FAULHABER

Getting started with FAULHABER EtherCAT

Summary

How to setup a FAULHABER MotionController with EtherCAT communication interface:
1. Cable Installation
2. Configure drive with FAULHABER MotionManager
3. Use Beckhoff TwinCAT 2 to drive the motor

Targets

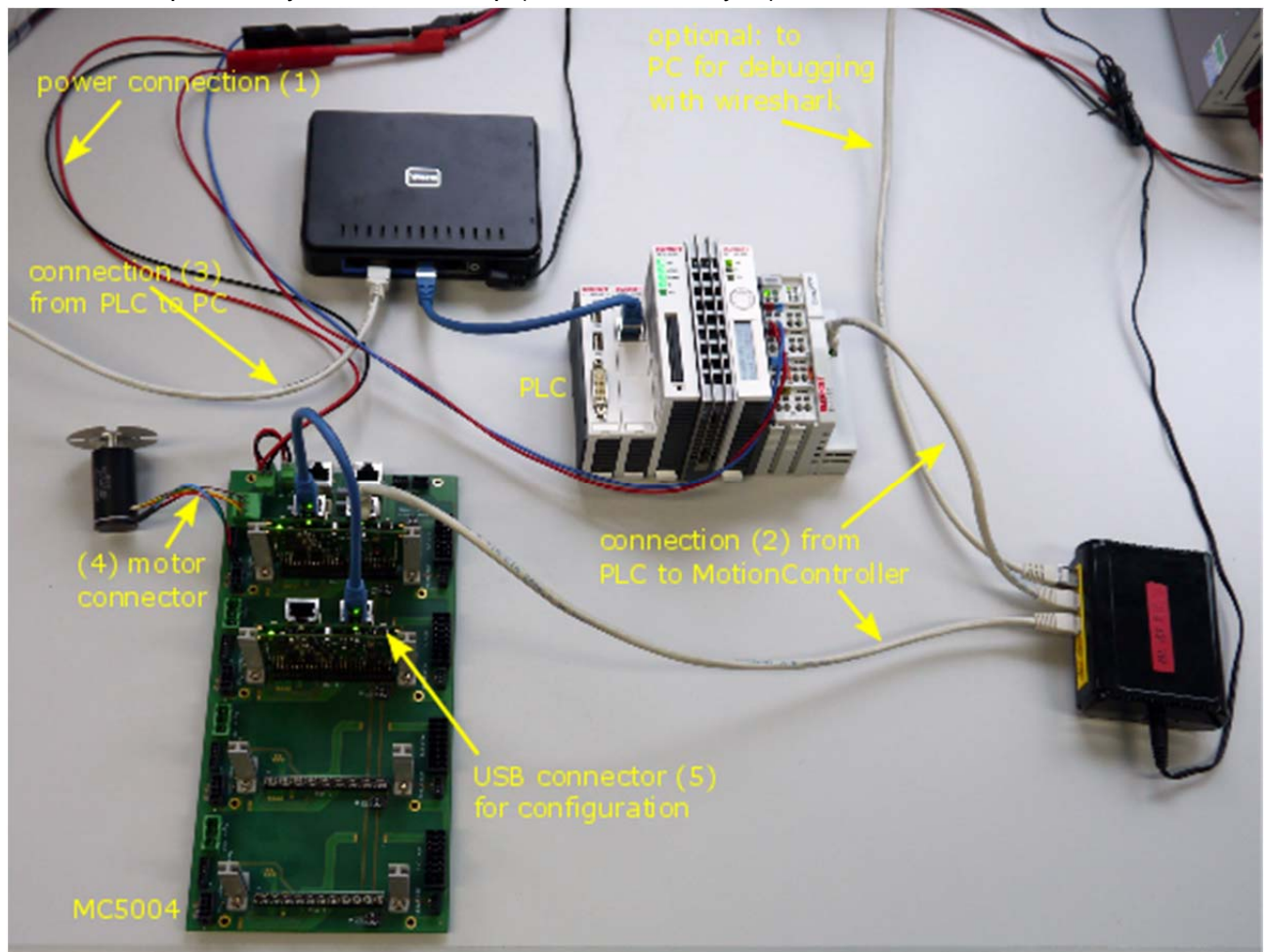FAULHABER MotionController with EtherCAT interface. Here, an MC5004 is used.

