User Manual

SmartWire-DT Gateway
EU5C-SWD-ETHERCAT

Hilscher Gesellschaft für Systemautomation mbH
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1 Introduction

1.1 About this document

1.1.1 Description of the contents

This manual describes the Hilscher **EU5C-SWD-ETHERCAT** SmartWire-DT Gateway. Here you will find information on how to install, configure and operate the gateway.

This manual is intended for automation technicians and engineers. Detailed knowledge of the **EtherCAT**® Real-Time Ethernet protocol is presumed. In addition, readers should also be familiar with the **TwinCAT System Manager** and the **SmartWire-DT** system.

> **Important:**
> ➢ To avoid personal injuries or damage of electrical devices, please read this manual carefully before installing and using the EU5C-SWD-ETHERCAT Gateway.
> ➢ Please first read the chapter *Safety* [▷ page 16].

1.1.2 List of revisions

Revision	Date	Revisions
1	2015-03-17	Created
2	2015-06-22	Design of safety messages updated
		Section *Error messages (emergency telegrams)* revised and renamed as *Emergency telegrams: Error and status messages (diagnosis)* [▷ page 80].

Table 1: List of revisions

1.1.3 Conventions in this document

Notes, operation instructions and results of operation steps are marked as follows:

Notes

> **Note:**
> <important note>

> **Note:**
> <simple note>

<note, where to find further information>

Operation instructions

1. <operational step>
> ➢ <instruction>

2. <operational step>
> ➢ <instruction>

Results

↳ <intermediate result>

⇨ <final result>

For a description of the labeling of **Safety Messages**, see section *Labeling of safety messages* [▶ page 20].

1.2   Versions of devices, firmware, software tools, drivers and device description files

The hardware revisions and software versions functionally belong together. This means that certain revisions of the hardware of the gateway need certain versions of firmware, software and drivers, in order to function properly.
This section lists the hardware revisions and the versions of the firmware, the configuration software and the drivers which functionally belong together and to which all instructions in this manual refer.

Device and firmware

This manual refers to the following hardware revision and firmware version of the EU5C-SWD-ETHERCAT Gateway:

Device type name	Protocol	Part number	Hardware revision	Firmware	Firmware version
EU5C-SWD-ETHERCAT	EtherCAT® slave	9233.922	3	E030F0U0.nxf	1.0.x.x

Table 2: Reference to hardware and firmware

Software tools

This manual refers to the following software versions:

Software	Manufacturer	Version
SWD-Assist	Eaton	2.xx
TwinCAT System Manager	Beckhoff Automation GmbH	2.11

Table 3: Reference to software tools

Drivers

This manual refers to the following driver versions:

Driver	File name	Version
Windows USB Driver	usbser.sys	Depending on Windows version

Table 4: Reference to drivers

Device description files

This manual refers to the following device description files (ESI - EtherCAT® Slave Information files):

Device description file	File name
ESI for EU5C-SWD-ETHERCAT gateway	Hilscher_EU5C-SWD-ETHERCAT_XXXXXXXX.xml
ESI for SWD participants	Eaton_EU5C-SWD-ETHERCAT_Modules_XXXXXXXX.xml
ESI for SWD partner devices by Phoenix	Phoenix_EU5C-SWD-ETHERCAT_Modules_XXXXXXXX.xml
ESI for SWD partner devices by Wöhner	Woehner_EU5C-SWD-ETHERCAT_Modules_XXXXXXXX.xml

Table 5: Reference to device description files

1.3   Software package

1.3.1   Overview

Hilscher offers the optional software package **EU5C-SWD-SW** (part number 3233.920) for SmartWire-DT Gateways. The package features the **SmartWire-DT Gateway Solutions** product DVD and a Mini-USB cable. The **SmartWire-DT Gateway Solutions** product DVD contains the EtherCAT® Slave Information files (**ESI**) necessary for configuring the EU5C-SWD-ETHERCAT gateway within the EtherCAT® network. If you do not need the whole package with the USB cable, you can download the contents of the product DVD separately and free of charge as ZIP file from our website www.hilscher.com under **Products** > **Partner Products** > **SmartWire-DT** > **EU5C-SWD-ETHERCAT** > **Downloads** > **Software**.

> **Note:**
> The TwinCAT System Manager used in the commissioning example in this document is not included on the product DVD. TwinCAT can be obtained from the Beckhoff Automation GmbH.

1.3.2   Contents of the product DVD

The **SmartWire-DT Gateway Solutions** product DVD contains software for all types of SmartWire-DT gateways. Depending on the gateway type you are using, you will need only certain features of the DVD.

The product DVD includes:

- Device description files

- Firmware

- Eaton SWD-Assist software

- Wizard for installing the software available on the DVD and for downloading the latest version of the SWD-Assist software from the internet

- Installation program for USB driver (USB driver is needed for connecting the gateway to a PC in order to use the Eaton SWD-Assist software)

- Installation program for the Hilscher Ethernet Device Configuration Tool

- Documentation in PDF format

- Installation program for Adobe Reader

The product DVD has the following directories:

Directory	Contents
Documentation	PDF manuals in German and English and installation program for Adobe Reader
EDS	Electronic device description files and bitmaps, to be imported directly into Master/ Controller configuration software.
Firmware	Loadable gateway firmware
fscommand	Files for start screen of product DVD
Setups & Drivers	SWD-Assist software Folder: `SWD-Assist` Wizard for installing the software available on the DVD and for downloading the latest version of the SWD-Assist software from the internet Folder: `Setup` Installation program for Ethernet Device Configuration Tool Folder: `EnDeviceCfg` Installation program (`setup.exe`) and .INF- and .CAT- files for Windows USB driver. Folder: `USB Driver`

Table 6: Directory of the product DVD

Note:

You can use the wizard on the product DVD to download updates of the Eaton SWD-Assist software, or you can download SWD-Assist directly from the www.moeller.net website under **Support** > **Download Center**. Direct link:

http://downloadcenter.moeller.net/en/software.a487d8b7-da91-486f-b3ba-a7ca2035db99

1.3.3   How to use the product DVD

Insert the **SmartWire-DT Gateway Solutions** product DVD into the DVD drive of your configuration PC.
If the auto start function of your DVD drive is enabled, the start screen of the DVD automatically opens. You can also start the DVD by double-clicking the `SmartWire.exe` file in the root directory of the DVD.

In the menu of the start screen of the DVD, click **Install Planning and Configuration Tools** to open a wizard for installing the software programs stored on the DVD. The wizard also helps you to download the latest version of the Eaton planning software SWD-Assist from the internet. It automatically checks for already installed software components (which e. g. might have been installed for an earlier project), and lists the missing components accordingly. The following options might be offered:

- **USB Driver**: installs USB driver for Windows on your PC.

- **Download Center SWD-Assist (manual update)**: connects your browser to a web page where you can download the latest version of the SWD-Assist software.

- **SWD Planning Software SWD-Assist Vx.xx**: installs the SWD-Assist software version provided on the DVD.

- **Ethernet Device Scanner/Configuration Tool**: installs the Hilscher Ethernet Device Configuration Tool.

- **GSDML, EDS, ESI files (HTML page)**: opens a web page containing links to the device description files.

In the main menu of the start screen of the DVD, you can furthermore open a web page which provides an overview of all available documents (menu **Documentation**). You can also directly open the folder containing the device description files (menu **Open Electronic Device Description Files Directory**).

1.3.4   Notes on installing the USB Driver

If you intend to use the SWD-Assist software, you should first install the USB driver on your PC before you connect the gateway via USB.

To install the USB driver from the DVD, choose **Install Planning and Configuration Tools** in the DVD menu to open the installation wizard, and then select the **USB driver** option. As an alternative, you can use the Windows Explorer to open the `Setups & Drivers\USB` Driver folder on the DVD, and then double-click the `setup.exe` file. Just follow the instructions of the installation routine afterwards.

> **Note:**
> Under Windows XP, the installation process is not yet finished by the setup. The installation process has to be completed in the **Found new Hardware Wizard**, which automatically opens when you connect the gateway to a PC via USB cable for the first time (see below).

Windows XP

When you connect the gateway via USB for the first time to a PC running under Windows XP, the **Found New Hardware Wizard** opens:

➢ Answer the question **Can Windows connect to Windows Update…?**, with **No, not this time**. Then click **Next** button.

➢ If you have already carried out the setup of the USB driver (as recommended), you can ignore the wizard's request to insert a CD or floppy disk. Answer the **What do you want the wizard to do**? question by selecting the **Install the software automatically** option, then click **Next** button.

➢ After the installation is complete, click **Finish** button.

Windows 7 and 8

The USB connection is instantly operative under Windows 7 and 8 if you have carried out the setup of the USB driver before first connecting the USB cable (as recommended).

Uninstall USB Driver

If you want to remove the USB driver from a PC running under Windows XP, choose **Start** menu > **Control Panel** > **Add or Remove Programs**, then select:
Windows Driver Package – **Hilscher GmbH (hilusbser) Ports** entry.
Click **Change/Remove** button to uninstall the driver.

Under Windows 7 and 8, choose **Start** menu > **Control Panel** > **Uninstall a program**, then select:
Windows Driver Package – **Hilscher GmbH (hilusbser) Ports** entry.
Click **Uninstall/Change** button to uninstall the driver.

1.4   Documentation overview

Besides this user manual at hand (path on product DVD: `Documentation \english\2. Hardware\EU5C-SWD-ETHERCAT UM xx EN.pdf`), the following documents are also relevant for the user of the EU5C-SWD-ETHERCAT Gateway:

Title	Contents	Publisher	Document ID	Path on product DVD
SmartWire-DT Modules	Information on engineering, installation and programming of the individual SmartWire-DT slaves.	Eaton	`MN05006001Z-EN`	`Documentation\english\ 3.SmartWire-DT\SmartWire-DT – Units\ MN05006001Z_EN.pdf`
SmartWire-DT The System	Information on function, installation, commissioning and diagnostics of the SmartWire-DT system.	Eaton	`MN05006002Z-EN`	`Documentation\english\ 3.SmartWire-DT\SmartWire-DT – The System\ MN05006002Z_EN.pdf`
SWD-Assist Online help	Online help for SWD-Assist planning software	Eaton	–	Included in SWD-Assist software
TwinCAT System Manager Online help	Online help TwinCAT System Manager	Beckhoff	–	Included in TwinCAT software
Wiring Instructions EtherCAT	Wiring instructions for EtherCAT® devices	Hilscher	`DOC121104UMxxEN`	`Documentation\english \5.Installation Instructions\ Wiring Instructions EtherCAT UM 01 EN.pdf`

Table 7: Documentation overview

1.5 Legal notes

1.5.1 Copyright

1.5.2 Important notes

1.5.3   Exclusion of liability

The software was produced and tested with utmost care by Hilscher Gesellschaft für Systemautomation mbH and is made available as is. No warranty can be assumed for the performance and flawlessness of the software for all usage conditions and cases and for the results produced when utilized by the user. Liability for any damages that may result from the use of the hardware or software or related documents, is limited to cases of intent or grossly negligent violation of significant contractual obligations. Indemnity claims for the violation of significant contractual obligations are limited to damages that are foreseeable and typical for this type of contract.

It is strictly prohibited to use the software in the following areas:

- for military purposes or in weapon systems;

- for the design, construction, maintenance or operation of nuclear facilities;

- in air traffic control systems, air traffic or air traffic communication systems;

- in life support systems;

- in systems in which failures in the software could lead to personal injury or injuries leading to death.

We inform you that the software was not developed for use in dangerous environments requiring fail-proof control mechanisms. Use of the software in such an environment occurs at your own risk. No liability is assumed for damages or losses due to unauthorized use.

1.5.4   Warranty

Although the hardware and software was developed with utmost care and tested intensively, Hilscher Gesellschaft für Systemautomation mbH does not guarantee its suitability for any purpose not confirmed in writing. It cannot be guaranteed that the hardware and software will meet your requirements, that the use of the software operates without interruption and that the software is free of errors. No guarantee is made regarding infringements, violations of patents, rights of ownership or the freedom from interference by third parties. No additional guarantees or assurances are made regarding marketability, freedom of defect of title, integration or usability for certain purposes unless they are required in accordance with the law and cannot be limited. Warranty claims are limited to the right to claim rectification.

1.5.5   Export regulations

The delivered product (including the technical data) is subject to export or import laws as well as the associated regulations of different counters, in particular those of Germany and the USA. The software may not be exported to countries where this is prohibited by the United States Export Administration Act and its additional provisions. You are obligated to comply with the regulations at your personal responsibility. We wish to inform you that you may require permission from state authorities to export, re-export or import the product.

1.5.6   Registered Trademarks

Adobe Reader® is a registered trademark of Adobe Systems Incorporated.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

SmartWire-DT® is a registered trademark of Eaton Corporation.

TwinCAT® is a registered trademark of Beckhoff Automation GmbH, Germany.

Windows® XP, Windows® 7 and Windows® 8 are registered trademarks of the Microsoft Corporation.

All other mentioned trademarks are property of their respective legal owners.

2 Safety

2.1 General note

The user manual, all accompanying texts and the documentation are written for the use of the products by educated personnel. When using the products, all safety instructions, property damage messages and all valid legal regulations have to be observed. Technical knowledge is presumed. The user has to assure that all legal regulations are obeyed.

2.2 Intended use

The purpose of the EU5C-SWD-ETHERCAT Gateway described in this user manual is to create a connection between SmartWire-DT slaves and an EtherCAT® master in an overriding EtherCAT® network.

2.3 Personnel qualification

The gateway must be installed, configured and removed by qualified personnel only. Job-specific technical skills for people professionally working with electricity must be present concerning the following issues:

- Safety and health at work
- Mounting and connecting of electrical equipment
- Measurement and analysis of electrical functions and systems
- Evaluation of the safety of electrical systems and equipment
- Installing and configuring IT systems

2.4 References safety

[S1] ANSI Z535.6-2006 American National Standard for Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials

[S2] IEC 60950-1, Information technology equipment - Safety -
Part 1: General requirements,
(IEC 60950-1:2005, modified); German Edition EN 60950-1:2006

[S3] EN 61340-5-1 and EN 61340-5-2 as well as IEC 61340-5-1 and IEC 61340-5-2

2.5   Safety instructions to avoid personal injury

To ensure your own personal safety and to avoid personal injury, you must read, understand and follow the following safety instructions in this manual and all warning messages before you install and operate the gateway.

2.5.1   Electrical shock hazard

Take care of the following safety measures before installing or uninstalling the gateway:

- First disconnect the power plug of the device.
- Make sure that the device is disconnected from the power supply.
- Cover or enclose neighboring units that are live.

Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.

2.5.2   Danger of unintended starting up of machines

- Install automation devices and related operating elements in a way that they are well protected against unintentional operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- You must take safety precautions (emergency switching off) in the external circuitry of the gateway and any power modules type EU5C-SWD-PF1-1 or EU5C-SWDPF2-1 that are used. To do so, plan to switch off the power supply to the contactor coils AUX.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

2.6   Safety instructions to avoid property damage

To avoid damage to your gateway or your communication system, you must read, understand and follow the following safety instructions and all safety instructions and warnings in this manual concerning property damage, before you install and operate the gateway.

2.6.1   General safety instructions concerning supply voltage

- In safety-relevant applications the power supply providing power to the SmartWire-DT system must feature a PELV power feed module (protective extra low voltage).

- Switch off the power supply if you are reconnecting slaves in the SmartWire-DT system or reconnecting the ribbon cable connection. Otherwise the SmartWire-DT slaves can be destroyed!

- The gateway has protection against polarity reversal for the 24-V-DC-POW supply. However, if the gateway is connected via the serial interface to an earthed device (for example to a PC), the gateway can be destroyed, if the polarity of the power supply is reversed!

- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.

- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.

- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.

2.6.2   Device destruction by exceeding allowed supply voltage

The gateway must only be operated with the specified supply voltage.

- Make sure that the limits of the allowed range for the supply voltage are not exceeded. A supply voltage above the upper limit can cause severe damage of the gateway!

- A supply voltage below the lower limit can cause malfunction of the gateway!

- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.

The allowed range for the supply voltage is indicated in section *Technical data EU5C-SWD-ETHERCAT gateway* [▶ page 93]

2.6.3   Electrostatic sensitive device

The gateway is sensitive to electrostatic discharge, which can cause internal damage and affect its normal operation. Therefore adhere to the necessary safety precautions for components that are vulnerable to electrostatic discharge when you install or remove the gateway. Follow the guidelines listed hereafter when you handle the gateway:

- Touch a grounded object to discharge potential static before you handle the gateway.

- Wear an approved grounding wrist strap.

- If possible, use a static-safe workstation.

- When not in use, store the device in appropriate static-safe packaging.

2.7   Labeling of safety messages

In this document the safety instructions and property damage messages are designed according both to the internationally used safety conventions as well as to the **ANSI Z535** standard.

*   The **Section Safety Messages** at the beginning of a chapter are pinpointed particularly and highlighted by a signal word according to the degree of endangerment. The kind of danger is specified exactly by the safety message text and optionally by a specific safety sign.

*   The **Integrated Safety Messages** embedded in operating instructions are highlighted by a signal word according to the degree of endangerment. In the safety message, the nature of the hazard is indicated.

Signal words and safety signs in safety messages on personal injury

Signal word	Meaning
⚠ DANGER	Indicates a direct hazard with high risk, which will have as consequence death or grievous bodily harm if it is not avoided.
⚠ WARNING	Indicates a possible hazard with medium risk, which will have as consequence death or (grievous) bodily harm if it is not avoided.
⚠ CAUTION	Indicates a minor hazard with medium risk, which could have as consequence personal injury if it is not avoided.

Table 8: Signal words in safety messages on personal injury

Safety sign	Sort of warning or principle
	Warning of lethal electrical shock
	Principle: Disconnect the power plug

Table 9: Safety signs in messages on personal injury

Signal words and safety signs in safety messages on property damage

Signal word	Meaning
NOTICE	Indicates a property damage message

Table 10: Signal words in safety messages on property damage

Safety sign	Sort of warning or principle
	Warning of property damage by electrostatic discharge

Table 11: Safety signs in safety messages on property damage

3   Description of the EU5C-SWD-ETHERCAT gateway

3.1   Function

The EU5C-SWD-ETHERCAT gateway integrates a SmartWire-DT network into an EtherCAT® network. The gateway creates a data connection between the participants (the slave devices) of the subordinate SmartWire-DT network and the master device or PLC of the super ordinate EtherCAT® network.

The gateway acts as master (a.k.a. "Coordinator") in the SmartWire-DT network on the one hand, and on the other hand as modular slave in the EtherCAT® network. It thereby presents each connected SmartWire-DT participant as individual module to the EtherCAT® master.

The cyclic process data is exchanged transparently between both networks. 1000 Bytes of process input/output data can in sum be exchanged with up to 99 SmartWire-DT participants (slaves). The maximum number of cyclic input data as EtherCAT® slave is 800 bytes, maximum number of cyclic output data is 641 bytes.
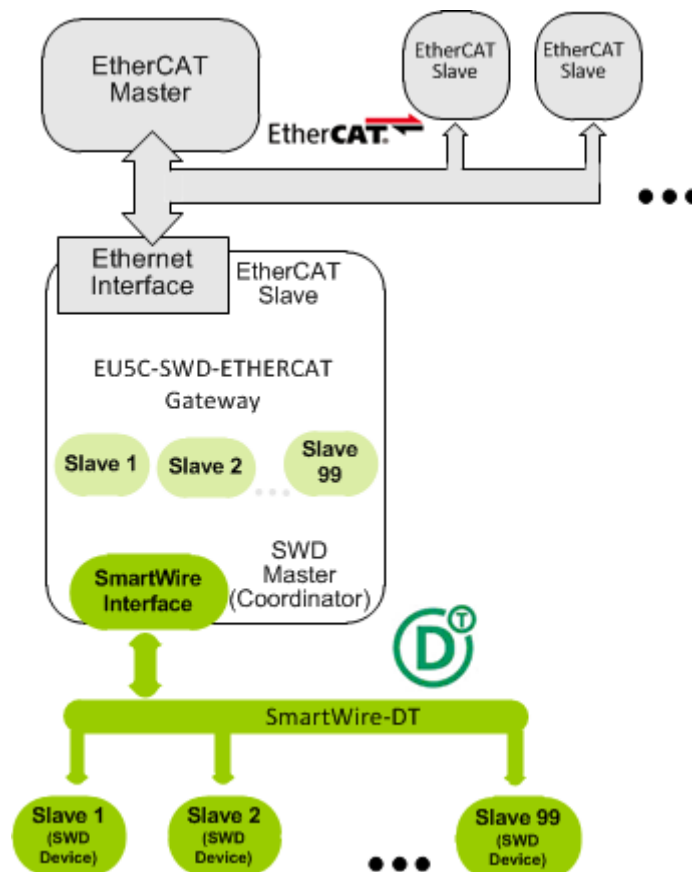
Figure 1: Data flow EU5C-SWD-ETHERCAT Gateway

3.2   Configuration

3.2.1   SmartWire-DT configuration

The EU5C-SWD-ETHERCAT Gateway is easily commissioned by an automated configuration function: On pushing the configuration button on the front of the gateway, the gateway scans the current SmartWire-DT network configuration, the so-called actual configuration. It then stores the actual configuration as target configuration zero voltage-safe in the device, thus making the target configuration available for a comparison of actual and targeted SmartWire-DT configuration, which takes place each time the gateway is being switched on.

When the gateway is switched on after a target configuration has already been stored, the gateway automatically rescans the connected actual configuration and checks it against the target configuration. If the gateway recognizes that a required SmartWire-DT slave cannot be reached or a wrong slave type is determined, it will not go into operation. If the actual configuration complies with the target configuration, the gateway gets ready for EtherCAT® and waits for the EtherCAT® configuration. The gateway checks the project configuration, which it receives from the EtherCAT® master, against the target configuration. Discrepancies between target and project configuration are indicated by the **Config** LED of the gateway.

Eaton SWD-Assist planning software

Despite the fact that you can configure the SmartWire-DT network in the gateway simply by using the configuration button, it is nevertheless recommended to use the SWD-Assist software to plan, dimension and document the SmartWire-DT network.

For further information, please refer to the SWD-Assist online help.

Note:
You will find the Eaton SWD-Assist software on the product DVD, which is included in the EU5C-SWD-SW software package (order number 3233.920) available from Hilscher.
You can use the wizard on the product DVD to download updates of the Eaton SWD-Assist software, or you can download SWD-Assist directly from the www.moeller.net website under **Support** > **Download Center**. Direct link:
http://downloadcenter.moeller.net/en/software.a487d8b7-da91-486f-b3ba-a7ca2035db99

3.2.2 EtherCAT configuration

The gateway is commissioned in EtherCAT® by using an EtherCAT® engineering tool (e. g. TwinCAT System Manager) and device description files in XML format, (the so-called EtherCAT® Slave Information or **ESI** files). These files are to be imported into the engineering tool. The device description files of the gateway are stored in the `EDS\EU5C-SWD-ETHERCAT\Vx.x.x.x` directory of the product DVD. The files contain all configuration data and all possible SmartWire-DT slaves as I/O modules.

> **Note:**
> The device description files contain only I/O information for SmartWire-DT slaves which were listed as sales products at the time of the creation of the file.

3.3 Interfaces

The gateway features a SmartWire-DT interface (plug, 8-pole), a 2-port switch Ethernet interface (RJ45) for connecting EtherCAT©, and a Mini-USB interface. Via the Mini-USB interface, the gateway can be accessed, configured and diagnosed with the SWD-Assist software.

3.4 Diagnosis

The gateway can be diagnosed by connecting the SWD-Assist software to the Mini-USB interface. For further information, please refer to the SWD-Assist online help.

The EtherCAT® protocol also provides diagnostic functions.
For further information, see section *Emergency telegrams: Error and status messages (diagnosis)* [▶ page 80].

3.5 Firmware and device description files

The EU5C-SWD-ETHERCAT Gateway is shipped with its most recent firmware already loaded. Which firmware version is loaded in the gateway at the time of delivery can be inferred from the device type label (see section *Device type label* [▶ page 30]).

