Getting started with FAULHABER EtherCAT

Summary

This Application Note describes how to setup a FAULHABER Motion Controller with EtherCAT communication interface, e. g. MC 5010 ET, MC 5004 ET, MC3606 ET, MC 3001 ET etc.

The application note is divided into three parts:

1. Cable installation
2. Configuring the Motion Controller with FAULHABER Motion Manager 7
3. Using Beckhoff TwinCAT 3 to drive the motor

Related FAULHABER Documents

Documentation	Description
Motion Manager 7	Instruction manual for FAULHABER Motion Manager PC software
Quick start description	Description of the first steps for commissioning and operation of FAULHABER Motion Controllers
Drive functions	Description of the operating modes and functions of the drive
Communication Manual EtherCAT	Description of the EtherCAT services implemented in the FAULHABER MotionController

Applies To

FAULHABER Motion Controller with EtherCAT interface.

Licensing

EtherCAT is a registered trademark and patented technology licensed by Beckhoff Automation GmbH in Germany.

Cable installation

You need the following connections:

1. Power and electronics connection with 24V.
2. “EtherCAT-In” connected to your PLC. Use a router in the middle for debugging so that you can get Wireshark trace from the communication between the PLC and the motion controller. For this you need a free network port on your PC.
3. Ethernet/USB connection from your PLC to a free network port on your computer.
4. Connect a motor to the FAULHABER motion controller.
5. USB connection from the PC to the FAULHABER motion controller for setup.

