCS read heads

Connecting an read head

1. Connect the power supply for the read head to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

2. Connect the RS 485 data line to the read head on terminals 4 and 5 of connector X1.

If you operate the WCS-PNG110 interface module at the beginning or end the RS 485 bus, you must activate the RS 485 terminator. To do this, use the "Termination" sliding switch.

Activating the RS 485 terminator

1. To operate on an RS 485 interface, move the sliding switch "Rx 422" on the read head side and the sliding switch "Rx 422" on the Modbus side to Off.

2. To activate the RS 485 terminator, move the sliding switch "Tx 422" on the read head side and the sliding switch "Tx 422" on the Modbus side to On.

3. To deactivate the RS 485 terminator, move the sliding switch "Tx 422" on the read head side and the sliding switch "Tx 422" on the Modbus side to Off.

4. If only one read head is connected, you must always activate the RS 485 terminator. To do this, move the sliding switch "Tx 422" on the read head side and the sliding switch "Tx 422" on the Modbus side to On.

S4 position	Description
0	1 read head connected, 38.4 kbaud
1	2 read heads connected, 38.4 kbaud
2	3 read heads connected, 38.4 kbaud
3	4 read heads connected, 38.4 kbaud
4	1 read head connected, 19.2 kbaud
5	2 read heads connected, 19.2 kbaud
6	3 read heads connected, 19.2 kbaud
7	4 read heads connected, 19.2 kbaud
8...F	Not used

Table 13.5   Adjustment options on rotary switch S4

Setting the number of connected read heads and baud rates

1. Use rotary switch S4 to set the number of connected read heads and the required baud rate. The positions for S4 can be found in the table.

2. Rotary switch S5 is not used. Set rotary switch S5 to position "0".

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13.3.2 Connection to the controller

Modbus RTU is connected via connectorconnector X3 on the bottom of the interface module.

Either 19.2 kbaud or 38.4 kbaud can be selected for the baud rate in the Modbus.

▶ **Connecting the device to the controller**

Connect the RS 485 data line to the Modbus RTU on terminals 4 and 5 of connector X3.

▶ **Setting the Modbus address**

Set the hexadecimal Modbus address using the two rotary switches S6 ("High") and S7 ("Low"). For example, to set address 19 (=13h) proceed as follows: S6=1, S7=3.

▶ **Selecting the baud rate**

Use rotary switch S4 to set the number of connected read heads and the required baud rate (see chapter 13.3.1).

13.3.3 Meaning of LEDs

Power:

The "Power" LED is green: The WCS-MBG110 interface module is correctly connected to the power supply.

Modbus Power:

The "Power" LED is green: The LED is connected directly to the supply voltage of the Modbus side.

Modbus State:

The "State" LED is green:	Data exchange active
The "State" LED flashes green:	The interface module is waiting for a connection
The "State" LED is red:	General bus fault

State:

The "state" LED is green: Data exchange is taking place with the readers. Using the four "Error No/Select ID" LEDS, the number of the currently polled reader is displayed.

ErrorNo/Select ID				Reader address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1
0	1	0	0	2
1	0	0	0	3

The "State" LED is red: The interface module has detected an error or a warning. The interface module displays the binary coded error and/or warning number via the "Error No/Select ID" LEDs. For a description of the error codes .

| Error (No. 1...5): | Switch the interface module off and back on. If the error occurs again, the module must be replaced. |
| Warning (No. 6...15): | The warning provides information. The interface module displays the warning for one minute and then resets automatically. |

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13.3.4 Activation of the read head(s)

	read head address 3		read head address 2		read head address 1		read head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

F0=0: The read head sends position data to the interface module. This standard function is automatically active after commissioning.

F0=1: The readhead transmits the result of the diagnostic function.

For more information on the function of F0 .

13.3.5 Data format of WCS-MBG110 interface module for one read head

The read head data is stored in 2 address holding registers. If no read heads are connected, the content of the register is 0000h.

Address holding register	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
40001h	0	0	0	0	0	0	0	0	OUT	ERR	A1	A0	DB	P18	P17	P16
40002h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40003h	0	0	0	0	0	0	0	0	OUT	ERR	A1	A0	DB	P18	P17	P16
40004h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40005h	0	0	0	0	0	0	0	0	OUT	ERR	A1	A0	DB	P18	P17	P16
40006h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00
40007h	0	0	0	0	0	0	0	0	OUT	ERR	A1	A0	DB	P18	P17	P16
40008h	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P01	P00

read head address 0:	Address holding register 40001h and 40002h
read head address 1:	Address holding register 40003h and 40004h
read head address 2:	Address holding register 40005h and 40006h
read head address 3:	Address holding register 40007h and 40008h

For information on the meaning of the data bit .

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14 WCS-PG210 Interface Module

14.1 Use and Application

The WCS-PG210 interface module acts as an interface between the WCS reader and the PROFIBUS. You can connect a maximum of four WCS readers of type LS221 (and/or LS121) to one WCS-PG210 interface module. If you connect several readers, they must have different addresses. The interface module constantly queries the position values of the readers and always has the current reader data. The update cycle for a reader is approximately 1 ms. The data is transferred between readers and the interface module with an RS485 interface. The data from the WCS-PG210 interface module is transferred to the controller via PROFIBUS DP.

The WCS-PG210 interface module has the following configuration:

Baud rate:	Max. 12 MBaud (automatic detection)
Diagnostic data:.	Max. 8 bytes
Sync:	Supported
Freeze	Supported
ID no.:	0X2079

14.2 Installation

14.2.1 Electrical Connection

The interface module has two terminals lugs for the connection to the protective ground. For the connection to the protective ground, use cable with a core cross-section of at least 1.5 mm^2.

