

# TwinCAT 3 NC Axes and FAULHABER MC V3.0 EtherCAT

## Summary

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This application note describes the necessary steps to control a FAULHABER MC V 3.0 ET version using a TwinCat based PLC. The MC is connected via its EtherCAT port to the PLC.

## Applies To

MC 5005 S ET, MC 5010 S ET, MC 5004 P ET and  
MCS ET

## Licensing

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

## Related FAULHABER Documents

Document	Description
Motion Manager 6	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 the operating modes and functions of the drive
Com Manual EtherCAT	Description of the EtherCAT services implemented in a FAULHABER MotionController

## Description

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This example shows the necessary steps for the implementation of a Faulhaber MC3 ET controller using a Beckhoff TwinCat3 environment.

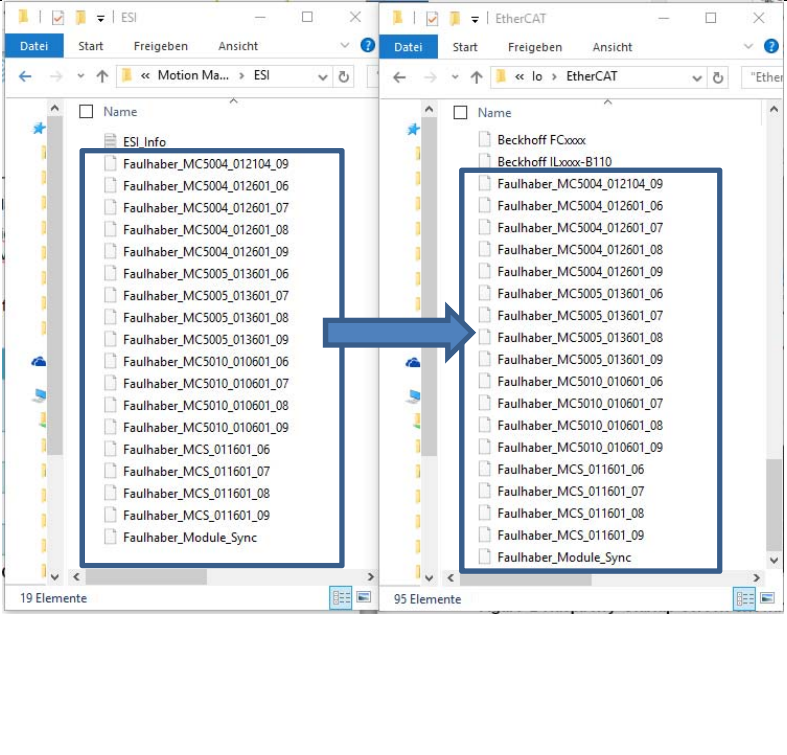
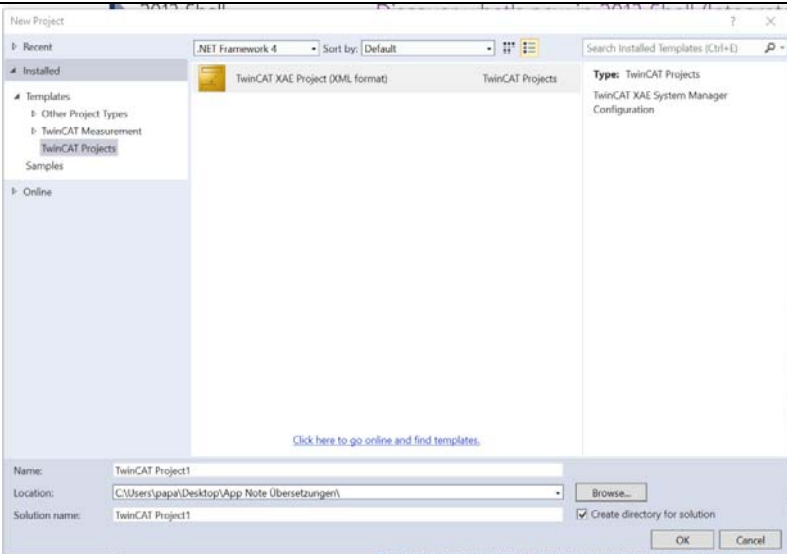
Therefore the application note is divided into two parts.