Licensing

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

Cable installation

You need the following connections:
1. Power and electronics connection with 24V.
2. EtherCAT-In connected to your PLC. For debugging, use a router in the middle, so you can get Wireshark-trace from the communication of the PLC with the MotionController; you need a free network port on your PC for that.
3. Ethernet connection from your PLC to a free network port on your computer; preferably use router in the middle to get an IP address via DHCP (e.g. D-Link DIR-100, Trendnet TW100)
4. Connect a drive with the MotionController.
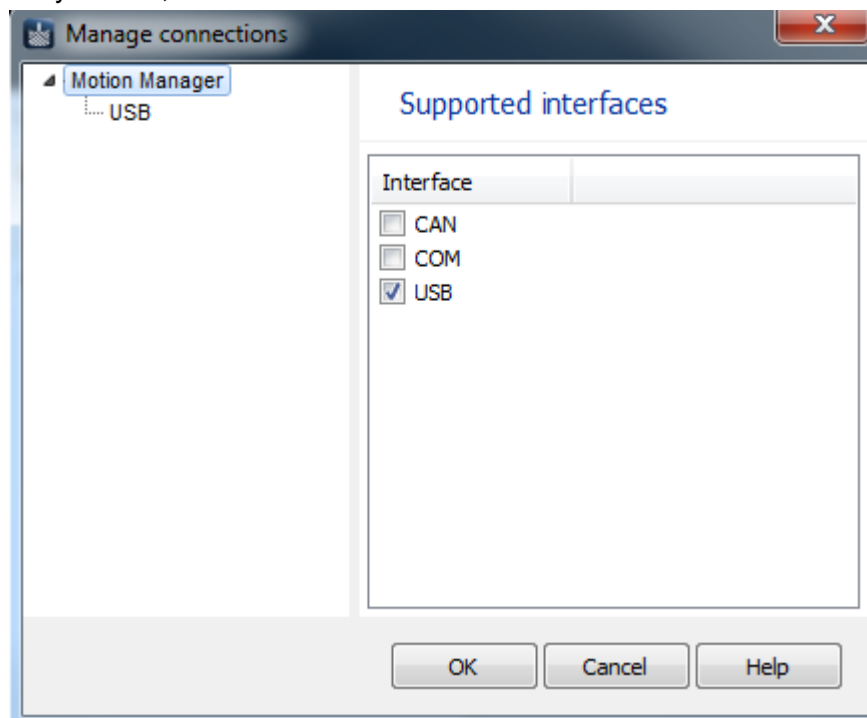5. USB-port with your PC for setup (do not connect yet!).
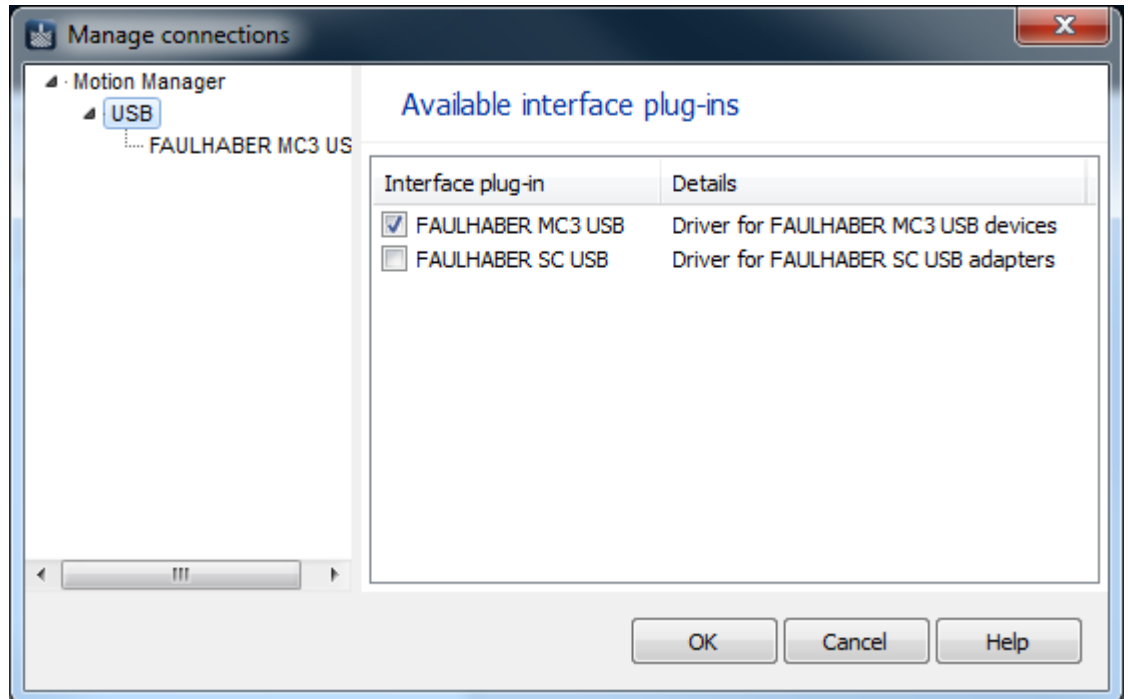
MotionManager

