acontis technologies GmbH

SOFTWARE

EC-Engineer

User Manual

Version 4.1

Edition: August 21, 2025

Contents

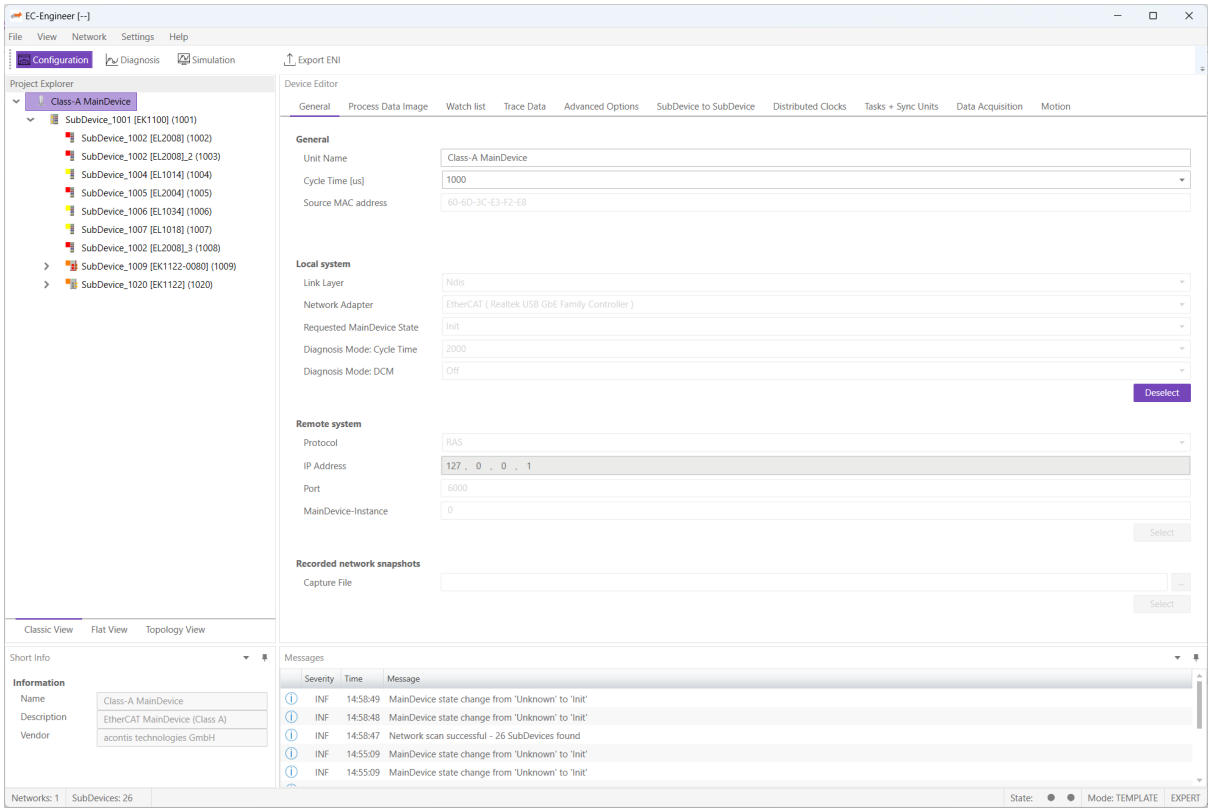
1 Introduction

Since this software is not intended to offend any sensibilities, the term MainDevice (abbreviated MainDevice) replaces “master” and SubordinateDevice (abbreviated SubDevice) replaces “slave”.

1.1 Overview

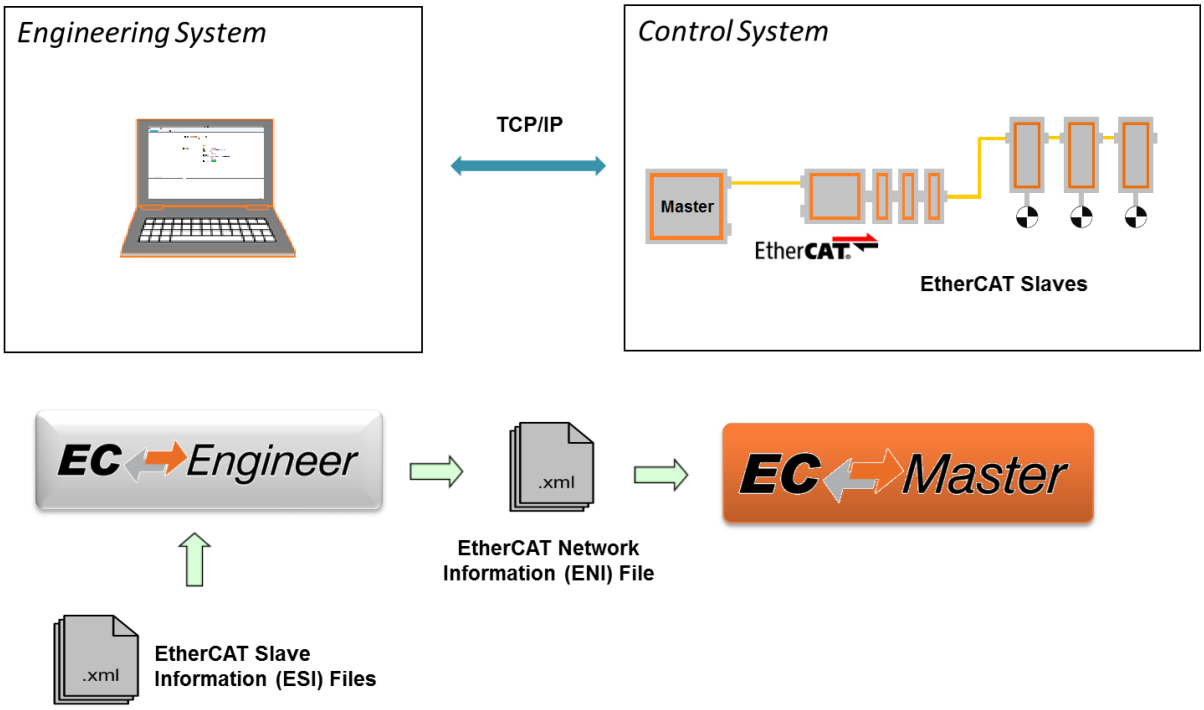
EC-Engineer is a configuration and diagnosis tool for EtherCAT networks that are controlled by the EC-Master.

The following screenshot shows the EC-Engineer:



It runs on the Engineering System where the engineer can configure the EtherCAT network. All SubDevices default to settings that match the SubDevice’s typical use case. Complex networks or installations with special requirements need adjustments to the default settings. Using the Configuration Mode, the user can configure his EtherCAT network according to the project’s needs.

As the result of his work the user can export the EtherCAT Network Information (`ENI`) file, which is necessary to run the EC-Master on the Control System:



If he has the possibility to connect his Engineering System to the Control System, he can also scan his existing EtherCAT network. The EC-Engineer will then read the network configuration and add all SubDevices to the project explorer. Now the user can fine tune the network or directly export the `ENI` file.

If the control system is now running, he can connect to it by using the remote diagnosis functionality and verify that everything is fine by accessing the states, variables, object dictionaries, ESC registers EEPROM data.

1.2 Features

The following table shows the features of the EC-Engineer:

General features	Feature ID	Free	Standard	Plus
Classic view	100	✔	✔	✔
Flat view	101	✔	✔	✔
Topology view	102	✔	✔	✔
Multiple Instances	103	✔	✔	✔
Different themes	104	✔	✔	✔
Different Languages	105	✔	✔	✔
Command line interface	106	✔	✔	✔
EMI Manager	107	✔	✔	✔
ESI Manager	108	✔	✔	✔
Expert Mode	109	✔	✔	✔
Edit topology view	110	✔	✔	✔
Offline Diagnosis	111	✘	✔	✔
Unlimited SubDevice Count	112	✘	✔	✔

Configuration features	Feature ID	Free	Standard	Plus
Set up distributed clocks	200	✔	✔	✔
Configure MDP SubDevices	201	✔	✔	✔
Custom PDO mapping	202	✔	✔	✔
Changing name of variables	203	✔	✔	✔
Group support / Hot Connect / Pinned Group	204	✔	✔	✔
EoE Support	205	✔	✔	✔
Startup Commands	206	✔	✔	✔
CoE Object-Dictionary (offline)	207	✔	✔	✔
Enable / disable SubDevice	208	✔	✔	✔
SubDevice to SubDevice	209	✔	✔	✔
Support gateway SubDevices (EL6692, EL6631-0010, …)	210	✔	✔	✔
Export ENI-File	211	✘	✔	✔
Export Process variables	212	✔	✔	✔
Multiple Cyclic Tasks	213	✘	✔	✔
Import SubDevices from ENI	214	✔	✔	✔
SoE Object-Dictionary (offline)	215	✔	✔	✔
Change revision of SubDevice	216	✔	✔	✔
Scan topology of local system	217	✔	✔	✔
Scan topology of remote system	218	✘	✔	✔
Scan PDO configuration from SubDevice	219	✔	✔	✔
Scan MDP configuration from SubDevice	220	✔	✔	✔
Define project templates	221	✘	✔	✔
Support gateway MainDevices (EL6751, EL6731, …)	222	✘	✘	✔
EtherCAT P support	223	✔	✔	✔
SubDevice to SubDevice in Cycle	224	✘	✔	✔

Diagnosis features	Feature ID	Free	Standard	Plus
Watch list with export	300	✔	✔	✔
ESC Register	301	✔	✔	✔
FoE support	302	✘	✔	✔
DC Diagnosis	303	✔	✔	✔
Extended Diagnosis	304	✔	✔	✔
Trace Data Variables	305	✔	✔	✔
EoE endpoint support	306	✘	✔	✔
Export CoE Object-Dictionary	307	✔	✔	✔
Local System with Windows MainDevice	308	✔	✔	✔
Remote System via RAS-Client	309	✘	✔	✔
Reading count of SubDevices or frames	310	✔	✔	✔
Compare configured and found SubDevices	311	✔	✔	✔
See value of variables in a list view or chart view	312	✔	✔	✔
Changing value of a variable	313	✔	✔	✔
Reading/Writing values (CoE OD)	314	✔	✔	✔
EEPROM Reading/Writing values	315	✘	✔	✔
Reading error or frame counters	316	✔	✔	✔
Diagnosis History of MainDevice or SubDevice	317	✔	✔	✔
Reading/Writing values (SoE OD)	318	✔	✔	✔

1.3 Supported SubDevices of Beckhoff EL6xxx

The following table shows the supported SubDevices of Beckhoff EL6xxx in the EC-Engineer:

Name	Free	Standard	Plus
EL6001 Interface (RS232)	✔	✔	✔
EL6002 Interface 2Ch. (RS232)	✔	✔	✔
EL6021 Interface (RS422/485)	✔	✔	✔
EL6021-0021 Interface (RS422/485 line device)	✔	✔	✔
EL6022 Interface 2Ch. (RS422/485)	✔	✔	✔
EL6080 EtherCAT Memory Terminal (128kB)	✔	✔	✔
EL6224 / EP6224 IO-Link Gateway	✔	✔	✔
EP6228 / EPP6228 IO-Link Gateway	✔	✔	✔
EL6601 1 Port Switch (Ethernet, CoE)	✔	✔	✔
EL6614 4 Port Switch (Ethernet, CoE)	✔	✔	✔
EL6631-0010 PROFINET IO Device	✔	✔	✔
EL6633-0010 PROFINET IO Device	✔	✔	✔
EL6690 EtherCAT Bridge terminal (Primary)	✔	✔	✔
EL6690 EtherCAT Bridge terminal (Secondary)	✔	✔	✔
EL6692 EtherCAT Bridge terminal (Primary)	✔	✔	✔
EL6692 EtherCAT Bridge terminal (Secondary)	✔	✔	✔
EL6695 EtherCAT Bridge terminal (Primary)	✔	✔	✔
EL6695 EtherCAT Bridge terminal (Secondary)	✔	✔	✔
EL6731 PROFIBUS DP MainDevice	✘	✘	✔
EL6731-0010 PROFIBUS DP SubDevice	✔	✔	✔
EL6751 CANopen MainDevice	✘	✘	✔
EL6751-0010 CANopen SubDevice	✘	✘	✔
EL6752 DeviceNet MainDevice	✘	✘	✔
EL6752-0010 DeviceNet SubDevice	✘	✘	✔

Not listed devices are not supported.

1.4 Requirements

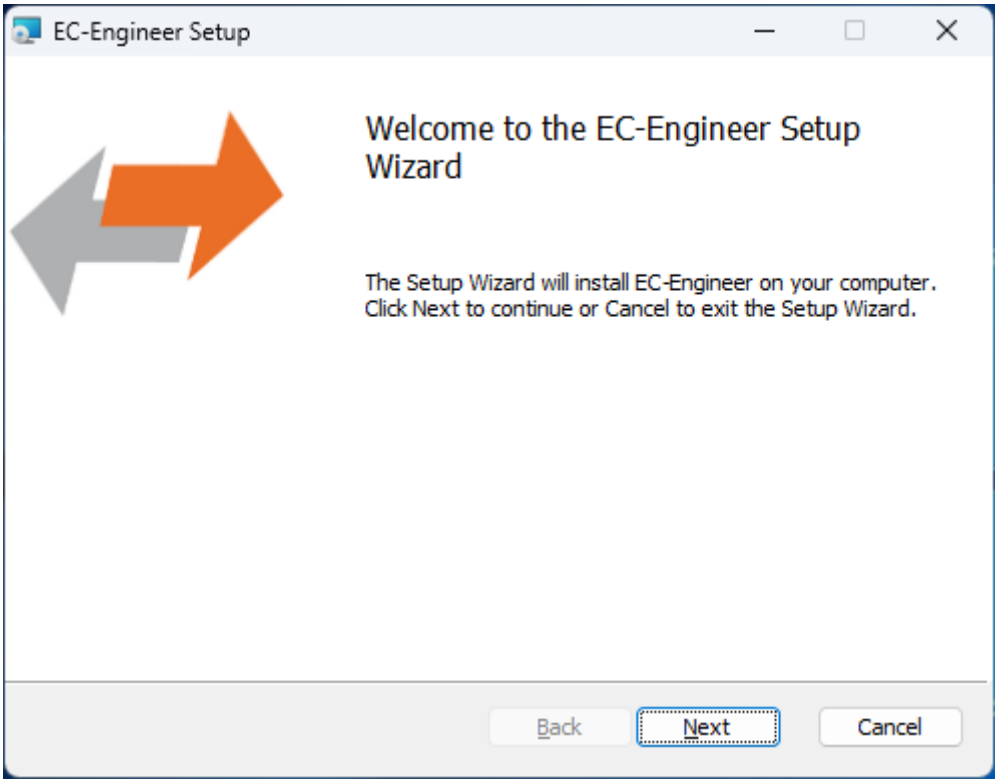
- Microsoft Windows 10 and above
- Microsoft .NET Framework 4 Client Profile
- Screen resolution at least 1024x768 pixel
- Memory as recommended for operating system
- Disk space approximately 80 MB (depend on number of `ESI` files)

2 Installation

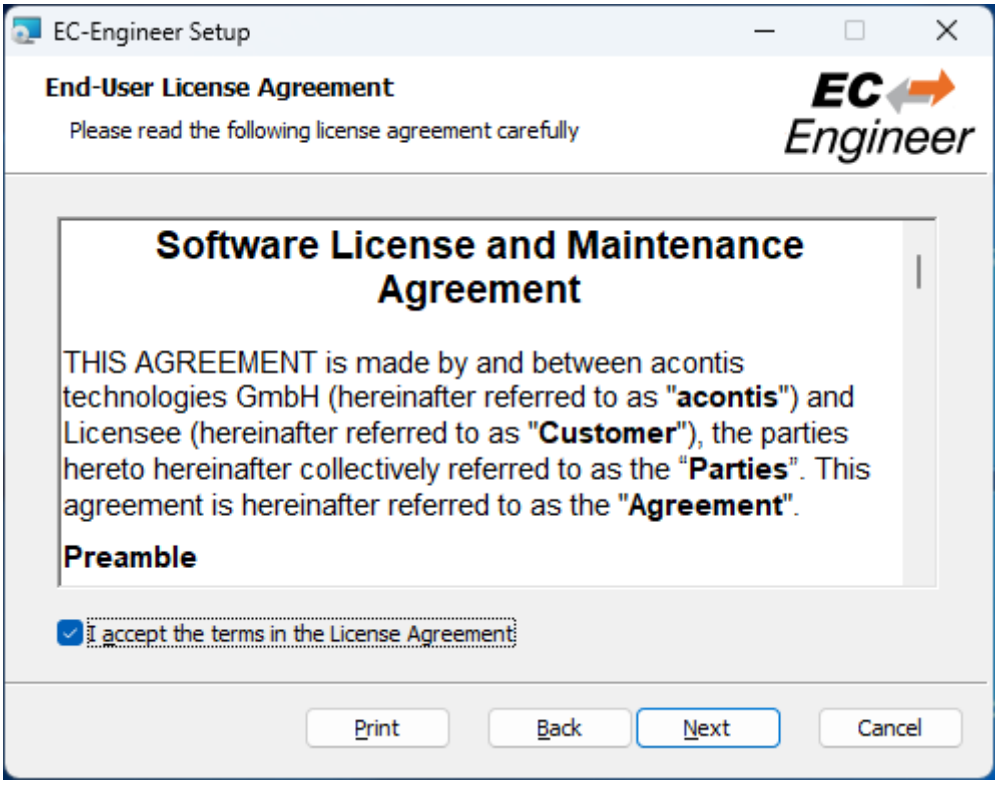
2.1 Setup Process

The EC-Engineer can be installed by executing the `setup.exe` (requires administrator privileges) and follow the screen instructions:

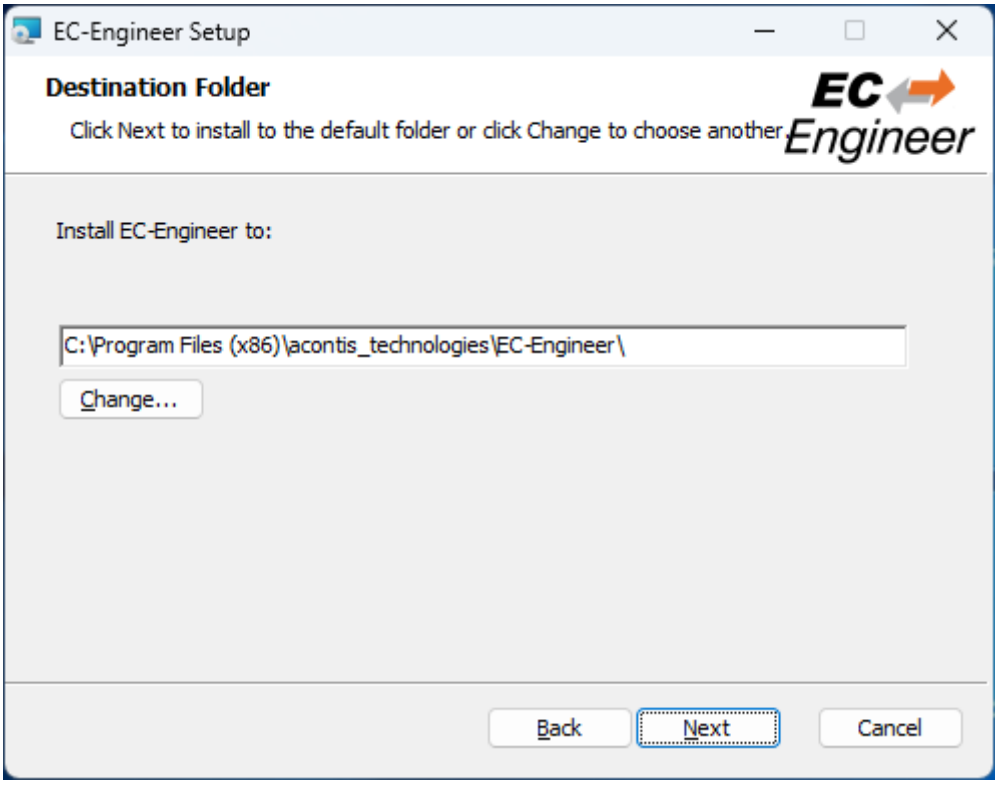
Welcome page:



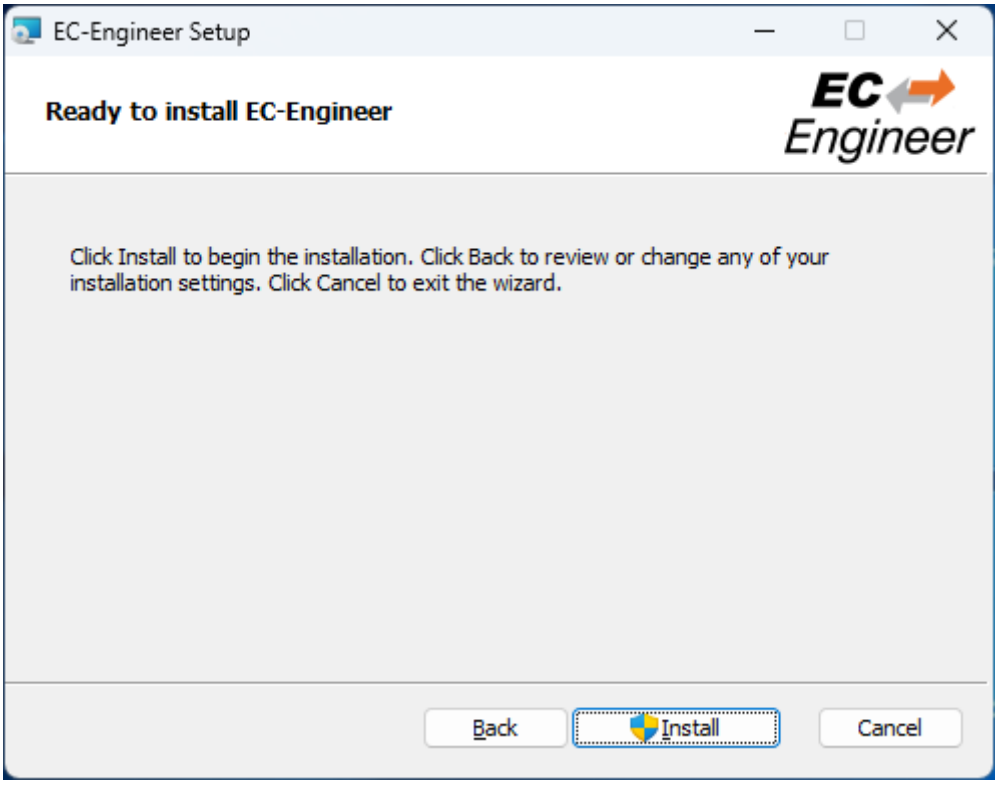
License Agreement:



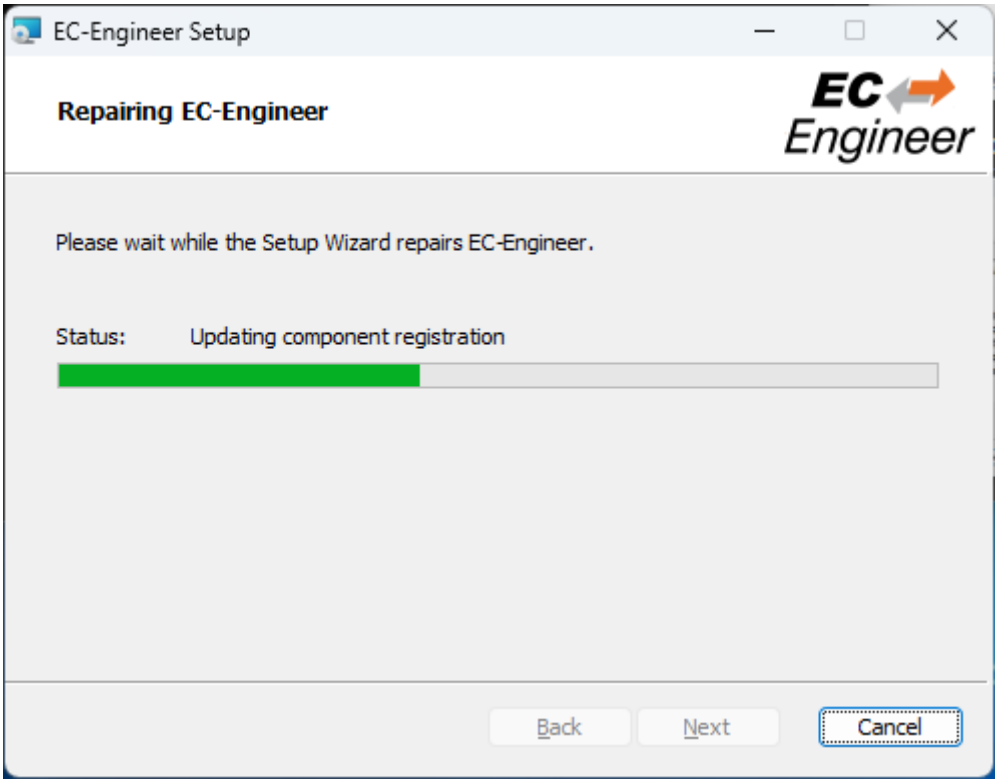
Select Installation Folder:



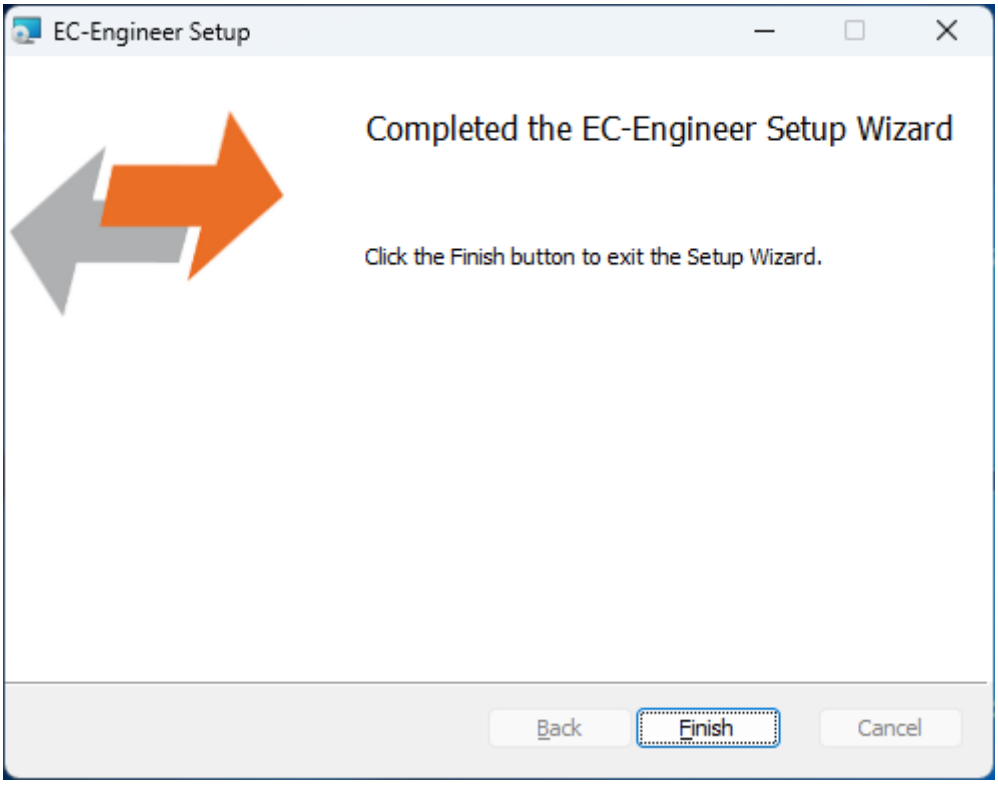
Confirm Installation:



Installing:



Installation Complete:



2.2 Silent Installation (optional)

The EC-Engineer can be also installed in silent mode by using the command line parameters of `msiexec`.

Sample 1: Installs EC-Engineer into default installation folder

```
PS C:
    > msiexec /i c:/temp/ECEngineerSetup.msi /quiet /qn /norestart /log
↪   c:/temp/install.log
```

Sample 2: Installs EC-Engineer into “C:/EC-Engineer”

```
PS C:
    > msiexec /i c:/temp/ECEngineerSetup.msi /quiet /qn /norestart /log
↪   c:/temp/install.log INSTALLLOCATION="C:/EC-Engineer"
```

For more information please refer command line parameters of `msiexec`.

Note: The system requirements (see section “1.3”) will be not checked!

2.3 File and Folder Structure

The setup process will copy all necessary files into the following folder:

Installation directory:

/Doc
Release notes and the user manual

/EEC
Files for mapping emergency error codes

/Languages
Lanugage specific files

/

- EC-Engineer.exe
- EcWrapper.dll
- …

All users directory: (%ALLUSERSPROFILE%/EC-Engineer, like C:/ProgramData/EC-Engineer)

/CAPTURE
Capture files which can be analysed in offline diagnosis mode (see *Capture File*)

/EMI
EtherCAT MainDevice Information files

/EtherCAT
EtherCAT SubDevice Information (`ESI`) Files. Can be modified via *ESI-Manager*

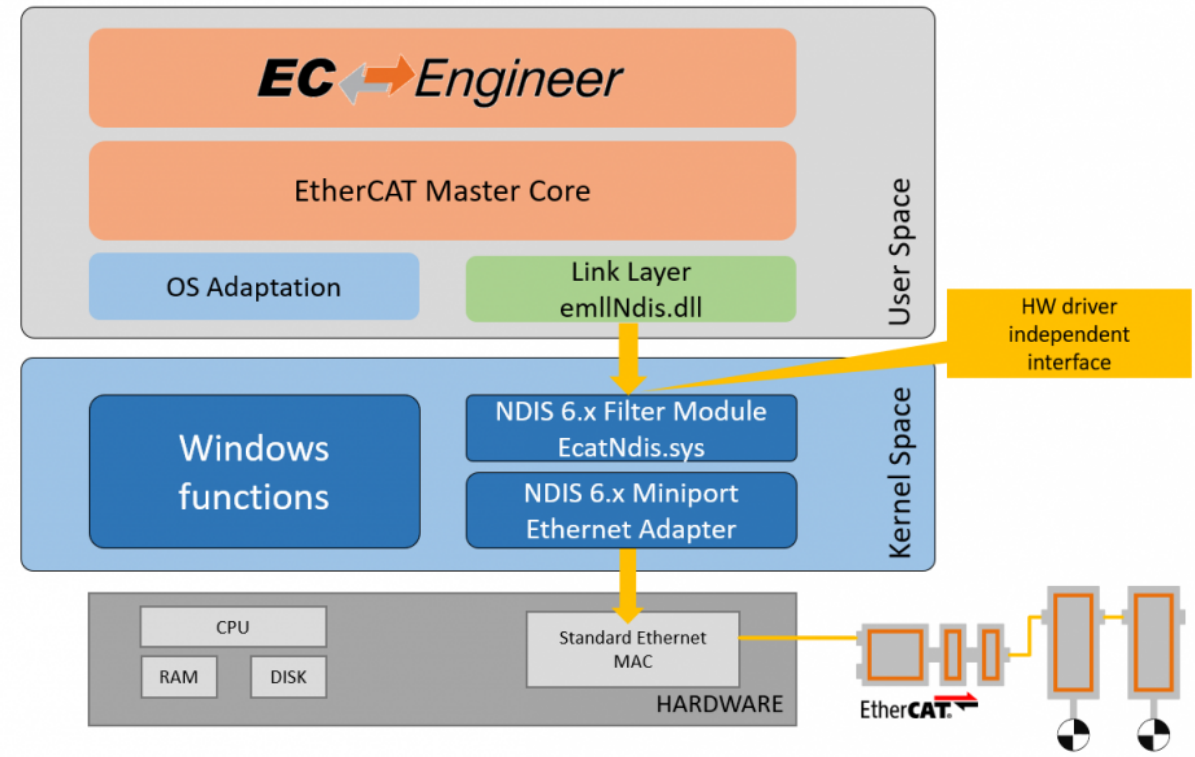
/

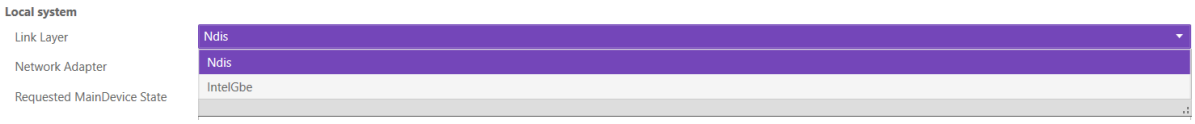
- **ESICache.xml (ESI-File-Cache for faster access of `ESI` files)**
  - EC-Engineer.log (Log File)
  - User.myusername.xml (User specific settings)

2.4 NDIS Driver

The Network Driver Interface Specification (NDIS) is the specification for a network driver architecture that allows transport protocols like TCP/IP to communicate with an underlying physical network adapter. For sending and receiving EtherCAT frames in Windows, EC-Engineer makes use of the well-known Windows packet capture library, WinPcap. However, WinPcap was based on the NDIS 5.x driver model, and development has ceased. The latest versions of Windows 10 do not support this old NDIS 5.x version anymore, so now EC-Engineer (V3.2 and higher) includes an installation package in the install directory of EC-Engineer to install the acontis NDIS 6.x Filter Module `EcatNdis.sys`. With this new Filter Module and the new NDIS Link Layer `emllNdis.dll`, it is now possible for EC-Engineer to work without WinPcap on all Windows 10 versions.

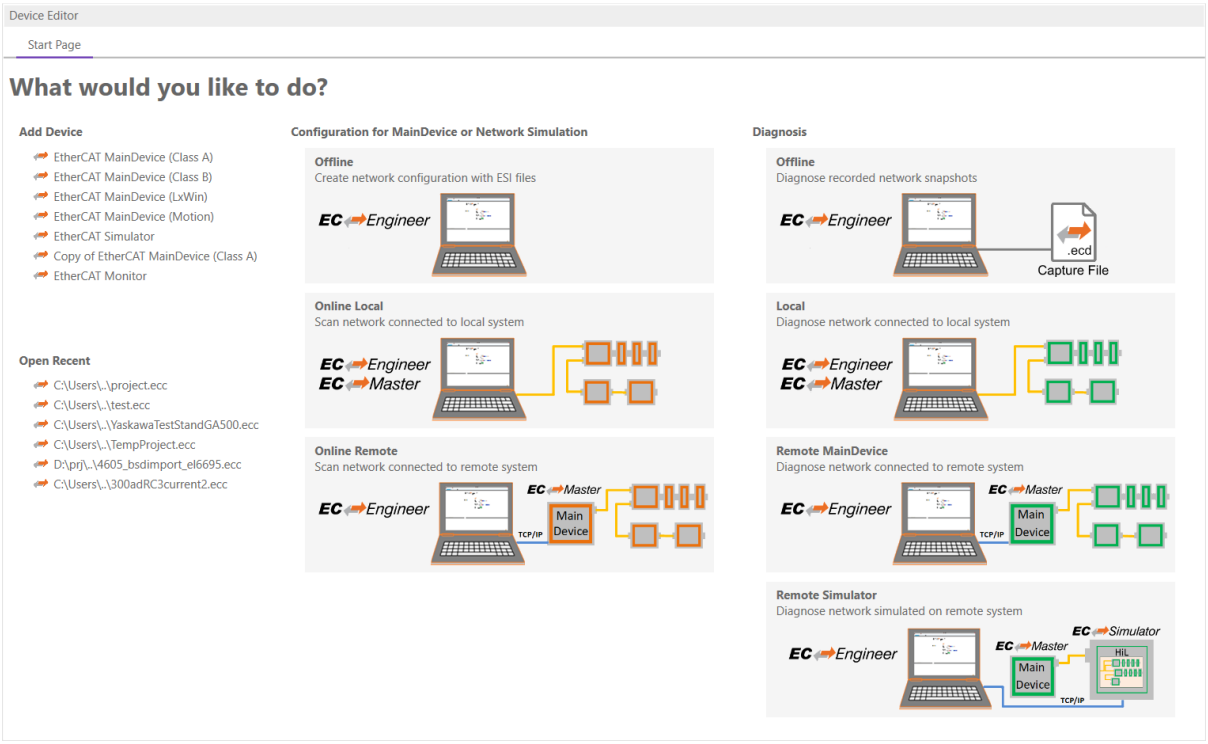
Note: Please restart EC-Engineer after the NDIS installation.


EC Engineer
EtherCAT Master Core
OS Adaptation
Link Layer
emllNdis.dll
User Space
HW driver
independent
interface
Windows
functions
NDIS 6.x Filter Module
EcatNdis.sys
NDIS 6.x Miniport
Ethernet Adapter
Kernel Space
CPU
RAM
DISK
Standard Ethernet
MAC
HARDWARE
EtherCAT


Local system
Link Layer
Network Adapter
Requested MainDevice State
Ndis
Ndis
IntelGbe

3 Getting Started

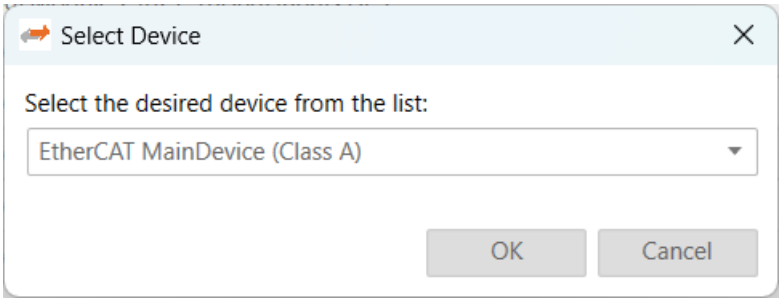
For a better usability, the product comes up with a start page, where the user can choose what he wants to do:



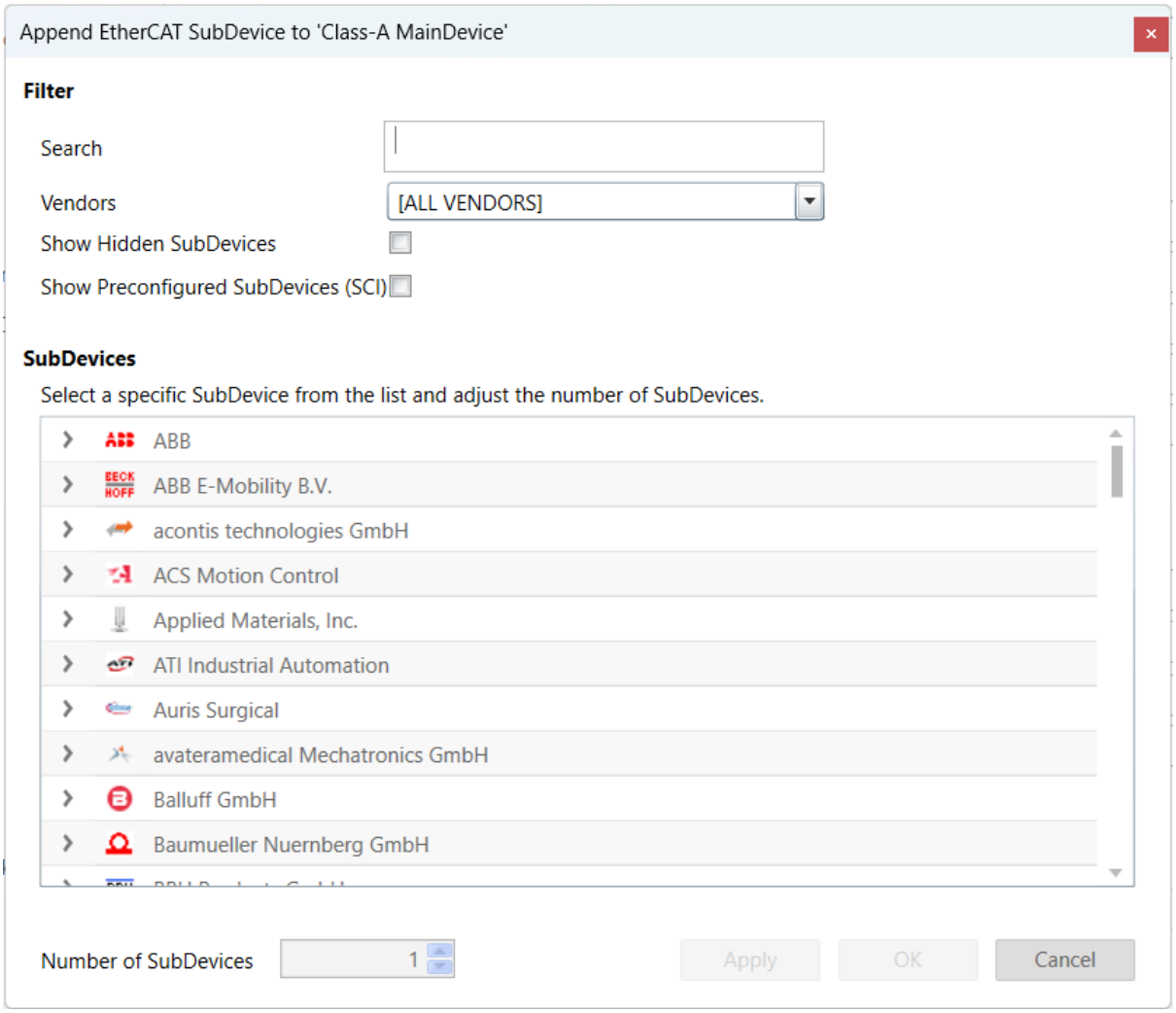
3.1 Offline (Configuration)

This mode is for configuring the EtherCAT network in the office by manually adding SubDevices to the network.

If the user clicks on this link he will see first the *Select MainDevice Dialog* for choosing the desired MainDevice (at the moment he can choose between Class A and Class B MainDevice):



Afterwards he will see the *SubDevice Select Dialog*, where he can configure his EtherCAT network:

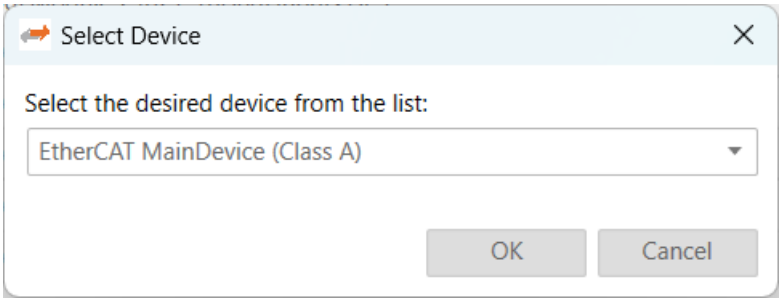


If you can not find your SubDevice or if you want to use your own `ESI` file, you can edit this list by using the *ESI-Manager*. After configuring the network you can select the *network* node and use the *Export ENI* button for generating an `ENI` file.

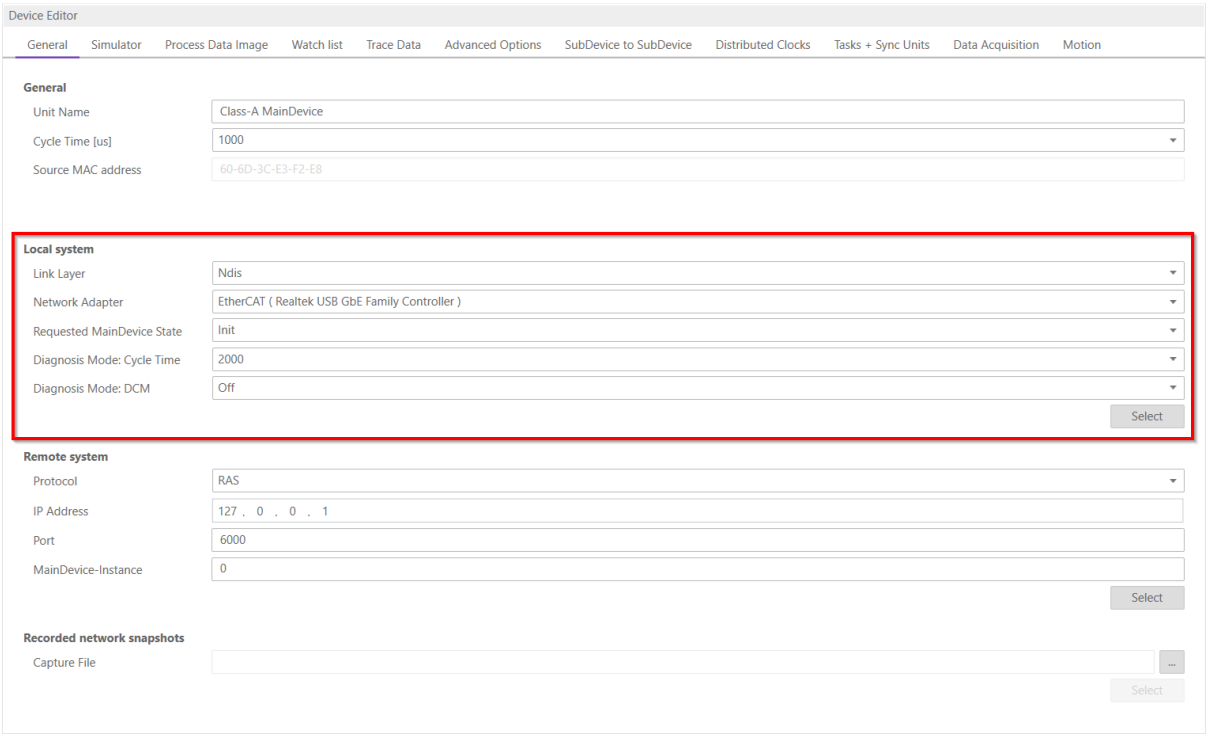
3.2 Online Local

This mode can be used if SubDevices are connected to the Engineering System by scanning the EtherCAT network configuration.

If user clicks on this link he will see first the *Select MainDevice Dialog* for choosing the desired MainDevice (at the moment he can choose between Class A and Class B MainDevice):



Afterwards he will see the *General-Tab*, where he can choose the network adapter which is connected to the control system:



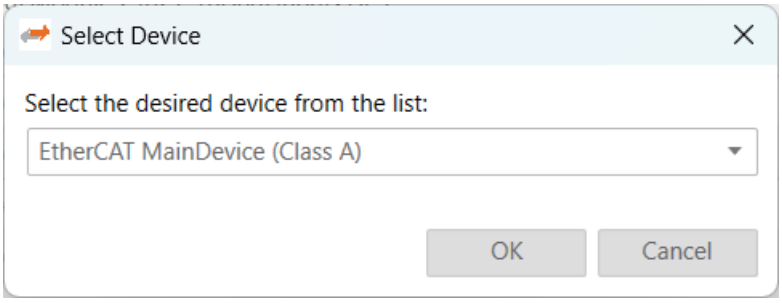
After selecting the network adapter, the EC-Engineer scans the control system and adds the network configuration to the project explorer. Here the user can adjust the configuration or use the *Export ENI* button for generating directly an `ENI` file.

Note: Please make sure that the selected network adapter is connected to the EtherCAT SubDevices.

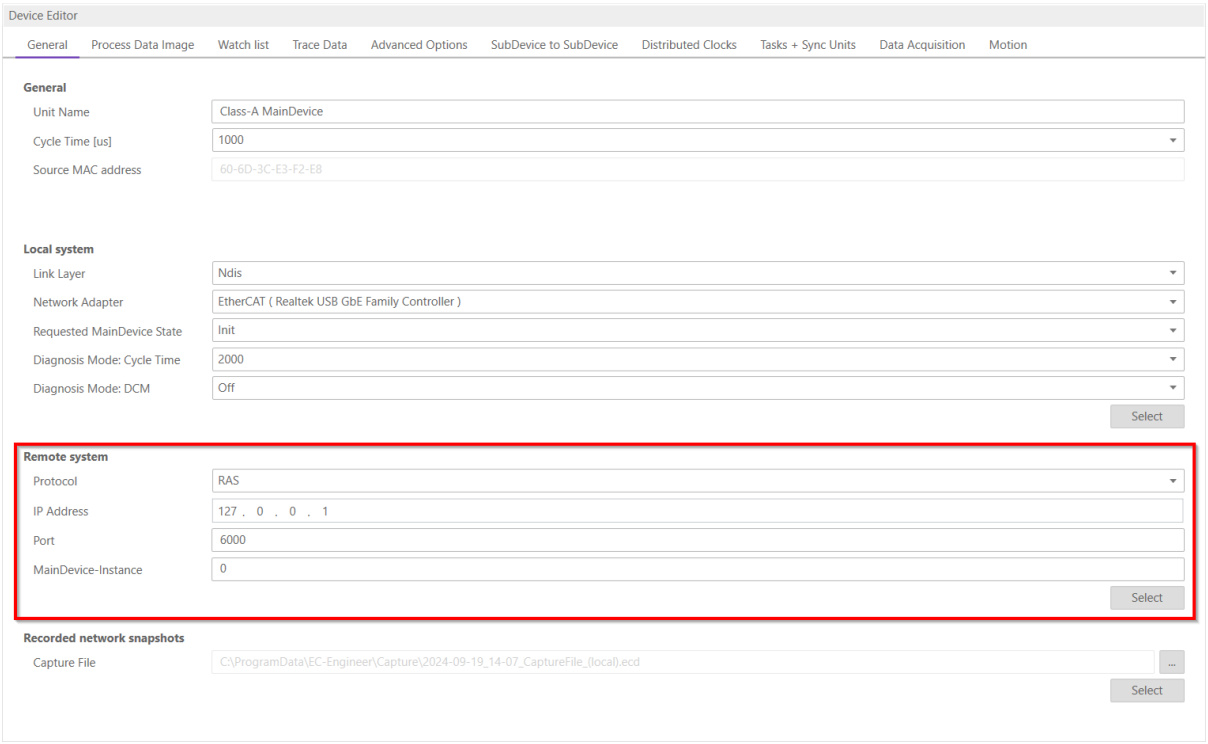
3.3 Online Remote

This mode can be used if SubDevices are connected to the control system. Means user can connect via TCP/IP to the control system if EC-Master RAS (remote access service) server is running and scan the EtherCAT network configuration.

If user clicks on this link he will see first the *Select MainDevice Dialog* for choosing the desired MainDevice (at the moment he can choose between Class A and Class B MainDevice):



Afterwards he will see the *General-Tab*, where he can enter the IP address of the remote system (and if necessary change the port and the MainDevice-instance, but normally this should not be necessary):

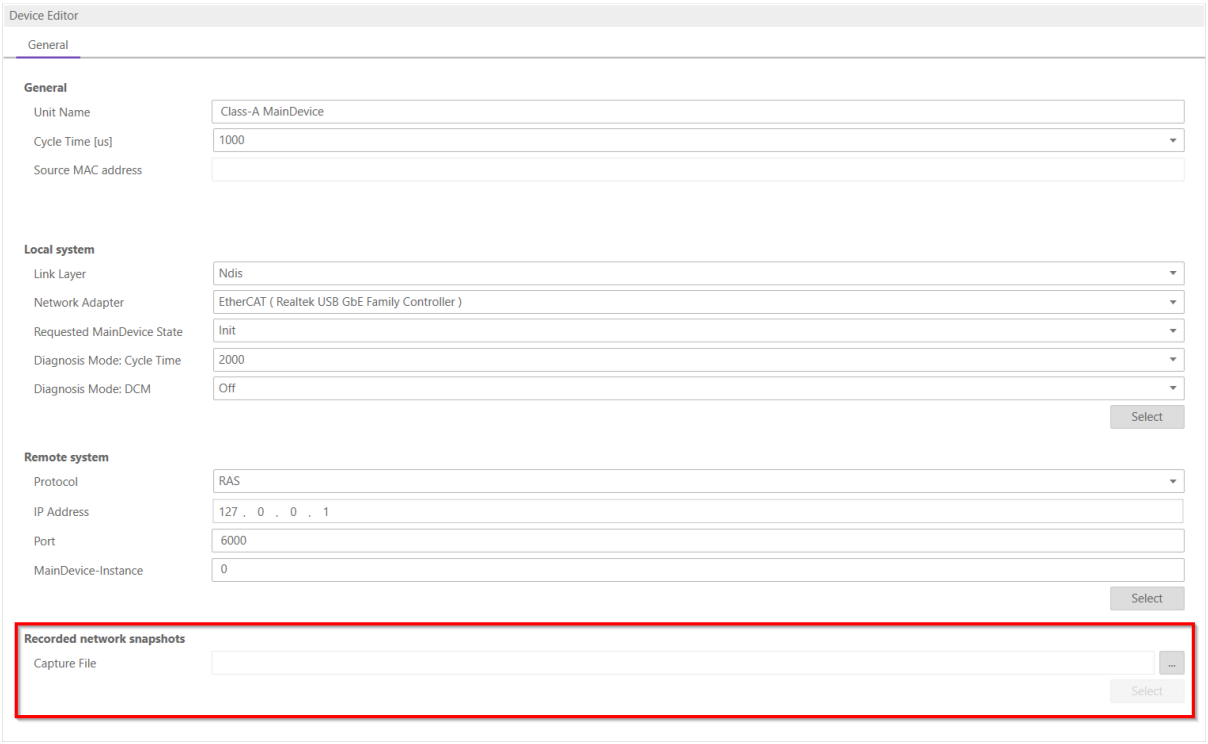


After entering the IP address, a click to *Select* tells the EC-Engineer to connect to and scan the remote system. The EC-Engineer adds all SubDevices of the network configuration to the project explorer. Here the user can adjust the configuration or use the *Export ENI* button for generating directly an `ENI` file.

3.4 Offline Diagnosis

This mode should be used if the user wants to analyse a previously created capture file. This can be done offline, which means that the “real system” no not necessary.

If user clicks on this link he will see the *General-Tab*, where he can enter the path to the capture, which contains one or more previously taken snapshots:

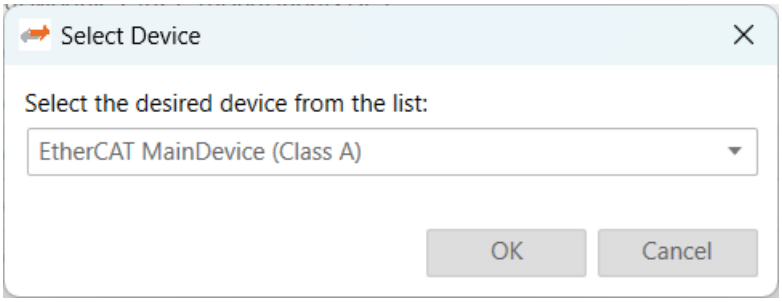


After choosing the path to the capture file, a click to *Select* switches the EC-Engineer into Diagnosis Mode. Now, the user can analyse the previously taken snapshots of a EtherCAT system.

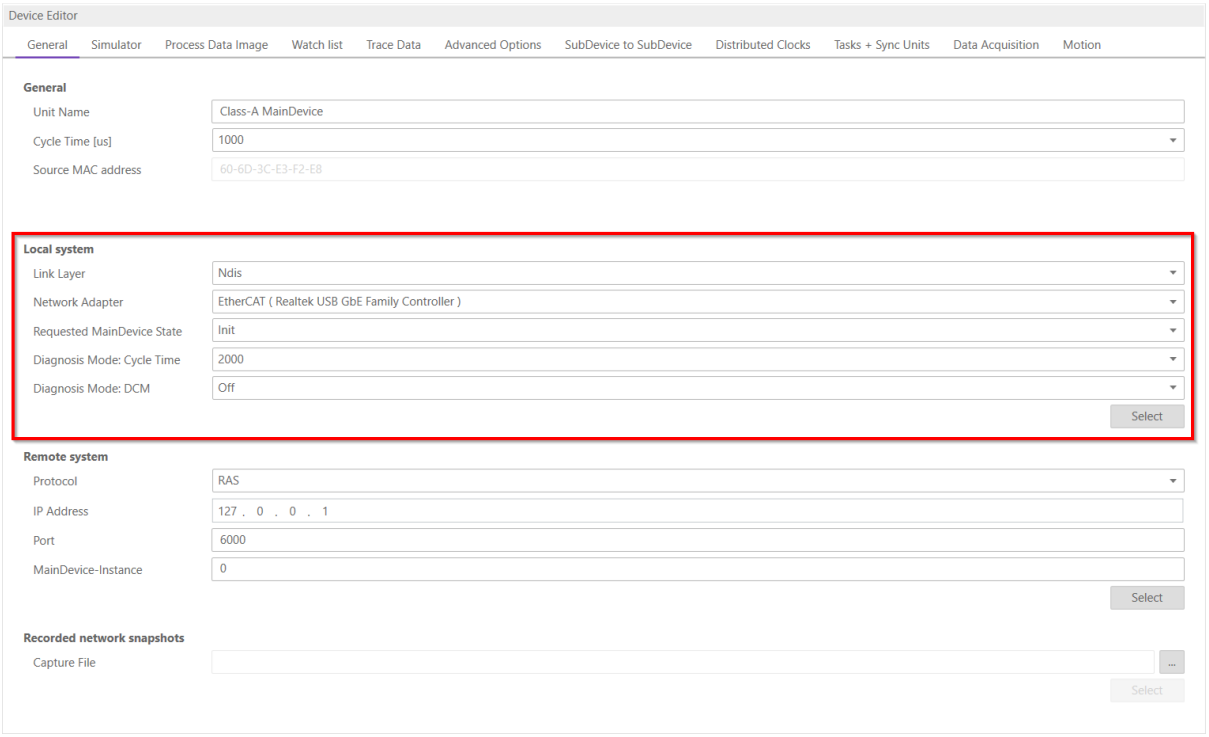
3.5 Local

This mode should be used to diagnose the network, connected to the local system.

If user clicks on this link he will see first the *Select MainDevice Dialog* for choosing the desired MainDevice (at the moment he can choose between Class A and Class B MainDevice):



Afterwards he will see the *General-Tab*, where he can choose the network adapter which is connected to the control system:

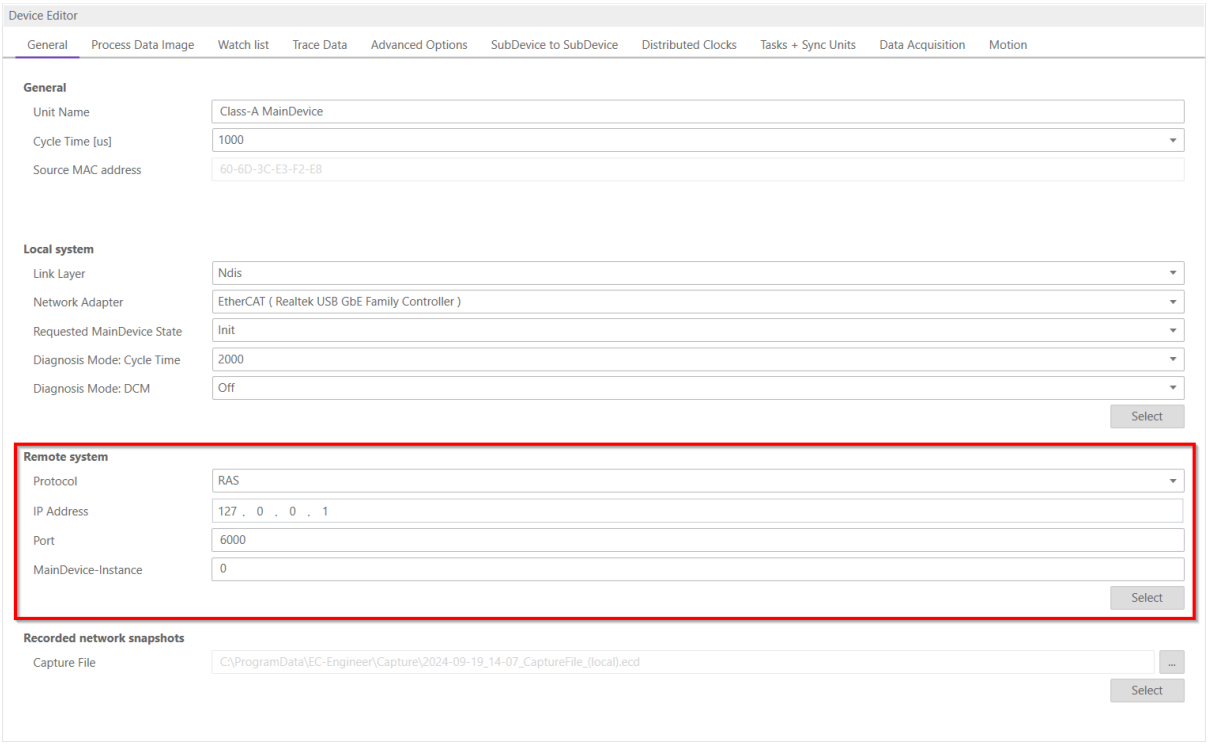


After selecting the network adapter, the EC-Engineer scans the control system and is starting the diagnosis mode.

3.6 Remote MainDevice

This mode can be used if SubDevices are connected to the control system. Means user can connect via TCP/IP to the control system if EC-Master RAS (remote access service) server is running and diagnose the remote EtherCAT network.

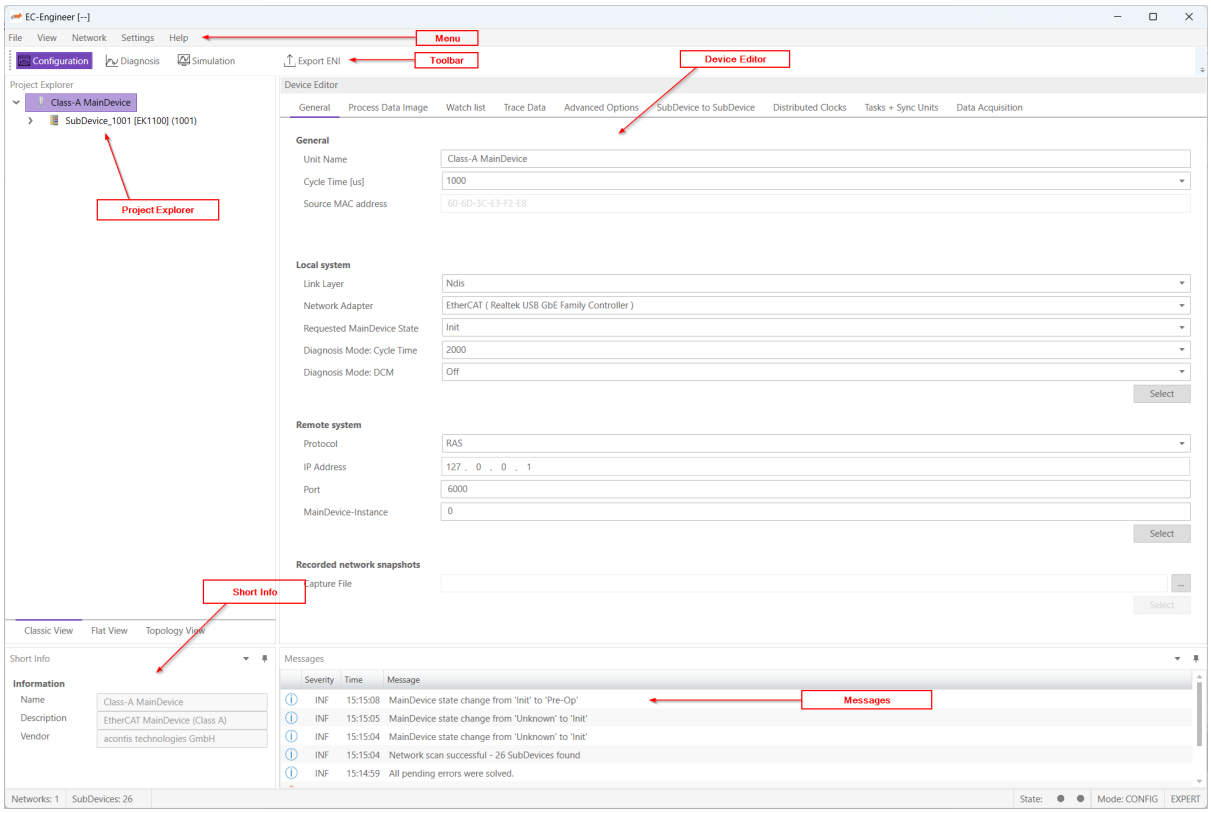
If user clicks on this link he will see the *General-Tab*, where he can enter the IP address of the remote system (and if necessary change the port and the MainDevice-instance, but normally this should not be necessary):


Device Editor
General
Process Data Image
Watch list
Trace Data
Advanced Options
SubDevice to SubDevice
Distributed Clocks
Tasks + Sync Units
Data Acquisition
Motion
General
Unit Name
Class-A MainDevice
Cycle Time [us]
1000
Source MAC address
60-6D-3C-E3-F2-E8
Local system
Link Layer
Ndis
Network Adapter
EtherCAT (Realtek USB GbE Family Controller)
Requested MainDevice State
Init
Diagnosis Mode: Cycle Time
2000
Diagnosis Mode: DCM
Off
Select
Remote system
Protocol
RAS
IP Address
127 . 0 . 0 . 1
Port
6000
MainDevice-Instance
0
Select
Recorded network snapshots
Capture File
C:\ProgramData\EC-Engineer\Capture\2024-09-19_14-07_CaptureFile_(local).ecd
...
Select

4 Graphical user interface

4.1 Overview

This section gives an overview about the graphical user interface:



The graphical user interface is divided into five parts:

Menu/Tool/Status bar:
Shows current status or mode of the EC-Engineer and allows the user to change it.

Project Explorer:
Shows different views of the current network configuration

Device Editor:
Show information about the selected device, like process variables.

Short Info:
Show short information about selected device, like name, description or vendor.

Messages:
Shows notifications which occur e.g. when the EtherCAT Device has changed its operation state or a SubDevice has been removed from (or added to) the EtherCAT network.

4.2 Menu/Tool/Status bar

4.2.1 File

New / Open / Save / Save As / Print:
Start new configuration or open/save/print existing configuration

Add MainDevice:

Add a new MainDevice-Unit to the configuration. At the moment we have five MainDevice:

- EtherCAT MainDevice (Class A)
- EtherCAT MainDevice (Class B)
- EtherCAT MainDevice (LxWin)
- EtherCAT MainDevice (Motion)
- EtherCAT Simulator

ESI-Manager:
Add, delete or export `ESI` and `SCI` files (see: *ESI-Manager*)

EMI-Manager:
Add, delete or modify `EMI` files (see: *EMI-Manager*)

Recent Projects:
Open recent project

Exit:
Closes the EC-Engineer

4.2.2 View

Message Window:
Shows/Hides the message window

Short-Info Window:
Shows/Hides the short-info window

Expert Tabs:
(De-)Activates expert mode

Simulator Tabs:
(De-)Activates simulator mode

Motion Tabs:
(De-)Activates motion mode

Refresh:
Updates the current view

4.2.3 Network

Scan EtherCAT Network:
Scans the connected network for SubDevices

Edit Topology:
Opens a dialog to change the current topology of the project and a bus merge is possible (for more information see *EoE Endpoint Configuration*)

Export `ENI` File / Export `ENI` Variants / Import `ENI` File / Export `EXI` File / Process Variables / EEPROM File
Creates an `ENI` file, or ENI variants (see *Export ENI Variants*) / imports an `ENI` file or export the process variables or the eeprom to a file

Network Mismatch Analyzer (active only in diagnosis mode):
Compares the configured SubDevices with the connected SubDevices. See *Network Mismatch Analyzer*

Line Crossed Analyzer (active only after scan):
Shows wrong connected SubDevices. See *Line Crossed Analyzer*

Inspection Report (active only in diagnosis mode):
Opens a statistic about the state of the network. Collects some useful data like error counters and so on. Possibility to print a PDF. See *Inspection Report*

Hardware Diagnostics:
Enables or disables the additional hardware diagnosistics and warnings in project explorer.

Acknowledge all warnings (active only in diagnosis mode):
Clears the yellow warning icon of all SubDevices

Clear Error Counters (active only in diagnosis mode):
Clears the error counters of all connected SubDevices (for more information about the extended diagnosis, see *Extended Diagnosis*)

Self Test Scan:
Executes a self test routine for EC-Master and the network (for more information about the Self Test Scan, see *Self Test Scan*)

Rescue Scan:
Executes the rescue scan. Can help if frames get lost with a switch for example

Take Snapshot:
Takes a snapshot from the current diagnosis state and saves it into a capture file (for more information about the snapshots and capture files, see *Capture File*)

Automatic Snapshot Mode:
Activates the automatic snapshot mode to take snapshots based on the configured rules

Snapshot:
Changes the active snapshot

EoE Endpoint Configuration (active only for local or remote system):
Activates EoE Endpoint support in diagnosis mode

4.2.4 Settings

Message Level:
Change the current message level

Project Template:
Shows project template settings dialog

Settings:
Shows more settings in the dialog *Settings*

4.2.5 Help

Show User Manual:
Shows this user manual

Show Log File:
Shows the log file

Check for updates:
Enable / disable automatic update check (once per month). Also a manual update check is performed on activation.

About …:
Show the about dialog

4.3 Project Explorer

4.3.1 Drag and Drop

It is possible to drag and drop files here to import/open them

Project file
Opens the configuration stored in the `ECC`, only one project file can be imported at a time.

ESI files
Adds the files to the ESI-Manager, it only allows `ESI`, `SCI` and `ZIP` files, multiple files are allowed.

The context menu of one or more selected SubDevices has the following entries:

Append SubDevices:
Appends a new SubDevices

Remove SubDevices:
Deletes the selected SubDevices

Cut/Copy/Paste:
Extended clipboard operations, which should help the user to move or multiply existing SubDevice definitions.

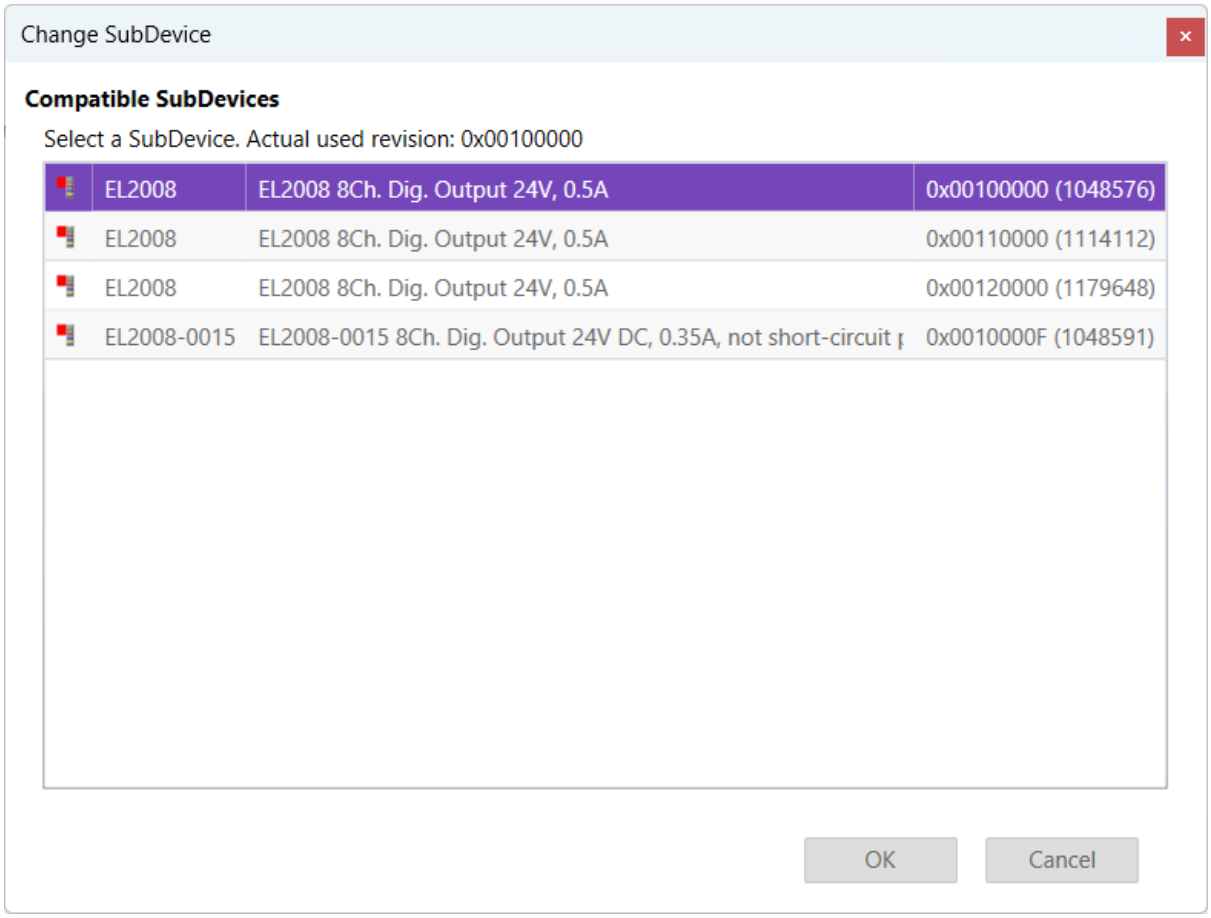
Enable SubDevices:
Appends disabled SubDevices to the process image at the previous position. If this is not possible, the SubDevice will be marked as “not connected” and the user can append the SubDevice by using “cut” & “paste”.

Disable SubDevices:
Removes the SubDevices from process image and from the exported `ENI` file, but keeps the SubDevice as “disabled” in the project.

Reload ESI data:
Reloads ESI data which are stored in the project file from global ESI cache (after adding a SubDevice to the project the ESI data will be stored in the project file).

Export SCI:
Exports a SCI file. A SCI file is like an ESI file but preconfigured. So it is possible to create a fixed SubDevice which can be added to the configuration and is working out of the box.

Change SubDevice:
Opens the following dialog, where the user can select a compatible SubDevice (this is helpful, if the user wants to update the SubDevice to a new revision and keeps his configuration). This is also used to change from an ESI to a SCI file.



Import Beckhoff SubDevice Description, to import SubDevice settings from TwinCAT (or ET9000)

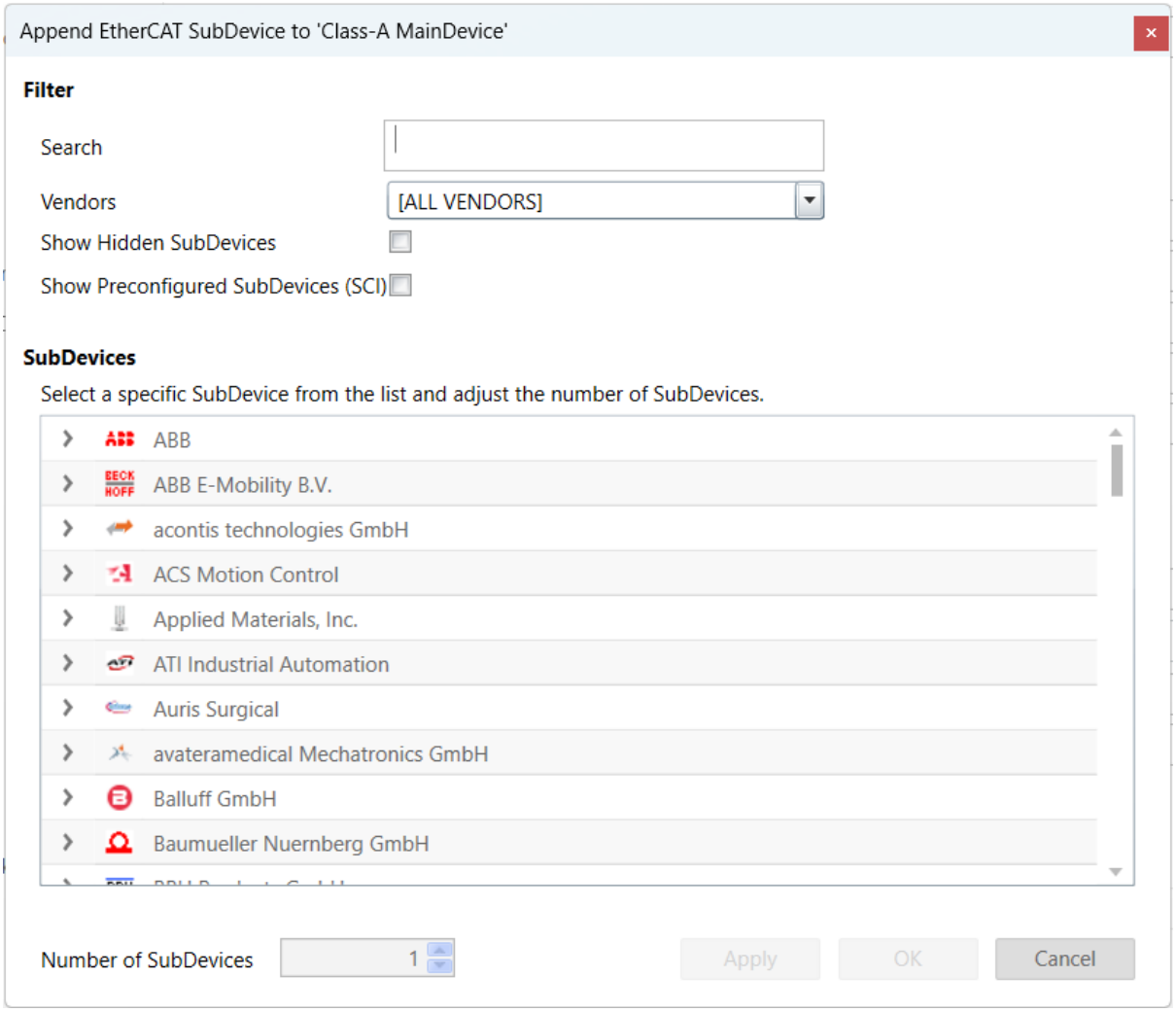
Import SubDevice settings from "Beckhoff SubDevice Description" files

- Open project in TwinCAT
- Select SubDevice to export
- Main menu "TwinCAT"
- Selected Item
- Export XML Description
- Import the exported file (imported will be MDP configuration, PDOs, DC settings, …)

Import init commands of SubDevice from "Beckhoff Init Command Description" files

- Open project in TwinCAT
- Select SubDevice to export
- Open tab “Startup”
- Context menu: “Export to XML”
- Import the exported file (imported will be the exported init commands)

If user tries to append SubDevice he will see the following dialog:



Filter

Search: Keyword to filter the SubDevices by type name. Vendors: List of all available vendors. User can filter all SubDevices by selecting the desired vendor from the list. If it makes sense, the recommended vendor is already preselected, e.g. if you try to append a SubDevice to an E-Bus. Show Hidden SubDevices: Shows also hidden SubDevices (e.g. with older revisions, if newer SubDevices are available) Show Preconfiguren SubDevices: Shows also SubDevices from SCI files

List of available SubDevices

User can select the SubDevice which should be added, be expanding the three levels: vendors, groups and the SubDevices themselves. The 3rd level consists of three parts: Type name, description and the revision number.

Number of SubDevices

User can change this value to add more than one SubDevice of the same type.

