



## **Commissioning of the Festo CMMT Drives with Allen-Bradley ControlLogix/CompactLogix via EtherNet/IP Using Festo Telegram 908 and CIP Sync™.**

This Application Note provides a step-by-step guide for commissioning CMMT servo drives with an Allen-Bradley ControlLogix / CompactLogix PLCs using CIP Sync™ protocol-level time-synchronization within the EtherNet/IP network.

CMMT-AS-...-MP  
CMMT-ST-...-MP

Title .... Commissioning of the Festo CMMT Drives with Allen-Bradley ControlLogix/CompactLogix via EtherNet/IP  
Using Festo Telegram 908 and CIP Sync™.

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# Table of Contents

|          |                                                                    |           |
|----------|--------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Introduction .....</b>                                          | <b>7</b>  |
| 1.1      | Software Required.....                                             | 7         |
| 1.2      | Hardware Required .....                                            | 7         |
| 1.3      | Hardware Overview of CMMT-AS Drive.....                            | 7         |
| 1.4      | Overview of Connection Technology .....                            | 8         |
| 1.4.1    | [18] Standard Ethernet.....                                        | 9         |
| 1.4.2    | [X19] Real-time Ethernet (RTE) port 1 and port 2 .....             | 9         |
| 1.5      | Topology Overview.....                                             | 10        |
| <b>2</b> | <b>CIP Synchronization Library .....</b>                           | <b>11</b> |
| 2.1      | Substitution of Rockwell Motion Instructions with Festo AOIs ..... | 11        |
| 2.2      | Festo_CIP_AxisEnable .....                                         | 12        |
| 2.2.1    | Festo_CIP_AxisEnable Block In-Out Variables.....                   | 12        |
| 2.2.2    | Festo_CIP_AxisEnable Block Input Variables .....                   | 12        |
| 2.2.3    | Festo_CIP_AxisEnable Block Output Variables.....                   | 13        |
| 2.3      | Festo_CIP_Init .....                                               | 14        |
| 2.3.1    | Festo_CIP_Init Block In-Out Variables.....                         | 14        |
| 2.3.2    | Festo_CIP_Init Block Input Variables .....                         | 14        |
| 2.3.3    | Festo_CIP_Init Block Output Variables.....                         | 15        |
| 2.3.4    | Initializing Festo_CIP_Init Upon Parameter Modification .....      | 15        |
| 2.4      | Festo_CIP_Home .....                                               | 16        |
| 2.4.1    | Festo_CIP_Home Block In-Out Variables.....                         | 16        |
| 2.4.2    | Festo_CIP_Home Block Input Variables .....                         | 16        |
| 2.4.3    | Festo_CIP_Home Block Output Variables .....                        | 17        |
| 2.5      | Festo_CIP_Reset.....                                               | 18        |
| 2.5.1    | Festo_CIP_Reset Block In-Out Variables .....                       | 18        |
| 2.5.2    | Festo_CIP_Reset Block Input Variables.....                         | 18        |
| 2.5.3    | Festo_CIP_Reset Block Output Variables.....                        | 19        |
| 2.6      | Festo_CIP_Read.....                                                | 20        |
| 2.6.1    | Festo_CIP_Read Block In-Out Variables .....                        | 20        |
| 2.6.2    | Festo_CIP_Read Block Output Variables.....                         | 20        |
| 2.7      | Festo_CIP_Write .....                                              | 21        |
| 2.7.1    | Festo_CIP_Write Block In-Out Variables.....                        | 21        |
| 2.7.2    | Festo_CIP_Write Block Output Variables .....                       | 21        |
| 2.8      | User Defined Data Type .....                                       | 22        |
| 2.8.1.1  | AxisRef Structure .....                                            | 22        |
| 2.8.2    | Festo_ DriveState.....                                             | 24        |
| 2.9      | Festo Telegram 908 .....                                           | 25        |
| 2.9.1    | STW1.....                                                          | 26        |
| 2.9.2    | XSOLL_A .....                                                      | 27        |