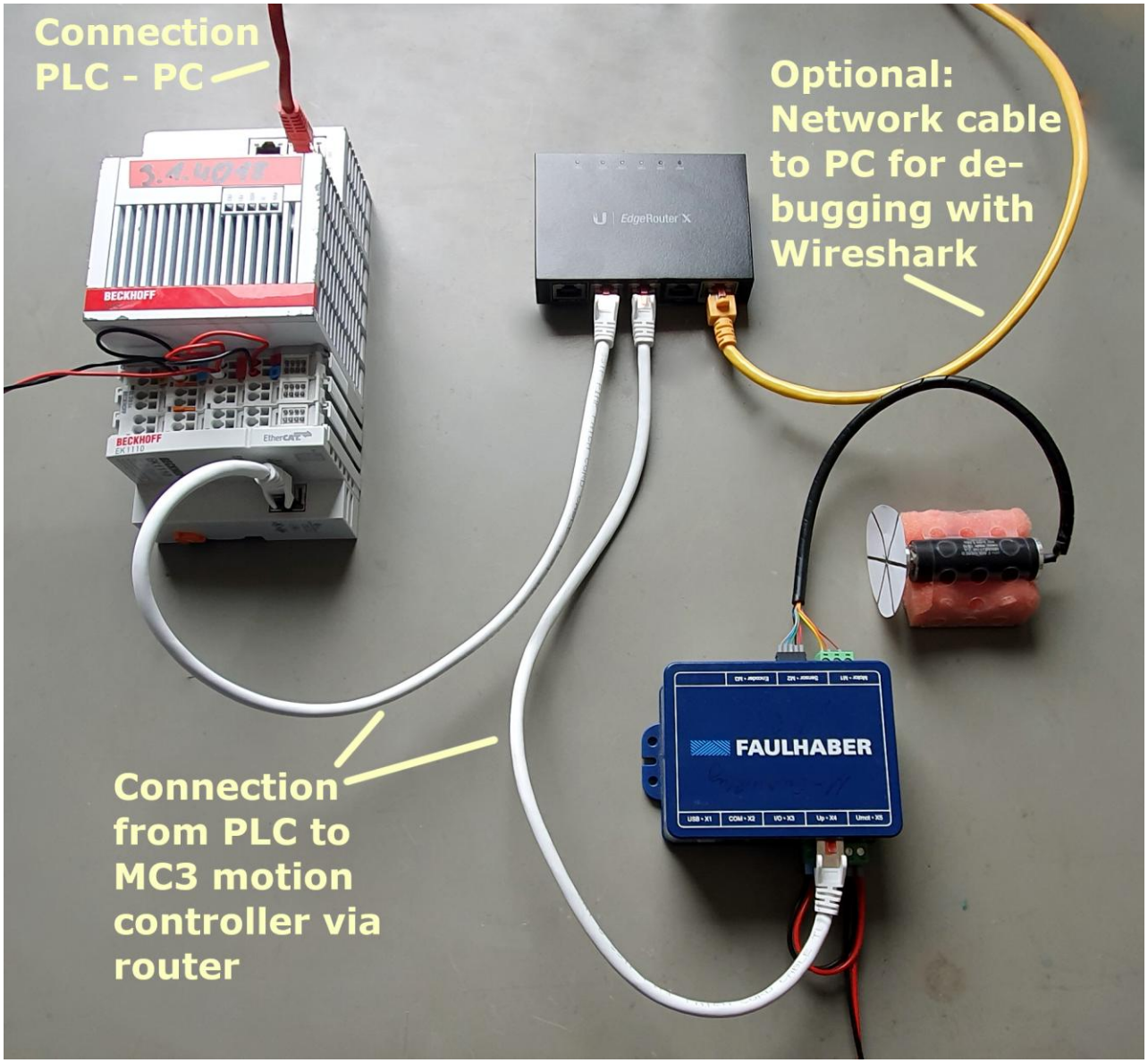


Figure 1: Hardware overview

Configuration of the Motion Controller

Basic configuration of Motion Controller

a) Install and open [FAULHABER Motion Manager]

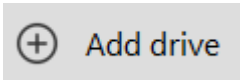
b) Add a new drive 

Figure 2: Add new drive

c) Setup your motion control system by clicking on the appropriate items:

