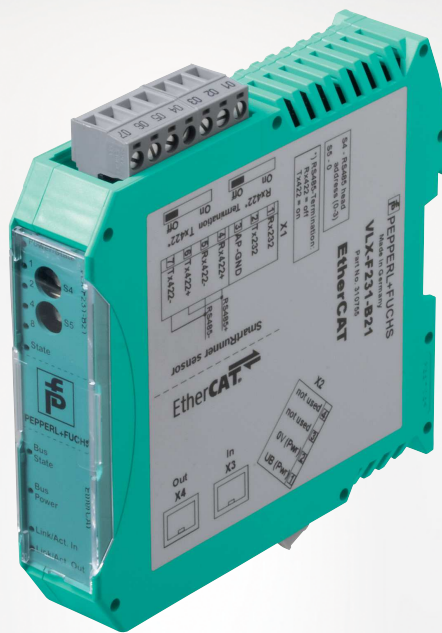


VLX-F231-B21 Interface Module EtherCAT

Manual



EtherCAT 

Your automation, our passion.

 **PEPPERL+FUCHS**

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Worldwide

Pepperl+Fuchs Group
Lilienthalstr. 200
68307 Mannheim
Germany
Phone: +49 621 776 - 0
E-mail: info@de.pepperl-fuchs.com

North American Headquarters

Pepperl+Fuchs Inc.
1600 Enterprise Parkway
Twinsburg, Ohio 44087
USA
Phone: +1 330 425-3555
E-mail: sales@us.pepperl-fuchs.com

Asia Headquarters

Pepperl+Fuchs Pte. Ltd.
P+F Building
18 Ayer Rajah Crescent
Singapore 139942
Phone: +65 6779-9091
E-mail: sales@sg.pepperl-fuchs.com
<https://www.pepperl-fuchs.com>

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1 Introduction

1.1 Content of this Document

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

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



Note

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

The documentation comprises the following parts:

- This document
- Datasheet

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

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

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and 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.

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 VLX-F231-B21 interface module acts as an interface between SmartRunner (from now on referred to as the sensor) and the EtherCAT controller. Data is transferred between the sensor or sensors and the interface module via the RS-485 interface and from the interface module to the controller via the EtherCAT interface.

You can connect up to four sensors to an interface module. The number of connected sensors is configured in the hardware project planning.

2.2 Dimensions

The interface module housing has the following dimensions.

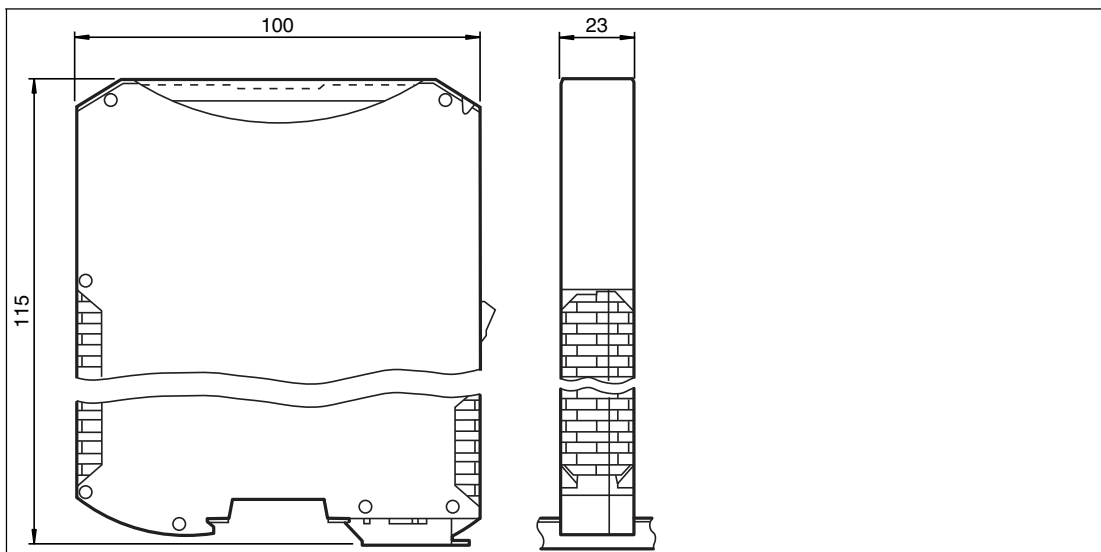


Figure 2.1 Dimensions

2.3 Design of the Device

Device Components

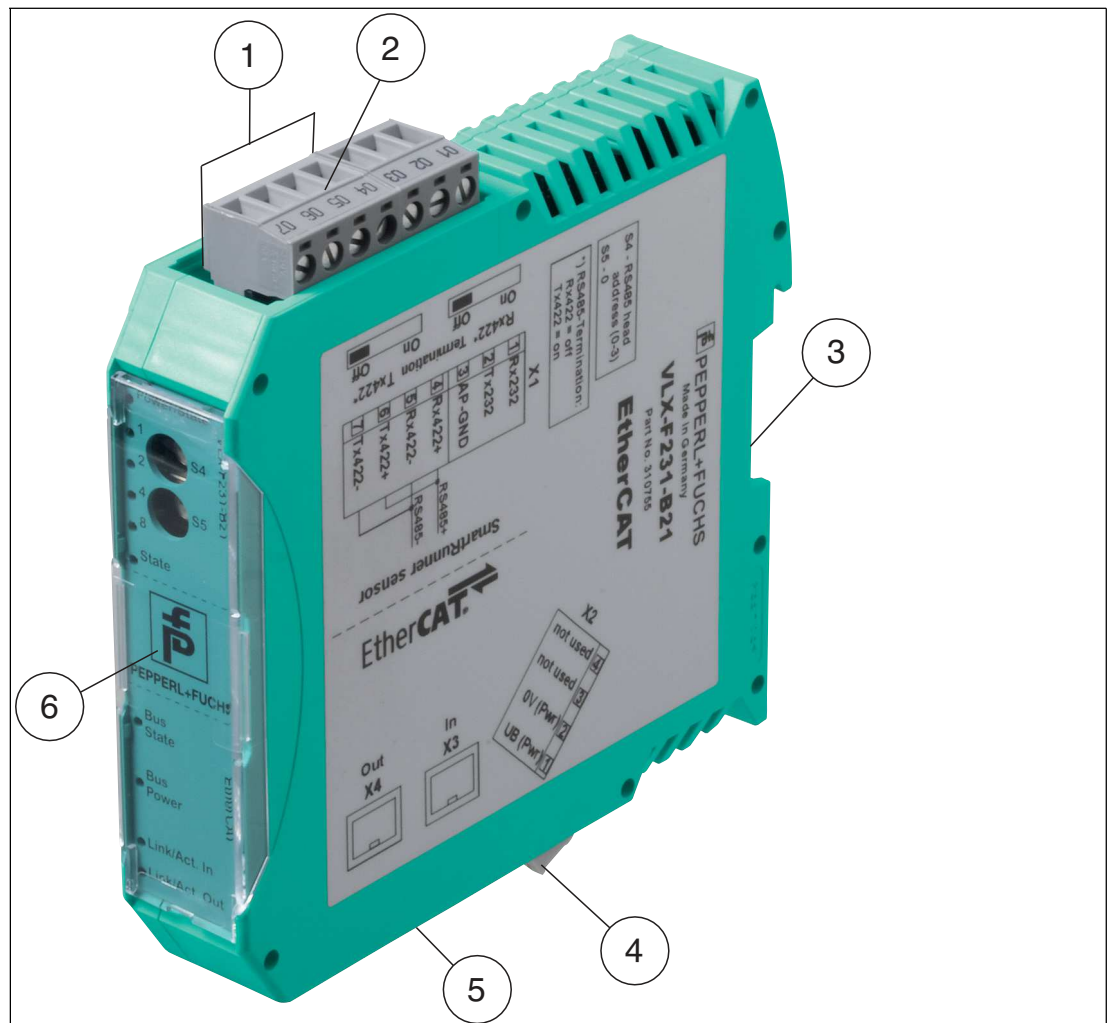


Figure 2.2 Interface module overview

- 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

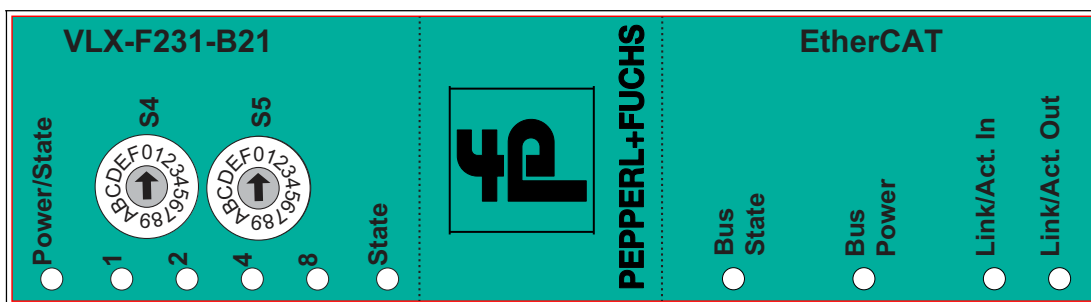


Figure 2.3 Front panel overview

Sensor

Power:

The "Power" LED lights up green: power supply is present.