EtherCAT® allows you to update the firmware via Ethernet connection by using the TwinCAT System Manager. For more details on this, please refer to chapter *Updating firmware with TwinCAT System Manager* [▶ page 85]. In case of a missing or defective firmware, a firmware "recovery" process is possible via HTTP. Please refer to chapter *Firmware recovery via HTTP* [▶ page 88].

Device description files (ESI) for the gateway and the SWD participants (SWD devices) are included on the product DVD in the `EDS\EU5C-SWD-ETHERCAT\Vx.x.x.x` folder.
As an alternative, you can download latest versions of the ESI files from our website www.hilscher.com under **Products** > **Partner Products** > **SmartWire-DT** > **EU5C-SWD-ETHERCAT** > **Downloads**.

4 Requirements for operation

The following prerequisites must be fulfilled to operate the gateway:

4.1 Network systems

- SmartWire-DT network with maximum number of up to 99 participants/ stations/slaves and maximum extension of up to 600 meters.
- EtherCAT® network with EtherCAT® PLC (master device). Maximum cable length for one segment (i. e. cable between two devices or hubs) is 100 meters.

4.2 Power supply

> ⚠ **WARNING**
>
> **Danger of unsafe operation of the system**
>
> In safety-relevant applications the power supply providing power for the SmartWire-DT system must feature a PELV power feed module (protective extra low voltage).

> ⚠ **WARNING**
>
> **Danger of unsafe operation of the system**
>
> You must take safety precautions (emergency switching off) in the external circuitry of the gateway and any power modules type EU5C-SWD-PF1-1 or EU5C-SWDPF2-1 that are used. To do so, plan to switch off the power supply to the contactor coils **AUX**.

> **NOTICE**
>
> **Device destruction**
>
> Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.

> **Important:**
> Please take into consideration the total power consumption of your SmartWire-DT network and, if necessary, plan for an additional feeder module EU5C-SWD-PF2.
> You can find information on the power consumption in the operating manuals of the SmartWire-DT devices.

4.2.1   POW power connection

A Power supply of 24 V DC for the coupling unit and for the Smart-Wire-DT slave electronics is needed at the connection **POW**.

On the SmartWire-DT gateway, connect the **POW** and **AUX** supply voltages via separate miniature circuit-breakers or fuses:

Miniature circuit-breaker 24 V DC for POW

- Cable protection in accordance with **DIN VDE 0641** Part 11, IEC/EN 60898:
  Miniature circuit-breaker 24 V DC rated operational current 3 A; trip types **C** or Fuse 3 A, utilization class gL/gG

- Cable protection for cable AWG 24 in accordance with **UL 508** und CSA-22.2 No. 14:
  Miniature circuit-breaker 24 V DC rated operational current 3 A; Tripping characteristics C or Fuse 3 A

4.2.2   AUX power connection

If any switching devices are also to be connected, for example via the DIL-SWD-32-001/002 SmartWire-DT slaves, a 24 V DC supply will also be required at the **AUX** power connection. This provides the supply for activating the contactor coils. This supply must be protected by an automatic circuit-breaker (3A gG/gl or 3 A miniature circuit-breaker with a Z characteristic).
If switching devices with an activation power greater than 3 A are connected, an additional feeder module EU5C-SWD-PF1 or EU5C-SWD-PF2 must be used.

On the SmartWire-DT gateway, connect the **POW** and **AUX** supply voltages via separate miniature circuit-breakers or fuses:

Miniature circuit-breaker 24 V DC for AUX

- Cable protection in accordance with **DIN VDE 0641** Part 11, IEC/EN 60898:
  Miniature circuit-breaker 24 V DC rated operational current 3 A; trip type **Z** or Fuse 3 A, utilization class gL/gG

- Cable protection for cable AWG 24 in accordance with **UL 508** und CSA-22.2 No. 14:
  Miniature circuit-breaker 24 V DC rated operational current 2 A; Tripping characteristics **Z** or Fuse 2 A

5   Device picture, connectors and LEDs

5.1   Device picture

(1)	24 V power supply POW
(2)	EtherCAT® interface (RJ45)
(3)	LEDs EtherCAT® communication status (see subsequent section for details)
(4)	Mini-USB interface
(5)	Configuration button
(6)	LEDs gateway functions (see subsequent section for details)
(7)	24 V power supply AUX
(8)	SmartWire-DT connection (plug, 8-pole)
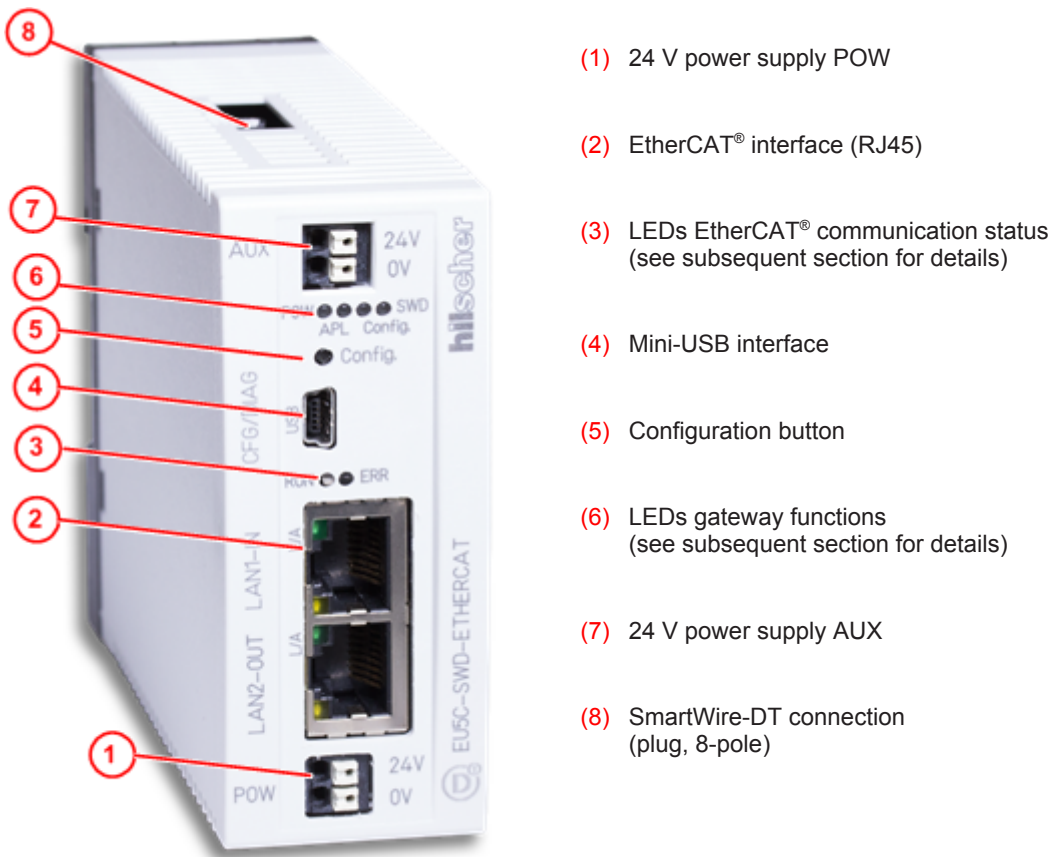
Table 12: Front view EU5C-SWD-ETHERCAT gateway

5.2 Positions and meaning of the LEDs

5.2.1 Positions of the LEDs

(1)	**POW**: System status
(2)	**APL**: Application status
(3)	**Config.**: Configuration status
(4)	**SWD**: SmartWire-DT status
(5)	**RUN**: EtherCAT® bus status
(6)	**ERR**: EtherCAT® bus error
(7)	**L/A**: LINK/Activity for channel 0
(8)	Receive/Transmit (RX/TX) for channel 0
(9)	**L/A**: LINK/Activity for channel 1
(10)	Receive/Transmit (RX/TX) for channel 1
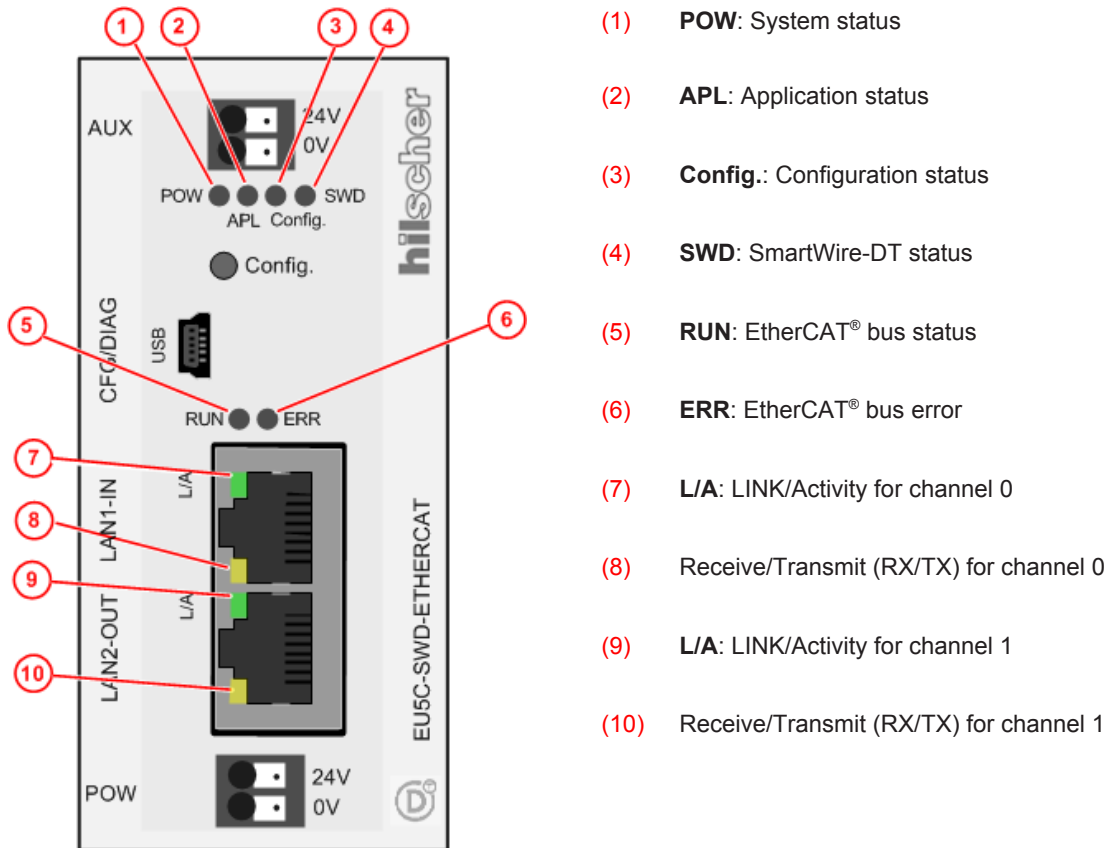
Table 13: LEDs EU5C-SWD-ETHERCAT Gateway

5.2.2 Description of the LEDs

LED	Color	State	Meaning
POW System status Number in picture: (1)	**Duo LED yellow/green**		
	⬤ (yellow)	On	Operating system running, firmware has been started.
	☀☀ (green/yellow)	Blinking green/yellow	Second Stage Bootloader is not able to load the firmware. The device needs to be sent-in for servicing.
	⬤ (green)	On	Backup firmware is active. The gateway needs a firmware recovery as described in chapter *Firmware-Recovery per HTTP* [▶ page 88].
	☀ (green)	Blinking green	ROM loader is not able to find bootable image. The device needs to be sent-in for servicing.
	⬤ (off)	Off	Power supply for device is missing or hardware is defect.
APL Application status Number in picture: (2)	Duo LED red/green		
	⬤ (green)	On	Communication on EtherCAT® and SmartWire-DT is in cyclic data exchange and the gateway function is executed.
	☀ (green)	Blinking 1 s off, 1 s on	Gateway is initialized, but the communication on EtherCAT® or SmartWire-DT is not in cyclic data exchange.
	☀ (red)	Blinking 1 s off, 1 s on	Gateway is initialized, but the SmartWire-DT configuration is missing or in error.
	⬤ (red)	On	Gateway has detected an error during the initialization: Missing configuration, error in configuration or internal error.
Config. Configuration status Number in picture: (3)	**Duo LED red/green**		
	⬤ (green)	On	The project configuration complies with the target configuration. Data exchange between gateway and PLC via EtherCAT® is possible.
	☀ (green)	Blinking	The project configuration does not comply with the target configuration, but is compatible with it. Data exchange between gateway and PLC via EtherCAT® is possible.
	⬤ (red)	On	The project configuration and the target configuration are not compatible. Data exchange between gateway and PLC via EtherCAT® **is not possible**.
	⬤ (off)	Off	No communication with the EtherCAT® PLC or the gateway does not have a project configuration.
SWD SmartWire-DT status Number in picture: (4)	**Duo LED red/green/orange** (orange = red/green at the same time)		
	⬤ (green)	On	The actual configuration complies with the target configuration. Data exchange between gateway and SmartWire-DT slaves takes place.
	☀ (red)	Blinking	The gateway misses its target configuration or a necessary SmartWire-DT slave is missing or the target configuration does not comply with the actual configuration. **No data exchange** between gateway and SmartWire-DT slaves.
	☀ (green)	Blinking	Slave addressing is active (after power-on or download of a project configuration containing empty modules). **No data exchange** between gateway and SmartWire-DT slaves.
	⬤ (red)	On	Short-circuit on the 15 V power supply or no SmartWire-DT slave is connected. **No data exchange** between gateway and SmartWire-DT slaves.
	☀ (orange)	Blinking	After having pressed the configuration button: The gateway reads the actual configuration and stores it as target configuration.

LED	Color	State	Meaning
RUN EtherCAT® Bus status Number in picture: (5)	**Duo LED red/green**		
	● (off)	Off	**INIT**: The device is in state INIT
	☀ (green)	Blinking	**PRE-OPERATIONAL**: The device is in state PRE-OPERATIONAL
	☀ (green)	Single flash	**SAFE-OPERATIONAL**: The device is in state SAFE-OPERATIONAL
	● (green)	On	**OPERATIONAL**: The device is in state OPERATIONAL
ERR EtherCAT® Bus error Number in picture: (6)	**Duo LED red/green**		
	● (off)	Off	**No error**: EtherCAT® communication of the device is in working condition
	☀ (red)	Blinking	**Invalid Configuration**: General Configuration Error (Example: State change commanded by master is impossible due to register or object settings.)
	☀ (red)	Single flash	**Unsolicited State Change**: Slave device application has changed the EtherCAT® state autonomously: Parameter "Change" in the AL status register is set to 0x01:change/error (Example: Synchronization Error, device enters Safe-Operational automatically.)
	☀ (red)	Double flash	**Application Watchdog Timeout:** An application watchdog timeout has occurred. (Example: Sync Manager Watchdog timeout)
	● (red)	On	**PDI Watchdog Timeout:** A PDI Watchdog timeout has occurred (Example: Application controller is not responding any more)
L/A (RJ45) Ch0 & Ch1 Numbers in pictures: (7) and (9)	**LED green**		
	● (green)	On	Link: Gateway has connection to EtherCAT®
	☀ (green)	Blinking	Activity: Gateway sends/receives EtherCAT® frames
	● (off)	Off	Gateway has no connection to EtherCAT®
(RJ45) Ch0 & Ch1 Numbers in pictures: (8) and (10)	**LED yellow**		
	● (yellow)	-	Not used

Table 14: Description of the LEDs

5.3   Pinning of the Real-Time Ethernet interface

The following picture shows the pinning of the EtherCAT interface of the gateway.
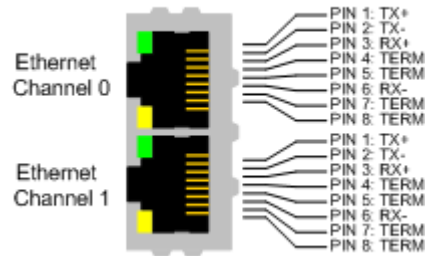
Figure 2: Pinning of the Ethernet interface (RJ45)

Pin	Signal	Description
1	TX +	Transmit Data +
2	TX –	Transmit Data –
3	RX +	Receive Data +
4	TERM	Bob Smith Termination
5	TERM	
6	RX –	Receive Data –
7	TERM	Bob Smith Termination
8	TERM	

Table 15: Ethernet interface channel 0 and channel 1 pin assignment (RJ45)

> **Note:**
> The Ethernet interface supports auto crossover.

5.4   Device type label

The EU5C-SWD-ETHERCAT Gateway is equipped with a device type label, which provides the following information:
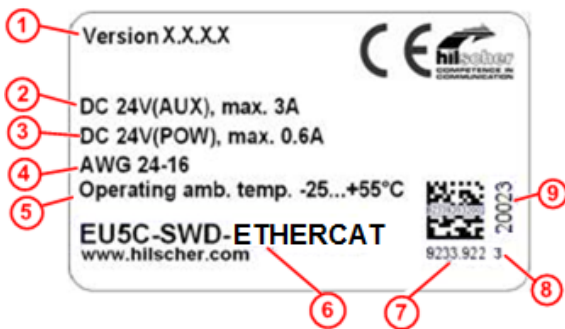
(1) Version of firmware (at time of delivery)

(2) Information on power supply for switching devices (AUX)

(3) Information on power supply for Gateway and Smart-Wire-DT slaves (POW)

(4) Information on wire gauge of power supplies

(5) Operating ambient temperature

(6) Device type name

(7) Part number

(8) Hardware revision number

(9) Serial number

Table 16: Device type label EU5C-SWD-ETHERCAT Gateway

6 Getting started

The following table provides an overview of the steps necessary for installing and commissioning the EU5C-SWD-ETHERCAT Gateway.

#	Step	For details see
1	**Install gateway**	Chapter *Installing gateway* [▶ page 32]
1.1	Take safety precautions	Section *Safety messages* [▶ page 32]
1.2	Mount gateway onto top hat rail	Section *Mounting gateway* [▶ page 33]
1.3	Connect gateway to power supply	Section *Connecting gateway to power supply* [▶ page 36]
1.4	Connect gateway to SmartWire-DT network	Section *Connecting SmartWire-DT* [▶ page 38]
1.5	Connect gateway to EtherCAT® network	Section *Connecting EtherCAT* [▶ page 39]
2	**Configure gateway**	Chapter *Configuring gateway* [▶ page 41]
2.1	Configure SmartWire-DT network in gateway	Section *Configuring SmartWire-DT network in gateway (creating target configuration)* [▶ page 41]
2.2	Import device description files in EtherCAT® engineering tool (TwinCAT System Manager)	Section *Configuring gateway in TwinCAT* [▶ page 44]
2.3	Configure gateway in EtherCAT® engineering tool	
3	**Configure SmartWire-DT devices in engineering tool**	Section *Configuration data of the SWD devices* [▶ page 57]
3.1	Configure SmartWire-DT network coordinator parameters (if other than default settings are used)	Section *Configuring SmartWire-DT Coordinator* [▶ page 52]
3.2	Configure Device Options (if other than default settings are used)	Section *Configuring device options of SmartWire-DT devices in TwinCAT* [▶ page 58]
3.3	Configure Device Parameters (if other than default settings are used)	Section *Configuring device parameters (sensor parameters of I/O modules)* [▶ page 65]

Table 17: Getting started

7   Installing gateway

7.1   Safety messages

⚠ WARNING

Electrical shock

Please observe the following safety messages when you install and handle the gateway:
- ➢ First disconnect the power plug of the device.
- ➢ Make sure that the power supply is off at the device.
- ➢ Cover or enclose neighboring units that are live.

NOTICE

Electrostatic Sensitive Device

The gateway is sensitive to electrostatic discharge, which can cause internal damage and affect its normal operation. Therefore adhere to the necessary safety precautions for components that are vulnerable to electrostatic discharge, when you install or handle the gateway:
- ➢ Do not touch the metal pins of the connectors of the gateway.
- ➢ Touch a grounded object to discharge potential static.
- ➢ Wear an approved grounding wrist strap.
- ➢ If available, use a static-safe workstation.
- ➢ When not in use, store the device in an appropriate static-safe packaging.

7.2   Mounting gateway

No tools are required for mounting the EU5C-SWD-ETHERCAT Gateway onto a top hat rail. The back of the gateway (1) carries a spring-fitted bolt (2) by which the gateway can be clamped to the rail (3).
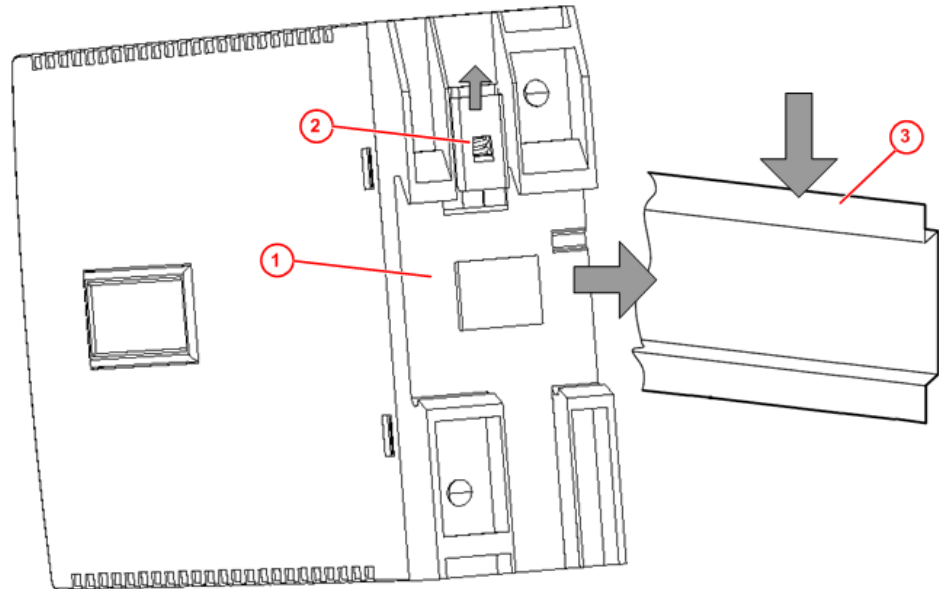
Figure 3: Mounting principle of the gateway

7.2.1   Mounting gateway onto top hat rail

To mount the gateway onto the top hat rail, proceed as follows:

⚠ **WARNING** **Electrical shock:** Make sure that the gateway is disconnected from any power supply! Cover or enclose neighboring units that are live!

➢ Tilt the gateway slightly and hook it into the upper railing from above, thereby pushing down the gateway with slight force, in order to overcome the resistance of the spring in the bolt.
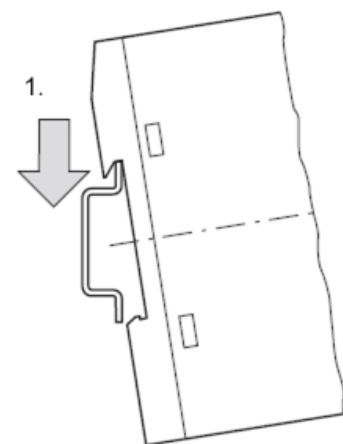
Hook gateway to upper railing

➢ Keep on pushing the gateway downwards and tilt it back into vertical position, thereby hooking the gateway into the lower railing.
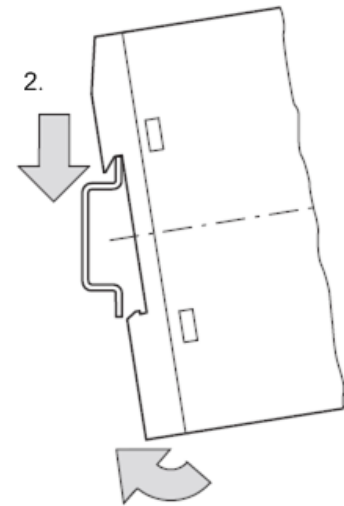
Hook gateway to lower railing

➢ Let go of the gateway. The spring inside the bolt automatically pushes the gateway upwards into the railings, thereby fixing the gateway to the top hat rail.
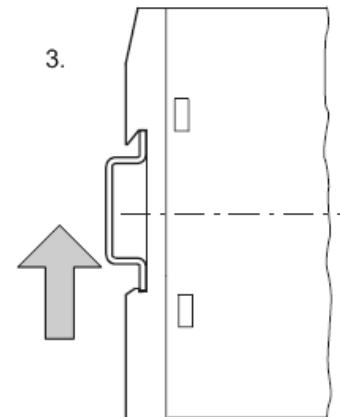
Gateway is clamped to top hat rail

7.2.2   Removing gateway from top hat rail

To remove the gateway from the top hat rail, proceed as follows:

⚠ **WARNING** **Electrical shock:** Make sure that the gateway is disconnected from any power supply! Cover or enclose neighboring units that are live!

