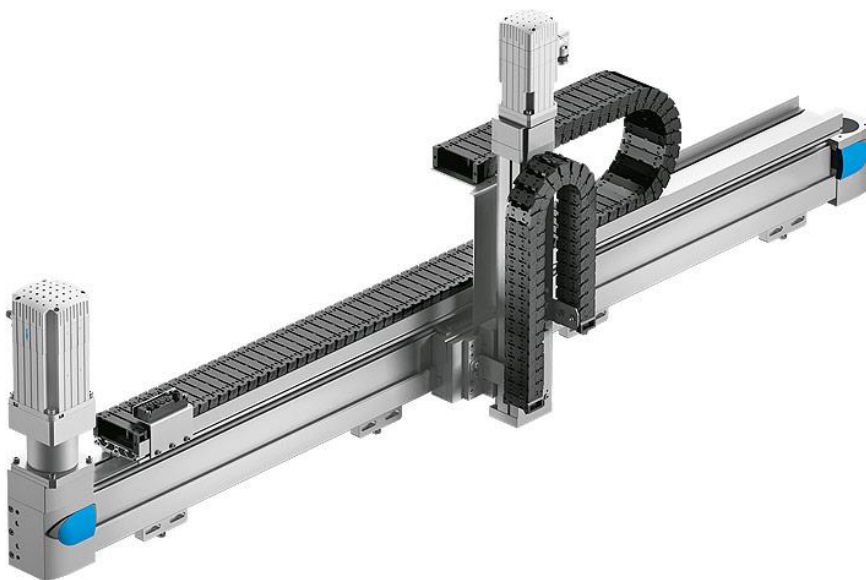




Festo_MotionControl_CiA402

Description

Library for using Festo Drives
in the Omron PLCopen environment.



Date
25.06.2021

Festo SE & Co. KG
Ruiter Straße 82
73734 Esslingen

www.festo.com/contact

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1 Important instructions

1.1 Version overview

Author	Date	Version	Comments
chmm	09.08.2016	1.0.0	Library created
chmm	20.02.2019	2.0.1	Bugfix for CMMT-AS CMMT-ST added
chmm	02.04.2019	2.0.1	Error code description extended
chmm	13.05.2019	3.0.0	Function block "Festo_MC_ReadAxisError" added Bugfix in "Festo_MC_Power_Home" Function block "Festo_GetDriveError" deleted Namespace for function blocks defined
chmm	04.07.2019	3.0.1	"TimeoutTime" to 10 s set (for commutation-angle detection)
chmm	13.08.2019	3.0.1	Extension of instruction guide by CMMT-AS and CMMT-ST
chmm	25.02.2020	3.0.2	Legal form of the company changed (cover sheet)
chmm	25.06.2021	3.2.0	Input "TimeoutTimeHomingRun" added Function block "Festo_MC_ReadAxisError" for EMCA-EC released

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1.4 Target group

This manual is intended exclusively for technicians trained in control and automation technology, who have experience in installation, commissioning, programming and diagnostics of positioning systems and the relevant fieldbus (EtherCAT). They must have a good knowledge of Omron Sysmac Studio and their NC-Axis programming.

1.5 Service

If you have any technical problems, contact your local Festo service partner or use the respective contact form at the following website, please.

www.festo.com/contact

1.6 Safety instructions

When commissioning and programming positioning systems, you must observe the safety regulations in the manuals and operating instructions for the components used. The user must ensure that nobody has access to the sphere of influence of the connected actuators. Access to the potential danger area must be prevented by suitable measures such as barriers and warning signs. If additional commercially available components such as sensors and actuators are connected, the specified limits for pressures, temperatures, electrical data, torques, etc. must not be exceeded.

2 Introduction

2.1 Basic principles

This documentation will guide you through the steps to integrate a Festo Controller in the Omron Motion Control environment using Cyclic Synchronous Profile mode. The precondition is a good knowledge of Omron Sysmac Studio and their NC-Axis programming. Additionally, you need FCT (Festo Configuration Tool) or FAS (Festo Automation Suite) to setup the servo controller. Please note that you might need different Plugins for FCT for different servo controllers (for example CMMP-AS). All Festo software is available on our web site in the support portal.



To control the Festo drives in Omron Sysmac Studio, you must use the Motion Control library provided by Omron.



Warning

This document is only a help to integrate the Festo drive into the Sysmac Studio environment. To establish a safe operation, it is necessary to take into account all the parts of the system and their safety information

2.2 Requirements

The “Festo_MotionControl_CiA402” is tested and released for following Festo products:

Motor Controller	Fieldbus	Drive-Profile	Firmware	Plug-in	Cycle time
CMMP-AS-M3	EtherCAT	CiA402	4.0.1501.1.4 or higher	2.3.0.0 or higher	2 ms + n*1 ms
EMCA-EC	EtherCAT	CiA402	1.4.0.9 or higher	1.5.0.56 or higher	2 ms + n*1 ms
CMMT-AS	EtherCAT	CiA402	14.0.4.102 and higher	1.1.1.8 or higher	1 ms + n*1 ms
CMMT-ST	EtherCAT	CiA402	14.0.4.102 and higher	1.1.1.14 or higher	1 ms + n*1 ms



Please make sure that you are using the correct and actual XML-file for the motor controller and the motor unit. You'll find them in the “Support Portal” on the Festo homepage (www.festo.com).



Note

Always observe the information and safety instructions in the documentation of the motor controller.

2.3 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 Configuration Tool (FCT)** or via **Festo Automation Suite (FAS)**
- 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 afore mentioned methods.

2.3.1 NC driven homing run

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

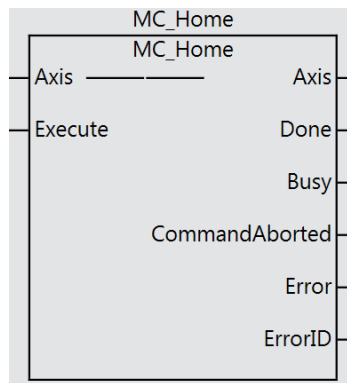


Figure 1: MC_Home function block from Omron



The limit switches must be connected to the PLC.



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



We recommend the NC driven homing run! This is Omron standard. Please refer to the Omron documentation for how to use the MC_Home function block.

2.3.2 Axis driven homing run

By using the Axis driven homing run, you have to use the Festo_MC_Power_Home function block from Festo. This includes the functionality of the MC_Power and MC_Home function blocks from Omron.



We recommend using the NC driven homing run, because it is standard in Omron.

3 Content of the library Festo_MotionControl

3.1 Overview

The library Festo_MotionControl is composed of two function blocks:

- **Festo_MC_Power_Home** --> enabling the motor controller and starting homing run
- **Festo_GetDriveError** --> reading the current error numbers of the device



Use the Festo_MotionControl library with the **Motion Control** library from Omron.



The Festo_MotionControl library uses the following function blocks from Omron:

- **MC_ChangePDSSState** (changing the controlword of the drive)
- **EC_CoESDORead** (reading SDO objects)



The function block **MC_ChangePDSSState** is only available in the new PLC firmware. Please make sure that you are using an Omron PLC with the **version 1.10 or higher**.

3.2 Festo_MC_Power_Home

The function block Festo_MC_Power_Home sets the CMMx motor controller in DS402 Cyclic Synchronous Profile mode (csp mode 8) and enables the drive. With a rising edge at Input StartHoming, the function block starts the controller driven homing run in the FCT configured method.



If you use the Festo_MC_Power_Home function block, you can't use the MC_Power and MC_Home function block from Omron. The Festo_MC_Power_Home replaces both.

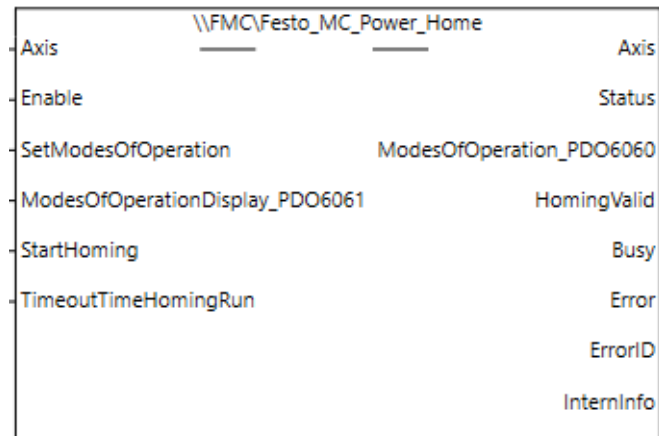


Figure 2: Festo_MC_Power_Home function block

Var_In_Out

Variable	Type	Description
Axis	_sAXIS_REF	Axis structure

Var_Input

Variable	Type	Description
Enable	BOOL	Enables the drive
SetModesOfOperation	SINT	Commanded "modes of operation" of drive according CiA402 specification (set this input to the mode you want to use for the movement, for example cyclic synchronous position mode (8))
ModesOfOperationDisplay_PDO6061	SINT	Input for mode of operation display from drive (statusword 6061h)
StartHoming	BOOL	Starts homing run
TimeoutTimeHomingRun	TIME	Time for timeout supervision during homing run (default =70 sec)

Var_Ouput

Variable	Type	Description
Status	BOOL	Drive is enabled
ModesOfOperation_PDO6060	SINT	Output for mode of operation to drive (controlword 6060h)
HomingValid	BOOL	Drive is referenced
Busy	BOOL	Function block is in action
Error	BOOL	Function block ended with error
ErrorID	WORD	Error number of the occurred error (see chapter chapter 3.4)
InternInfo	WORD	Internal information of the function block

3.3 Festo_MC_ReadAxisError

The function block “Festo_MC_ReadAxisError” reads the most recent axis error of the motor controller or the motor unit.

