MANUAL

WCS-PNG210
WCS PROFINET IO
Interface Module

CE

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1 Introduction

1.1 Content of this Document

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

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

Note!

Visit www.pepperl-fuchs.com to access further documentation for full information about the product.

The documentation comprises the following parts:

- This document
- Datasheet

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

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

1.2 Target Group, Personnel

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

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

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

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1.3 Symbols Used

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

Warning Messages

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

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

Danger!
This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!
This symbol indicates a possible fault or danger.

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

Caution!
This symbol indicates a possible fault.

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

Informative Symbols

Note!
This symbol brings important information to your attention.

Action

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

2 Product Description

2.1 Use and Application

The WCS-PNG210 interface module acts as an interface between the WCS reader and the PROFINET IO controller. The device has two PROFINET ports. The second port can be used, for example, as an outgoing PROFINET port. The data between the WCS reader and WCS-PNG210 is transmitted via an RS-485 interface. The data from the WCS-PNG210 to the controller is transmitted via the PROFINET 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 WCS readers, they must have different addresses. The number of connected WCS readers is configured in the hardware project settings.

2.2 Dimensions

The interface module housing has the following dimensions.

Figure 2.1   Dimensions

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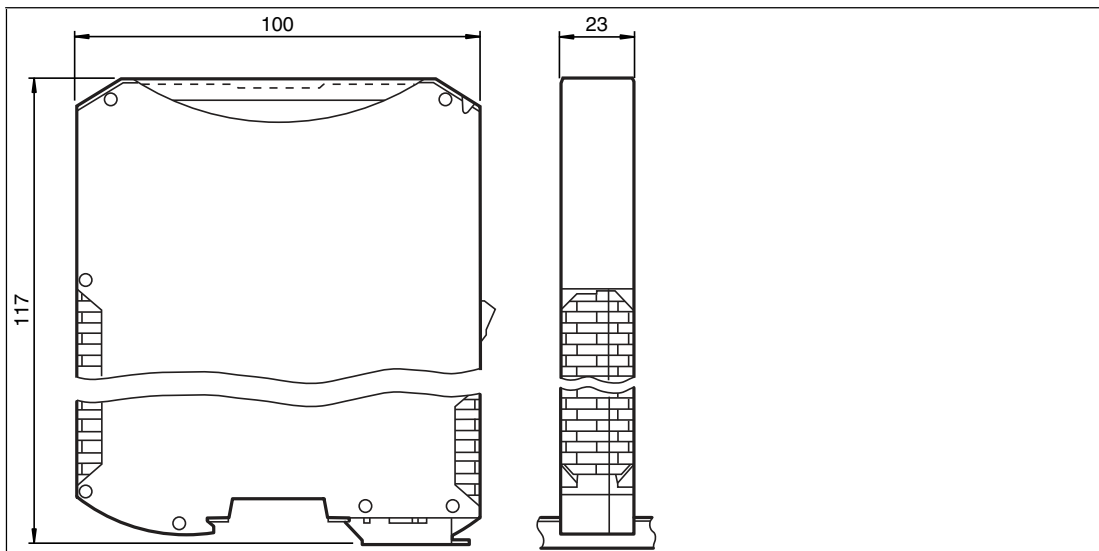## 2.3 Design of the Device

