Operating instruction manual

DTM for Hilscher EtherCAT Master devices

Configuration of Hilscher master devices

V1.1100

Hilscher Gesellschaft für Systemautomation mbH
www.hilscher.com

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1 Introduction

1.1 About this manual

This manual provides information on how to set and configure the device parameters of a netX based EtherCAT Master device using the EtherCAT Master DTM, and what can be read from the diagnosis panes.

> 📖 Refer to the operator manual, "netDevice and netProject", how to create a network configuration, or in the user manual for the generic DTM, for EtherCAT Slave devices, how to configure the EtherCAT Slave device.

Error codes

> 📖 All status and error codes you find in the API manual "Hilscher status and error codes".

1.1.1 Online help

The EtherCAT Master DTM contains an integrated online help.

➢ To open the online help, click on **Help** or press **F1**.

1.1.2 List of revisions

Index	Date	Version	Component	Changes
11	2022-06-27	1.1100	ECATMasterDTM.dll, ECATMasterGUI.ocx	Document revised. Chapter Error codes removed. See API Manual "Hilscher status and error codes" instead.

Table 1: List of revisions

1.2 Overview use cases

In the table below you find an overview of the applicable use cases.

Use case	Description	Chapter, section
Device start up	• Creating project configuration • Start/stop communication	*Device start up* [▶ page 16] *Create project configuration* [▶ page 19] *Start/stop communication* [▶ page 21]
Driver and device assignment settings	• Verifying or adapting driver settings • Configuring drivers • Assigning device (with or without firmware) • Selecting and downloading firmware	*Overview settings for driver and device assignment* [▶ page 22] *Verifying or adapting driver settings* [▶ page 25] *Configuring drivers* [▶ page 27] *Assigning device (with or without firmware)* [▶ page 34] *Selecting and downloading firmware* [▶ page 39]
Licensing	(licenses for master protocols)	*Licensing* [▶ page 46]
Configuring device parameters	• General settings • Select process data handshake method • Emulate topology • Configure mailbox • Set parameters for FMMU/SyncMan • Set process data • Set device address • Init commands	*Overview of configuring device parameters* [▶ page 58] *General* [▶ page 60] *Process data handshake* [▶ page 63] *Topology* [▶ page 65] *Mailbox* [▶ page 71] *FMMU/Sync Man* [▶ page 78] *Process data* [▶ page 81] *Address table* [▶ page 83] *Init commands* [▶ page 85]
Connecting/disconnecting device	Establishing online connection	*Connecting/disconnecting device* [▶ page 88]
Downloading configuration	Download to the device	*Download configuration* [▶ page 90]
Importing network structure	Identifying network configuration automatically.	*Network scan* [▶ page 92]
Online comparison	Compare configured devices and network scan result	*Online comparison* [▶ page 100]
Diagnosis	• General diagnosis • Master diagnosis • Station diagnosis • Firmware diagnosis	*Overview diagnosis* [▶ page 103] *General diagnosis* [▶ page 104] *Master diagnosis* [▶ page 106] *Station diagnosis* [▶ page 107] *Firmware diagnosis* [▶ page 108]
Extended diagnosis	Finding communication/configuration errors.	*Extended diagnosis* [▶ page 109]
Packet Monitor	Test of send and receive data.	*Packet monitor* [▶ page 120]
IO Monitor	Test of communication.	*I/O monitor* [▶ page 123]
Process Image Monitor	Display fieldbus structure and data structure of the input and output data of the devices transmitted on the bus.	*Process image monitor* [▶ page 124]
User rights	Definition of access rights	*User rights* [▶ page 127]

Table 2: Overview use cases

1.3 About the EtherCAT Master DTM

The EtherCAT Master DTM is used to configure an EtherCAT Master device. The configuration is done using the FDT frame application SYCON.net, which serves as configuration software.

1.4 Requirements EtherCAT Master DTM

To configure the an EtherCAT Master device with the EtherCAT Master DTM the following requirements have to be accomplished:

- Completed hardware installation of a netX based DTM-compatible EtherCAT Master device, including loaded firmware, license and loaded cifX configuration file,

- Installed FDT/DTM V 1.2 compliant frame application,

- Loaded DTM in the Device Catalog of the FDT Framework.

> **Note:**
> If the EtherCAT Master DTM and the EtherCAT Master device are installed on the same PC, the **cifX device driver** must be installed on that PC, as you can connect the DTM to the device.

> For more information to the hardware installation, please refer to the corresponding User Manual of your device. Information on how to order and to download the license to the device, you will find in this manual in the sections about the use case "Licensing".

1.5   System requirements

- PC with 1 GHz processor or higher

- Windows® XP SP3,
  Windows® Vista (32-Bit) SP2,
  Windows® 7 (32-Bit and 64-Bit) SP1,
  Windows® 8 (32-Bit and 64-Bit),
  Windows® 8.1 (32-Bit and 64-Bit),
  Windows® 10 (32-Bit and 64-Bit)

- Administrator privilege required for installation

- Internet Explorer 5.5 or higher

- RAM: min. 512 MByte, recommended 1024 MByte

- Graphic resolution: min. 1024 x 768 pixel

- Keyboard and Mouse

- Restriction: Touch screen is not supported.

Note:
If the project file is used on a further PC,
- this PC must also comply with the above system requirements,
- the device description files of the devices used in the project must be imported into the configuration software SYCON.net on the new PC,
- and the DTMs of the devices used in the project must also be installed on that further PC.

1.6 DTM dialog structure

The graphical user interface of the DTM is composed of different areas and elements listed hereafter:

1. A header area containing the **General device information**,
2. the **Navigation area** (area on the left side),
3. The **Dialog pane** (main area on the right side),
4. **OK**, **Cancel**, **Apply**, **Help**,
5. The **Status line** containing information e. g. the online-state of the DTM.
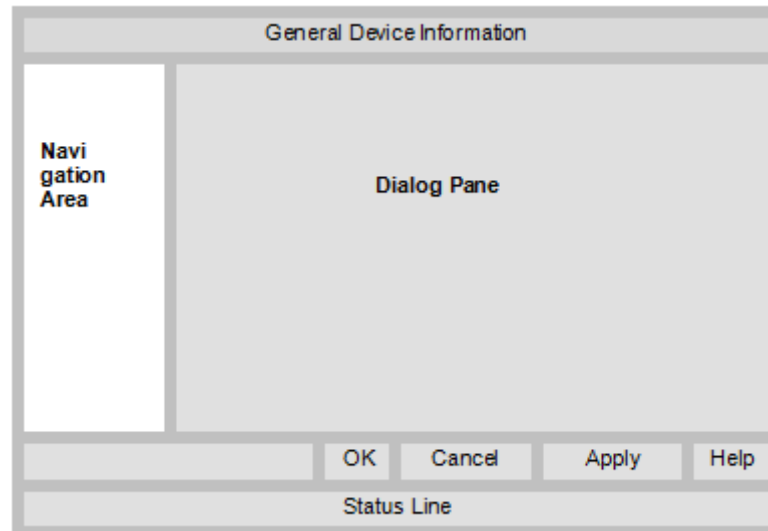
Figure 1: Dialog structure EtherCAT Master DTM

1.6.1 General device information

Parameter	Description
IO device	Device name
Vendor	Vendor name of he device
Device ID	Identification number of the device
Vendor ID	Identification number of the vendor

Table 3: General device information

1.6.2 Navigation area

In the navigation area, you can select the individual dialog panes via the folder structure of the DTM.
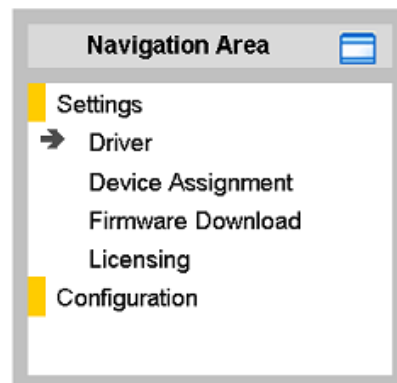
Figure 2: Navigation area

➢ Select the required folder and subfolder.

⇨ The corresponding dialog pane appears.

➢ Click ☐, to hide or to open the navigation area.

1.6.3 Dialog panes

At the dialog pane the Settings, Configuration, Diagnosis/Extended Diagnosis or the Tools panes are opened via the corresponding folder in the navigation area.

1.6.4 OK, Cancel, Apply, Help,

In the configuration software SYCON.net the following is valid:

	Description
OK	To confirm your latest settings, click **OK**. All changed values will be applied on the frame application database. The dialog then closes.
Cancel	To cancel your latest changes, click **Cancel**. Answer to the safety query "Configuration data has been changed. Do you want to save the data?" by **Yes**, **No** or **Cancel**. • **Yes**: The changes are saved or the changed values are applied on the frame application database. The dialog then closes. • **No**: The changes are *not* saved or the changed values are *not* applied on the frame application database. The dialog then closes. • **Cancel**: Back to the DTM.
Apply	To confirm your latest settings, click **Apply**. All changed values will be applied on the frame application database. The dialog remains opened.
Help	To open the DTM online help, click **Help**.

Table 4: OK, Cancel, Apply, Help

1.6.5   Status bar

The status bar displays information about the current state of the DTM. The current activity, e.g. download, is signaled graphically via icons in the status bar.
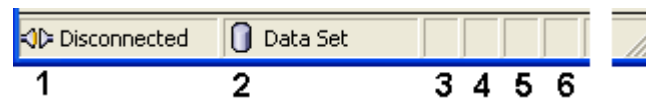
Figure 3: Status bar – status fields 1 to 6

Status field	Icon / description	
1	**DTM connection states**	
		Connected: Icon closed = Device is online
		Disconnected: Icon opened = Device is offline
2	**Data source states**	
		Data set: The displayed data is read out from the instance data set (database).
		Device: The displayed data is read out from the device.
3	**States of the instance date set**	
		Valid Modified: Parameter is changed (not equal to data source).
4	**Changes directly made on the Device**	
		Load/configure diagnosis parameters: Diagnosis is activated.
6	**Device diagnosis status**	
		Save operation succeeded: The save operation has been successful. Further messages due to successful handling of device data.
		Firmware Download: Firmware download is running
		Save operation failed: The save operation has failed. Further fail operation messages due to incorrect communication due to malfunction in the field device or its peripherals.

Table 5: Status bar icons [1]
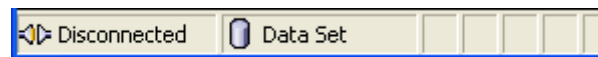
Offline state	
Save operation succeeded	
Firmware download	
Firmware download successful	
Online state and diagnosis	
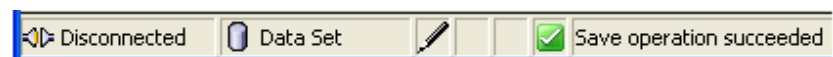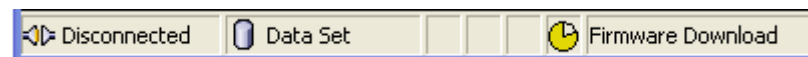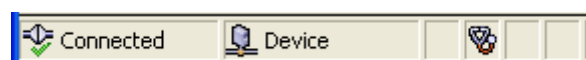
Table 6: Status bar display examples

2   Safety

2.1   General note

The documentation in the form of a user manual, an operating instruction manual or other manual types, as well as the accompanying texts, have been created for the use of the products by qualified personnel. When using the products, all Safety Messages, Integrated Safety Messages, Property Damage Messages and all valid legal regulations must be obeyed. Technical knowledge is presumed. The user has to assure that all legal regulations are obeyed.

2.2   Intended use

The EtherCAT Master DTM serves for configuration and diagnosis of EtherCAT Master devices.

2.3   Personnel qualification

Personnel responsible for the application of the network system shall be aware of the system behavior and shall be trained in using the system.

2.4 Safety messages

2.4.1 Communication stop caused by firmware or configuration download

If you want to perform either a firmware update (as a download) or a configuration download, both via the EtherCAT Master DTM, please be aware of the following:

- Together with the firmware download, an automated reset to the device is performed that will interrupt all network communication and all established connections will drop.

- If you download the configuration during bus operation, the communication between master and slaves stops.

Possible faulty system operation

- An unpredictable and unexpected behavior of machines and plant components may cause personal injury and property damage.

➢ Stop the application program, before starting the firmware update or before downloading the configuration.

➢ Make sure that your equipment operates under conditions that prevent personal injury or property damage. All network devices should be placed in a fail-safe mode, before starting the firmware update or before downloading a configuration.

Loss of device parameters, overwriting of firmware

- Both the firmware download and the configuration download erase the configuration database. The firmware download overwrites the existing firmware in the network device.

➢ To complete the firmware update and to make the device operable again, re-load the configuration after the firmware update has been finished.

Device parameters that have been saved volatile, e. g. as the temporarily set IP address parameters, are getting lost during the reset.

- In order to prevent loss of configuration data, make sure that your project configuration data are saved non-volatile, before you initiate a firmware update or download the configuration.

➢ In order to prevent loss of configuration data, before you initiate a firmware update or download the configuration, make sure that your project configuration data are saved non-volatile.

2.4.2 Mismatching system configuration

Mismatching system configuration loaded into the device may result in faulty data mapping in the application program. Thus, unexpected equipment operation may cause personal injury or damage to equipment.

➢ In the device, use only a configuration suitable for the system.

2.5   Property damage

2.5.1   Power disconnect during firmware or configuration download

If during the process of downloading a firmware or configuration,

- the power supply to a PC with the software application is interrupted,
- or the power supply to the EtherCAT Master device is interrupted,
- or a reset to the device is done.

This may lead to the following consequences:

Loss of device parameters, firmware corruption

- The firmware download or the configuration download is interrupted and remains incomplete.
- The firmware or the configuration database will be corrupted and device parameters will be lost.
- Damage to the device may occur, as the device cannot be rebooted.

Whether these consequences occur depends on when the power disconnect occurs during the download.

➢ During configuration download process, do not interrupt the power supply to the PC or to the device, and do not perform a reset!

Otherwise, you might be forced to send in your device for repair.

Power drop during write and delete accesses in the file system

The FAT file system in the netX firmware is subject to certain limitations in its operation. Write and delete accesses in the file system (firmware update, configuration download etc.) can destroy the FAT (File Allocation Table) if the accesses cannot be completed if the power drops. Without a proper FAT, a firmware may not be found and cannot be started.

Make sure that the power supply to the device is not interrupted during write and delete accesses in the file system (firmware update, configuration download, etc.).

2.5.2   Invalid firmware

Loading invalid firmware files could render your module unusable.

➢ Only load firmware files to the device that are valid for this device.

Otherwise, you might be forced to send in your device for repair.

2.6   Safety messages on firmware or configuration download

If you perform a firmware download or a configuration download via the EtherCAT Master DTM, adhere to the following warnings:

⚠ WARNING

Communication stop caused by firmware or configuration download

Initiating a firmware or configuration dowload process during bus operation will stop the communication and a subsequent plant stop may cause unpredictable and unexpected behavior of machines and plant components, possibly resulting in personal injury and damage to your equipment.
The firmware download overwrites the existing firmware. The communication stop may cause loss of device parameters and the device may be damaged.
➢ Stop the application program, before you start the firmware or configuration download.
➢ Make sure that all network devices are in a fail-safe condition.

⚠ WARNING

Mismatching system configuration

Mismatching system configuration loaded into the device may result in faulty data mapping in the application program. Thus, unexpected equipment operation may cause personal injury or damage to equipment.
➢ In the device, use only a configuration suitable for the system.

NOTICE

Power disconnect while downloading firmware or configuration

If the power supply to the PC or device is interrupted while the firmware or configuration is being downloaded, the download will be aborted, the firmware may be corrupted, the device parameters may be lost, and the device may be damaged.
➢ During firmware or configuration download process, do not interrupt the power supply to the PC or to the device, and do not perform a reset to the device!

NOTICE

Invalid firmware

Loading invalid firmware files could render your device unusable.
➢ Only proceed with a firmware version valid for your device.

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3   Device start up

3.1   Configuration steps

The following overview provides to you the step sequence on how to configure a netX based EtherCAT Master device with EtherCAT Master DTM as it is typical for many cases. It is assumed at this point that the hardware installation has been completed.

Step	Brief description	Further information
Add EtherCAT Slave in the device catalog	Open configuration software SYCON.net. Add device by importing the device description file to the Device Catalog. - **Network > Import device descriptions**.	Section *Create project configuration* [▶ page 19], or Operating instruction manual "SYCON.net" and Operating instruction manual "netDevice and netProject"
Load device catalog	- Select **Network > Device catalog**, - **Reload catalog**.	
Create new project / Open existing project	- Select **File > New** or **File > Open**.	
Insert the master device and the slave device and into configuration	- In the **Device catalog**, select the master device and insert the device via drag & drop **to the line** in the network view. - In the **Device catalog**, select the slave device and insert the device via drag and drop **to the master bus line** in the network view.* *This step will not be necessary if the network structure is scanned automatically.* **Important!** In order to select the desired device in the device catalog, note the details about the DTM and the device at the bottom of the window. When sorting by fieldbus, display of multiple devices with identical names by different vendors is possible.	
Open master DTM configuration dialog	Open the master DTM configuration dialog. - Double click to the device icon of the master. - The master DTM configuration dialog is displayed.	-
Verify or adapt driver settings	In the master DTM configuration dialog: - select **Settings > Driver**. **Note!** For PC cards cifX the **cifX device driver** is preset as a default driver. For all the other Hilscher devices, the **netX driver** is preset as a default driver. • Use the **cifX device driver** if the EtherCAT Master DTM is installed on the same PC as the EtherCAT Master device. • Use the **netX driver** to establish a USB, Serial (RS232) or TCP/IP connection from the EtherCAT Master DTM to the EtherCAT Master device. • The **3Sgateway driver for netX (V3.x)** is used only in relationship with CODESYS. To search for devices you can check one or multiple drivers simultaneously. - Verify that the default driver is checked. - If necessary, check another driver or multiple drivers.	Section *Overview settings for driver and device assignment* [▶ page 22] or *Verifying or adapting driver settings* [▶ page 25]

Step	Brief description	Further information
Configure driver	If you use the **netX driver**, you respectively must configure it. For **netX Driver and communication via TCP/IP** set the IP adress of the device. - Select **Settings** > **Driver** > **netX driver** > **TCP connection**. - Via [icon] add an IP range. - Under **IP address** enter the IP Address of the device or an IP range. - Click **Save**. Adjust the driver parameters **netX driver USB/RS232** only if they differ from the default settings. **Note!** • The **cifX device driver** requires no configuration. • The configuration of the **3Sgateway driver for netX (V3.x)** is carried out via the CODESYS user interface.	*Configuring netX driver* [▶ page 28]
Assign master device (with or without firmware)	Assign the master device to this driver. In the master DTM configuration dialog: - Select **Settings** > **Device assignment**, - select a master device (with or without firmware), - therefore check the appropriate checkbox. - Click **Apply**.	*Assigning device (with or without firmware)* [▶ page 34]
Select and download firmware	If not yet a firmware was loaded to the device: - Adhere to the necessary safety precautions to prevent personnel injury and property damage. In the master DTM configuration dialog: - Select **Settings** > **Firmware download**, - clock **Browse..**, - select a firmware file, - click **Open**. - Click **Download** and **Yes**.	*Safety messages on firmware or configuration download* [▶ page 15] *Selecting and downloading firmware* [▶ page 39]
Assign master device once more (with firmware and system channel) *For repeated download this step is omitted.*	In the master DTM configuration dialog: - Select **Settings** > **Device assignment**, - click **Scan**, - select the master device (with loaded and defined system channel), - therefore check the appropriate checkbox. - Click **Apply**. - Close the master DTM configuration dialog via **OK**.	*Selecting the device once more (with firmware)* [▶ page 37]
Configure slave device* (*This step will not be necessary if the network structure is scanned automatically.*)	Configure the slave device. - Double click to the device icon of the slave. - The slave DTM configuration dialog is displayed. In the slave DTM configuration dialog: - Select **Configuration > Behavior**. - Set the Watchdog control and Interval. - Set the timeout values for various state machine transitions. - Specify which verifications to perform during device check-up. - Choose between combined and separate EtherCAT commands for read and write accesses. - Select **Configuration > Process data**. - Configure the process data of the slave (PDO assignment and PDO contents). - Close the slave DTM configuration dialog via **OK**.	Operating instruction manual "Generic DTM for EtherCAT Slave devices"

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Step	Brief description	Further information
Configure master device	Configure the master device. - Double click to the device icon of the master. - The master DTM configuration dialog is displayed. In the master DTM configuration dialog: - Select **Configuration** > **Process data handshake**. - Set the process data handshake procedure. - Select **Configuration** > **Topology**. - Model the network topology according to the requirements. - Select **Configuration** > **Mailbox**. - For slaves with configurable CoE parameters, make entries on the 'Start-up' and 'Userdef Start-up' tabs. - Select **Configuration** > **FMMU/ SyncMan**. - Set the parameters for FMMU and for the Sync manager. - Select **Configuration** > **Process data**. - Assign symbolic names for the configured modules or measuring signals. - Select **Configuration** > **Address table**. - Set the address information and parameters for the process data objects (PDO). - Select **Configuration** > **Init Commands**. - Edit the table of Init commands according to the requirements. - Close the master DTM configuration dialog via **OK**.	Sections *Overview of configuring device parameters* [▶ page 58] *General* [▶ page 60] *Process data handshake* [▶ page 63] *Topology* [▶ page 65] *Mailbox* [▶ page 71] *FMMU/Sync Man* [▶ page 78] *Process data* [▶ page 81] *Address table* [▶ page 83] *Init commands* [▶ page 85]
Save project	- Select **File** > **Save**.	Operating instruction manual "SYCON.net"
Connect master device	- Right click to the device icon of the master, - select **Connect**.	Section *Connecting/ disconnecting device* [▶ page 88]
Download configuration	- Adhere to the necessary safety precautions to prevent personnel injury and property damage that may occur in consequence of a communication stop or in consequence of a mismatching system configuration. - Right click to the device icon of the master, - select **Download**.	Section *Safety messages on firmware or configuration download* [▶ page 15] or *Download configuration* [▶ page 90]
Network scan	Alternative to manual configuration of the slave device, you can scan the network structure (in the master DTM). Proceed as follows: 1. Click **Network scan**. 2. Make the settings in the **Scan response** dialog. 3. Click **Create devices**. 4. Download the current slave device configuration to the master device.	Section *Network scan* [▶ page 92]
Diagnosis	- Right click to the device icon of the master. - Select **Diagnosis**. - The master DTM diagnosis dialog is displayed. (1.) Check whether the communication is OK: **Diagnosis** > **General diagnosis** > **Device status "Communication"** must be green! (2.) **"Communication"** is green: Open the IO monitor and test the input or output data. (3.) **"Communication"** is not green: Use diagnosis and extended diagnosis for troubleshooting. - Close the master DTM diagnosis dialog via **OK**.	Section *Diagnosis* [▶ page 103] Section *Extended diagnosis* [▶ page 109]
I/O monitor	- Right click to the device icon of the master, - select **Diagnosis**, - select **Tools** > **I/O monitor**, - check the input or output data. - Close the I/O monitor dialog via **OK**.	Section *I/O monitor* [▶ page 123]

Step	Brief description	Further information
Disconnect	- Right click to the device icon of the Master, - select **Disconnect**.	Section *Connecting/ disconnecting device* [▶ page 88]

Table 7: Getting started – Configuration steps

3.2 Create project configuration

1. Complete the slave device in the device catalog.
   - ➢ Open configuration software SYCON.net.
   - ➢ Add the slaves in the device catalog by importing the device description file.
   - ➢ Select **Network** > **Import device descriptions**.

2. Load device catalog
   - ➢ - Select **Network** > **Device catalog**.
   - ➢ - Select **Reload catalog**.

3. Create or open a project
   - ➢ Create new project / open existing project:
   - ➢ - Select **File** > **New** or **File** > **Open**.

4. Insert master or slave device in configuration.
   - ➢ In the device catalog click to the master device and insert the device via drag and drop **to the line** in the network view.
   - ➢ In the Device Catalog click to the slave device* and insert the device via drag and drop **to the master bus line** in the network view.*

   This step will not be necessary if the network structure is scanned automatically.

   Important:

   In order to select the desired device in the device catalog, note the details about the DTM and the device at the bottom of the device catalog window. When sorting by fieldbus, several devices with the same name from different vendors can be displayed.

   For further information, see operating instruction manual "SYCON.net" or "netDevice and netProject".

3.3   Importing network structure

As an alternative to manually configure the slave device, you can automatically scan the network structure by using the context menu **Network scan** and create the device. Then you can download the configuration of the slave device to the master device.

Take the following steps:

1. Start the **Network scan** function.

2. Make the settings in the **Scan response** dialog of the master DTM.

3. Select **Create devices**.

4. Download the configuration of the slave device to the master device.

For more information, refer to the section *Network scan* [▶ page 92].

3.4   Start/stop communication

You can manually start or stop the communication between an EtherCAT Master device and EtherCAT Slave devices.

- **Start communication** can be enabled if the communication was stopped before or if the configuration requires this (controlled release of communication).

- **Stop communication** can be enabled if the communication was started.

To start or to stop the communication, proceed as follows:

Start communication

➢ Connecting device:

> **Note:**
> To manually start the communication of the device at the bus, an online connection from the EtherCAT Slave DTM to the EtherCAT Slave device is required. Further information can be found in the section *Connecting/disconnecting device* [▶ page 88].

➢ Select **Additional functions** > **Service** > **Start communication** from the context menu (right mouse click).

⇨ The device communicates at the bus.

Stop communication

⚠ **WARNING** **Faulty system operation possible, overwriting of firmware or loss of device parameters**

Before stopping the communication:

➢ Stop the application program.

➢ Make sure that all network devices are in a fail-safe condition.

After carrying out the security measures:

➢ Select **Additional functions** > **Service** > **Stop communication** from the context menu (right mouse click).

⇨ The communication of the device at the bus is stopped.

4   Settings

4.1   Overview settings for driver and device assignment

Under "Settings" you can make different basic settings for your device:

- To establish a connection from the EtherCAT Master DTM to the EtherCAT Master device, check whether the default driver is hooked up in the dialog box **Driver** and if necessary, check another or several drivers.

- In the **Device assignment** pane, select the device and assign it to the driver.

- The dialog in the **Firmware download** pane is used to load a new firmware into the device.

- The dialog in the **Licensing** or **License** pane allows you to order licenses for master protocols and utilities and transfer them to your device.
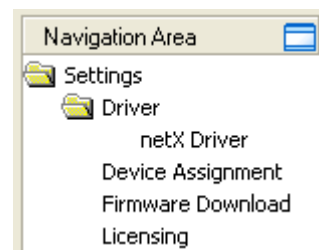
Figure 4: Navigation area - Settings (example)

There may be more drivers.

> **Note:**
> To edit the dialog boxes under **Settings**, you need the user rights for "Maintenance".

Overview on steps

To establish a connection between the EtherCAT Master DTM and the EtherCAT Master device, the following steps are required:

1. Verifying or adapting driver settings

   ➢ In the FDT container, **netDevice** double-click on the EtherCAT Master icon.

   ➩ The DTM configuration dialog opens.

   ➢ Check whether the default driver is checked and if necessary, tick another or several drivers.

   ➢ Select **Settings** > **Driver**.

   > **Note:**
   > For PC cards cifX the **cifX device driver** is preset as a default driver. For all the other Hilscher devices, the **netX driver** is preset as a default driver.

- Use the **cifX device driver** if the EtherCAT Master DTM is installed on the same PC as the EtherCAT Master device.