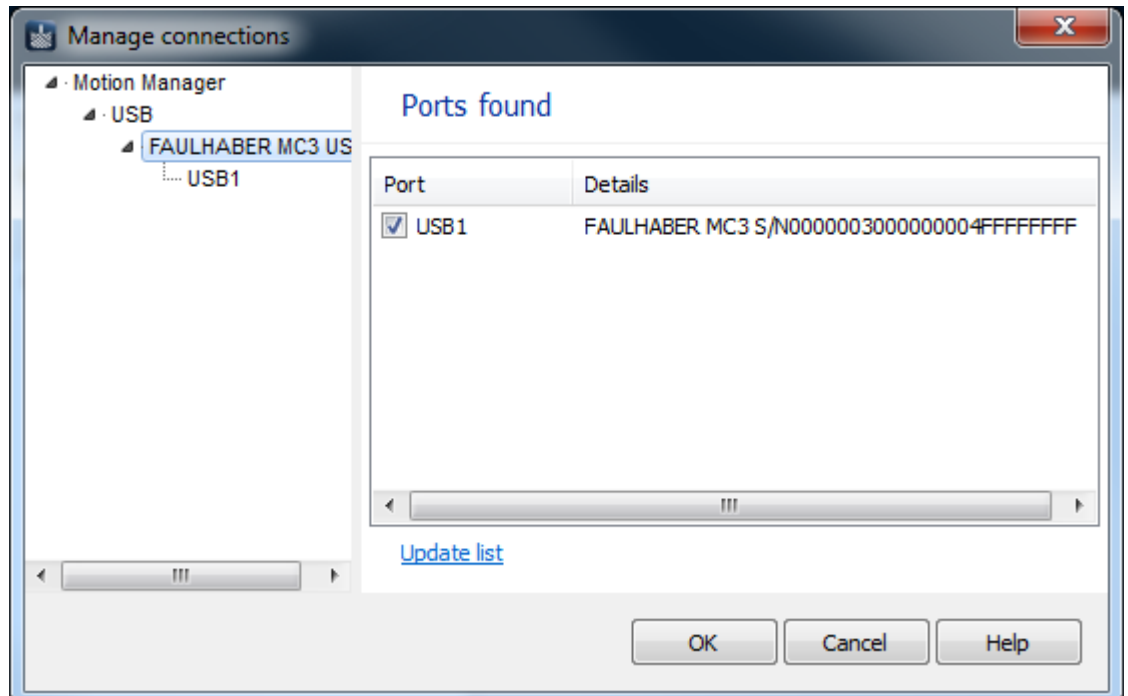Configure drive to run the connected motor.

