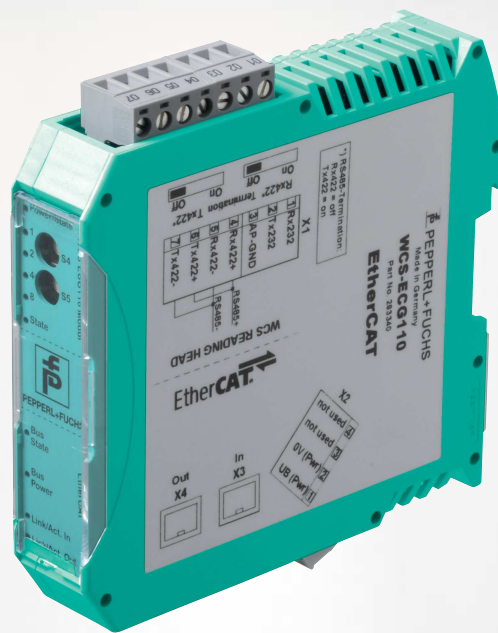


# WCS-ECG110 interface module

# WCS EtherCAT interface module

Manual



EtherCAT®

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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



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### Note

For full information on the product, refer to the further documentation on the Internet at [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

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The documentation comprises the following parts:

- This document
- Datasheet

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

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

## 1.2 Target Group, Personnel

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

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

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

### 1.3 Symbols Used

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

#### Warning Messages

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

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



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#### **Danger!**

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

---



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#### **Warning!**

This symbol indicates a possible fault or danger.

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

---



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#### **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.

---



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#### **Action**

1. 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-ECG110 interface module serves as an interface between the WCS reader and the EtherCAT controller. The device has 2 EtherCAT ports. The data is transferred between the WCS reader(s) and the WCS-ECG310 via the RS-485 interface, and from the WCS-ECG310 to the control panel via the EtherCAT protocol.

You can connect up to 4 WCS readers of type LS221 or LS121. If you connect several readers, they must have different addresses. The number of connected readers is configured in the hardware project settings.

### 2.2 Dimensions

The interface module housing has the following dimensions.