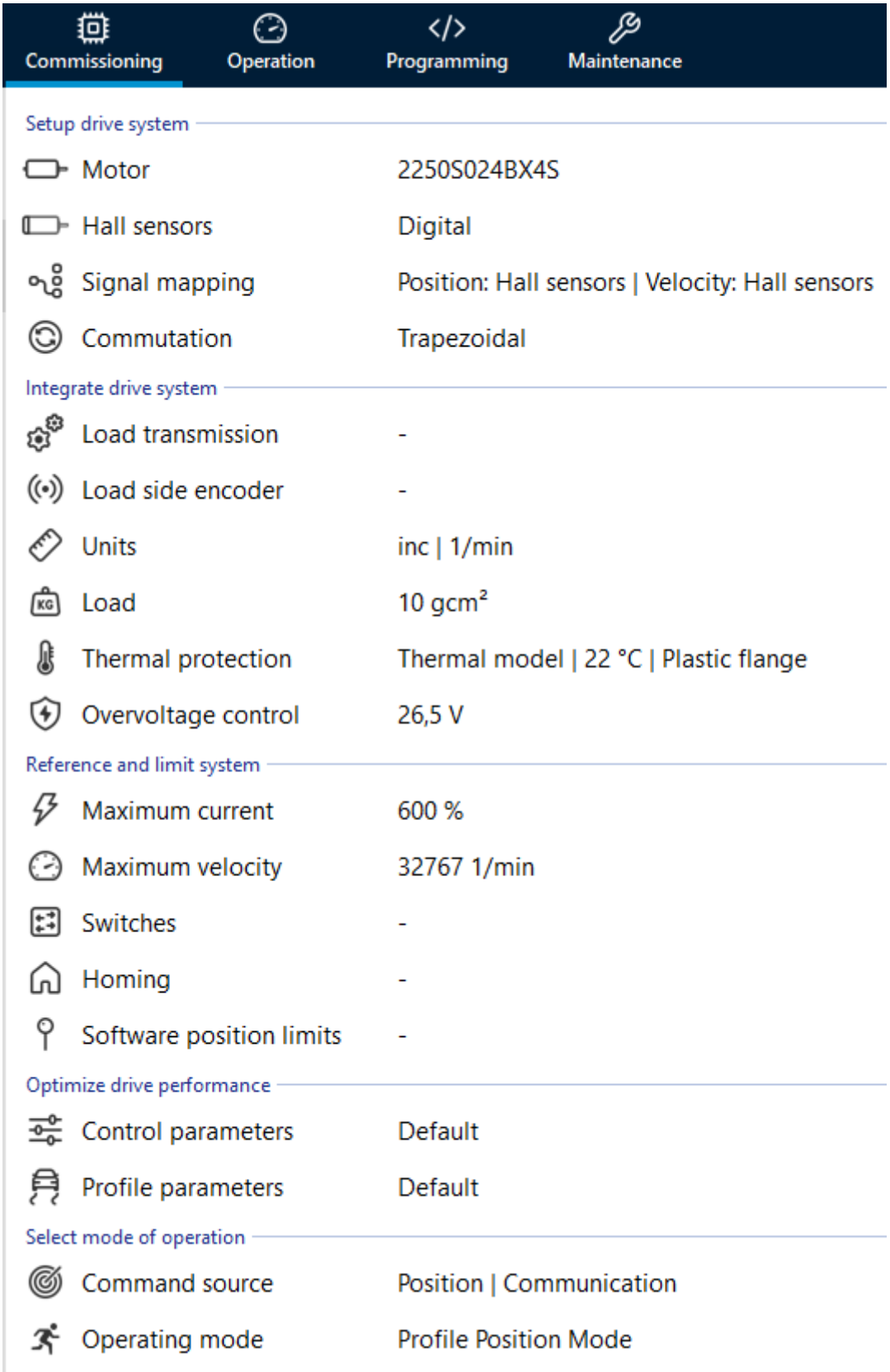


Figure 3: Motor and controller configuration

After you set up everything, save the setup inside your motion controller by clicking on the floppy disk symbol:

Figure 4: Save configuration

Now, the basic configuration of your controller and drive is completed.

Operate the motor

Select ‘Operation’ and click on “Motion Cockpit”:

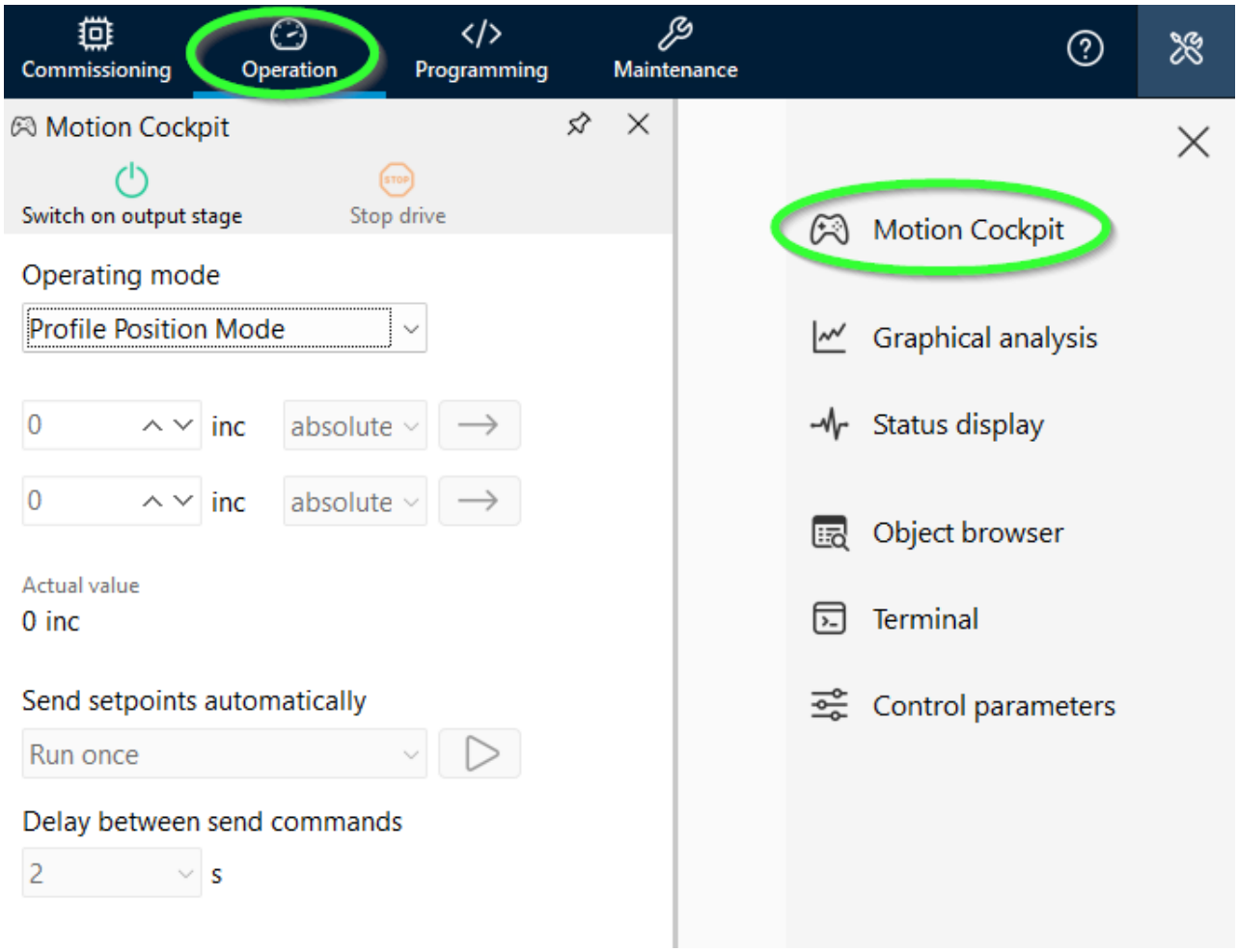


Figure 9: Motion Cockpit

d) Select the “Profile Velocity Mode” and hit “Activate”.
e) Activate the Power stage by hitting “Switch on output stage”.
f) Enter 100 into one of the target velocity fields and hit the right-pointing arrow.
g) The drive should turn with 100 rpm.