State:

The "State" LED is green: Data exchange is taking place with the sensors. The four "Error No/Select ID" LEDs are used to display the number of the currently polled sensor.

Error No/Select ID				Sensor 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 lights up 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.

LED ErrorNo/Select ID				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	Sensor communication, RS send buffer overflow
1	0	0	0	8	Sensor communication, RS receive buffer overflow
1	0	0	1	9	Sensor 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 Significance 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 Switch S4

Configuration	Switch position S4
1 sensor	1
2 sensors	2
3 sensors	3
4 sensors	4

Rotary Coding Switch S5

Make sure that the switch is in **switch position 0**.

EtherCAT

Bus 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	The application has timed out (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 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).

Bus Power:

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

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).

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.

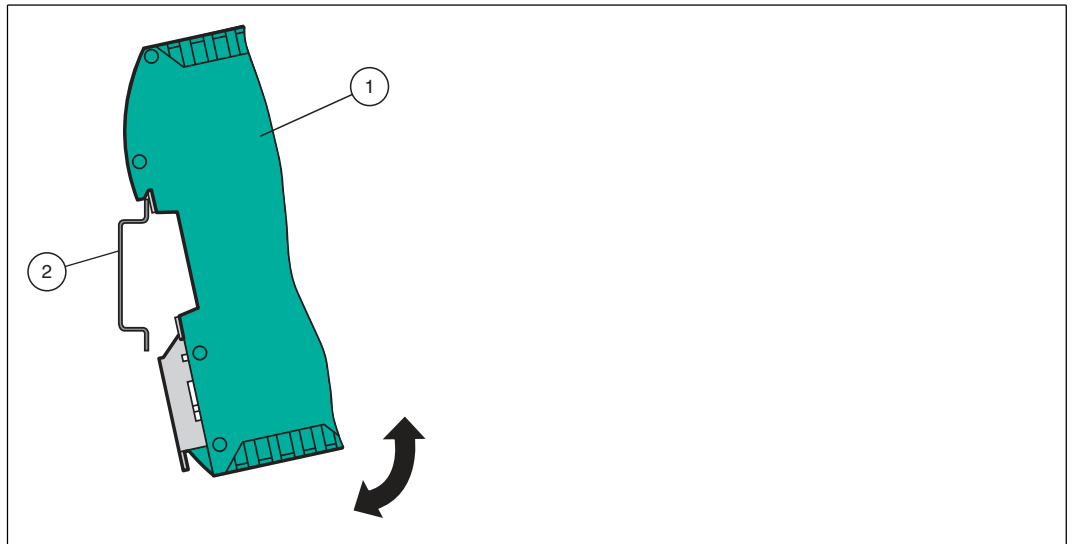


Figure 3.1 Mounting

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 mm².



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

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

- Observe 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 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 unsuitable tool may damage the screw heads. Use a slot-head screwdriver sized 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).

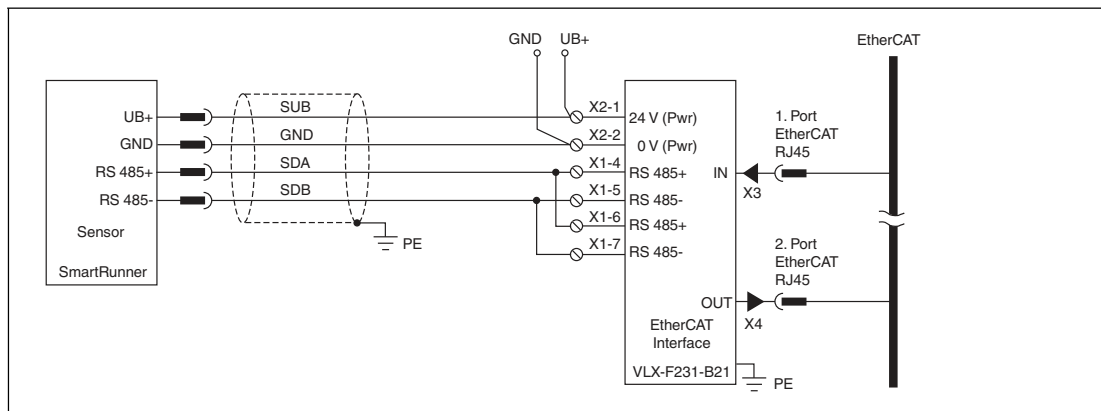


Figure 3.2 Electrical connection

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 technologies when wiring the assembly:

- Standard screw/plug connection (supply + RS)
- 8-pin RJ45 connection (EtherCAT® connection)

When using standard screw terminals, one cable 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 mm²
- Solid cable: 1 x 0.25 ... 1.5 mm²

The plug-in terminal strip combines a standard screw connection and a connector. The connector is coded and therefore cannot 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 X2

Terminal		Description
1	UB (Pwr)	Operating voltage interface module/ operating voltage sensor
2	0 V (Pwr)	Ground of interface module/ground of sensor
3	not used	is not used
4	not used	is 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.

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



Note

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



Preparing for Operation on RS-485 Interface

For operation on an RS-485 interface, the terminal on plug 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+	Data line RS-485+ to sensor
5	Rx 422-	Data line RS-485- to sensor
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



RS-485 Bus Termination

If the interface module is operated as the first or last physical device in an RS-485 bus or if you operate one read head on the interface module, a bus termination must be performed on this interface module.