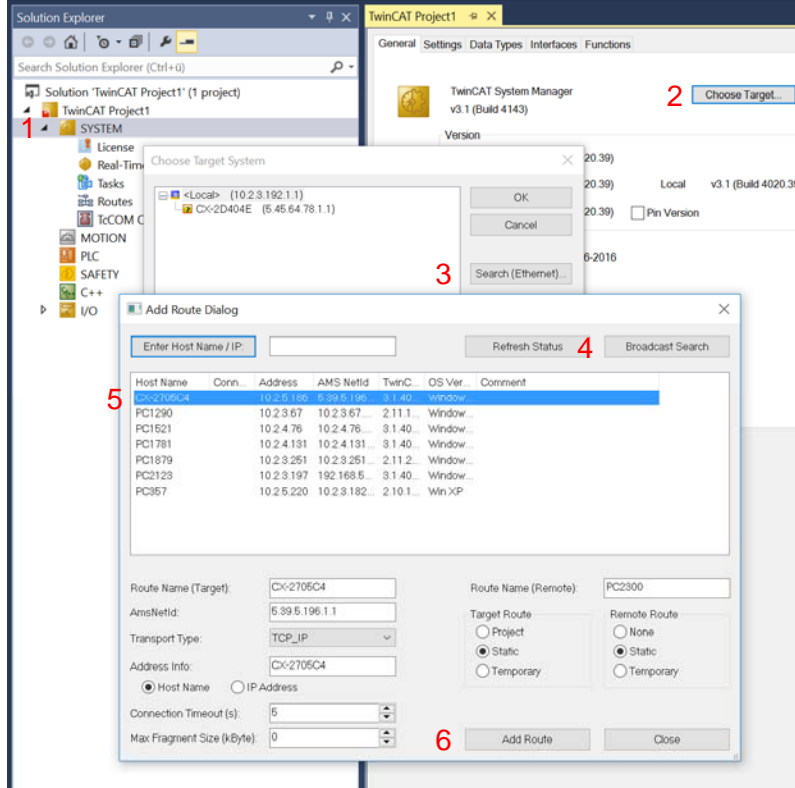
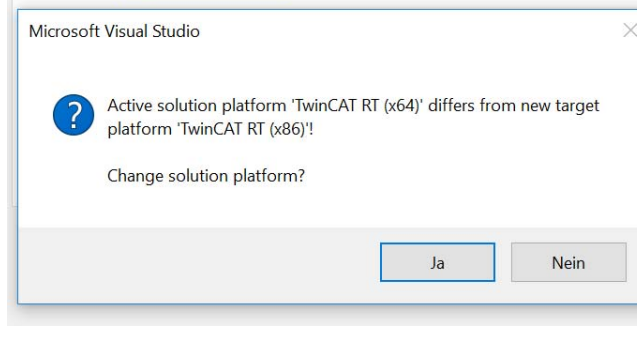
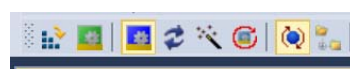
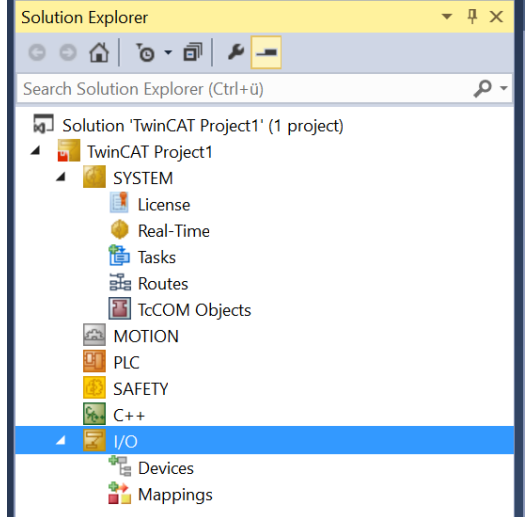
1. Implementation of Faulhaber MC3.0 ET into TwinCat 3
2. Configuring Motion Controller as NC axis