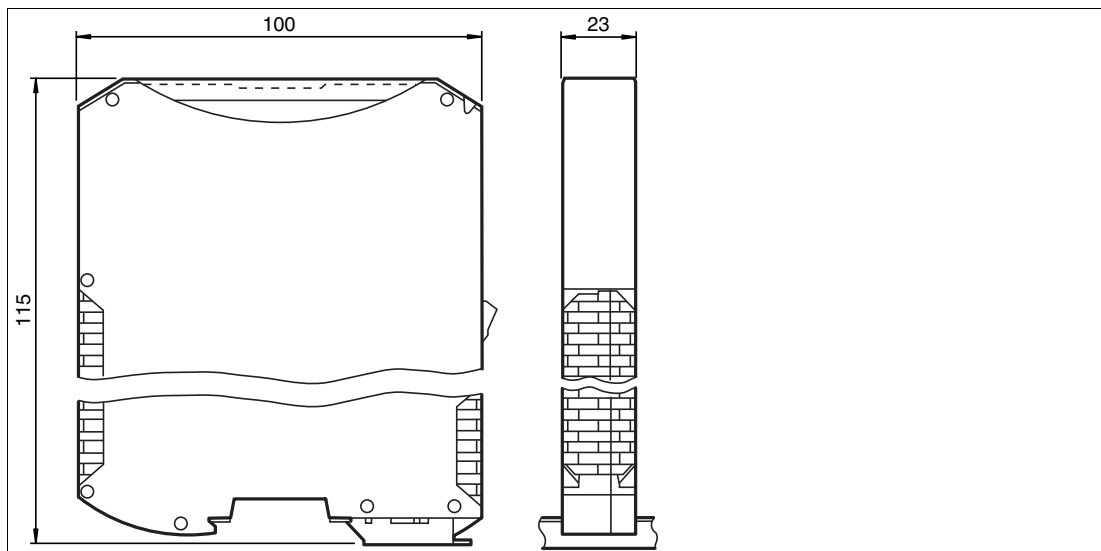


Figure 2.1 Dimensions

## 2.3 Design of the Device

### Device components

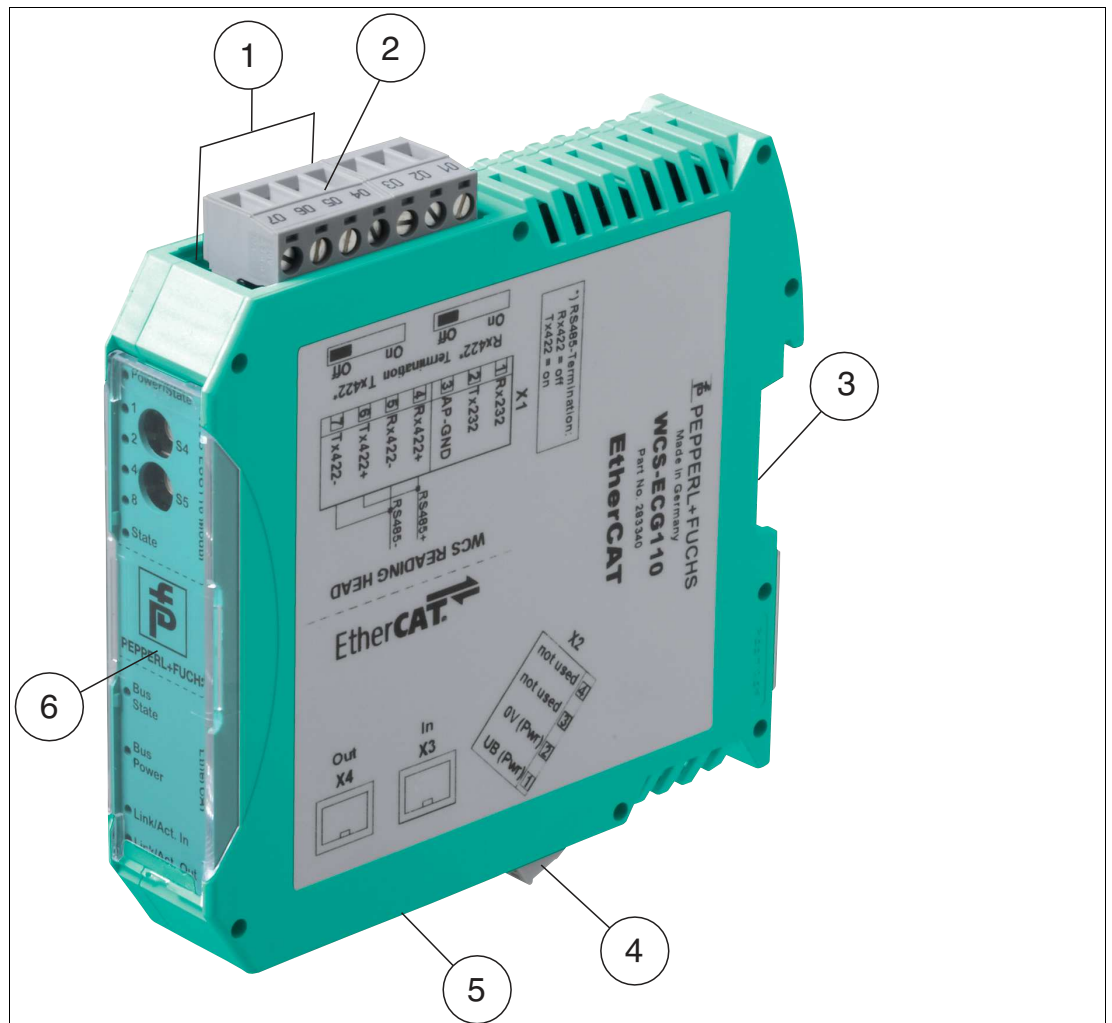


Figure 2.2 Interface module overview

- 1 RS-485 bus termination slide switch
- 2 X1: RS-485 interface
- 3 Mounting bracket
- 4 X2: Connection for power supply
- 5 X3: EtherCAT communication interface
- 6 Front panel with rotary coding switches and indicator lights

**Front panel**

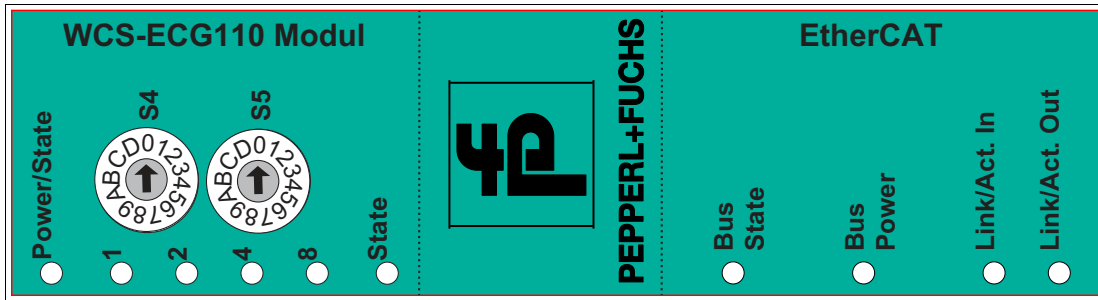


Figure 2.3 Front panel overview

**Power:**

The "Power" LED is green: The WCS-ECG110 interface module is correctly connected to the power supply.

**State:**

The "State" LED is green: Data is being exchanged with the WCS readers. Using the 4 "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 via the four "ErrorNo/Select ID" LEDs 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
0	1	0	1	5	Script error
0	1	1	0	6	Reserved
0	1	1	1	7	WCS reader communication, RS send buffer overflow
1	0	0	0	8	WCS reader communication, RS receive buffer overflow
1	0	0	1	9	WCS reader communication, RS timeout
1	0	1	0	10	General fieldbus error
1	0	1	1	11	Parity error 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 (display via the four "Error No/Select ID" LEDs when the "State" LED lights up red and thus indicates an error or a warning)

### Rotary coding switches S4 and S5

Set the number of connected WCS read heads with rotary switch **S4** (see chapter 4.2). Rotary switch **S5** has no function and is always set to switch position 0.

### EtherCAT State:

ERR State (red LED)	Error	Description
Off	No error	The EtherCAT communication of the device is ready for operation.
Flashing	Invalid configuration	General Configuration error (example: wrong object settings)
1 x flashing	Unprompted status change	The application changed the EtherCAT state independently: The parameter "Change" in the AL-status register is set to 0x01: Change/Error
2 x flashing	Application Watchdog Timeout	A timeout of the application has occurred (example: 10 ms IR error)

RUN State (green LED)	Status	Description
Off	INIT	The device is in the INIT status.
flashing	PRE-OPERATIONAL	The device is in PRE-OPERATIONAL status.
1 x flashing	SAFE OPERATIONAL	The device is in the SAFE-OPERATIONAL status.
on	OPERATIONAL	The device is in OPERATIONAL status.

The states of the LEDs are defined as follows:

LED status	Definition
on	The LED is permanently on.
Off	The LED is permanently off.
Flashing	The LED changes the state from ON to OFF at a frequency of 2.5 Hz: ON for 200 ms, followed by OFF for 200 ms.
1 x flashing	The LED lights up briefly (200 ms), followed by a long OFF phase (1000 ms).
2 x flashing	The LED shows a series of short flashes twice (200 ms), separated by an OFF phase (200 ms). The series is completed with a long OFF phase (1000 ms).

### EtherCAT Power:

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

### EtherCAT Link/Activity In:

The "Link/Activity" LED at the IN port is directly activated by the EtherCAT processing unit and lights up **green** when the gateway at the RJ45(In) is located on an operational network (link pulses are received) and flickers in case of network data traffic (activity).