1. Do NOT connect the FAULHABER MotionController to your computer. Install USB driver first, see the following steps.
2. Install MotionManager 6 and start it.
3. Connect USB cable from PC to FAULHABER MotionController
4. Power your controller, check that the power-LED on the controller is on.
5. Windows will install USB drivers.
6. MotionManager menu:
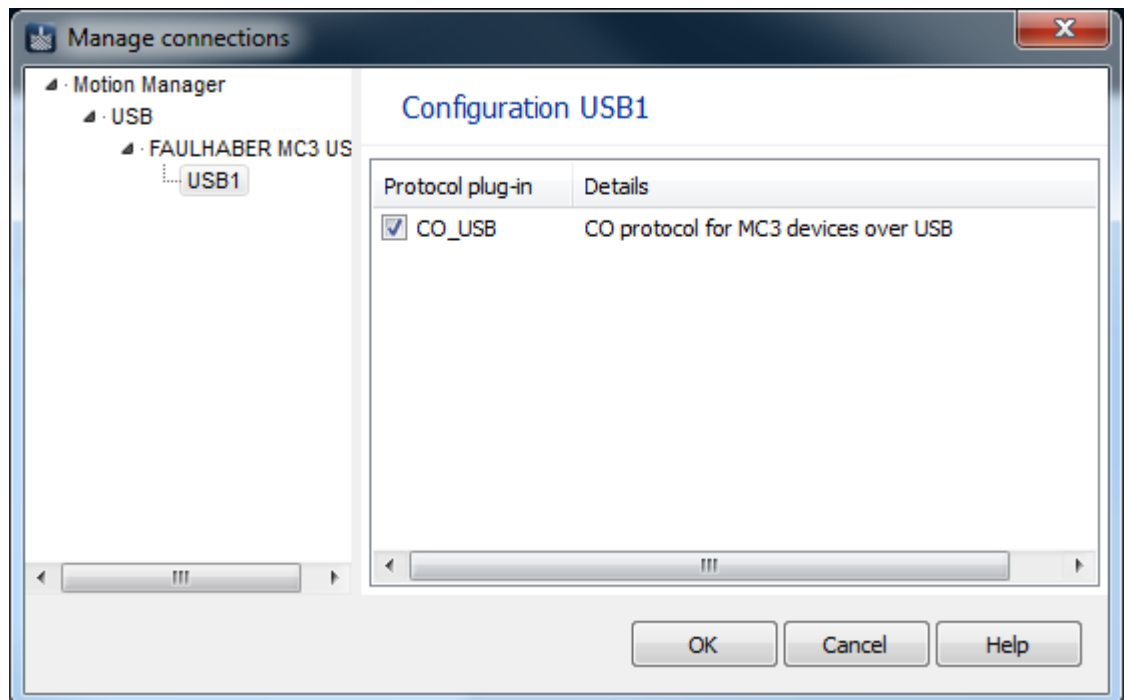   a. „Terminal" → „Manage Connections…"
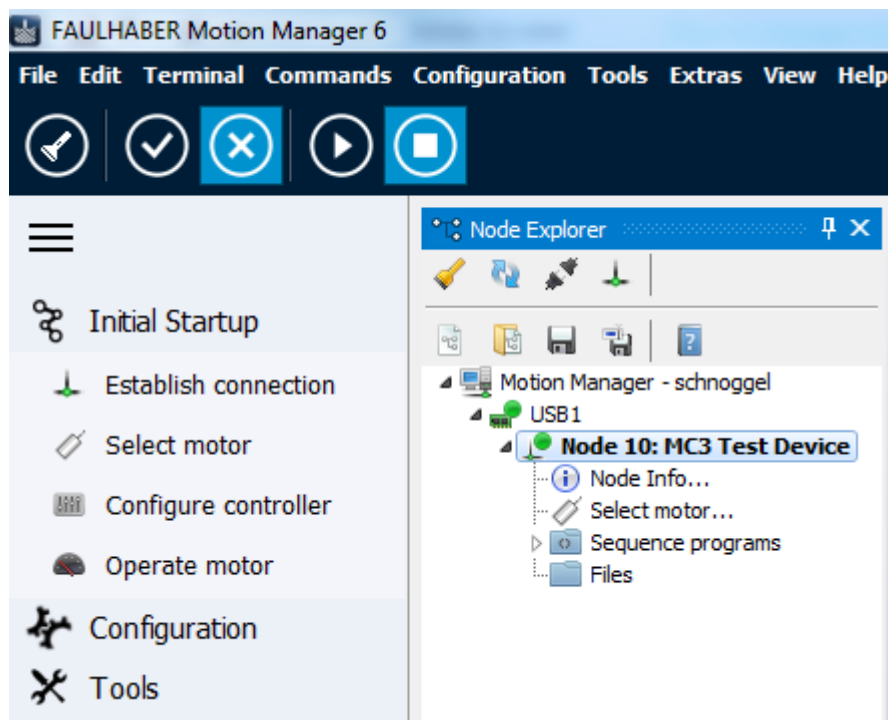   b. Only select ‚USB':

c. Only select ‚FAULHABER MC3 USB':

d. Make sure the motion controller is powered and connected to your computer via USB. Click „Update list" if necessary.

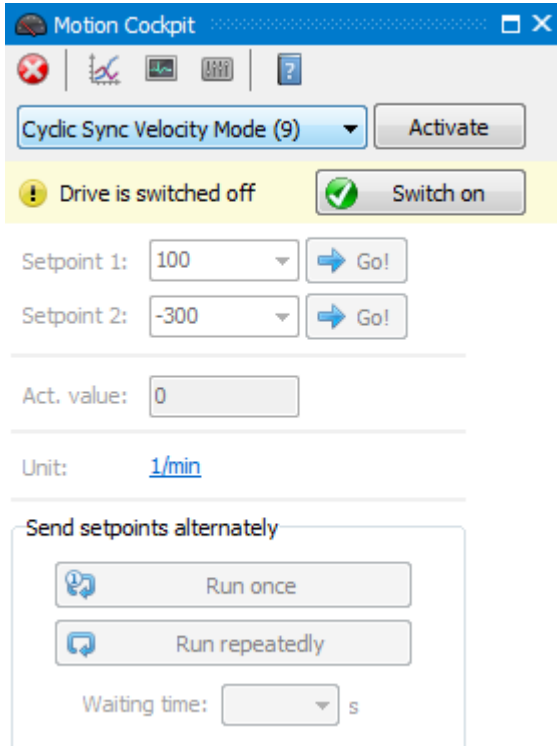e. Select your USB port:

f. Select ‚CO_USB'. Click ‚OK':

g. The controller is found:

7. Setup the motor:
   a. In the main menu of the MotionManager: „Select Configuration" → „Initial Startup" → „Select motor…"
   b. Select motor type, series, and type. Hit ‚Next'
   c. Select encoder system. Normally, leave as it is. Hit ‚Next'
   d. Assign encoder lines. Normally, leave as it is. Hit ‚Next'
   e. Hit ⬇ Transfer configuration

f. Hit ‚Next'

g. Select check-box. Hit ✅ Start adjustment of the Hall sensor signals

h. The motor will turn and automatically adjust the hall signals. This must succeed! Otherwise, correct any error first before proceeding.

i. Hit ‚Finished' and permanently save changes to the controller.