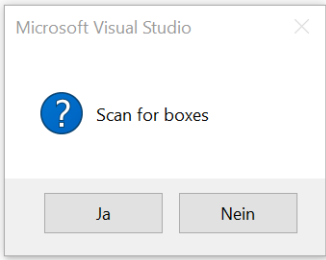

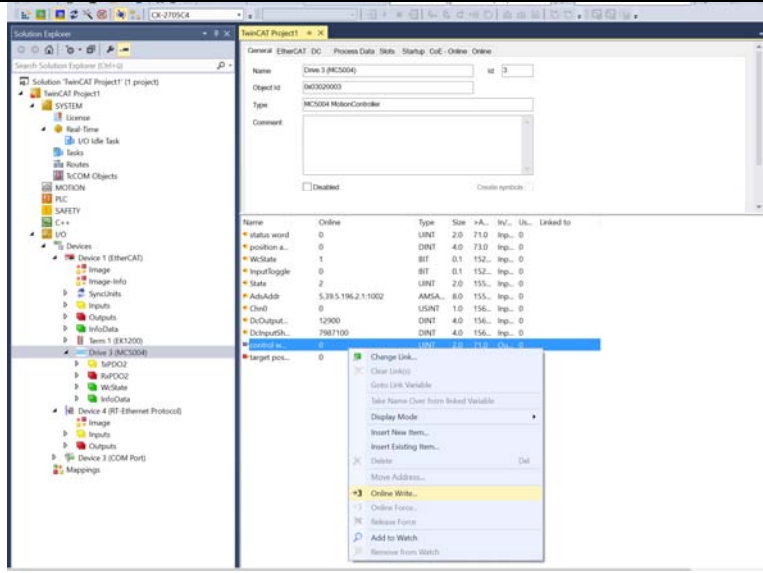
The general implementation of the MC is independent of configuration as a NC axis.

➔ It is possible to run the MC without a NC kernel on top

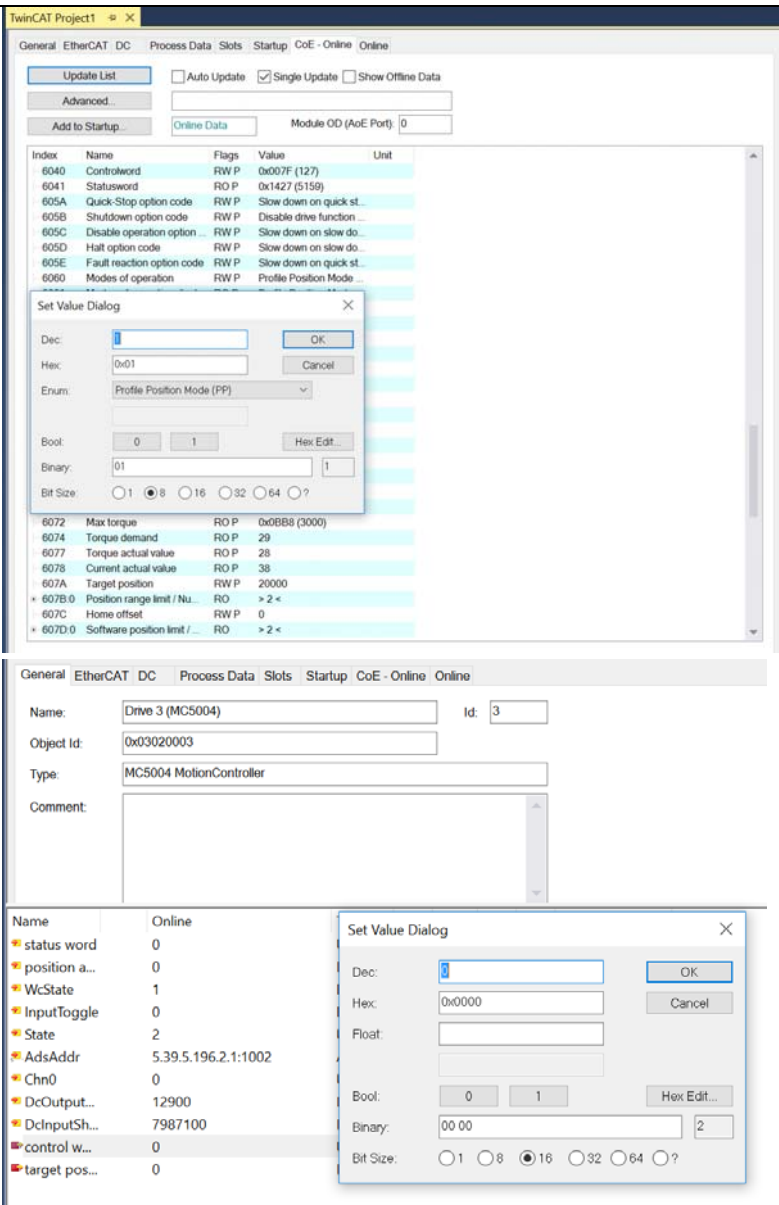
## Implementation of Faulhaber MC3.0 ET into TwinCat 3