- Use the **netX driver** to establish an USB, Serial (RS232) or TCP/IP connection from the EtherCAT Master DTM to the EtherCAT Master device.

- The **3Sgateway driver for netX (V3.x)** is used only in relationship with CODESYS. The version V3.x refers to the driver version defined by 3S-Smart Software Solutions GmbH.

To search for devices on the network, you can check one or more drivers at the same time.

➢ Check if the default driver for your device is checked.

➢ Respectively check another driver or multiple drivers.

2. Configuring drivers

➢ If you use the **netX driver**, you respectively must configure it.

> **Note:**
> The **cifX device driver** requires no configuration.
> The configuration of the **3Sgateway driver for netX (V3.x)** is carried out via the CODESYS surface.

➢ Go to **Settings** > **Driver** > **netX driver** to open the driver dialog box for the **netX driver** and if necessary, press **F1**, so that the separate help for the **netX driver** appears.

➢ For **netX Driver** and communication via TCP/IP set the IP address of the device.

Adjust the driver parameters **netX driver USB/RS232** only if they differ from the default settings.

3. Assigning the master device to the DTM

➢ First, you scan for the device (with or without firmware) and select the device.

➢ Select **Settings** > **Device assignment**.

➢ Under **Device selection**, select *suitable only* or *all* and click **Scan**.

➢ In the table, check the required devices.

➢ Select **Apply**.

4. Selecting and downloading the firmware

- ➢ If not yet a firmware was loaded to the device, select and download the firmware.
- ➢ Select **Settings** > **Firmware download**.
- ➢ Select and download the firmware via **Download**.
- ➢ Click **Apply**.
- ➢ Scan for and select the devices (with firmware and defined system channel) once more. *For repeated download this step is omitted.*
- ➢ Select **Settings** > **Device assignment**.
- ➢ Select **Scan**.
- ➢ In the table, check the required device.
- ➢ Close the DTM configuration dialog via **OK**.

5. Connecting the device

- ➢ In **netDevice** put a right-click on the EtherCAT Master icon.
- ➢ Select the **Connect** command from the context menu.
- ⇨ In the network view, the device description at the device icon of the master is displayed with a green colored background. The EtherCAT Master device now is connected to the EtherCAT Master DTM via an online connection.

For more information on the required settings, see sections *Verifying or adapting driver settings* [▶ page 25], *Assigning device (with or without firmware)* [▶ page 34], *Selecting and downloading firmware* [▶ page 39]or *Licensing* [▶ page 45].

Descriptions of the netX Driver are avaible in the DTM user interface as online help:
- ➢ Therefore, click **Settings** > **Driver** > **netX driver** and press the **F1** key.

4.2   Verifying or adapting driver settings

The **Driver** dialog pane displays the drivers available to establish a connection from the EtherCAT Master DTM to the device.

> **Note:**
> A default driver is set in the configuration software.

Proceed as follows:

1. Select driver.

    ➢ Select **Settings** > **Driver** in the navigation area.

    ⇨ The **Driver** dialog pane is displayed. This shows the available drivers and the pre-setting of the default driver.

	Driver	Version	ID
☑	CIFX Device Driver	1.101.1.9801	{368BEC5B-0E92-4C0E-B4A9-64F62AE7AAFA}
☐	3SGateway Driver for netX (V3.x)	0.9.1.2	{787CD3A9-4CF6-4259-8E4D-109B6A6BEA91}
☐	netX Driver	1.103.2.5183	{B54C8CC7-F333-4135-8405-6E12FC88EE62}

Figure 5: Default driver ‚cifX Device Driver' for PC cards cifX (example)

	Driver	Version	ID
☐	CIFX Device Driver	1.101.1.9801	{368BEC5B-0E92-4C0E-B4A9-64F62AE7AAFA}
☐	3SGateway Driver for netX (V3.x)	0.9.1.2	{787CD3A9-4CF6-4259-8E4D-109B6A6BEA91}
☑	netX Driver	1.103.2.5183	{B54C8CC7-F333-4135-8405-6E12FC88EE62}

Figure 6: Default driver ‚netX Driver' for Hilscher devices except for PC cards cifX (example)

Parameter	Description
Driver	Name of the driver. (For further details, see the descriptions of the action steps.) **Default driver** (Pre-settings in the configuration software): For PC cards cifX the **cifX device driver** is preset as a default driver. For all the other Hilscher devices the **netX driver** is preset as a default driver. To search for devices you can check multiple drivers simultaneously.
Version	ODMV3 version of the respective driver
ID	ID of the driver (driver identification)

Table 8: Parameters of the driver selection list

2. Verify whether the default driver is checked.

    ➢ To establish a connection from the EtherCAT Master DTM to the EtherCAT Master device, check whether the default driver is hooked up in the dialog box Driver and if necessary, check another or several drivers.

3. Respectively check another driver or multiple drivers.

    ➢ Check the checkbox for the driver in the selection list.

> **Note:**
> The driver used for the connection from the EtherCAT Master DTM to the EtherCAT Master device must be supported by the device and must be available for the device.

- Use the **cifX device driver** if the EtherCAT Master DTM is installed on the same PC as the EtherCAT Master device.

- Use the **netX driver** to establish an USB, Serial (RS232) or TCP/IP connection from the EtherCAT Master DTM to the EtherCAT Master device.

- The **3Sgateway driver for netX (V3.x)** is used only in relationship with CODESYS. The version V3.x refers to the driver version defined by 3S-Smart Software Solutions GmbH.

To search for devices on the network you can check multiple drivers simultaneously.

Driver		Version	ID
☑	CIFX Device Driver	1.101.1.9801	{368BEC5B-0E92-4C0E-B4A9-64F62AE7AAFA}
☐	3SGateway Driver for netX (V3.x)	0.9.1.2	{787CD3A9-4CF6-4259-8E4D-109B6A6BEA91}
☑	netX Driver	1.103.2.5183	{B54C8CC7-F333-4135-8405-6E12FC88EE62}

Figure 7: Manual selection of multiple drivers (example)

4.3 Configuring drivers

4.3.1 cifX device driver

In the EtherCAT Master DTM for the **cifX device driver** no driver dialog pane is available, since for the cifX device driver no driver settings are required.

The cifX device driver will be used if the EtherCAT Master DTM is installed in the same PC as the EtherCAT Master device.

> **Note:**
> To establish a connection from a DTM to a master device via the **cifX device driver**, the cifX device driver must be installed and the driver must have access to the master device.

4.3.2 netX driver

The **netX driver** is used to connect the DTM to the device via different connection types. The DTM communicates with the device via an USB connection, a serial (RS232) connection or a TCP/IP connection. The netX Driver establishes

- via the USB interface of the device and the USB port of the PC an USB connection to the device,
- via the RS232 interface of the device and the COM port of the PC a serial connection (RS232) to the device
- and via Ethernet a TCP/IP connection to the device.

To connect the DTM to the physical layer of the device the netX driver software works in combination with the software components:

- "USB/COM connector" for the USB connection and for the serial connection (RS232) and
- "TCP/IP connector" for the Ethernet connection.

4.3.3   Configuring netX driver

The following steps are required to configure the netX driver:

USB/RS232 Connection

To set the driver parameters for an USB/RS232 connection note:

> **Note:**
> Adjust the driver parameters netX driver USB/RS232 only if they differ from the default settings. After saving the changed driver parameters, these parameters are used for the device assignment when scanning devices.

For setting the driver parameters for an USB connection or a serial connection:

1. Set the driver netX driver USB/RS232 parameters.

   ➢ Open the driver dialog via **Settings** > **Driver** > **netX driver** > **USB/ RS232 connection**.

TCP/IP connection

For setting the driver parameters for a TCP/IP connection:

2. Set IP address of the device.

   ➢ Select **Settings** > **Driver** > **netX driver** > **TCP connection**.

   ➢ Add an IP range via **Select IP range** ⊕.

   ➢ Under **IP range configuration** > **IP address** enter the IP address of the device (**Use IP range** is unchecked).

3. Or set IP range:

   ➢ Check **Use IP range**.

   ➢ Under **IP range configuration** > **IP address** enter the start address (left side) and the ending address of the IP scanning range (right side).

4. Save the IP address or the IP search range.

   ➢ Click on **Save**.

   ⇨ After saving the changed driver parameters, these parameters are used for the device assignment when scanning devices.

4.3.4   netX driver - USB/RS232 connection

The communication from the DTM to the device via an USB/RS232 connection is used when the DTM is installed on a PC and between the PC and the device

- an USB connection,

- or a serial connection (RS232) exists.

The DTM accesses the device via the USB interface or via the RS232 interface. This requires either to connect an USB port of the PC to the USB interface of the device using an USB cable or to connect a physical COM port of the PC to the RS232 interface of the device via a serial cable.

The **netX driver / USB/RS232 connection** supports all physical and virtual COM ports available on the PC.

Via the RS232 interface or USB interface, the device is configured or diagnosis is performed.

4.3.4.1   Driver parameters for netX driver - USB/RS232 connection

The settings of the driver parameters for the USB/RS232 connection are made via the **netX driver** / **USB/RS232 connection** configuration dialog.

➢ Open the **USB/RS232 connection** dialog via navigation area **Settings** > **Driver** > **netX driver**.

↳ The **USB/RS232 connection** dialog is displayed:

Figure 8: cifX driver > USB/RS232 connection

Parameter	Description	Range of value / value
Enable USB/RS232 connector (restart of ODM required)	checked: The cifX driver can communicate via the USB/RS232 interface. unchecked: The cifX driver cannot communicate via the USB/RS232 interface. If the check mark for **Enable USB/RS232 connector** is set or removed, then the ODM server must be restarted[1], to make the new setting valid. ———— [1] Restart the ODM server via the **ODMV3 tray application**: - In the foot line click on [icon] using the right mouse key. - In the context menu select **Service > Start**.	checked, unchecked; Default: unchecked
Select port	Depending on the COM ports (interfaces) available on the PC, they will be listed under **Select port**.	COM 1 to COM N
Port configuration		
Disable port	checked: No connection. unchecked: The cifX driver tries to establish a connection using the configured USB/RS232 interface.	checked, unchecked (Default)
Baud rate	Transfer rate: Number of bits per second. The device must support the baud rate.	9.6, 19.2, 38.4, 57.6 bzw. 115.2 [kBit/s]; Default (RS232): 115.2 [kBit/s]
Stop bits	Number of stop bits sent after the transfer of the send data for synchronization purposes to the receiver.	Stop-Bit: 1, 1.5, 2; Default (RS232): 1
Send timeout	Maximum time before the transfer of the transmission data is canceled, when the send process fails, for example, because of the transfer buffer is full.	100 … 60.000 [ms]; Default (RS232 and USB): 1000 ms
Reset timeout	Maximum time for a device reset, including the re-initialization of the physical interface used for the communication.	100 … 60.000 [ms]; Default (RS232 und USB): 5000 ms
Byte size	Number of bits per byte by byte specification	7 Bit, 8 Bit; Default (RS232): 8 Bit
Parity	In the error detection in data transmission using parity bits, "parity" describes the number of bits occupied with 1 in the transmitted information word. No Parity: no parity bit Odd Parity: The parity is "odd" if the number of bits occupied with 1 in the transmitted information word will be odd. Even parity: The parity is "even" if the number of bits occupied with 1 in the transmitted information word will be even. Mark Parity: if the parity bit is always 1, this will be named mark-parity (the bit does not contain any information). Space Parity: if the parity bit always 0, this will be named space-parity (the bit represents an empty space).	No Parity, Odd Parity, Even Parity, Mark Parity, Space Parity; Default (RS232): No Parity
Keep alive timeout	The "Keep Alive" mechanism is used to monitor whether the connection to the device is active. connection errors are detected using a periodic heartbeat mechanism. The heartbeat mechanism will be initiated after the set time has elapsed if the communication has failed.	100 … 60.000 [ms]; Default (RS232 und USB): 2000 ms
Restore	Resets all settings in the configuration dialog to the default values.	
Save	Saving all settings made in the configuration dialog **cifX driver** > **USB/RS232 connection**, i. e. only for the selected connection type.	
Save all	Saving all settings made in the configuration dialog **cifX driver**, i. e. for all connection types.	

Table 9: Parameters cifX driver > USB/RS232 connection

4.3.5   netX driver - TCP/IP connection

The communication from the DTM to the device via a **TCP/IP connection** is used in the following two typical applications:

Application 1: The device has its own Ethernet interface. The DTM is installed on a PC and the TCP/IP connection is established from this PC to the stand-alone device. The IP address of the device is used.

Application 2: The device is installed in a remote PC. The DTM is installed on an additional PC and the TCP/IP connection is established from this PC to the remote PC. The IP address of the remote PC is used. For the TCP/IP connection is made, on the remote PC the cifX TCP/IP server must be started. The cifX TCP/IP server allows the remote access to the device via a TCP/IP connection.

> **Note:**
> An exe file for the cifXTCP/IP server is provided on the product CD in the Tools directory.

Via the TCP/IP interface of the device or of the remote PC, the device is configured or diagnosis is performed.

4.3.5.1 Driver parameters for cifX driver - TCP/IP connection

The settings for the driver parameters for the TCP/IP connection are made via the **netX driver / TCP connection** configuration dialog.

➢ Open the **TCP connection** dialog via navigation area **Settings** > **Driver** > **netX driver**.

↳ The dialog **netX driver** is displayed:

➢ Select **TCP connection**.

Figure 9: netX driver > TCP connection

Parameter	Description	Range of value / value
Enable TCP connector (restart of ODM required)	checked: The cifX driver can communicate via the TCP/IP interface. unchecked: The cifX driver cannot communicate via the TCP/IP interface. If the check mark for **Enable TCP connector** is set or removed, then the ODM server must be restarted[1], to make the new setting valid. _____ [1] Restart the ODM server via the **ODMV3 tray application**: - In the foot line click on ⬛ using the right mouse key. - In the context menu select **Service > Start**.	checked, unchecked; Default: unchecked
Select IP range	Via **Select IP range** already created IP ranges can be selected. Via ⬛ an additional IP range can be added. Via ⬛ an IP range can be deleted.	
Scan timeout [ms]	With **Scan timeout** can be set, how long to wait for a response while a connection is established.	10 … 10.000 [ms]; Default: 100 ms
IP range configuration		
Disable IP range	checked: No connection. unchecked: The cifX driver tries to establish a connection using the configured TCP/IP interface.	checked, unchecked (Default)

Parameter	Description	Range of value / value
IP address (links)	Enter the IP address of the device, (if **Use IP range** is not checked). Enter the IP address of the device, (if **Use IP range** is not checked).	valid IP address; Default: 192.168.1.1
Use IP range	checked: An IP address range is used. unchecked: Only one IP address is used.	checked, unchecked; Default: unchecked
IP address (right)	Enter the end address of the IP scanning range, (only if **Use IP range** is checked).	valid IP address; Default: 0.0.0.0
Address count	Displays the scanning range address count, depending on the selected IP-start or IP-end address. (For this read the note given below.)	recommended: 10
TCP Port	Identifies the endpoint of a logical connection or addresses a specific endpoint on the device or PC.	0 – 65535; Default Hilscher device: 50111
Send timeout	Maximum time before the transfer of the transmission data is canceled if the send process fails, for example, because of the transfer buffer is full.	100 … 60.000 [ms]; Default (TCP/IP): 1000 ms
Reset timeout	Maximum time for a device reset, including the re-initialization of the physical interface used for the communication.	100 … 99.999 [ms]; Default (TCP/IP): 20.000 ms
Keep alive timeout	The "Keep Alive" mechanism is used to monitor whether the connection to the device is active. Connection errors are detected using a periodic heartbeat mechanism. The heartbeat mechanism will be initiated after the set time has elapsed if the communication has failed.	100 … 60.000 [ms]; Default (TCP/IP): 2000 ms
Restore	Resets all settings in the configuration dialog to the default values.	
Save	Saving all settings made in the configuration dialog **cifX driver** > **TCP/IP connection**, i. e. only for the selected connection type.	
Save all	Saving all settings made in the configuration dialog **cifX driver**, i. e. for all connection types.	

Table 10: Parameters netX driver > TCP connection

→ **Note:**

Do not use large IP ranges in combination with a low scan timeout. Microsoft introduced in Windows® XP SP2 a limit of concurrent half-open outbound TCP/IP connections (connection attempts), to slow the spread of virus and malware from system to system. This limit makes it impossible to have more than 10 concurrent half-open outbound connections. Every further connection attempt is put in a queue and forced to wait. Due to this limitation, a large IP range used in combination with a low scan timeout could prevent the connection establishment to a device.

4.4 Assigning device (with or without firmware)

> **Note:**
> In the **Device assignment** dialog pane, you first must assign the EtherCAT Master device to the EtherCAT Master DTM by checking the check box. This is essential to establish an online connection from the EtherCAT Master DTM to the EtherCAT Master device later, as described in section *Connecting/disconnecting device* [▷ page 88].

Therefore, in the **Device assignment** dialog pane you scan for the EtherCAT Master device and select it.

If the device did not get a firmware or shall get a new firmware:

1. First you scan for the device (with or without firmware) and select the device,

2. then you download a firmware to the device, and

3. subsequently you scan for the device (with firmware) once more and select the device again.

   ➢ Proceed in the order mentioned.

4.4.1 Scanning for devices

➢ Select **Settings** > **Device assignment** in the navigation area.

↳ The dialog pane Device assignment is displayed.

➢ Under **Device selection**, select *suitable only*.

➢ Select **Scan**, to start the scanning process.

⇨ In the table all devices are displayed, which can be connected to the EtherCAT Master DTM via the preselected driver.
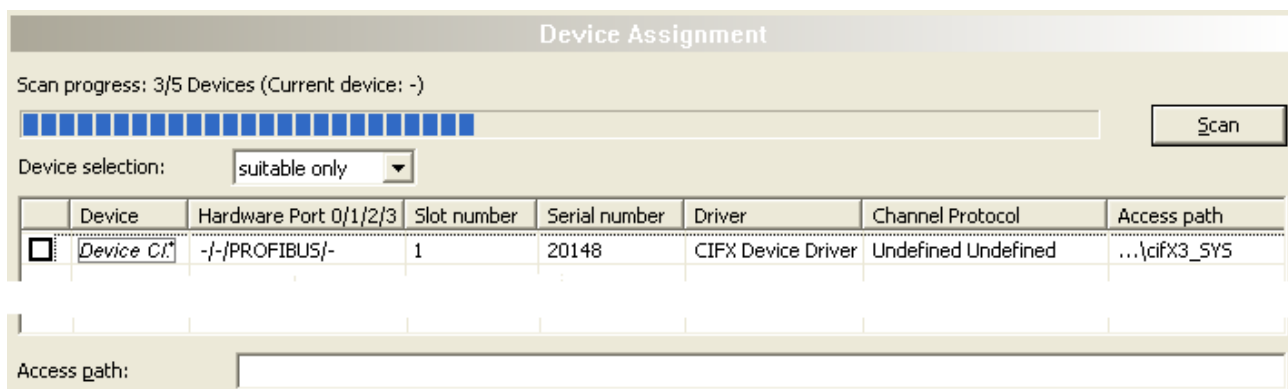
Figure 10: Device Assignment - detected devices (example: device without firmware)

> **Note:**
> For devices, which have been found via the **cifX device driver** in the column **Access path** the indication …\cifX[*0toN*]_**SYS** is displayed. This is correct, as long as a device did not get a firmware. After the firmware download has been completed, in the column Access path the indication …\cifX[0toN]_**Ch**[*0to3*] is displayed.

Parameter	Description	Range of value / value
Device selection	Selecting *suitable only* or *all* devices.	suitable only, all
Device	*The device name (= name of the device class) of the EtherCAT Master device appears.	
Hardware Port 0/1/2/3	Shows, which hardware is assigned to which communication interface.	
Slot number	Shows the **Slot number (card ID)**, preset at the PC card cifX via the **Rotary switch** s**lot number (card ID)**. The indication **n/a** means, that no **Slot nummer (card ID)** exists. This will occure if the PC card cifX is not equipped with a **Rotary switch slot number (card ID)**or for PC cards cifX equipped with a **Rotary switch slot number (card ID)** if the rotary switch is set to the value 0 (zero).	1 to 9, n/a
Serial number	Serial number of the device	
Driver	Name of the driver.	
Channel Protocol	Shows, which firmware is loaded to which device channel. The data for the used channel consists of the protocol class and the communication class. a.) For devices without firmware: Undefined Undefined, b.) For devices with firmware: Protocol name corresponding to the used Firmware	
Access path (last column on the right)	Depending on the used driver in the column **Access path** different data to the device is displayed. For the **cifX device driver** the following data is displayed: a.) For devices without firmware: …\cifX[*0toN*]_SYS, b.) For devices with firmware: …\cifX[*0toN*]_Ch[*0to3*]. cifX[*0toN*] = Board number 0 to N Ch[*0to3*] = Channel number 0 to 3	Depending on the device and on the driver: board or channel number, IP address or COM interface
Access path (at the lower side of the dialog pane)	If in the table a device is checked, under **Access path** (at the lower side of the dialog pane) the driver identification or depending on the used driver additional data to the device will be displayed. For the **cifX device driver** the following data is displayed: a.) For devices without firmware: …\cifX[*0toN*]_SYS, b.) For devices with firmware: …\cifX[*0toN*]_Ch[0to3]. cifX[*0toN*] = Board number 0 to N Ch[*0to3*] = Channel number 0 to 3	Driver identification (ID) Depending on the device and on the driver: board or channel number, IP address or COM interface

Table 11: Parameters of the Device Assignment

4.4.1.1   Selecting suitable only or all devices

All

➢ Under **Device selection** select *all*.

➢ Select **Scan**.
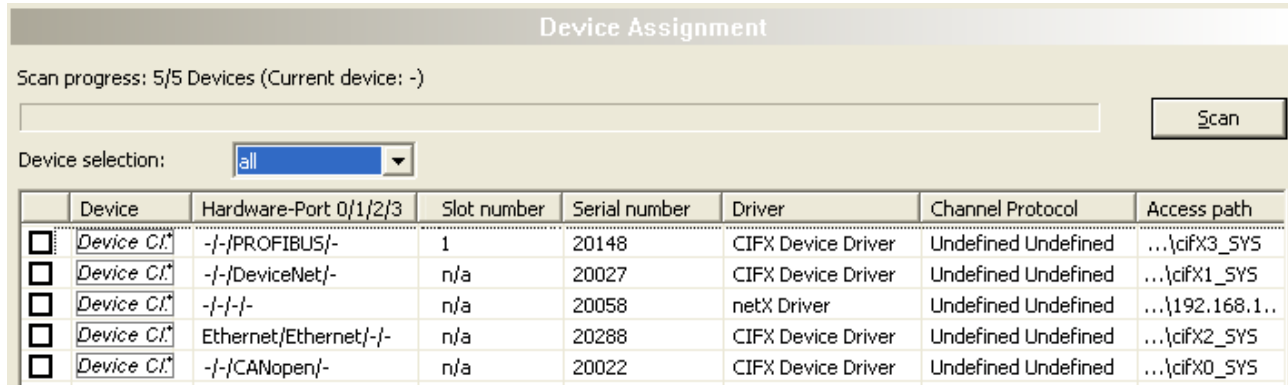
Figure 11: Device Assignment - detected devices (example: device without firmware)

↳ In the table all devices are displayed, which are attainable in the
network and which can be connected to a single DTM each via the
preselected drivers.

> **Note:**
> During a subsequent firmware download in the selection window
> **Select firmware file** all files from the selected folder are displayed,
> under **Files of type** *„All Files (*.*)"* is displayed and the check box
> **Validate the selected firmware file.** is unchecked.

suitable only

➢ Under **Device selection** select suitable only.

➢ Select **Scan**.

↳ In the table all devices are displayed, which can be connected to the
EtherCAT Master DTM via the preselected driver.

> **Note:**
> During a subsequent firmware download in the selection window
> **Select firmware file** only firmware files from the selected folder are
> displayed, under **Files of type** „Firmware Files (*.nxm)" or
> *„Firmware Files (*.nxf)"* is displayed and the check box **Validate the
> selected firmware file.** is checked.

4.4.2 Selecting the device (with or without firmware)

> **Note:**
> A connection with the EtherCAT Master DTM can only be established with *one* EtherCAT Master device.

To select the physical EtherCAT Master device (with or without firmware):

➢ Check the appropriate device.

🖎 Under **Access path** (below in the dialog pane) the access path to the device, e. g. the driver identification, or depending on the used driver additional access data of the device is displayed.

➢ Select **Apply**, to apply the selection.

Figure 12: Device Assignment - selecting device (example: device without firmware / one device selected)

> **Note:**
> Before an online connection from the EtherCAT Master DTM to the EtherCAT Master device can be established, a firmware must be loaded to the device and the device must be selected once more.

For further information refer to section *Selecting and downloading firmware* [▷ page 39] or to section *Selecting the device once more (with firmware)* [▷ page 37].

4.4.3 Selecting the device once more (with firmware)

> **Note:**
> For repeated download this step is omitted.

To select the EtherCAT Master device (with firmware and defined system channel) once more, proceed as described hereafter:

➢ Under **Device selection** select *all* or *suitable only*.

➢ Select **Scan**.

🖎 For selection *All*: The table shows all devices which can be reached in the network and which can be connected to a DTM via the preselected drivers.

⤷ For selection *suitable only*: In the table all devices are displayed, which can be connected to the EtherCAT Master DTM via the preselected drivers.

➢ Check the appropriate device.

➢ Select **Apply**, to apply the selection.

➢ Or select **OK**, to apply the selection and to close the DTM interface dialog.

➢ Connect the DTM to the device using the context menu (right mouse click).

Figure 13: Device Assignment - selecting device (example: devices with and without firmware / one device selected)

Note:

After the firmware download has been completed, for the devices which have been detected via the cifX Device Driver the following data is displayed:

In the column **Channel protocol**: The data for the firmware for the used channel

In the column **Access path** or under **Access path** (below in the dialog pane): The data: …\cifX[*0toN*]_Ch[*0to3*].

cifX[*0toN*] = board number 0 to N

Ch[*0to3*] = channel number 0 to 3

For further information how to establish an online connection from the EtherCAT Master DTM to the EtherCAT Master device, refer to section *Connecting/disconnecting device* [▷ page 88].

4.5   Selecting and downloading firmware

Requirements

> **Note:**
> Before downloading the firmware, you must select the driver and the Master device (with or without firmware) and assign the hardware to the device. For more information, see section *Overview settings for driver and device assignment* [▷ page 22].

How to proceed

You can use the dialog **Firmware download** to transfer a firmware to the device. Load the firmware into the device as described below:

1. Select the firmware file.

   ➢ In the navigation area, select **Settings** > **Firmware download**

   ↳ The dialog pane **Firmware download** is displayed.

Figure 14: Firmware download

Element	Description
Name	The path and name of the selected firmware file are displayed.
Version	The version and build version of the selected firmware file are displayed.
Browse…	Via "Browse..." you can select the firmware file to download.
	Note! If the device is not assigned to the hardware, the error message "The device is not assigned to the hardware!" is displayed.
Download	Via "Download" you can download the firmware to the device.

Table 12: Firmware download parameters

➢ Select **Browse...**.

