

Omron PLC and FAULHABER V3.0 EtherCAT

Summary

How to use an Omron PLC to command a FAULHABER EtherCAT motion controller.

Applies To

All FAULHABER Motion Controllers with EtherCAT.
Omron PLCs of the NJ... and NX1... type.

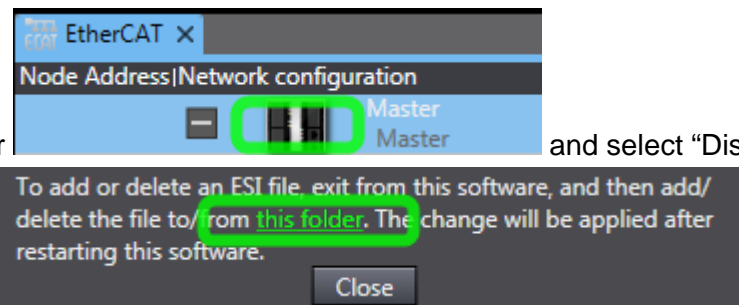
Licensing


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

Pre-Requisites

A FAULHABER motion controller is connected to your Omron PLC.
Sysmac Studio has online connection to the Omron PLC.

Install ESI Files



Right-click the master  and select "Display ESI Library".

To add or delete an ESI file, exit from this software, and then add/delete the file to/from this folder. The change will be applied after restarting this software.

Click the 'this folder':

Insert **only the needed FAULHABER ESI** files into this directory.

NEVER insert ESI files ending in _06.xml!

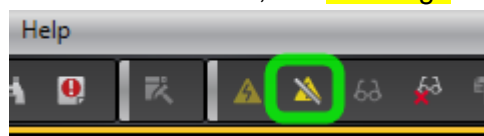
Also insert the file "**Faulhaber_Module_Sync.xml**".

Restart Sysmac Studio.

Basic Set-Up

Go Online

Make sure the Sysmac Studio is online connected to the PLC, the **flash sign** must be crossed out



and there must be a yellow line beneath it:



If the flash sign looks like this: → Press the flash sign so that the crossed out version is highlighted.

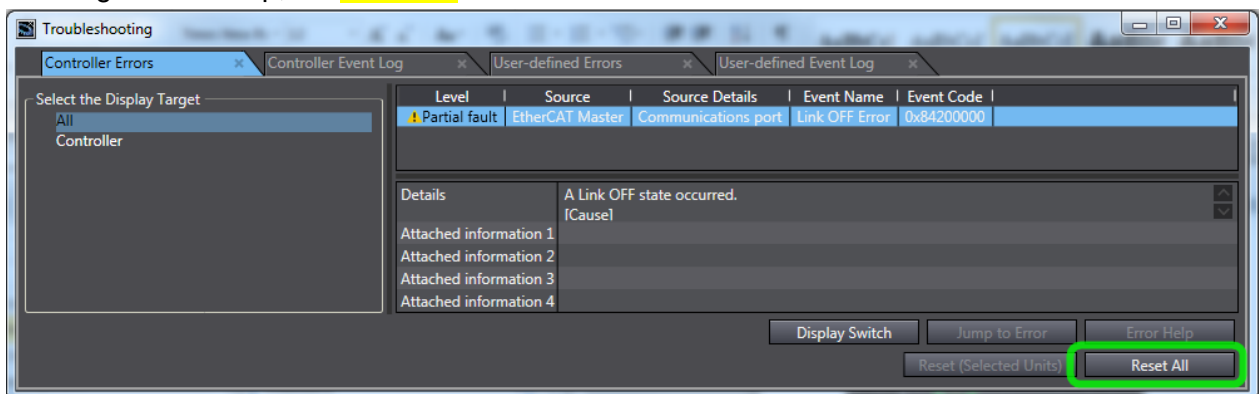
Reset Errors

Always do this step, even if there are no errors!

Repeat this as often as possible!

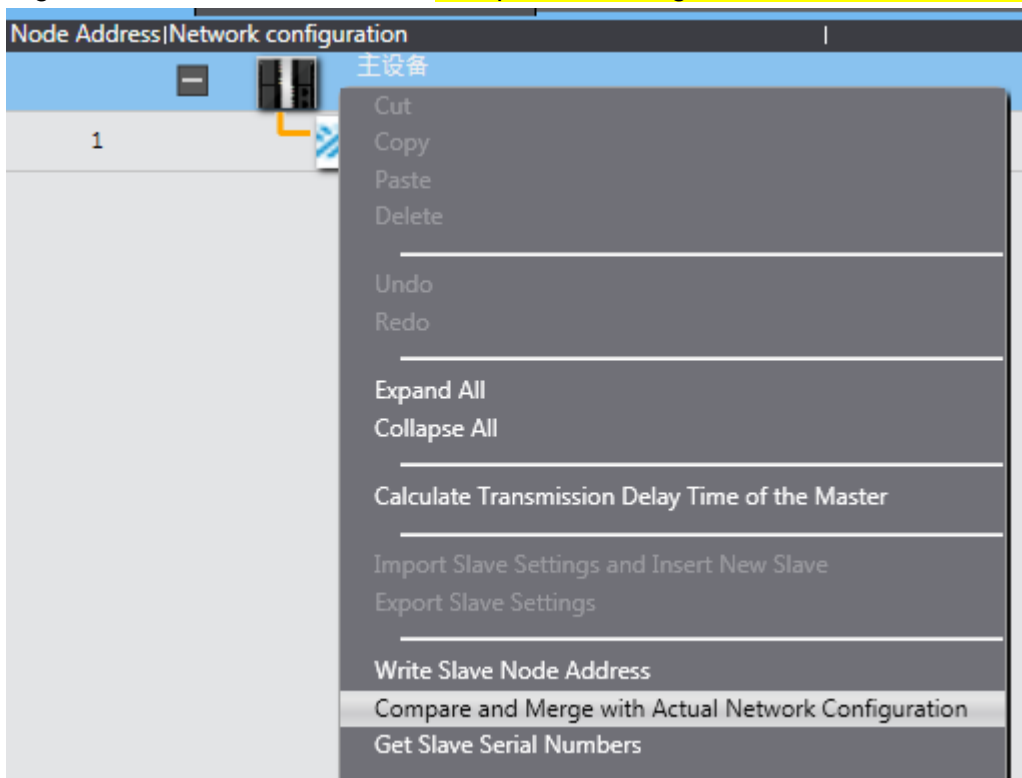
Click 'Troubleshooting' in the main menu 'Tools'.

A dialog will show up, hit 'Reset All':



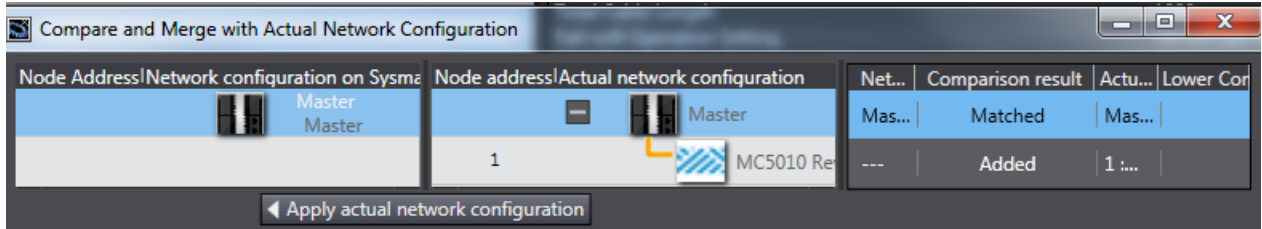
Check Actual Configuration

Right click on the master, select 'Compare and Merge with Actual Network Configuration':