### EtherCAT Link/Activity Out:

The "Link/Activity" LED at the OUT port is directly activated by the EtherCAT processing unit and lights up **green** when the gateway at the RJ45(Out) is located on an operational network (link pulses are received) and flickers in case of network data traffic (activity).

## 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.

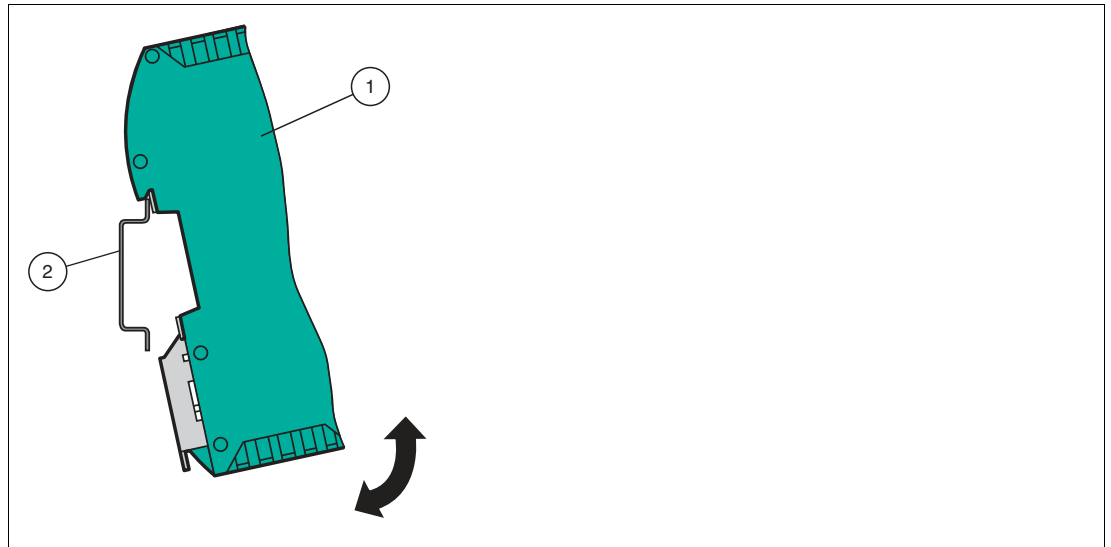


Figure 3.1 Mounting

1. Hook the module (1) onto 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<sup>2</sup>.



#### Note

##### Vertical Installation

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

## 3.2 Electrical Connection



### Danger!

Device damage due to incorrect installation

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, crimp the stranded conductors with wire end ferrules.
- Make sure that the insulation on the conductors extends all the way 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).

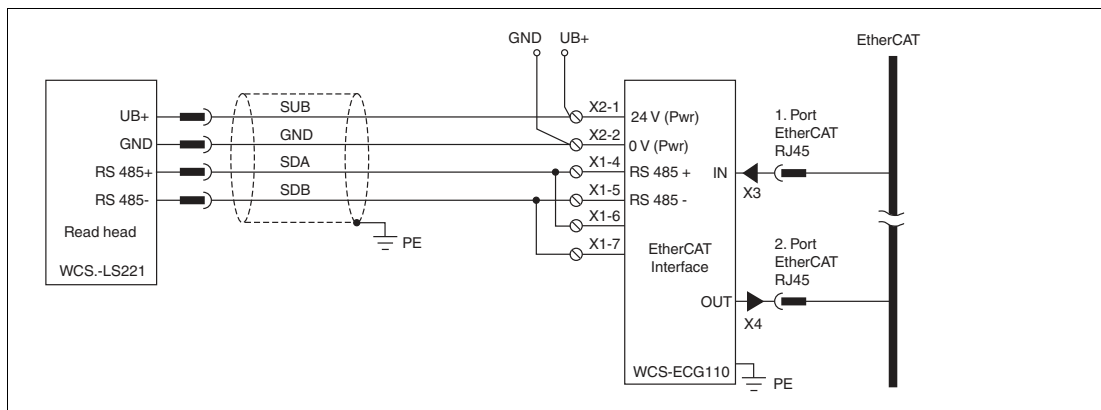


Figure 3.2 Electrical Connection

Plug X1 is located on the top side of the interface module, and plug X2 is located 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 connection (EtherCAT connection)

When using 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<sup>2</sup>
- Solid cable: 1 x 0.25 ... 1.5 mm<sup>2</sup>

The plug-in terminal strip combines a standard screw connection and a plug connector. The plug connector is coded and therefore cannot be plugged in incorrectly.



### Connecting the power supply

1. Connect the operating voltage (10 VDC...33 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 for interface module/ operating voltage for WCS reader
2	0 V (Pwr)	Ground for interface module/ground for 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.



### EtherCAT® communication interface

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

1. Insert the EtherCAT® connectors into one of the RJ45 socket(s) with the inscription "In" (cable from master) or "Out" (further cable to the next EtherCAT® slave).



**Note**

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



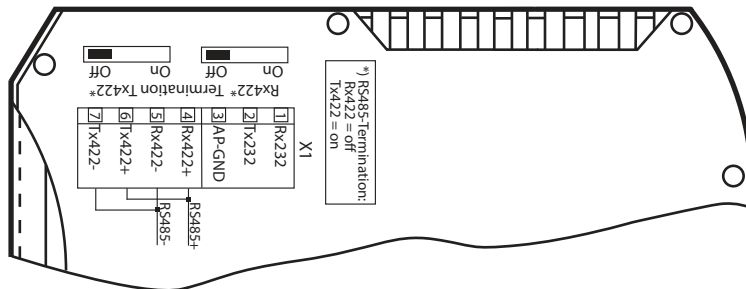
### Preparing for operation on the RS-485 interface

For operation on an RS-485 interface, the terminals 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

**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 "Rx 422 Termination" slide switch to "Off" and the "Tx 422 Termination" slide switch to "On." This activates the RS-485 terminator (150  $\Omega$ ) 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.