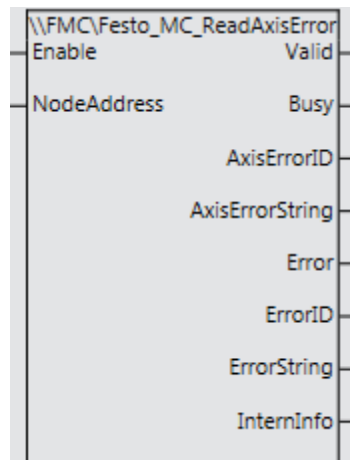


Figure 3: Festo_MC_ReadAxisError function block

Var_Input

Variable	Type	Description
Execute	BOOL	As long as "Enable" is true, axis error will be read.
NodeAddress	UINT	Node address of the device (you'll find the node address of the slave in the EtherCAT Master configuration).

Var_Ouput

Variable	Type	Description
Valid	BOOL	If true, a valid set of outputs is available at FB
Busy	BOOL	Reading of axis error is active
AxisErrorID	UDINT	Value of the actual axis error
AxisErrorString	STRING	String with axis error information
Error	BOOL	Function block ended with error
ErrorID	WORD	Error number of the occurred error (see chapter chapter 3.4)
InternInfo	WORD	Internal information of the function block

3.4 ErrorIDs of the function blocks

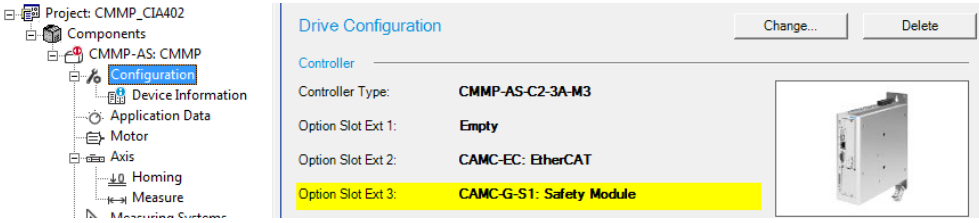
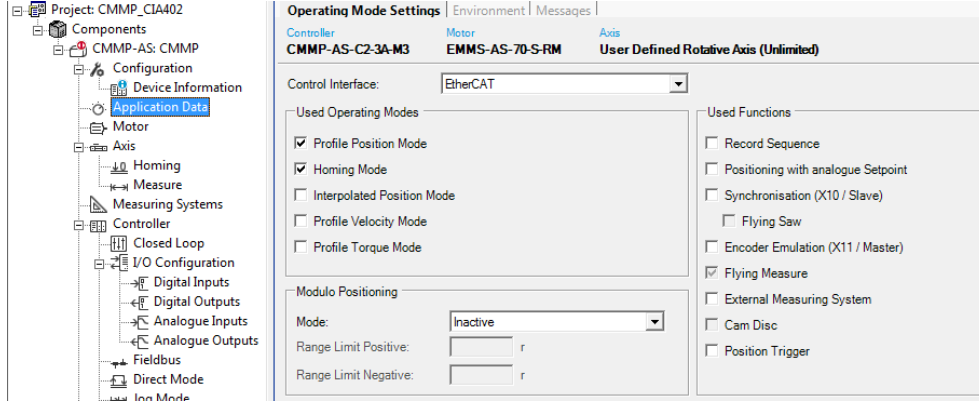
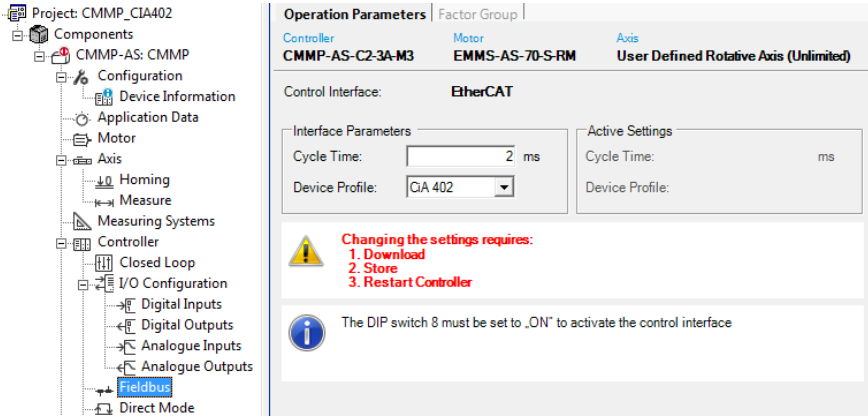
The output ErrorID of the two function blocks from Festo gives you some more information about the occurred error.

ErrorID	Description	InternInfo
20	Timeout of the function block "Festo_MC_ReadAxisError" - Check the communication between PLC and motor controller	Internal state in which the error occurred
30	Error with the internally used function block "EC_CoESDORed" from Omron.	The number of "InternInfo" is the "AbortCode" of the internally used function block "EC_CoESDORed". Please check the manual from Omron for more information.
40	Unknown EtherCAT slave connected (unknown product code)	-
200	Timeout of the function block "Festo_MC_Power_Home" - Check the communication between PLC and motor controller - Check the connection of the function block (in- and outputs)	010 = ModesOfOperation could not be written
		020 = ModesOfOperation could not be written or Drive is not ready to switch on
		040 = Timeout during enabling or timeout during commutation-angle detection
		110 = Drive could not be set to homing mode
		131 = Homing run error
		160 = ModesOfOperation could not be written
300	Error with the internally used function block "MC_ChangePDSSState" from Omron.	The number of "InternInfo" is the ErrorID of the internally used function block "MC_ChangePDSSState". Please check the manual from Omron for more information.
400	Drive error during the drive was enabled. - Read the current drive error with the "Festo_MC_ReadAxisError" function block - Remove the drive error and start drive enabling again	

4 Instruction guide for drive configuration

4.1 Configure an EtherCAT drive with Festo Configuration Tool (FCT) – CMMP-AS and EMCA-EC

After the successful electrical installation of the drive, CMMP-AS and EMCA-EC must be configured with FCT. The following steps only comprise the specific configurations for the Omron MC-Axis.

No	Action
1	Check the optional card slots. The EtherCAT-card has to be installed in the second slot. 
2	Check the Application Data. 
3	Select CiA402 as the protocol under the fieldbus configuration tab. The drive cycle time must be the same as in the Omron PLC. 

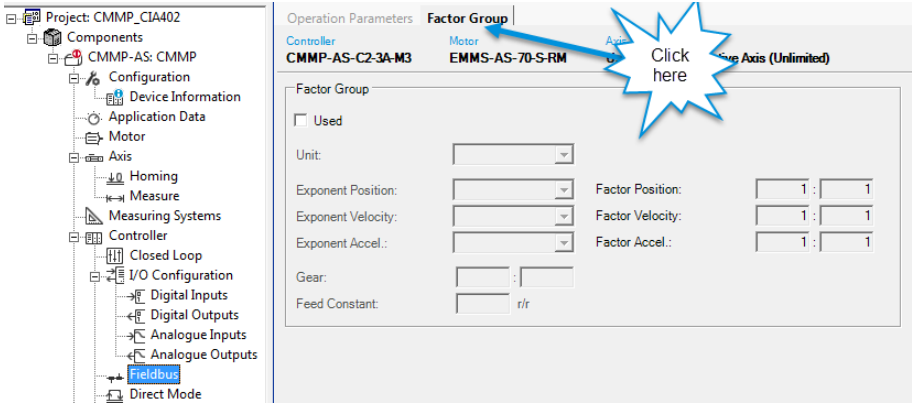
4a

Scaling for CMMP-AS:

The factor group for CMMP-AS is not used in default. In this case the controller transfers “increments” via the fieldbus. If you want to use the factor group, you also must change the scaling of the MC-Axis in the Omron PLC. The scaling needs to be equal to the Omron MC-Axis. In the picture below the scaling is switched off.



The corresponding “Unit Conversion Settings” of the Omron MC-Axis to this setting of CMMP-AS are shown on page 19.