Beckhoff TwinCAT 3

As PLC, a Beckhoff CX5120 was used for the setup. This PLC runs TwinCAT 3 in real-time.

For configuring the Beckhoff PLC you need to download the engineering version of TwinCAT 3, called “eXtended Automation Engineering (XAE)”.
You may download it here: Software | Beckhoff Worldwide
Install the software and then restart your system.

Install ESI

You need the **E**therCAT **S**lave **I**nformation file for communication. It is included in the FAULHABER Motion Manager at C:\Users\Public\Documents\Faulhaber\Motion Manager 7\Device description\ESI. Older version of Motion Manager put hit here: C:\Program Files (x86)\Faulhaber\Motion Manager 6\ESI
The hardware setup of this example is a MC 5010 ET. The correct ESI file in this case is FAULHABER_MC5004_10601_#.xml ESI file.
→ “#” refers to the revision number of the firmware.

Copy this file to the EtherCAT-directory of you TwinCat installation. Depending on the directory where you installed it, it might be something like “C:\TwinCAT\3.1\Config\Io\EtherCAT”.
After that, restart TwinCAT.

Previous editions of the firmware (before 2023, up to firmware index ‘L’) additionally required the file “FAULHABER_Module_Sync.xml”. It had to be copied in the same way as the main ESI file. With newer versions, you do not need this anymore. For older versions, please copy it to the same location.

Setup TwinCAT

Open TwinCAT and create a new project.

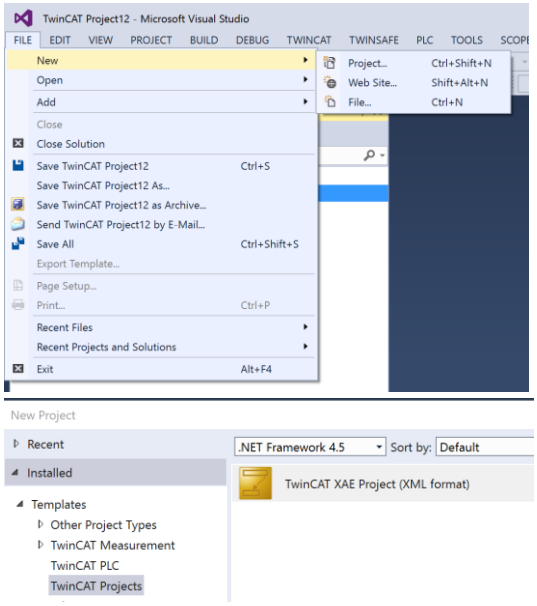


Figure 11: Create a new project

Hit “SYSTEM” on the left side and then “Choose Target…” on the right side.