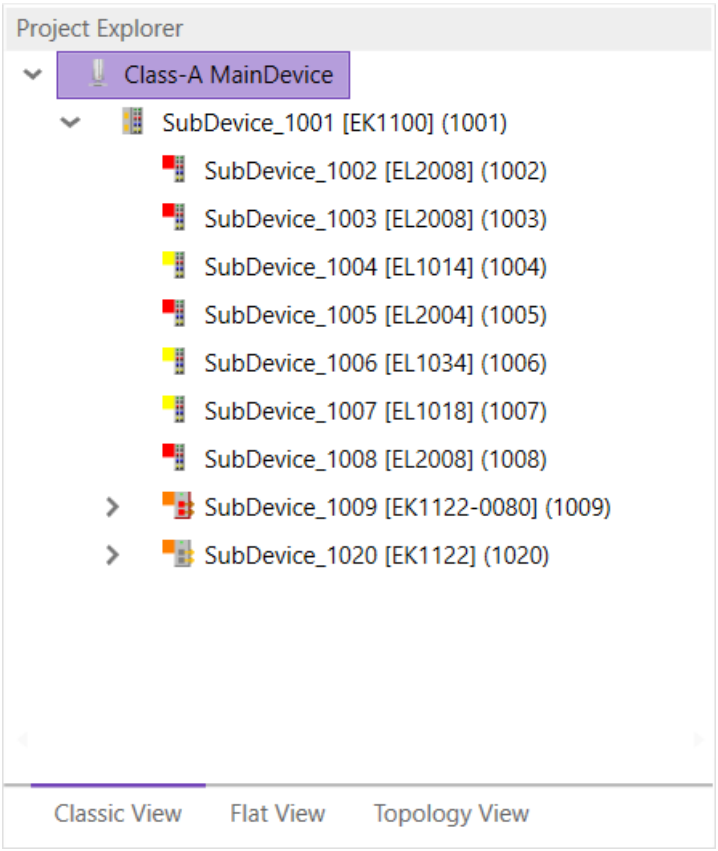
Apply
Add SubDevices of the same and different type, the dialog will automatically reopen after appending the previous SubDevice. The number of SubDevices must be set at “1” to use this function.

Ok Add SubDevices of the same type, based of the “Number of SubDevices” selected.

4.3.2 Configuration Mode

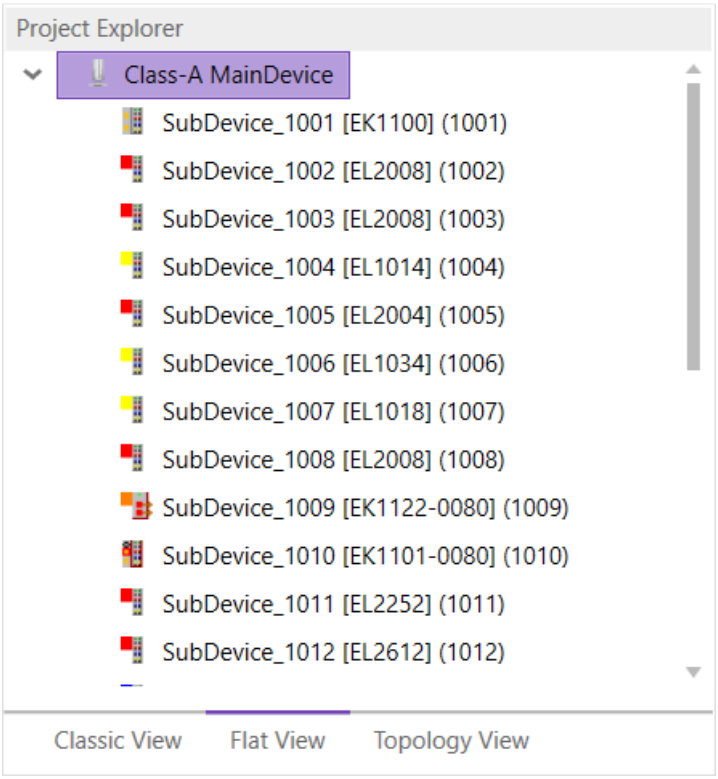
There are three topology visualisation views:

Classic View



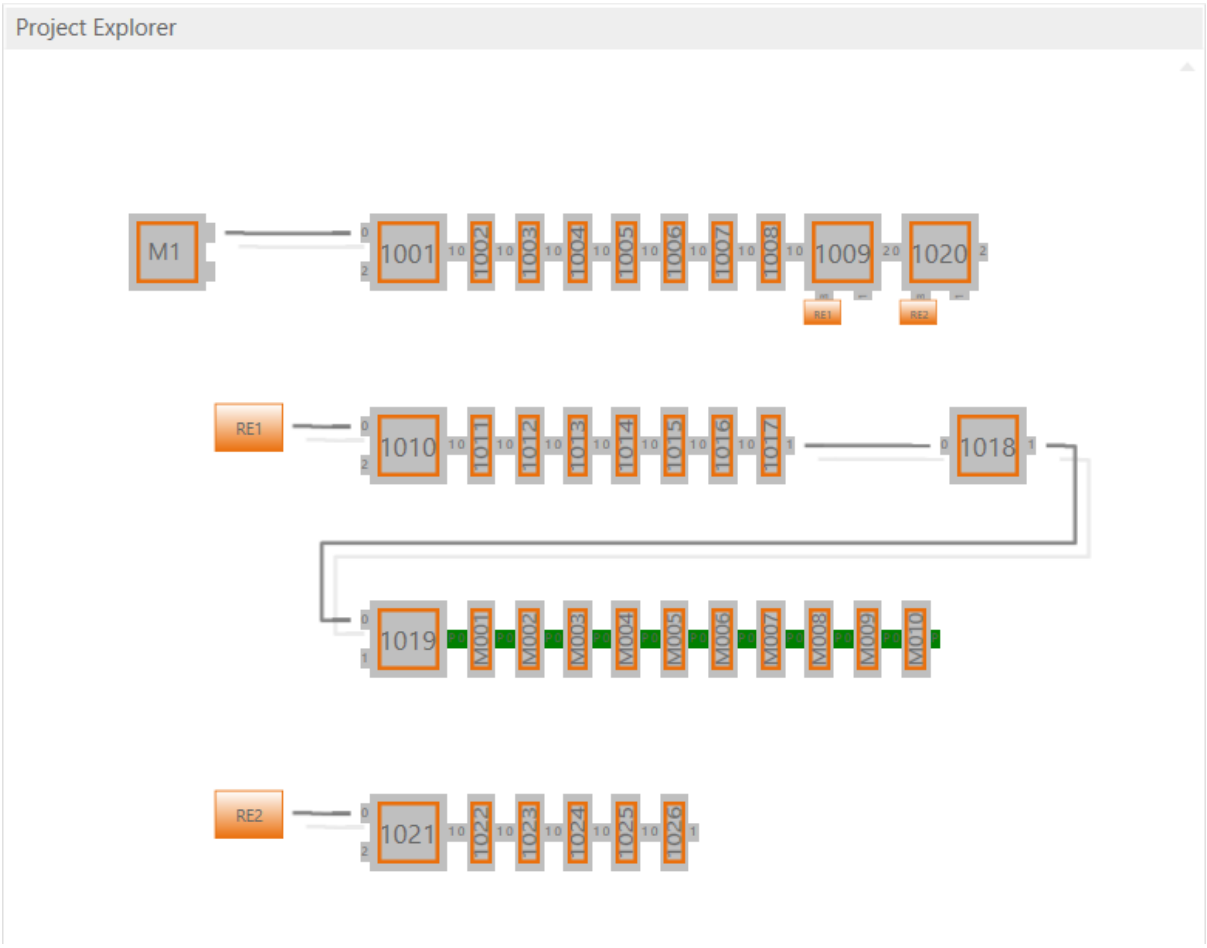
This is a tree view with multiple levels.

Flat View



This view shows all SubDevices in a flat list, as they are connected in the EtherCAT network.

Topology View

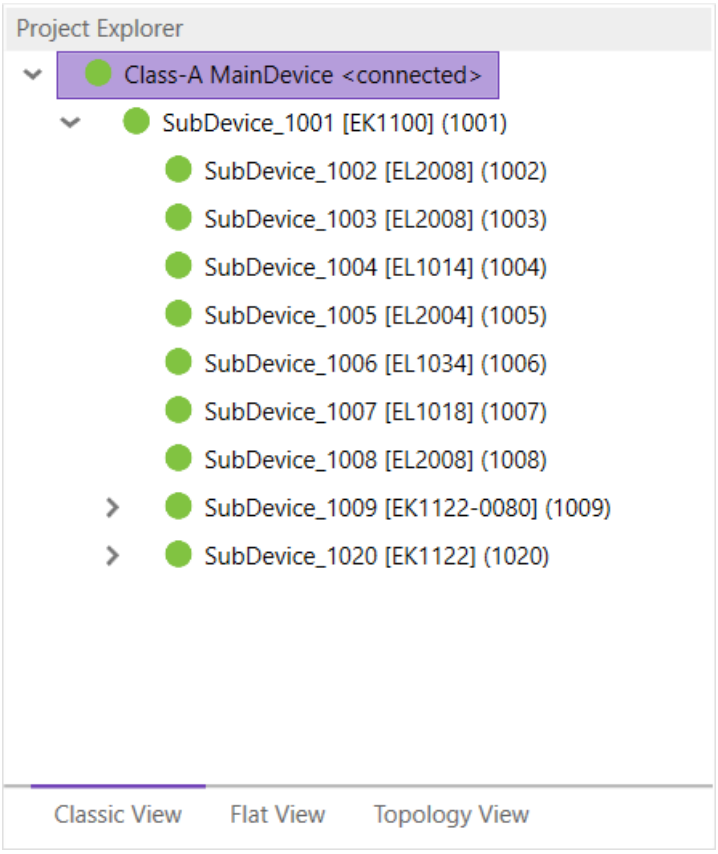


This view shows a graphical tree of all SubDevices, as they are connected in the EtherCAT network.

4.3.3 Diagnosis Mode

There are three topology visualisation views:

Classic View

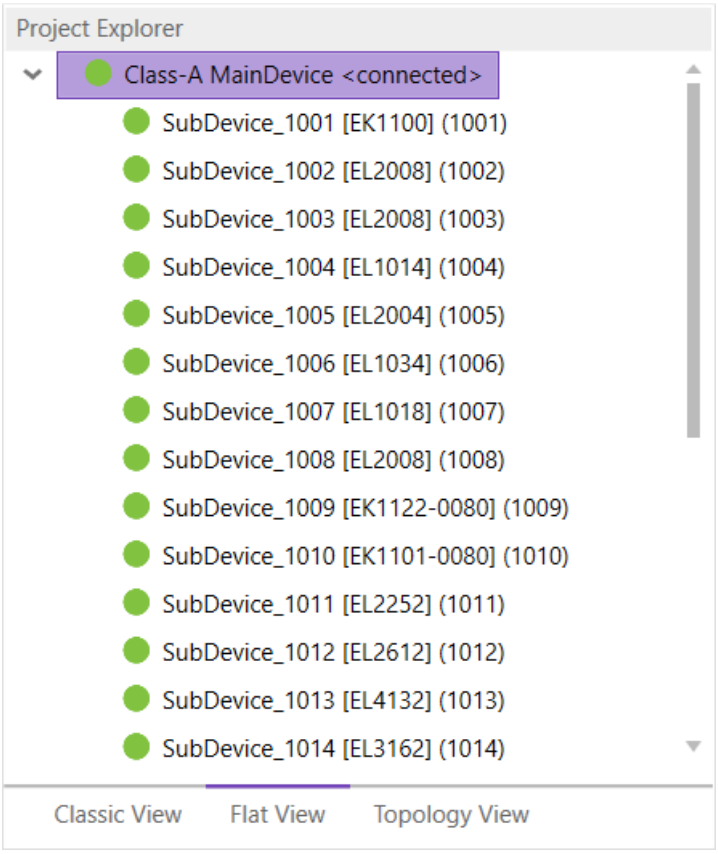


This is a tree view with multiple levels.

Possible device states:

- Init Bootstrap
- Pre-Op
- Safe-Op
- Op

Flat View

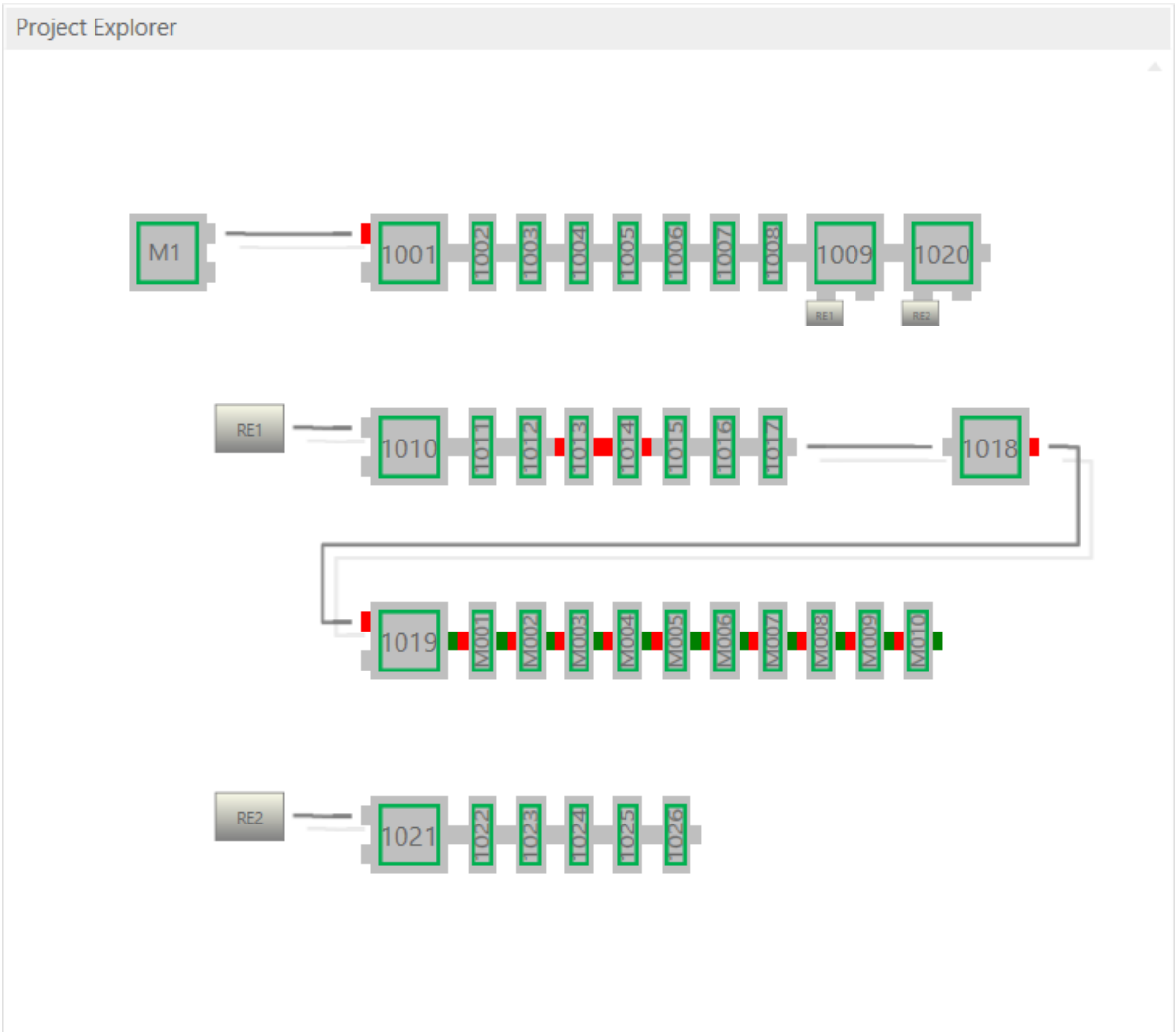


This view shows all SubDevices in a flat list, as they are connected in the EtherCAT network.

Possible device states:

- Init Bootstrap
- Pre-Op
- Safe-Op
- Op

Topology View



This view shows a graphical tree of all SubDevices, as they are connected in the EtherCAT network.

Possible device states:

- Init Bootstrap
- Pre-Op
- Safe-Op
- Op

Possible port states:

- Bad Cable Quality
- Constricted Cable Quality
- Good Cable Quality

If cable quality is constricted or bad, please check the error counters of the SubDevice (for more information about the extended diagnosis, see *Extended Diagnosis*).

The context menu of the MainDevice has the following entries:

Network Mismatch Analyzer:
Compares the configured SubDevices with the connected SubDevices.

Write all Station Aliases:
Write the current physical address of each SubDevice to the configured station alias in EEPROM.

Acknowledge all warnings:
Clears the yellow warning icon of all SubDevices.

Clear Error Counters:
Clears the error counters of all connected SubDevices.

Hardware Diagnostics:
Enables or disables the additional hardware diagnosistics and warnings.

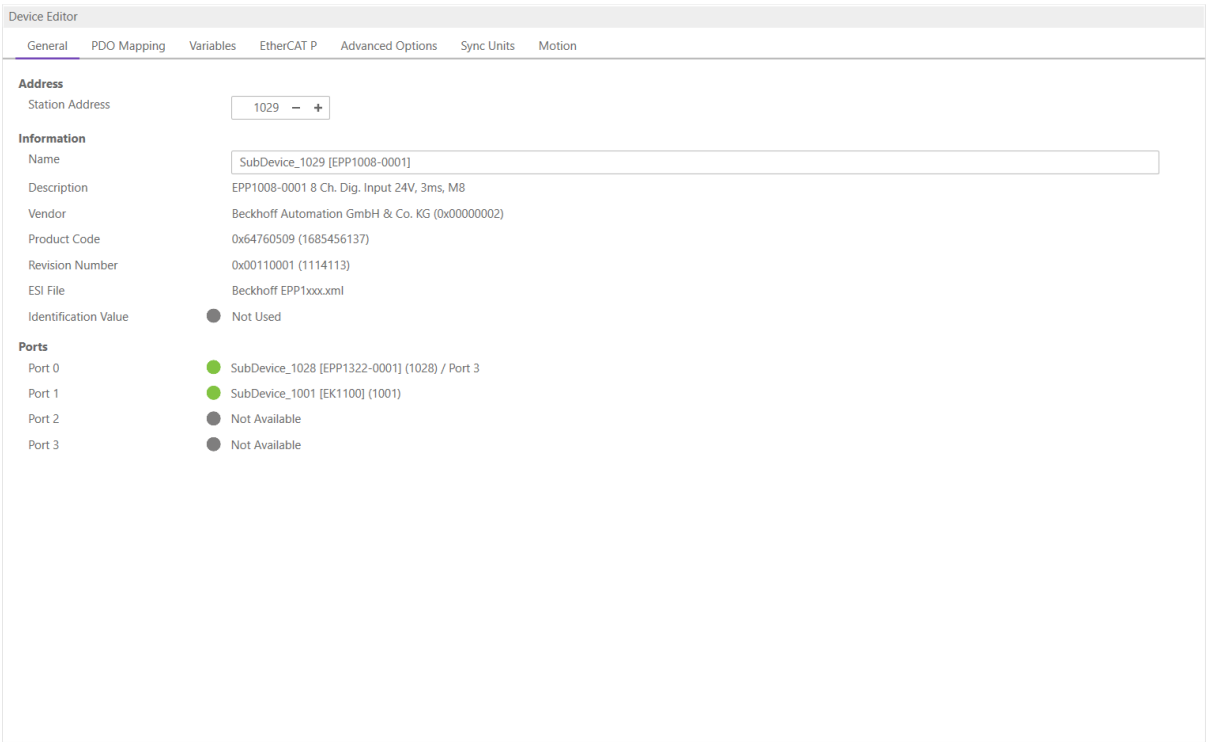
Take Snapshot:
Takes a snapshot from the current diagnosis state and saves it into a capture file (for more information about the snapshots and capture files, see *Capture File*).

Automatic Snapshot Mode:
Activates the automatic snapshot mode to take snapshots based on the configured rules.

Enable Performance Monitoring:
Activates the Performance Monitoring.

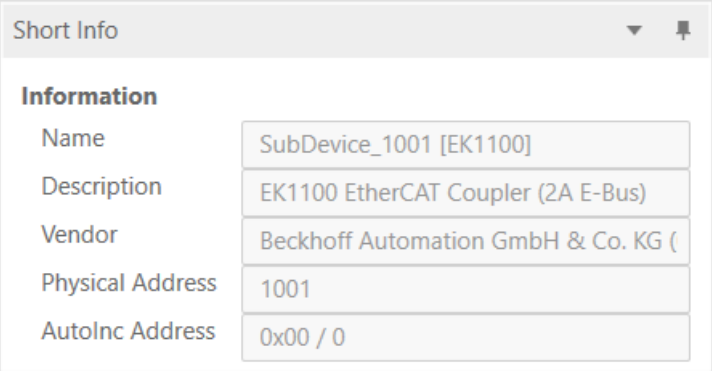
4.4 Device Editor

This Editor gives the user the possibility to read and write information of the selected device or SubDevice:



4.5 Short Info

This window shows short information about selected device, like name, description or vendor:



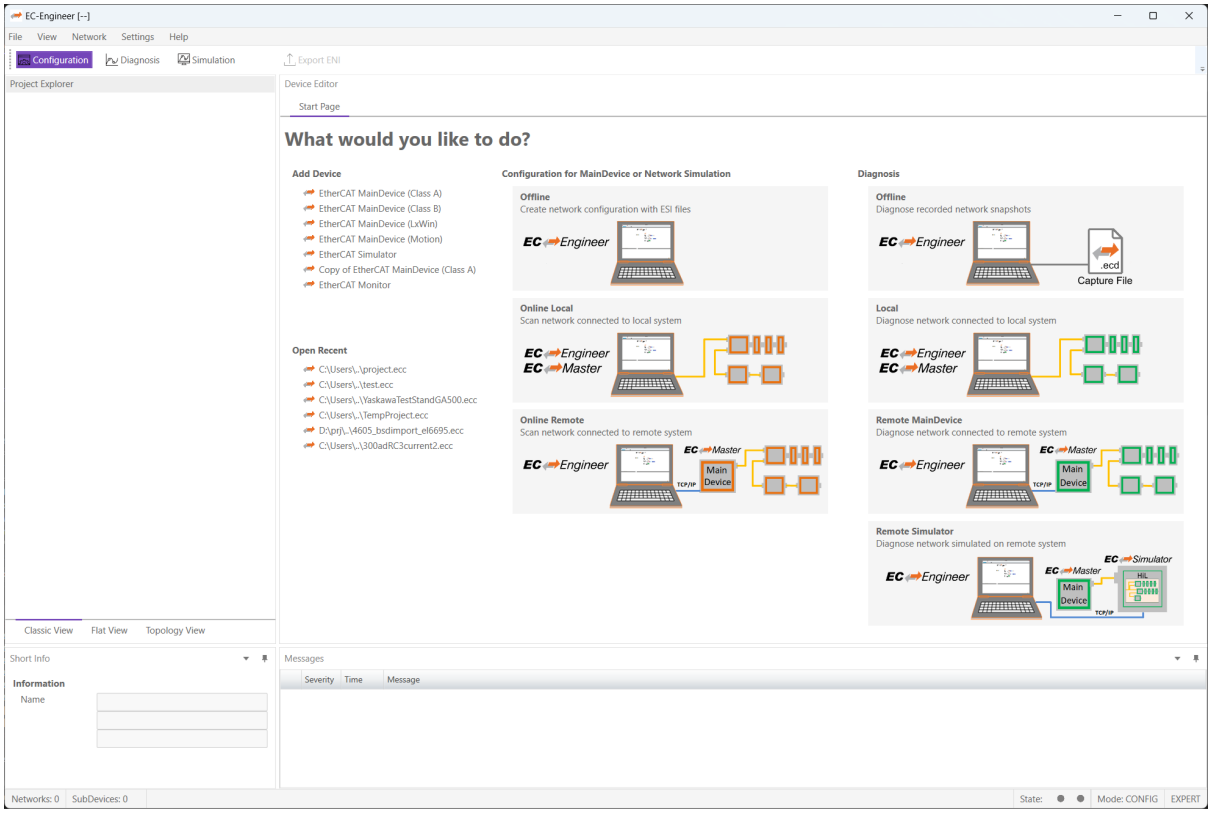
4.6 Message Window

Shows notifications which occur e.g. when the EtherCAT MainDevice has changed its operation state or a SubDevice has been removed from (or added to) the EtherCAT network:

5 Configuration Mode

5.1 Overview

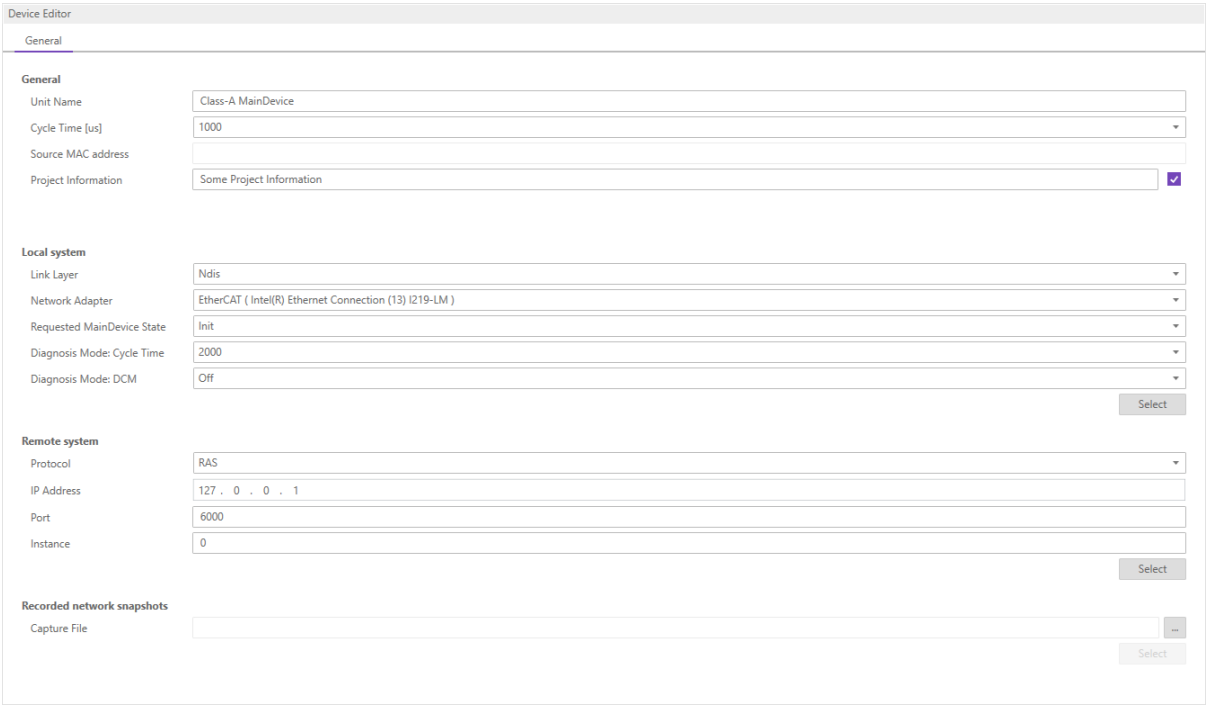
At startup of EC-Engineer, the user will see this page:



5.2 Device Settings

5.2.1 General

In this tab, the user can configure the name of the MainDevice and the cycle time. If he wants to connect to a control system, this can be also configured:



General

Unit Name:
Name of the MainDevice

Cycle Time:
Interval in microseconds in which all EtherCAT commands will be sent from the MainDevice. The user can choose between the following values: 125, 250, 500, 1000, 2000 and 4000. This value is used in the ENI.

Source MAC address:
MAC address of the connected system (will be filled during bus scan)

Project Information:
Information about the project (enable the CheckBox will also include this information as a comment in the exported ENI file)

SubDevices connected to local system

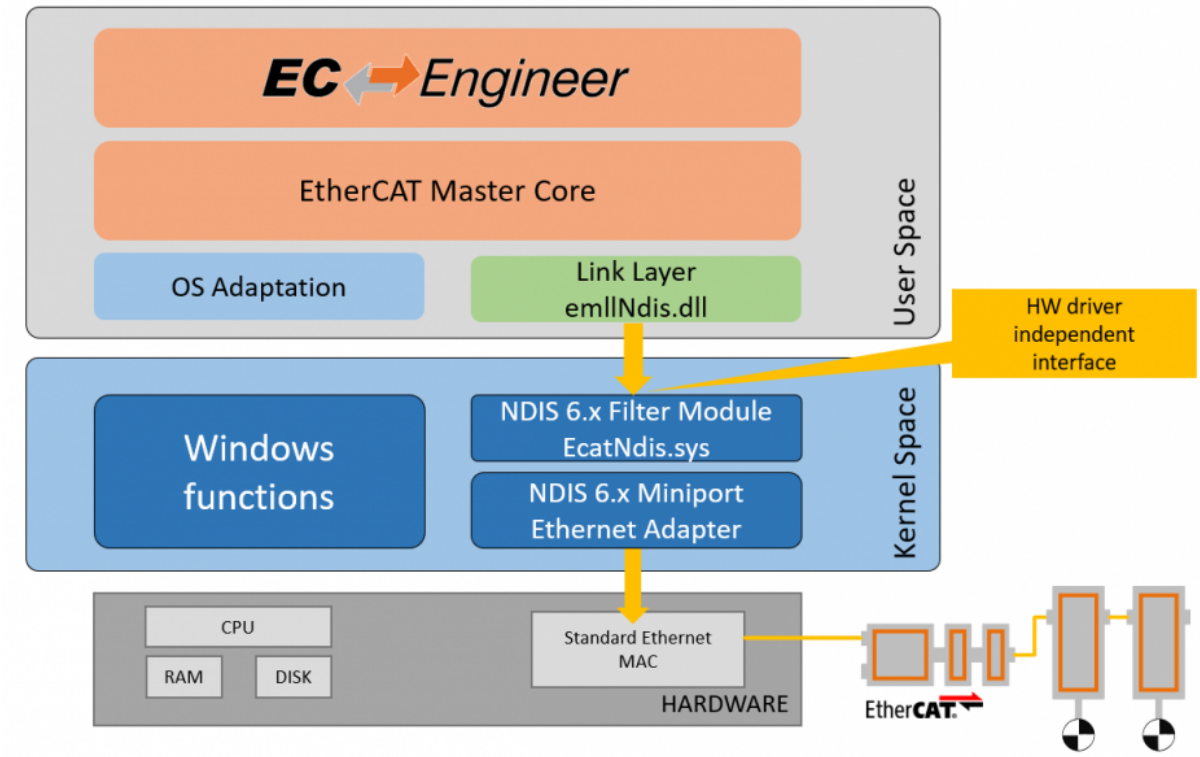
Link Layer:
Select the EtherCAT driver which is used.

Network Adapter:
Network adapter which is connected to the control system.

Requested MainDevice State:
EC-Engineer is trying to put the master to this state after connecting.

Diagnosis Mode: Cycle Time:
This Cycle Time is only used for local diagnosis, but not for the ENI.

Diagnosis Mode: DCM:
Select the DCM Mode for local diagnosis.



SubDevices connected to remote system

Protocol:

Protocol of the remote system

- RAS (Default port is 6000)
- **Mailbox Gateway (Default port is 34980)**
  - EC-Master V3.0.1.22 and above
  - TwinCAT 3.1.4024 or TwinCAT 3.1.4022.30 and above

IP Address:
IP address of the remote system, which is connected to the control system

Port:
Port of the remote system, which is connected to the control system

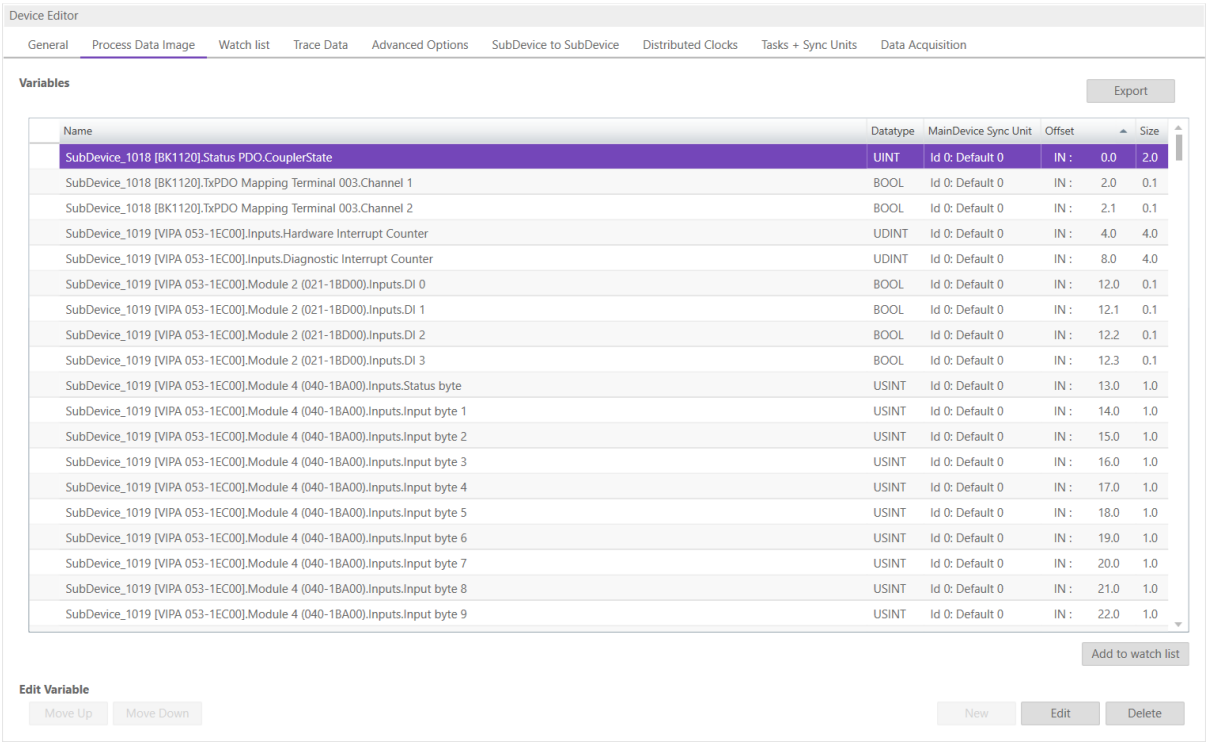
MainDevice-Instance:
Used to determine which MainDevice instance should be used in the remote system (MainDevice supports up to 10 instances).

Data to load from capture file

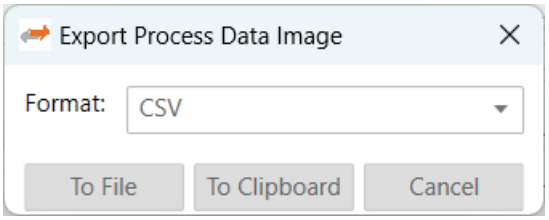
Capture File:
Path to the capture file, which contains one ore more snapshots

5.2.2 Process Data Image

In this tab, the user can see all variables of the process data image. It can also be exported.



If the variables should be exported, the following dialog appears:



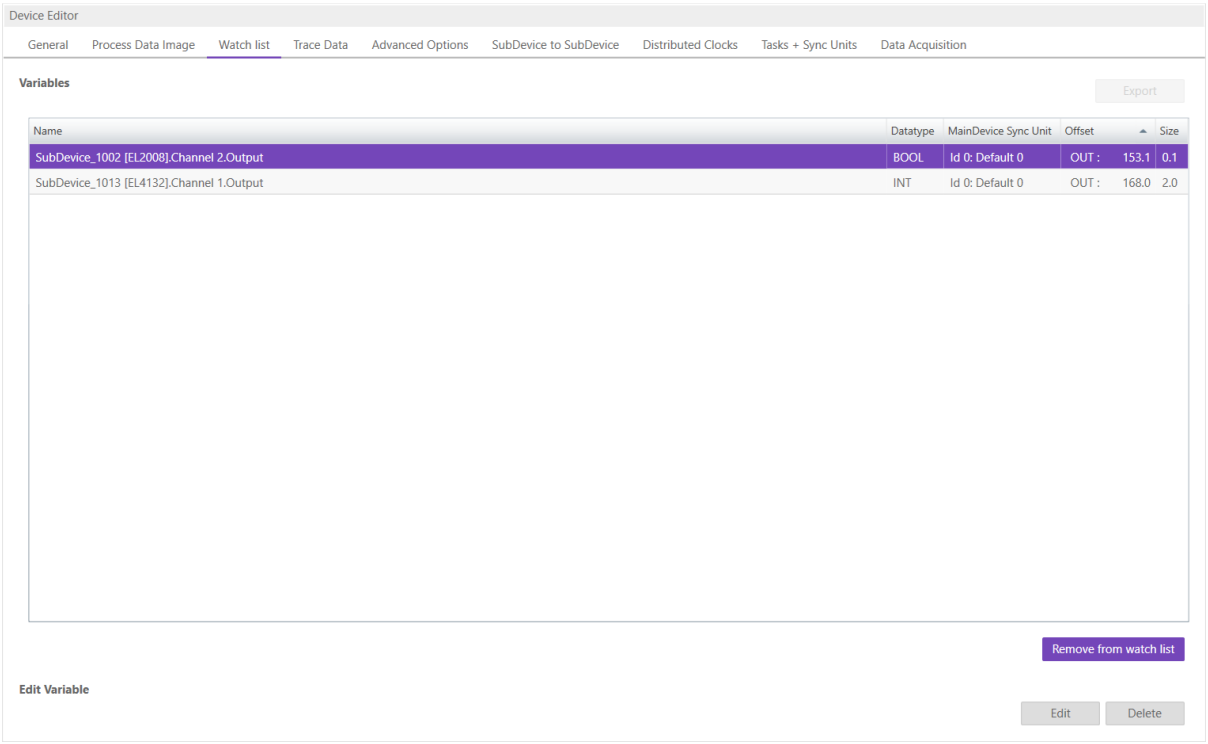
Export Formats:

- `CSV` File (Semicolon separated text file)
- `CSV PLC` File (Semicolon separated text file, where offsets are in PLC format)
- `PD Layout` File (C-Header file which can be used from EC-Master-Demo application)
- `XML` File (Like ProcessImage in `ENI`)

The variables can also be added to the watchlist, to have a better overview in diagnosis mode.

5.2.3 Watchlist

In this tab, the user can see all variables which were added to the watchlist in config mode:



The variables can be edited and removed from the watchlist.

5.2.4 EtherCAT P Overview

In this tab, the user can check the EtherCAT P system, if there are EtherCAT P SubDevices in the configuration. For those EtherCAT P SubDevices, he can calculate and check the power consumptions in the EtherCAT P segments based on cables and loads:

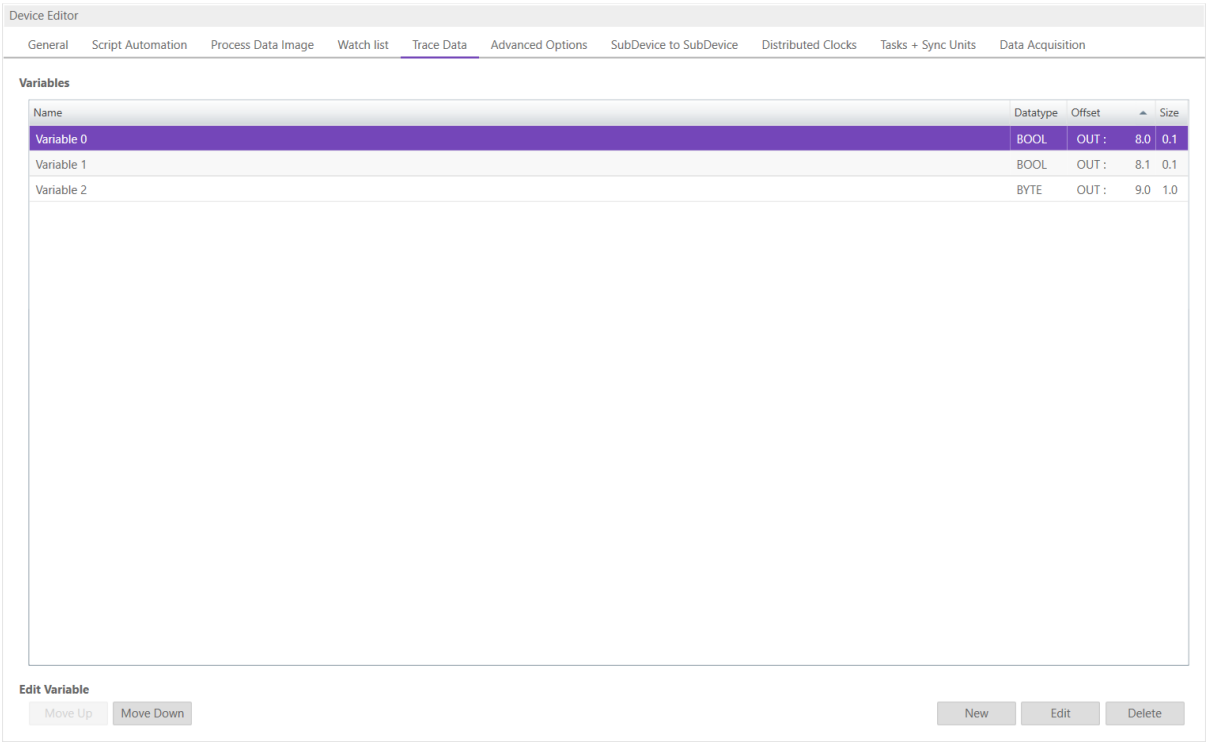
In the ComboBox the user can switch between all Power Sourcing Devices (PSD) in the configuration. In the grid are shown all the supplied SubDevices from the selected PSD, with the calculated voltages and currents and the selected loads. The values which are to high or to low are marked red.

Hint: These values are not relevant for the `ENI`-File. They are just a help for the user what might not work. The `ENI` File can be exported anyway.

On the *Validate* Button, the user can check the whole configuration. If there is an error somewhere, the corresponding PSD is selecte. If there are no errors the user will get a message box.

5.2.5 Trace Data (Expert)

In this tab, the user can add trace variables:



Trace Data

Trace variables which can be added from the user.

Buttons

New/ Edit/Delete:

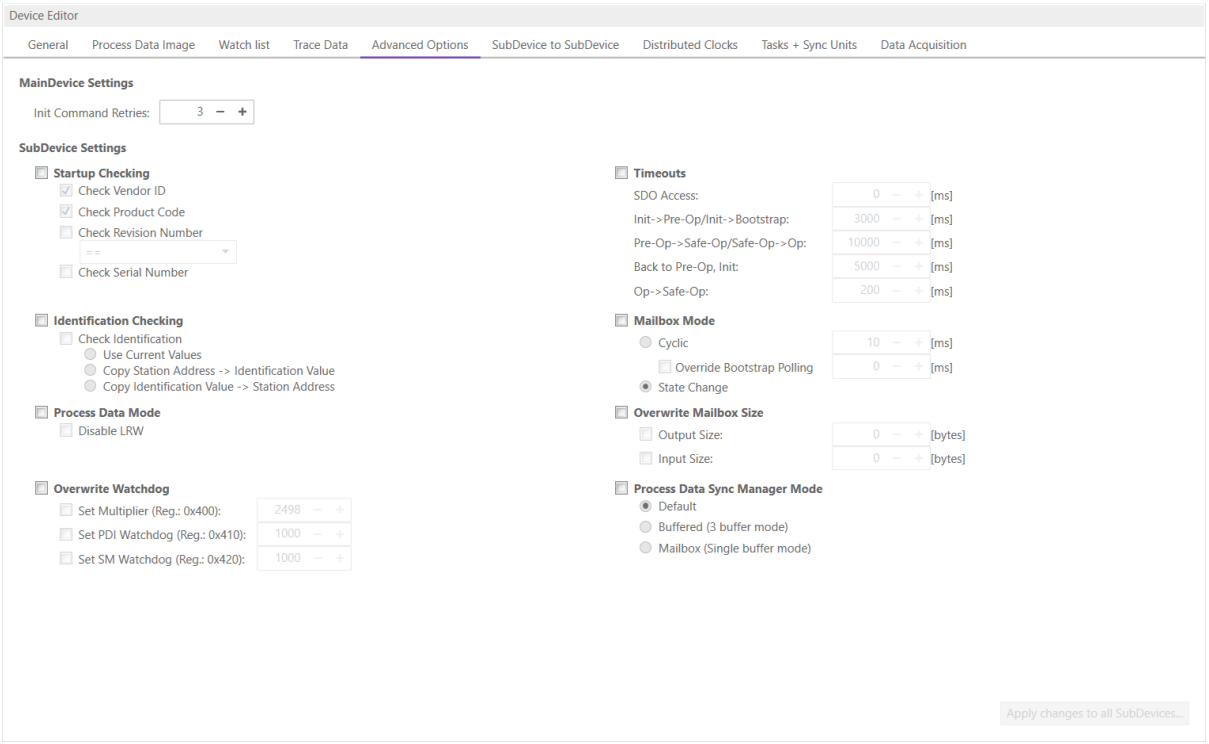
Used for changing the list.

Up/Down:

Moving the selected variable up or down

5.2.6 Advanced Options

In this tab, the user can change MainDevice specific settings or he can change SubDevice specific settings which will be applied to all SubDevices:



MainDevice Settings

Init Command Retries: Number of retries, to handle transmission errors.

SubDevice Settings

- SubDevice settings can be applied to all SubDevices with one click on the button *Apply changes to all SubDevices*. For a detailed description of the Advanced SubDevice Options see SubDevice chapter.
- **Identification Checking**

  Use Current Values Identification Checking will be activated for all SubDevices with the current values

  ---

  Important: If current is 0, the Identification is not activated!

  Copy Station Address –> Identification Checking will be activated for all SubDevices with the station address as identification value

  Copy Identification Value –> Identification Checking will be activated for all SubDevices and the identification value is also used as station address

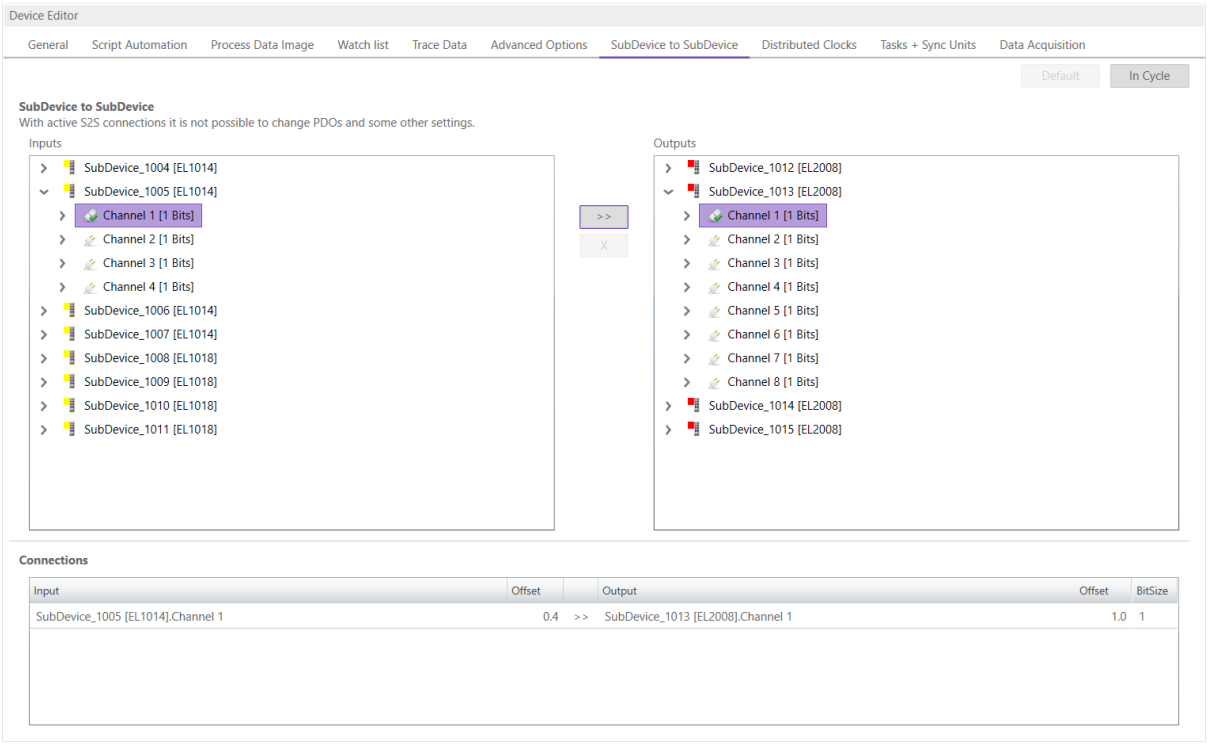
5.2.7 SubDevice to SubDevice

In this tab, the user can configure the SubDevice to SubDevice communication by connecting 2 variables or PDOs.

This tab consists of 2 views:

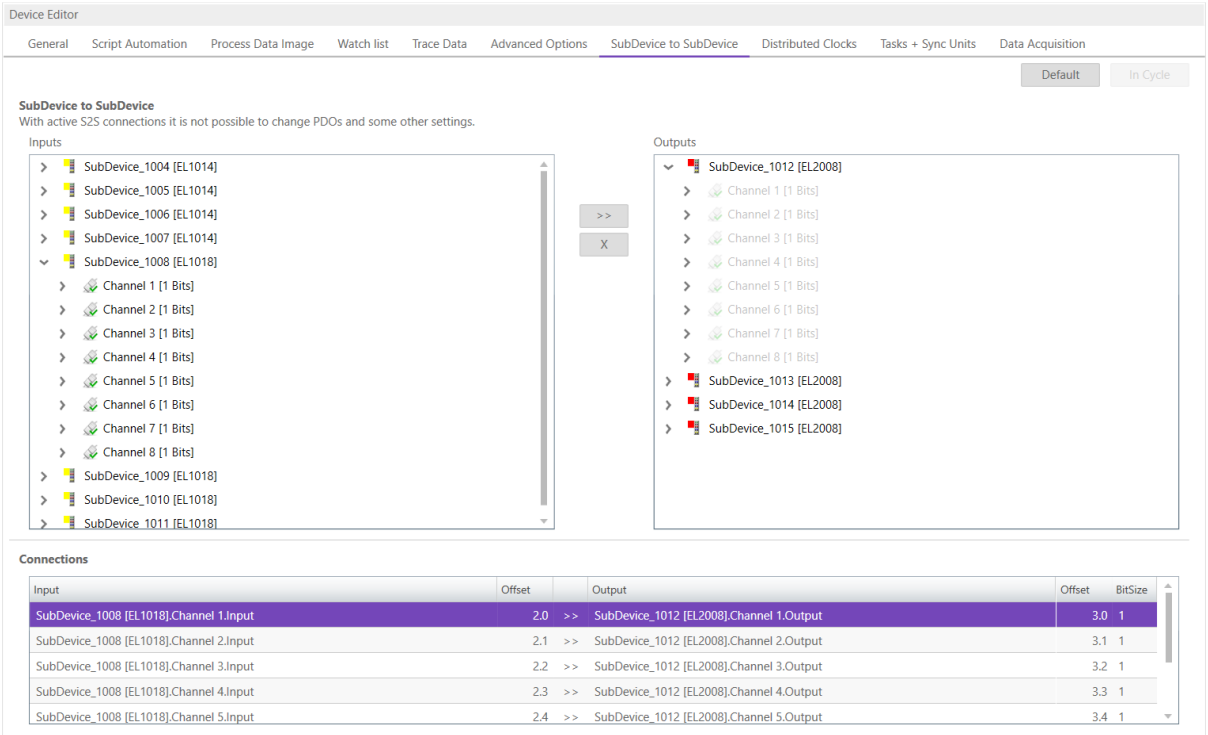
Default view

In this view, the user can configure the SubDevice to SubDevice communication by using copy infos in `ENI` file. This is the default way.



In cycle view (Expert)

In this view, the user can configure the on cycle SubDevice to SubDevice communication by setup the process image and the FMMU in a way that inputs of the source SubDevice will be directly written into the outputs of the destination SubDevice during one cycle.



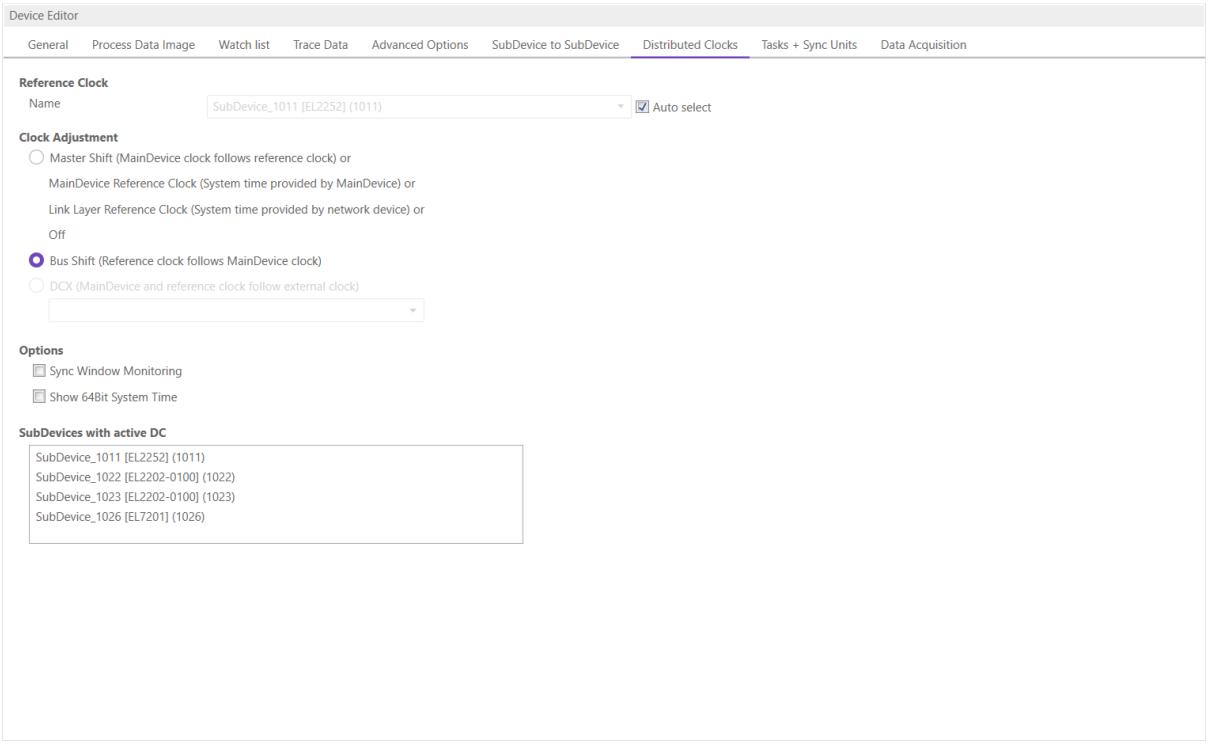
Limitations of one cycle SubDevice to SubDevice communication:

- Input SubDevice must be located before output SubDevice

- Complete sync unit of the SubDevice must be connected (this means all PDOs of a sync unit must be connected and not only one variable)

5.2.8 Distributed Clocks

In this tab, the user can change distributed clock related settings:



Reference Clock

Name:
Name of the reference clock. By default, this is the first SubDevice with DC support.

Clock Adjustment

Master Shift:
The reference clock controls the MainDevice time

Bus Shift:
The MainDevice time controls the reference clock

External Mode:
The reference clock is controlled by an external sync device

Options

Sync Window Monitoring:
A command (datagram) will be inserted in the cyclic frame to read the ESC registers 0x092C. If this is selected the MainDevice will throw a notification.

Show 64Bit System Time:
MainDevice supports SubDevices with 32bit and 64bit system time register (0x0910). If this is selected he will interpret it as 64bit system time.

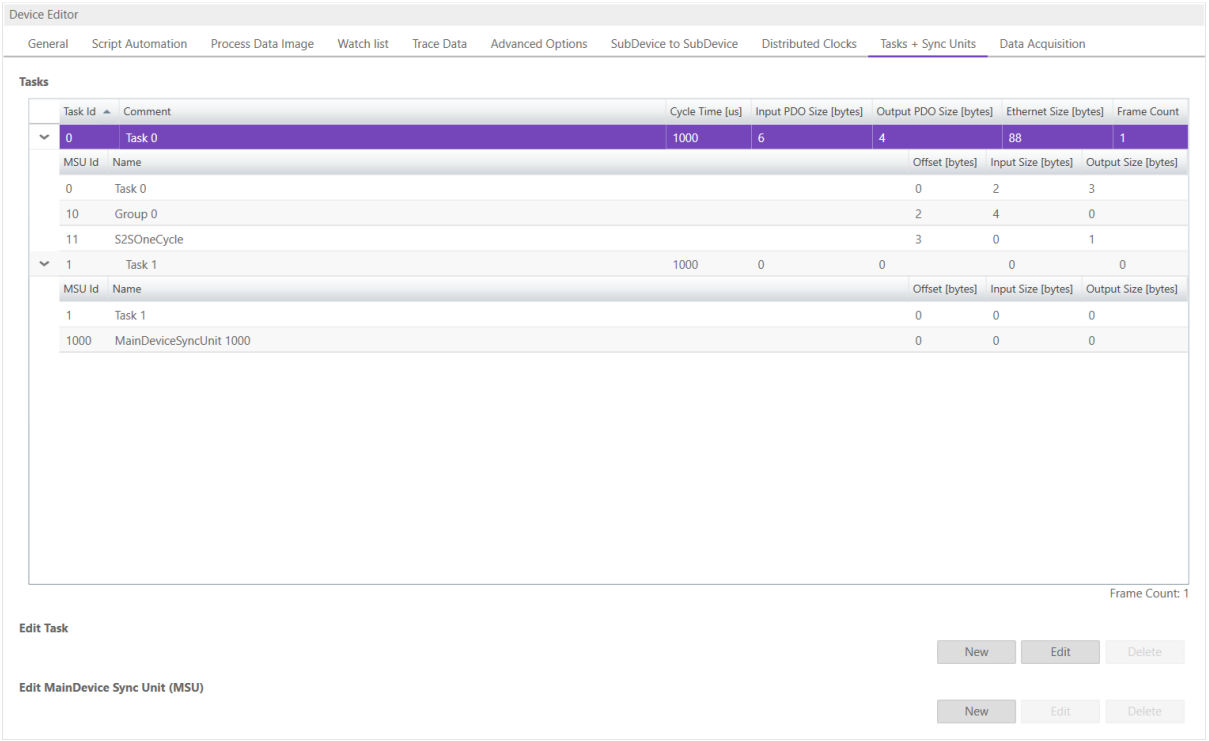
SubDevices with active DC
Shows a list of all SubDevices with active DC.

5.2.9 Tasks + Sync Units (Expert)

This tab consists of two views:

Tasks

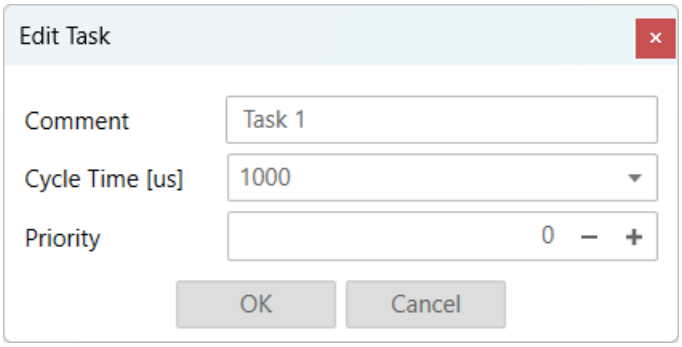
In this view, the user can define additional cyclic tasks and MainDevice sync units. After adding a new MainDevice sync unit, the user can assign one or more SubDevice sync units on tab *SubDevice Sync ▸ Units* to this MainDevice sync unit:



Tasks:
List of cyclic tasks and MainDevice sync units.

Buttons:
New/Edit/Delete: Used for changing the list.

If the user wants to edit a task, the following dialog will appear:

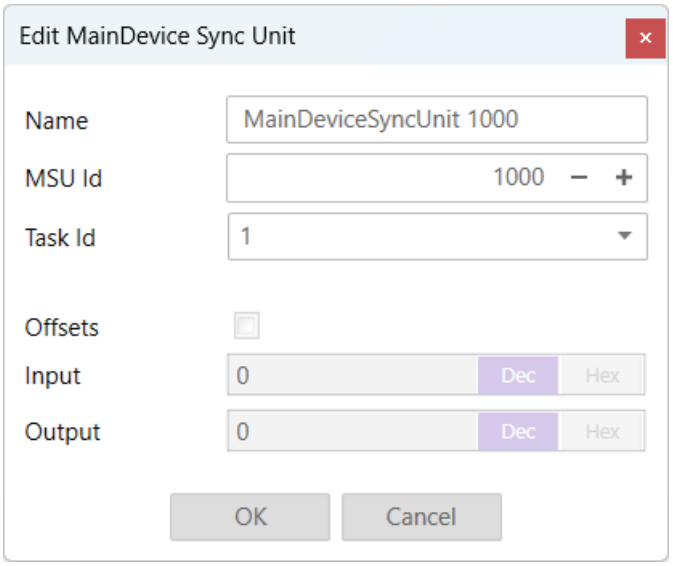


Comment:
Comment of this task (will be written to `ENI` file)

Cycle Time:
Cycle time of this task

Priority:
Priority of the task sending the frames. The lower the value, the higher the priority of the task. Every priority value shall only be used once. Allowed values: 1 … 62 (O). 0 is the default and means no priority is set.

If user wants to edit a MainDevice sync unit, he will see the following dialog:



Name:
Name of this MainDevice sync unit (will be written to `ENI` file)

Sync Unit Id:

Id of this MainDevice sync unit (will be written to `ENI` file).

- ID 0 .. 9: Generated / internal MainDevice sync unit
- ID 10 .. 999: Generated / internal MainDevice sync unit for groups
- ID 1000 .. 1999: User defined MainDevice sync unit

Task Id:
Task Id to which is this MainDevice sync unit assigned

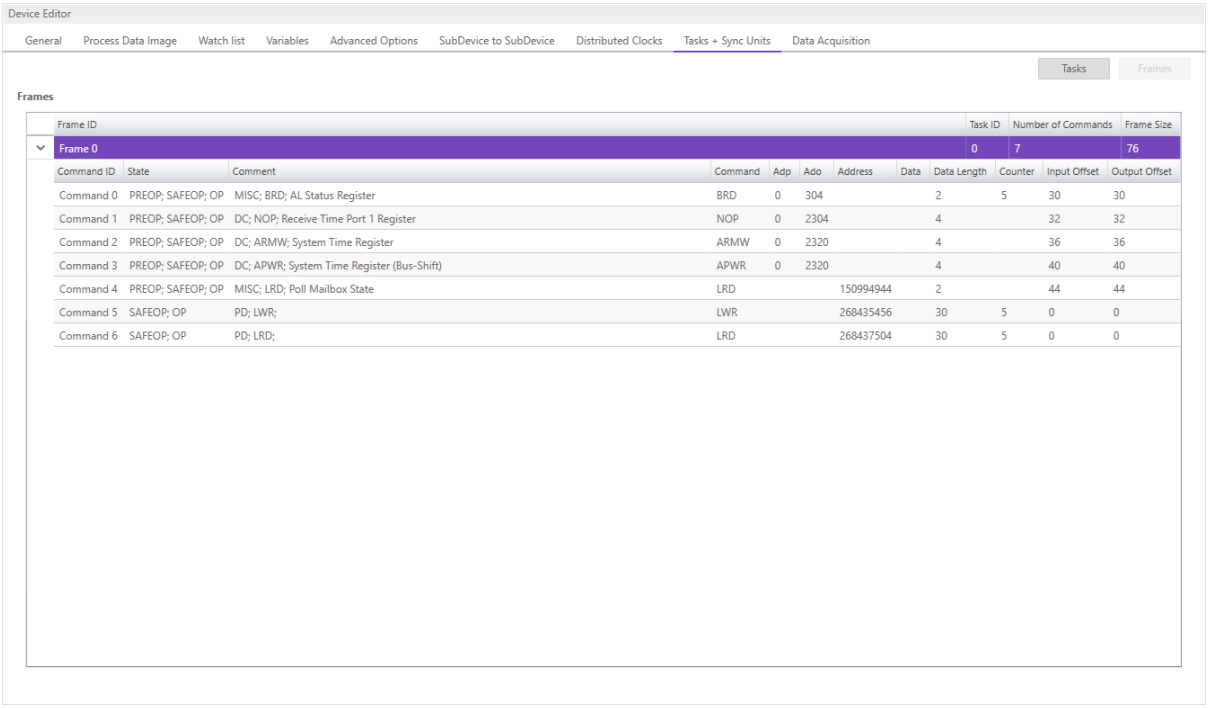
Offsets:
Activate to pin this MainDevice sync unit to a specific offset

Input:
Input offset of pinned MainDevice sync unit

Output:
Output offset of pinned MainDevice sync unit

Frames

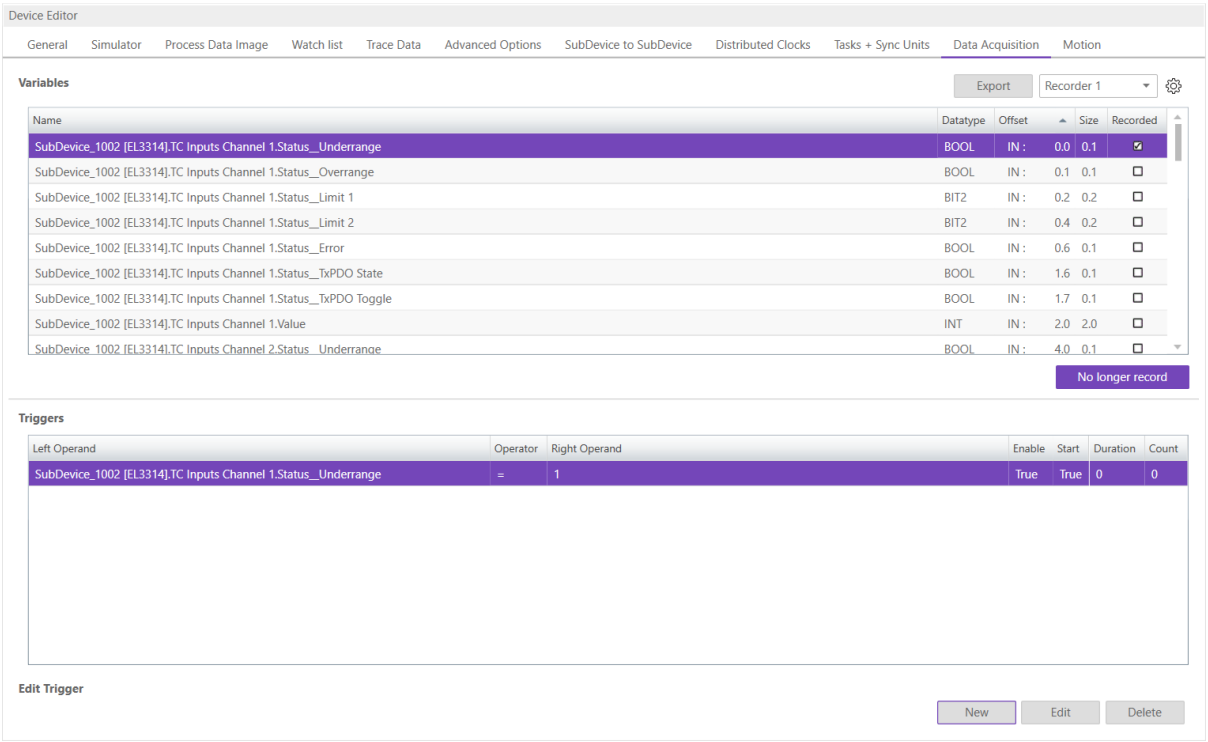
In this view, the user can see the frames information, as well as the information of each of their commands.



5.2.10 Data Acquisition

In this tab, the user can configure our Data Acquisition (DAQ) library. This library can be used from EC-Master to record process data in realtime.

After adding a new *recorder*, the user can select the variables which should be recorded and specify some triggers:



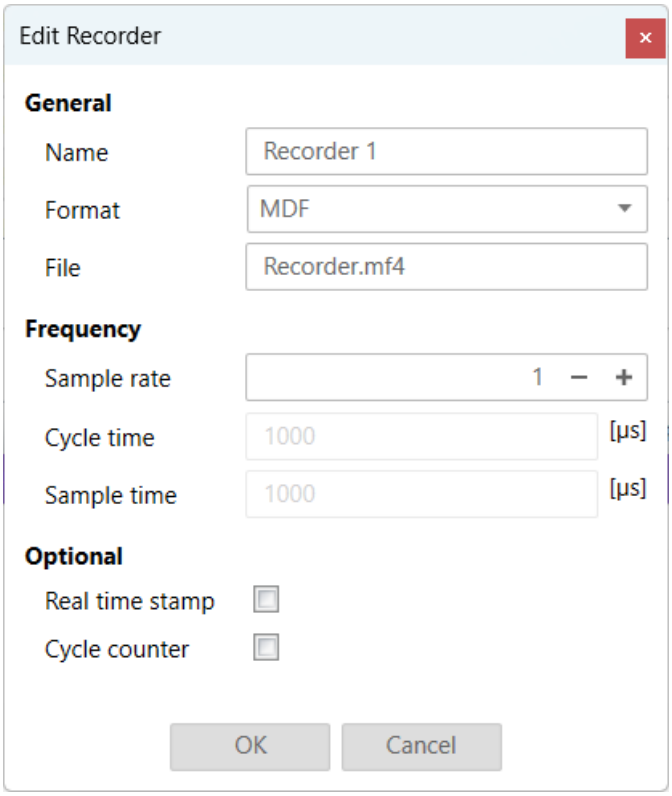
Variables:

Add/Remove:
Used for adding or removing the selected variable to the recording.

Triggers:

New/Edit/Delete:
Used for changing the trigger list.

If user wants to edit a recorder, he will see the following dialog:



Name:
Name of the recorder

File:
Absolute path of the recorder file on the MainDevice system

Format:

Format of the recorder file, e.g.

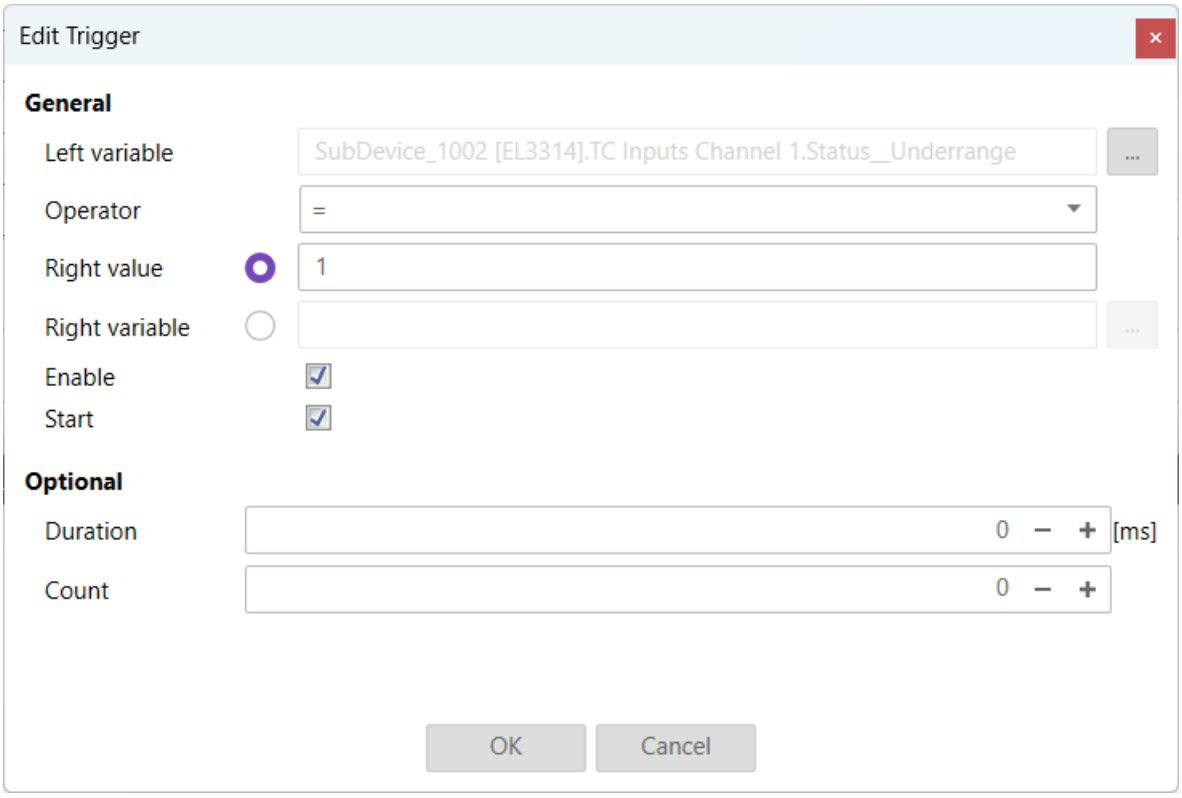
- `MDF` (Measurement Data Format)
- `CSV` (Comma Separated Values)

Sample Rate:
Sample rate of the recorded data e.g. every cycle or every second cycle, …

Real time stamp:
Adds a real time stamp to the recorded data

Cycle counter:
Adds a cycle counter to the recorded data

If user wants to edit a trigger, he will see the following dialog:



General

Left variable:
Name of the left variable

Operator:
Operator of the trigger (e.g. =, >, >=, <, <=, !=)

Right value:
Value of the right operand to compare the left variable against a static value e.g. trigger, if variable is greater than 5

Right variable:
Name of the right variable to compare the left variable against the value of another variable e.g. trigger, if variable 1 is smaller than variable 2

Enable:
Enabled or disabled trigger (can be enabled from application later)

Start:
Start or stop trigger

Optional

Duration:
Duration in ms (0 = infinite) e.g. trigger should start recording for 500 ms

Count:
Trigger count (0 = infinite) e.g. trigger should hit only for 5 times

For more information please refer the manual of the EC-Master-Data-Acquisition-Library.

5.2.11 Motion Settings (Motion Tabs only)

In this tab, the user change settings for the EcMasterDemoMotion Configuration. It is also possible to export the `DemoMotionConfig.xml` file:

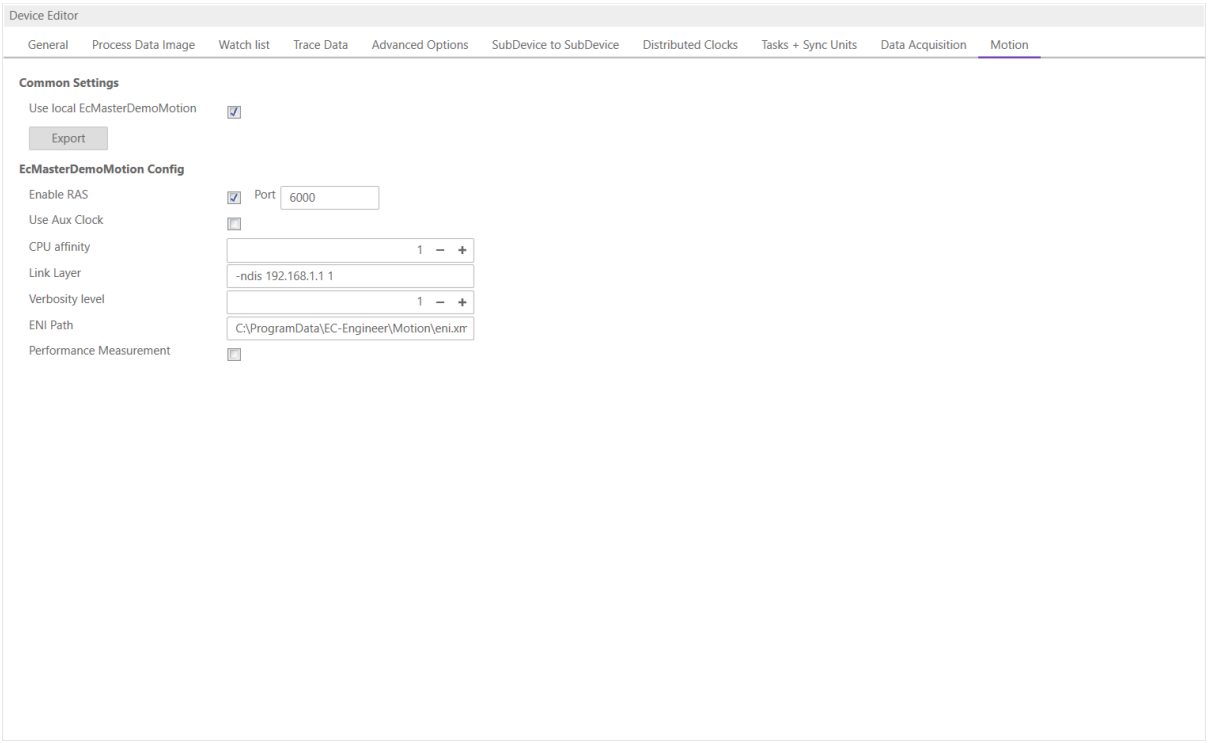
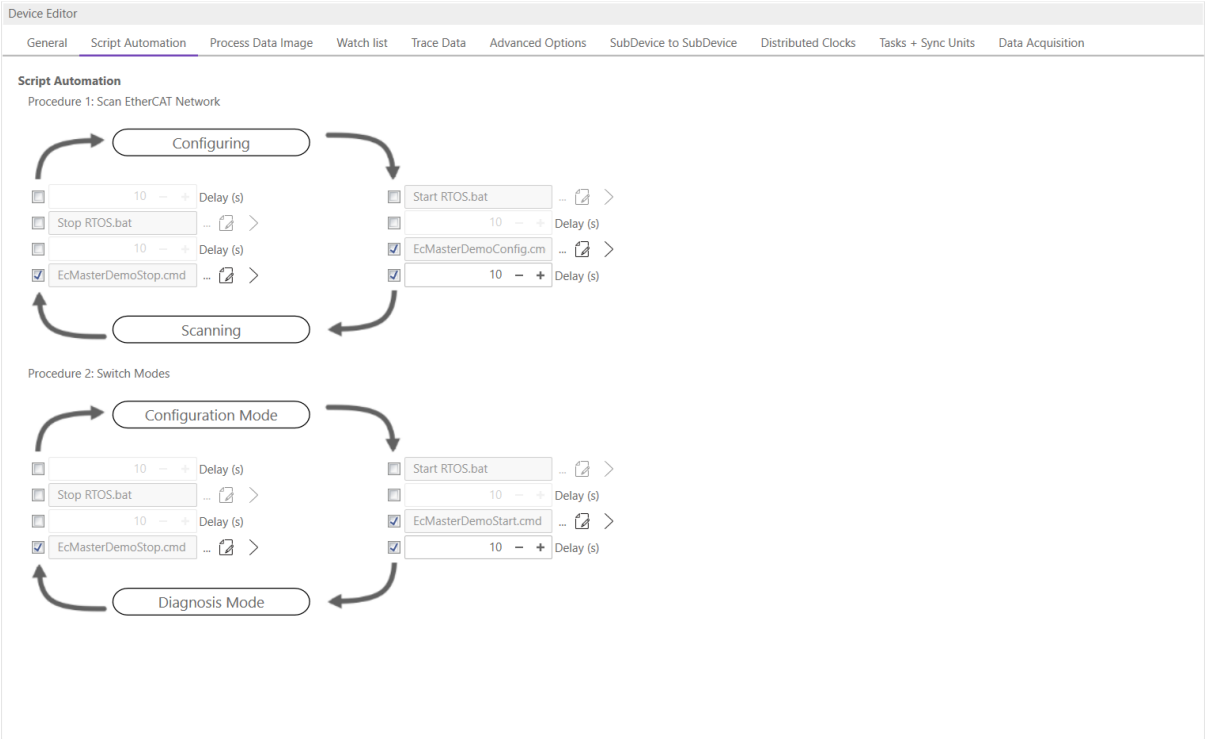


Fig. 1: When “Use local EcMasterDemoMotion” is selected, the ENI and the config files are automatically exported to the EC-Engineer Motion folder in ProgramData when switching to diagnosis mode. With the Motion EMI, the script automation is activated. Per default when switching to diagnosis mode the EcMasterDemoMotion.exe is started and EC-Engineer connects with RAS. So it is very simple to start with Motion directly in EC-Engineer.