Insert Slave

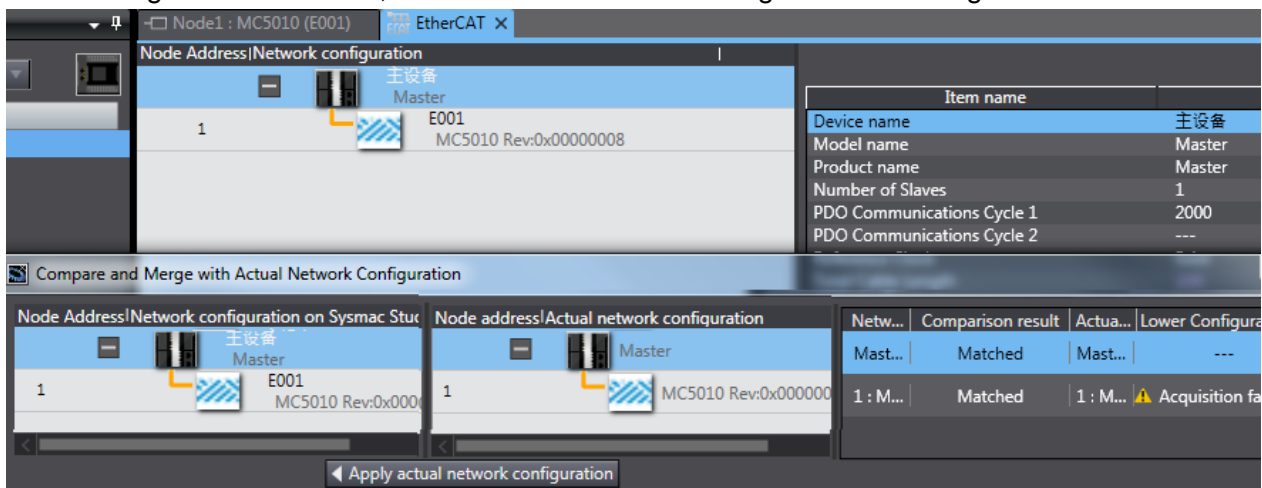
If you started this for the first time or changed the slaves connected to the PLC, you must update that information. Press **“Apply actual network configuration”**:



Then synchronize this. This is described in the last chapter **“Synchronize Setup with Slave”**

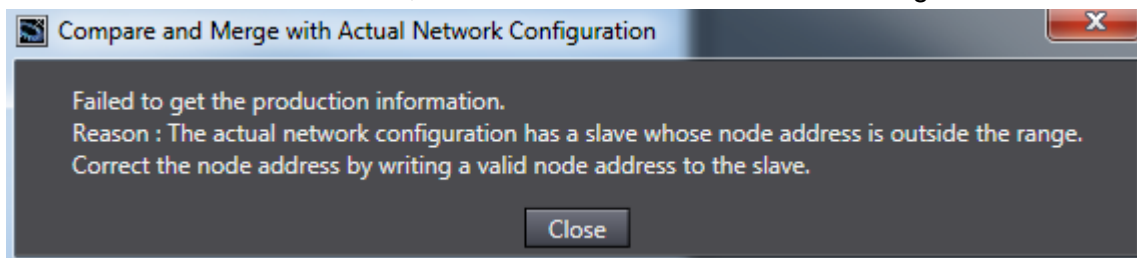
Correct Slave

If this configuration is correct, there will be no error message and the dialog will look like this:



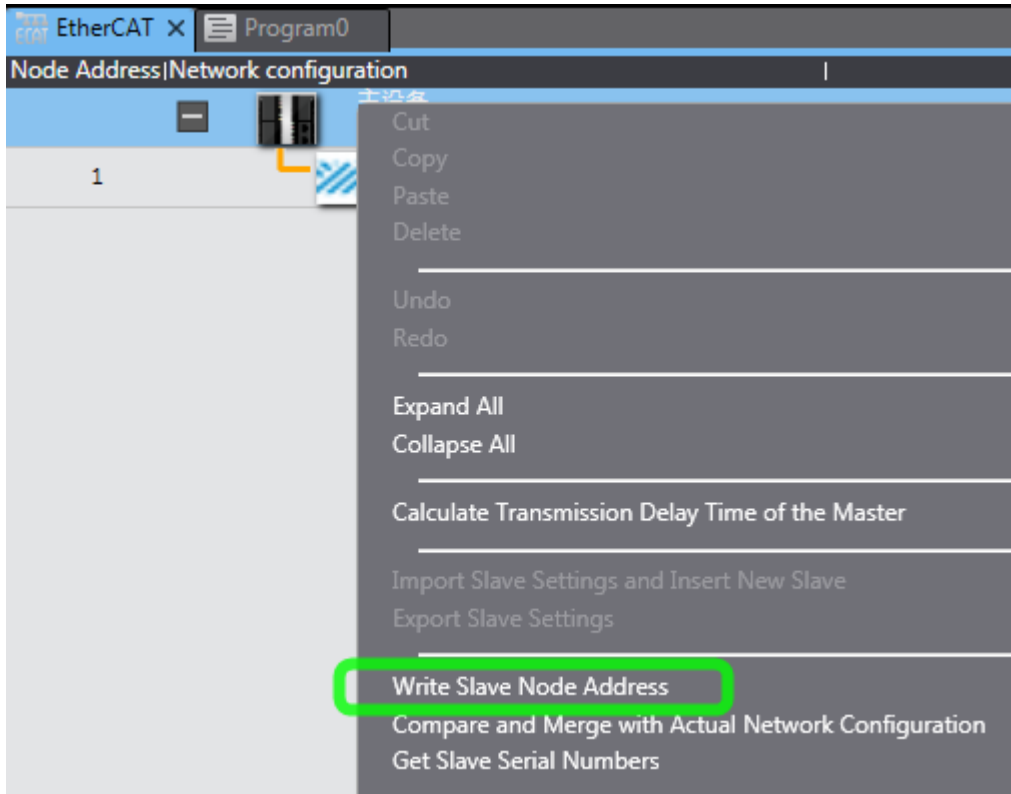
Wrong Node Number

If the slave’s node address is 0, Omron PLC cannot access it and will give this error message:



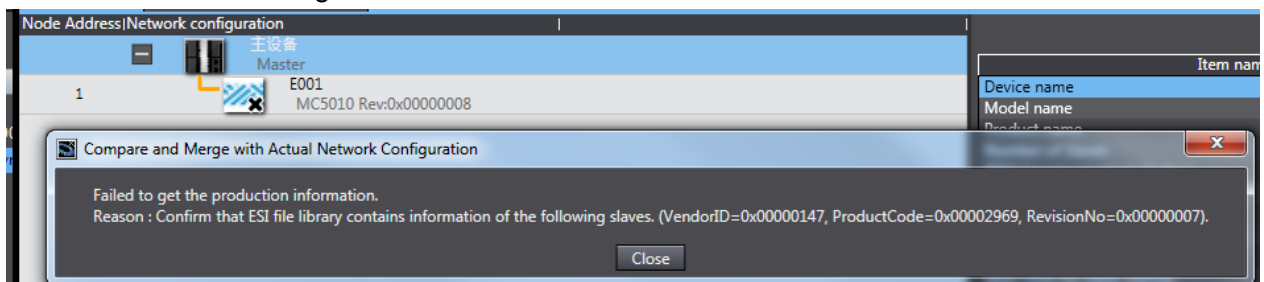
Resolve Wrong Node Number

Right-Click the master and click 'Write Slave Node Address'. As new value, enter a number other than 0. Then, you must **cycle power** of the motion controller (turn it off and on again)



Wrong Slave Revision

This slave has the wrong revision number 7. It should be revision number 8:



Resolve Wrong Slave Revision

Use a Beckhoff PLC to update the slave to the right value. This is described in FAULHABER application note 154, "Updating EtherCAT EEPROM".