8. Run the motor: From the main menu, select „Tools" → „Motion Cockpit":

a. Select ‚Cyclic Sync Velocity Mode' and hit ‚Activate'

b. If drive is switched off, hit ‚Switch on'

c. Enter ‚100' into the topmost entry field and hit ‚Go!'. The drive should turn. If not, **correct any error first** before proceeding.

Beckhoff TwinCAT 2

There are two types of PLC for controlling a drive: soft-PLCs and dedicated hardware PLCs.

A Soft-PLC is a piece of software running on your computer. The better ones are deeply embedded into the Windows system and take over a whole kernel of your computer's processor, which then is not available any more to Windows. The simpler soft-PLCs like Beckhoff's TwinCAT are a regular program and must share resources with other programs. Thus, they are not hard real-time capable. FAULHABER does not recommend them. Additionally, Beckhoff's TwinCAT 2 only runs on 32 bit Windows and on 64 bit systems needs to be run in a virtual environment („Windows Virtual PC": „XP Mode") which is a rather painful experience.

Far better results are achieved with dedicated hardware PLCs. For this documentation, a Beckhoff CX1010-N0100 is used. This PLC runs TwinCAT 2 in hard real-time.

For configuring the PLC you need to download at least the engineering version of TwinCAT. Download from: http://www.beckhoff.de/english/download/tc2-download.htm what suits your system: „TwinCAT 2.11 x64 Engineering" if you have a 64 bit operating system or „TwinCAT 2.11 R3" for 32 bit systems.
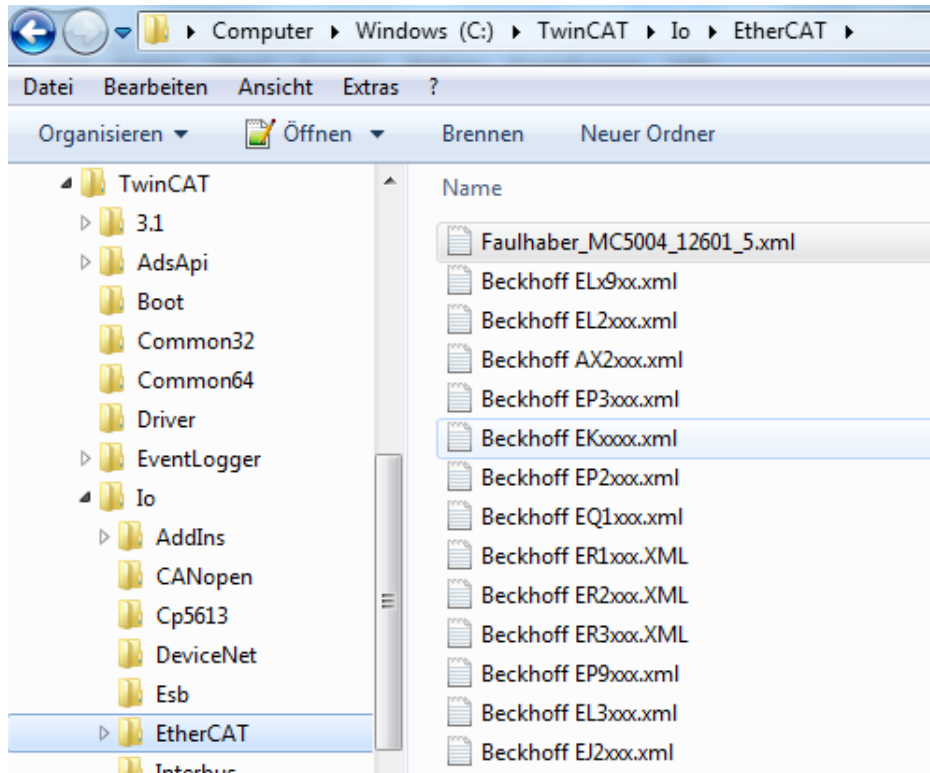
Install it, then restart your system.

Install ESI

From FAULHABER, you need the **EtherCAT Slave Information** file. For MC5004, it is FAULHA-BER_MC5004_12601_#.xml, where "#" denotes the revision number of the drive's firmware. Additionally, you need FAULHABER_Module_Sync.xml.

Copy **both** files to the directory IO\EtherCAT of your TwinCAT installation. For TwinCAT 2, the base path normally is C:\TwinCAT, for TwinCAT 3 it is C:\TwinCAT\3.1\Config). TwinCAT must be
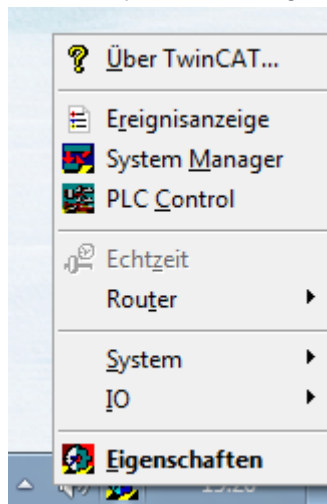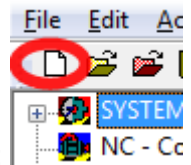
closed!