5.2.12 Scripts

In this tab, the user can select scripts that are executed in the different modes. The tab is only visible when the script mode is activated in the `EMI` file:



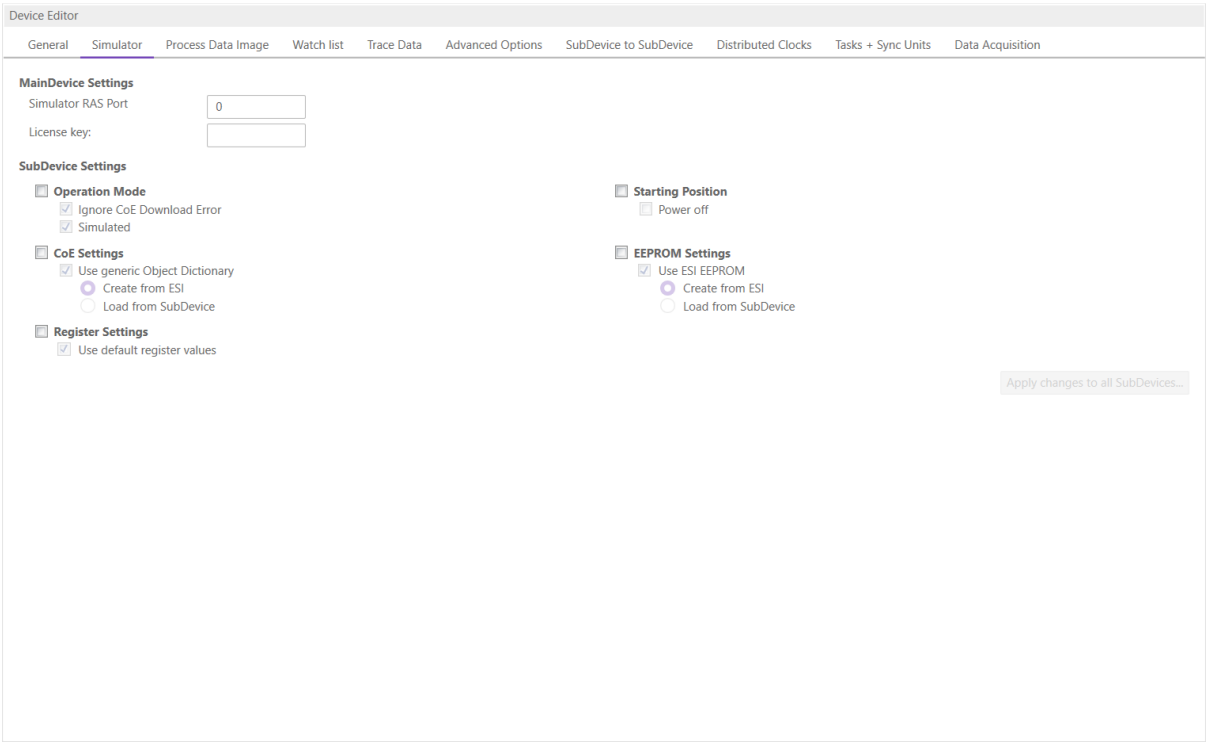
The first procedure is for scanning the network. There is the possibility of starting two scripts before the scan, and two scripts after the scan. It is also possible to set a delay between them. A usecase for this could be to start e.g. LxWin –> then start the MainDevice on the real-time system –> scan the network –> stop the MainDevice –> stop LxWin.

The second procedure is for switching the modes (configuration and diagnosis). The user can e.g. start LxWin –> start the MainDevice –> switch to diagonis. On switching back the user can stop the MainDevice and stop LxWin. Or it is also possible not to stop the LxWin for example.

The *Configuration* and *Configuration Mode* circles are the starting points. Then the scripts are called clockwise following the arrows and the red numbers.

5.2.13 Simulator Settings (Simulator Tabs only)

In this tab, the user can change the settings for the simulator. The tab is only visible when the user uses EC-Simulator `EMI` or when the MainDevice has an linked simulator unit. The linked simulator unit can be created through the context menu of the MainDevice, or when the simulator link layer is selected:



Simulator RAS Port:
The port which is opend through the simulator link layer

License key:
The license key for the simulator

SubDevice Settings:

Operation Mode:
Ignore Download Error

CoE Settings:
Select which CoE should be used in `EXI`

Register Settings:
Select if register should be in `EXI`

Starting Position:
Select if SubDevice shall be powered on or off on start

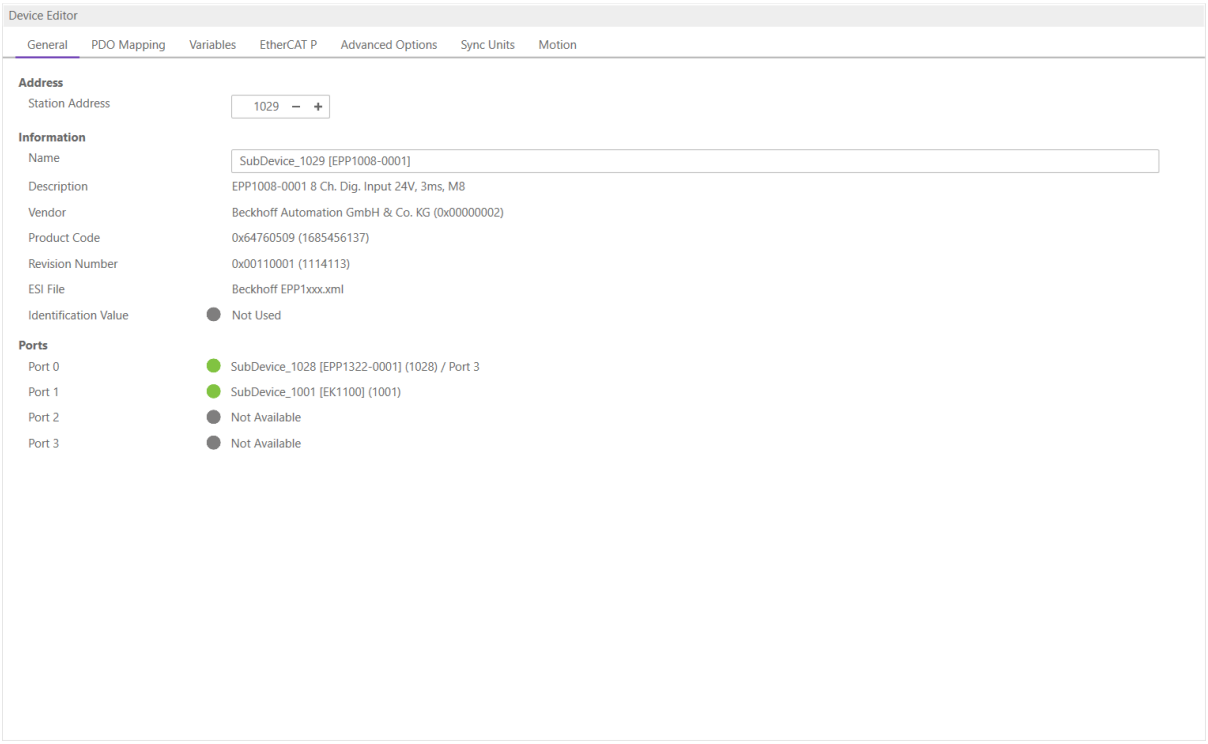
EEPROM Settings:
Select which EEPROM values should be used

The `EXI` file can be exported through the *Export EXI* button right from the *Export ENI* Button or through the context menu.

5.3 SubDevice Settings

5.3.1 General (SubDevice)

In this tab, the user can see general SubDevice settings like station address or the name of the SubDevice. Also the connected ports can be seen.



Address

Station Address:
Station address of the SubDevice. By default, the first station address is 1001.

Information

Name:
Name of the SubDevice. By default the following format is used “SubDevice_N [TYPE]”

Description:
Description of the SubDevice (Read from `ESI` file)

Vendor:
Name of the vendor the SubDevice

Product Code:
Product Code of the SubDevice

Revision Number:
Revision Number of the SubDevice

ESI File:
Name of the `ESI` `file where the description of the SubDevice is stored. :file:`ESI` files can be managed by using the *ESI-Manager*

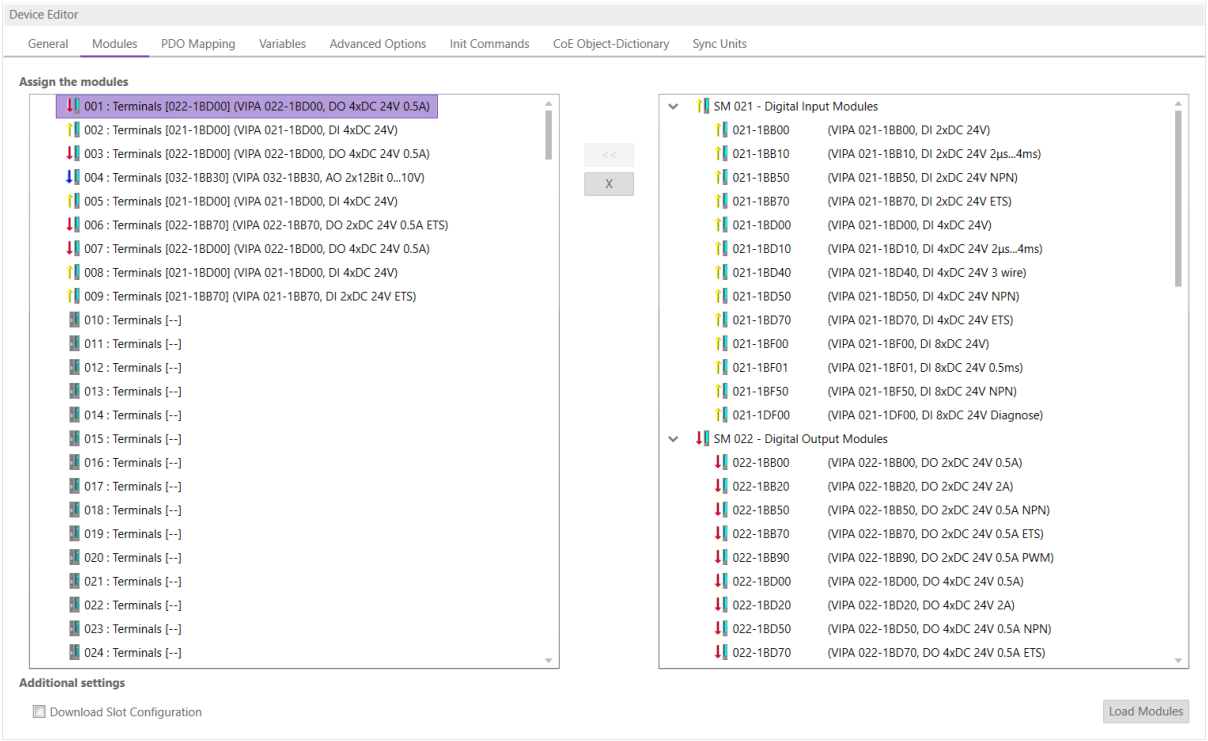
Identification Value:
Identification Value of the SubDevice

Ports

Connected Devices:
List of connected devices

5.3.2 Modules

In this tab, the user has can assign modules into the specific slots. He can also change the setting for downloading the slot configuration to the SubDevice:



Connect module to slot (“<<”)
Used for connecting the selected module (from the right list) to the selected slot (from the left list). If the slot is already connected, the module will be inserted and the subsequent modules will be moved (if this is supported from the SubDevice)

Disconnect module from slot (“X”)
Used for disconnecting the selected slot (left list)

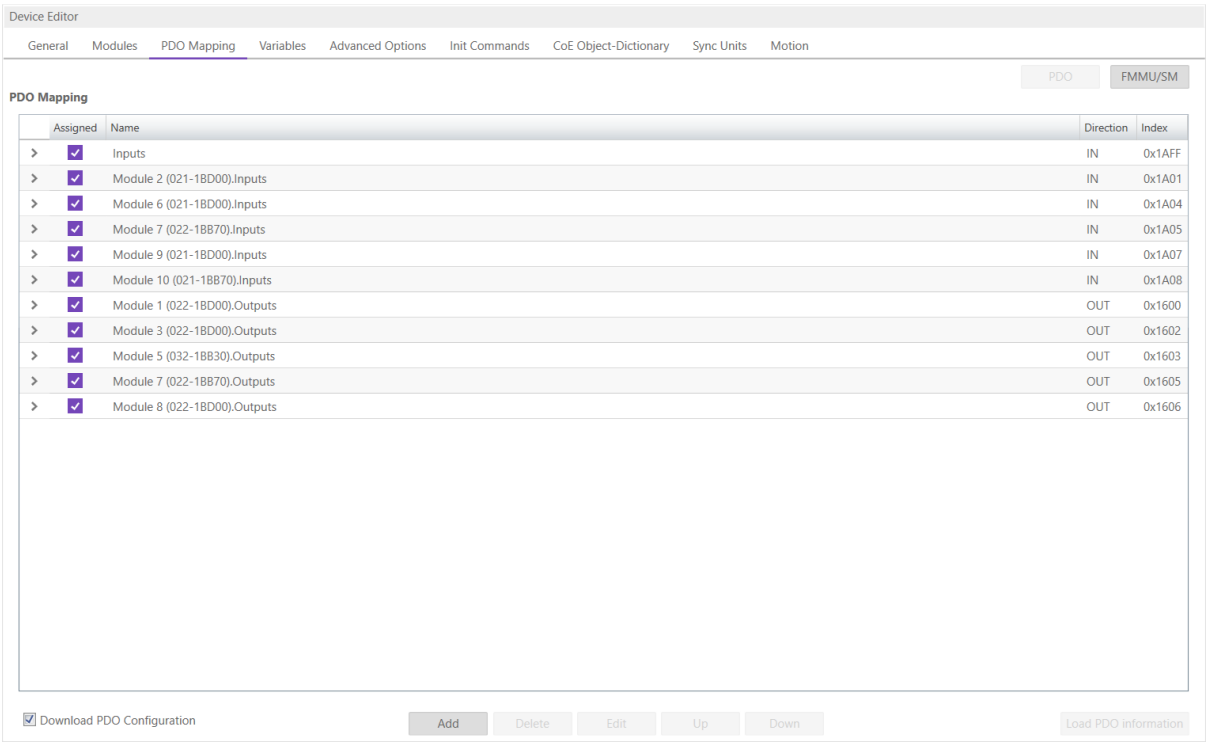
Note: The modules can be also connected and disconnected by using the context menu in the project explorer.

5.3.3 PDO Mapping

This tab consists of 2 views:

PDO

In this tab, the user can see the current PDO mappings. For some SubDevice types the user can activate or deactivate some PDO configurations:



Lists of inputs or outputs

Checkbox:
Signals if PDO will be used for the current configuration or not.

Buttons

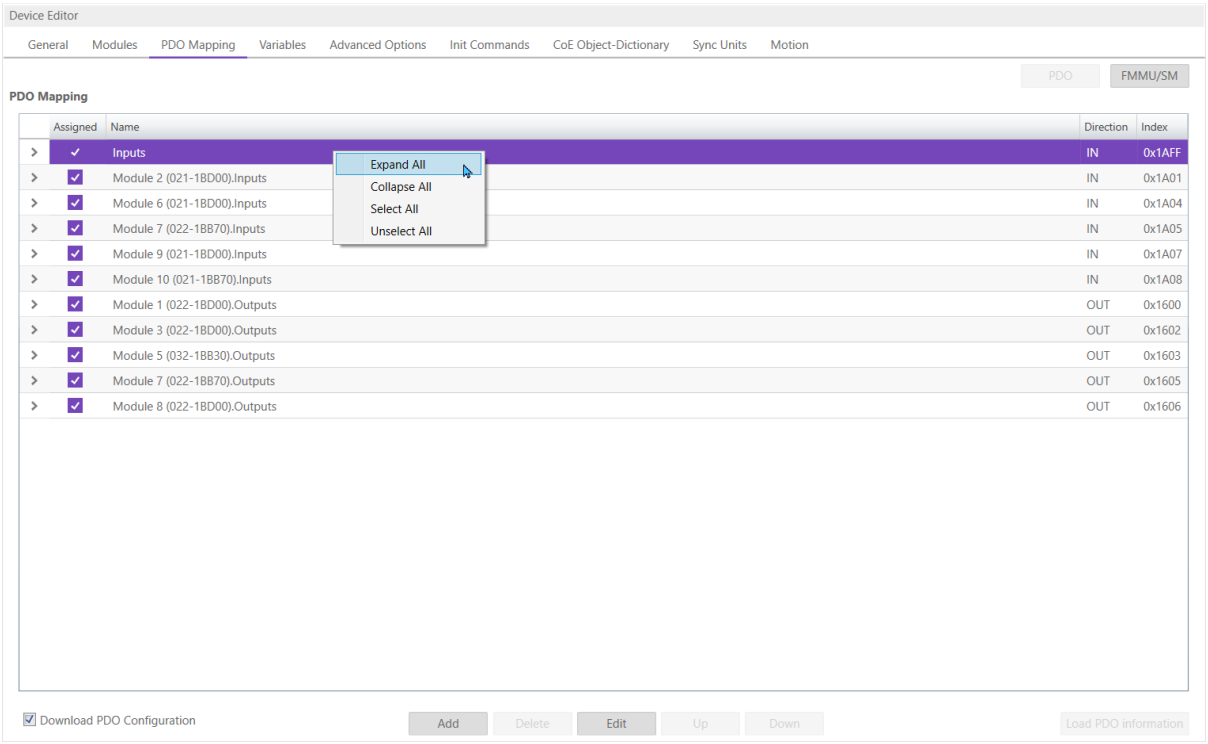
Add/Delete/Edit:
Used for changing the lists, if it is allowed by the `ESI`. First the list which should be changed must be selected.

Up/Down:
Moving the selected PDO in the selected list up or down

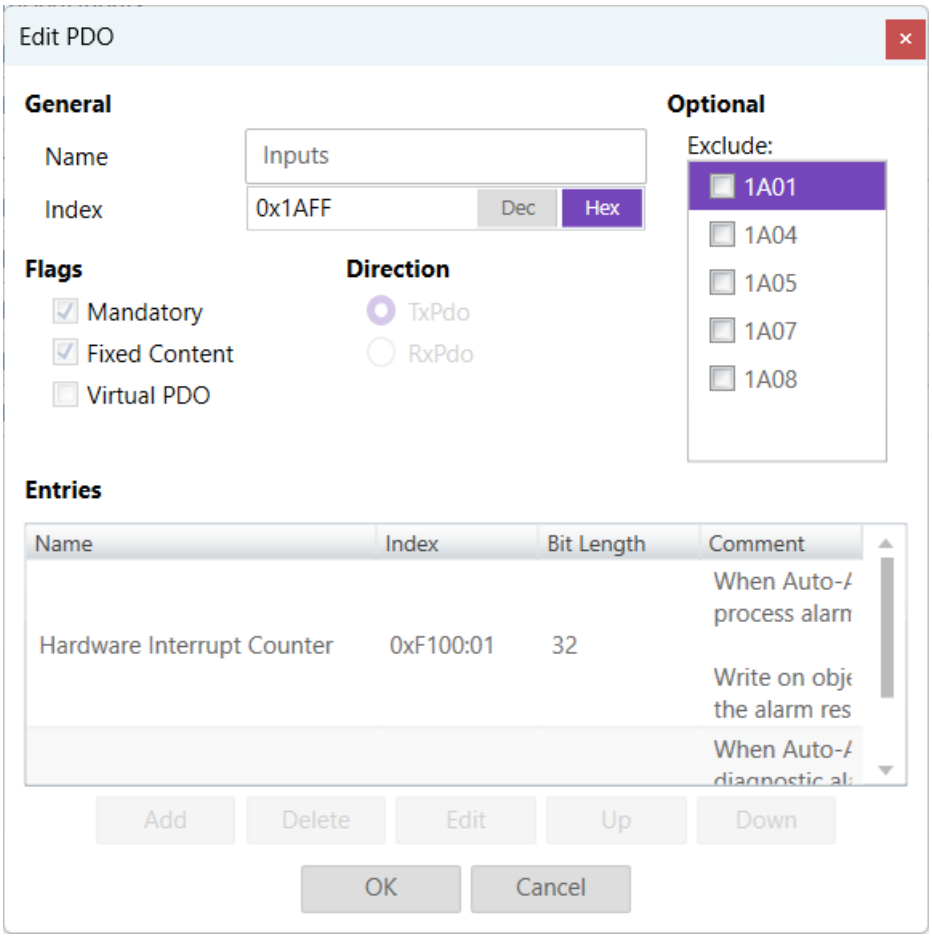
Load PDO information:
If EC-Engineer is connected to the control system, the user can load the PDO information directly from the SubDevice

Context Menu

Both lists provide a context menu:



If user wants to add or edit a PDO, he will see the following dialog:



General:

Name:
Name of the PDO

Index:
Index of the PDO (can be entered in hexadecimal or decimal)

Flags:

Mandatory:
PDO cannot be deleted

Fixed Content:
Content of PDO cannot be changed

Virtual PDO:
PDO has no entries

Direction:

TxPdo:
Input PDO

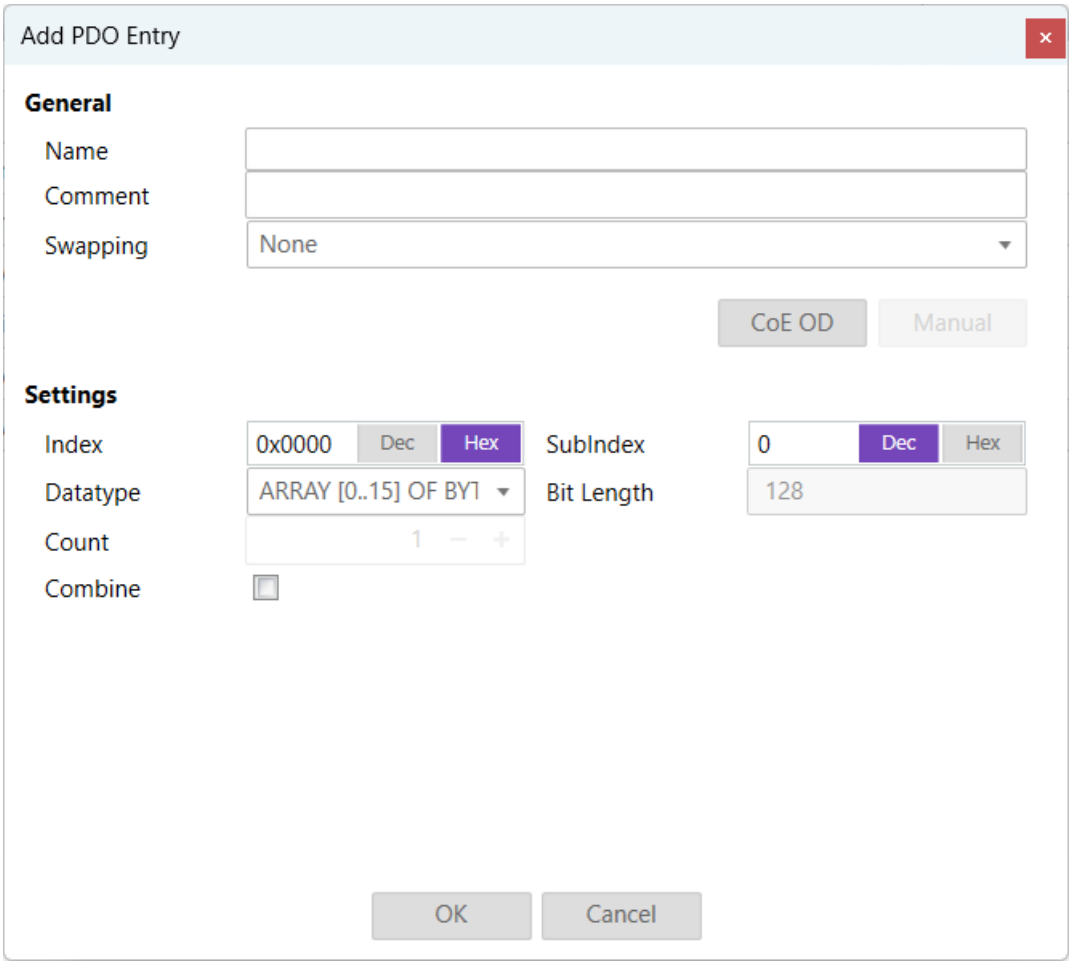
RxPdo:
Output PDO

Sync Manager:
Selected the Sync Manager, which should be used (only visible if more than one can be used)

Exclude:
Select the PDOs which cannot be activated if this PDO is activated

Entries:
List of configured PDO entries

If user wants to add or edit a PDO entry, he will see the following dialog:



General

Name:
Name of the PDO entry

Comment:
Commet of the PDO entry

Swapping:
Swapping mode of the PDO entry

The user can either add the entry from the CoE Object-Dictionary or manually input it.

Modes

CoE OD:
If the Object-Dictionary is supported by the SubDevice, the user can choose an object from it.

Manual:
The user can manually enter the information of the entry in this mode.

Settings

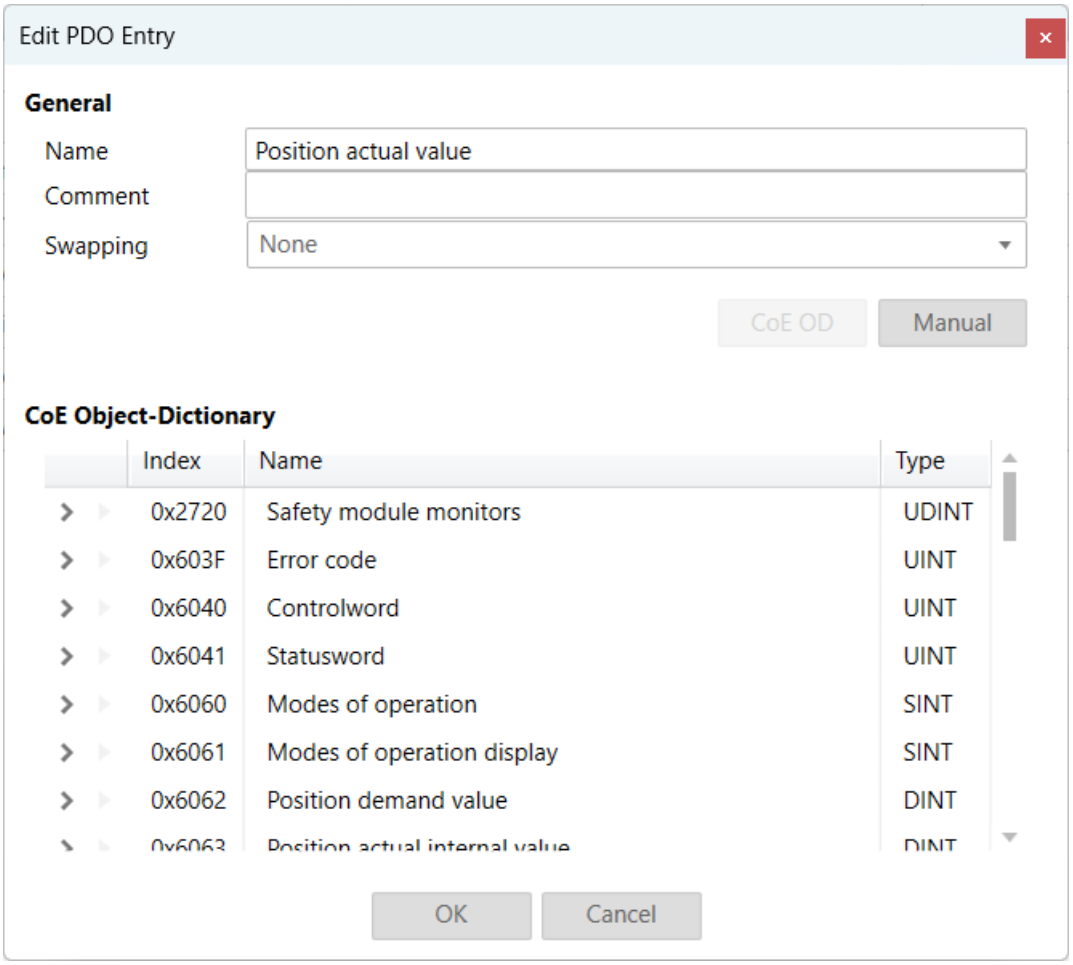
Index:
Index of the PDO entry (can be entered in hexadecimal or decimal)

Subindex:
Subindex of the PDO entry (hexadecimal)

Datatype:
List of available datatypes

Bit Length:
Length of the PDO entry in bits

CoE Object-Dictionary (loaded only if Object-Dictionary is supported by SubDevice)



General

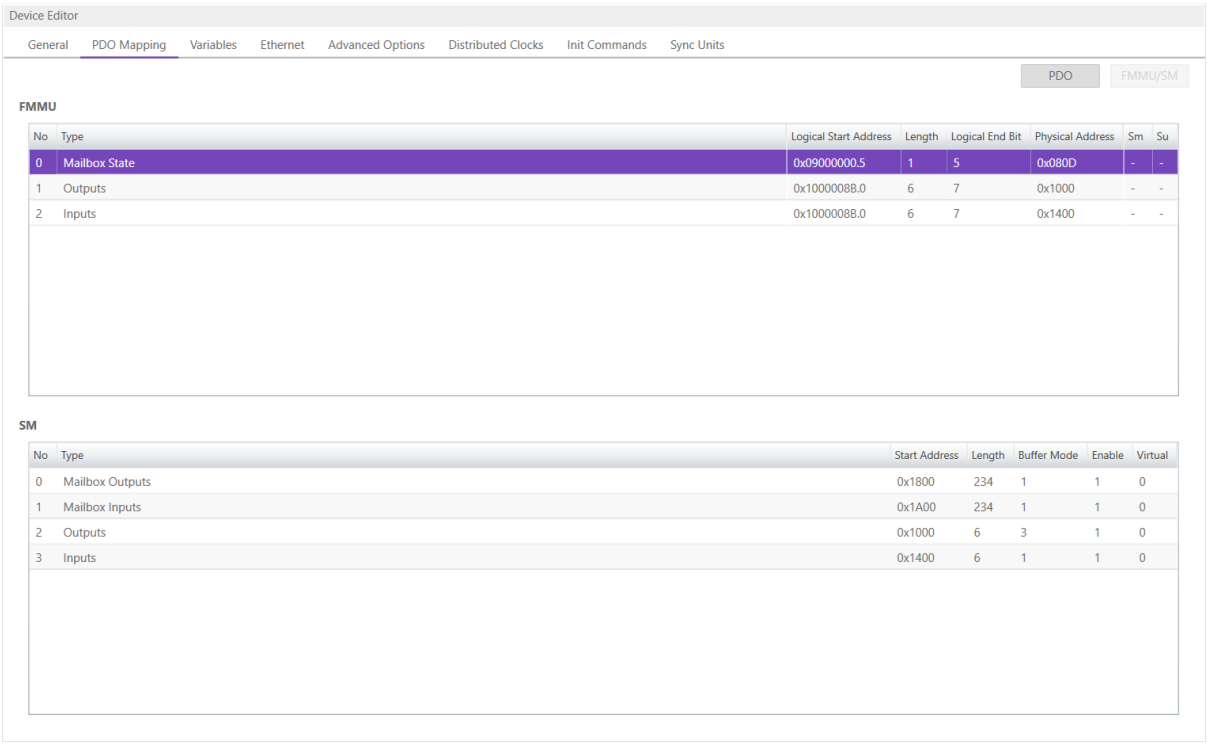
Name:
Name of the PDO entry

Comment:
Commet of the PDO entry

Swapping:
Swapping mode of the PDO entry

FMMU/SM (Expert)

In this tab, the user can see some information about FMMU and SyncManager:

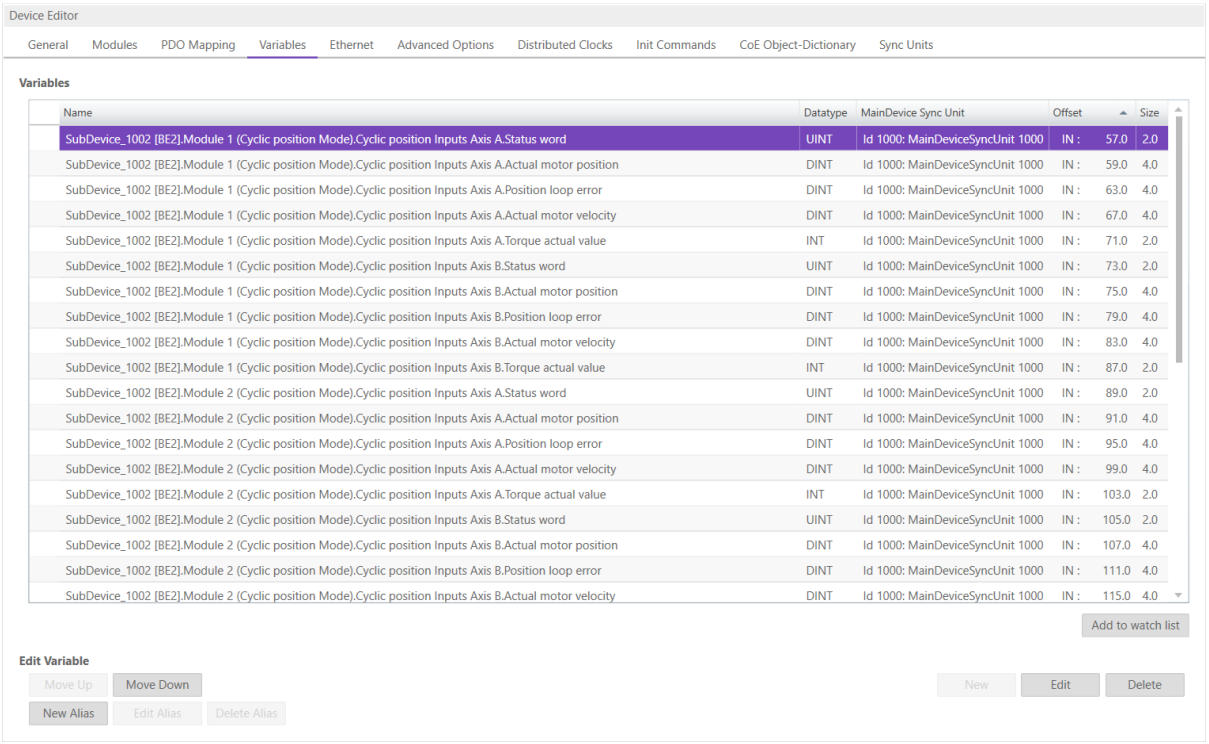


Lists of FMMUs
: Available FMMUs comes from the `ESI` file.

Lists of SyncManagers
: Available SyncManagers comes from the `ESI` file.

5.3.4 Variables

In this tab, the user can see the variables of the SubDevice and if it is allowed he can also add/edit/delete/move variables. Also "Add to watchlist" is possible:



Lists of Variables

Variables comes from the `ESI` file or will be generated from the configurator.

Buttons

New/Edit/Delete:

Used for changing the list.

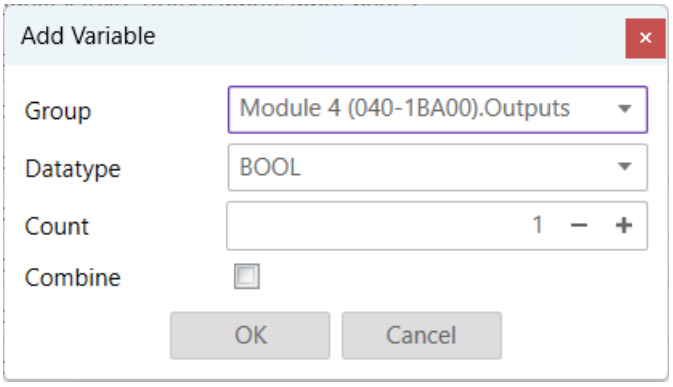
Up/Down:

Moving the selected variable up or down

New/Edit/Delete Alias:

Used for changing alias variables

If user wants to add a variable, he will see the following dialog:



Options

Group:

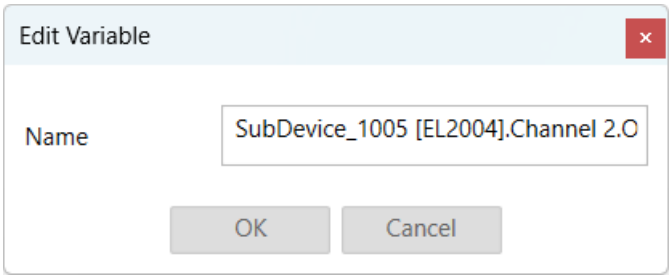
List of possible groups, where the new variable should be added

Datatype:
List of possible datatypes of the new variable

Count:
Number of variables, which should be added

Combie:
Combines all variables to an array

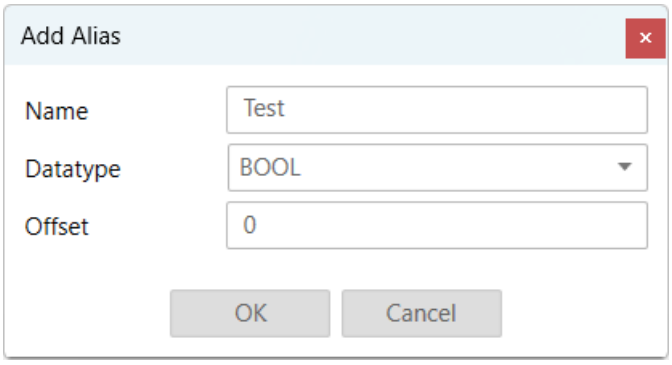
If user wants to edit a variable, he will see the following dialog:



Options

Name:
Name of the variable, which can be changed from the user

If user wants split a variable into multiple parts to build e.g. a structure, he can add an alias to a vailable. In that case he will see the following dialog:



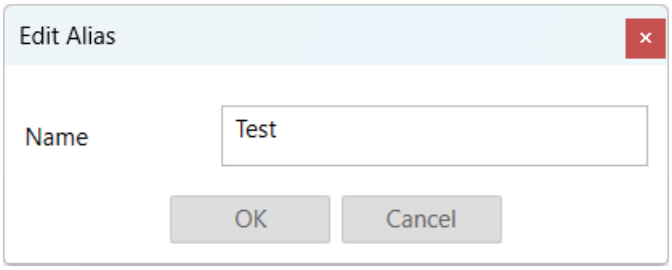
Options

Name:
Name of the alias

Datatype:
List of possible datatypes of the new alias

Offset:
Bit offset of the alias

If user wants to edit a alias, he will see the following dialog:

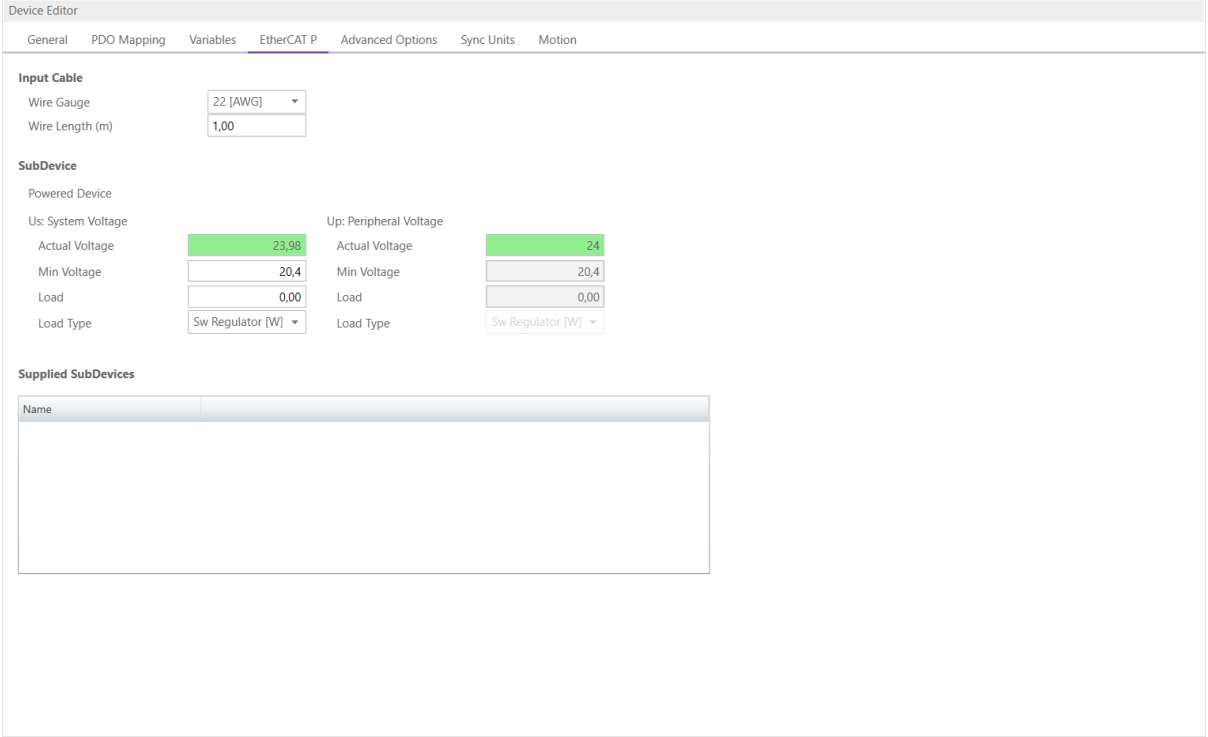


Options

Name:
Name of the alias, which can be changed from the user

5.3.5 EtherCAT P

In this tab, the user can configure the selected EtherCAT P SubDevice. The Tab is only visible when the selected SubDevice is an EtherCAT P SubDevice:



Wire Gauge:
The wire type of the input cable

Wire Length:
The wire length of the input cable

Us:

System Voltage

The system voltage shall supply all internal and externally connected types of sensors and inputs. All bus system relevant parts of the device shall completely be powered by the Us.

Actual Voltage:
The actual voltage at the SubDevice

Min Voltage:
The min Voltage the SubDevice needs. Value is from `ESI` but also editable.

Load:
The Load which is externally needed.

Load Type:
The Load Type of the externally needed load

Up:

Peripheral Voltage:

Up is used to supply internal and externally connected actuators and outputs.

Actual Voltage:
The actual voltage for the outputs

Min Voltage:
The min Voltage the SubDevice needs. Value is from `ESI` but also editable.

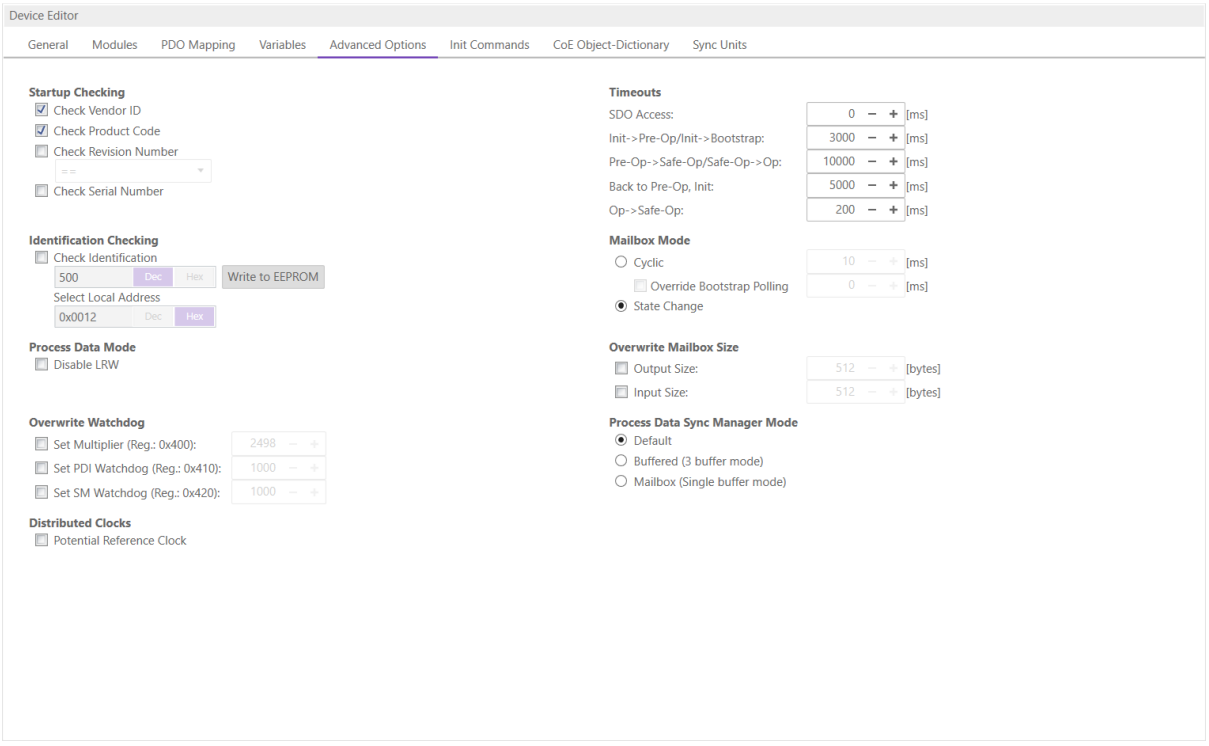
Load:
The Load which is externally needed.

Load Type:
The Load Type of the externally needed load

Load Types:
Sw Regulator in Watt LDO in Ampere Resistor in Ohm

5.3.6 Advanced SubDevice Options

In this tab, the user can change advanced options of the SubDevice:



Startup Checking

MainDevice will check the Vendor ID, Product code, Revision number if the state machine changes from INIT to PREOP of the SubDevice. Revision number can be verified by six ways:

- “==” –> HI word is equal, LO word is equal
- “>=” –> HI word is equal or greater, LO word is equal or greater
- “LW ==” –> HI word is equal
- “LW ==, HW >=” –> LO word is equal, HI word is equal or greater
- “HW ==” –> LO word is equal
- “HW ==, LW >=” –> HI word is equal, LO word is equal or greater

Identification Checking

If ‘Check Identification is selected, the Identification Value of the SubDevice is checked. In the ‘Select Local Address’ Box is the register of the Identification Value.

Process Data Mode

Disable LRW: Determines whether LRD/LWR command or the LRW command is used for accessing process data. Cable redundancy needs LRD/LWR, SubDevice-to-SubDevice-copy needs LRW.

Watchdog

Set Multiplier:
Writes the configured value to the corresponding SubDevice register: 0x0400

Set PDI Watchdog:
Writes the configured value to the corresponding SubDevice register: 0x0410 (0 = Watchdog is disabled)

Set SM Watchdog:
Writes the configured value to the corresponding SubDevice register: 0x0420 (0 = Watchdog is disabled)

Distributed Clocks

Potential Reference Clock: Set to use SubDevice as a potential reference clock

- This might be useful, if e.g. a hot connect SubDevice, which is used as reference clock, was disconnected from the network
- In that case the EC-Master searches for the first potential reference clock
- If no potential reference clock SubDevice was found, the first DC SubDevice will be used

Timeouts

SDO Access:
Internal MainDevice timeout which is used for accessing the SDO (0 = Use internal default value of the MainDevice)

Init –> PreOp:
Internal MainDevice timeout with is used for changing SubDevice state

Pre-Op –> Save-Op or Safe-Op –>Op:
Internal MainDevice timeout with is used for changing SubDevice state

Back to Pre-Op, Init:
Internal MainDevice timeout with is used for changing SubDevice state

Op –> Safe-Op:
Internal MainDevice timeout with is used for changing SubDevice state

Mailbox Mode

Cyclic:
Interval in milliseconds within the input mailbox will be read (polling mode)

Override Bootstrap Polling
Interval in milliseconds within the bootstrap will be read (when activated, it uses the polling time from the mailbox by default)

State Change:
The input mailbox will be read only if the status bit is set

Overwrite Mailbox Size

Output Size:
Overwrites mailbox output size

Input Size:
Overwrites mailbox input size

Process Data Sync Manager Mode

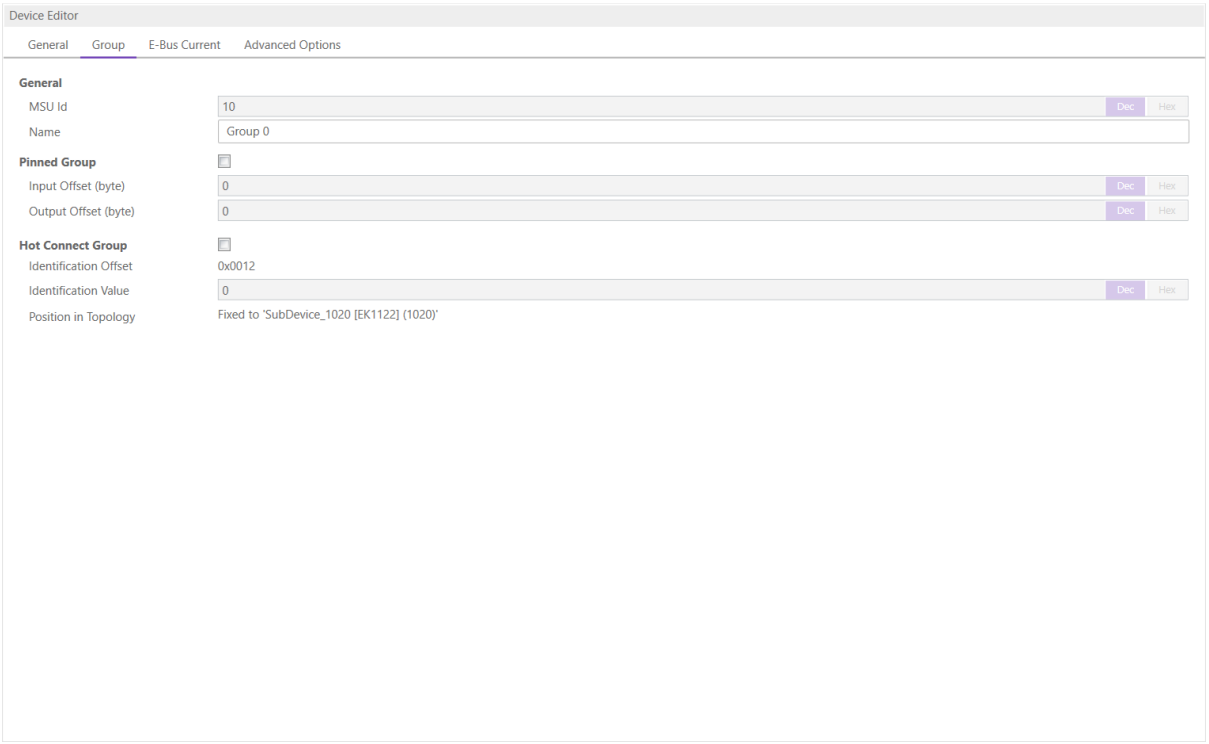
Default:
Uses sync manager mode from `ESI` file

Buffered (3 buffer mode):
Enables 3 buffer mode

Mailbox (Single buffer mode):
Enables single buffer mode

5.3.7 (Hot Connect) Groups

In this tab, the user can choose if this group has a fixed offset in the process data image or if this group is a hot connect group:



Note: Tab is only visible if SubDevice is the first member of a group.

General

MSU Id:
Generated MainDevice Sync Unit Id

Name:
Name of the group

Pinned Group

Input Offset:
Fixed input offset of the group in the process data image in bytes

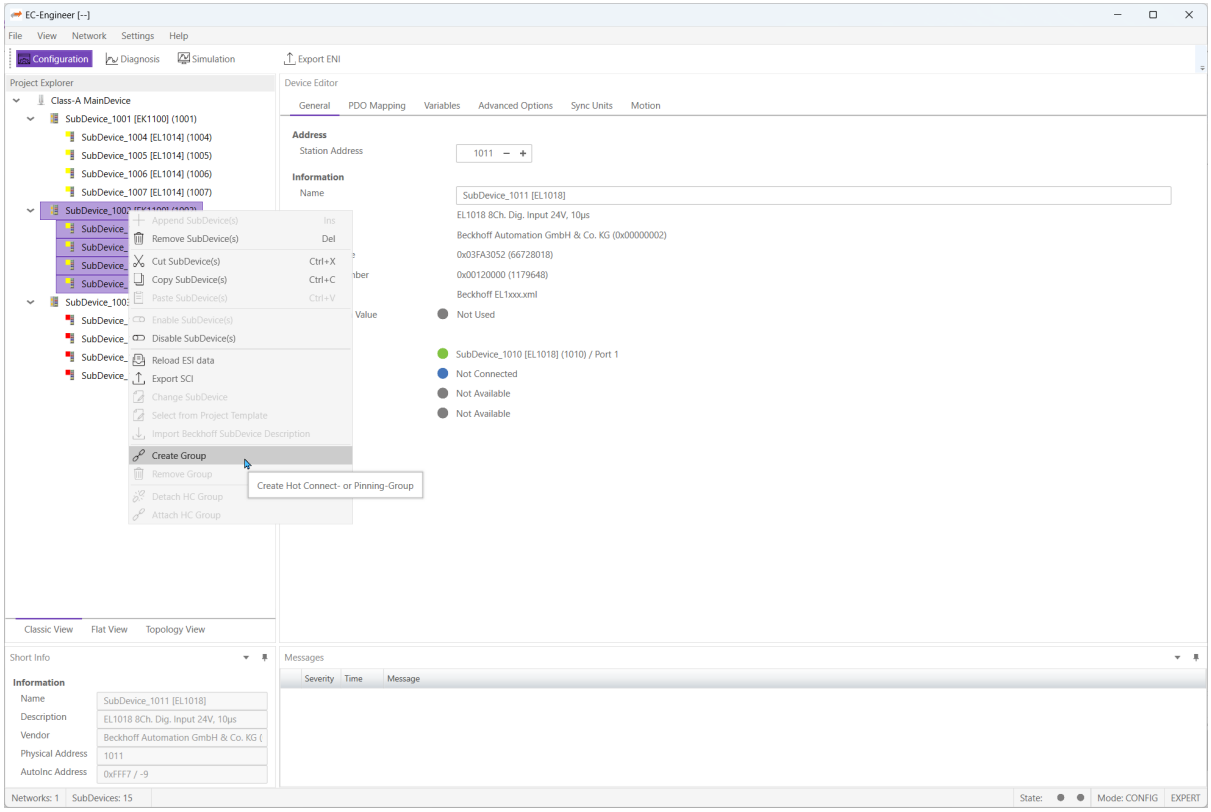
Output Offset:
Fixed output offset of the group in the process data image in bytes

Hot Connect Group

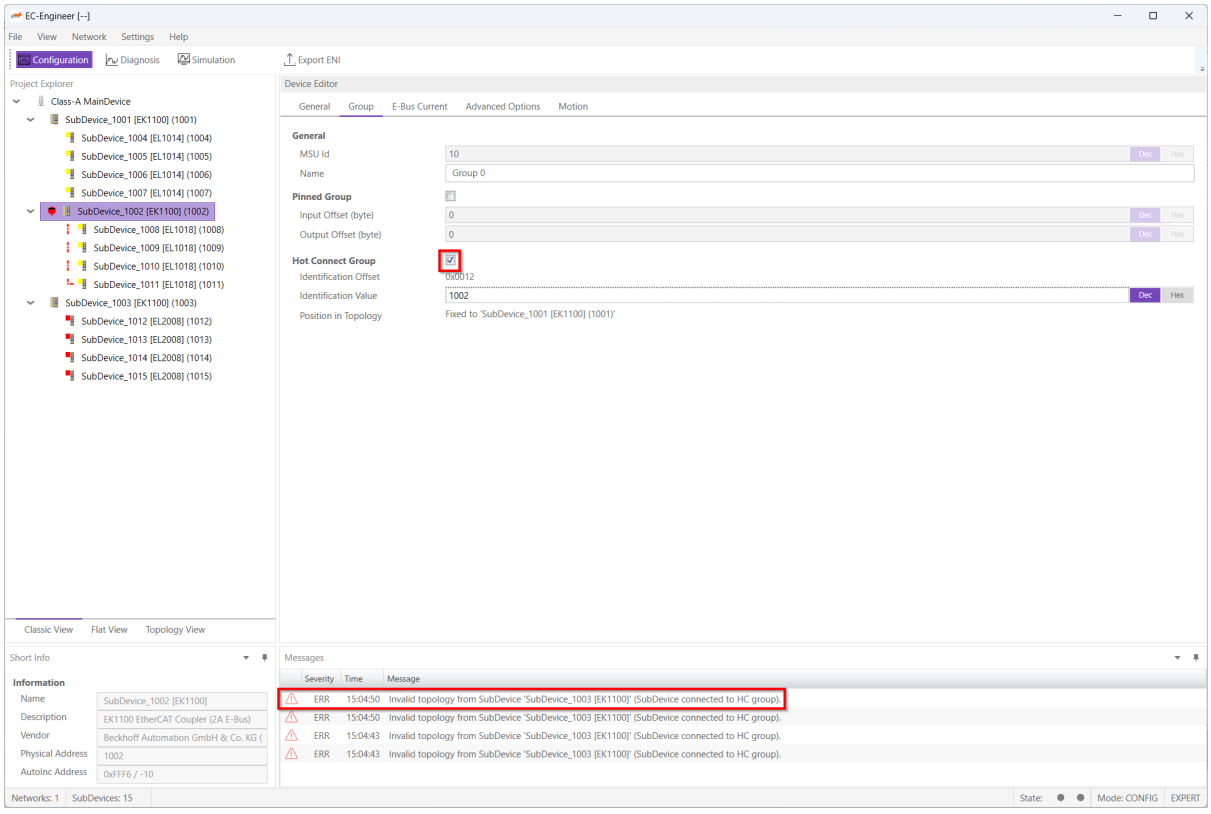
Identification Offset:
Register offset where the identification can be read from the SubDevice

Identification Value:
Hardware identification value or configured station alias address can be used. For more information about the configured station alias address, see *EEPROM*

A new group can be created by selecting all SubDevices (by using the `SHIFT` key or the `CTRL` key), open the context menu and select *Create Group* in the project explorer:



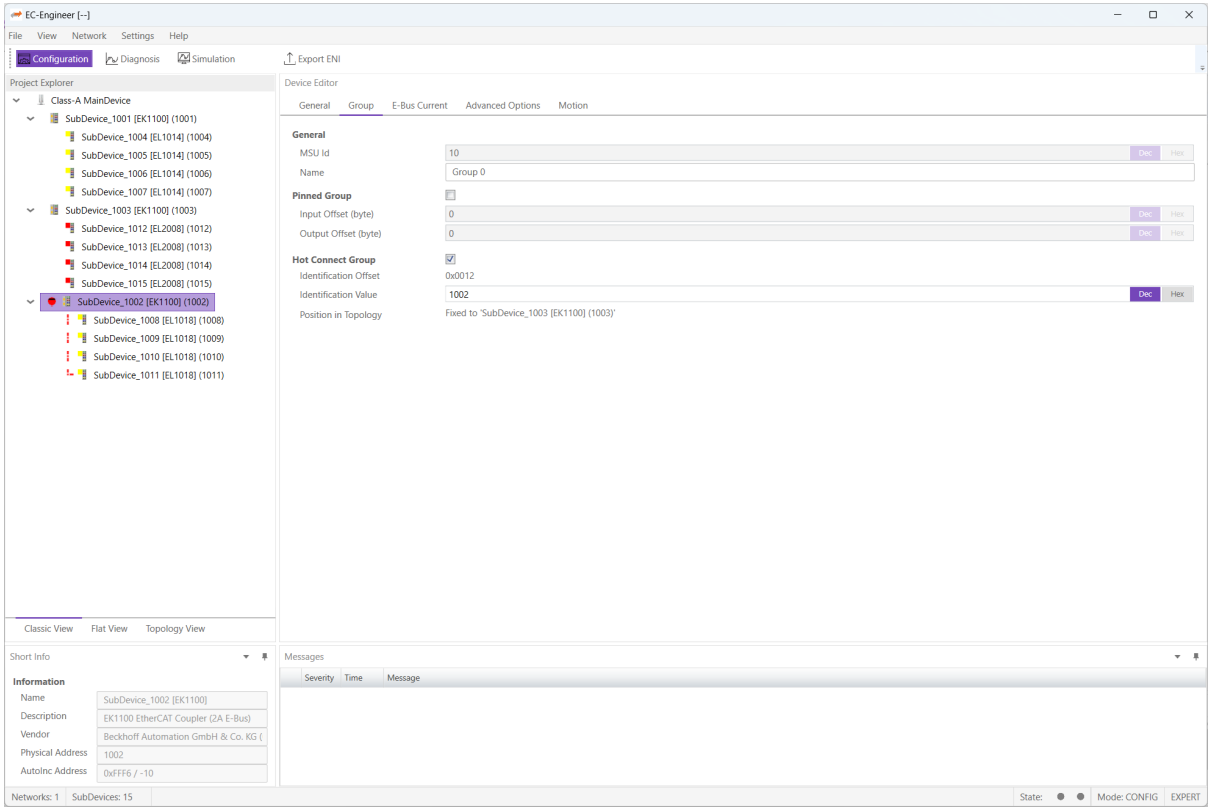
The new group can be modified by selecting the head SubDevice of this group and open tag *Group*:

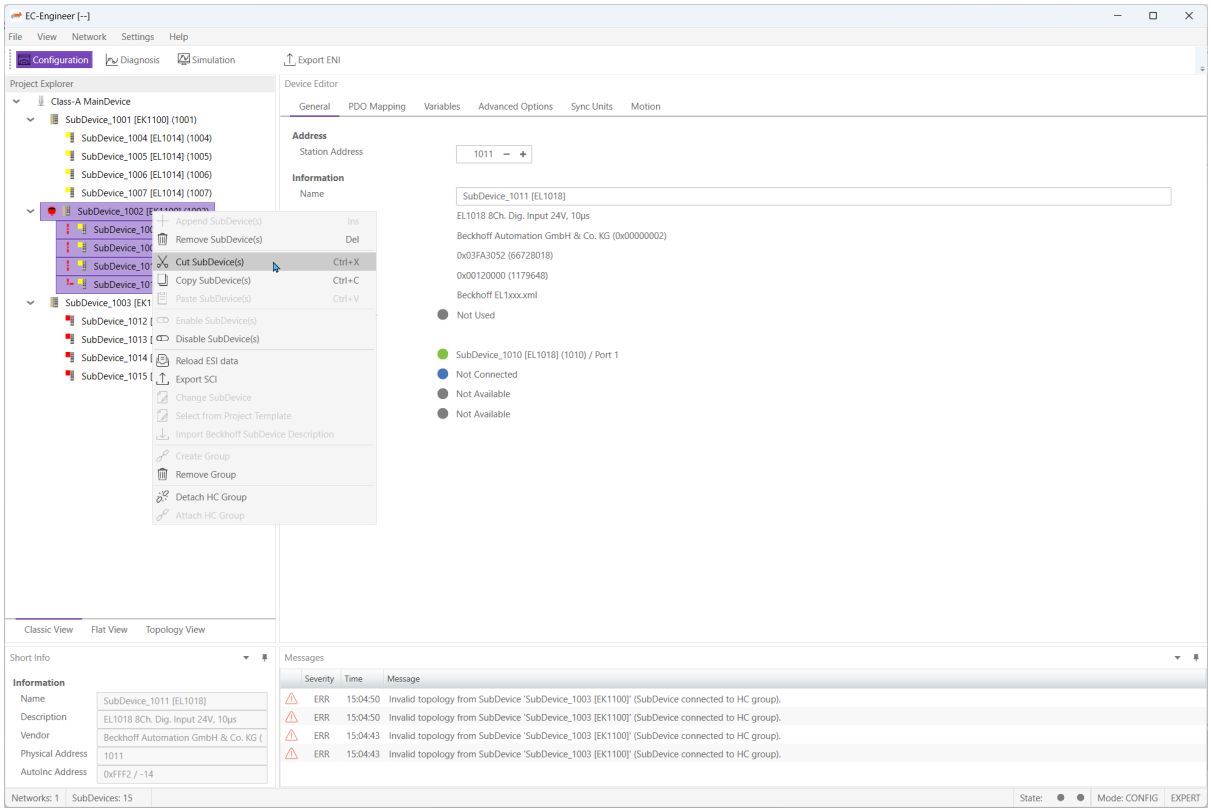


On this tab, the user can pin this group of SubDevices to a specific offset in the process image and / or build a hot connect group. If we do this, in that case this will generate an invalid topology error, because a normal SubDevice is

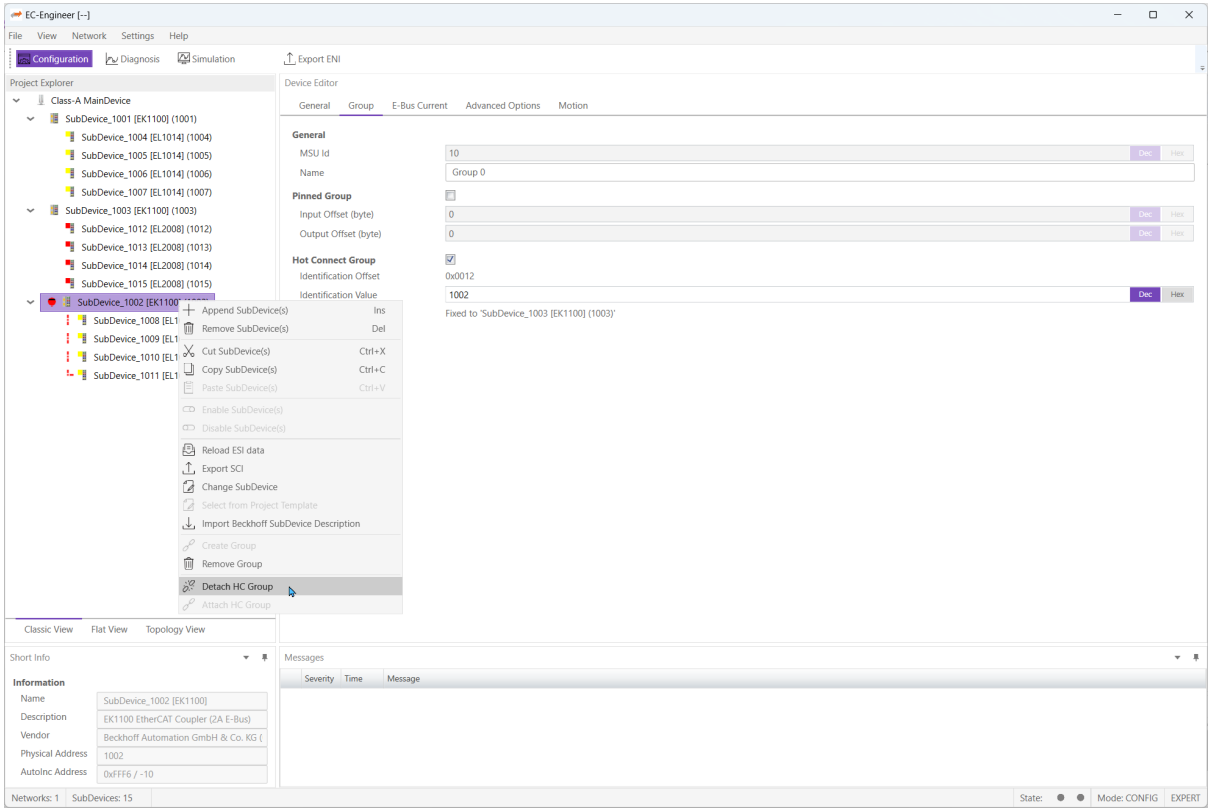
still connected to this hot connected, which is not allowed.

In that case we can use “cut & paste” to solve this issue by connecting this hot connect group to the end of the SubDevices:





Now, we have a hot connect group which is connectable only to SubDevice 1011. If we want to connect this group to any SubDevice on the network, we have to detach the group:



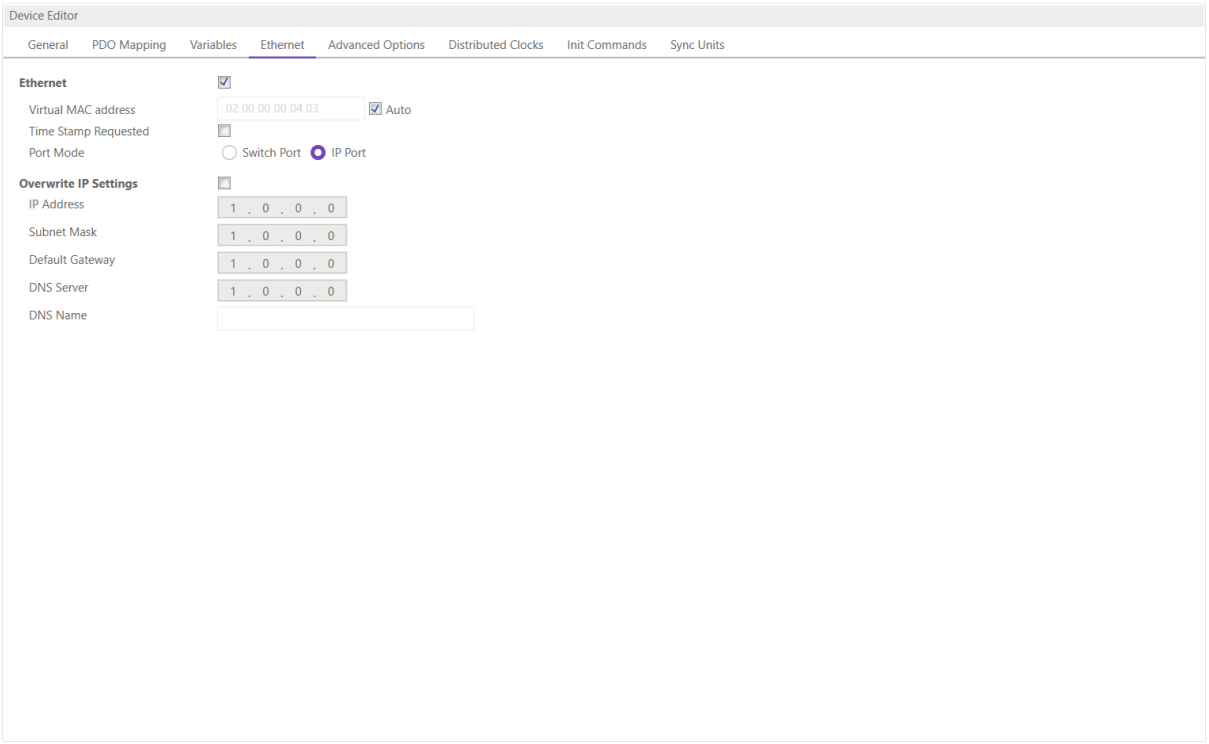
A group can be deleted by selecting the head SubDevice of this group, open the context menu and select “Remove Group” in the project explorer (only attached HC groups can be deleted).

Possible group related error messages:

- Detached group can not be attached to the old position in the tree (e.g. previous SubDevices was deleted or disabled) the head SubDevice of the group will be reported as “not connected”. In that case the user can connect the head SubDevice by using “cut” and “paste”.
- Invalid topology from SubDevice (fixed HC group on MainDevice) was displayed: this means that the first HC group which is connected to the MainDevice should be detached, because this is not valid in the `ENI` file
- Invalid topology from SubDevice (SubDevice connected to HC group) was displayed: this means that a normal SubDevice is connected to a hot connect group and should be also moved also into a hot connect group or moved to another position in the tree

5.3.8 Ethernet (EoE)

In this tab, the user can activate EoE support and change the settings:



Ethernet (activates EoE support):

Virtual MAC address:
Virtual MAC address. If “Auto” is checked, the Virtual MAC address will be generated from the Station Address, e.g. Station Address is “1010” (= 0x03F2), will generate the Virtual MAC address: “01 00 00 00 03 F2”

Time Stamp Requested:
SubDevice will response with the exact send time and the same Frame Number and he should response as soon as possible

Port Mode:
SubDevice can run in “Switch Port” or in “IP Port” mode

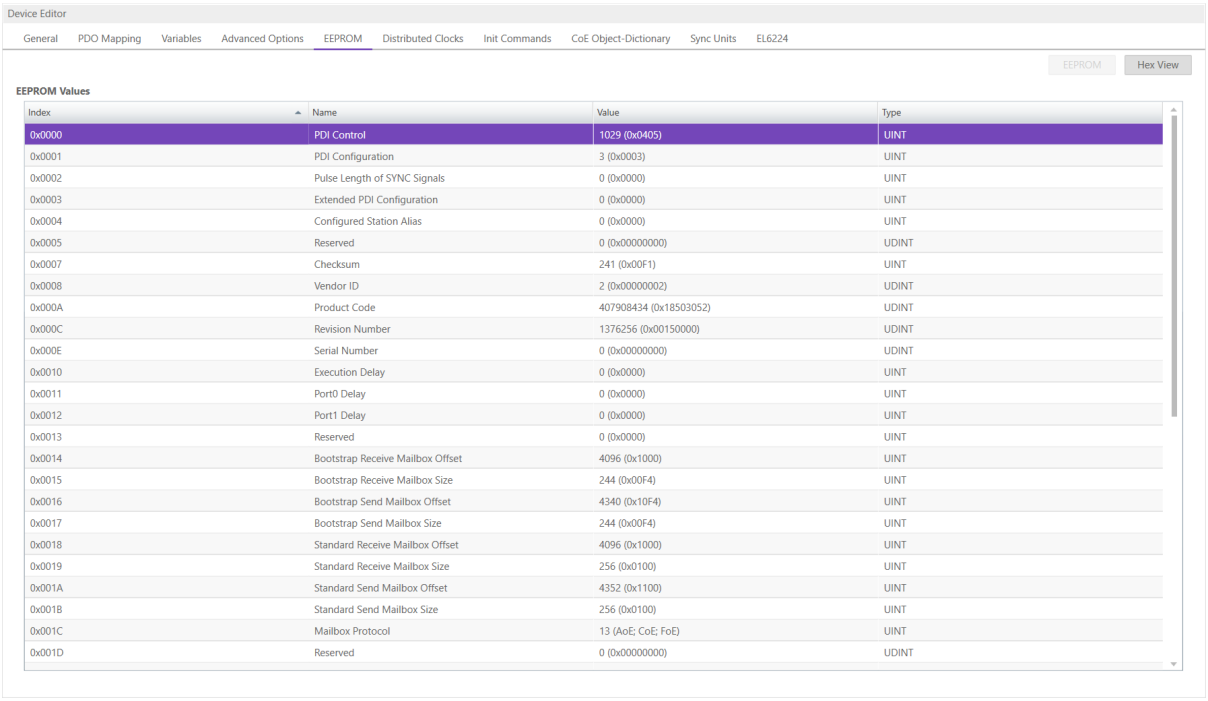
Override IP Settings:
All IP settings will be overwritten from MainDevice like IP Address, Subnet Mask, Default Gateway, DNS Server and DNS Name.

5.3.9 EEPROM (Expert)

This tab consists of two views:

Smart View

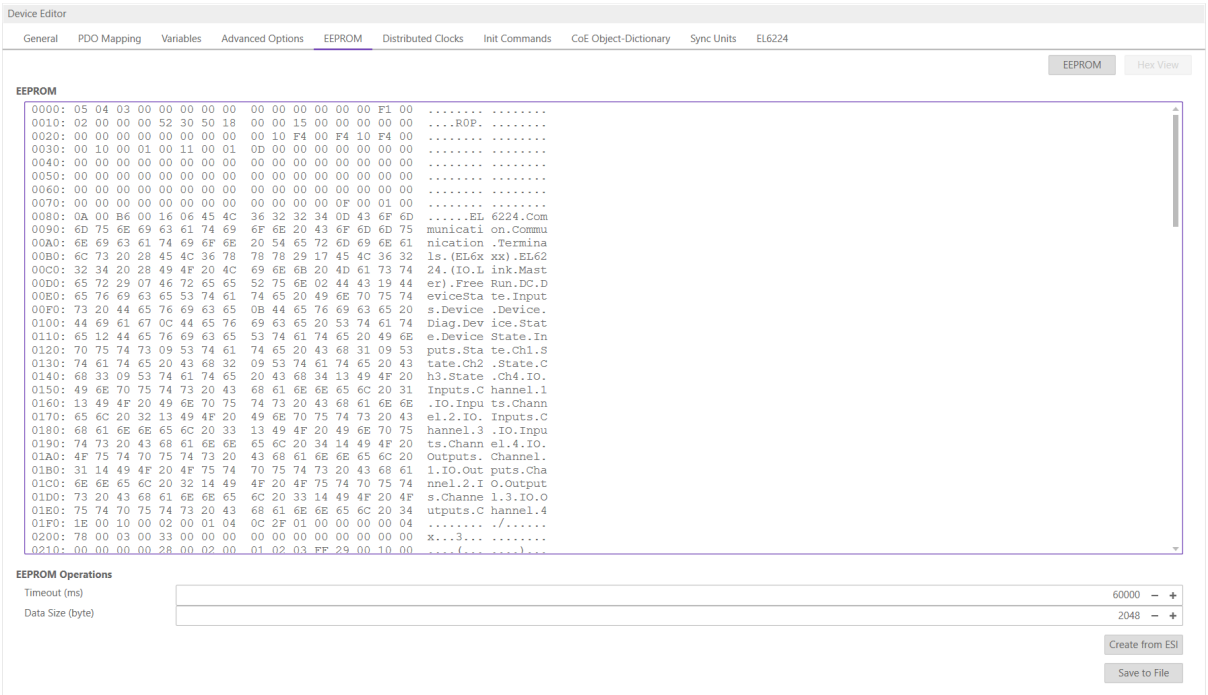
In this view, the user can see the values of the EEPROM from the ESI file.