➢ Push down the gateway with slight force (to overcome the resistance of the spring in the bolt), then unhook the gateway first from the lower railing and then from the upper railing.
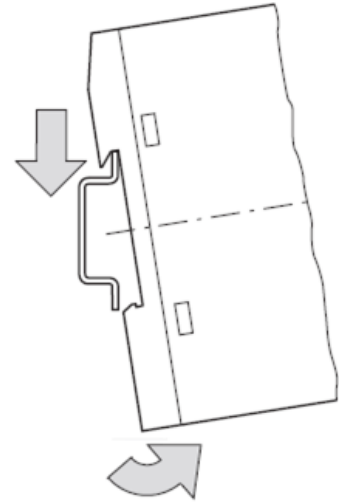
Unhook gateway

7.3   Connecting gateway to power supply

⚠ DANGER

Danger of lethal injuries by unexpected starting up of motors or machinery!

If you have already integrated devices into a system, secure the operating range of any connected parts of the system against access, so that nobody is endangered by motors or machinery starting up unexpectedly.

⚠ WARNING

Danger of unsafe operation of the system

In safety-relevant applications the power supply providing power for the SmartWire-DT system must feature a PELV power feed module (protective extra low voltage).

⚠ WARNING

Danger of unsafe operation of the system

You must take safety precautions (emergency switching off) in the external circuitry of the gateway and any power modules type EU5C-SWD-PF1-1 or EU5C-SWDPF2-1 that are used. To do so, plan to switch off the power supply to the contactor coils **AUX**.

❗ Important:

Please take into consideration the total power consumption of your SmartWire-DT network and, if necessary, plan for an additional feeder module EU5C-SWD-PF2. You can find information on the power consumption in the operating manuals of the SmartWire-DT devices.

➢ Connect the 24 V DC voltage to the **POW** terminals on the front side of the gateway. The **POW** connection provides the voltage for the gateway itself and for the SmartWire-DT slave electronics.

➔ Note:

For the 15 V supply of the SmartWire-DT slaves, the gateway contains an additional power feed module with an amperage of 0.7 A.

> ➢ If necessary, connect the 24 V DC voltage for the contactor coils to the **AUX** terminals on the front side of the gateway.
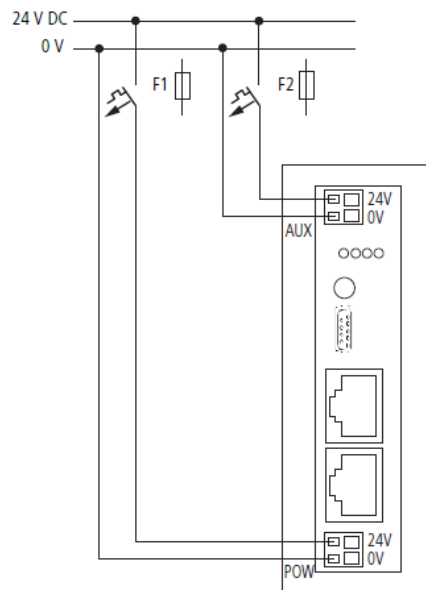
Figure 4: Gateway power supply

→ Note:

The **AUX** supply is required if any switching devices are also to be connected, for example, via the DIL-SWD-32-001/002 SmartWire-DT slaves. The **AUX** connection provides the supply for activating the contactor coils.
This supply must be protected by an automatic circuit-breaker (3A gG/gl or 3 A miniature circuit-breaker with a Z characteristic).
If switching devices with an activation power greater than 3 A are connected, an additional feeder module EU5C-SWD-PF1 or EU5C-SWD-PF2 must be used.

Potential conditions between the components

The entire SmartWire-DT system operates on a common supply voltage. Provide a common star point for the earth wiring. In this way, the various slaves in the SmartWire-DT system will not be electrically isolated from one another.
The EtherCAT network and the SmartWire-DT system are electrically isolated from one another.

7.4   Connecting SmartWire-DT

➢ Connect the SmartWire-DT network to the gateway. To do so, use the SmartWire-DT cable SWD4-100LF8-24 and the SWD4-8MF2 relevant blade terminal or prefabricated cables of type SWD4-(3/5/10)F8-24-2S.
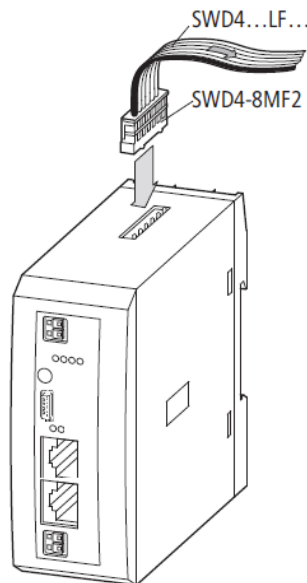
Figure 5: Connecting SmartWire-DT to gateway

NOTICE

Device destruction

Switch off the power supply before you are reconnecting slaves in the SmartWire-DT system or reconnecting the ribbon cable connection. Otherwise the SmartWire-DT slaves can be destroyed!

Detailed instructions on adapting the SmartWire-DT external device plug (SWD4-8SF2-5) to the 8 pole Smart-Wire-DT cable are provided in chapter *Fitting external device plugs SWD4-8SF2-5* of the manual *SmartWire-DT – The System*, MN05006002Z-EN (previously AWB2723-1617en).

7.5   Connecting EtherCAT

Important:
Please note that data exchange between the gateway and the EtherCAT® network can only take place after a SmartWire-DT network has been connected and configured in the gateway.

➢ Connect the RJ45 plug of the EtherCAT® cable to the upper Ethernet socket (labeled **LAN1-IN**) on the gateway.
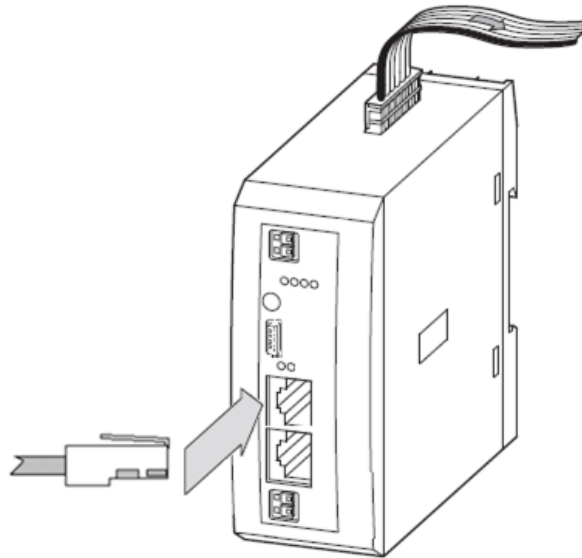
Figure 6: Connecting EtherCAT to gateway

Important:
Please observe the following notes on EtherCAT® cabling:
➢ Use shielded Ethernet cables that meet the requirements of at least category 5 (Cat 5) according to EN 50173 or ISO/IEC 11801.
➢ Do not use hubs in an EtherCAT® network.
➢ Do not use switches in a productive system. Use a switch for diagnostic purpose only and only between EtherCAT® master and first EtherCAT® slave device (100 MBit/s, Full Duplex). A switch has influence to the real-time characteristics of the EtherCAT network.
➢ The cable length between two EtherCAT® devices must not exceed 100 meter.

See also the user manual *Wiring Instructions EtherCAT*, DOC121104UMxxEN, stored on the product DVD in the `Documentation\english\5.Installation Instructions` directory.

7.6   EMC-conformant wiring of the network

Undesired faults can occur on the bus due to electromagnetic interference. This can be minimized beforehand by the implementation of suitable EMC measures. These include:

- EMC-conformant system configuration,

- EMC compliant cable routing,

- Measures that do not allow the occurrence of large differences in potential and

- correct installation of the EtherCAT system (cables, connection of the bus connectors, etc.)

The effects of electromagnetic interference can be significantly reduced by fitting a shield.

> For more detailed information on this, please refer to the IAONA Industrial Ethernet -Planning and Installation Guide by IAONA e.V. Magdeburg, Germany.

8 Configuring gateway

8.1 Overview

For data exchange between the gateway and the EtherCAT® master, the gateway needs a valid target configuration and a valid project configuration. The target configuration of the SmartWire-DT network can be created and stored in the gateway by using the configuration button on the gateway device. The project configuration must be created and transferred to the gateway by means of the EtherCAT® engineering tool (i. e. TwinCAT). This chapter describes how to create and store these configurations in the gateway.

8.2 Configuring SmartWire-DT network in gateway (creating target configuration)

8.2.1 Overview

When you commission the gateway, you have to read-in the actual configuration of the SmartWire-DT network (i. e. the line-up of the participants/devices connected to the SWD bus) and store it as target configuration.

Reading and storing the SmartWire-DT network configuration takes place by pressing the configuration button on the gateway (for the position of the configuration button, see figure *Frontansicht EU5C-SWD-ETHERCAT Gateway* [▷ page 26]). All SmartWire-DT slaves are re-addressed in ascending order by this process.

This process should only take place in the case of:

- initial commissioning,
- replacement of a defective slave or
- deliberate change to the configuration.

NOTICE

Hazard of device damage by disruption of voltage supply while creating target configuration!

Do not interrupt the voltage supply while creating the target configuration of the gateway. Power failure during a writing process within the file system can cause severe malfunctioning of the device.

Important:
If there is a faulty configuration and the configuration button is pressed, only the slaves up to the failed device are addressed and stored. Use of the remaining slaves is not possible until the defective slave has been replaced and the configuration has been read-in again by pressing the configuration button.

The remanently stored target configuration is compared with the current configuration (actual configuration) each time the gateway is restarted and during bus operation. If the gateway recognizes that a required SmartWire-DT slave cannot be reached or a wrong slave type is determined, the gateway will not go into operation or stops operating. This depends in each case on the setup of the network which has been defined in the planned/project configuration. In case of error, the SmartWire-DT status LED (SWD LED) starts to blink in red (for the position of the SWD LED, see section *Positionen der LEDs* [▶ page 27]).

If a SmartWire-DT slave has failed, the SmartWire-DT network can still be operated with the remaining slaves, depending on the settings in the planned/project configuration (even after a repeated power up of the gateway). The failure is reported to the application.

8.2.2   Prerequisites

Prerequisites for reading-in the SmartWire-DT configuration are:

- All SmartWire-DT slaves are connected to the SmartWire-DT line.
- The SmartWire-DT status LEDs of the individual SmartWire-DT slaves are on or are flashing.
- The SmartWire-DT network is connected to the gateway.
- The voltage POW is applied to the gateway and the power **POW** LED is on.
- The EtherCAT® network is connected to the gateway and the gateway is either in INIT or PRE-OP state (the **RUN** LED is off or is blinking, see also section *Positions and meaning of the LEDs* [▶ page 27]).
- The voltage AUX is applied (if necessary).

8.2.3   Step-by-step instructions

To read-in the SmartWire-DT configuration, proceed as follows:

➢ Press the configuration button on the gateway for **at least two seconds** (for the position of the configuration button, see figure in section *Device picture* [▶ page 26]).

> **Note:**
> Take care to push-in the button properly. You have to feel and overcome a slight resistance at the end when pushing the button into the gateway, otherwise the button will not trigger.

↳ The SmartWire-DT status LED (SWD LED) on the gateway begins to flash orange. The SmartWire-DT status LEDs on the SmartWire-DT slaves also flash. All slaves are addressed in sequence, the complete configuration is stored retentively as gateway target configuration.

> **NOTICE**
>
> **Hazard of device damage by disruption of voltage supply while creating target configuration!**
>
> Do not interrupt the voltage supply while creating the target configuration of the gateway. Power failure during a writing process within the file system can cause severe malfunctioning of the device.

✎ The SmartWire-DT status LED (SWD LED) on the gateway shows steady green.

> **→ Note:**
>
> As an alternative, you can generate and store the target configuration by using the SWD-Assist software. For this, the gateway must be connected to SWD-Assist via USB. For details, please refer to the SWD-Assist online help.

8.3 Configuring gateway in EtherCAT

8.3.1 Device description files

The EU5C-SWD-ETHERCAT Gateway is integrated as slave in the EtherCAT® network. Configuring the gateway in the EtherCAT® engineering tool requires two device description files in XML format containing standardized descriptions of the gateway and the SmartWire devices.

You will find the device description files on the product DVD in the `EDS\EU5C-SWD-ETHERCAT\Vx.x.x.x` directory. You can also download the latest versions of the files from our website www.hilscher.com under **Products** > **Partner Products** > **SmartWire-DT** > **EU5C-SWD-ETHERCAT** > **Downloads**.

Copy the device description files to the relevant directory of your EtherCAT® engineering tool or use the corresponding import function of the tool. For further information on this, please refer to the documentation of your engineering tool.

> **🛈 Important:**
>
> Please note that data exchange between the gateway and the EtherCAT® network can only take place after a SmartWire-DT network has been connected and configured in the gateway (see section *Configuring SmartWire-DT network in gateway (creating target configuration)* [▶ page 41]).

8.3.2 Configuring gateway in TwinCAT

This section describes how to create the project configuration for the EU5C-SWD-ETHERCAT gateway by using the TwinCAT System Manager V2.11 on a standard PC. In this example, TwinCAT in combination with the standard Ethernet network adapter of the PC serve also as Soft PLC and EtherCAT® master device simultaneously. Please note that commissioning the gateway in an EtherCAT® network controlled by a "real" hardware PLC is not subject of this document.

8.3.2.1 Prerequisites

- EU5C-SWD-ETHERCAT gateway

- The gateway is connected to a SmartWire-DT network

- The gateway contains a valid SmartWire-DT configuration (the SWD LED shows steady green light)

- PC with installed TwinCAT System Manager and Ethernet adapter

- The Ethernet adapter of the PC is connected to the gateway via EtherCAT® network

- Device description files of the EU5C-SWD-ETHERCAT gateway

8.3.2.2 Step-by-step instructions

1. Copy device description files into TwinCAT directory.

   ➢ In the Windows Explorer, open the directory where the device description files are stored. On the product DVD, this is the `EDS\EU5C-SWD-ETHERCAT\Vx.x.x.x` directory.

   ➢ Copy the device description files.

   > **→ Note:**
   > You need the `Phoenix_EU5C-SWD-ETHERCAT_Modules_XXXXXXXX.xml` and the `Woehner_EU5C-SWD-ETHERCAT_Modules_XXXXXXXX.xml` files only if the Smart-Wire-DT network includes partner devices by Phoenix or Wöhner.

   ➢ Copy the files to the `TwinCAT\Io\EtherCAT` directory of the TwinCAT installation on your configuration PC.

   ↳ The device description files of the gateway and the SmartWire devices are now available in the TwinCAT System Manager.

2. Start TwinCAT.

   ➢ In the Windows start menu, select **All Programs** > **TwinCAT System** > **TwinCAT System Manager**.

↳ The TwinCAT System Manager opens:
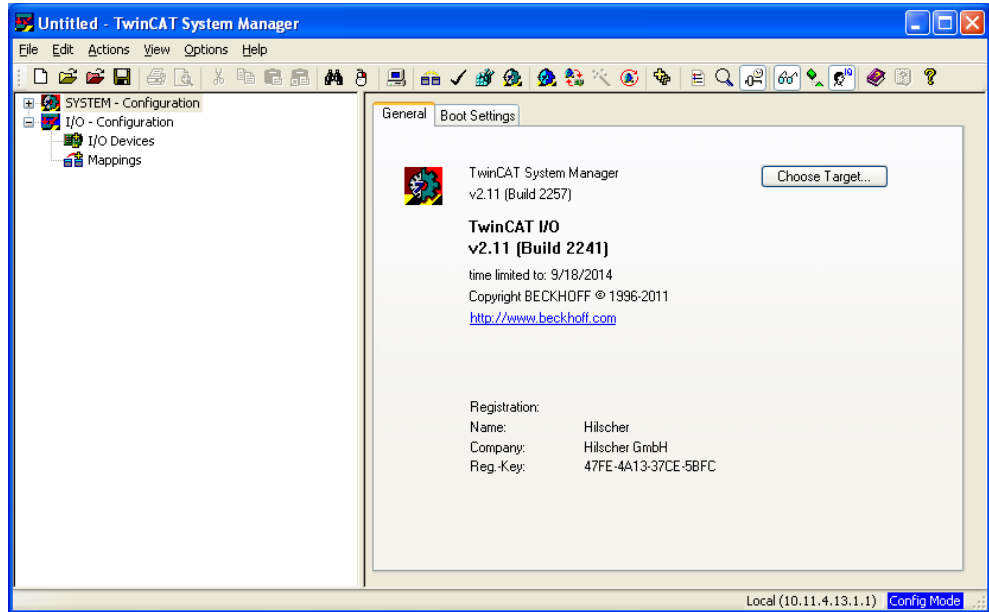
Figure 7: TwinCAT start screen

If you already dispose of a project into which you want to integrate the gateway, open the corresponding project file.

If you haven't created a project yet, you first have to configure the Ethernet adapter of your PC as EtherCAT® master device.

3. Configure Ethernet adapter as EtherCAT® master device.

➢ In the Menu, choose **Options** > **Show Real Time Ethernet Compatible Devices…**

↳ The **Installation of TwinCAT RT-Ethernet Adapters** dialog window opens:
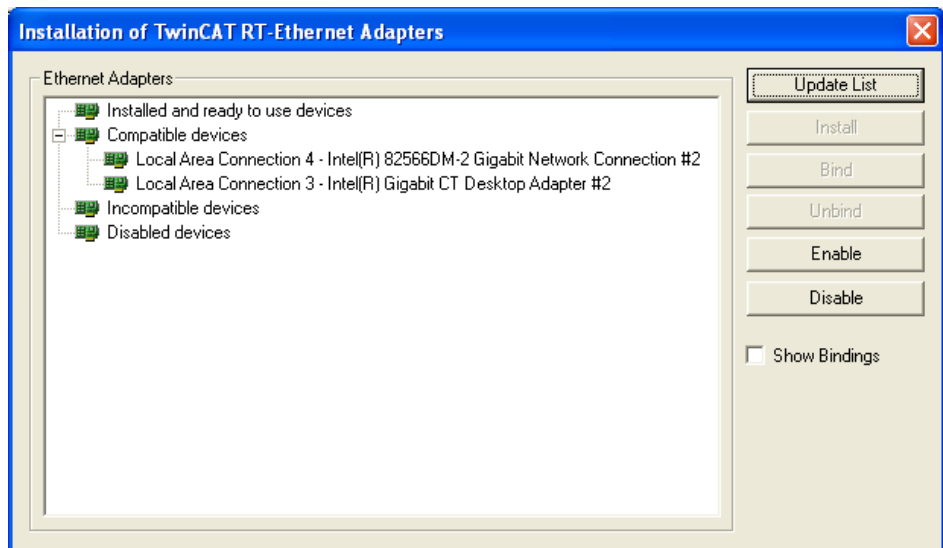
Figure 8: Installing TwinCAT Ethernet adapter (1)

> **Note:**
> TwinCAT features two different drivers for Ethernet network adapters:
>
> The **TwinCAT Driver for Real-Time Ethernet** provides "hard" RTE support for EtherCAT® applications, but can only be used with Intel-based network adapters. Adapters on your PC recognized by TwinCAT and supported by this driver are listed under **Compatible devices** (see picture above).
>
> The **TwinCAT Real-Time Ethernet Intermediate Driver** can be used for network adapters without an Intel chip set, but lacks "hard" RTE support for EtherCAT®. Adapters on your PC recognized by TwinCAT and supported by this driver are listed under **Incompatible devices**.

➢ Select the network adapter which you want to use as TwinCAT master device, then click **Install** Button.

➷ After successful installation, the selected network adapter will be displayed as "TwinCAT Ethernet Adapter" under **Installed and ready to use devices**:
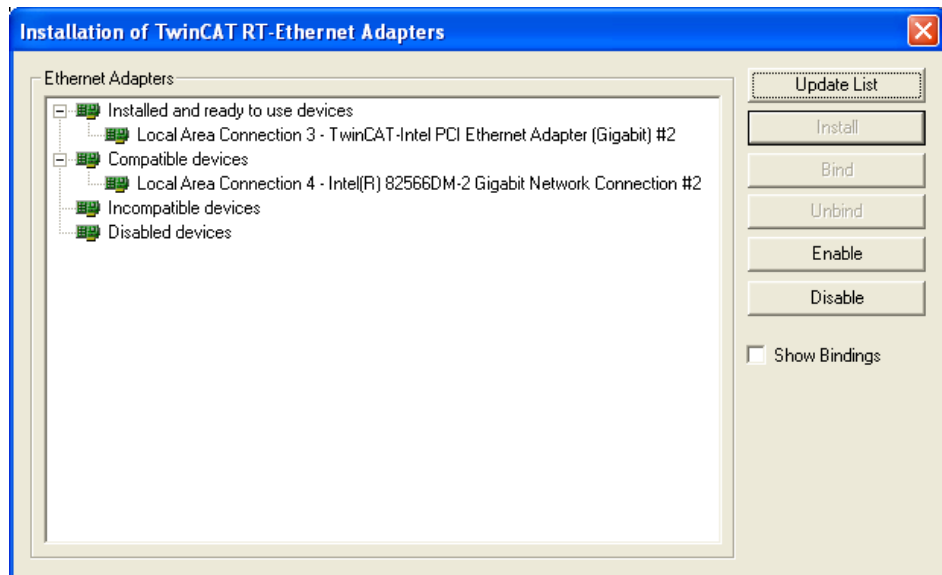
Figure 9: Installing TwinCAT Ethernet adapter (2)

➢ Close the dialog window by clicking on the red button in the upper right corner of the dialog window.

4. Scan for EtherCAT® devices.

    ➢ In the navigation tree of the TwinCAT System Manager, select **I/O Devices** element, then choose **Scan Devices…** entry from the context menu.
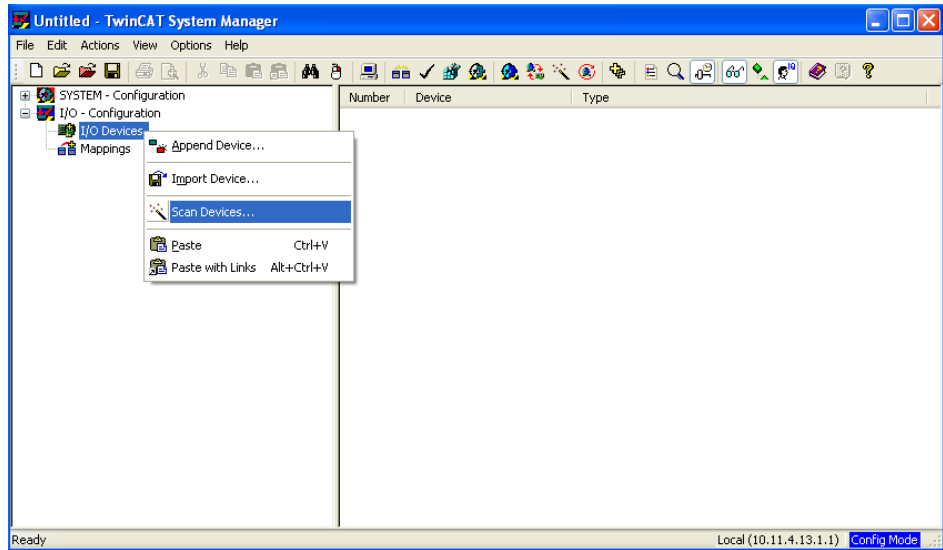
Figure 10: Scan devices

    ✎ A message appears, telling you that not all types of devices can be found automatically:
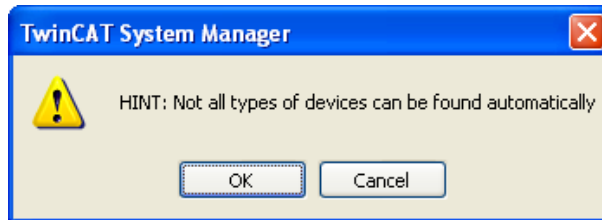
Figure 11: Message prior to device scan

    ➢ Acknowledge with **OK**.

