

# **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**

|                          | EtherCAT ×  |                                      |
|--------------------------|---|--------------------------------------|
|                          | Node Address   Network configuration  |                                      |
| Right-click the master   | H Master<br>Master  | and select "Display ESI Library".    |
| Click the 'this folder': | To add or delete an ESI file, exit from this software<br>delete the file to/ rom <u>this folder</u> . The change will<br>restarting this software.<br>Close | e, and then add/<br>be applied after |
| Insert only the neede    | <b>d</b> FAULHABER ESI files into this director   | V.                                   |
| NEVER insert ESI files   | s ending in _06.xml!  | ,.                                   |
| Also insert the file "Fa | ulhaber_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

| 🛔 👰 🗖 🗛 🗛 👘 |     | Help       |   | - | -  | -          |   |
|-------------|-----|------------|---|---|----|------------|---|
|             | ••• | 4 <u>0</u> | 民 |   | 63 | <b>€</b> ∂ | e |

and there must be a yellow line beneath it:





 $\rightarrow$  Press the flash sign so that

If the flash sign looks like this: 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':

| Troubleshooting                          | 1 M 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  | N R ARCANCE  |                                 |
|--|--|--|---------------------------------|
| Controller Errors × Controller Event I   | .og × User-defined Errors ×  | User-defined Event Log ×   |                                 |
| Select the Display Target All Controller | Level   Source   Source<br>Partial fault EtherCAT Master Communic                            | Details   Event Name   Event Code<br>ations port Link OFF Error 0x84200000 |                                 |
|  | Details A Link OFF state occu<br>ICausel<br>Attached information 1<br>Attached information 2 | rred.  |                                 |
|  | Attached information 3<br>Attached information 4   |  |                                 |
|  |  | Display Switch Jump<br>Reset (Sele   | e to Error Error Help Reset All |

## **Check Actual Configuration**

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

| Node Address Network configu | ration I  |
|------------------------------|---|
|                              | 主设备   |
|                              | Cut   |
| 1 🐂 🎽                        | Сору  |
| _                            | Paste   |
|                              | Delete  |
|                              | Undo  |
|                              | Redo  |
|                              | Expand All  |
|                              | Collapse All  |
|                              | Calculate Transmission Delay Time of the Master     |
|                              | Import Slave Settings and Insert New Slave          |
|                              | Export Slave Settings                               |
|                              | Write Slave Node Address                            |
|                              | Compare and Merge with Actual Network Configuration |
|                              | Get Slave Serial Numbers                            |



#### **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":

| S Compare and Merge with Actual Network Configuration |   |     |                   |                |
|---|---|-----|-------------------|----------------|
| Node Address Network configuration on Sysma           | Node address Actual network configuration | Net | Comparison result | Actu Lower Cor |
| Master<br>Master                                      | Master                                    | Mas | Matched           | Mas            |
|   | 1 MC5010 Re                               |     | Added             | 1:             |
|   |   |     |                   |                |

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:

| <b>-</b> ₽   | - Node1 : MC5010 (E001)              | therCAT ×  |              |                   |                        |                |
|--------------|--------------------------------------|--|--------------|-------------------|------------------------|----------------|
|              | Node Address Network configuration   | 1  |              |                   |                        |                |
|              |                                      | ter  |              | Item name         | _                      | -              |
|              | 1                                    | E001   | Device name  |                   |                        | 主设备            |
|              | - ////.                              | MC5010 Rev:0x00000008                                  | Model name   |                   |                        | Master         |
|              |                                      |  | Product name | e                 |                        | Master         |
|              |                                      |  | Number of SI | aves              |                        | 1              |
|              |                                      |  | PDO Commu    | nications Cycle 1 |                        | 2000           |
|              |                                      |  | PDO Commu    | nications Cycle 2 |                        |                |
| 📓 Compare an | d Merge with Actual Network Configur | ation  | -            |                   |                        |                |
| Node Address | Network configuration on Sysmac Stue | Node address <sup> </sup> Actual network configuration | Netw         | Comparison result | Actua L                | ower Configura |
|              | 土 定番<br>Master                       | Master   | Mast         | Matched           | Mast                   |                |
| 1            | E001<br>MC5010 Rev:0x000(            | 1 MC5010 Rev:0x000                                     | 0000 1 : M   | Matched           | 1 : M   <mark>4</mark> | Acquisition fa |
|              |                                      |  |              |                   |                        |                |
|              |                                      |  |              |                   |                        |                |