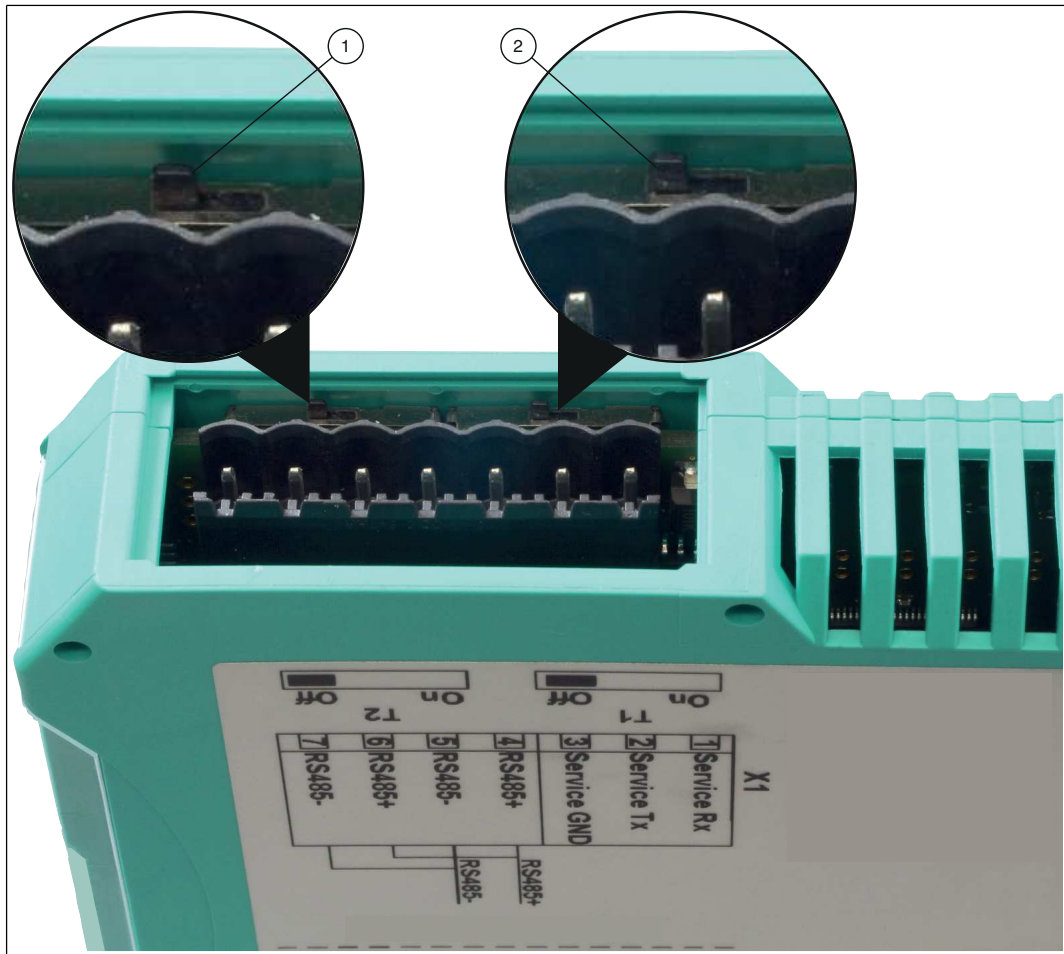


Figure 3.3 RS-485 bus termination

1. Set the T2 slide switch (1) to "On" to activate the bus termination (150 Ω) or to "Off" to deactivate the bus termination.
2. Set the T1 slide switch (2) permanently to "Off."

3.3 Dismounting



Dismounting the modules

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

1. Disconnect all the supply and signal lines.

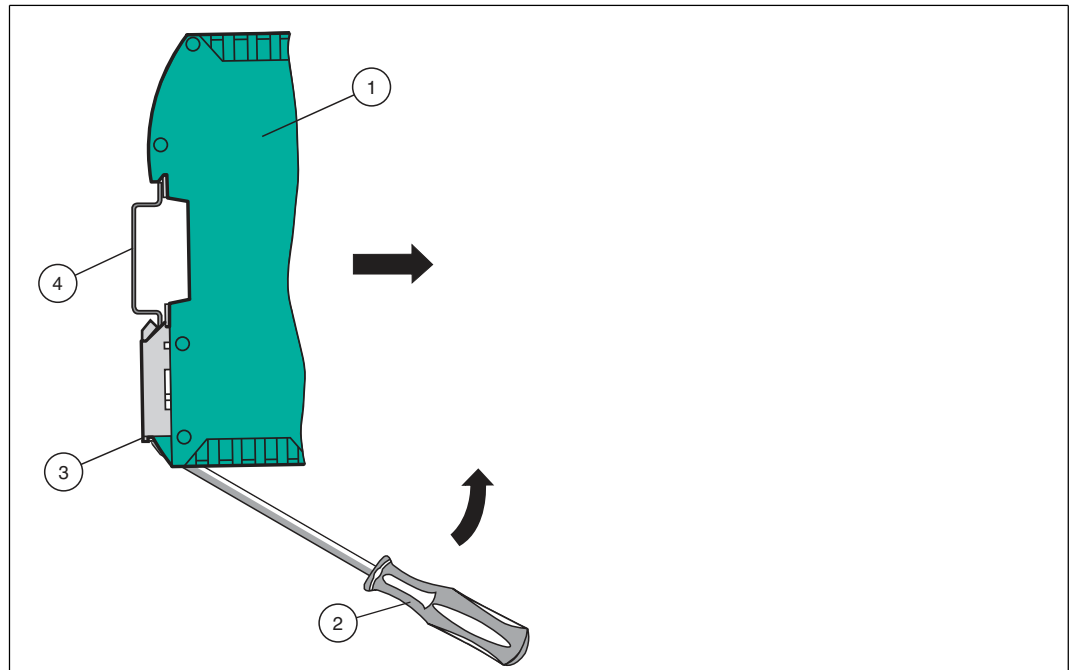


Figure 3.4 Dismounting

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

Components

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

- VLX-F231-B21 interface module
- Cordset from the interface module to the read head
- Connector for the EtherCAT® connection to the interface module
- Ethernet cable
- 10 VDC...30 VDC voltage supply
- ESI file (the ESI 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. Connect the module to the EtherCAT® network at the interface labeled "In" (cable from master) or "Out" (further cable to the next slave).
2. Connect the sensor to the interface module. For information on commissioning the sensor, please refer to the instruction manual for the sensor.
3. Ground the DIN mounting rail onto which the assembly is clipped.
4. Connect the direct current to the terminals provided.
5. Use any programming tool for project planning. The ESI file can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the product/keyword field and click "Search."



Note

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

4.2 Connecting the Sensor

If you connect several sensors to one interface module, the sensors must have different addresses. The different addresses will allow the programmable logic controller to allocate the data to the right sensors. If you connect only one sensor to an interface module, this sensor always receives the address 0. You can connect up to four sensors to an interface module via an RS-485 cable. Each sensor is supplied with the default address of 0. Details of how to change the address of the sensor can be found in the instruction manual for the sensor.

Sensor connection pin	Interface module terminal
1	X2-1
2	X1-4
4	X1-5
3	X2-2

Table 4.1 Connecting the sensor/sensors

Setting the Number of Connected Sensors

Set the number of connected sensors in the hardware project settings.

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 4.2 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

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



Setting data exchange mode

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

4.4 Configuration with TwinCAT® 3



Caution!

Malfunction due to incorrectly configured devices

Incorrectly configured devices can cause the plant to malfunction.

- Put devices into operation only once they have been configured correctly.

There are two options for configuring the interface module:

- **Offline configuration**, if configuration is to take place before the plant creation, e.g., on a laptop as a programming system
- **Online configuration** via a scan of the existing network if the controller is already connected to the EtherCAT system and all components of the EtherCAT network are ready for operation.

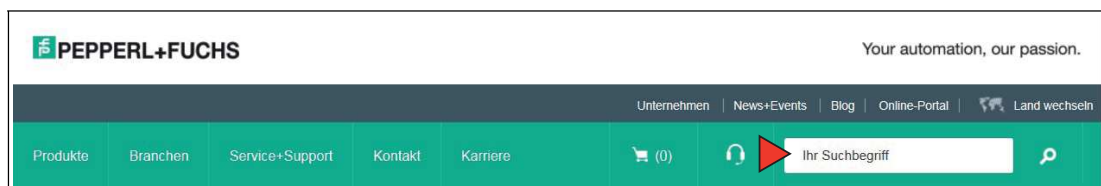
Sample online configuration

The following describes the online configuration.

Here, all available slaves are automatically integrated into the EtherCAT network by the master.

You can carry out the project planning of the interface module using the TwinCAT EtherCAT master/system manager. The properties of the interface module are described in an XML-based device description file—the ESI file (EtherCAT Slave Information).

The ESI file can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the product/keyword field and click "Search."



Select your product from the list of search results. Click 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.



Installing the ESI File

1. Copy the ESI file into the following folder: C:\TwinCAT\3.1\Config\Io\EtherCAT
2. Install the ESI file in TwinCat.

↳ The modules are available in the hardware catalog.



Selecting the Controller

From the drop-down list (1) in the menu bar, select your controller. In this example, it is the "TwinCAT CE7 (ARMV7)" controller.

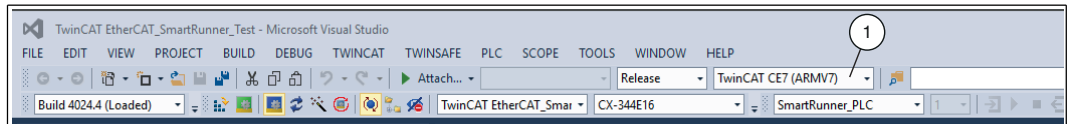


Figure 4.1 Selecting the controller



Selecting a Target System

If you intend to address the TwinCAT runtime environment installed on a controller remotely from a different system as a development environment, the target system must be specified beforehand.

Select a device as the target system (1) from the drop-down window in the menu bar.