Clamp		Designation
1	24 V (Pwr)	Operating voltage interface module/operating voltage reader
2	0 V (Pwr)	Ground interface module/ground reader
3	RS 485-	Data line RS 485- to reader
4	RS 485+	Data line RS 485+ to reader
5		Not used

Table 14.1   Terminals, WCS-PG210 interface module
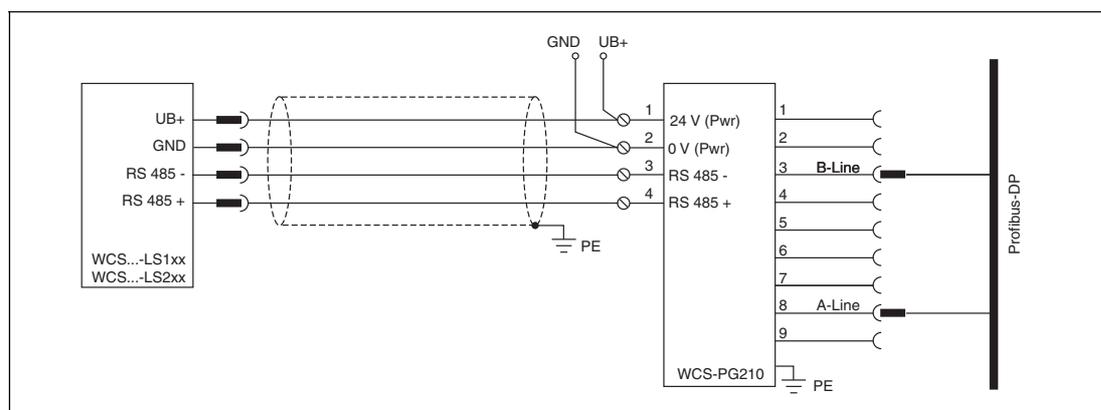
Figure 14.1   Electrical Connection

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Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

▶ **Connecting the interface module to the voltage**

Connect the operating voltage (24 V ±DC 20 %) to terminals 1 and 2 of the 5-pin plug on the interface module.

↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

14.3   Commissioning

14.3.1   Connection of the reader(s)

If you install several WCS readers together on one bus (maximum of 4 readers), the readers must have different addresses. In this way, the controller can assign each one individually. If you connect only one WCS reader to the interface module, this reader always receives the address 0. You can connect up to four WCS readers via an RS485 line on the interface module. The address of the readers is contained in the model designation, e.g., LS221-0: reader with the address 0, LS221-1: reader with address 1. If no address is specified, the WCS reader has the address 0.

Reader terminal pin			Interface module terminal
WCS2A	WCS3A	WCS3B	
2	1	1	1
4	2	2	4
1	3	4	3
3	5	3	2

Table 14.2   Connection of WCS readers

▶ **Connecting the reader**

1. Connect the power supply for the reader to terminals 1 and 2 of the 5-pin plug on the interface module.

2. Connect the RS485 data line to the reader at terminals 3 and 4.

3. Always set the "Interface" sliding switch to position "485".

4. Switch the terminator on or off via the "RS Termination" sliding switch. If the interface module is located at the beginning or end of the data line to the readers, activate the terminator. To do so, switch the "RS Termination" sliding switch to On. If only one reader is connected, always set the "RS Termination" sliding switch to "On".

14.3.2   Connection to the controller

The connection to the PROFIBUS DP is via a 9-pin connector, in accordance with the PROFIBUS standard. Therefore you need a 9-pin Sub-D plug that you can plug into the 9-pin Sub-D socket on the device. This plug is not supplied with the interface module.

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PIN	Designation
1	Protective ground
2	Not used
3	B line
4	Not used
5	Weight
6	5 VDC
7	Not used
8	A line
9	Weight

Table 14.3   PIN assignment for the 9-pin connector

Setting the PROFIBUS Address

Set the PROFIBUS address using the two "PROFIBUS ID" rotary switches ("High" and "Low"). For example, you set the address 19 (=13 h) as follows: High=1, Low=3.

Switching the Terminator On/Off

You switch the terminator on or off in the PROFIBUS via the "Termination" sliding switch.

14.3.3   Meaning of LEDs

Power:

The "Power" LED is green: The WCS-PG210 interface module is correctly connected to the power supply.

BusPower:

The "BusPower" LED is green: The LED is connected directly to the supply voltage of the PROFIBUS side.

BusState:

The LED is green:	Data exchange on the PROFIBUS
The LED flashes red/green:	The interface module is waiting for PROFIBUS configuration data
The LED is red:	Error on the PROFIBUS

BusError:

The "BusError" LED is red: The interface module cannot exchange any data on the PROFIBUS.

State:

The "state" LED is green: Data exchange is taking place with the readers. Using the four "Error No/Select ID" LEDs, the number of the currently polled reader is displayed.

ErrorNo/Select ID				Reader address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1
0	1	0	0	2
1	0	0	0	3

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The "State" LED is red: The interface module has detected an error or a warning. The interface module displays the binary coded error or warning number via the LEDs "Error No/Select ID" and sends the number to the PROFIBUS master via the external diagnostic byte. For a description of the error codes see chapter 14.3.8.

Error (No. 1...7):	Switch the interface module off and back on. If the error occurs again, the module must be replaced.
Warning (No. 8...15):	The warning provides information. The interface module displays the warning for one minute and then resets automatically.

14.3.4 Data Exchange with the PROFIBUS DP Master

To configure the PROFIBUS DP master you need the General Station Description file (GSD file). These are available on our website to download: http://www.pepperl-fuchs.com.

With the configuration file, you can choose one, two, three, or four connected readers. Regardless of the number of readers, 1 byte is reserved for activating the reader(s) in the master. For the response data, 4 bytes are reserved per reader (configuration data for four readers: 0x20, 0xD1, 0xD1, 0xD1, 0xD1).

14.3.5 Activation of the reader(s)

	Reader address 3		Reader address 2		Reader address 1		Reader address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

For a description of the function of F0 .

14.3.6 Data Format of WCS-PG210 Interface Module for One Reader

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word n	0	0	0	0	0	P18	P17	P16	P15	P14	P13	P12	P11	P10	P09	P08
Word n+1	P07	P06	P05	P04	P03	P02	P01	P00	0	0	0	DB	ERR	OUT	A1	A0
Word n+2	0	0	0	0	0	0	0	0	0	S06	S05	S04	S03	S02	S01	S00

For a description of the data bits see chapter 16.