## Wrong Node Number

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

| Compare and Merge with Actual Network Configuration  |  |
|--|--|
| Failed to get the production information.<br>Reason : The actual network configuration has a slave who<br>Correct the node address by writing a valid node address | se node address is outside the range.<br>to the slave. |
| Close  |  |



## **Resolve Wrong Node Number**

Right-Click the master and click ,Write Slave Node Address<sup>6</sup>. As new value, enter a number other than 0. Then, you must **cycle power** of the motion controller (turn it off and on again)

| 📅 EtherCAT 🗙 📄 Program0          |   |
|----------------------------------|---|
| Node Address Network configurati | on l  |
|                                  | පද<br>Cut   |
| 1 💆                              | Copy  |
|                                  | Delete  |
|                                  | Undo  |
|                                  | Redo  |
|                                  | Expand All  |
|                                  | Collapse All  |
|                                  | Calculate Transmission Delay Time of the Master     |
|                                  | Import Slave Settings and Insert New Slave          |
|                                  | Export Slave Settings                               |
| 0                                | Write Slave Node Address                            |
|                                  | Compare and Merge with Actual Network Configuration |
|                                  | Get Slave Serial Numbers                            |

## **Wrong Slave Revision**

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

| N N      | ode Address Network configuration   | <u>_</u> !                        |
|----------|---|-----------------------------------|
|          | 王 王 世<br>Master   | Item nam                          |
|          | 1 E001  | Device name                       |
| Ŀ        | - MC5010 Rev:0x0000008  | Model name                        |
| 1(<br>17 | Compare and Merge with Actual Network Configuration   |                                   |
|          | Failed to get the production information.<br>Reason : Confirm that ESI file library contains information of the following slaves. (VendorID=0x00000147, ProductCode=0x<br>Close | 00002969, RevisionNo=0x00000007). |
|          |   |                                   |

## **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):



 $\rightarrow$  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:

| 主设备         |                           |                                      |
|-------------|---------------------------|--------------------------------------|
| Master      | Item name                 | Value                                |
| E001        | Device name               | E001                                 |
| MC5010 Rev: | Model name                | MC5010                               |
|             | Product name              | MC5010 MotionController              |
|             | Revision                  | 0x0000008                            |
|             | PDO Communications Cycle  | PDO Communications Cycle             |
|             | Node Address              | 1                                    |
|             | Enable/Disable Settings   | Enabled 🔹                            |
|             | Serial Number             | 0x0000000                            |
|             | PDO Map Settings          | Edit PDO Map Settings                |
|             | Enable Distributed Clock  | Enabled (DC-Synchronous)             |
|             | Shift Time Setting        | Disabled                             |
|             | Reference Clock           | Exist                                |
|             | Setting Parameters        | Setting<br>Edit Setting Parameters   |
|             | Backup Parameter Settings |                                      |
|             | Module Configuration      | Setting<br>Edit Module Configuration |