Device Components
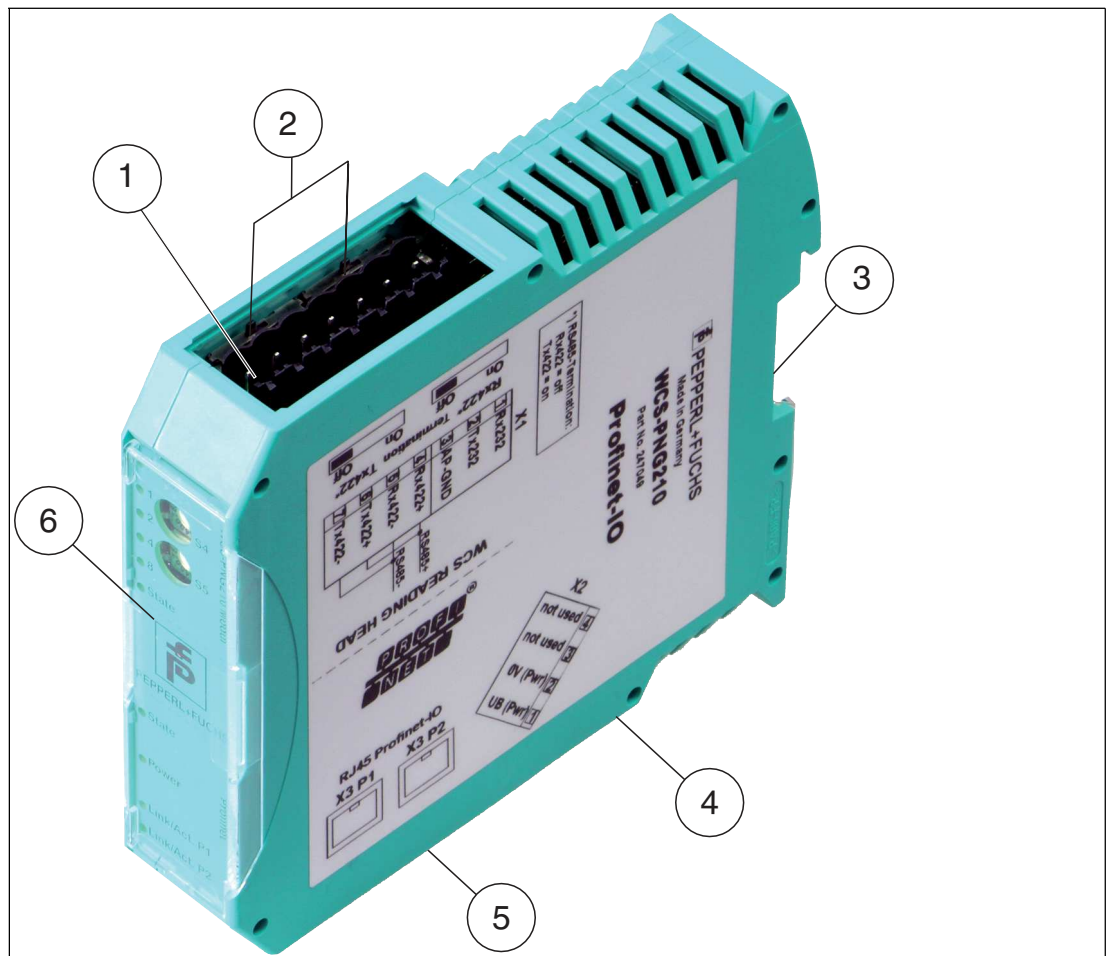

Figure 2.2   Interface module overview

1   X1: RS-485 interface

2   RS-485 bus termination slide switch

3   Mounting bracket

4   X2: Connection for power supply

5   X3: PROFINET IO communication interface

6   Front panel with rotary coding switches and indicator lights

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Front panel
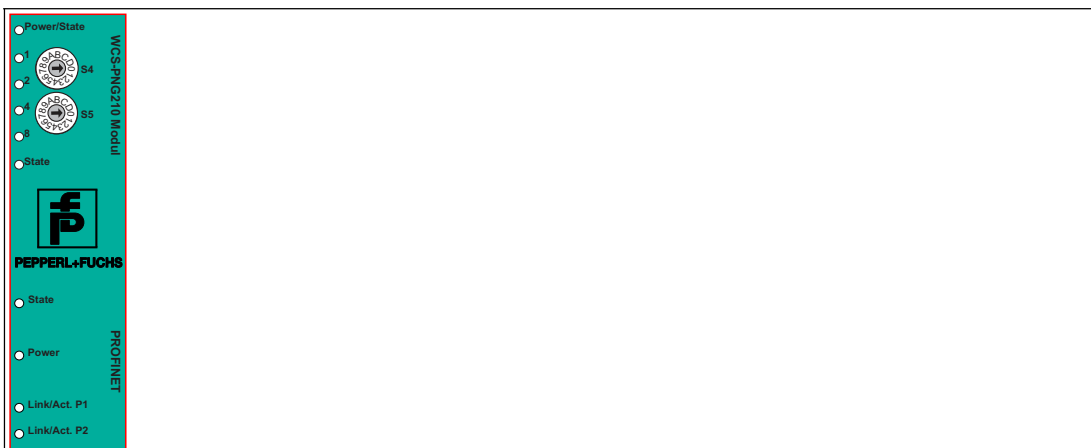

Figure 2.3   Front panel overview

Power:

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

State:

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

Table 2.1   Display of the four LEDs "Error No/Select ID" when the "State" LED lights up green

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.

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.

ErrorNo/Select ID LED				Error number	Error description
LED8	LED4	LED2	LED1		
0	0	0	0	0	Reserved
0	0	0	1	1	Hardware error
0	0	1	0	2	EEPROM error
0	0	1	1	3	Internal memory error
0	1	0	0	4	Fieldbus hardware error or incorrect fieldbus ID

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ErrorNo/Select ID LED				Error number	Error description
LED8	LED4	LED2	LED1		
0	1	0	1	5	Script error
0	1	1	0	6	Reserved
0	1	1	1	7	Communication WCS reader, RS send buffer overflow
1	0	0	0	8	Communication WCS reader, RS receive buffer overflow
1	0	0	1	9	Communication WCS reader, RS timeout
1	0	1	0	10	General fieldbus error
1	0	1	1	11	Parity or frame check error
1	1	0	0	12	Reserved
1	1	0	1	13	Fieldbus configuration error
1	1	1	0	14	Fieldbus data buffer overflow
1	1	1	1	15	Reserved

Table 2.2   Meaning of the error codes (four LEDs display "Error No/Select ID", if the "State" is illuminated red and thus indicates an error or a warning)

Rotary coding switches S4 and S5

The two switches control the operating modes. Ensure that the two switches are at **position 0** to enable the data exchange mode.

PROFINET State:

LED "PROFINET State"	PROFINET interface state
Lights up green	Data exchange in progress
Flashes green	PROFINET is initialized, waiting for connection with IO controller
Lights up red	Error with PROFINET hardware
Flashes red	Error during PROFINET initialization

Table 2.3   "PROFINET State" LED display

PROFINET Power:

The "PROFINET Power" LED is green: The LED is connected directly to the electrically isolated 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 pulses are 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 pulses are found. When there is data traffic on the network, the LED flashes green at the same speed as the sent/received data.

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3 Installation

3.1 Mounting

Mounting the modules

The module is fastened to a DIN mounting rail with a width of 35 mm using a snap-on fixing method.
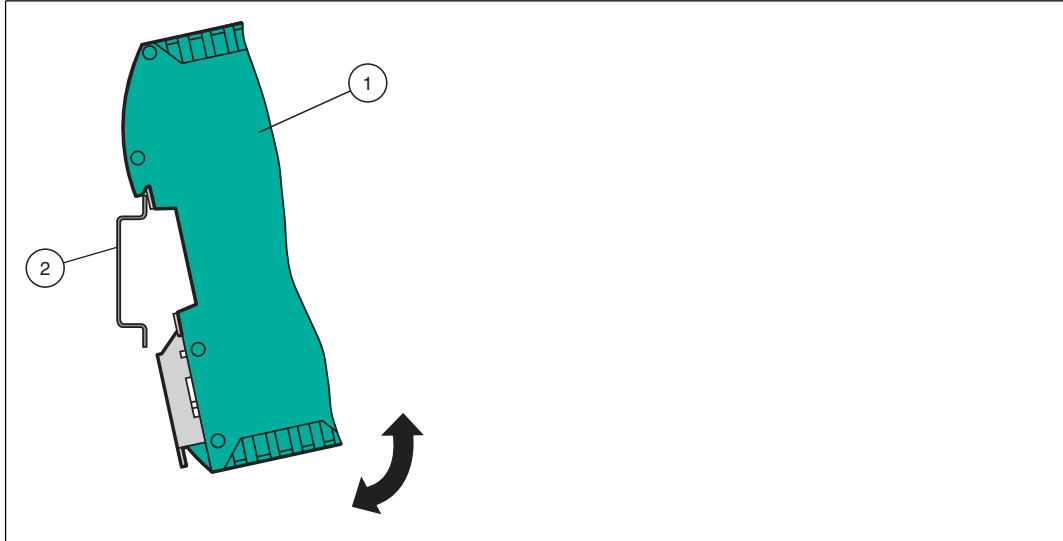

Figure 3.1   Mounting

1. Hook the module (1) into the DIN mounting rail (2) from above and press it down until it snaps into place.

    ↳ The module is mounted.