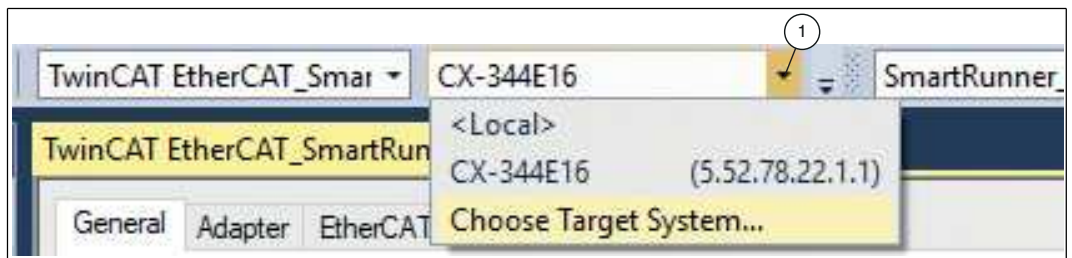


Figure 4.2 Selecting a target system

↳ You have successfully searched for a device in TwinCAT and added the device as a target system. The menu bar (1) displays the new target system.



Starting Configuration Mode

1. Click the "Restart TwinCAT System" function (1) in the menu bar.

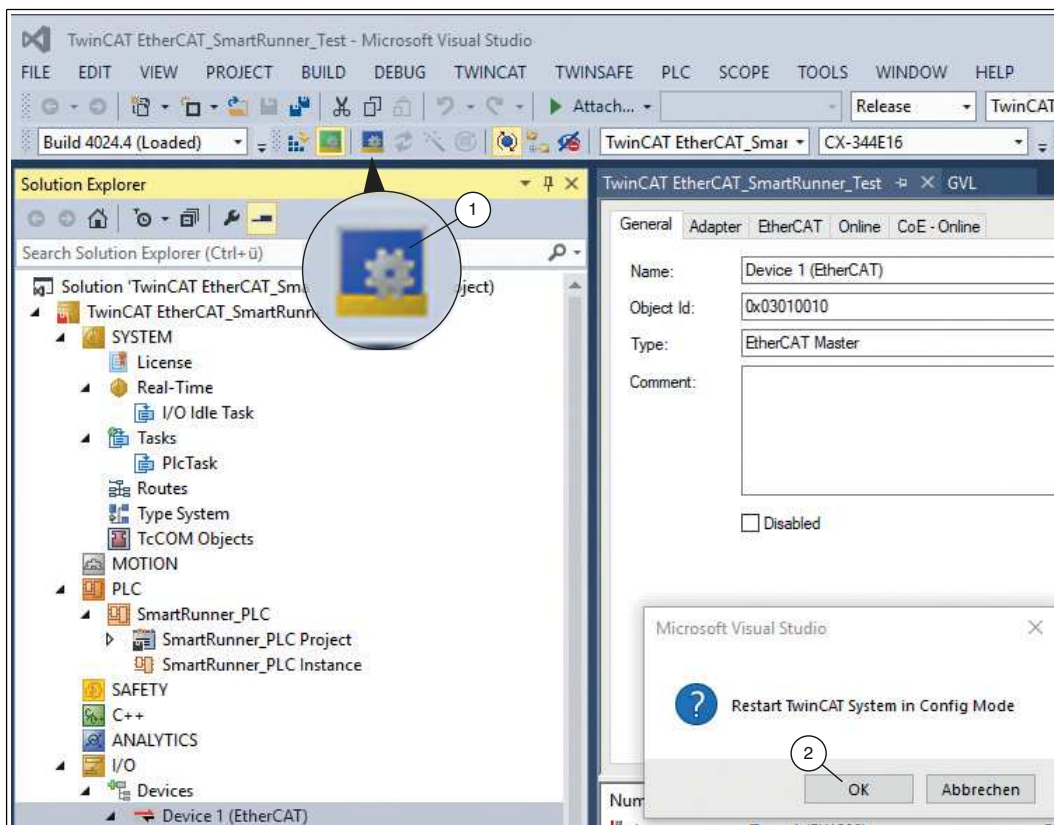


Figure 4.3 Run mode

↳ The "Restart TwinCAT System in Config Mode" selection window opens.

2. Click "OK" (2) to confirm your selection.

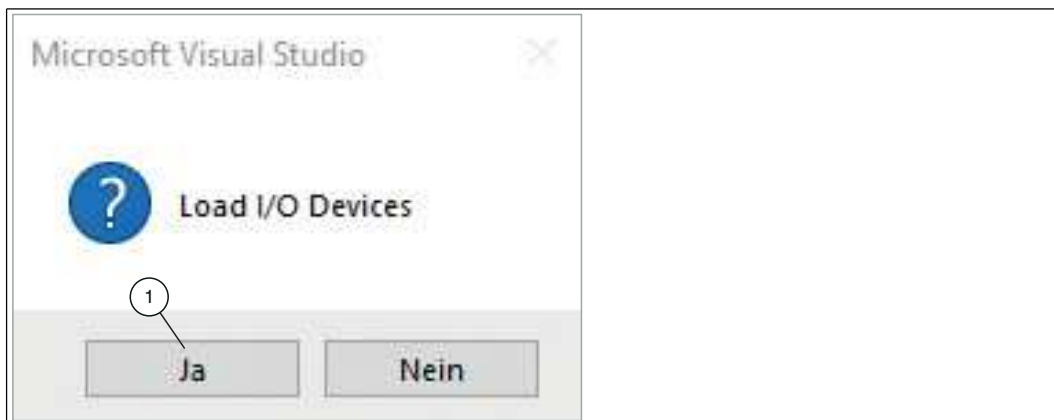


Figure 4.4 Load I/O Devices

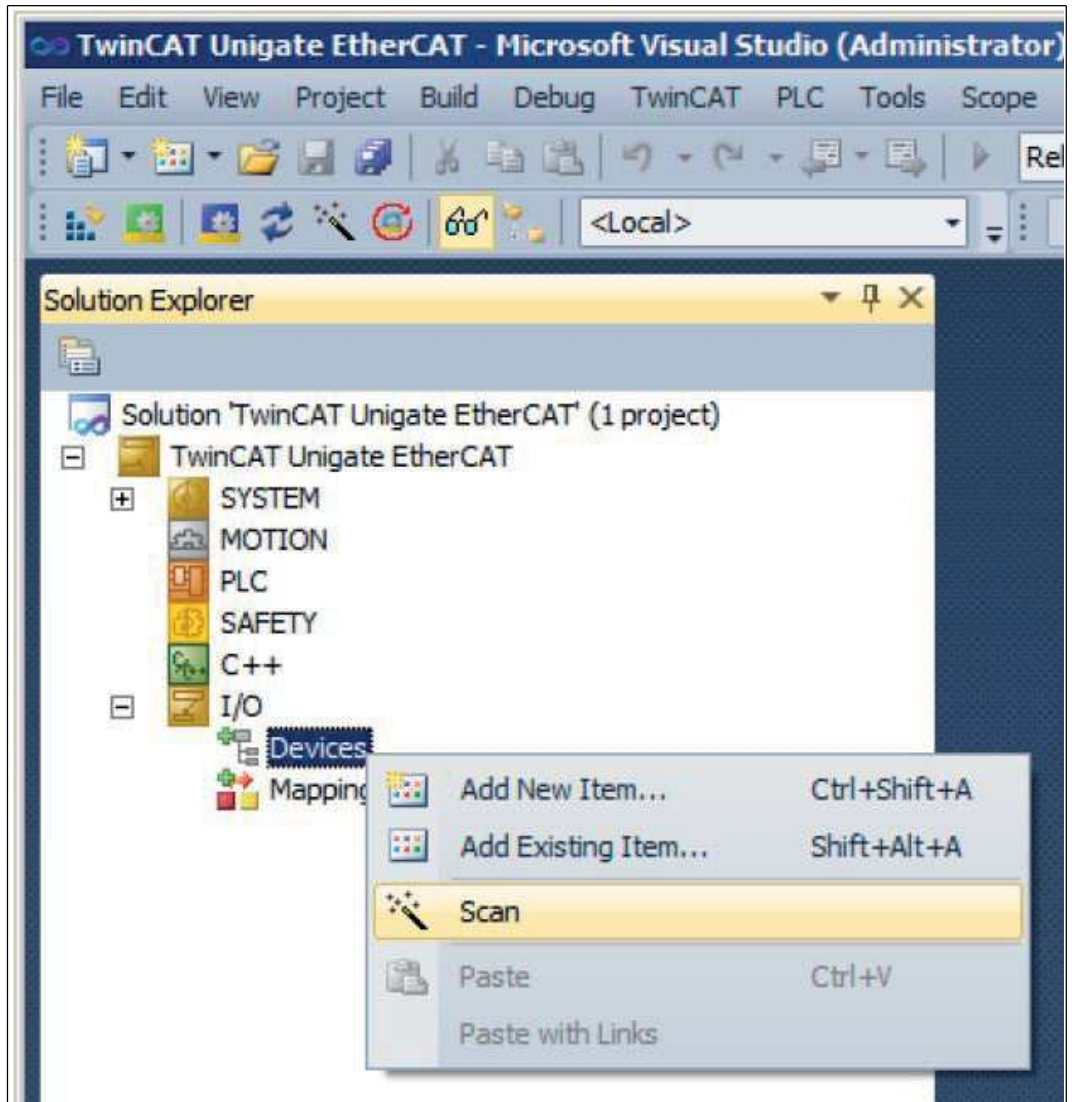
↳ The "Load I/O Devices" selection window opens.