14.3.7 PROFIBUS Diagnostics

In addition to the standard diagnostics data (6 bytes), the WCS-PG210 interface module supports device-specific diagnostics. The length of the specific diagnostics data is 1 byte. This results in a maximum length of diagnostics data of 8 bytes. If there is an error or warning message, the diagnostics byte transmits the corresponding code. If the "State" LED is red, this code is displayed via the four LEDs "Error No/Select ID", i.e., the LED display portrays the contents of the diagnostics byte.

14.3.8 Error Codes

ErrorNo/Select ID				Designation
8	4	2	1	
0	0	0	0	Reserved
0	x	x	x	Internal error, interface module
1	x	x	0	Internal warning, interface module
1	0	0	1	Timeout when receiving the reader data

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ErrorNo/Select ID				Designation
8	4	2	1	
1	0	1	1	Data transfer error from the reader
1	1	0	1	Fieldbus error (configuration error, no connection...)
1	1	1	1	Internal warning, interface module

Table 14.4   Error code meaning

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15 WCS-PNG210 Interface Module

15.1 Use and Application

The WCS-PNG210 interface module acts as an interface between the WCS reader and PROFINET IO. The device has two PROFINET ports. The second port can be used as an outgoing PROFINET port. Data is transferred between the reader and the interface module via an RS485 interface. The data from the interface module to the PLC is transferred using the PROFIBUS protocol. You can connect a maximum of four WCS readers of type LS221 (and/or LS121) to one WCS-PNG210 interface module. If you connect several readers, they must have different addresses. The number of connected readers is configured in the hardware project settings.

15.2 Installation

15.2.1 Electrical Connection

Connector X1 is located on the top side of the interface module, connector X2 on the underside.
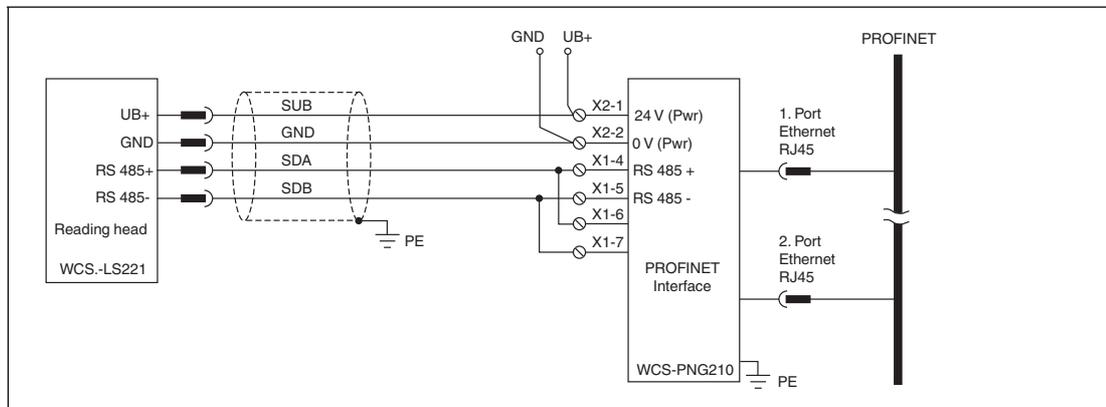
Figure 15.1   Electrical connection

Note!

To use with an RS485 interface, terminal "Rx 422+" on connector X1 must be connected to terminal "Tx 422+", and terminal "Rx 422-" must be connected to terminal "Tx 422-".

Clamp		Designation
4	Rx 422+	Data line RS 485+ to reader
5	Rx 422-	Data line RS 485- to reader
6	Tx 422+	
7	Tx 422-	

Table 15.1   Terminal X1

Preparing to use the RS485 interface

1. Connect terminal 4 "Rx 422+" to terminal 6 "Tx 422+".

2. Connect terminal 5 "Rx 422-" to terminal 7 "Tx 422-".

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Clamp		Designation
1	UB (Pwr)	Operating voltage interface module/ operating voltage reader
2	0 V (Pwr)	Ground interface module/ground reader

Table 15.2   Terminal X2

Caution!

Damage to the device

Connecting an alternating current can damage the device or result in it malfunctioning.

Connect interface module to direct current (DC).

Connecting the interface module to the voltage

Connect the operating voltage (10 VDC ... 30 VDC) to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

↳ The "Power" LED lights up green.

Note!

Grounding of the mounting rail

The mounting rail must be grounded to the switch cabinet. The connection wire must have a cross section of at least 10 mm^2.

15.3   Commissioning

15.3.1   Meaning of LEDs

Power:

The "Power" LED is **green**: The WCS-PNG210 interface module is correctly connected to the power supply.

1, 2, 4, 8 and State:

The "State" LED lights up or flashes **green**: Data exchange is taking place with the readers.

The number of the reader that the interface module is exchanging data with is displayed by the four LEDs "1, 2, 4, 8".

LED				Reader address
8	4	2	1	
0	0	0	1	0
0	0	1	0	1
0	1	0	0	2
1	0	0	0	3

The "State" LED is **red**: The interface module has detected an error or a warning.

The interface module displays the binary coded error and/or warning number via the "1, 2, 4, 8" LEDs. For a description of the error codes see chapter 16.5.

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| Error (No. 1...5): | Switch the interface module off and back on. If the error occurs again, the module must be replaced. |
| Warning (No. 6...15): | The warning provides information. The interface module displays the warning for one minute and then resets automatically. |

PROFINET State:

The "PROFINET State" LED is **green**: Data exchange is active.

The "PROFINET State" LED flashes **green**: PROFINET is initialized.

The "PROFINET State" LED flashes **red**: Error during PROFINET initialization.

The "PROFINET State" LED is **red**: Error in the PROFINET hardware.

PROFINET Power:

The "PROFINET Power" LED is **green**: The LED is connected directly to the supply voltage of the PROFINET side.