|          |                                                                        |           |
|----------|------------------------------------------------------------------------|-----------|
| 2.9.3    | STW2.....                                                              | 27        |
| 2.9.4    | Timestamp Setpoint.....                                                | 27        |
| 2.9.5    | ZSW1.....                                                              | 28        |
| 2.9.6    | XIST_A.....                                                            | 29        |
| 2.9.7    | ZSW2.....                                                              | 29        |
| 2.9.8    | NIST_A .....                                                           | 29        |
| 2.9.9    | Fault and Warn Code .....                                              | 29        |
| <b>3</b> | <b>Festo Automation Suite Configuration Overview .....</b>             | <b>30</b> |
| 3.1      | Setting the IP Address of the CMMT Drive .....                         | 30        |
| 3.2      | Overview of CMMT Offline Configuration.....                            | 31        |
| 3.3      | Overview of CMMT Online Configuration .....                            | 35        |
| <b>4</b> | <b>RSLink Classic Configuration Overview .....</b>                     | <b>40</b> |
| 4.1      | Allen Bradley PLC IP Address Configuration .....                       | 40        |
| 4.1.1    | IP Configuration of Allen-Bradley PLC through RSLink .....             | 40        |
| <b>5</b> | <b>Studio 500 Configuration Overview .....</b>                         | <b>41</b> |
| 5.1      | Creating a new project in Studio 5000.....                             | 41        |
| 5.2      | Install the EDS File of CMMT-EP to Studio 5000 .....                   | 43        |
| 5.3      | Adding CMMT-AS Drive into the network.....                             | 46        |
| 5.4      | Controller Configuration for Motion Control with CIP Synchronize ..... | 49        |
| 5.4.1    | Enable Time Synchronization for CompactLogix PLC.....                  | 49        |
| 5.4.2    | Enable Time Synchronization for a ControlLogix PLC .....               | 50        |
| 5.4.3    | Add and Configure Motion Group.....                                    | 53        |
| 5.4.4    | Add and Configure Motion Group Axis .....                              | 55        |
| 5.5      | Importing and configuring the CIP_Sync AOIs .....                      | 59        |
| 5.6      | Motion_Task Configuration .....                                        | 61        |
| 5.6.1    | Adding a Motion Task .....                                             | 61        |
| 5.6.2    | Add a Motion Group Task Program .....                                  | 63        |
| 5.6.3    | Add a Motion Group Task Program Routine .....                          | 64        |
| 5.6.4    | Add and Configure the AOI Festo_CIP_Read .....                         | 65        |
| 5.6.5    | Add and Configure the AOI Festo_CIP_Write .....                        | 69        |
| 5.7      | Main Task Configuration.....                                           | 75        |
| 5.7.1    | Configuration of MainTask Properties.....                              | 75        |
| 5.7.2    | Add and Configure the AOI Festo_CIP_Init .....                         | 76        |
| 5.7.3    | Add and Configure the AOI Festo_CIP_Reset .....                        | 88        |
| 5.7.4    | Add and Configure the AOI Festo_CIP_AxisEnable .....                   | 91        |
| 5.7.5    | Add and Configure the AOI Festo_CIP_Home .....                         | 94        |
| 5.7.6    | Add and Configure Rockwell Instruction MAM .....                       | 96        |
| 5.7.7    | Instruction MAM Operands and Configuration .....                       | 99        |
| 5.7.8    | Move Type Details.....                                                 | 100       |
| 5.7.9    | Position Values Based on Move Type .....                               | 101       |
| 5.7.10   | Message (MSG) Communication Path .....                                 | 101       |

|          |                                                                |            |
|----------|----------------------------------------------------------------|------------|
| 5.8      | Procedure for Importing a Routine Program in Studio 5000 ..... | 104        |
| 5.8.1    | Adding a Motion Task .....                                     | 104        |
| 5.8.2    | Importing the Festo_ReadWriteProgram_L5X Routines .....        | 106        |
| 5.8.3    | Configuration of MainTask Properties.....                      | 108        |
| 5.8.4    | Importing the Festo_MainProgram_L5X Routines.....              | 109        |
| <b>6</b> | <b>Sample Code: CIP Synchronization AOI Blocks .....</b>       | <b>112</b> |
| 6.1      | Initialization of the AOI Festo_CIP_Init .....                 | 112        |
| 6.2      | Sample Code of AOI Festo_CIP_Reset .....                       | 113        |
| 6.3      | Sample Code of AOI Festo_CIP_AxisEnable .....                  | 113        |
| 6.4      | Sample Code of AOI Festo_CIP_Home .....                        | 114        |
| 6.5      | Sample Code of Rockwell Instruction MAM .....                  | 115        |