Setup Synchronization

Go Offline

Make sure the Sysmac Studio is offline and not connected to the PLC: The **flash sign** must NOT be crossed out and there must NOT be a yellow line beneath it. This is correct:



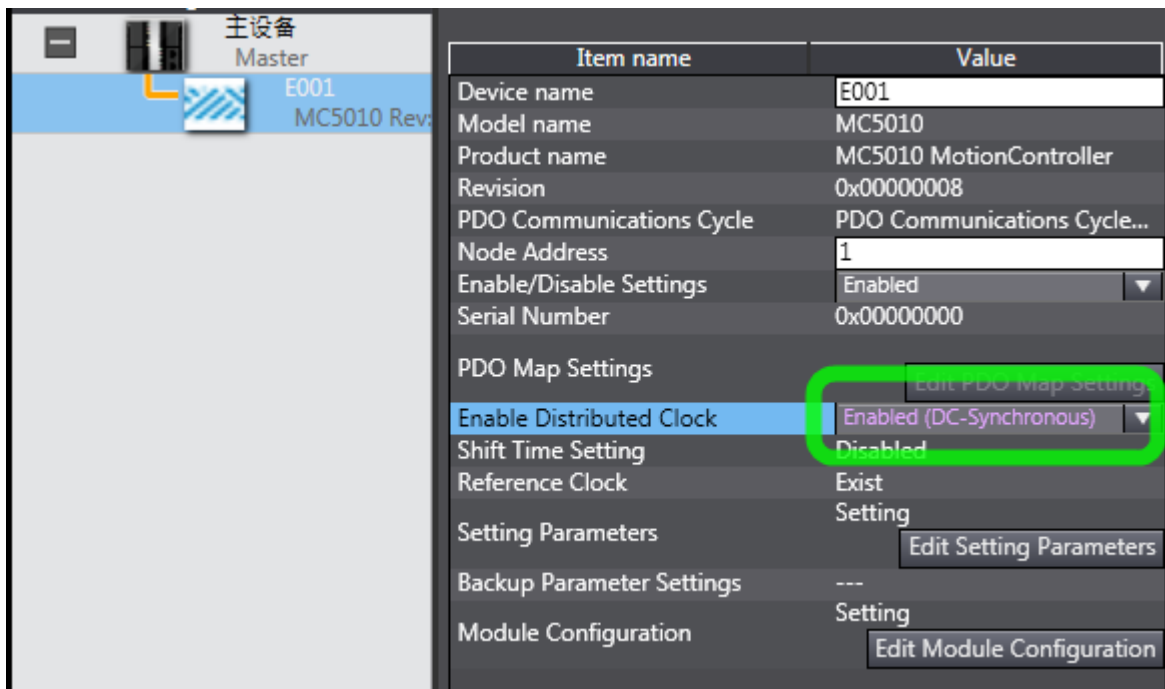
If the flash sign looks like this (which is a problem and must be handled):



→ Press the crossed out flash sign so that the normal version gets highlighted.

Change 'Distributed Clock' Setting

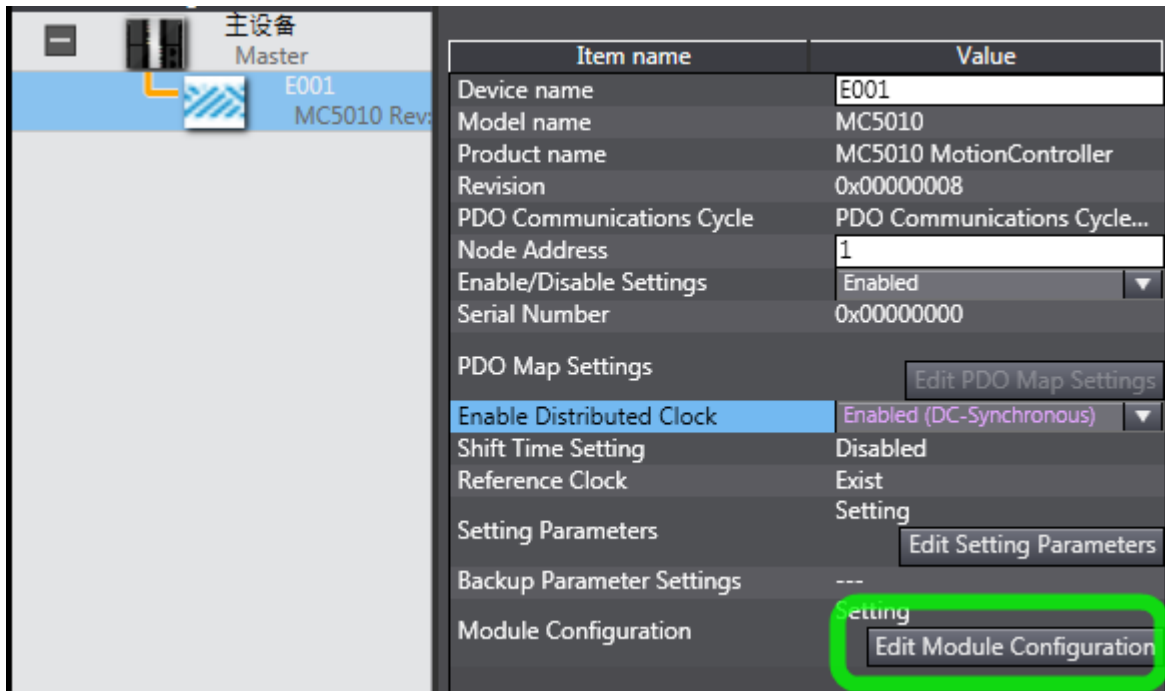
If '**Enable Distributed Clock**' is set to 'Disabled', change it to 'Enabled' so that this setting looks like this:



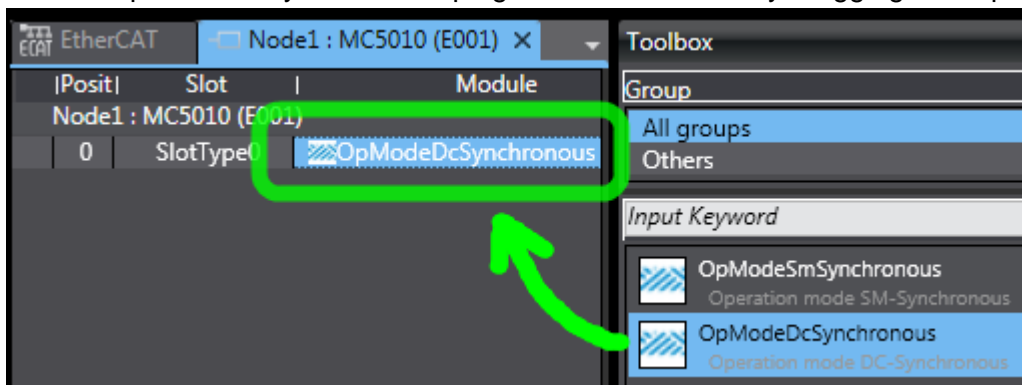
Item name	Value
Device name	E001
Model name	MC5010
Product name	MC5010 MotionController
Revision	0x00000008
PDO Communications Cycle	PDO Communications Cycle...
Node Address	1
Enable/Disable Settings	Enabled
Serial Number	0x00000000
PDO Map Settings	Edit PDO Map Setting
Enable Distributed Clock	Enabled (DC-Synchronous)
Shift Time Setting	Disabled
Reference Clock	Exist
Setting Parameters	Setting
	Edit Setting Parameters
Backup Parameter Settings	---
Module Configuration	Setting
	Edit Module Configuration

Plug in DC-Sync Module

Select 'Edit Module Configuration':



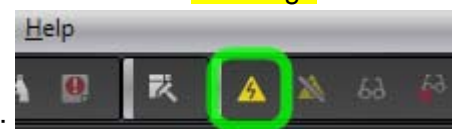
Make sure the module plugged into the slot is called "OpModeDcSynchronous". If it is empty or shows "OpModeSmSynchronous" plug in the DC module by dragging it into place:



Change PDO Mapping

Go Offline

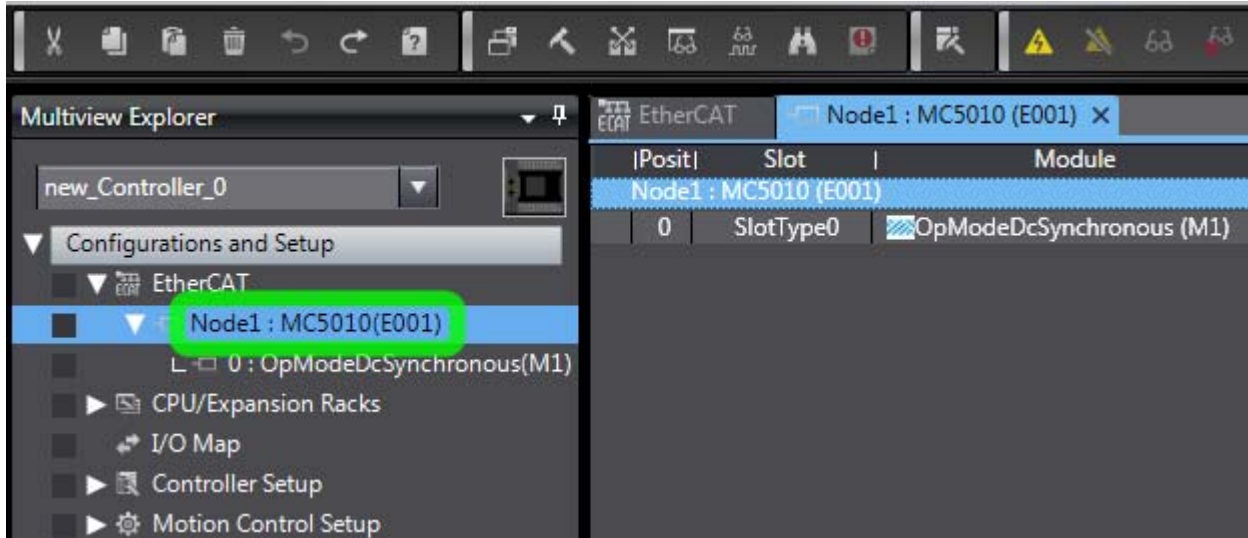
Make sure the Sysmac Studio is offline and not connected to the PLC: The **flash sign** must NOT be crossed out and there must NOT be a yellow line beneath it:



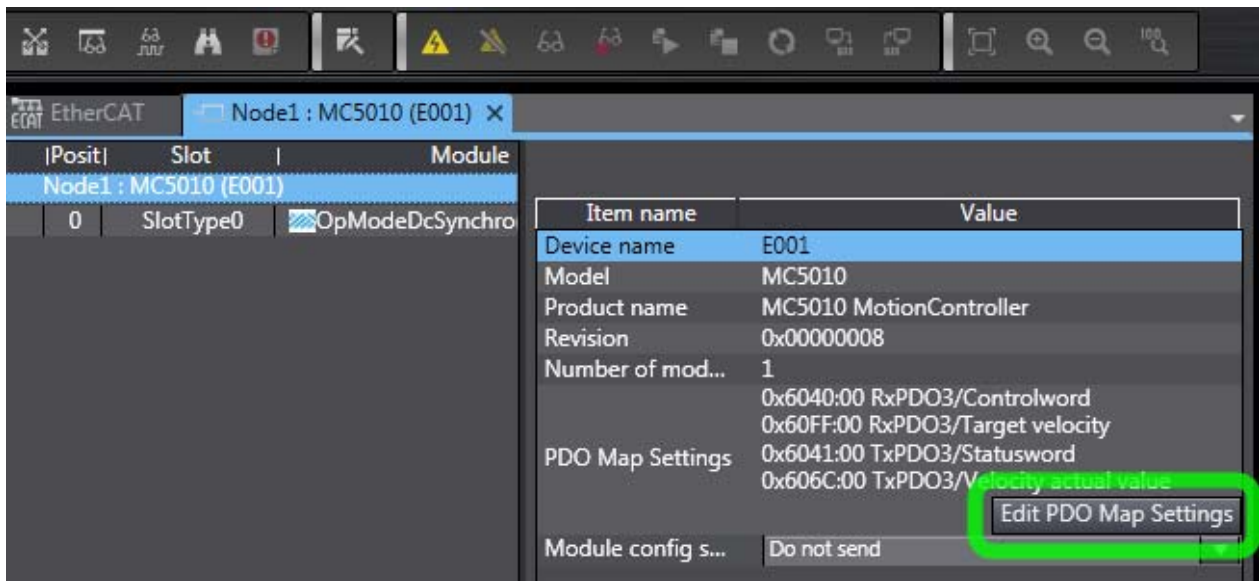
If the flash sign looks like this: → Press the crossed out flash sign so that the normal version is highlighted.

Modify Mapping

Double-click the node which is the FAULHABER drive:

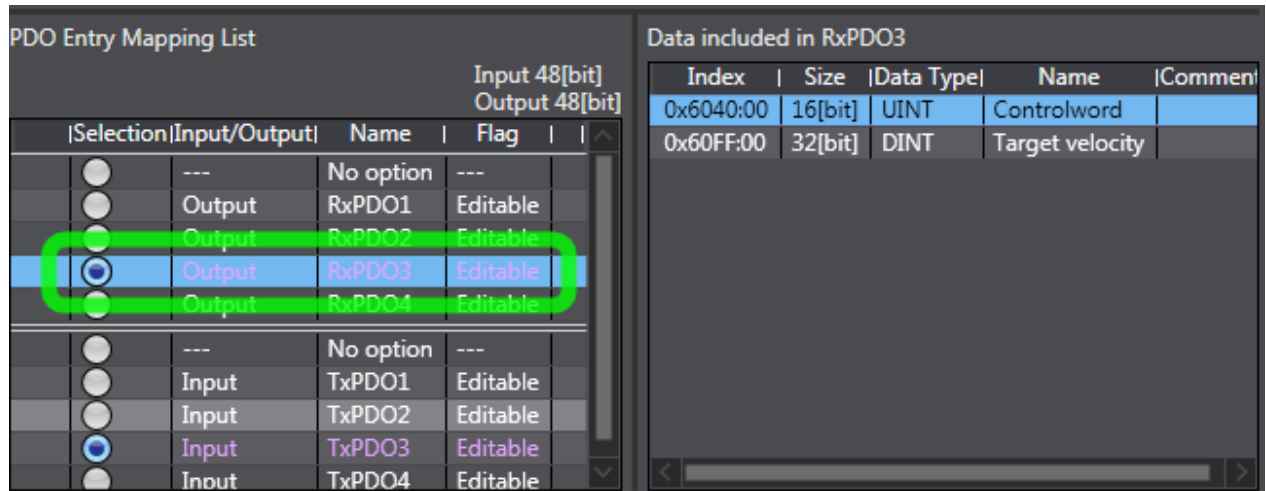


Click the PDO-button:

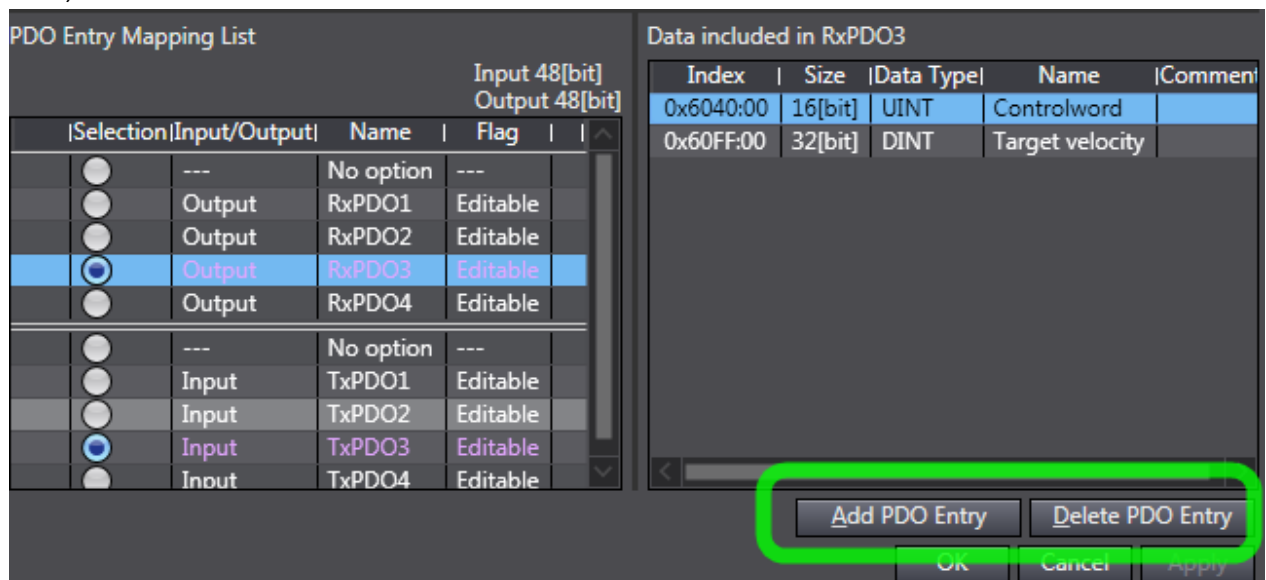


A new window opens.

On the left hand side, select the PDO you want to edit:



Then, on the right hand side, right-click the existing entries and change them (add or delete entries):



If you are done, hit OK.

Synchronize Setup with Slave

Synchronize your program with the PLC to activate the new configuration: Go online and then hit

the synchronization button: 

Activate more than one TxPDO/RxPDO

OMRON Sysmac Studio groups together all PDO entries. So only ONE PDO can be activated. Sometimes this is not enough, since only 4 mappings are allowed per PDO. The ESI files must be modified to enable this.

Contact FAULHABER support mcsupport@faulhaber.de or use the following guideline.

Go Offline

Make sure, Sysmac Studio is offline and not connected to the PLC: The **flash sign** must NOT be

crossed out and there must NOT be a yellow line beneath it:



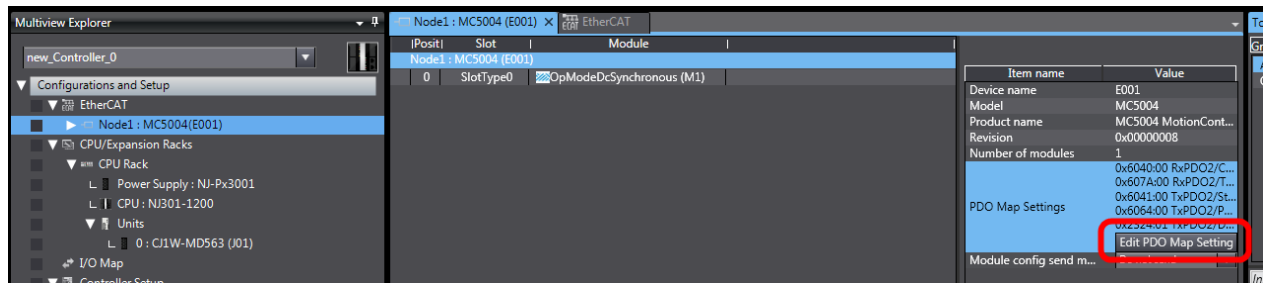
If the flash sign looks like this:



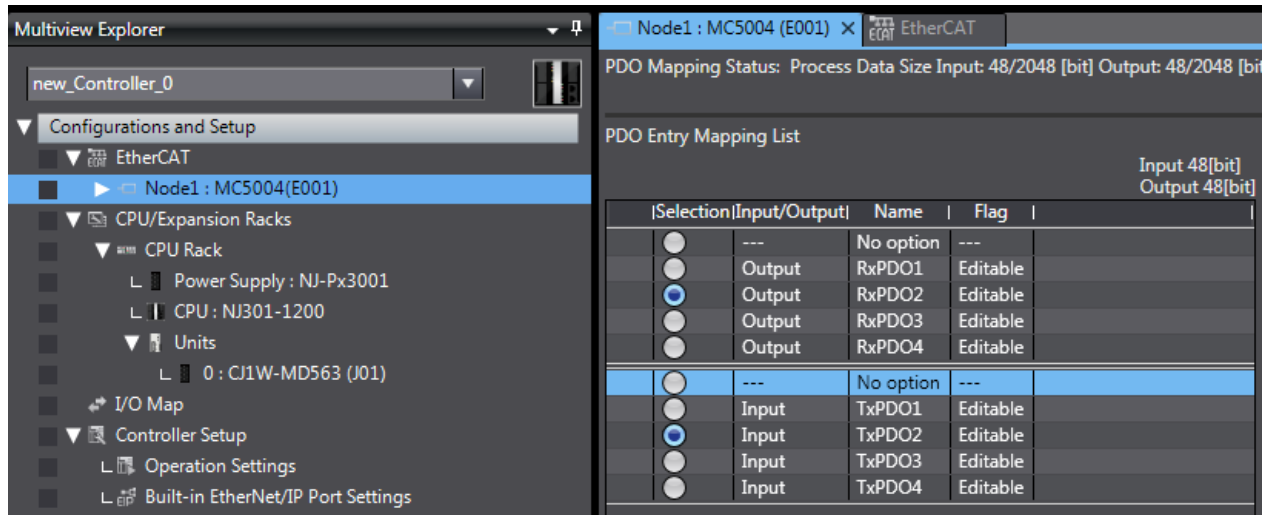
→ Press the crossed out

flash sign so that the normal version is highlighted.

Display PDO mapping



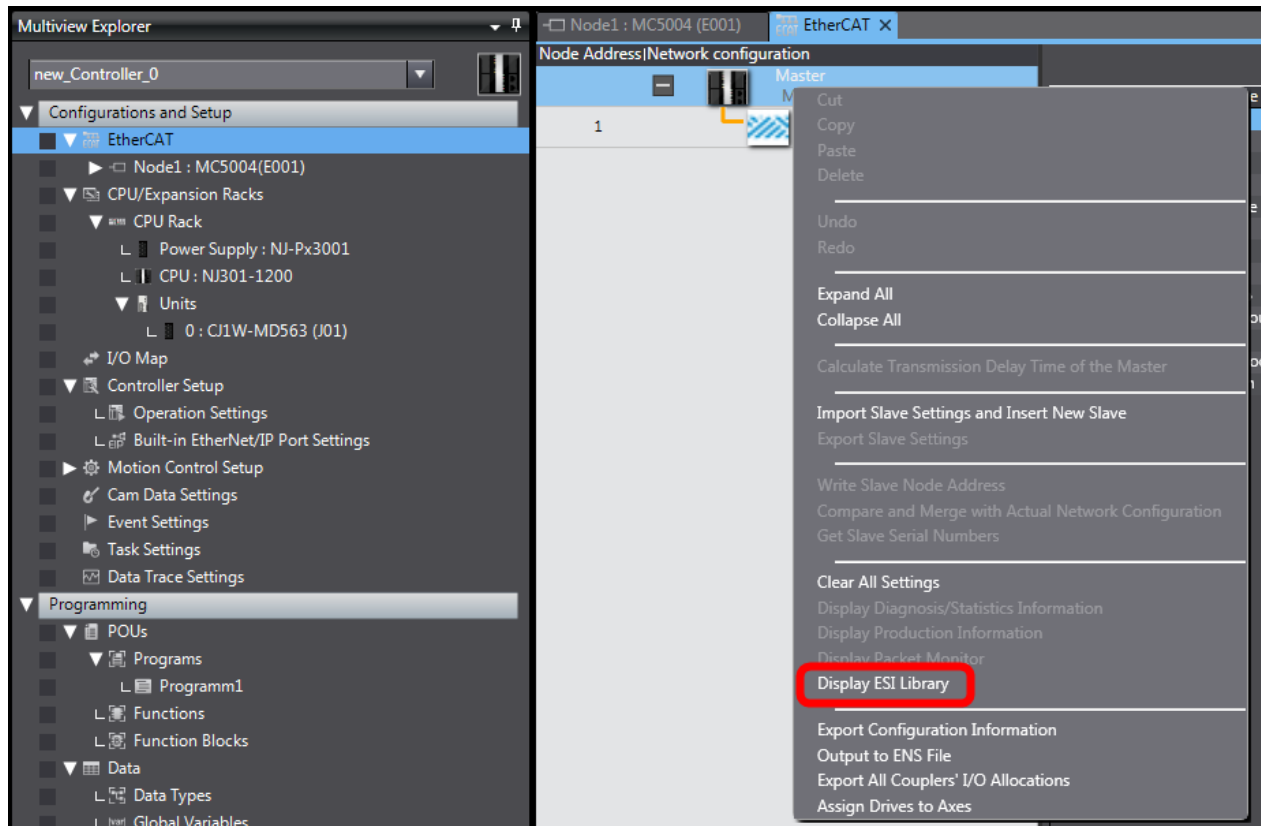
Standards IEC 61800-301 and CiA 402-3 enforce multiple PDOs to map the same object. Omron does not obey this and groups together these PDOs. The user can only select **ONE** PDO:



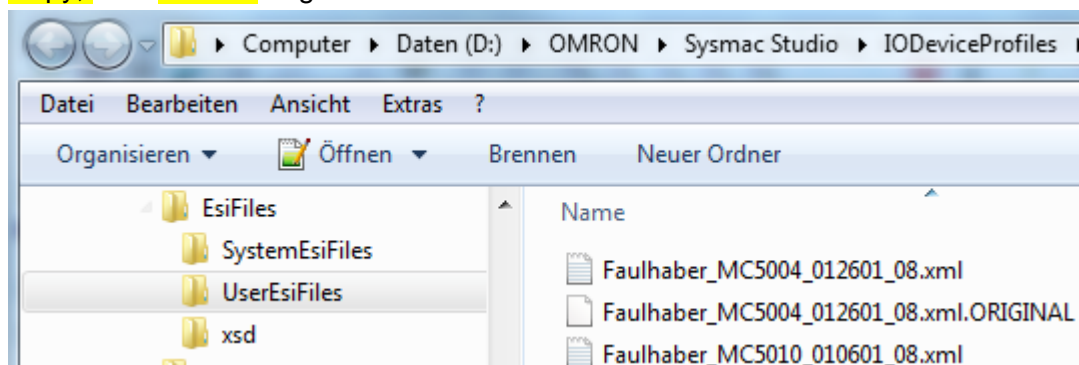
If the user wants to activate more than one PDO, the ESI file must be modified.

Edit ESI-Library

Right click on 'Master', select 'Display ESI Library'



Copy, then rename original ESI file toORIGINAL:



Edit original ESI file (the one withoutORIGINAL).

Search for:

- <Name>RxPDO2</Name>
- <Name>RxPDO3</Name>
- <Name>RxPDO4</Name>

For each entry, remove the block <ENTRY> ... </ENTRY> that contains <Index>#x6040</Index>. Remove the block completely, including the <ENTRY>... </ENTRY>.:

```
<!-- RxPDO2 is enabled by default, others are disabled -->
<RxPdo Mandatory="false" Fixed="false" Sm="2">
  <Index>#x1601</Index>
  <Name>RxPDO2</Name>
  <Entry>
    <Index>#x6040</Index>
    <SubIndex>0</SubIndex>
    <BitLen>16</BitLen>
    <Name>control word</Name>
    <DataType>UINT</DataType>
  </Entry>
  <Entry>
    <Index>#x607a</Index>
    <SubIndex>0</SubIndex>
    <BitLen>32</BitLen>
    <Name>target position</Name>
    <DataType>DINT</DataType>
  </Entry>
</RxPdo>
```

Again, search for:

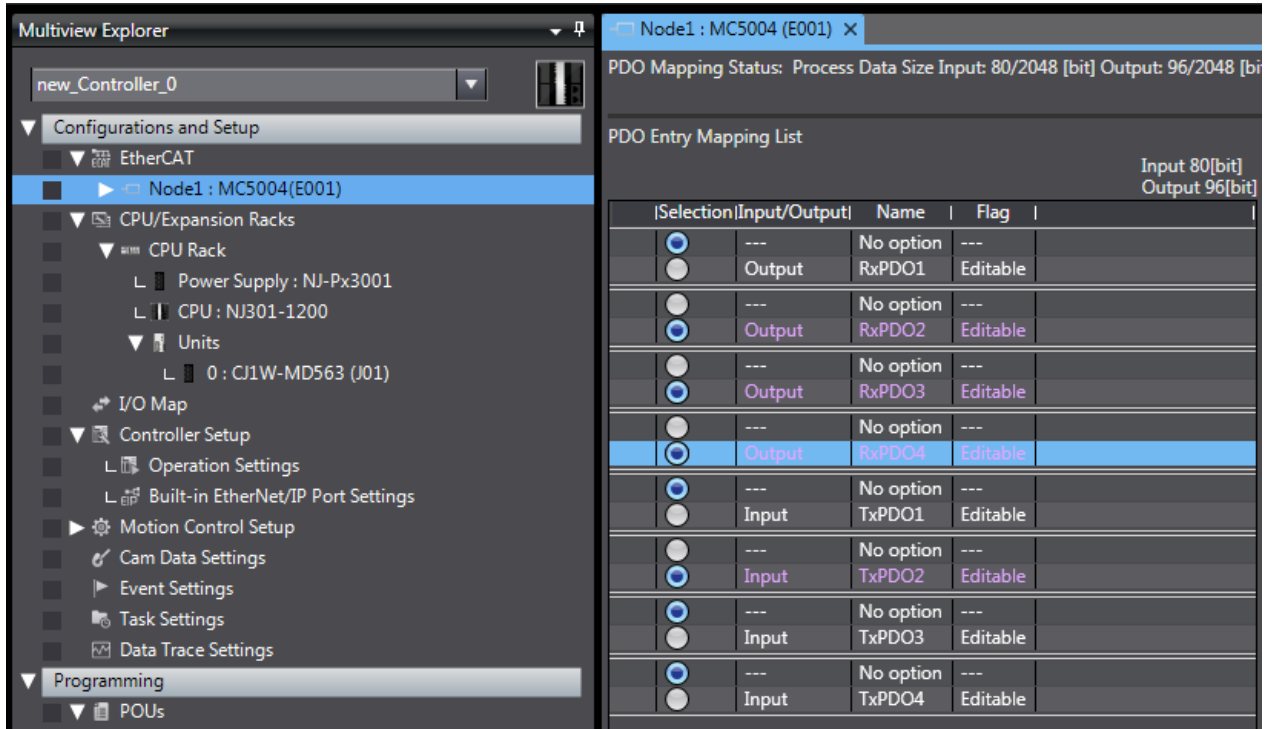
- <Name>TxPDO2</Name>
- <Name>TxPDO3</Name>
- <Name>TxPDO4</Name>

For each entry, remove the block <ENTRY> ... </ENTRY> that contains <Index>#x6041</Index>. Remove the block completely.

Restart Sysmac Studio

Close and open Sysmac Studio again. It will ask you whether the current ESI files should be changed. Click yes.