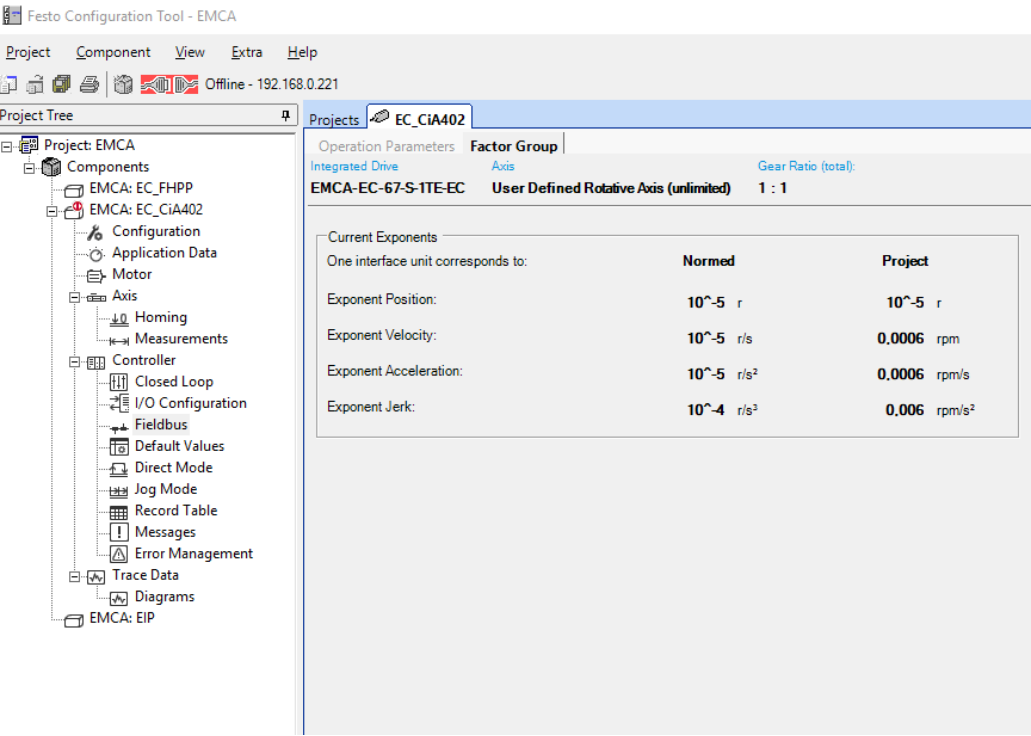
4b

Scaling for EMCA-EC

The “Exponent Position” of EMCA-EC is set fix to 10⁻⁵. This means the EMCA transfers the position value multiplied with factor 10⁻⁵ via the fieldbus.

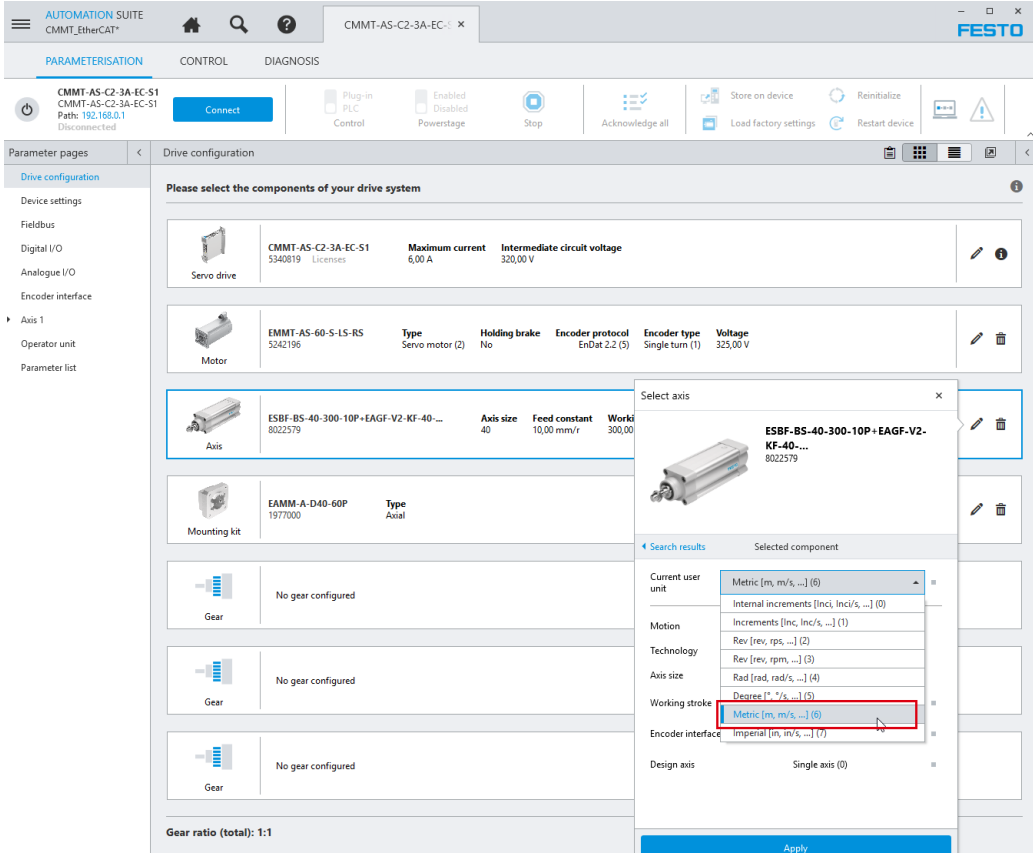
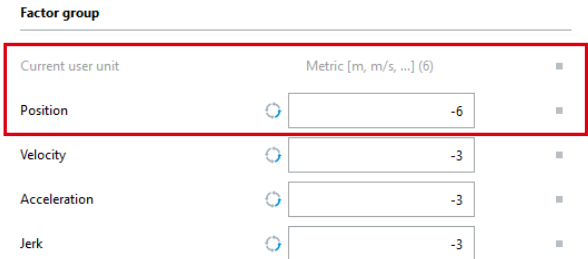


The corresponding “Unit Conversion Settings” of the Omron MC-Axis to this setting of EMCA-EC are shown on page 19.



4.2 Configure an EtherCAT drive with Festo Automation Suite (FAS) – CMMT-AS and CMMT-ST

After the successful electrical installation of the drive, CMMT-AS and CMMT-ST must be configured with FAS. The following steps only comprise the specific configurations for the Omron MC-Axis.

No	Action
1	Configure a new project with the “Start first setup assistant” and set user unit for example to “Metric” for a linear axis. If you use a rotative axis you can use “Revision” or “Degree”. 
2	The standard value of position factor group for CMMT-AS and CMMT-ST is -6. We recommend to don't change this for the first commissioning. i The corresponding “Unit Conversion Settings” of the Omron MC-Axis to this setting of CMMT-AS and CMMT-ST are shown on page 19. 

3

We recommend starting after a successful configuration a manual movement via the FAS. Check with a tape measure if the axis moves about this distance.

PARAMETERISATIONCONTROLDIAGNOSIS

Test-FW-AS_CHMM

CMMT-AS-C2-3A-EC-S1

Path: 192.168.0.212

Disconnected

Connect

Plug-in

PLC

Control

Enabled

Disabled

Powerstage

Stop

Acknowledge all

Store on device

Reinitialize

Restart device

Control pages

<

Manual movement

Manual movement

Record list

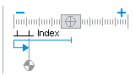
Page is disabled due to the following reasons:

The plug-in is offline.

Homing

Homing invalid

Negative stop with zero pulse (-1)



Start homing

Save zero point offset

Manual movement

Position actual value (encoder 1)0,00 mm

Jog:

—

+

Single step:

—

0,00 mm

+

Target position:

0,00 mm

0,40 m/s

Execute

Stop movement

Active closed loop parameter set

Closed loop parameter set 1

Transition time

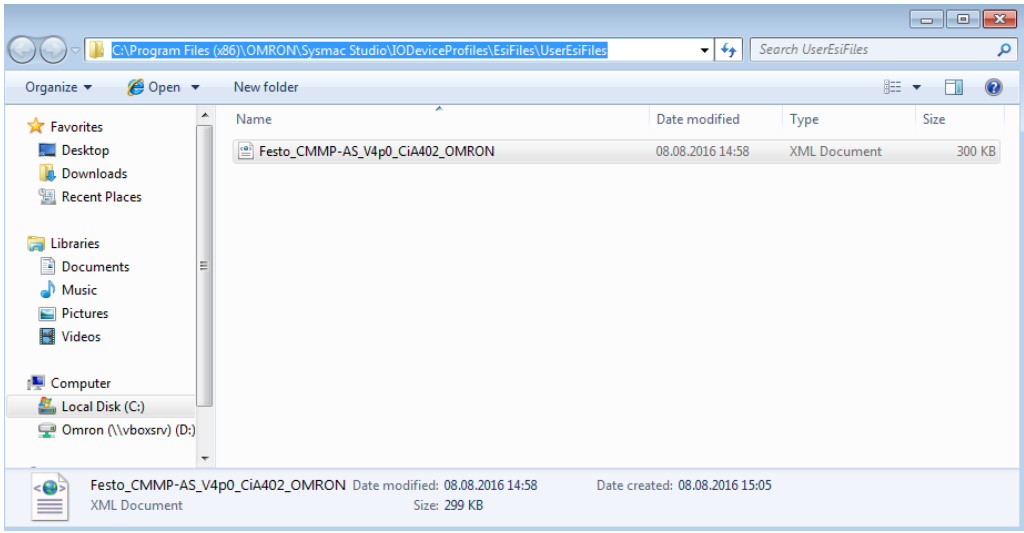
2

Activate closed loop parameter set

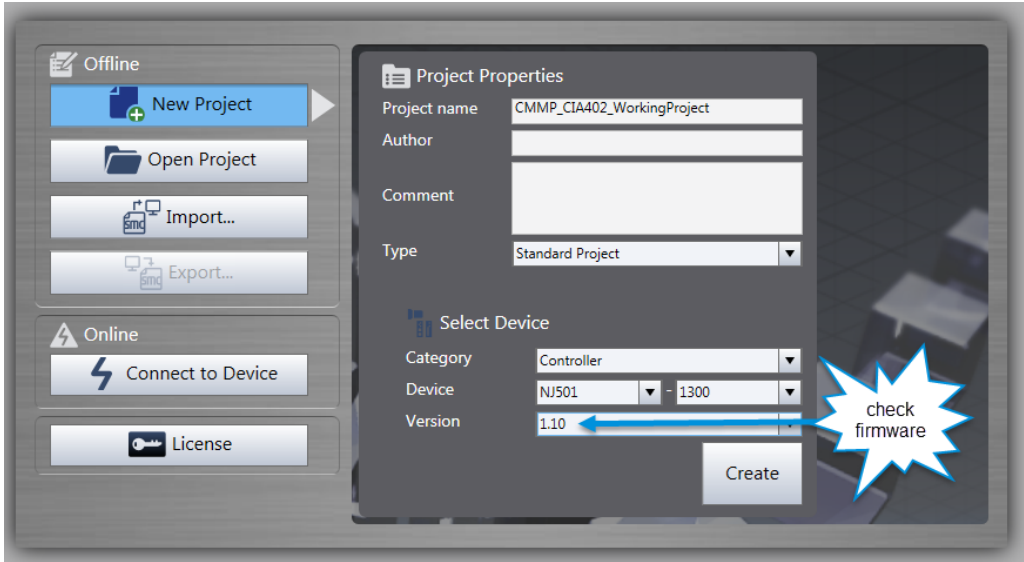
14

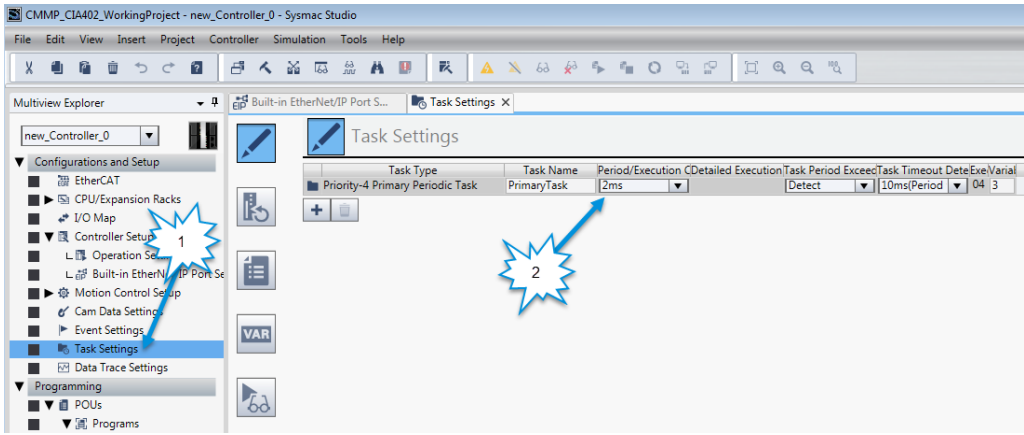
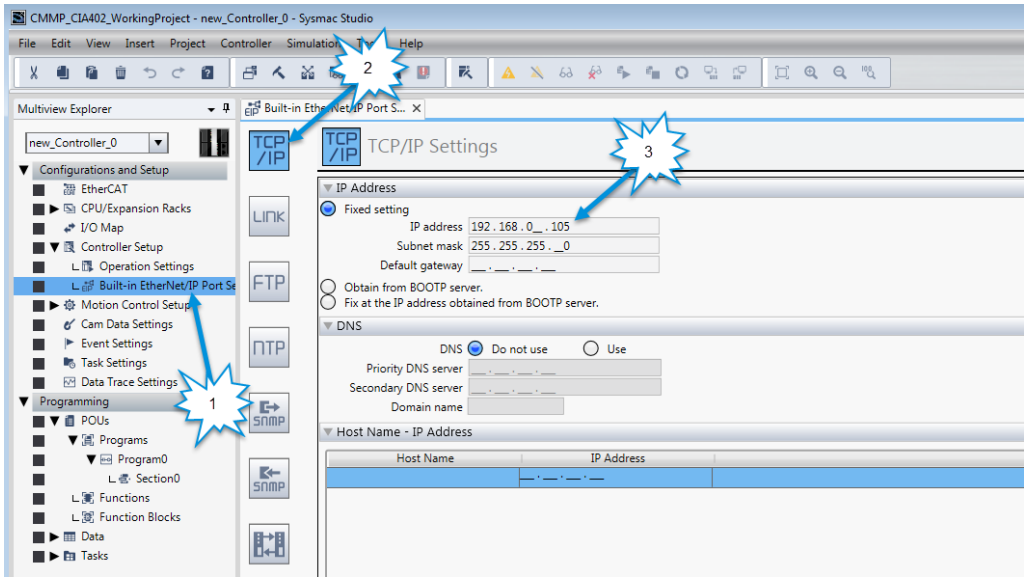
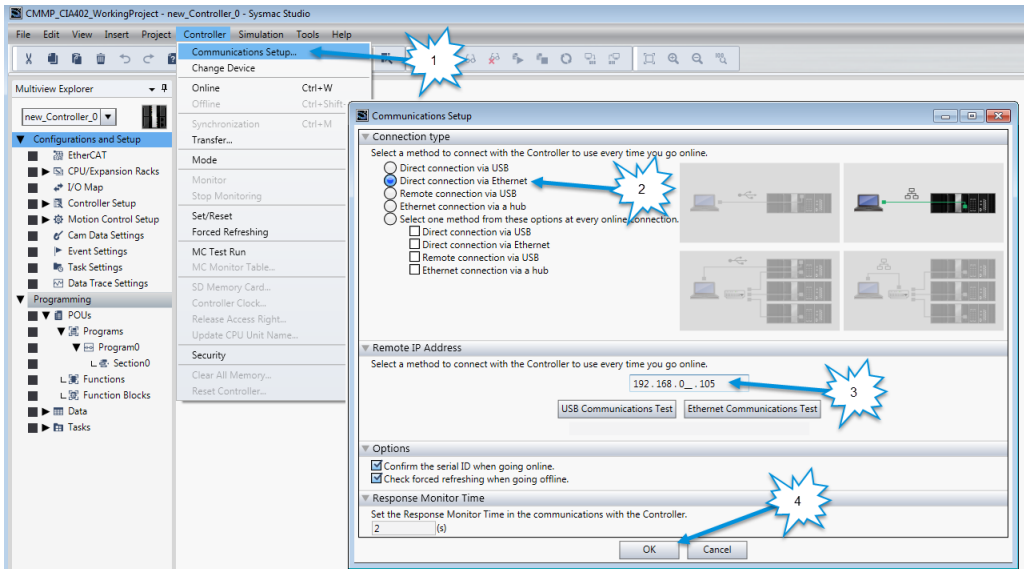
4.3 Configure an EtherCAT drive in Omron Sysmac Studio