Note!

Heat dissipation

You may place other modules to the left and right of the module.
Above and below the modules, there must be at least 5 cm of free space for heat dissipation.

2. You must connect the DIN mounting rail to the switch cabinet's equipotential busbar. The connection wire must have a cross section of at least 10 mm^2.

Note!

Vertical installation

You can also install the DIN mounting rail vertically, so that the modules can be rotated by 90° for mounting.

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3.2 Electrical connection

STOP

Danger!

Device damage due to incorrect installation

A faulty installation of cables and connection lines can endanger the function and the electrical safety of the device.

- Note the permissible core cross section of the conductor.

- If you are using stranded conductors, make sure that these stranded conductors are crimped with wire end ferrules.

- Make sure that conductors are insulated all the way up to the terminal.

- Observe the tightening torque for the screws on the terminal. The tightening torque is 0.5 Nm.

- Using an inappropriate tool may damage the screw heads. Use a slot-head screwdriver of size 3.5 x 0.5.

- Connecting an alternating current can damage the device or cause the device to malfunction. Connect the device to direct current (DC).
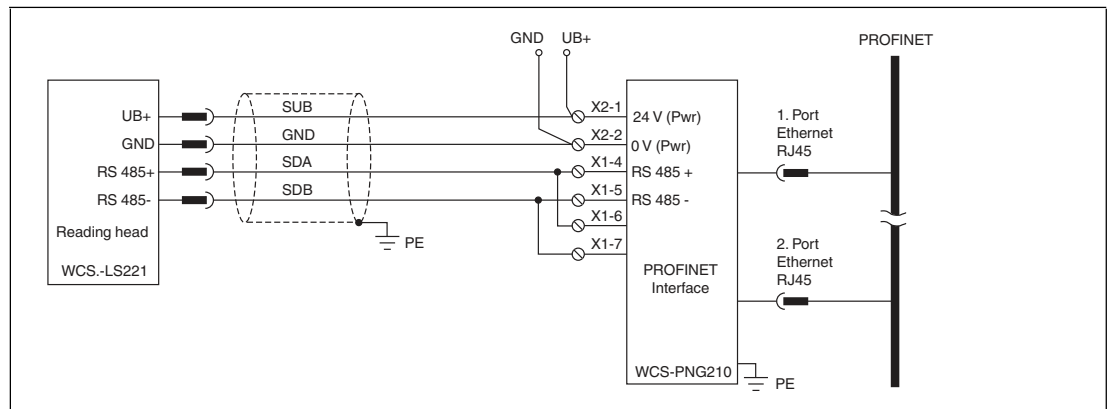

Figure 3.2   Electrical connection

Plug X1 is located on the top side of the interface module, plug X2 on the underside.

Connection technology

You must/may use the following connection technology when wiring the assembly:

- Standard screw/plug connection (supply + RS)

- 8-pin RJ45 connector (PROFINET IO connection)

In the case of the standard screw terminals, one line per connection point can be clamped. To tighten the screws, use a screwdriver with a blade width of 3.5 mm.
Permissible cable cross section:

- Flexible cable with wire end ferrule: 1 x 0.25 ... 1.5 mm^2

- Solid cable: 1 x 0.25 ... 1.5 mm^2

The plug-in terminal strip represents a combination of standard screw connections and plug connectors. The plug connector is coded and can therefore not be plugged in incorrectly.

Connecting the power supply

Connect the operating voltage (10 VDC...30 VDC) to terminals 1 and 2 of the 4-pin plug X2 on the interface module. In addition, note the label on the module.

↳ The "Power" LED lights up green.

Terminal		Description
1	UB (Pwr)	Operating voltage interface module/ operating voltage WCS reader
2	0 V (Pwr)	Ground interface module/ground WCS reader
3	Not used	Not used
4	Not used	Not used

Table 3.1   Terminal X2

Equipotential bonding connection

The connection to equipotential bonding occurs automatically when attaching to the DIN mounting rail.

PROFINET IO communication interface

This interface can be found on the module in the form of two 8-pin RJ45 sockets on the bottom of the housing.

Insert the PROFINET connector into the RJ45 socket(s) with the label "RJ45 PROFINET IO".

Note!

Ensure that the cable length to the neighboring Ethernet nodes is at least 0.6 m.

Preparing to use the RS-485 interface

For operation on an RS-485 interface, the terminal on connector X1 must be connected as follows:

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

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

Terminal		Description
4	Rx 422+	RS-485+ data line to WCS reader
5	Rx 422-	RS-485- data line to WCS reader
6	Tx 422+	Connect terminal 6 "Tx 422+" to terminal 4 "Rx 422+"
7	Tx 422-	Connect terminal 7 "Tx 422-" to terminal 5 "Rx 422-"

Table 3.2   Terminal X1

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Note!