Your PDO settings will look like this, you may select multiple PDOs:



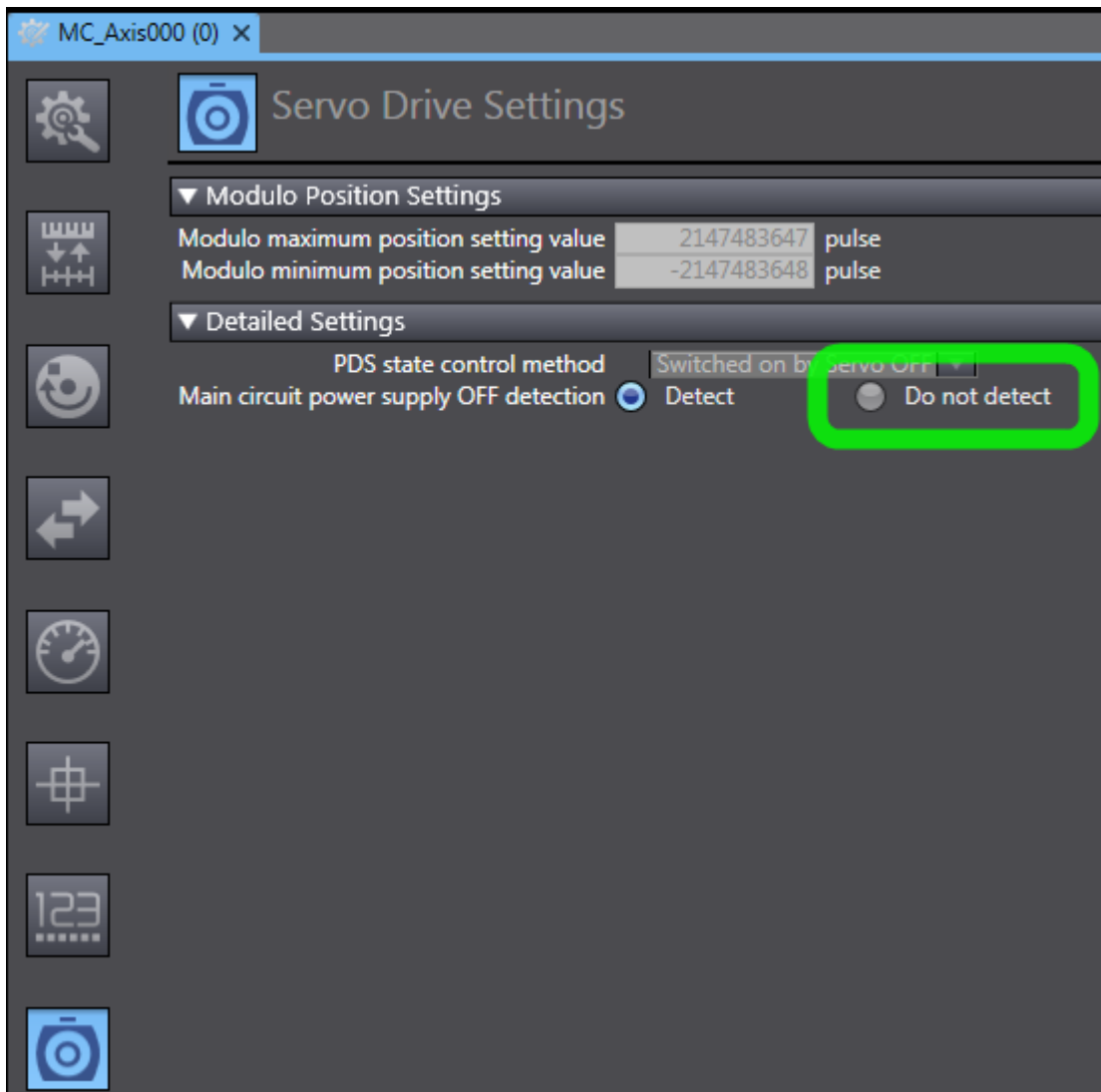
The screenshot shows the Multiview Explorer software interface. On the left, a tree view shows the configuration structure for 'new_Controller_0', with 'Node1 : MC5004(E001)' selected. On the right, the 'PDO Entry Mapping List' is displayed, showing a table of PDO configurations. The table has columns for Selection, Input/Output, Name, and Flag. The 'RxPDO4' entry is highlighted in blue.

Selection	Input/Output	Name	Flag
<input type="radio"/>	---	No option	---
<input type="radio"/>	Output	RxPDO1	Editable
<input type="radio"/>	---	No option	---
<input checked="" type="radio"/>	Output	RxPDO2	Editable
<input type="radio"/>	---	No option	---
<input checked="" type="radio"/>	Output	RxPDO3	Editable
<input type="radio"/>	---	No option	---
<input checked="" type="radio"/>	Output	RxPDO4	Editable
<input type="radio"/>	---	No option	---
<input type="radio"/>	Input	TxPDO1	Editable
<input type="radio"/>	---	No option	---
<input checked="" type="radio"/>	Input	TxPDO2	Editable
<input type="radio"/>	---	No option	---
<input type="radio"/>	Input	TxPDO3	Editable
<input type="radio"/>	---	No option	---
<input checked="" type="radio"/>	Input	TxPDO4	Editable

Using Motion Control Axes

If you are using motion control axes, Omron wants to check the power state of the axes. It assumes this information to be in bit five of the status word. However, this is not the case and the axis will never turn on.

To disable this check, go to the 'Axis Settings' of the corresponding axis, highlight 'Servo Drive Settings' and check the button 'Do no detect' for the entry "Main circuit power off detection".



Mapping 'Modes of Operation'

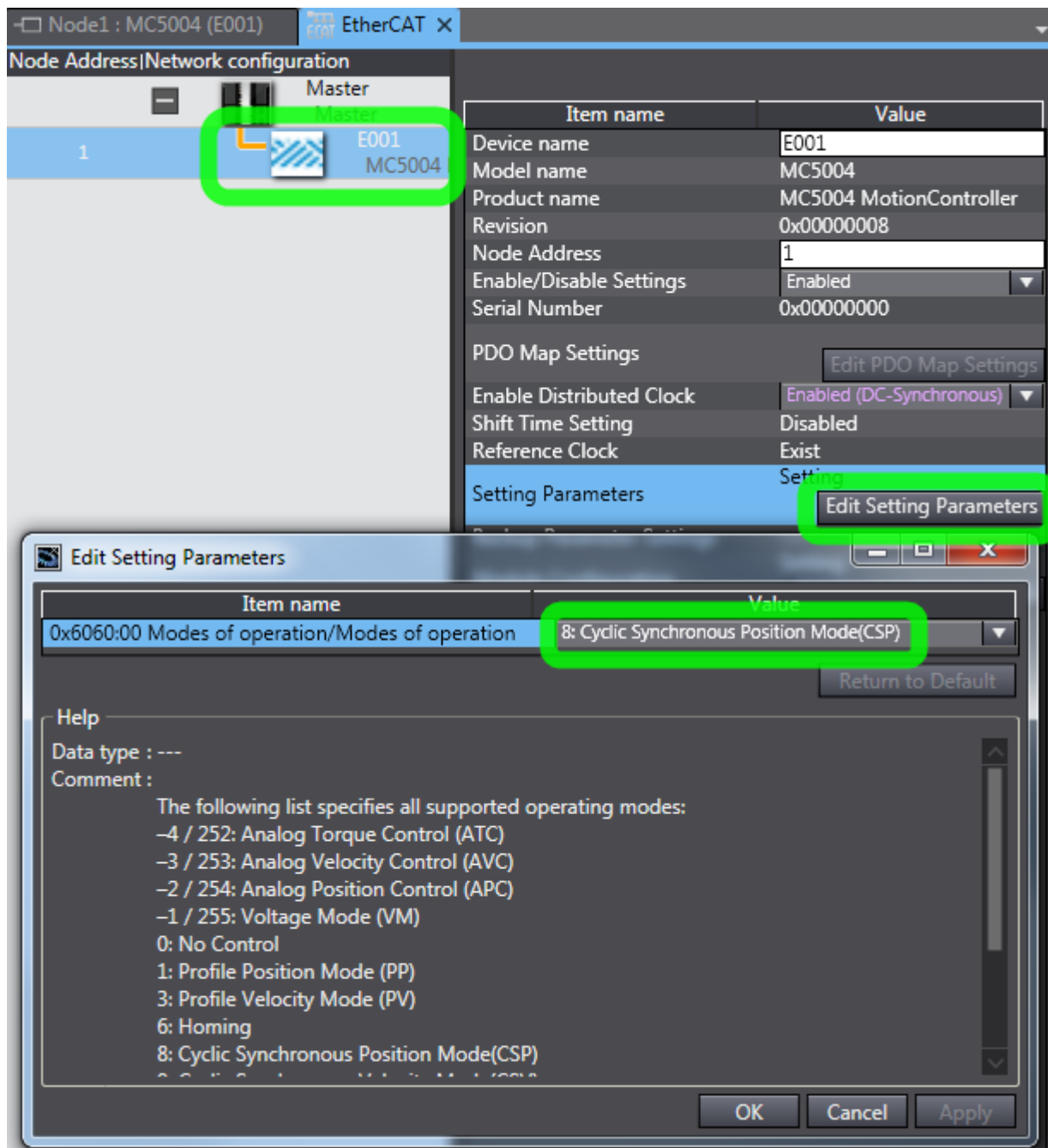
Including objects 6060 (mode of operation) or 6061 (display mode of operation) into the process image does not work, since Sysmac has problems with the object's data type: In the ESI, it is specified as "USINT", an 8 bit unsigned number.