    ✎ The **New devices found** dialog window opens:
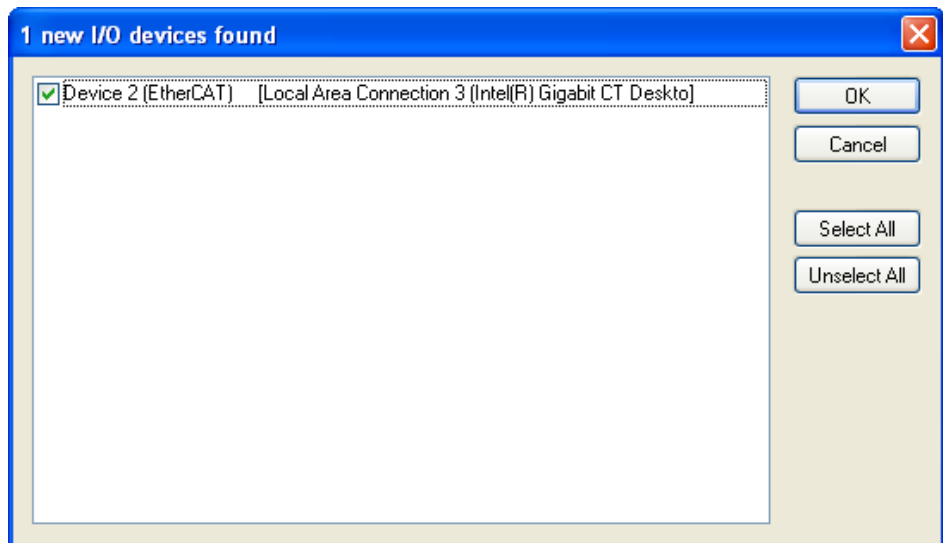
Figure 12: New devices found dialog window

> ➢ Activate the check box in front of the device which you want to use as EtherCAT® master device, then click **OK**.

> ↳ The **New devices found** dialog window closes and the selected master device is inserted in the navigation tree below the **I/O Devices** element. Also, the System Manager asks you to **Scan for boxes…** (i. e. EtherCAT® slave devices):
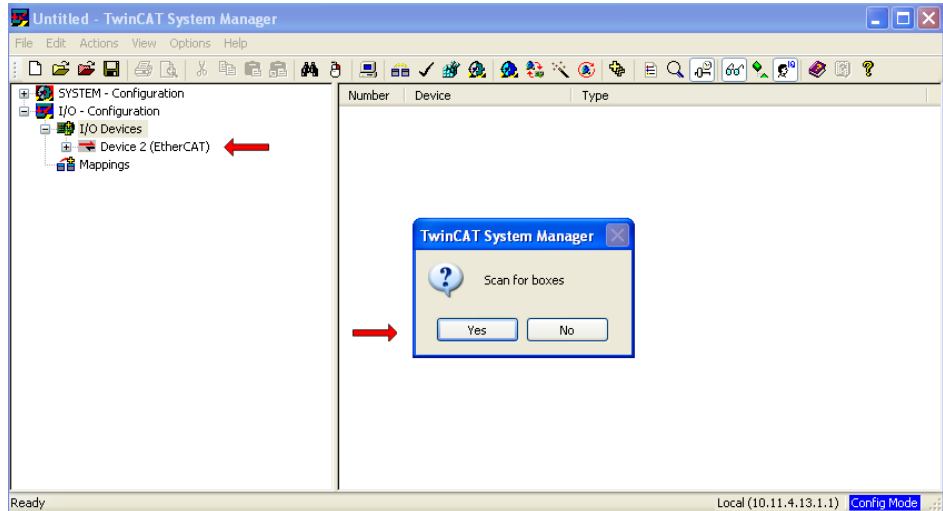
Figure 13: Scan for boxes

> ➢ Start the scanning for boxes process by clicking **Yes**.

> ↳ If a "ready-for-operation" EU5C-SWD-ETHERCAT gateway has been properly connected to the EtherCAT® master device (i. e. the corresponding Ethernet adapter of your PC), the gateway will be found and displayed as **Box [x] (EU5C-SWD-ETHERCAT)** below the master device in the navigation tree. The SmartWire slaves connected to the gateway will also be found and added to the gateway entry as subordinate modules.
> The System Manager asks you to activate the **Free Run** mode:
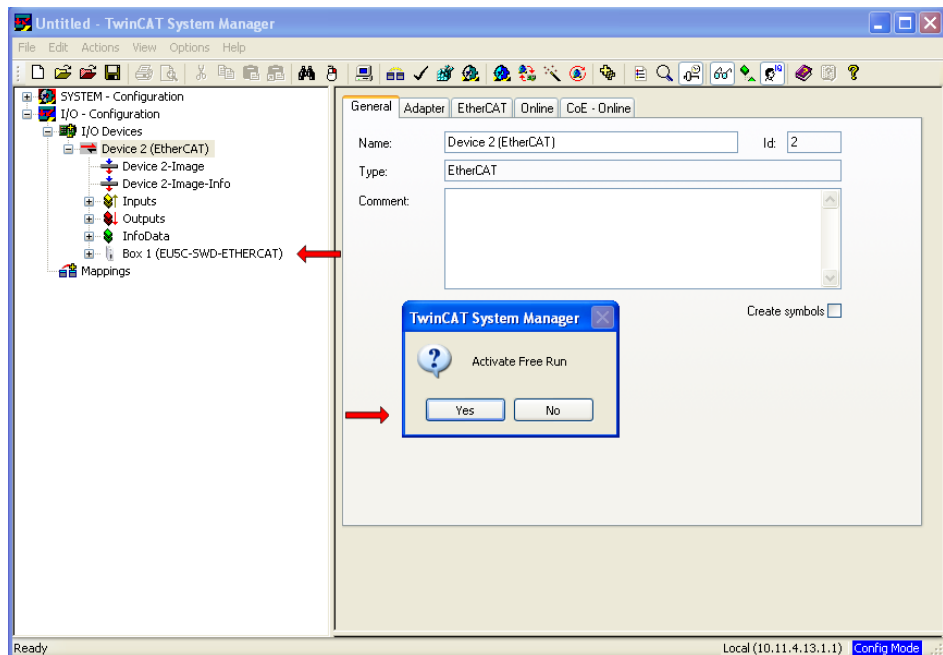
Figure 14: EU5C-SWD-ETHERCAT Gateway found as new box

> ➢ Activate the **Free Run** mode by clicking **Yes**.

> ↳ In **Free Run** mode, the TwinCAT configuration data is being transferred to the gateway. Cyclic data between the EtherCAT® master and the SmartWire slaves (modules) via the gateway are being exchanged.

5. Testing cyclic data exchange with SmartWire slaves.

> ➢ In the navigation tree of the TwinCAT System Manager, click on the plus symbol in front of the gateway element **Box [x] (EU5C-SWD-ETHERCAT)** to expand the tree structure.

> ↳ The SmartWire slaves connected to the gateway are being displayed in the navigation tree below the gateway as **Module 1, Module 2** etc.:
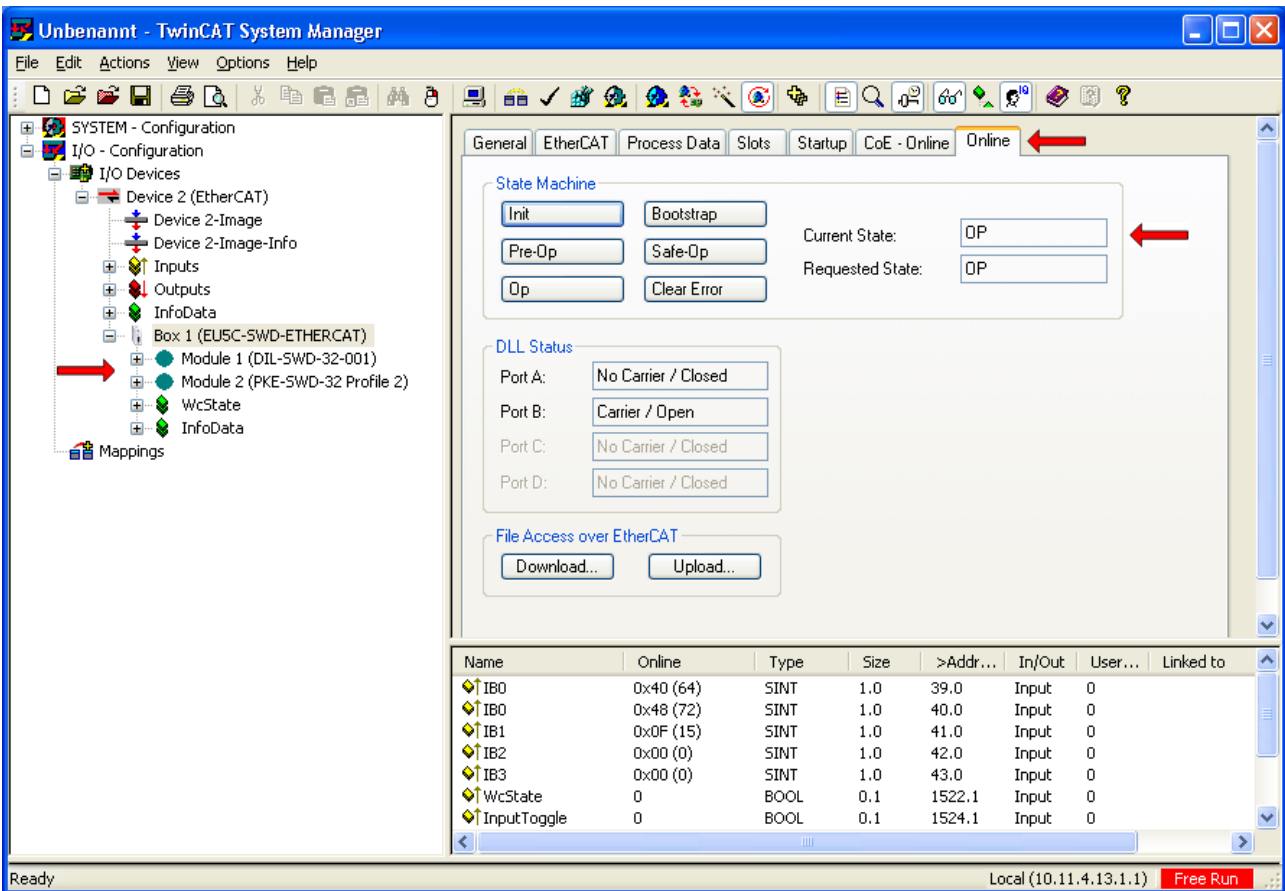
Figure 15: EU5C-SWD-ETHERCAT Gateway process data (1)

> ➢ Select the gateway in the navigation tree, then open the **Online** tab in the main window.

> ↳ When **Free Run** mode is active, the **Current State** field in the **State Machine** area displays **OP** state (operational). The lower area of the main window shows the I/O data of the SmartWire slaves.

> ➢ Create output data at one of the SmartWire slaves. In this example, the switch of a device connected to the **DIL-SWD-32-001** slave (Module 1) is being toggled.

➥ This event is indicated by a changed value in the **Online** field of the first **IB0** object in the lower area of the main window:

Name		Online	Type	Size	>Addr...	In/Out	User...	Linked to
IB0	➡	0x44 (68)	SINT	1.0	39.0	Input	0	
IB0		0x48 (72)	SINT	1.0	40.0	Input	0	
IB1		0x0F (15)	SINT	1.0	41.0	Input	0	
IB2		0x00 (0)	SINT	1.0	42.0	Input	0	
IB3		0x00 (0)	SINT	1.0	43.0	Input	0	
WcState		0	BOOL	0.1	1522.1	Input	0	

Figure 16: EU5C-SWD-ETHERCAT Gateway process data (2)

9   Parameterization

9.1   Process data

Cyclic data in EtherCAT® is exchanged via so-called **Process Data Objects** (**PDO**s).

- **Output data** of a SmartWire-DT device is mapped to object **RxPDO**, index 0x1600, sub index 0x00 and following.

- **Input data** of a SmartWire-DT device is mapped to object **TxPDO**, index 0x1A00, Sub index 0x00 and following.

The EtherCAT® master adds all configured PDOs to the **RxPDO Assign Object** index 0x1C12 and to the **TxPDO Assign Object** index 0x1C13.

The EtherCAT® master loads this configuration data into the gateway via SDOs when the gateway is in state **Pre-Operational**.
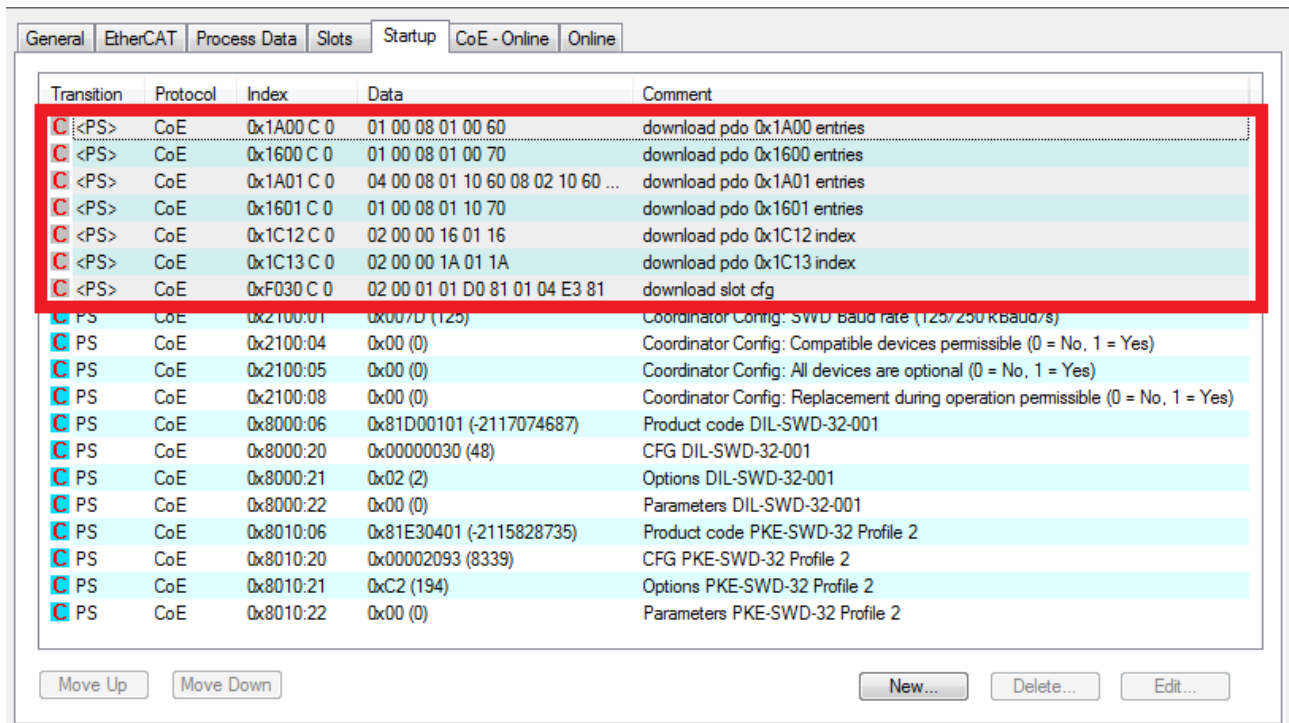
Figure 17: Process data mapping in TwinCAT

9.2   Configuring SmartWire-DT Coordinator

9.2.1   Overview

Being the master device in the SmartWire-DT network, the EU5C-SWD-ETHERCAT gateway serves as a so-called "Coordinator" controlling the data transfer procedure within the SmartWire-DT network in accordance with the SmartWire-DT protocol. Via the Coordinator, you can configure the following properties:
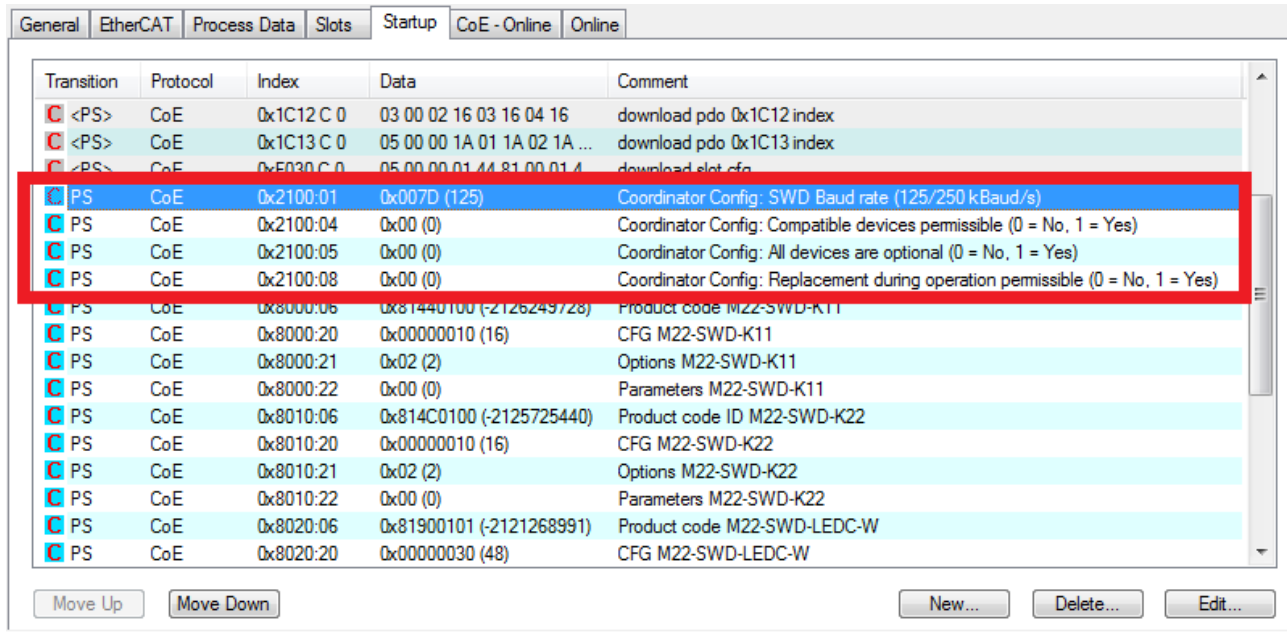
- the Baud rate of the SmartWire-DT network (**SWD Baud rate**)

- allowing the use of compatible SmartWire-DT devices (**Compatible devices permissible**)

- the handling of failing SmartWire-DT devices (**All devices are optional**)

- the handling of the replacement of SmartWire-DT devices during bus operation (**Replacement during operation permissible**)

In the EtherCAT® engineering tool (i. e. TwinCAT), these Coordinator parameters are mapped to the following configuration elements and indices (all values in hex):

Coordinator Config: index `0x2100`

- **SWD Baud rate**: sub index `01`

- **Compatible devices permissible**: sub index `04`

- **All devices are optional**: sub index `05`

- **Replacement during operation permissible**: sub index `08`

In the TwinCAT System Manager, the configuration elements of the Coordinator look as follows:

Figure 18: Configuration data of the SWD Coordinator (gateway) in TwinCAT

The EtherCAT® master loads this configuration data into the gateway via SDOs when the gateway is in state **Pre-Operational**.

In the configuration elements of the Coordinator, you can set the following parameters:

Element			Settings and their meaning	Enter byte value	
Index	Parameter	Description		Dez	Hex
0x2100:01	SWD Baud rate	Baud rate of the SmartWire-DT network	**125** kBit/s *(Default)*	125	0x7D
			250 kBit/s	250	0xFA
0x2100:04	Compatible devices permissible	Allows replacement/ substitution of SmartWire-DT devices by compatible devices	**FALSE** (0): The devices in the project configuration must comply 100 % with the devices in the target configuration. If not, no data interchange takes place with the EtherCAT® master. *(Default)*	0	0x00
			TRUE (1): Data exchange with the EtherCAT® master takes place, if the connected SmartWire-DT devices are different but compatible with the devices in the project configuration. (This condition is indicated by the gateway **Config** LED blinking green.)	1	0x01
0x2100:05	All devices are optional	Individual configuration whether a SmartWire-DT device can be missing is allowed	**FALSE** (0): You can configure for each SmartWire-DT device individually, whether it is allowed to be missing. *(Default)* (See section *Configuring device options of SmartWire-DT devices in TwinCAT* [▶ page 58])	0	0x00
			TRUE (1): Data exchange with the EtherCAT® master takes place even if there is a random number of missing devices in the SmartWire-DT network. The corresponding settings in the device options of the individual SmartWire-DTdevice slaves thus have no effect and are overruled.	1	0x01
0x2100:08	Replacement during operation permissible	Online replacement of SmartWire-DT devices during bus operation is allowed	**FALSE** (0) Not allowed; new SmartWire-DT devices must always be read into the SWD configuration by pushing the configuration button. *(Default)*	0	0x00
			TRUE (1) Allows online replacement of SmartWire-DT devices during bus operation *without* having to push the configuration button afterwards in order to read them into the SWD configuration.	1	0x01
			Note: If this parameter is set to TRUE, the **All devices are optional** parameter must also be set to TRUE, otherwise the whole SWD bus will be turned off after losing communication with one or several SWD devices. Please note also that online replacement during bus operation is only possible if SWD4-FFR-PF/ST…. power supply module/cable adapters are being used. Otherwise replacement must take place while power is switched off at the gateway. After return of voltage supply, the network will automatically be reconfigured (without having to push the configuration button).		

Table 18: Parameter settings of SWD Coordinator

The following exemplary step-by-step instructions show how to change the baud rate of the SmartWire-DT network from 125 kBit/s to 250 kBit/s.

9.2.2 Prerequisites

- PC with installed TwinCAT System Manager V2.11 and Ethernet adapter

- You have created a valid project configuration (see *Configuring gateway in TwinCAT* [▶ page 44]) and have opened the project configuration in the TwinCAT System Manager.

9.2.3 Step-by-step instructions

➢ In the navigation tree of the TwinCAT System Manager, select the gateway, then open the **Startup** tab in the main window.