Index	Name	Value	Type
0x0000	PDI Control	1029 (0x0405)	UINT
0x0001	PDI Configuration	3 (0x0003)	UINT
0x0002	Pulse Length of SYNC Signals	0 (0x0000)	UINT
0x0003	Extended PDI Configuration	0 (0x0000)	UINT
0x0004	Configured Station Alias	0 (0x0000)	UINT
0x0005	Reserved	0 (0x00000000)	UDINT
0x0007	Checksum	241 (0x00F1)	UINT
0x0008	Vendor ID	2 (0x00000002)	UDINT
0x000A	Product Code	407908434 (0x18503052)	UDINT
0x000C	Revision Number	1376256 (0x00150000)	UDINT
0x000E	Serial Number	0 (0x00000000)	UDINT
0x0010	Execution Delay	0 (0x0000)	UINT
0x0011	Port0 Delay	0 (0x0000)	UINT
0x0012	Port1 Delay	0 (0x0000)	UINT
0x0013	Reserved	0 (0x0000)	UINT
0x0014	Bootstrap Receive Mailbox Offset	4096 (0x1000)	UINT
0x0015	Bootstrap Receive Mailbox Size	244 (0x00F4)	UINT
0x0016	Bootstrap Send Mailbox Offset	4340 (0x10F4)	UINT
0x0017	Bootstrap Send Mailbox Size	244 (0x00F4)	UINT
0x0018	Standard Receive Mailbox Offset	4096 (0x1000)	UINT
0x0019	Standard Receive Mailbox Size	256 (0x0100)	UINT
0x001A	Standard Send Mailbox Offset	4352 (0x1100)	UINT
0x001B	Standard Send Mailbox Size	256 (0x0100)	UINT
0x001C	Mailbox Protocol	13 (AoE; CoE; FoE)	UINT
0x001D	Reserved	0 (0x00000000)	UDINT

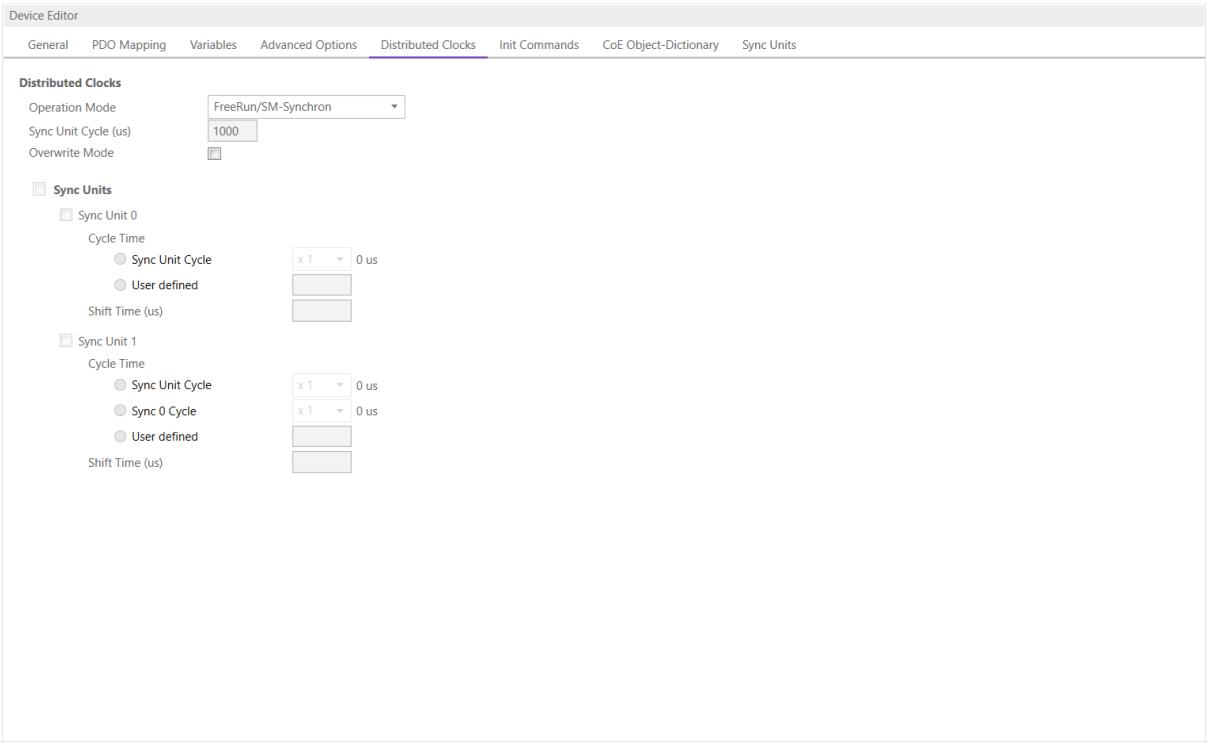
Hex View

In this view, the user can create an EEPROM from an `ESI` file and save the EEPROM to disk.



5.3.10 Distributed Clock

In this tab, the user can change distributed clock related settings:



Reference Clock

Operation Mode:
Selectable DC operation modes. The modes cannot be edited.

Sync Unit Cycle:
Base interval in microseconds which will be used from MainDevice (see *General*)

Overwite Mode:
Overwrites the settings of the selected operation mode (might be necessary, if the SubDevice doesn't offer the right operation mode)

Sync Units

Sync Unit 0

Cycle Time

Sync Unit Cycle:
Unit is synchronized relative to the Unit Cycle

User defined:
Unit has its own interval

Shift Time
Unit is adjusted by the shift time

Sync Unit 1

Cycle Time

Sync Unit Cycle:
Unit is synchronized relative to the Unit Cycle

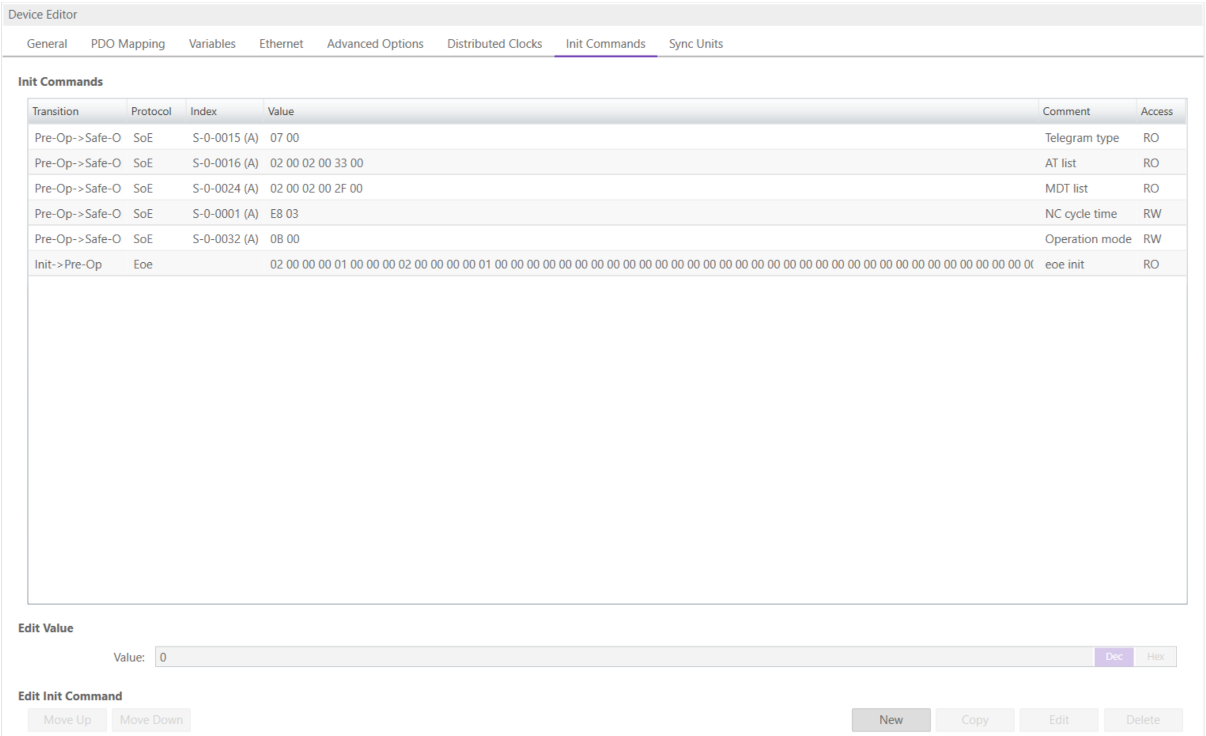
Sync 0 Cycle:
Unit is synchronized relative to the first Sync Unit

User defined:
Unit has its own interval

Shift Time
Unit is adjusted by the shift time

5.3.11 Init Commands (Expert)

In this tab, the user can view the current configured init commands and if it is allowed he can also add/edit/delete init commands:



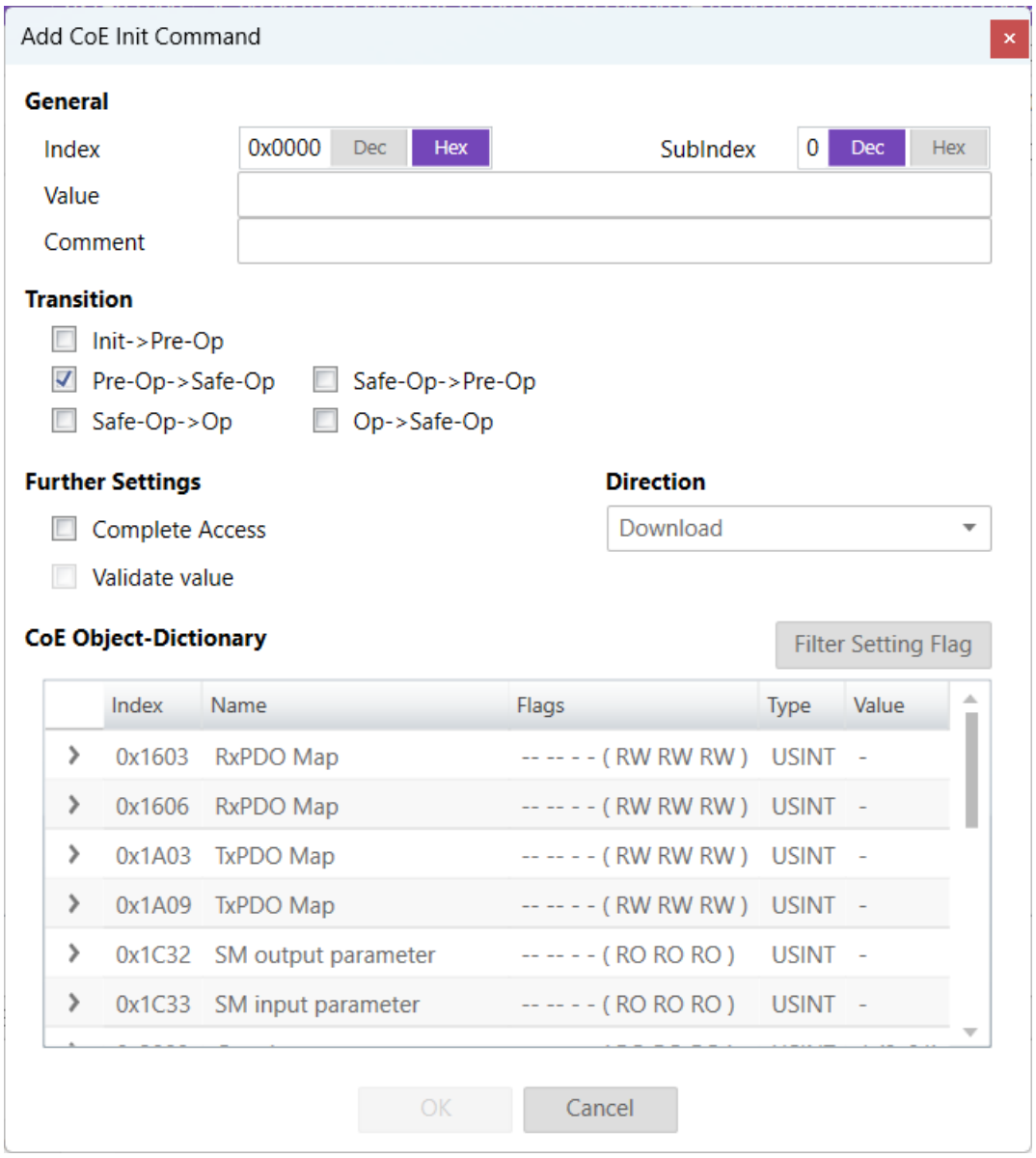
Lists of Init Commands
Init Commands comes from the `ESI` file or will be generated from the configurator. The "Access" column tells the user if this Init Command can be edited (RW = Read/Write) or not (RO = Read-Only).

Buttons

New/Copy/Edit/Delete:
Used for changing the list

Up/Down:
Moving the selected Init Command up or down

At the moment only Init Commands of the CoE- and SoE- Protocol can be added or changed. If the user wants to do this he will see the following dialog (CoE):



General

Index:
CoE-Index of the Init Command

SubIndex:
CoE-SubIndex of the Init Command

Value:
Value of the Init Command, which should be written in the chose transition (only available if direction is set to “Download”). If type of value is unknown, the hex format must be used like “00 11 22 33 …”.

Comment:
Comment of the Init Command

Transition
Determines in which transition the Init Command will be executed

Further Settings
Determines if the complete SDO object should be written/read

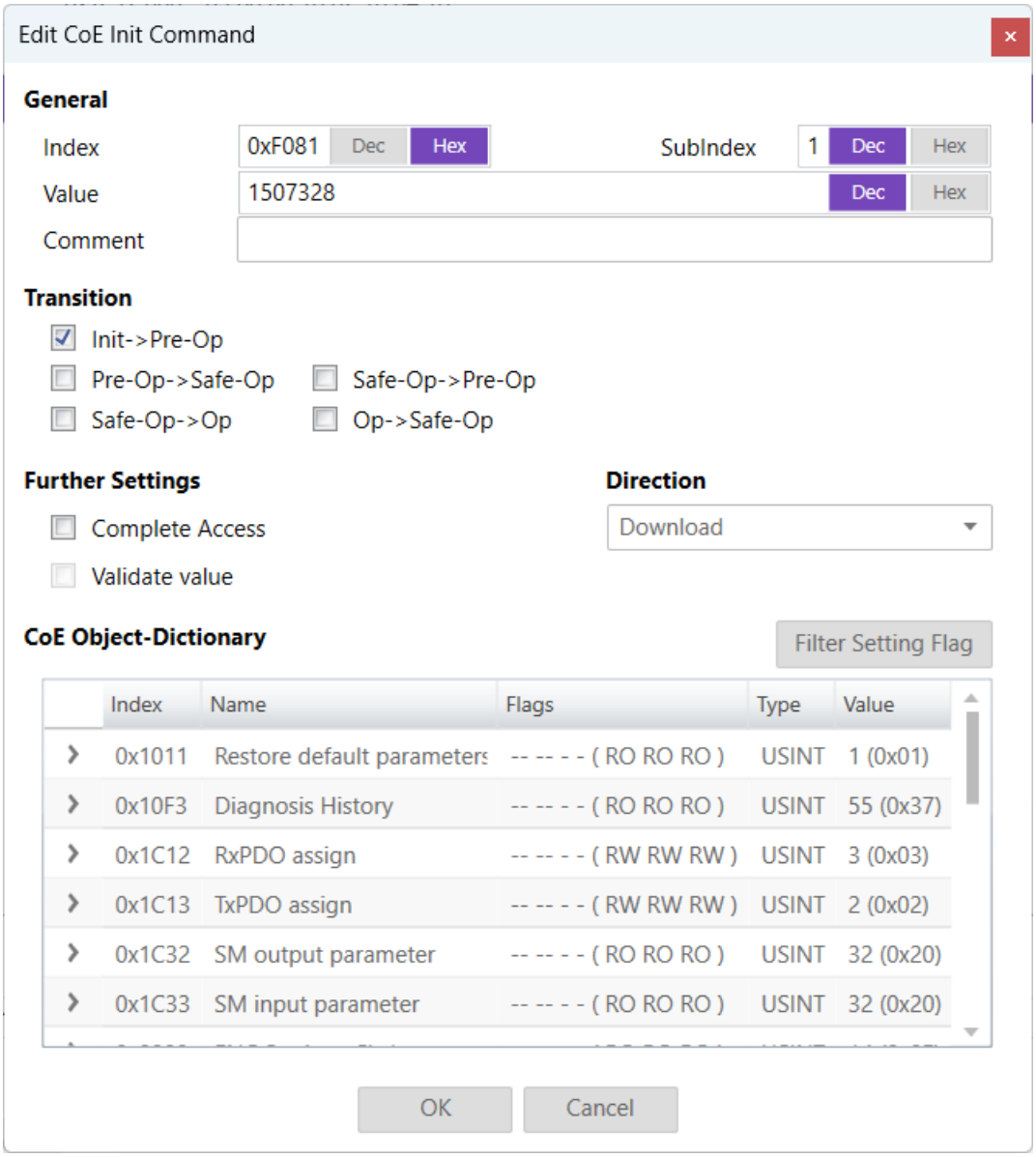
Direction

Determines the direction of the Init Command

Download:
Writes value to SubDevice

Upload:
Reads value from SubDevice (e.g. necessary if value must be confirmed)

For SoE the user will see the following dialog:



General

Index:
SoE Idn of the Init Command

Channel:
The channel of the Init Command

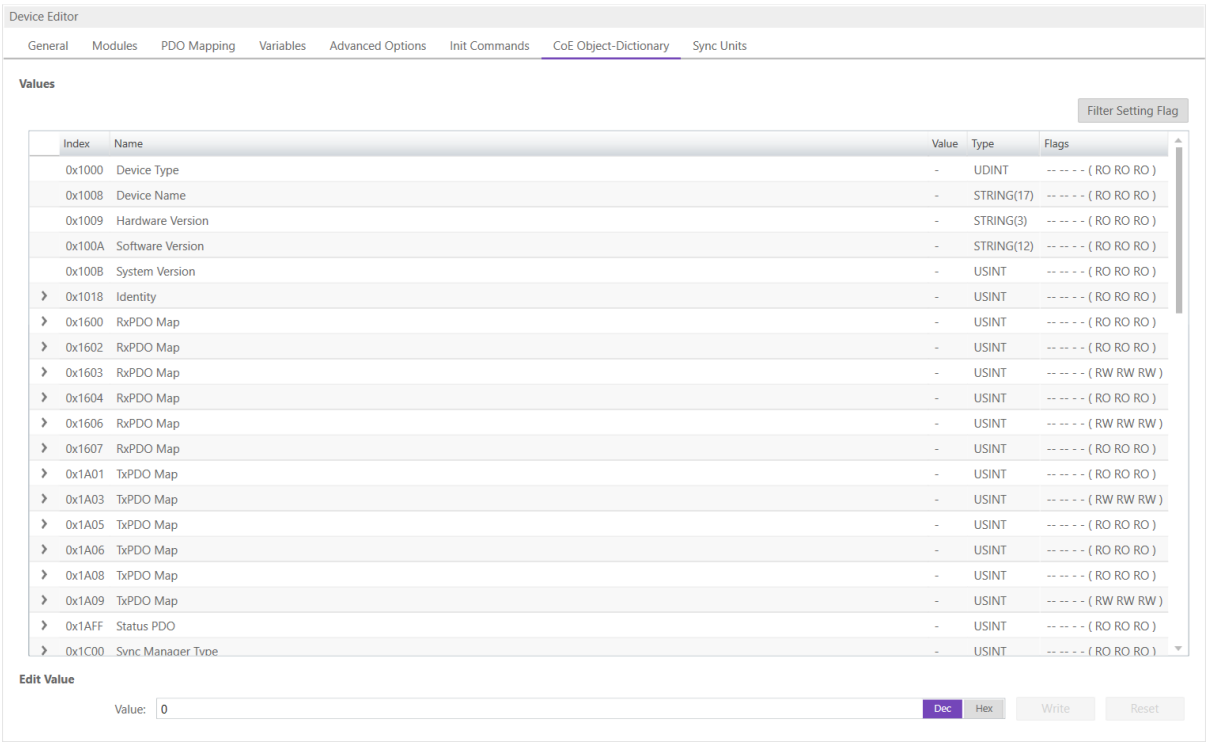
Value:
Value of the Init Command

Comment:
Comment of the Init Command

Transition
Determines in which transition the Init Command will be executed

5.3.12 CoE Object-Dictionary

In this tab, the user can see and edit the offline CoE object dictionary.



Lists of CoE Object-Dictionary entries

- Entries comes from the `ESI` file or will be generated from the configurator.
- **The "Flags" column tells the user if this entry is an PDO entry and if it can be edited**
  - "AA BB C D (EE FF GG)"
  - AA = Mapping as RX PDO or not
  - BB = Mapping as TX PDO or not
  - C = Backup Flag
  - D = Settings Flag
  - EE = Access rights for PreOp (RO, WO, RW)
  - FF = Access rights for SafeOp (RO, WO, RW)
  - GG = Access rights for Op (RO, WO, RW)

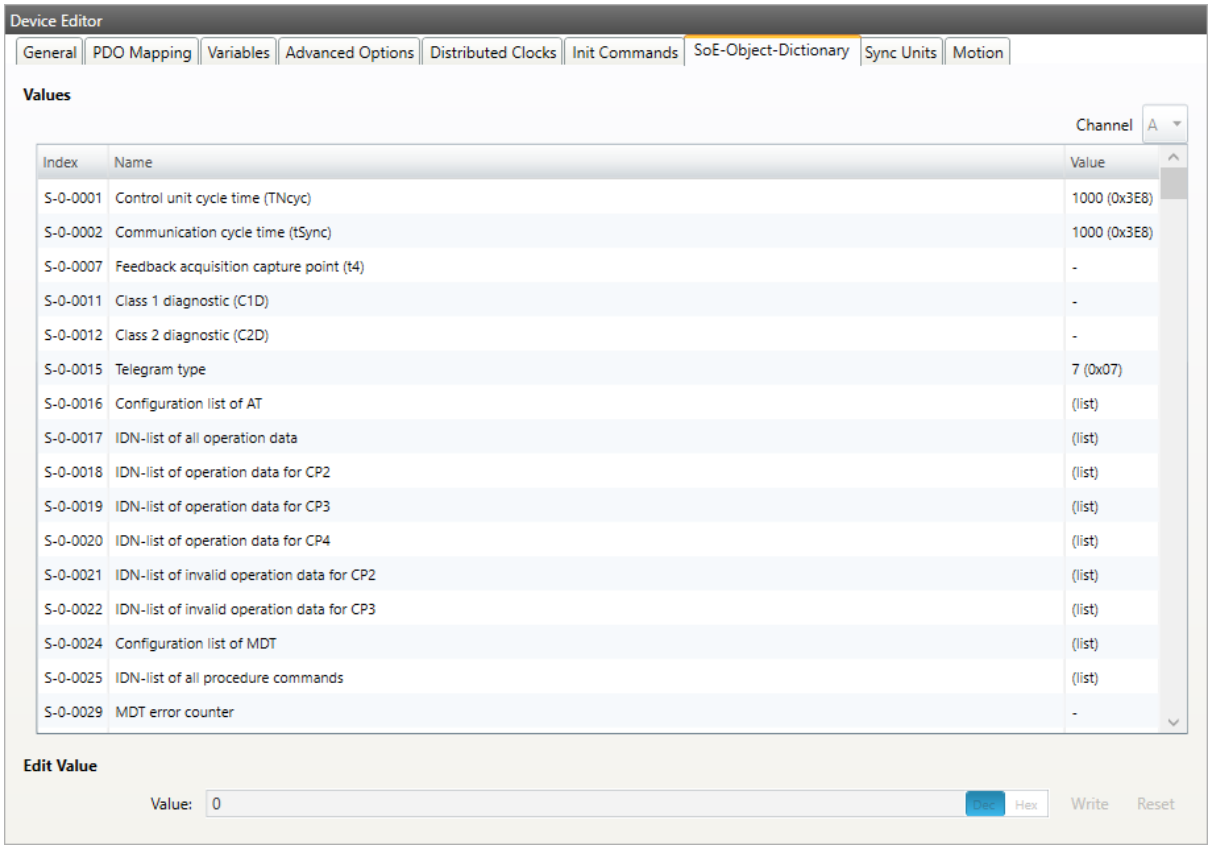
Buttons

Update:
Changes the selected entry

Reset:
Resets the selected entry to `ESI` default

5.3.13 SoE Object-Dictionary

In this tab, the user can see and edit the offline SoE object dictionary.



Lists of SoE Object-Dictionary entries
Entries comes from the `ESI` file

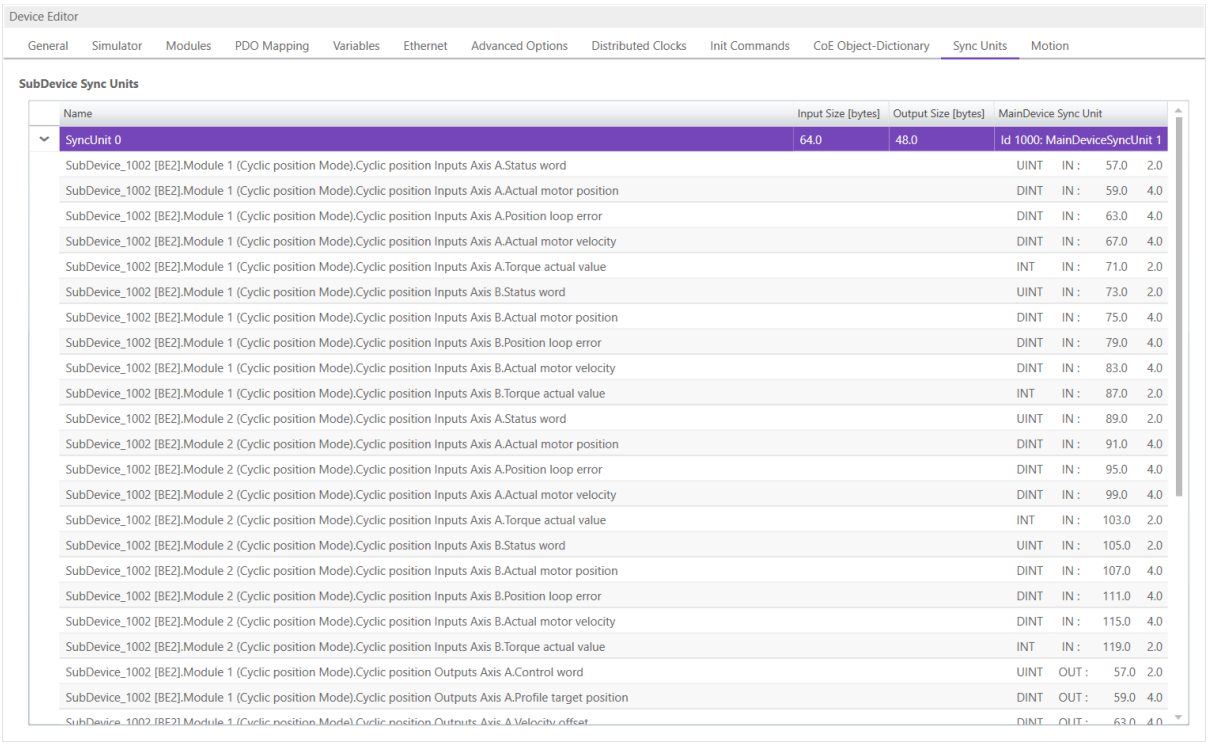
Buttons

Update:
Changes the selected entry

Reset:
Resets the selected entry to `ESI` default

5.3.14 Sync Units (Expert)

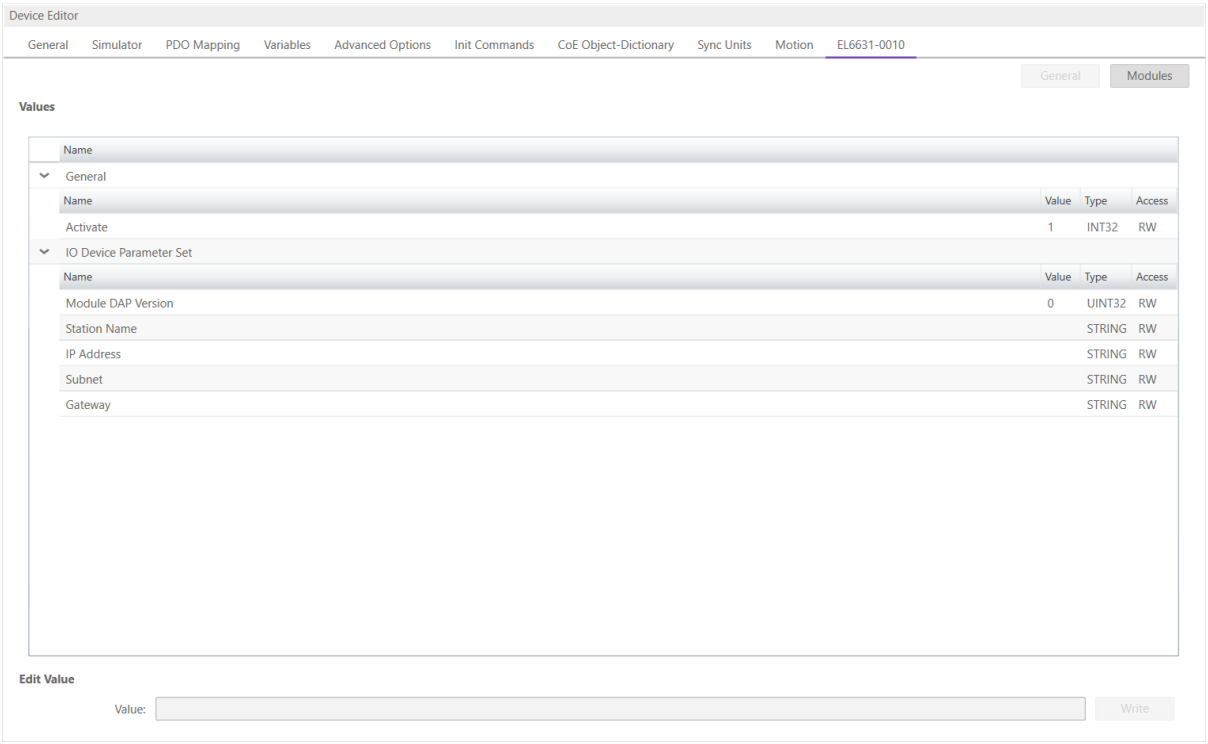
In this tab, the user can assign a SubDevice sync unit to a specific MainDevice sync unit by using the combobox column "MainDevice Sync Unit" (only visible if user has defined additional MainDevice sync units).



5.3.15 Profinet IO Device

In this tab, the user can configure the Profinet IO Device.

General



General

Activate:
Activates the automatism for generating PDOs and Init Commands

IO Device Parameter Set

Module DAP Version:
Module DAP version of the DP SubDevice (0 = Auto, 1 = V2.0, 2 = V2.25, 3 = V2.3, at least FW 02, 4 = V2.31, at least FW 03, 5 = V2.32, at least FW 08, 6 = V2.33, at least FW 10, 7 = V2.33, at least FW 14, 8 = V2.41, at least FW 17, 9 = V2.44)

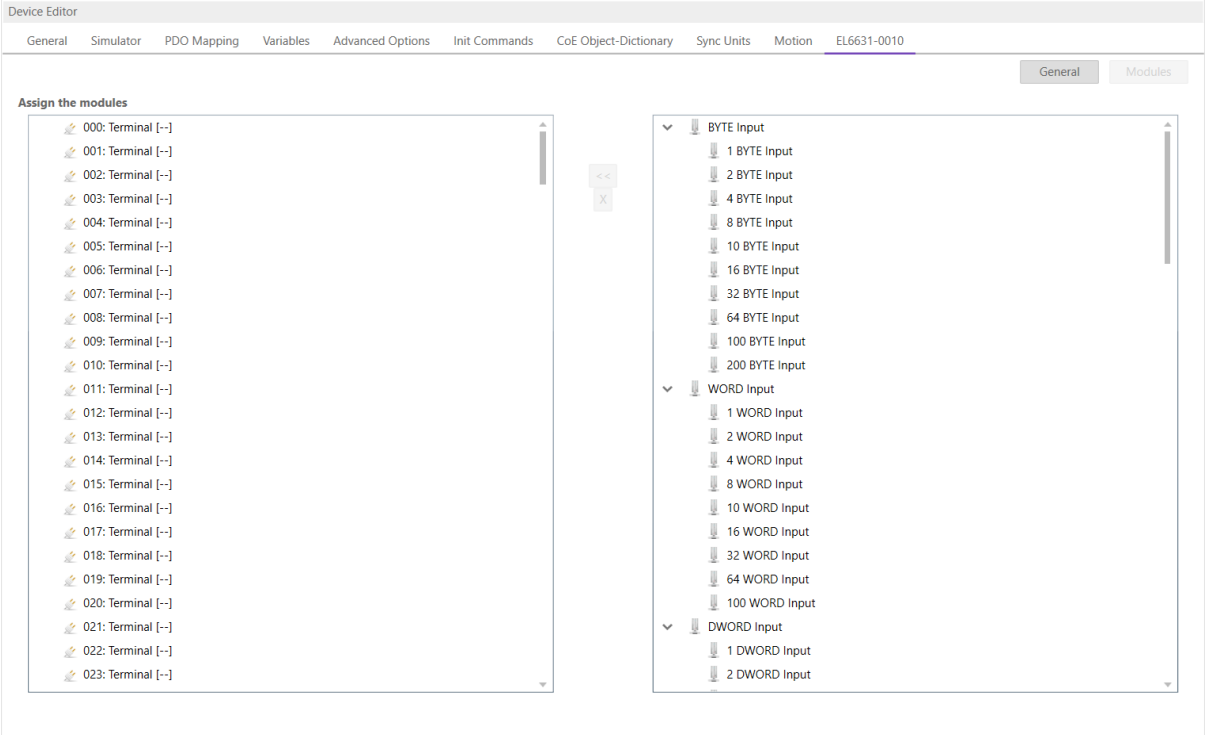
Station Name:
Station name of the DP SubDevice (max: 240 chars)

IP Address:
IP Address of the DP SubDevice

Subnet:
Subnet of the DP SubDevice

Gateway:
Gateway of the DP SubDevice

Modules



Connect module to slot (“<<”)
Used for connecting the selected module (from the right list) to the selected slot (from the left list).

Disconnect module from slot (“X”)
Used for disconnecting the selected slot (left list)

Supported devices

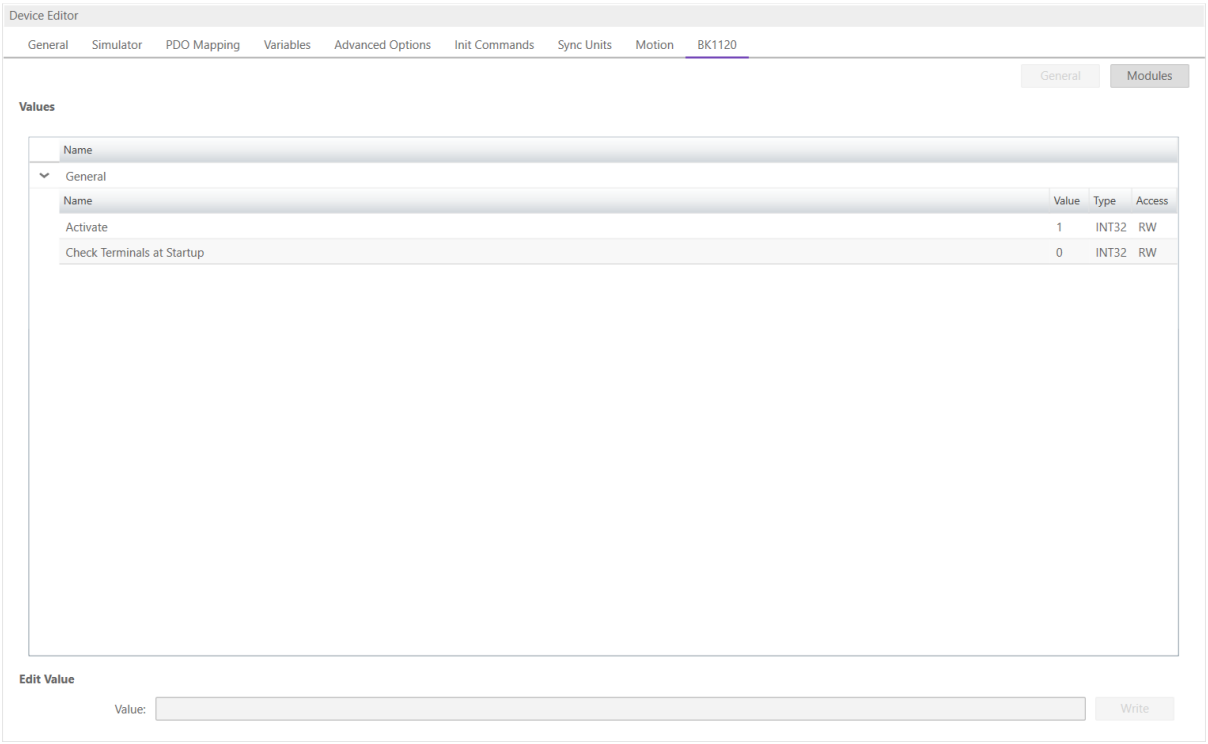
Profinet IO device

- EL6631-0010
- EL6633-0010

5.3.16 K-bus Coupler

In this tab, the user can configure the K-bus Coupler or IP Link Coupler.

General

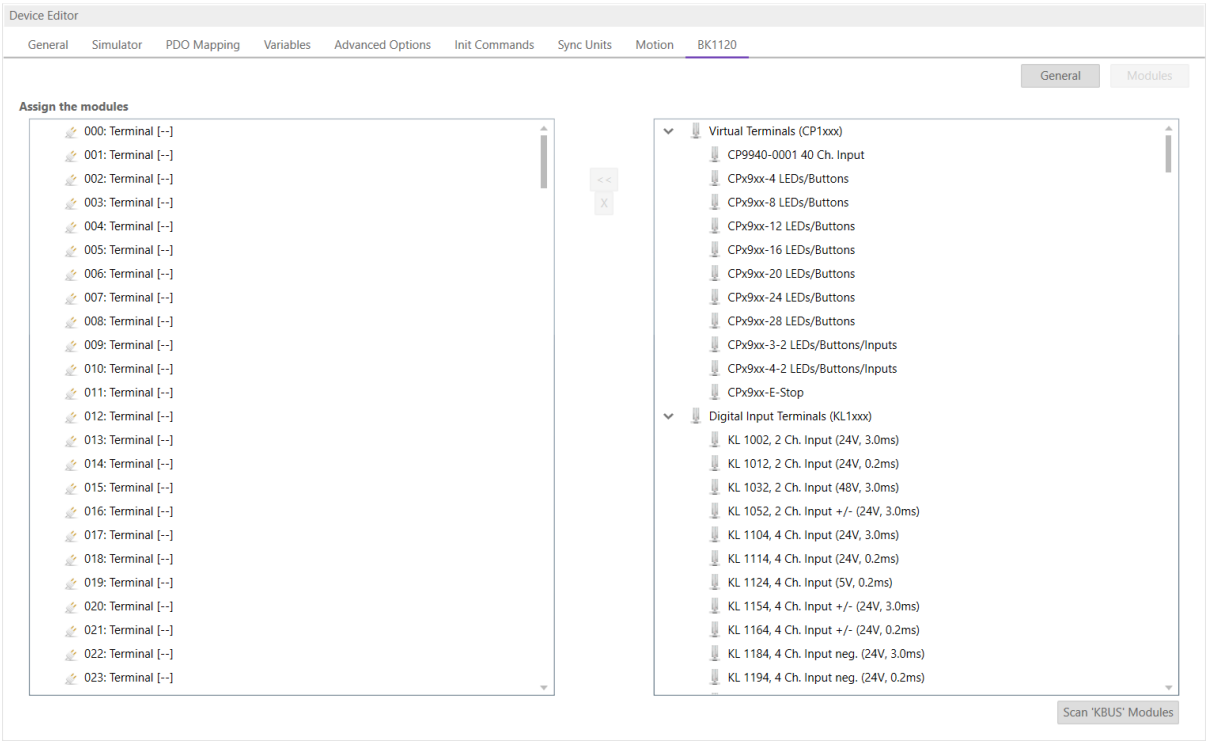


General

Activate:
Activates the automatism for generating PDOs and Init Commands

Check Terminals at Startup:
Activates the automatism for checking terminals at startup

Modules



Connect module to slot (“<<”)
Used for connecting the selected module (from the right list) to the selected slot (from the left list).

Disconnect module from slot (“X”)
Used for disconnecting the selected slot (left list)

Supported devices

K-bus Coupler

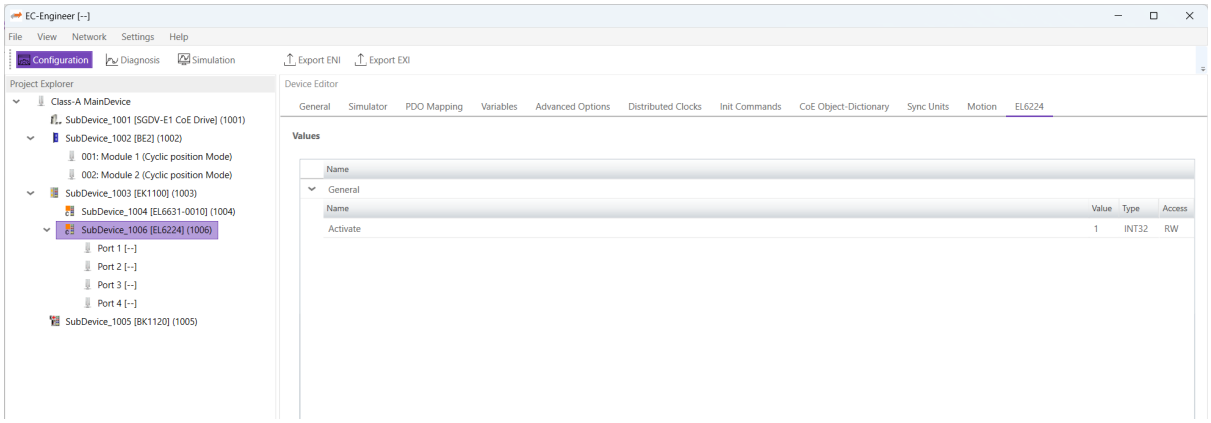
- BK1120
- BK1150
- BK1250

IP Link Coupler

- IL2300-B110
- IL2301-B110
- IL2302-B110

5.3.17 IO–Link (EL6224)

In this tab, the user can configure the IO-Link MainDevice EL6224. He can activate the MainDevice to activate the ports. The user can see 4 or 8 ports. Depends on the configured SubDevice.

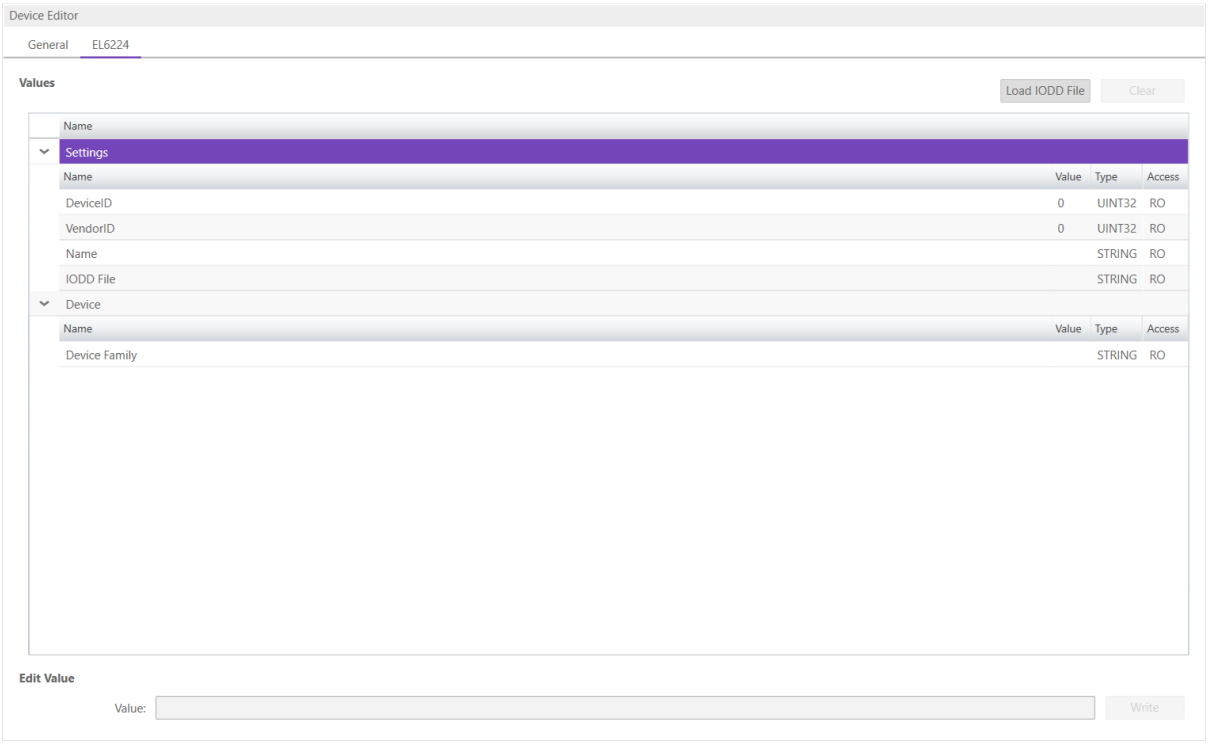


Supported devices

- EL6224
- EP6224-2022
- EP6224-3022
- EP6228-0022
- EPP6228-0022

Note: Please be careful when using the EP(P)6228 that there are no double assignments through the Modules-Tab.

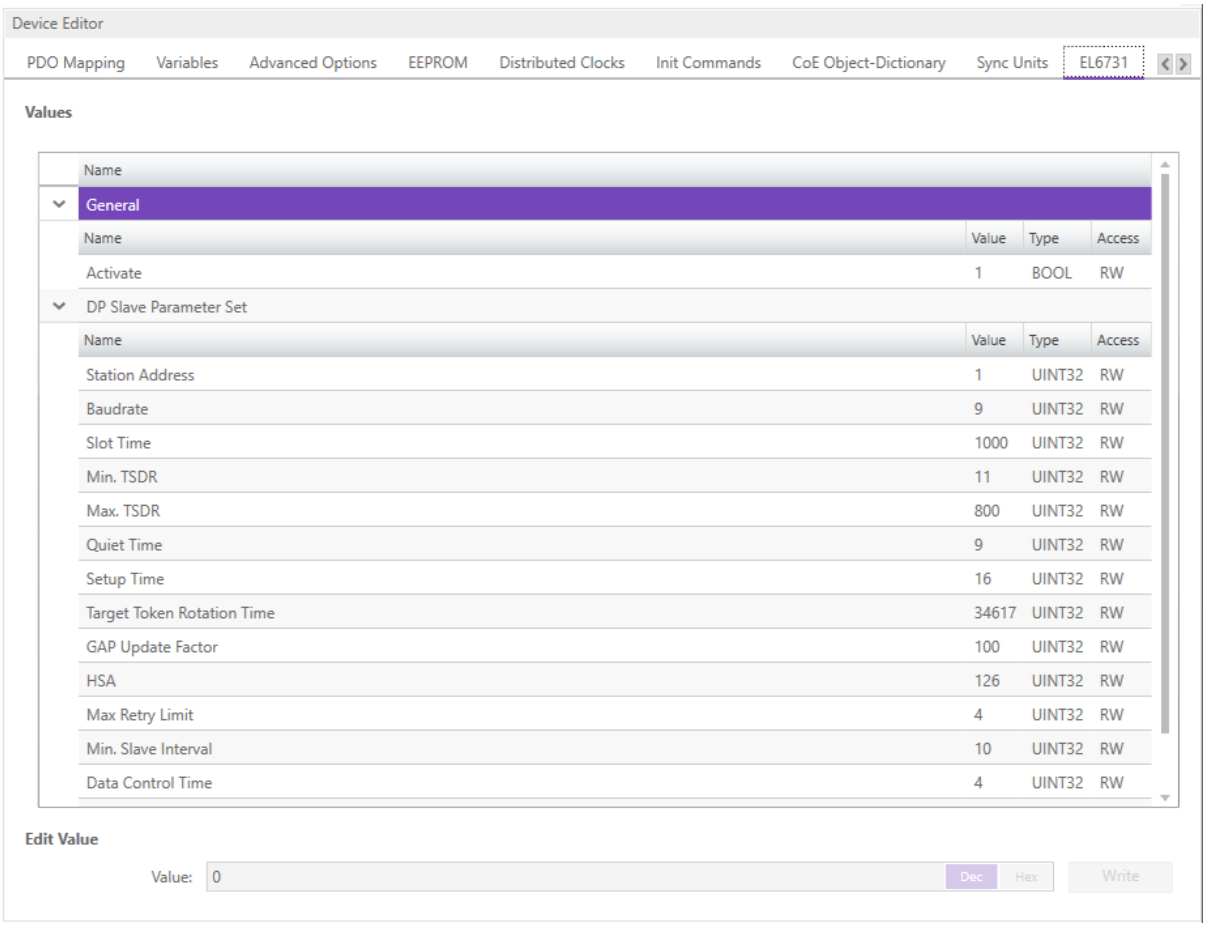
The user can load an IODD file on any of the ports. By clicking on clear, the port will be cleared again.



Note: If the user wants to load a new IODD file, there is no need to clear the port first, they can directly load it.

5.3.18 Profibus DP MainDevice (EL6731)

In this tab, the user can configure the Profibus DP MainDevice EL6731.



General

Activate:
Activates the automatism for generating PDOs and Init Commands

DP Slave Parameter Set

Station Address:
Station Address of the Profibus DP MainDevice (permitted values: 0-255)

Baudrate:
Baudrate of the Profibus DP MainDevice (0 = 9.6 kBaud, 1 = 19.2 kBaud, 2 = 93.75 kBaud, 3 = 187.5 kBaud, 4 = 500 kBaud, 6 = 1.5 MBaud, 7 = 3 MBaud, 8 = 6 MBaud, 9 = 12 MBaud)

Slot Time:
Slot Time of the Profibus DP MainDevice

Min. TSDR:
Min. TSDR of the Profibus DP MainDevice

Max. TSDR:
Max. TSDR of the Profibus DP MainDevice

Quiet Time:
Quiet Time of the Profibus DP MainDevice

Setup Time:
Setup Time of the Profibus DP MainDevice

Target Token Rotation Time:
Target Token Rotation Time of the Profibus DP MainDevice

GAP Update Factor:
GAP Update Factor of the Profibus DP MainDevice

HSA:
HSA of the Profibus DP MainDevice

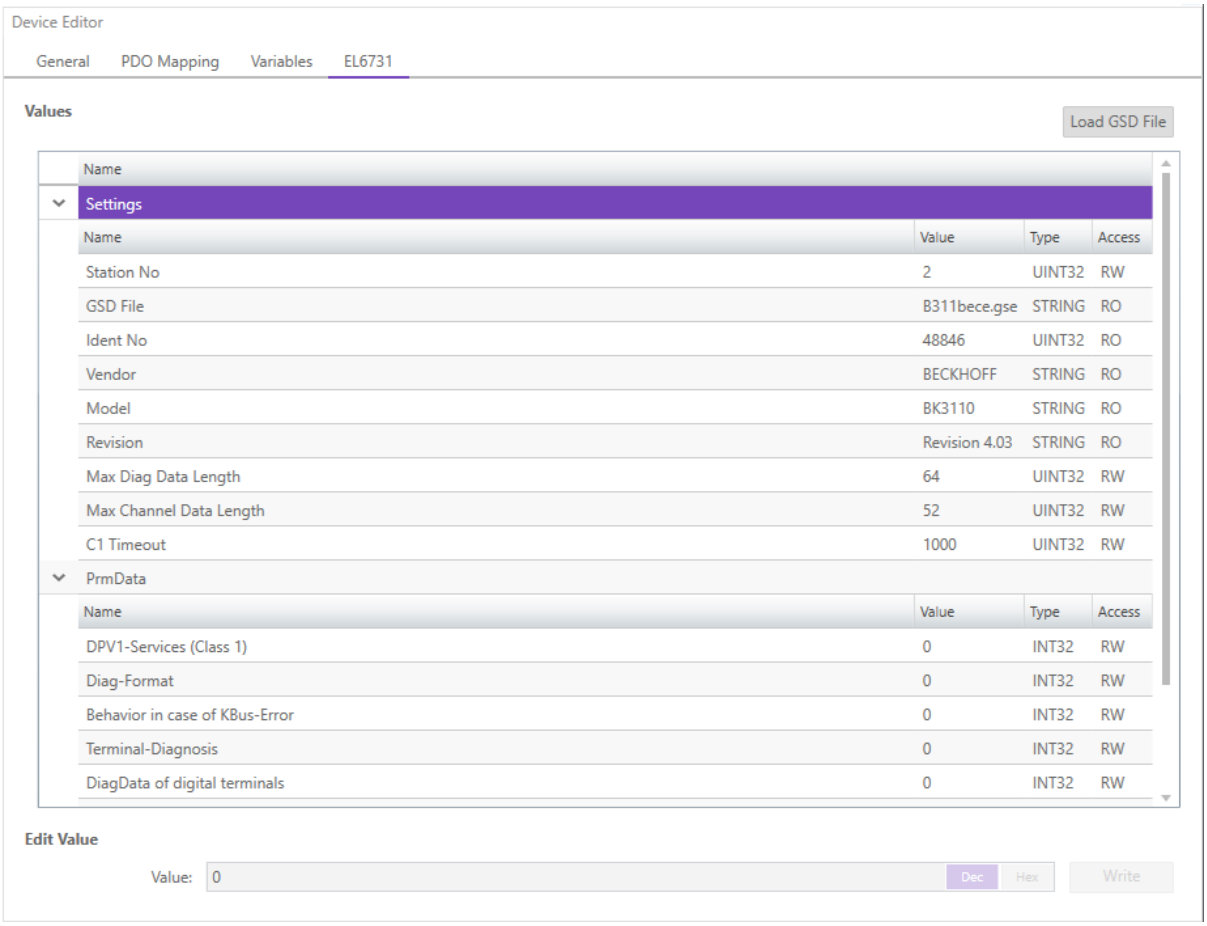
Max Retry Limit:
Max Retry Limit of the Profibus DP MainDevice

Min. Slave Interval:
Min. Slave Interval of the Profibus DP MainDevice

Operate Delay (in 100 ms):
Operate Delay of the Profibus DP MainDevice

Cycle Time (ns):
Cycle Time of the Profibus DP MainDevice

The Profibus DP MainDevice supports up to 126 Profibus DP SubDevices. They can be added in the tree by clicking 'Append Module'.



Settings

Station No:
Station No of the Profibus DP SubDevice

GSD File:
GSD File of the Profibus DP SubDevice, which can be loaded with button "Load GSD File"

Ident No:
Ident No of the Profibus DP SubDevice

Vendor:
Vendor of the Profibus DP SubDevice

Model:
Model of the Profibus DP SubDevice

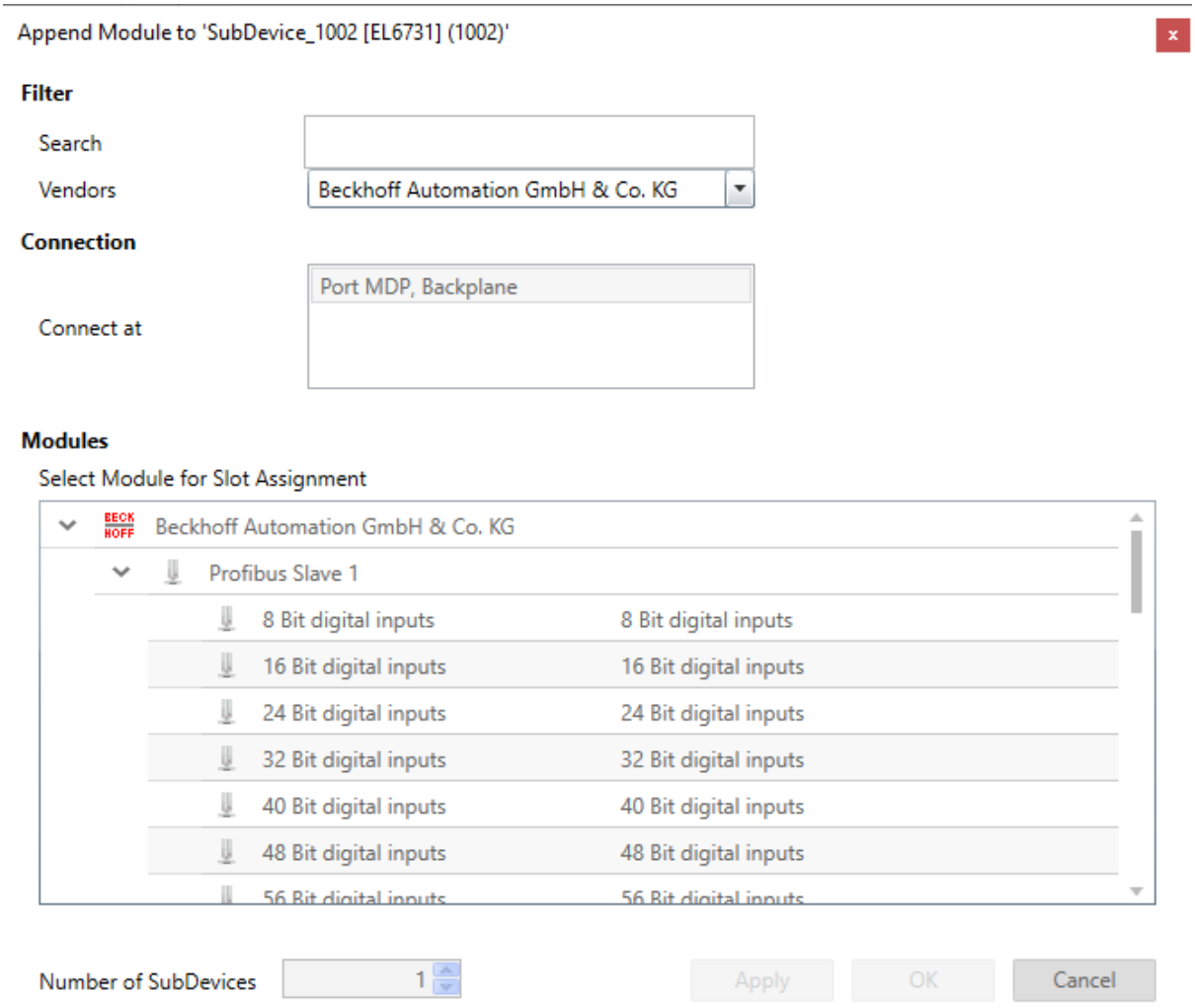
Revision:
Revision of the Profibus DP SubDevice

Max Diag Data Length:
Max Diag Data Length of the Profibus DP SubDevice

Max Channel Data Length:
Max Channel Data Length of the Profibus DP SubDevice

C1 Timeout:
C1 Timeout of the Profibus DP SubDevice

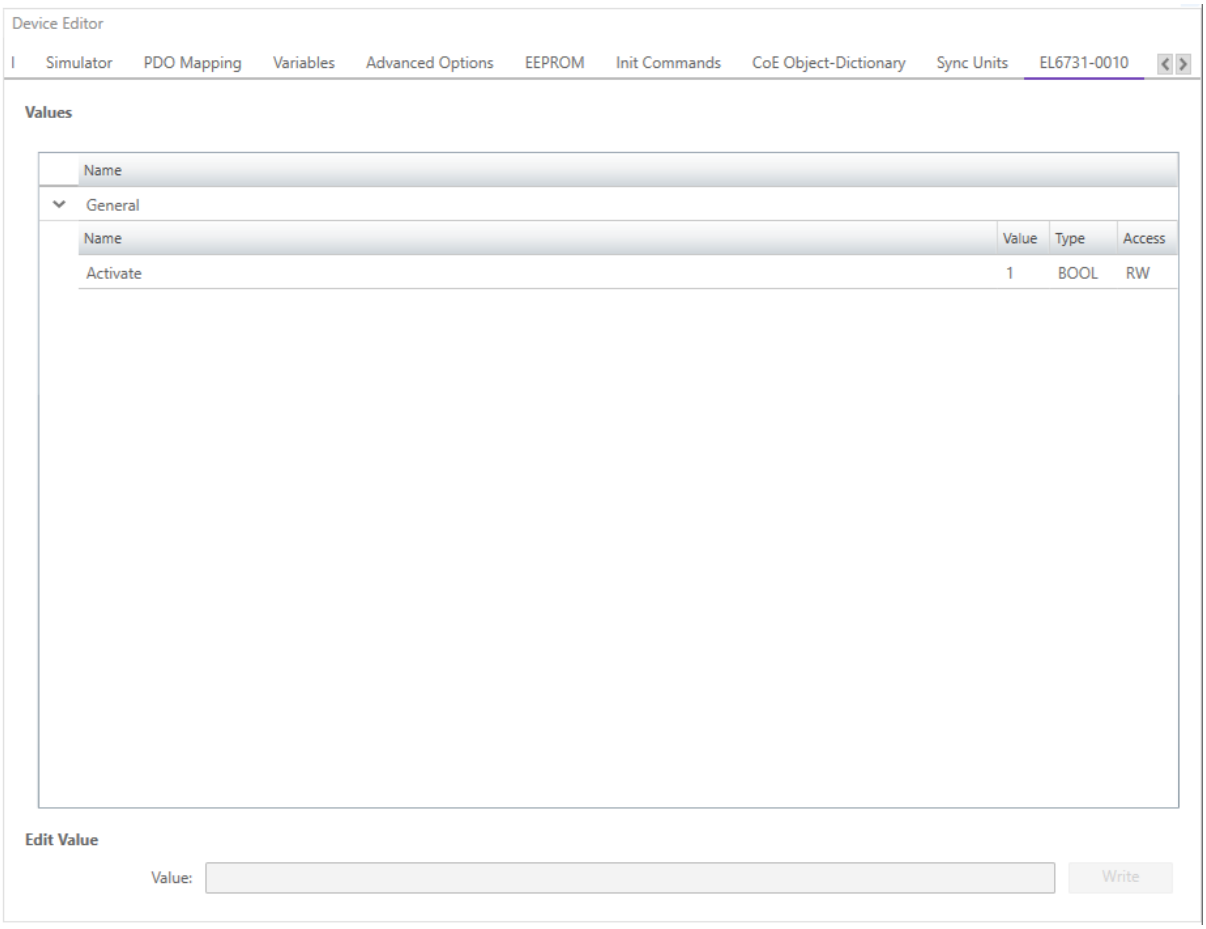
The IO configuration of the Profibus DP SubDevice can be done by adding specific Profibus DP Modules to the Profibus DP SubDevice. They can be added in the tree by clicking 'Append Sub Module'.



Note: DP PrmData can be also configured, if the specific Profibus DP SubDevice supports them in the GSD file.

5.3.19 Profibus DP SubDevice (EL6731-0010)

In this tab, the user can configure the Profibus DP SubDevice EL6731-0010.

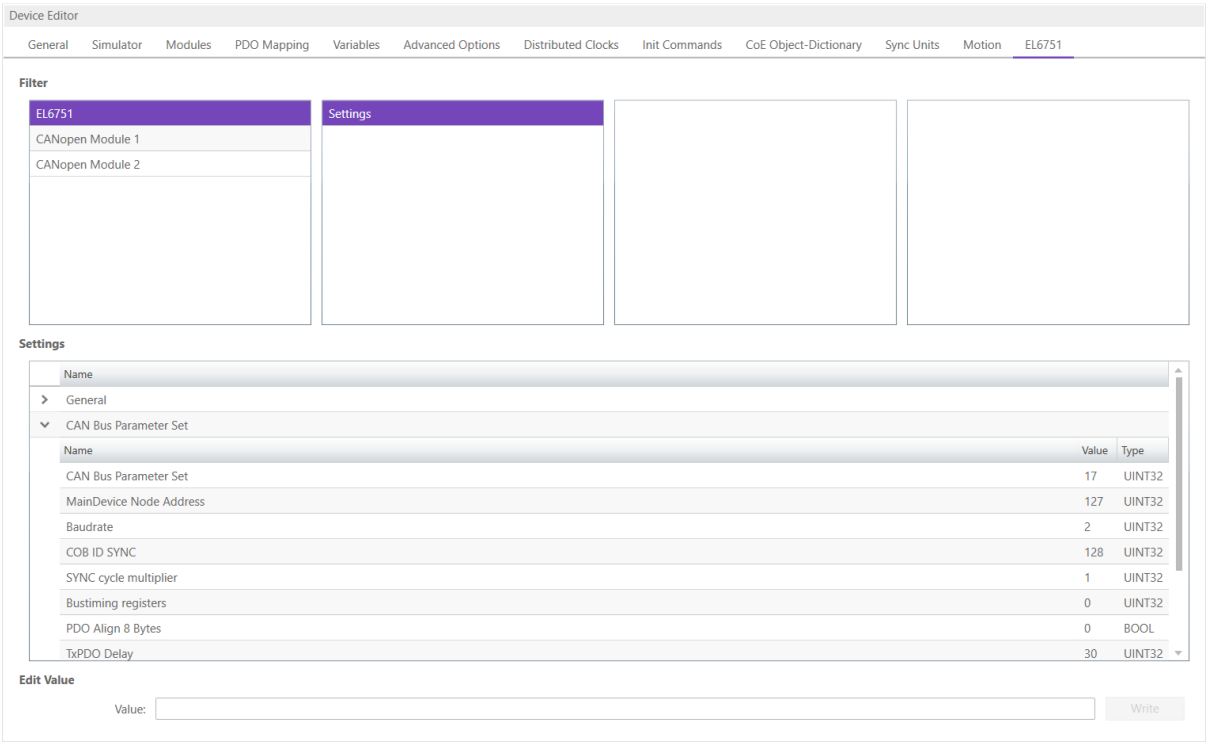


Note: It can be configured similiar like the Profibus DP MainDevice, except it has not all settings and supports only one Profibus DP SubDevice. It also supports a special Profibus DP SubDevice which can be used without GSD file and has a fixed set of Profibus DP Modules.

5.3.20 CANopen MainDevice (EL6751)

In this tab, the user can configure the CANopen MainDevice EL6751. He can add Modules, PDOs, SDOs and variables by clicking the right mouse button. To activate the MainDevice, the user have to go to the general settings of the EL6751 entry, and set activated to '1'. If activated is '1' all init commands and PDOs will be activated automatically.

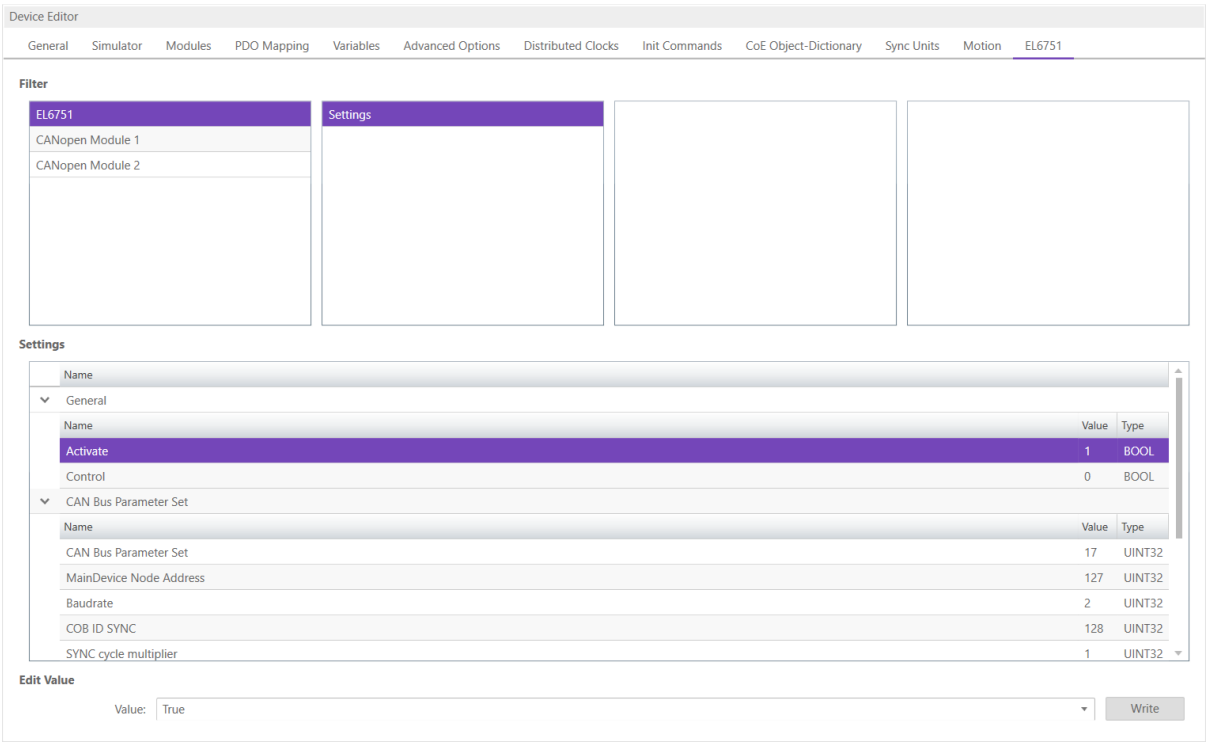
Also the user can rename and delete modules, PDOs, SDOs, and variables:



5.3.21 CANopen SubDevice (EL6751-0010)

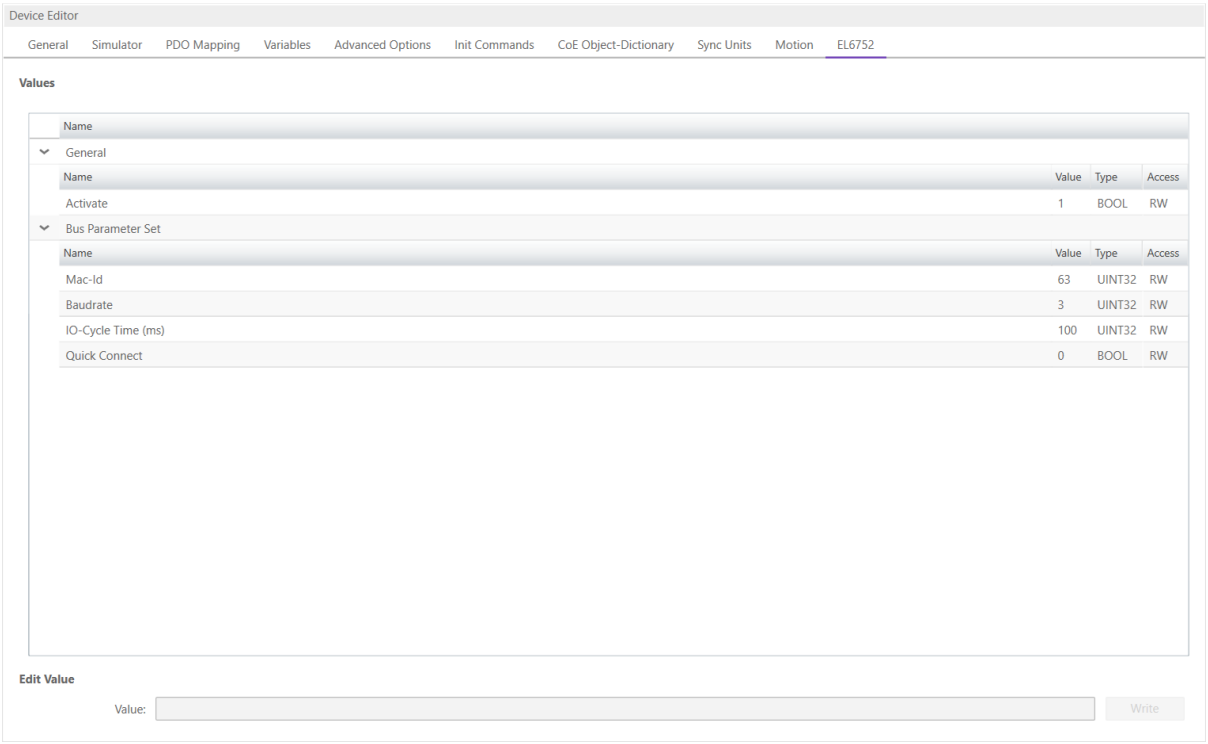
In this tab, the user can configure the CANopen SubDevice EL675-0010. He can add PDOs and variables by clicking the right mouse button. To activate the gateway, the user have to go to the general settings of the EL6751-0010 entry, and set activated to '1'. If activated is '1' all init commands and PDOs will be activated automatically.

Also the user can rename and delete PDOs and variables:



5.3.22 DeviceNet MainDevice (EL6752)

In this tab, the user can configure the DeviceNet MainDevice EL6752.



General

Activate:
Activates the automatism for generating PDOs and Init Commands

Bus Parameter Set

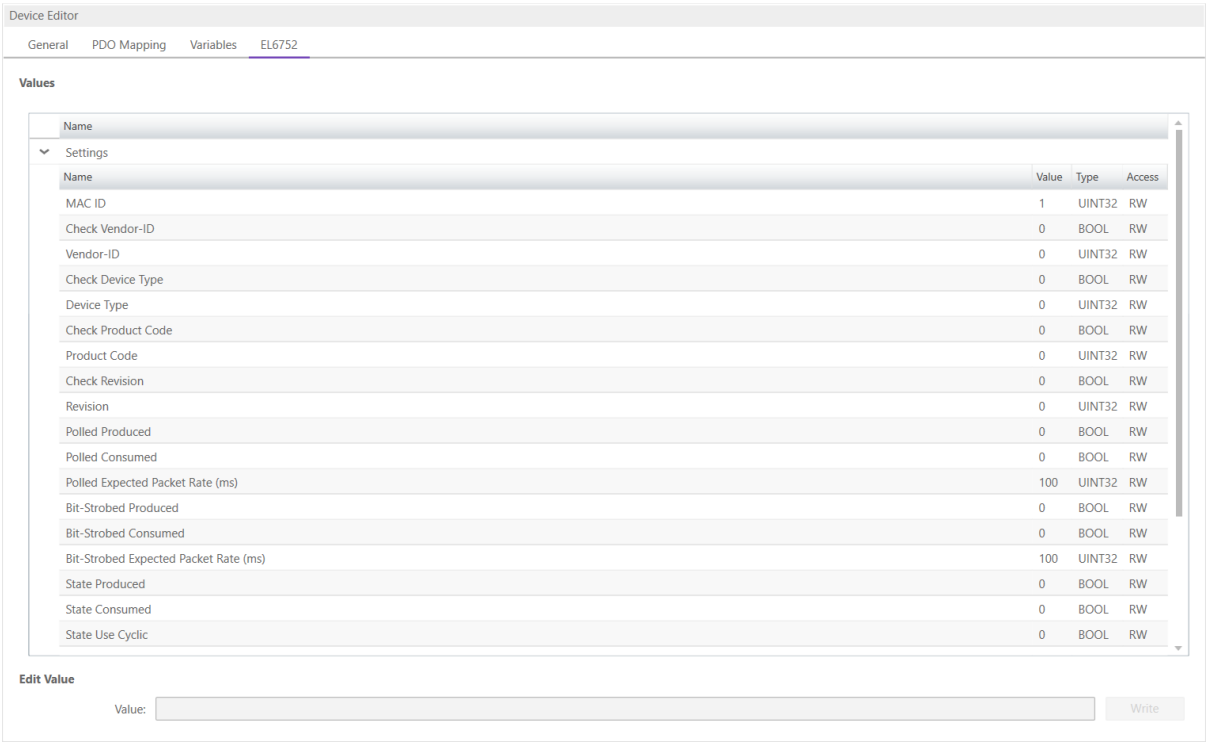
Mac-Id:
Mac-Id of the DeviceNet MainDevice (permitted values: 0-63)

Baudrate:
Baudrate of the DeviceNet MainDevice (3 = 125 kBaud, 2 = 250 kBaud, 1 = 500 kBaud)

IO-Cycle Time:
IO-Cycle Time of the DeviceNet MainDevice

Quick Connect:
Enables Quick Connect of the DeviceNet MainDevice

The DeviceNet MainDevice supports up to 63 DeviceNet SubDevices. They can be added in the tree by clicking 'Append Module'.