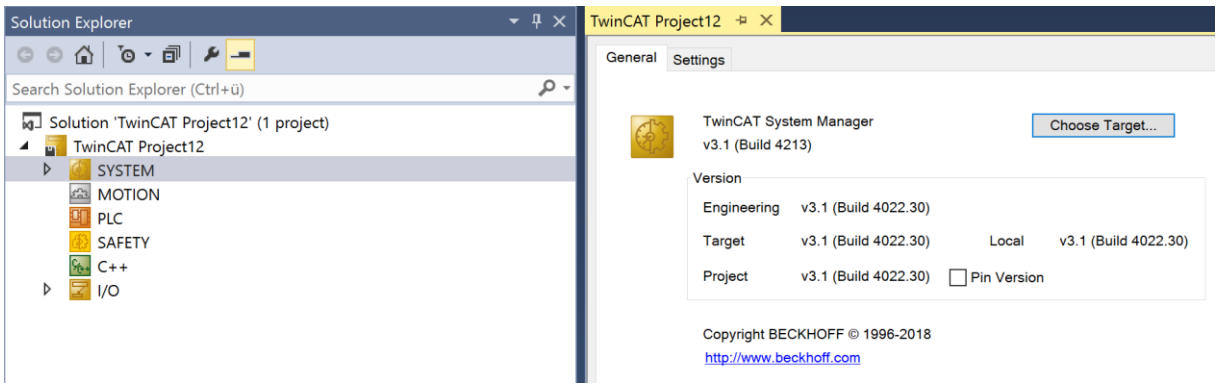


Figure 13: Choose your hardware target

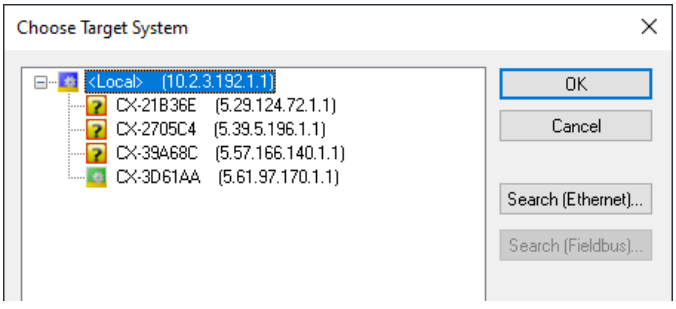


Figure 14: Start “Ethernet search”

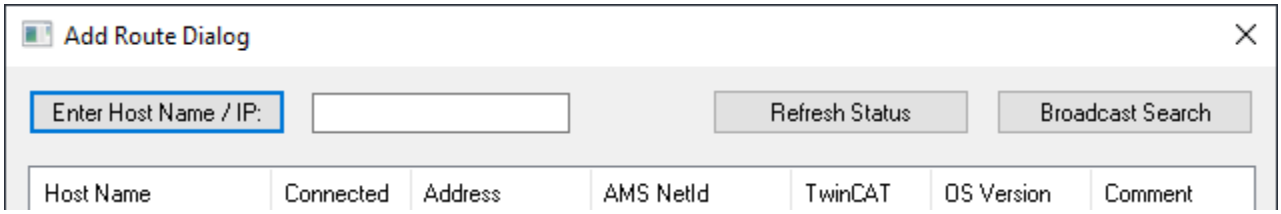


Figure 15: Start “Broadcast Search”

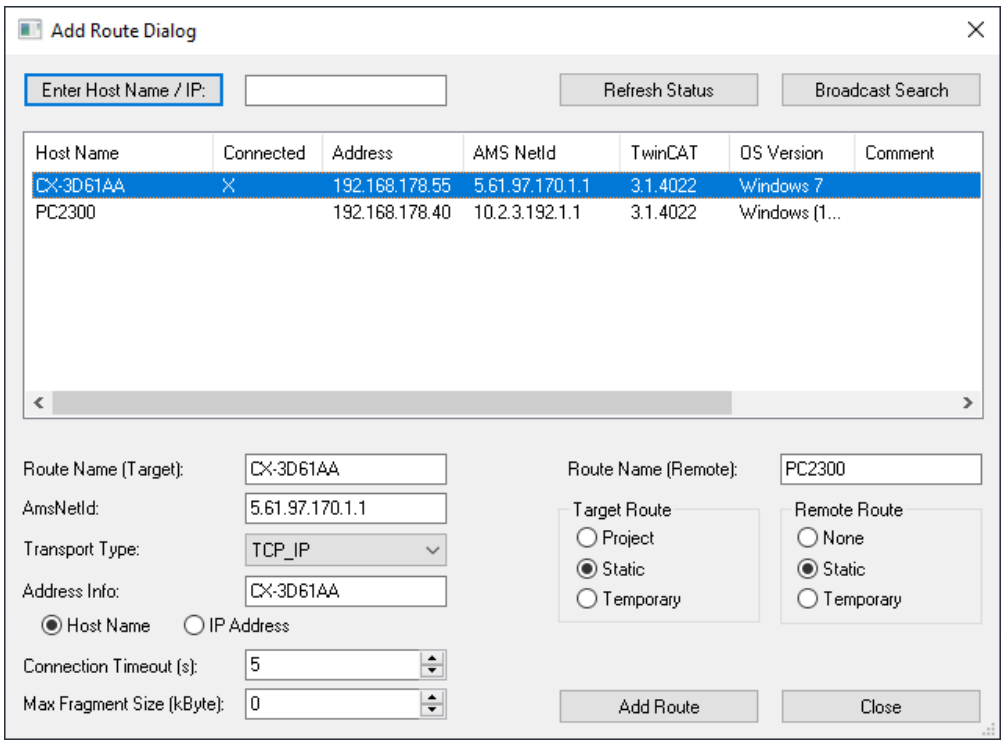


Figure 16: Adding the found device

If the PLC is directly connected to your PC then you have to select “IP Address”.
In a network (e.g. router) please use the “Host Name”.