4.3.1 Import a new EtherCAT-Drive-XML into Omron Sysmac Studio

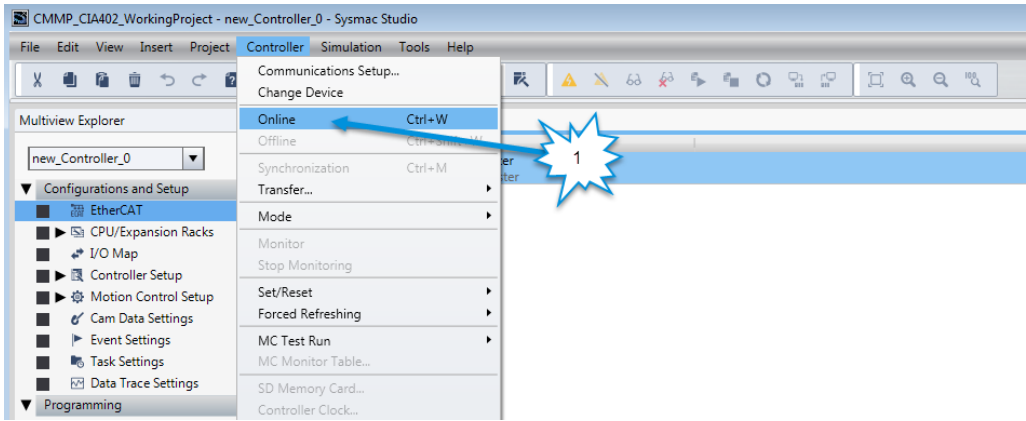
No	Action
1	If the Omron Sysmac Studio is started, close it.
2	Copy the latest xml-file of the drive to the folder: C:\Program Files (x86)\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles 
3	Restart the Omron Sysmac Studio

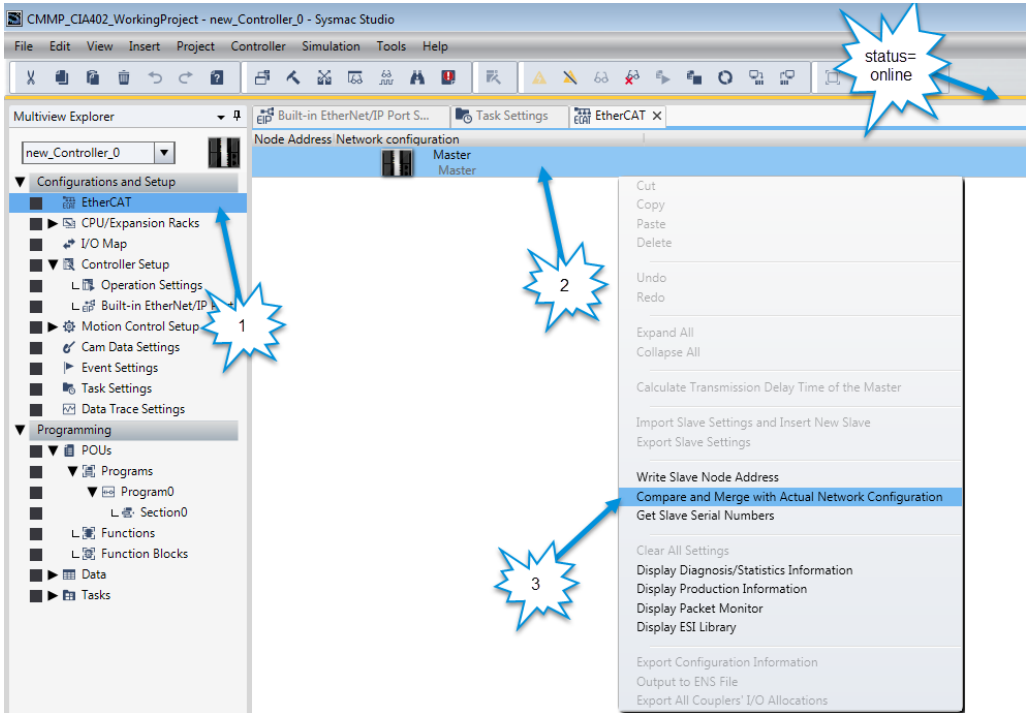
4.3.2 Append a Festo EtherCAT Axis to the EtherCAT Master

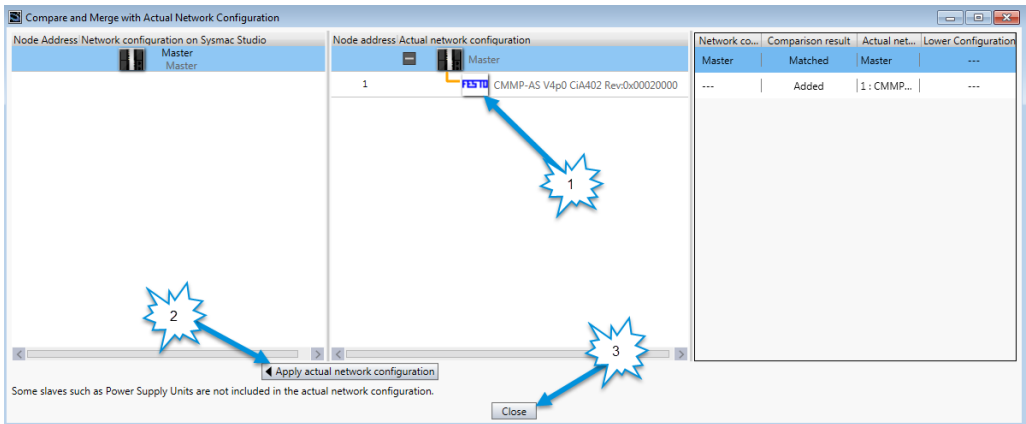
No	Action
1	Create a new project. Make sure that the firmware version of the Omron PLC is 1.10 or higher . If you use an older firmware, the Festo_MotionControl library isn't usable. 

- 2 Check the Task Settings. There make sure that the cycle time of the PLC and the Festo motor controller are identical.
 
- 3 Set the IP address of the PLC.
 
- 4 Set the communication setup between programming PC and Omron PLC. You also can check the valid Ethernet communication (see bubble 3).
 

- 5 Connect to PLC (go online).

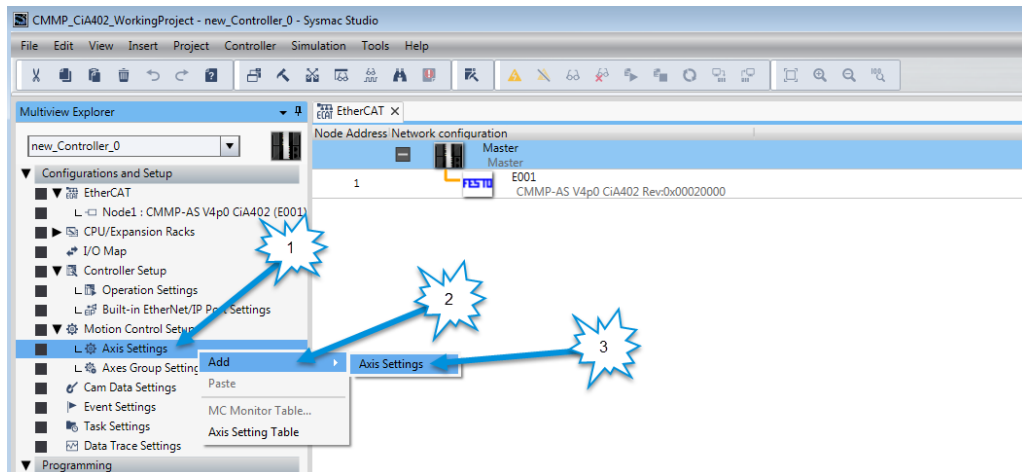

- 6 You'll see at the yellow line that you are online now. Compare and merge with the actual EtherCAT network configuration. Please check that the upper Port is connected at the CMM-AS.


- 7 See at the actual network configuration and apply these.