# 1 Introduction

This Application Note provides a step-by-step guide for commissioning CMMT-AS servo drives with an Allen-Bradley PLC using **CIP Sync™** protocol-level time-synchronization within the **EtherNet/IP** network. It covers the configuration of the motion controller, network setup, and synchronization procedures to ensure precise and reliable motion control integration. The following AOIs, created by Festo, support the required functionality of the system.

## 1.1 Software Required

| Software Name                       | Software Version     |
|-------------------------------------|----------------------|
| Festo Automation Suite              | V2.11.0.657 or above |
| Festo Automation Suite CMMT Plug-in | V2.11.0.663 or above |
| Studio 5000                         | V28 or above         |

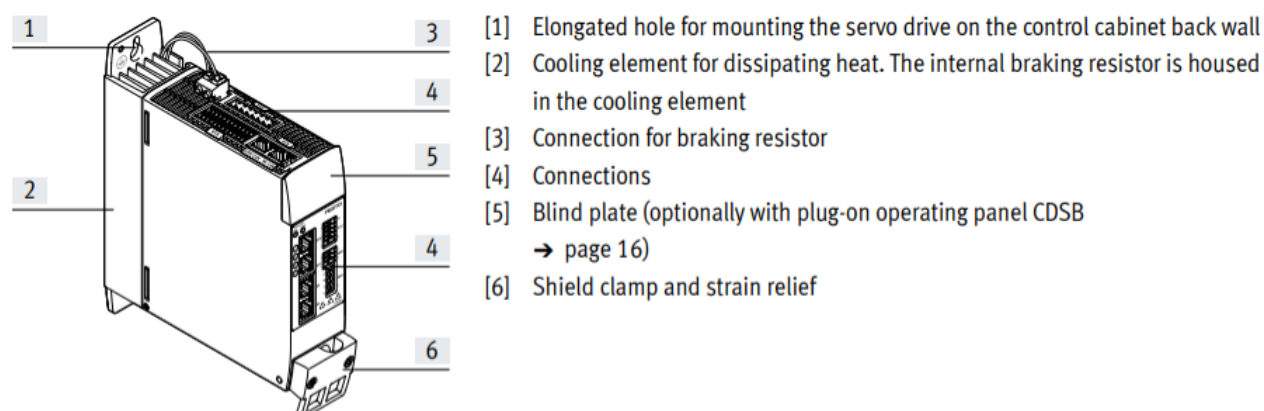
Table 1.1: Software Required

## 1.2 Hardware Required

| Device Name    | Device Type                       | Version / Firmware                                           |
|----------------|-----------------------------------|--------------------------------------------------------------|
| CompactLogix™  | 1769-L27ERM-QBFC1B                | V28.01 or above                                              |
| CMMT Drive     | CMMT-AS-...-MP/<br>CMMT-ST-...-MP | V36.12.0 (Only Linear) / V37.1.4<br>(Linear/Rotary) or above |
| Ethernet Cable | -                                 | Free Version                                                 |