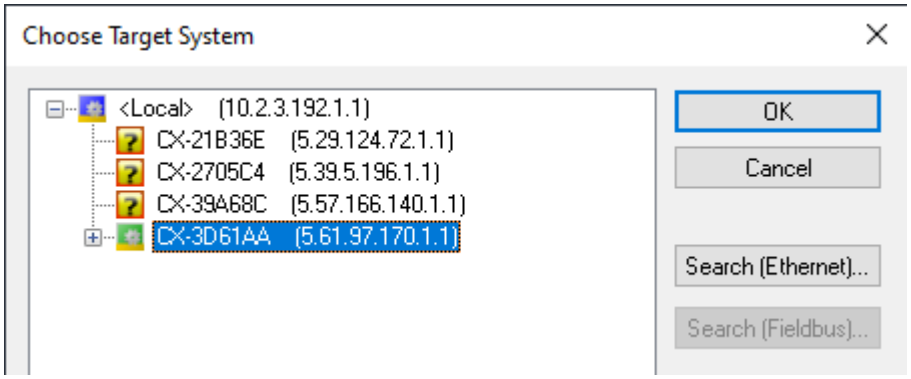


Figure 17: Select the found PLC

Scan for EtherCAT devices

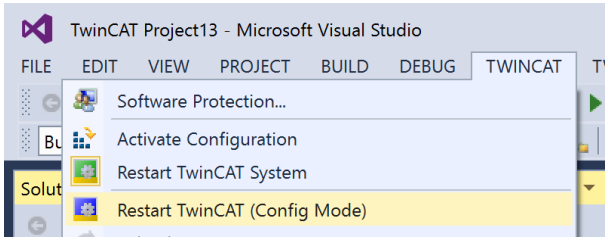


Figure 18: Activate the “config mode”

Hit “I/O” ➔ right click on Devices ➔ “Scan”

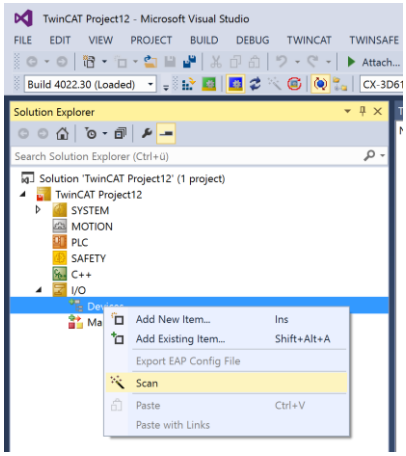


Figure 19: Scan for hardware

Select all devices found, confirm to scan for boxes and don’t link the axis to “NC/CNC configuration for now. Just close this window.
➔Activate the “free run” again.

On the left side under Device 1 (EtherCAT) theFAULHABER motion controller is listed, for this example it is a MC5004:

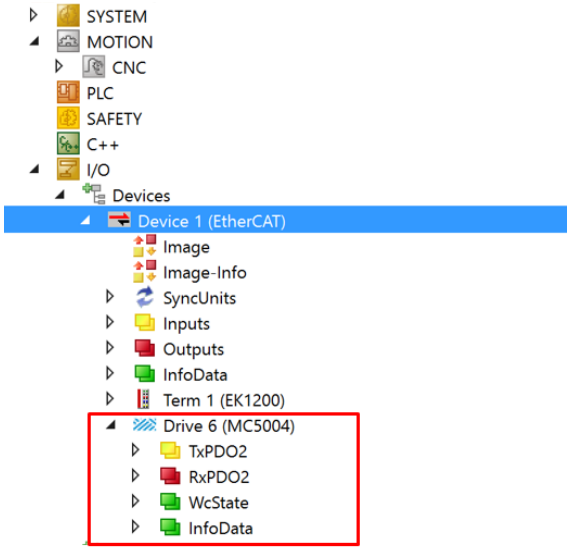


Figure 20: MC5004 is listed

Startup the controller

Click on the EtherCAT Master. This is one level above the MC5004:

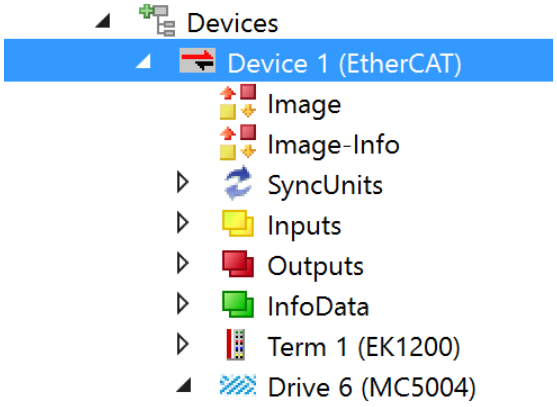


Figure 21: ET Master

Seelct “Online” on the right side.

