

How to connect CMMT through EtherCat to an OMRON PLC in Sysmac Studio

This document will go through a Step by Step description of what must be done to connect CMMT to an OMRON PLC through EtherCAT and integrating it to the Motion Control (MC) elements

CMMT

TitleHow to connect CMMT through EtherCat to an OMRON PLC in Sysmac Studio
Version 1.40
Document no. 100197
Originalen
AuthorFesto

Last saved 06.12.2022

Copyright Notice

This documentation is the intellectual property of Festo SE & Co. KG, which also has the exclusive copyright. Any modification of the content, duplication or reprinting of this documentation as well as distribution to third parties can only be made with the express consent of Festo SE & Co. KG.

Festo SE & Co KG reserves the right to make modifications to this document in whole or in part. All brand and product names are trademarks or registered trademarks of their respective owners.

Legal Notice

Hardware, software, operating systems and drivers may only be used for the applications described and only in conjunction with components recommended by Festo SE & Co. KG.

Festo SE & Co. KG does not accept any liability for damages arising from the use of any incorrect or incomplete information contained in this documentation or any information missing therefrom.

Defects resulting from the improper handling of devices and modules are excluded from the warranty.

The data and information specified in this document should not be used for the implementation of safety functions relating to the protection of personnel and machinery.

No liability is accepted for claims for damages arising from a failure or functional defect. In other respects, the regulations with regard to liability from the terms and conditions of delivery, payment and use of software of Festo SE & Co. KG, which can be found at www.festo.com and can be supplied on request, shall apply.

All data contained in this document do not represent guaranteed specifications, particularly with regard to functionality, condition or quality, in the legal sense.

The information in this document serves only as basic information for the implementation of a specific, hypothetical application and is in no way intended as a substitute for the operating instructions of the respective manufacturers and the design and testing of the respective application by the user.

The operating instructions for Festo products can be found at www.festo.com.

Users of this document (application note) must verify that all functions described here also work correctly in the application. By reading this document and adhering to the specifications contained therein, users are also solely responsible for their own application.

Table of contents

1	Components/Software used	5
2	Testing connection to the PLC	6
3	Sysmac Studio configuration.....	7
3.1	EtherCAT Network Preparations	7
3.1.1	Installing the ESI File.....	7
3.2	Starting a Project.....	7
3.3	Setting up the controller.....	8
3.3.1	IP address	8
3.3.2	PLC Module configuration	10
3.4	EtherCAT Network Setup in Sysmac Studio	11
3.4.1	Writing the Configured Station Alias	11
3.4.2	Scanning the EtherCAT network.....	12
3.4.3	Enable Distributed Clocks (DC)	13
4	Axis Setting.....	14
4.1	Axis Basic Settings for positioning mode	14
4.2	Axis Basic Settings for Torque mode	15
4.3	Unit Conversion Settings.....	16
4.3.1	For a Linear System.....	16
4.3.2	For a Rotary System	17
5	Characteristic of homing run	19
5.1	Axis driven homing run	19
5.1.1	Integrating the Festo_MotionControl_CiA402 Library	20
5.1.2	Integrating the Power_Home FB	22
5.2	NC Driven homing run	23
5.2.1	Servo Drive Settings	24
5.3	Transfer to Controller	26
6	Control in Position Mode	27
7	Control in Torque Mode	28

1 Components/Software used

Type/Name	Version Software/Firmware	Date of manufacture
CMMT-AS	V016.0.9.10_release	2019
Festo Automation Suite	1.2.1.16	2019
CMMT-AS Plug-In	1.2.0.25	2019
NJ301-1100 Omron PLC	1.10	--
Sysmac Studio Standard Edition	Ver.1.13	--

Table 1.1: 1 Components/Software used

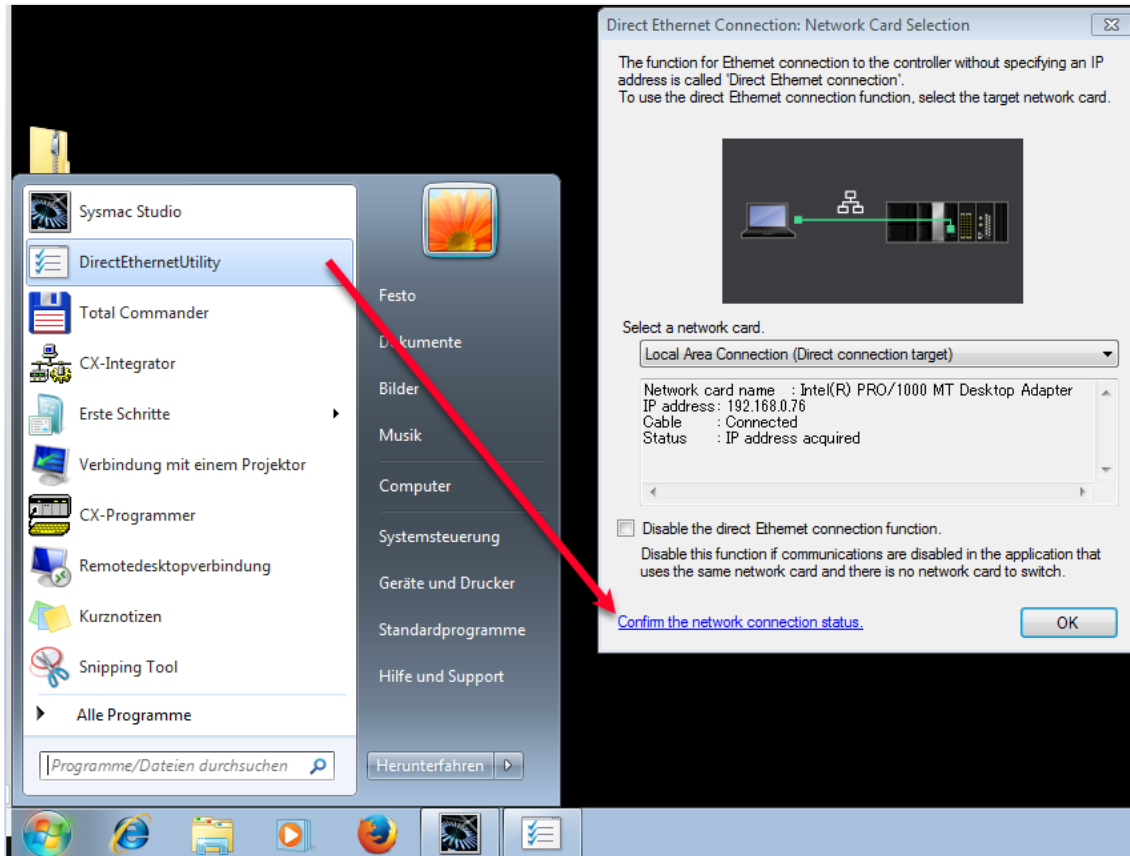


Information

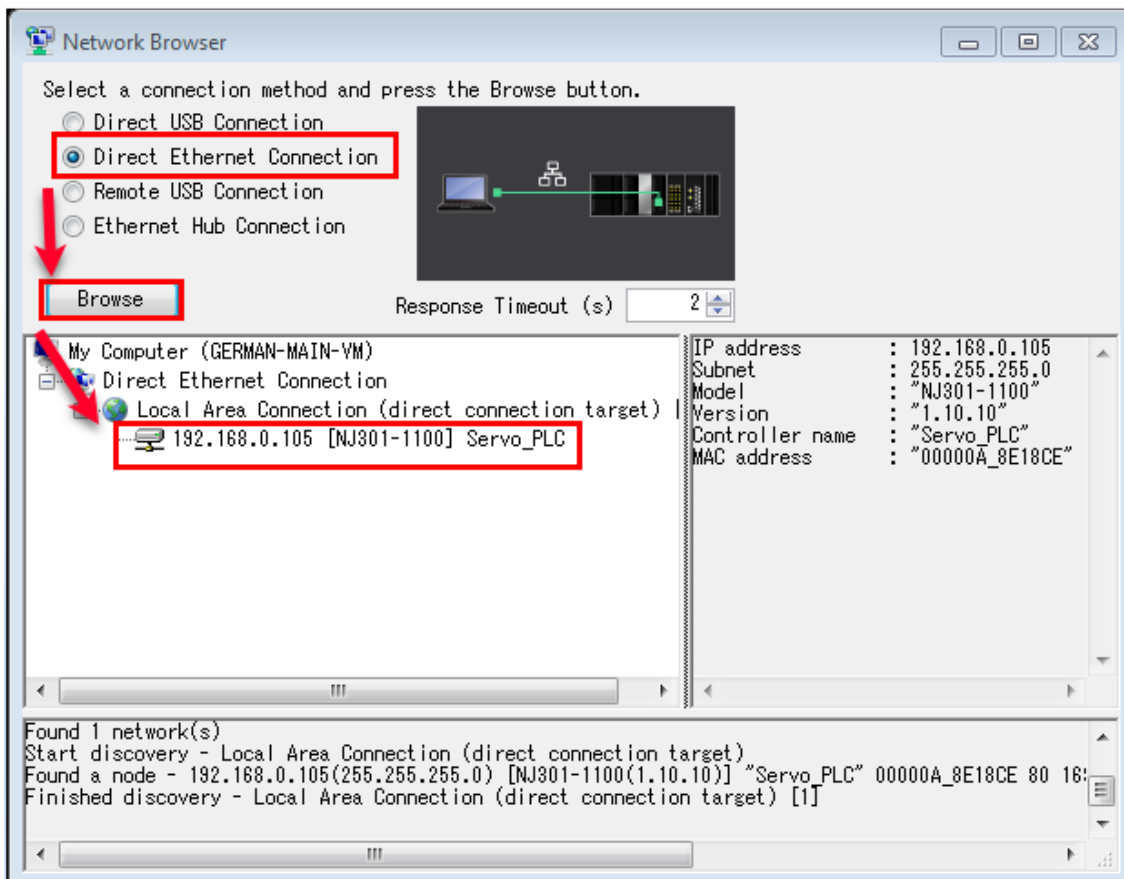
This AppNote describes the procedure with the CMMT-AS motor controller. The CMMT-AS servo drive controller and CMMT-ST servo drive controller for extra-low voltage are based on the same software platform. Therefore, the described settings can also be used as a reference for its parameterization. It is hereby expressly pointed out, that this has not been explicitly tested and therefore the function cannot be guaranteed!

2 Testing connection to the PLC

After installing Sysmac Studio, Omron provides an IP scanning software labelled as DirectEthernetUtility. It is recommended to use this tool in case the IP address is unknown or has been forgotten. Start DirectEthernetUtility and click on Confirm the network connection status



Select the connection method and click on Browse to find the device.