Settings

MAC ID:
MAC ID of the DeviceNet SubDevice

Check Vendor-ID:
Enable to check Vendor-ID

Vendor-ID:
Vendor-ID of the DeviceNet SubDevice

Check Device Type:
Enable to check Device Type

Device Type:
Device Type of the DeviceNet SubDevice

Check Product Code:
Enable to check Product Code

Product Code:
Product Code of the DeviceNet SubDevice

Check Revision:
Enable to check Revision

Revision:
Revision of the DeviceNet SubDevice

Polled Produced:
Enable if DeviceNet SubDevice has produced data in Polled DeviceNet mode

Polled Consumed:
Enable if DeviceNet SubDevice has consumed data in Polled DeviceNet mode

Polled Expected Packet Rate:
Expected packet rate in Polled DeviceNet mode

Bit-Strobed Produced:
Enable if DeviceNet SubDevice has produced data in Bit-Strobed DeviceNet mode

Bit-Strobed Consumed:
Enable if DeviceNet SubDevice has consumed data in Bit-Strobed DeviceNet mode

Bit-Strobed Expected Packet Rate:
Expected packet rate in Bit-Strobed DeviceNet mode

State Produced:
Enable if DeviceNet SubDevice has produced data in Change of State or Cyclic DeviceNet mode

State Consumed:
Enable if DeviceNet SubDevice has consumed data in Change of State or Cyclic DeviceNet mode

State Use Cyclic:
Enable to activate Cyclic DeviceNet mode or disable to activate Change of State DeviceNet mode

State Send-Rate:
Send rate in Change of State or Cyclic DeviceNet mode

State Inhibit-Time:
Inhibit time in Change of State or Cyclic DeviceNet mode

State Acknowledge:
Enable acknowledge in Change of State or Cyclic DeviceNet mode

State Acknowledge-Timeout:
Acknowledge timeout in Change of State or Cyclic DeviceNet mode

State Acknowledge-Retry-Limit:
Acknowledge retry limit in Change of State or Cyclic DeviceNet mode

Max Startups:
Maximum amount of supported startups (permitted values: 0-99)

Coupler State:
Enable if DeviceNet SubDevice provides CouplerState (information is available e.g. for Beckhoff Bus Couplers like BK52x0, IPxxxx-B520, …)

Startup

Class ID:
Class ID of the startup

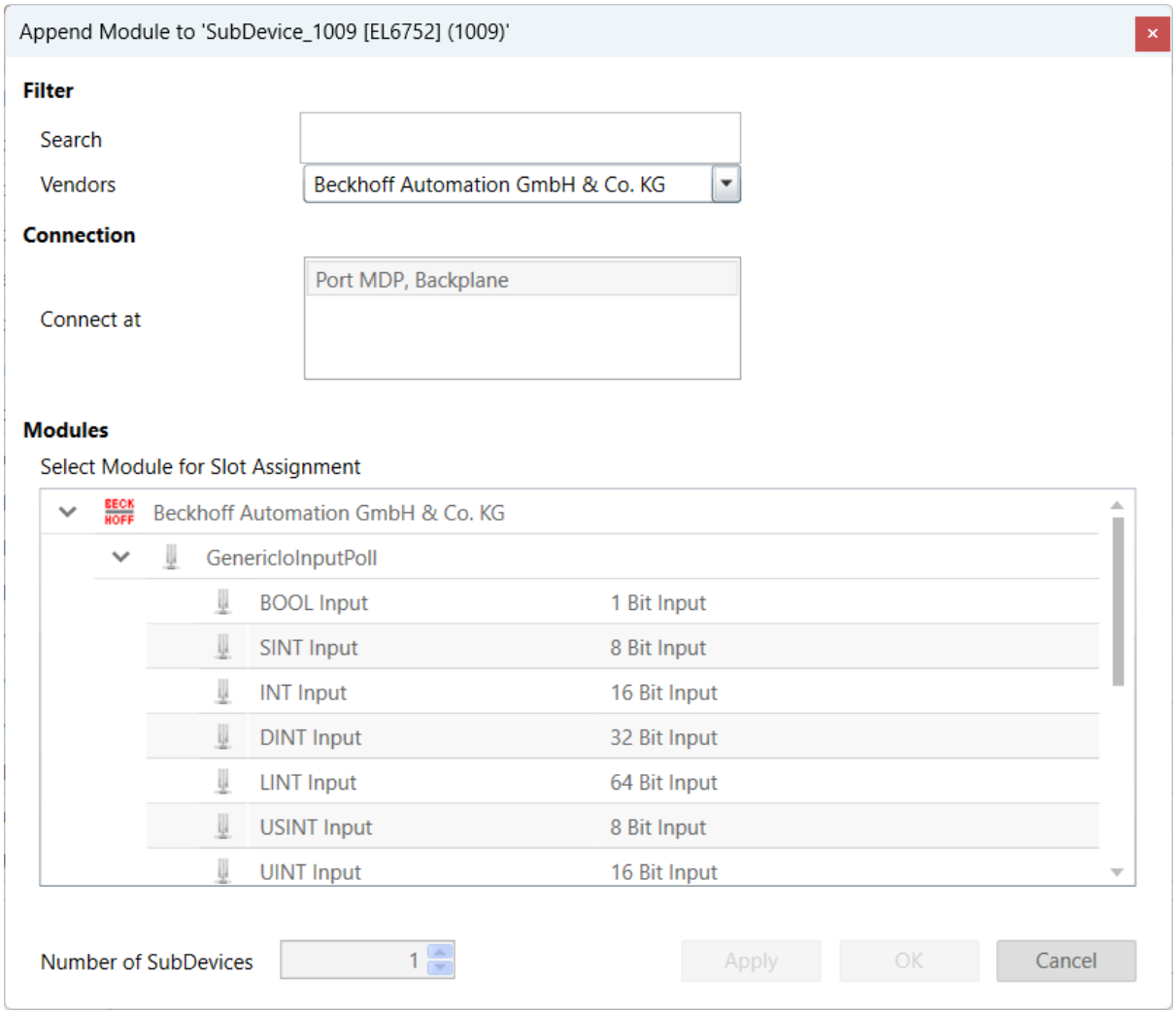
Instance ID:
Instance ID of the startup

Attribute ID:
Attribute ID of the startup

Value:
Value of the startup in bytes like “00 11 22”

Name:
Name of the startup

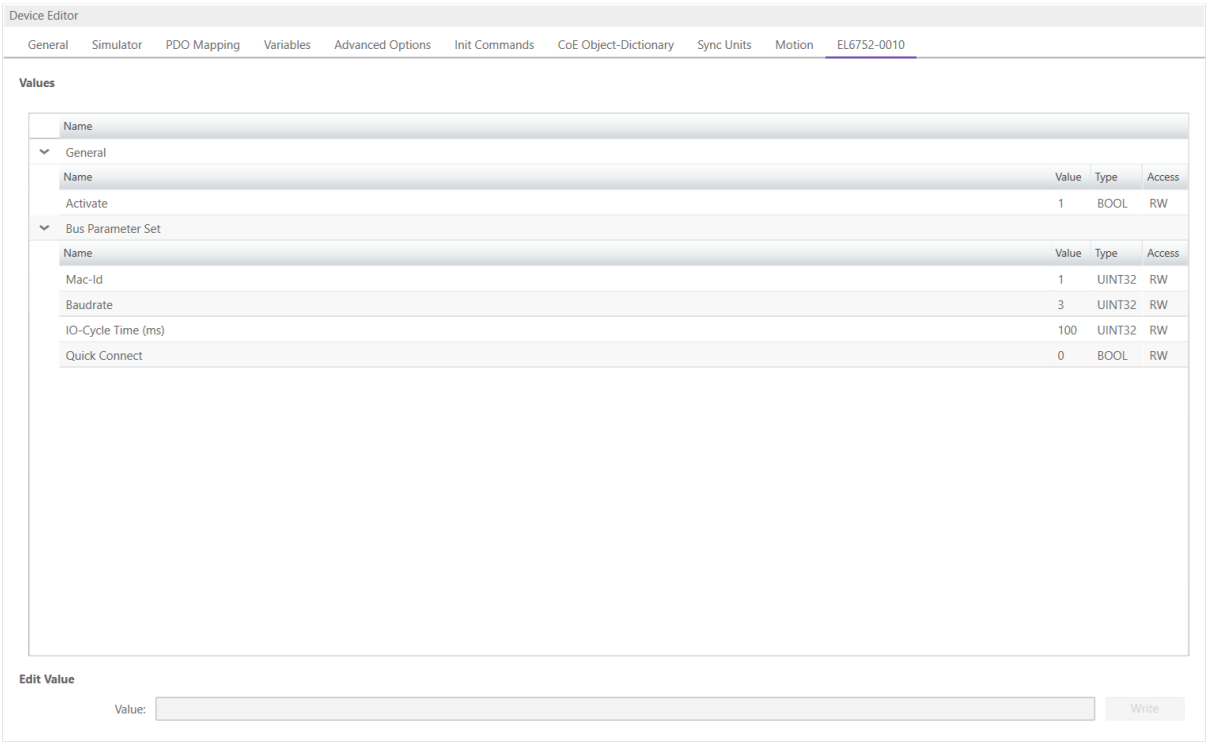
The IO configuration of the DeviceNet SubDevice can be done by adding specific DeviceNet Modules to the DeviceNet SubDevice. They can be added in the tree by clicking ‘Append Sub Module’.



Note: The modules must be choosed from the specific group, depending on the selected DeviceNet mode (Polled, Bit-Strobed, State).

5.3.23 DeviceNet SubDevice (EL6752-0010)

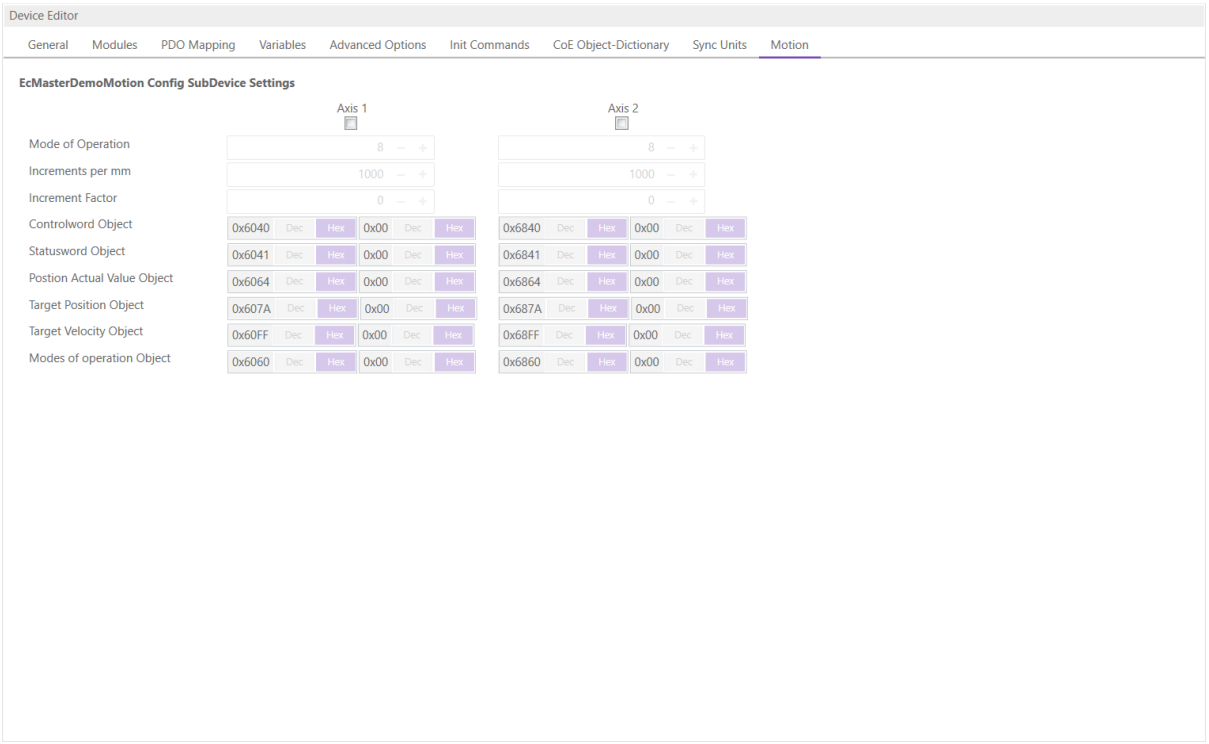
In this tab, the user can configure the DeviceNet SubDevice EL6752-0010.



Note: It can be configured similiar like the DeviceNet MainDevice, except it has not all settings and supports only one DeviceNet SubDevice.

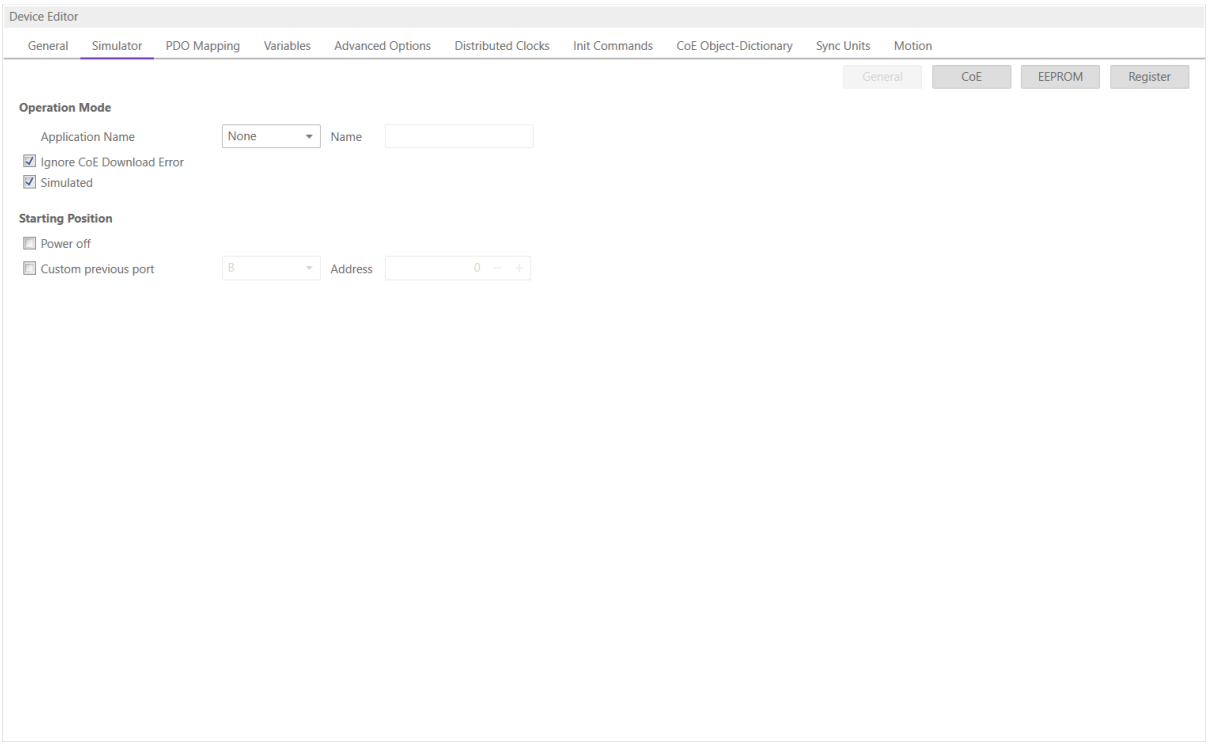
5.3.24 Motion (Motion Mode only)

On this tab the user can change the and activate the axis for the motion. The settings are used in the `xml` file which can be exported from the MainDevice motion tab, to configure the Demo Motion:



5.3.25 Simulation Settings

On this tab the user can change the simulator settings for the SubDevice:



Application Name:

The application name for the `EXI` file

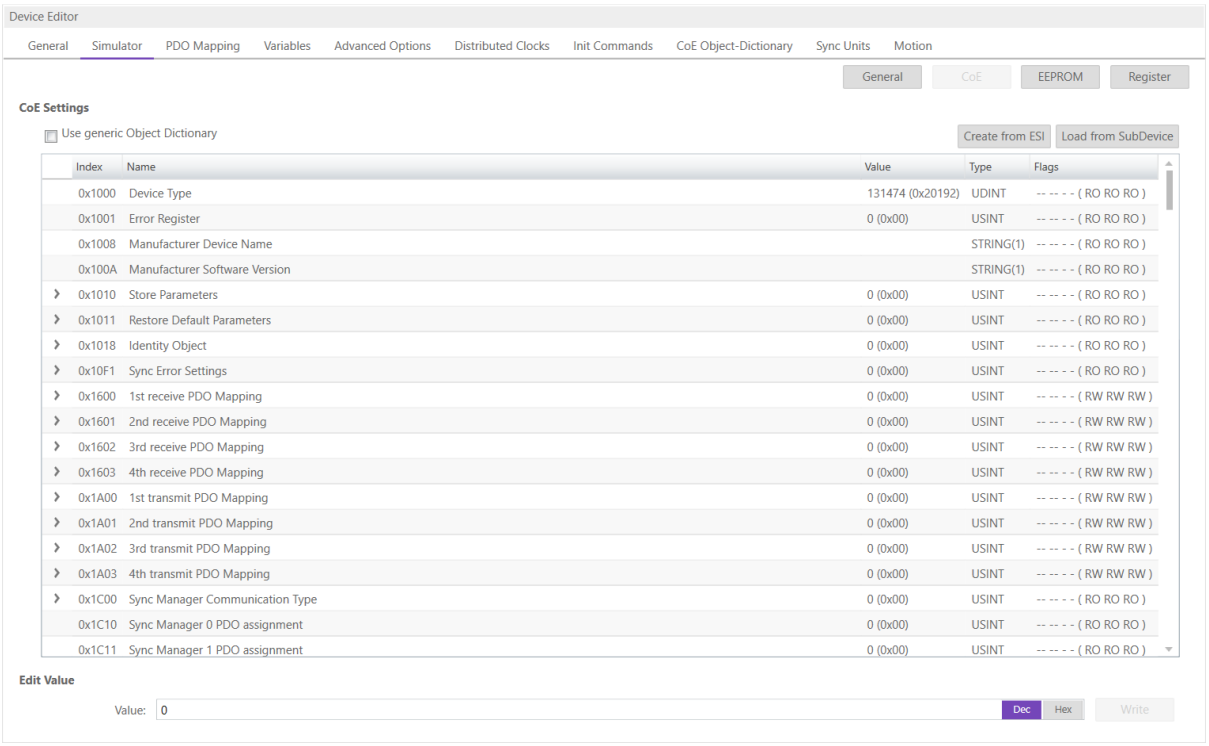
Ignore Download Error:
Ignores errors on download

Starting Position

Power Off:
Select if SubDevice should be powered on or off on start

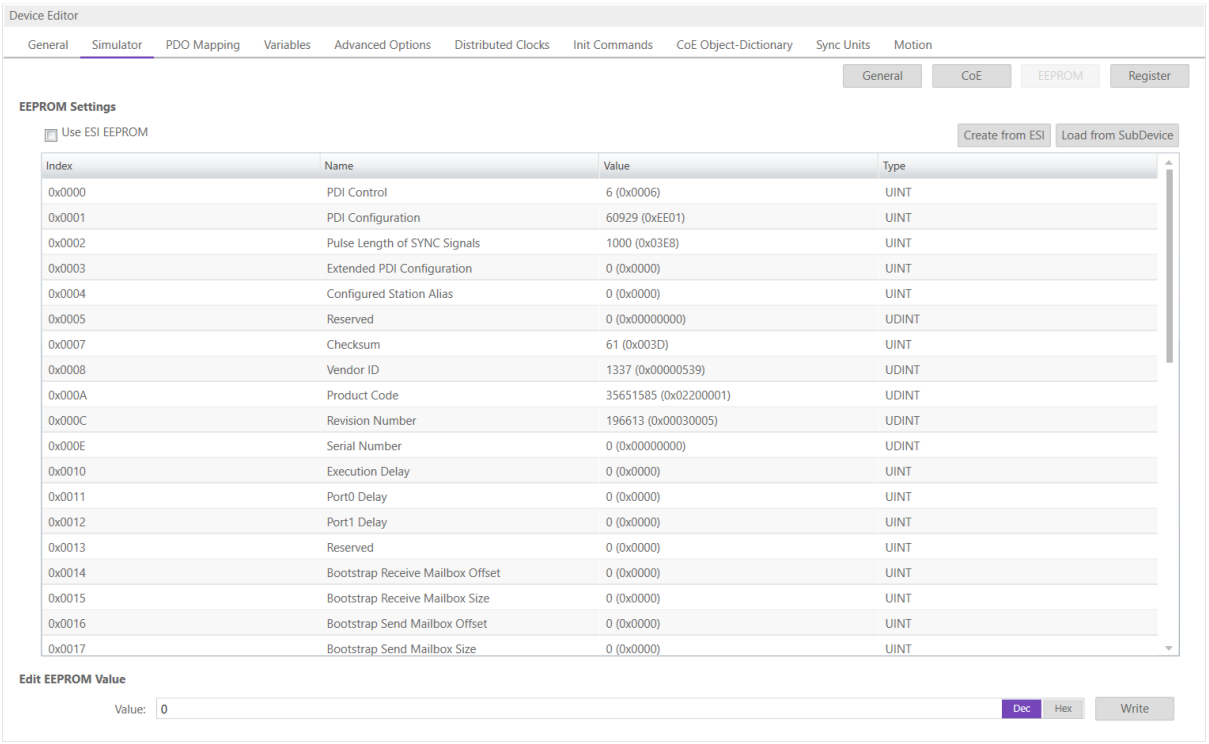
Custom previous port:
manipulate the topology

CoE Tab



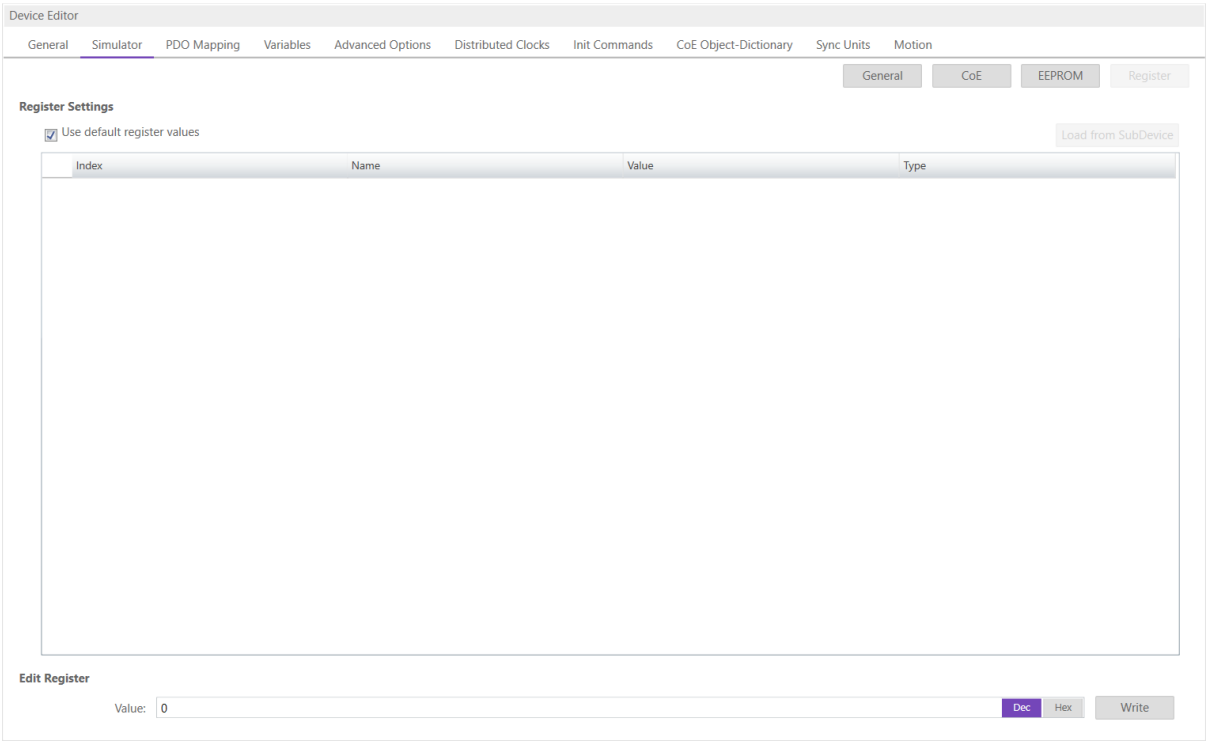
The simulated CoE can be changed here.

EEPROM Tab



The simulated EEPROM can be changed here.

Register Tab



The simulated Registers can be changed here.

5.4 Export ENI

To run the EC-Master you basically need an EtherCAT-Network-Information (ENI) file to initialize and control an EtherCAT network. After configuring the EtherCAT network with EC-Engineer, you can export this ENI file and copy it on the control system to run the EC-Master.

Note: The EtherCAT-Network-Information (ENI) File will be generated according to ETG.2100 standard V1.0.1

5.5 Export EXI

To run the EC-Simulator you basically need an ENI or better an EXI file to simulate an EtherCAT network. After configuring the EtherCAT network with EC-Engineer, you can export this EXI file and use it to start the EC-Simulator. The EXI and Simulator functions has to be activated in the Menu View –> Simulator Tabs.

6 Diagnosis

6.1 Overview

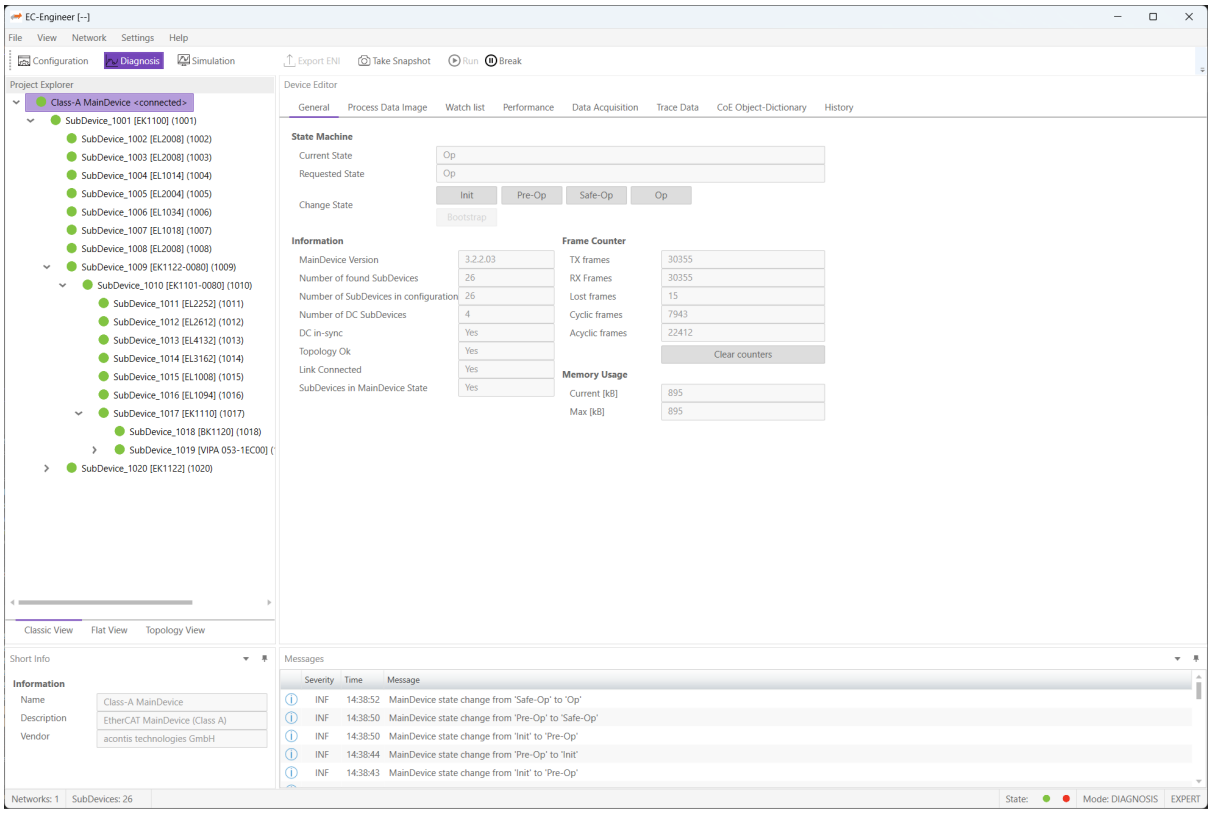
EC-Engineer is a diagnosis application specifically developed to analyze EtherCAT networks that are controlled by an EtherCAT MainDevice. Automated control systems usually require high availability of the whole system. Due to the rough industrial environment this is often hardly to achieve.

If high availability shall be guaranteed for an automated control system it is important to verify and maintain the field bus. Using EC-Engineer it is possible to take a look into the “health” of the EtherCAT system. Detection of signs of system degradation prior to running into a system failure will be of great benefit. In that case it is possible to exchange the problematic components (cables, SubDevice devices).

Many aspects of diagnosis are covered by the EC-Engineer:

- System analysis and maintenance
- Error detection
- Documentation

After switching into diagnosis mode of EC-Engineer, the user will see this page:

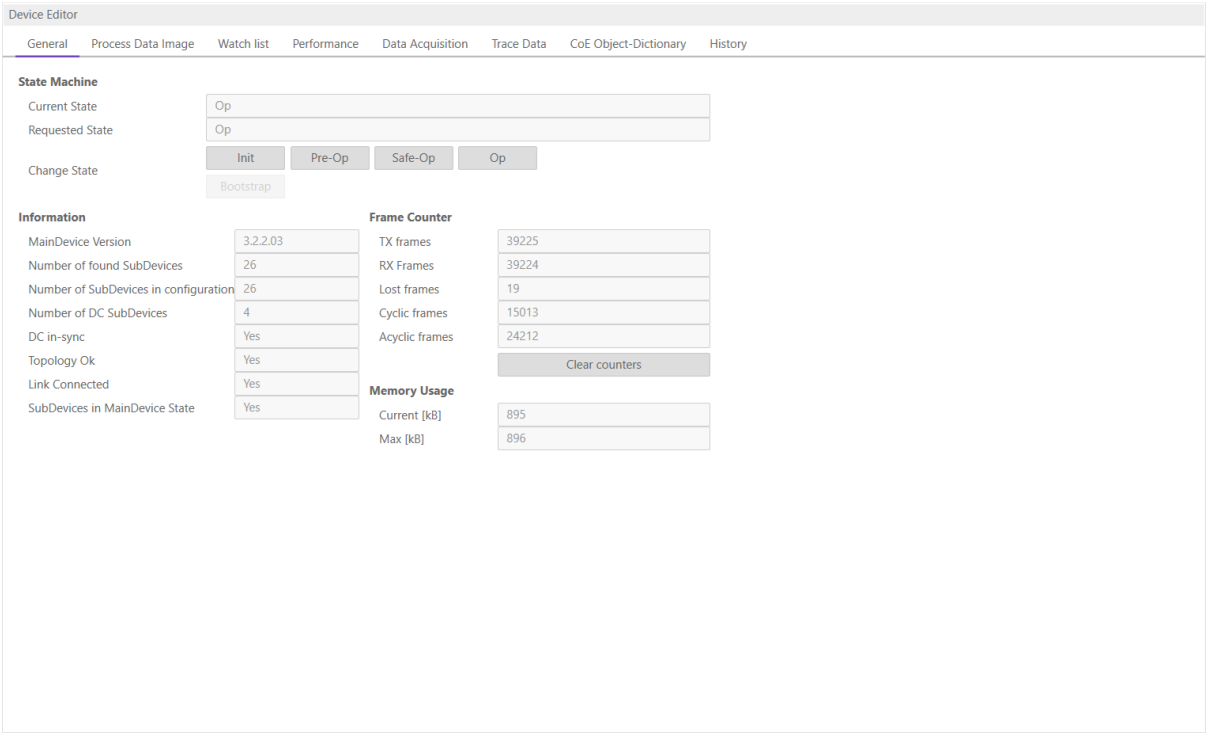


6.2 Device

This section shows the current “health” state of the MainDevice and helps the user to analyze MainDevice related problems.

6.2.1 General

In this tab, the user can see the current state of the state machine of the MainDevice. He has also an overview over the current “health” state of his EtherCAT network:



State Machine

Current State:
Current state of the MainDevice

Requested State:
Requested state of the MainDevice

Change State:
MainDevice can reach the states INIT, PRE-OP, SAFE-OP and OP.

Information

Device version:
Version number of the running MainDevice

Number of found SubDevices:
Number of SubDevices, which were found from device on the network

Number of SubDevices in configuration:
Number of SubDevices, which are configured in the `ENI` file

Number of DC SubDevices:
Number of SubDevices with DC support, which were found from MainDevice on the network

DC in-sync:
Signals that all SubDevices with DC support are correctly synchronized or not. If not all SubDevices are correctly synchronized, please refer the *Message Window* for more information.

Topology OK:
Signals that topology is “okay” or not. If topology is not “okay”, you have a mismatch between the configured bus and the currently connected bus. Please open the ‘Network Mismatch Analyzer’ (Menu Network Network Mismatch Analyzer) to solve the problem.

Link Connected:
Signals the link is connected.

SubDevices in MainDevice State:
Signals that all SubDevices are in MainDevice state.

Frame Counter

TX frames:
Number of sent frames

RX frames:
Number of received frames

Lost frames:
Number of lost frames

Cyclic frames:
Number of cyclic frames

Acyclic frames:
Number of acyclic frames

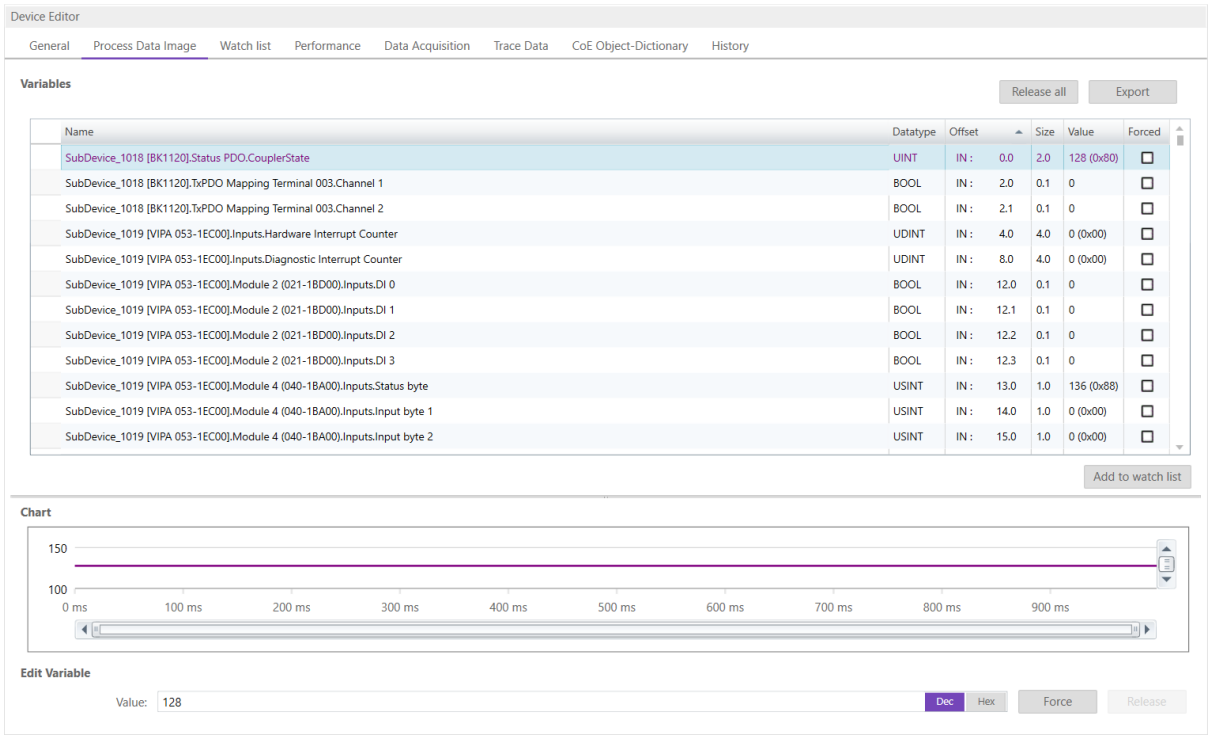
Memory Usage

Current:
Current memory usage in bytes

Max:
Maximum memory usage in bytes

6.2.2 Process Data Image

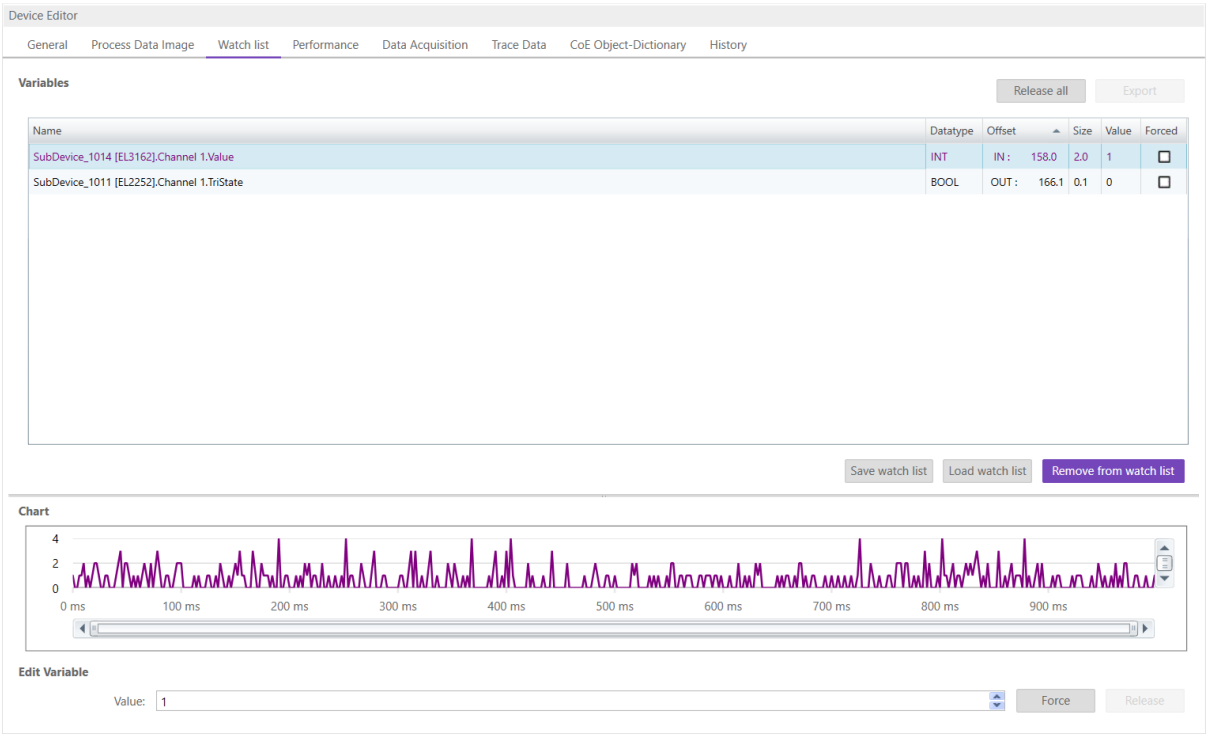
In this tab, the user can see and change the values of the process variables. The variables will be forced to the value the user entered. The user can press release to release the variable. If one or two variables are selected, a chart of the values is shown. Also resize and zoom is possible to see more details. The chart will be updated every 250 milliseconds:



It is also possible to add the variables to a watch list (next chapter).

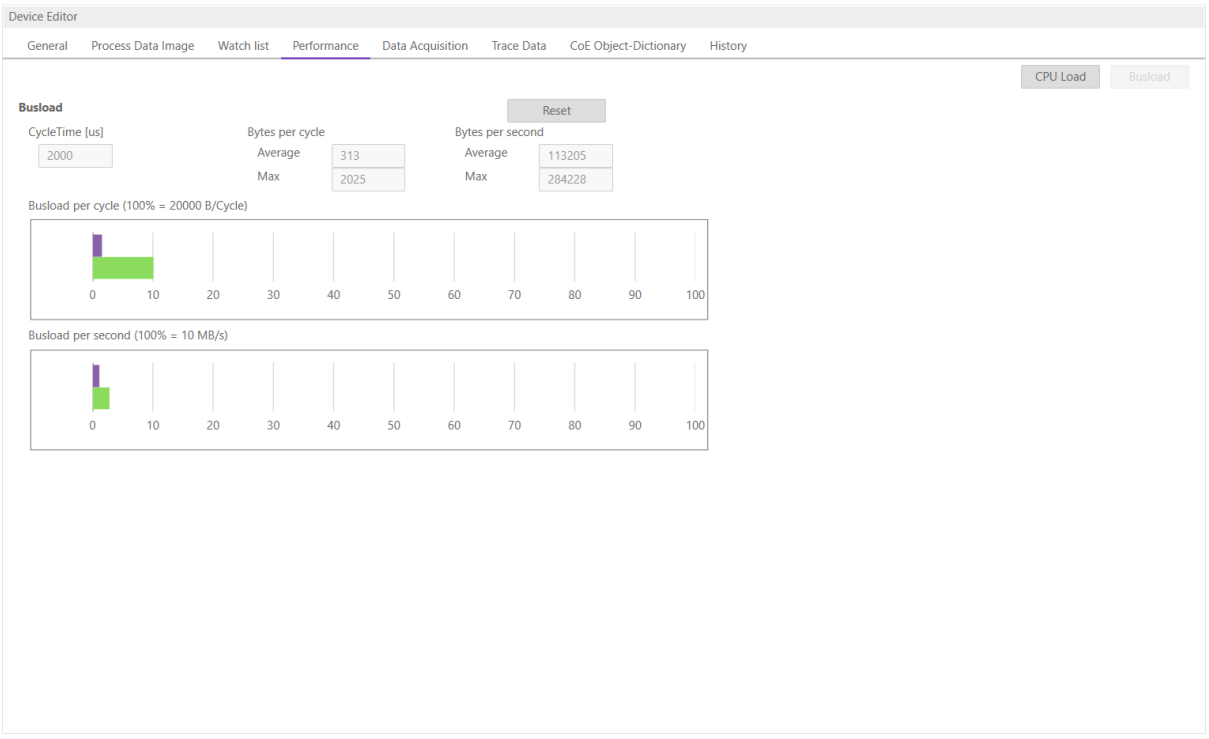
6.2.3 Watch list

In this tab, the user can monitor selected variables. He can go through the SubDevices and add variables to the watch list to monitor them. The user can also export or import the watch list, so changes can be saved:



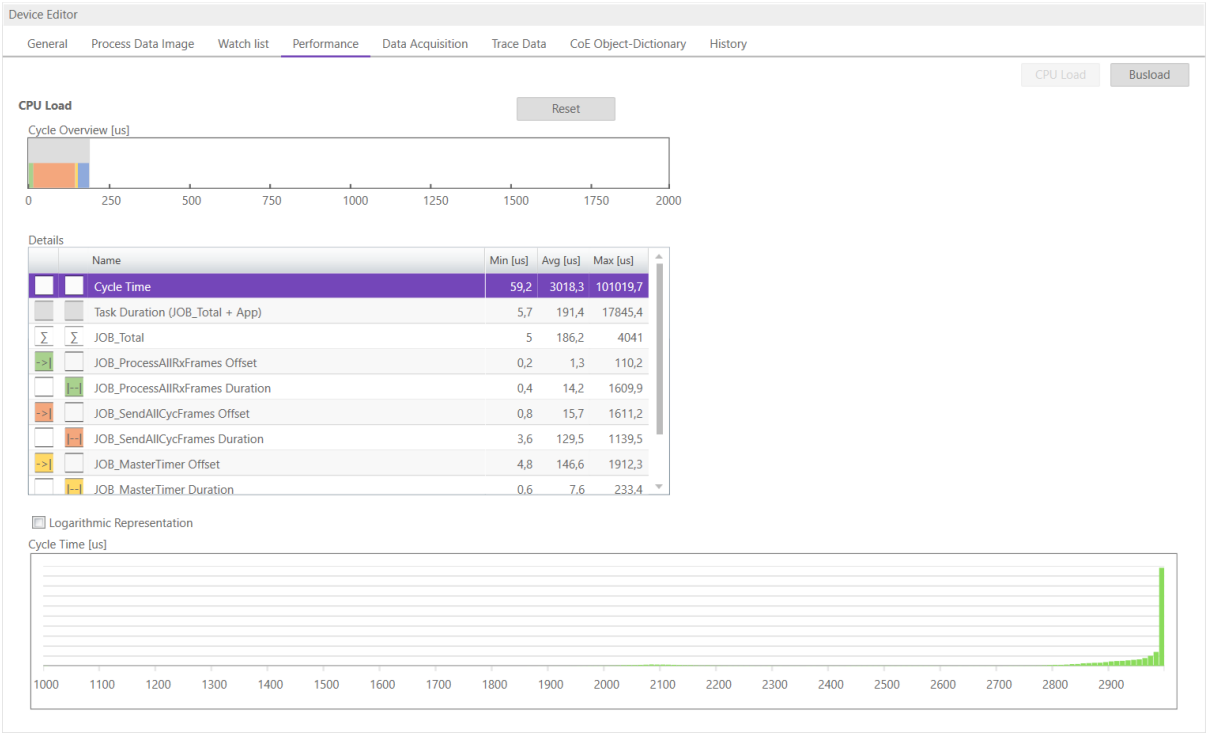
6.2.4 Performance

This tab is split into two sub tabs. On one the user can see the busload per cycle and per second:



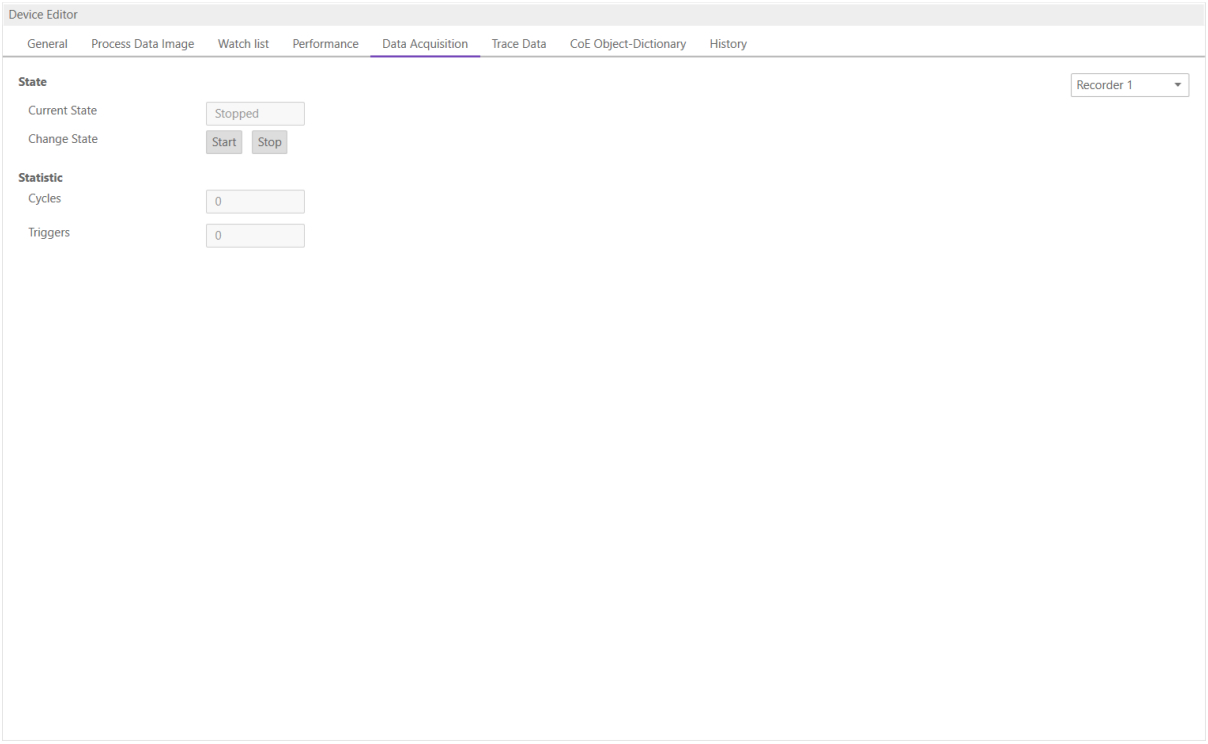
On the other tab the user can the CPU load. In the grid is a list of all running jobs and how long they take. In the diagram above is a summary of all jobs. When a job is selected, the chart shows how many

times a job has taken how long to complete.



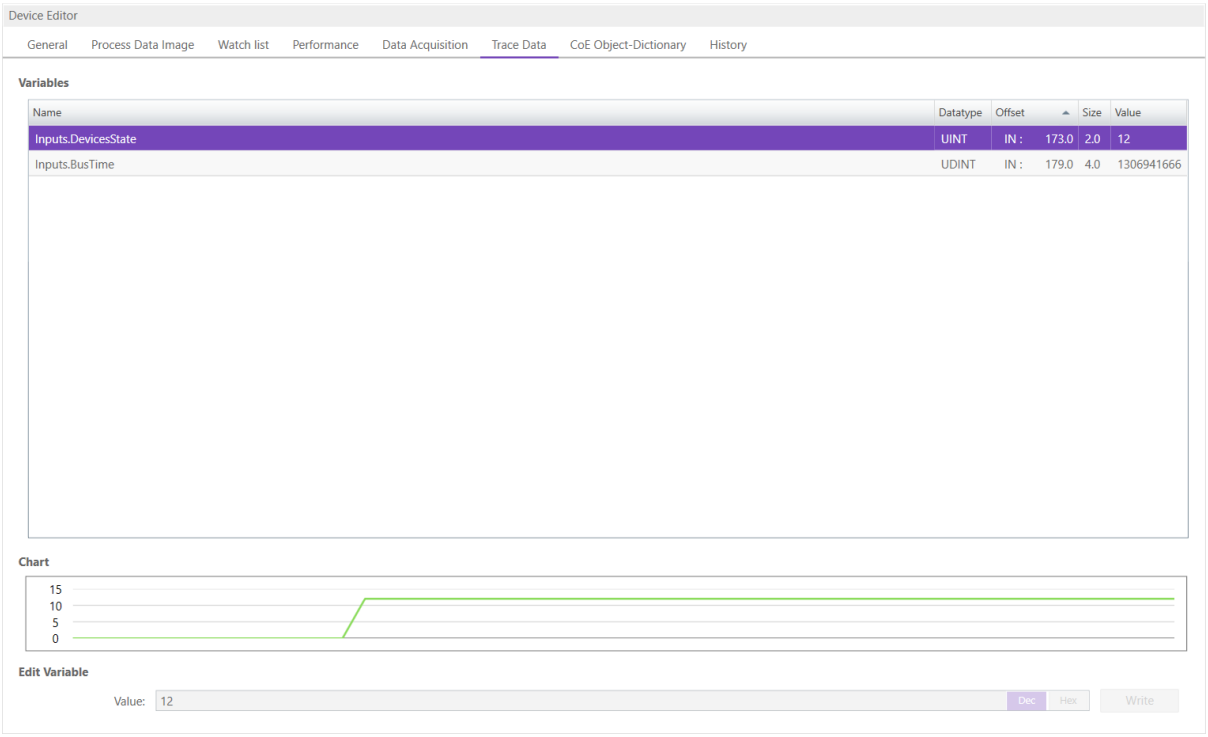
6.2.5 Data Acquisition Diagnosis

In this tab, the user can start and stop the DAQ recorders. Also he can see some statistics of running recorders.



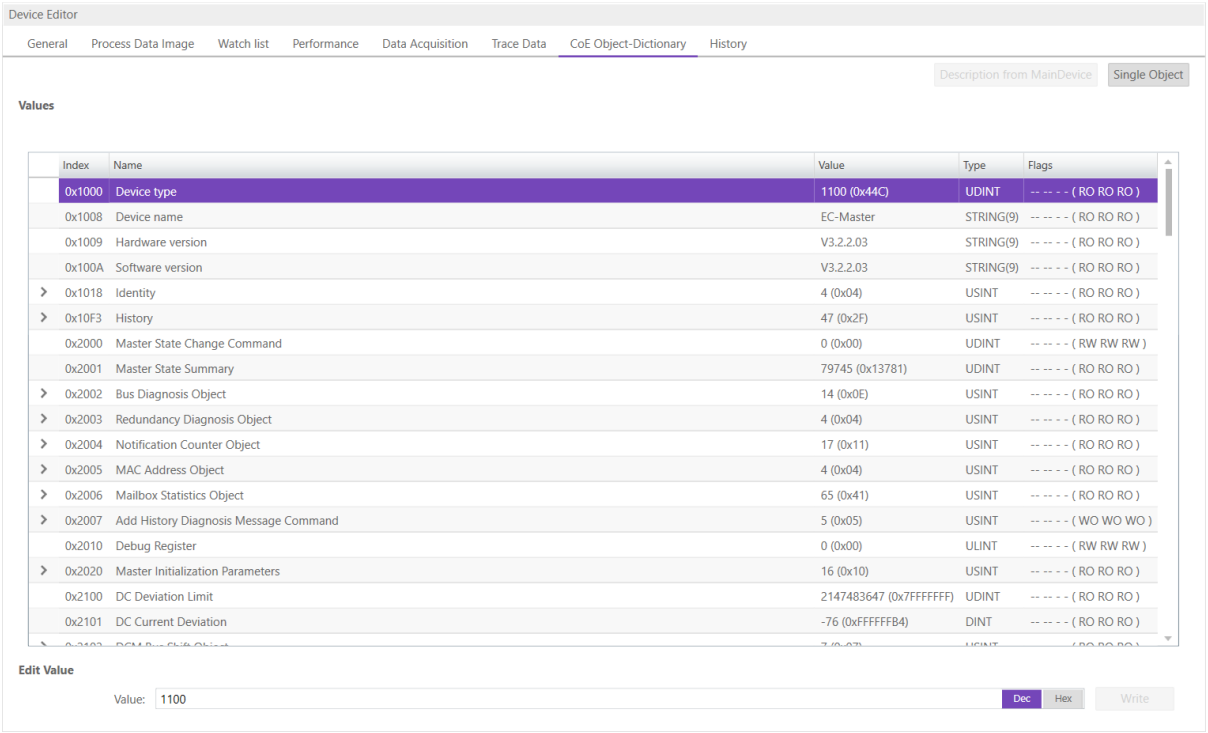
6.2.6 Trace Data (Expert)

In this tab, the user can see and change the values of the trace variables. If he selects a variable he will see a chart of the values. The chart will be updated every 250 milliseconds:



6.2.7 CoE Object-Dictionary (Device)

In this tab, the user can see and change the values of the object dictionary of the MainDevice:



Lists of CoE Object-Dictionary entries

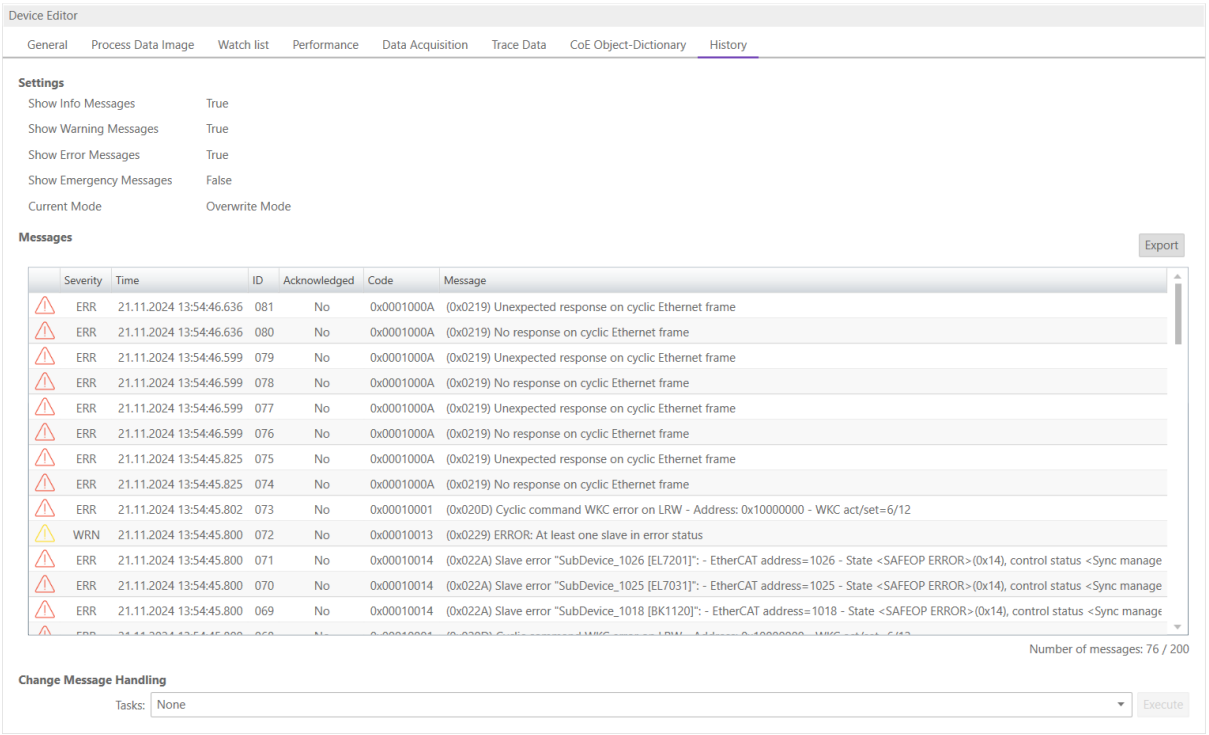
- Entries are uploaded by the MainDevice from the SubDevice
- **The "Flags" column tells the user if this entry is an PDO entry and if it can be edited**
  - "AA BB (CC DD EE)"
  - AA = Mapping as RX PDO or not
  - BB = Mapping as TX PDO or not
  - CC = Access rights for PreOp (RO, WO, RW)
  - DD = Access rights for SafeOp (RO, WO, RW)
  - EE = Access rights for Op (RO, WO, RW)

Buttons

Update:
Changes the selected entry

6.2.8 History (Device)

In this tab, the user can see and change the diagnosis history of the MainDevice (Supported from EC-Master V2.7 and above). It is also possible to export the data:



Settings

Show Info Messages:
Info messages will be collected from MainDevice

Show Warning Messages:
Warning messages will be collected from MainDevice

Show Error Messages:
Error messages will be collected from MainDevice

Show Emergency Messages:
Not supported from MainDevice

Current Mode:
Overwrite Mode: Messages will be overwritten if buffer is full Acknowledge Mode: Not supported from MainDevice

Messages
List of history messages

Change Message Handling

Enable/Disable Info Messages:
Enable or disable info messages

Enable/Disable Warning Messages:
Enable or disable warning messages

Enable/Disable Info Messages:
Enable or disable info messages

Enable/Disable Error Messages:
Enable or disable error messages

Enable Acknowledge Mode:
Enable acknowledge mode

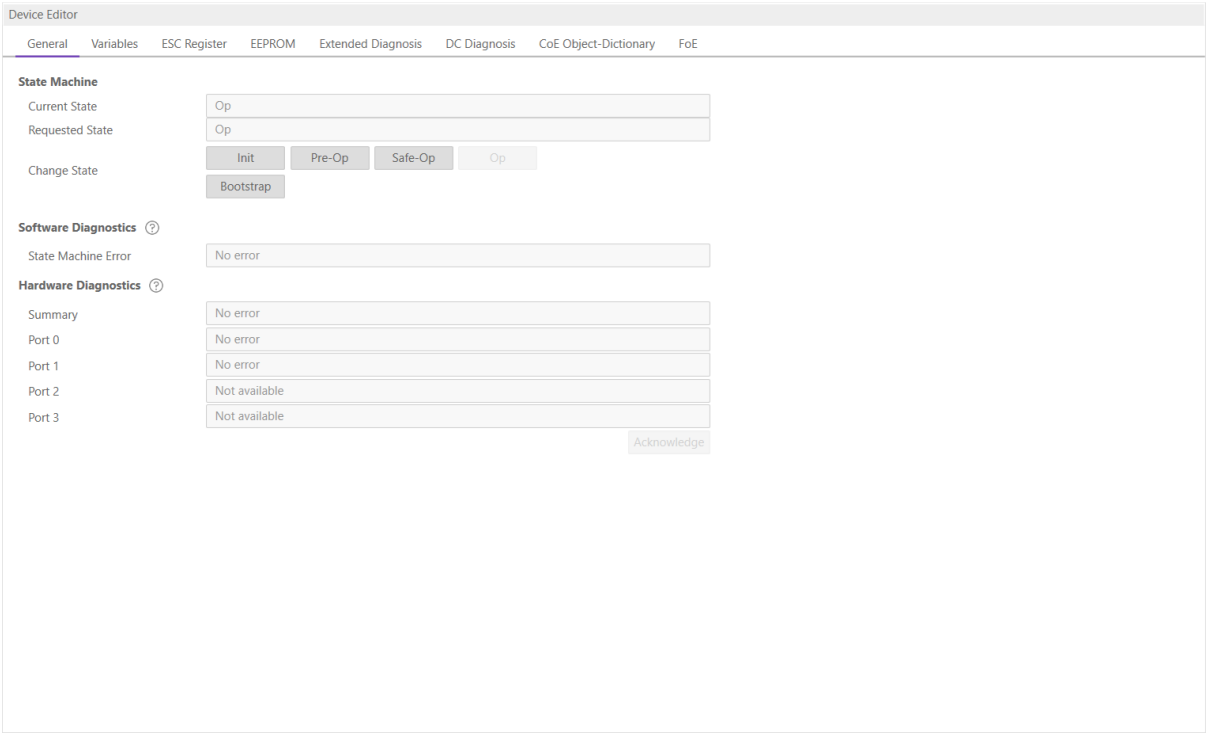
Clear All Messages:
Clear all messages

6.3 SubDevice

This section shows the current “health” state of the selected SubDevice and helps the user to analyze SubDevice related problems.

6.3.1 General (SubDevice)

In this tab, the user can see the current state of the state machine of the SubDevice:



State Machine

Current State:
Current state of the selected SubDevice

Requested State:
Requested state of the selected SubDevice

Change State:
SubDevice can reach the states INIT, BOOTSTRAP, PRE-OP, SAFE-OP and OP.

Software Diagnostics

State Machine Error:
SubDevice error which occurred during state transition

Hardware Diagnostics

Summary:
Summary of hardware diagnostics

Port A:
Port specific error

Port D:
Port specific error

Port B:
Port specific error

Port C:
Port specific error

Buttons

Acknowledge:
Acknowledge the current error state and notify the user again if error state was changed again.

Possible warning and errors:

Disturbed Connection:
There may be problems in the connection between two SubDevices. The message will tell either that there is a problem between two SubDevices or two ports. The warning appears if error counters are increased (Invalid Frame: 0x300-0x306, RX Errors: 0x301-0x307, Lost Link: 0x308-0x30B). The value from which a warning is issued can be set in the User.xml files in C:/ProgramData/EC-Engineer. More information below.

Bad Connection:
The same as “Disturbed Connection” but the error counters are higher. The value from which an error is issued can be set in the User.xml files in C:/ProgramData/EC-Engineer. More information below.

Line break:
A line break is detected before a SubDevice. This error is detected by looking at the topology.

Link missing:
A link is missing on input port of the SubDevice. This error is detected by looking at the topology.

Multiple warnings:
There are multiple warning for this port.

Multiple errors:
There are multiple errors for this port.

Multiple warnings and errors:
There are multiple warning and errors for this port.

State Machine:
See ETG1020 “Description of AL Status Codes” or ETG.1000.6. This error is detected by looking at the AL Status (0x130).

How to solve errors?

- Lost Link errors are often caused by the power supply system
- Helpful might be the usage of an extra power supply
- It is recommended to clear all error counters after startup

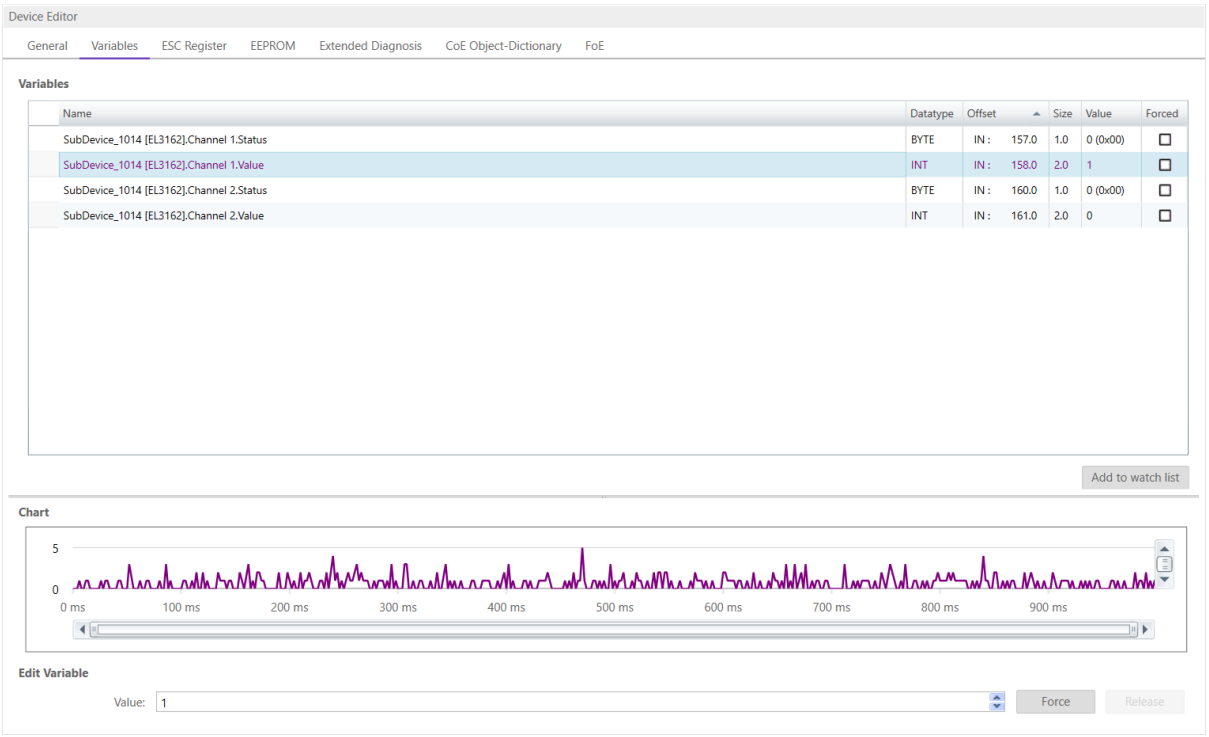
How to change amount of errors leading to a warning or error:

- Open C:/ProgramData/EC-Engineer
- Search for DiagGeneral
- **Change the values which should be adjusted**
  - LostLink: The value entered is used
  - All others are calculated depending on the amount of cyclic frames: (Value / CyclicFrames) x 10^6

Note: Please refer also the “ETG.1600 EtherCAT Installation Guideline”: http://www.ethercat.org/ETG1600.

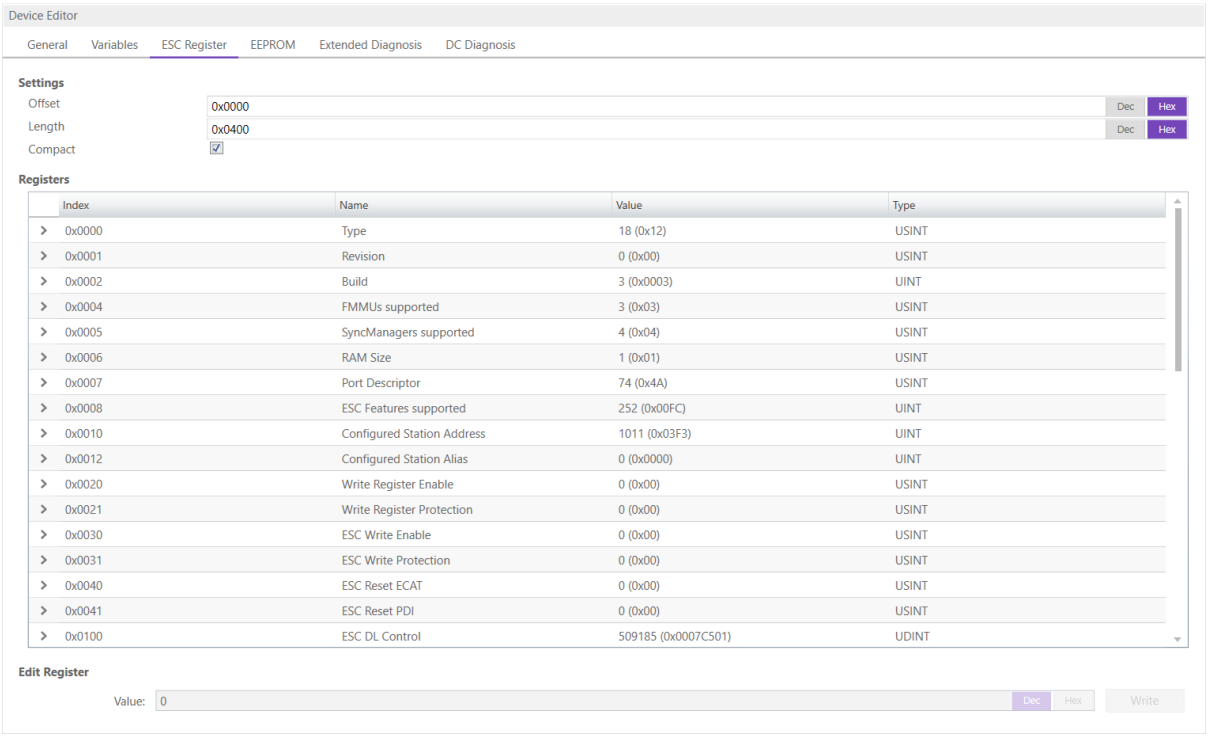
6.3.2 Variables

In this tab, the user can see and change the values of the process variables. The variables will be forced to the value the user entered. The user can press release to release the variable. If one or two variables are selected, a chart of the values is shown. Also resize and zoom is possible to see more details. The chart will be updated every 250 milliseconds:



6.3.3 ESC Register

In this tab, the user can see the values of the registers. In the settings section he can set the offset and the length. If he activates the compact view, he will only see the registers which have a description:

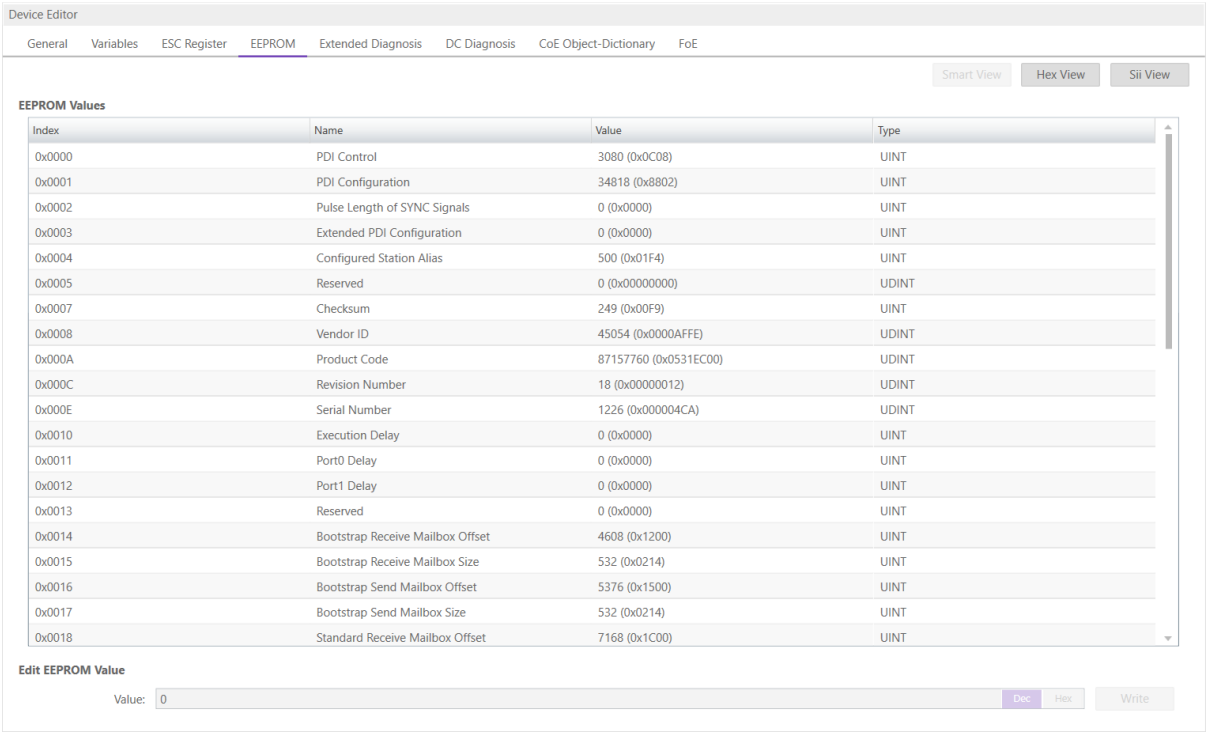


6.3.4 EEPROM

This tab consists of three views:

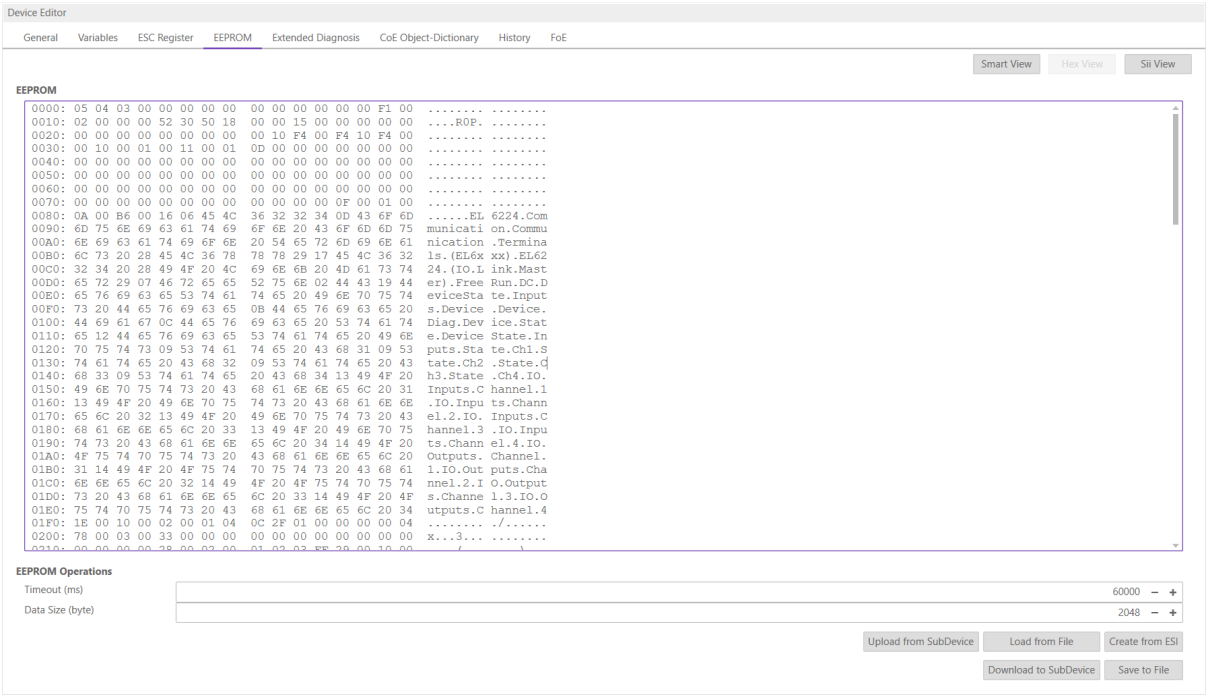
Smart View

In this view, the user can see and change the values of the EEPROM.



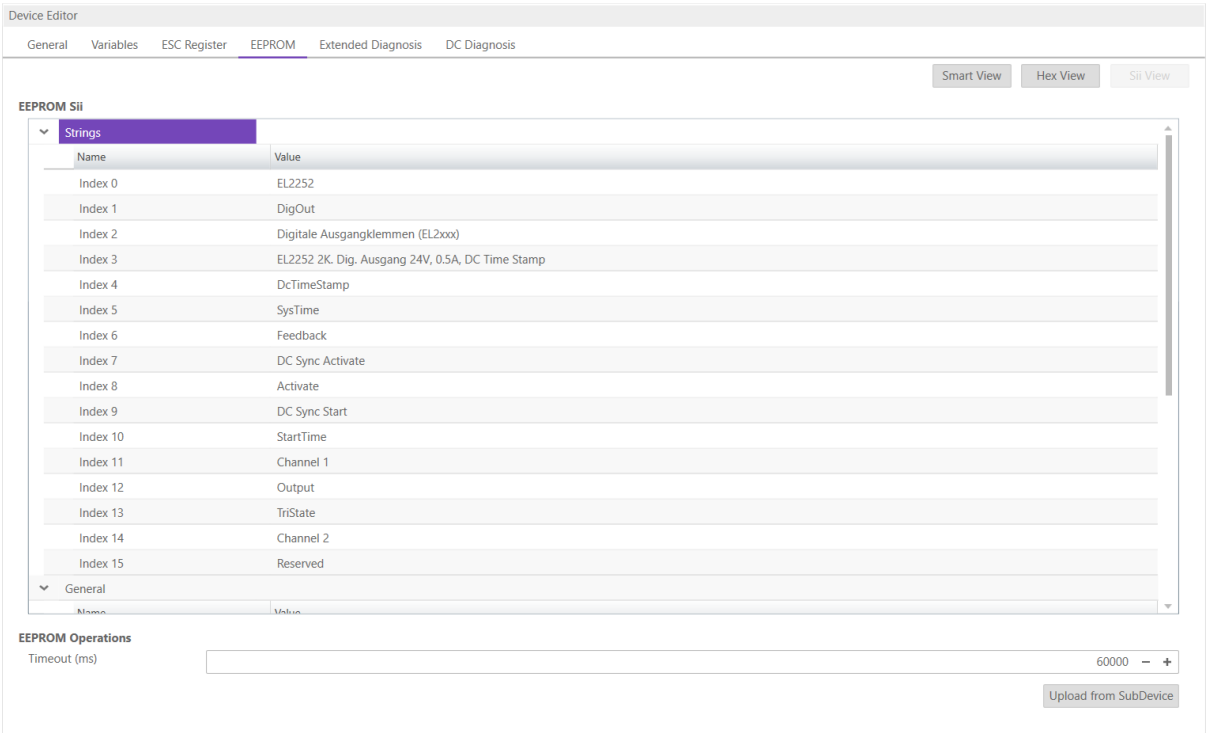
Hex View

In this view, the user can create an EEPROM from an `ESI` file, upload the EEPROM from the SubDevice, load an EEPROM from the disk, download the EEPROM to the SubDevice or save the EEPROM to disk.



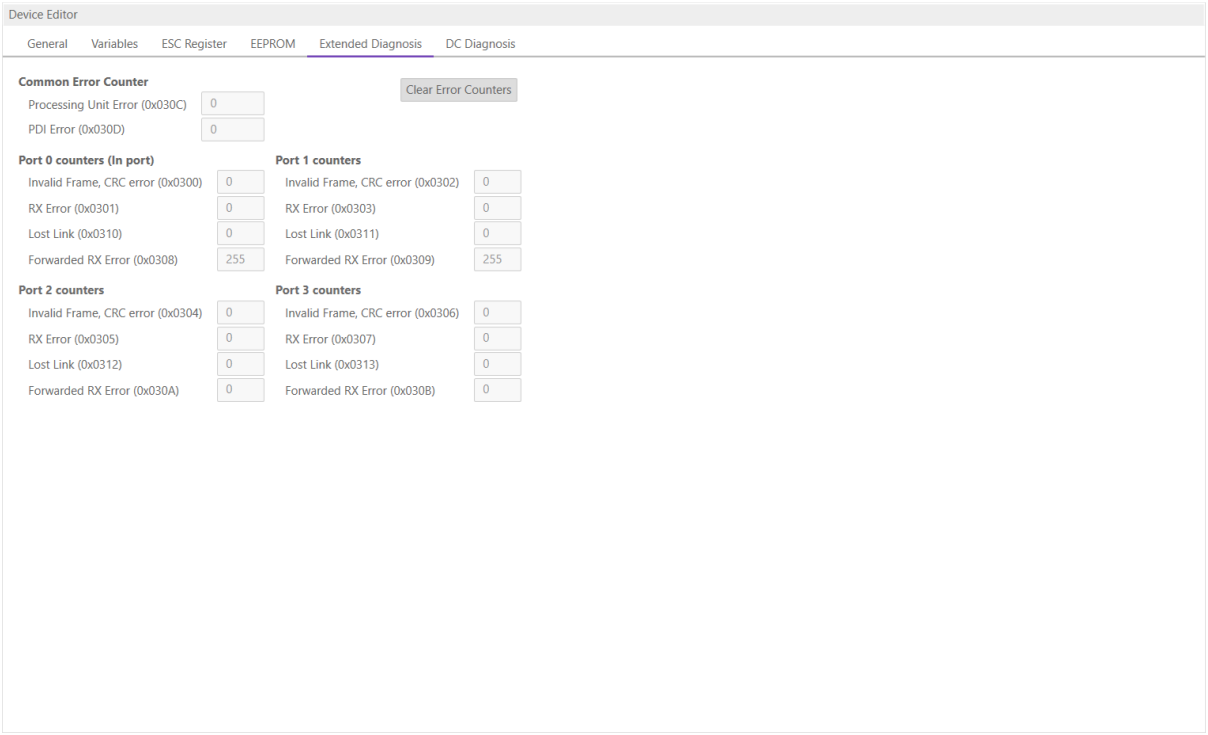
SII View

In this view, the user can create a SubDevice Information Interface (SII), by uploading the EEPROM data from the SubDevice.



6.3.5 Extended Diagnosis

In this tab, the user can see the extended diagnosis information:



There will be a red ! to signalize that a counter is higher than 0. Except for the forwarded errors.

If an error counter is '-' it was not read. If it is '0' it is really zero. So there is a difference between '0' and '-'.