Nr	Screenshot	Description
1		<ul style="list-style-type: none"> <li>- Ensure that the latest Motion Manager version is installed</li> <li>- Import all .xml files from the Motion Manager to the TwinCat file system</li> <li>- Start TwinCat engineering environment</li> </ul> <p>Link to MoMan .xml Files: C:\ProgramFiles(x86)\Faulhaber\Motion Manager 6\ESI</p> <p>Link to TwinCat file System: C:\TwinCAT\3.1\Config\Io\EtherCAT</p> <p>This step is only necessary, if there was an update of the .xml files and for the first implementation of the Faulhaber components into TwinCat.</p>
2		<ul style="list-style-type: none"> <li>- Create a new TwinCat solution</li> </ul>

<p>3</p>	 <p>The screenshot shows the TwinCAT System Manager interface. A 'Choose Target System' dialog is open, displaying a list of discovered devices. Below it, the 'Add Route Dialog' is open, showing a table of discovered devices and configuration options for adding a route.</p> <table border="1" data-bbox="271 627 893 817"> <thead> <tr> <th>Host Name</th> <th>Conn...</th> <th>Address</th> <th>AMS NetId</th> <th>TwinC...</th> <th>OS Ver...</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>CX&lt;2705C4</td> <td></td> <td>10.2.3.186</td> <td>5.39.5.196</td> <td>3.1.40</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC1290</td> <td></td> <td>10.2.3.67</td> <td>10.2.3.67...</td> <td>2.11.1</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC1521</td> <td></td> <td>10.2.4.76</td> <td>10.2.4.76...</td> <td>3.1.40</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC1781</td> <td></td> <td>10.2.4.131</td> <td>10.2.4.131...</td> <td>3.1.40</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC1879</td> <td></td> <td>10.2.3.251</td> <td>10.2.3.251...</td> <td>2.11.2</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC2123</td> <td></td> <td>10.2.3.197</td> <td>192.168.5...</td> <td>3.1.40</td> <td>Window...</td> <td></td> </tr> <tr> <td>PC357</td> <td></td> <td>10.2.5.220</td> <td>10.2.3.182...</td> <td>2.10.1</td> <td>Win XP</td> <td></td> </tr> </tbody> </table>	Host Name	Conn...	Address	AMS NetId	TwinC...	OS Ver...	Comment	CX<2705C4		10.2.3.186	5.39.5.196	3.1.40	Window...		PC1290		10.2.3.67	10.2.3.67...	2.11.1	Window...		PC1521		10.2.4.76	10.2.4.76...	3.1.40	Window...		PC1781		10.2.4.131	10.2.4.131...	3.1.40	Window...		PC1879		10.2.3.251	10.2.3.251...	2.11.2	Window...		PC2123		10.2.3.197	192.168.5...	3.1.40	Window...		PC357		10.2.5.220	10.2.3.182...	2.10.1	Win XP		<p>Choose your target system:</p> <ol style="list-style-type: none"> <li>1. Open the System configuration</li> <li>2. „Choose Target System“</li> <li>3. „Search“ for devices</li> <li>4. Mostly the „Broadcast search“ finds every plc which is connected to your TCP_IP network</li> <li>5. Select your target system</li> <li>6. Add your target system route</li> </ol> <p><u>Beckhoff default account information</u></p> <p>User: administrator Password: 1</p>