3. Click "Yes" (1) to confirm your selection.
↳ TwinCAT is started in run mode.
4. Deactivate the "Free Run" by clicking "No" in the "Activate Free Run" selection window.



Searching for Devices on the Network

Click through the project tree until you see a symbol labeled "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. When a device is detected, the window **1 new I/O devices found** opens. The device can be added to the project tree.



Adding the Device to the Network

1. Right-click "Devices 1 (EtherCAT)" (1) and select the "Add New Item..." option (2).

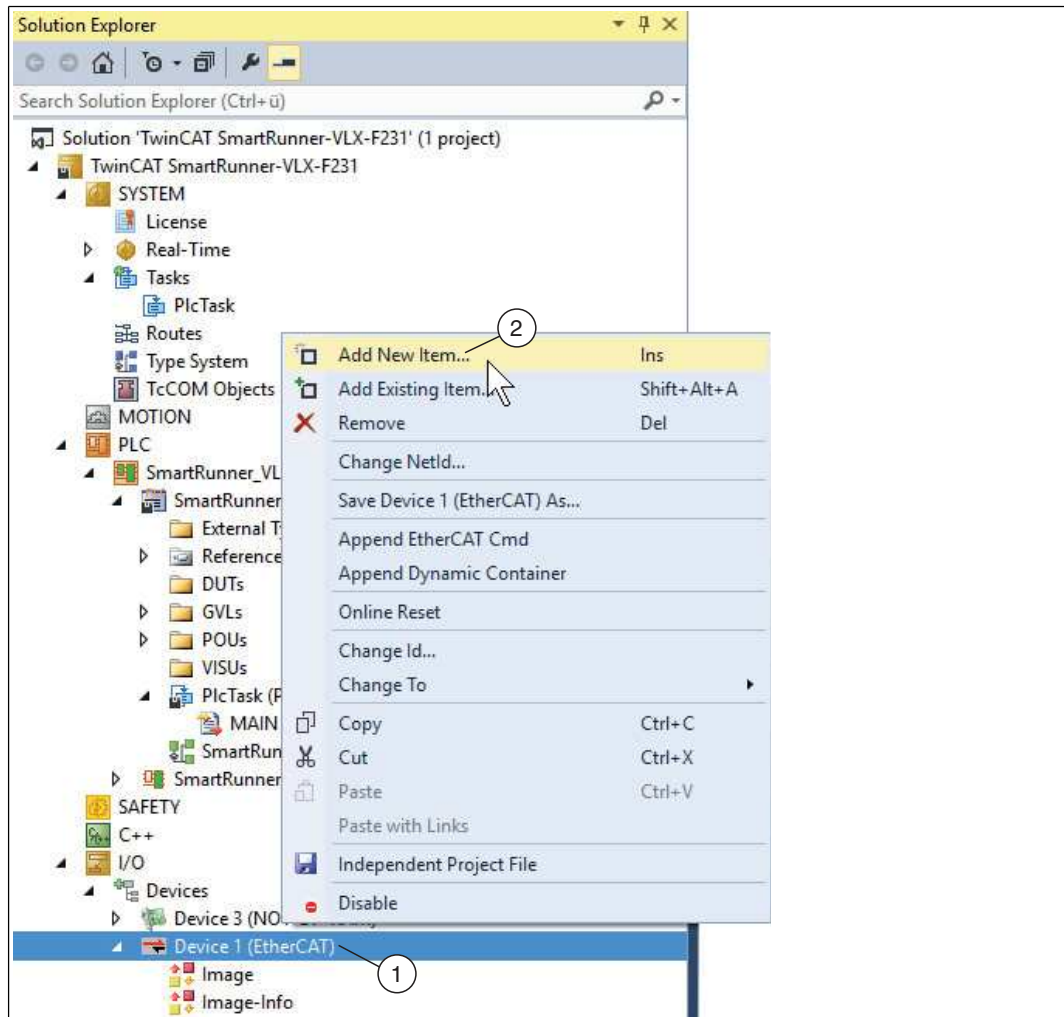


Figure 4.5 Adding a new device

↳ The "Insert EtherCAT Device" selection window opens.

2. Depending on your application, select one, two, three, or four connected read heads and click "OK" to confirm. If you have connected a SmartRunner to your interface module, select "1 x SmartRunner(ESI)."

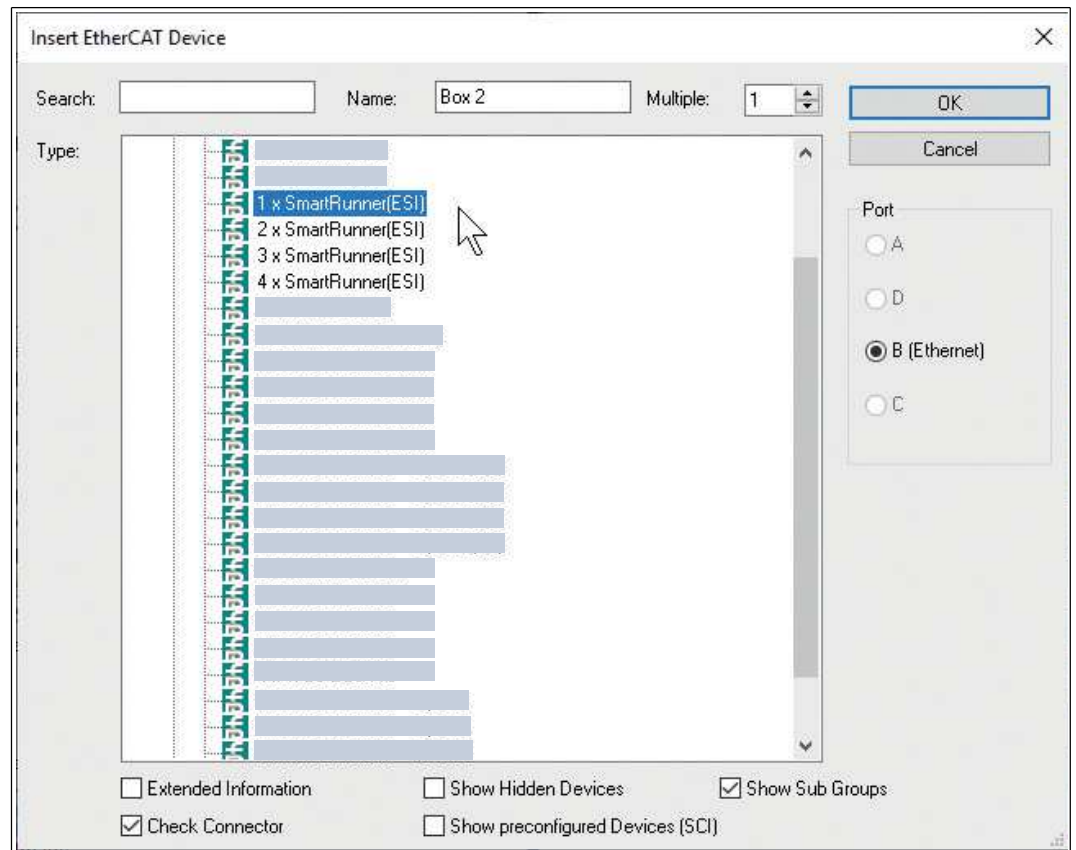


Figure 4.6 Selecting the device

↳ The device appears in the "Box 1 (UNIGATE 1 x SmartRunner)" project tree.