Common Error Counter

Processing Error Counter:
Indicates that SubDevice received "not EtherCAT frames", which are not allowed in the EtherCAT segment (of course acceptable in a test environment)

PDI Error Counter:
Counts if a PDI access has an interface error (read from register: 0x30D)

Port 0..3

- Invalid Frame Counter of Port y (read from register: 0x0300+y*2)
- RX Error Counter of Port y (read from register: 0x0300+y*2+8Bit)
- Lost Link Counter of Port y (read from register: 0x0310+y)
- Forwarded RX Error Counter of Port y (read from register: 0x0308+y)

Acknowledge warning
If one of the error counters increase there will be a warning in the tree, sigalized with an icon. With this button it is possible to acknowledge this warning. So the SubDevice can be monitored again and the icon will come back with the next error.

To see this information the error counters must be read by the EtherCAT MainDevice. Only if this is activated the EC-Engineer is able to read this. Here is a quick overview on how to activate this function on different MainDevices:

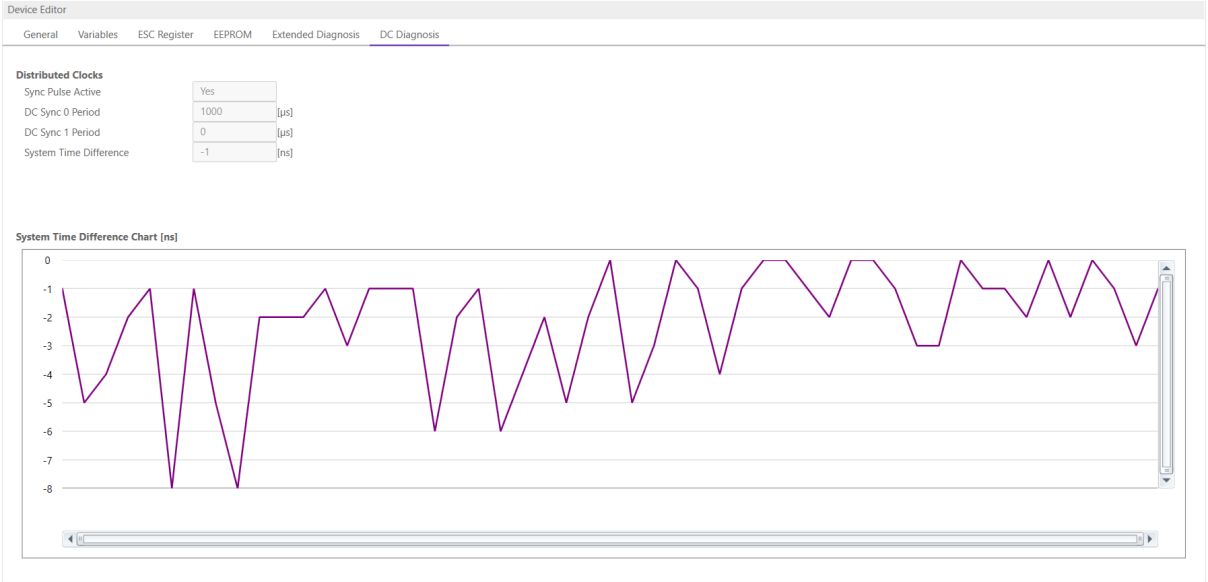
acontis EC-Master:

To activate the error collection of the acontis EC-Master, the follwing API has to be called:

```
/* SubDevice statistics polling for error diagnostic */
EC_T_DWORD dwPeriodMs = 1000;
dwRes    =    ecatIoCtl(EC_IOCTL_SET_SLVSTAT_PERIOD,    (EC_T_BYTE*)&dwPeriodMs,
sizeof(EC_T_DWORD), EC_NULL, 0, EC_NULL);
if (dwRes != EC_E_NOERROR)
{
            EcLogMsg(EC_LOG_LEVEL_ERROR,    (pEcLogContext,    EC_LOG_LEVEL_ERROR,
"ecatIoControl(EC_IOCTL_SET_SLVSTAT_PERIOD) returns with error=0x%x\n", dwRes));
    goto Exit;
}
```

6.3.6 DC Diagnosis

In this tab, the user can see all DC related values of the SubDevice:



Distributed Clock

Sync Pulse Active:
Sync pulse was received or not

DC Sync 0 Period:
Configured period for sync unit 0

DC Sync 1 Period:
Configured period for sync unit 1

System Time Difference:
Time difference of SubDevice clock to reference clock

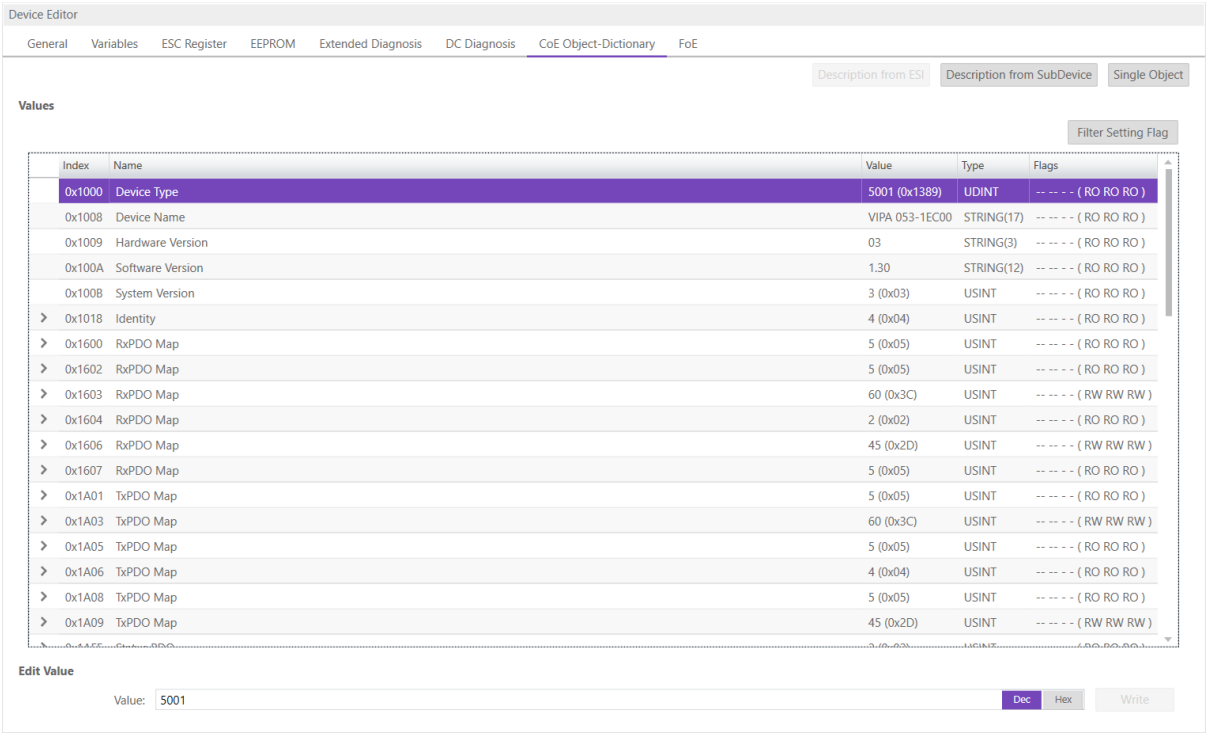
System Time Difference Chart
Chart displaying the System Time Difference over time (The amount of entries and visibility can be change in *Expert*)

Note: The option “Sync Window Monitoring” must be enabled.

6.3.7 CoE Object-Dictionary

This tab consists of different modes:

Description from `ESI`
In this tab, the user can see the description of the object dictionary from `ESI` and the values from the SubDevice.



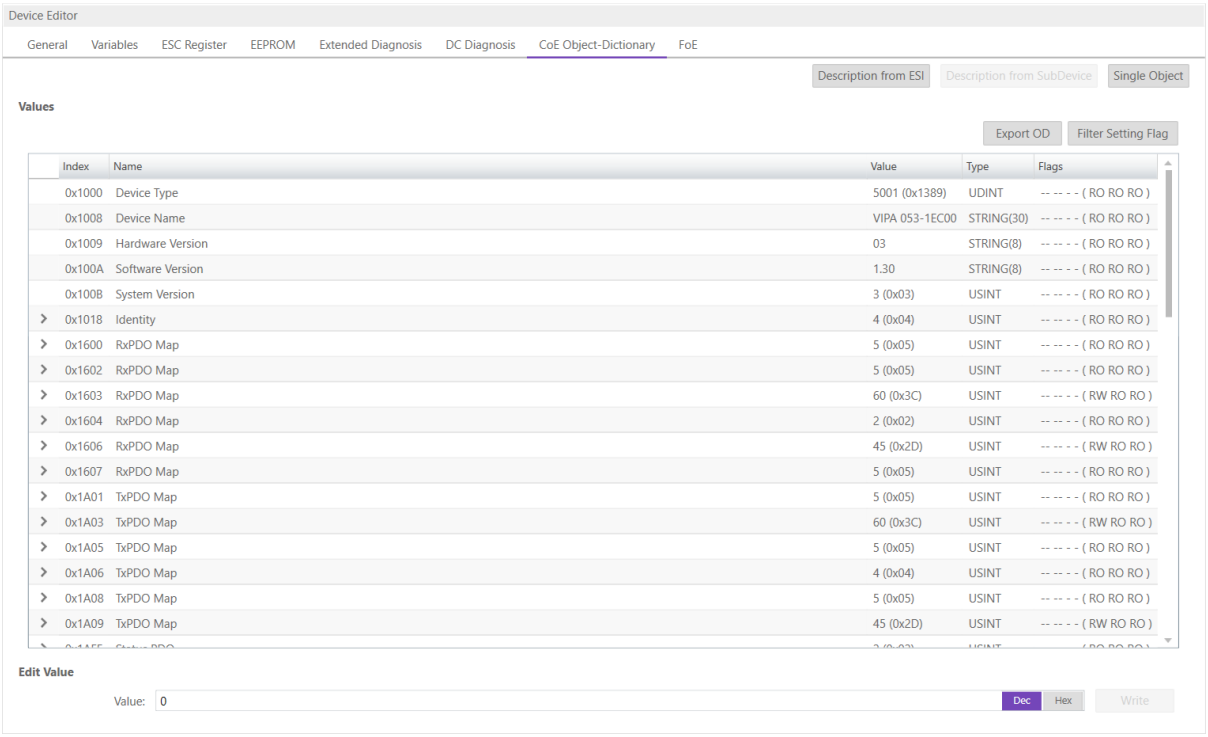
Lists of CoE Object-Dictionary entries

- Entries comes from `ESI`
- **The "Flags" column tells the user if this entry is an PDO entry and if it can be edited**
  - "AA BB C D (EE FF GG)"
  - AA = Mapping as RX PDO or not
  - BB = Mapping as TX PDO or not
  - C = Backup Flag
  - D = Settings Flag
  - EE = Access rights for PreOp (RO, WO, RW)
  - FF = Access rights for SafeOp (RO, WO, RW)
  - GG = Access rights for Op (RO, WO, RW)

Buttons

Write:
Writes the selected entry

Description from SubDevice
In this tab, the user can see the description of the object dictionary and the values from SubDevice. He can also change the values and has the possiblillty to export the object dictionary.



Lists of CoE Object-Dictionary entries

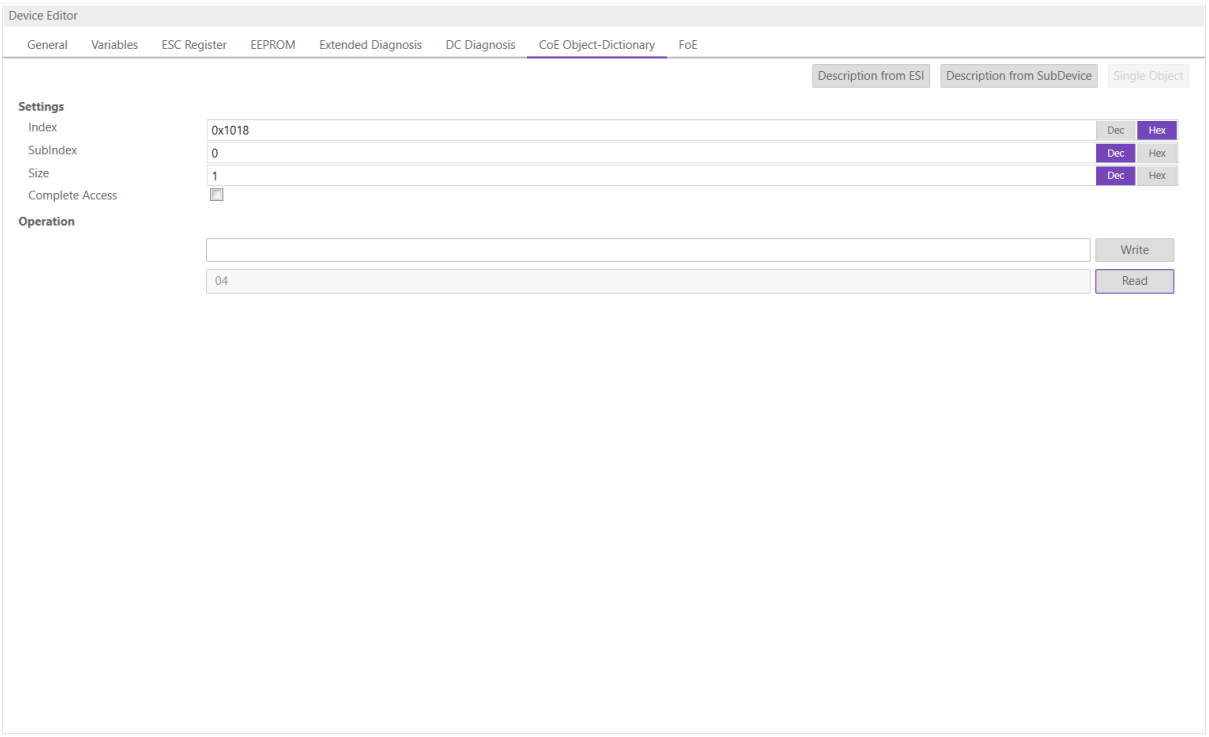
- Entries are uploaded from the SubDevice (if “SDO Information Service” is supported)
- **The “Flags” column tells the user if this entry is an PDO entry and if it can be edited**
  “AA BB C D (EE FF GG)” - AA = Mapping as RX PDO or not - BB = Mapping as TX PDO or not - C = Backup Flag - D = Settings Flag - EE = Access rights for PreOp (RO, WO, RW) - FF = Access rights for SafeOp (RO, WO, RW) - GG = Access rights for Op (RO, WO, RW)

Buttons

Write:
Writes the selected entry

Single Object

In this tab, the user can read and write (not EC-Inspector) the values of the object dictionary of the SubDevice.



Settings

Index:
Index of the CoE value

SubIndex:
SubIndex of the CoE value

Size:
Size of the CoE value (only used for reading)

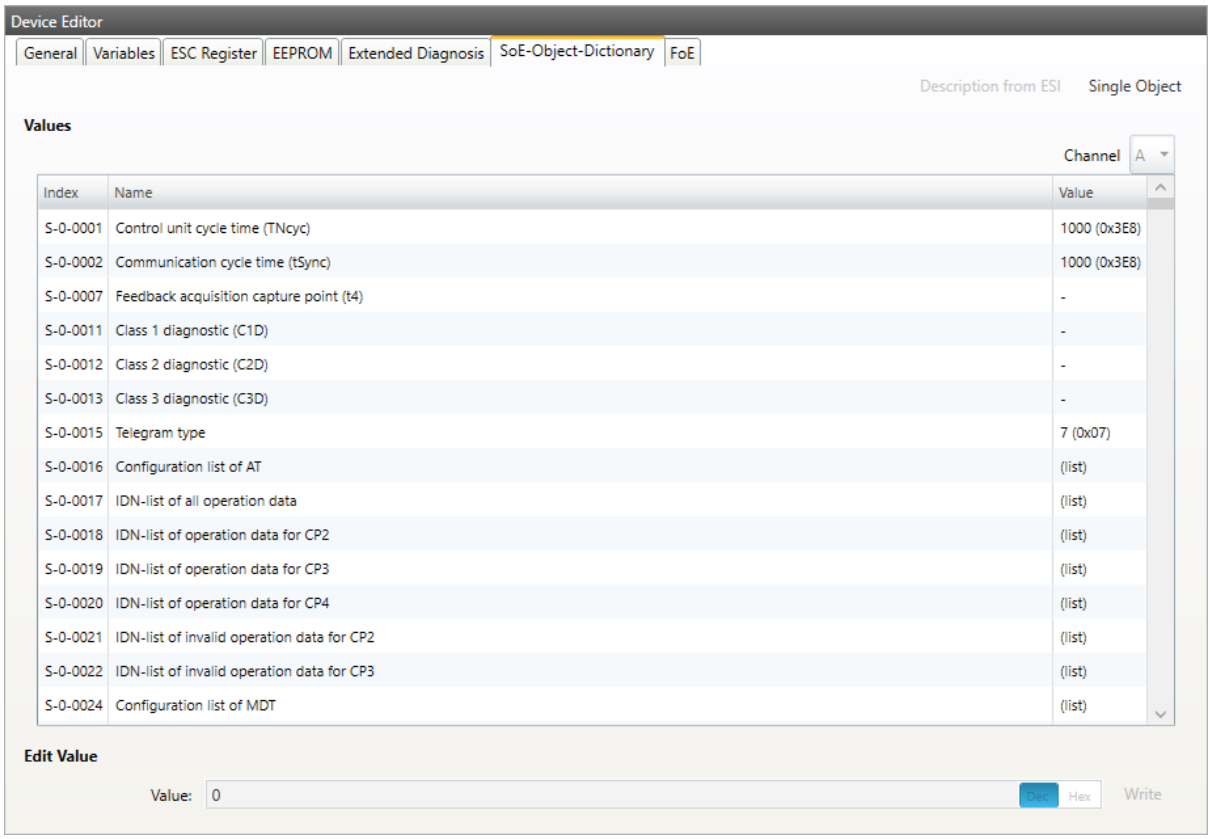
Complete Access:
Activate, if complete access mode should be used for reading or writing the CoE value (can be used only if it is supported from SubDevice)

Operation

Write:
Writes the value to the SubDevice (Hex format, like: “00 11 22 33 …”)

Read:
Reads the value from SubDevice (Hex format, like: “00 11 22 33 …”)

6.3.8 SoE Object-Dictionary



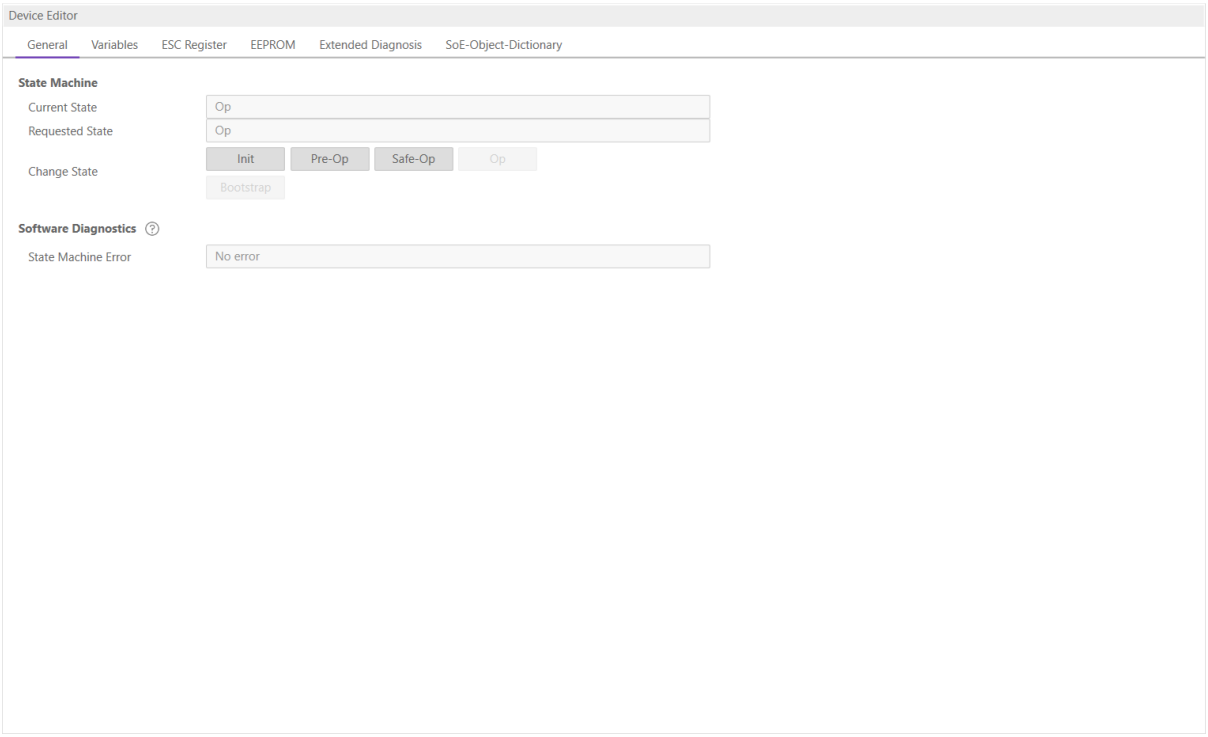
Lists of SoE Object-Dictionary entries

- Values are uploaded by the MainDevice from the SubDevice
- Entries comes from the `ESI`

Buttons

Write:
Writes the selected entry

Expert View
In this tab, the user can read and write the values of the object dictionary of the SubDevice:



Settings

Channel:
Channel of the SoE value

IDN:
Index of the CoE value

Size:
Size of the CoE value (only used for reading)

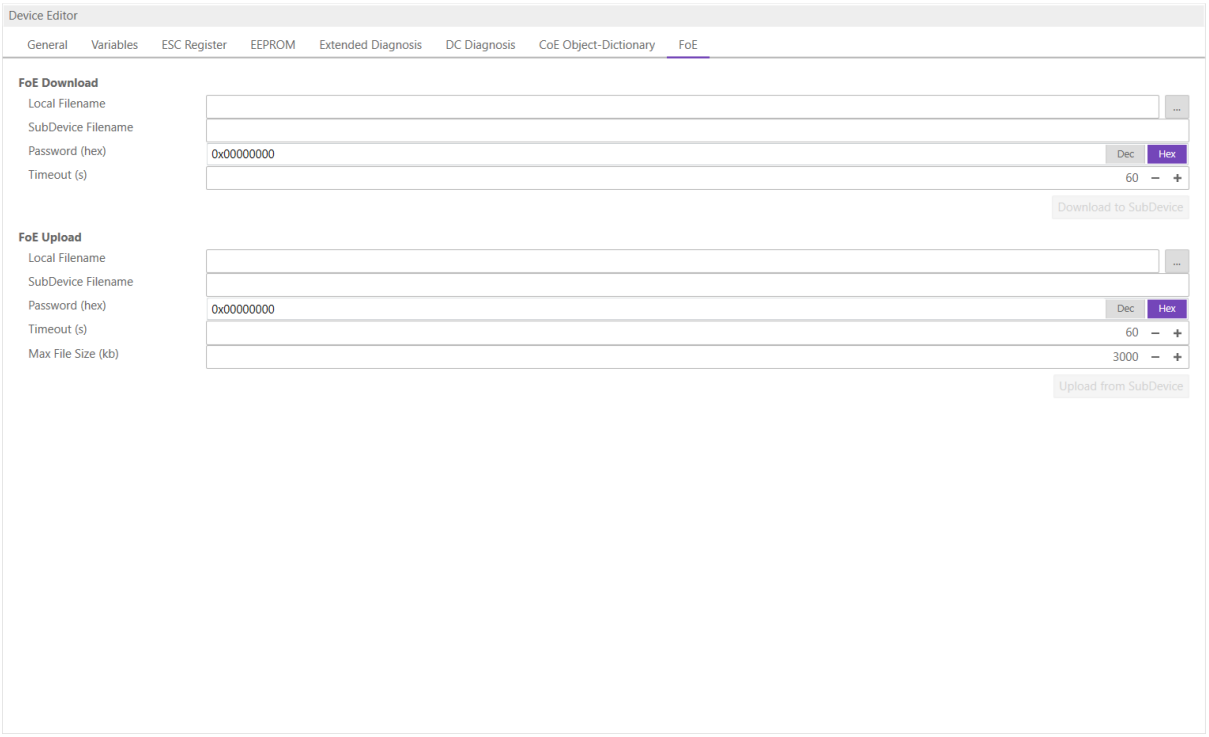
Operation

Write:
Writes the value to the SubDevice (Hex format, like: “00 11 22 33 …”)

Read:
Reads the value from SubDevice (Hex format, like: “00 11 22 33 …”)

6.3.9 File over Ethernet (FoE)

In this tab, the user has the possibility to download or upload a file to the SubDevice:



FoE Operations

Local Filename:
Name of the file on the harddrive

SubDevice Filename:
Name of the file on the SubDevice

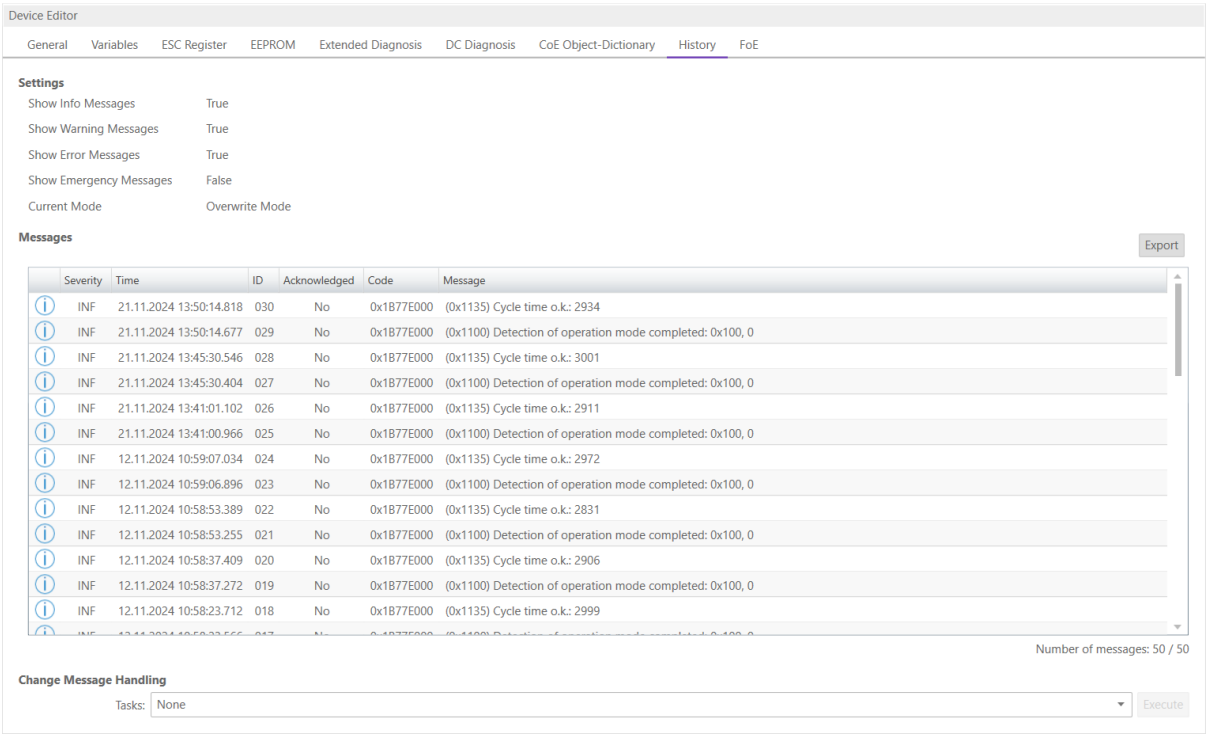
Password:
Password on the SubDevice as a hex-number

Timeout:
Timeout for downloading or uploading the file in milliseconds

Max File Size:
Maximal file size which should be uploaded from the SubDevice in kilo bytes

6.3.10 History (SubDevice)

In this tab, the user can see and change the diagnosis history of the SubDevice. It is also possible to export the data:



Settings

Show Info Messages:
Info messages will be collected from SubDevice

Show Warning Messages:
Warning messages will be collected from SubDevice

Show Error Messages:
Error messages will be collected from SubDevice

Show Emergency Messages:
Emergency messages will be collected from SubDevice

Current Mode:
Overwrite Mode: Messages will be overwritten if buffer is full Acknowledge Mode: Messages will be discarded if buffer is full

Messages

List of history messages

Change Message Handling

Enable/Disable Info Messages:
Enable or disable info messages

Enable/Disable Warning Messages:
Enable or disable warning messages

Enable/Disable Info Messages:
Enable or disable info messages

Enable/Disable Error Messages:
Enable or disable error messages

Enable/Disable Emergency Messages:
Enable or disable emergency messages

Enable Acknowledge Mode:
Enable acknowledge mode

Enable Overwrite Mode:
Enable overwrite mode

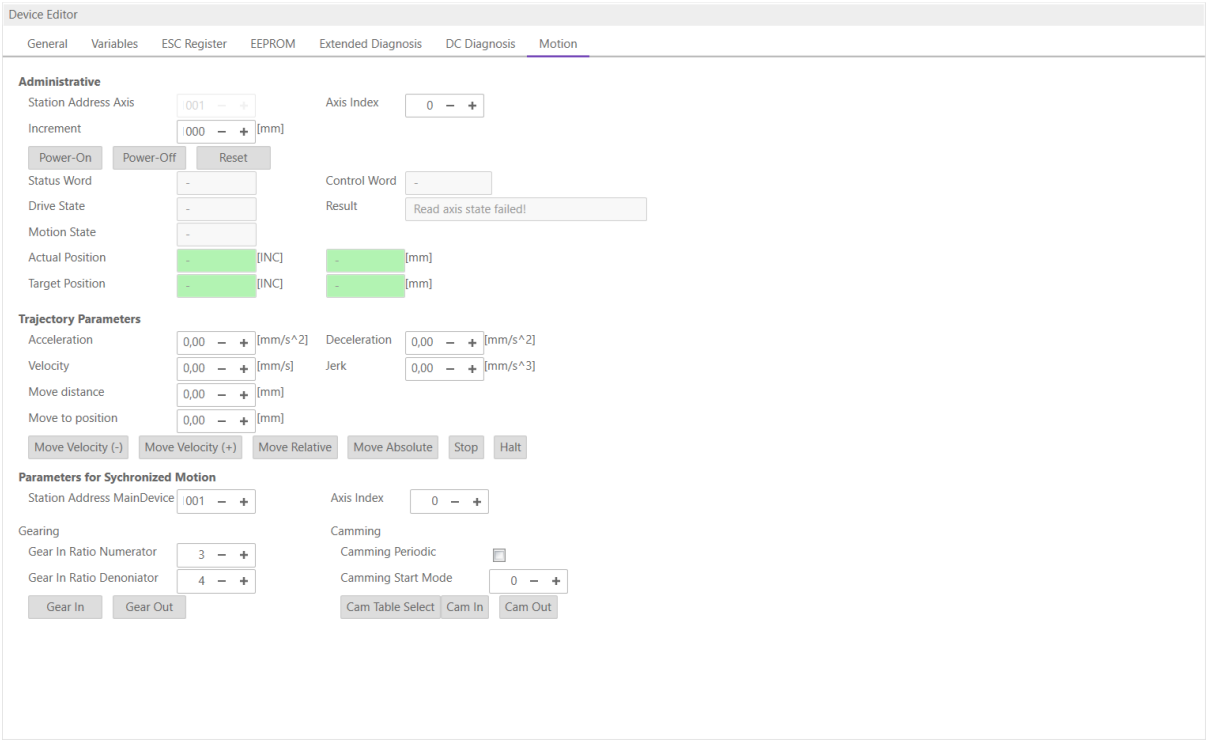
Clear All Messages:
Clear all messages (only available if “Overwrite Mode” is active)

Clear All Acknowledged Messages:
Clear all acknowledged messages (only available if “Acknowledge Mode” is active)

Acknowledge All Messages:
Acknowledge all messages, that they can be overwritten from new messages (only available if “Acknowledge Mode” is active)

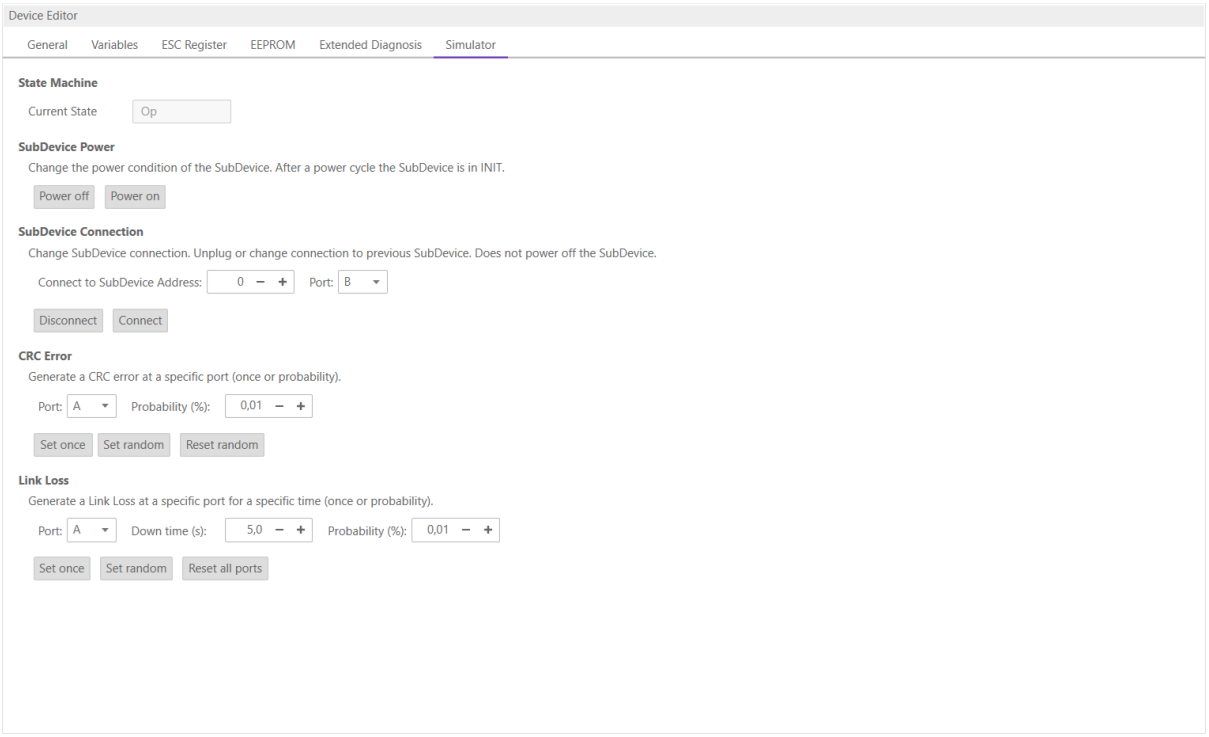
6.3.11 Motion (Motion Tabs only)

In this tab, the user can see and change the motion settings of the SubDevice. He can read important variables and change velocity and direction of the axis. Also gearing and camming are possible to use:



6.3.12 Simulator (Simulator Tabs only)

In this tab, the user can see and change the simulator settings of the SubDevice. He can manipulate the SubDevice e.g. power, disconnect and produce errors:



State Machine
Shows the current state of the SubDevice

SubDevice Power

Power off:
Turn the SubDevice power off

Power on:
Turn the SubDevice on to Init state

SubDevice Connection

Disconnect:
Disconnect the SubDevice. SubDevice will not be turned off

Connect:
Connect SubDevice to selected address and port. Default is the port where the SubDevice was connected before

CRC Error

Set once:
Create one CRC error at the selected port

Set random:
Generate CRC errors at the selected port with the selected probability until reset is executed

Reset random:
Reset the CRC generation

Link Loss

Set once:
Create one Link Loss at the selected port for the selected time

Set random:
Generate Link Losses at the selected port with the selected probability for the selected time until reset is executed

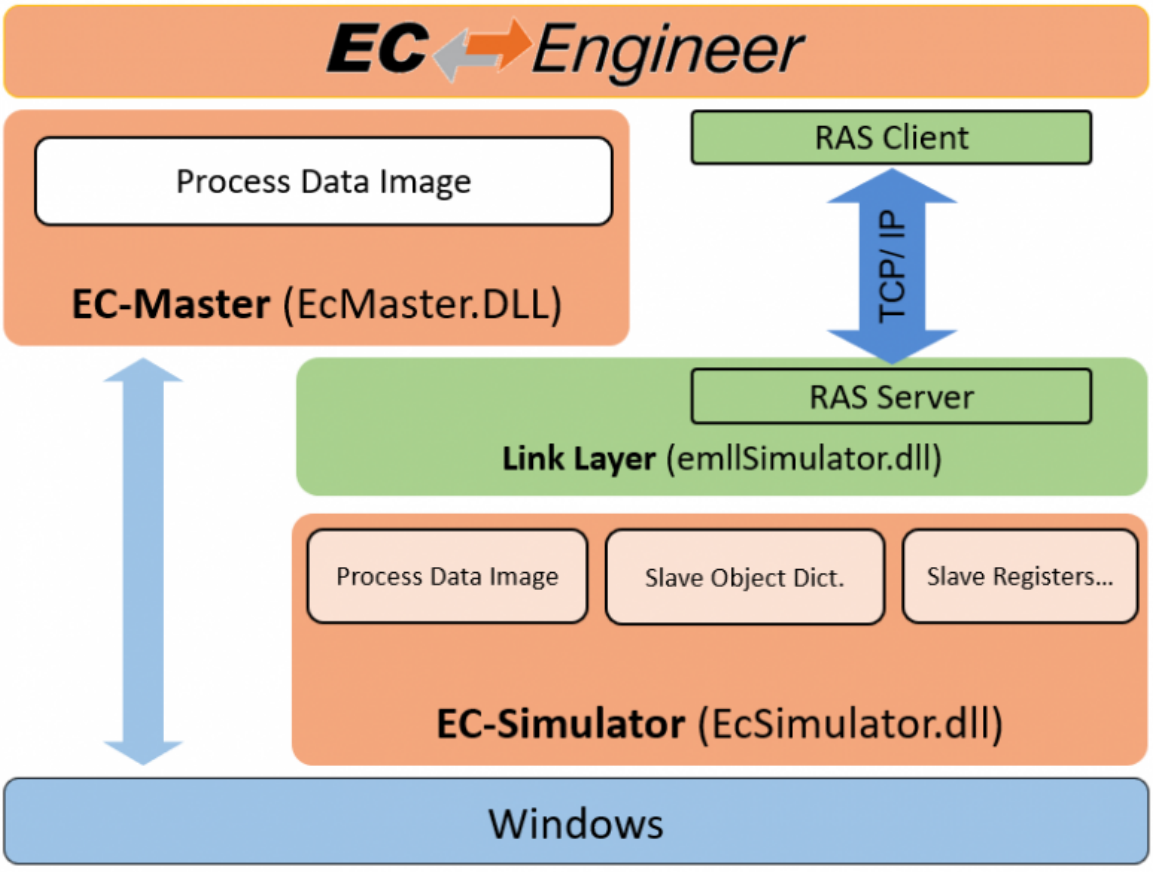
Reset random:
Reset the Link Loss on all ports

7 Simulator Mode

With the new EC-Engineer it is possible to use the EC-Simulator.

There are two possibilities:

1. The user can activate the Simulator Tabs and create an `EXI` File to start the simulator. It is also possible to connect to a remote system with a running Simulator. More information about offline configuration and remote diagnosis can be found in the Getting Started Chapter.
2. The second possibility is, that the user has already a configuration with a MainDevice. Now the user can do a right click on Simulation in the toolbar to start EC-Simulator with this config. Now the user has a running Simulator and running EC-Master.

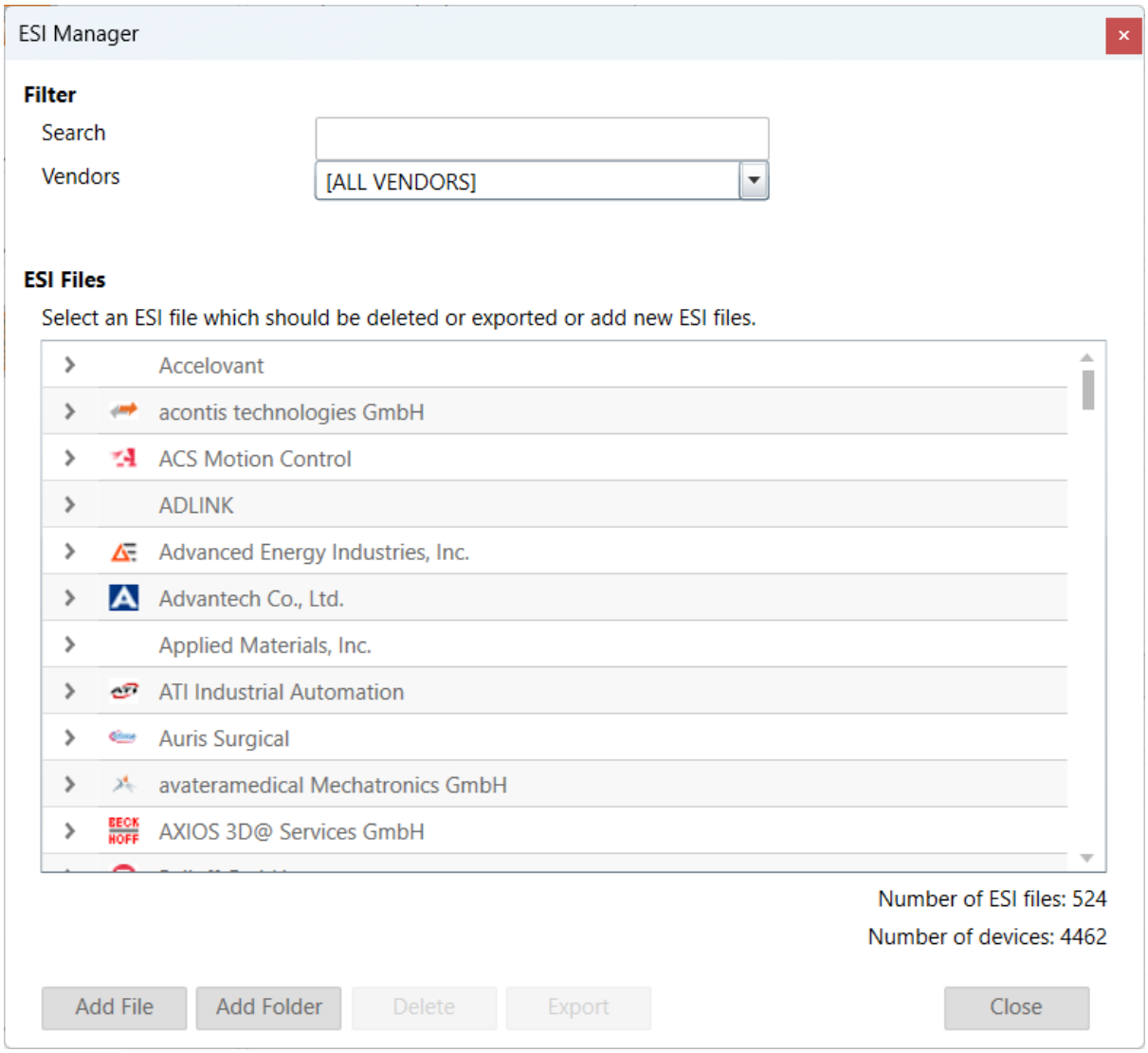


8 Additional Tools

8.1 ESI-Manager

ESI-Manager can be found through the main menu File -> ESI-Manager.

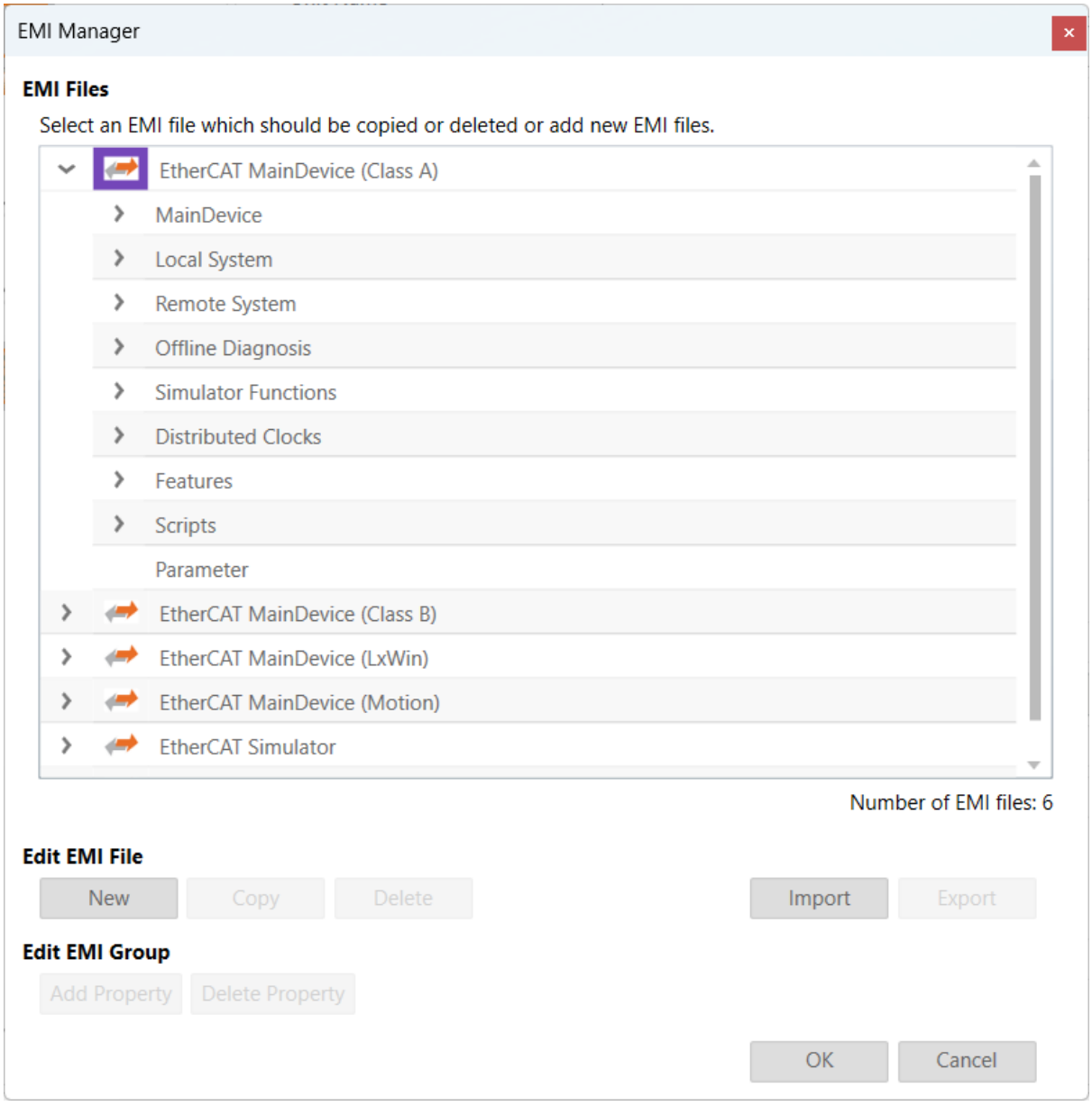
This dialog helps the user to administrate his `ESI` and `SCI` files. Here, he can add/delete/export `ESI` and `SCI` files.



8.2 EMI-Manager

EMI-Manager can be found through the main menu File -> EMI-Manager.

This dialog helps the user to administrate his EtherCAT MainDevice Information (`EMI`) files.



`EMI` files, are files which are specify the MainDevice features. Means that options and dialogs can be restricted to those features which are supported by the control system, e.g. available cycle times, support of scan for MDP modules or DC synchronization.

8.2.1 Administration

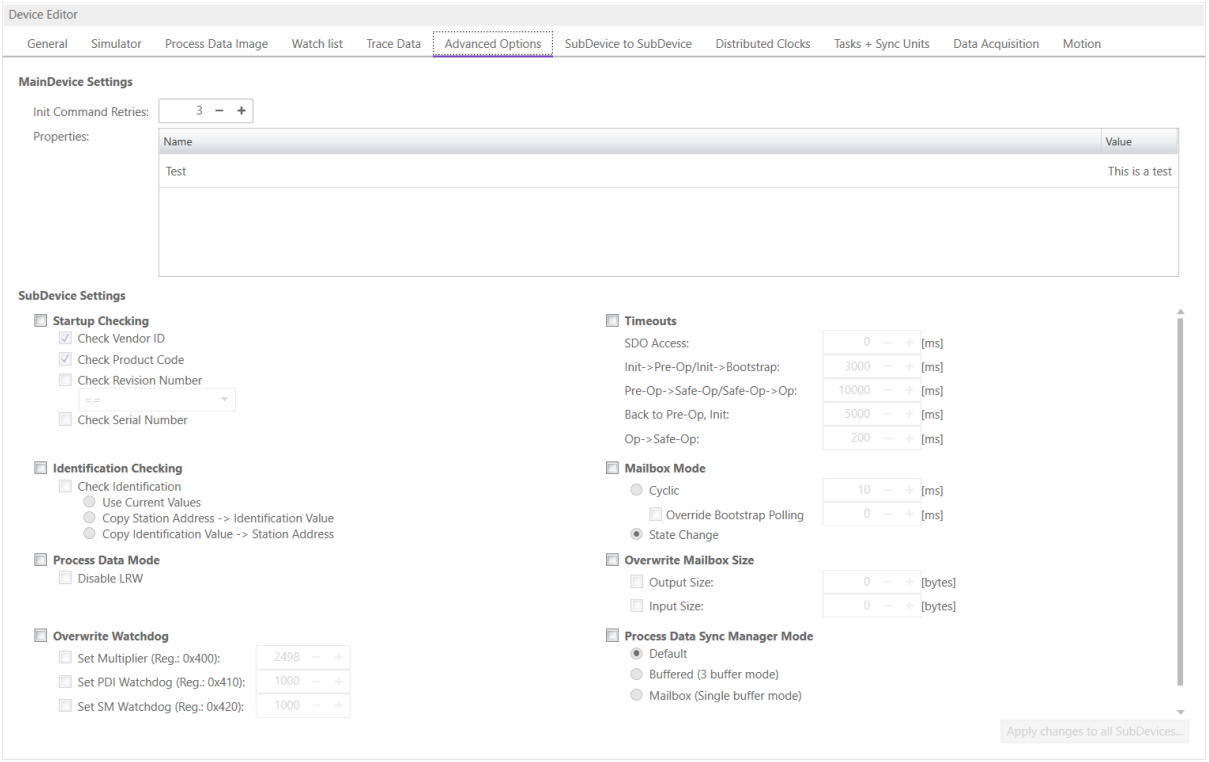
This dialog helps the user to administrate his EtherCAT MainDevice Information (`EMI`) files.

By default EC-Engineer has two files included (read-only):

`EtherCATMaster_ClassA.emi`: `EMI` template which is prepared for configuring a “Class A” MainDevice `EtherCATMaster_ClassB.emi`: `EMI` template which is prepared for configuring a “Class B” MainDevice

If the user wants to customize EC-Engineer, he can create a new `EMI` file with defaults, copy an existing `EMI` template or import an `EMI` file.

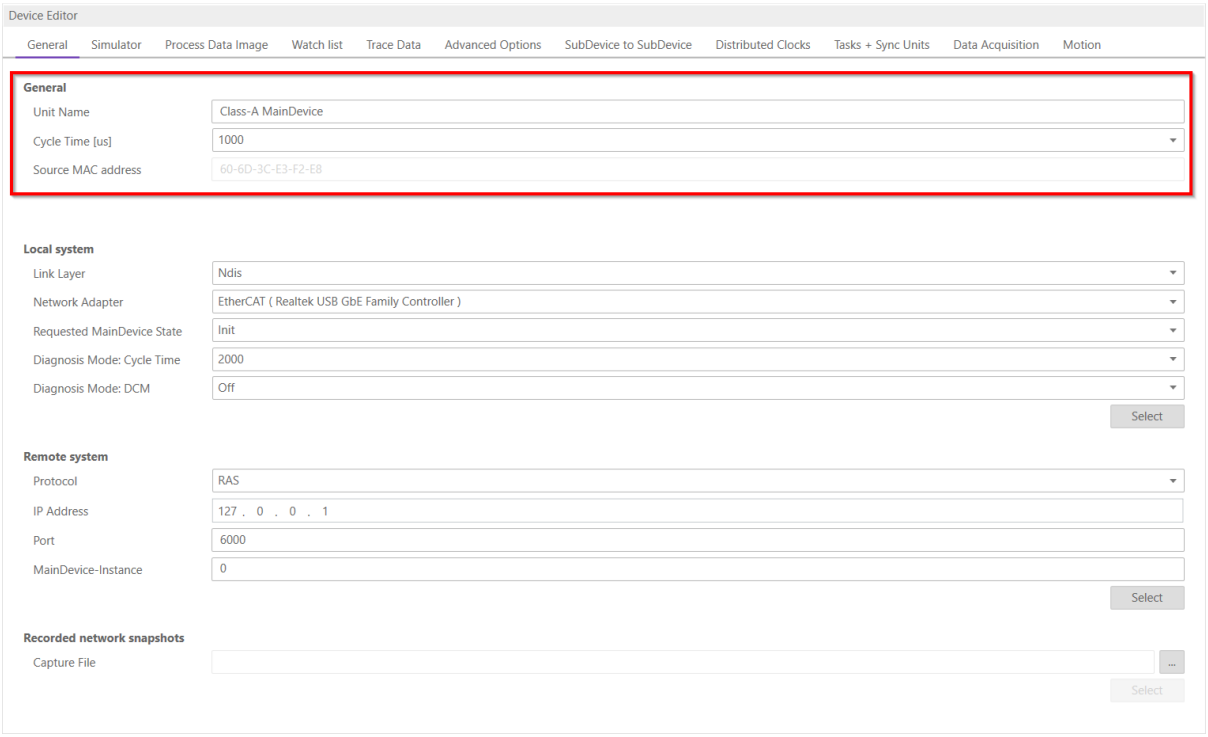
If he wants to add new properties to a group, he can add this only to the group “Parameters”. This group is by default empty, but if user has added some properties, he will see the list of properties on tab “Advanced Options” of the MainDevice, where the values can be modified.



8.2.2 Supported Entries

The following `EMI` entries are supported:

MainDevice Group



Display Group:
Shows or hides group

Lock Group:
Locks or unlocks group

Name of MainDevice:
Default MainDevice name

Show name of MainDevice:
Enable if user should be able to view and change the name of the MainDevice

Lock name of MainDevice:
Enable if user should not be able to change the name of the MainDevice

Cycle Time:
Default Cycle Time

Show Cycle Time:
Enable if user should be able to view and change the Cycle Time

Lock Cycle Time:
Enable if user should not be able to change the Cycle Time

List values of Cycle Time:
Enter possible values of Cycle Time

Frequency:
Default Frequency

Show Frequency:
Enable if user should be able to view and change the Frequency

Lock Frequency:
Enable if user should not be able to change the Frequency

List values of Frequency:
Enter possible values of Frequency

Cycle Time Mode:
Enter Cycle Time Mode (0 = Cycle Time, 1 = Frequency)

Init Command Retries:
Init Command Retries

Maximal SubDevice Count:
Enter maximal count of SubDevices which are allowed to configure (0 = use default limit of MainDevice)

SubDevice Start Address:
Enter default start address for all SubDevices

Scan for MDP SubDevices:
Enable for activating MDP-Scan if it is supported from SubDevice

PDO Upload:
Enable for activating PDO upload during scan if it is supported from SubDevice

Byte-Align Process Data Image:
Enable if process data image should be byte aligned and not as small as possible

Edit Complete Variable Name:
Enable if user should be able to edit the complete variable name

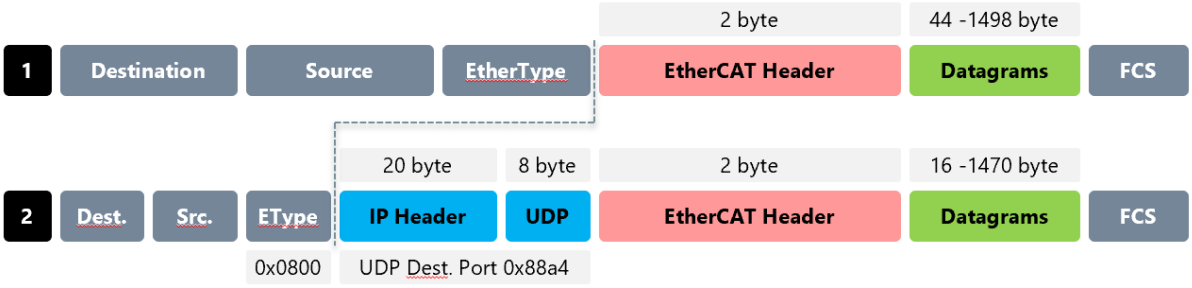
Process Image Layout:
Enter process image layout features (0 = default, 0x1 = with protocol data, 0x2 = with VLAN tag, 0x4 = without frame alignment, 0x8 = alphabetic port order, 0x10 = Compatibility to `ENI` spec V1.0.0, 0x20 = Moves AL Status command to the end, 0x40 = Disable command splitting, 0x80 = Compatibility to `ENI` spec V1.0.1, 0x100 = Compatibility to `ENI` spec V1.0.2)

Output Port Vendor Id:
Enter output port vendor id of the MainDevice (0 = All Vendors, 1..n = Specific Vendor)

Word-Aligned EtherCAT Datagrams:
Enable if EtherCAT datagrams should be word aligned

Cyclic Frame Layout:
Enter cyclic frame layout mode (0 = default, 1 = single logical command per frame)

Ethernet Type UDP:

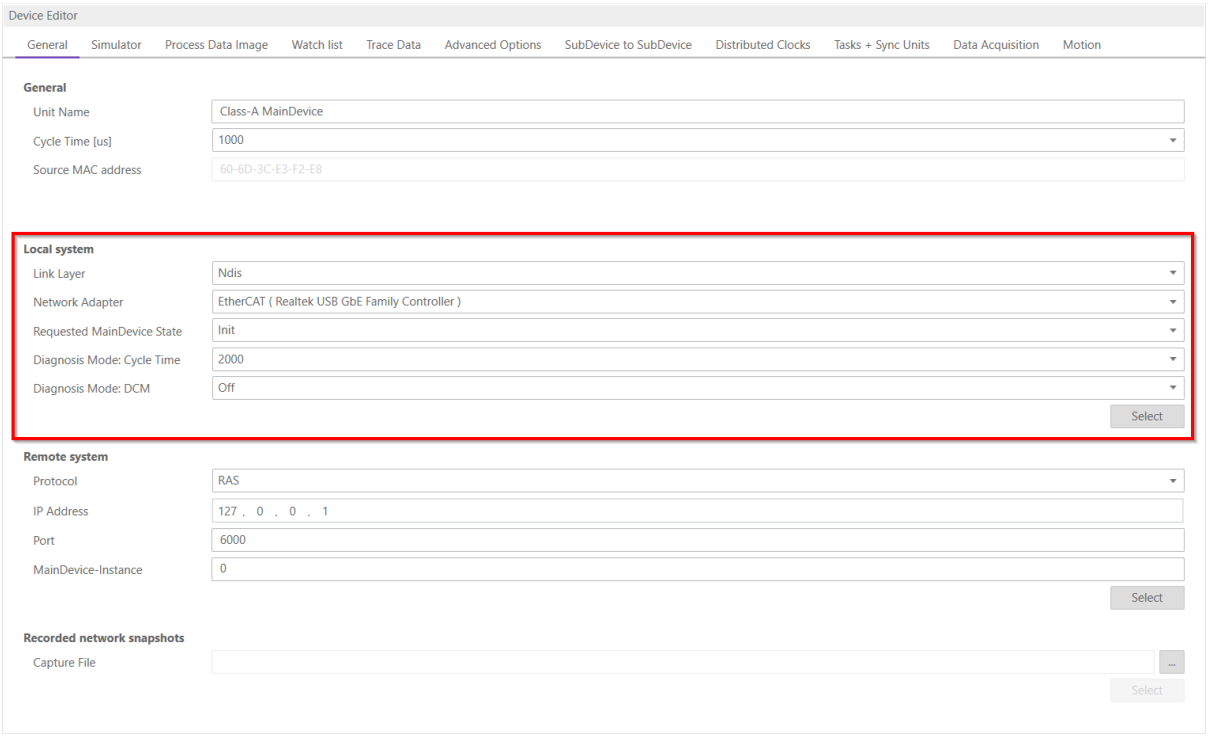


Remove DC NOP Command:
Does not include NOP Command in `ENI`

Cable Redundancy:
Sets disable LRW for all SubDevices to use cable redundancy and enables an opportunity to select a second adapter and link-layer

Junction Redundancy:
Allows to user to scan also with connected junction redundancy

Local System



Display Group:
Shows or hides group

Lock Group:
Locks or unlocks group

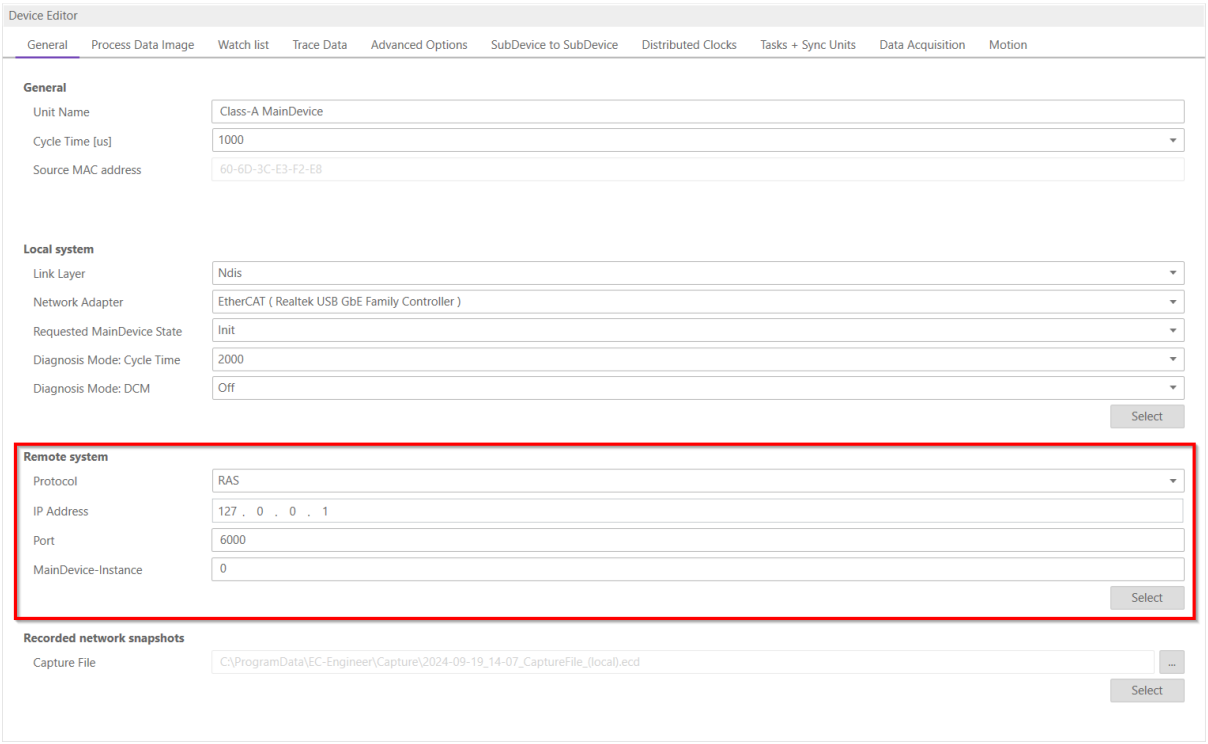
Network Adapter:
Enter index of Network Adapter in the Network Adapter List

Show Network Adapter:
Enable if user should be able to view and change the Network Adapter

Lock Network Adapter:
Enable if user should not be able to change the Network Adapter

DCM on:
EC-Engineer deactivated DCM on default. Enable if it should be turned off

Remote System



Display Group:
Shows or hides group

Lock Group:
Locks or unlocks group

Protocol:
Select protocol for Remote System

Show Protocol:
Enable if user should be able to view and change the protocol

Lock Protocol:
Enable if user should be not able to change the protocol

IP Address:
Enter IP Address for Remote System

Show IP Address:
Enable if user should be able to view and change the IP Address

Lock IP Address:
Enable if user should be not able to change the IP Address

Port:
Enter Port for Remote System

Show Port:
Enable if user should be able to view and change the Port”

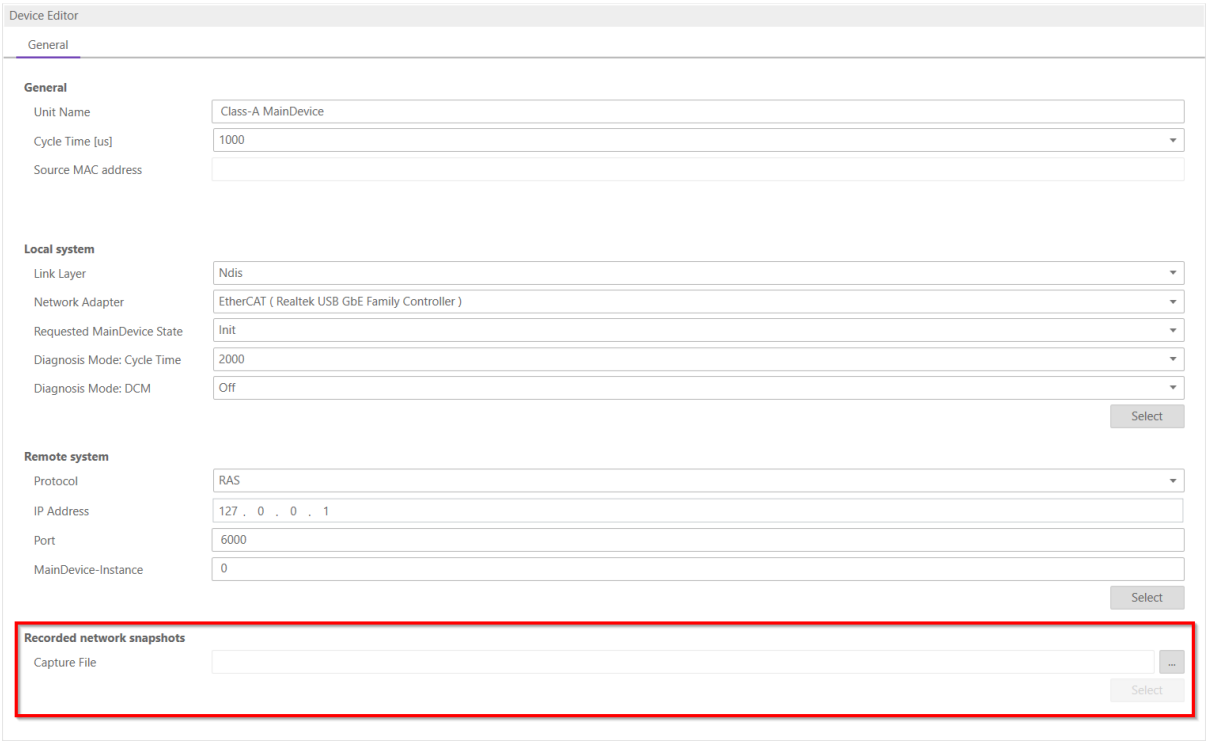
Lock Port:
Enable if user should be not able to change the Port

MainDevice-Instance:
Enter MainDevice-Instance number

Show MainDevice-Instance:
Enable if user should be able to view and change the MainDevice-Instance

Lock MainDevice-Instance:
Enable if user should be not able to change the MainDevice-Instance

Offline Diagnosis



Display Group:
Shows or hides group

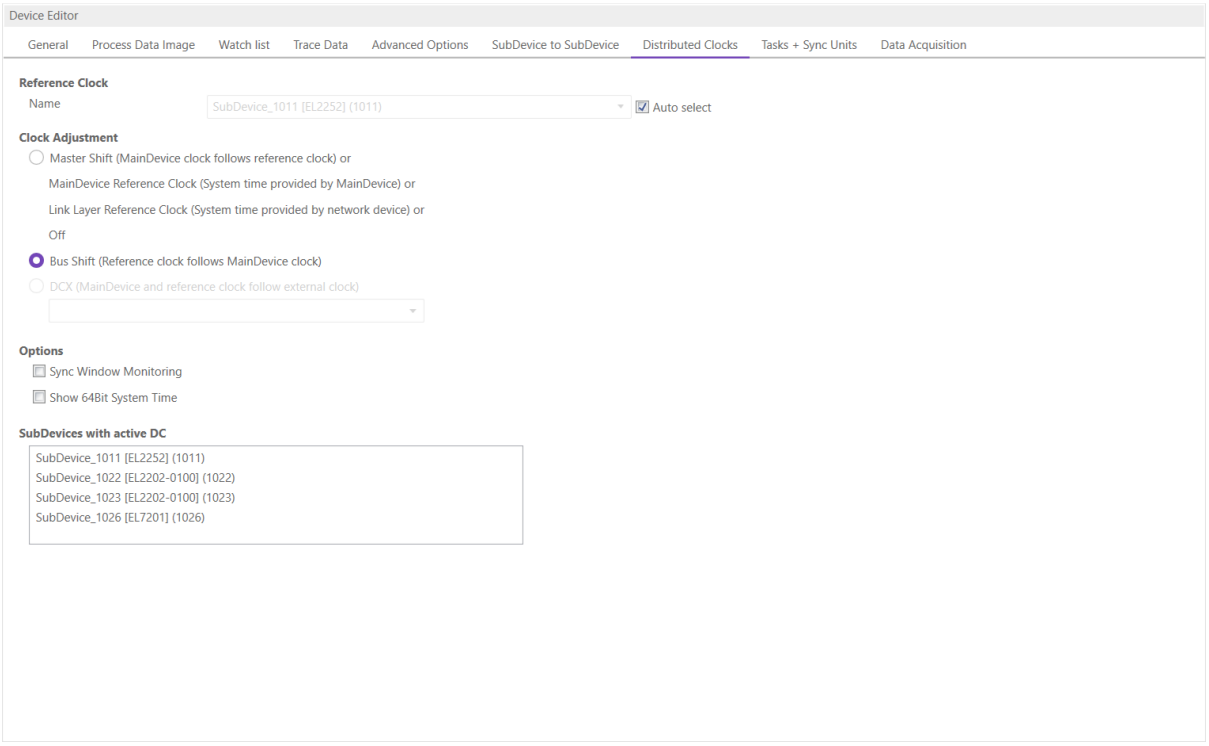
Lock Group:
Locks or unlocks group

Simulator Functions

Display Group:
Shows or hides group

Lock Group:
Locks or unlocks group

Distributed Clocks



Display Group:
Shows or hides group

Clock Adjustment:
Enter clock adjustment value (0 = default, 1 = MainDevice Shift, 2 = Bus Shift

Lock Clock Adjustment:
Enable if user should not be able to change clock adjustment

Show Clock Adjustment:
Enable if clock adjustment should be visible

Continuous Propagation Compensation:
Enter default value of Continuous Propagation Compensation

Show Continuous Propagation Compensation:
Enable if user should be able to change value of Continuous Propagation Compensation

Sync Window Monitoring:
Enter default value of Sync Window Monitoring

Show External Mode:
Enable if user should be able to use an external sync device as reference clock

System Time 64 Bit:
Enter default value of System Time 64 Bit

Features

AoE:
Enable if MainDevice supports AoE

EoE:
Enable if MainDevice supports EoE

FoE:
Enable if MainDevice supports FoE

SoE:
Enable if MainDevice supports SoE

VoE:
Enable if MainDevice supports VoE

Export Variables:
Enable if user should be able to export variables

Show Enable Column:
Shows column for enable variables on `XML` export

Generate SubDevice Name with Type:
Enable if type of SubDevice should be added to SubDevice names on generating `ENI` file

Lock Variables:
Locks or unlocks variables for editing in diagnosis mode

Show Variable Chart:
Enable if user should be able to view the chart of a variable

Show Variable Comments:
Enable if user should be able to view and edit the comments of a variable

Allow E-Bus as HC Head:
Enable if Ebus shall be allowed as HC Head

`ENI` Deployment:
yes: something is done with `ENI` after export, no: nothing done ask: you will be ask to deploy

Deployment Mode:
0: copy to path, 1: execute batch at path

Deployment Path:
Path to copy `ENI` or to batch for execution

Hot Connect:
Enable if MainDevice supports hot connect

Scripts

Display Group:
Shows or hides the Scripts Tab

P1:

Scan Start Script 1:
First script executed before scanning

Scan Start Script 2:
Second script executed before scanning

Scan Stop Script 3:
First script executed after scanning

Scan Stop Script 4:
Second script executed after scanning

P2:

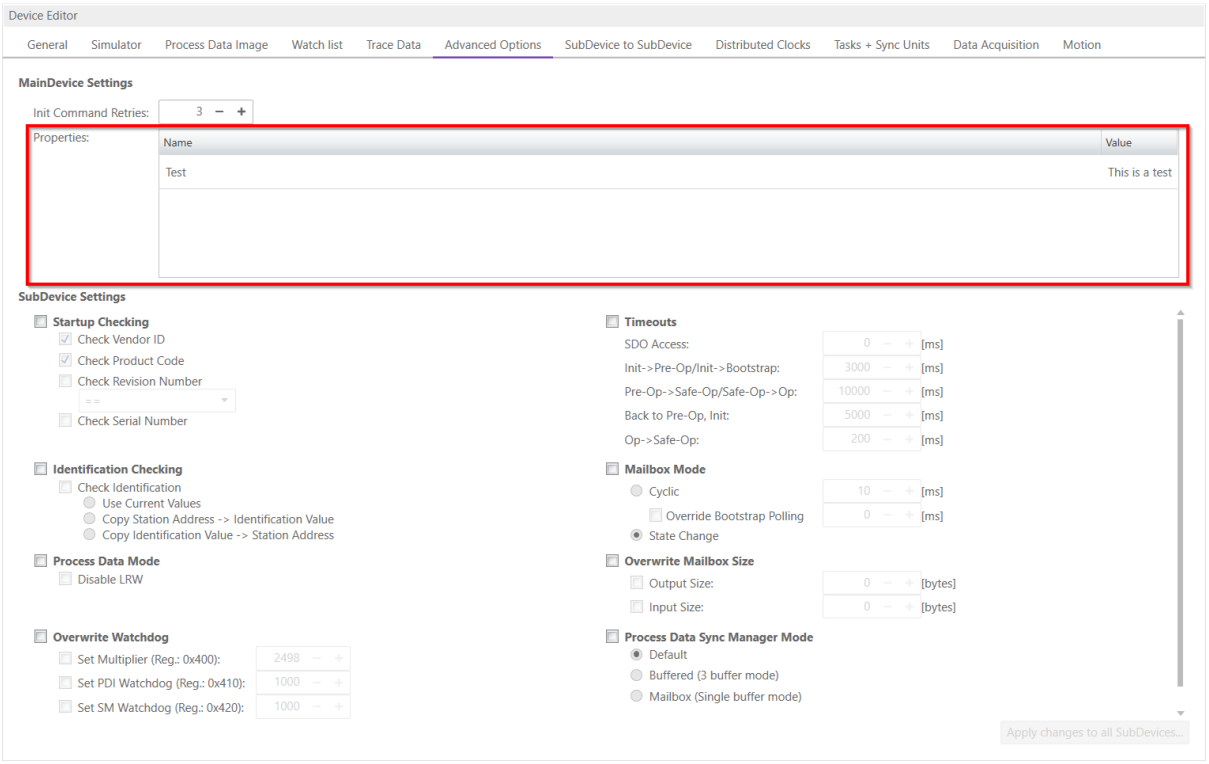
Diag Start Script 1:
First script executed before switch to diag

Diag Start Script 2:
Second script executed before switch to diag

Diag Stop Script 3:
First script executed before switching to config

Diag Stop Script 4:
Second script executed before switching to config

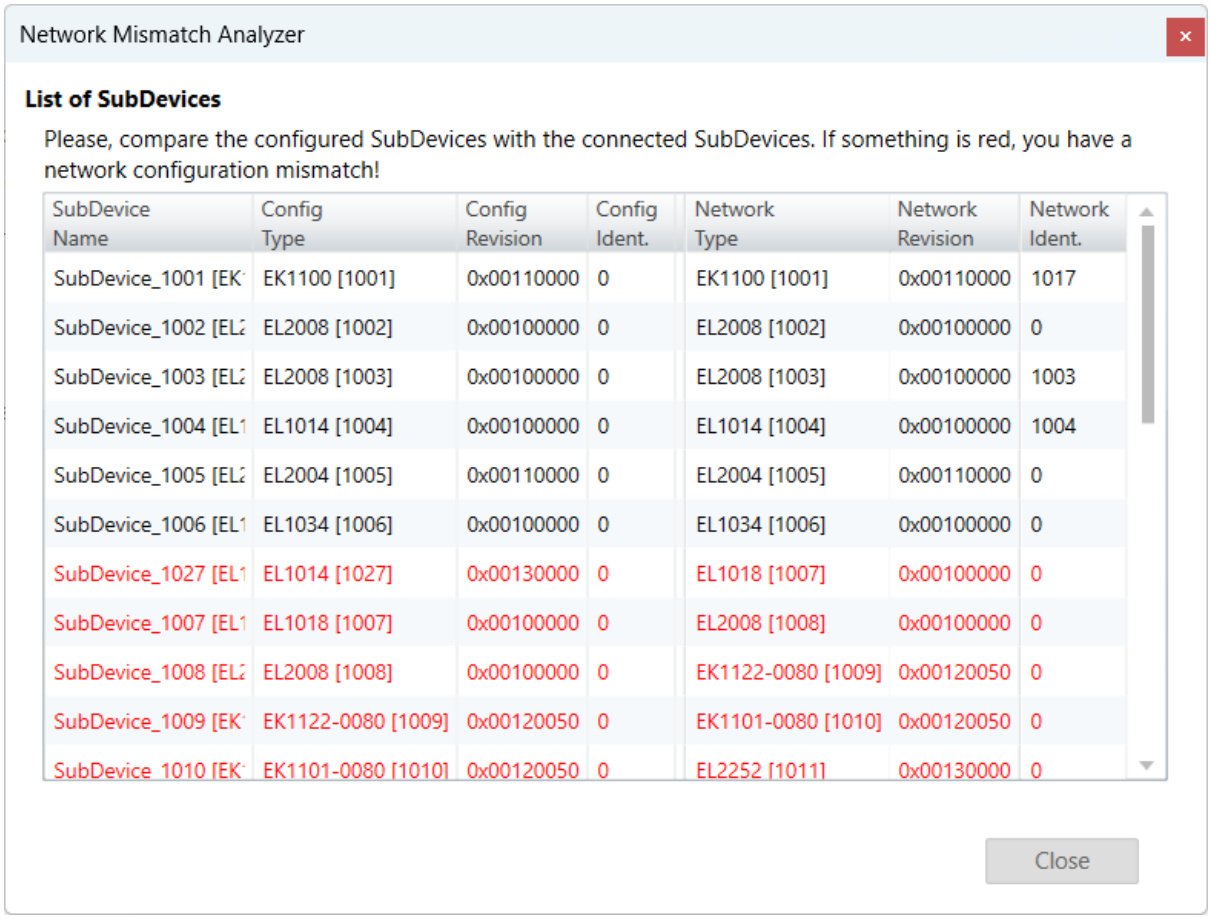
Parameters



User defined properties, which will be written into `ENI` file and can be interpreted by the application inside EC-Master.