↳ The configuration elements are listed in the **Startup** tab.
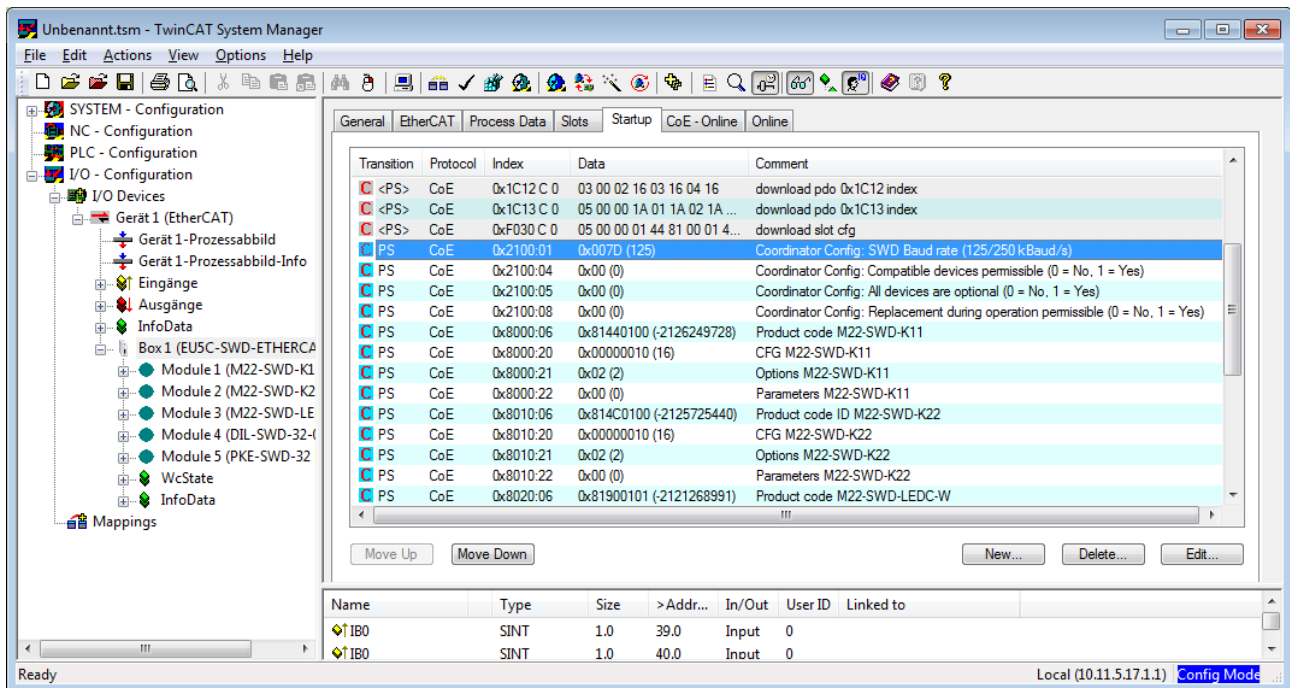
Figure 19: Editing parameters of SWD Coordinator (1)

➢ Search the list for the configuration element of the Coordinator parameter that you want to edit. A Coordinator parameter can be recognized by the index `0x2100:XX` and the `Coordinator Config: [Parameter]` entry in the **Comment** column.

➢ For this example, select the element marked with the index `0x2100:01` and the **Comment** entry `Coordinator Config: SWD Baud rate (125/250 kBaud/s)`, then click **Edit** button (or double-click the element).

➴ The **Edit CANopen Startup Entry** dialog window opens. The **Data (hexbin)** field displays the preset hexadecimal value of the byte configuring this parameter. In case of the baud rate, this is the value `7D 00` (the `00` byte is a reserved byte):

Figure 20: Editing parameters of SWD Coordinator (2)

➢ In the **Data (hexbin)** field, enter the new hexadecimal value of the parameter. Omit the `0x` prefix; i. e. enter the value `0xFA` simply as string `FA`. You can delete the reserved second byte (i. e. the `00` byte).
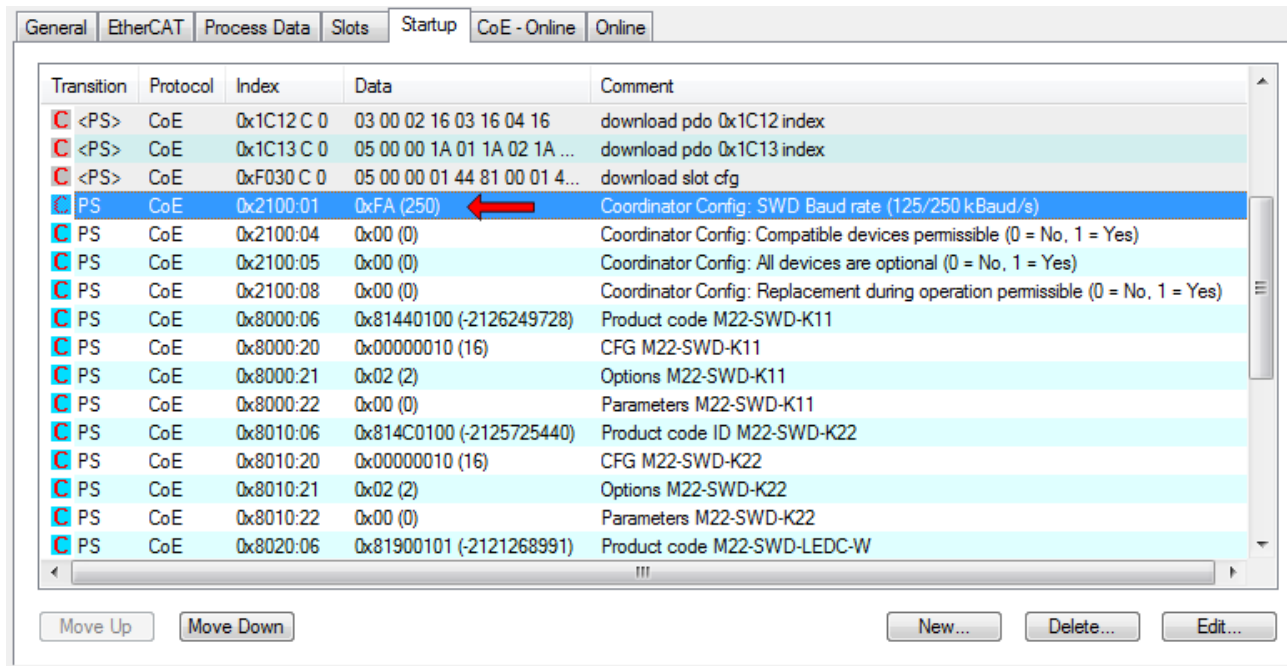
Note:
Entering the value `FA` (decimal = `250`) in this example causes the Coordinator (i. e. the gateway) to run the SmartWire-DT network with a `250` kBaud/s rate.
What value has to be entered for other parameters is shown in table *Parameter settings of SWD Coordinator* in section *Overview* [▶ page 52].

➢ Take over the new value by clicking the **OK** button.

↳ The **Data** column of the **Startup** tab displays the changed value (the corresponding decimal value is displayed in brackets behind the hexadecimal value).

Figure 21: Editing parameters of SWD Coordinator (3)

➢ In the main menu of the TwinCAT System Manager, choose **Actions** > **Activate Configuration…** to download the changed configuration data.

9.3 Configuration data of the SWD devices

9.3.1 Overview

Besides information on process data, the ESI files of the SmartWire-DT device also contain device-specific information like module ID (**Product code**), configuration data (**CFG**), device options (**Options**) and additional device parameters (**Parameters**).
When a SmartWire-DT device (i. e. a module) is added to the project configuration, the EtherCAT® engineering tool (i. e. TwinCAT) maps these data sets to the following elements (all values in hex):

Device (Module) 1: index `0x8000`

- Module ID (**Product code**): sub index `06`
- Configuration data (**CFG**): sub index `20`
- Device options (**Options**): sub index `21`
- Device parameters (**Parameters**): sub index `22`

Device (Module) 2: index `0x8010`

- Module ID (**Product code**): sub index `06`
- Configuration data (**CFG**): sub index `20`
- Device options (**Options**): sub index `21`
- Device parameters (**Parameters**): sub index `22`

etc...

In the TwinCAT System Manager, the configuration elements of the SWD-devices *DIL-SWD-32-001* and *PKE-SWD-32 Profile 2* for instance look as follows:

Transition	Protocol	Index	Data	Comment
C \<PS\>	CoE	0x1C12 C 0	02 00 00 16 01 16	download pdo 0x1C12 index
C \<PS\>	CoE	0x1C13 C 0	02 00 00 1A 01 1A	download pdo 0x1C13 index
C \<PS\>	CoE	0xF030 C 0	02 00 01 01 D0 81 01 04 ...	download slot cfg
C PS	CoE	0x2100:01	0x007D (125)	Coordinator Config: SWD Baud rate (125/250 kBaud/s)
C PS	CoE	0x2100:04	0x00 (0)	Coordinator Config: Compatible devices permissible (0 = No, 1 = Yes)
C PS	CoE	0x2100:05	0x00 (0)	Coordinator Config: All devices are optional (0 = No, 1 = Yes)
C PS	CoE	0x2100:08	0x00 (0)	Coordinator Config: Replacement during operation permissible (0 = No...
C PS	CoE	0x8000:06	0x81D00101 (-2117074687)	Product code DIL-SWD-32-001
C PS	CoE	0x8000:20	0x00000030 (48)	CFG DIL-SWD-32-001
C PS	CoE	0x8000:21	0x02 (2)	Options DIL-SWD-32-001
C PS	CoE	0x8000:22	0x00 (0)	Parameters DIL-SWD-32-001
C PS	CoE	0x8010:06	0x81E30401 (-2115828735)	Product code PKE-SWD-32 Profile 2
C PS	CoE	0x8010:20	0x00002093 (8339)	CFG PKE-SWD-32 Profile 2
C PS	CoE	0x8010:21	0xC2 (194)	Options PKE-SWD-32 Profile 2
C PS	CoE	0x8010:22	0x00 (0)	Parameters PKE-SWD-32 Profile 2

General | EtherCAT | Process Data | Slots | Startup | CoE - Online | Online

Move Up | Move Down | New... | Delete... | Edit...

Figure 22: Configuration data elements of SWD devices in TwinCAT

The EtherCAT® master loads this configuration data into the gateway via SDOs when the gateway is in state **Pre-Operational**.
Also, the device parameters (**Parameters**) of sub index 22 are loaded into the corresponding SmartWire-DT device, if the device is an I/O module (the purpose of the device parameters is to configure the sensors of I/O modules).
The module ID (**Product code**) of sub index 06 and the configuration data (**CFG**) of sub index 20 are needed by the gateway for identification and configuration purposes and must not be changed. The device options (**Options**) of sub index 21 and the device parameters (**Parameters**) of sub index 22 on the other hand can be edited if necessary. This is described in the following sections.

9.3.2 Configuring device options of SmartWire-DT devices in TwinCAT

9.3.2.1 Overview

Each SWD device carries an element for configuring certain device options in TwinCAT. With this **Options** element (sub index 21), you can determine for each device individually, whether its presence in the SmartWire-DT network is mandatory or whether it may be substituted by an M22-SWD-NOP universal module.
The preset defaults for all devices are:

- Presence in SmartWire-DT network: **device must be present**

- Replacement/substitution by universal module: **not allowed**

> **Note:**
> If you reconfigure the "presence option" of an individual device in order to allow it to be missing in the SmartWire-DT network, this option will only be effective if the **All Modules Optional** (index 0x2100:08) parameter of the Coordinator is being kept at its default 0x00 setting. This allows you to configure the "presence option" for each device individually in its device options element. See also section *Configuring SmartWire-DT Coordinator* [▶ page 52].

The parameters of the **Options** element (i. e. the device options) are configured by entering a single hexadecimal options byte.
Please note that this byte does not only define the two options mentioned above (i. e. presence in the SWD network and replacement by universal module), but also defines other parameters like e. g. payload formats. The presets of these other parameters may vary from device to device and must not be changed by the user.
Each parameter is represented by a single bit in the options byte, each bit set TRUE has an individual byte value. The assignment of parameters to bits and their byte values are shown in the subsequent table:

Bit	Parameter (function)	Description	Configuration	Byte value	
				Dez	Hex
0	Parameter (Device)	Extended parameters	**FALSE**(0): Device has no extended parameters	0	0x00
		Important: Do not change this parameter!	**TRUE**(1): Device has extended parameters	1	0x01
1	Presence (Coordinator)	Presence in SmartWire-DT network	**FALSE**(0): Device may be absent in current SWD bus configuration	0	0x00
			TRUE(1): Device must be present in current SWD bus configuration (default)	2	0x02
2	CRC8 (Coordinator)	Cyclic input data with CRC8	**FALSE**(0): Device sends its cyclic input data without CRC8	0	0x00
		Important: Do not change this parameter!	**TRUE**(1): Device sends its cyclic input data followed by CRC8	4	0x04
3	Motorola (Coordinator)	Format of payload data words	**FALSE**(0): Device codes/decodes payload data words in its own little-endian format	0	0x00
		Important: Do not change this parameter!	**TRUE**(1): Device codes/decodes payload data words in big-endian format	8	0x08
4	Replacement	Substitution by universal module	**FALSE**(0): Replacement of device by universal module is not allowed (default)	0	0x00
			TRUE(1): Device can be replaced by universal module	16	0x10
5	Reserved	Bit is not used (0)		0	0x00
6	Profile (Device)	Support of data profiles *Important: Do not change this parameter!*	**FALSE**(0): Device does not have different data profiles	0	0x00
			TRUE(1): Device supports different data profiles and requires the Coordinator to set the profile accordingly	64	0x40
7	AcycService (Device)	Support of acyclic data requests	**FALSE**(0): Device does not have acyclic data objects	0	0x00
		Important: Do not change this parameter!	**TRUE**(1): Device supports acyclic read/write requests from Coordinator	128	0x80

Table 19: Bit assignment of parameters of options byte

The logically ORed byte values of the individual bits amount to the value of the options byte. To change an individual parameter, you have to look at the bit representing this parameter. After having set the bit on TRUE in order to activate the corresponding parameter (respectively the desired function), you have to logically OR the new byte value of the changed bit with the byte values of the other TRUE bits. For examples of how to perform such a calculation, see section *Examples of calculating the options byte* [▶ page 62].

The following exemplary step-by-step instructions show how to change the default options of the DIL-SWD-32-001 device, in order to allow the replacement of the device by a universal module.

9.3.2.2   Prerequisites

- PC with installed TwinCAT System Manager V2.11 and Ethernet adapter
- You have created a valid project configuration (see *Configuring gateway in TwinCAT* [▶ page 44]) and have opened the project configuration in the TwinCAT System Manager
- The project features the DIL-SWD-32-001 SmartWire-DT contactor module

9.3.2.3   Step-by-step instructions

➢ In the navigation tree of the TwinCAT System Manager, select the gateway, then open the **Startup** tab in the main window.

↴ The configuration elements are listed in the **Startup** tab:
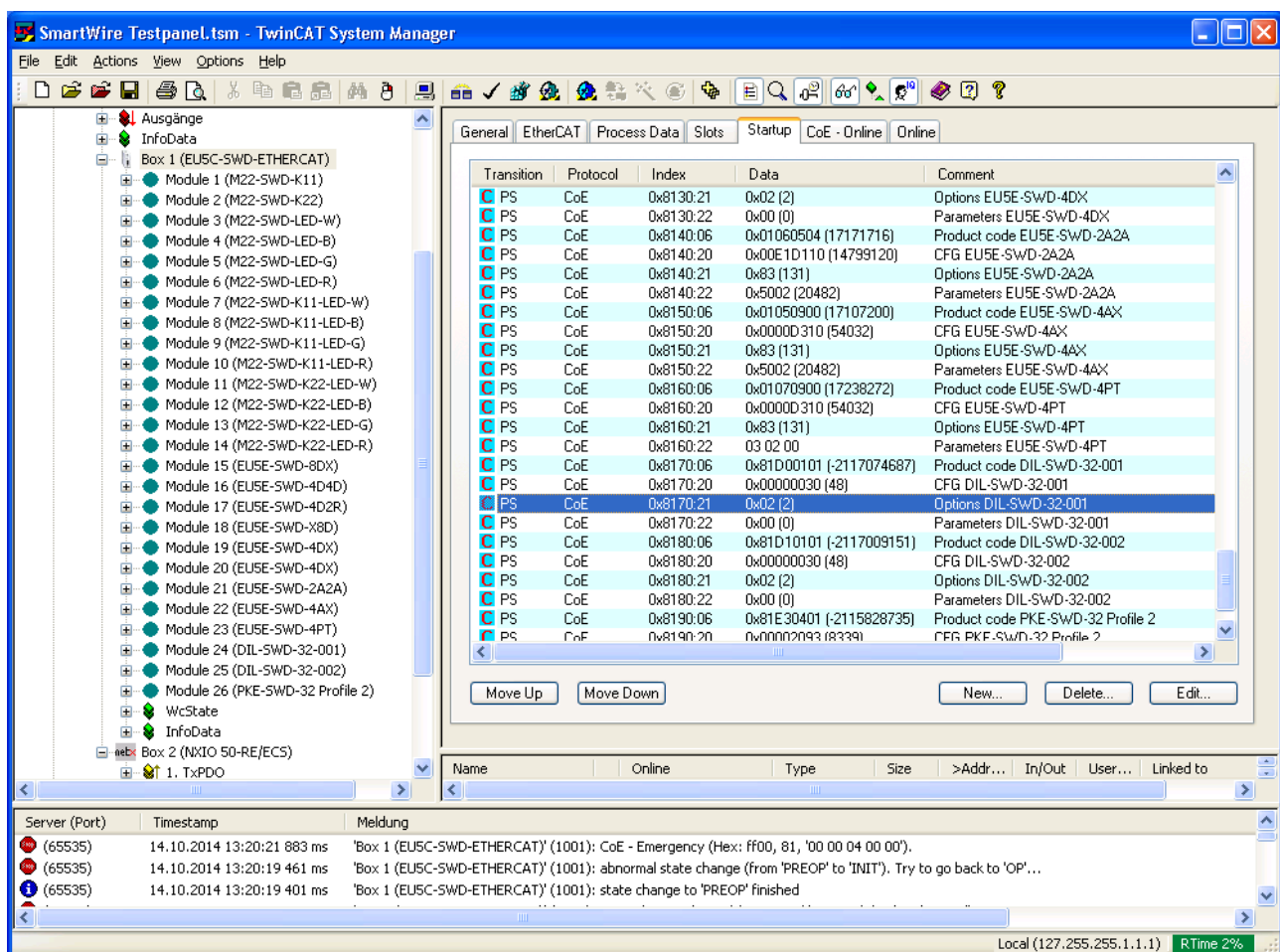
Figure 23: Editing device options of SWD device (1)

➢ Search the list for the SmartWire-DT device and the **Options** element that you want to edit. An **Options** element can be recognized by the index `0x8XXX:21` and the `Options [device name]` entry in the **Comment** column.

➢ Select the **Options** element, then click **Edit** button (or double-click the element).

↳ The **Edit CANopen Startup Entry** dialog window opens. The **Data (hexbin)** field displays the preset hexadecimal value of the options byte. In case of the `DIL-SWD-32-001` device, this is the value `02`:

Figure 24: Editing device options of SWD device (2)

➢ Enter the new hexadecimal value of the options byte into the **Data (hexbin)** field. Omit the `0x` prefix; i. e. enter the value `0x12` simply as string `12`.

→ **Note:**

Individual parameters of the **Options** element (i. e. the device options) can only be configured by entering a single hexadecimal options byte. For changing one or several parameters, you therefore have to recalculate the whole options byte of the device. The outcome of this calculation depends on the parameter bits you have changed and on the default settings of the device.
Entering the value `12` in this example means that the device may in future be replaced by a universal module in the SmartWire-DT network.
For examples of how to calculate the options byte, see section *Examples of calculating the options byte* [▷ page 62].

➢ Take over the new value by clicking the **OK** button.

↳ The **Data** column of the **Startup** tab displays the changed hexadecimal value of the options byte (the corresponding decimal value is displayed in brackets).
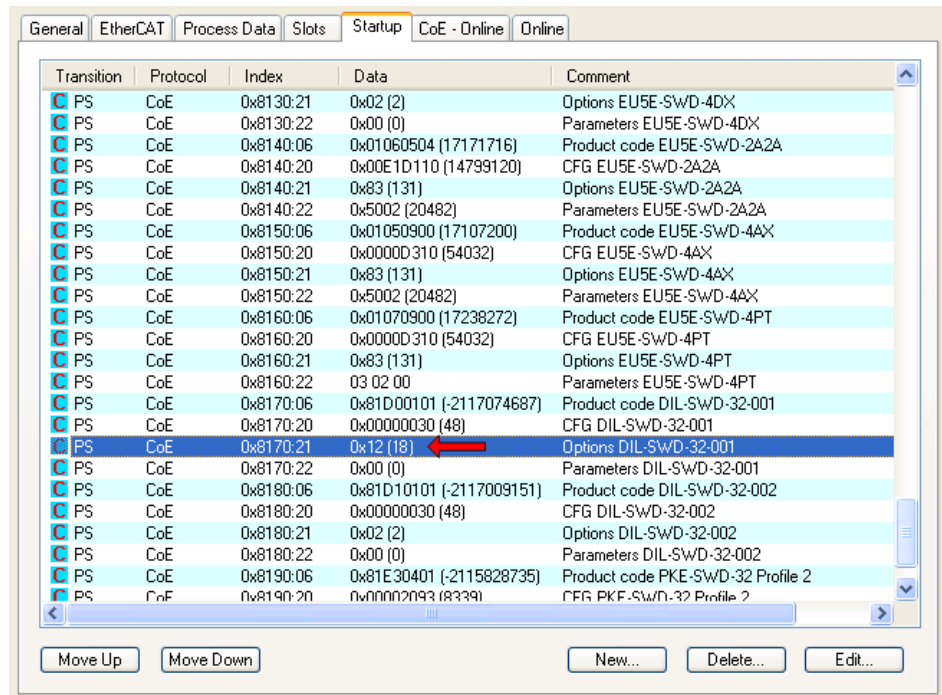
Figure 25: Editing device options of SWD device (3)

➢ In the main menu of the TwinCAT System Manager, choose **Actions** > **Activate Configuration…** to download the changed configuration data.

9.3.2.4 Examples of calculating the options byte

Individual parameters of the **Options** element (i. e. the device options) can only be configured by entering a single hexadecimal options byte.
The logically ORed byte values of the individual bits representing the configuration parameters amount to the value of the options byte.
To change an individual parameter, you have to look at the bit representing this parameter. After having set the bit on TRUE in order to activate the corresponding parameter (respectively the desired function), you have to "logically OR" (i. e. "add up") the new byte value of the changed bit with the byte values of the other TRUE bits. Please note that each active bit (i. e. each bit set TRUE) has a different byte value. The assignment of parameters to bits and their byte values are shown in table *Bit assignment of parameters of options byte* in section *Overview* [▷ page 58]. Because all bits set to FALSE have the byte value 0, you can ignore all FALSE bits in the addition.

Example 1

This example shows how to calculate the default value `0x02` of the options byte of the `DIL-SWD-32-001` SWD device.
The `02` value of the options byte results from the fact that all bits except Bit 1 have been set to FALSE, thus all having the byte value 0; Bit 1 on the other hand has been set to TRUE, thus having the byte value `02`, which after logical ORing amounts to the value `0x02` for the whole options byte:

	Bit 0 (Extended parameters)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 1 (Presence in SmartWire-DT network)	= TRUE(1) =	2 (Dez) =	0x02 (Hex)
+	Bit 2 (Cyclic input data with CRC8)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 3 (Format of payload data words)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 4 (Substitution by universal module)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 5 (reserved)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 6 (Support of data profiles)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
+	Bit 7 (Unterstützung azyklischer Dienste)	= FALSE(0) =	0 (Dez) =	0x00 (Hex)
=	**Options Byte**		**2 (Dez)**	**0x02 (Hex)**

This options byte means for the `DIL-SWD-32-001` device that it must be present in the current bus configuration (Bit 1 = TRUE), but that is has no extended parameters (Bit 0 = FALSE) and does not use CRC8 with its cyclic input data (Bit 2 = FALSE) etc.

If you now want to allow the substitution of the device within the SmartWire-DT bus by an universal module, you have to set Bit 4 to TRUE and then add the newly created byte value (in this case `16 [Dez]` respectively `0x10 [Hex]`) to the other byte values in order to calculate options byte:

	Bit 0 (Extended parameters)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 1 (Presence in SmartWire-DT network)	= TRUE(1) =	2 (Dez)	= 0x02 (Hex)
+	Bit 2 (Cyclic input data with CRC8)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 3 (Format of payload data words)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 4 (Substitution by universal module)	= TRUE(1) =	16 (Dez)	= 0x10 (Hex)
+	Bit 5 (reserved)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 6 (Support of data profiles)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 7 (Support of acyclic data requests)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
=	**Options Byte**		**18 (Dez)**	**= 0x12 (Hex)**

`0x12` thus is the value you have to enter as options byte for the device in TwinCAT, in case you want to allow its replacement by universal module.