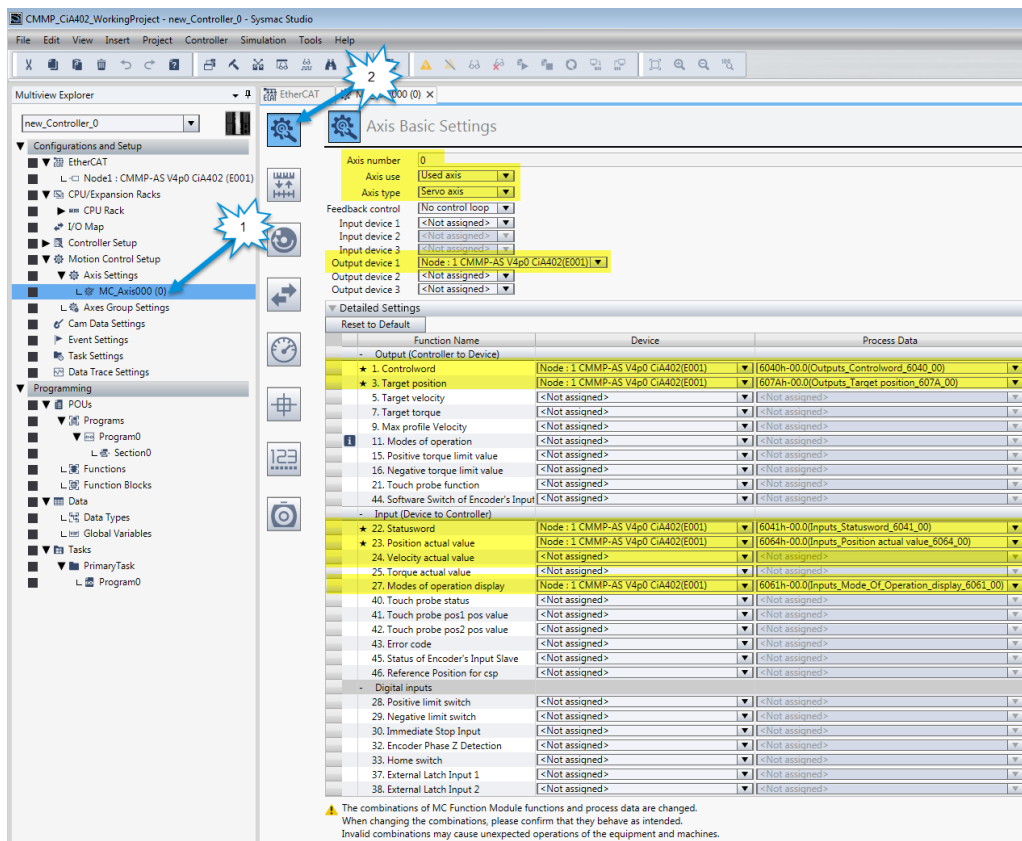


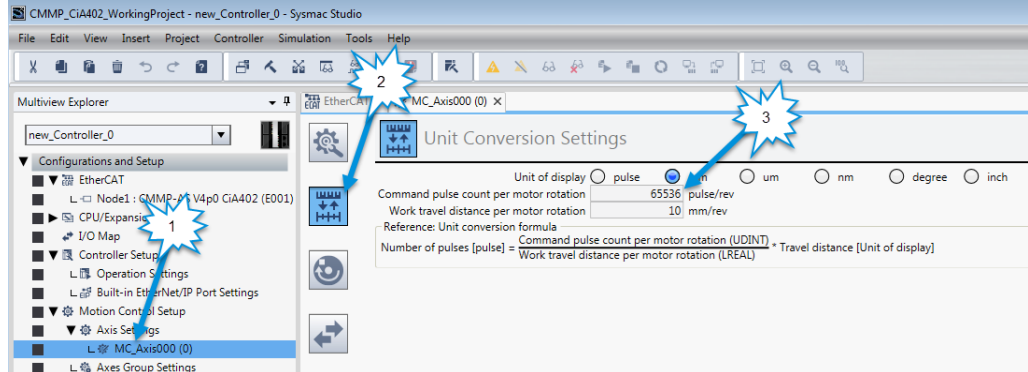
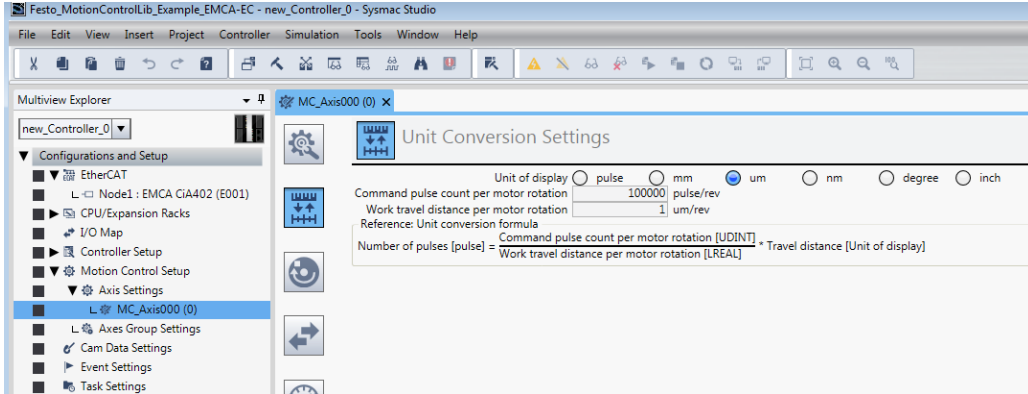
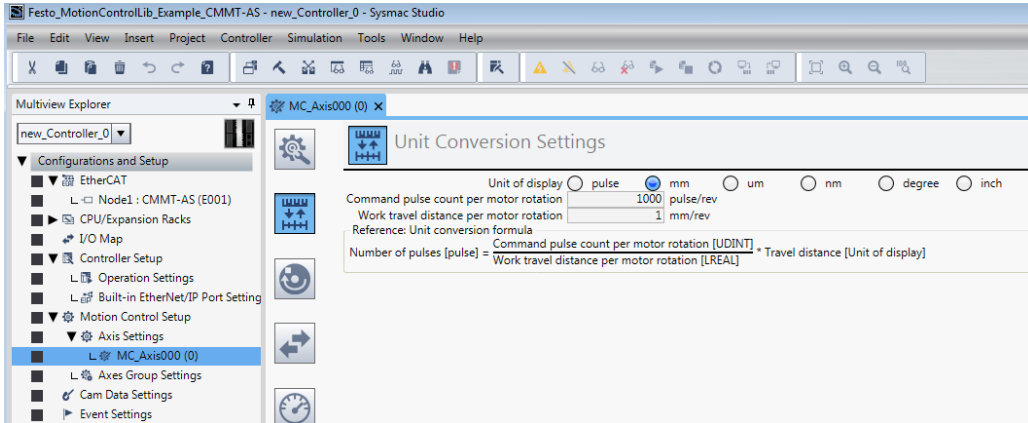
8 Disconnect PLC (go offline).