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<p>4</p>	 <p>The screenshot shows a dialog box from Microsoft Visual Studio with the text: 'Active solution platform 'TwinCAT RT (x64)' differs from new target platform 'TwinCAT RT (x86)!'. Below the text is the question 'Change solution platform?' and two buttons: 'Ja' and 'Nein'.</p>	<ul style="list-style-type: none"> <li>- Switch to platform solution</li> </ul> <p>Now you are in remote control mode of your PLC.</p> <p>For the further configuration, ensure that your plc is in “config Mode”</p> 																																																								
<p>5</p>	 <p>The screenshot shows the Solution Explorer in TwinCAT. The tree view is expanded to show the 'I/O' folder, which contains sub-folders for 'Devices' and 'Mappings'.</p>	<ul style="list-style-type: none"> <li>- Open the I/O configuration and scan for devices by right clicking on „devices“</li> </ul>																																																								

<p>6</p>		<ul style="list-style-type: none"> <li>- Confirm the search for boxes</li> </ul> <p>Depended on the TwinCat version, the software recognizes the MC and is going to ask, if you would like to link the controller to a NC axis.</p> <p>Chapter “2. Configure Motion Controller as NC axis” will show, how to link the MC to the NC axis, manually and additional configurations.</p>
<p>7</p>		<ul style="list-style-type: none"> <li>- Activate configuration</li> </ul> <p>After the configuration is activated, the PLC changes to run mode. You could also switch back to config mode (blue) and activate the free run.</p> <p>Configuration changes are only possible in config mode of the plc. Every time the configuration has changed, it has to be reactivated.</p>
<p>8</p>		<p>The Drive configuration offers you acces e.g. to the PDO Mapping, Controller Object browser online Data (CoE), Process data, ...</p> <p>From that point, it is possible to control the MC manually, by writing online values.</p>

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The screenshot shows the TwinCAT Project1 interface. The top window displays a list of drive parameters with columns for Index, Name, Flags, Value, and Unit. A 'Set Value Dialog' is open over this window, showing fields for Dec (1), Hex (0x01), Enum (Profile Position Mode [PP]), Bool (0), Binary (01), and Bit Size (8). Below this, another window shows drive configuration details for 'Drive 3 (MC5004)' with fields for Name, Object Id, Type, and Comment. A second 'Set Value Dialog' is open over a table of drive status, with Dec (3), Hex (0x0000), Float, Bool (0), Binary (00 00), and Bit Size (16) fields.