### 3.3 Dismounting



#### Dismounting the modules

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

1. Disconnect all the supply and signal lines.

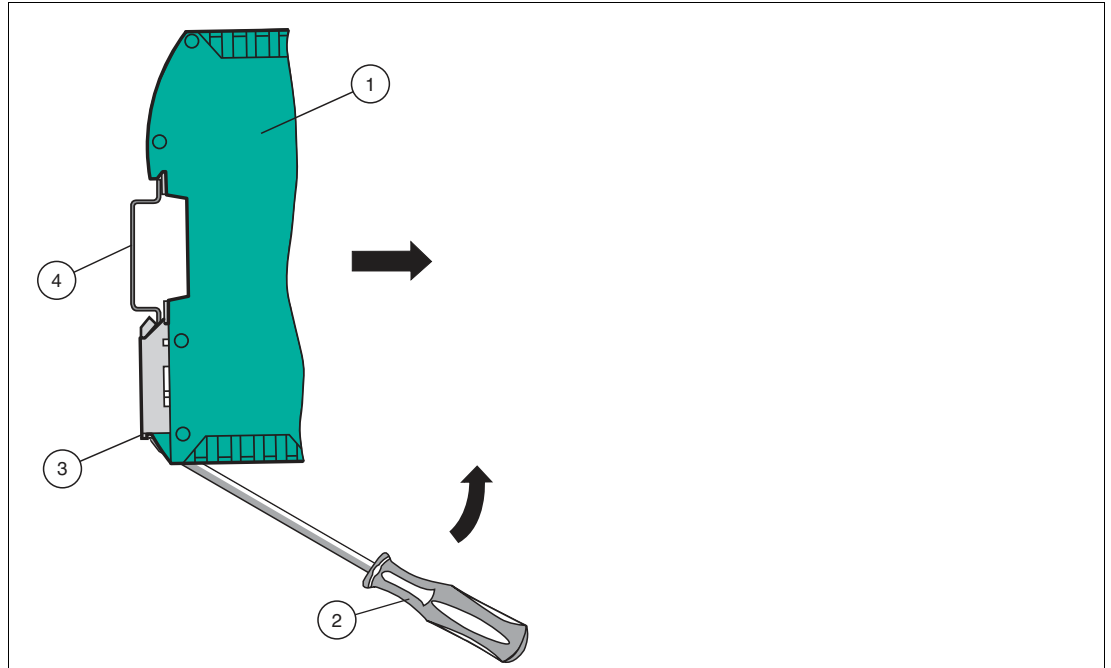


Figure 3.3 Dismounting

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.

## 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 must only be carried out by trained personnel in accordance with the safety regulations.

#### Components

To commission the module, you will require the following components:

- WCS-ECG110 interface module
- Cordset from the interface module to the reader
- Connector for the EtherCAT® connection to the interface module
- Ethernet cable
- 10 VDC...33 VDC power supply
- ESI file (the ESI file can be obtained free of charge from our website [www.pepperl-fuchs.com](http://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 an EtherCAT® 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 EtherCAT® IO controller (PLC).

2. Assign an EtherCAT® device name.



#### Note

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

3. Connect the module to the EtherCAT® network at the interface with the label "In" (cable from master) or "Out" (further cable to the next slave).
4. Connect the process device (reader) to the interface module. For information on commissioning the reader, please refer to the instruction manual for the reader.
5. Ground the DIN mounting rail onto which the assembly is snapped.
6. Connect the direct current to the terminals provided.
7. Use any programming tool for configuration. The ESI file can be downloaded from our website: [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com). Simply enter the product name or item number in the Product/Keyword field and click the "Search" icon.



**Note**

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

## 4.2 Connecting the WCS Reader

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 4 WCS readers to an interface module via an RS-485 cable. Each WCS reader is supplied with the default address of 0. Details of how to change the address of the WCS reader can be found in the configuration instructions for the WCS reader.

The number of connected readers and their operating mode is configured in the hardware project settings. To the Hardware Configuration, see chapter 4.4.

WCS reader terminal pin		Terminal on interface module
WCS2B	WCS3B	
2	1	X2-1
4	2	X1-4
1	4	X1-5
3	3	X2-2

Table 4.1 Connection of WCS readers

### Setting the number of connected WCS readers

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

#### Rotary switch S4

Switch setting S4	Number of WCS readers	Reader address
1	1 WCS reader	0
2	2 WCS readers	0, 1
3	3 WCS readers	0, 1, 2
4	4 WCS readers	0, 1, 2, 3
5	1 WCS reader with velocity output	0
6	2 WCS readers with velocity output	0, 1
7	3 WCS readers with velocity output	0, 1, 2
8	4 WCS readers with velocity output	0, 1, 2, 3

Table 4.2 Position of rotary switch S4 for setting the number of WCS readers

**Example**

You have connected 3 readers to the interface module and want to use the velocity output. Move the rotary switch S4 to switch position 7 and set the addresses 0,1,2 on the 3 readers.

**Note****Rotary switch S5**

Rotary switch S5 has no function. Always set rotary switch S5 to position 0.



### Connecting the WCS Reader

1. Connect the power supply for the WCS reader to terminals 1 and 2 of the 4-pin connector X2 on the interface module.
2. Connect the RS 485 data line to the WCS reader on terminals 4 and 5 of connector X1.  
If you operate the WCS-ECG110 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 switch "**Rx 422**" to OFF.
2. To activate the RS485 terminator, slide the switch "**Tx 422**" to ON.
3. To deactivate the RS485 terminator, slide the switch "**Tx 422**" to OFF.
4. If only one reader is connected, you must always activate the RS485 terminator. For this purpose, slide the switch "**Tx 422**" to ON.