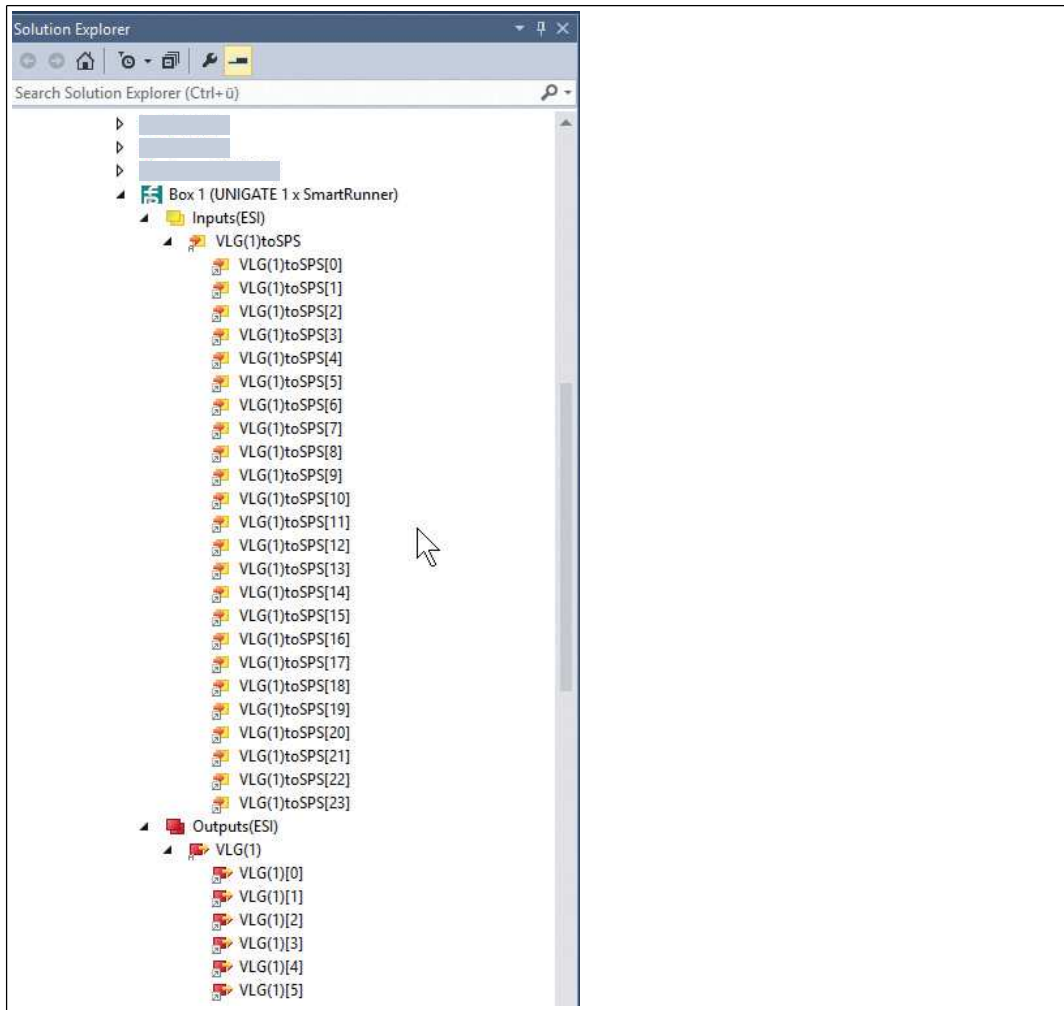


Figure 4.7 Input and output variables



Note

The input and output variables are displayed below the device in the project tree. These variables will be linked to the appropriate hardware variable in the coming steps.



Creating a Global Variable List

A global variable list is used to declare, edit, and display global variables. If you add a GVL to the project, the variables apply to the entire project.

1. Select "GVL" in the project tree.
2. Select the "Add > Global Variable List" command from the context menu.
3. Create a variable table for the required input and output variables.

```

TwinCAT SmartRunnerSoftPLC
1  {attribute 'qualified_only'}
2  VAR_GLOBAL
3  Byte1-Status      AT  %I^: USINT;
4  Byte2-Result     AT  %I^: USINT;
5  Byte3-Counter    AT  %I^: USINT;
6  Byte4-Quality    AT  %I^: USINT;
7  Byte5-Quality    AT  %I^: USINT;
8  Byte6-Quality    AT  %I^: USINT;
9  Byte7-PosX       AT  %I^: USINT;
10 Byte8-PosX       AT  %I^: USINT;
11 Byte9-PosZ       AT  %I^: USINT;
12 Byte10-PosZ      AT  %I^: USINT;
13 Byte11-Checksum  AT  %I^: USINT;
14 Byte12           AT  %I^: USINT;
15 Byte13           AT  %I^: USINT;
16 Byte14           AT  %I^: USINT;
17 Byte15           AT  %I^: USINT;
18 Byte16           AT  %I^: USINT;
19
20 Byte17-Status    AT  %I^: USINT;
21 Byte18-Result    AT  %I^: USINT;
22 Byte19-Counter   AT  %I^: USINT;
23 Byte20-QualityA  AT  %I^: USINT;
24 Byte21-QualityB  AT  %I^: USINT;
25 Byte22-QualityC  AT  %I^: USINT;
26 Byte23-QualityD  AT  %I^: USINT;
27 Byte24-Checksum  AT  %I^: USINT;
28
29 Byte0-Reserved   AT  %Q^: USINT;
30 Byte1-Trigger    AT  %Q^: USINT;
31
32 Byte2-Reserved   AT  %Q^: USINT;
33 Byte3-Teach      AT  %Q^: USINT;
34
35 Byte4-Reserved   AT  %Q^: USINT;
36 Byte5-Choose prof. AT  %Q^: USINT;
37 END_VAR
    
```

Figure 4.8 Variable table



Linking Variables

1. Right-click in the project tree to select the target variables to be linked.
2. Click the "Change Link" function (1) in the context menu.