↳ If the device is not assigned to the hardware, the error message "The device is not assigned to the hardware!" is displayed.
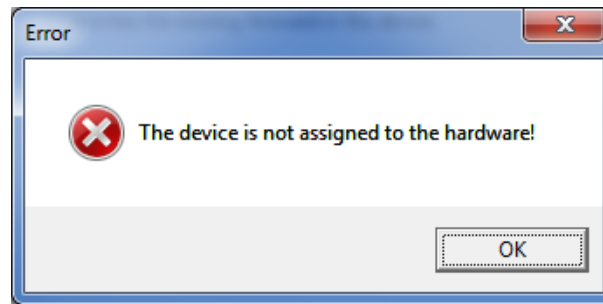
Figure 15: Error Message "The device is not assigned to the hardware!"

➢ Click **OK** and select and assign the master device as described in section *Assigning device (with or without firmware)* [▶ page 34].

↳ If a hardware has been assigned to the device, the selection window **Select firmware file** opens.

➢ Enlarge the selection window to view the columns **Hardware** and **Version**.
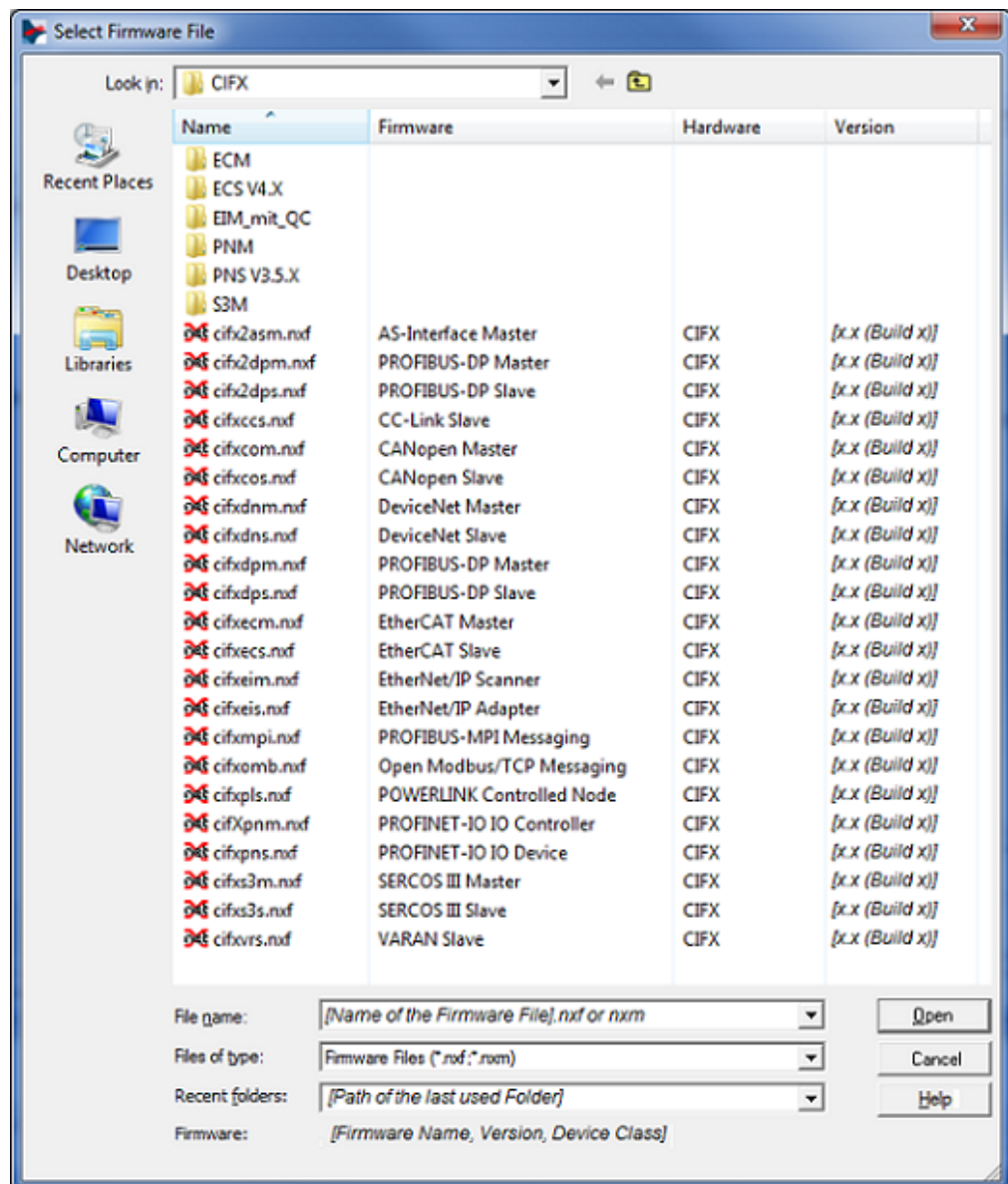
Figure 16: "Select firmware file" selection window (example CIFX)
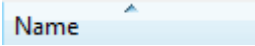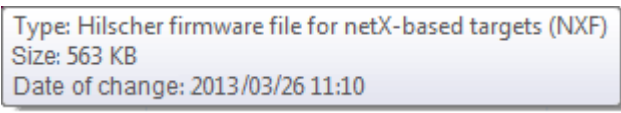
Parameter	Description	Range of value / value
Column **Name**	File name of the firmware file To sort the entries of the window **Select firmware file** by name click to the column head ![Name].	nxf, nxm
Column **Firmware**	Name of the firmware (consisting of the protocol name and the protocol class)	
Column **Hardware**	Device class of the assigned hardware	e. g. CIFX, COMX, COMX 51, NETJACK 10, NETJACK 50, NETJACK 51, NETJACK 100, NETTAP 50 (Gateway), NETTAP 100 (Gateway), NETBRICK 100 (Gateway)
Column **Version**	Firmware version	x.x (build x)
Tooltip	To view the tooltip display, move the mouse pointer over the selected firmware line. Type: Hilscher firmware file for netX-based targets (NXF) Size: 563 KB Date of change: 2013/03/26 11:10	
File of Type	*"All Files (*.*)"* if before in the **Device assignment** pane the list entry **all** was selected. *"Firmware Files (*.nxm)"* or *"Firmware Files (*.nxf)"* if before in the **Device assignment** pane under **Device selection** - **suitable only** was selected.	All Files (*.*), Firmware Files (*.nxm), Firmware Files (*.nxf)
Recent folders	Path of the recently opened folder	
Firmware	As soon as the firmware file has been selected, under **Firmware** the name, the version and the build version as well as the device class for the selected firmware is displayed.	Name, Version, Build Version, Device Class for the selected firmware
Help	Button to open the online help of the DTM.	

Table 13: Parameters "Select firmware file"

Further descriptions to the selection window **Select firmware file** are included in the context sensitive help (**F1** key) of the Microsoft Corporation.

> **Note:**
> After in the **Device assignment** pane under **Device selection** - **all** or **suitable only** has been set, during a subsequent firmware download in the selection window **Select firmware file** the following data is displayed or set:

(for the list box entry ->)	all	suitable only
In the selection window **Select firmware file**:	all files from the selected folder	only firmware files from the selected folder
Under **File of type***:	"All Files (*.*)"	"Firmware files (*.nxm)", "Firmware Files (*.nxf)"
Validation:	A restricted validation will be performed if the selected firmware is applied for the download.	A validation is made whether the firmware file is suitable for the EtherCAT Master DTM.
These settings in the selection window **Select firmware file** can also be changed manually.		

Table 14: In the selection window "Select firmware file"

➢ In the selection window mark the firmware file to be loaded using the mouse.

↳ In the selection window under **Firmware** the name and the version of the firmware are displayed.

➢ In the selection window select the **Open** button.

↳ A validation is made, whether the selected firmware file is suitable for the EtherCAT Master device.

↳ If a firmware file has been selected that is valid for the selected device, the selection window closes immediately (without dialog).

↳ If a firmware file has been selected that is not valid for the selected device, the query **Select firmware file** appears:
"Invalid firmware for assigned device!
[*detailed explanation*]
Should the firmware file nevertheless be applied for the download?"

Figure 17: Request Select firmware file - Example Invalid Firmware

> **NOTICE** **Invalid firmware**
>
> Loading invalid firmware files could render your device unusable.
>
> ➢ Only proceed with a firmware version valid for your device.
> ➢ Answer to the request with **No** and select a valid firmware.
> ➭ The selection window closes.

2. Transmit firmware to the device.

    ➢ Note the following safety information:

> **⚠ WARNING** **Communication stop caused by firmware update, faulty system operation possible, overwriting of firmware or loss of device parameters**
>
> Before you initiate a firmware download process, while the bus is still in operation status:
>
> ➢ Stop the application program.
> ➢ Make sure that all network devices are in a fail-safe condition.

> **NOTICE** **Firmware corruption or loss of parameters caused by power disconnect during firmware download**
>
> ➢ During firmware download process, do not interrupt the power supply to the PC or to the device, and do not perform a reset to the device!
> ➢ In the dialog pane **Firmware download** click to the **Download** button, to download the firmware.
> ➭ The request **Do you really want to download the firmware?** is displayed.
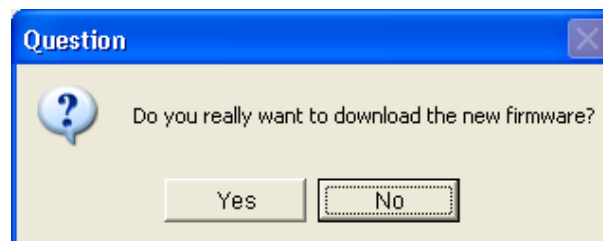
Figure 18: Request - Do you really want to download the firmware?

    ➢ Click **Yes**.

    ➢ If you are sure, that you have selected the appropriate firmware file answer to the request with **Yes** otherwise with **No**.

    ➭ During the download, a progress bar is displayed ("Download active, device performs initialization…"), in the status line a clock / green hook symbol is displayed and in the dialog pane **Firmware download** the button **Download** is grayed out.

    ➭ In the **Firmware download** dialog pane the path and name as well as the version of the selected firmware file are displayed.
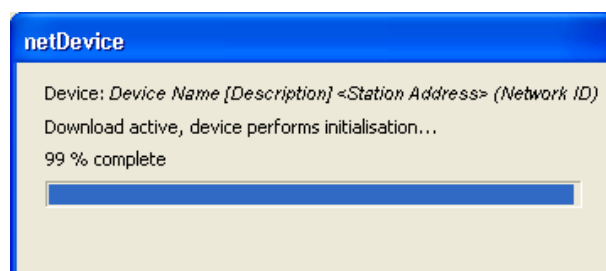
Figure 19: Firmware download - progress bar
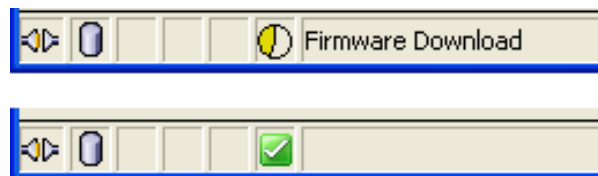
Figure 20: Clock symbol and hook symbol green
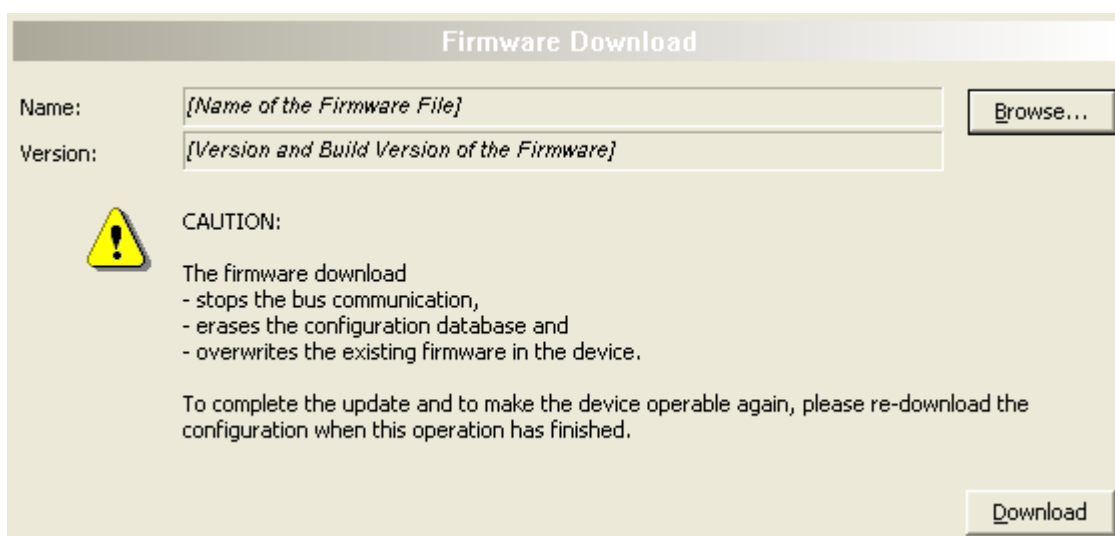
Figure 21: Firmware download - download

4.6   Licensing

To open the Licensing pane:

➢ In the navigation area select **Settings** > **Licensing**.

✎ The dialog pane **Licensing** is displayed.

Figure 22: Licensing

Using the license dialog, you can order licenses for **Master protocols** and **Utilities** and transfer them to your device. Further information on the license dialog is described in the section *Licensing* [▶ page 46].

5 Licensing

Using the license dialog, you can order licenses for **Master protocols** and **Utilities** and transfer them to your device.

5.1 Opening license dialog

You first open the **License** window.

> **Note:**
>
> You first need to assign the master device to the DTM. Only then the device data and the licenses already present in the device are displayed in the **License** dialog.

How to proceed:

1. Assign the master device to the DTM.

   ➢ In the FDT container **netDevice**, double click to the device icon.
   ➢ Select **Settings**> **Driver**.
   ➢ Select one or several drivers (checking).
   ➢ **Select Settings > Driver** > [*Name of the assigned driver*].
   ➢ Configure the driver settings if necessary.
   ➢ Select **Settings** > **Device assignment**.
   ➢ Under **Device selection**, select *suitable only* or all and click **Scan**.
   ➢ In the table, check the required device.
   ➢ Click **Apply**.
   ➢ Close the DTM configuration dialog via **OK**.

   For details to the device assignment, refer to section *Settings* [▶ page 22].

2. Open the **License** pane.

   ➢ Right-click on the device icon in the FDT container **netDevice**.
   ➢ From the context menu, select **Additional functions**> **License**.
   ⇨ The **License** window opens.
   ⇨ The title bar contains the notation of the device description: *Symbolic Name [Device Description] <Station Address > (#Network ID)*.

5.2 License dialog

In the **License** pane, you can:

- check, which licenses for Master protocols or Utilities are present in the device (Position (1) in the figure below),
- order licenses (Positions (2) to (11)),
- transfer license to the device (12),

Figure 23: License pane

> **Note:**
> To display further entries under License Type, move the scroll box (a) downwards or upwards. To display further entries under **Request form, please fill out**, move the scroll box (b) downwards or upwards.

5.3   Which licenses are present in the device?

Check, which licenses are present in the device.

How to proceed:

➢ Open the **License** pane as described under section *Opening license dialog* [▶ page 46].
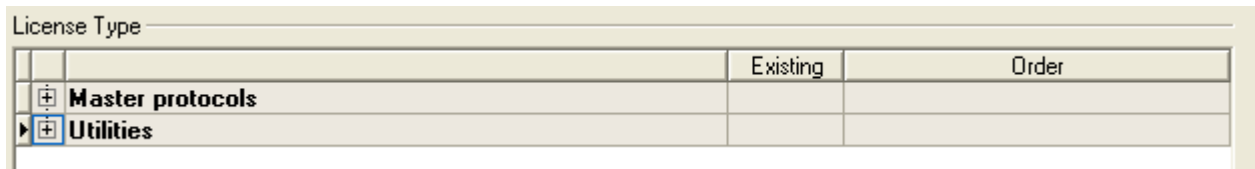
Figure 24: License pane - License Type

➢ Under **License type** click ⊞ at **Master protocols**.

↳ The **Master protocols** overview opens:

Figure 25: License pane – License Type / Master protocols

➢ Or click ⊞ at **Utilities**.

↳ The **Utilities** overview opens:

Figure 26: License pane – License Type / Utilities

↳ The column **Existing** indicates which licenses are present in the device.

Yes = License is present in the device.

No = License is not present in the device.

> **Note:**
> In newer versions of the present configuration software, under **License type** may be displayed additional licenses or other protocols that can be ordered later.

5.3.1 License for master protocols

One General Master License:

On the device maximally 1 communication protocol with master function can be implemented.

Two General Master Licenses:

On the device maximally 2 communication protocols with master function can be implemented.

The license includes the following master protocols:

- AS-Interface Master
- CANopen Master
- DeviceNet Master
- EtherCat Master
- EtherNet/IP Scanner
- PROFIBUS Master
- PROFINET IO RT Controller
- Sercos Master

5.3.2 Licenses for utilities

SYCON.net

OPC Server

QVis Minimum Size

- QVis Standard Size
- QVis Maximum Size
- CoDeSys Minimum Size
- CoDeSys Standard Size
- CoDeSys Maximum Size

For the Utilities QVis and CoDeSys only one license can be selected alternatively:

- *Minimum Size*,
- *Standard Size* or
- *Maximum Size*.

5.4 How to order a license?

To order a license, proceed as follows:

1. Open the license dialog.
   - ➢ Refer to Section *Opening license dialog* [▶ page 46].
2. Select the required licenses.
   - ➢ Refer to Section *Selecting license(s)* [▶ page 50].
3. Enter the ordering data.
   - ➢ Refer to Section *Ordering data* [▶ page 51].
4. Place your order.
   - ➢ Refer to Section *Ordering the license* [▶ page 53].

5.5 Selecting license(s)

You can select licenses for Master protocols and / or Utilities.

1. Selecting license(s) for Master protocol(s):
   - ➢ In the **License** pane under **License type** click ⊞ at **Master protocols**.
   - ➢ Under **Order** check as many licenses must run simultaneously on your device:
     One General Master License or
     Two General Master Licenses.
2. And/or select license(s) for utility(utilities):
   - ➢ In the **License** pane under **License type** click ⊞ at **Utilities**.
   - ➢ Under **Order** check the required utility(utilities)
     (*single or several*):
   - • SYCON.net
   - • OPC Server
   - • QVis Minimum Size*
   - • QVis Standard Size*
   - • QVis Maximum Size*
   - • CoDeSys Minimum Size**
   - • CoDeSys Standard Size**
   - • CoDeSys Maximum Size**

   For *) and **) minimum size, standard size or maximum size can be selected only as an alternative.

5.6 Ordering data

- Device information

The "Device Information" required for the order are read from the device and automatically filled in the order.

- Ordering Data

➢ Enter the Ordering Data into the **License** pane.

➢ Enter the **Data to manage the Order** (therefore refer to section *Data to manage the order (license information)* [▶ page 52]).

5.6.1 Device information (ordering data read from the device)

The following ordering data is read from the device and displayed in the **License** pane:

- Manufacturer
- Article number
- Serial number
- Chip type
- Step (chip revision)
- Romcode revision
- Checksum (checksum of the device data)

The gray fields under **Request Form**, **please fill out** > **Value** contain the ordering data read from the device:

Name	Value
Manufacturer*	0x0001
Article number*	1251100
Serial number*	20007
Chiptype*	0x00000001
Step*	0x00000000
Romcode revision*	0x00000000
Checksum*	G

Request Form, please fill out

Fields marked with '*' are mandatory.
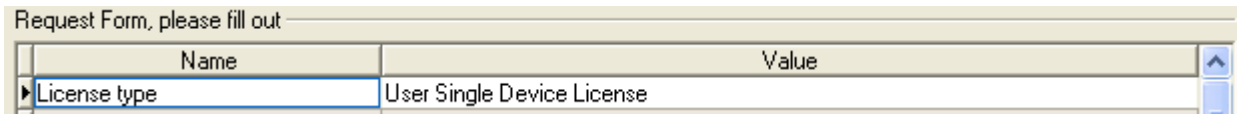
Figure 27: License pane - request form, please fill out / device information

These ordering data read out from the device are displayed automatically from the device.

5.6.2 Data to manage the order (license information)

For your order, you must enter the following data to the **License** pane:
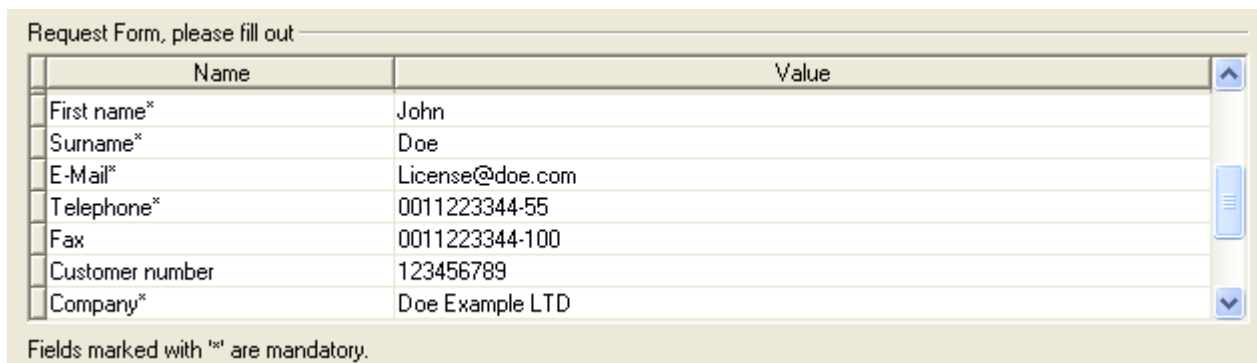
- License type (User Single Device License).

Figure 28: License pane - Request form, please fill out / License type

➢ Select the license type under **Request form, please fill out > Value**, (for future application, currently only *User Single Device License* can be selected).

- Mandatory data to the order request (editable fields):
  – First name
  – Surname
  – E Mail (address, to which the license download link shall be send.)
  – Telephone
  – Company
  – Address
  – Country
  – City, State, Zip

Figure 29: License pane - request form, please fill out / mandatory data

➢ Enter all mandatory fields under **Request form, please fill out > Value** (marked with*).

- Additional order data, not mandatory (editable fields):
  – Fax
  – Customer number
  – Order number
  – Value added tax identification number

➢ Under **Request form, please fill out > Value** enter all fields for the additional data, which is not mandatory.

5.7 Ordering the license

Place your order in the **License** pane. Therefore:

Figure 30: License pane – selecting the subsidiary / ordering / contacts

➢ Select the subsidiary (4), to which the order shall be send.

➢ Place the order:

- by **E-Mail** (5),

- or by **Fax** (6) or by **Telephone** (7),

- or in a **file** (8).

The **Contact data** of the selected subsidiary is displayed under the positions (9), (10) and (11).

5.7.1   Ordering the license by e-mail

You can place your order by e-mail.

➢ In the **License** pane, click **e-mail… (5)**.

✎ The order e-mail **License request** opens:

Figure 31: Example: Order e-mail License request

The order e-mail **License request** contains:

- the **E-mail…** of the selected subsidiary (a),

- the automatically generated **XML file** (b) *EmailOrderRequest_-[Devicenumber]_[Serialnumber].xml* with a summary info of the **order information**,

- the **Order address** (c),

- the **License information** (d),

- the **License type** (e),

- the **Device information** (f),

- the **ordered licenses** (g).

➢ Send the order e-mail **License request**.

⇨ The order process is complete.

5.7.2   Ordering the license by fax or by telephone

You can place your order by fax or by telephone.

➢ In the **License** pane, click **Print fax form** (6) or **Telephone…** (7).

↳ The summary of the ordering data *PrintOrderRequest_[Devicenumber]_[Serialnumber].html* is opened in a browser window.

> **Note:**
> If your browser does not display the order data or the window **Move element** or **Copy element** is displayed, check the safety settings of your system.

netX License Order Form

Doe Example LTD
2000th Rd
ⓒ
NY 11417
U. S.
fax: +11223344-100

Licensee Information ⓓ

First Name:	*John*
Surname:	*Doe*
e-Mail:	*License@doe.com*
Telephone:	*0011223344-55*
Fax:	*0011223344-100*
Customer No:	*123456789*
Company:	*Doe Example LTD*
Address:	*2000th Rd*
Country:	*U. S.*
City Zip:	*NY 11417*
Order Number:	*987654321*
Tax Ident. Number:	*test*

License Type ⓔ
User Single Device License

Device Information ⓕ

Manufacturer:	*0x0001*
Device Number:	*1251100*
Serial Number:	*20007*
Chip Type:	*0x00000001*
Step:	*0x00000000*
Romcode Revision:	*0x00000000*
License Flags 1:	*0x7f*
License Flags 2:	*0x0*

Ordered Licenses ⓖ
Master Protocols

- One General Master License
- AS-Interface Master
- CANopen Master
- DeviceNet Master
- EtherCat Master
- EtherNet/IP Scanner
- PROFIBUS Master
- PROFINET IO RT Controller
- SERCOS III Master
- Sercos III Master

Utilities

- SYCON.net

Date: _____   Signature: _____

Figure 32: Example: Order data form PrintOrderRequest

The order data form contains:

- the **Order address (c)** ,
- the **License information** (c),
- the **License type** (e),
- the **Device information** (f),
- the **ordered Licenses** (g).
- ➢ Print the order data form, sign it and send it by fax.
- ➢ In the **License** pane, use the Fax number (10), which is displayed after the subsidiary, was selected.

Or:

- ➢ Keep ready the data form and communicate the order data via telephone.
- ➢ In the **License** pane, use the telephone number (11), which is displayed after the subsidiary, was selected.
- ⇨ The order process is complete.

5.7.3 Exporting license request to a file

If you are working on a process computer without an e-mail client, you can export your order information to a file, save the file to a removable disk and place your order manually via e-mail from a different PC.

- ➢ In the **License** pane, click **Export license request…** (8).
- ↳ The window **Browse for folder** is displayed.
- ➢ Choose for or create a new folder on a removable disk.
- ➢ Save the automatically generated **XML file** *EmailOrderRequest_- [Devicenumber]_[Serialnumber].xml* with a summary info of the **order information** to this folder.
- ➢ Send this file from a PC with an e-mail client manually via e-mail.
- ➢ Therefore use an e-mail address, which is displayed after the subsidiary was selected in the **License** pane (see Position (9), figure *License pane* [▸ page 47]).
- ⇨ The order process is complete.

5.8   How to get the license and transfer it to the device

> **Note:**
> License files can only be delivered via e-mail. The e-mail contains a link to download the license file.

According to the license you ordered, you will receive an e-mail containing a **Link to download the license file**. This leads to a server PC on which the license file is provided. Using the received link you will have to save the license file on your PC and then transfer the license to your device. If your e-mail client is on another PC as your device, you must save your license file e. g. to an USB stick.

Steps on how to proceed

1. Save the license file to a PC or a disk.
   - ➢ Click to the **Link to download the license file** in the e-mail.
   - ➢ Save the license file *.nxl* to a PC or a removable disk.

2. Download the license file to the device.
   - ➢ Respectively connect the removable disk with the license file to the PC, which is connected to your device.
   - ➢ In the **License** pane, click **Download license** (12) in the **License** pane in the configuration software.
   - ↳ The file selection window **Open** is displayed.
   - ➢ Therein select the license file *netX License Files (*.nxl)*.
   - ➢ Click **Open**.
   - ↳ The license file is transferred to the device.
   - ↳ After this the license is present in the device and is activated with the next device reset.

> **Note:**
> To activate the license in the device for the first time, a device reset is required.

3. Activate device reset
   - ➢ To check whether the license has been activated, follow the steps in section *Which licenses are present in the device?* [▶ page 48].

6 Configuration

6.1 Overview of configuring device parameters

Under "Configuration", you can configure your device.