Index	Name	Flags	Value	Unit
6040	Controlword	RW P	0x007F (127)	
6041	Statusword	RO P	0x1427 (5159)	
605A	Quick-Stop option code	RW P	Slow down on quick st...	
605B	Shutdown option code	RW P	Disable drive function ...	
605C	Disable operation option ...	RW P	Slow down on slow do...	
605D	Halt option code	RW P	Slow down on slow do...	
605E	Fault reaction option code	RW P	Slow down on quick st...	
6060	Modes of operation	RW P	Profile Position Mode ...	
6072	Max torque	RO P	0x0BB8 (3000)	
6074	Torque demand	RO P	29	
6077	Torque actual value	RO P	28	
6078	Current actual value	RO P	38	
607A	Target position	RW P	20000	
607B.0	Position range limit / Nu...	RO	> 2 <	
607C	Home offset	RW P	0	
607D.0	Software position limit / ...	RO	> 2 <	

Name	Online
status word	0
position a...	0
WcState	1
InputToggle	0
State	2
AdsAddr	5.39.5.196.2.1:1002
Chn0	0
DcOutput...	12900
DcInputSh...	7987100
control w...	0
target pos...	0


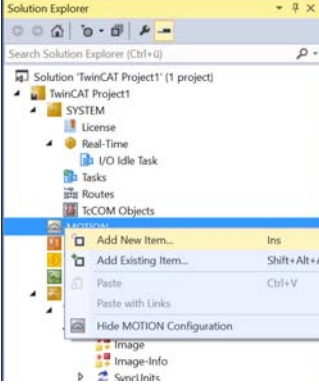
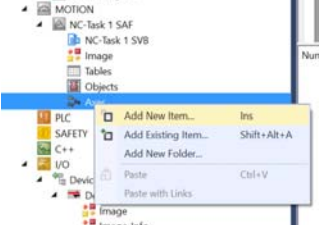
Test run:

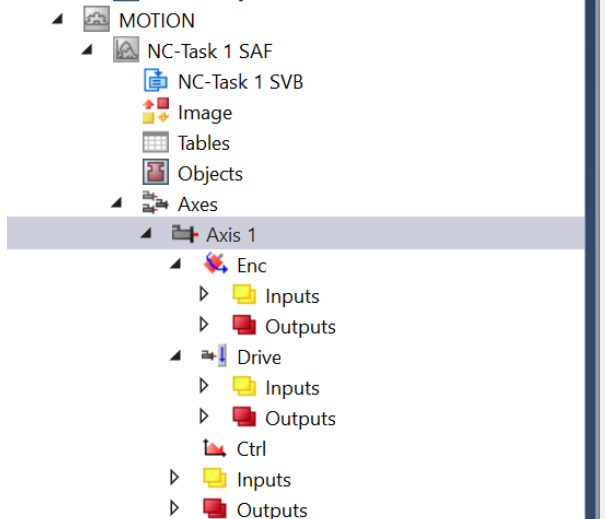
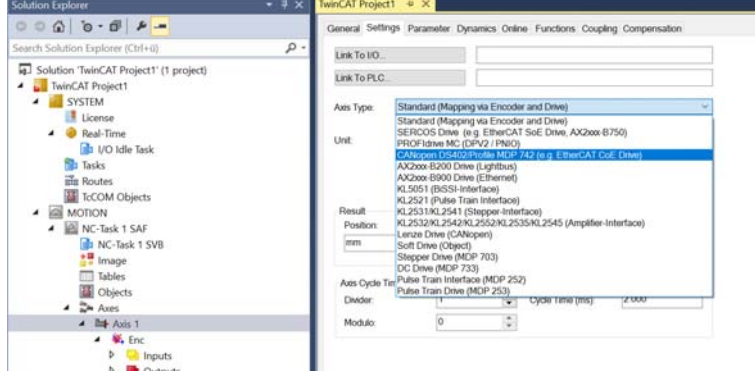
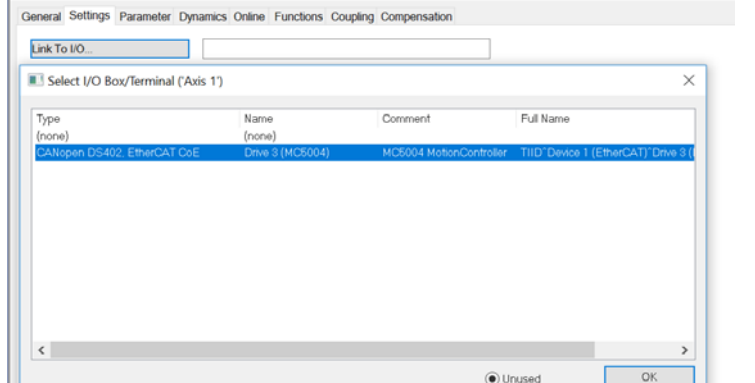
- Change Modes of Operation (Object 0x6060.00) := 1 (PP Mode)
- Enable the power stage by writing following commands to the controlword
  - o 0x6040 := 0x0006
  - o 0x6040 := 0x0007
  - o 0x6040 := 0x000F
- Set Target Position to 4096
- Start positioning (Controlword := 0x005F)