PROFINET Link/Activity P1:

The "Link/Activity" LED on port 1 is controlled directly by the PROFINET processor and is **green** if the Ethernet link pulse is found. When there is data traffic on the network, the LED flashes **green** at the same speed as the sent/received data.

PROFINET Link/Activity P2:

The "Link/Activity" LED on port 2 is controlled directly by the PROFINET processor and is **green** if the Ethernet link pulse is found. When there is data traffic on the network, the LED flashes **green** at the same speed as the sent/received data.

15.3.2   Connecting the readers

If you install several WCS readers together on one interface module, the readers must have different addresses. This will allow the PLC to allocate the data to the correct readers. If you connect only one WCS reader to the interface module, this reader is always given the address 0. You can connect up to four WCS readers to the interface module via an RS485 line. When delivered, each reader has the default address 0. For information on how to change the address of the reader, see the configuration instructions for the reader.

The number of connected readers and their operating mode is configured in the hardware project settings. For hardware planning, use the GSD file which can be downloaded from our website: http://www.pepperl-fuchs.com (see chapter 15.3.4).

Reader terminal pin		Interface module terminal
WCS2B	WCS3B	
2	1	X2-1
4	2	X1-4
1	4	X1-5
3	3	X2-2

Table 15.3   Connection of WCS readers

Connecting the reader

1. Connect the power supply for the reader to terminals 1 and 2 of the 4-pin connector X2 on the interface module.

2. Connect the RS485 data line to the reader on terminals 4 and 5 of connector X1.

If you operate the WCS-PNG210 interface module at the beginning or end of the RS485 bus, you must activate the RS485 terminator.

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▶ **Activating the RS485 terminator**

1. To use with an RS485 interface, slide the "Rx 422" switch to OFF.

2. To activate the RS485 terminator, slide the "Tx 422" switch to ON.

3. To deactivate the RS485 terminator, slide the "Tx 422" switch to OFF.

4. If only one reader is connected, you must always activate the RS485 terminator. Slide the "Tx 422" switch to ON.

15.3.3 Connecting the WCS-PNG210 to the Network

The connection to PROFINET IO is made via the two "RJ 45 PROFINET IO" sockets on the underside of the interface module. The front socket is labeled "X3 P1", and the rear socket is labeled "X3 P2".

Pin assignment X3 P1 & X3 P2

Clamp		Designation
1	TD+	Transmission line +
2	TD-	Transmission line -
3	RD+	Receive line +
4		
5		
6	RD-	Receive line -
7		
8		

Table 15.4   Terminals of the 8-pin "RJ 45 PROFINET IO" sockets

Note!

The cable to the surrounding modules on the Ethernet line must be at least 0.6 m long.

▶ **Connecting the device to the controller**

Plug the PROFINET connector into the RJ 45 socket. Use a Cat. 5 data cable.

▶ **Setting data exchange mode**

Set the "S4" and "S5" rotary switches to position 0.

15.3.4 Integrating WCS-PNG210 into the Network

Caution!

Device not configured or configured incorrectly

System failure caused by incorrectly configured device

Configure the device prior to commissioning.

Note!

Various configuration tools are available to allow you to configure the interface module. This manual describes how to configure a Siemens SIMATIC controller as an example. If you are using a PLC from a different manufacturer, the process is similar to the one described here.

The device properties are held in a GSD file. PROFINET IO uses the XML-based GSDML language for this purpose. The GSD file can be downloaded from our website: http://www.pepperl-fuchs.com.

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▶ ## Downloading a GSD file from the Internet

On our home page (http://www.pepperl-fuchs.com), select the product selector and look for the product designation (WCS-PNG210). Click on **Technical Documents**.

↪ This will take you to the GSD file, which has been compressed ready to download.

Every node within a PROFINET network must have a unique name. Every node is identified by its device name and IP address.

When delivered, the WCS-PNG210 interface module has the following configuration:
IP address: 0.0.0.0
Device name: "empty"
During the project planning phase you have to change the IP address and the device name. If you are using more than one interface module in the network, you must assign each interface module a name that will enable the PLC to uniquely identify the device, e.g., WCS-PNG210A, WCS-PNG210B, etc. Each name may appear only once in the network.

▶ ## Adding the device to the network

1. Open SIMATIC Manager and select the PROFINET IO system.

2. Install the GSD file by clicking on **Options** and then **Install GSD File**.

   ↪ The device data is added to the hardware catalog.

3. Open the hardware catalog and browse through the tree structure until you see a WCS-PNG210 symbol (PROFINET IO > Additional Field Devices > Gateway > Pepperl+Fuchs WCS).

4. Drag the WCS-PNG210 from the tree structure and drop it into your PROFINET IO system.

   ↪ The symbol for the WCS-PNG210 is shown in the PROFINET IO system.

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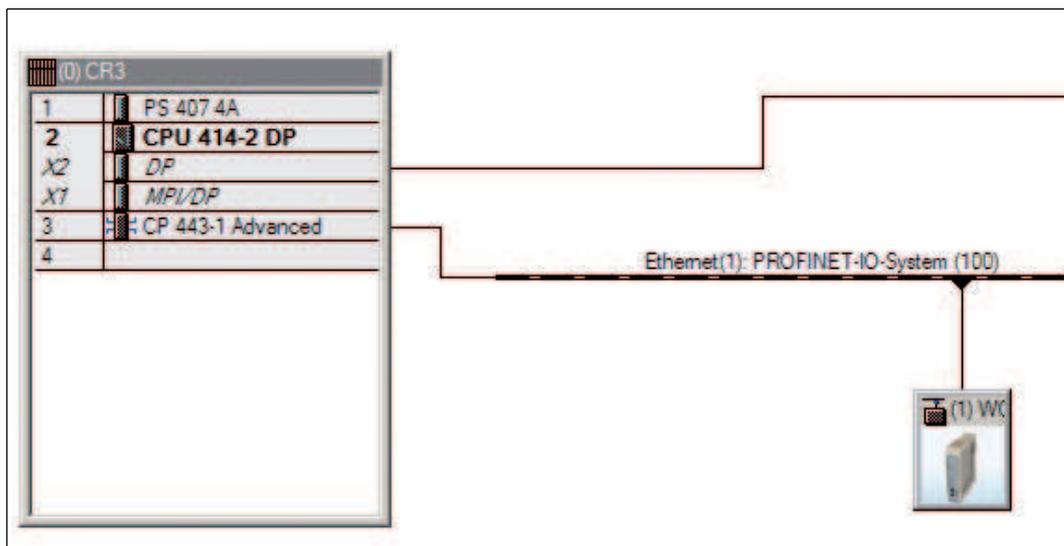
5. Double-click on the device symbol.