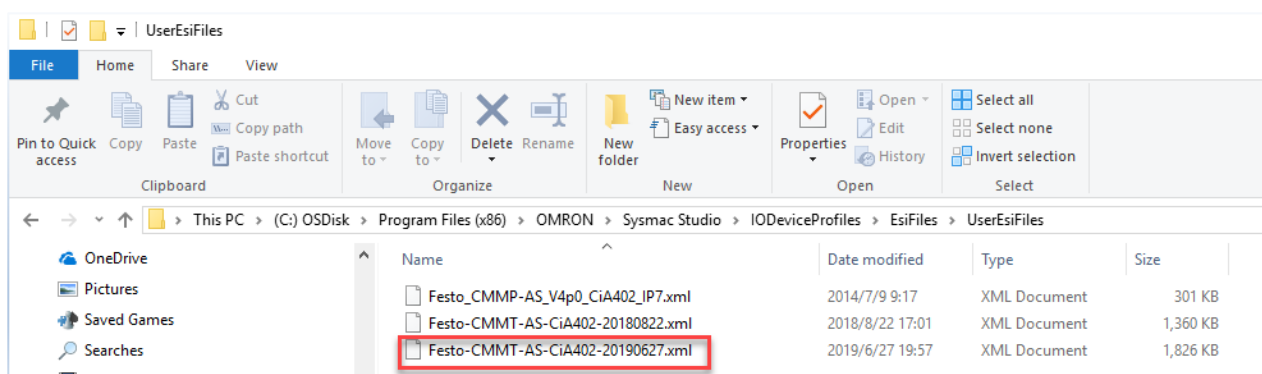
3 Sysmac Studio configuration

3.1 EtherCAT Network Preparations

3.1.1 Installing the ESI File

1. Make sure that Omron Sysmac Studio is closed.
2. Download the EtherCAT ESI File for CMMT from the Festo Support portal.
3. Paste it into the following folder:

C:\Program Files (x86)\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles



4. Start Sysmac Studio

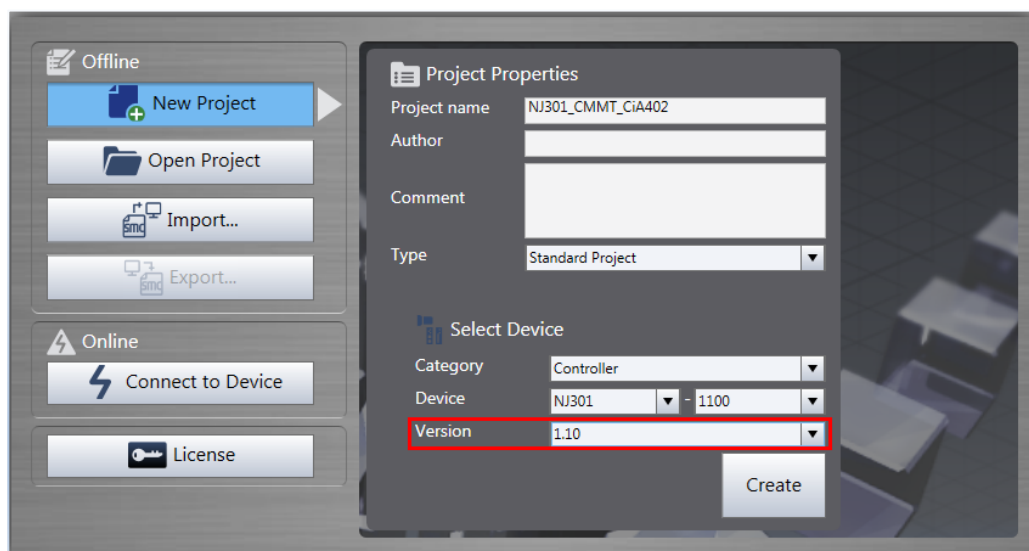
3.2 Starting a Project

Create a New Project selecting **Device Type and Version** that you have.



Note

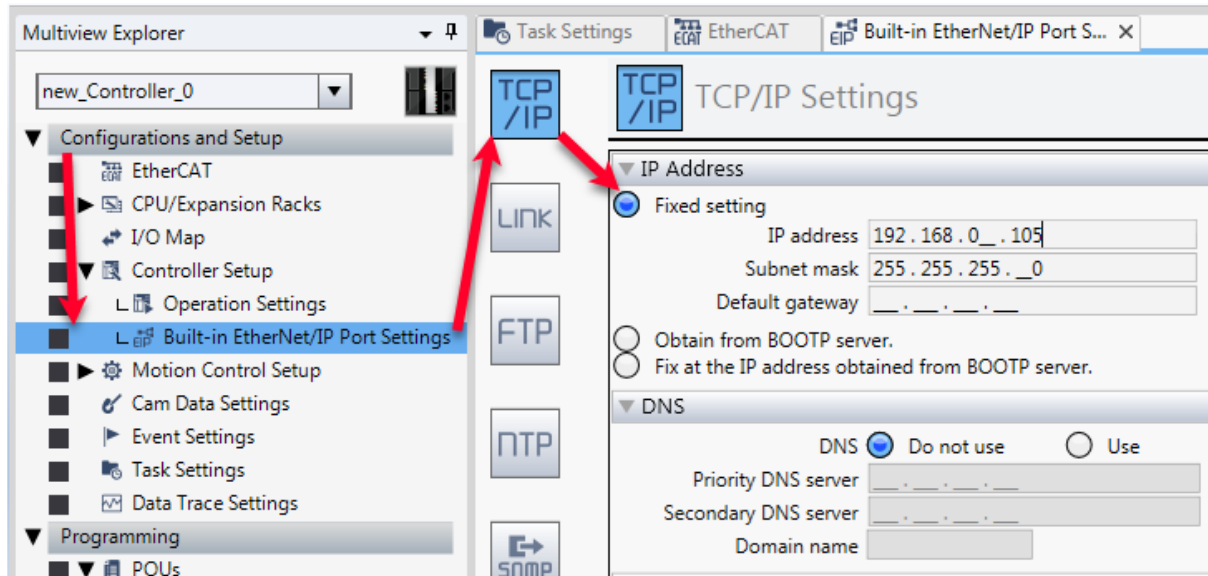
The Device Version **MUST BE 1.10 OR HIGHER**. An older controller will not be compatible with the Festo_MotionControl library. Contact OMRON concerning FW updates.



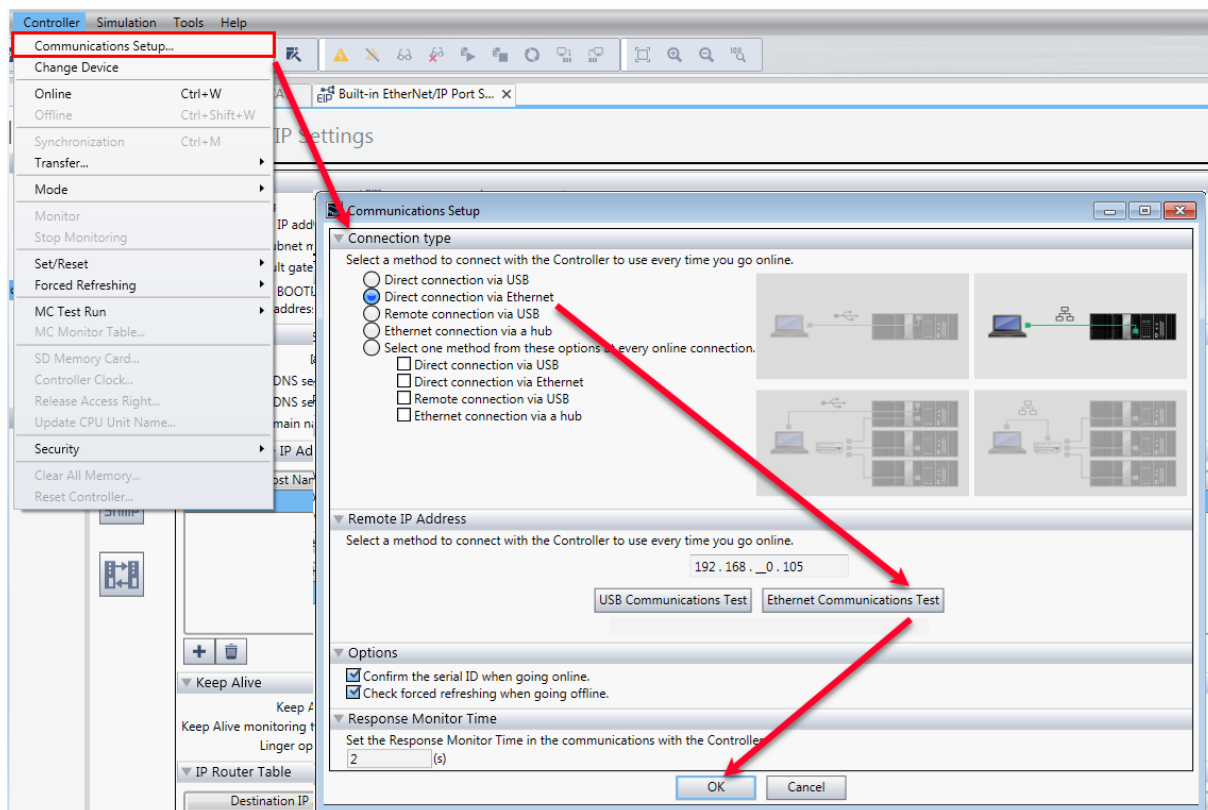
3.3 Setting up the controller

3.3.1 IP address

Set the IP address of the PLC in the project by opening the Configurations and Setup Menu -> Controller Setup -> Built-in Ethernet/IP Port Settings -> TCP/IP -> Fixed Setting



Make the communication setup by clicking on Controller -> Communication Setup... -> Select connection method -> Communications Test.



**Note**

A successful test will display the message Test OK

▼ Remote IP Address

Select a method to connect with the Controller to use every time you go online.