### 4.3 Connection to the network

The connection to the EtherCAT IO is made via the two "RJ 45 EtherCAT IN and OUT" sockets on the underside of the interface module. The front socket is labeled "X3 IN," and the rear socket is labeled "X4 OUT." Connect the device to the EtherCAT network at the interface with the label "In" (cable from master) or "Out" (further cable to the next slave).

#### Pinout X3 IN & X4 OUT

Terminal		Description
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 4.3 Terminals of the 8-pin "RJ45 EtherCAT 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

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



#### Setting data exchange mode

1. Set rotary switch "S5" to position 0. The rotary switch "S4" is set in accordance with the connected readers.

## 4.4 Integrate Interface Module 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.

You will need an ESI file to operate the module described in this manual. The ESI file must be imported into the corresponding configuration tool before commissioning the module. The ESI file can be downloaded from our website: [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com). Simply enter the product name or item number in the Product/Keyword field and click the "Search" icon.



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.

### EtherCAT® 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 EtherCAT® IO controller (PLC). For this purpose, the module has a device name that is used to address it.

### EtherCAT® 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 EtherCAT® 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

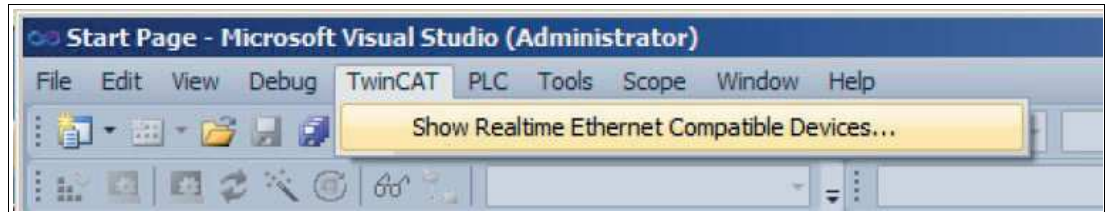
Various configuration tools are available to allow you to configure the interface module. In this manual, we describe the configuration example for EtherCAT® Master "TwinCAT" by Beckhoff. If you are using a programmable logic controller (PLC) from a different manufacturer, the process will be similar to the one described here.