RS-485 bus termination
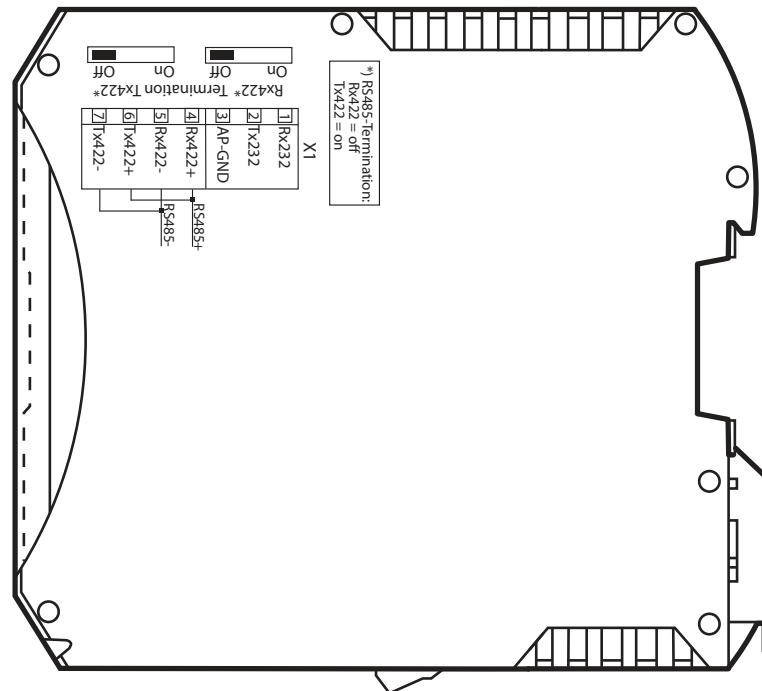
If the interface module is operated as the first or last physical device in an RS-485 bus, there must be a bus termination on this module. To do this, set the slide switch "Rx 422 Termination" to "Off" and the slide switch "Tx 422 Termination" to "On". This activates the RS-485 terminator (150 Ω) built into the interface module.

If you only connect one WCS reader to the interface module, you must always activate the RS-485 terminator, see also Cable routing in the RS-485 bus.

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3.3 Dismounting

Dismounting the modules

Use a suitable slot-head screwdriver for dismounting the module.

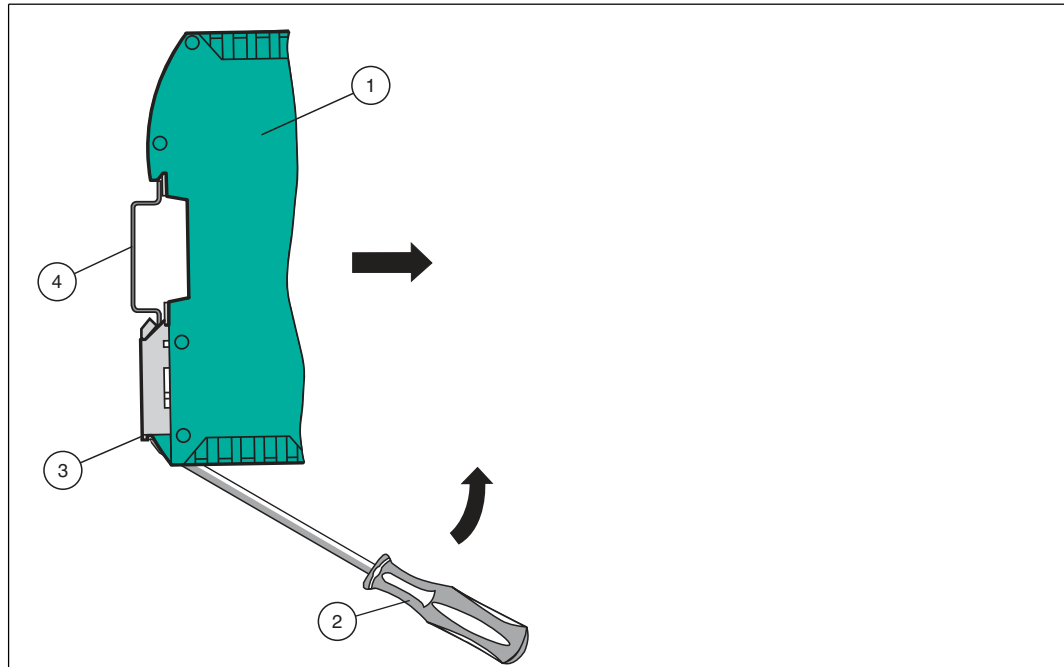1. Disconnect all the supply and signal lines.

Figure 3.3   Dismounting

2. Insert the screwdriver (2) into the groove of the mounting bracket (3).

3. Press the screwdriver (2) in the specified direction until the lock on the DIN mounting rail (4) opens, see figure.

4. Then press the module (1) upwards and lift it out of the DIN mounting rail.

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4 Commissioning

4.1 Introduction

⚠️ **Warning!**

Danger to life due to defective work

Errors during installation and commissioning can cause life-threatening injuries and significant property damage.

- Installation and commissioning may only be carried out by trained personnel in accordance with the safety regulations.

Components

To commission the module, you require the following components:

- WCS-PNG210 interface module
- Connection cable from the interface module to the reader
- Connector for the PROFINET connection to the interface module
- Ethernet cable
- 10 VDC...33 VDC power supply
- GSDML file (the GSDML file can be obtained free of charge from our website www.pepperl-fuchs.com).

▶ Connecting the interface module

To ensure that the assembly functions correctly, you must carry out the following steps during commissioning:

1. Assign a PROFINET address.

Note!

On delivery, the module does not yet have an IP address. In normal operation, the IP address is usually assigned to the module by the PROFINET IO controller (PLC).

2. Assign a PROFINET device name.

Note!

On delivery, the module does not yet have a device name. The device name is assigned to the gateway via the project planning software.

3. Connect the module to PROFINET using the interface labeled "RJ45 PROFINET IO".
4. To commission the process equipment (reader), please refer to its manual.
5. Ground the DIN mounting rail onto which the assembly is snapped.
6. Connect the direct current to the terminals provided.
7. Use any planning tool for project planning. The GSDML file can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the Product/Keyword search box and click Search.

Note!

A more detailed description of the procedure for the individual steps is provided on the following pages.

4.2 Connecting WCS readers

If you connect several WCS readers to one interface module, the WCS readers must have different addresses. This will allow the programmable logic controller to allocate the data to the correct WCS readers. If you only connect one WCS reader to an interface module, this WCS reader always receives the address 0. You can connect up to four WCS readers to an interface module via an RS-485 cable. On delivery, the default address of each WCS reader is 0. Refer to the configuration instructions for the WCS reader if you need to change the address of the WCS reader.