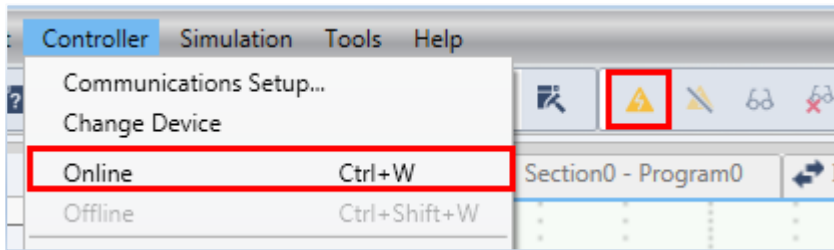
192 . 168 . __0 . 105

USB Communications Test Ethernet Communications Test

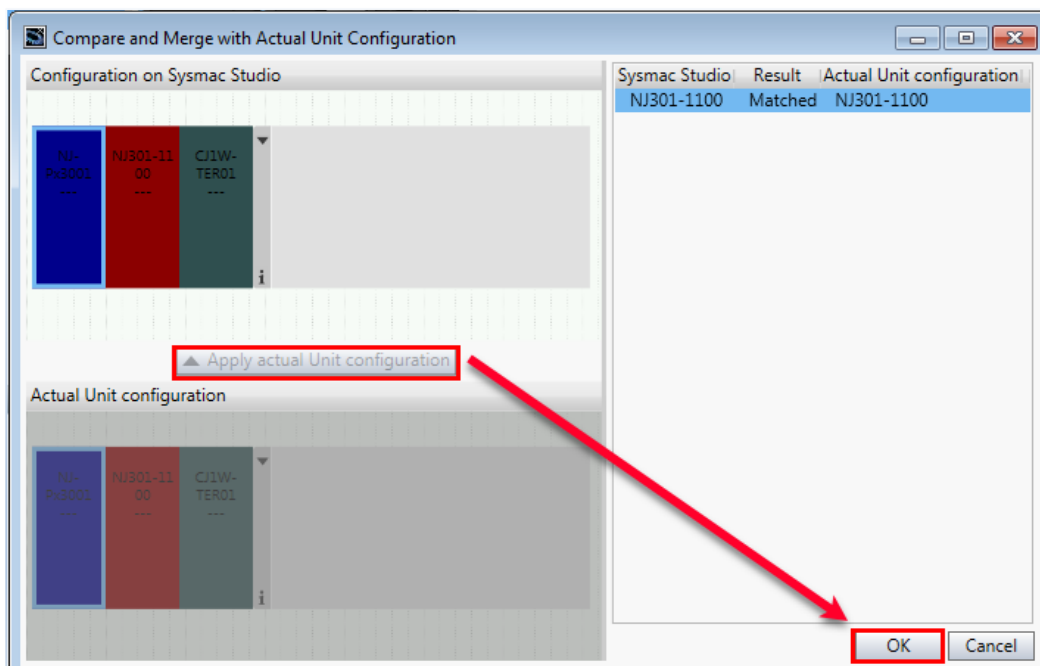
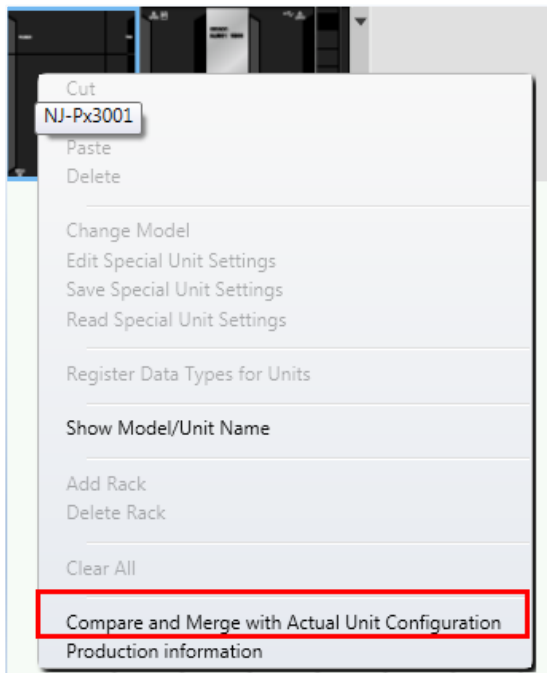
Test OK

3.3.2 PLC Module configuration

First establish an online connection to the PLC by clicking on Controller -> Online.



Double-click on the CPU/Expansion Racks. Right click any of the shown modules and select the Compare and Merge with Actual Unit Configuration Option -> Apply actual Unit configuration



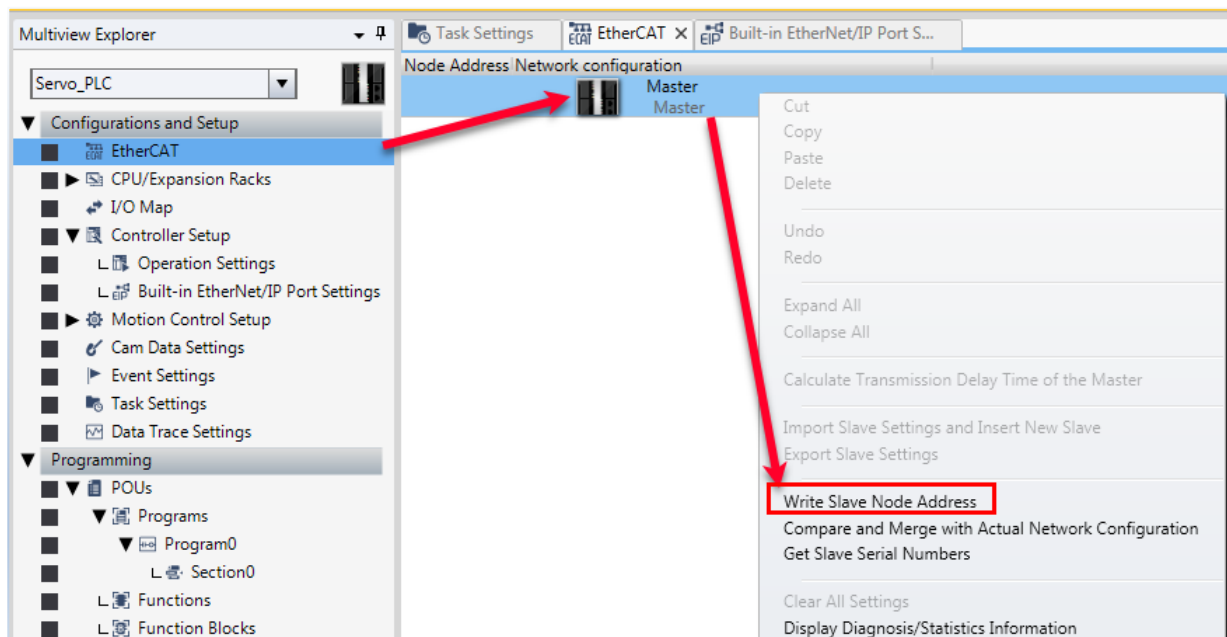
3.4 EtherCAT Network Setup in Sysmac Studio

While Online with the PLC, double click on the EtherCAT Tab under Configurations and Setup.

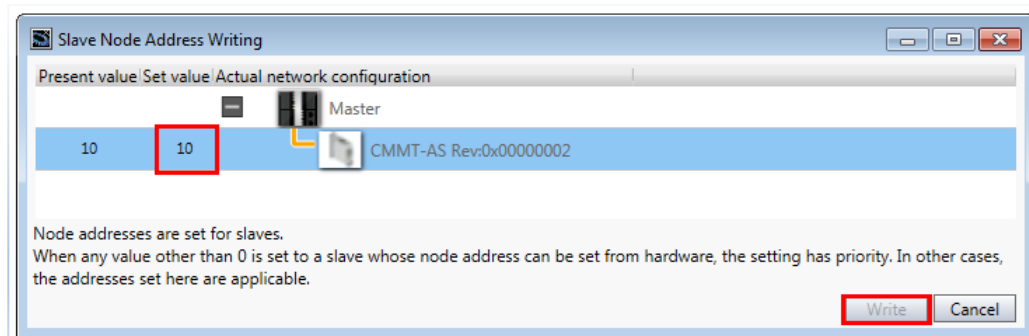
3.4.1 Writing the Configured Station Alias

It is important to point out that OMRON EtherCAT Masters require that connected devices provide a Configured Station Alias. This is a number that is stored in the EtherCAT slaves EEPROM.

A number to a new device can be provided by right clicking on the Master -> Write Slave Node Address



Give all the EtherCAT slaves in the network a different Address.

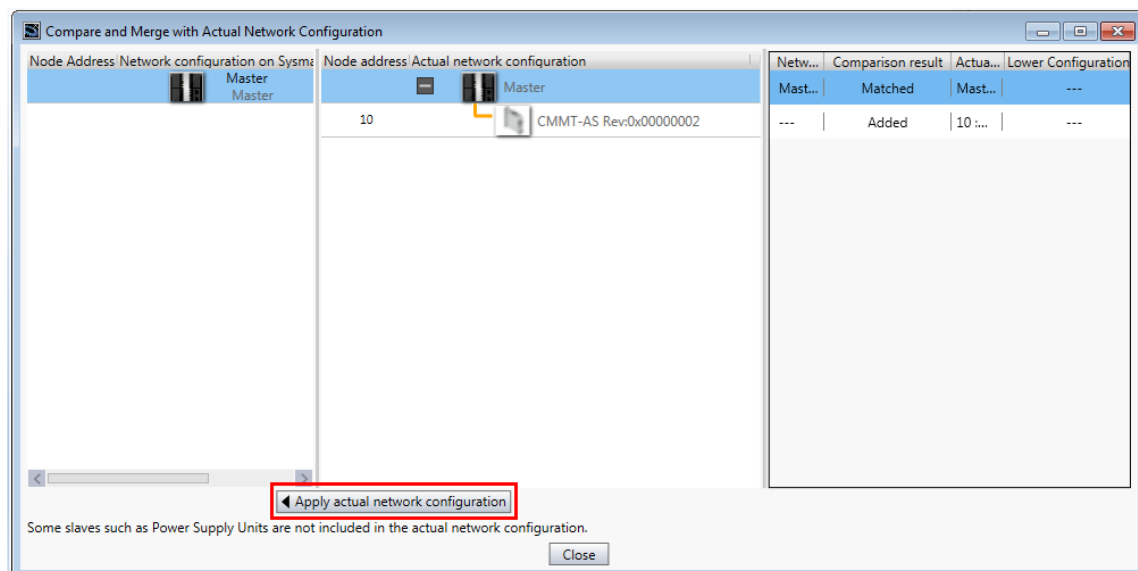
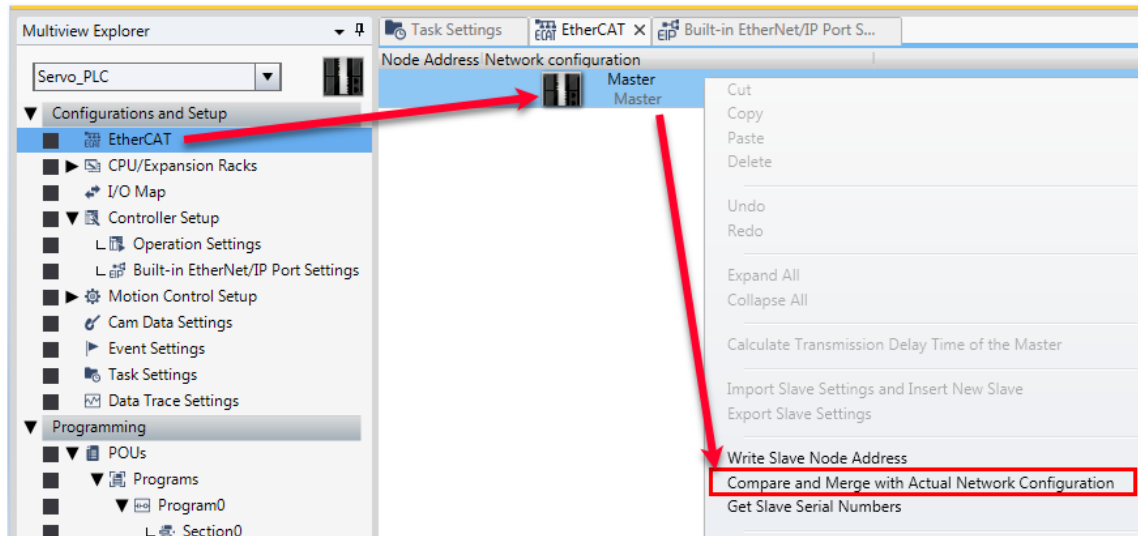


Note

Explicit Device Identification is NOT supported by Omron EtherCAT Masters. This means that Identification through DIL Switches is NOT supported.