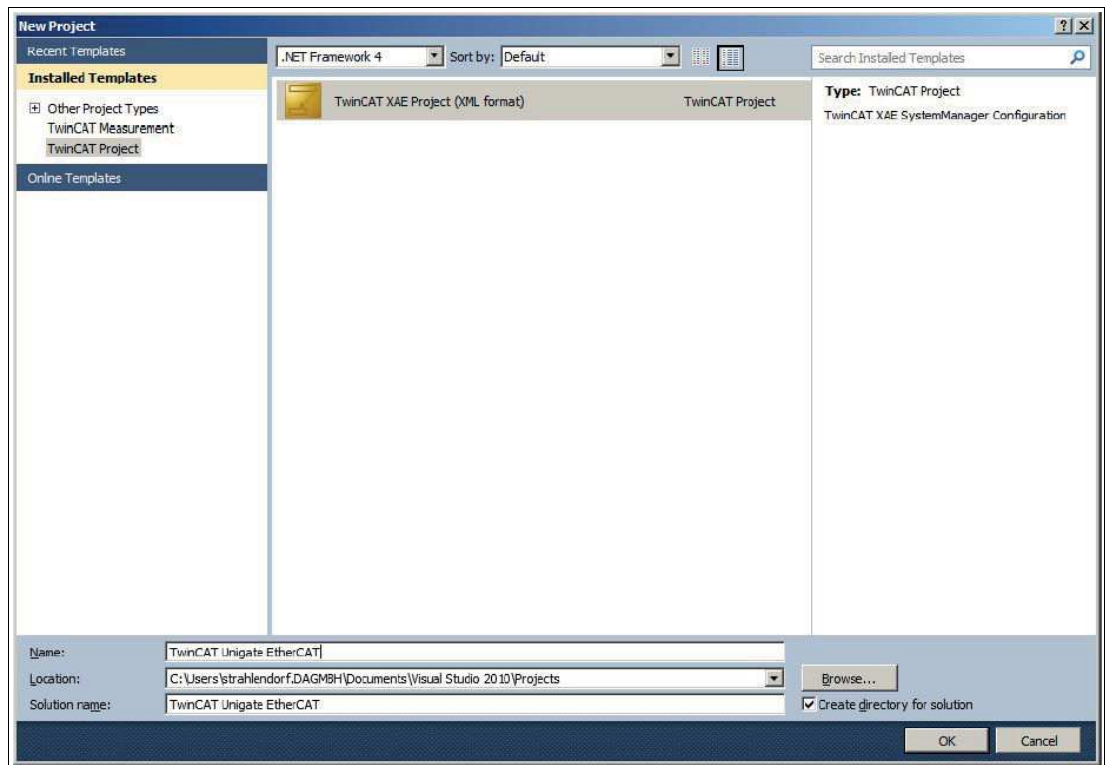


### Adding the device to the network

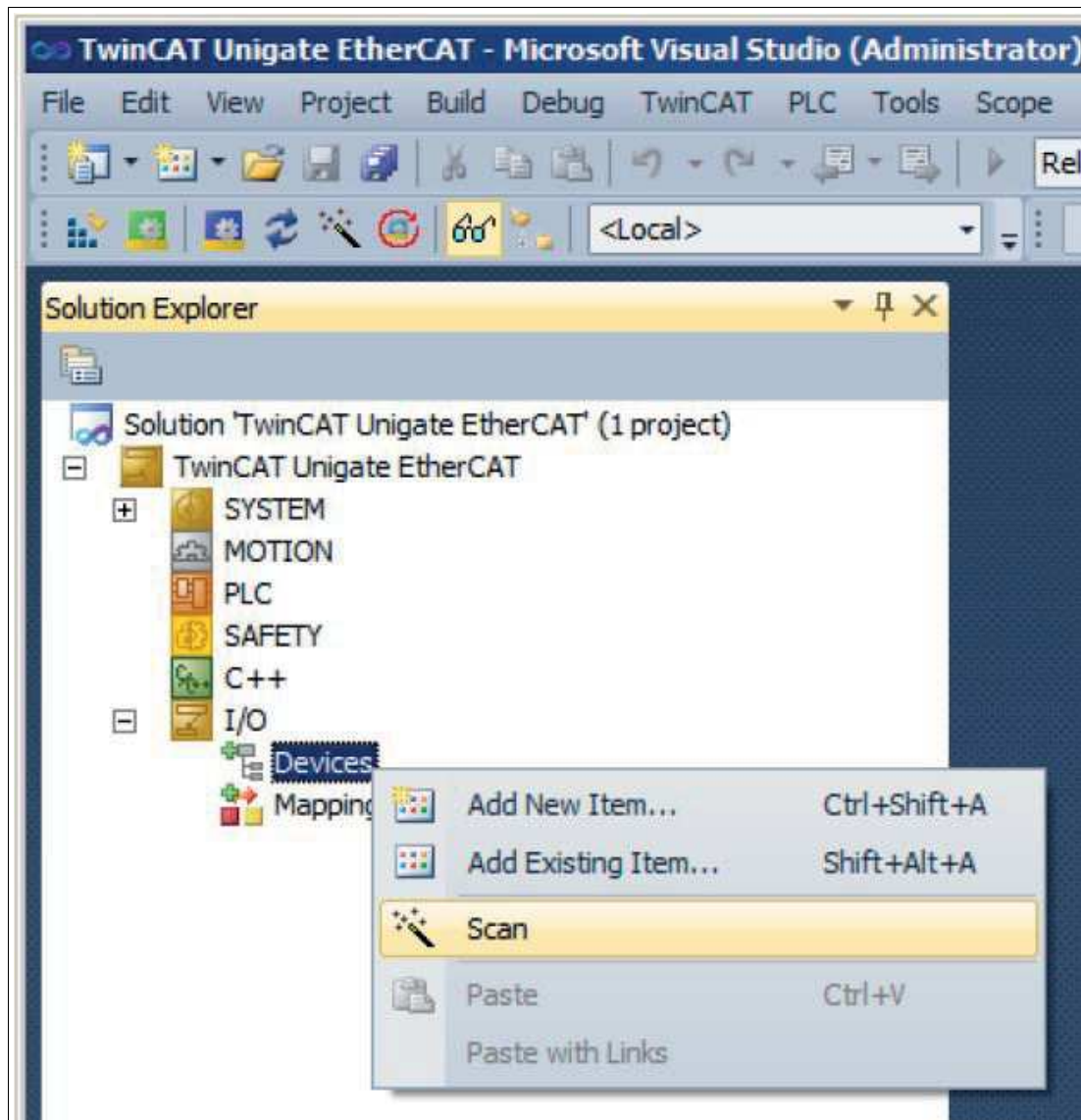
1. Download and install the software "TwinCAT 3.1 - eXtended Automation Engineering" (XAE). The software is available on the website of the manufacturer Beckhoff at <http://www.beckhoff.com/english.asp?download/tc3-download-xae.htm>.
2. After the installation, copy the ESI file into the following folder:  
C:\TwinCAT\3.1\Config\lo\EtherCAT
3. Open TwinCAT V3 and check to see if your Ethernet card works with the software. If your device is displayed in the sub-folder "Installed and ready to use devices", you can proceed.



4. Open a new TwinCAT project.



5. Click through the device tree until you see a symbol with the label Devices. Right-click the symbol and select **Scan**.



↳ A window **1 new I/O devices found** opens if a device was detected. The device can now be added to the device tree.

6. Double-click on the device symbol.  
↳ The **Properties** window opens.
7. Enter the required network configuration.



### Searching for a device on the network

1. To search for a new device, click through the device tree until you see a symbol with the label **Devices**. Right-click the symbol and select **Scan**.  
↳ The PLC interrogates the network to see which nodes are present (Broadcast query). A list of the connected devices is displayed in the window.



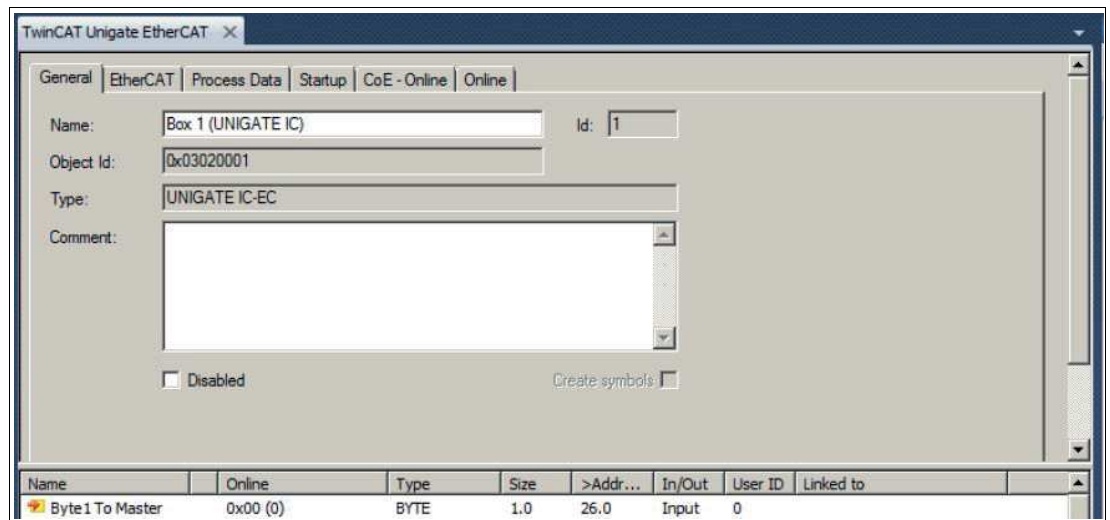
## Changing the device name



### Note

The PLC must not communicate with the device via EtherCAT while you are changing the device name. If you try to change the device name while the plant is in operation, an error message will be output.