WCS reader terminal pin				Interface module terminal
WCS2A	WCS2B	WCS3A	WCS3B	
2	2	1	1	X2-1
4	4	2	2	X1-4
1	1	3	4	X1-5
3	3	5	3	X2-2

Table 4.1   Connecting the WCS reader(s)

Setting the number of connected WCS readers

Set the number of connected WCS readers in the hardware project settings, see chapter 4.4.

4.3 Connecting the WCS-PNG210 to the network

The connection to the PROFINET IO is made via the two "RJ45 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

Terminal		Designation
1	TD+	Transmission line +
2	TD-	Transmission line -
3	RD+	Receive line +
4	n.c.	Not connected
5	n.c.	Not connected
6	RD-	Receive line -
7	n.c.	Not connected
8	n.c.	Not connected

Table 4.2   Terminals of the 8-pin "RJ45 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 RJ45 socket. Use a Cat. 5 data cable.

Setting data exchange mode

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

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## 4.4 Integrating WCS-PNG210 into the network

Caution!

Malfunction due to incorrectly configured devices

Incorrectly configured devices can cause malfunction of the plant.

■ Only put devices into operation after they have been configured correctly.

To operate the module described in this manual, you will need a GSDML file. The GSDML file must be imported into the corresponding configuration tool prior to commissioning the module. The GSDML file can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the Product/Keyword search box and click Search.
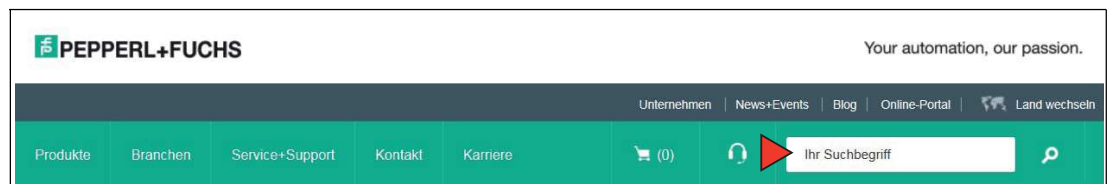
Select your product from the list of search results. Click on the information you require in the product information list, e.g., **Software**.

A list of all available downloads is displayed.

PROFINET address assignment

On delivery, the interface module does not yet have an IP address. In normal operation (data exchange mode), the IP address is usually assigned to the module by the PROFINET IO controller (PLC). For this purpose, the module has a device name that is used to address it.

PROFINET device name

On delivery, the module does not yet have a device name. The device name is assigned to the module via the project planning software. The following rules from the PROFINET specification apply to the device name:

■ It consists of one or more name parts separated by a dot

■ The total length is 1 to 240 characters.

■ The length of a name part is between 1 and 63 characters.

■ A name part consists exclusively of lowercase letters, numbers, and the hyphen.

■ Neither the first nor the last character of a name part is a hyphen.

■ The first part of the name does not begin with "port-xyz" or "port-xyz-abcde", where a, b, c, d, e, x, y, and z are digits.

■ It does not have the form "k.l.m.n", where k, l, m, and n are numbers between 0 and 999.

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.

Adding the device to the network

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

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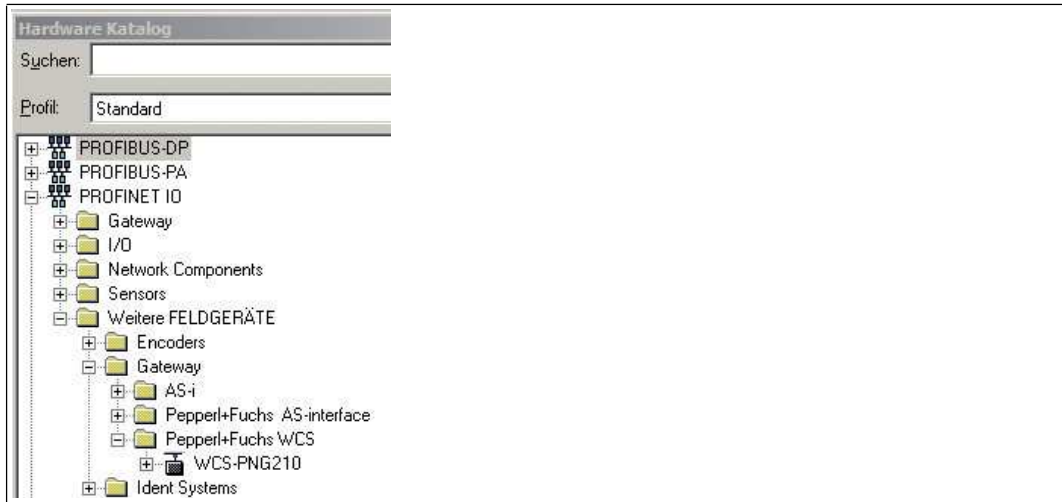
4. Drag the WCS-PNG210 from the tree structure and drop it into your PROFINET IO system.

   ↳ The symbol for the WCS-PNG210 is shown in the PROFINET IO system.
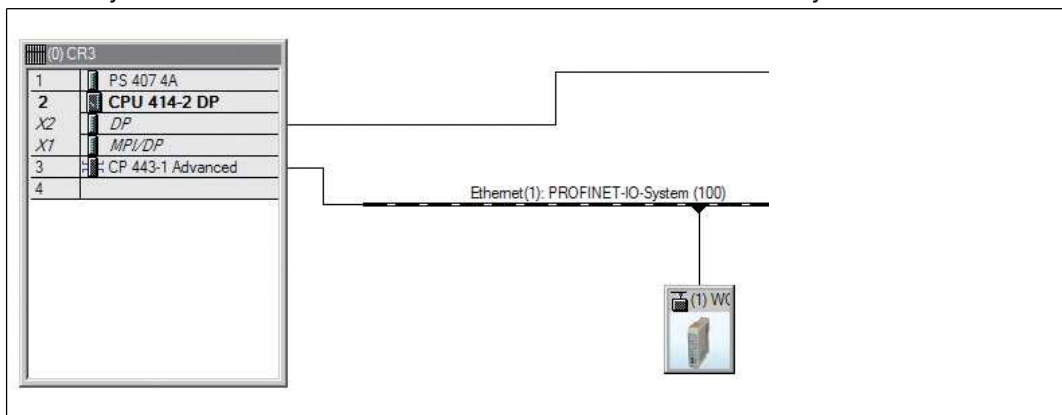
5. Double-click on the device symbol.