Sysmac Studio, however, converts this into an "ARRAY OF BOOL", which is wrong. When going online and transferring this to the FAULHABER motion controller, this will result in an error message.

Data included in RxPDO2				
Index	Size	Data Type	Name	Comment
0x6040:00	16[bit]	UINT	Controlword	
0x607A:00	32[bit]	DINT	Target position	
0x6060:00	8[bit]	ARRAY[0..7] OF BOOL (BIT8)	Modes of operation	The fo... -4 / 2... -3 / 2... -2 / 2... -1 / 2... 0: No... 1: Prof... 3: Prof... 6: Ho... 8: Cycl... 9: Cycl... 10: Cy... Negati...

Solution 1: Do not use 6060

If you only need to set up mode of operation once, it is not necessary to map it into the process image, since it is already set by the Omron PLC during start-up. This is configured in the EtherCAT settings of the slave by clicking on “Edit Setting Parameters” and specifying the correct startup mode:



Solution 2: Use SDO service

Using the following code, you can change 'mode of operation' manually and do not have to include it into the process image:

Internals	Name	Data Type	Initial Value
Externals	SdoObject	_sSDO_ACCESS	(Index:=0, Subindex:=0,IsCompleteAc
	EC_CoESDOWrite_instance	EC_CoESDOWrite	
	WriteBuffer	UDINT	


```

135 (* set modes of operation to 1 == profile position *)
136 1000: (* sdo: write 6060 = 1 (PP) *)
137     control_word := 16#0000;
138     progstep :=1010;
139 1010:
140     EC_CoESDOWrite_instance(Execute:=FALSE, WriteDat:=WriteBuffer);
141     progstep := 1020;
142 1020:
143     SdoObject.Index :=UINT#16#6060;
144     SdoObject.Subindex :=USINT#0;
145     WriteBuffer := 1; // PP
146     EC_CoESDOWrite_instance(
147         Execute :=TRUE,
148         NodeAdr :=UINT#1,
149         SdoObj :=SdoObject,
150         TimeOut :=UINT#20,
151         WriteDat:=WriteBuffer,
152         WriteSize :=1,
153         AbortCode => ExitCode);
154 IF (EC_CoESDOWrite_instance.Done=TRUE) THEN
155     progstep := 1200;
156 ELSIF (EC_CoESDOWrite_instance.Error=TRUE) THEN
157     progstep := 5000; (* error! go to error resolution *)
158 END_IF;

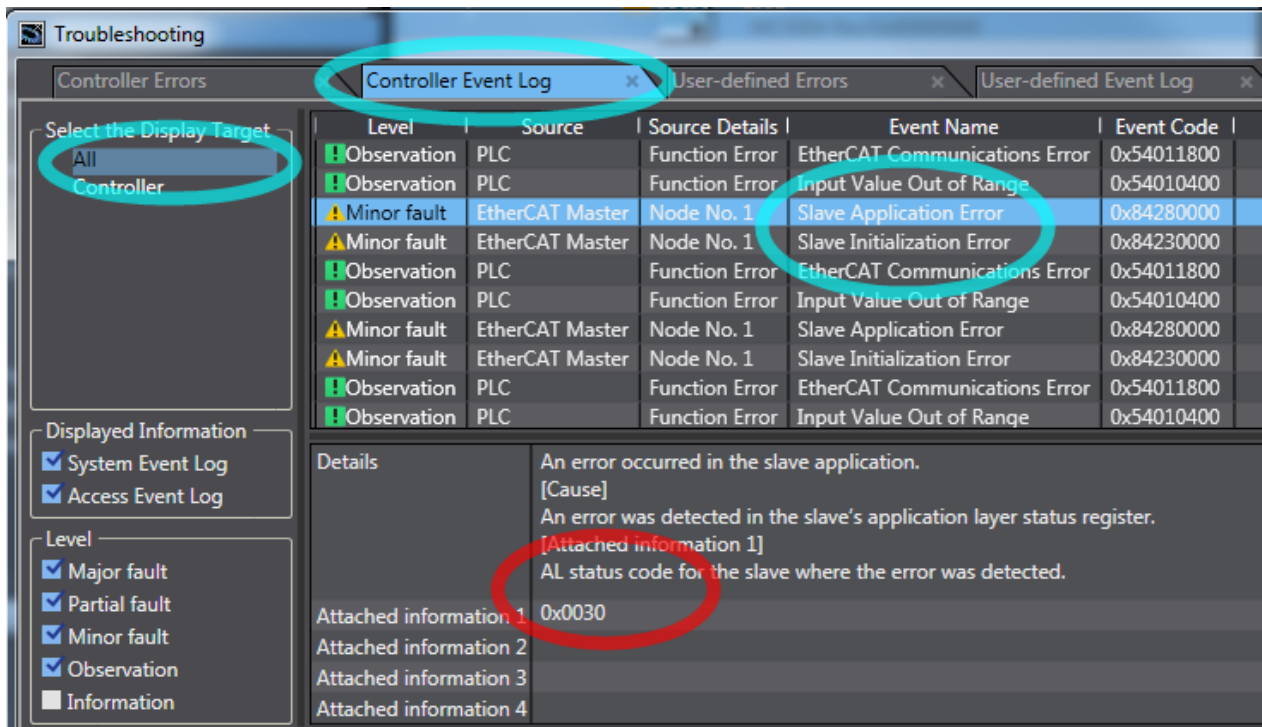
```

Trouble Shooter

Omron Sysmac Studio is very complex and thus has a program called **troubleshooting**, that helps you in finding problems:

Connect to your PLC and open it with the icon  or under Tools/Troubleshooting.

Switch to 'Controler Event Log' and look for 'Slave Application Error'.



The most important information is the **AL status code**. It shows exactly what is the problem with the drive. There is an explanation for all error codes in the '**Communications Manual EtherCAT**'. In the chapter 'Error handling' is a sub-chapter '**EtherCAT AL status codes and troubleshooting**'. Here you will find a list of all AL status codes and what to do about them

In the above example the AL status codes reported 0x0030. That translates to 'Faulty configuration of DC mode': The PLC switched DC on but did not initialise it correctly. That happened, because the DC module was plugged but the synchronization setting was set to 'SM mode'. It should have been 'DC mode'

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