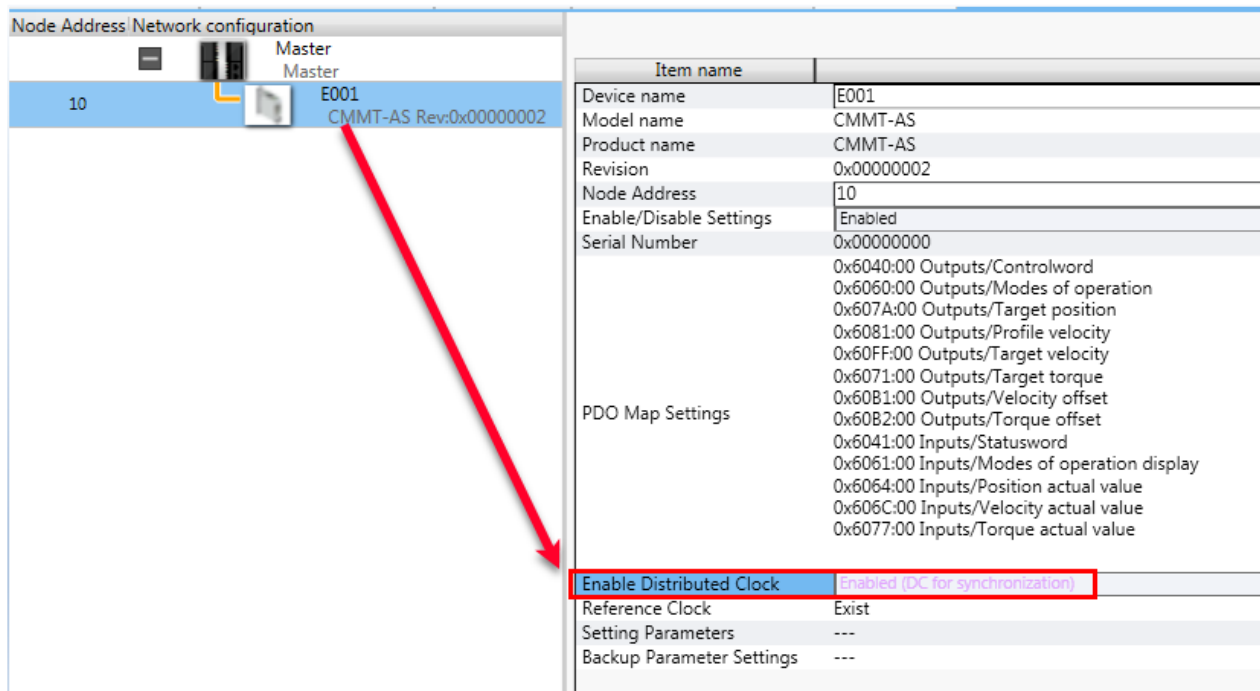
3.4.2 Scanning the EtherCAT network

Right click on the EtherCAT Master module -> Compare and Merge with Actual Network Configuration.



3.4.3 Enable Distributed Clocks (DC)

Go Offline. Click on the CMMT on the EtherCAT Tab and Enable DC for synchronization.



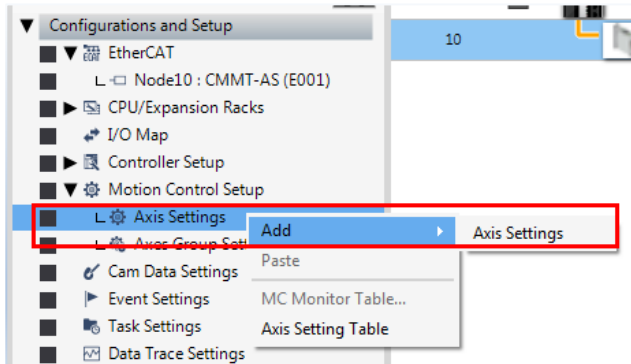
The screenshot shows the Sysmac Studio configuration window. On the left, under 'Node Address' and 'Network configuration', a device 'E001 CMMT-AS Rev:0x00000002' is selected. A red arrow points from this device to the 'Enable Distributed Clock' setting in the right pane. The right pane shows the configuration for the selected device, including various parameters and the 'Enable Distributed Clock' setting, which is highlighted with a red box and set to 'Enabled (DC for synchronization)'.

Item name	
Device name	E001
Model name	CMMT-AS
Product name	CMMT-AS
Revision	0x00000002
Node Address	10
Enable/Disable Settings	Enabled
Serial Number	0x00000000
PDO Map Settings	0x6040:00 Outputs/Controlword 0x6060:00 Outputs/Modes of operation 0x607A:00 Outputs/Target position 0x6081:00 Outputs/Profile velocity 0x60FF:00 Outputs/Target velocity 0x6071:00 Outputs/Target torque 0x60B1:00 Outputs/Velocity offset 0x60B2:00 Outputs/Torque offset 0x6041:00 Inputs/Statusword 0x6061:00 Inputs/Modes of operation display 0x6064:00 Inputs/Position actual value 0x606C:00 Inputs/Velocity actual value 0x6077:00 Inputs/Torque actual value
Enable Distributed Clock	Enabled (DC for synchronization)
Reference Clock	Exist
Setting Parameters	---
Backup Parameter Settings	---

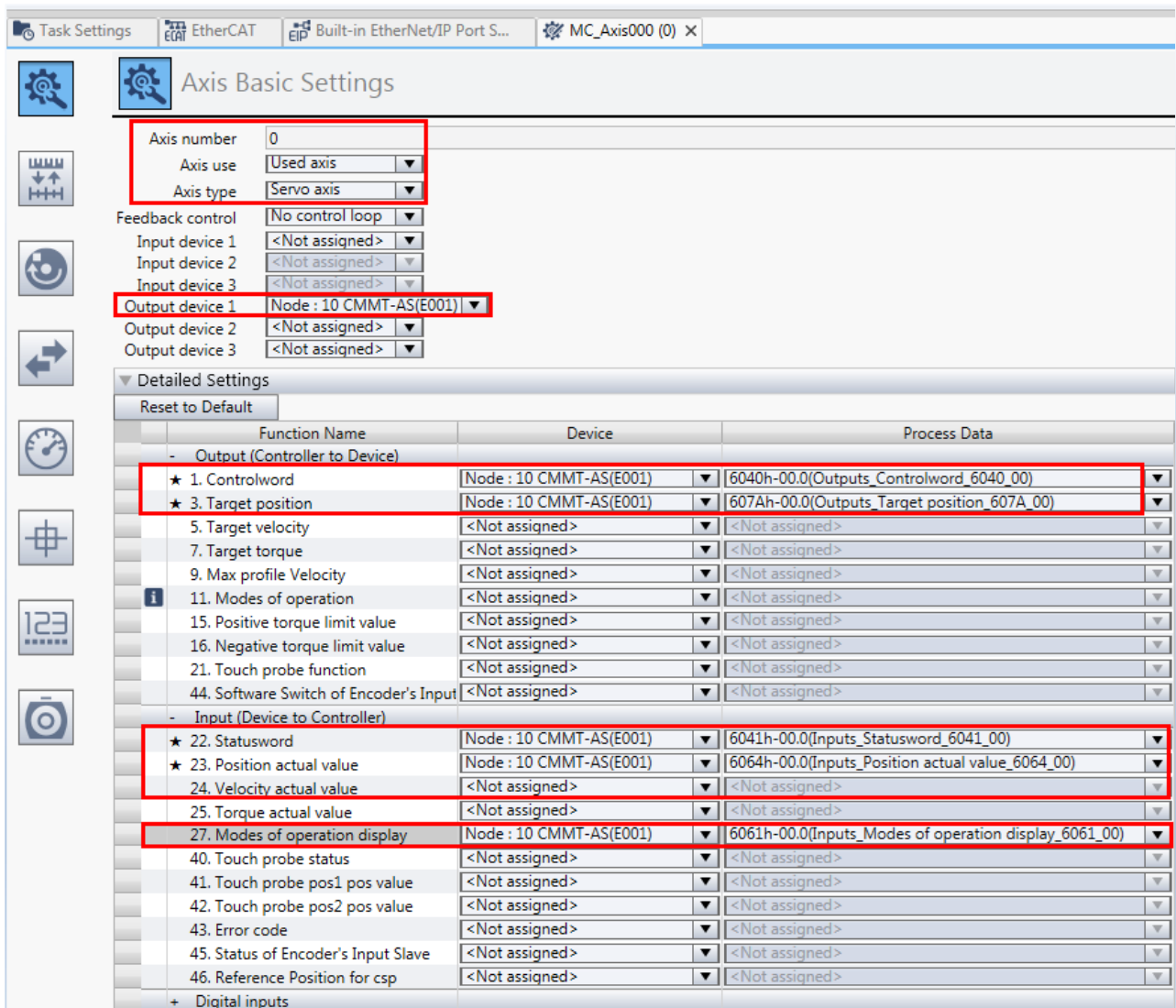
4 Axis Setting

4.1 Axis Basic Settings for positioning mode

Add Motion Axis to the Motion Control Setup -> Add -> Axis Settings

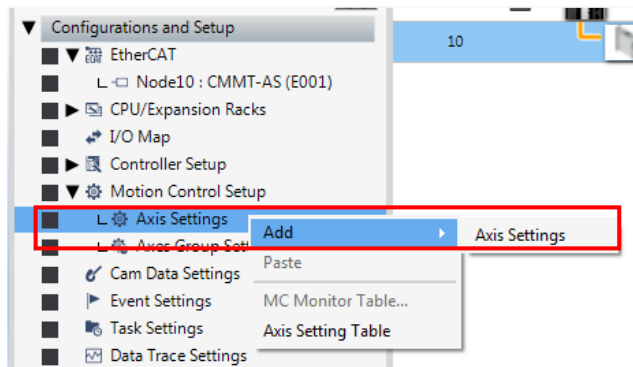


Double Click on the added MC_Axis000 and check the following settings:

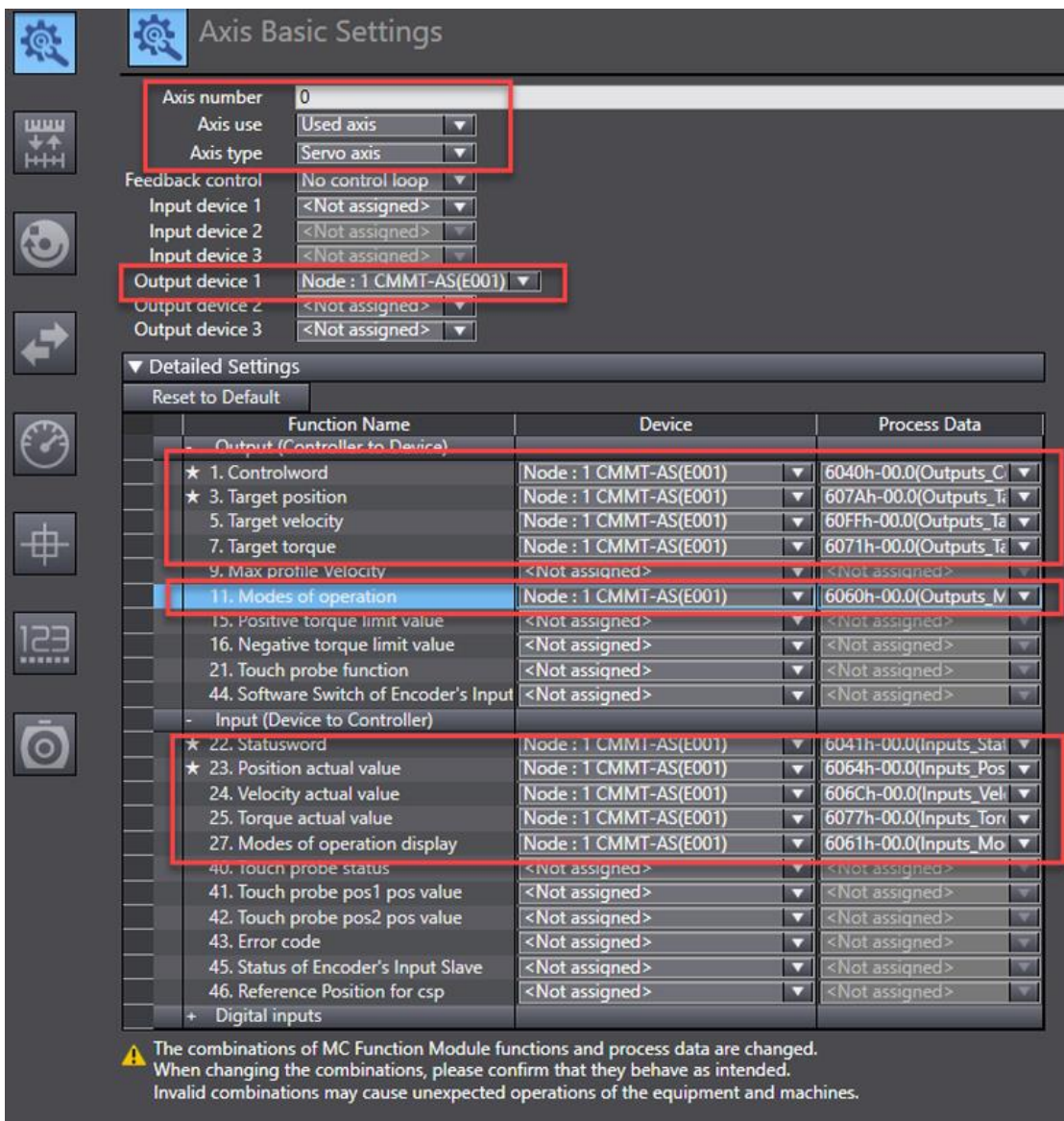


4.2 Axis Basic Settings for Torque mode

Add Motion Axis to the Motion Control Setup -> Add -> Axis Settings



Double Click on the added MC_Axis000 and check the following settings:



4.3 Unit Conversion Settings

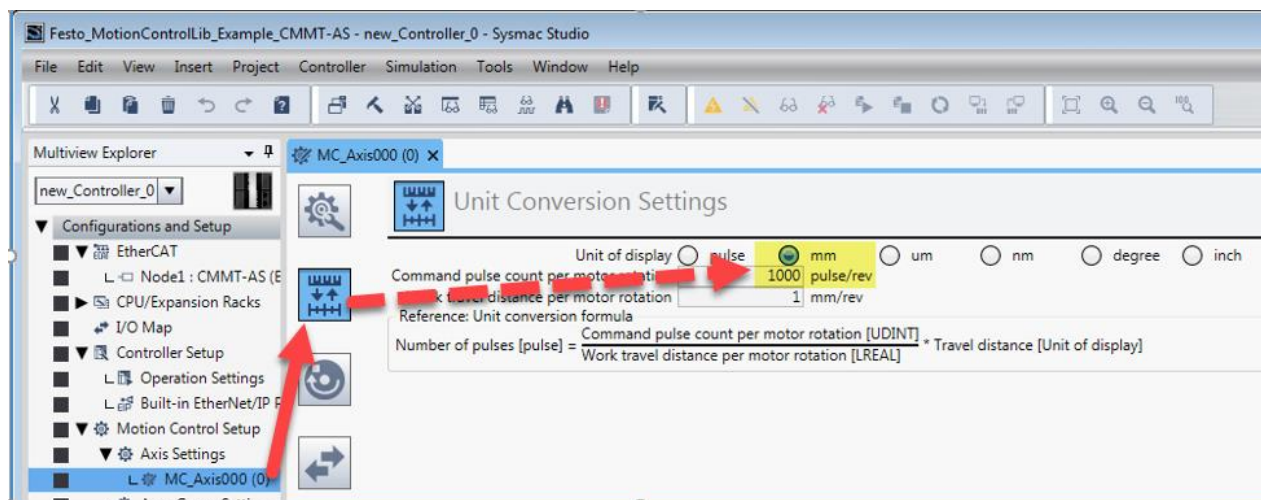
4.3.1 For a Linear System

The setting between Festo Automation Suite and Sysmac Studio should align with each other, eg: if you set the exponent of position to -6 in FAS, please set the command pulse count per motor rotation to 1000 accordingly in Sysmac Studio.

The value “Work travel distance per motor rotation” can be used to set at the function block a value with higher resolution. In this example the value is 1, this means the set position of the function block has a resolution for 1 mm (value 100 at FB means 100 mm). If you set the “Work travel distance per motor rotation” to the value 10 the resolution is 0.1 mm (value 100 at FB means 10.0 mm).

Factor group

Current user unit	Metric [m, m/s, ...] (6)
Position	-6
Velocity	-3
Acceleration	-3
Jerk	-3



4.3.2 For a Rotary System

The setting between Festo Automation Suite and Sysmac Studio should align with each other as well, eg: if you set the exponent of position to -6 in FAS, please set the command pulse count per motor rotation to 1000000 accordingly in Sysmac Studio.

The value “Work travel distance per motor rotation” can be used to set at the function block a value with higher resolution. In this example the value is 1, this means the set position of the function block has a resolution for 1 degree (value 100 at FB means 100 degree). If you set the “Work travel distance per motor rotation” to the value 10 the resolution is 0.1 degree (value 100 at FB means 10.0 degree).

Factor group

Current user unit	Degree [°, °/s, ...] (5)	
Position	-6	
Velocity	-3	
Acceleration	-3	
Jerk	-3	

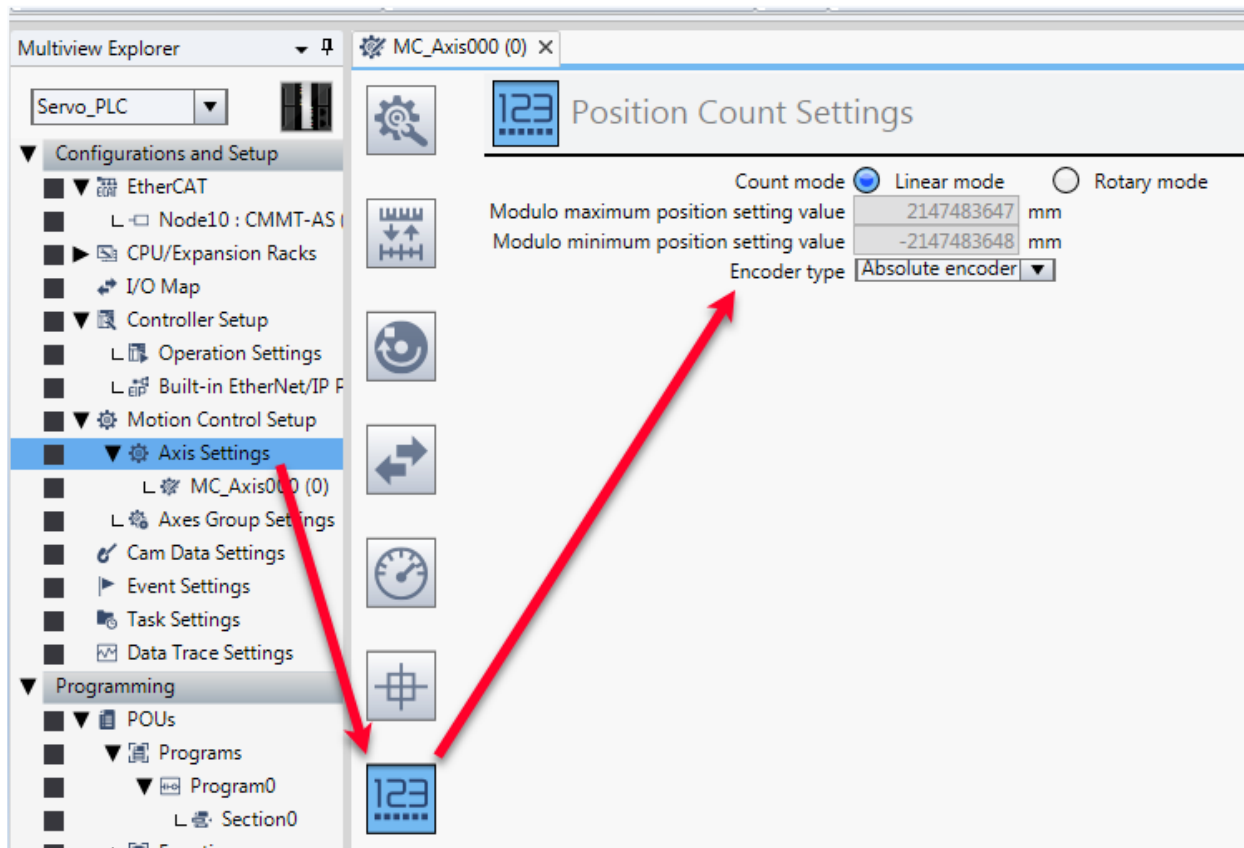
The screenshot shows the Sysmac Studio interface. On the left, the Multiview Explorer shows the project structure with 'new_Controller_0' selected. The 'Unit Conversion Settings' window is open, showing the following settings:

- Unit of display: ☒ pulse ☐ mm ☐ um ☐ nm ☒ degree ☐ inch
- Command pulse count per motor rotation: 1000000
- Work travel distance per motor rotation: 1
- Reference: Unit conversion formula
- Number of pulses [pulse] = Command pulse count per motor rotation [UDINT] * Travel distance [Unit of display]

A red arrow points from the 'MC_Axis000 (0)' entry in the Multiview Explorer to the 'Unit Conversion Settings' window.