- In the **General** window, general settings for the EtherCAT Master can be adapted (a description, the device name, the parameters synchronization and redundancy).

- Under **Process Data Handshake**, the method to be used for the process data handshake is selected.

- In the **Topology** window, the network topology can be edited in the connection view.

- Under **Mailbox**, (for slaves with configurable CoE parameters) entries can be made on the 'Start-up' and 'Userdef Start-up' tabs.

- The parameters for FMMU and the Sync-Manager can be set in the **FMMU/SyncMan** window.

- The **Process data** pane serves as a process data interface for the EtherCAT Master DTM to the outside.

- The **Address table** shows a list of all addresses used in the process image memory.

- In the **Init Commands** window, the Init commands can be edited according to the requirements.
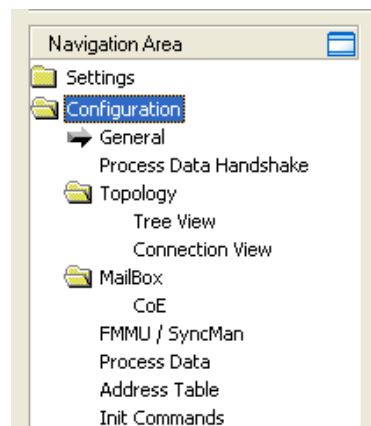
Figure 33: Navigation area - Configuration

Configuring device parameters

The following steps are required to configure the parameters of the EtherCAT Master device using the EtherCAT Master DTM:

1. Select the method for the process data handshake.
   - ➢ In the navigation area, select **Configuration** > **Process data handshake**.

2. Recreate the network topology.
   - ➢ In the navigation area, select **Configuration** > **Topology**.
   - ➢ In the graphical editor, recreate the current network topology according to the requirements. To do this, use the connection view.

3. Set parameters for the FMMU and the sync manager.

   ➢ In the navigation area, select **Configuration** > **FMMU/SyncMan**.

4. Setting process data

   ➢ In the navigation area, select **Configuration** > **Process data**.

   ➢ Set symbolic names for the configured modules or measuring signals.

   ➢ Apply all settings.

5. If necessary, set the device address.

   ➢ In the navigation area, select **Configuration**> **Address table**.

6. Edit the table of init commands.

   ➢ In the navigation area, select **Configuration > Init commands**.

7. Close the master DTM configuration dialog.

   ➢ Click **OK** to close the master DTM configuration dialog and save the configuration.

8. Download configuration parameters to the EtherCAT Master device.

   ➢ Adhere to the necessary safety precautions to prevent personnel injury and property damage that may occur in consequence of a communication stop or in consequence of a mismatching system configuration. You find the corresponding safety information in section *Safety messages on firmware or configuration download* [▶ page 15].

→ **Note:**

To transfer the configuration to the EtherCAT Master device, download the data of the configuration parameters into the EtherCAT Master device. See also section *Download configuration* [▶ page 90].

For further information about configuration, see the sections:

- *General* [▶ page 60]
- *Process data handshake* [▶ page 63]
- *Topology* [▶ page 65]
- *Mailbox* [▶ page 71]
- *FMMU/Sync Man* [▶ page 78]
- *Process data* [▶ page 81]
- *Address table* [▶ page 83]
- *Init commands* [▶ page 85]

6.2 General

The **General** dialog pane shows the current device name (editable) and the description of the EtherCAT Master, and also allows performing basic settings (synchronization mode, redundancy, timing, target state).

➢ Select **Configuration** > **General** in the navigation area.

Figure 34: Configuration > General

Parameter	Description	Range of Value / Value
Name of Station	Network name of the EtherCAT Master station. Must be a DNS compatible name.	1 - 240 characters
Device name	Symbolic name of the EtherCAT Master DTM.	
Synchronization mode	EtherCAT Slave devices can operate in different synchronization modes. There is the choice between three synchronization modes. These modes are required for the distributed clocks features.	Freerun only Freerun with DC DC Synchronized
Reference clock	In this field, the DTM automatically displays the device name with appended *AutoInc* and *Station Addresses'* values.	
Activate redundancy	This checkbox shall be marked if working with redundancy is intended. If you use distributed clocks or do not intend working with redundancy, then do not mark this checkbox.	checked, not checked Default: not checked
Freerun cycle (µs)	Cycle time of the EtherCAT Master running free. This parameter is only relevant when running the EtherCAT Master firmware V3 and configuring it via `*.nxd` file (not `*.xml`).	>= 250 µs Default: 1000 µs

Parameter	Description	Range of Value / Value
Target state	Desired state of the EtherCAT Master. This parameter is only relevant when running the EtherCAT Master firmware V3 and configuring it via `*.nxd` file (not `*.xml`).	Init Pre-Operational Safe-Operational Operational

Table 15: Parameters of the General dialog pane

➢ Edit the text in the **Description** field, to change the name of the device according to your needs.

The following synchronization modes can be selected under **Synchronization** > **Mode**:
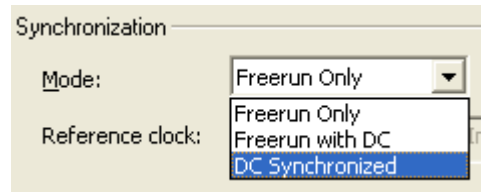
Figure 35: EtherCAT Master DTM, "General" dialog pane, synchronization modes

These have the following meaning:

- *„Freerun Only"* -> no synchronization
- *"Freerun with DC"* -> synchronized on SyncManager event when process data is written (read)
- *„DC Synchronized"* -> synchronized on DC sync event

The following actions only apply to the 'EtherCAT Master firmware V3'.

➢ In case *Freerun with DC* or *DC Synchronized* is activated, the first EtherCAT Slave with DC enabled will be used as the reference clock. EtherCAT Master cyclically has to read the bus time from the appropriate register of the clock master and write this value in the corresponding registers of all other DC slaves.

➢ Adjust the desired cycle time of the EtherCAT Master for free running operation. Values lower than 250 μs are not permitted. Avoid larger values of the free running cycle time than 5000 μs as there is no experience with such long cycle times, these have not been tested.

➢ Adjust the desired target state of the EtherCAT Master.

Synchronization modes for EtherCAT Slave devices

In general, there are three synchronization modes:

- Free run – Local timer: The EtherCAT Slave exclusively uses local timers and does not synchronize with any external time sources at all.
- Sync. with SM2/3 SyncManager Event: The EtherCAT Slave synchronizes with sync managers for output or input.
- Sync. with DC Sync Event (Sync0/Sync1 Hardware Signals): The EtherCAT Slave synchronizes with the Sync0/Sync1 hardware signals by the EtherCAT Slave hardware.

Error messages

The following error messages may be issued when errors occur while specifying data:

Invalid cycle time for free run (i.e. value too small (< 250) or too large (>65535)):
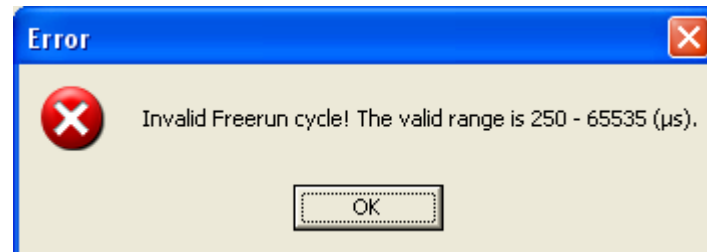
Figure 36: Error "Invalid freerun cycle"

Action to be done:

Put in a value within the specified range of permitted values between 250 and 65535.

When synchronization mode is [Freerun with DC] or [DC Synchronized], it is not allowed to activate redundancy!
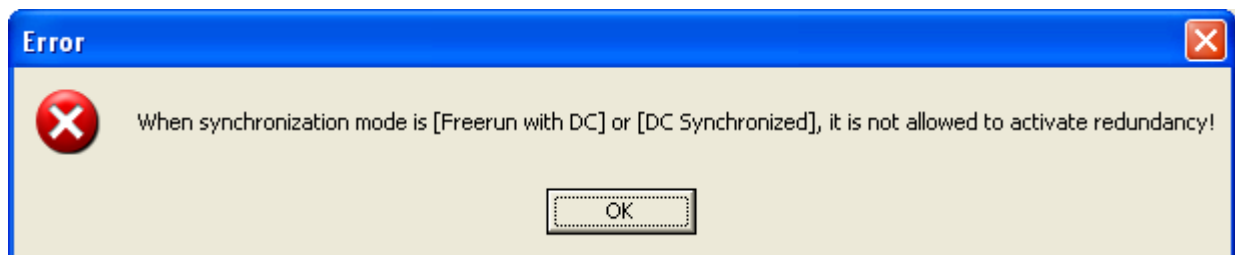
Figure 37: Error "When synchronization mode is [Freerun with DC] or [DC Synchronized], it is not allowed to activate redundancy!"

Action to be done:

Distributed clocks and redundancy exclude each other. Decide, whether you prefer working with distributed clocks or with redundancy and select the settings accordingly!

6.3   Process data handshake

Various types of process data handshakes are used for setting the handshake of the process data for the netX EtherCAT Master device. The selection of the used process data handshake is important for the correct data exchange between the application program and the device.

➢ Select **Configuration** > **Process data handshake** in the navigation area.
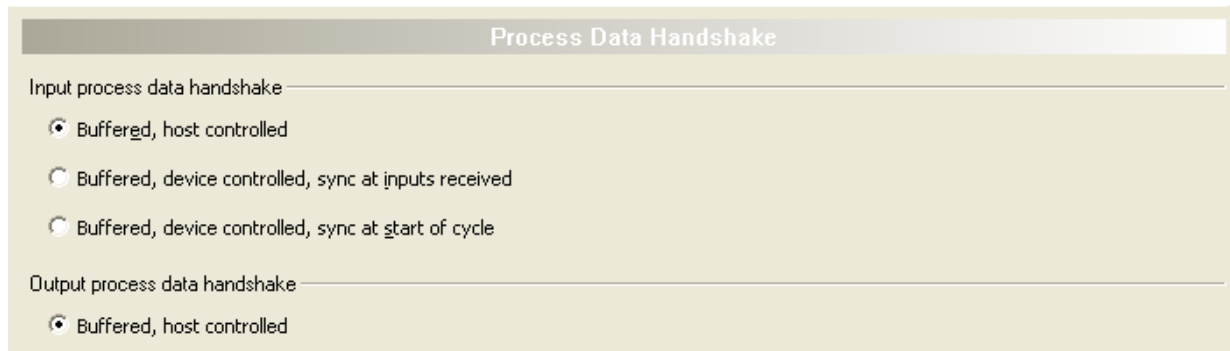
Figure 38: Configuration > Process data handshake

Process data exchange between the netX-based protocol stack (device) and host-based application (host) can be controlled either by the one or by the other side over process data handshakes in DPM:

The host application can exchange the process data with the protocol stack over DPM in host-controlled mode.

In **buffered mode without synchronization**, the data exchange between netX based protocol stack and host, based application is decoupled from each other (not synchronized). In this case, the stack handles the reception and transmission of the data from/to the bus/network automatically and uses buffers to handle data consistently. Independently of the bus/network state (i.e. cycle start, incoming data, requests etc.) the host application can access the already completely received data or provide to netX the data required to send, which will be processed with the next bus cycle.

In **buffered mode with synchronization**, the process data exchange between netX based protocol stack and host, based application is linked (synchronized) to the bus communication. In this case, the stack handles the receiving and transmission of the data from/to the bus/network and process data exchange with the host application is synchronized with protocol specific bus/network event.

EtherCAT Master supports the following handshake modes:

- buffered host controlled mode without synchronization
  (Default, the data exchange by is decoupled from bus cycle.)

- buffered device controlled mode with synchronization at input received.
  (Mode 1)

- buffered device controlled mode with synchronization at start of cycle.
  (Mode 2)

The latter two process data handshake modes are only applicable for input data handshake. These are explained in the following:

Mode 1
(Device controlled mode with synchronization at input received)

Mode 1 provides the synchronization event to the host after all frames were transmitted and received by the master. Master updates the input image in DPM (Bus -> Host) with received data and toggles handshake. This handshake toggle serves as the synchronization event (i.e. interrupt) for the host application to start the "read-calculate-write" process.
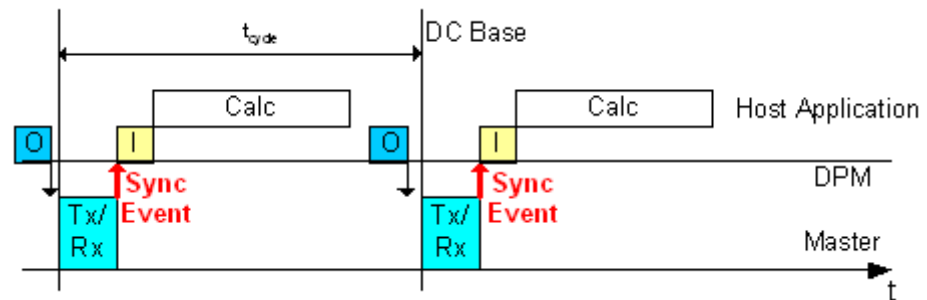
Figure 39: Data exchange timing in mode 1

> **Note:**
> EtherCAT master starts the bus cycle based on the internal timer
> EtherCAT master sends the old data again if the host application does not finish the data update in DPM until the start of the next bus cycle. Diagnosis is reported in this case.

Mode 2
(Device controlled mode with synchronization at start of cycle)

Mode 2 provides the synchronization event to the host at bus cycle start. Before that, the master has updated the input image in DPM (Bus -> Host) with data received in previous cycle and toggles handshake. This handshake toggle serves as the synchronization event (i.e. interrupt) for the host application to start the "read-calculate-write" process. In the same time starts the master to transmit and receive the frames on the bus.
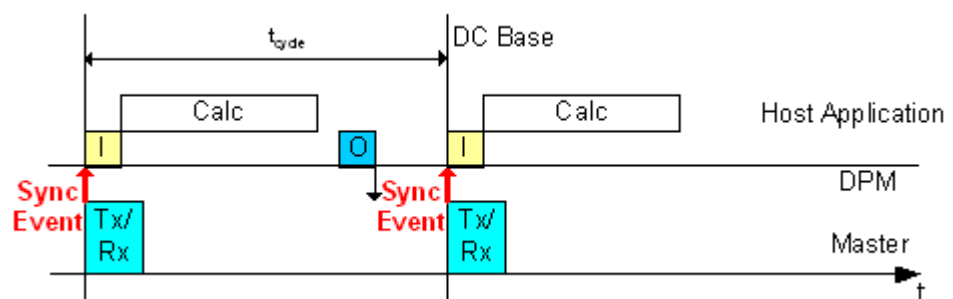
Figure 40: Data exchange timing in mode 2

> **Note:**
> EtherCAT Master starts the bus cycle based on the internal timer.
> EtherCAT Master sends the old data again if the host application does not finish the data update in DPM until the start of the next bus cycle. Diagnosis is reported in this case.

6.4   Topology

6.4.1   Tree view

The dialog pane **Topology, Tree view** displays the 'Tree view' of the topology providing an overview about the structure of the EtherCAT network.

➢ Select **Topology** > **Tree view** in the navigation area.

✎ The upper part of the dialog pane shows the structure tree of the current configuration of the EtherCAT network.
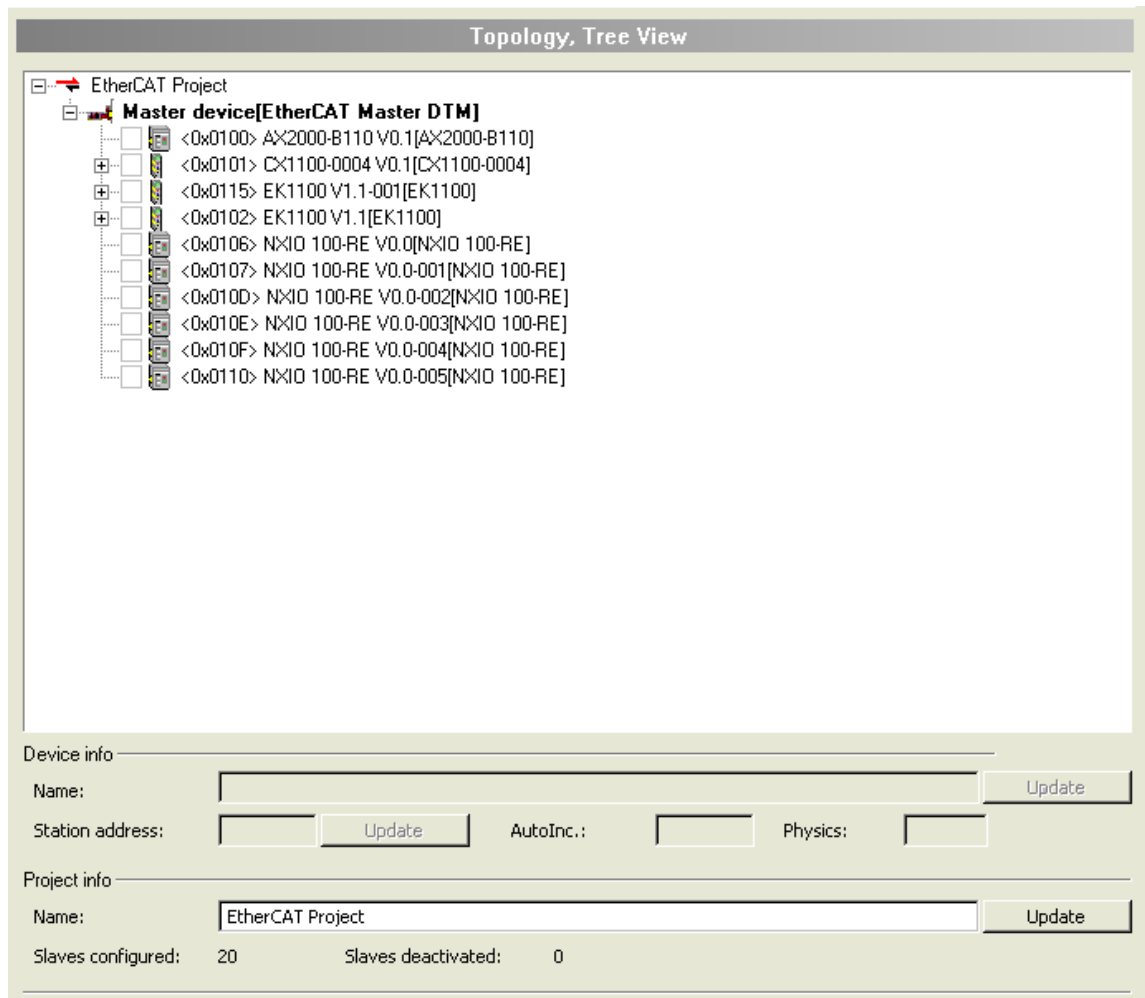
Figure 41: Topology >Tree view

The first element of the tree is the EtherCAT project, which is located on the highest hierarchy level. One level below you find the EtherCAT Master device. A further level below you can find simple and complex EtherCAT Slaves.

For all slaves the station address and both the short and the long form of the device name are included in the tree view. Complex slaves can be recognized by expandable entries while the entries belonging to simple slaves cannot be expanded.

Left of the device entry in the tree there is a checkbox. Checking it denotes deactivating the slave that is the slave device will be excluded from the configuration, removing also all ports' connection information. If you do so,

the device entries' checkbox is marked with a red cross. In order to activate the device again, it is just necessary to uncheck the box and reconnect the device as needed.

If you click at a slave's entry in the screen with right mouse button, a context menu appears.
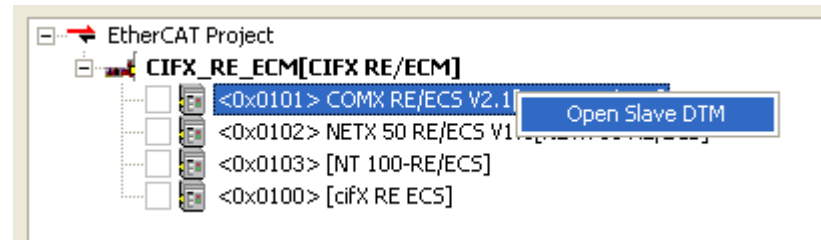
Figure 42: Context menu with the entry 'Open Slave DTM'

Choosing the *'Open Salve DTM'* entry will open the configuration dialog of the corresponding EtherCAT Slave's DTM. This allows quickly adjusting slave parameters when checking the EtherCAT Master's configuration.

If you click at any entry in the screen with left mouse button, the entry will be highlighted. If the entry was not the project entry, the name of the device is displayed in an editable field within the *'Device info'* area of the dialog pane. This allows changing the name of device, if necessary. Changes made by editing the field are stored by clicking the 'Update' button. The corresponding entries in the tree view of the network topology are adapted accordingly then. An *'Update'* button is available for the following input fields:

- Name in ‚Device info' area

- Station address in ‚Device info' area

- Name in ‚Project info' area

About possible errors during updating, see below.

The *'Device info'* area also provides the following information besides the name of the device:

- The 'Station address' (only if an EtherCAT Slave has been selected previously). This field is also editable and has an 'Update' button allowing to store changes, if necessary.

- The read-only *'Auto Increment'* value according to the EtherCAT specification. This field is not editable.

- The read-only field *'Physics'* denotes the physical medium (and thus the port type) used for the connections. In addition, this field is not editable.

Physics in the context of EtherCAT port configuration is described by a sequence of up to four characters (depending on the number of ports) indicating the port type(s) to be applied. The coding is as follows:

Physics	Port type
K	E-Bus
Y	100Base-TX
F	100Base-FX

Table 16: Coding of parameter "Physics"

The ‚*Project info'* area always shows the name of the project in an editable field, again along with a respective ‚*Update'* button. It also displays both the number of configured and of deactivated slaves.

The following error messages may be issued when errors occur while updating:

1. Wrong station address (i.e. value too small or too large):

Figure 43: Error "Wrong station address"

Action to be done:

➢ Put in a value within the specified range of permitted values between 0 and 65535.

2. Wrong station name:
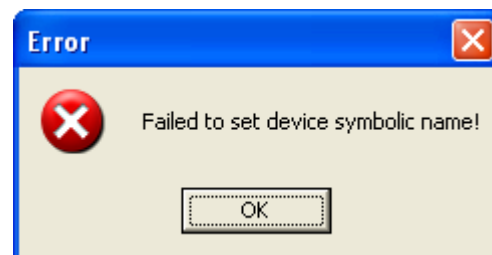
Figure 44: Error "Wrong station name"

Action to be done:

➢ Put in a valid name (i.e. not empty, does not contain any special characters).

6.4.2   Connection view

The dialog pane **Topology**, **Connection view** displays the topology tree in connection view allowing you to check how all EtherCAT Slave devices configured for use with the EtherCAT Master are connected.

➢ Select **Topology** > **Connection view** in the navigation area.

✎ A screen similar to the following will appear:
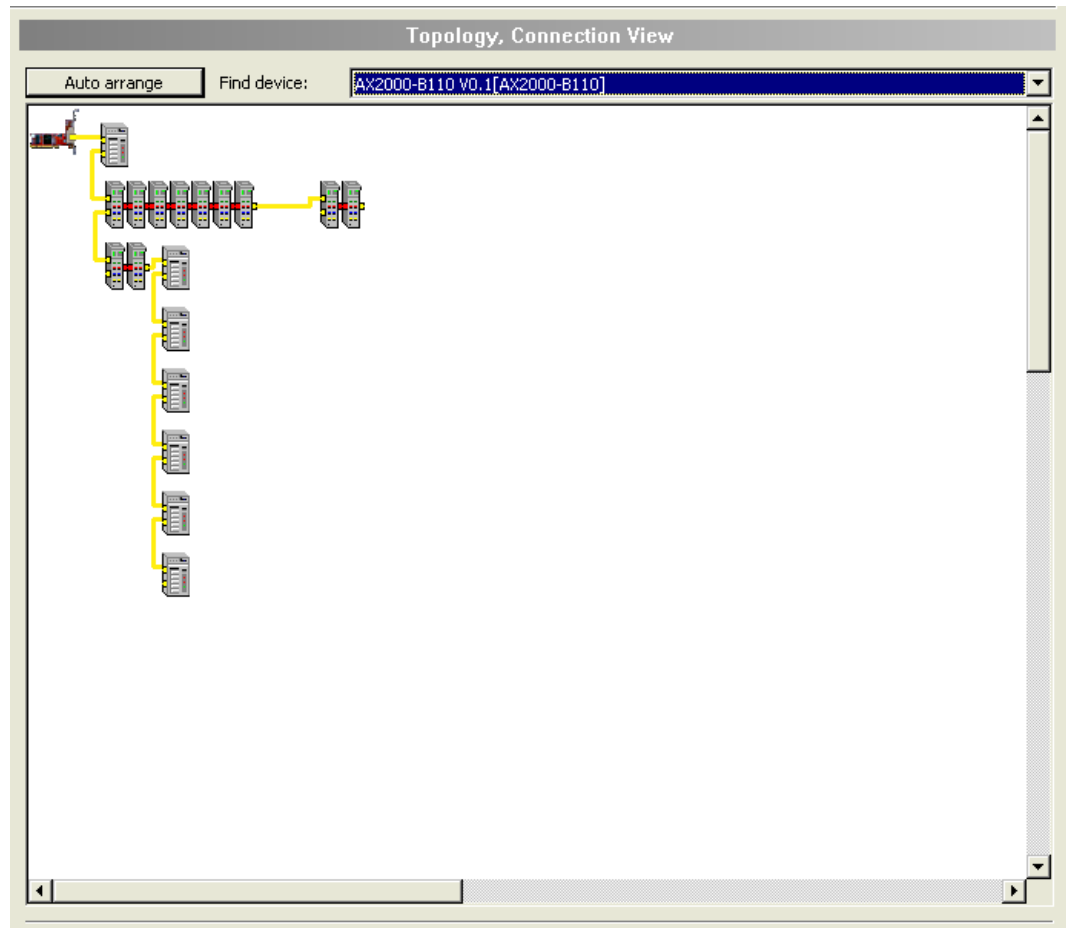
Figure 45: Topology > Connection view

The color coding is:

• Yellow lines indicate Ethernet connections (such as 100-TX).

• Red lines indicate Beckhoff E-Bus connections.

> **Note:**
> To fix or pin a device's position in the view, right-click on it and choose the option *'Pin device'* from the context menu appearing then. Fixed devices are marked with a blue arrow symbol. To unpin it, right-click on it and choose the option *'Unpin device'* from the context menu in the same manner, also see below.

In order to restore the initial state of the arrangement after reordering EtherCAT Slave devices of the EtherCAT network, do the following:

➢ Click at the *'Auto arrange'* button

↳ The initial state of the arrangement is restored then.

The *'Find device'* functionality allows you to easily locate any EtherCAT Slave device in the graphical representation of the EtherCAT network topology.

➢ Open *'Find device'*.

↳ All devices of the network are listed there.

➢ Select the name of the desired device.

↳ An additional lamp symbol will indicate the location of the chosen device in the connection view of the EtherCAT network topology

Multiple tool tip for devices is available which is composed of the title *"Selected device's info"*.