9 Add a new motion axis.

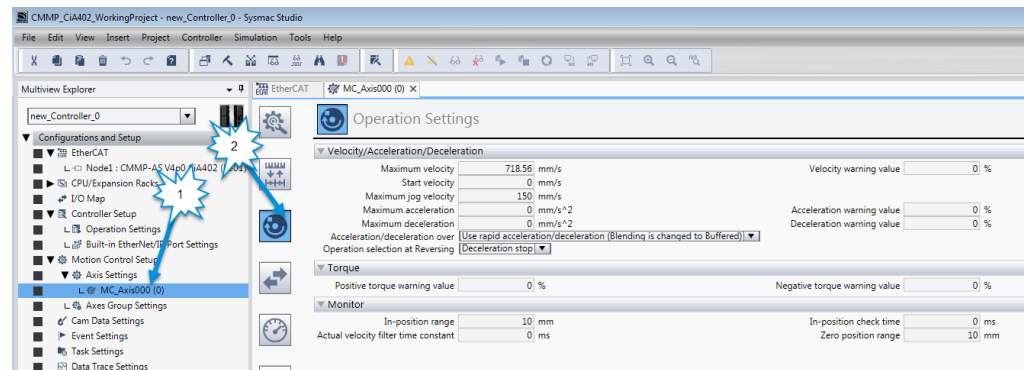


10 Set the basic axis settings as highlighted in the followed figure.

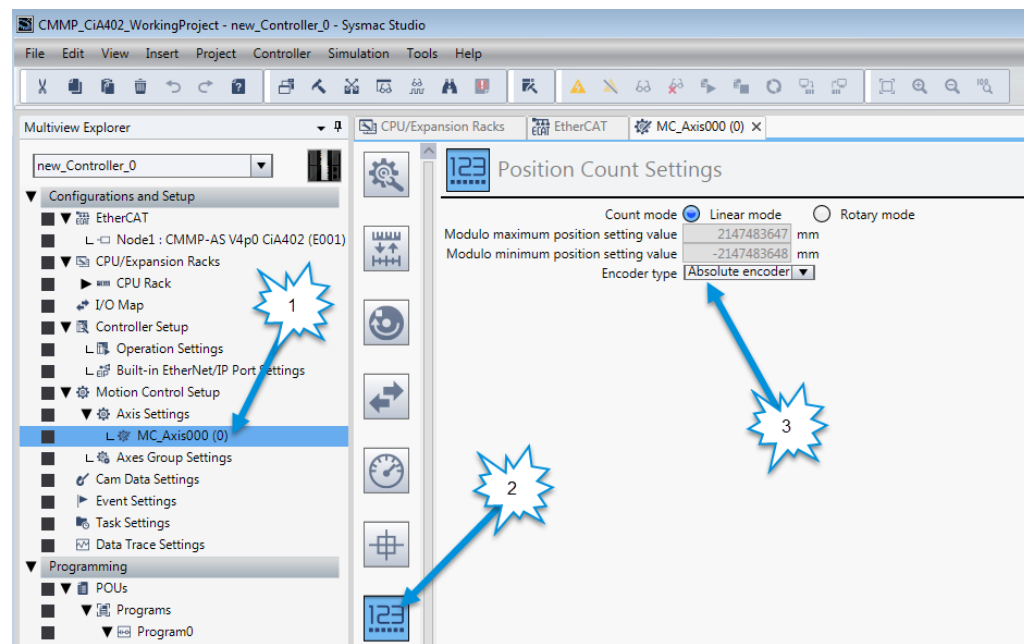


11a	Unit Conversion Settings for CMMP-AS: Set the unit of display and the number of pulses. These settings must be the same as in the FCT. In case of the CMMP-AS motor controller, the factory setting for the “Command pulse count per motor rotation” value is 65 536. The value “Work travel distance per motor rotation” can be used to set at the function block a value with higher resolution. In this example the value is 10, this means the set position of the function block has a resolution for 0.1 mm (value 100 at FB means 10.0 mm). If you set the “Work travel distance per motor rotation” to the value 1 the resolution is 1 mm (value 100 at FB means 100 mm). 
11b	Unit Conversion Settings for EMCA-EC: Set the unit of display and the number of pulses. These settings must be the same as in the FCT. In case of the EMCA-EC motor unit, the factory setting for the “Command pulse count per motor rotation” value is 100 000. 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 revision (value 100 at FB means 100 revisions). If you set the “Work travel distance per motor rotation” to the value 10 the resolution is 0.1 revision (value 100 at FB means 10.0 revisions). 
11c	Unit Conversion Settings for CMMT-AS and CMMT-ST: Set the unit of display and the number of pulses. These settings must be the same as in the FAS. In case of the CMMT-AS and CMMT-ST servo drives, the factory setting for the “Command pulse count per motor rotation” value is 1 000 (if you use user unit “Metric”). For the user unit “Revision” or “Degree” set the “Command pulse count per motor rotation” to value 1 000 000. 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). 

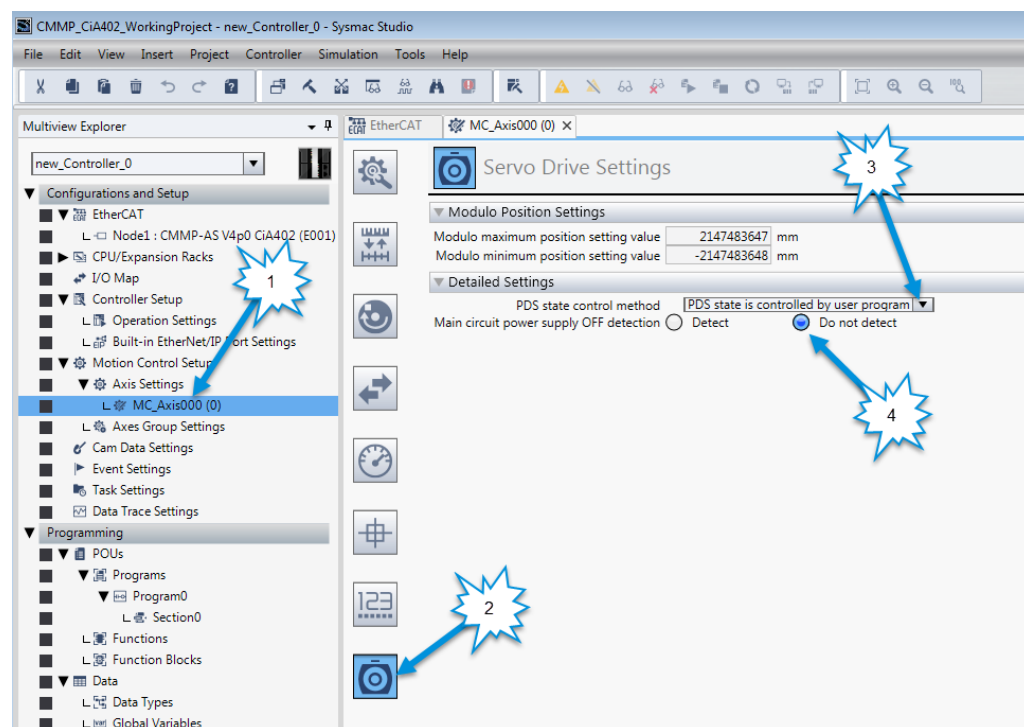
12 Set the operation settings of the axis as configured in the FCT.



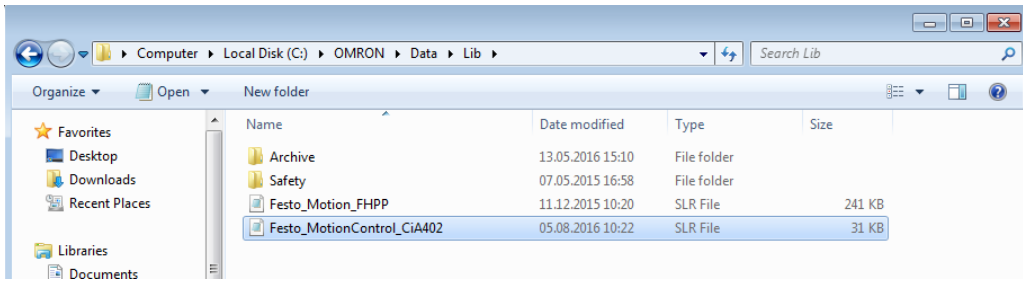
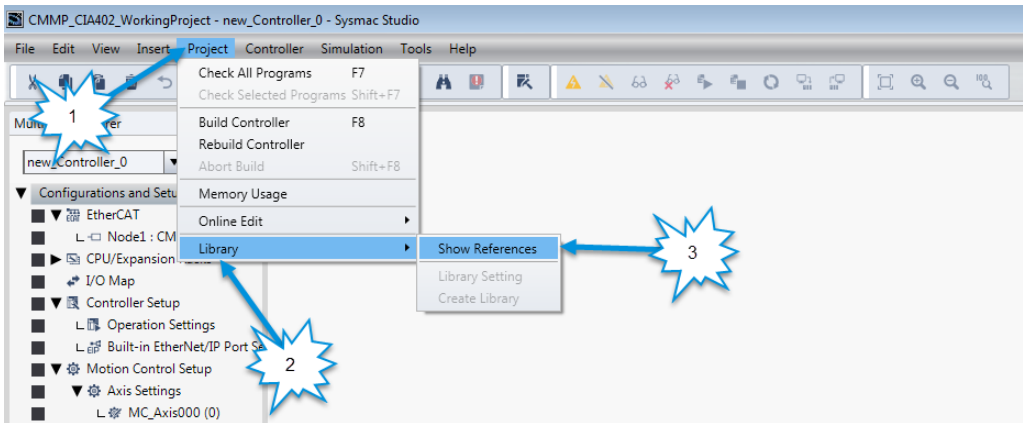
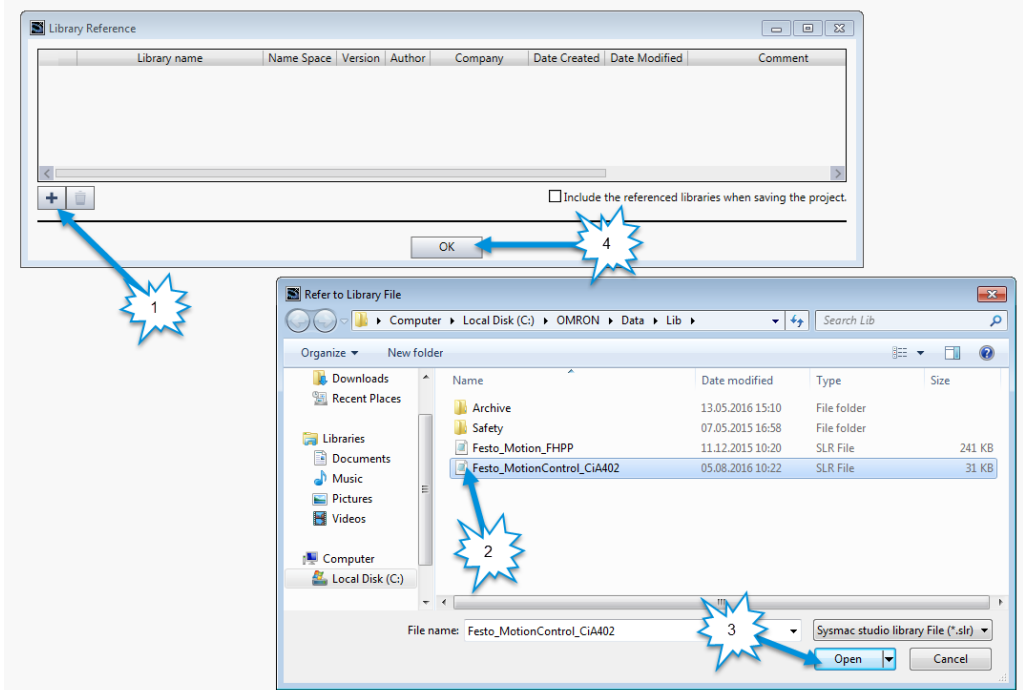
13 Set encoder type of the axis to Absolute encoder.