Setup TwinCAT

Start TwinCAT by clicking the blue helmet on the right hand side of your computer's status bar:
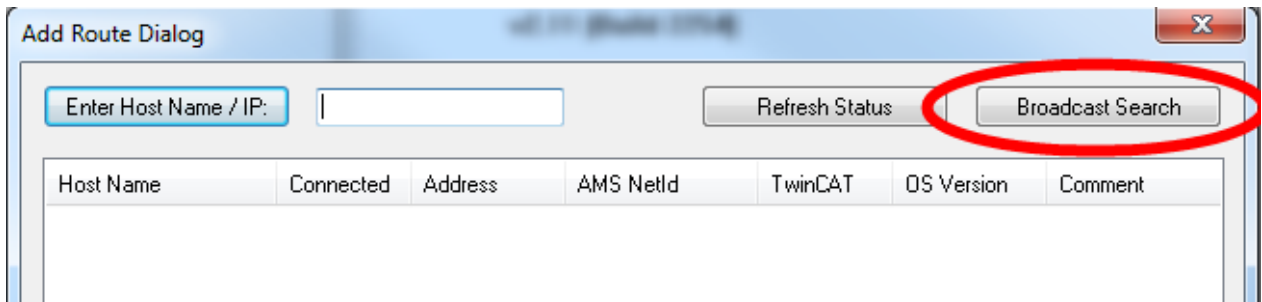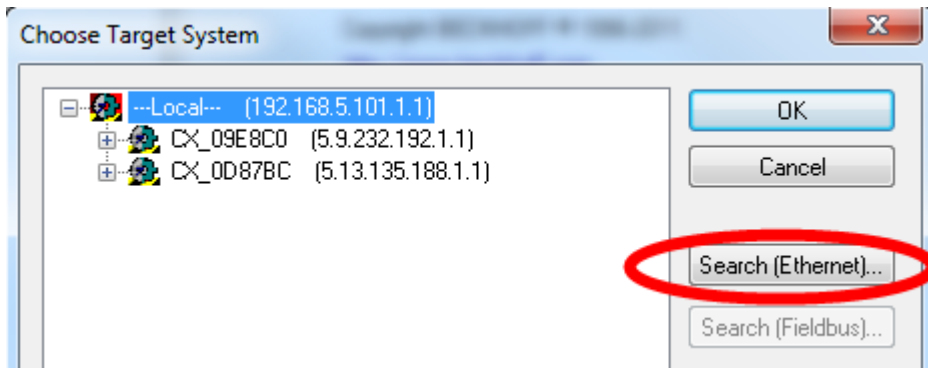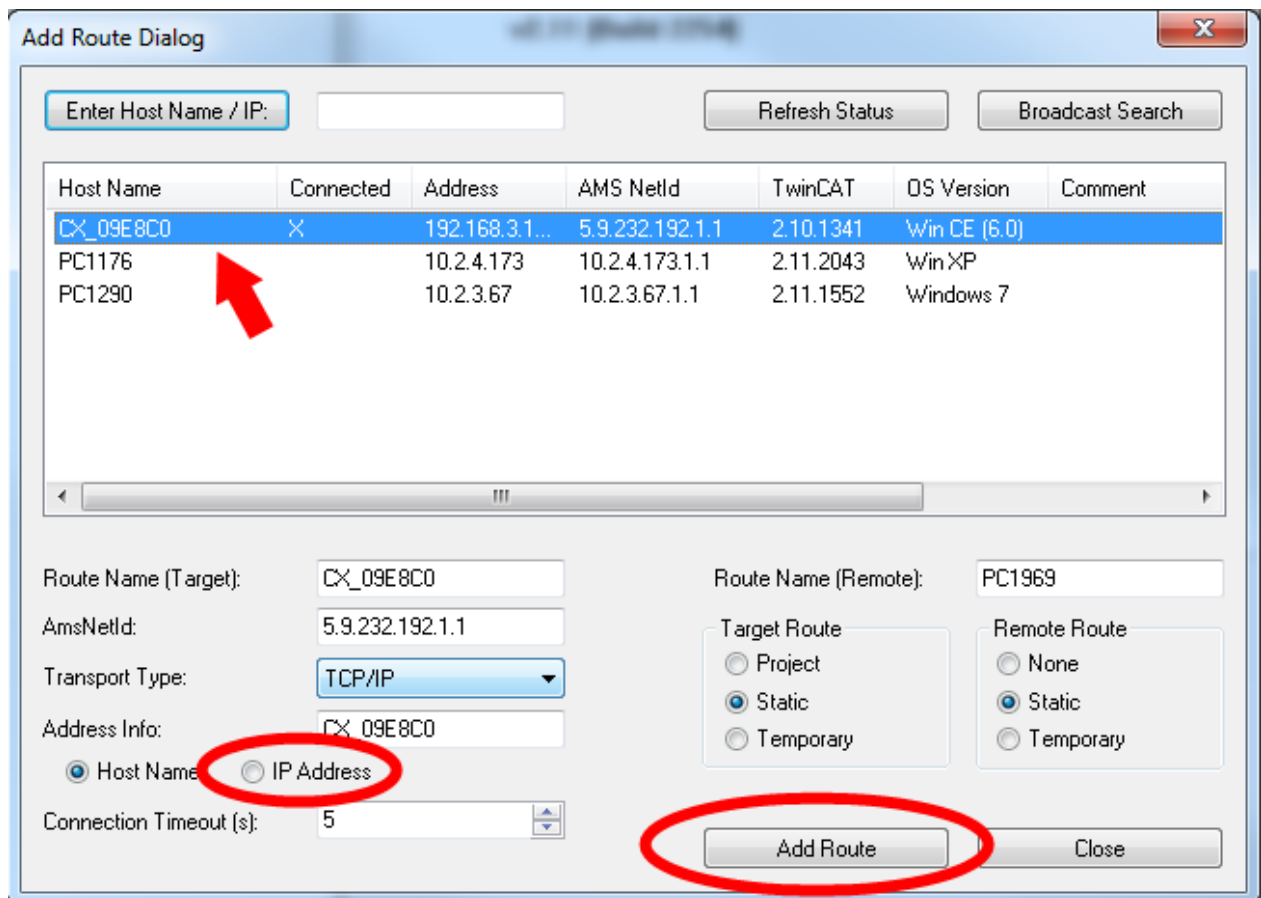