1. Stop communication if it is active.
2. Select **Pepperl+Fuchs WCS** from the list of nodes (default device name: UNIGATE-IC) and double-click on the device symbol.



3. In the WCS module **Properties** window, enter the new device name in the **Name** field and save the configuration.  
 ↳ The interface module is given the name you entered and can then be uniquely identified by the PLC.

Depending on your application, select one, two, three or four connected readers and the operating mode. In the first 4 operating modes, 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.

## 4.5 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 results of the diagnostic function.

## 4.6 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 4.4 Data format for each connected WCS reader in "only Position" operating mode, reader address = 0...3

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 4.5 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	-

## 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.

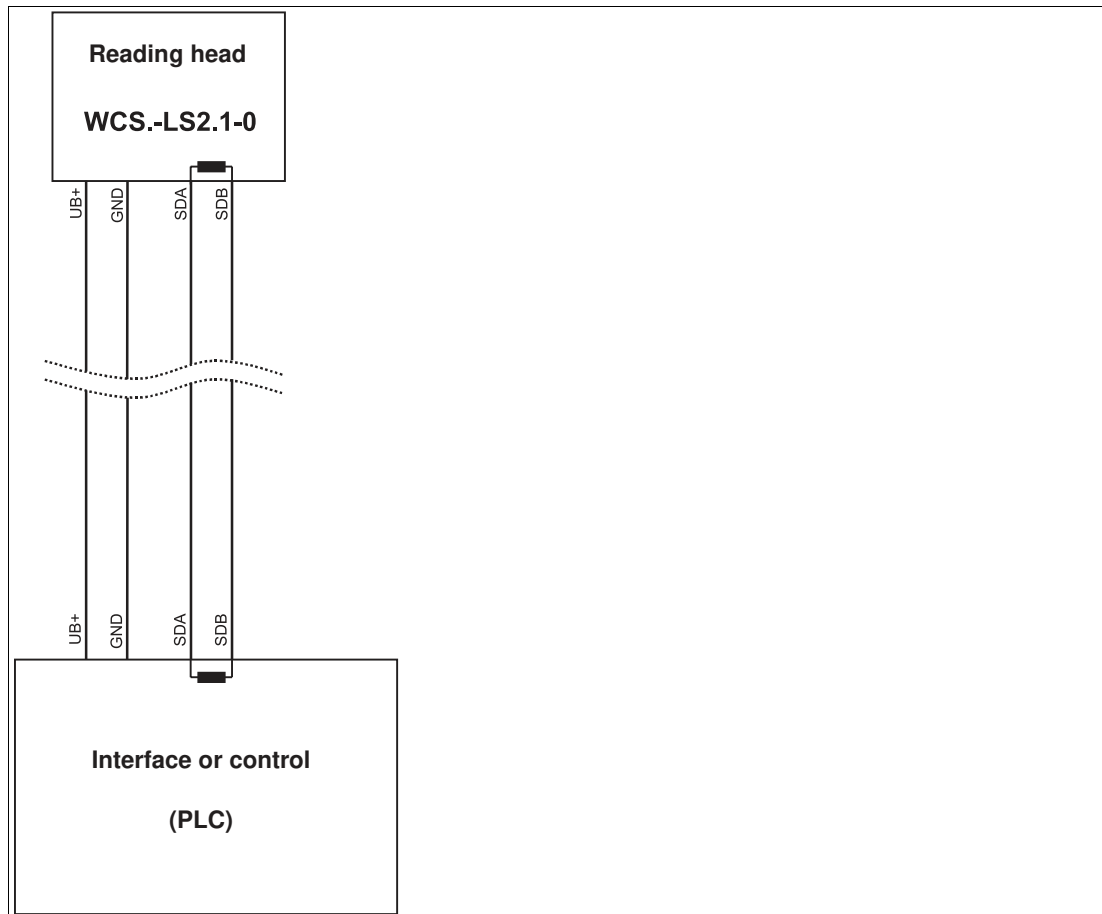


Figure 5.1 Connection of **one** reading head

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.