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

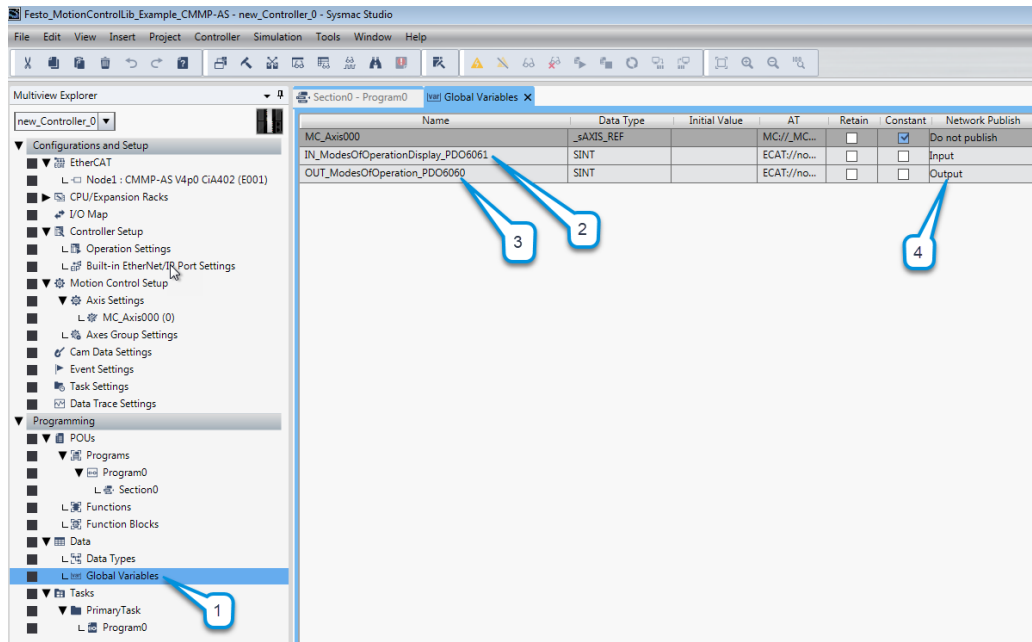


4.3.3 Import the Festo_MotionControl_CiA402 library into the project

- 1 In Omron Sysmac Studio the library is stored in current folder:
C:\OMRON\Data\Lib
 Store the Festo_MotionControl_CiA402 library in this folder.
 
- 2 Open the library references.
 
- 3 Create a new reference (import library).
 

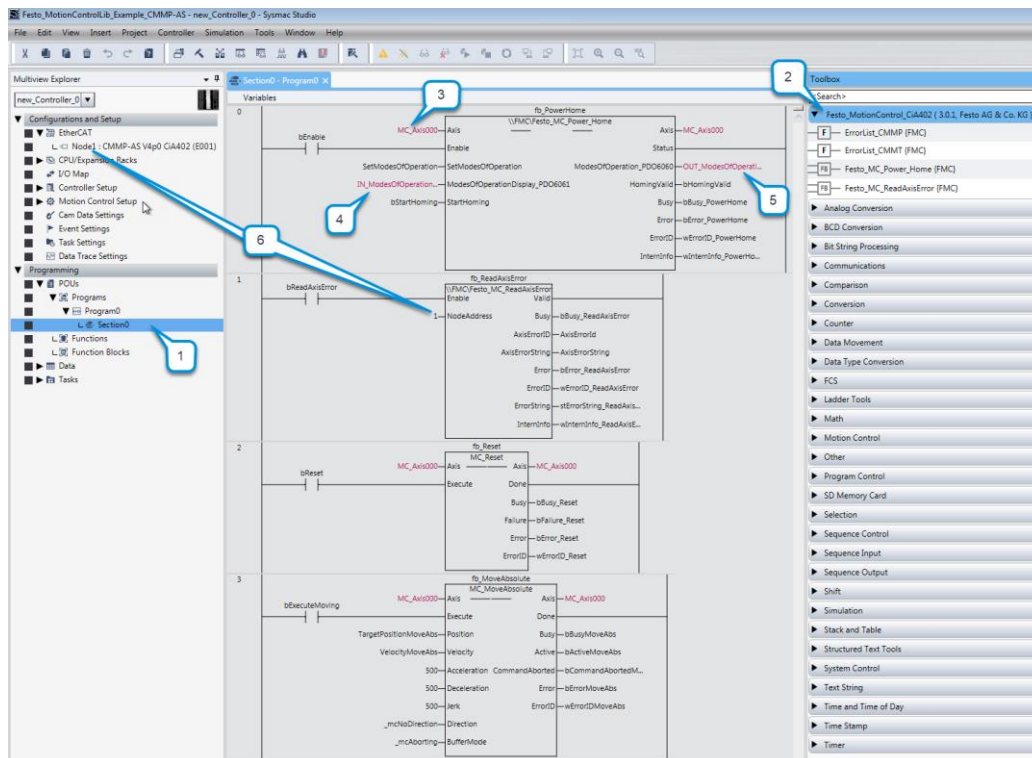
4.3.4 Link the PLC program to the motion axis

- 1 Open global variables in the programming section (bubble 1). Create two variables per drive for connecting the PDOs (bubble 2 and 3). Check the network publish option of the variables (see bubble 4).



- 2 Open the code section in your PLC program (bubble 1). There you can see the referenced library in the toolbox on the right side (see bubble 2). Link the input Axis of the Festo_MC_Power_Home function block with the global variable of the motion axis. This will be generating automatically when a motion axis is added and has the same name (see bubble 3). In the next step, map the two global variables which you have created for connecting the PDOs (see bubble 4 and 5).

To read the actual error numbers of the drive, you must link the node address to the function block Festo_MC_ReadAxisError (see bubble 6).



3 Map the global variables for modes of operation and modes of operation display with the motion axis.

Position	Port	Description	R/W	Data Type	Variable	Variable Comme	Variable Type
Node1	CMMP-AS V4p0 CIA402	Outputs_Controlword_6040_00	W	UINT			
		Outputs_Mode_Of_Operation_6060_00	W	USINT	OUT_ModesOfOperation_PDO6060		Global Variables
		Outputs_Target position_607A_00	W	DINT			
		Outputs_Homing method_6098_00	W	SINT			
		Inputs_Statusword_6041_00	R	UINT			
		Inputs_Mode_Of_Operation_display_6061_00	R	USINT	IN_ModesOfOperationDisplay_PDO6061		Global Variables
		Inputs_Position actual value_6064_00	R	DINT			
		Inputs_Error register_1001_00	R	USINT			
		Inputs_Velocity actual value_606C_00	R	DINT			
		Inputs_Following error actual valu_60F4_00	R	DINT			
CPU Rack	CPU Rack 0						

4 Connect to PLC (go online).

1 Online (Ctrl+W)

2 bReset

3 bExecuteMoving

5

Transfer configuration and program to the PLC.

The screenshot displays the Sysmac Studio interface for a Festo_MotionControlLib_Example_CMMF-AS - new_Controller_0 project. The 'Controller' tab is active, and the 'Transfer...' option is highlighted in the 'Controller' menu. A callout box points to the 'status = online' indicator in the top right corner. The main workspace shows a ladder logic diagram with three rungs. Rung 1 is labeled 'bPowerHome' and 'MC_Axis000'. Rung 2 is labeled 'bReset' and 'MC_Axis000'. Rung 3 is labeled 'bExecuteMoving' and 'MC_Axis000'. The diagram includes various function blocks and data points related to motion control, such as 'bStartHoming', 'StartHoming', 'bHomingValid', 'bBusy_PowerHome', 'bError_PowerHome', 'wErrorID_PowerHome', 'wInternInfo_PowerHo...', 'bReadAxisError', 'Valid', 'NodeAddress', 'Busy', 'bBusy_ReadAxisError', 'AxisErrorID', 'AxisErrorID', 'AxisErrorString', 'AxisErrorString', 'Error', 'bError_ReadAxisError', 'ErrorID', 'wErrorID_ReadAxisError', 'ErrorString', 'stErrorString_ReadAxis...', 'InternInfo', 'wInternInfo_ReadAxisE...', 'bReset', 'MC_Reset', 'Axis', 'MC_Axis000', 'Execute', 'Done', 'Busy', 'bBusy_Reset', 'Failure', 'bFailure_Reset', 'Error', 'bError_Reset', 'ErrorID', 'wErrorID_Reset', 'bExecuteMoving', 'MC_MoveAbsolute', 'Axis', 'MC_Axis000', 'Execute', 'Done', 'Busy', 'bBusyMoveAbs', 'TargetPositionMoveAbs', 'Position', 'Active', 'bActiveMoveAbs', 'VelocityMoveAbs', 'Velocity', 'CommandAborted', 'bCommandAbortedM...', '500', 'Acceleration', 'Deceleration', 'Error', 'bErrorMoveAbs', '500', 'Jerk', 'ErrorID', 'wErrorIDMoveAbs', 'Direction', 'BufferMode', and 'BufferMode'.