   ↳ 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.

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▶ 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 plant is in operation.

1. Stop PROFINET communication if it is active.

2. Select **Pepperl+Fuchs WCS** from the list of nodes and click on **OK**.

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 entered and can then be uniquely identified by the PLC.

4. In the WCS module **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.

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

Regardless of the number of WCS readers, 1 byte is reserved for querying the diagnosis of the WCS readers in the master. For the response data, 4 bytes are reserved per WCS reader in the "only Position" operating mode (configuration data for 4 WCS readers: 0x20, 0xD1, 0xD1, 0xD1, 0xD1). In the "Position and Speed" operating mode, 6 bytes are reserved per WCS reader (configuration data for 4 WCS 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.
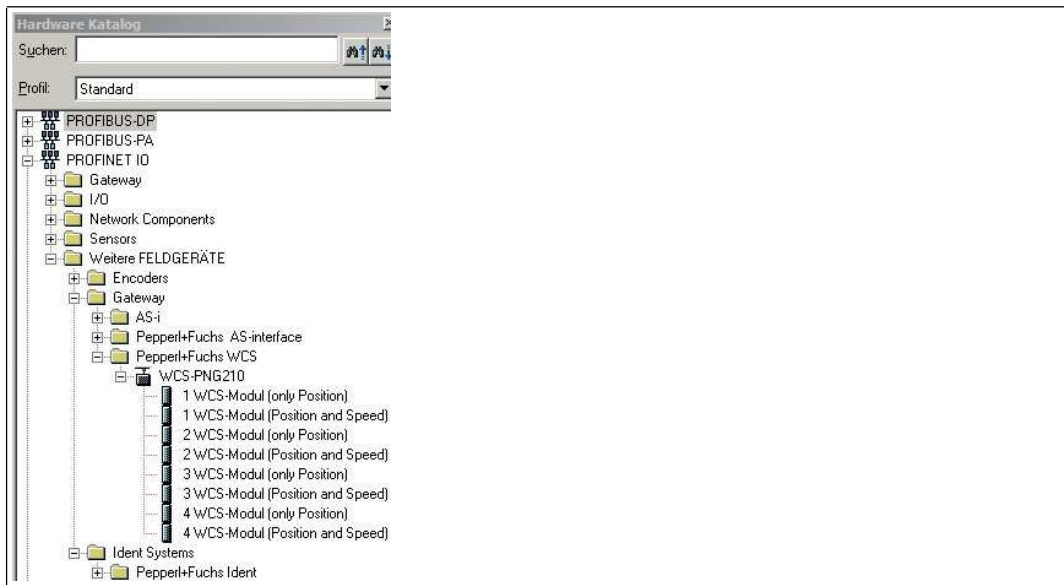
3. Select the module with the appropriate number of readers and operating mode and drag it into the window where the modules are listed.

↳ 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.

4.5 Data format for modules

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

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

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

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 4.4   Data format for each connected WCS reader in "Position and Speed" operating mode, reader 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 to 2.7 m/s
A1, A0: reader address, 00 = WCS reader address #1
DB: pollution display, 1 = cleaning necessary
OUT: code rail loss, 0 = code rail recognized
ERR: error display, error code (LEDs)

Address bits A1 and A0

A1	A0	Reader address
0	0	Reader address 0
0	1	Reader address 1
1	0	Reader address 2
1	1	Reader address 3

Status bits

DB	ERR	OUT	Description	Optical state of WCS reader
0	0	0	Current position value binary coded in P00...P18	Good
0	0	1	WCS reader outside of the code rail, not a position value	Good
			P0...P18=0: WCS reader partly outside the code rail	
			P0=1, P2...P18=0: WCS reader completely outside of the code rail	
1	0	0	Current position value binary coded in P00...P18	Poor
1	0	1	No position value, WCS reader outside of the code rail	Poor
X	1	X	No position value, error message from WCS reader, error number binary coded in P00...P18	-

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5 Appendix

5.1 Cable Routing in the RS-485 Bus

The data cables 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 readers and can be switched on and off with the interface module.