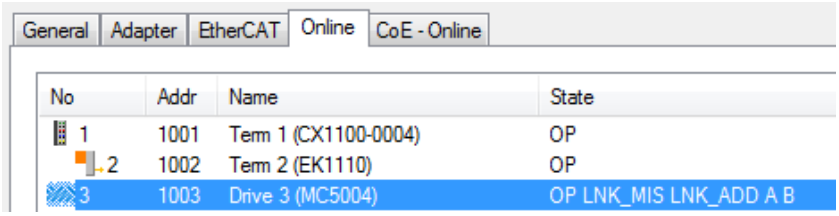


Figure 22: Overview of all device status

If the “State” contains “LNK_MIS LNK-ADD …”, the Ethernet cables are plugged in reverse. Unplug them and insert them correctly.
The motion controller’s “IN”-port has to be connected with your PLCs “OUT”-port. When the setup is correct, the MC will enter “OP” state.

Select the FAULHABER motion controller in the left hand pane. Then click “Online” on the right-hand pane.

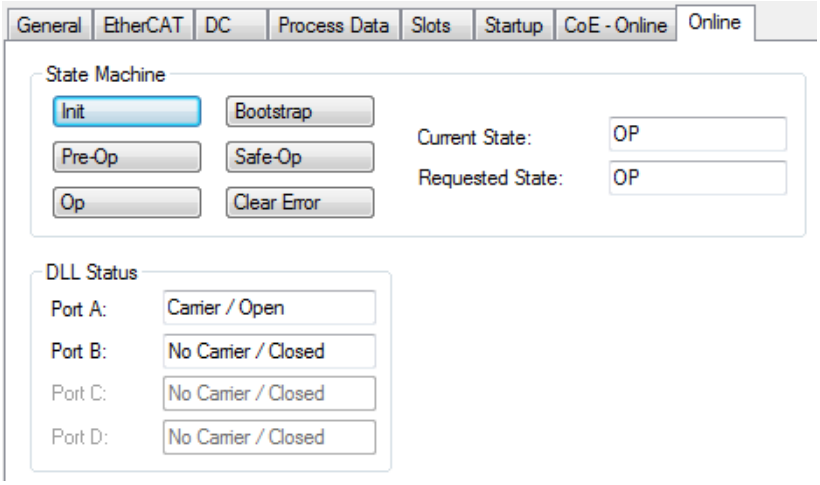


Figure 23: The device status of the MC5004

The “State” should be “OP”. If there is an “Error” hit the “Clear Error” button.

Setup the controller

Select the FAULHABER motion controller on the left side and “CoE-Online” on the right side.
In this object dictionary all parameters are listed.

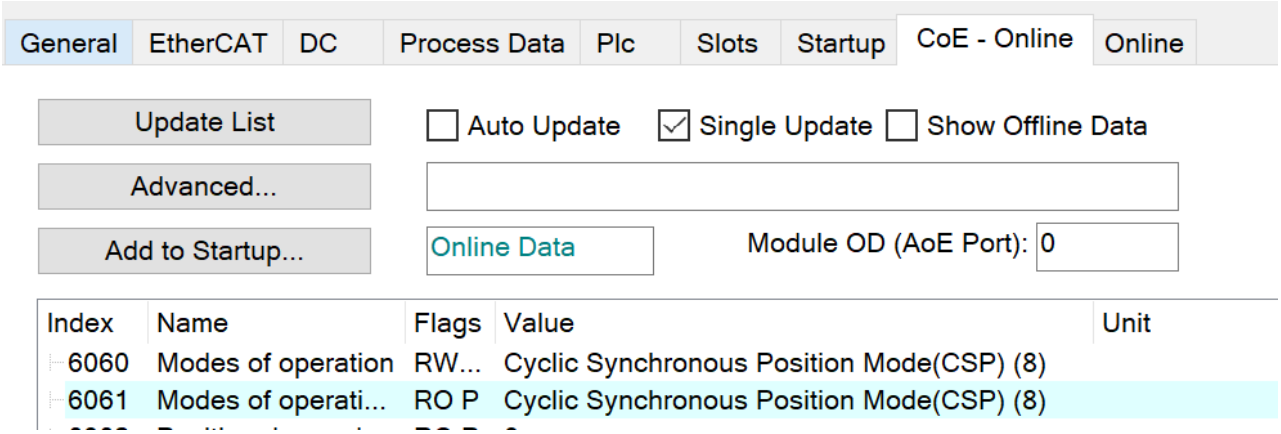


Figure 24: The “CoE-Online”