Selected Device's Info

Descr.: NT 100-RE/ECS V1.0[NT 100-RE/ECS]
Physics: YY
AutoInc: 0xFFFE
Logical: 0x103

Figure 46: "Selected device's info"

The following information about this device is displayed:

Item	Description
Descr.	Description, i.e. long and short form of device name
Physics	Used port type, see below
AutoInc	Auto increment address as described in the EtherCAT specification.
Logical	Logical address (i.e. station address)

Table 17: Information displayed when pointing at a symbol of a device

Physics in the context of EtherCAT port configuration is described by a sequence of up to four characters (depending on the number of ports) indicating the port type(s) to be applied. The coding is as follows:

Physics	Port type
K	E-Bus
Y	100Base-TX
F	100Base-FX

Table 18: Coding of parameter "Physics"

In order to open the context menu of any EtherCAT Slave device, proceed as follows:

➢ Perform a mouse click with the right mouse button at the graphical representation of the desired EtherCAT Slave device.

✎ The context menu will be opened.

If the selected EtherCAT Slave device has not been fixed previously (i.e. it has not been marked with a blue arrows), the context menu offers the following entries
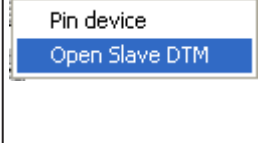
Pin device Open Slave DTM	*'Pin device'*
	Fixes (or pins) the device in the connection view.
Pin device *Open Slave DTM*	*'Open Slave DTM'*
	If you choose this context menu option, the configuration dialog of the corresponding EtherCAT Slave's DTM will be opened. This allows quickly adjusting slave parameters when checking the EtherCAT master's configuration.

Table 19: Context menu entries for unpinned EtherCAT Slave devices in connection view

If the selected EtherCAT Slave device has been fixed previously (i.e. it has been marked with a blue arrows), the context menu offers the following entries
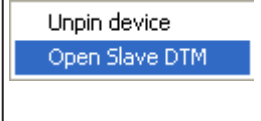
Unpin device Open Slave DTM	*'Unpin device'*
	Inhibits fixing (pinning) the device in the connection view.
Unpin device *Open Slave DTM*	*'Open Slave DTM'*
	If you choose this context menu option, the configuration dialog of the corresponding EtherCAT Slave's DTM will be opened, see above.

Table 20: Context menu entries for pinned EtherCAT Slave devices in connection view

6.5 Mailbox

6.5.1 CoE

The **CoE** dialog pane displays information about the CoE (*CANopen over EtherCAT*) functionality for acyclic, mailbox-based communication.

➢ Select **Mailbox** > **CoE** in the navigation area.
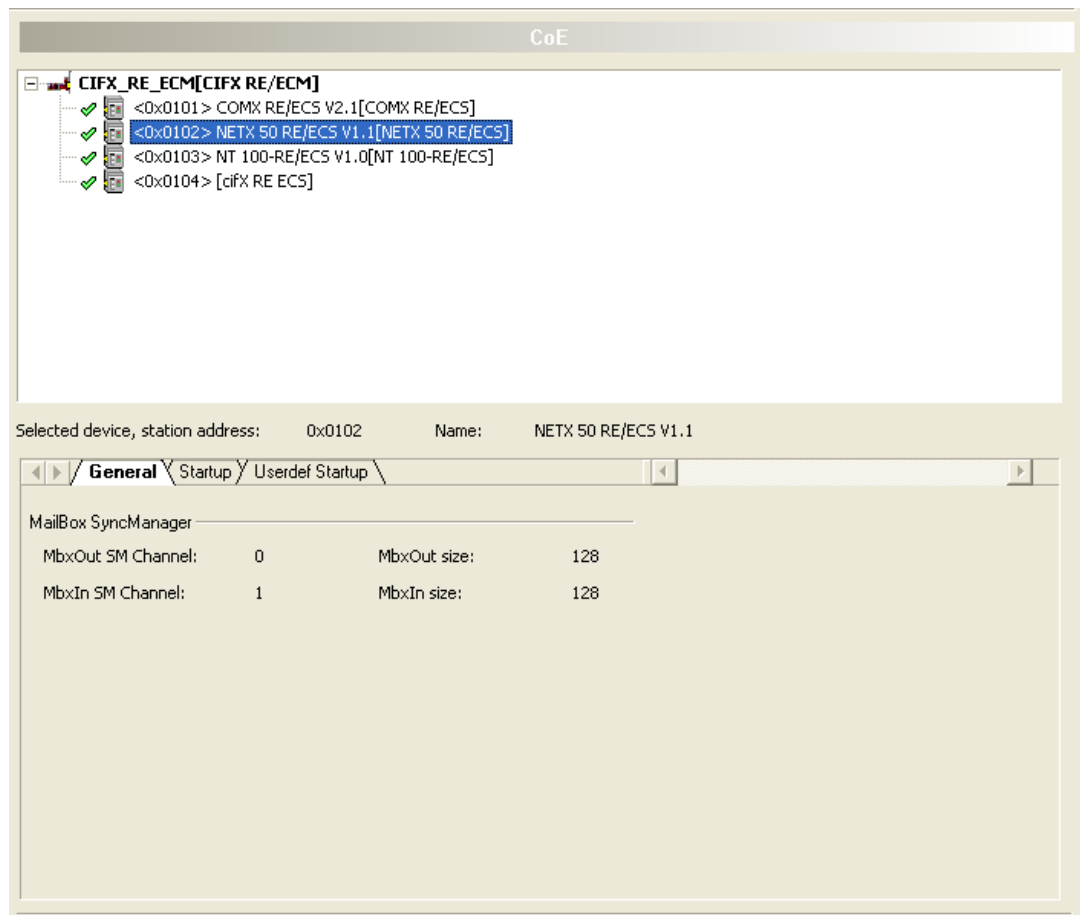
Figure 47: Mailbox > CoE

The upper part of the dialog pane displays a topology tree allowing an easier access to the configured slaves.

For each EtherCAT slave device, the station address and name of the slave will be displayed. Items, which are deactivated, are present in the tree structure, but the description text is displayed in red color.

Configurable slaves with respect to CoE are marked with a check mark (indicated in green color). If you select the master or a slave which has not been checked, then the lower part of the dialog pane will be simply grey and the text "No CoE configuration needed" will appear in the center of this area:
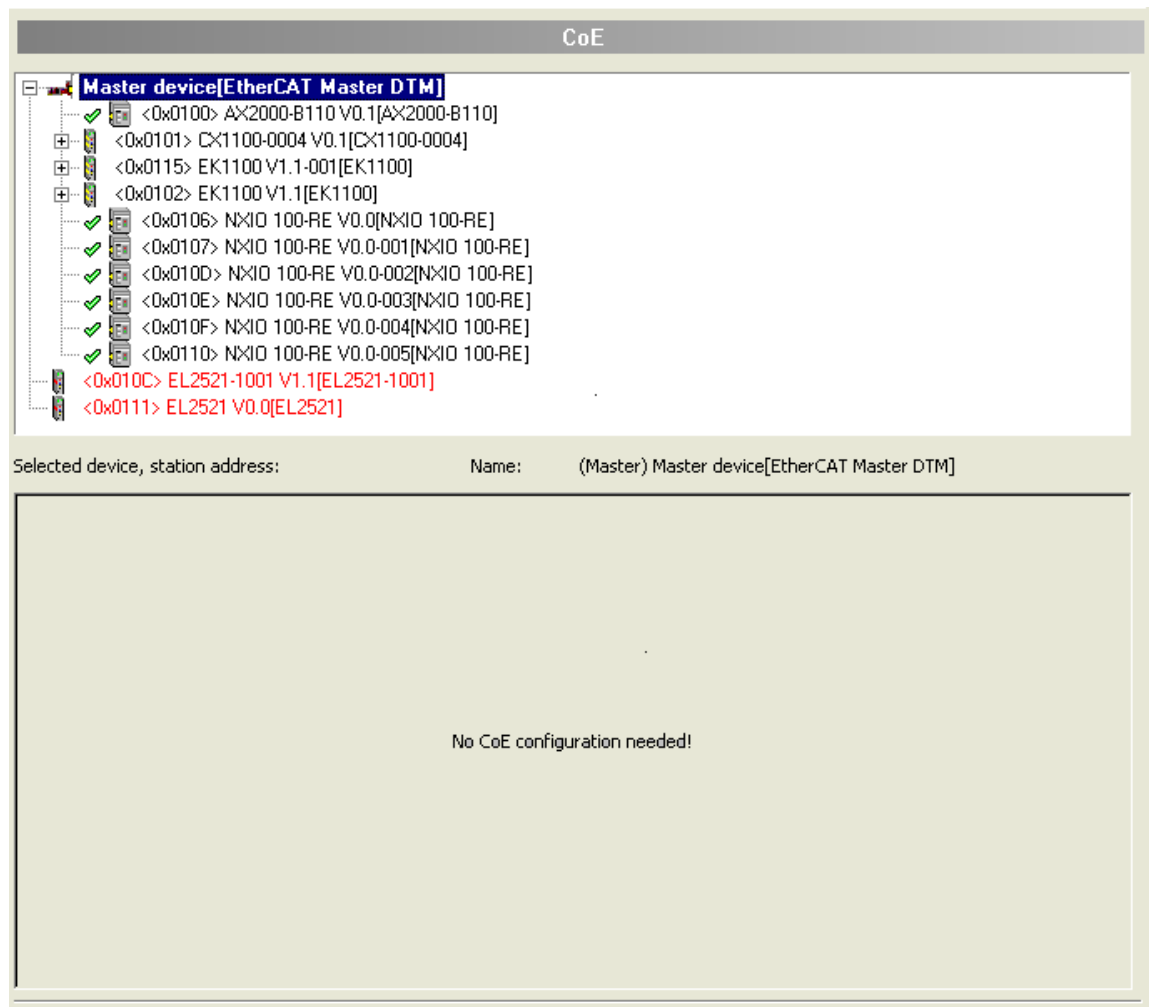
Figure 48: Mailbox > CoE:

Otherwise, the following will happen:

- The station address and name of the selected EtherCAT Slave device will be displayed
- A register consisting of 3 register cards will appear:

  General

  Start-up

  Userdef start-up

6.5.1.1   General

The general page displays some important general information concerning mailboxes. In detail, these are:

- The Sync Manager Channel Number of the Input Mailbox,

- the Sync Manager Channel Number of the Output Mailbox,

- the size of the Input Mailbox and the Output Mailbox.
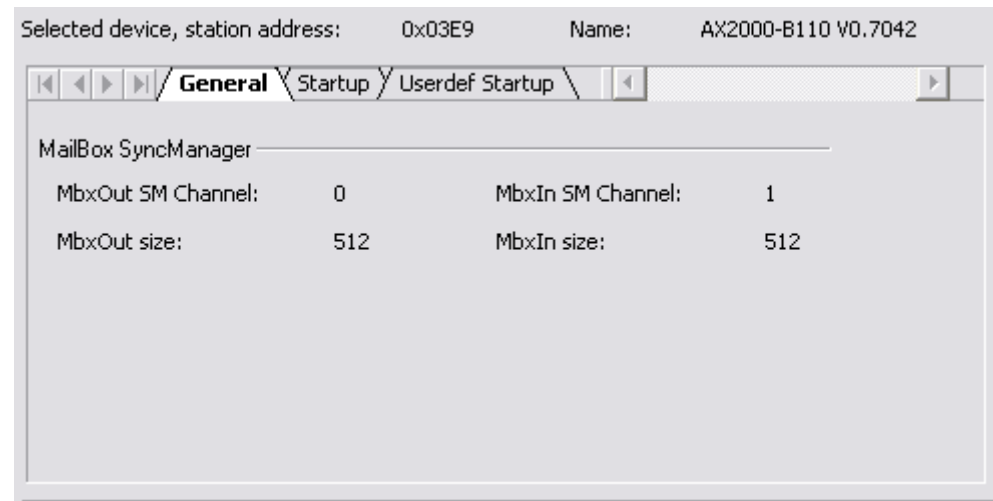
Figure 49: Mailbox > CoE, 'General' Register Card

6.5.1.2   Start-up

The start-up page allows to specify which data should be written into the EtherCAT object dictionary of the selected device (whose station address and name are displayed at the top of the register card) when particular changes of state of the EtherCAT device take place.

In detail, the following information may be specified

Transition

The transition, which triggers the write access to the object dictionary.

Index and subindex

Index and subindex are used for addressing objects within the object dictionary. Refer to the EtherCAT specification for more information about the object dictionary.

Data

The data to write to the location specified using index and subindex within the object dictionary upon occurrence of the specified transition. The length depends on the chosen index and subindex.

Comment

Description of start-up command.

> **Note:**
> A key symbol in front of the line denotes a fixed startup command.

Transition	Index.Subindex	Data	Comment
PS	0x1C12.00	00	clear sm pdos (0x1C12)
PS	0x1C12.01	1702	download pdo 0x1C12 index
PS	0x1C12.00	00	download pdo 0x1C12 count
PS	0x1C13.00	00	clear sm pdos (0x1C13)
PS	0x1C13.01	1B03	download pdo 0x1C13 index
PS	0x1C13.00	00	download pdo 0x1C13 count
PS	0x6060.00	FE	Op mode
PS	0x60C2.01	02	Cycle time
PS	0x60C2.02	FD	Cycle exp

Selected device, station address: 0x03E9   Name: AX2000-B110 V0.7042

General / **Startup** \ Userdef Startup

Figure 50: Mailbox > CoE, 'Start-up' register card

6.5.1.3   User defined, start-up

Similarly, the 'Userdefined start-up' page allows to specify data to be written to a specific location within the object dictionary addressed by index and subindex triggered by a transition that also can be explicitly specified. Again, a comment can be added to the entry.

Transition

You can select which transition triggers the write access to the object dictionary. by marking the corresponding check box. The following state transitions are available to be chosen as triggering event for writing into the object dictionary:

State transition	Description
I2P	Init state to Pre-Operational State
P2S	Pre-Operational State to Safe-Operational State
S2P	Safe-Operational State to Pre-Operational State
O2S	Operational State to Safe-Operational State
S2O	Safe-Operational State to Operational State

Table 21: Mailbox > CoE, 'Start-up' register card, description of the state transitions

Note:
It is also possible to mark more than one check box to trigger the same action by separate state transitions.

- **SDO** (Index and subindex)
  The SDO input area is used to specify which index and subindex should be used for addressing the desired object within the object dictionary.

- The **index** is specified hexadecimally within the left field of the SDO input area. At maximum 4 positions can be specified here for input.

- The **sub-index** is specified decimally within the right field of the SDO input area. At maximum 3 positions can be specified here for input. Refer to the EtherCAT specification or the EtherCAT Protocol API Reference Manuals for more information about the object dictionary.

- **Data**
  The data to write to the location specified using index and subindex within the object dictionary upon occurrence of the specified transition. The length depends on the chosen index and subindex.
  You may specify a string here as it is converted if necessary.

- **Comment**
  Description of start-up command.

Add CoE Start-up Command Button

You have to click this button to add a newly defined SDO to the list of start-up commands shown in page 'Startup'.

If the data are not correctly entered in hexadecimal format at *‚Add CoE Start-up'*, the following error message box will be displayed:
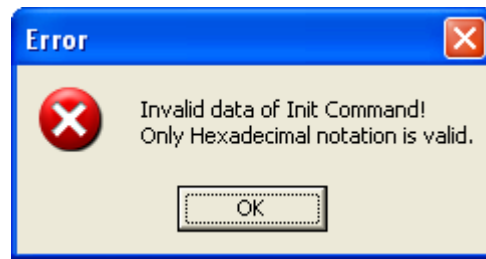
Figure 51: Error message box at incorrect Input of Init Command Data

> **Note:**
> Omit the leading *'0x'* when entering hexadecimal data *'Add CoE Start-up'*. Otherwise, this message box might also be displayed.

If at *'Add CoE Start-up'* no transition at all has been specified, the following error message box will be displayed:
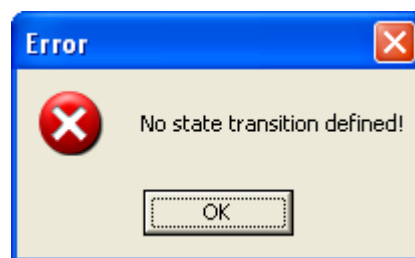
Figure 52: Error message box at incorrect Input of Init Command Data

'Load Object Dictionary from DDF' Button

The object dictionary can be loaded from the Device Description XML file if available and displayed here. Objects can be directly selected from the dictionary for further editing of its data and comment and for defining transition states for its transfer!

The list box in the lower part of the register card may contain a part of the contents of the object dictionary.

Figure 53: Mailbox > CoE, 'Userdef Start-up' register card

6.6   FMMU/Sync Man

6.6.1   FMMU and SyncMan

The **FMMU/ Sync Man** dialog pane displays a combined view of all Fieldbus Memory Management Units defined in the EtherCAT Master configuration together with the associated sync managers. All values shown here cannot be edited. To access the dialog pane:

➢ Select **FMMU / Sync Man** in the navigation area.

FMMU / SyncMan

Fieldbus Memory Management Unit:

Station address	L start	Length	L EndBit	P start	Flags	Sm	Su
0x0101	0x00200000.0	0x00C8	7	0x1100.0		2	
0x0101	0x00100000.0	0x00C8	7	0x1358.0		3	
0x0101	0x00400000.0	0x0000.1	0	0x080D.0		1	
0x0102	0x002000C8.0	0x00C8	7	0x1100.0		2	
0x0102	0x001000C8.0	0x00C8	7	0x1D00.0		3	
0x0102	0x00400000.1	0x0000.1	1	0x080D.0		1	
0x0103	0x00200190.0	0x00C8	7	0x1100.0		2	
0x0103	0x00100190.0	0x00C8	7	0x1358.0		3	
0x0103	0x00400000.2	0x0000.1	2	0x080D.0		1	
0x0104	0x00200258.0	0x0064	7	0x1100.0		2	
0x0104	0x00100258.0	0x0064	7	0x1358.0		3	
0x0104	0x00400000.3	0x0000.1	3	0x080D.0		1	

Sync Manager:

Station address	Channel	start	Length	Buffer	Access	Watchdog	Master
0x0101	0	0x1000	0x0080	1	Write	Disabled	
0x0101	1	0x1080	0x0080	1	Read	Disabled	
0x0101	2	0x1100	0x00C8	3	Write	Enabled	
0x0101	3	0x1358	0x00C8	3	Read	Disabled	
0x0102	0	0x1000	0x0080	1	Write	Disabled	
0x0102	1	0x1080	0x0080	1	Read	Disabled	
0x0102	2	0x1100	0x00C8	3	Write	Enabled	
0x0102	3	0x1D00	0x00C8	3	Read	Disabled	

Figure 54: Configuration > FMMU/ SyncMan

The upper part of the dialog pane displays a table containing information related to the Fieldbus Memory Management Units.

> **Note:**
>
> The contents of this table can be sorted in ascending (arrow upwards) or descending order (arrow downwards) of the following columns by clicking once or twice at the respective column head:
>
> *Station address, L start, Length, L EndBit, P start, Sm*

A Fieldbus Memory Management Unit, shortly FMMU, provides a mapping between logical addresses within the EtherCAT network on one hand and physical addresses on the various slaves within the EtherCAT network on the other hand.

EtherCAT supports combining information from multiple slaves even within one single data telegram. This central feature of EtherCAT is achieved by the use of the FMMU logically mapping physical addresses from different slaves into one combined space of memory.

The FMMU provides up to 16 FMMU channels depending on the device. Each FMMU channel defines a specific memory assignment (denominated as memory translation) between a contiguous area of logical memory of the EtherCAT network and another contiguous area of physical memory of the slave device.

Aim of this concept is mapping any memory area within an EtherCAT slave to any logical memory area within the address space of the EtherCAT network . bit-wise mapping is supported.

Parameter	Description	Range of Value / Default Value
Station Address	This parameter denotes the station address which has been assigned to the EtherCAT slave by the master at initialization and which has been stored in the configured station address register of the slave.	0-65535/None
Logical Start Address	This parameter contains the byte address in the logical memory area of the memory translation where the contiguous area to be mapped starts.	0-232-1/None
Length	This parameter contains the size in bytes of the translated memory area.	0-65535/None
Logical End Bit	This parameter contains the bit offset of the logical end address, i.e. the address where the contiguous memory area ends.	0-255/None
Physical Start Address	This parameter contains the byte address in the physical memory area of the memory translation where the contiguous area to be mapped starts.	0-65535/None
Flags	See explanations just below.	True or false/None
Sync Manager	Number of sync manager, see explanation below	0-31/None
Sync unit	Sync unit	

Table 22: FMMU-related information

The flags each stored within a single bit of its own have the following meaning:

- Read Enable

This flag contains the information whether a read operation is currently allowed, or not. If set to 1, reading will be enabled, otherwise disabled.

> **Note:**
> A read operation in this context denotes a data transfer where the physical memory is the source and the logical memory is the destination.

- Write Enable

This flag contains the information whether a write operation is currently allowed, or not. If set to 1, writing will be enabled, otherwise disabled.

> **Note:**
> A write operation in this context denotes a data transfer where the logical memory is the source and the physical memory is the destination.

- Channel Enable

This flag contains the information whether the memory translation defined in the channel is currently active, or not. If set to 1, writing will be enabled, otherwise disabled.

The lower part of the dialog pane displays a table containing information related to the sync managers.

> **Note:**
> The contents of this table can be sorted in ascending (arrow upwards) or descending order (arrow downwards) of the following columns by clicking once or twice at the respective column head:
> *Station address, Channel, Start Address, Length, Buffer Type, Access*

According to the EtherCAT specification, the main task of a sync manager is the coordination of access to concurrently used objects.

In order to perform this coordination task, a sync manager is organized as a collection of control elements; these are usually denominated as channels.

A sync manager channel defines a consistent area of application memory.

Parameter	Description
Station Address	This parameter denotes the station address which has been assigned to the EtherCAT slave by the master at initialization and which has been stored in the configured station address register of the slave.
Channel	Channel number (Allowed range of values: 0...3)
Start Address	This parameter contains the start address of the consistent application memory area.
Length	This parameter contains the size of the consistent application memory area (specified in bytes).
Buffer Type	This parameter contains the information whether the access type to the consistent application memory area is queued or buffered.
Access	This parameter contains the information if the consistent application memory area is read or written by the master.
Watchdog	This parameter contains the information if the monitoring of an access to the consistent application memory area is enabled. Values are Enabled and Disabled.
Master	This parameter may contain additional data associated with the EtherCAT Master.

Table 23: SyncManager-related information

The connection used for logically joining the FMMU channels to the sync manager channels is the station address.

6.7   Process data

For the EtherCAT Master DTM the **Process data** pane serves as an external process data interface, e. g. for data transfer to a PLC unit. The process data pane lists the slave devices connected to the master, as well as the configured modules or input or output signals of the devices. This makes the fieldbus structure visible.

For the configured modules, submodules or measuring signals names (tags) can be set (column "Tag").

In addition, it can be specified which signal data is to be made available on the OPC server (column SCADA).

Figure 55: Process data (*display device name)

Column	Symbol	Description
Type	Device	Device labeling* provided by the hardware followed by the device's name of station in pointy brackets
	module, submodule I/O signal	Description of the modules, submodules or input or output signals configured on the device (not editable)
Tag	Device	Symbolic name* of the device
	module, submodule I/O signal	Symbolic name for the modules, submodules or input or output signals configured on the device (editable)
	warning	Duplicate Tag at the same level can cause errors by use of OPC!

Column	Symbol	Description
SCADA		Selection option which module, submodule or signal data should be made available on the OPC server.
		„SCADA" (= Supervisory Control and Data Acquisition), here used with the meaning „to provide for visualizing purposes".
*Depending on the protocol, either the device name or the symbolic name can be edited via the device symbol context menu.		

Table 24: Process data

6.8   Address table

The **Address table** dialog pane shows a list of all addresses used in the process data image. The displayed addresses refer to the used EtherCAT Master.

To configure the address data:

➢ Select **Configuration** > **Address table** in the navigation area.

Figure 56: Configuration > Address Table (Example)

Parameter	Description
Device	Descriptive name of a device
Station address	The station address having been assigned to the EtherCAT Slave by the master at initialization and which has been stored in the configured station address register of the slave.
PDO index	Index of Process Data Object within object dictionary
PDO name	Name of Process Data Object
PDO-Entry index	Index of Process Data Object Entry within object dictionary
PDO-Entry name	Descriptive name of Process Data Object Entry
Type	Data type (such as integer or Boolean).
Address	Address
Length	Length in bytes or bits (if specified after decimal point).

Table 25: Address table pane parameters - inputs / outputs

Use **Display mode** Display mode: Hexadecimal ▼ to select data display mode decimal or hexadecimal.

The **CSV export** option allows to export input- and output addresses as CSV file (CSV = comma separated value). Therefore:

➢ Click to the **CSV export** button.

↳ A file saving dialog opens.

➢ Save the data as *.CSV file.

You can open the generated data by means of a spreadsheet application.

Sort addresses

➢ To sort the address data, click on the respective column header.

6.9 Init commands

The '**Init commands** dialog pane allows to display a sequence of initialization commands.

➢ Select **Configuration** > **Init commands** in the navigation area.
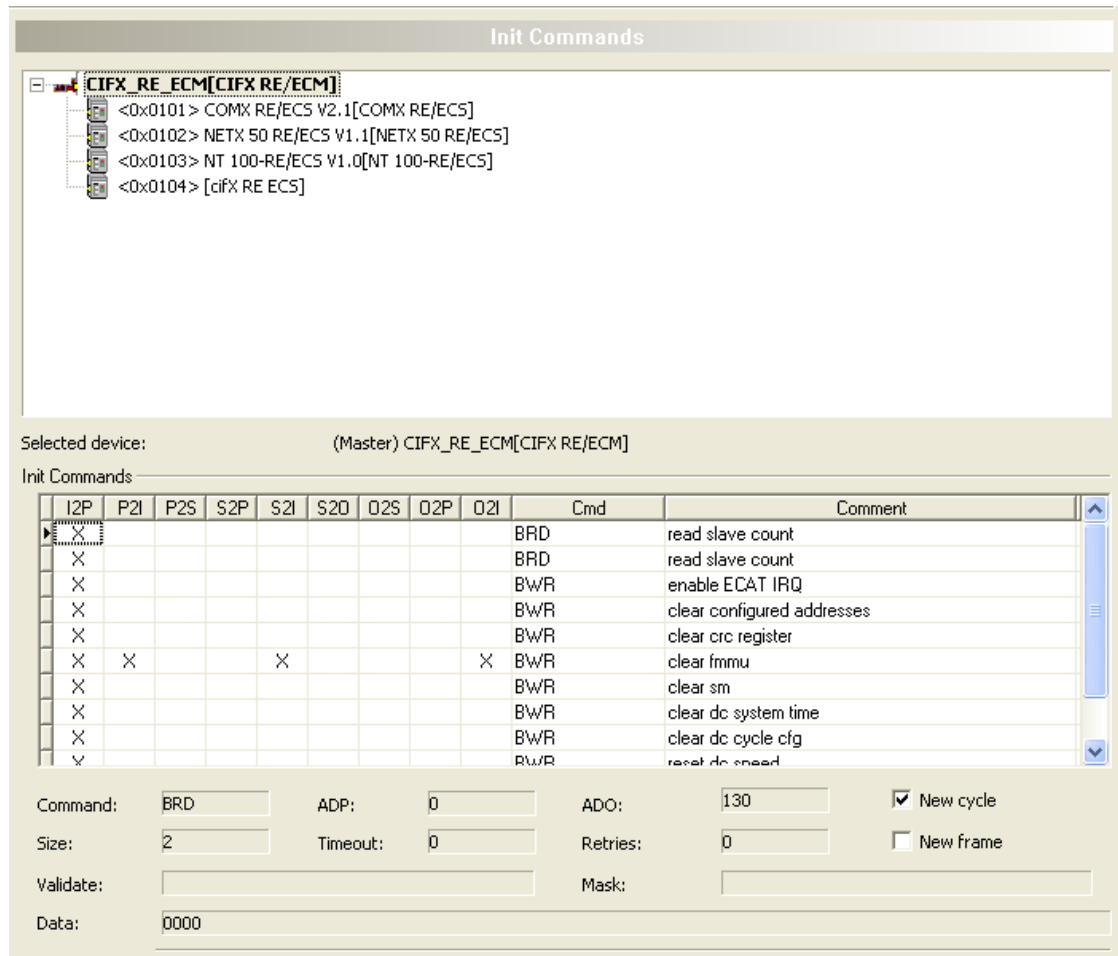
Figure 57: 'Init Commands' page

The upper part of the *'Init Commands'* dialog pane displays the structure of the EtherCAT network in a very similar manner as the *'Topology>TreeView'* page does. The only relevant difference is the absence of the project item, so only the master and all of its slaves are present in this structure tree of the EtherCAT network.