Example 2

This example shows how to calculate the default value `0xC2` of the options byte of the `PKE-SWD-32-Profile 2` SWD device:

	Bit 0 (Extended parameters)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 1 (Presence in SmartWire-DT network)	= TRUE(1) =	2 (Dez)	= 0x02 (Hex)
+	Bit 2 (Cyclic input data with CRC8)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 3 (Format of payload data words)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 4 (Substitution by universal module)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 5 (reserved)	= FALSE(0) =	0 (Dez)	= 0x00 (Hex)
+	Bit 6 (Support of data profiles)	= TRUE(1) =	64 (Dez)	= 0x40 (Hex)
+	Bit 7 (Support of acyclic data requests)	= TRUE(1) =	128 (Dez)	= 0x80 (Hex)
=	**Options Byte**		**194 (Dez)**	**= 0xC2 (Hex)**

If you now want to allow the device to be missing within the SmartWire-DT bus and also that it may be replaced by an universal module, you have to set Bit 1 to FALSE and Bit 4 to TRUE. The calculation for this looks as follows:

	Bit 0 (Extended parameters)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 1 (Presence in SmartWire-DT network)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 2 (Cyclic input data with CRC8)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 3 (Format of payload data words)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 4 (Substitution by universal module)	= TRUE(1)	= 16 (Dez)	= 0x10 (Hex)
+	Bit 5 (reserved)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 6 (Support of data profiles)	= TRUE(1)	= 64 (Dez)	= 0x40 (Hex)
+	Bit 7 (Support of acyclic data requests)	= TRUE(1)	= 128 (Dez)	= 0x80 (Hex)
=	**Options Byte**		**208 (Dez)**	**= 0xD0 (Hex)**

`0xD0` thus is the value you have to enter as options byte for the device in TwinCAT.

Hint:
The Windows calculator (if configured accordingly) can be used to display the corresponding bit values of a hexadecimal byte value. Thus you can check, which of the bits are being set to FALSE (0) and which of the bits are being set to TRUE (1) when you enter a certain byte value:
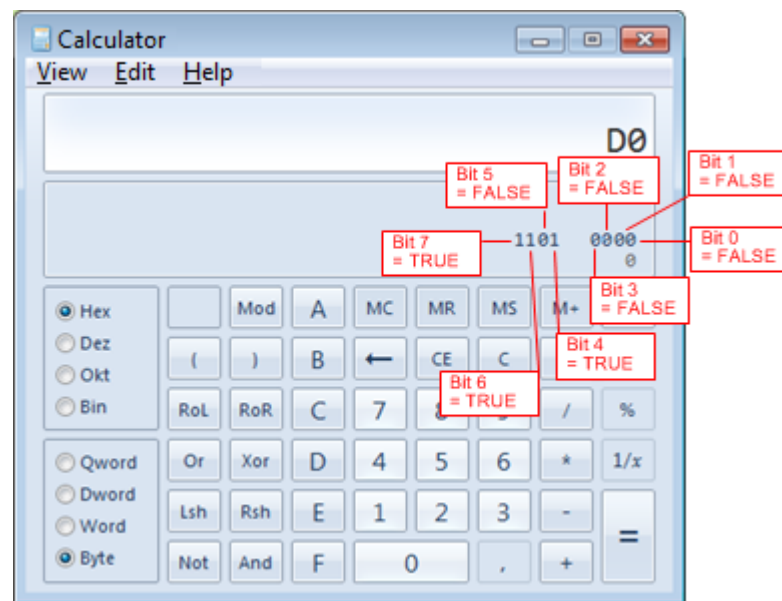
Figure 26: "Programmer" view of Windows 7 calculator

9.3.3   Configuring device parameters (sensor parameters of I/O modules)

9.3.3.1   Overview

For some SmartWire-DT devices, individual device parameters can be configured.

Configurable parameters of the SmartWire-DT devices are described in the manual *SmartWire-DT Modules*, Doc ID MN05006001Z-EN, which is stored on the product DVD in the directory `Documentation\english\3.SmartWire-DT \SmartWire-DT – Units\MN05006001Z_EN.pdf`

This section describes how to configure sensor type, refresh rate and averaging of the inputs/outputs modules **EU5E-SWD-4AX**, **EU5E-SWD-2A2A** and **EU5E-SWD-4PT** by editing their **Parameters** element (sub index `22`) in TwinCAT.
Please note that this section is of exemplary nature. You always have to look up the definite bit assignment of the parameter byte of individual devices in the latest documentation of the device's manufacturer.

The subsequent tables show the bit assignments of the **Parameters** bytes of the SmartWire-DT devices **EU5E-SWD-4AX**, **EU5E-SWD-2A2A** and **EU5E-SWD-4PT**:

EU5E-SWD-4AX

Bit	Parameter (function)	Configuration			Byte value	
					Dez	Hex
0	Sensor selector Input 1	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			1	0x01
1	Sensor selector Input 2	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			2	0x02
2	Sensor selector Input 3	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			4	0x04
3	Sensor selector Input 4	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			8	0x08
4 - 5	Reading refresh rate	**Bit 5**	**Bit 4**	**Milli seconds**		
		FALSE(0)	FALSE(0)	20 ms	0	0x00
		FALSE(0)	TRUE(1)	100 ms (default)	16	0x10
		TRUE(1)	FALSE(0)	200 ms	32	0x20
		TRUE(1)	TRUE(1)	500 ms	48	0x30
6	Mean value (averaging)	FALSE(0): off			0	0x00
		TRUE(1): on (default)			64	0x40
7	Reserved	FALSE(0)			0	0x00

Table 20: Bit assignment of parameter byte of EU5E-SWD-4AX

EU5E-SWD-2A2A

Bit	Parameter (function)	Configuration			Byte value	
					Dez	Hex
0	Sensor selector Input 1	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			1	0x01
1	Sensor selector Input 2	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			2	0x02
2	Actuator selector Output 1	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			4	0x04
3	Actuator selector Output 2	FALSE(0): Voltage (default)			0	0x00
		TRUE(1): Current			8	0x08
4 - 5	Reading refresh rate	**Bit 5**	**Bit 4**	**Milli seconds**		
		FALSE(0)	FALSE(0)	20 ms	0	0x00
		FALSE(0)	TRUE(1)	100 ms (default)	16	0x10
		TRUE(1)	FALSE(0)	200 ms	32	0x20
		TRUE(1)	TRUE(1)	500 ms	48	0x30
6	Mean value (averaging)	FALSE(0): off			0	0x00
		TRUE(1): on (default)			64	0x40
7	Reserved	FALSE(0)			0	0x00

Table 21: Bit assignment of parameter byte of EU5E-SWD-2A2A

EU5E-SWD-4PT

Byte 1:

Bit	Parameter (function)	Configuration			Byte value	
					Dez	Hex
0 - 1	Sensor selection Input 1	**Bit 1**	**Bit 0**	**Sensor type**		
		FALSE(0)	FALSE(0)	Not used (default)	0	0x00
		FALSE(0)	TRUE(1)	PT100	1	0x01
		TRUE(1)	FALSE(0)	PT1000	2	0x02
		TRUE(1)	TRUE(1)	NI1000	3	0x03
2 - 3	Sensor selection Input 2	**Bit 3**	**Bit 2**	**Sensor type**		
		FALSE(0)	FALSE(0)	Not used (default)	0	0x00
		FALSE(0)	TRUE(1)	PT100	4	0x04
		TRUE(1)	FALSE(0)	PT1000	8	0x08
		TRUE(1)	TRUE(1)	NI1000	12	0x0C
4 - 5	Sensor selection Input 3	**Bit 5**	**Bit 4**	**Sensor type**		
		FALSE(0)	FALSE(0)	Not used (default)	0	0x00
		FALSE(0)	TRUE(1)	PT100	16	0x10
		TRUE(1)	FALSE(0)	PT1000	32	0x20
		TRUE(1)	TRUE(1)	NI1000	48	0x30
6 - 7	Sensor selection Input 4	**Bit 7**	**Bit 6**	**Sensor type**		
		FALSE(0)	FALSE(0)	Not used (default)	0	0x00
		FALSE(0)	TRUE(1)	PT100	64	0x40
		TRUE(1)	FALSE(0)	PT1000	128	0x80
		TRUE(1)	TRUE(1)	NI1000	192	0xC0

Table 22: Bit assignment of parameter byte 1 of EU5E-SWD-4PT

Byte 2:

Bit	Parameter (function)	Configuration			Byte value	
					Dez	Hex
0 - 1	Measurement display	**Bit 1**	**Bit 0**	**Unit**		
		FALSE(0)	FALSE(0)	Degrees Celsius (default)	0	0x00
		FALSE(0)	TRUE(1)	Degrees Fahrenheit	1	0x01
		TRUE(1)	FALSE(0)	Binary value	2	0x02
2 - 3	Reading refresh rate	**Bit 3**	**Bit 2**	**Rate**		
		FALSE(0)	FALSE(0)	0.25 s (default)	0	0x00
		FALSE(0)	TRUE(1)	1 s	4	0x04
		TRUE(1)	FALSE(0)	2.5 s	8	0x08
		TRUE(1)	TRUE(1)	10 s	12	0x0C
4	Reserved	FALSE(0)			0	0x00
5	Reserved	FALSE(0)			0	0x00
6	Reserved	FALSE(0)			0	0x00
7	Reserved	FALSE(0)			0	0x00

Table 23: Bit assignment of parameter byte 2 of EU5E-SWD-4PT

The following exemplary step-by-step instructions show how to change the parameter "Reading refresh rate" of the EU5E-SWD-4AX device from 100 ms (default) to 200 ms.

9.3.3.2   Prerequisites

- PC with installed TwinCAT System Manager V2.11 and Ethernet adapter

- You have created a valid project configuration (see section *Configuring gateway in TwinCAT* [▶ page 44]) and have opened the project configuration in the TwinCAT System Manager

- The project features the EU5E-SWD-4AX SmartWire-DT I/O module

9.3.3.3   Step-by-step instructions

➢ In the navigation tree of the TwinCAT System Manager, select the gateway, then open the **Startup** tab in the main window.

↳ The configuration elements are listed in the **Startup** tab.
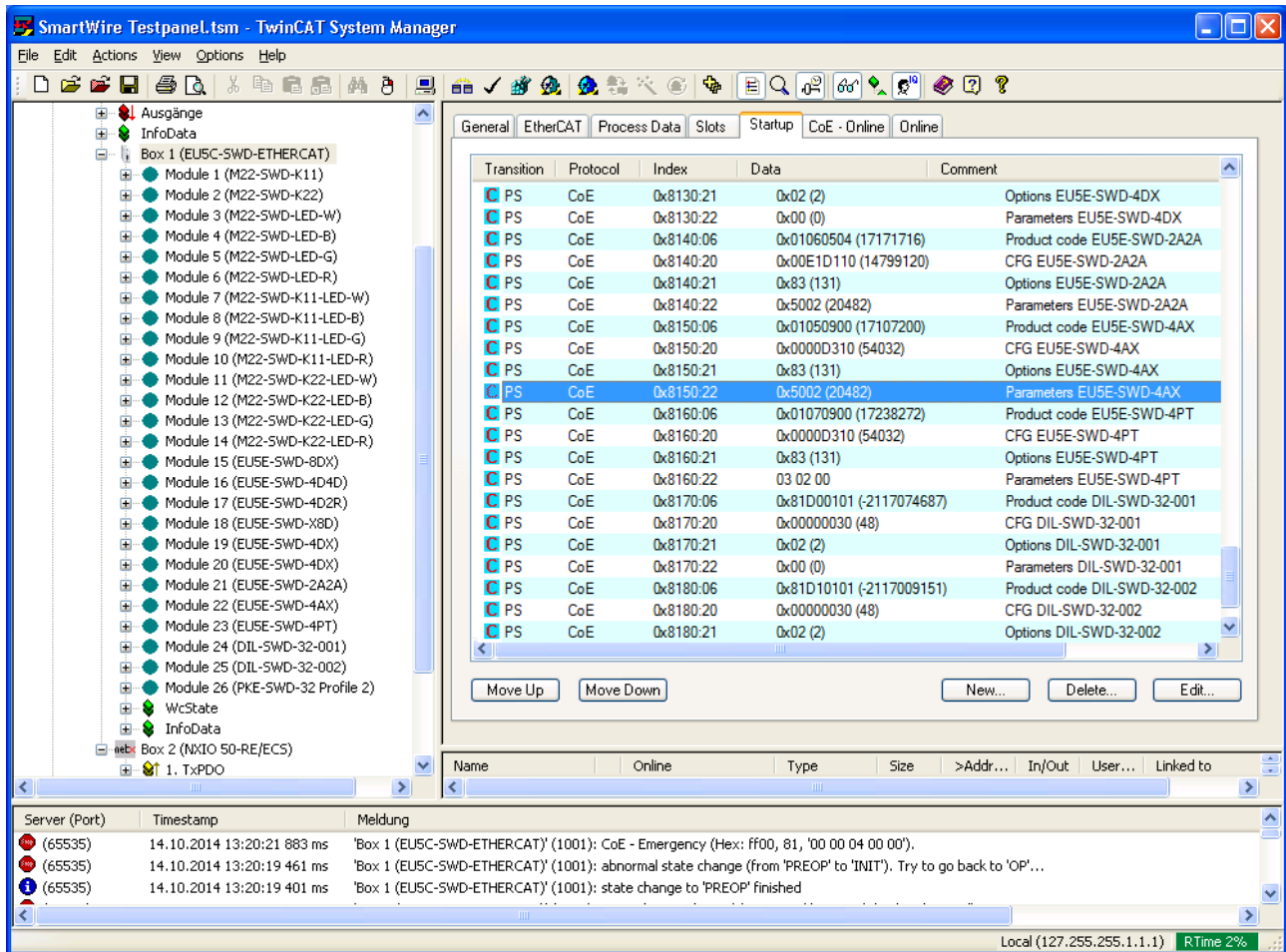
Figure 27: Editing device parameters of SWD device (1)

➢ Search the list for the SmartWire-DT device and the **Parameters** element that you want to edit. An **Parameters** element can be recognized by the index `0x8XXX:22` and the `Parameters [device name]` entry in the **Comment** column.

➢ Select the **Parameters** element, then click **Edit** button (or double-click the element).

↳ The **Edit CANopen Startup Entry** dialog window opens. The **Data (hexbin)** field displays the preset hexadecimal value of the parameter byte. In case of the `EU5E-SWD-4AX` device, this is the value `02 50`:

Figure 28: Editing device parameters of SWD device (2)

Important:

Please note that the first byte in the **Data (hexbin)** field (in this example `02`) is the "length byte" denoting the total number of bytes contained in the Parameters element. This first length byte must not be changed.
In case of the devices `EU5E-SWD-4AX` and `EU5E-SWD-2A2A`, the Parameters element consists of two bytes of which you are allowed to change only the second byte. In case of the `EU5E-SWD-4PT` device, the Parameters element consists of three bytes of which you are allowed to change only the last two bytes.

➢ In the **Data (hexbin)** field, change the value of the second byte. Omit the `0x` prefix; i. e. enter the value `0x60` simply as string `60`.

Note:

The **Parameters** can only be configured by entering hexadecimal byte values. For changing the parameters, you therefore have to recalculate a new byte value. The outcome of this calculation depends on the parameter bits you are changing and on the default settings of the device. Entering the value `60` in this example changes the "Reading refresh rate" of the device from `100 ms` (default) to `200 ms`.
For an example of how to calculate the parameters byte, see section *Example of calculating the parameters byte* [▸ page 70].

➥   Take over the new value by clicking the **OK** button.

↲   The **Data** column of the **Startup** tab displays the changed hexadecimal value of the parameters byte (the corresponding decimal value is displayed in brackets).
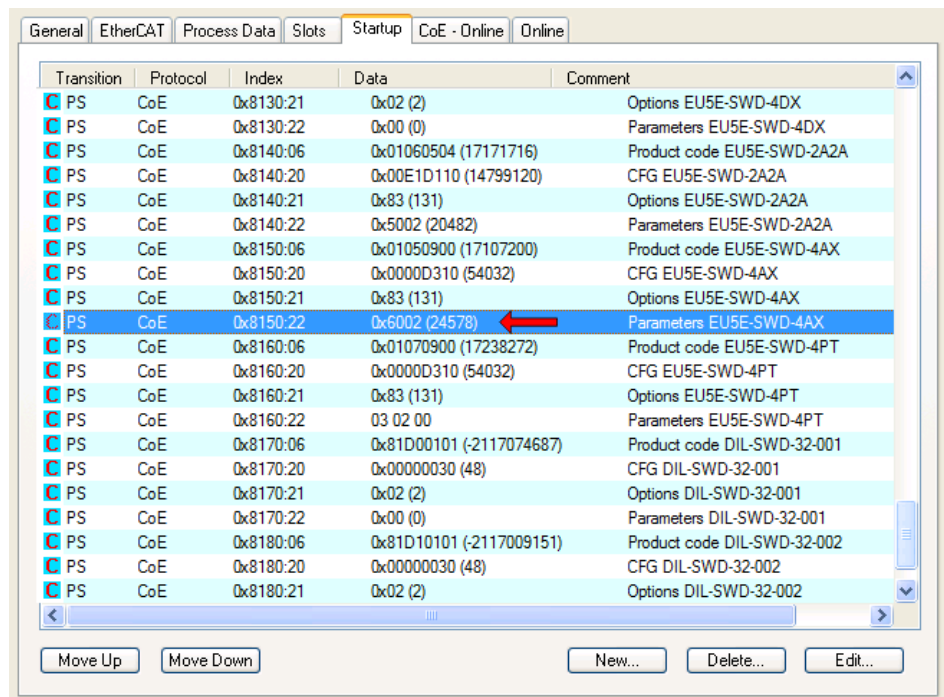
Figure 29: Editing device parameters of SWD device (3)

➥   In the main menu of the TwinCAT System Manager, choose **Actions** > **Activate Configuration…** to download the changed configuration data.

9.3.3.4   Example of calculating the parameters byte

This example shows how to calculate the default value `0x50` of the parameter byte of `the EU5E-SWD-4AX SWD` device:

	Bit 0 (Sensor selector input 1)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 1 (Sensor selector input 2)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 2 (Sensor selector input 3)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 3 (Sensor selector input 4)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 4 (Reading refresh rate)	= TRUE(1)	= 16 (Dez)	= 0x10 (Hex)
+	Bit 5 (Reading refresh rate)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 6 (Mean value/averaging)	= TRUE(1)	= 64 (Dez)	= 0x40 (Hex)
+	Bit 7 (Reserved)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
=	**Parameter Byte**		**80 (Dez)**	**= 0x50 (Hex)**

If you want to change the "Reading refresh rate" of the device from `100 ms` (default) to `200 ms`, you have to set Bit 4 to FALSE and Bit 5 to TRUE (see table *Bit assignment of parameter byte of EU5E-SWD-4AX*):

	Bit 0 (Sensor selector input 1)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 1 (Sensor selector input 2)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 2 (Sensor selector input 3)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 3 (Sensor selector input 4)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 4 (Reading refresh rate)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
+	Bit 5 (Reading refresh rate)	= TRUE(1)	= 32 (Dez)	= 0x20 (Hex)
+	Bit 6 (Mean value/averaging)	= TRUE(1)	= 64 (Dez)	= 0x40 (Hex)
+	Bit 7 (Reserved)	= FALSE(0)	= 0 (Dez)	= 0x00 (Hex)
=	**Parameter Byte**		**96 (Dez)**	**= 0x60 (Hex)**

`0x60` thus is the value you have to enter as parameter byte for the device in TwinCAT.

10 Acyclical communication

10.1 Overview

The EtherCAT® master exchanges acyclic data with individual SmartWire-DT slaves via gateway by using the **index 0x2200**, **sub index 1** object and the **index 0x2200**, **sub index 2** object.

The subsequent section describes a typical acyclic communication process (see also diagram on the following page):

1. The EtherCAT® master sends a task (read or write request) for a SmartWire-DT slave to the **index 0x2200**, **sub index 1** object by using an **SDO Download Request**. The gateway acknowledges the reception of the task by sending back an **SDO Download Confirmation**.

2. The gateway forwards the task to the SWD slave. The SWD slave executes the requested read or write task in the specified SWD Index.

3. While the gateway is waiting for an answer from the SWD slave, the EtherCAT® master regularly queries the state of the task by sending **SDO Upload Requests** to the **index 0x2200**, **sub index 2** object. As long as the gateway has not yet received the answer from the SWD slave (SmartWire DT communication is slower than EtherCAT® communication) the **SDO Upload Confirmation** conveys the **Request State** 1 (= „in progress").
The EtherCAT® master thus has to keep on sending **SDO Upload Requests** to the gateway.

4. The answer from the SWD slave arrives in the gateway, where it is stored in the **index 0x2200**, **sub index 2** object. In case the task has been successfully executed, the **Request State** is set to 2 (= „finished").

5. On the next **SDO Upload Request**, the newly arrived answering data from the SWD slave is being sent from the gateway to the EtherCAT® master in the **SDO Upload Confirmation**. In case of a read request, it contains the data which was read from the SWD Index of the SWD slave. The **Request State** and the **Error Code**, which are also contained in the **SDO Upload Confirmation**, indicate to the master whether the task has been finished successfully or if an error occurred.
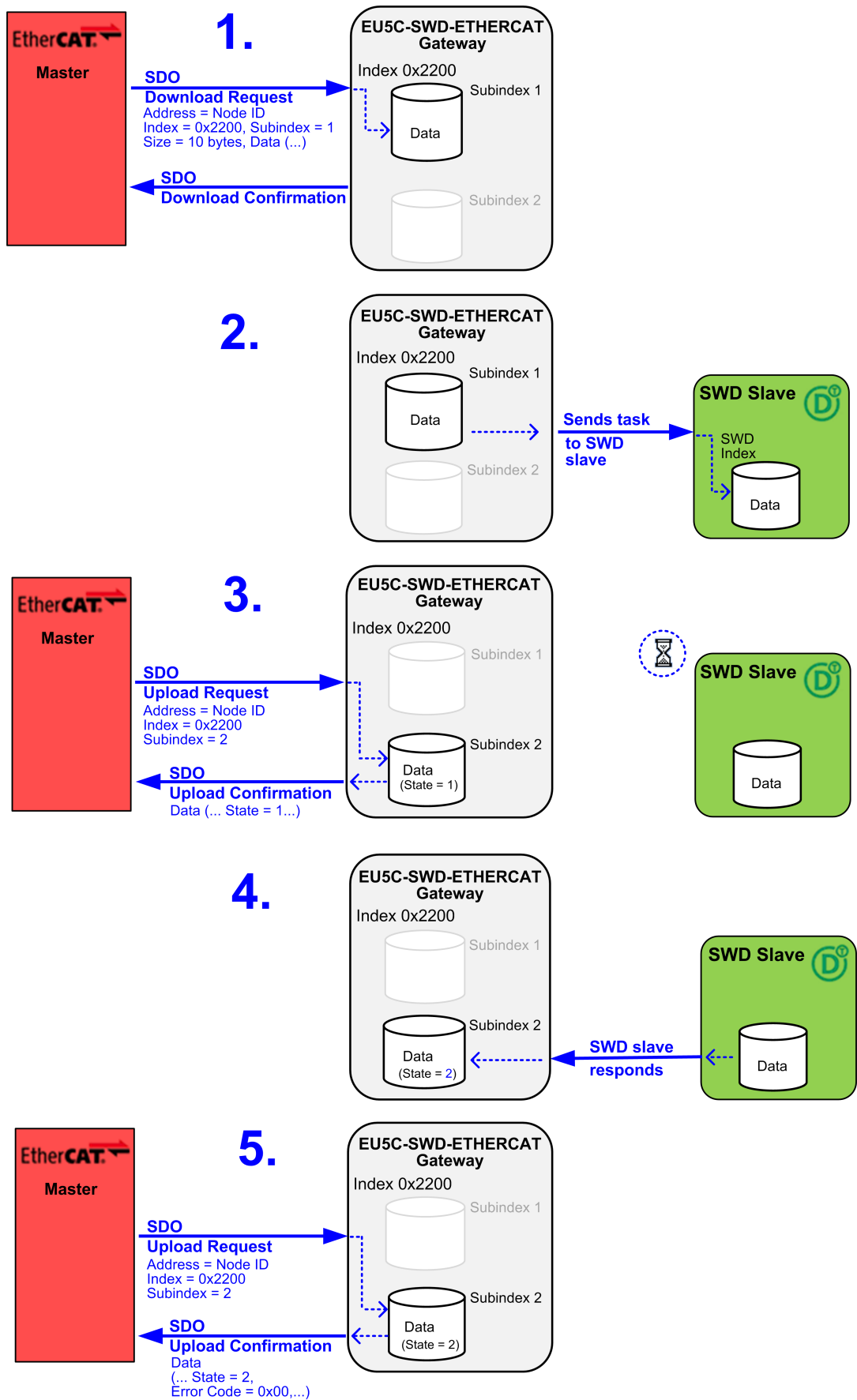
Figure 30: Conducting acyclical communication

10.2 Read request: reading data of an SWD Slave

10.2.1 Activating read request

A reading task (**Read Request**) for a SmartWire-DT slave is conveyed in an **SDO Download Request** from the EtherCAT® master to the **index 0x2200**, **sub index 1** object in the gateway.
The **SDO Download Request** contains the following elements:

Element	Description	Data type	Value / value range
Header			
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Download	uint8	0x01
Size	Amount of data of the SDO Download	-	10 Bytes
Data for SWD slave			
Slave Address	Address of the SWD slave that you want to read (according to project configuration)	uint8	1…99
SWD Index	SWD-specific index of the SWD slave. Determines which kind of data you want to read, e. g. error counter or firmware version.	uint8	0…255
Request Type	Type of request. A read request must have the value 1	uint8	1
Length	Maximum length of the expected response in bytes. Must be at least as long as the SWD object (in bytes).	uint8	1…120
Job ID	Freely selectable value, serves as job identification	uint8	0…255
Reserved Bytes	Five reserved bytes	uint8[5]	0x00, 0x00, 0x00, 0x00, 0x00

Table 24: Elements SDO Download of a read request

The gateway acknowledges the reception of the task by sending back an **SDO Download Confirmation** to the EtherCAT® master. The gateway also forwards the task to the SWD slave, where the reading task is performed in the specified SWD Index. The SWD slave then sends back the answer to the gateway, where it is stored in the **index 0x2200**, **sub index 2** object. The EtherCAT® master can then fetch the answer by sending an **SDO Upload Request**.