Scroll down to object “6060“➔ “Modes of operation“.
Double-click on the value and enter 8 in the “Dec”-field of the popup.
“6061“ = “Modes of operation display” must change to 8.
When this happens the modes of operation changed to “Cyclic Synch Position Mode”

The default PDO mapping is defined by the ESI file.

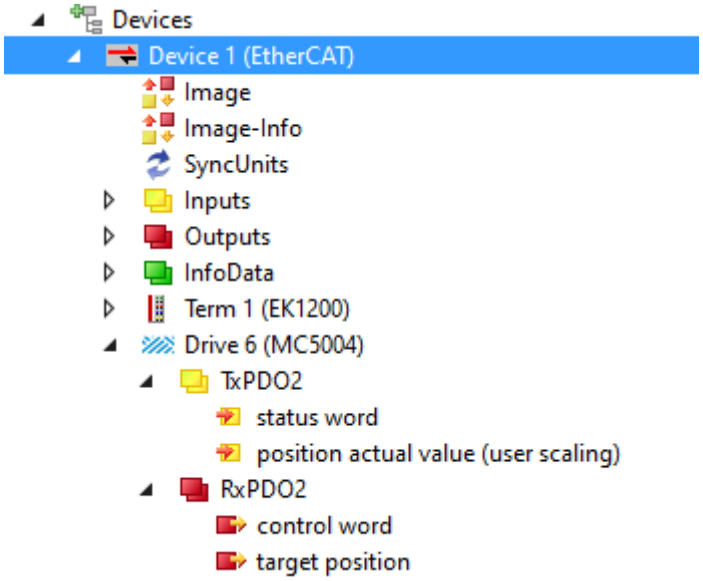


Figure 25: PDO mapping

The default PDO 2 supports a miminum set of objects necessary for positioning.
PDO mapping can be modified individually for each application.

Run the drive

Cyclic data overwrites mailbox data every cycle! Thus, PDO-mapped data has to be changed in the process image. The next steps show how to enable the power stage and run the motor.
The standard process image table allows to change the TxPDOs and monitor the RxPDOs.
You can find it in the lower right hand pane.

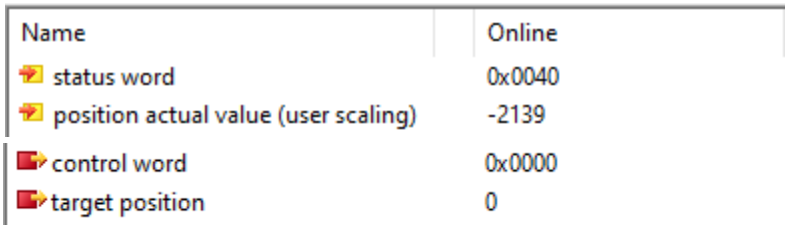


Figure 26: process image table

The “status word” in the process image table is 40(hex).
Right-click on “control word” and select “Online Write”. Enter 6 and OK.
You can see a change of the status word in the process image table to 21(hex).
Right-click on “control word” and select “Online Write”. Enter decimal 15 and OK.
You can see a change of the status word in the process image table to 27(hex).
The power stage is now enabled.
Right-click on “target position” and select “Online Write”. Enter decimal 10000 and OK.
The motor should turn now. Observe “position actual value” it should be 10000 as well after position is reached.

Implementation of FAULHABER MC3 ET in TwinCAT environment is finished successfully.

If your application requires synchronisation of multiple axes, you might use cyclic operation modes like CSP (cyclic synchronous position). Cyclic modes require the PLC to calculate the motion profile. This is done by the “NC axis”. The required steps to integrate FAULHABER MC3 ET in TwinCAT environment as “NC axis” is explained application note 169, which is found here: https://www.faulhaber.com/application-notes/en/

If not using a “NC axis” please make sure to use profile operation modes like PP (profile position) or PV (profile velocity).

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