## Plug in DC-Sync Module

Select 'Edit Module Configuration':

| 💼 🖬 主设备     |                           |                                      |
|-------------|---------------------------|--------------------------------------|
| Master      | Item name                 | Value                                |
| E001        | Device name               | E001                                 |
| MC5010 Rev: | Model name                | MC5010                               |
|             | Product name              | MC5010 MotionController              |
|             | Revision                  | 0x0000008                            |
|             | PDO Communications Cycle  | PDO Communications Cycle             |
|             | Node Address              | 1                                    |
|             | Enable/Disable Settings   | Enabled 🔻                            |
|             | Serial Number             | 0x0000000                            |
|             | PDO Map Settings          | Edit PDO Map Settings                |
|             | Enable Distributed Clock  | Enabled (DC-Synchronous) 🔻           |
|             | Shift Time Setting        | Disabled                             |
|             | Reference Clock           | Exist                                |
|             | Setting Parameters        | Setting<br>Edit Setting Parameters   |
|             | Backup Parameter Settings |                                      |
|             | Module Configuration      | Setting<br>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:

| ETAT EtherCAT | - Node1 : MC5010 (E001) 🗙  |       | Toolbox  |
|---------------|--|-------|--|
| Posit  S      | Slot   Module  | e     | Group  |
| Node1 : MC5   | 010 (E <mark>0</mark> 01)  |       | All groups   |
| 0 Slot        | tType0 2000 Contract Type0 2000 Contract Type0 2000 Contract Contr | onous | Others   |
|               |  |       | langt Kanagard                                       |
|               |  |       | Input Keyword  |
|               |  |       | OpModeSmSynchronous<br>Operation mode SM-Synchronous |
|               |  |       | OpModeDcSynchronous                                  |

## **Change PDO Mapping**

#### **Go Offline**

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





## **Modify Mapping**

Double-click the node which is the FAULHABER drive:



#### Click the PDO-button:

| *       | 63                          | 66<br>VIII. | A              | 0           | R,       | <b>A</b> | *    | 69  | 69  | \$      | £.,   | 0                            |                                  | P.                               | Ц   | Q  | Q                                  | 100 <sub>4</sub> |       |
|---------|-----------------------------|-------------|----------------|-------------|----------|----------|------|-----|---|---------|-------|------------------------------|----------------------------------|----------------------------------|---|--|------------------------------------|------------------|-------|
| ecat Ei | therC/                      | AT.         |                | Node1       | : MC5010 | 0 (E001  | ) ×  |     |   |         |       |                              |                                  |                                  |   |  |                                    |                  | -     |
| P<br>No | osit <br>ode1 :             | S<br>MC5    | Slot<br>010 (E | <br>001)    |          | Mo       | dule |     |   |         |       |                              |                                  |                                  |   |  |                                    |                  |       |
|         | 0 SlotType0 OpModeDcSynchro |             | nchro          |             | Item     | name     | 1    |     |   |         | Value | 8                            |                                  |                                  | 1   |  |                                    |                  |       |
|         |                             |             | Dev            | Device name |          |          | E001 |     |   |         |       |                              |                                  |                                  |   |  |                                    |                  |       |
|         |                             |             |                |             |          |          |      | Mo  | Model                                     |         |       | MC5010                       |                                  |                                  |   |  |                                    |                  |       |
|         |                             |             |                |             |          |          |      | Pro | Product name<br>Revision<br>Number of mod |         |       | MC5                          | 010 N                            | lotion(                          | ontroll   | er   |                                    |                  |       |
|         |                             |             |                |             |          |          |      | Rev |   |         |       | 0x00                         | 00000                            | )8                               |   |  |                                    |                  |       |
|         |                             |             |                |             |          |          |      | Nu  |   |         |       | 1                            |                                  |                                  |   |  |                                    |                  |       |
|         |                             |             |                |             |          |          |      | PD  | O Maj                                     | o Setti | ings  | 0x60<br>0x60<br>0x60<br>0x60 | 40:00<br>FF:00<br>41:00<br>6C:00 | RxPDC<br>RxPDO<br>TxPDO<br>TxPDO | )3/Cont<br>)3/Targe<br>)3/Statu<br>)3/Velo<br>E | rolwo<br>et velo<br>isworo<br>city a<br>dit PE | ord<br>ocity<br>d<br>tool<br>OO Ma | value<br>ap Sett | tings |
|         |                             |             |                |             |          |          |      | Mo  | dule (                                    | onfig   | s     | Do n                         | not sen                          | d                                |   |  |                                    |                  | 15    |