10.2.2 Querying the state of the read request

Querying the state of the read request

The **SDO Upload Request** sent by the EtherCAT® master to the gateway contains the following elements:

Element	Description	Data type	Value / value range
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Upload	uint8	0x02

Table 25: Elements of SDO Upload Request for a read request

Answer from the gateway

The **SDO Upload Confirmation** sent by the gateway to the EtherCAT®
master contains the following elements:

Element	Description	Data type	Value / value range
Header			
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Upload	uint8	0x02
Size	Amount of data of the SDO Upload	-	10 Bytes + n *
Data of SWD slave			
Slave Address	Address of the SWD slave of which data has been read.	uint8	1…99
SWD Index	SWD index of the data which has been read, e. g. error counter or firmware version.	uint8	0…255
Request Type	Type of request. A read request has the value 1	uint8	0x01
Length	Length of the received response (payload data) in bytes	uint8	1…120
Job ID	Freely selectable value, serves as job identification	uint8	0…255
State	State of the response	uint8	Idle = 0 In Progress = 1 Finished = 2 Error = 3
Error Code	Error detected by the gateway	uint32	No error = 0x00000000 JOBID_BUFFER_FULL = 0xC0AD0002 JOB_DENIED = 0xC0AD0003 NOT_AVAILABLE = 0xC0AD0004
Data	Payload data which has been read according to SWD Index, e. g. error counter or firmware version.	uint8 [n-1] *	(…)
		* n = amount of read bytes	

Table 26: Elements of SDO Upload Confirmation for a read request

Note:
If no answer from the SWD slave has yet arrived at the gateway,
the **State** element (state of the response) has the value 1 (= „in
progress") and the **Data** element (payload data) is omitted.

10.2.3 Example of a read request

10.2.3.1 Activating read request

In case the EtherCAT® master wants to read the error counter (SWD Index 127) of the 5th SmartWire-DT slave (slave address 5), and the expected response should be no longer than 120 Bytes, the **SDO Download Request** sent to the gateway looks as follows (gateway has Node ID 3 in this example):

Syntax									
Header				**Data**					
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	Reserved Bytes
0x03	0x2200	0x01	0xA	0x05	0x7F	0x01	0x78	0x01	0x00, 0x00, 0x00, 0x00, 0x00

Table 27: Example SDO Download Request for a read request

10.2.3.2 Querying the state of the read request

Querying the state of the read request

The **SDO Upload Request** sent by the EtherCAT® master to the gateway looks as follows:

Syntax		
Address	Object index	Sub index
0x03	0x2200	0x02

Table 28: Example SDO Upload Request for a read request

Answer of the gateway in case of an unfinished read request

If the gateway has not yet received the answer from the SWD slave, the **SDO Upload Confirmation** sent by the gateway to the EtherCAT® master looks as follows:

Syntax										
Header				**Data**						
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	State	Error Code
0x03	0x2200	0x02	0xA	0x05	0x7F	0x01	0x00	0x01	0x01	0x00000000

Table 29: Example SDO Upload Confirmation for an unfinished read request

Answer of the gateway in case of a finished read request

If the answer from the SWD slave has arrived, the **SDO Upload Confirmation** sent by the gateway to the EtherCAT® master looks as follows:

Syntax											
Header				**Data**							
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	State	Error Code	Data
0x03	0x2200	0x02	0x82	0x05	0x7F	0x01	0x78	0x01	0x02	0x0000 0000	(…)

Table 30: Example SDO Upload Confirmation for a finished read request

10.3 Write request: writing data in an SWD Slave

10.3.1 Activating write request

A writing task (**Write Request**) for a SmartWire-DT slave is conveyed in an **SDO Download Request** from the EtherCAT® master to the **index 0x2200**, **sub index 1** object in the gateway.
The **SDO Download Request** contains the following elements:

Element	Description	Data type	Value / value range
Header			
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Download	uint8	0x01
Size	Amount of data of the SDO Download	-	10 Bytes + n *
Data for SWD slave			
Slave Address	Address of the SWD slave that you want to read (according to project configuration)	uint8	1…99
SWD Index	SWD-specific index of the SWD slave. Determines where to write the data to.	uint8	0…255
Request Type	Type of request. A write request must have the value 2	uint8	2
Length	Length of the data (in bytes) to be written.	uint8	1…120
Job ID	Freely selectable value, serves as job identification	uint8	0…255
Reserved Bytes	Five reserved bytes	uint8[5]	0x00, 0x00, 0x00, 0x00, 0x00
Data	Data to be written (payload data)	uint8[n-1] *	(...)
			* n = amount of bytes to be written

Table 31: Elements SDO Download of a write request

The gateway acknowledges the reception of the task by sending back an **SDO Download Confirmation** to the EtherCAT® master. The gateway also forwards the write request to the SWD slave, where the writing is performed in the specified SWD Index. The SWD slave then sends back an acknowledgement to the gateway, where it is stored in the **index 0x2200**, **sub index 2** object. The EtherCAT® master can then fetch the acknowledgement from there by sending an **SDO Upload Request**.

10.3.2 Querying the state of the write request

Querying the state of the write request

The **SDO Upload Request** sent by the EtherCAT® master to the gateway contains the following elements:

Element	Description	Data type	Value / value range
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Upload	uint8	0x02

Table 32: Elements of SDO Upload Request for a write request

Answer from the gateway

The **SDO Upload Confirmation** sent by the gateway to the EtherCAT® master contains the following elements:

Element	Description	Data type	Value / value range
Header			
Address	Node ID of the gateway (according to project configuration)	uint16	0…65535
Index	Object index for acyclical communication	uint16	0x2200
Sub index	Index for SDO Upload	uint8	0x02
Size	Amount of data of the SDO Upload	-	10 Bytes
Data of SWD slave			
Slave Address	Address of the SWD slave of which data has been read.	uint8	1…99
SWD Index	SWD index into which the data was written	uint8	0…255
Request Type	Type of request. A write request has the value 2	uint8	0x02
Length	Length of the written data in bytes	uint8	1…120
Job ID	Freely selectable value, serves as job identification	uint8	0…255
State	State of the response	uint8	Idle = 0 In Progress = 1 Finished = 2 Error = 3
Error Code	Error detected by the gateway	uint32	No error = 0x00000000 JOBID_BUFFER_FULL = 0xC0AD0002 JOB_DENIED = 0xC0AD0003 NOT_AVAILABLE = 0xC0AD0004

Table 33: Elements of SDO Upload Confirmation for a write request

> **Note:**
> If no acknowledgement from the SWD slave has yet arrived at the gateway, the **State** element (state of the response) has the value 1 (= „in progress").

10.3.3   Example of a write request

10.3.3.1   Activating read request

In case the EtherCAT® master wants to reset the error counter (SWD Index 127) of the 5th SmartWire-DT slave (slave address 5) to zero (i. e. Data = 0), the **SDO Download Request** sent to the gateway looks as follows (gateway has Node ID 3 in this example):

Syntax										
Header				**Data**						
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	Reserved Bytes	Data
0x03	0x2200	0x01	0xB	0x05	0x7F	0x02	0x01	0x01	0x00, 0x00, 0x00, 0x00,0x00	0x00

Table 34: Example SDO Download Request for a write request

10.3.3.2   Querying the state of the write request

Querying the state of the write request

The **SDO Upload Request** sent by the EtherCAT® master to the gateway looks as follows:

Syntax		
Address	Object index	Sub index
0x03	0x2200	0x02

Table 35: Example SDO Upload Request for a write request

Answer of the gateway in case of an unfinished write request

If the gateway has not yet received the acknowledgement from the SWD slave, the **SDO Upload Confirmation** sent by the gateway to the EtherCAT® master looks as follows:

Syntax										
Header				**Data**						
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	State	Error Code
0x03	0x2200	0x02	0xA	0x05	0x7F	0x02	0x01	0x01	0x01	0x00000000

Table 36: Example SDO Upload Confirmation for an unfinished write request

Answer of the gateway in case of a finished write request

If the acknowledgement from the SWD slave has arrived, the **SDO Upload Confirmation** sent by the gateway to the EtherCAT® master looks as follows:

Syntax										
Header				**Auftragsdaten**						
Address	Object index	Sub index	Size	Slave Address	SWD Index	Request Type	Length	Job ID	State	Error Code
0x03	0x2200	0x02	0xA	0x05	0x7F	0x02	0x01	0x01	0x02	0x00000000

Table 37: Example SDO Upload Confirmation for a finished write request

10.4   Emergency telegrams: Error and status messages (diagnosis)

10.4.1   Overview

The gateway reports changes concerning the state of the gateway or the state of the SmartWire-DT network by means of an Emergency Telegram. Errors occurring in individual SWD slaves are also reported to the EtherCAT master by the gateway by means of an Emergency Telegram. In cases of messages concerning the state of the gateway or the SWD network, the Emergency Telegram generated by the gateway begins with the **Entry Type** (byte 0) = 0xFF. In cases of error messages concerning individual SWD slaves, the Emergency Telegram begins with the **Entry Type** (byte 0) = 0x70. Resolved errors are also reported by the gateway to the EtherCAT master by means of an Emergency Telegram. For these "error reset" messages, the telegram starts with the **Entry Type** (byte 0) = 0x00.

The gateway stores each error message in its message buffer, from where it is deleted only after the corresponding error has been resolved (Error Reset). Whether further error messages still exist in the error buffer or not, is signaled to the EtherCAT master in each Emergency Telegram by a flag in Bit 0 of the **Error Type** (Byte 2) field.
An Emergency-Telegram consists of eight bytes and has the following structure:

Error Code		Error Register	Additional Information				
Entry Type	**Address**	**Error Type**	**Diagnosis Code**	**Error Flags**			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
May contain one of the following three message types: 0xFF message generated by the gateway about SWD errors or status changes. 0x70 error of an individual SWD slave. 0x00 resolved error (error reset).	ID of the concerned device: 0x00 Gateway (SWD master) 0x01... 0x63 SWD slave	The first bit (**bit 0**) indicates whether the message buffer still contains error or status messages: **Bit 0** = 0 no further messages **Bit 0** = 1 buffer contains at least one more message **Note**: **Bit 1** to **7** are reserved.	In case of **Entry Type** (Byte 0) = 0x70 (error of individual SWD slave), this byte features a diagnostic code specifying the nature of the error. For details see section *Error messages (diagnosis) of individual SWD slaves (Entry Type = 0x70)* [▸ page 81] In case of **Entry Type** (Byte 0) = 0xFF (SWD network error/status change message issued by the gateway), this byte is not used (= 0x00). The nature of the SWD network error/status message is then specified in the **Error Flags** (bytes 4 to 7), not in the diagnosis code. In case of an **Entry Type** (byte 0) = 0x00(resolved error/error reset), this byte specifies the error of the individual slave that has been resolved.	In case of **Entry Type** (Byte 0) = 0xFF (SWD network error/status change message issued by the gateway), these bytes feature error flags specifying the nature of the error/status change. For details see section *Messages generated by the gateway (Entry Type = 0xFF)* [▸ page 83]. In case of **Entry Type** (Byte 0) = 0x70 (error of individual SWD slave), these bytes are not used (= 0x00). In case of **Entry Type** (byte 0) = 0x00 (resolved error/error reset), these bytes specify the nature of the SWD network error that has been resolved.			

Table 38: Structure of Emergency Telegram

10.4.2   Error messages (diagnosis) of individual SWD slaves (Entry Type = 0x70)

In case of error/diagnosis messages issued by individual SmartWire-DT devices, the Emergency Telegram which the gateway sends to the EtherCAT master always begins with **Entry Type** (byte 0) = 0x70, thus signaling to the EtherCAT master the occurrence a newly detected ("incoming") error/diagnosis from an individual SmartWire-DT device. In cases of messages about resolved errors (error reset), the Emergency Telegram begins with **Entry Type** (byte 0) = 0x00.

The SWD device reporting the error can be the gateway itself (in its role as SWD master) or one of the 99 SWD slave devices. The ID of the concerned SWD device is indicated in the **Address** field (byte 1) of the Emergency Telegram. The address value 0x00 represents the gateway itself, values 0x01 to 0x63 represent the consecutively numbered SWD slaves from device 1 to device 99.

The nature of the error is indicated in the **Diagnosis Code** field (byte 3) of the Emergency Telegram (the **Error Flag** fields [bytes 4 to 7] are not used here). Note that the diagnostic codes are defined by the manufacturers of the individual SWD devices and can therefore differ from device to device. For the EU5C-SWD-ETHERCAT gateway, there is currently only one code defined:

Diagnosis Code	Meaning	Used by
0xF3	Project configuration does not comply with target configuration.	EU5C-SWD-ETHERCAT gateway

Table 39: Diagnosis Code of gateway

The diagnosis codes of individual SmartWire-DT slaves can be looked-up in the user manual of the corresponding device (for devices manufactured by Eaton, for example, this would be the manual *SmartWire-DT modules*, MN05006001Z-EN). The subsequent table provides some examples of diagnostic codes of SmartWire-DT slave devices:

Diagnosis Code	Meaning	Used by
0x00	No diagnostic message active	All devices that support the extended diagnosis
0x10	Contact in middle position	RMQ
0x11	Contact short-circuit	RMQ
0x13	Output overload	I/O module

Table 40: Examples of diagnostic codes of SWD slaves

Example: Emergency Telegram for new ("incoming") error/diagnosis of SWD device

If an I/O module placed on position 5 within the SmartWire-DT network (i. e. **Address** = 0x05) detects an output overload, (i. e. **Diagnosis Code** = 0x13), the telegram looks as follows:

Error Code		Error Register								Additional Information				
Entry Type	**Address**	**Error Type**								**Diagnosis Code**	**Error Flags**			
Byte 0	Byte 1	Byte 2								Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Bit 0	reserved											
			Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7					
0x70	0x05	1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0x13	0x00	0x00	0x00	0x00

Table 41: Emergency Telegram for new ("incoming") error/diagnosis of SWD device

Example: Emergency Telegram for resolved error/diagnosis of an SWD device (Error Reset)

If the same I/O module reports that the output is not overloaded any longer (output overload error has been reset), and there are no further error/diagnosis messages stored in the message buffer of the gateway, the telegram looks as follows:

Error Code		Error Register								Additional Information				
Entry Type	**Address**	**Error Type**								**Diagnosis Code**	**Error Flags**			
Byte 0	Byte 1	Byte 2								Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Bit 0	reserved											
			Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7					
0x00	0x05	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0x13	0x00	0x00	0x00	0x00

Table 42: Emergency Telegram in case of a resolved error

> **Note:**
> If an error has been resolved, but the message buffer of the gateway is still holding at least one further unresolved error/diagnosis issue, the gateway indicates the fact that there still are pending error issues by setting **bit 0** of the **Error Type** field (byte 2) = 1.

10.4.3 Messages generated by the gateway (Entry Type = 0xFF)

In case of messages issued by the gateway concerning errors or status changes of the SmartWire-DT network, the Emergency Telegram begins with **Entry Type** (byte 0) = `0xFF`. In case of messages about resolved errors (Error Reset), the Emergency Telegram begins with **Entry Type** (byte 0) = `0x00`.

If the error on the SWD bus is related to an individual SWD slave (e. g. a mandatory SWD device is missing), the **Address** field (byte 1) of the Emergency Telegram indicates the ID of the concerned slave device.

The nature of the error/status change is specified in the **Error Flags** (bytes 4 to 7) of the Emergency Telegram (the **Diagnosis Code** field [byte 3] is not used here). The following **Error Flags** are currently defined:

Byte		Hex	Relevance	Meaning
4	-	-	-	Currently not used
5	0	0x01	-	-
	1	0x02	-	-
	2	0x04	Info	SWD: Checking project configuration
	3	0x08	-	-
	4	0x10	Info	SWD: Extended diagnosis of a device is present
	5	0x20	-	-
	6	0x40	-	-
	7	0x80	-	-
6	0	0x01	Error	SWD: Mandatory SmartWire-DT device is missing
	1	0x02	Warning	SWD: Optional SmartWire-DT device is missing
	2	0x04	-	-
	3	0x08	-	-
	4	0x10	-	-
	5	0x20	Error	SWD: No valid project configuration
	6	0x40	-	-
	7	0x80	-	-
7	0	0x01	Error	SWD: Short circuit in the 15V voltage supply of the SmartWire-DT bus
	1	0x02	Error	SWD: Internal error of the SmartWire-DT coordinator
	2	0x04	Info	SWD: At least one SmartWire-DT device sends basic diagnosis
	3	0x08	Error	SWD: No SmartWire-DT device detected
	4	0x10	Info	SWD: Using compatible devices is allowed
	5	0x20	Info	SWD: All devices are registered as „optional"
	6	0x40	Info	SWD: Comparison of project configuration with target configuration disabled
	7	0x80	-	-

Table 43: Error Flags in case of messages generated by the gateway

Example: Emergency Telegram for new ("incoming") error/diagnosis of SWD bus

If a mandatory SmartWire-DT slave (in this example slave device No. 5) is missing, the Emergency Telegram reporting this bus error looks as follows:

Error Code		Error Register								Additional Information				
Entry Type	Address	Error Type								Diagnosis Code	Error Flags			
Byte 0	Byte 1	Byte 2								Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Bit 0	reserved											
			Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7					
0xFF	0x05	1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0x00	0x00	0x00	0x01	0x00

Table 44: Emergency Telegram for incoming error on SWD bus

Example: Emergency Telegram for resolved SWD bus error (Error Reset)

If the gateway reports, that the mandatory SmartWire-DT slave is not missing any longer (i. e. device has returned on the bus), and there are no further error/diagnosis messages stored in the message buffer of the gateway, the telegram looks as follows:

Error Code		Error Register								Additional Information				
Entry Type	Address	Error Type								Diagnosis Code	Error Flags			
Byte 0	Byte 1	Byte 2								Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
		Bit 0	reserved											
			Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7					
0x00	0x05	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0x00	0x00	0x00	0x01	0x00

Table 45: Emergency Telegram in case of resolved SWD bus error

> **Note:**
>
> If an error has been resolved, but the message buffer of the gateway is still holding at least one other unresolved error/diagnosis issue, the gateway indicates this in the telegram by setting **Bit 0** of the **Error Type** field (byte 2) = 1.

11 Updating firmware with TwinCAT System Manager

11.1 Overview

The EU5C-SWD-ETHERCAT Gateway is shipped with its most recent firmware already loaded. The version of the loaded firmware is stated on the device type label. When you perform a firmware update, the old firmware file in the gateway will automatically be overwritten. The project configuration and the target configuration in the gateway remain untouched by the firmware update.

This section describes how to update the firmware of the EU5C-SWD-ETHERCAT gateways by using the TwinCAT System Manager V2.11.

NOTICE

Hazard of device damage by disruption of voltage supply during firmware update!

Do not interrupt the voltage supply while updating the firmware of the gateway. Power failure during a writing process within the file system can cause severe malfunctioning of the device.

Note:

In case of a missing or defective firmware (which is indicated by a green **POW** LED), the "regular" firmware update process described in this chapter is not working. In this case, proceed as described in chapter *Firmware recovery via HTTP* [▶ page 88].

11.2 Prerequisites

- The gateway is connected to a SmartWire-DT network
- The gateway contains a SmartWire-DT configuration
- PC with installed TwinCAT System Manager V2.11 and Ethernet adapter
- The Ethernet adapter of the PC is connected to the gateway via EtherCAT® network
- You have access to the new firmware file which you want to download to the EU5C-SWD-ETHERCAT gateway

11.3 Step-by-step instructions

➢ Open your EU5C-SWD-ETHERCAT project in the TwinCAT System Manager or create a new project as described in section *Configuring gateway in TwinCAT* [▶ page 44].

➢ Select the gateway in the navigation tree of the TwinCAT System Manager, then open the **Online** tab in the main window.
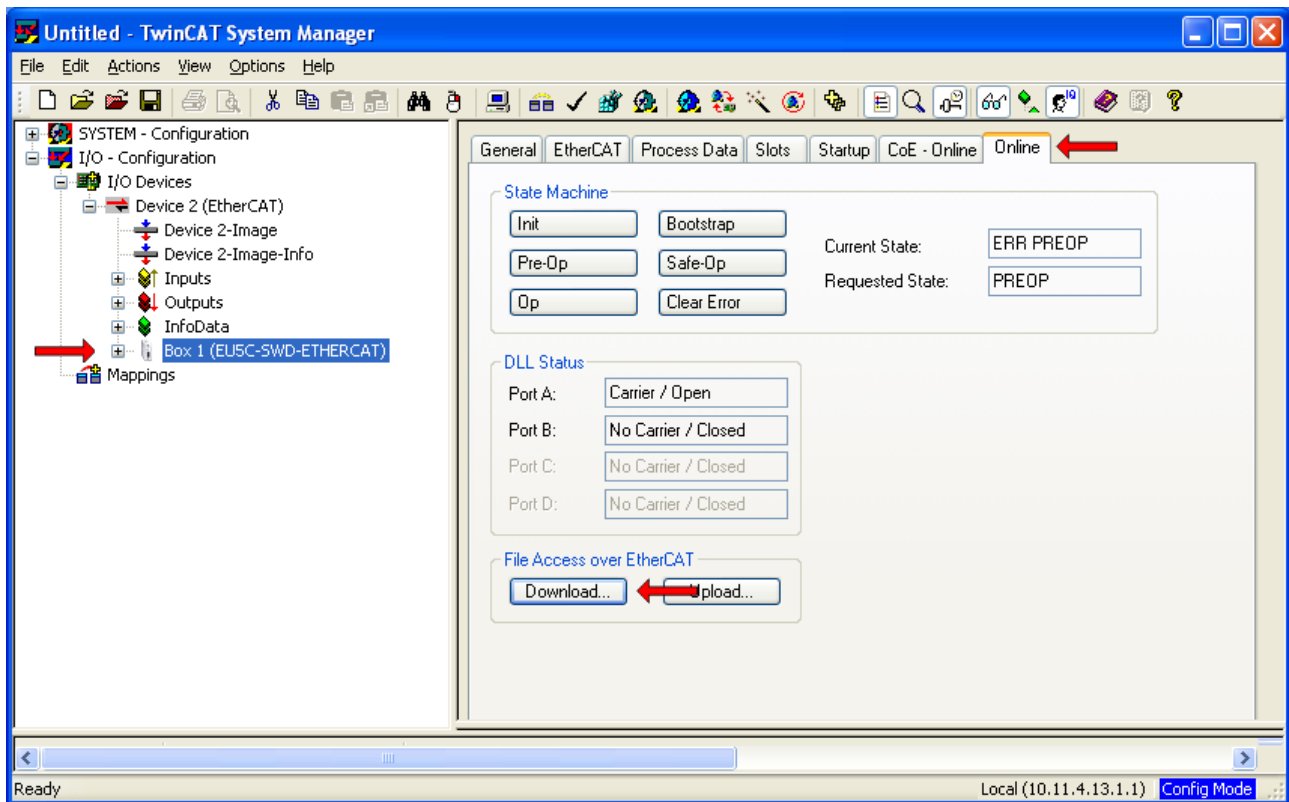
Figure 31: "Online" tab

➢ In the **File Access over EtherCAT** area of the **Online** tab, click **Download...** button.