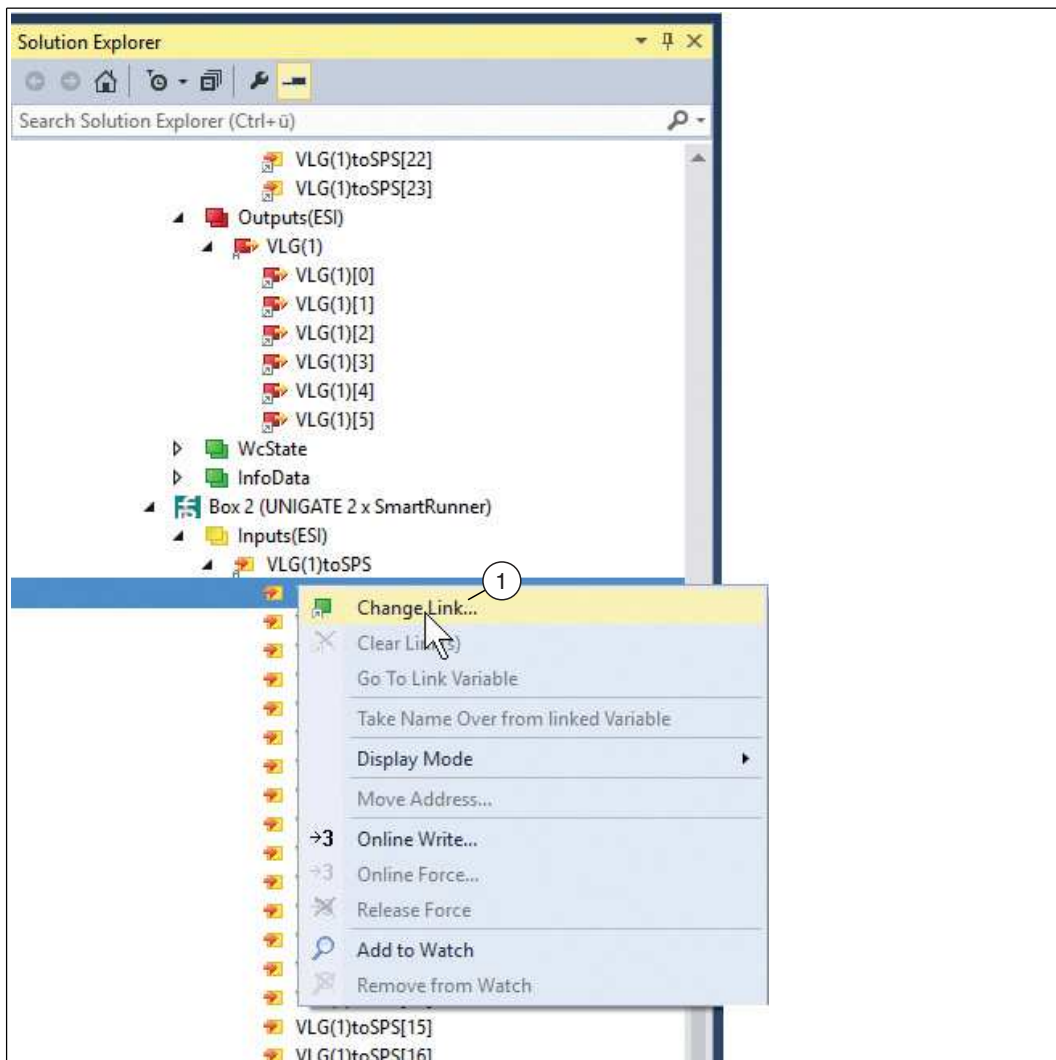
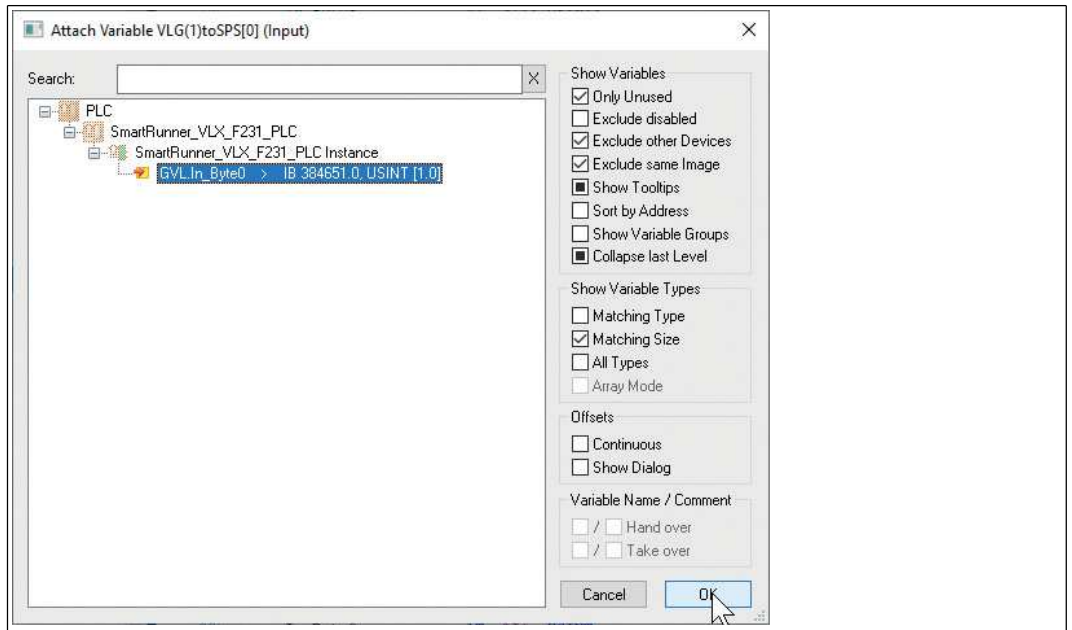


Figure 4.9 Change link

↳ The selection window for determining the target variables to be linked opens.

3. In the tree view of the selection window, all target variables suitable for linking are displayed (depending on whether the variable type selected is input or output variable). Make the required links and click "OK" to confirm your settings.



Building the Project

The following describes how to start the build process for the PLC project.

Select the "BUILD" menu and run the "Build SmartRunner_VLX-F231_PLC" function.

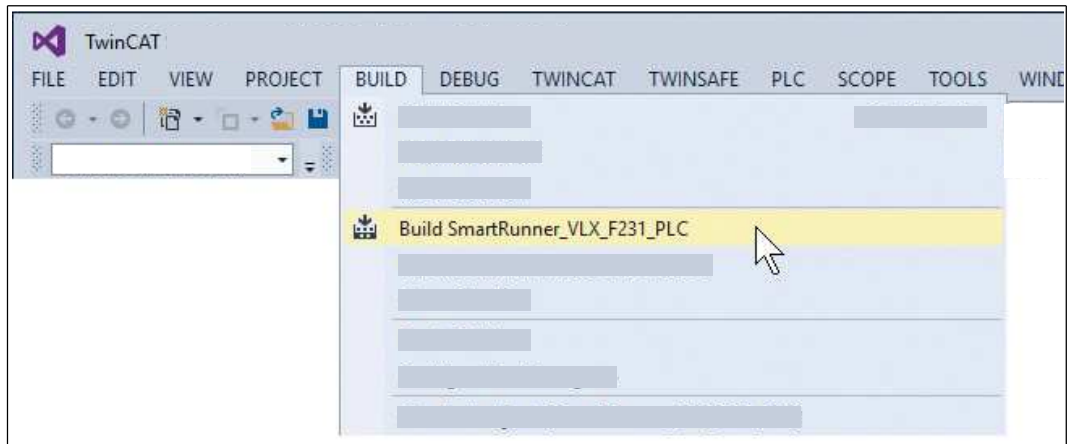


Figure 4.10 Creating a project command

↳ The build process is started.



Note

When building, TwinCAT performs a syntactic check of all objects used in the PLC project. When building is complete, TwinCAT displays any error messages or warnings in the error list view.



Transfer a Project Configuration

Once you have configured the controller and the device in the project and you have built the project configuration, you can transfer the project configuration to the controller. This provides the controller with all the settings and data for data exchange.

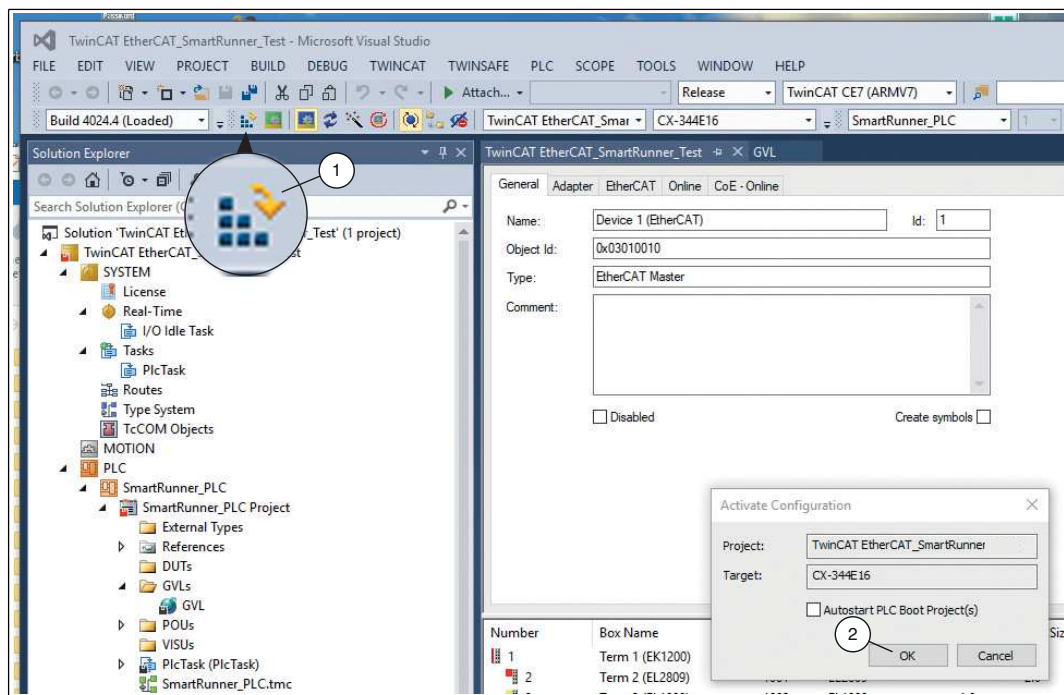


Figure 4.11 Loading a project configuration

1. Click the "Activate Configuration" function (1) in the menu bar.
↳ The "Activate Configuration" selection window opens.
2. Click "OK" (2) to confirm your selection.
↳ A new configuration is activated. The previous configuration is overwritten.