The Motor should execute a relative positioning of 4096 Inc.

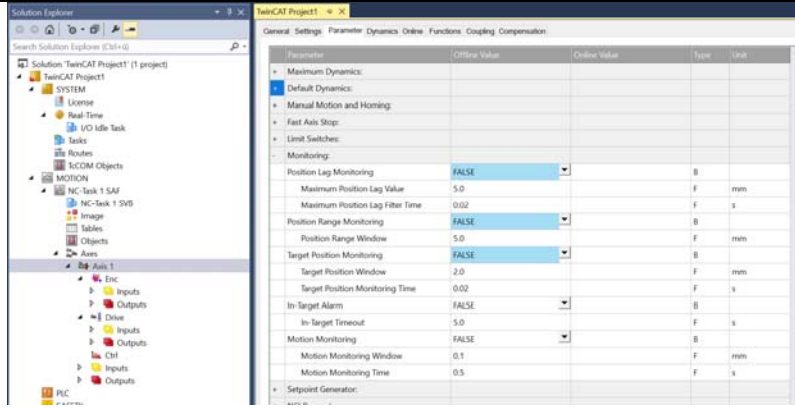

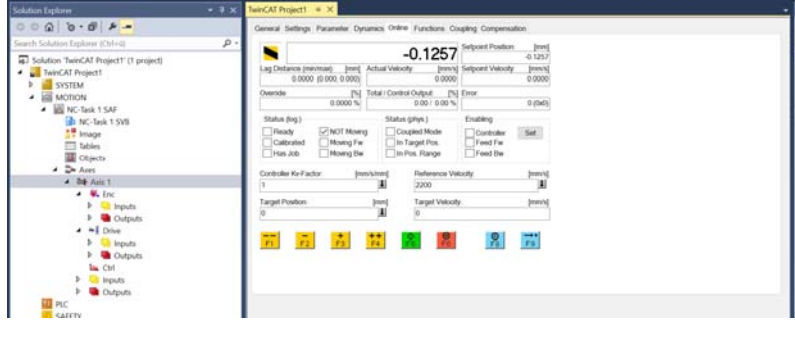
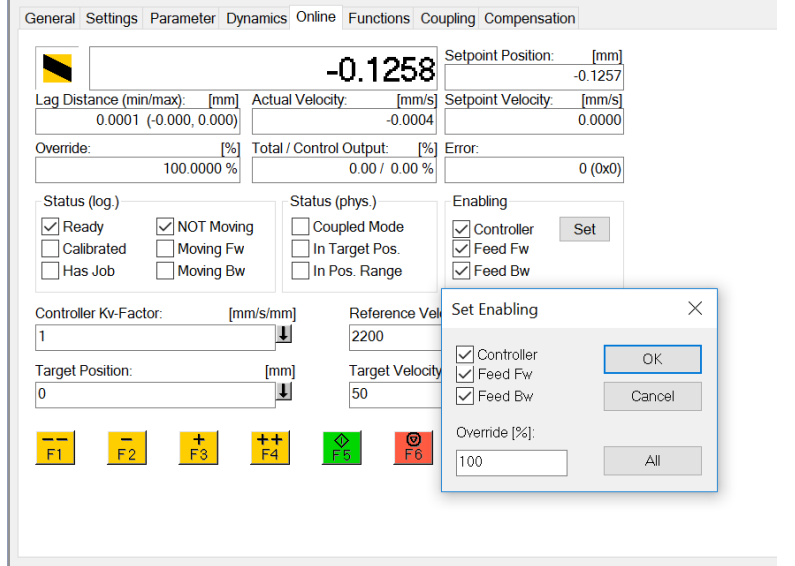
From now on it is possible to link the controller mapping to the plc program and run the drive without a NC axis.