Axis Setting

On the Position Count Settings tab, change the Encoder Type to Absolute encoder



5 Characteristic of homing run

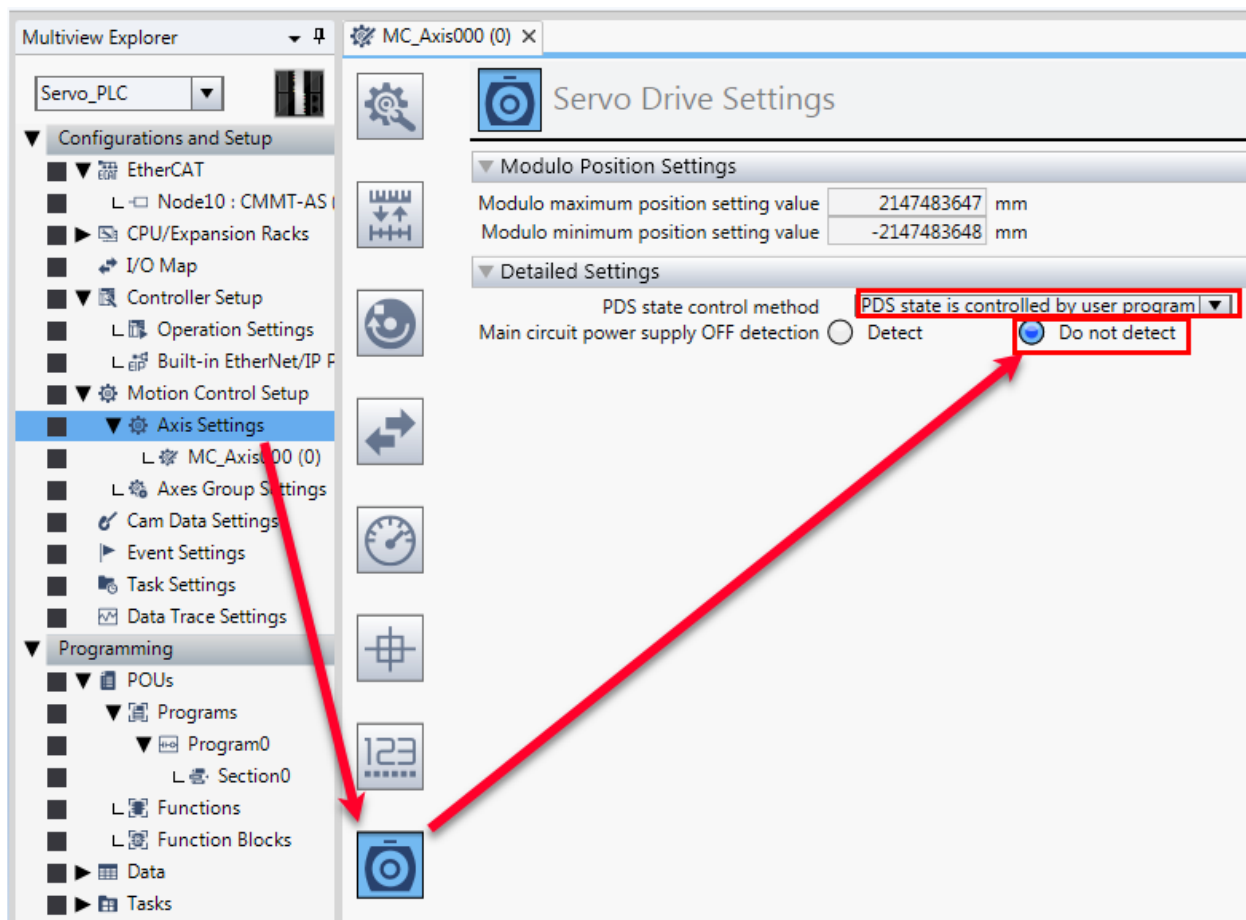
To run an electrical drive system, the system must be referenced. This can be done in several ways

- Via the **Festo Automation Suite**
- Via fieldbus **NC driven**
- Via fieldbus **axis driven** (more complex because it is necessary to switch the operating modes)

In a running system, it is only possible to use the last two aforementioned methods.

5.1 Axis driven homing run

Set the PDS state control method to PDS is controlled by user program and Do not detect Main circuit power supply.



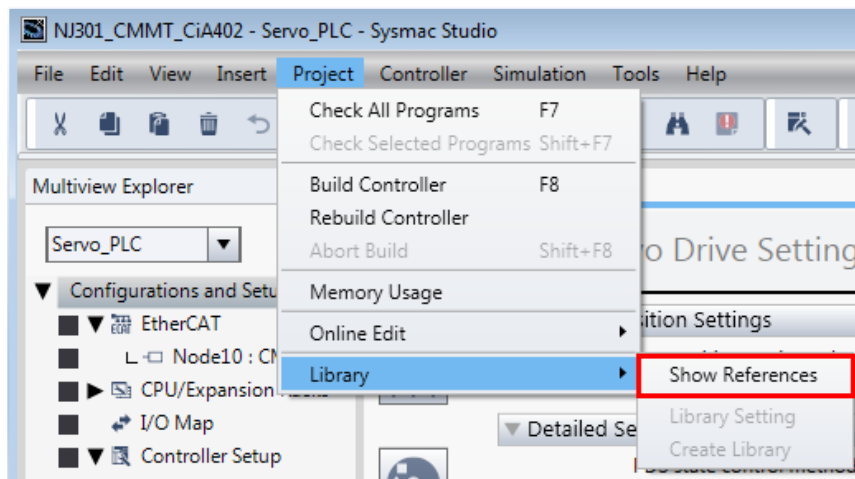
5.1.1 Integrating the Festo_MotionControl_CiA402 Library

With Festo Axis in CiA402, the Mode of Operation must be set by the programmer. To avoid having to manually change between modes' of operation, the Festo_MotionControl_CiA402 library has been developed.

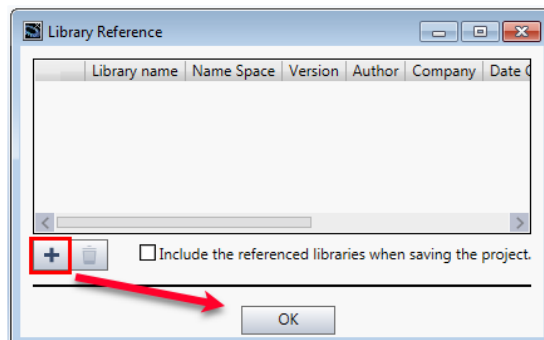
Download the CiA 402 Festo library for Omron from the support portal.

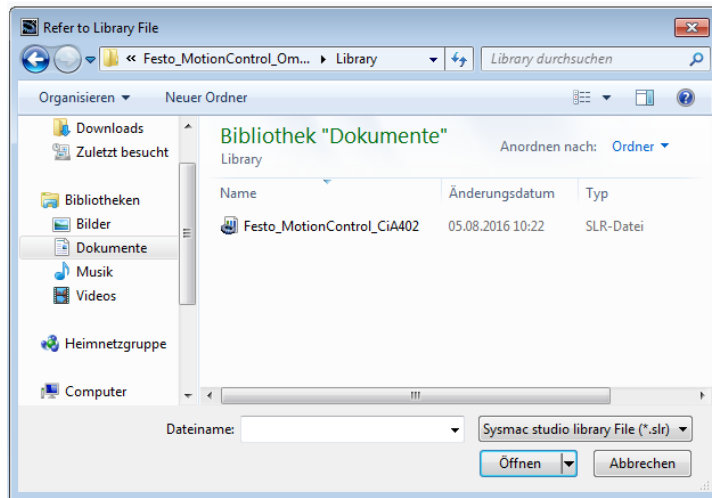
Function blocks Omron	3.0.1	→ Function blocks
CiA 402 function blocks for motor controller - Sysmac Studio	13/08/2019	→ File and language versions
		★★★★★ (8)
+ CiA 402 motion library for Omron NJ301 and NJ501 PLCs to support the drive-controlled homing with motor controller from Festo.		

Open the library references by going to Project -> Library -> Show References



Add the library by clicking on the “+” symbol.





5.1.2 Integrating the Power_Home FB

Once the library has been added to the project, call the Festo_MC_Power_Home block on one of the programming sections.

The Axis element was generated in step 3.5, this same name must be used in the Axis input for all PLCOpen FBs

A detailed description of what each input does comes with the library.

Internals	Name	Data Type	Initial Value	AT
Externals	bEnableCMMT	BOOL		
	uiSetMode	USINT		
	bStartHoming	BOOL		
	bReadError	BOOL		
	CMMT_Reset	MC_Reset		
	bResetError	BOOL		
	eTargetPosition	LREAL		
	eMedianPos	LREAL		
	CMMT_MoveAbsolute	MC_MoveAbsolute		
	bMoveAbsoute	BOOL		
	CMMT_MoveVelocity	MC_MoveVelocity		
	bVelocityTrg	BOOL		
	CMMT_TorqueControl	MC_TorqueControl		
	bTorqueControl	BOOL		
	ui	SINT		
	bEnableMultiple	BOOL		

Block configuration details:

- Axis: MC_Axis000
- Enable: bEnableCMMT
- SetModesOfOperation: uiSetMode
- ModesOfOperation_PDO6060: OUT_ModesOfOperation_PDO6060
- ModesOfOperationDisplay_PDO6061: IN_ModesOfOperationDisplay_PDO6061
- StartHoming: bStartHoming
- HomingValid: Enter Variable
- Busy: Enter Variable
- Error: Enter Variable
- ErrorID: Enter Variable
- InternInfo: Enter Variable

Link a variable to input ActualModeOfOperation and output uiSetModeOfOperation when control in **positioning mode**. Afterwards, it must be linked to the CMMT through the I/O Map tab.