The lower part of the *'Init Commands'* dialog pane displays:

• The long form of the name of the selected EtherCAT (master or slave) device.

• The heading *'Init Commands'*

> **Note:**
> In case a slave has been selected for display, the station address uniquely identifying this slave. This is displayed directly subsequent to the heading *'Init Commands'*.

• A table indicating the sequence of command execution and the dependence from state transition of the device's EtherCAT state machine.

- An area containing some fields displaying the parameters of the selected command.

The table shows the sequence how the commands are executed and the information at which state transitions this happens. For each command the following information is displayed:

- *Whether the command should be executed at 9 specific state transitions (first 9 columns)*

- *The command code*

- *A comment (short text describing the intention of the command)*

These 9 state transitions are in this sequence:

- *Init to Pre-Operational*

- *Pre-Operational to Init*

- *Pre-Operational to Safe- Operational*

- *Safe- Operational to Pre-Operational*

- *Safe- Operational to Init*

- *Safe- Operational to Operational*

- *Operational to Safe- Operational*

- *Operational to Pre-Operational*

- *Operational to Init*

Possible command codes are:

Command code	Description
APRD	Auto-Increment Read
APWR	Auto-Increment Write
NPRD	Node-addressed Physical Read
NPWR	Node-addressed Physical Write
BRD	Broadcast Read
BWR	Broadcast Write
LRD	Logical Read
LWR	Logical Write

Table 26: Possible command codes in Init commands

For more information on this topic see section 7.1.3 "EtherCAT telegram structure" of the EtherCAT specification, version 1.0, on page 70.

The parameter area contains the following items:

Parameters	Description
Command code	The command code of the selected line (one of the codes from the table just above)
ADP	This numeric parameter contains the configured station address.
ADO	This numeric parameter contains the physical memory address
New Cycle	An Boolean parameter whether a new cycle should be started.
New Frame	An Boolean parameter whether a new frame should be started.
Size	The size of the command.
Timeout	The timeout value valid for the command
Retries	The valid retry limit for the command (i.e. the maximum number of allowed retries)
Validate	Validation data
Mask	A mask indicating which bits are valid.
Data	The relevant data.

Table 27: Parameters of EtherCAT command

6.10 Connecting/disconnecting device

> **Note:**
> Several EtherCAT Master DTM functions, e. g. diagnosis or the configuration download in SYCON.net, require an online connection from the EtherCAT Master DTM to the EtherCAT Master device.

Connecting device

To establish an online connection from the EtherCAT Master device to the EtherCAT Master DTM, take the following steps:

Under **Settings** in the **Driver** pane:

➢ Verify that the default driver is checked and respectively check another or multiple drivers.

➢ Configure the driver if necessary.

Under **Settings** in the **Device assignment** pane:

➢ Scan for the devices (with or without firmware).

➢ Select the device (with or without firmware) and apply the selection.

Before you download the firmware, adhere to the necessary safety precautions to prevent personnel injury and property damage that may occur in consequence of a communication stop. For details, refer to section *Safety messages on firmware or configuration download* [▶ page 15].

Under **Settings** in the **Firmware download** pane, if not yet a firmware was loaded to the device:

➢ Selecting and downloading the firmware.

Under **Settings** in the **Device assignment** pane, if not yet a firmware was loaded to the device:

➢ Scan for the device (with firmware) once more.

➢ Select the device (with firmware) once more.

An overview of the descriptions for these steps you find in the section *Overview settings for driver and device assignment* [▶ page 22].

➢ In the DTM interface dialog, select the **OK** button, to apply the selection and to close the DTM interface dialog.

➢ Right-click on the EtherCAT Master icon.

➢ Select the **Connect** command from the context menu.

➢ The EtherCAT Master device now is connected to the EtherCAT Master DTM via an online connection. In the network view, the device description at the device icon of the master is displayed with a green colored background.

Disconnecting device

To disconnect an online connection from the EtherCAT Master device to the EtherCAT Master DTM, take the following steps:

➢ In the DTM interface dialog, select the **OK** button, to close the DTM interface dialog.

➢ Right-click on the EtherCAT Master icon.

➢ Select the **Disconnect** command from the context menu.

⇨ In the network view, the device description is not any more displayed with a green colored background. Now the online connection from EtherCAT Master device to the EtherCAT Master DTM.

6.11 Download configuration

The device configuration is created "offline" in the DTM (application program). A download to the device is required, to transfer the configuration with the parameter data to the device.

> **→ Note:**
>
> To download configuration parameter data to the EtherCAT Master device an online connection from the EtherCAT Master DTM to the EtherCAT Master device is required. Further information can be found in *Connecting/disconnecting device* [▶ page 88].

⚠ WARNING **Communication stop caused by configuration download, faulty system operation possible or loss of device parameters**

Before you initiate a configuration download process, while the bus is still in operation status:

➢ Stop the application program.

➢ Make sure that all network devices are in a fail-safe condition.

⚠ WARNING **Mismatching system configuration, faulty system or device operation possible**

➢ In the device, use only a configuration suitable for the system.

NOTICE **Loss of device parameters caused by power disconnect during configuration download**

➢ During configuration download process, do not interrupt the power supply to the PC or to the device, and do not perform a reset to the device!

Download steps

In order to transfer the configuration with the corresponding data of the configuration parameters to the EtherCAT Master device, download the data using the frame application netFrame in SYCON.net via **Device** > **Download** or context menu **Download**.

➢ Select **Download** in the context menu of the device.

↳ If the download is started as long as the slave devices are connected to the master device, the following message is displayed: "If you attempt to download during bus operation, communication between master and slaves is stopped. Do you really want to download?"
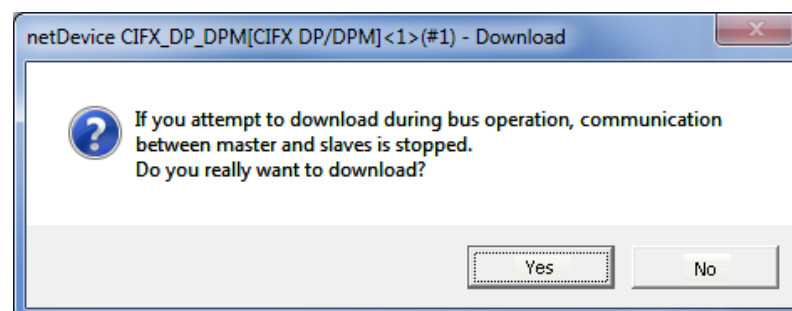
Figure 58: netDevice Message: Download

> **Important:**
> If the communication between the master device and the slave devices is stopped, the data exchange between the master device and the slave devices is stopped.

➢ Click **Yes** if you intend to download the configuration.

↳ Then the current configuration in the application program is down loaded to the device.

➢ Otherwise click to **No**.

6.12 Network scan

With the function **Network scan...** of the EtherCAT Master DTM you can find out automatically which EtherCAT Slave device are attached to the EtherCAT Master device and how these devices are configured. During the network scan the master device requests the ident codes of the slave devices found at the bus. For each connected master device, its ident code is read out.

In the **Scan response** dialog of the master DTM the assigned device description files or DTM devices are displayed. Exactly one ident code is assigned to each device description file and to each DTM device. Different versions (also language versions) of the same device description file are defined by the same ident code. For each identified device, you can select the assigned DTM device according to the firmware loaded in that slave device. Via **Create devices** for each slave device, the selected DTM device is created.

6.12.1 Requirements

The EtherCAT Master device must be configured.

> **Important:**
> The configuration of the master device must be loaded into the master device. For further information, see section *Configuration steps* [▶ page 16].

6.12.2 Overview on steps

1. Start the **Network scan** (in the master DTM).
2. Make the settings in the **Scan response** dialog.
3. Click **Create devices**.
4. Via **Download**, download the current configuration of the slave devices to the master device.

6.12.3   Starting network scan

➢ In netDevice: Right-click on the device symbol of master DTM.

➢ Select **Network scan...** from the context menu.
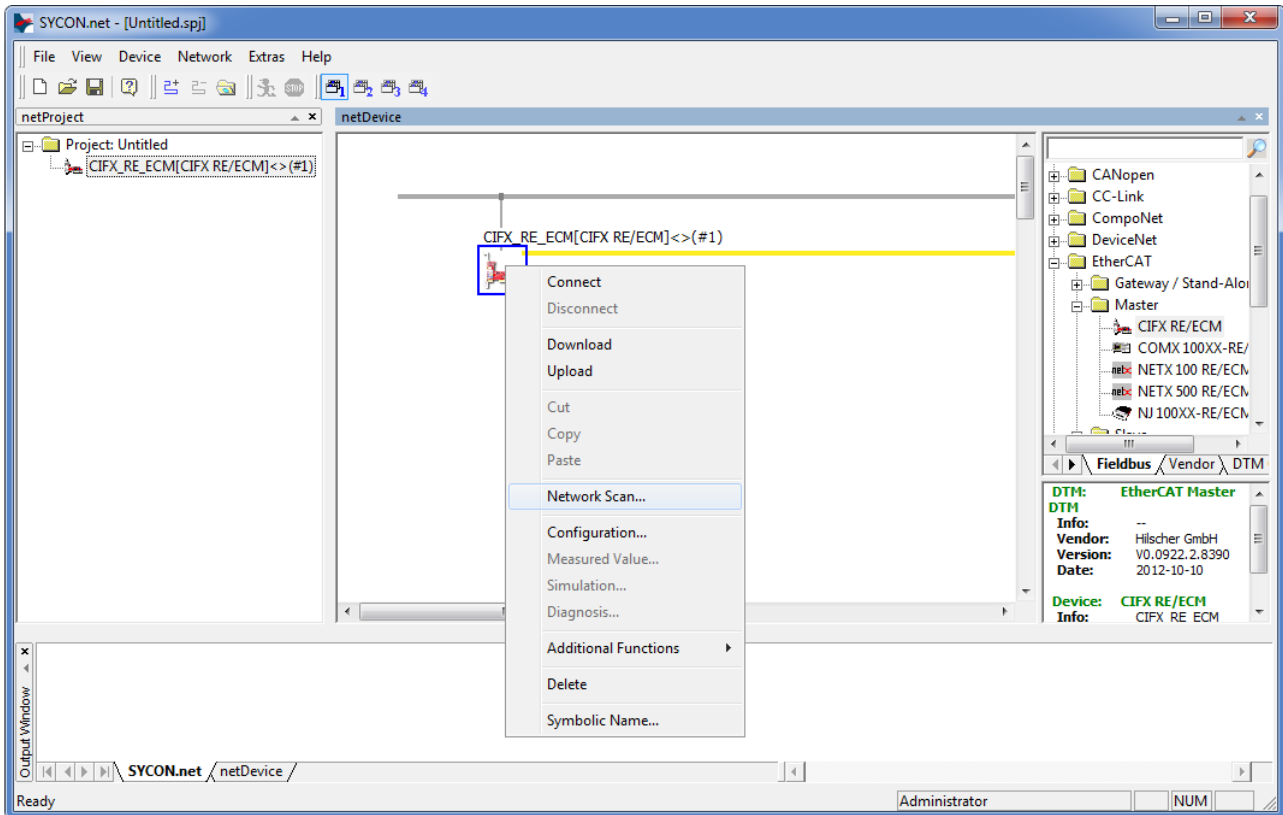
Figure 59: Starting 'Network scan' (example)

➢ Wait for a moment.

> **Note:**
> It may take a few seconds to display the **Scan response** dialog of the EtherCAT Master DTM.

➢ Via **Network scan...** an online connection from the EtherCAT Master DTM to the EtherCAT Master device is established. SYCON.net scans, which EtherCAT Slave devices are connected to the network or the EtherCAT Master device.

⇨ The Scan response dialog of the master DTM appears.
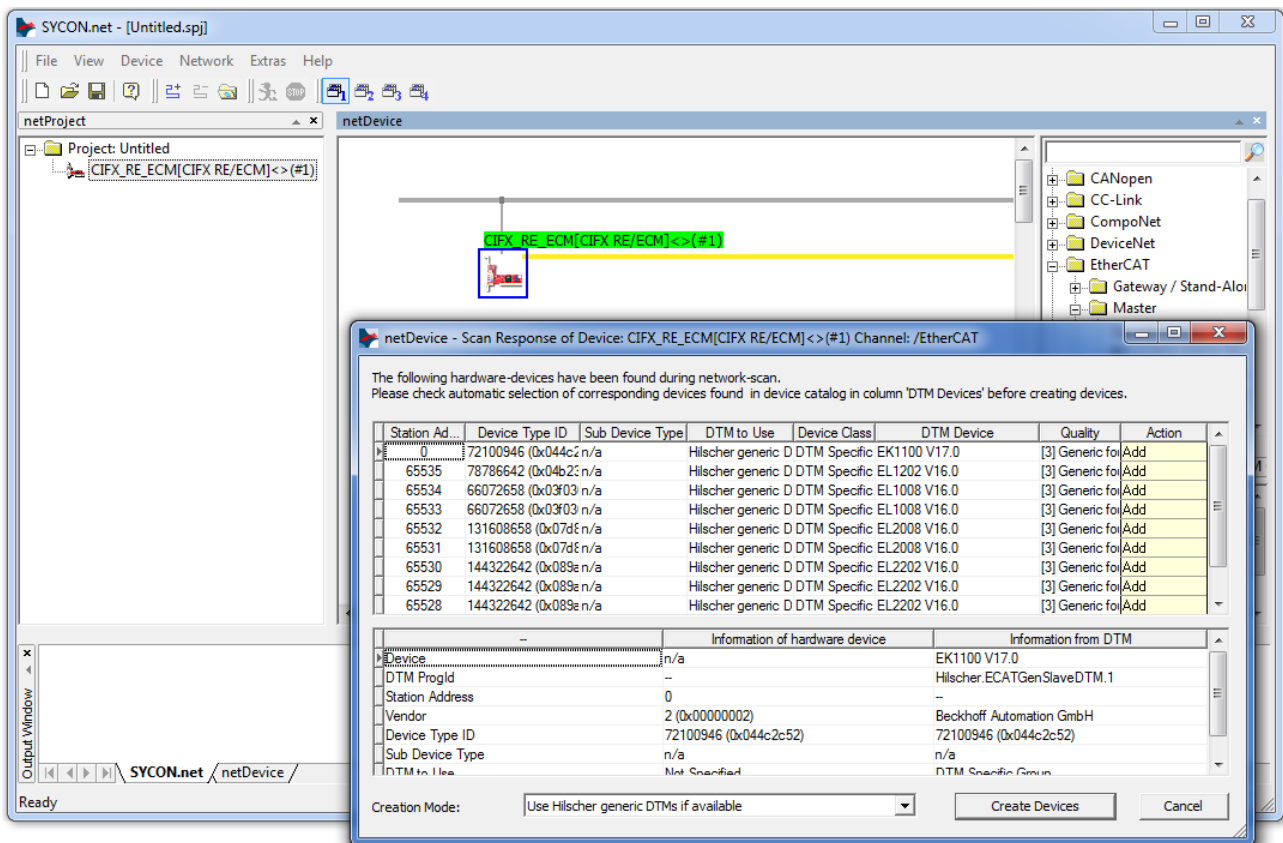
Figure 60: Scan response dialog of the master DTM (example)

6.12.4   Scan response dialog settings

➢ Make the settings in the **Scan response** dialog of the EtherCAT Master DTM.

↳ In the **DTM device** column the DTM devices assigned to the found ident codes appear.
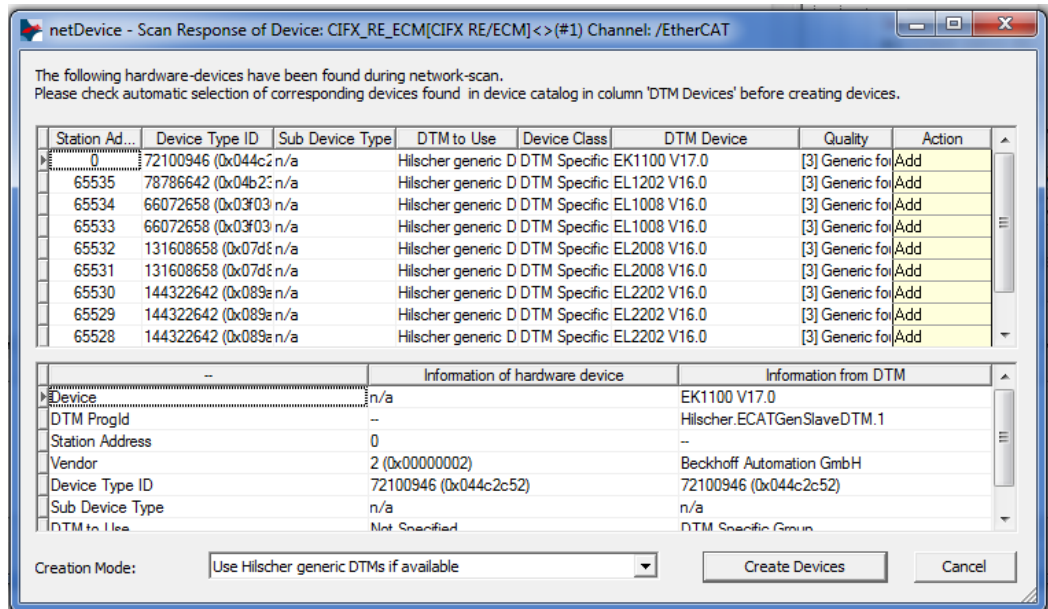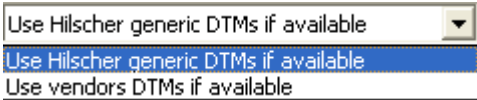
Figure 61: Scan response dialog of the EtherCAT Master DTM (example)

➢ In the **DTM device** column, select for every identified device the DTM device corresponding to the firmware loaded in this EtherCAT Slave.

• If in the **DTM device** column no DTM device or a DTM device not desired is displayed, add the required DTM devices to the device catalog.

• Or adapt the creation mode under **Creation mode**.

➢ In the **Action** column select, whether the found DTM device shall be:

• *added or skipped*
(if a device is not yet present in the project),

• or *replaced or skipped*
(if a device is already present in the project).

6.12.5   Scan response dialog

In the following table, you find a description about the **Scan response** dialog of the EtherCAT Master Master DTM.

Column	Description
Title bar	With the text: "*Symbolic Name [Device description] (#Network ID)* channel/*[Name of the network]*". It is the symbolic name of the EtherCAT EtherCAT Master device.
Instruction	In the Network Scan window, the instruction text is displayed: **The following hardware-devices have been found during network scan. Please check automatic selection of corresponding devices found in device catalog in column 'DTM devices' before creating devices.**
Station address	EtherCAT station address, which displays the logical sequence of the devices within a EtherCAT network.
Colors	Meaning of colors in the **Scan response** dialog of the EtherCAT Master DTM: Red: If a field marked in red appears in column **Station address**, the respective DTM device is already present on the network. Yellow: If a field appears marked in yellow, a selection can be made by a combo box.
Device type ID	Identification (ID): Ident code read out from each device (Unique Identifier)
Sub device type	Sub-device type of the device type, if applicable (not used in PROFIBUS).
DTM to use	Display of the DTM devices, which are assigned to the ident codes found during scanning: If *Use Hilscher generic DTMs if available* is displayed without color marking, there is no selection possibility. If *Use Hilscher generic DTMs if available* is displayed marked in yellow, the following selection can be made: Use Hilscher generic DTMs if available ▼ Use Hilscher generic DTMs if available Use vendors DTMs if available (In the figure shown example DTMs are displayed.) A selection will only be displayed if under **Creation Mode > Choose for each device** was selected and if another DTM has been found for the respective device. A selection will only be displayed if under **Creation mode > Choose for each device** was selected and if another DTM has been found for the respective device.
Device class	Device class of the EtherCAT Slave device.
DTM device	Found DTM device (the device name as taken from the DTM). Only the device description files or **DTM devices** can be displayed within the column DTM devices: • Which are available in the device catalog for the scanned ident code, • Respectively, which belong to the selection made under **Creation mode** • and which belong to the selection made under **Creation mode** > **Choose for each device** under **DTM to create**.

	For each device type ID in the column DTM device the following is displayed:	This means, within the device catalog of netDevice for the found ident code and the selected Creation mode these alternatives are available:
	• *no* device,	• no DTM,
	• *one* single device	• a device description file respectively a DTM device of a manufacturer,
	• or *multiple* devices (within a combobox).	• or one or more device description files respectively a DTM devices of a manufacturer.

Quality	Associated quality information Display: [1] DTM found, [3] Generic found
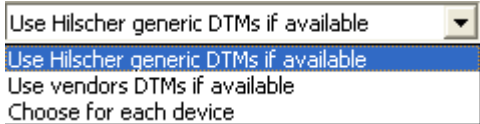
Column	Description
Action	The action to be performed with the corresponding device during the process of device creation.
	• If no device is present within the current project, the selection **Add**/**Skip** will appear.
	• If there is already a device present within the current project, the selection **Replace**/**Skip** will appear.
	Add adds during the device creation process a new instance for the selected DTM to the newly found device address.
	Skip skips the device creation process for the respective device address.
	Replace erases the instance of the DTM currently located at this address during the device creation process, and replaces it with the instance of the chosen DTM.
Table below	
	The lower table in the **Scan response** dialog of the EtherCAT Master DTM shows a comparison of possible differences in device information taken from:
	• The hardware device (displayed in central column of 3)
	• and the DTM (displayed in right column of 3)
	The left column contains which information is compared between the information sources "Hardware Device" and "DTM".
	Note! If a field contains the text 'n/a', the corresponding information is not applicable in the current context (fieldbus).
Creation mode	Under **Creation mode** one of the following options can be selected:
	• Use Hilscher generic DTM if available
	• Use vendors DTMs if available
	• Choose for each device
	Scan response dialog of the EtherCAT Master DTM > "Creation mode"
	Use Hilscher generic DTMs if available ▼
	Use Hilscher generic DTMs if available
	Use vendors DTMs if available
	Choose for each device
Create devices	About **Create devices**...
	• for each EtherCAT Slave device the previously selected DTM device is created.
	• the EtherCAT Slave device configuration is uploaded to the created EtherCAT Slave DTM and thereby the module configuration is generated.
	In case a conflict occurs between a device description file and a device, the **Upload** dialog appears where conflicts are displayed in red.
Cancel	Click **Cancel** to leave the dialog without creating a device.

Table 28: Description on the Scan response dialog of the EtherCAT Master DTM

6.12.6   Creating devices

➢ In the **Scan response** dialog of the EtherCAT Master DTM click **Create devices**.

➫ For each EtherCAT Slave device the previously selected DTM device is created.

➫ The dialog **netDevice** appears showing the progress bar **Creating DTM Device**. The dialog shows the progress of the device creating process.

> **Note:**
> Depending on the manufacturer of the respective device, also a dialog with some slight deviations from this one may be displayed.
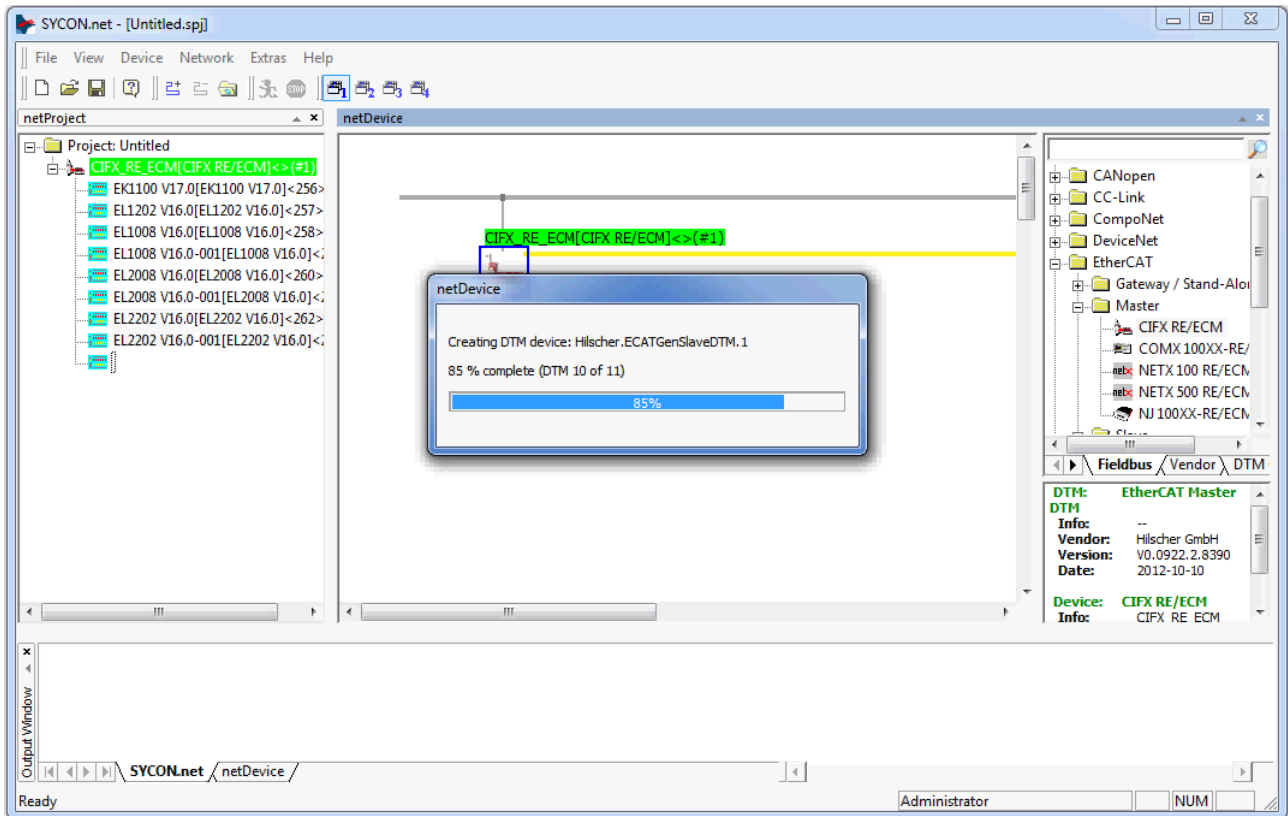
Figure 62: Creating the DTM devices (Example)

⇨ The generated EtherCAT Slave devices are added to the master bus in the network.
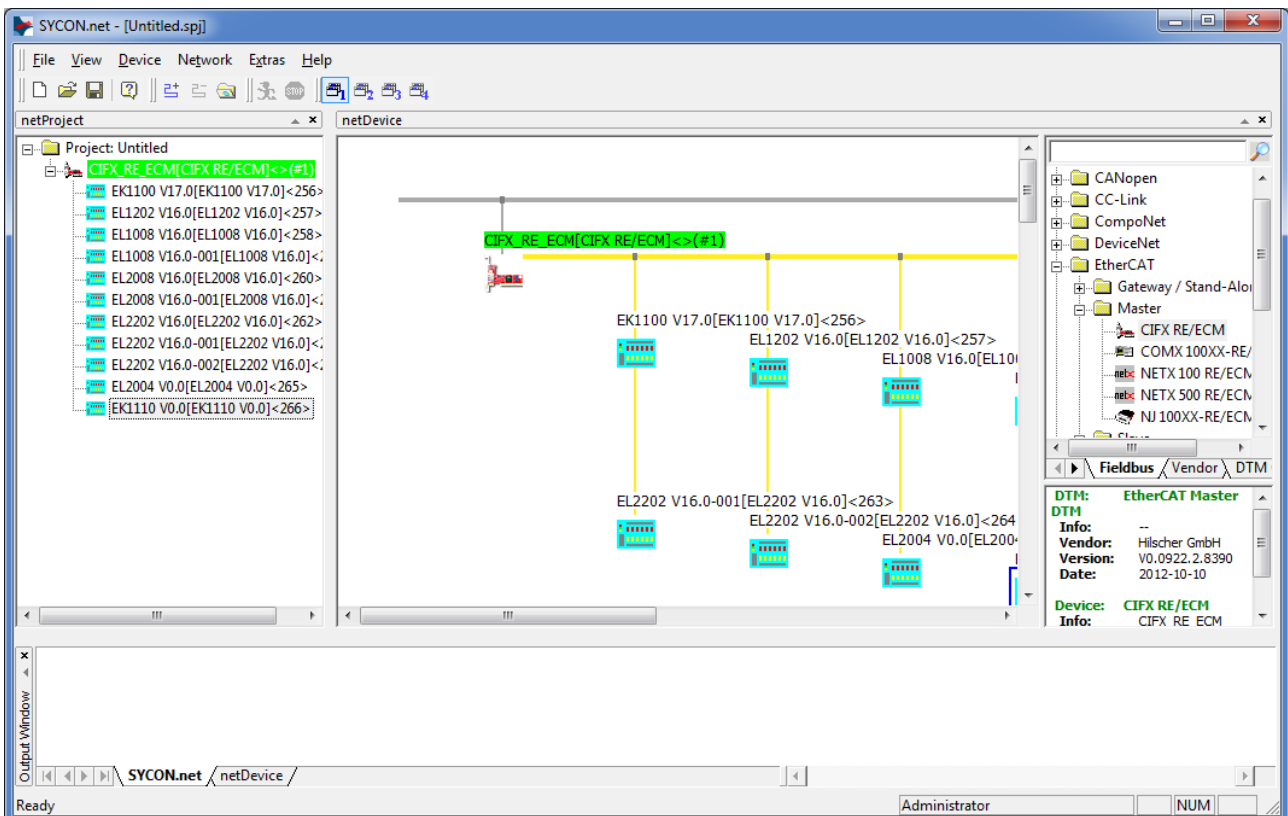
Figure 63: Created EtherCAT Slave devices in the network (Example)

6.12.7   Downloading configuration

Safety precautions

Adhere to the necessary safety precautions to prevent personnel injury and property damage. For more refer to section *Safety messages on firmware or configuration download* [▶ page 15].