A new window opens.



| PDO | PDO Entry Mapping List |              |           |                   |                    |        | Data included in RxPDO3 |                 |                    |                     |          |
|-----|------------------------|--------------|-----------|-------------------|--------------------|--------|-------------------------|-----------------|--------------------|---------------------|----------|
|     |                        |              |           | Input 4<br>Output | 18[bit]<br>t 48[bi | it]    | Index<br>0x6040:00      | Size<br>16[bit] | Data Type <br>UINT | Name<br>Controlword | (Comment |
|     | Selection              | Input/Output | Name      | Flag              | <u> </u>           | $\geq$ | 0x60FF:00               | 32[bit]         | DINT               | Target velocity     |          |
|     |                        |              | No option |                   |                    | ш      |                         |                 | 1                  |                     |          |
|     |                        | Output       | RxPDO1    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     | •                      | Output       | RxPDO2    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     |                        | Output       | RxPDO3    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     | 0                      | Output       | RxPDO4    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     |                        |              | No option |                   |                    | ш      |                         |                 |                    |                     |          |
|     |                        | Input        | TxPDO1    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     |                        | Input        | TxPDO2    | Editable          |                    | ш      |                         |                 |                    |                     |          |
|     | 0                      | Input        | TxPDO3    | Editable          |                    | 11     |                         |                 |                    |                     |          |
|     |                        | Input        | TxPDO4    | Editable          | $\sim$             |        | <                       |                 |                    |                     |          |

#### 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):

| PDO Entry Mapping List |                         |              |           |          |         | 1 | Data included in RxPDO3 |         |             |                   |         |
|------------------------|-------------------------|--------------|-----------|----------|---------|---|-------------------------|---------|-------------|-------------------|---------|
|                        |                         |              |           | Input 4  | 8[bit]  |   | Index                   | Size    | Data Type   | Name              | Comment |
|                        |                         |              |           | Output   | 48[bit] |   | 0x6040:00               | 16[bit] | UINT        | Controlword       |         |
|                        | Selection               | Input/Output | Name      | Flag     |         |   | 0x60FF:00               | 32[bit] | DINT        | Target velocity   |         |
|                        |                         |              | No option |          |         | Ш |                         |         |             |                   |         |
|                        |                         | Output       | RxPDO1    | Editable |         |   |                         |         |             |                   |         |
|                        |                         | Output       | RxPDO2    | Editable |         |   |                         |         |             |                   |         |
|                        | $\overline{\mathbf{O}}$ | Output       | RxPDO3    | Editable |         |   |                         |         |             |                   |         |
|                        |                         | Output       | RxPDO4    | Editable |         |   |                         |         |             |                   |         |
|                        |                         |              | No option |          |         |   |                         |         |             |                   |         |
|                        | $\overline{\mathbf{O}}$ | Input        | TxPDO1    | Editable |         |   |                         |         |             |                   |         |
|                        | $\odot$                 | Input        | TxPDO2    | Editable |         |   |                         |         |             |                   |         |
|                        | $\odot$                 | Input        | TxPDO3    | Editable | -       |   |                         |         |             |                   |         |
|                        |                         | Input        | TxPDO4    | Editable | $\sim$  |   |                         |         |             |                   |         |
|                        |                         |              |           |          |         |   |                         | Add     | d PDO Entry | <u>D</u> elete PD | O Entry |
|                        |                         |              |           |          |         |   |                         |         | OK          | Cancel            | Apply   |

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:

## 🔺 🔌 & 🍄 🋸 💼 💽 및 🔛

## 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 <u>mcsupport@faulhaber.de</u> 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