Position	Port	Description	R/W	Data Type	Variable	Variable Comment	Variable Type
EtherCAT Master Node10	CMMT-AS	Outputs_Controlword_6040_00	W	UINT			
		Outputs_Modes of operation_6060_00	W	SINT	uiSetModeOfOperation		Program0 Internals
		Outputs_Target position_607A_00	W	DINT			
		Outputs_Profile velocity_6081_00	W	UDINT			
		Outputs_Target velocity_60FF_00	W	DINT			
		Outputs_Target torque_6071_00	W	INT			
		Outputs_Velocity offset_6081_00	W	DINT			
		Outputs_Torque offset_60B2_00	W	INT			
		Inputs_Statusword_6041_00	R	UINT			
				Inputs_Modes of operation display_60	R	SINT	uiActualModeOfOperation
		Inputs_Position actual value_6064_00	R	DINT			
		Inputs_Velocity actual value_606C_00	R	DINT			
		Inputs_Torque actual value_6077_00	R	INT			
		Inputs_Torque actual value_6077_00	R	INT			

5.2 NC Driven homing run

By using the NC driven homing run, you have to use the MC_Home function block from Omron.

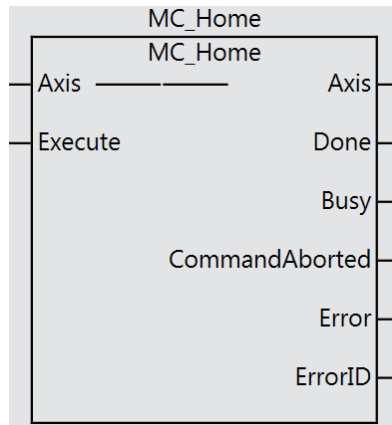


Figure 1: MC_Home function block from Omron



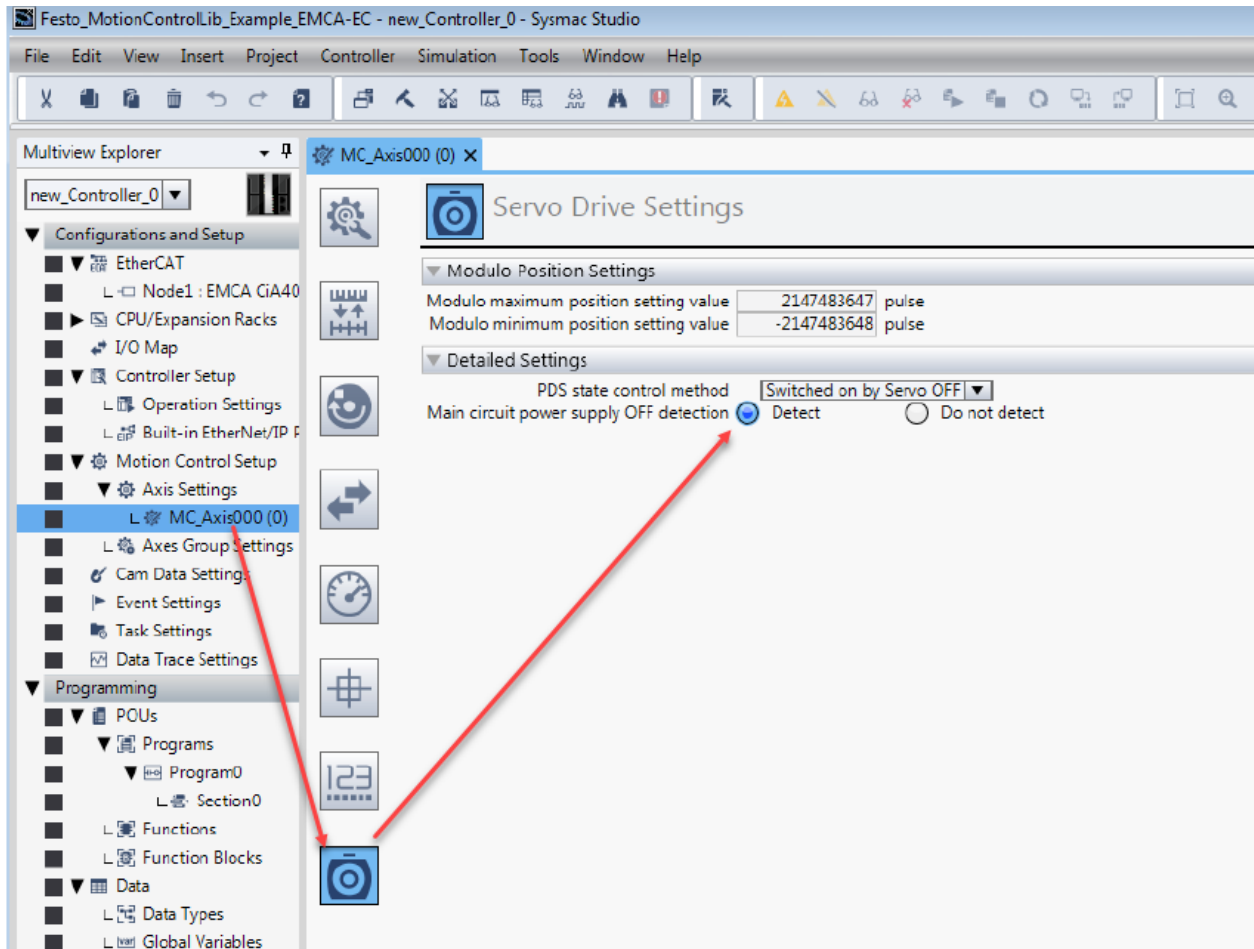
The limit switches have to be connected to the PLC



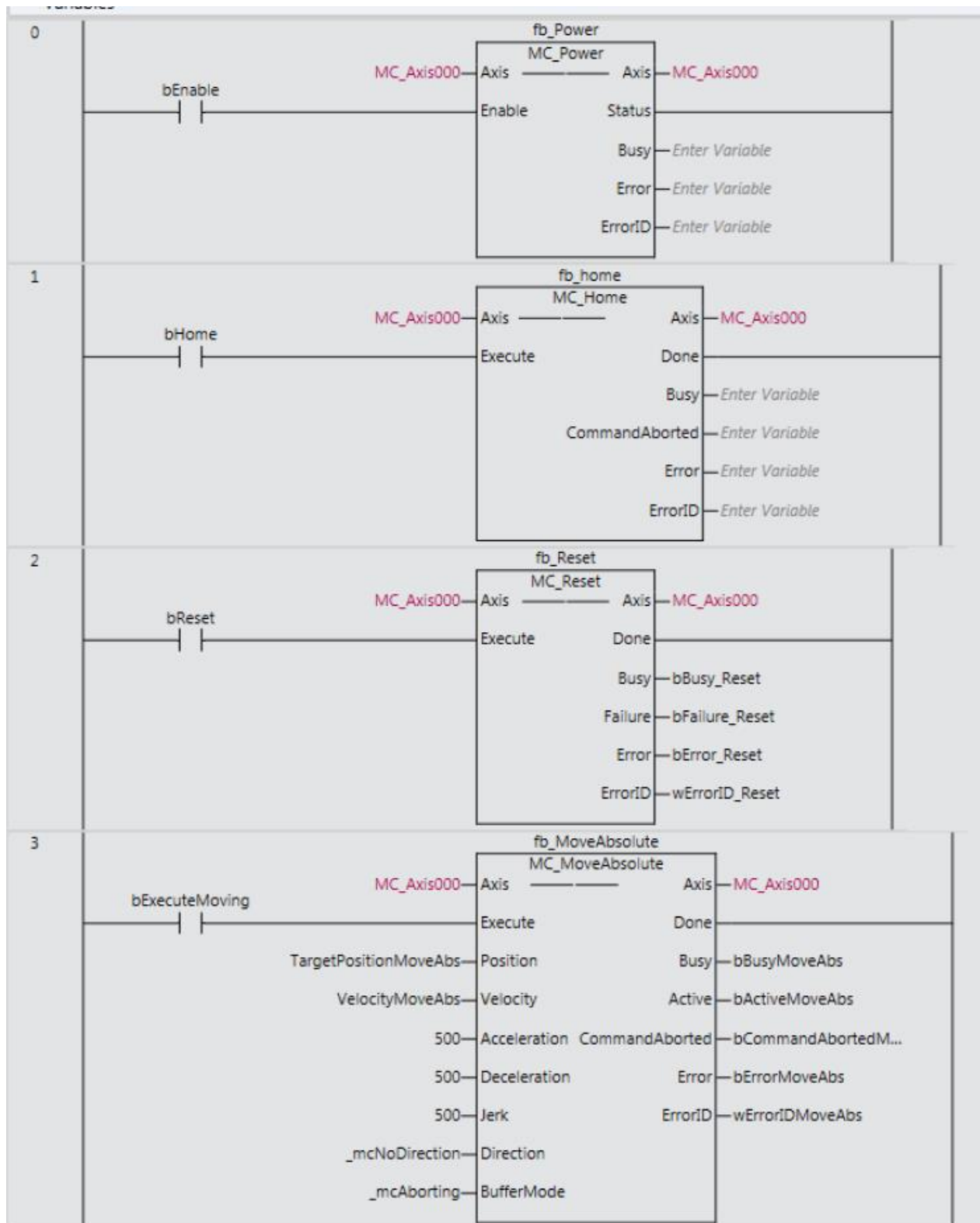
The observation of the axis limits has to be done by the NC.
Therefore the controller internal SW limits are deactivated by the start-up parameters.

5.2.1 Servo Drive Settings

Set method of PDS state control and enable the power supply OFF detection.

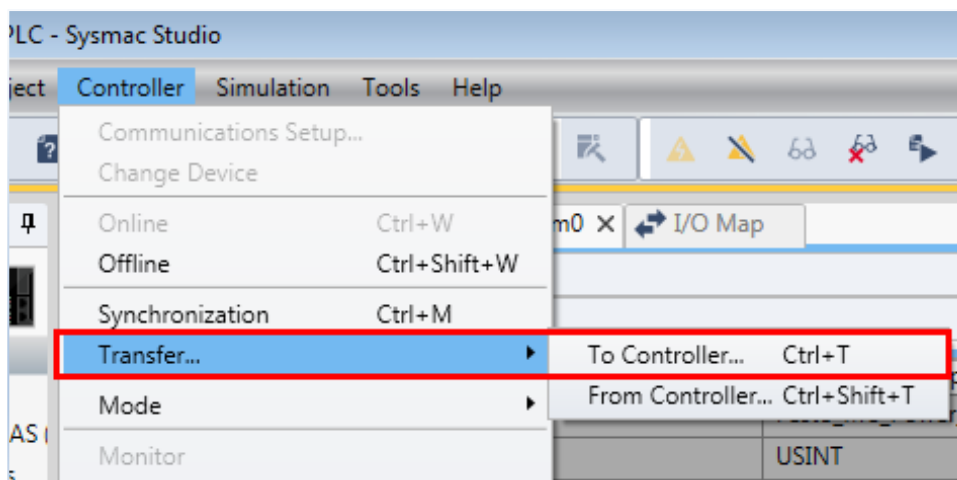
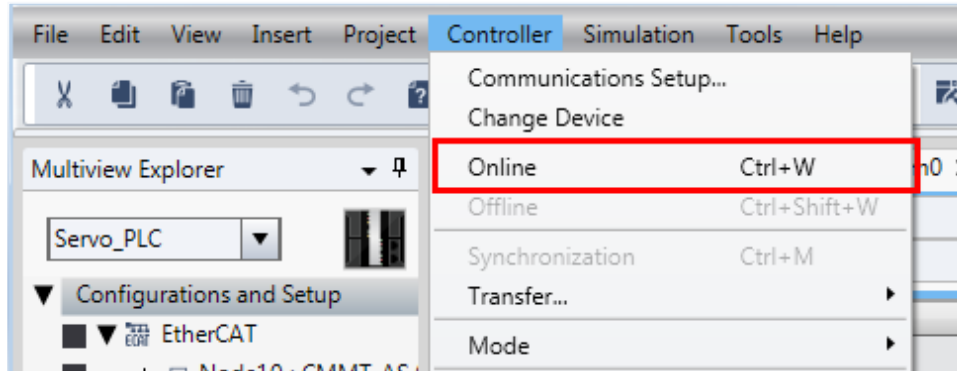


Link the Function Blocks to the configured Axis.