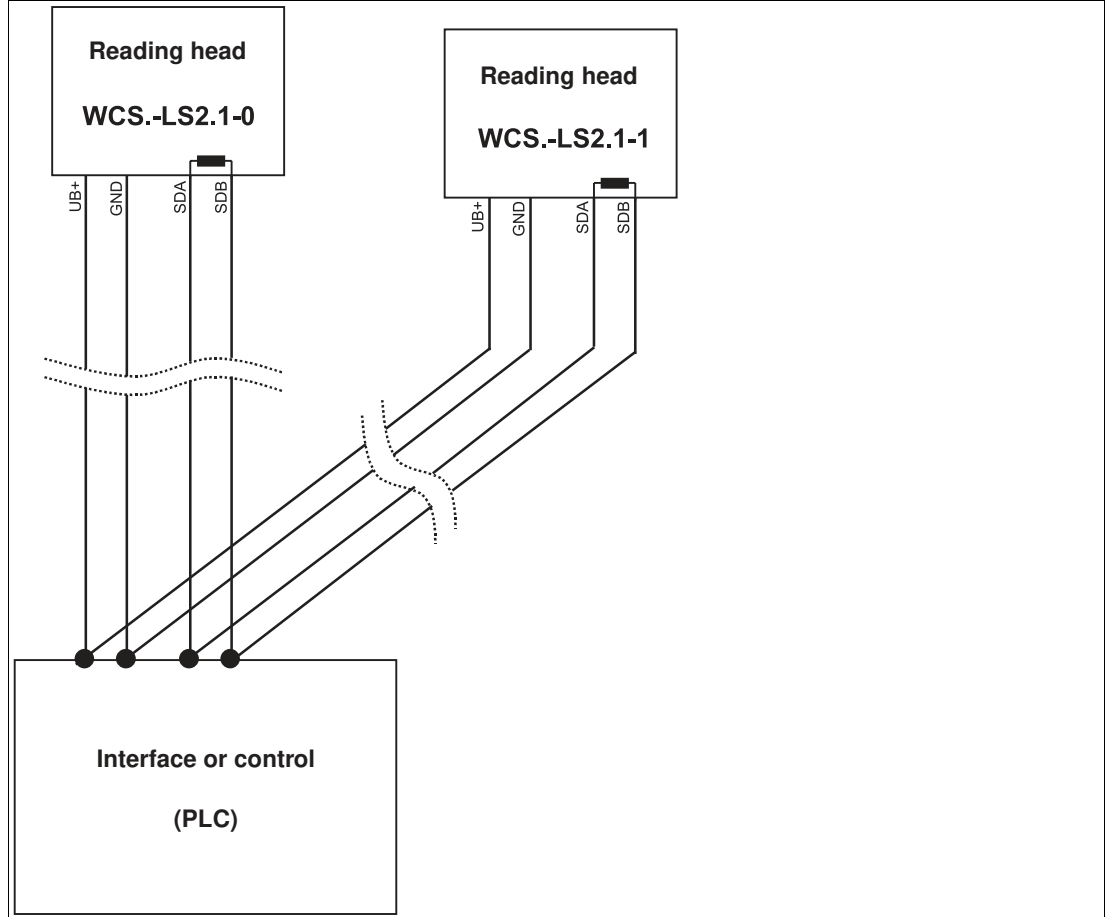


Figure 5.2 Connection of **two** reading heads, Version A

- **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.

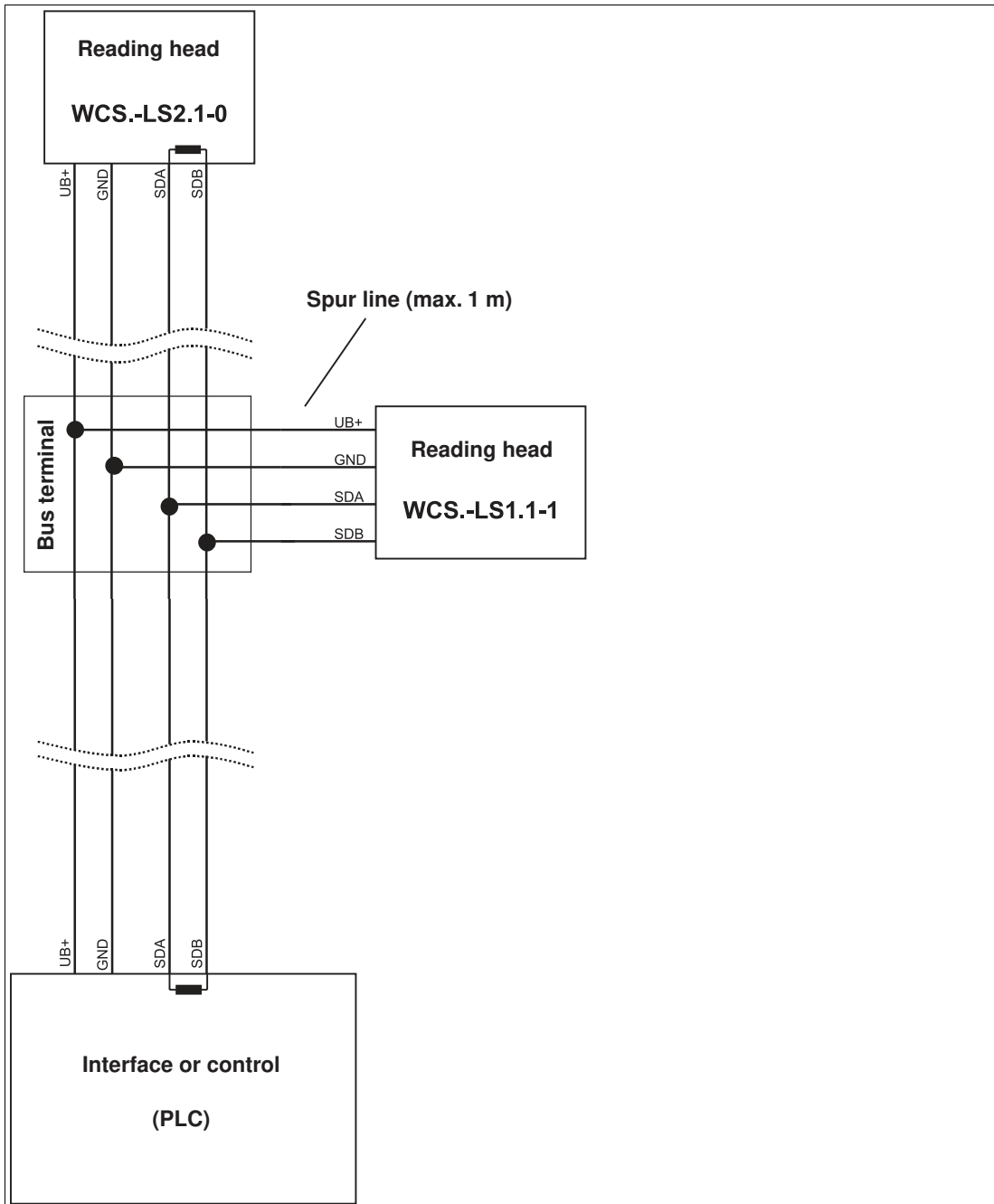


Figure 5.3 Connection of **two** reading heads, Version B

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.

## 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 capacity of the data cable—core-core— for data transfer, and on the cross section of the cables for power supply to 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, 6-wire data cables (3 x 2) can be used. These data cables use two pairs for the power supply (doubling the cable cross-section), and one pair for the RS-485 data line.

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 <sup>2</sup>	0.25 mm <sup>2</sup>
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

## 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

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

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