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:

| Multiview Explorer 🗸 🗸                 | - Node1 : MC  | 5004 (E001) >  | C CAT Ether    | CAT        |                                |  |  |
|--|---------------|----------------|----------------|------------|--------------------------------|--|--|
| new_Controller_0                       | PDO Mapping S | tatus: Process | ; Data Size In | put: 48/20 | 048 [bit] Output: 48/2048 [bit |  |  |
| Configurations and Setup               | PDO Entry Map | oing List      |                |            |                                |  |  |
| ▼ ₩ EtherCAT                           | Input 48[bit] |                |                |            |                                |  |  |
| Node1 : MC5004(E001)                   |               |                |                |            | Output 48[bit]                 |  |  |
| V 🖙 CPU/Expansion Racks                | Selection     | Input/Output   | Name           | Flag       | 1 [                            |  |  |
| ▼ #m CPU Rack                          |               |                | No option      |            |                                |  |  |
| Power Supply : NI-Px3001               |               | Output         | RxPDO1         | Editable   |                                |  |  |
|  | •             | Output         | RxPDO2         | Editable   |                                |  |  |
|  |               | Output         | RxPDO3         | Editable   |                                |  |  |
| V Nunits                               |               | Output         | RxPDO4         | Editable   |                                |  |  |
| ∟ 0 : CJ1W-MD563 (J01)                 |               |                | No option      |            |                                |  |  |
| 🖈 I/O Map                              |               | Input          | TxPDO1         | Editable   |                                |  |  |
| 🔻 🕅 Controller Setup                   |               | Input          | TxPDO2         | Editable   |                                |  |  |
| ∟ 🕼 Operation Settings                 |               | Input          | TxPDO3         | Editable   |                                |  |  |
| ∟ 🛱 Built-in EtherNet/IP Port Settings |               | Input          | TxPDO4         | Editable   |                                |  |  |

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 to ....ORIGINAL:



Edit original ESI file (the one without ....ORIGINAL).