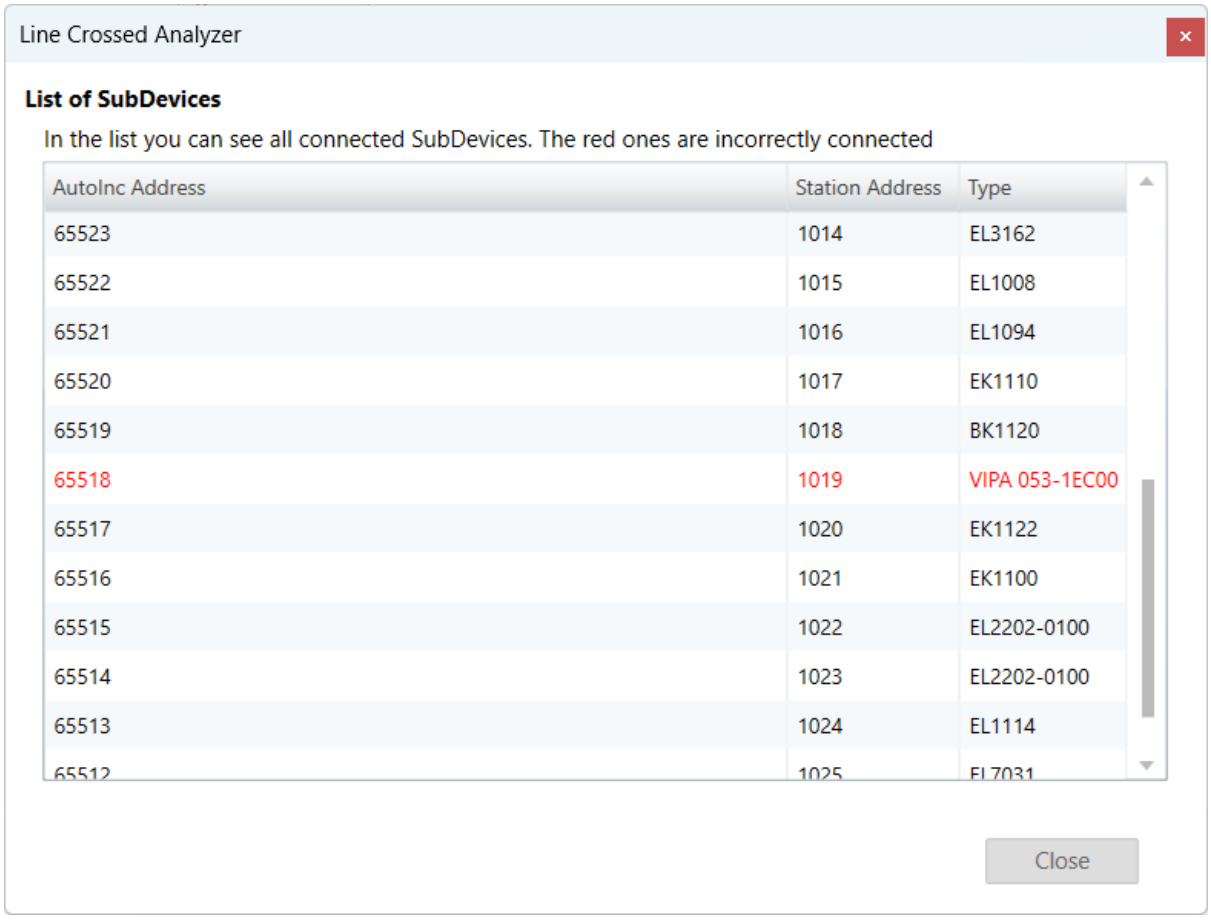
8.3 Network Mismatch Analyzer

If you have a network mismatch in your EtherCAT network it is not so easy to find the problem. For this you have the Network Mismatch Analyzer. You find it in the network main menu. If you see here some "red" entries, means that this is the start point of your network mismatch:



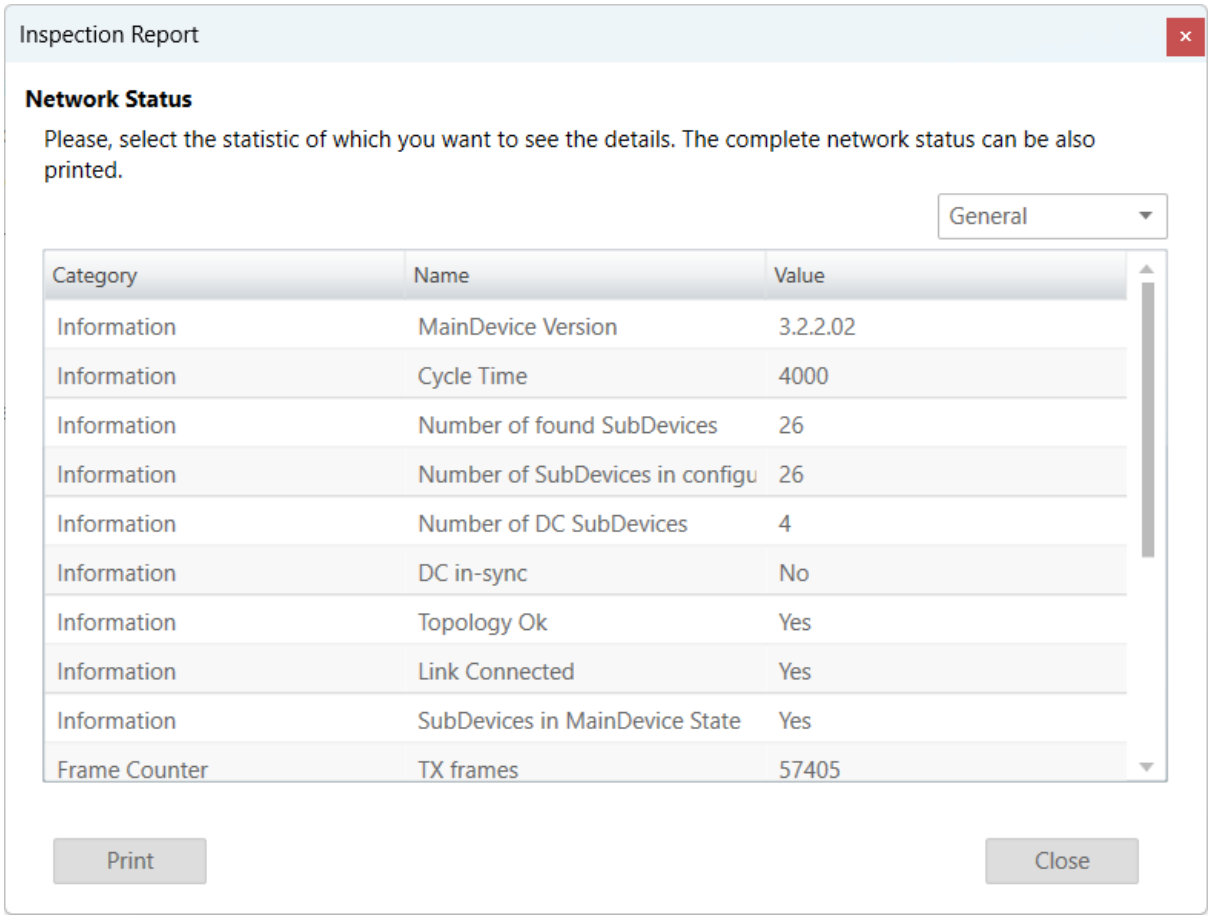
8.4 Line Crossed Analyzer

If you have connected a line to a wrong port, you can see in the Line Crossed Analyzer which SubDevice is incorrectly connected. The wron entries will be red:



8.5 Inspection Report

If you want to print or show a report about the actual session, it is possible with the inspection report. I shows a lot of different data about the network communication. It is also possible to print a PDF.



8.6 EoE Endpoint Configuration

If you want to use EoE SubDevices with your local MainDevice, you can activate the EoE Endpoint.

Note: This feature is only available if the package “Tap-Windows” from OpenVPN is installed: http://openvpn.net/index.php/download/community-downloads.html

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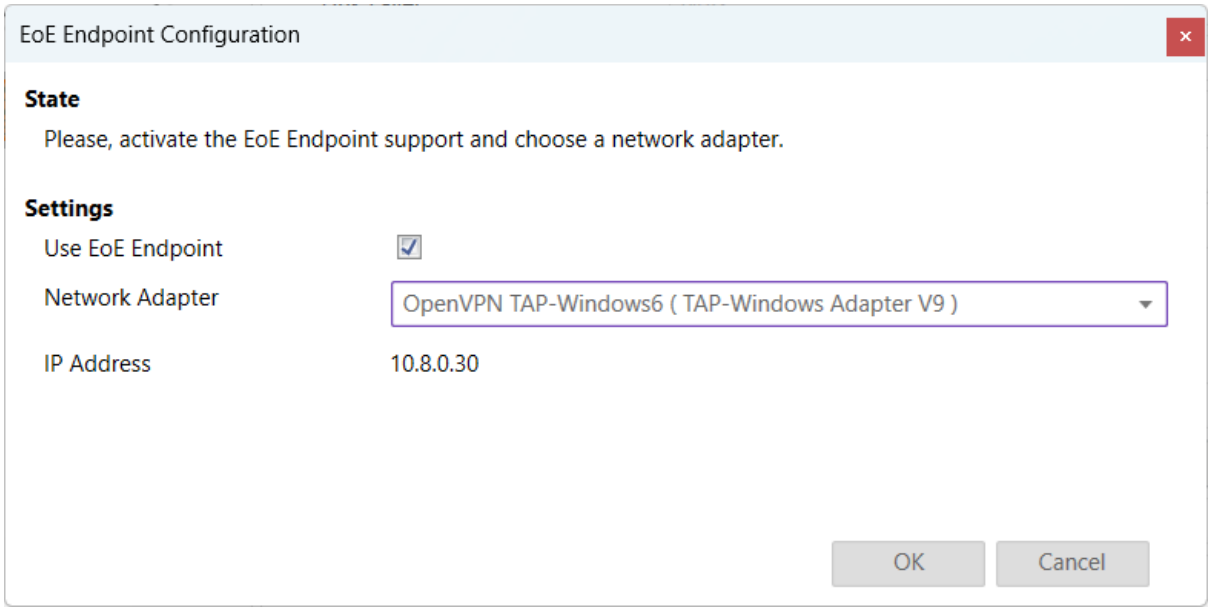
If this package is installed, you will see the following dialog:



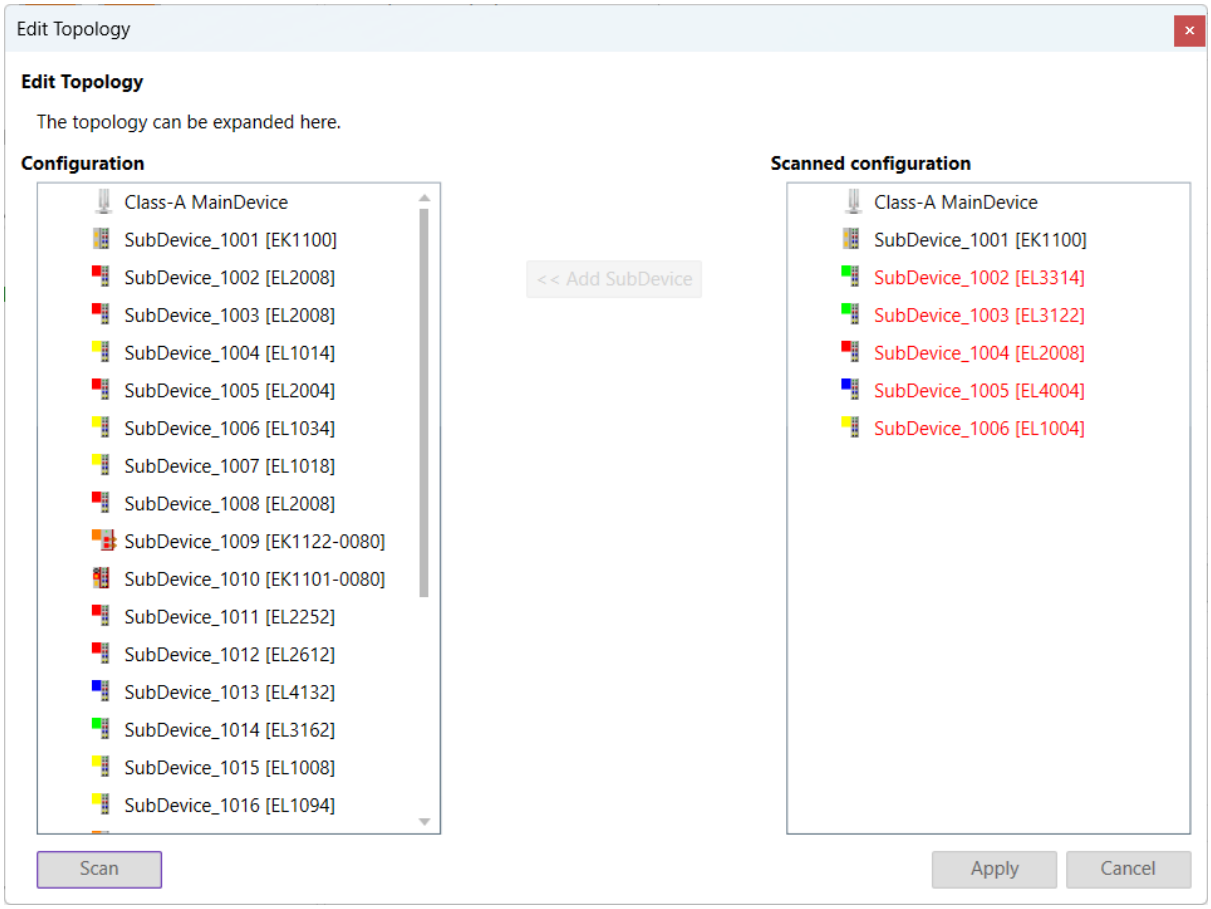
Settings

Use EoE Endpoint:
Activate EoE Endpoint support for the selected device

Network Adapter:
List of installed network adapters (TAP)

IP Address:
IP Address of the selected network adapter

8.7 Edit Topology



Disconnect:
Disconnets the selected port

Connect:
Connects the selected SubDevice in the not connect SubDevices list, with the selected port in the configuration

Up: Moves the SubDevice up in the configuration

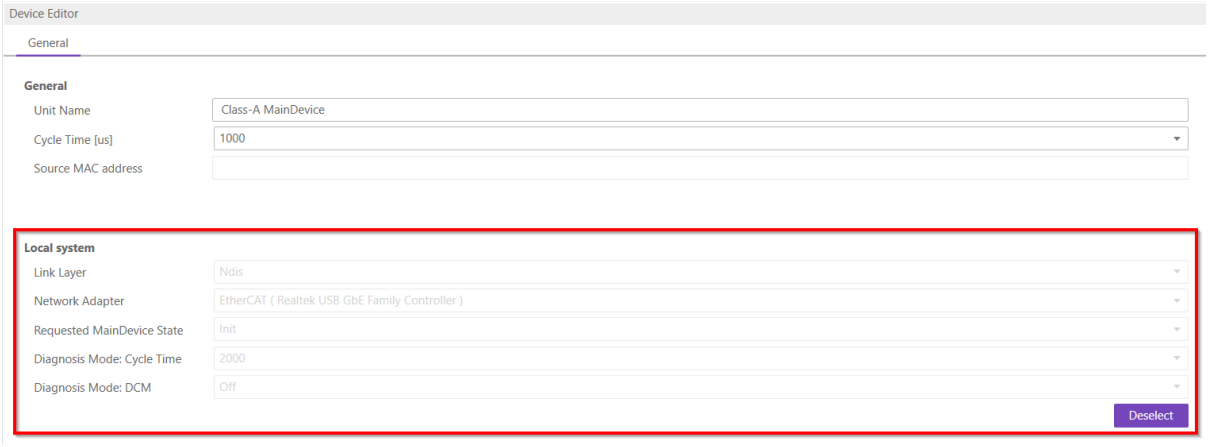
Down:
Moves the SubDevice down in the configuration

Scan:
Scans the network. The network is shown by the scanned configuration. It is possible to add SubDevice to the configuration with “Add SubDevice”.

Apply:
The configuration will be applied to the EC-Engineer (only possible if all SubDevices are connected)

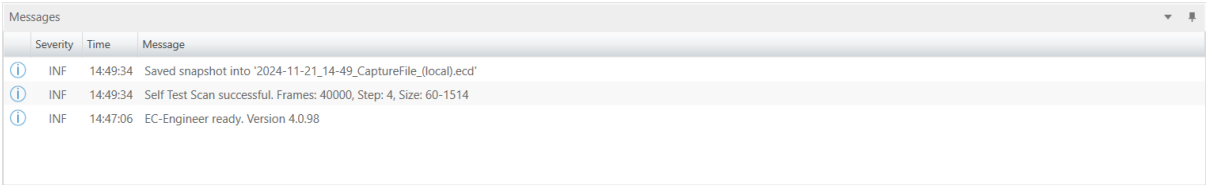
8.8 Self Test Scan

To perform a Self Test Scan, a MainDevice and a target system must be selected.



The settings for the Self Test Scan can be found on the expert tab in the settings dialog, see *Expert*.

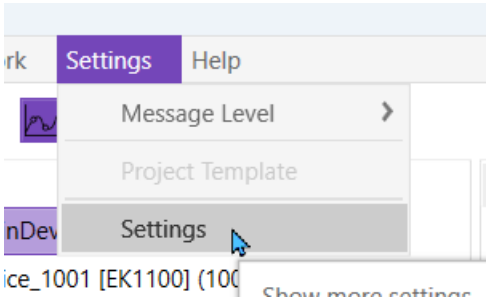
After the Self Test Scan is successful, we get the following logs from the message panel.



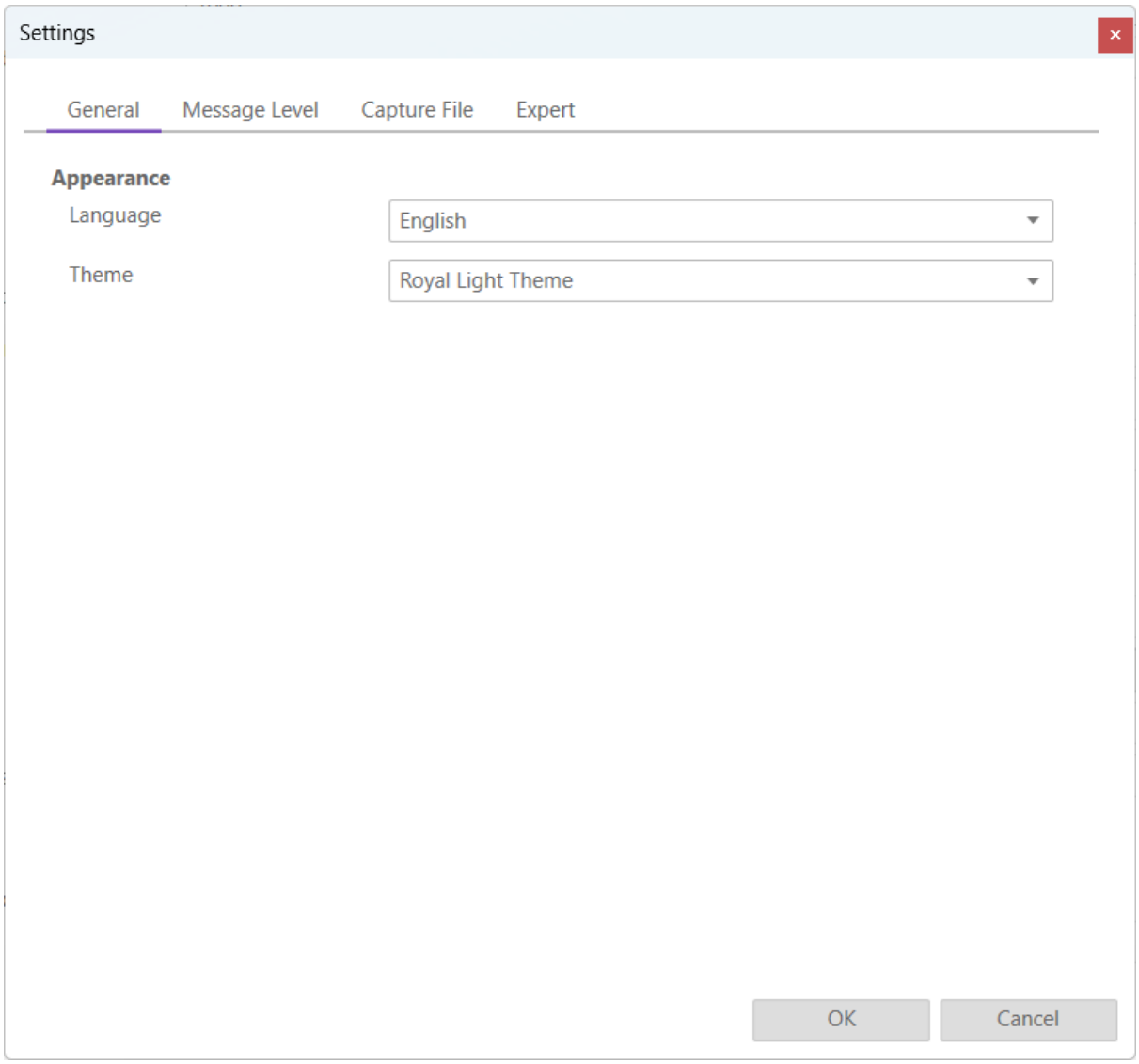
A capture file is produce after the scan and it is saved to diagnose the results. The file is saved in the path given in the capture file settings.

8.9 Settings

Can be found inside the settings menu bar.



8.9.1 General

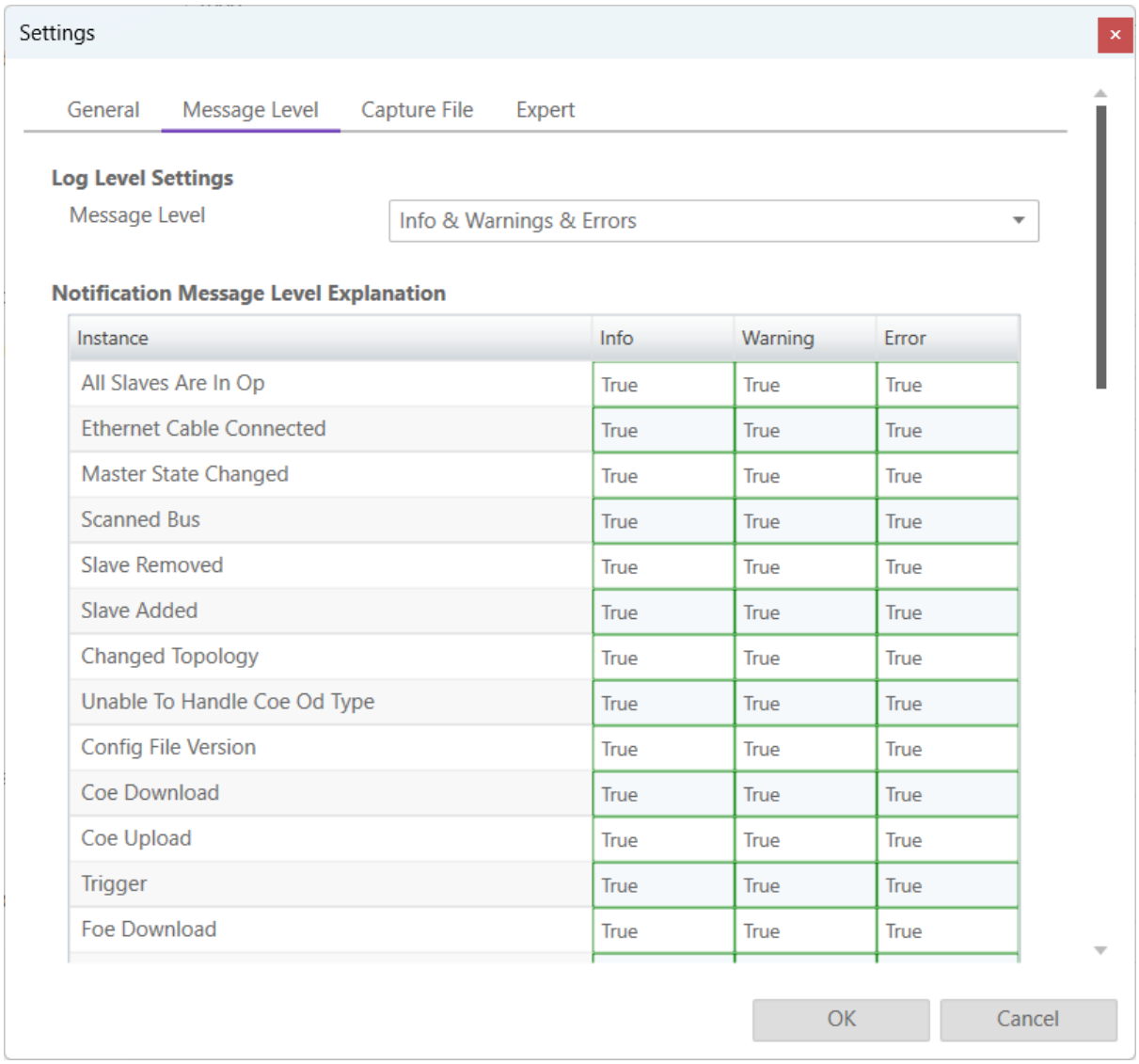


Appearance

Language:
Changes the current language

Theme:
Changes the current theme

8.9.2 Message Level



In this tab the log level of the message panel can be changed.

Log Level Settings

Message Level:
Changes what messages are displayed on the message panel

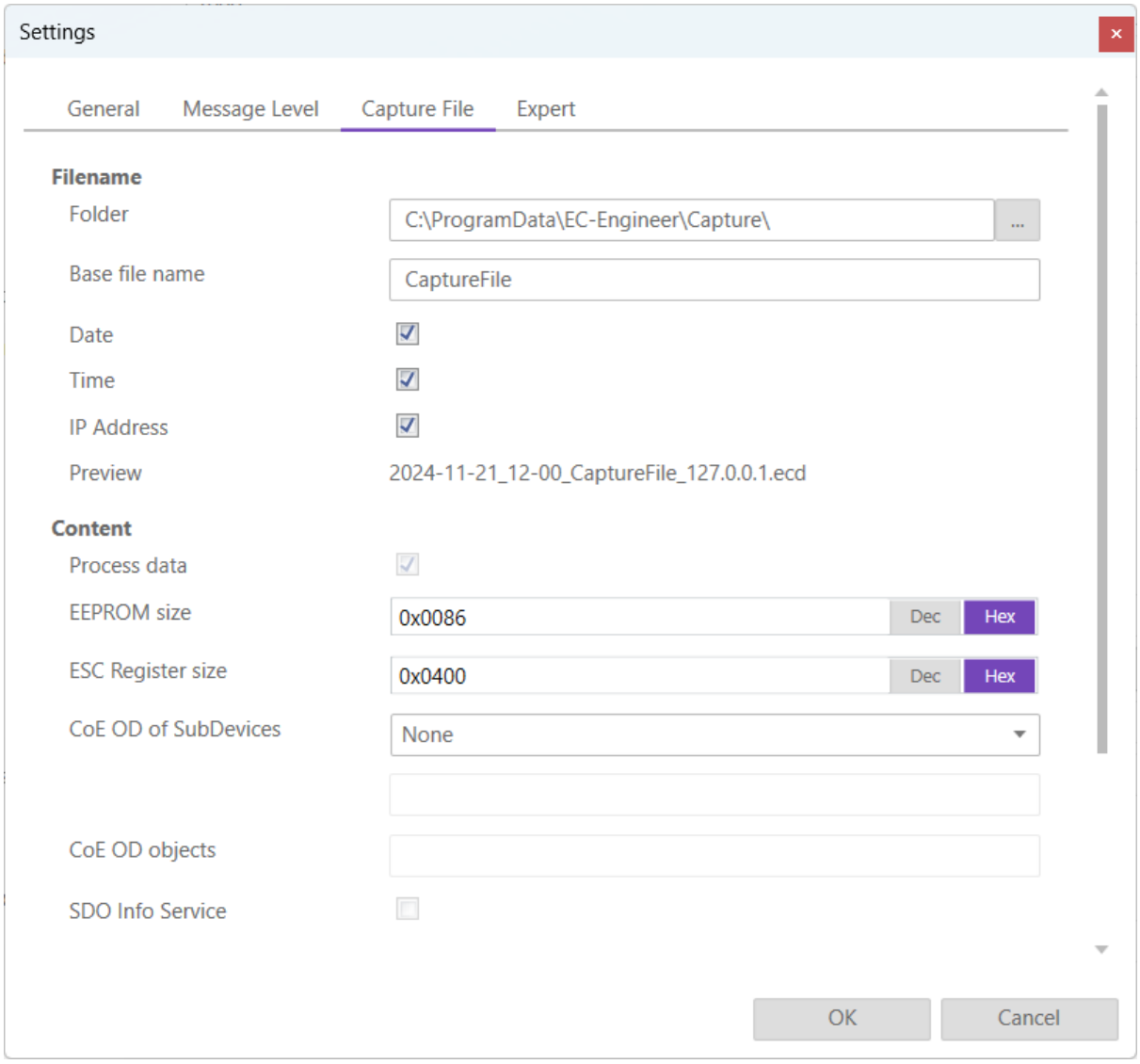
Explanation
We can see what messages are displayed depending on the selected message level (true it is displayed, false it is not displayed)

8.9.3 Capture File

A capture file could be helpful, if a very large system is given or the system is not always available. In that case the user can connect to their system, save one or more snapshots into a capture file and analyse the created capture file later.

Another use case is, that their system from time to time some problems. In that case the user can activate the automatic mode and create the snapshots at specific intervals or based on specific MainDevice notifications.

At the moment there are the following options:



Filename

Folder:
Path, where the capture files should be saved

Base file name:
Base file name of the generated capture file name

Date:
Activate, to add the date to the generated capture file name

Time:
Activate, to add the time to the generated capture file name

IP Address:
Activate, to add the IP address to the generated capture file name

Preview:
Shows a preview of the generated capture file name

Content

Process data:
Activate to add process data to the capture file (read-only)

EEPROM size:
Enter size of the EEPROM (0x86 = default, 0 = no EEPROM)

ESC Register size:
Enter size of the ESC Registers (0x400 = default, 0 = no ESC register)

CoE OD of SubDevices:

Select the SubDevices of which the CoE OD information will be captured

None:
CoE OD will be not captured

All:
CoE OD will be captured of all SubDevices

User defined:
CoE OD will be captured of the defined SubDevices by physical address (e.g. 1001-1003; 1005)

CoE OD objects:
Enter index of specific objects or all objects will be collected (e.g. 0x1018; 0x7000-0x7FFF)

SDO Info Service:
Activate to use the SDO Info Service for loading the CoE Object Dictionary instead of readying the information from the `ESI` file.

Automatic Mode

Interval (min):
Time to wait until next snapshot will be taken

Maximum Snapshots:
Enter count of maximum snapshots

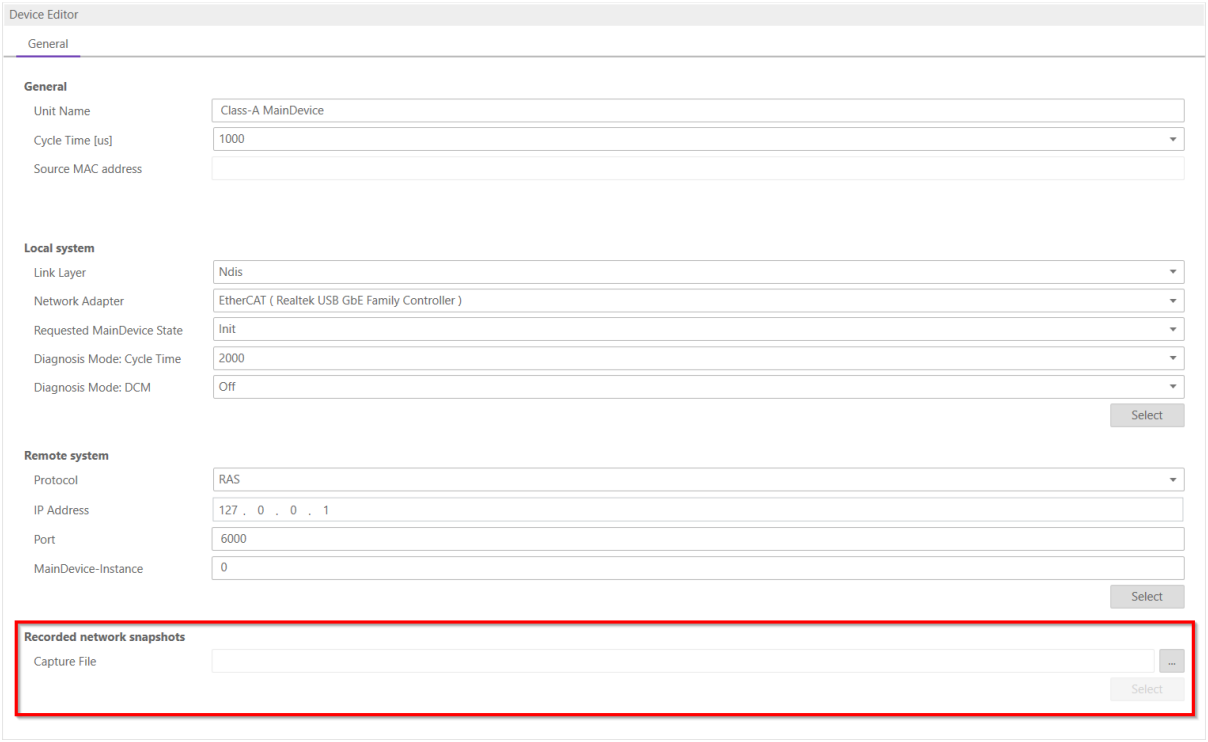
Notifications:

Select the notifications, which will trigger a snapshot. The following notifications are availabe (for more information about notifications please refer the manual of EC-Master):

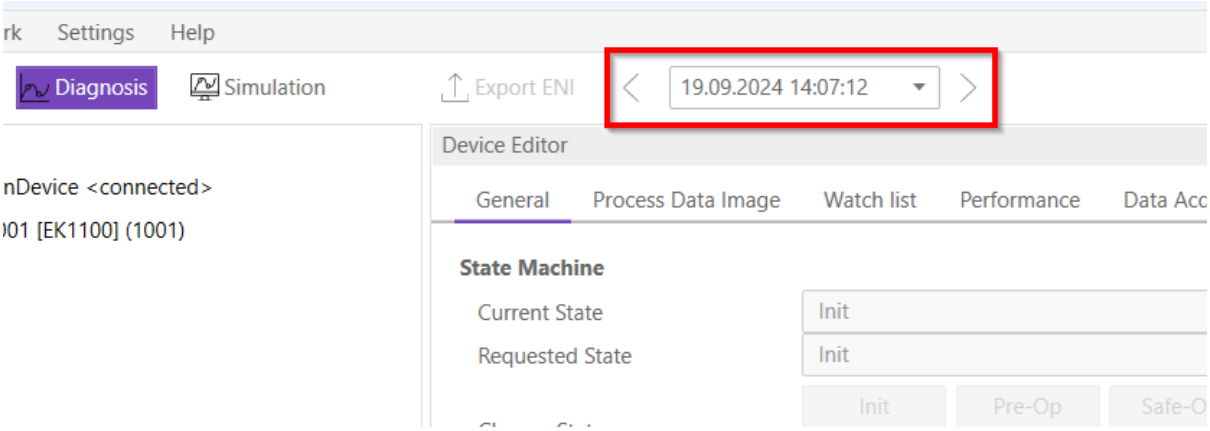
- STATECHANGED
- ETH_LINK_CONNECTED
- ETH_LINK_NOT_CONNECTED
- SLAVE_STATECHANGED
- SLAVE_PRESENCE
- SLAVE_INITCMD_RESPONSE_ERROR

- STATUS_SLAVE_ERROR
- SLAVE_UNEXPECTED_STATE
- DC_SLV_SYNC
- DCM_SYNC

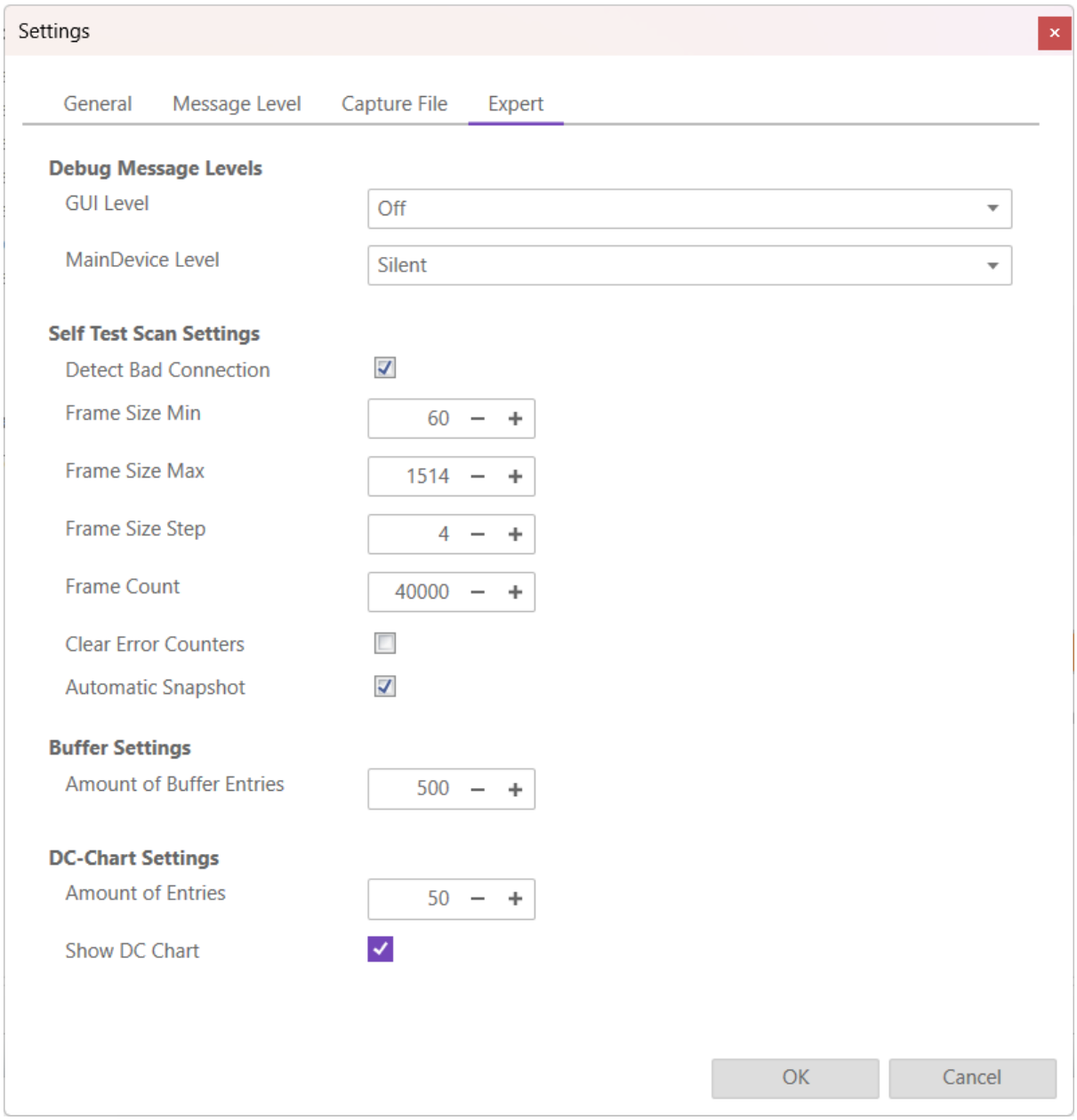
After the snapshot(s) is / are made in diagnosis mode they can be selected in the overview in config mode:



After the selection switching to diagnosis mode is possible. In the toolbar will be an additional combobox to select the snapshot and switch between them:



8.9.4 Expert



Debug Message Levels

GUI Level
Changes the GUI debug message level

MainDevice Debug Message Level
Changes the MainDevice debug message level

Self Test Scan Settings

Detect Bad Connection
(De-)Activates bad connection detection

Frame Size Min
Changes the min frame size

Frame Size Max
Changes the max frame size

Frame Size Step
Changes the frame step size

Frame Count
Changes the frame count

Clear Error Counters
Resets the error counters on the MainDevice

Automatic Snapshots
Enables the creation of a snapshot after running a successful Self Test Scan

Buffer Settings

Amount of Buffer Entries
Changes the amount of entries in the Buffer/Charts (eg. Variables)

DC-Chart Settings

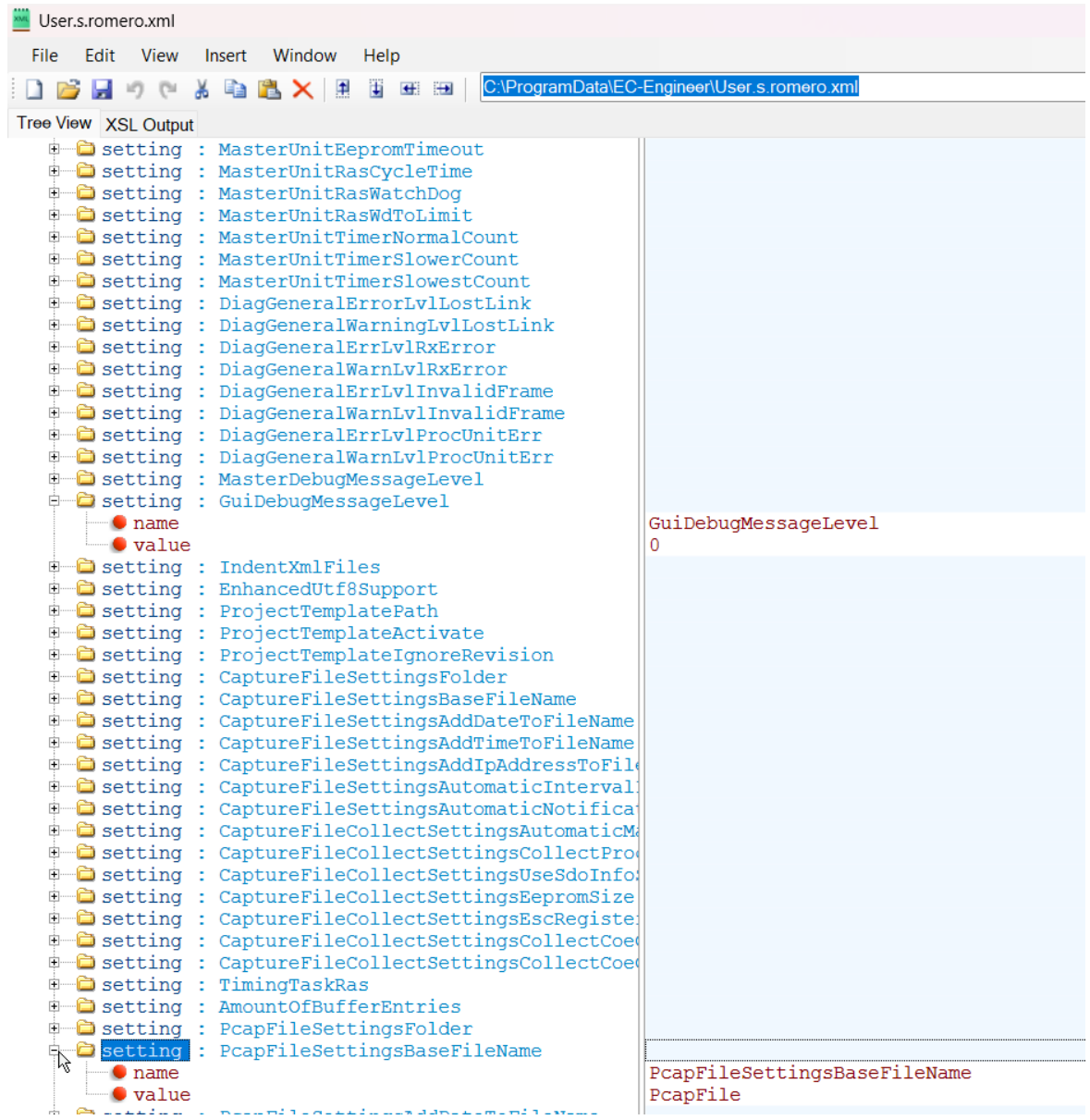
Amount of Entries
Changes only the amount of entries in the chart in the DC Diagnosis Tab

Show DC Chart
Check to display the chart in the DC Diagnosis Tab

8.9.5 Settings File

Inside this file the user can modify all settings, including some that are not present in the settings dialog.

Warning: Only modify this file if you know what you are doing.

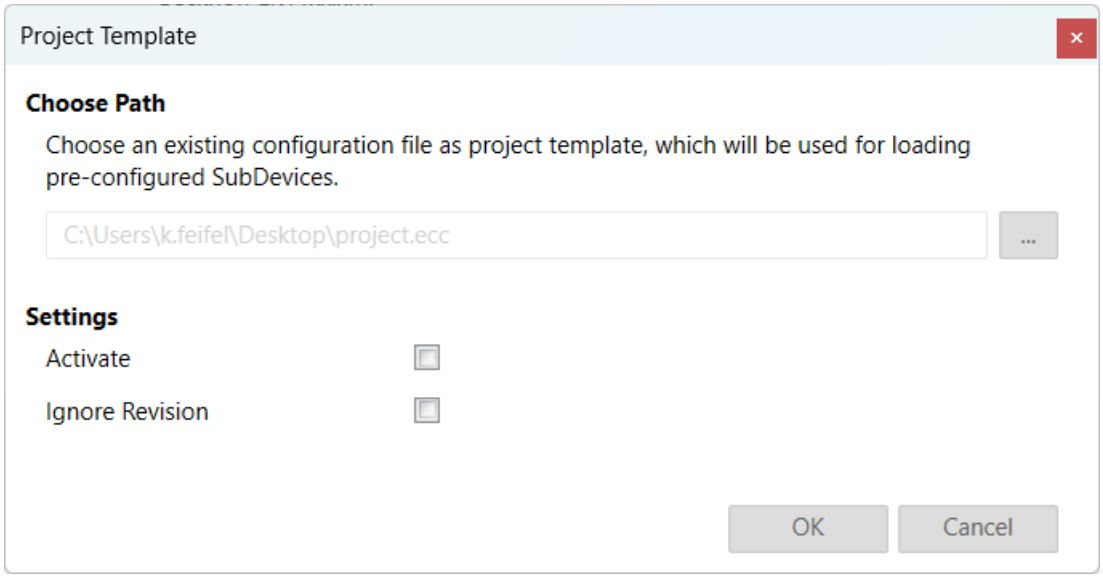


The file can be located either at “C:/ProgramData/EC-Engineer/User.<username>.xml” or insdie the install directory.

8.10 Project Templates

If you have a lot of SubDevices with the same configuration (e.g. PDOs, InitCmds) you can use a project template. In that case new SubDevices will be first copied from this template (if available) and then taken from the `ESI` cache. This behaviour is also used for the bus scan.

At the moment there are the following options:



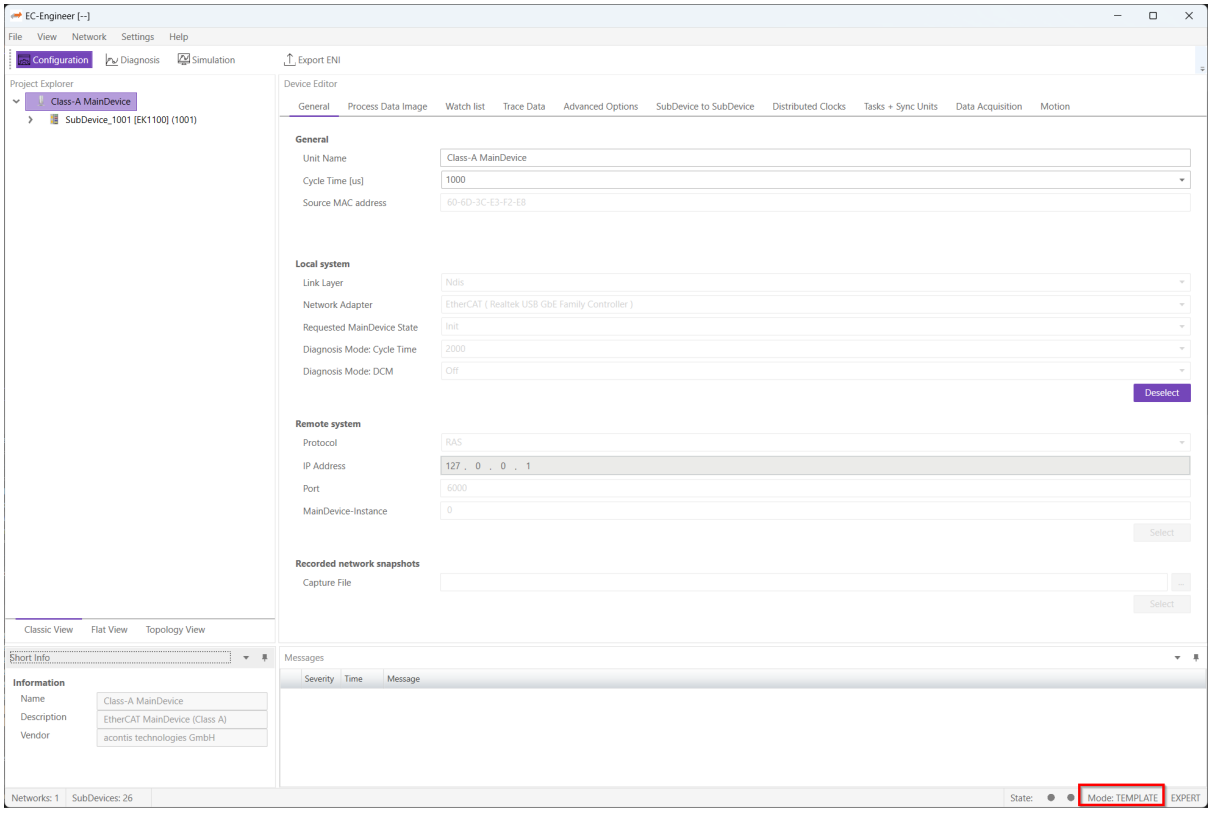
Path: Path to the selected project template

Settings

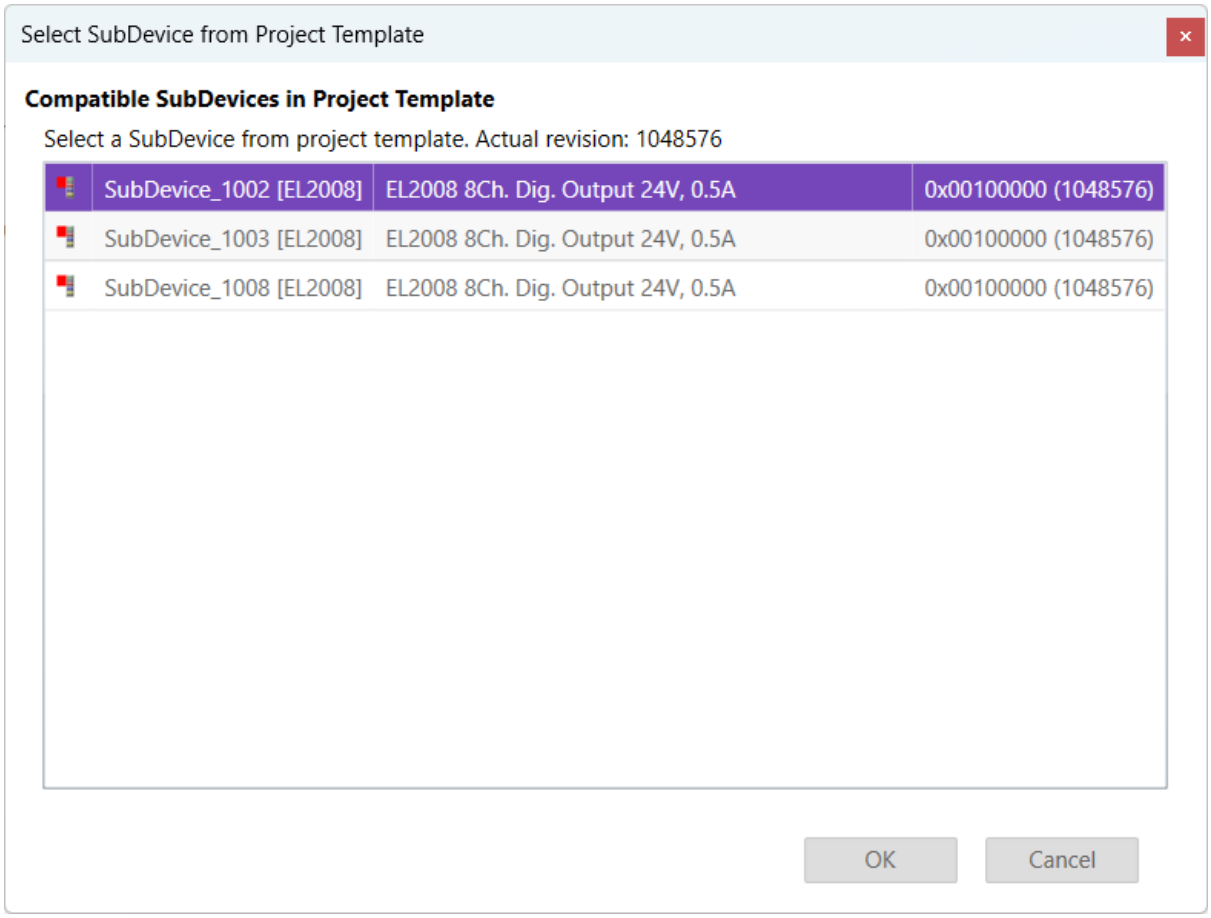
Activate:
True, for activating this project template (necessary if you want to turn it temporary off)

Ignore Revision:
The revision will be not used as search criteriom

If the project template mode is active, it will be displayed in the status bar:



Normally the first match will be taken from project template. If this is wrong, you can open the context menu *Select from Project Template* and select another one:



8.11 Real-time Support

Normally on Windows you do not have real-time support, but to get DCM in sync you can install the “ECAT driver” in the following modes:

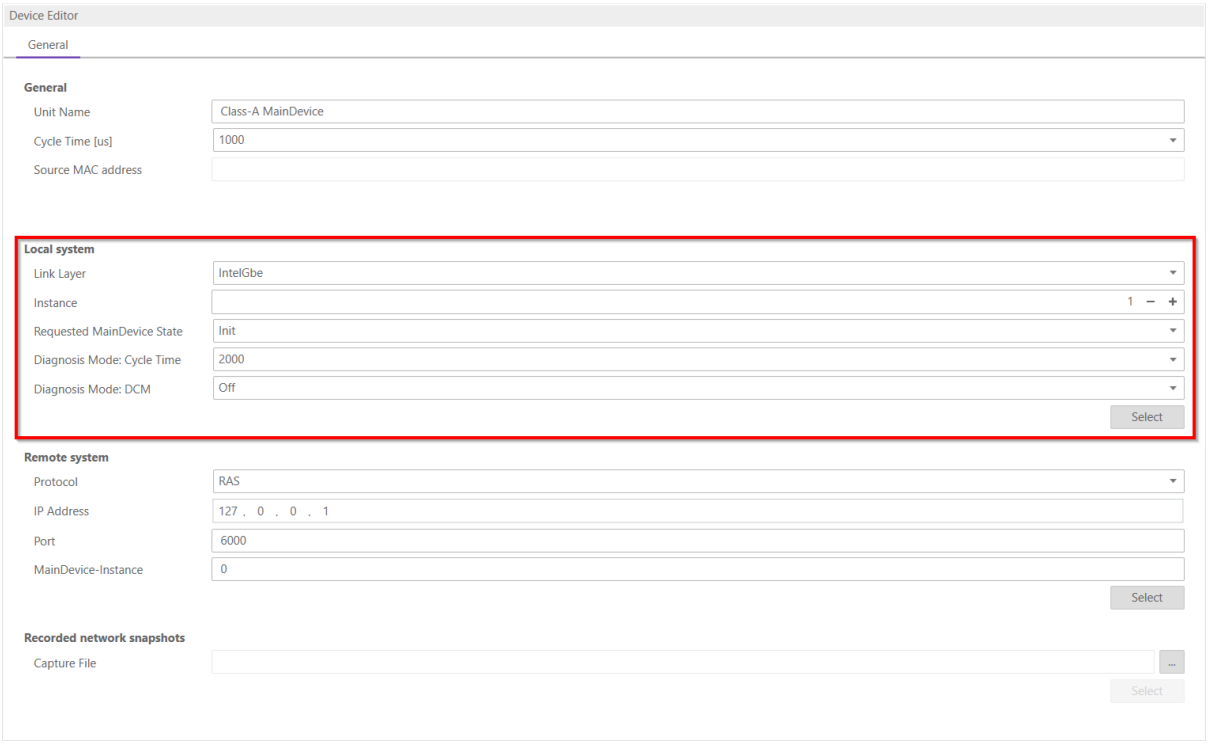
Network driver
The network driver can be used from the optimized link layers

The real-time support is normally hidden in EC-Engineer. It can be activate by copying the specific link layer libraries into the installation directory of EC-Engineer.

For the local system, EC-Engineer will turn on DCM and use the real-time clock for generating the job task cylces. For more information about how to install the “ECAT driver” please refer the manual of EC-Master Class A DCM on Windows

8.11.1 Optimized Link Layers

After activating the real-time support the optimized link layer can be selected in the option “Link Layer”:



Depending on the link layer type the user can chose the network adapter or the instance.

The following optimized link layers are currenty supported:

`emllI8254x.dll` (Intel PRO/1000 Network Adapters)

`emllI8255x.dll` (Intel PRO/100 Network Adapters)

`emllIRTL8139.dll` (Realtek 8139 Fast Ethernet Adapters)

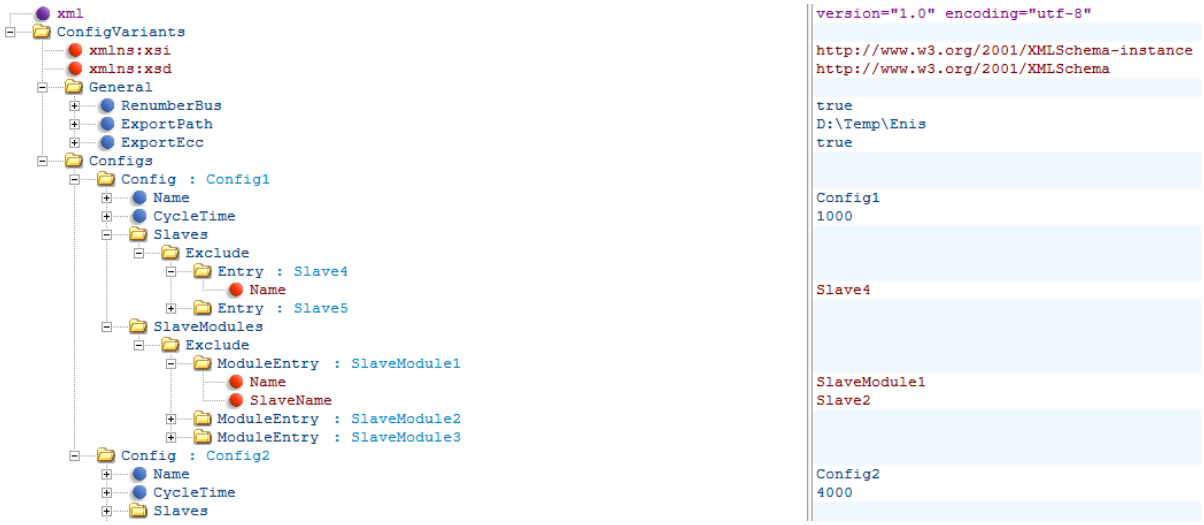
`emllIRTL8169.dll` (Realtek Gigabit Ethernet Adapters)

`emllICCAT.dll` (BECKHOFF CCAT)

For more information about optimized link layers and how to install the ECAT driver please refer the manual of EC-Master Class B EcatDrv for Optimized Link Layers

8.12 Export ENI Variants

With this function it is possible to export different ENI file variants of an config. Therefore a xml file has to be created. Then it is possible to select this xml file and create more ENI files at once. The xml file should look like this:



RenumberBus: If this is true, all SubDevices will be enumerated in a row. Otherwise each SubDevice stays with his address.

Export Path: The path were the ENI / ECC files should be saved.

ExportEcc: If true, also the ECC file be exported and not only the ENI.

Each Config needs a name. This name is used for the ENI file and the optional ECC file.

CycleTime (optional): If this is set the cycle time will be changed to this value.

Exclude: To find a SubDevice in the config the name is required. With the exclude it is possible to remove some SubDevices from a big config for example.

Include: To find a SubDevice in the config the name is required. With the include it is possible to easy delete all SubDevices in the config despite except the include ones.

Exclude (SubDeviceModules): To find a SubDeviceModule in the config the name and the name of the SubDevice are required. With the exclude it is possible to remove some SubDeviceModules from a big config for example.

Include (SubDeviceModules): To find a SubDeviceModule in the config the name and the name of the SubDevice are required. With the include it is possible to easy delete all SubDeviceModules in the config despite except the include ones.

Warning: Please use Exclude OR Include. Both in the same config does not work

9 Command Line Interface

For helping users in some special situations and to do not confuse other users the EC-Engineer supports a small command line interface:

/HELP, /?
Shows the help dialog

/CFG = config.ecc
Open a specific configuration file config.ecc directly after starting EC-Engineer

/EMI = emi.xml
Sets the path to the EMI file which should be used (Mandatory if ecc does not already exist)

/REMOTE = "127.0.0.1:6000:0"
Activates the remote system, where IP address is "127.0.0.1", port is 6000, MainDevice instance is set to 0

/ENIEXPORT = config.eni
Activates an automatic ENI export on close

/EXIEXPORT = config.exi
Activates an automatic EXI export on close

/CYCLETIME = "2000"
Changes the cycle time from ecc or EMI in config

/DIAG
Activates diagnosis mode

/CAPTURE= capture.ecd
Open a specific capture file capture.ecd directly after starting EC-Engineer and activates the diagnosis mode

/ENIBUILDER
Activates the EniBuilder support, means two additional context menu entries of the device will be available to export and import the configuration file for the EniBuilder

/PROJECTTEMPLATEPATH
Opens a specific configuration file as project template

/FORCECFG= config.ecc
Activates the "integration" mode, to be able create an ENI file automatically on closing EC-Engineer

Some menu entires are also hidden, like

- "New/Open/Save"
- "EMI Manager"
- "Export Process Variables / Import ENI file / Export ENI file"
- Toolbar

Further supported parameters:

/EMI = emi.xml
Sets the path to the EMI file which should be used (Mandatory)

/LOCAL = "127.0.0.1"
Activates the local system and the network adapter with IP address "127.0.01" will be chosen. If you use the optimized LinkLayer you can write */LOCAL* ="I8254x" or */LOCAL* ="RTL8169" (*/LOCAL* or */REMOTE* or */CAPTURE* is mandatory).

/REMOTE = "127.0.0.1:6000:0:0"
Activates the remote system, where IP address is “127.0.0.1”, port is 6000, MainDevice instance is set to 0 and protocol is 0 (RAS). It is also supported to use the DNS name instead of the IP address (*/LOCAL* or */REMOTE* or */CAPTURE* is mandatory). It is also possible to set the parameter for more MainDevice instances (only if ecc exists with more MainDevices). Therefore just add the additional parameter with a ‘;’. E.g.: */REMOTE* =”127.0.0.1:6000:1;127.0.0.2:6001:2” or */REMOTE* =”127.0.0.1:6000:1:0;127.0.0.2:6001:2:0”

/CAPTURE = C:/myfile.ccd:0
Activates the offline diagnosis system, where the path to the capture file is `c:/myfile.ccd` and the selected snapshot is “0” (*/LOCAL* or */REMOTE* or */CAPTURE* is mandatory)

/ENIEXPORT = config.eni
Activates the `ENI` export (Optional)

/EXIEXPORT = config.exi
Activates the `EXI` export (Optional)

/VAREXPORT = config.var
Activates the process variables export (Optional)

/VARTYPE = "csv|plc|pd|xml" (default=csv)
Sets the format of the process variables export SubDevice (for more information about the supported formats

/EBIEXPORT = config.ebi
Activates the EBI (EniBuilder input file) export

/SCAN
Scans the bus after startup

/FORCEDIAG
Activates the diagnosis mode after startup. If diagnosis mode can not be activated the application will be closed.

/CYCLETIME ="1000"
Sets the MainDevice cycle time and locks it for the user

/AUTOSAVE
Current configuration will be saved automatically on exit (without asking the user if he want to discard all changes)

/ALLMASTERUNITS
If there is more than one MainDevice in the ecc, you can create an `ENI` file and variable export for all with this paramter

Samples
Run EC-Engineer, scan automatically the local system with IP address 127.0.0.1, export `ENI` file and export process variables (as CSV Format) on closing

```
> EcEngineer.exe /FORCECFG="cfg_local.ecc" /EMI="emi.xml" /LOCAL=127.0.0.1
↪  /SCAN /ENIEXPORT="cfg_local.eni" /VAREXPORT="cfg_local.var"
↪  /VARTYPE="csv"
```

Run EC-Engineer, scan automatically the remote system with IP address 127.0.0.1, Port 6000, MainDeviceInstance 0, export `ENI` file and export process variables (as PLC Format) on closing

```
> EcEngineer.exe /FORCECFG="cfg_remote.ecc" /EMI="emi.xml"
↪  /REMOTE=127.0.0.1:6000:0:0 /SCAN /ENIEXPORT="cfg_remote.eni"
↪  /VAREXPORT="cfg_remote.var" /VARTYPE="plc"
```

Run EC-Engineer and switch to diagnosis mode

```
> EcEngineer.exe /FORCECFG="cfg_remote.ecc" /EMI="emi.xml"
↪  /REMOTE=127.0.0.1:6000:0:0 /FORCEDIAG
```

Run EC-Engineer and switch to offline diagnosis mode

```
> EcEngineer.exe /FORCECFG="cfg_capture.ecc" /EMI="emi.xml"
↪  /CAPTURE=C:/myfile.ccd:0 /FORCEDIAG
```

In case of an error, EC-Engineer will do the following

- Add error message to the log file (message level must be set to “All Messages”)
- If the GUI is already visible, he will show a message box
- Set exit code to “-1”

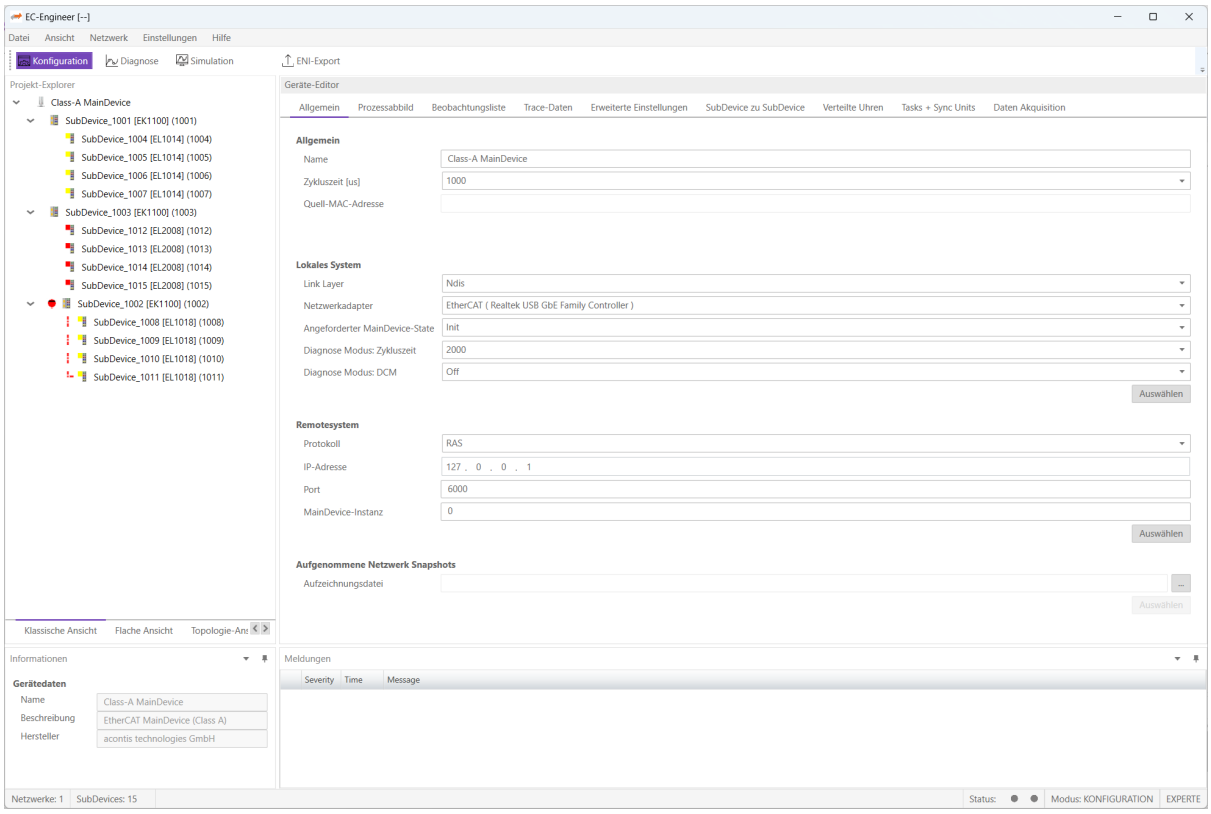
10 Customization

10.1 Multi-Language-Support

EC-Engineer supports multiple languages, which can be changed at runtime. Adding support for further lanuages is quite easy because it is just a simple `XML` file which must be added to the kit.

All language files are stored in: “%ProgramFiles%/acontis_technologies/EC-Engineer/Languages/…`

EC-Engineer has also full UNICODE support, which means that it is also possible to support Asian languages:

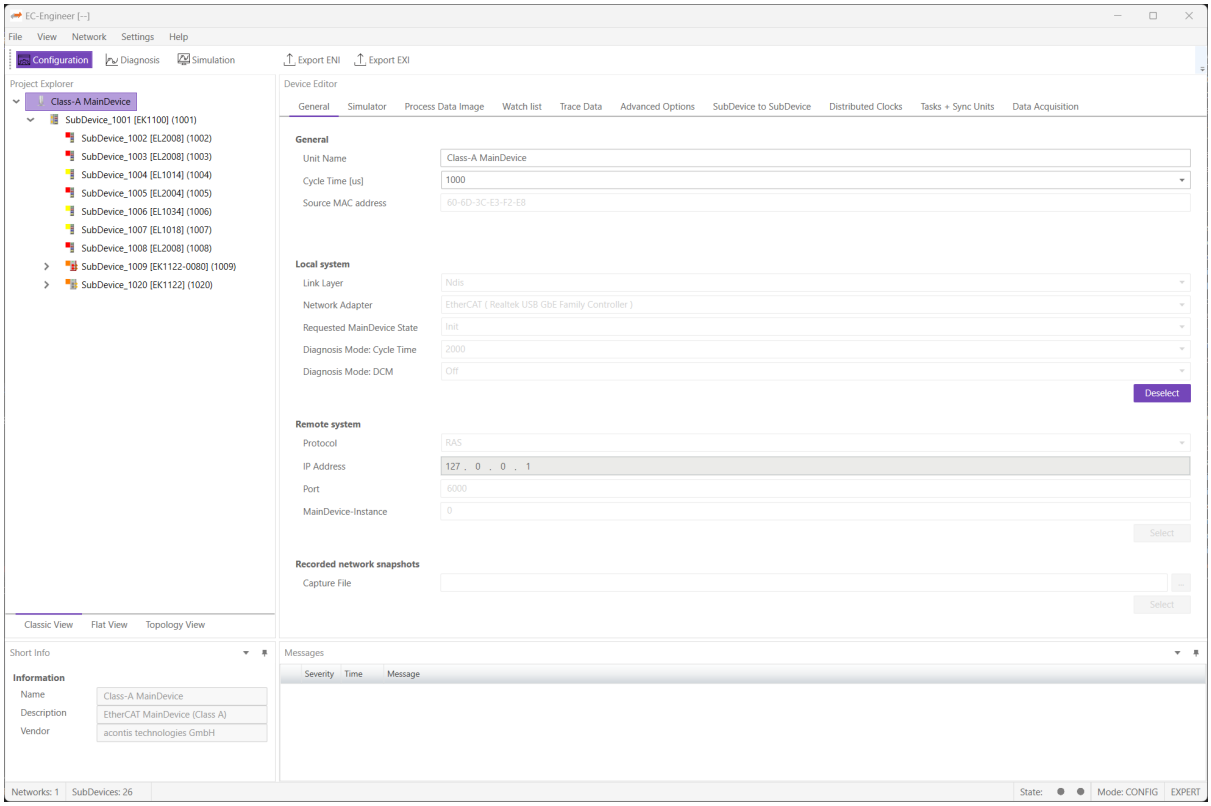


10.2 Themes

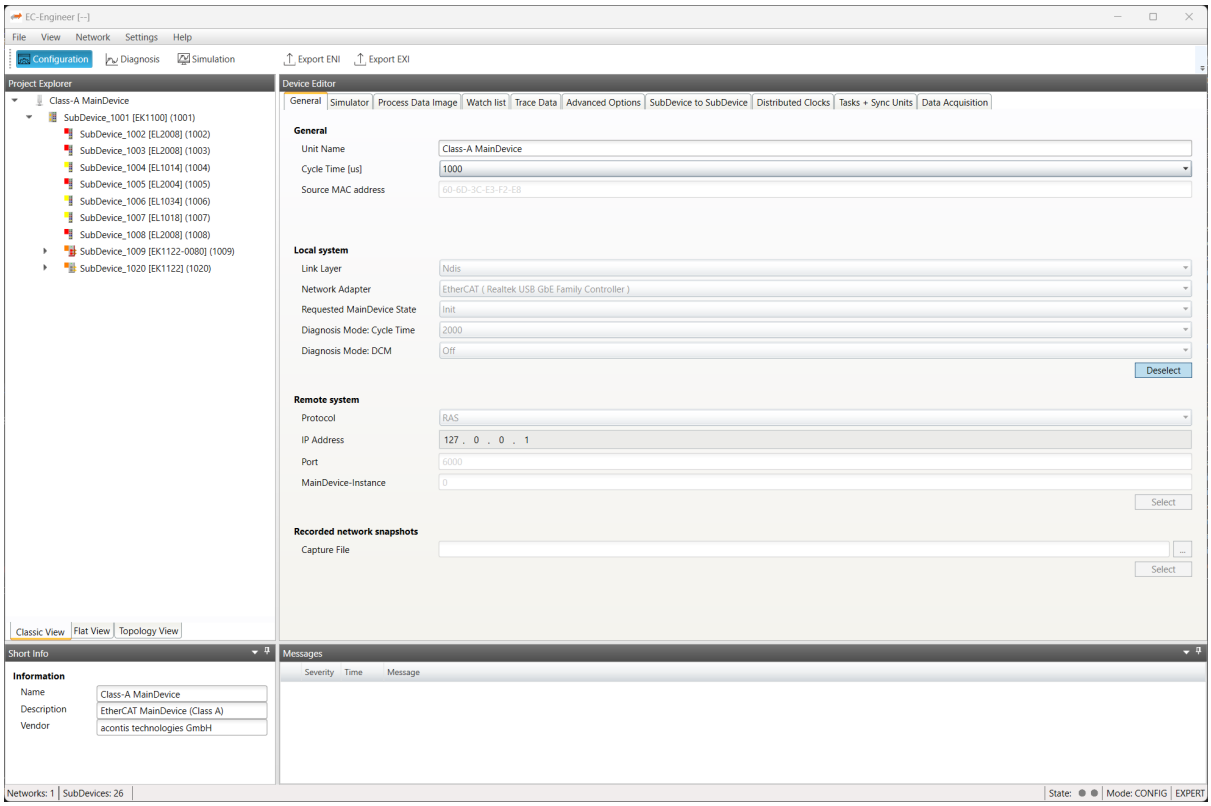
EC-Engineer supports multiple themes, which can be changed during compile time. Adding support for further themes is quite easy because a theme consists of a couple of XAML files which must be added to the kit.