## Configuring Motion Controller as NC axis

Nr	Screenshot	Description
1		<p>Initial state:</p> <ul style="list-style-type: none"> <li>- Run through step 1-6 of “Implementation of Faulhaber MC3.ET into TwinCat3”</li> <li>- Set Modes of Operation 0x6060 := 8 (CSP)</li> </ul>
2		<ul style="list-style-type: none"> <li>- Add New Motion Item</li> <li>- Add NC/PTP NCI Configuration</li> </ul>
3		<ul style="list-style-type: none"> <li>- Add New NC Axes Item</li> <li>- Add New Continuous Axis</li> </ul>

<p>4</p>		<p>The NC axis has been added successfully.</p> <p>Settings of NC axis: The NC axis is a virtual numerical controlled axis. Therefore there are 3 major configuration categories.</p> <p><u>Axis1</u> contains the general configuration of the NC axis e.g. link to the I/O device, definition of the axis type (DSP402,...), monitoring functions of the NC axis etc.</p> <p><u>Enc</u> contains the NC-Encoder configuration e.g. scaling factor mm/inc, soft position limits etc.</p> <p><u>Drive</u> contains the NC-Drive configuration e.g. Invert motor polarity, reference velocity etc.</p> <p>For more detailed information, take a look at <a href="https://infosys.beckhoff.com/">https://infosys.beckhoff.com/</a></p>												
<p>5</p>		<ul style="list-style-type: none"> <li>- Configure the NC axis type as CANopen (DSP 402 CoE)</li> </ul>												
<p>6</p>	 <table border="1" data-bbox="175 1680 893 1904"> <thead> <tr> <th>Type</th> <th>Name</th> <th>Comment</th> <th>Full Name</th> </tr> </thead> <tbody> <tr> <td>(none)</td> <td>(none)</td> <td></td> <td></td> </tr> <tr> <td>CANopen DS402 EtherCAT CoE</td> <td>Drive 3 (MC5004)</td> <td>MC5004 MotionController</td> <td>TIID'Device 1 (EtherCAT) Drive 3</td> </tr> </tbody> </table>	Type	Name	Comment	Full Name	(none)	(none)			CANopen DS402 EtherCAT CoE	Drive 3 (MC5004)	MC5004 MotionController	TIID'Device 1 (EtherCAT) Drive 3	<ul style="list-style-type: none"> <li>- Link the NC axis to Faulhaber I/O device</li> </ul>
Type	Name	Comment	Full Name											
(none)	(none)													
CANopen DS402 EtherCAT CoE	Drive 3 (MC5004)	MC5004 MotionController	TIID'Device 1 (EtherCAT) Drive 3											



<p>7</p>		<ul style="list-style-type: none"> <li>- For the first test run, set all Monitoring functions of Axis 1 to FALSE</li> <li>- Activate the configuration</li> </ul> 
<p>8</p>		<p>The online View allows you to control the NC axis manually</p> <ul style="list-style-type: none"> <li>- Enter Target velocity &gt;0</li> </ul>
<p>9</p>		<ul style="list-style-type: none"> <li>- Enable the NC state machine</li> </ul> <p>Now it is possible to run the Motor with F1 – F4</p> <p>Implementation of Faulhaber MC3 ET in TwinCat environment as NC axis is finished successfully</p>



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