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>...

```
<!-- RxPD02 vis enabled by default, others are disabled -->
<RxPdo Mandatory="false" Fixed="false" Sm="2">
    <Index>#x1601</Index>
    <Name>RxPDO2</Name>
    Sntry>
        <lsdex>#x6040</Index</pre>
        <SubIndex>0</Subindex>
        <BitLen>16 BitLen>
        <Name>control word</Name>
        <DataType>UINT</DataType>
       ntry>
    <Entry>
        ><Index>#x607a</Index>
        <SubIndex>0</SubIndex>
       ><BitLen>32</BitLen>
       ><Name>target ·position</Name>
       →<DataType>DINT</DataType>
  \rightarrow </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.



| Multiview Explorer 🗸 🗸  | -CI Node1 : MC5004 (E001) ×   |
|---|---|
| new_Controller_0  | PDO Mapping Status: Process Data Size Input: 80/2048 [bit] Output: 96/2048 [bi  |
| Configurations and Setup  The EtherCAT  Note: N | PDO Entry Mapping List<br>Input 80[bit]<br>Output 96[bit]   |
| V St CPU/Expansion Racks  | Selection Input/Output  Name   Flag   |
| ▼ === CPU Rack  | O      No option        Output     RxPDO1     Editable  |
| L ■ CPU: NJ301-1200   | Image: only on the second s |
| L 0 : CJ1W-MD563 (J01)  | Image: organization     Image: organization       Image: organization     Output       Image: organization     RxPDO3       Image: organization     Editable  |
| ▼   | Image: output     No option        Image: output     RxPDO4     Editable  |
| ∟≓ Built-in EtherNet/IP Port Settings   | O      No option        ●     Input     TxPDO1     Editable   |
| <ul> <li>✔ Cam Data Settings</li> <li>▶ Event Settings</li> </ul>   | Input     No option        Input     TxPDO2     Editable  |
| Task Settings   | O          No option            ●         Input         TxPDO3         Editable   |
| <ul> <li>✓ Programming</li> <li>✓ 1 POUs</li> </ul>   | O      No option        ●     Input     TxPDO4     Editable   |

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

## **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 include | d in RxPC | 002                      |                    |   |
|--------------|-----------|--------------------------|--------------------|---|
| Index        | Size      | I Data Type              | Name               | Comment   |
| 0x6040:00    | 16[bit]   | UINT                     | Controlword        |   |
| 0x607A:00    | 32[bit]   | DINT                     | Target position    |   |
| 0x6060:00    | 8[bit]    | ARRAY[07] OF BOOL (BIT8) | Modes of operation | The fo<br>-4 / 2<br>-3 / 2<br>-2 / 2<br>-1 / 2<br>0: No<br>1: Prof<br>3: Prof<br>3: Prof<br>6: Ho<br>8: Cycl<br>9: Cycl<br>10: Cy<br>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 Ether-CAT settings of the slave by clicking on "Edit Setting Parameters" and specifying the correct startup mode:



| - Nodel : MC5004 (E001)   |  | ,   |
|---|--|---|
| Node Address   Network configuration  |  |   |
| Master  |  |   |
| Master  | Item name  | Value   |
| 1 MC5004  | Device name  | E001  |
| WIC3004   | Model name   | MC5004  |
|   | Product name   | MC5004 MotionController                         |
|   | Revision   | 0x0000008                                       |
|   | Frankla / Disabla Sattings   |   |
|   | Sorial Number  |   |
|   |  | 0.000000  |
|   | PDO Map Settings   | Edit PDO Map Settings                           |
|   | Enable Distributed Clock   | Enabled (DC-Synchronous) 🔻                      |
|   | Shift Time Setting   | Disabled  |
|   | Reference Clock  | Exist   |
|   | Setting Parameters   | Setting   |
|   | Setting Fullemeters  | Edit Setting Parameters                         |
| Edit Setting Parameters   |  |   |
|   |  |   |
| Item name   |  | Value   |
| Item name<br>0x6060:00 Modes of operation/Modes of operation  | eration 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of ope | eration 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation  | eration 2 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of ope | eration 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation<br>Help<br>Data type :   | eration 2 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :  | eration 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup  | eration 8: Cyclic Synchronous P  | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control   | eration 8: Cyclic Synchronous P<br>ported operating modes:<br>(ATC)                        | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of op  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)            | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control<br>-3 / 253: Analog Velocity Control<br>-2 / 254: Analog Position Control  | eration 8: Cyclic Synchronous P<br>ported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC)  | Value<br>osition Mode(CSP)  Return to Default   |
| Item name<br>0x6060:00 Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control<br>-3 / 253: Analog Velocity Control<br>-2 / 254: Analog Position Control<br>-1 / 255: Voltage Mode (VM)   | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control<br>-3 / 253: Analog Velocity Control<br>-2 / 254: Analog Position Control<br>-1 / 255: Voltage Mode (VM)<br>0: No Control  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)<br>Return to Default |