Five themes are already included into EC-Engineer:

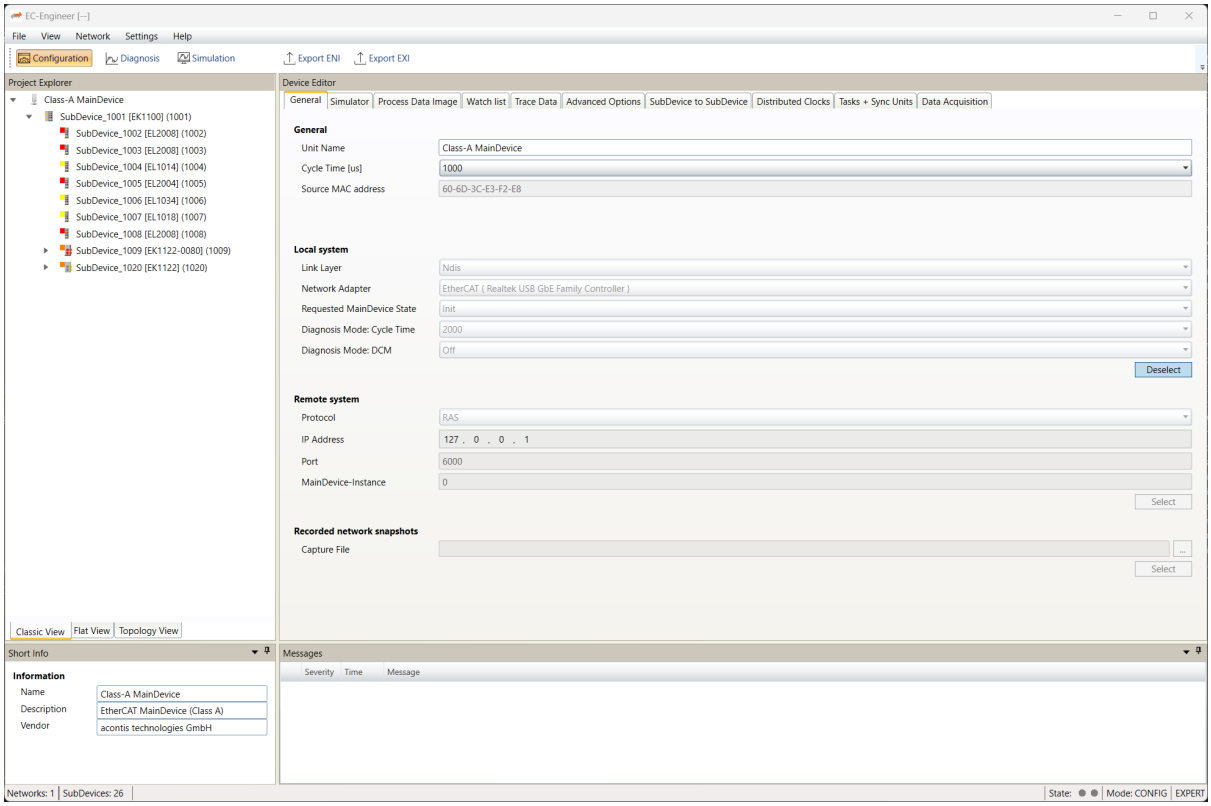
Royal Light Theme



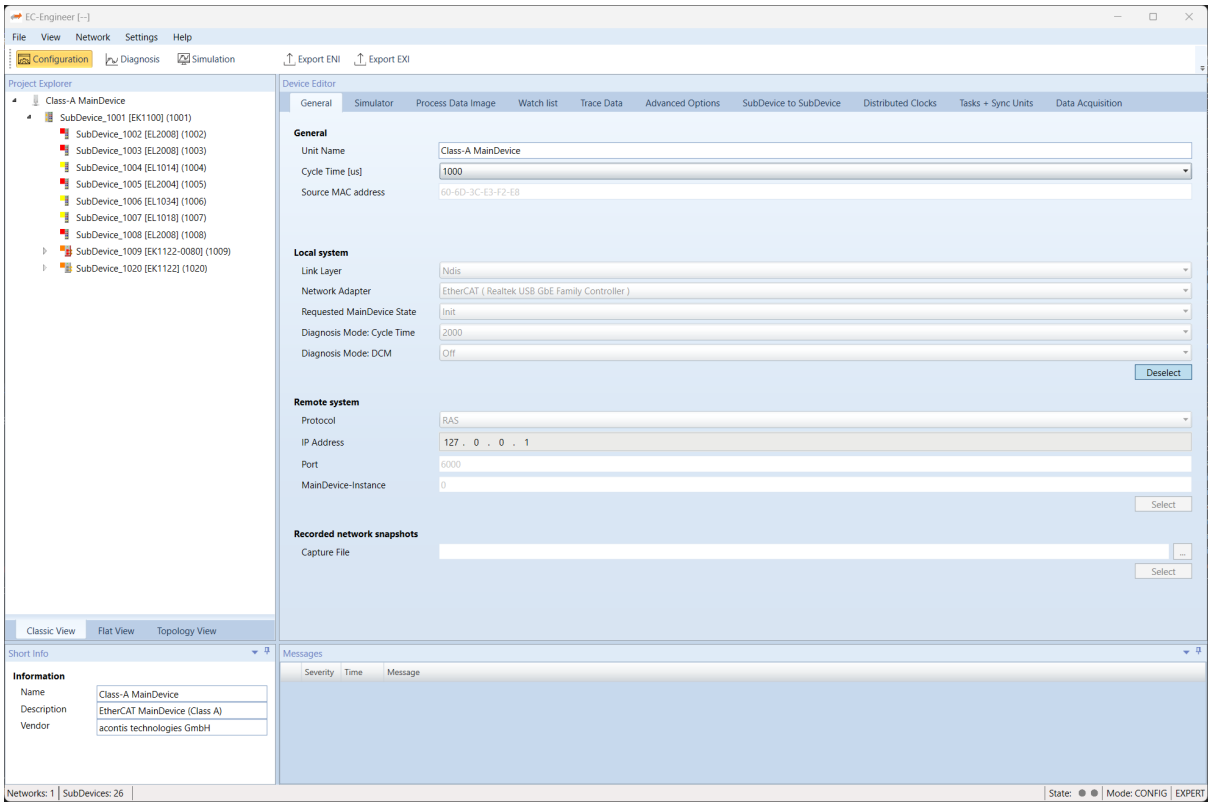
IG Theme



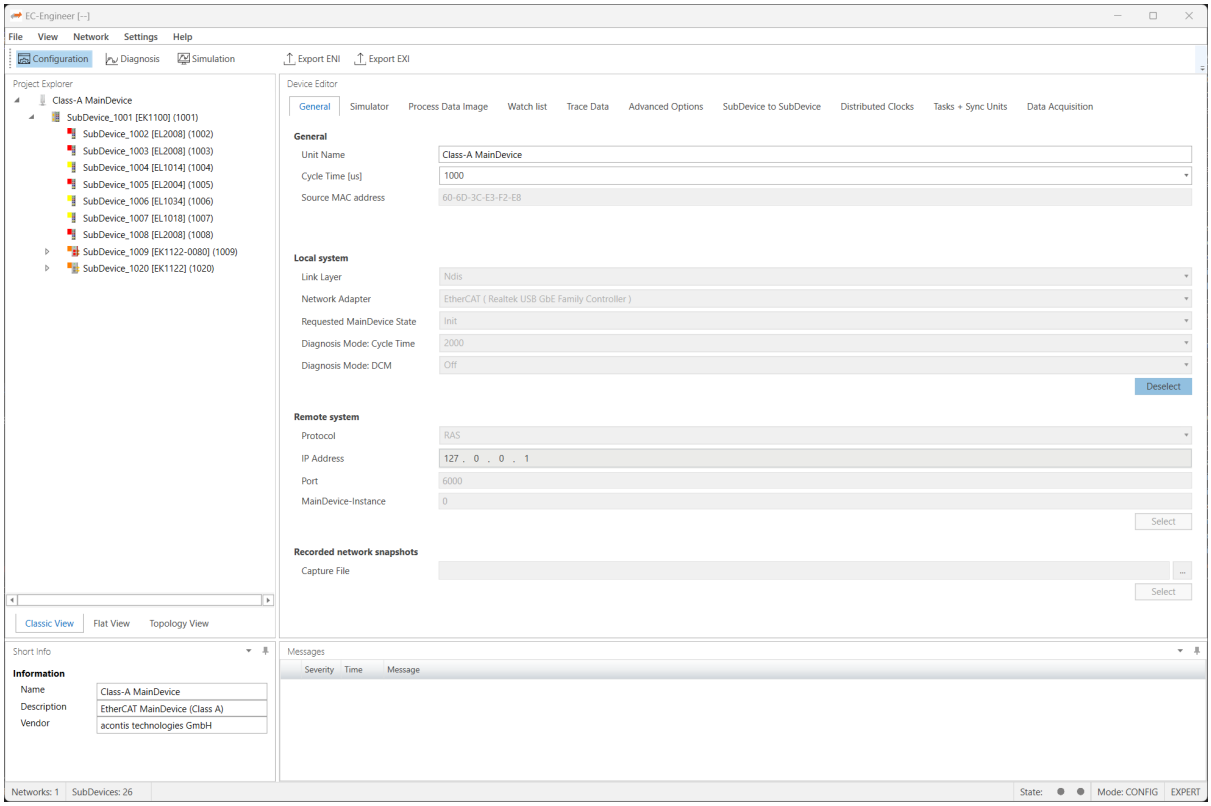
Luna Theme



Office 2010 Blue Theme

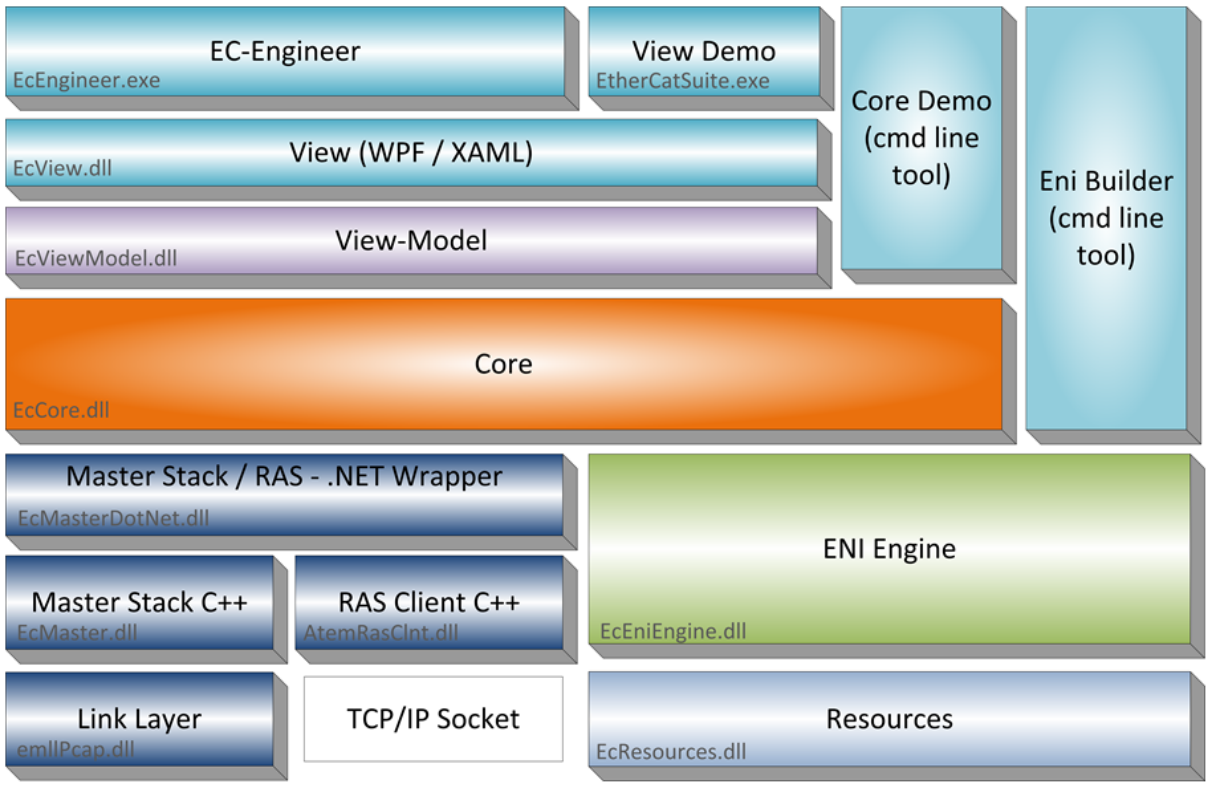


Office 2013 Theme



10.3 Integration into 3rd-Party Applications

The software architecture of EC-Engineer is keept very modular:



This allows us adjust to customer needs and to integrate it into nearly every customer engineering environment. We can integrate the complete product or only parts of it, like:

View-Layer
Only changes on XAML-level needed, only a few changes are necessary to get your own look and feel

ViewModel-Layer
For a customer which has already his own GUI or wants to be very flexible

Core-Layer

- Used with CoreDemo as a commandline tool
- Used directly as library by adding the C# assembly as reference to the exisiting project

EniEngine-Layer

- Used with EniBuilder as a commandline tool
- Used directly as library by adding the C# assembly as reference to the exisiting project

If you are interested in integrating the product or parts of the product into your existing framework, please contact us.

11 Licensing

11.1 Third party Software

EC-Engineer is using the following third party software:

- Infragistics

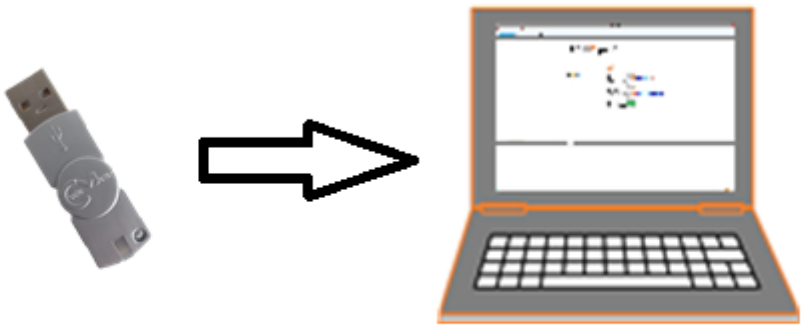
11.2 EC-Engineer License

For EC-Engineer we have two license models:

- Node Locked License
- Floating License

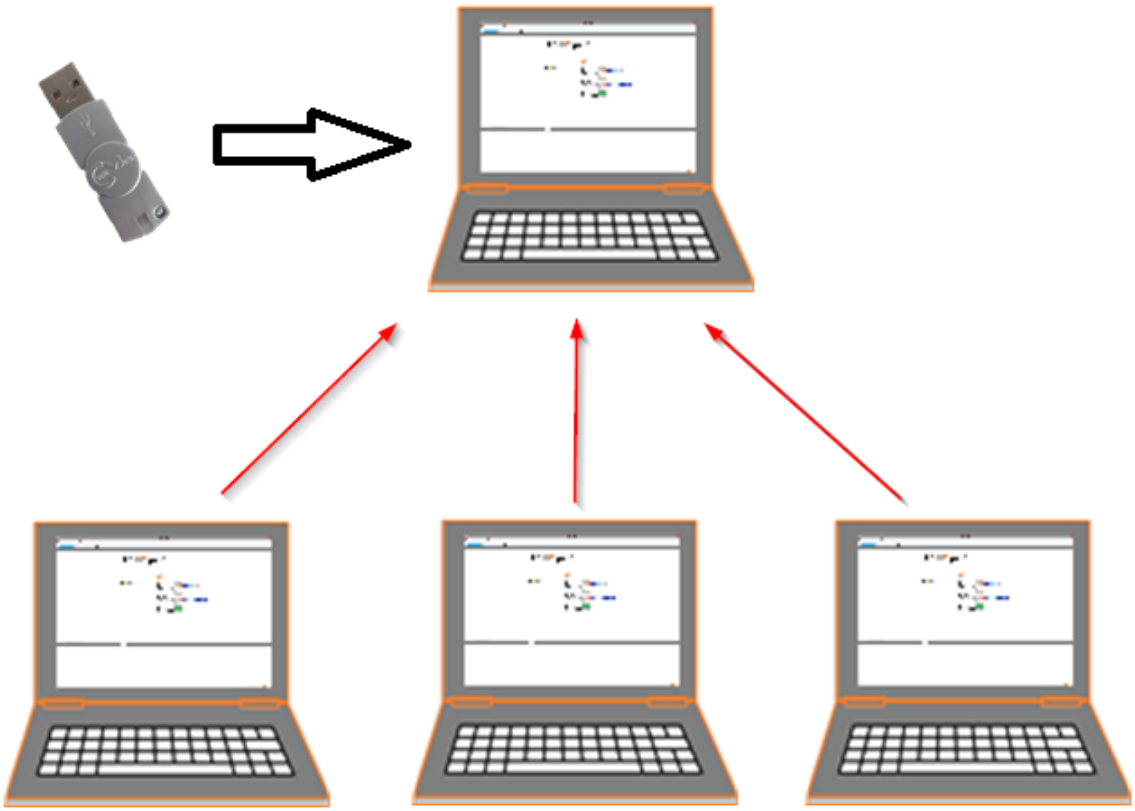
11.3 Node Locked License

If you choose this license model, you need an USB dongle for every single computer. This dongle must be plugged into the computer where you want to use EC-Engineer.



11.4 Floating License

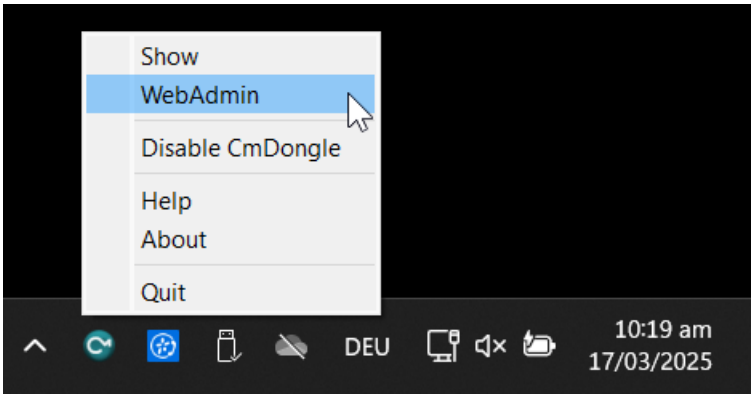
If you choose this license model, you need only one USB dongle with multiple floating licenses. This dongle must be plugged into your license server and all client computers will connect to this license server.



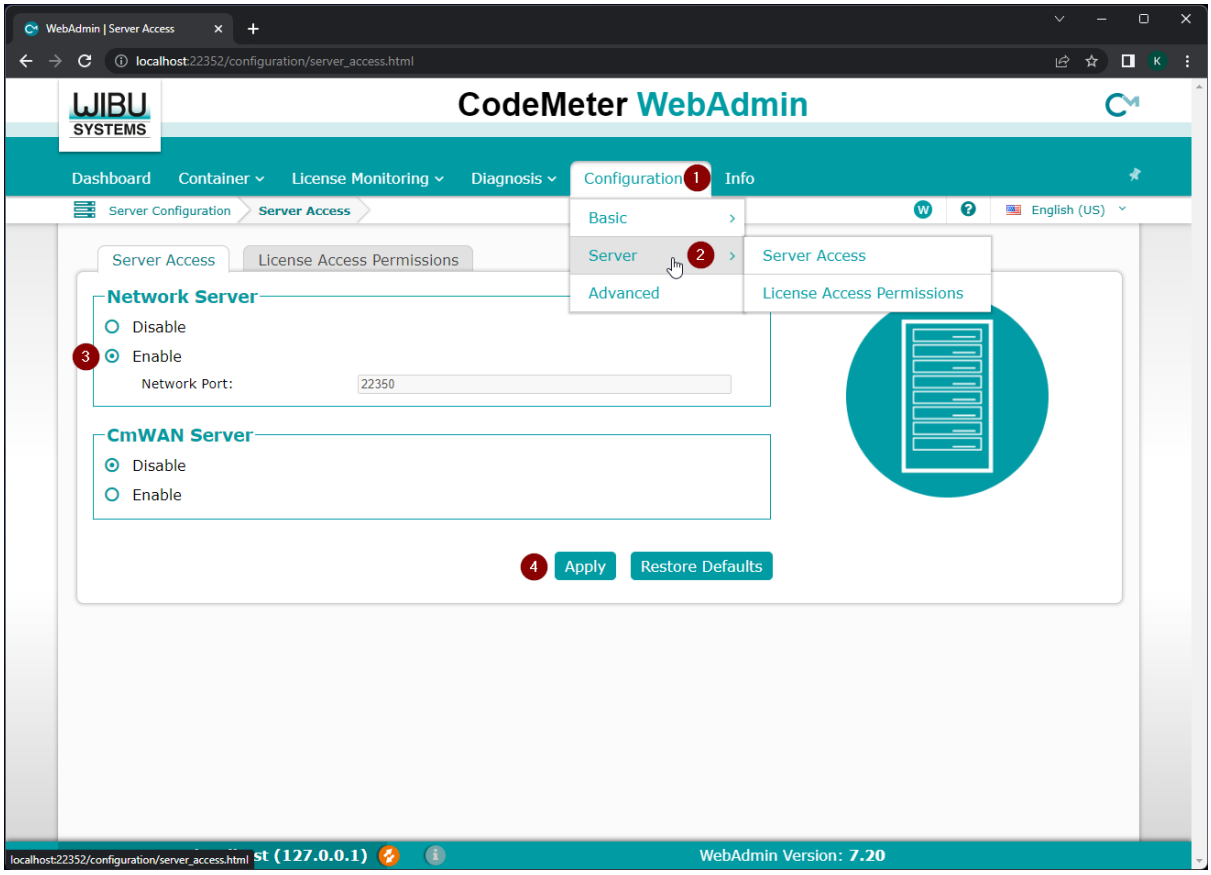
Note: This requires that the “WebAdmin” of the “Code Meter” is installed on the system. Please download and install the “Code Meter Runtime” from WIBU: https://www.wibu.com/

11.4.1 Configure License Server

Install the “Dongle-Version” of EC-Engineer on your license server, plug-in your USB dongle and open the “WebAdmin”:

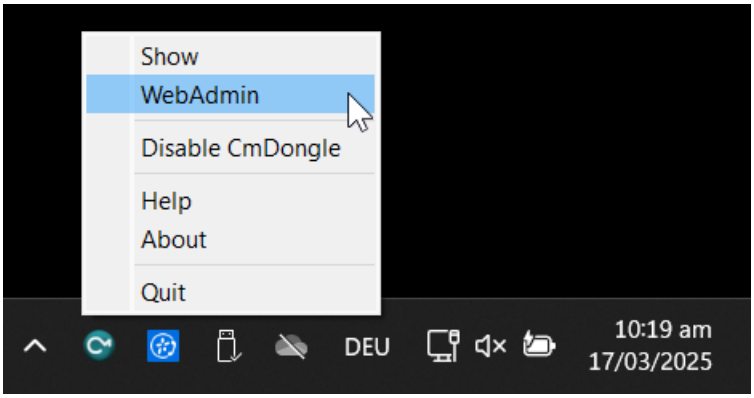


In the “WebAdmin” navigate to “Configuration Server”, select the option “Run Network Server” and press *Apply*:

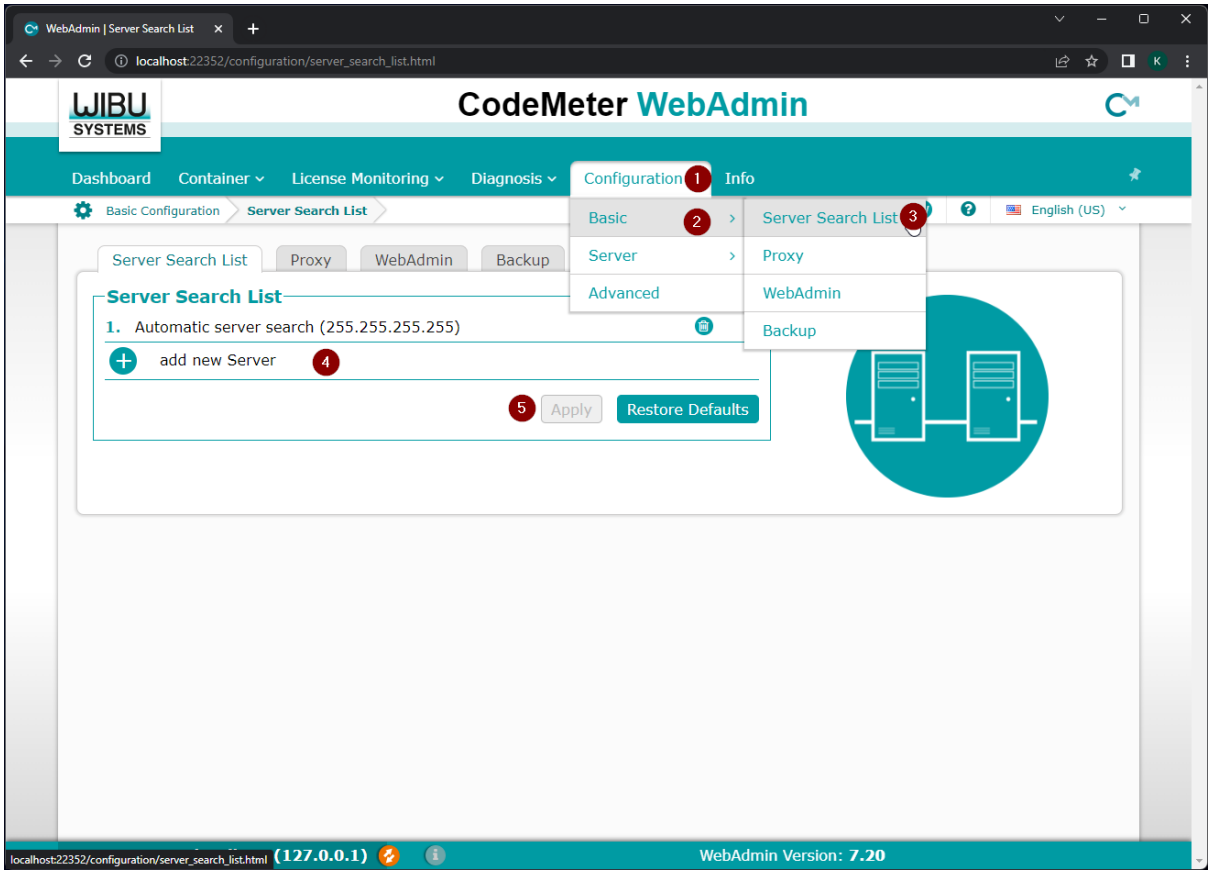


11.4.2 Configure Client Computer

Install the "Dongle-Version" of EC-Engineer and open the "WebAdmin":

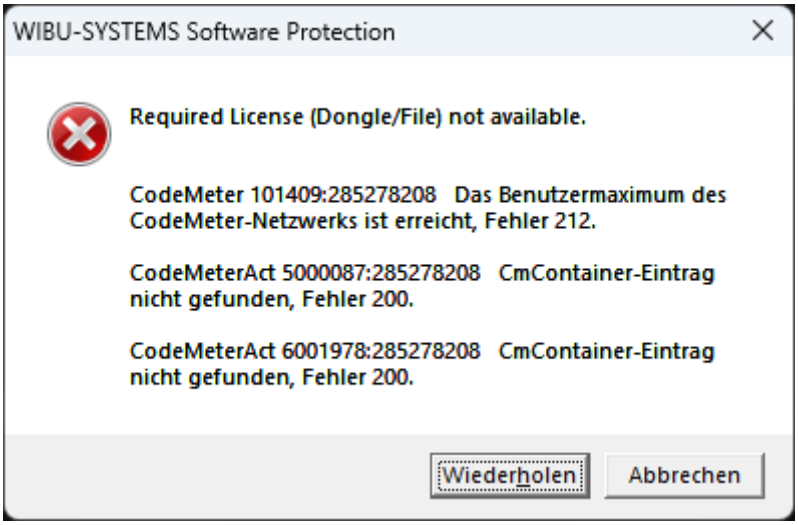


In the "WebAdmin" navigate to "Configuration Network", press *add*, enter your IP address of your license server and press *Apply*:



Now, you should be able to start EC-Engineer.

Note: If too many clients are connected you will, you will receive the following error message:

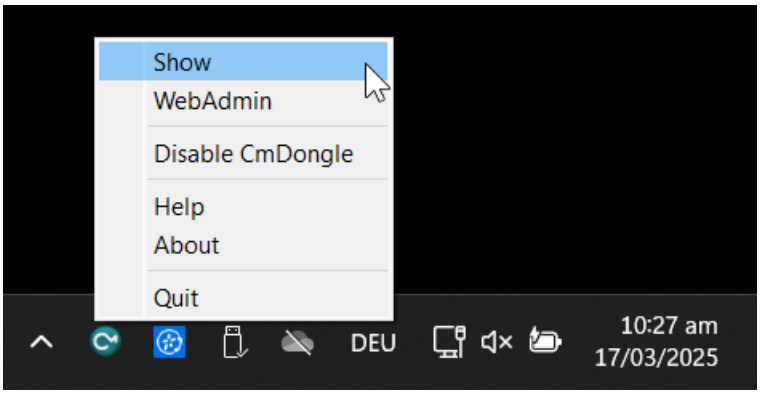


In that case, you should try to close unused EC-Engineer instances or buy more floating licenses.

11.5 License Update

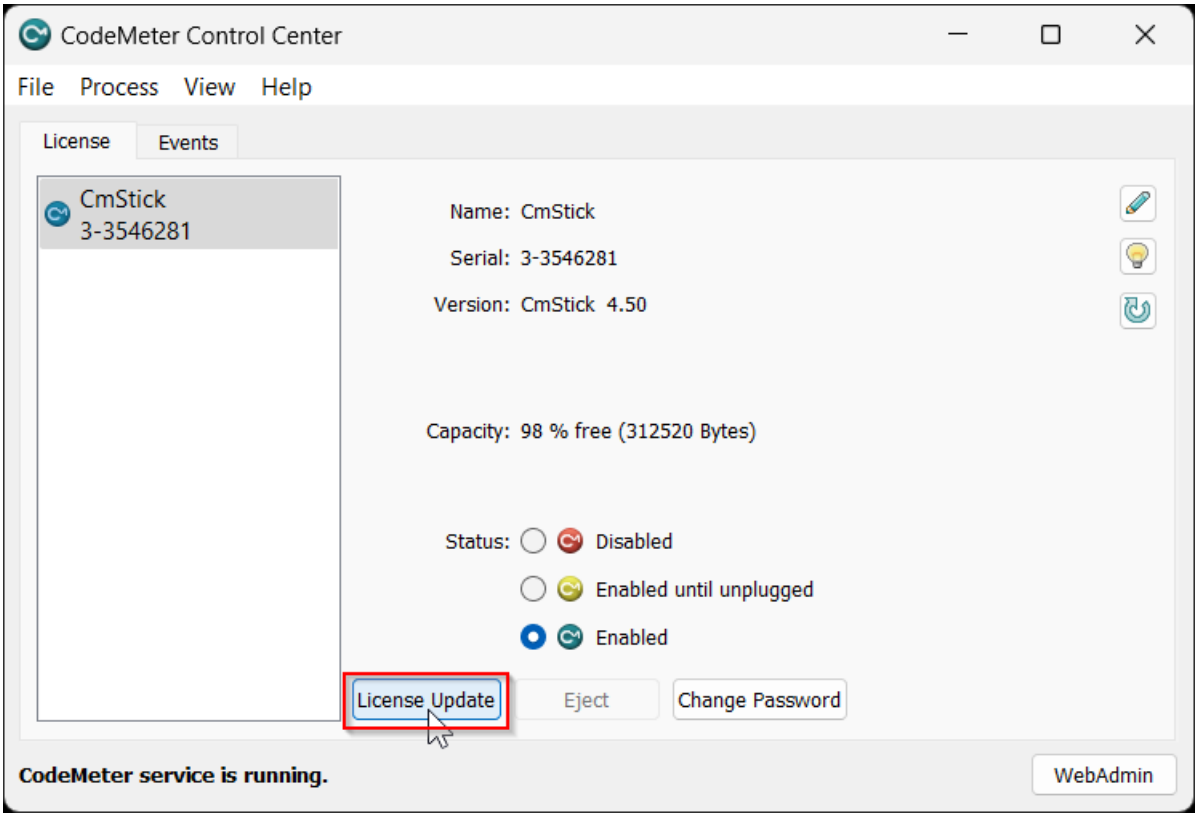
11.5.1 Request License Update

Step 1: Install the "Dongle-Version" of EC-Engineer and open the "CodeMeter Control Center":

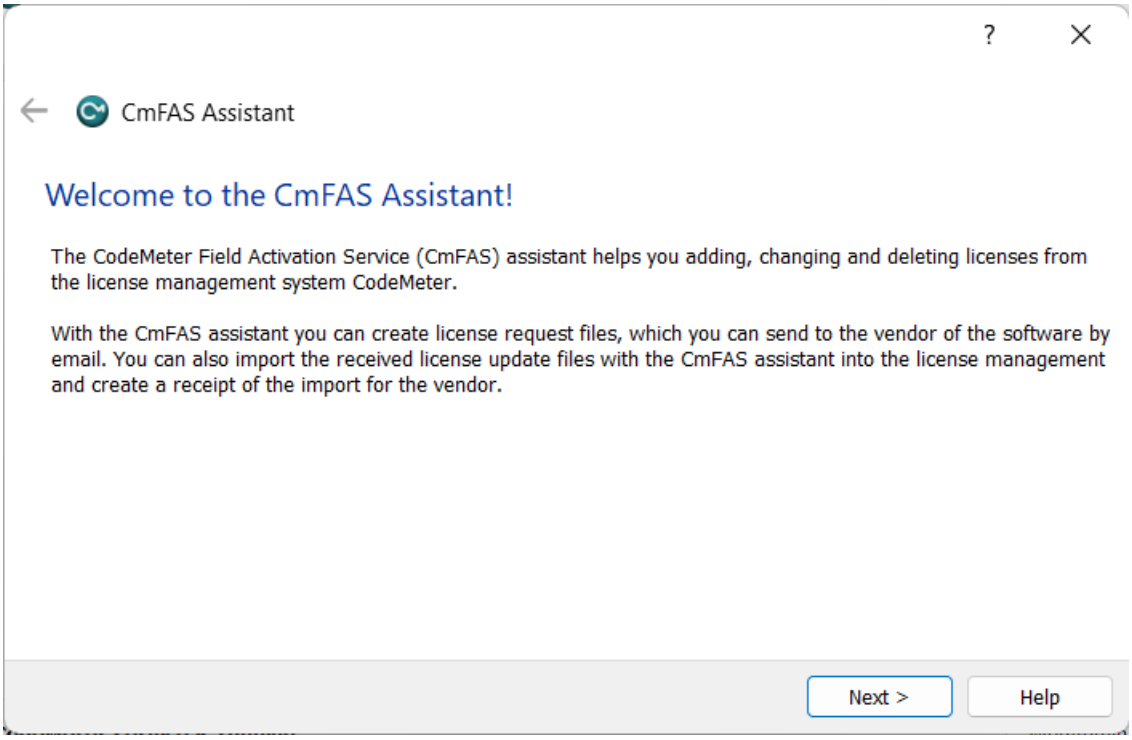


If the selected license is a virtual dongle, simply drag and drop the WibuCmLIF file onto the CodeMeter Control Center. Otherwise, the dongle should already be visible.

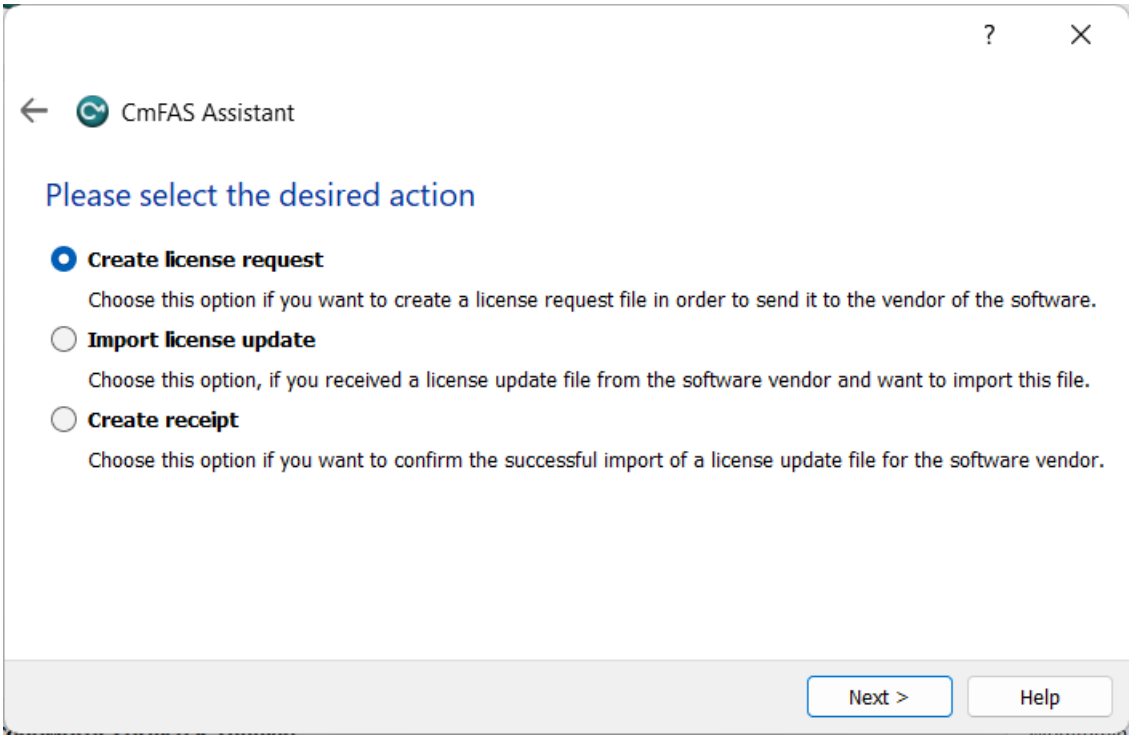
Step 2: In the "CodeMeter Control Center" open the "CmFAS Assistent" by clicking on *License Update*:



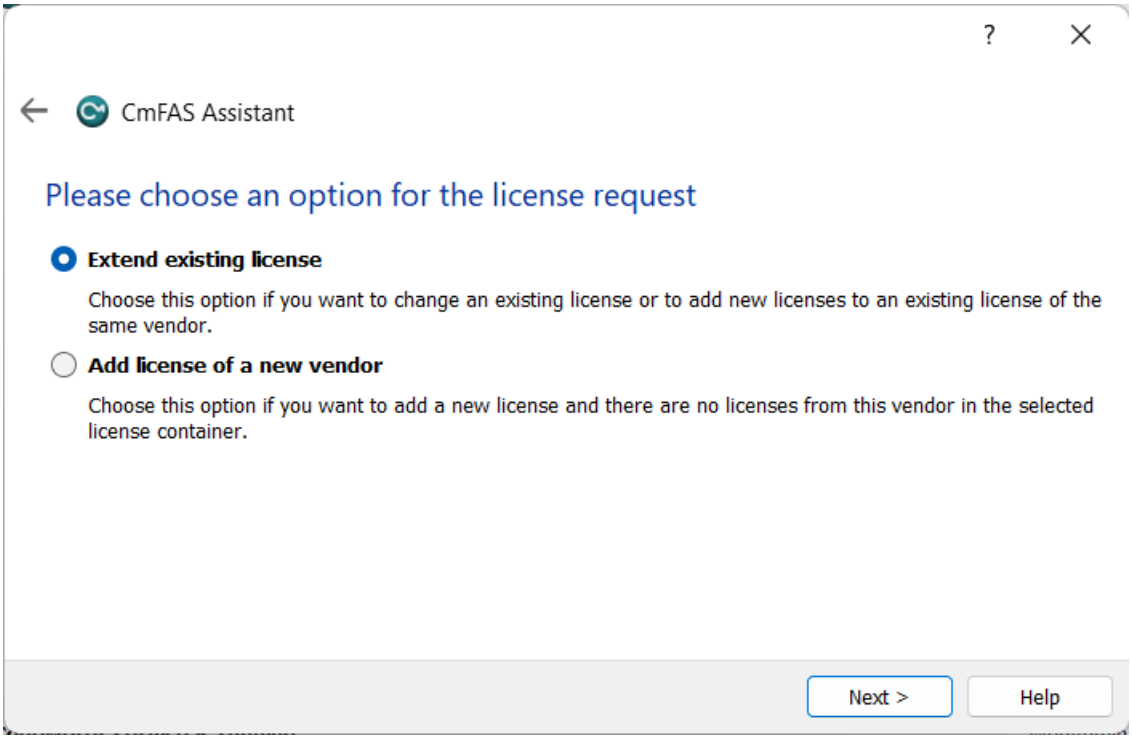
Step 3: Now, follow the assistant until you can select a file name:



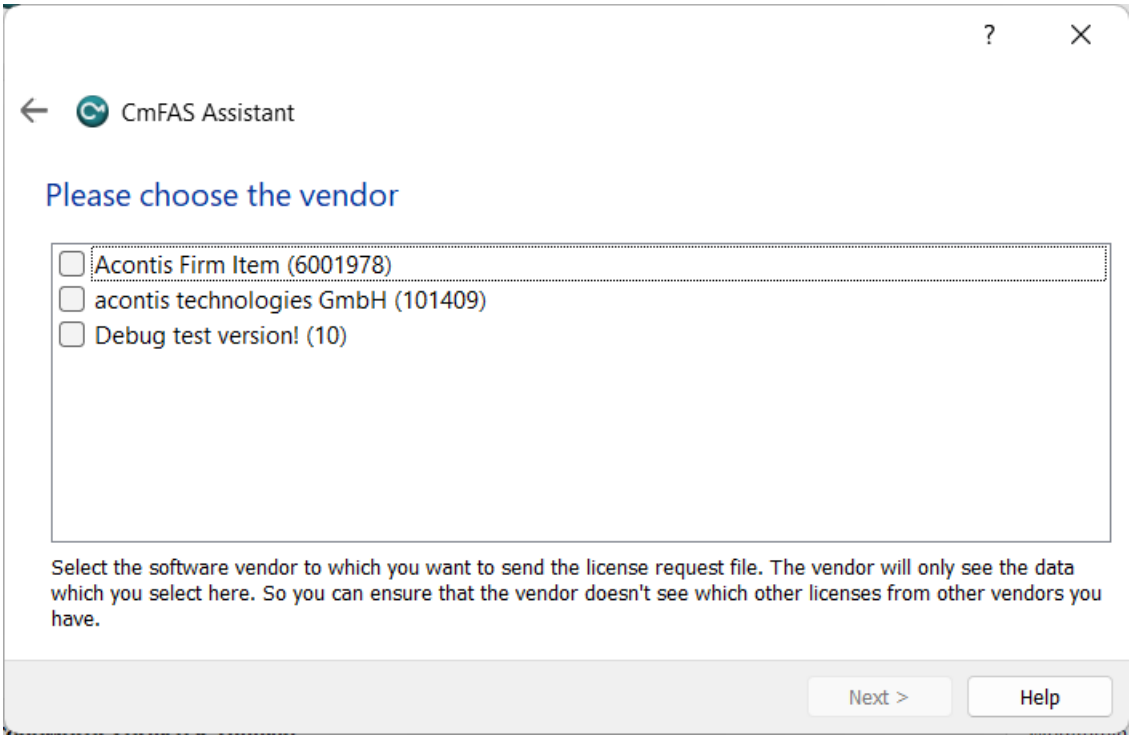
Step 4: Select "Create license request":



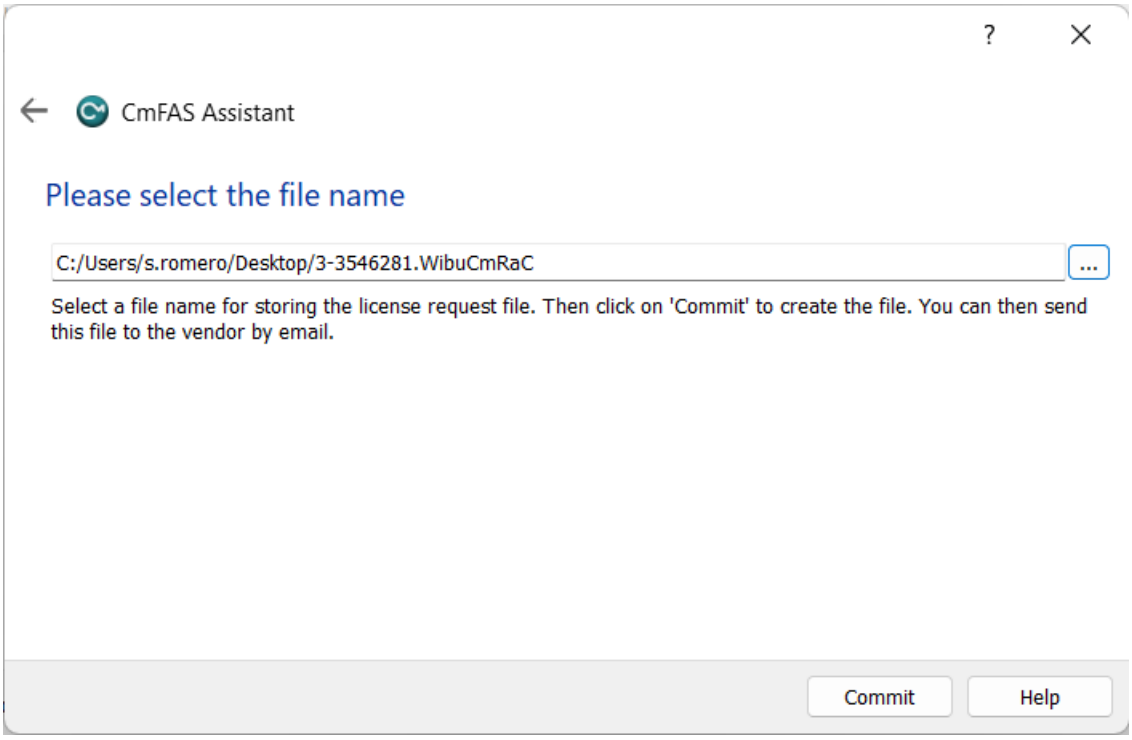
Step 5: Select "Extend existing license":



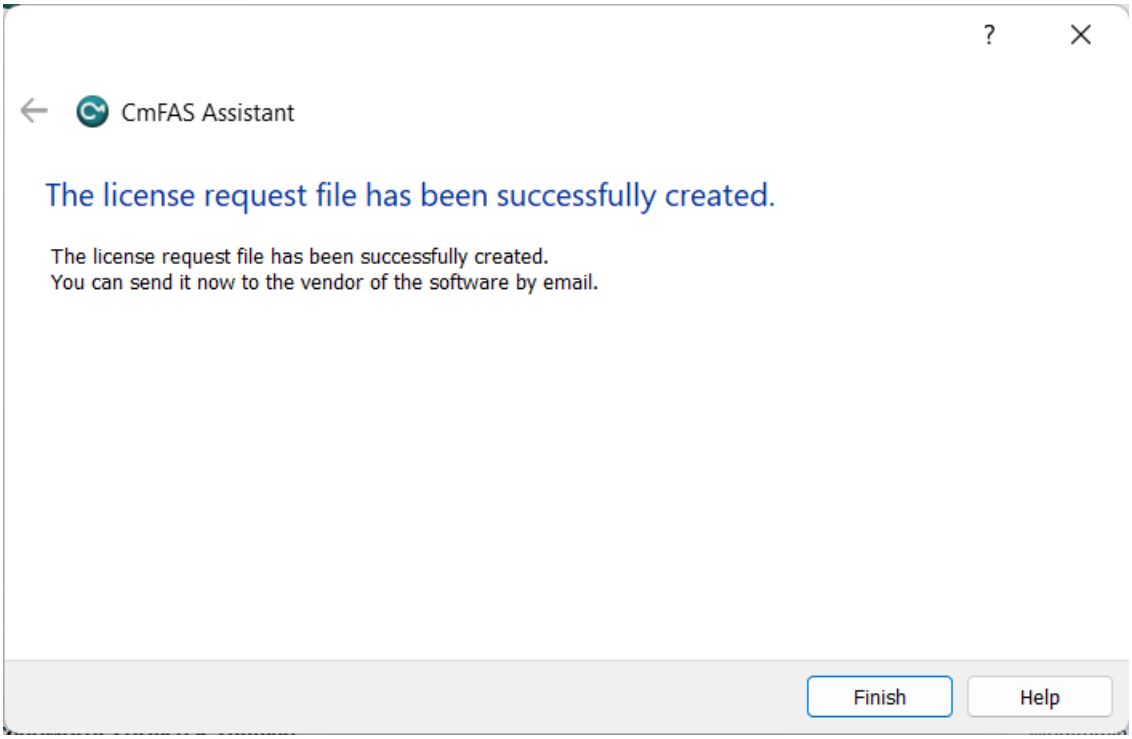
Step 6: Keep the selected the vendor:



Step 7: Select the file name:



Step 8: Finish the assistant:



Step 9: Your license request file `*.WibuCmRaC` has been successfully created. Please send it to sales@acontis.com

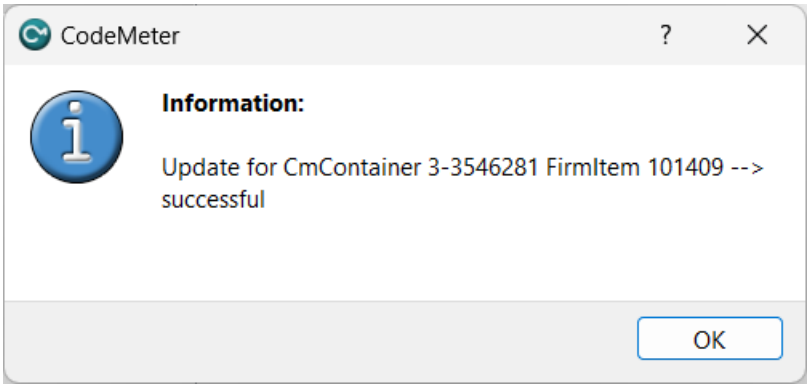
11.5.2 Install License Update

After you have been sent your license request file you will receive the license update file `*.WibuCmRaU`.

Step 1: Connect your dongle.

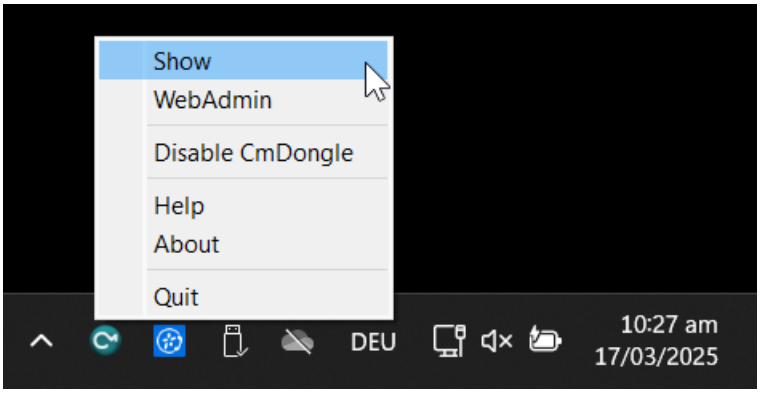
Step 2: Copy the license update file to your desktop.

Step 3: Double-click on the license update file:

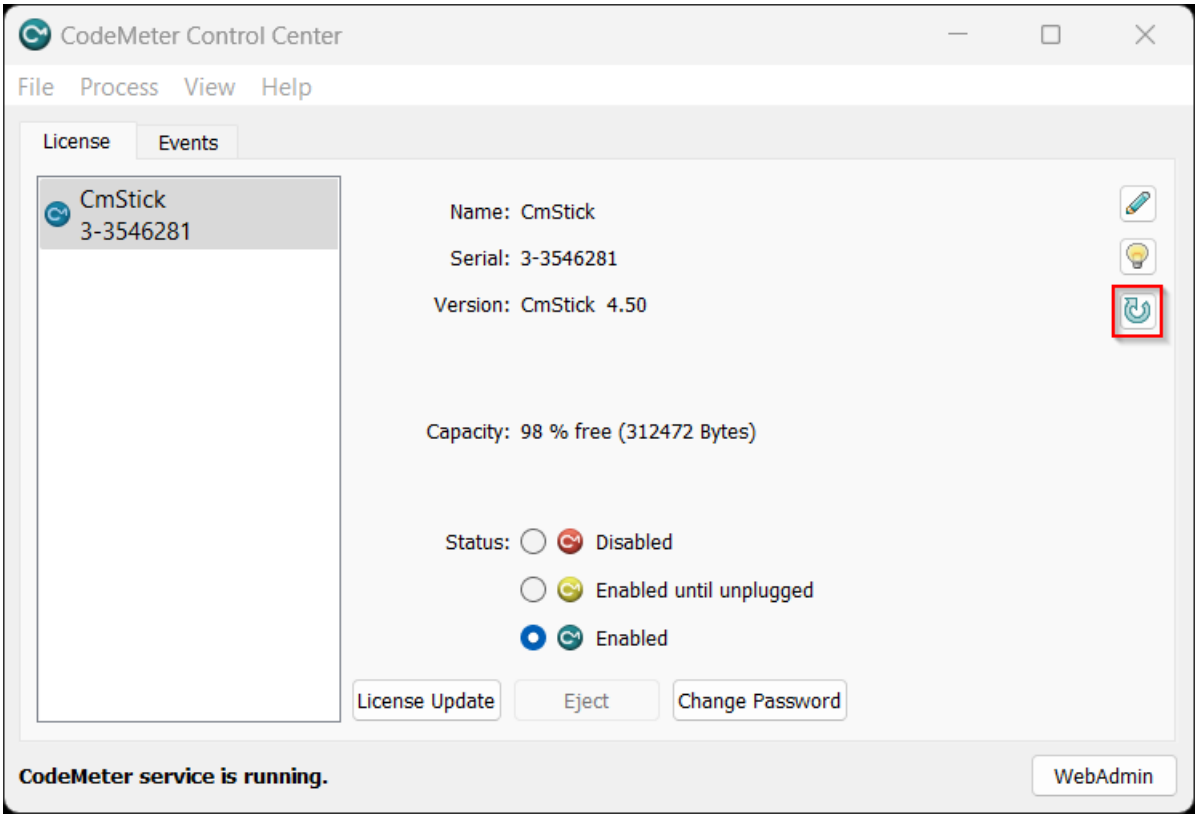


11.6 Dongle Firmware Update

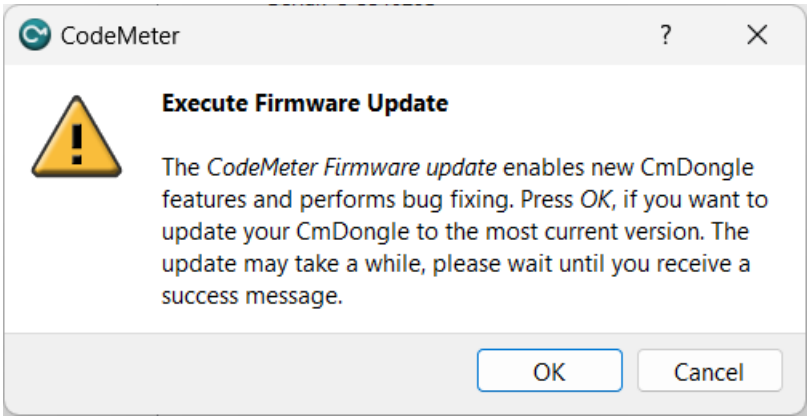
Step 1: Install the "Dongle-Version" of EC-Engineer and open the "CodeMeter Control Center":



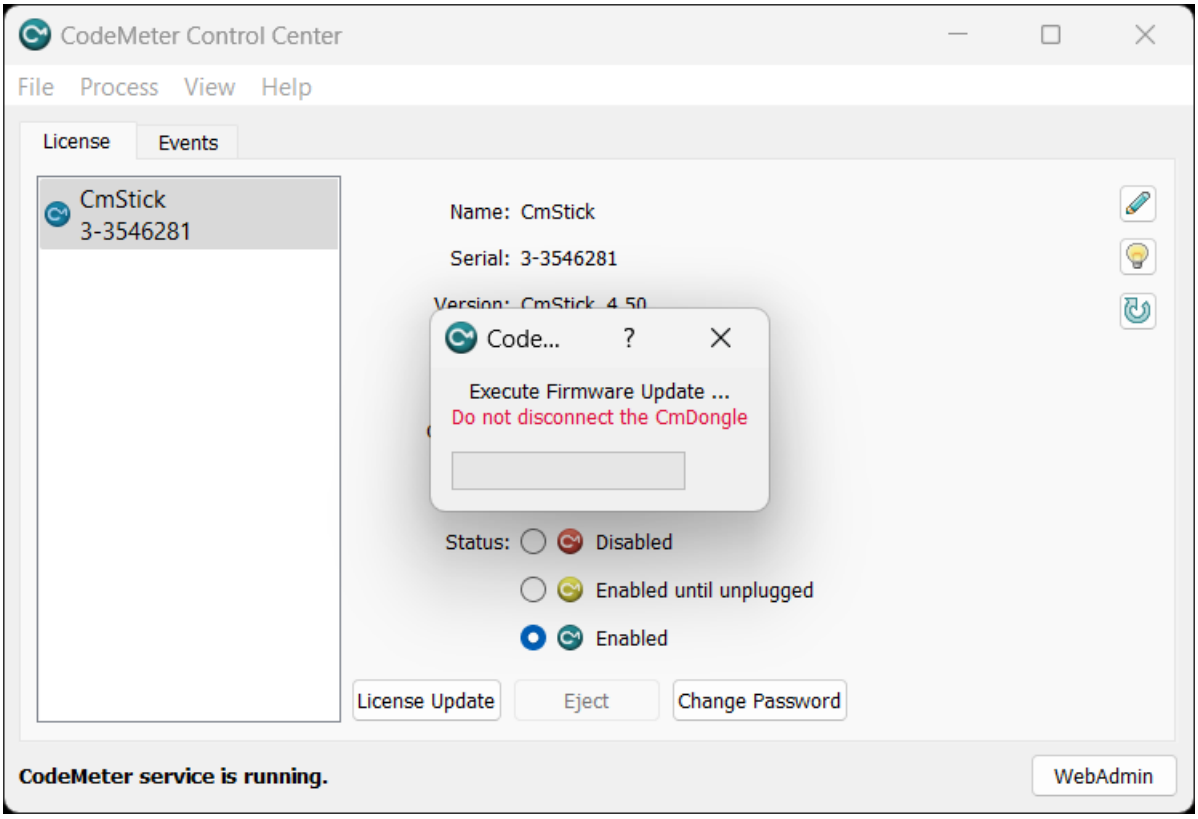
Step 2: In the "CodeMeter Control Center" click on *Update Firmware of selected Cm Dongle*:



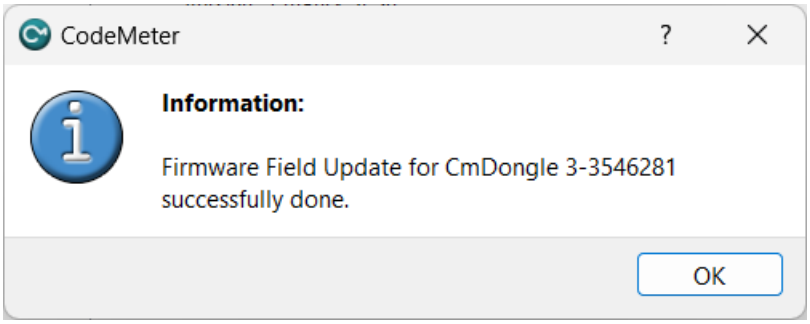
Step 3: Execute firmware update by pressing *OK*:



Step 4: Wait until firmware update was executed:



Step 5: Firmware update was done and dongle can be removed:

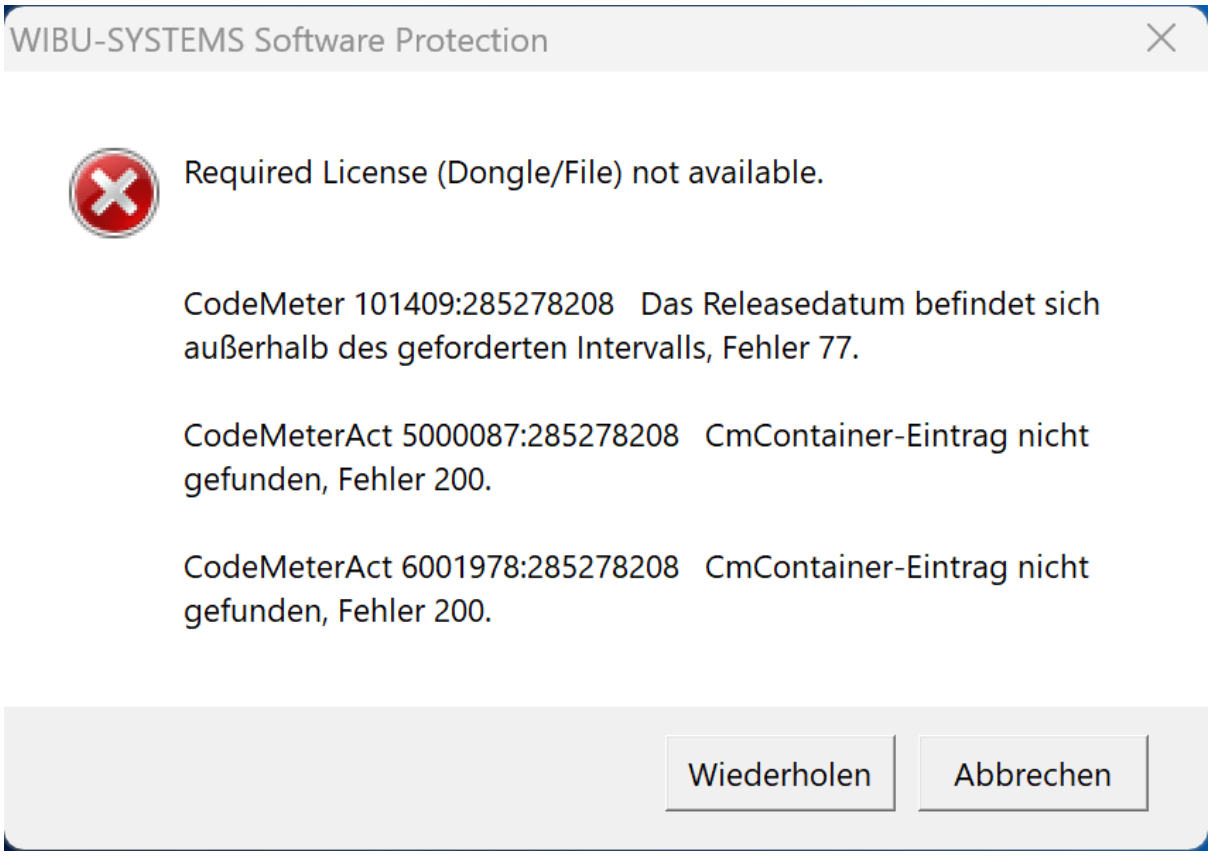


11.7 Expiration Date Dongle

If you chosed a expiration dongle you can find your expiration date in the 'About Dialog'. If you have an unlimited dongle you will not see a date in the dialog.

If you see this date you can not use an Engineer which was released after the expiration date, but all older ones are possible.

If you try to start an Engineer which is newer than the expiration date, you will get the following error:



12 FAQ, Tips

12.1 Help in case of a problem

If you have a problem with EC-Engineer or something does not run as expected, please try first the following things:

- Read messages in message window
- Increase message level *Menu ‣ Settings ‣ All Messages*
- Read log file for more information *Menu ‣ Help ‣ Show ‣ Log ‣File*
- Restart EC-Engineer and try to do it again
- **Contact support by sending a mail to ecsupport@acontis.com and attach the following information**
  - Project file `.ecc` or `.eci` if available
  - EC-Engineer Version *Menu ‣ Help ‣ About*
  - Log file *Menu ‣ Help ‣ Show Log File*
  - Short description how the reproduce it

12.2 Shortcuts

EC-Engineer supports shortcuts for the most commonly used actions, like:

Menu

- `Ctrl` + `N`: Create new project
- `Ctrl` + `O`: Open project
- `Ctrl` + `S`: Save project
- `Alt` + `F4`: Exit program

12.3 Internal User Specific Settings

EC-Engineer saves all user specific settings in a subfolder of the all users directoy %ALLUSERSPROFILE%/EC-Engineer like C:/ProgramData/EC-Engineer.

In this directoy there is a `XML` file called `User.myusername.xml`. In this file, the user can find additional settings, which can be helpful for solving some problems:

MasterUnitLocalCycleTime = 1
: Bus cycle time of the internal MainDevice in milliseconds

MasterUnitLocalWorkerSleepTimeMs = 100
: Cycle time of the local MainDevice thread in milliseconds

MasterUnitRemoteWorkerSleepTimeMs = 300
: Cycle time of the remote MainDevice thread in milliseconds

MasterUnitTimerNormalCount = 4

- Time shift to cycle time of the normal refresh cycle

- E.g. local MainDevice = 100 ms, normal refresh cycle is every 400 ms
- Used e.g. for updating MainDevice information, error counters of SubDevice, …

MasterUnitTimerSlowerCount = 20

- Time shift to cycle time of the slower refresh cycle
- E.g. local MainDevice = 100 ms, slower refresh cycle is every 2 seconds
- Used e.g. for updating the SubDevice information, EEPROM data, register data, …

MasterUnitTimerSlowestCount = 120

- Time shift to cycle time of the slowest refresh cycle
- E.g. local MainDevice = 100 ms, slower refresh cycle is every 12 seconds
- Used e.g. for updating the CoE Object Dictionary, …

MasterUnitScanBusTimeout = 5000
Timeot for bus scan in milliseconds

MasterUnitMailboxTimeout = 5000
Timeout for mailbox access in milliseconds

MasterUnitStateChangeTimeout = 5000
Timeout for changing state machines in milliseconds

MasterUnitRegisterTimeout = 3000
Timeout for register access in milliseconds

MasterUnitProcessDataTimeout = 1000
Timeout for process data access in milliseconds

MasterUnitEepromTimeout = 3000
Timeout for EEPROM access in milliseconds

MasterUnitRasCycleTime = 0
Internal RAS cycle time for polling

MasterUnitRasWatchDog = 0
Internal RAS watchdog interval

MasterUnitRasWdToLimit = 0
Internal RAS watchdog limit

DiagGeneralErrorLvlLostLink = 10
Theshold value for the “Lost Link Errors”, which leads to an error

DiagGeneralWarningLvlLostLink = 1
Theshold value of the “Lost Link Errors”, which leads to a warning

DiagGeneralErrLvlRxError = 10
Theshold value for the “RX Errors”, which leads to an error

DiagGeneralWarnLvlRxError = 0.001
Theshold value of the “RX Errors”, which leads to a warning

DiagGeneralErrLvlInvalidFrame = 10
Theshold value for the “Invalid Frames”, which leads to an error

DiagGeneralWarnLvlInvalidFrame = 0.001
Theshold value of the “Invalid Frames”, which leads to a warning

DiagGeneralErrLvlProcUnitErr = 1000
Theshold value for the “Processing Unit Errors”, which leads to an error

DiagGeneralWarnLvlProcUnitErr = 100
Theshold value of the “Processing Unit Errors”, which leads to a warning

MasterDebugMessageLevel = 0
Activates extended debug messages of the EC-Master (0 = Silent, 1 = Any, 2 = Critical, 3 = Error, 4 = Warning, 5 = Info, 6 = InfoApi, 7 = Verbose, 8 = VerboseCyc)

GuiDebugMessageLevel = 0
Activates extended debug messages of the GUI (0 = Off, 1 = Errors, 2 = All)

IndentXmlFiles = False
Activates indenting of XML files (makes exported XML files readable, but increases size)

EnhancedUtf8Support = False
Activates the enhanced UTF-8 support, which might be necessary if characters will be not displayed correctly

12.4 FAQ

Solutions for possible problems:

- **The integrated Device does not react as estimated**
  Increase the message level (Menu Settings All Messages) and try it again.
- **EC-Engineer reports a message with ErrCode: 0x…**
  Error Codes comes directly from the Device. If you want to know what to know how to solve this problem, please refer the manual of EC-Master / EC-Monitor.
- **EC-Engineer reports the following message: Not all EtherCAT SubDevice devices are in operational state**
  Check if all SubDevices have a green icon. If the color is not green, open tab “Diagnosis SubDevice General”. Here you can see the error state of the SubDevice. If it has no error, try to change the state to OP again.
- **EC-Engineer reports the following message: Changing topology failed: Bus configuration mismatch (ErrCode: 0x9811001E)**
  The configured bus and the currently connected bus does not match. Please open the ‘Network Mismatch Analyzer’ (Menu Network Network Mismatch Analyzer) to solve the problem.
- **EC-Engineer reports the following message: SubDevice ‘…’ has unexpected state (Current state: ‘…’, Expected state: ‘…’)**
  Select the SubDevice and open the tab “General”. Here you can see the error state of the SubDevice. If it has no error, try to change the state again.
- **SubDevice reports the error state: “Sync manager watchdog” (Diagnosis SubDevice General)**
  You need a realtime operating system. If you still want to use your SubDevice on Windows, you can turn off this watchdog (SubDevice->Advanced Settings: Set SM Watchdog = 0).
- **How can I update the firmware of my SubDevice via FoE?**

  For updating the firmware of your SubDevice via FoE, please follow these steps:

  - Enable diagnosis mode
  - Set MainDevice state to INIT
  - Select your SubDevice, and set his state machine to BOOTSTRAP
  - Enter path of file on SubDevice (optional)
  - Enter password (optional)
  - Press button “Download” (it will open the FileOpen-Dialog, where you can choose the file which contains the new firmware and uploads this file)

- **Connect to local system is not possible**
  Is Npcap / NDIS installed?

  Is at least one network adapter installed?

- **Why is the process image size different between EC-Engineer and EC-Master?**
  EC-Engineer shows on tab *Process Data Image* not the real size of the process data image. It show only the offsets and the size of the variables.

  If you want to get the real size of the process data image, which is used from EC-Master, you have to look into the `ENI` file: `EtherCATConfig/Config/ProcessImage/Inputs/ByteSize` or `EtherCATConfig/Config/ProcessImage/Outputs/ByteSize`. This is the offset + size of the last variable and additional administration data depending on the SubDevices which are used (AL-Status, DC Support, Mailbox, …).

- **EC-Engineer reports the following message: Failed to query EtherCAT SubDevices. No SubDevices found.**
  Verify that NDIS or Npcap driver is installed. WinPcap may not work anymore.

  Try to restart you operating system, because this is sometimes necessary if you e.g. using a USB network adapter

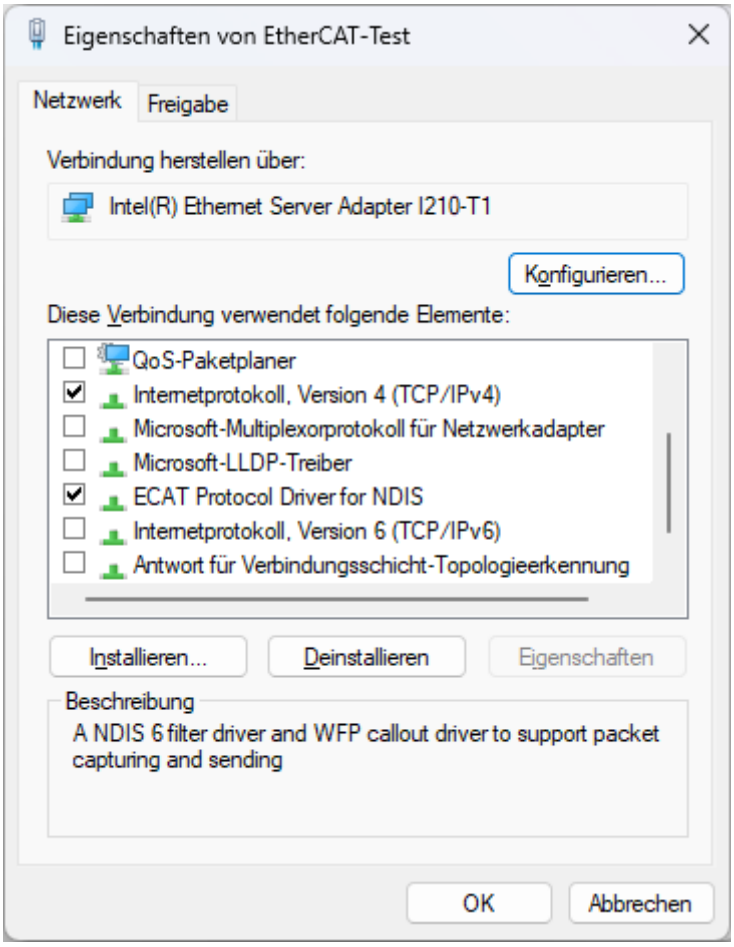
  Increase the message level (Menu Settings All Messages)

  Turn on debug message of the MainDevice

  - Stop “EC-Engineer”
  - Set “MasterDebugMessageLevel” to “7” (verbose) in `%ProgramData%/EC-Engineer/user.myusername.xml`
  - Start “EC-Engineer” again

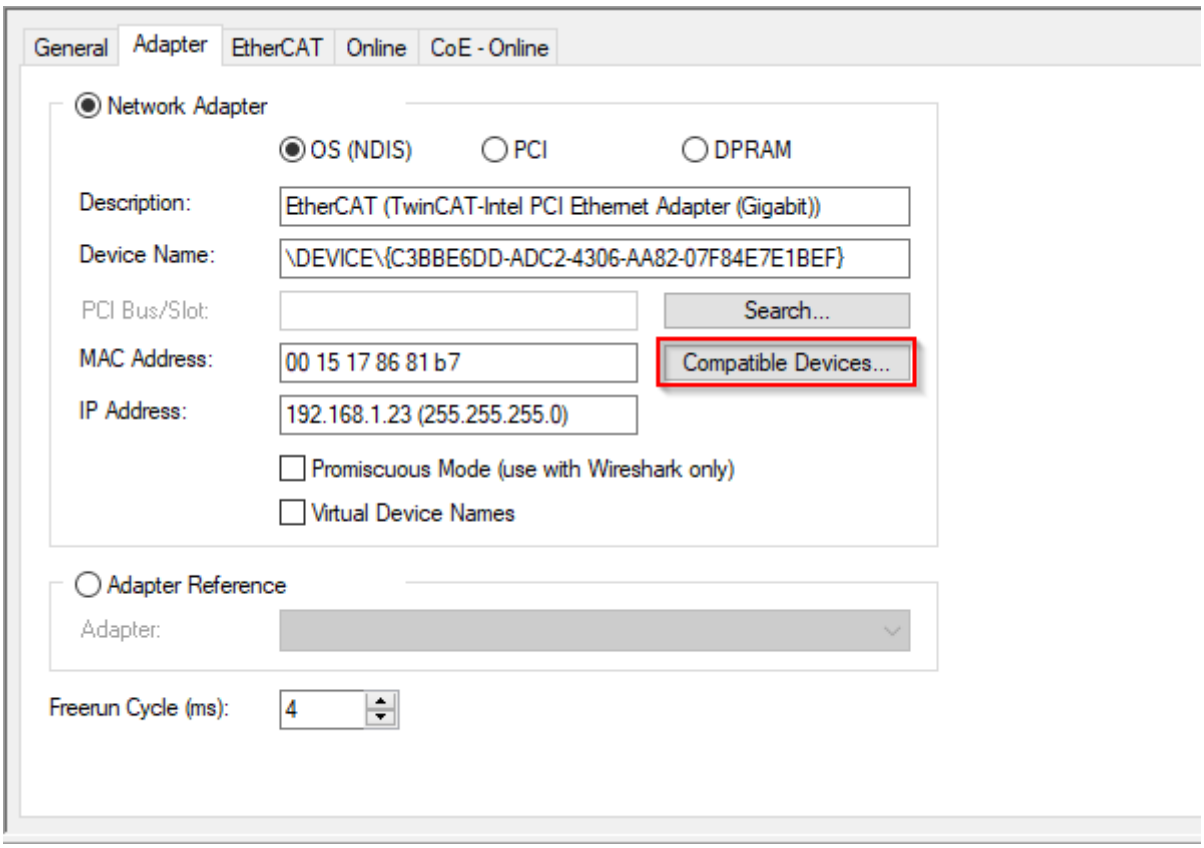
  - **EC-Engineer reports the following message: Network scan successful - 0 SubDevices found.**
    Make sure you have connected the input and not the output port of your first SubDevice to the computer.

    Open “Network and Internet Connections Network Connections” and open the properties of your network adapter and uncheck all protocols except “Internet Protocol (TCP/IPv4)”

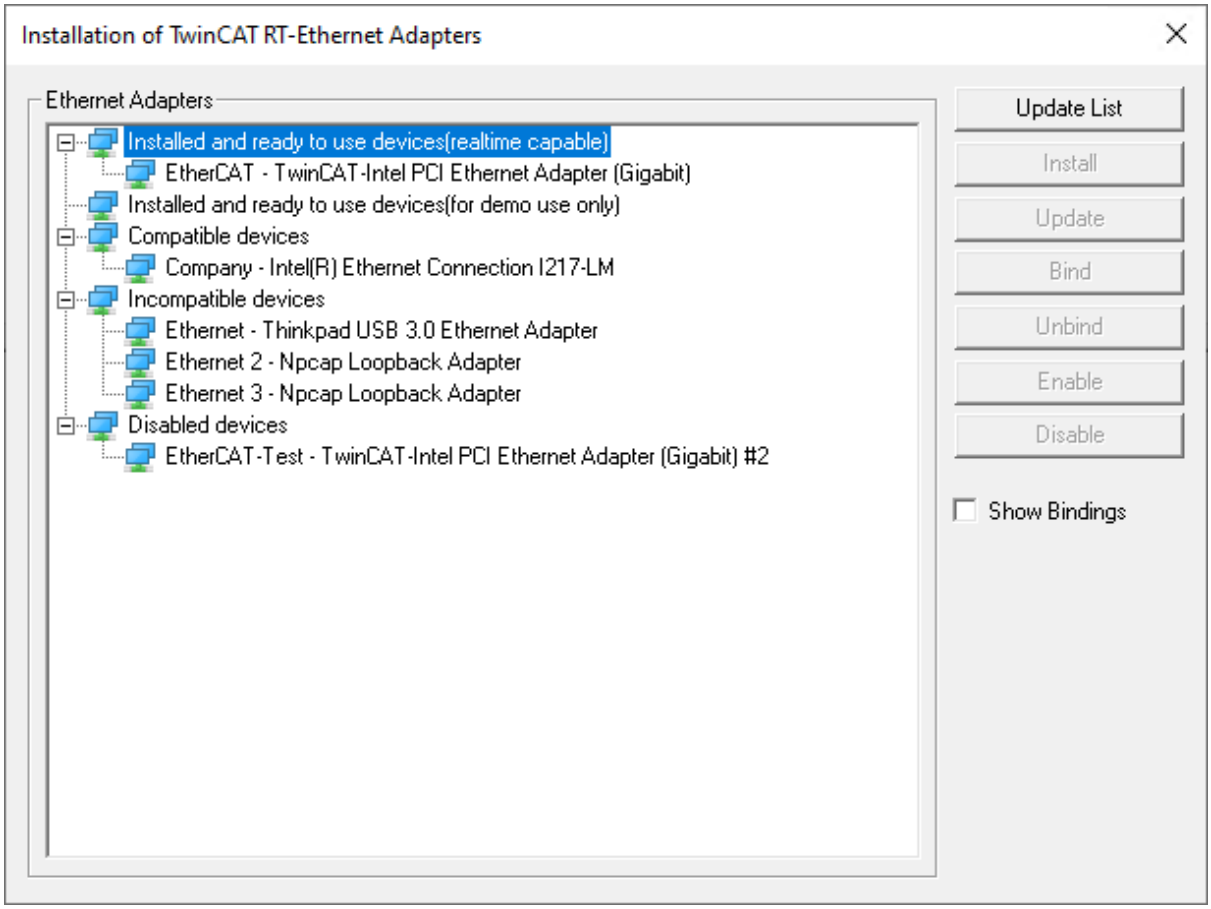


Do you have TwinCAT installed on this machine?

Open “Compatible Devices”:



Uninstall or disable the “TwinCAT RT-Ethernet Adapter” for your network adapter:



If this doesn't help, try to disable the "TwinCAT RT-Ethernet Driver" in the properties of your network adapter and reboot your system.

Run EC-Engineer with administrative rights? Does it help?

Do you have a some kind of security software (like firewall, antivirus, …) installed on this machine?
Try to turn it off and check if problem is solved

Do you have problems on sending or receiving pakets?
Install "Wireshark" and check which pakets are missing

Do you have only problems on sending packets?
Try to exclude ethernet protocol type "0x88a4" from your firewall. For more information see https://en.wikipedia.org/wiki/EtherCAT/

Try it with Npcap instead of WinPcap. Make sure you chose "Install Npcap in WinPcap API-compatible Mode"

– **How can I create `ENI` files for SubDevices from the Beckhoff CX5000 series?**
The `ENI` file of those SubDevices must start with an Ebus SubDevice, but EC-Master exports only an MII port. This problem can be solved by first adding a helper SubDevice "EK1200". The "real" EBus SubDevices can be connected afterwords to this helper SubDevice.

- **WebAdmin in Dongle-Version shows page not found, what can I do?**
  You have to download and install the Code Meter Runtime from WIBU https://www.wibu.com/
- **UTF8 characters e.g. in variables or PDOs will be not displayed correctly**
  This requires the enhanced UTF-8 support and can be enabled by setting "EnhancedUtf8Support = True", (see *Internal User Specific Settings*)