Displaying Online

After you have configured the interface modules, ensure that the EtherCAT device is functional. Proceed as follows:

1. Select your device from the project tree (1).
2. Select the "Online" tab (2).
3. Ensure that the device status "Actual State" (3) is set to "OP" (Operational).

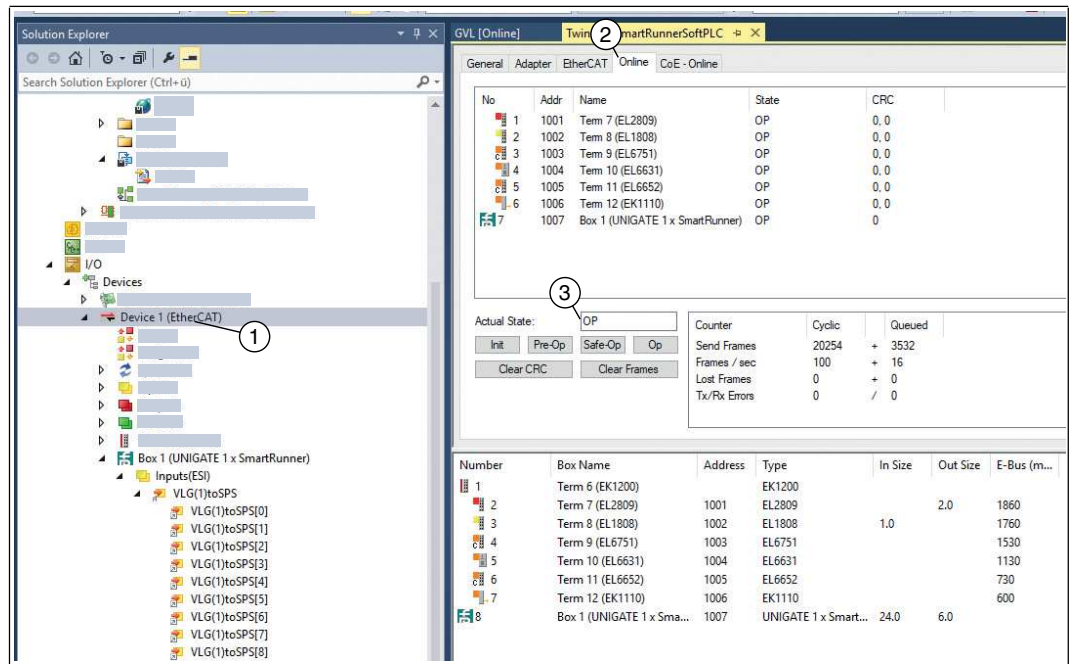


Figure 4.12 Sample online display

↳ Communication is active.

4.5 Data Format for Modules

Output Parameters

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 - Reserved	0	0	0	0	0	0	0	0
Byte 1 - Trigger	0	0	0	0	0	0	0	1
Byte 2 - Reserved	0	0	0	0	0	0	0	0
Byte 3 - Teach	0	0	0	0	0	0	0	1
Byte 4 - Reserved	0	0	0	0	0	0	0	0
Byte 5 - Choose profile ¹	0	0	x	x	x	x	x	x

1. Only for VLM350-F280-R4-1001, VLM350-F280-R4-1002, and VLM350-F280-R4-1101

Legend

x	1 ... 32	Profile number
	0	Not defined
	> 32	Not defined

Trigger

After changing *Bit 0* from **0 to 1**, a "**Trigger**" is activated. This means that the sensor triggers an image capture process. In order to run an additional "**Trigger**," **Bit 0** must be reset.

Teach

After changing *Bit 0* from **0 to 1**, a "**Teach-In**" is triggered. This means that the sensor initiates the teach-in process. A trigger must then be transmitted. In order to run the "**Teach**" process again, **Bit 0** must be reset.

Input Parameters

Note

The two protocols "Result Protocol" and "Teach Result Protocol" are connected. The two protocols cannot be run at the same time. Only one of the two protocols can be run at a time.



Result Protocol

Result data provides the measurement status and result as a response.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1 - Status	0	-	Addr 1	Addr 0	Event	WRN	No Match	ERR
Byte 2 - Result	0	R6	R5	R4	R3	R2	R1	R0
Byte 3 - Counter	0	C06	C05	C04	C03	C02	C01	C00
Byte 4 - Quality	0	Q06	Q05	Q04	Q03	Q02	Q01	Q00
Byte 5 - Quality	0	Q16	Q15	Q14	Q13	Q12	Q11	Q10
Byte 6 - Quality	0	Q26	Q25	Q24	Q23	Q22	Q21	Q20
Byte 7 - PosX	0	PosX13	PosX12	PosX11	PosX10	PosX09	PosX08	PosX07
Byte 8 - PosX	0	PosX06	PosX05	PosX04	PosX03	PosX02	PosX01	PosX00
Byte 9 - PosZ	0	PosZ13	PosZ12	PosZ11	PosZ10	PosZ09	PosZ08	PosZ07
Byte 10 - PosZ	0	PosZ06	PosZ05	PosZ04	PosZ03	PosZ02	PosZ01	PosZ00
Byte 11 - Checksum	0	xor	xor	xor	xor	xor	xor	xor
Byte 12	0	0	0	0	0	0	0	0
Byte 13	0	0	0	0	0	0	0	0
Byte 14	0	0	0	0	0	0	0	0
Byte 15	0	0	0	0	0	0	0	0
Byte 16	0	0	0	0	0	0	0	0

Legend

Status	Addr	Device address
	Event	Event occurred (future) Currently read as 0
	WRN	Unused
	No Match	Profile does not match the saved profile
	ERR	System error or evaluation error
Result	R0 ... R6	Profile number 1 ... 32 0x00 = no object found
Quality	Q00 ... Q26	Quality of the current profile (0 = no profile found, 100 = perfect match) Quality: Quality Good Quality2: Quality Variation Quality3: Quality Outliers
Counter		Increments for each evaluation, is restarted at 0x3F
Position Data ¹	PosX13 ... PosX00	X-deviation of current profile from saved profile
	PosZ13 ... PosZ00	Z-deviation of current profile from saved profile

1. Only for VLM350-F280-R4-1001, VLM350-F280-R4-1002, and VLM350-F280-R4-1101

Teach Result Protocol

Teach Result Data returns the status and result of the teach-in process as a response.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 17 - Status	0	-	Addr 1	Addr 0	Event	WRN	0	ERR
Byte 18 - Result	0	0	0	0	0	0	0	0
Byte 19 - Counter	0	C06	C05	C04	C03	C02	C01	C00
Byte 20 - Quality A	0	QA6	QA5	QA4	QA3	QA2	QA1	QA0
Byte 21 - Quality B	0	QB6	QB5	QB4	QB3	QB2	QB1	QB0
Byte 22 - Quality C	0	QC6	QC5	QC4	QC3	QC2	QC1	QC0
Byte 23 - Quality D	0	QD6	QD5	QD4	QD3	QD2	QD1	QD0
Byte 24 - Checksum	0	xor	xor	xor	xor	xor	xor	xor

Legend

Status	Addr	Device address
	Event	Event has occurred - for future use, currently read as 0
	WRN	Unused
	ERR	System error or evaluation error
Result	R0	For extended protocol Always 0
Counter	C00 ... C06	Increments with each teach-in
Quality A		The quality of the current teach-in 0 = teach-in not possible 100 = perfect teach-in
Quality B-D		Unused

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