How to proceed

Via the **Download** function of the EtherCAT Master DTM, download the current configurations of the EtherCAT Slave devices to the EtherCAT Master device.

➢ In netDevice: right-click on the device symbol of the DTM.
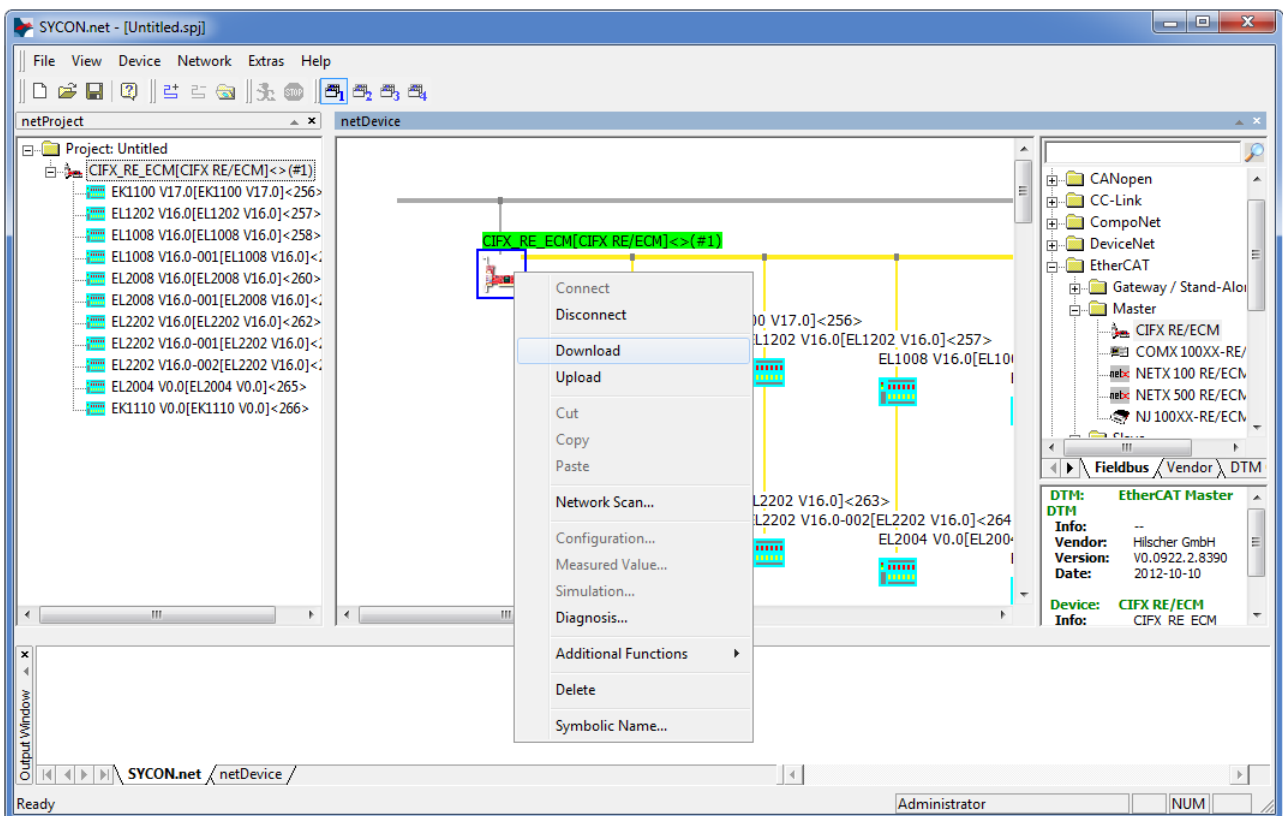
Figure 64: 'Download' current Configuration to the EtherCAT Master device (Example)

➢ Select **Download** from the context menu.

➫ The Dialog **netDevice - Download** appears: "If you attempt to download during bus operation, communication between master and slaves is stopped. Do you really want to download?"

➢ Click Yes.

➫ The dialog **netDevice** appears showing the progress bar **Download active, device performs initialisation…**.

⇨ The **netDevice** window shows the message (example): "Download succeeded to device CIFX_RE_ECM[CIFX_RE/ECM]<1>(1#)."

6.13 Online comparison

SYCON.net offers the possibility to compare online between the configured devices and the scanned devices on the other hand.

Online connection to the device

> **→ Note:**
> Accessing the online comparison dialog panes of the EtherCAT Master DTM requires an online connection from the EtherCAT Master DTM to the EtherCAT Master device device. For further information refer to section *Connecting/disconnecting device* [▶ page 88].

To access the online comparison of the topology:

➢ Select **Online comparison** in the navigation area.

↳ A "split screen" display appears allowing to precisely compare:

• The device information stored in the configuration of SYCON.net on the left half of the window.

• The device information scanned from the network presented on the right half of the window.
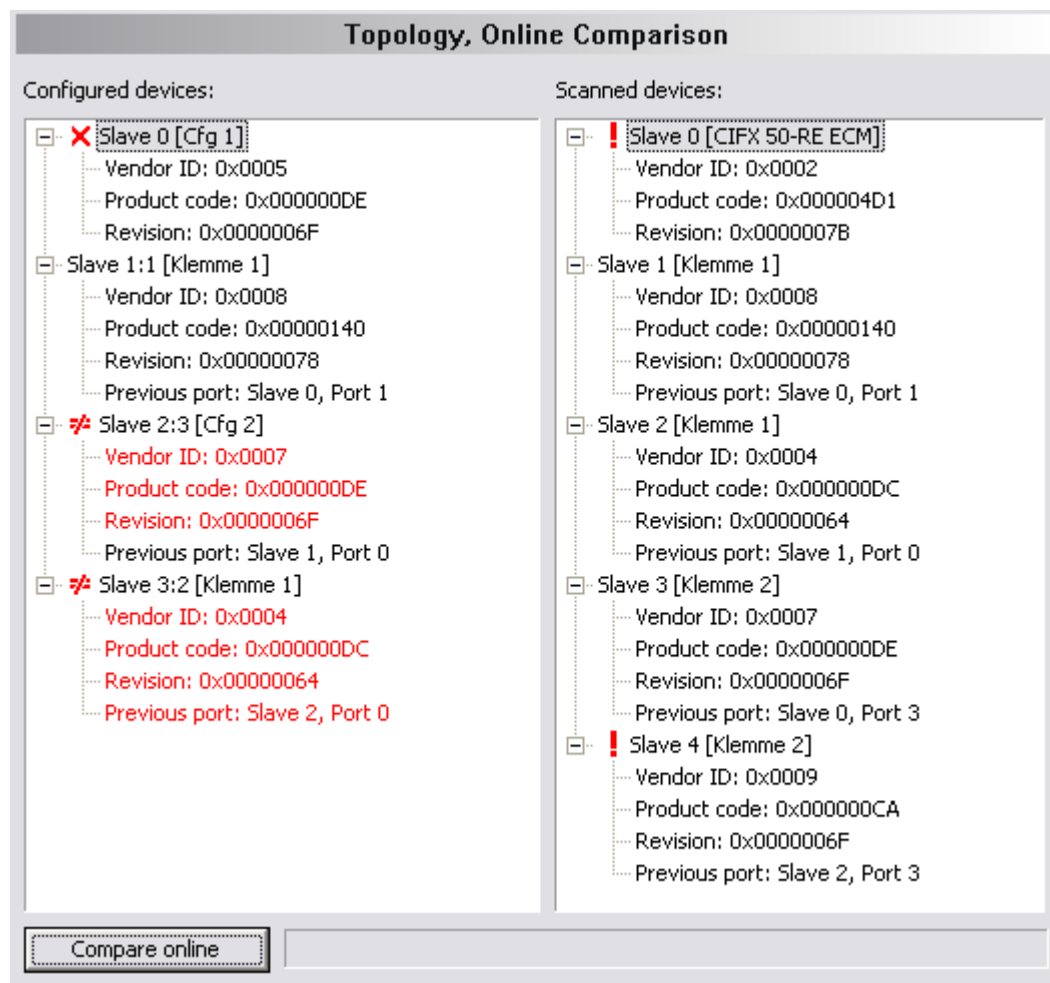
Figure 65: Online comparison (before pressing button 'Compare online')

At the bottom you find a button *"Compare online'"* In order to start the comparison process between the configuration information stored internally in SYCON.net and the current configuration information derived by an EtherCAT network scan, proceed as follows:

➢ Click at the button **Compare online**, which you can find at the bottom of the window.

↳ The text in the button will immediately change to **Stop process** then. The display will look like this:
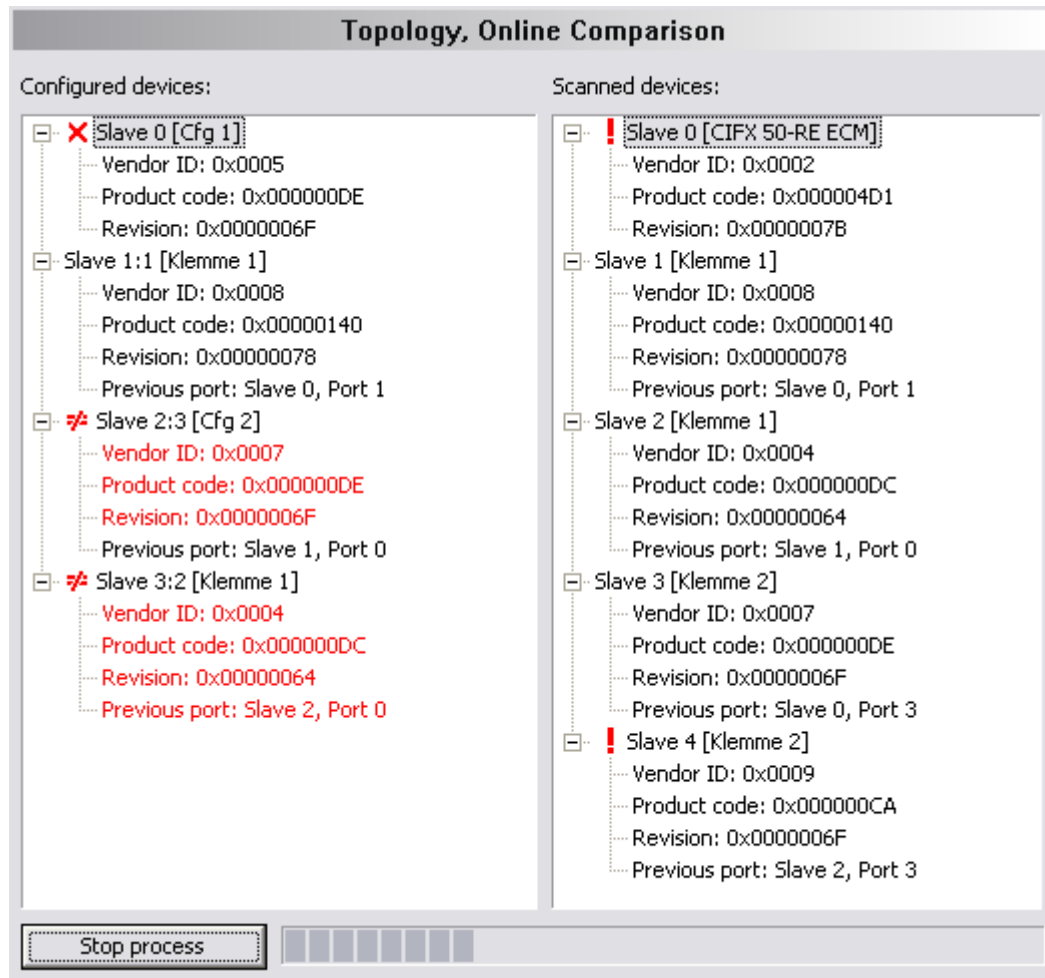
Figure 66: Online comparison (after pressing button "Compare online"

In order to stop the comparison process described above:

➢ Just click the button **Stop process** again.

↳ The comparison process will be interrupted.

The information, which is displayed for each device, may include:

• The Vendor ID

• The Product Code

• The Revision number

• Information on previously used ports

Information items differing between configuration and network scan are displayed in red. If the results are equal, they are displayed by black text.

In front of the name of the respective slave device additional information can be displayed. The meaning is:

Sign	Description
✗	A red x indicates that the configured devices could not be discovered on the bus.
No sign at all	The configured device exactly matches the scanned information about the device in the same position, i.e. the position addresses are equal.
≠	The configured device matches the scanned information about the device, but in a different position, i.e. the position addresses are not equal. Both values are displayed separated by a colon (for instance, 2.3 means, the device configured at position 2 could be found by the network scan, but under position 3)
!	A red exclamation mark indicates a slave has been discovered by the network scan, which has not been configured at all. This can only appear on the right part of the screen.

Table 29: Description of signs in cnline comparison

7 Diagnosis

7.1 Overview diagnosis

Under "Diagnosis", you can can diagnose your device. The dialog Diagnosis serves to diagnose the device behavior and communication errors. For diagnosis, the device must be in online state.
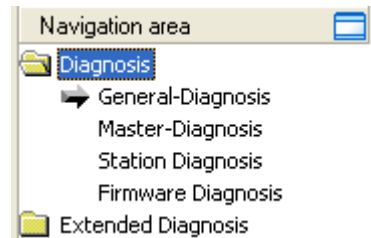
Figure 67: Navigation area - Diagnosis EtherCAT Master DTM

Online connection to the device

> **Note:**
> Accessing the **Diagnosis** panes of the EtherCAT Master DTM requires an online connection from the EtherCAT Master DTM to the EtherCAT Master device. For further information refer to section *Connecting/disconnecting device* [▸ page 88].

How to proceed

➢ In the master DTM diagnosis dialog, check whether the communication is OK: **Diagnosis** > **General diagnosis** > **Device status "Communication"** must be green!

➢ **"Communication"** is green: Open the **IO monitor** and test the input or output data.

➢ **"Communication"** is not green: Use **Diagnosis** and **Extended diagnosis** for troubleshooting.

Extended diagnosis

The **Extended diagnosis** helps to find communication and configuration errors, when default diagnosis fails.

7.2   General diagnosis

Information regarding the Device State and other general diagnosis parameters are displayed in the **General Diagnosis** dialog.

Figure 68: General diagnosis

LED	Description	Color	State
	Device state		
Communication	Shows whether the EtherCAT device executes the network communication.	(green)	In COMMUNICATION state
		(gray)	Not in COMMUNICATION state
Run	Shows whether the EtherCAT device has been configured correctly.	(green)	Configuration OK
		(gray)	Configuration not OK
Ready	Shows whether the EtherCAT device has been started correctly. The EtherCAT device waits for a configuration.	yellow	Device READY
		(gray)	Device not READY
Error	Shows whether the EtherCAT device records a device status error. For further information about the error characteristics and the number of counted errors refer to the extended diagnosis.	(red)	ERROR
		(gray)	No ERROR
	Network state		
Operate	Shows whether the EtherCAT device is in data exchange. In a cyclic data exchange the input data or the output data of the EtherCAT Master is transmitted to the EtherCAT Slave.	(green)	In OPERATION state
		(gray)	Not in OPERATION state
Idle	Shows whether the EtherCAT device is in data exchange.	(yellow)	In IDLE state
		(gray)	Not in IDLE state
Stop	Shows whether the EtherCAT device is in Stop state: There is no cyclic data exchange at the EtherCAT network. The EtherCAT device was stopped by the application program or it changed to the Stop state because of a bus error.	(red)	In STOP state
		(gray)	Not in STOP state

LED	Description	Color	State
Offline	The EtherCAT Master is offline as long as it does not have a valid configuration.	(yellow)	In OFFLINE state
		(gray)	Not in OFFLINE state
	Configuration state		
Configuration locked	Shows whether the EtherCAT device configuration is locked, to avoid the configuration data is typed over.	(yellow)	Configuration not LOCKED
		(gray)	Configuration not LOCKED
New Configuration pending	Shows whether a new EtherCAT device configuration is available.	yellow	New configuration pending
		(gray)	No new Configuration pending
Reset required	Shows whether a firmware reset is required as a new EtherCAT device configuration has been loaded into the device.	yellow	RESET required
		(gray)	No RESET required
Bus ON	Shows whether the bus communication was started or stopped. I. e., whether the device is active on the bus or no bus communication to the device is possible and no response telegrams are sent.	(green)	Bus ON
		(gray)	Bus OFF

Table 30: Indication general diagnosis

Parameter	Description
Communication error	Shows the name of the communication error. If the cause of error is resolved, the value will be set to zero again.
Watchdog time	Shows the watchdog time in ms.
Error count	This field holds the total number of errors detected since power-up, respectively after reset. The protocol stack counts all sorts of errors in this field no matter whether they were network related or caused internally.

Table 31: Indication general diagnosis

7.3   Master diagnosis

Information regarding the slave state, slave errors and slaves configured, active or in diagnostic is displayed in the **Master Diagnosis** dialog.

Figure 69: Master diagnosis

Parameter	Description	Range of value / value
Slave state	Shows whether slave state is ok or not. The slave state field for master diagnosis shows whether the master is in cyclic data exchange to all configured slaves. In case there is at least one slave missing or if the slave has a diagnostic request pending, the status will be set to FAILED. For protocols that support non-cyclic communication only, the slave state is set to OK as soon as a valid configuration is found.	UNDEFINED, OK, FAILED
Slave error log indicator	Shows whether the slave error log indicator is available. The error log indicator field holds the number of entries in the internal error log. If all entries are read from the log, the field will be set to zero.	EMPTY, AVAILABLE
Configured slaves	Shows the number of configured slaves. Number of configured slaves in the network according to the slave list derived from the configuration database created by the configuration software. The list includes the slaves to which the master has to open a connection.	
Active slaves	Shows number of active slaves. Number of slaves in data exchange mode. The list includes the slaves to which the Master has successfully opened a connection	
Slaves with diagnostic	Shows number of slaves with diagnostic. Number of slaves with diagnosis or error slaves.	

Table 32: Parameters Master diagnosis

7.4   Station diagnosis

Figure 70: Station diagnosis

The **Station diagnosis** shows the status for all EtherCAT Slave device, which are configured in the EtherCAT Master. The EtherCAT Master DTM updates this display cyclically.

Column	Description	Value range / value
Status	The status of the device addressed under the displayed station address.	Running, Diagnosis, Not found, Error
Station address	Station address under which the device is addressed.	Valid station address
Auto increment address	Addressing of the slave devices based on their physical order.	
Slave name	Name of the device assigned to the displayed station address.	1 - 240 characters

Table 33: Columns of the Station diagnosis table

The legend below describes the possible values for the state of a device, which is assigned to a station address.

Color	Name	Description
green	Running	The device associated with this station address is running.
yellow	Diagnosis	Diagnosis is available for the device associated with this station address.
blue	Not found	The device associated with this station address was parameterized, but not found.
red	Error	An error message is available for the device associated with this station address.
		For the status ‚error' additionally a textual error messages can appear.

Table 34: Possible values for the status

7.5   Firmware diagnosis

In the dialog **Firmware Diagnosis**, the current task information of the firmware is displayed.

Under **Firmware** or **Version** the name of the firmware and version (including the date) are indicated.

Figure 71: Firmware Diagnosis

Task information:

The table **Task Information** is listing the task information of the single firmware tasks.

Task	Description
Task	Name of task
Name of task	Name of the task
Version	Version number of the task
Prio	Priority of the task
Description	Description of the task
Status	Current status of the task

Table 35: Description table task information

8 Extended diagnosis

8.1 Overview extended diagnosis

The "Extended Diagnosis" of the EtherCAT Master DTM helps to find communication and configuration errors, when default diagnosis fails. Therefore, it contains a list of diagnosis structures as online counter, states and parameters.

The table below gives an overview for the extended diagnosis dialog panes descriptions of the EtherCAT Master DTM:

Folder name / Section	Subsection
different folders	*Task information* [▶ page 110]
RX-SYSTEM	*IniBatch status* [▶ page 111]
ECAT_MASTER	*Low level error counter* [▶ page 112]
	Packet counter stack [▶ page 113]
	Internal status stack [▶ page 114]
ECAT_MASTER_AP	*Packet counter AP task* [▶ page 115]
	DPM statistics [▶ page 117]
	Internal status of AP task [▶ page 118]

Table 36: Descriptions of the dialog panes extended diagnosis

> **Note:**
> Accessing the **Extended Diagnosis** dialog panes of the EtherCAT Master DTM requires an online connection from the EtherCAT Master DTM to the EtherCAT Master device. For further information, refer to section *Connecting/disconnecting device* [▶ page 88].

8.2   Task information

Figure 72: Extended Diagnosis > [Folder Name] > Task Information Example Display

Name	Description
Identifier	Identification number of the task
Major version	Task version, contains incompatible changes
Minor version	Task version, contains compatible changes
Maximum packet size	Maximum packet size, which the task sends
Default Queue	Queue handle, which is accessible via DPM by mailbox.
UUID	Unique user ID, 16 Byte indicator used for task identification and its affiliation e. g. to a stack (therein different identification data is coded in).
Init result	Error Code, 0= no Error
	The description of the error codes can be found in this manual or in the corresponding software reference manuals.

Table 37: Extended Diagnosis > [Folder Name] > Task Information

8.3   IniBatch status

Figure 73: Extended Diagnosis > [Folder name] > IniBatch Status example display

Name	Description
Communication Channel	Number of the communication channel used by the device.
Current State	Idle; IniBatch packets in progress; Retrying to send last packet; Error
IniBatch Result	Ok; No DBM file; No Packet table; No data set available; Data set is shorter than packet length; Packet Buffer is shorter than Packet length; Invalid packet destination; Logical queue not defined Send packet failed; Too many retries; Error in confirmation packet status
OpenDbm Result	Error when opening the IniBatch database Under "OpenDbm Result" the error code is typed in, when "IniBatch Result" == "No DBM file" (1) is.
SendPacket Result	Error when sending a packet Under "SendPacket Result" the error code is typed in, when "IniBatch Result" == "send packet failed" (8) is.
Confirmation Result	Confirmation error when sending packets Under "Confirmation Result" the packet specific error code from the ulSta is typed in, when "IniBatch Result " == "Error in confirmation packet status" (10) is.
Last Packet Number	Value depends by the communication system.
Last Packet Command	Value depends by the communication system.
Last Packet Length	Value depends by the communication system.
Last Packet Destination	Value depends by the communication system.

Table 38: Extended Diagnosis > [Folder name] > IniBatch Status

The task status "Confirmation Result" is bus specific. The other task status are rcx-related error codes.