Select ‚System Manager‘:

When SystemManager has started up, select File → New to start a new project:

Connect to your PLC

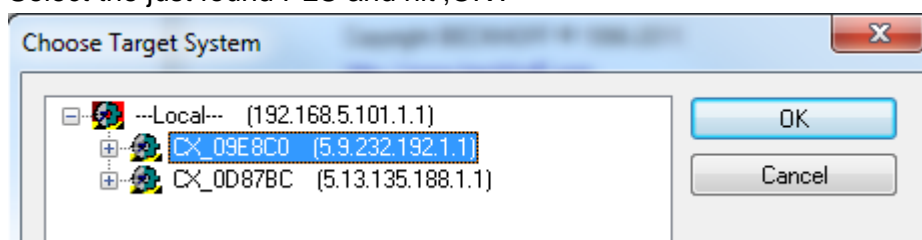Select ‚SYSTEM-Configuration‘ in the left pane, then ‚Choose Target‘ in the right:

If your Backhoff PLC is directly connected to your PC, select ‚IP Address'. Otherweise, leave ‚Host Name'.

If prompted for a user name and password, use ‚Administrator' as user and leave blank the password.

Hit ‚Close'.
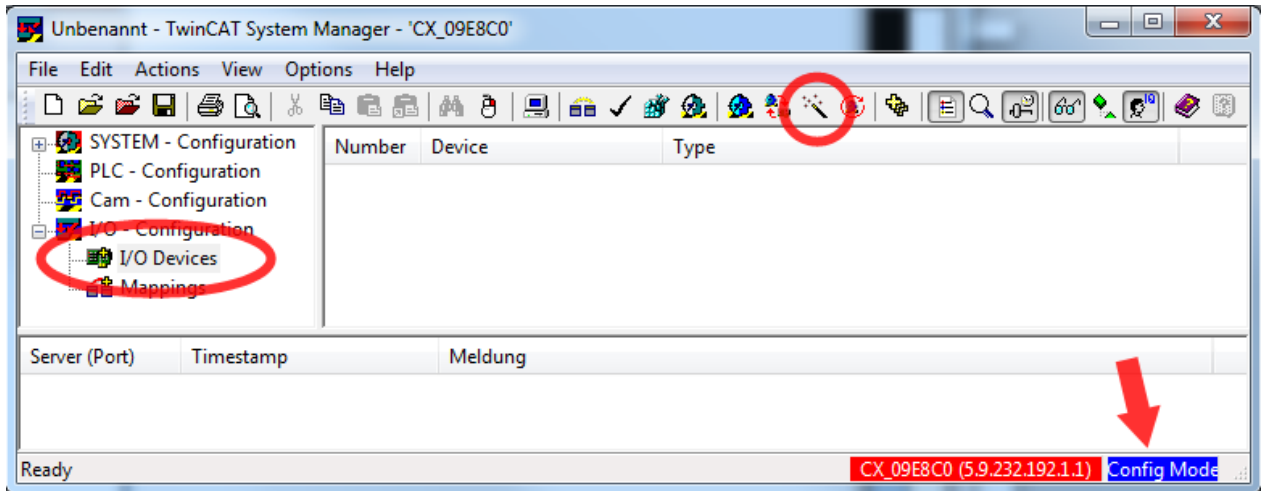
Find the controller

Select the just found PLC and hit ‚OK':

The mode indicator in the lower right corner should show ‚Config Mode'. If it is ‚Timeout', the connection does not work. You have a problem with your Beckhoff configuration and need to find out what it is.