↳ The **Properties** window opens.

6. Enter the required network configuration.

► Searching for a device on the network

To see which devices are on the network, click on **Browse** in the **Edit Ethernet Node** window.

↳ The PLC interrogates the network to see which PROFINET nodes are present (Broadcast query). A list of the connected devices is displayed in the window.

► Changing the device name

Note!

The PLC must not communicate with the device via PROFINET while you are changing the device name. An error message will be output if you try to change the device name while the system is running.

1. Stop PROFINET communication if it is active.

2. Select **Pepperl+Fuchs WCS** from the list of nodes (default device name: UNIGATE-PN) and click on **OK**.

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Edit Ethernet Node

Ethernet node

MAC address: 00-14-11-68-AC-E5   Nodes accessible online   Browse...

Set IP configuration

○ Use IP parameters

IP address: 172.24.55.14   Gateway
                            ○ Do not use router
Subnet mask: 255.255.255.192   ⊙ Use router
                                Address: 172.24.55.62

⊙ Obtain IP address from a DHCP server

Identified by
⊙ Client ID   ○ MAC address   ○ Device name
Client ID:

Assign IP Configuration

Assign device name

Device name: UNIGATE-PN   Assign Name

Reset to factory settings

Reset

Close   Help

3. In the field **Assign device name**, enter the device name for the interface module. Click on **Assign Name**.

↳ The interface module is given the name you enter and can then be uniquely identified by the PLC.

4. In the **Properties** window, enter the new device name and save the configuration.

↳ The PLC will recognize the name of the device and will be able to communicate with it.

Note!

An LED on the device can be made to flash using the configuration tools. If you have a number of WCS-PNG210 interface modules on the network, this function will enable to you to uniquely identify each device. Select the device from the list of Ethernet modules and click on **Flash**. The "State" LED on the relevant WCS-PNG210 interface module will start to flash.

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Depending on your application, select one, two, three, or four connected readers and the operating mode. When in the "only Position" operating mode, the readers output their position. In the "Position and Speed" operating mode, the readers output their position and the speed at which they are currently moving.

Regardless of the number of readers, 1 byte is reserved for querying the diagnosis of the readers in the master. For the response data, 4 bytes are reserved per reader in the "only Position" operating mode (configuration data for 4 readers: 0x20, 0xD1, 0xD1, 0xD1, 0xD1). In the "Position and Speed" operating mode, 6 bytes are reserved per reader (configuration data for 4 readers: 0x20, 0xD2, 0xD2, 0xD2, 0xD2).

Setting the number of readers, operating mode, and addresses

1. Open the hardware catalog and browse through the tree structure until you see the WCS-PNG210 symbol (PROFINET IO > Additional Field Devices > Gateway > Pepperl+Fuchs WCS).

2. Click on **+** next to the WCS-PNG210 symbol to expand the tree structure.
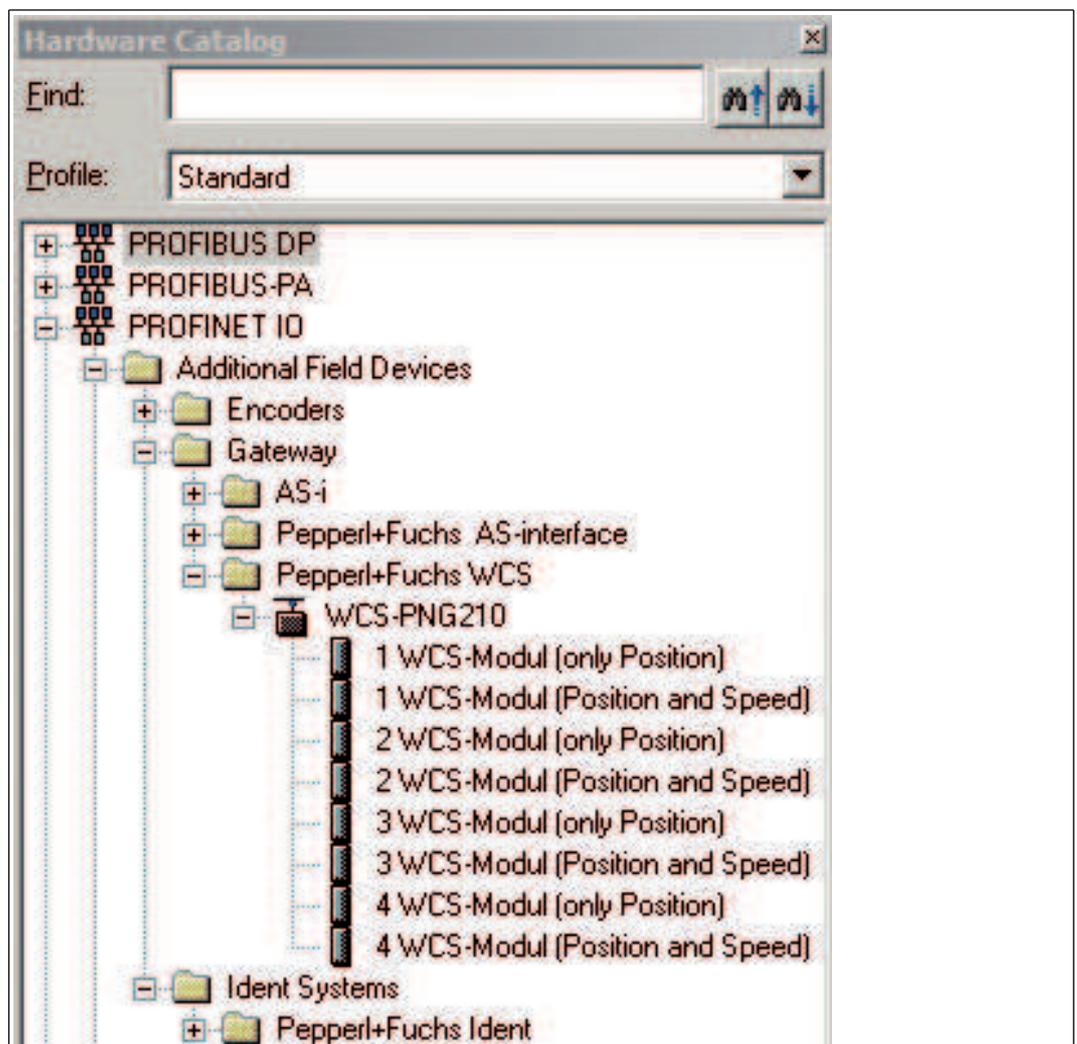
3. Select the module with the appropriate number of readers and operating mode and drag it into the window where the modules are listed.