🖔 The Windows file the selection dialog window opens:
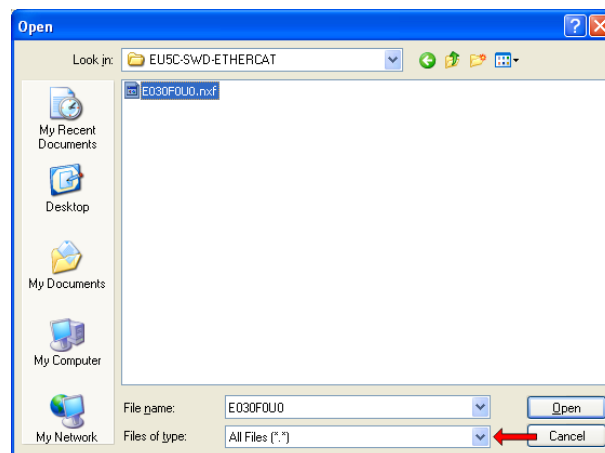
Figure 32: Select Firmware

➢ In the **Files of type** drop-down list, select **All Files (*.*)**, then navigate to the directory where the firmware intended for download is stored.

➢ Select **E030F0U0.nxf** file, then click **Open** button.

✎ The **Edit FoE Name** dialog window opens:

Edit FoE Name

String:	E030F0U0	OK
Hex:	45 30 33 30 46 30 55 30	Cancel
Length:	8	
Password (hex):	00000000	
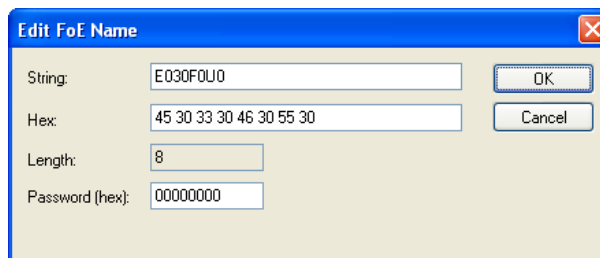
Figure 33: Edit firmware name (1)

➢ In the **String** field, add the file name extension `.nxf`

Important:

You must enter the file name extension `.nxf` here, otherwise the gateway will not accept the file ("nxf" stands for "netX firmware"). Take care to also enter the dot between name and extension !

Edit FoE Name

String:	E030F0U0.nxf ←	OK
Hex:	45 30 33 30 46 30 55 30 2E 6E 78 66	Cancel
Length:	12	
Password (hex):	00000000	
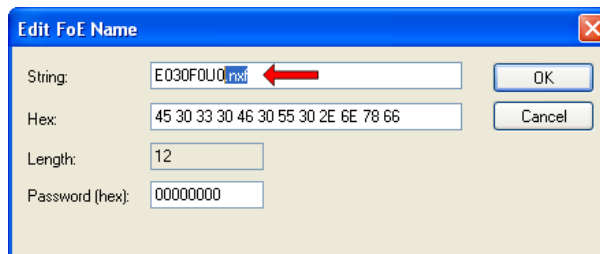
Figure 34: Edit firmware name (2)

➢ Click **OK** button.

✎ The download of the firmware is started. The download process can take several minutes. The progress of the download is indicated by a progress bar in the footer of the TwinCAT System Manager.

NOTICE

Hazard of device damage by disruption of voltage supply during firmware update!

Do not interrupt the voltage supply while downloading the firmware of the gateway. Power failure during a writing process within the file system can cause severe malfunctioning of the device.

➢ Wait until the download has been completed, then reset the gateway (i. e. briefly disconnect the gateway from the voltage supply) in order to start the new firmware.

12 Firmware recovery via HTTP

12.1 Overview

If the **POW** system status LED of the gateway shows steady green light, the "regular" firmware of the gateway is defective or missing (for the position of the **POW** LED see section *Positions of the LEDs* [▶ page 27]).

In this case only the so-called "backup firmware" is running and the device is not able to perform its normal gateway functions. This state can be resolved by downloading a fresh (i. e. uncorrupted) firmware file into the gateway via HTTP protocol. The backup firmware (which is part of the boot strap loader running in the gateway) carries a "web server" functionality for downloading a firmware file comfortably via its Ethernet interface.

For this, you just have to connect the gateway via its Ethernet interface to an active DHCP server and a configuration PC. The purpose of the DHCP server is to assign an IP address to the gateway. This assigned IP address can then be used by the configuration PC to connect to the download function of the backup firmware running in the gateway, in order to download the new firmware file via ordinary web browser.
If you do not know the exact IP address assigned to the gateway by the DHCP server, you can use the Hilscher **Ethernet Device Configuration** Tool on your configuration PC (included on the product DVD) in order to "read out" the newly assigned IP address from the gateway. (The tool uses the netIDENT protocol to search for all Hilscher devices within the connected IP network, and then lists all found devices and their IP addresses.)

> **Note:**
> This chapter describes only how to download the recovery firmware. Instructions on how to configure and operate a DHCP server are not subject of this manual. For information on using a DHCP server, please consult your local network administrator.

12.2 Prerequisites

- The gateway is supplied with voltage and the backup firmware inside the device is running (this is indicated by steady green light at the **POW** LED)
- The gateway **is disconnected** from the EtherCAT® network
- The gateway is connected to an active DHCP server via local Ethernet network
- The gateway is connected via local Ethernet network to a configuration PC with installed standard web browser
- You have access to the firmware file which you want to download to the gateway (the firmware file is stored on the **SmartWire-DT Gateway Solutions** product DVD in the `Firmware\EU5C-SWD-ETHERCAT \Vx.x.x.x` folder).

- You know the IP address, which the DHCP server has assigned to the gateway. If not, install the Hilscher **Ethernet Device Configuration Tool** on your configuration PC. This tool allows you to check the current IP address of the gateway (if the configuration PC and the gateway are connected to the same local Ethernet network). An installer for this program can be found on the product DVD in the `Software \EnDeviceCfg` folder (the program can also be installed by using the menu of the product DVD.)

12.3 Step-by-step instructions

1. Use DHCP server to assign IP address to gateway.

   ➢ Disconnect the gateway from the voltage supply.

   ➢ Plug a cable connected to the local Ethernet network (in which a DHCP server is active) into one of the Ethernet RJ45 sockets (labeled **LAN1-IN** or **LAN2-OUT**) on the front side of the gateway.

   ➢ Reconnect the gateway to the voltage supply.

   > **Note:**
   > The **L/A** LINK/Activity LEDs of the Ethernet RJ45 sockets remain dark when an Ethernet cable is plugged-in while the backup firmware is running – even if a successful IP communication with an local Ethernet network has been established.

   � The backup firmware running in the device now sends a so-called *DHCPDISCOVER message broadcast* into the Ethernet network, requesting an IP address from a DHCP server. If a DHCP service is available in the network, the gateway should be receiving a valid IP address from the server within a few seconds.

2. Check IP address.

   ➢ In the Windows Start menu of your configuration PC, select **All Programs** > **Hilscher GmbH** > **Ethernet Device Configuration**, to start the *Ethernet Device Configuration Tool*.

   ➢ The **Ethernet Device Configuration** tool opens:
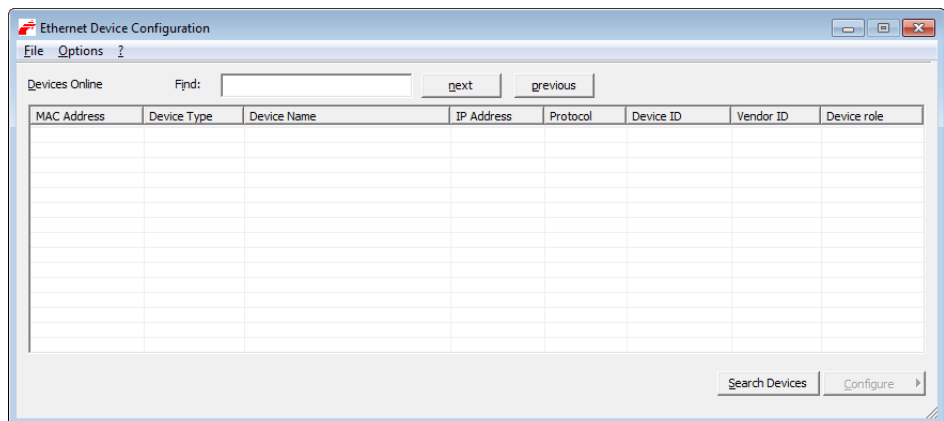
Figure 35: Ethernet Device Configuration Tool

   ➢ Click **Search Devices** button, to start searching for the gateway within the local Ethernet network.

➪ The tool starts scanning for devices and lists all found Hilscher devices and their IP addresses:
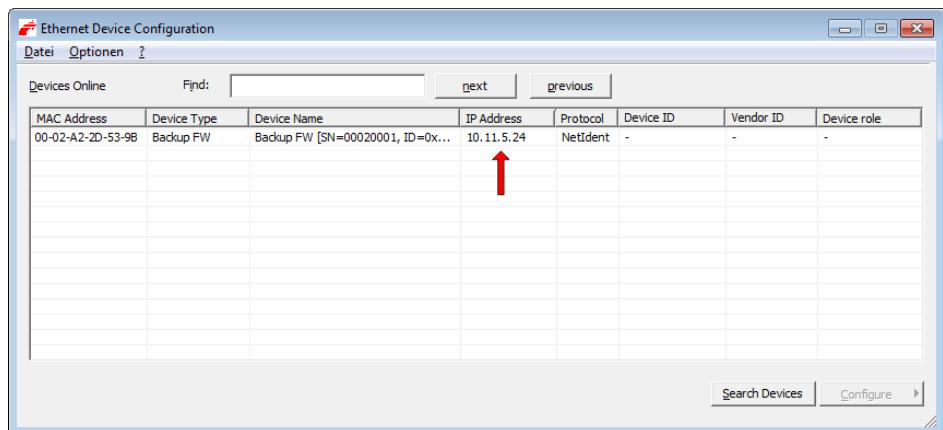
Figure 36: Found gateway in Ethernet Device Configuration Tool

➢ Note or write down the IP address.

Note:
If the default IP address `0.0.0.0` is displayed, the gateway has not yet received an IP address from a DHCP server. Make sure that the gateway is connected to a subnet with an active DHCP server. Then restart the gateway by briefly disconnecting the voltage supply while the Ethernet cable remains plugged-in. Wait a few seconds after reconnecting the voltage supply, then click the **Search Devices** button in the **Ethernet Device Configuration** Tool again.

3. Open web page for firmware download.
   ➢ Start the web browser on your configuration PC.
   ➢ In the address bar of your browser, enter the IP address of the gateway: `http://<IP address>`

↪ The **Firmware Update** page opens:
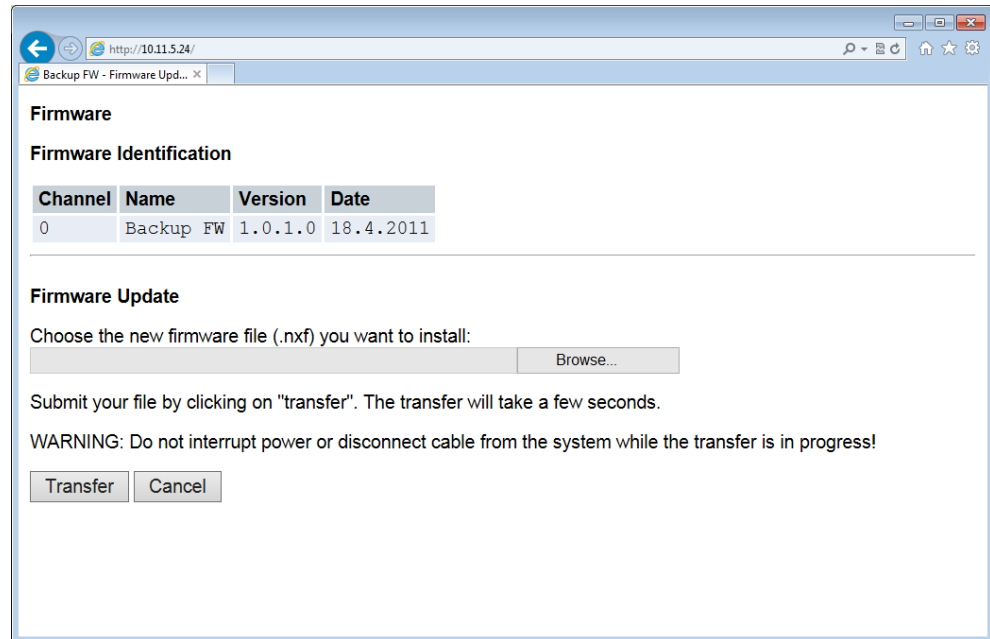
Figure 37: Firmware recovery via HTTP (as depicted in Internet Explorer)

4. Select firmware file for download.

➤ Click **Browse…** button, to open a dialog window for selecting the firmware file you want to download.

➤ Navigate to the directory in which the firmware file is stored, select the file, then click **Open**.

> **Note:**
> The name of the firmware file for the EU5C-SWD-ETHERCAT gateway is E030F0U0.nxf

↪ Path and name of the selected file are displayed in the field next to the **Browse…** button.

5. Download firmware file to gateway.

➤ Click **Transfer** button to download the new firmware file to the gateway.

➷ After you have started the download by clicking the **Transfer** button, the validity of the firmware file is being checked by the system. If the file fails the validity check, an error message will be displayed. If the file passes, the gateway requests you to perform a reset in order to start the new firmware:
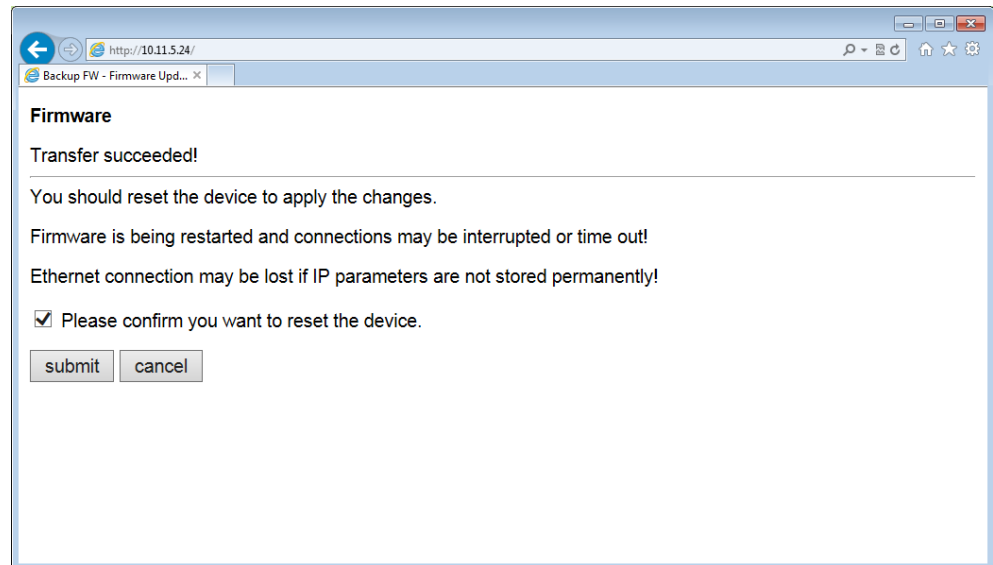
Figure 38: Reset after firmware download via HTTP (as depicted in Internet Explorer)

6. Perform reset.

➢ Activate the checkbox in front of **Please confirm…** to acknowledge that you want to reset the gateway.

> **Note:**
> You can use the **Cancel** button to uncheck the checkbox in front of **Please confirm...**

➢ Click **Submit** button to start the reset.

➷ After successful reset, the following message is displayed:
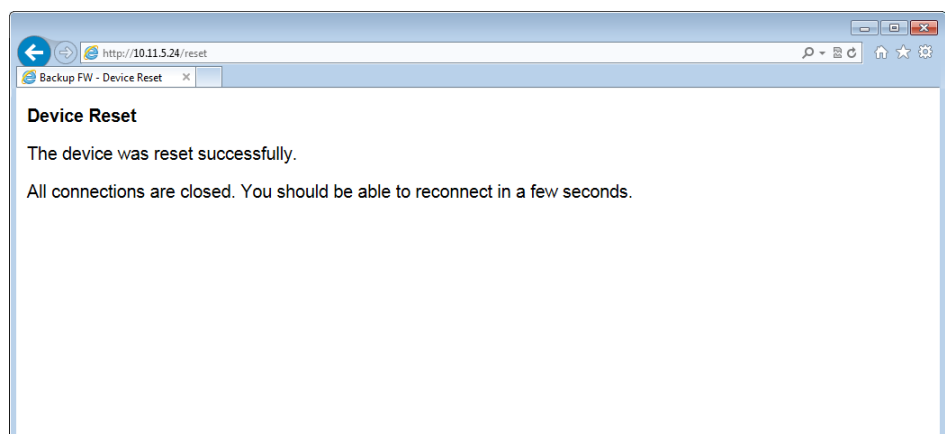
Figure 39: Successful device reset message (as depicted in Internet Explorer)

⇨ The **POW** system status LED at the gateway shows steady yellow light. The new firmware has been loaded and the gateway is ready for operation.

13 Technical data

13.1 Technical data EU5C-SWD-ETHERCAT gateway

Category	Parameter	Value
General	Part number	9233.922
	Dimensions (W x H x D)	35 x 90 x 127 mm
	Weight	160 g
	Mounting	Top hat rail 35 mm (IEC/EN 60715)
	Mounting position	Vertical
	Standards	IEC/EN 61131-2
	Communication controller	netX 50 processor
	Configuration and diagnostic interface	Mini-USB
	Integrated memory	8 MB SDRAM 4 MB serial Flash EPROM
Ambient mechanical conditions	Protection type (IEC/EN 60529, EN50178, VBG 4)	IP20
	Vibrations (IEC/EN 61131-2:2008)	Constant amplitude 3.5 mm: 5 – 9 Hz Constant acceleration 1 g: 9 – 150 Hz
	Mechanical shock resistance (IEC/EN 60068-2-27)	Semi-sinusoidal 15 g/11 ms: 9 Shocks
	Drop to (IEC/EN 60068-2-31)	Drop height: 50 mm
	Free fall, packaged (IEC/EN 60068-2-32)	Drop height: 1 m
Ambient climatic conditions	Operating ambient temperature (IEC 60068-2)	-25…+55 °C
	Condensation	Prevent by suitable measures
	Storage	-40…+70 °C
	Relative humidity, non-condensing (IEC/EN 60068-2-30)	5…95 %
Electromagnetic compatibility (EMC)	Pollution degree	2
	Electrostatic discharge (IEC/EN 61131-2:2008)	Air discharge (Level 3): 8 kV Contact discharge (Level 2): 4 kV
	Electromagnetic fields (IEC/EN 61131-2:2008)	80 – 1000 MHz: 10 V/m 1.4 – 2 GHz: 3 V/m 2 – 2.7 GHz: 1 V/m
	Radio interference suppression (SmartWire-DT)	EN 55011 Class A
	Burst (IEC/EN 61131-2:2008, Level 3)	Supply cables: 2 kV EtherCAT® bus cable: 1 kV SmartWire-DT cables: 1 kV
	Surge (IEC/EN 61131-2:2008, Level 1)	Supply cables: 0.5 kV EtherCAT® bus cable: 1 kV
	Radiated RFI (IEC/EN 61131-2:2008, Level 3)	0.15 – 80 MHz, 10 V, 80% AM / 1 KHz

Category	Parameter	Value
Supply voltage U_{AUX}	Rated operational voltage	24 V DC -15 % +20 %
	Input voltage residual ripple	≤ 5 %
	Protection against polarity reversal	Yes
	max. current I_{max}	3 A **Note**: If contactors with a total power consumption > 3 A are connected, a power feeder module EU5C-SWD-PF1/2 has to be used.
	Short-circuit strength	No, external fuse FAZ Z3
	Heat dissipation	Typ. 1 W
	Potential isolation	No
	Rated operating voltage of 24-V-DC slaves	Typical U_{AUX} -0,2 V
Supply voltage U_{POW}	Supply voltage	24 V DC -15 % +20 %
	Input voltage residual ripple	≤ 5 %
	Protection against polarity reversal	Yes
	Rated operational current I	111 mA (with two participants)
	Heat dissipation at 24 V DC	2.66 W (with two participants)
	Potential isolation between U_{POW} and 15-V-SmartWire-DT supply voltage	No
	Bridging voltage dips	10 ms
	Repeat rate	1 s
	Status display	**POW** LED
SmartWire-DT supply voltage	Rated operational voltage U_e	15 V ± 3 %
	max. current I_{max}	0.7 A **Note**: If contactors with a total power consumption > 0.7 A are connected, a power feeder module EU5C-SWD-PF2 has to be used.
	Short-circuit strength	Yes
Connection supply voltages	Connection type	Push-in terminals
	solid	0.2 – 1.5 mm^2 (AWG 24 – 16)
	Flexible with ferrule	0.25 – 1.5 mm^2
SmartWire-DT network	Participant type	SmartWire-DT master
	SmartWire-DT Master ASIC	SWD-80P-RS485
	Number of SmartWire-DT slaves	99
	Baud rate	125 / 250 kBd
	Address setting	Automatic
	Status display	SmartWire-DT master: **SWD** LED, duo color red/ green Configuration: **Config** LED, duo color red/green
	Connections	Plug, 8-pole
	Plug connectors	Blade terminal SWD4-8MF2

Category	Parameter	Value
Ethernet EtherCAT® network	Function of gateway	EtherCAT® Slave
	Baud rate	100 MBit/s
	Interface type	100 BASE-TX
	Auto-Negotiation	Supported
	Auto-Crossover	Supported
	Address setting	By project configuration
	Status display	EtherCAT® LEDs: **RUN** und **ERR**, duo color red/green
	Connector socket	2 x RJ45
	Connector plug	RJ45
	Potential isolation	Yes

Table 46: Technical data EU5C-SWD-ETHERCAT gateway

13.2 Technical data EtherCAT slave

Parameter	Description
Maximum number of cyclic input data	800 bytes (restricted by SWD)
Maximum number of cyclic output data	641 bytes (restricted by SWD)
Maximum number of cyclic input/output data in sum	1000 bytes (restricted by SWD)
Acyclic communication	SDO SDO Master-Slave SDO Slave-Slave (depending on master capability)
Type	Complex Slave
Functions	Emergency
FMMUs	8
SYNC Manager	4
Baud rate	100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3
Reference to firmware/stack version	V4.2.x.x

Table 47: Technical data EtherCAT slave protocol

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Contacts

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