If only **one WCS reader** is connected, one device is connected at the beginning and one device is connected at the end of the data line.
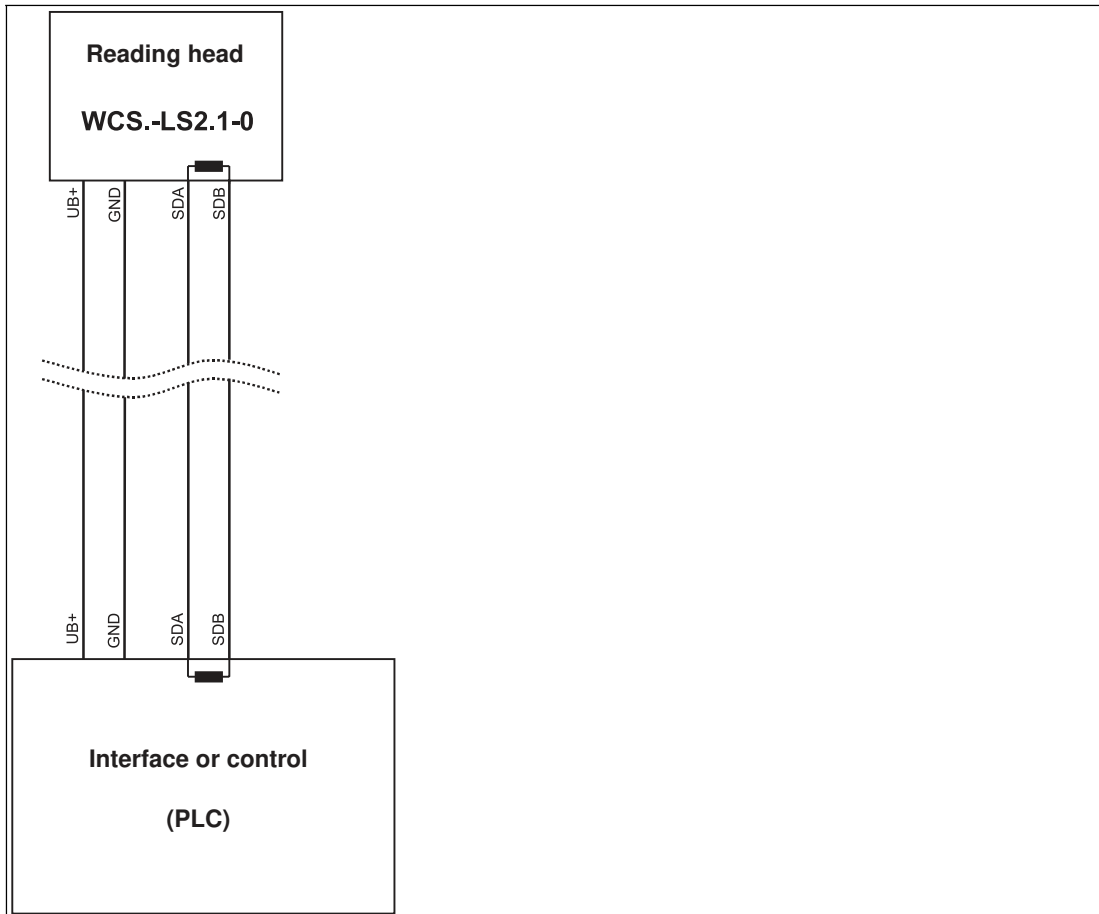

Figure 5.1   Connection of **one** reading head

If **two WCS readers** are connected to one interface module, there are two wiring versions:

■ **Version A:**

One WCS reader is located at the beginning and one WCS reader at the end of the data line. For both WCS readers, the RS-485 terminator is activated. The interface module is located between these two readers and does not have an RS-485 terminator. Each WCS reader is connected to the interface module by a separate data cable.
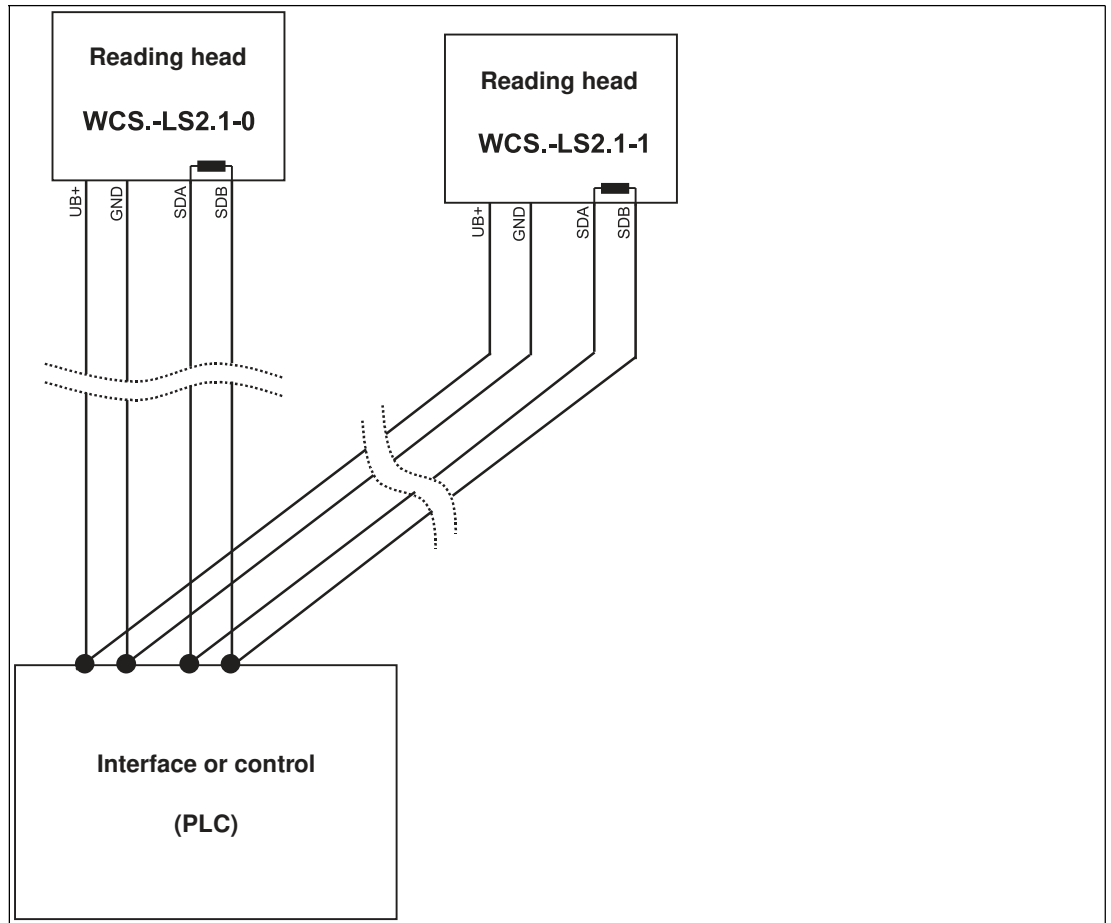
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Figure 5.2   Connection of **two** reading heads, Version A