8.4 ECAT_MASTER

8.4.1 Low level error counter

Figure 74: Extended diagnosis > ECAT_MASTER > Low level error counter

Name	Description
CYCCMD_WKC_ERROR counter	Counter for CYCCMD_WKC_ERROR
MASTER_INITCMD_WKC_ERROR counter	Counter for MASTER_INITCMD_WKC_ERROR
SLAVE_INITCMD_WKC_ERROR counter	Counter for SLAVE_INITCMD_WKC_ERROR
EOE_MBXRCV_WKC_ERROR counter	Counter for EOE_MBXRCV_WKC_ERROR
COE_MBXRCV_WKC_ERROR counter	Counter for COE_MBXRCV_WKC_ERROR
FOE_MBXRCV_WKC_ERROR counter	Counter for FOE_MBXRCV_WKC_ERROR
EOE_MBXSND_WKC_ERROR counter	Counter for EOE_MBXSND_WKC_ERROR
COE_MBXSND_WKC_ERROR counter	Counter for COE_MBXSND_WKC_ERROR
FOE_MBXSND_WKC_ERROR	Counter for FOE_MBXSND_WKC_ERROR
FRAME_RESPONSE_ERROR	Counter for FRAME_RESPONSE_ERROR
SLAVE_INITCMD_RESPONSE_ERROR	Counter for SLAVE_INITCMD_RESPONSE_ERROR
MASTER_INITCMD_RESPONSE_ERROR counter	Counter for MASTER_INITCMD_RESPONSE_ERROR
CMD_MISSING counter	Counter for CMD_MISSING
MBSLAVE_INITCMD_TIMEOUT counter	Counter for MBSLAVE_INITCMD_TIMEOUT
NOT_ALL_DEVICES_OPERATIONAL counter	Counter for NOT_ALL_DEVICES_OPERATIONAL
ETH_LINK_NOT_CONNECTED counter	Counter for ETH_LINK_NOT_CONNECTED
CYCCMD_TIMEOUT counter	Counter for CYCCMD_TIMEOUT
RED_LINEBRK counter	Counter for RED_LINEBRK
STATUS_SLAVE_ERROR counter	Counter for STATUS_SLAVE_ERROR
SLAVE_ERROR_STATUS_INFO counter	Counter for SLAVE_ERROR_STATUS_INFO
SLAVE_NOT_ADDRESSABLE counter	Counter for SLAVE_NOT_ADDRESSABLE

Table 39: Extended diagnosis > ECAT_MASTER > Low level error counter

8.4.2   Packet counter stack

Figure 75: Extended diagnosis > ECAT_MASTER > Packet counter stack

Name	Description
ulEthercatMasterCmdRegisterAtStackReq	Counter for ulEthercatMasterCmdRegisterAtStackReq
ulEthercatMasterCmdSetBusparamReq	Counter for ulEthercatMasterCmdSetBusparamReq
ulEthercatMasterCmdBusOnReq	Counter for ulEthercatMasterCmdBusOnReq
ulEthercatMasterCmdBusOffReq	Counter for ulEthercatMasterCmdBusOffReq
ulEthercatMasterCmdHostWdgTimeoutReq	Counter for ulEthercatMasterCmdHostWdgTimeoutReq
ulRcxGetSlaveHandleReq	Counter for ulRcxGetSlaveHandleReq
ulRcxGetSlaveConnInfoReq	Counter for ulRcxGetSlaveConnInfoReq
ulConfigurationReloadReq	Counter for ulConfigurationReloadReq
ulEthercatMasterCmdUpdateCommunicationStateRes	Counter for ulEthercatMasterCmdUpdateCommunicationStateRes
ulEthercatMasterCmdUpdateGlobalSlaveInfoRes	Counter for ulEthercatMasterCmdUpdateGlobalSlaveInfoRes
ulUnknownCommandReq	Counter for ulUnknownCommandReq
ulEthercatMasterCmdSdoUploadReq	Counter for ulEthercatMasterCmdSdoUploadReq
ulEthercatMasterCmdSdoDownloadReq	Counter for ulEthercatMasterCmdSdoDownloadReq
ulEthercatMasterCmdGetOdListReq	Counter for ulEthercatMasterCmdGetOdListReq
ulEthercatMasterCmdGetObjectDescReq	Counter for ulEthercatMasterCmdGetObjectDescReq
ulEthercatMasterCmdGetEntryDescReq	Counter for ulEthercatMasterCmdGetEntryDescReq
ulEthercatMasterCmdReadEmergencyReq	Counter for ulEthercatMasterCmdReadEmergencyReq
ulEthercatMasterCmdGetDcDeviationReq	Counter for ulEthercatMasterCmdGetDcDeviationReq
ulEthercatMasterCmdStartBusScanReq	Counter for ulEthercatMasterCmdStartBusScanReq
ulEthercatMasterCmdBusScanInfoReq	Counter for ulEthercatMasterCmdBusScanInfoReq

Table 40: Extended diagnosis > ECAT_MASTER > Packet counter stack

8.4.3   Internal status stack

Figure 76: Extended diagnosis > ECAT_MASTER > Internal status stack

Name	Description
Current state	Current state of EtherCAT stack: Possible values: ETHERCAT_MASTER_NOT_INIT ETHERCAT_MASTER_WAIT_FOR_BUSPARAM ETHERCAT_MASTER_CONFIGURED ETHERCAT_MASTER_WAIT_FOR_LINK ETHERCAT_MASTER_RUNNING ETHERCAT_MASTER_COMMUNICATING ETHERCAT_MASTER_IDLE ETHERCAT_MASTER_WATCHDOG_ERROR ETHERCAT_MASTER_BUS_SCAN
Error during reset	If an error occurred during reset, its error code is displayed here. In case of successful reset, the value 0x0 is displayed here.
Link	Status of link Possible values: • down • up
Hard reset required	A hard reset is required Possible Values: • no • yes

Table 41: Extended diagnosis > ECAT_MASTER > Internal status stack

8.5   ECAT_MASTER_AP

8.5.1   Packet counter AP task

Figure 77: Extended diagnosis > ECAT_MASTER_AP > Packet counter AP task

Name	Description
ulDiagInfoGetCommonStateReq	Counter for ulDiagInfoGetCommonStateReq
ulDiagInfoGetWatchdogTimeReq	Counter for ulDiagInfoGetWatchdogTimeReq
ulDiagInfoSetWatchdogTimeReq	Counter for ulDiagInfoSetWatchdogTimeReq
ulRcxGetSlaveHandleReq	Counter for ulRcxGetSlaveHandleReq
ulRcxGetSlaveHandleCnf	Counter for ulRcxGetSlaveHandleCnf
ulRcxGetSlaveConnInfoReq	Counter for ulRcxGetSlaveConnInfoReq
ulRcxGetSlaveConnInfoCnf	Counter for ulRcxGetSlaveConnInfoCnf
ulUnknownCommandReq	Counter for ulUnknownCommandReq
ulEthercatMasterCmdSetBusparamReq	Counter for ulEthercatMasterCmdSetBusparamReq
ulEthercatMasterCmdSetBusparamCnf	Counter for ulEthercatMasterCmdSetBusparamCnf
ulEthercatMasterCmdBusOnCnf	Counter for ulEthercatMasterCmdBusOnCnf
ulEthercatMasterCmdBusOffCnf	Counter for ulEthercatMasterCmdBusOffCnf
ulEthercatMasterCmdUpdateCommunicationStateInd	Counter for ulEthercatMasterCmdUpdateCommunicationStateInd
ulEthercatMasterCmdUpdateGlobalSlaveInfoInd	Counter for ulEthercatMasterCmdUpdateGlobalSlaveInfoInd

Name	Description
ulConfigurationReloadReq	Counter for ulConfigurationReloadReq
ulConfigurationReloadCnf	Counter for ulConfigurationReloadCnf
ulEthercatMasterApCmdHostWdgTimeoutReq	Counter for ulEthercatMasterApCmdHostWdgTimeoutReq
ulEthercatMasterCmdHostWdgTimeoutCnf	Counter for ulEthercatMasterCmdHostWdgTimeoutCnf
ulEthercatMasterCmdRegisterAtStackCnf	Counter for ulEthercatMasterCmdRegisterAtStackCnf
ulEthercatMasterCmdSdoUploadReq	Counter for ulEthercatMasterCmdSdoUploadReq
ulEthercatMasterCmdSdoDownloadReq	Counter for ulEthercatMasterCmdSdoDownloadReq
ulEthercatMasterCmdGetOdListReq	Counter for ulEthercatMasterCmdGetOdListReq
ulEthercatMasterCmdGetObjectDescReq	Counter for ulEthercatMasterCmdGetObjectDescReq
ulEthercatMasterCmdGetEntryDescReq	Counter for ulEthercatMasterCmdGetEntryDescReq
ulEthercatMasterCmdReadEmergencyReq	Counter for ulEthercatMasterCmdReadEmergencyReq
ulEthercatMasterCmdGetDcDeviationReq	Counter for ulEthercatMasterCmdGetDcDeviationReq
ulEthercatMasterCmdStartBusScanReq	Counter for ulEthercatMasterCmdStartBusScanReq
ulEthercatMasterCmdBusScanInfoReq	Counter for ulEthercatMasterCmdBusScanInfoReq
ulRcxStartStopCommReq	Counter for ulRcxStartStopCommReq

Table 42: Extended diagnosis > ECAT_MASTER_AP > Packet counter AP task

8.5.2   DPM statistics

Figure 78: Extended diagnosis > ECAT_MASTER_AP > DPM statistics

Name	Description
cyclic input data exchange requested counter	Counter for requested cyclic input data exchanges
cyclic output data exchange requested counter	Counter for requested cyclic output data exchanges
cyclic input data exchange executed counter	Counter for executed cyclic input data exchanges
cyclic output data exchange executed counter	Counter for executed cyclic output data exchanges
size of input process image	Size of input process image
size of output process image	Size of output process image

Table 43: Extended diagnosis > ECAT_MASTER_AP > DPM statistics

8.5.3   Internal status of AP task

Figure 79: Extended diagnosis > ECAT_MASTER_AP > Internal status of AP task

Name	Description
hard reset required	A hard reset is required Possible values: • no • yes

Table 44: Extended diagnosis > ECAT_MASTER_AP > Internal status of AP task

9   Tools

9.1   Overview tools

Under "Tools", the Packet monitor and the IO monitor are provided for test and diagnosis purposes.

- In the "Packet Monitor", data packets are used to communicate with the firmware and are exchanged between the application (configuration software) and the firmware in the device.

- The "I/O Monitor" offers an easy way to display data of the process image and to change the output data.
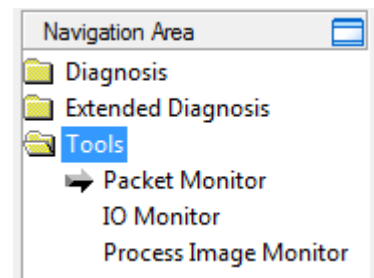
Figure 80: Navigation area - Tools (example)

Online connection to the device

> **Note:**
> Accessing the **Tools** dialog panes of the EtherCAT Master DTM requires an online connection from the EtherCAT Master DTM to the EtherCAT Master device. For further information refer to section *Connecting/disconnecting device* [▶ page 88].

9.2   Packet monitor

The Packet monitor serves for test and diagnosis purposes.

Data packets, i. e. messages are self-contained blocks of defined data length. The packets are used to communicate with the firmware and they are exchanged between the application (configuration software) and the firmware in the device. Packets can be sent once or cyclically to the connected device controlled by the user and packets received can be displayed.

Data packets comprise from a **Packet header** and the **Send data** or from a **Packet header** and the **Receive data**. The packet header can be evaluated by the receiver of the packet and contain the sender and receiver address, the data length, an ID number, status and error messages and the command or response code. The minimum packet size amounts 40 Byte for the packet header. The sending and receiving data is added.

> For further information to the packet description, refer to the Protocol API Manual.

➢ Open the **Packet monitor** via **Tools** > **Packet monitor**.

Figure 81: Packet monitor

Display mode switches the representation of the send and reception data between decimal and hexadecimal.

➢ Select **Reset counter** to reset the packet counter.

9.2.1 Sending packet

Figure 82: Send > Packet header and Send data

Packet header

Under **Send** > **Packet header** the elements of the packet header of the sending packet are displayed, which is transmitted from the application (configuration software) to the device. The packet header of the sending packets contain the elements described in the following table.

Element		Description
Dest	Destination Queue Handle	Contains the identifier of the receiver for the packet (*destination task queue* of the firmware).
Src	Source Queue Handle	Contains the identifier of the sender of the packet (sending task).
Dest ID	Destination Queue Reference	Contains an identifier for the receiver of unsolicited sent packets from the firmware to the application (configuration software).
Src ID	Source Queue Reference	Contains an identifier of the sender.
Len	Packet Data Length (in bytes)	Length of the send respectively receive data.
ID	Packet Identification As Unique Number	Identifies identical data packets among each other.
State	Status / Error Code	Transmits status or error codes to the packet sender.
Cmd	Command / Response Code	Command or respond code.
Ext	Extension	Field for extensions (reserved).
Rout	Routing Information	Internal value of the firmware.

Table 45: Descriptions Packet header

➢ Under **Dest** select the receiver (destination task queue).

➢ Under **Cmd** select the command identification (Request).

Auto Increment ID is an increment for the identifier of the data packets and increments the ID by 1 for each newly sent packet.

Send data

➢ Under **Send** > **Send data** enter the send data of the packet, which shall be transmitted from the application (configuration software) to the mailbox of the device. The meaning of the transmitted data depends on the command or response code.

Sending packets once or cyclic

➢ To send packet "once", select **Put packet**.

➢ To send packet "cyclic", select **Put cyclic**.

9.2.2 Receiving packet

Figure 83: Packet header and Receive data

Packet header

Under **Receive** > **Packet header** the elements of the packet header of the receiving packet are displayed, which are transmitted back from the device to the application (configuration software). The packet header of the receiving packets contain the elements described in the following table.

Element		Description
Dest	Destination Queue Handle	Contains the identifier of the receiver for the packet (*destination task queue* of the firmware).
Src	Source Queue Handle	Contains the identifier of the sender of the packet (sending task).
Dest ID	Destination Queue Reference	Contains an identifier for the receiver of unsolicited sent packets from the firmware to the application (configuration software).
Src ID	Source Queue Reference	Contains an identifier of the sender.
Len	Packet Data Length (in bytes)	Length of the send respectively receive data.
ID	Packet Identification As Unique Number	Identifies identical data packets among each other.
State	Status / Error Code	Transmits status or error codes to the packet sender.
Cmd	Command / Response Code	Command or respond code.
Ext	Extension	Field for extensions (reserved).
Rout	Routing Information	Internal value of the firmware.

Table 46: Descriptions Packet header

Receive data

Under **Receive** > **Receive data** the receiving data of the packet, which is transmitted back from the device to the application (configuration software) is displayed.

9.3   I/O monitor

The IO monitor serves for test and diagnosis purposes. It provides to view data of the process data image and to change output data easily. The display is always in a Byte manner.

> **Note:**
> Only change and write output data if you know that no plant disturbances are caused by this. All output data written by the IO monitor is transmitted at the bus and have effect on subordinate drives, IO etc.

Figure 84: IO monitor

Columns switches the number of columns.

Display mode switches the representation of the input and output data between decimal and hexadecimal.

Offset / Go moves the indication of the data to the entered offset value.

➢ Enter the output value and select **Update**.

⇨ The data of the process image are always displayed, even if these bytes are not reserved by the configuration.

9.4   Process image monitor

The window **Process image monitor** lists the slave devices connected to the master, as well as the configured modules or input or output signals of the devices. This makes visible the fieldbus structure and the data structure of the device's input and output data transmitted at the bus. Furthermore, the values of the signal data provided to the OPC server are displayed here.

➢ Open **Tools** > **Process image monitor**.
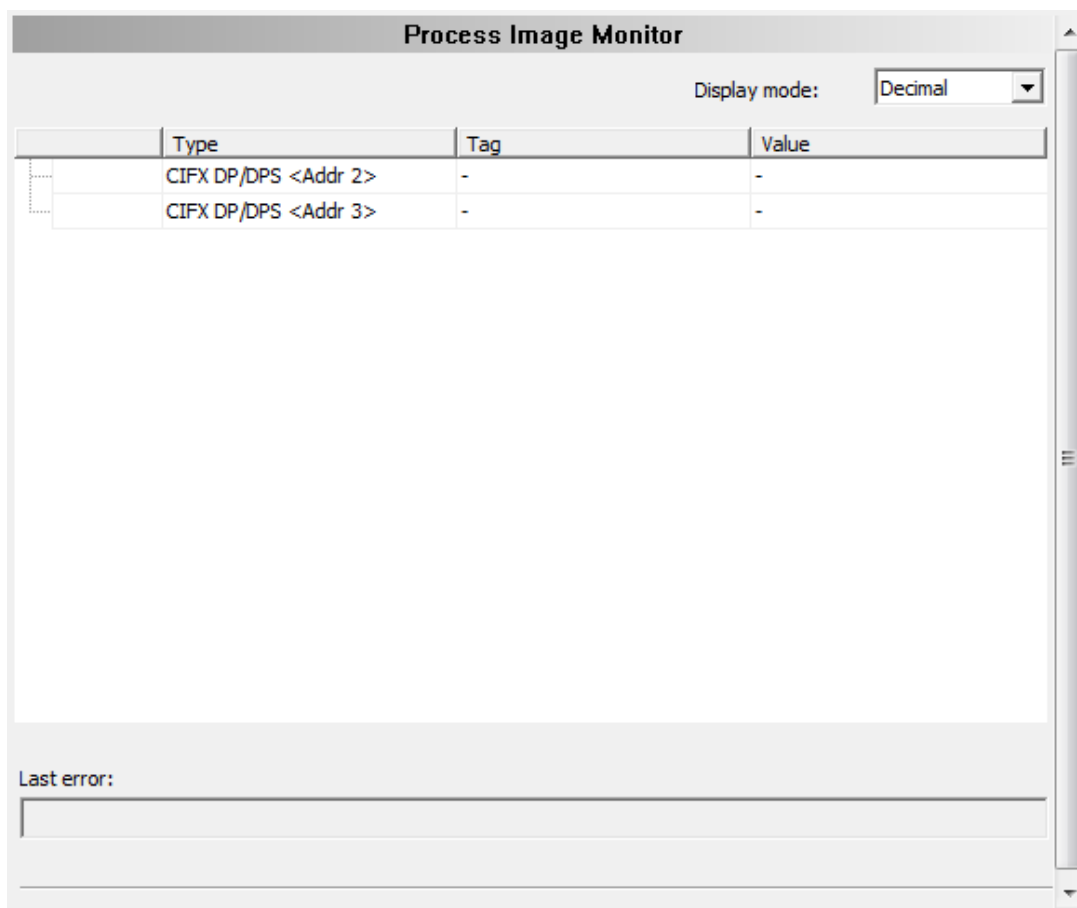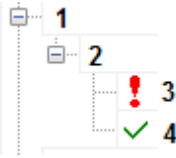
Figure 85: Window "Process image monitor"

Parameter	Description	Range of value/ value
Display mode	Display of the values in the column **Value** in decimal or hexadecimal mode.	Decimal (Default), Hexadecimal
	The tree shows the structure of the devices (1), modules (2) and the input data (3) and output data (4).	
?	Display when the input and output data is not completely read and analyzed.	
!	Display when the input and output data is not valid.	
✓	Display when the input and output data is valid.	
Type	Device labeling provided by the hardware: Also description of the modules or input or output signals configured to the device.	

Parameter	Description	Range of value/ value
TAG	Device name provided by the hardware (not changeable in the FDT container) or symbolic name for the modules configured to the device or for the input or output signals (changeable in the window **Configuration > Process data**).	
Value	Display of the valid input and output data values.	
Last error	Last occurred error (Description see appropriate Application Programming Manual)	

Table 47: Notes to the "Process image monitor" window

10 Appendix

10.1 References

[1] FDT Joint Interest Group (www.fdt-jig.org, FDT-JIG Working Group): Device Type Manager (DTM) Style Guide, Version 1.0; FDT-JIG - Order No. <0001-0008-000>, English, 2005.

[2] Hilscher Gesellschaft für Systemautomation mbH: Protocol API, EtherCAT Master, V 4.5.0, Protocol API Manual, Revision 6, DOC150601API06EN, English, 2020-09.

[3] Hilscher Gesellschaft für Systemautomation mbH: Protocol API, EtherCAT Salve, V 5.3.0, Protocol API Manual, Revision 4, DOC181005API04EN, English, 2021-09.

[3] EtherCAT Technology Group: EtherCAT communication specification, August 2007.

[4] International Electrotechnical Commission: International Standard, IEC 61158 Industrial communication networks - Fieldbus specifications, Part 2-6 Type 12 documents.

[5] Hilscher Gesellschaft für Systemautomation mbH: API, Hilscher status and error codes, firmware and drivers, revision 5, DOC100802API05EN, English, 2019-11.

[6] IEEE STANDARDS ASSOCIATION: 26514-2010 - IEEE Standard for Adoption of ISO/IEC 26514:2008 Systems and Software Engineering--Requirements for Designers and Developers of User Documentation, English, 2011-01.

Safety standard

American National Standards Institute, Inc.: American National Standard, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials, ANSI Z535.6-2016, English, 2016.

10.2 User rights

User-rights are set within the FDT-container. Depending on the level, the configuration is accessible by the user or read-only.

To access the **Settings**, **Configuration** and **Diagnosis** panes of the EtherCAT Master DTM you do not need special user rights. Also all users can select the decimal or hexadecimal Display mode or sort table entries.

> **Note:**
> To edit, set or configure the parameters of the **Settings** and **Configuration** panes, you need user rights for "Maintenance", for "Planning Engineer" or for "Administrator".

The following tables give an overview of the user right groups and which user rights you need to configure the single parameters.

10.2.1 Settings

Settings		Observer	Operator	Maintenance	Planning engineer	Adminis-trator
Driver	*Verifying or adapting driver settings* [▶ page 25]	D	D	X	X	X
	Configuring netX driver [▶ page 28]	D	D	X	X	X
Device Assignment	*Scanning for devices* [▶ page 34]	D	D	X	X	X
	Selecting the device (with or without firmware) [▶ page 37]	D	D	X	X	X
	Selecting the device once more (with firmware) [▶ page 37]	D	D	X	X	X
	Selecting and downloading firmware [▶ page 39]	D	D	X	X	X
Licen-sing	*Licensing* [▶ page 45]	D	D	X	X	X

Table 48: User rights settings (D = displaying, X = editing, configuring)

10.2.2 Configuration

	Observer	Operator	Maintenance	Planning engineer	Adminis-trator
General [▶ page 60]	A	A	X	X	X
Process data handshake [▶ page 63]	A	A	X	X	X
Topology [▶ page 65]	A	A	X	X	X
Mailbox [▶ page 71]	A	A	X	X	X
FMMU/Sync Man [▶ page 78]	A	A	X	X	X
Process data [▶ page 81]	A	A	X	X	X
Address table [▶ page 83]	A	A	X	X	X
Init commands [▶ page 85]	A	A	X	X	X

Table 49: User rights configuration (D = displaying, X = editing, configuring)

10.3 Conventions in this document

Instructions

1. Operation purpose
2. Operation purpose
   - ➢ Instruction

Results

⇘ Intermediate result

⇨ Final result

Signs

Sign	Note
➡	General note
❗	Important note that must be followed to prevent malfunctions.
📖ℹ	Reference to further information

Table 50: Signs

Signal words

Signal word	Description
⚠ DANGER	Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation, which if not avoided, may result in minor or moderate Injury.
NOTICE	Indicates a property damage message.

Table 51: Signal words

10.4 Legal notes

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- Medical devices used for life support and
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Glossary

CODESYS	COntroller DEvelopment SYStem: Development environment for programming controller applications (PLC) according to the international industrial standard IEC 61131-3
Data packet	Data packets, i. e. messages are self-contained blocks of defined data length. The packets are used to communicate with the firmware and they are exchanged between the application (configuration software) and the firmware in the device.
DPM	Dual-port memory
DTM	Device Type Manager: Software module with graphical user interface for the configuration and/or for diagnosis of devices
EtherCAT	Ethernet for Control Automation Technology: communication system for Industrial Ethernet designed and developed by Beckhoff Automation GmbH, Verl, Germany
EtherCAT Master	Device responsible for configuration and parameterization of: an EtherCAT segment, the controllers of all devices within this segment and all services for cyclic process data exchange, mailbox operation and diagnosis
EtherCAT Slave	Device which is configured by the EtherCAT master, receives data telegrams containing output data, executes commands issued by the EtherCAT master and provides input and status data
Ethernet	Network technology used both for office and industrial communication via electrical or optical connections. It has been developed and specified by the Intel, DEC and XEROX, provides data transmission with collision control and allows various protocols. As Ethernet is not necessarily capable for real-time application, various real-time extensions have been developed (industrial Ethernet, real-time Ethernet).
FDT	Field Device Tool: FDT specifies an interface, in order to be able to use DTM (Device Type Manager) in different applications of different manufacturers
FMMU	Fieldbus Memory Management Unit: Provides a mapping between logical addresses within the EtherCAT network on one hand and physical addresses on the various slaves within the EtherCAT network on the other hand.
IP	Internet Protocol: Belongs to the TCP/IP family of protocols and is defined in RFC791 (available on http://www.ietf.org/rfc/rfc791.txt). It is based on layer 3 of the ISO/OSI 7 layer model of networking and is a connectionless protocol, i. e. you do not need to open a connection to a computer before sending an IP data packet to it. Therefore, IP is not able to guarantee that the IP data packets really arrive at the recipient. On IP level, neither the correctness of data nor the consistence and completeness are checked. IP defines special addressing mechanisms; see IP address.

IP address	Identifies a device or a computer within an IP-based network and is defined in the Internet Protocol Version 4 (IPv4) as a 32-bit number. For ease of notation, the address is usually divided into four 8-bit numbers represented in decimal notation and separated by points: a.b.c.d. Each letter stands for an integer value between 0 and 255, e.g. 192.168.30.16. However, not all combinations are allowed, some are reserved for special purposes. The IP address 0.0.0.0 is defined as invalid.
Master	Type of device that initiates and controls the communication on the bus
Module	Hardware or logical component of a physical device
ODMV3	Online-Data-Manager Version 3: Application interface, respectively works as a server, which can be run as an out-proc server or system service. Its task is to provide different applications (e. g. SYCON.net), access to multiple devices and even share one device amongst several applications.
SCADA	Supervisory Control and Data Acquisition: A concept for the control and data acquisition of technical processes
Slave	Type of device that is configured by the Master and which then performs the communication
Submodule	Hardware or logical component of a physical device.
SYCON.net	multiprotocol-capable Hilscher configuration and diagnosis software (FDT frame application), that can be used to configure communication-capable fieldbus devices of different manufacturers in one project

Contacts

HEADQUARTER

Germany

Hilscher Gesellschaft für
Systemautomation mbH
Rheinstraße 15
65795 Hattersheim
Phone: +49 (0) 6190 9907-0
Fax: +49 (0) 6190 9907-50
E-mail: info@hilscher.com

Support

Phone: +49 (0) 6190 9907-990
E-mail: hotline@hilscher.com

SUBSIDIARIES

China

Hilscher Systemautomation (Shanghai) Co. Ltd.
200010 Shanghai
Phone: +86 (0) 21-6355-5161
E-mail: info@hilscher.cn

Support

Phone: +86 (0) 21-6355-5161
E-mail: cn.support@hilscher.com

France

Hilscher France S.a.r.l.
69800 Saint Priest
Phone: +33 (0) 4 72 37 98 40
E-mail: info@hilscher.fr

Support

Phone: +33 (0) 4 72 37 98 40
E-mail: fr.support@hilscher.com

India

Hilscher India Pvt. Ltd.
Pune, Delhi, Mumbai, Bangalore
Phone: +91 8888 750 777
E-mail: info@hilscher.in

Support

Phone: +91 8108884011
E-mail: info@hilscher.in

Italy

Hilscher Italia S.r.l.
20090 Vimodrone (MI)
Phone: +39 02 25007068
E-mail: info@hilscher.it

Support

Phone: +39 02 25007068
E-mail: it.support@hilscher.com

Japan

Hilscher Japan KK
Tokyo, 160-0022
Phone: +81 (0) 3-5362-0521
E-mail: info@hilscher.jp

Support

Phone: +81 (0) 3-5362-0521
E-mail: jp.support@hilscher.com

Republic of Korea

Hilscher Korea Inc.
13494, Seongnam, Gyeonggi
Phone: +82 (0) 31-739-8361
E-mail: info@hilscher.kr

Support

Phone: +82 (0) 31-739-8363
E-mail: kr.support@hilscher.com

Austria

Hilscher Austria GmbH
4020 Linz
Phone: +43 732 931 675-0
E-mail: sales.at@hilscher.com

Support

Phone: +43 732 931 675-0
E-mail: at.support@hilscher.com

Switzerland

Hilscher Swiss GmbH
4500 Solothurn
Phone: +41 (0) 32 623 6633
E-mail: info@hilscher.ch

Support

Phone: +41 (0) 32 623 6633
E-mail: support.swiss@hilscher.com

USA

Hilscher North America, Inc.
Lisle, IL 60532
Phone: +1 630-505-5301
E-mail: info@hilscher.us

Support

Phone: +1 630-505-5301
E-mail: us.support@hilscher.com