If it is ,RTime', use ,Actions' → ,Set/Reset TwinCAT to Config Mode' from the main menu.
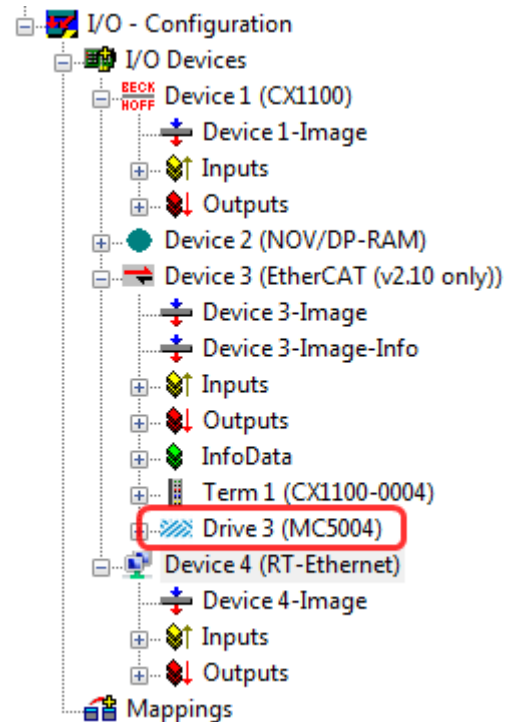
Select ,I/O Devices', then click the magic wand:

A hint apears (,Not all types of devices…'), discard it.
Select all the new I/O devies that where found. And hit o.k.
When asked, confirm to scan for boxes.
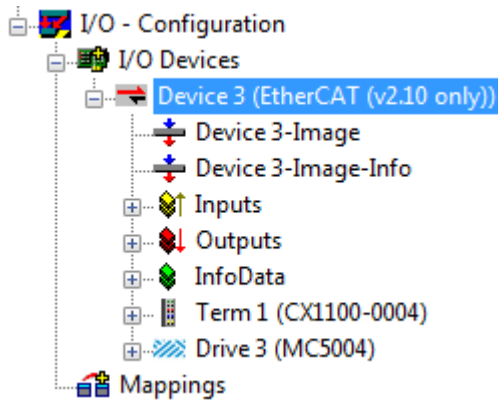When asked, do not append linked axis to NC-configuration.
Activate free run.

Somewhere in the left hand pane, the MC5004 shows up:

Startup the controller

Select the drive's master device. That is one level up from the MC5004:

In the right-hand pane, select ‚Online'. The Output will be something like this:

If the ‚State' is not only ‚OP' but something which contains ‚LNK_MIS LNK-ADD …', the ethernet cables are plugged in in reverse. That is, the ‚in'-cable is in the ‚out'-port and vice versa. Correct that.

Select the MC5004 in the left hand pane. In the right-hand pane, select ‚Online':
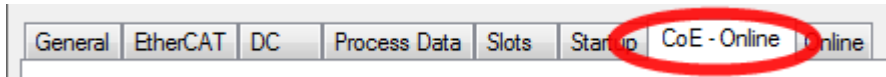

The ‚Current State' should be ‚OP'. If it is something with ‚Error', hit the ‚Clear Error' button.

Run the drive

Cyclic data overwrites mailbox data every cycle! Thus, PDO-mapped data has to be changed in the process image. The rest must be changed in the object dictionary.

Switch the drive to cyclic position mode

You use the object dictionary for that. In Free-Run Mode, select the MC5004 in the left hand pane. Select ‚CoE-Online' in the right hand pane:

Scroll down to entry „6060", „Modes of operation".
Double-click on the value (should be ‚1') and enter 8 in the ‚Dec'-field of the popup. Hit OK.
„6061" = „Modes of operation display" must change to 8.

Start the regulation

You use the process image for that. Enlarge the table in the lower right hand pane so you can read all entries:

Note the entry ‚status word', the lower byte is 40(hex).
Right-click on ‚control word' and select ‚Online Write'. Enter 6 and OK.
The lower byte of the status word changes to 21(hex).
Right-click on ‚control word' and select ‚Online Write'. Enter decimal 15 and OK.
The lower byte of the status word changes to 27(hex). The motor is in regulation now.

Position the drive

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.

Congratulations, you did it!

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