   ↳ The selected module is added to the list.

4. To change the input and output address of the module, double-click on the module and enter the addresses in the **Properties** window.

5. Click on **Transfer** to transfer all the settings to the PLC.

15.3.5 Request byte for read heads

	read head address 3		read head address 2		read head address 1		read head address 0	
Bit	7	6	5	4	3	2	1	0
	0	F0	0	F0	0	F0	0	F0

F0=0: The read head sends the position data to the interface module. This standard function is automatically active after commissioning.

F0=1: The read head sends the result of the diagnostic function.

For more information on the function of F0 .

15.3.6 Data Format of WCS-PNG210 Interface Module for the Readers

In "only Position" operating mode, 4 bytes are reserved for each reader.

Bit	7	6	5	4	3	2	1	0
Input address + 4 reader addresses + 0	0	0	0	0	0	P18	P17	P16
Input address + 4 reader addresses + 1	P15	P14	P13	P12	P11	P10	P09	P08
Input address + 4 reader addresses + 2	P07	P06	P05	P04	P03	P02	P01	P00
Input address + 4 reader addresses + 3	0	0	0	DB	ERR	OUT	A1	A0

Table 15.5   Data format for each connected reader in "only Position" operating mode, reader address = 0 ... 3

In "Position and Speed" operating mode, 6 bytes are reserved for each reader.

Bit	7	6	5	4	3	2	1	0
Input address + 6 reader addresses + 0	0	0	0	0	0	P18	P17	P16
Input address + 6 reader addresses + 1	P15	P14	P13	P12	P11	P10	P09	P08
Input address + 6 reader addresses + 2	P07	P06	P05	P04	P03	P02	P01	P00
Input address + 6 reader addresses + 3	0	0	0	DB	ERR	OUT	A1	A0
Input address + 6 reader addresses + 4	0	0	0	0	0	0	0	0
Input address + 6 reader addresses + 5	0	S06	S05	S04	S03	S02	S01	S00

Table 15.6   Data format for each connected reader in "Position and Speed" operating mode, reader address = 0 ... 3

For a description of the data bits see chapter 16.

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16 Appendix

16.1 Cable routing in the RS 485 bus

The data cable must always form an in-line connection between the first and the last node. This in-line connection must end with a terminator.

The RS 485 terminators are integrated in the WCS reading heads and can be switched on and off with the interface module.

If only **one reading head** is connected, one device is connected at the beginning and one device is connected at the end of the data line.
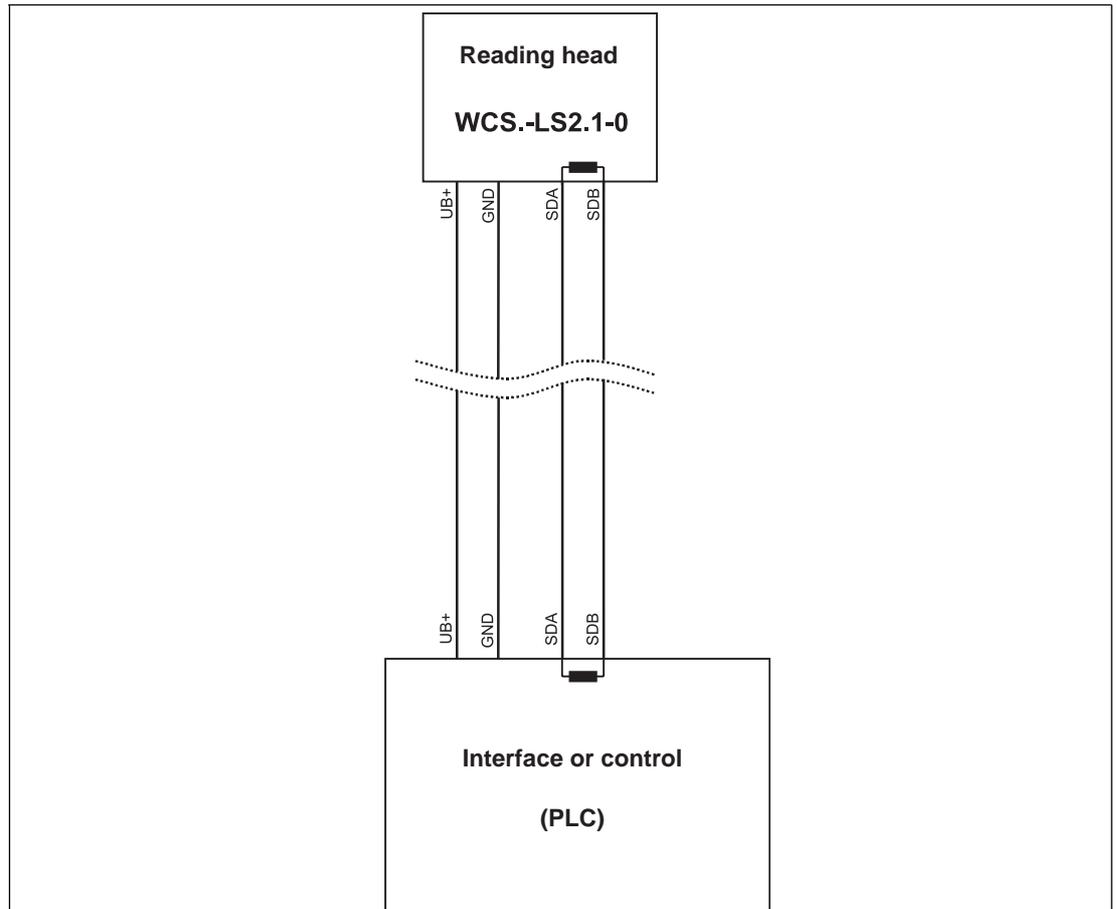
Figure 16.1   Connection of **one** reading head