■ **Version B:**

The interface module is located at the beginning of the data line; one WCS reader is located at the end of the data line. Both need the RS-485 terminator. The second WCS reader is connected to the line connection between the interface module and the first WCS reader through a short spur (length <1 m). Use a bus terminal to connect the spur.
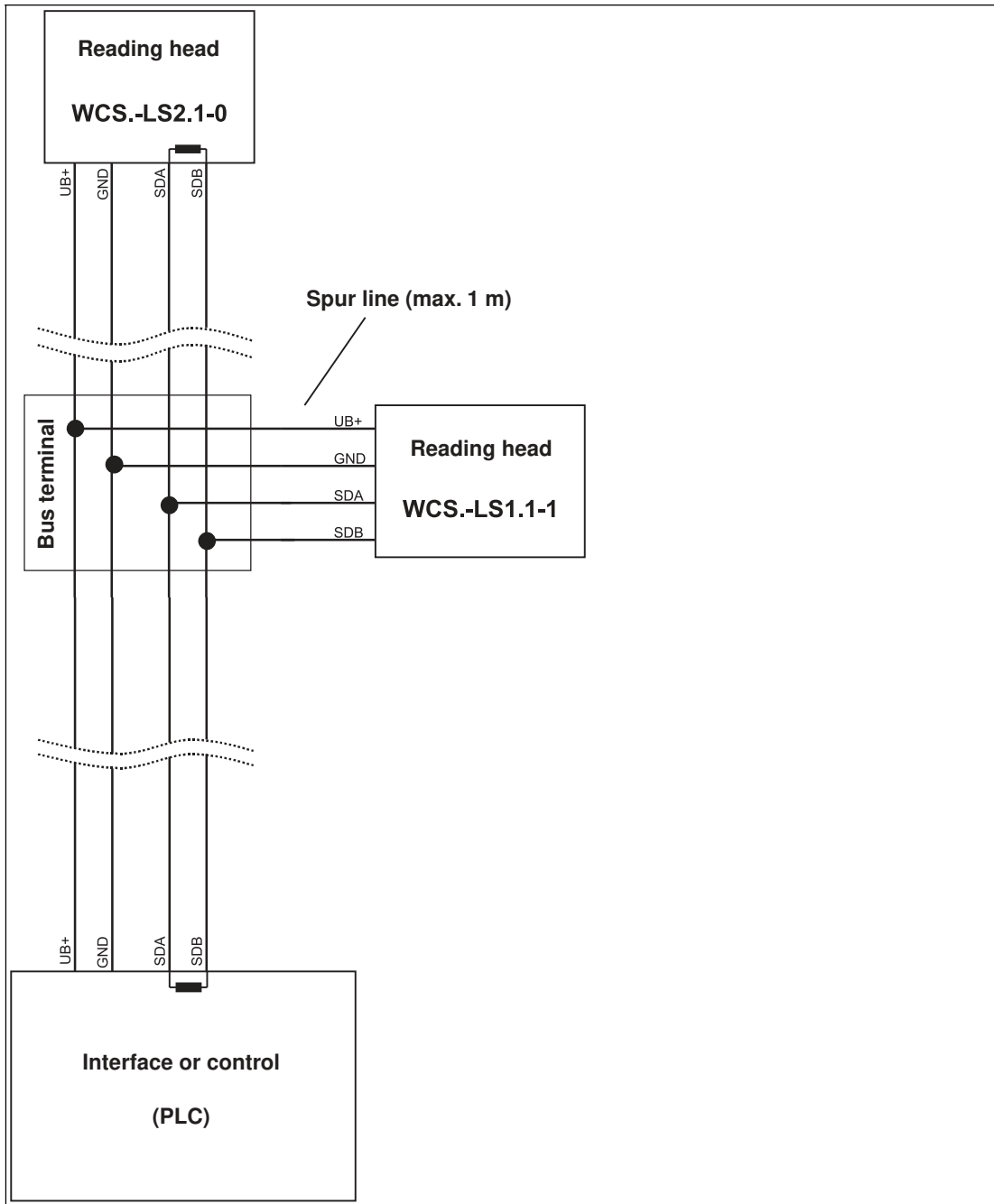
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Figure 5.3   Connection of **two** reading heads, Version B

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

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5.2 Data Cables and Accessories

RS-485 data cable

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

In the calculations, the worst-case scenario was assumed: All WCS readers are located at the end of the data line. In the case of large cable lengths, and when connecting multiple WCS2 readers with heating, six-wire data cable (3 x 2) can be used. These data cables use two pairs for the power supply (doubling the cable cross section), and one pair for the RS-485 data line.

Capacitance (core-core)	RS-485 interface		
	19.2 KB (LS246)	62.5 KB (LS221)	187.5 KB (LS211)
60 pF	500 m	500 m	300 m
90 pF	500 m	450 m	275 m
120 pF	500 m	400 m	250 m

The table shows the possible cable lengths depending on the cable capacitance (core-core). The number of connected WCS readers is of no significance.

WCS-DCS / WCS-DCF data cables

There are 2 types of data cable available:

. WCS-DCS for stationary cable routing

. WCS-DCF for trailing cable and drag chain installations.

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

	WCS-DCS	WCS-DCF
Capacitance (core-core)	95 pF/m	60 pF/m
Cross section	0.14 mm^2	0.25 mm^2
Number of wires	6 (3 x 2)	6 (3 x 2)
External diameter	5.8 mm	7.5 mm
Temperature range	-30 °C ... 70 °C	-40 °C ... 70 °C
Order designation	WCS-DCS	WCS-DCF

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Single-ended female cordsets and adapter cables

Field-attachable female connectors M12 x 1

	Number of poles	Cable diameter	Order designation
straight	4	6 mm – 8 mm	V1-G-PG9
angled	4	6 mm – 8 mm	V1-W-PG9
straight	5	6 mm – 8 mm	V15-G-PG9
angled	5	6 mm – 8 mm	V15-W-PG9
straight	6	6 mm – 8 mm	V17-G-PG9
angled	6	6 mm – 8 mm	V17-W-PG9 *)

Table 5.1   *) Cable outlet on top, not variable

Shielded connection cable with molded single-ended female cordset

	Number of poles	Cable length	Order designation
straight	4	2 m	V1-G-2M-PUR-ABG
straight	4	5 m	V1-G-5M-PUR-ABG
angled	4	2 m	V1-W-2M-PUR-ABG
angled	4	5 m	V1-W-5M-PUR-ABG
straight	5	5 m	V15-G-5M-PU R-ABG
angled	5	5 m	V15-W-5M-PUR-ABG
straight	8	2 m	V19-G-2M-PU R-ABG
straight	8	5 m	V19-G-5M-PU R-ABG

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