| Item name<br>0x6060:00 Modes of operation/Modes of op  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)                      |
| Item name<br>0x6060:00 Modes of operation/Modes of op  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)<br>Return to Default |
| Item name<br>0x6060:00 Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control<br>-3 / 253: Analog Velocity Control<br>-2 / 254: Analog Position Control<br>-1 / 255: Voltage Mode (VM)<br>0: No Control<br>1: Profile Position Mode (PP)<br>3: Profile Velocity Mode (PV)<br>6: Homing  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)                      |
| Item name<br>Ox6060:00 Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation/Modes of operation<br>Help<br>Data type :<br>Comment :<br>The following list specifies all sup<br>-4 / 252: Analog Torque Control<br>-3 / 253: Analog Velocity Control<br>-2 / 254: Analog Position Control<br>-1 / 255: Voltage Mode (VM)<br>0: No Control<br>1: Profile Position Mode (PP)<br>3: Profile Velocity Mode (PV)<br>6: Homing<br>8: Cyclic Synchronous Position M  | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)  Return to Default   |
| Item name<br>Ox6060:00 Modes of operation/Modes of operation comment :<br>The following list specifies all support of a second control -4 / 252: Analog Torque Control -3 / 253: Analog Velocity Control -2 / 254: Analog Position Control -1 / 255: Voltage Mode (VM)<br>0: No Control 1: Profile Position Mode (PP)<br>3: Profile Velocity Mode (PV)<br>6: Homing<br>8: Cyclic Synchronous Position Mode (PV)   | eration 8: Cyclic Synchronous P<br>oported operating modes:<br>(ATC)<br>I (AVC)<br>I (APC) | Value<br>osition Mode(CSP)                      |

#### **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 ' | x)                                   |  |  |  |  |  |
| 136       | 1000: (* sdo: write 6060 = 1 (   | PP) *)                |                                      |  |  |  |  |  |
| 137       | control_word := 16#0000;         |                       |                                      |  |  |  |  |  |
| 138       | progstep :=1010;                 |                       |                                      |  |  |  |  |  |
| 139       | 1010:                            |                       |                                      |  |  |  |  |  |
| 140       | EC_CoESDOWrite_instance          | (Execute:=FALSE, W    | /riteDat:=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            | e);                   |                                      |  |  |  |  |  |
| 154       | IF (EC_CoESDOWrite_instance)     | nce.Done=TRUE) TH     | IEN                                  |  |  |  |  |  |
| 155       | progstep := 1200;                |                       |                                      |  |  |  |  |  |
| 156       | ELSIF (EC_CoESDOWrite_in         | stance.Error=TRUE)    | THEN                                 |  |  |  |  |  |
| 157       | progstep := 5000; (*             | error! go to error r  | esolution *)                         |  |  |  |  |  |
| 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'.



| Troubleshooting  |  |   | - 10   | the local difference of the lo | -                        |  |  |  |
|--|--|---|--|--|--------------------------|--|--|--|
| Controller Errors  | Controller 8   | Event Log 💦   | User-defined   | l Errors × User-defined  | er-defined Event Log 🛛 🗙 |  |  |  |
| Select the Display Target  | Level<br>Observation<br>Observation<br>Minor fault<br>Observation<br>Observation<br>Minor fault<br>Minor fault<br>Observation<br>Observation<br>Observation<br>Observation | Source<br>PLC<br>EtherCAT Master<br>EtherCAT Master<br>PLC<br>EtherCAT Master<br>EtherCAT Master<br>PLC<br>PLC        | Source Details<br>Function Error<br>Function Error<br>Node No. 1<br>Function Error<br>Function Error<br>Node No. 1<br>Node No. 1<br>Function Error<br>Function Error<br>Function Error | Event NameEvent CodeEtherCAT Communications Error0x54011800Input Value Out of Range0x54010400Slave Application Error0x84280000Slave Initialization Error0x84230000EtherCAT Communications Error0x54011800Input Value Out of Range0x54010400Slave Application Error0x84280000Slave Application Error0x84280000Slave Initialization Error0x84280000Slave Initialization Error0x84230000EtherCAT Communications Error0x54011800Input Value Out of Range0x54010400   |                          |  |  |  |
| ✓ System Event Log<br>✓ Access Event Log<br>✓ Major fault<br>✓ Partial fault<br>✓ Observation<br>Information | Details<br>Attached informa<br>Attached informa<br>Attached informa<br>Attached informa  | An error o<br>[Cause]<br>An error w<br>[Attached<br>AL status o<br>ation 1<br>0x0030<br>ation 2<br>ation 3<br>ation 4 | occurred in the sla<br>vas detected in th<br>information 1]<br>code for the slave  | ave application.<br>le slave's application layer status re<br>e where the error was detected.  | gister.                  |  |  |  |

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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