If **two reading heads** are attached to one interface module, there are two wiring versions:

- **Version A:**

   One reading head is located at the beginning and one reading head at the end of the data line. With two reading heads, the RS 485 terminator is activated. The interface module is located between these two heads and does not have an RS 485 terminator. Each reading head is connected to the interface module by a separate data cable.

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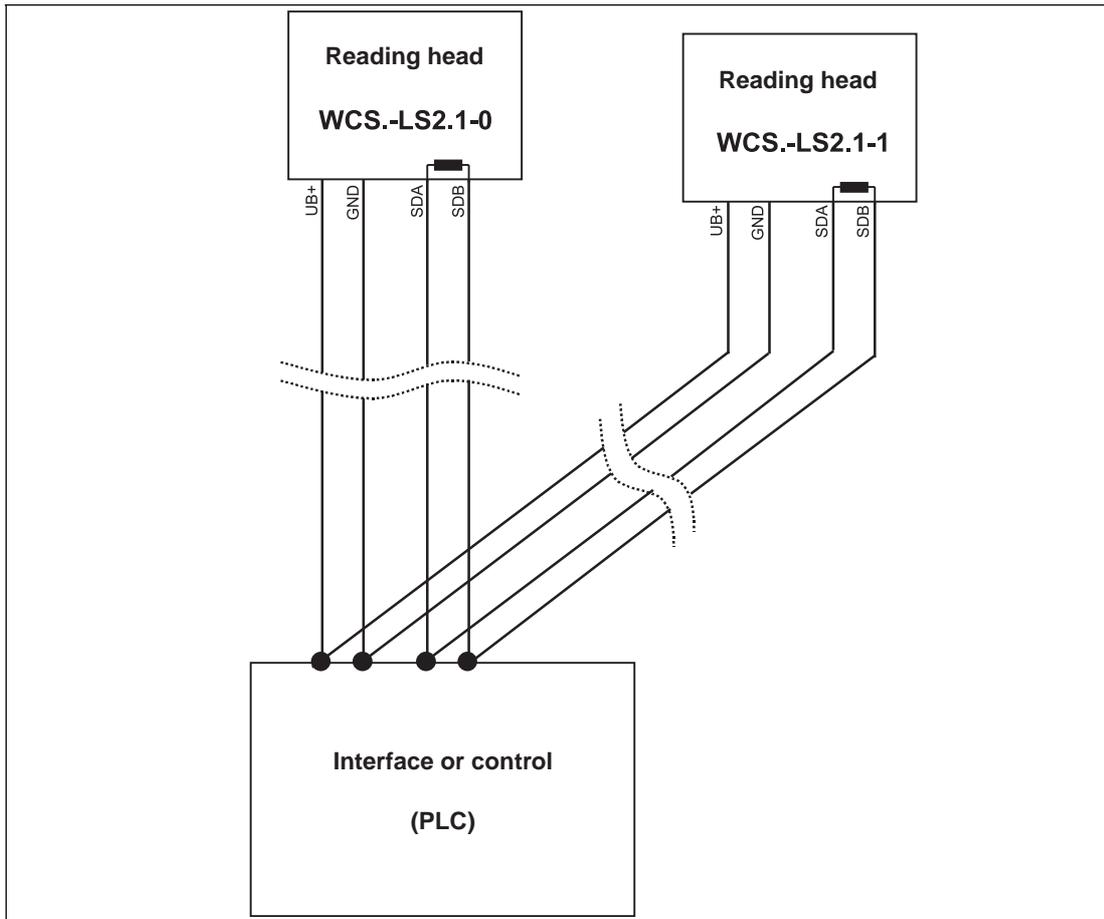
Figure 16.2   Connection of **two** reading heads, Version A

■ **Version B:**

The interface module is located at the beginning of the data line; one reading head is located at the end of the data line. Both need the RS 485 terminator. The second reading head is connected to the line connection between the interface module and the first reading head through a short spur (length < 1 m). Use bus terminal BT111 to connect the spur.