5.3 Transfer to Controller

Once all changes have been made, the last step is to go online and Transfer the parameters to the Omron controller.



Note

To avoid having to Transfer the whole controller configuration (once it's been done correctly) the Online changes instructions should be used to make changes which do not affect the topology or PLC settings.

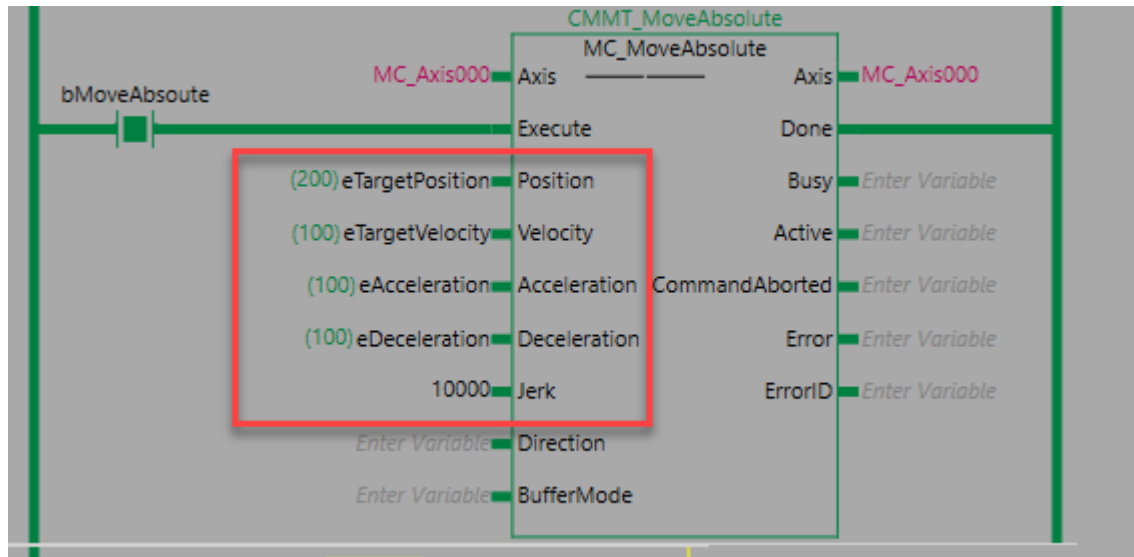


Note

The PLCOpen FBs are by default available in a project which has declared Axis. The traditional MC_Reset, MC_MoveAbsolute can be used to execute movements.

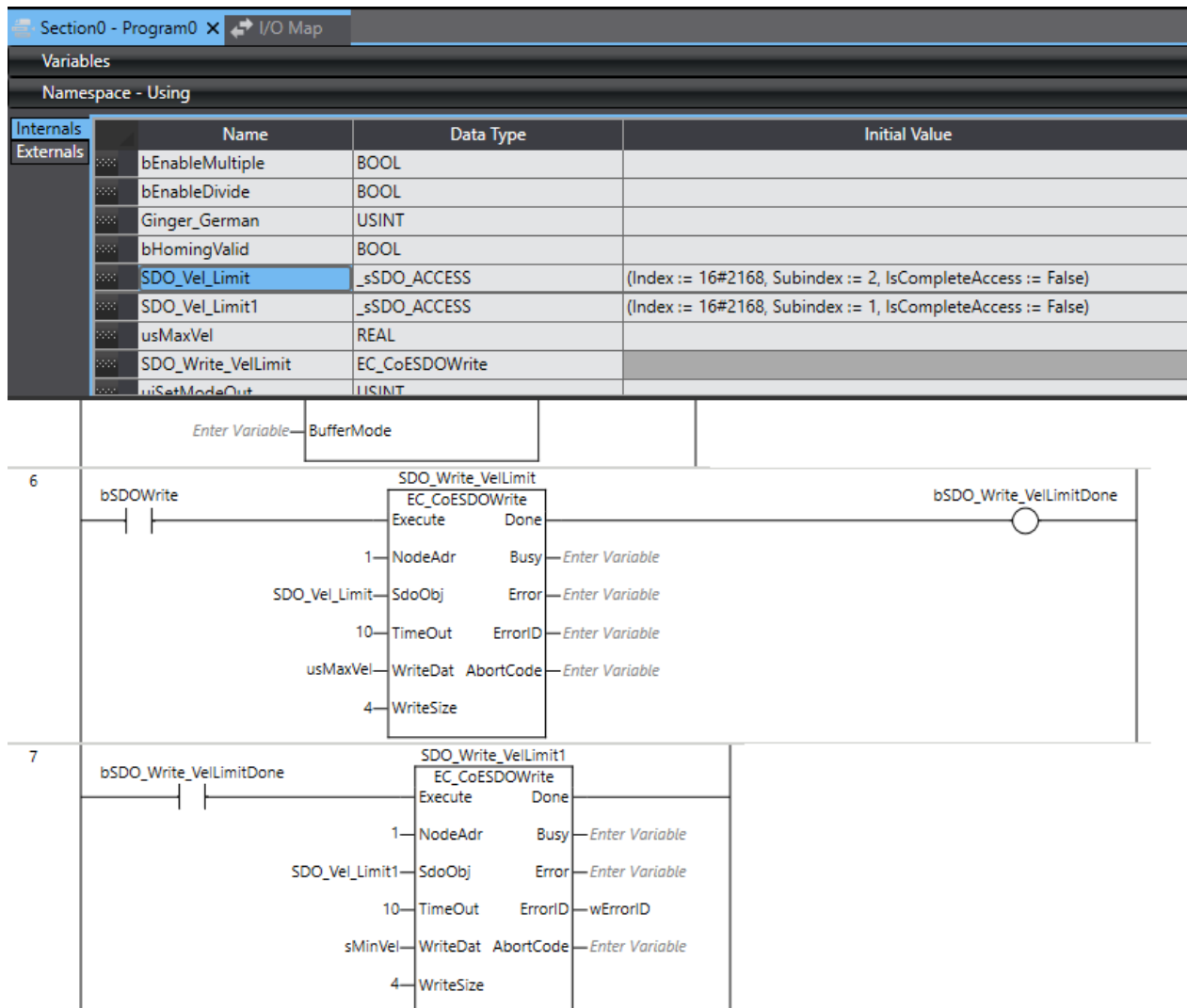
6 Control in Position Mode

Using PLCopen function block MC_MoveAbsolute to control CMMT in absolute positioning mode, these inputs- Position, Velocity, Acceleration, Deceleration and Jerk should be set to proper value, then trigger the Execute signal

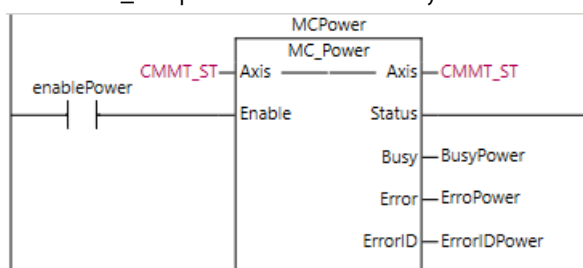


7 Control in Torque Mode

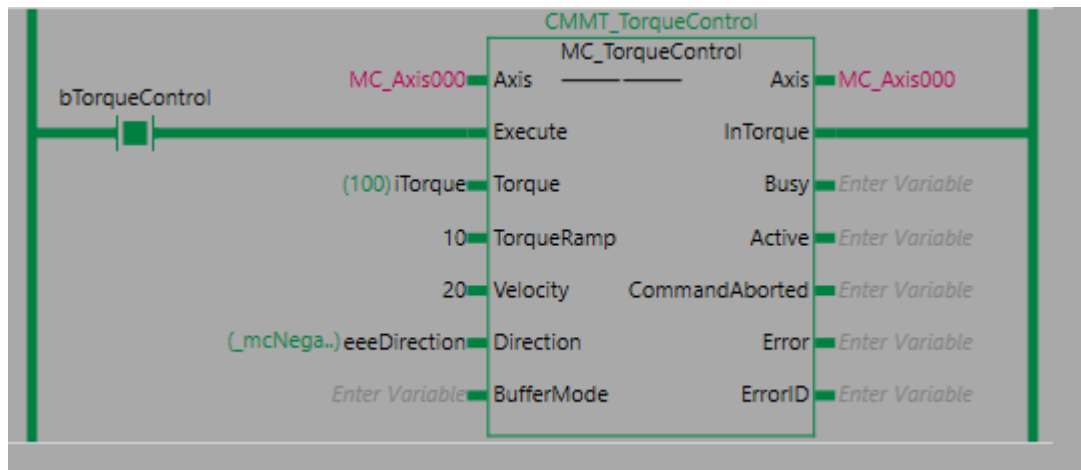
Using PLCopen function block MC_TorqueControl to control CMMT in force mode, we need to set speed limit control prior to starting the force control, EC_CoESDOWrite is used to set the velocity control, the object index 16#2168, subindex 1 for lower limit value velocity, and object index 16#2168, subindex 2 for upper limit value velocity.



Festo_MC_Power_Home and FB_TorqueControl needs to be connectet to PDO "ModesOfOperation". To use the function block FB_TorqueControl is necessary to use the standard function block MC_POWER.



Set the torque value and direct to control CMMT in different value and different direction, then trigger the Execute signal



Name	Valid Range	Description
Torque	0 to 1000	Specify the target torque to output to the Servo Drive in increments of 0.1%. Specify a percentage of the rated torque, i.e the rated torque is 100%. The units is %
TorqueRamp	Non-negative number	2019

**Note**

Please pay attention to the axis element setting up of force mode is different with the setting of position mode