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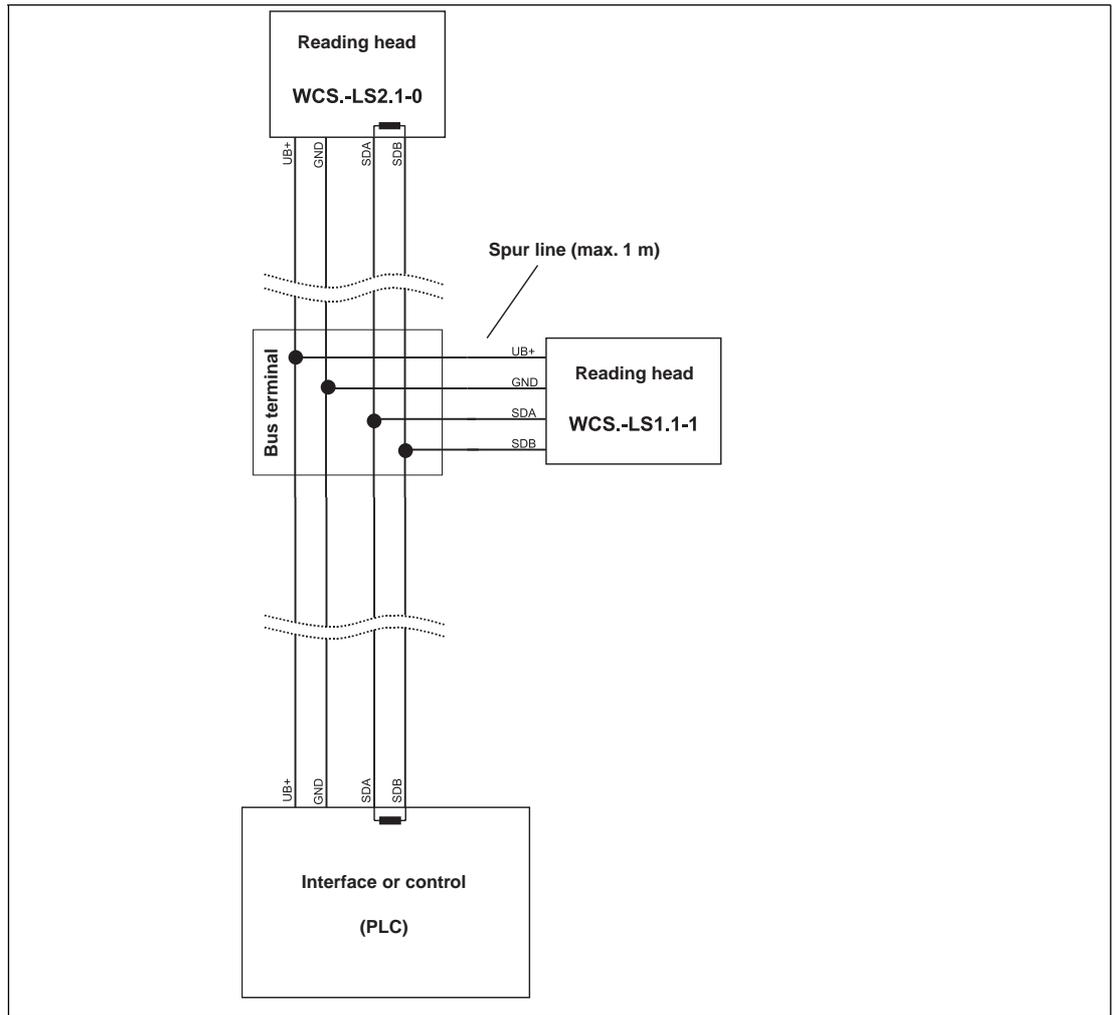
Figure 16.3   Connection of **two** reading heads, Version B

The wiring version used depends on which is best suited for the application. If **three** or **four reading heads** are used on the same interface module, connect these using spurs as shown in version B.

16.2   Meaning of F0

F0	Function number for read head
0	Send position value
1	Send diagnosis result

Diagnostic function F0=1

The read head can be requested to perform a diagnosis of the photoelectrics by means of the request byte. 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. 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 self-diagnosis of the read head.

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16.3 Data format for connected read heads

In the "only Position" operating mode 4 bytes are reserved for each read head.

Bit	7	6	5	4	3	2	1	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	0	DB	ERR	OUT	A1	A0

Table 16.1   Data format for each connected read head in "only Position" operating mode, read head address = 0 ... 3

In the "Position and Speed" operating mode 6 bytes are reserved for each read head.

Bit	7	6	5	4	3	2	1	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	0	DB	ERR	OUT	A1	A0
Byte 4	0	0	0	0	0	0	0	0
Byte 5	0	S06	S05	S04	S03	S02	S01	S00

Table 16.2   Data format for each connected read head in "Position and Speed" operating mode, read head address = 0 ... 3

Pxx: position data, P00 = LSB
Sxx: speed (in multiples of 0.1 m/s), S00 = LSB

Example: Byte 5 = 00011011 = 27, corresponds 2.7 m/s
A1, A0: read head address, 00 = read head #1
DB: clogging indicator, 1 = cleaning required
OUT: code rail loss, 0 = code rail identified
ERR: error message, error code (LEDs) see chapter 16.5. For more information about the data bits .

16.4 Data from read head

Meaning of A1 and A0

A1	A0	read head address
0	0	read head address 0
0	1	read head address 1
1	0	read head address 2
1	1	read head address 3

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Function number for read head F0=0 (send position value)

DB	ERR	OUT	Description	State of the read head
0	0	0	Current position value binary coded in P00...P18	good
0	0	1	read head outside of the code rail, not a position value	good
			P0...P18=0: read head partially outside of the code rail	
			P0=1, P2...P18=0: read head completely outside of the code rail	
1	0	0	Current position value binary coded in P00...P18	poor
1	0	1	not a position value, read head outside of the code rail	poor
x	1	x	not a position value, error message from read head, error number binary coded in P00...P18	-

Function number for read head F0=1 (send diagnosis result)

DB	ERR	OUT	Description	State of the read head
1	0	0	Diagnosis invalid, read head not outside of the code rail	-
1	0	1	Diagnosis result in P16...P18	
			P16...P18=0	good
			P16...P18>0	poor
x	1	x	Error message from read head, error message binary coded in P00…P04	-

16.5 Error codes

ErrorNo/Select ID LED				Error number	Designation
8	4	2	1		
0	1	1	1	7	Communication read head, send buffer overflow
1	0	0	0	8	Communication read head, receive buffer overflow
1	0	0	1	9	Communication read head, timeout
1	0	1	0	10	General fieldbus error
1	0	1	1	11	Parity or frame check error
1	1	0	1	13	Fieldbus error (configuration error, no connection ...)
1	1	1	1	14	Fieldbus data buffer overflow

Table 16.3   error code meaning

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