Table 1.2: Hardware Required

## 1.3 Hardware Overview of CMMT-AS Drive



## 1.4 Overview of Connection Technology

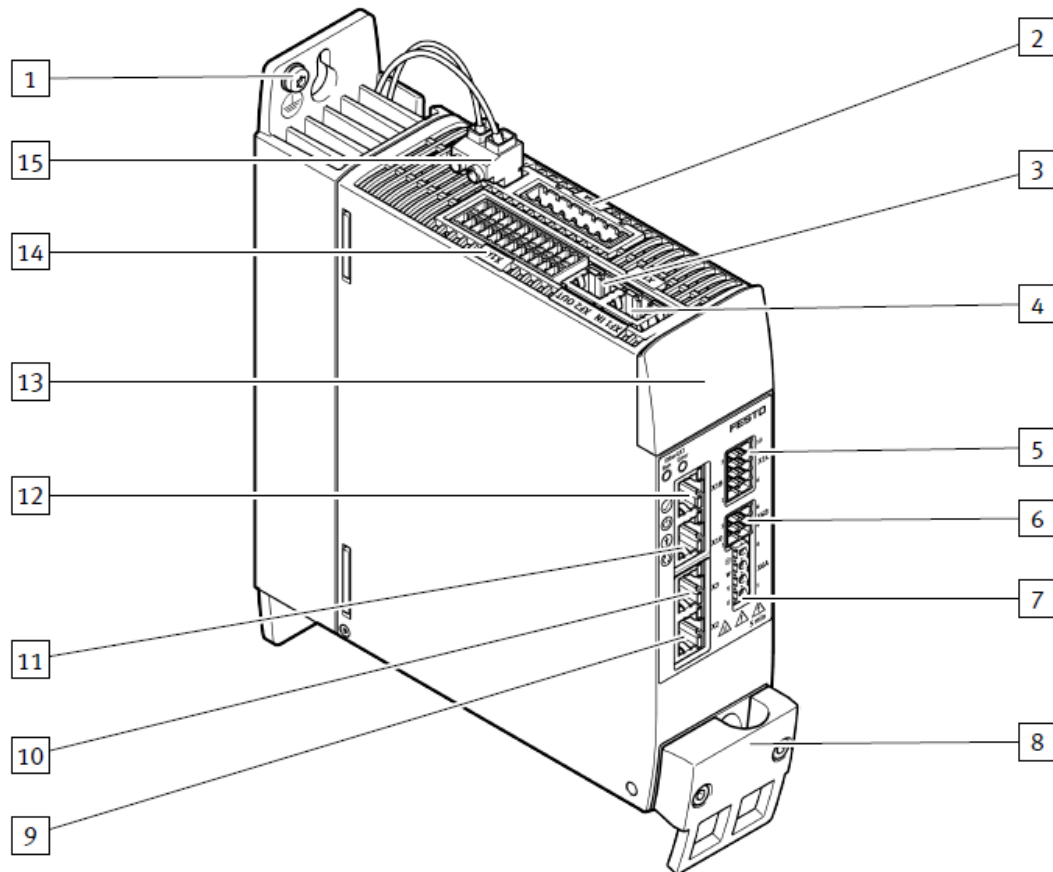


Fig. 2: Connections of the CMMT-AS-...-3A

- |                                                          |                                                               |
|----------------------------------------------------------|---------------------------------------------------------------|
| 1 PE connection, housing                                 | 9 [X2] encoder connection 1                                   |
| 2 [X9A] mains voltage, DC link voltage and logic voltage | 10 [X3] encoder connection 2                                  |
| 3 [XF2 OUT] RTE interface port 2                         | 11 [X10] device synchronisation                               |
| 4 [XF1 IN] RTE interface port 1                          | 12 [X18] standard Ethernet                                    |
| 5 [X1C] inputs/outputs for the axis                      | 13 [X5] connection for operator unit (behind the blind plate) |
| 6 [X6B] motor auxiliary connection                       | 14 [X1A] I/O interface                                        |
| 7 [X6A] motor phase connection                           | 15 [X9B] connection for braking resistor                      |
| 8 Shield clamp of motor cable                            |                                                               |

### 1.4.1 [18] Standard Ethernet

The interface [X18] is located on the front panel of the device. The following can be performed via the interface [X18] using the commissioning software.

- Diagnostics
- Parameterization
- Controller
- Firmware updates

### 1.4.2 [X19] Real-time Ethernet (RTE) port 1 and port 2

The interface [X19] is located on the top of the device. The interface [X19] permits RTE communication. The following protocols are supported by the interface [X19].

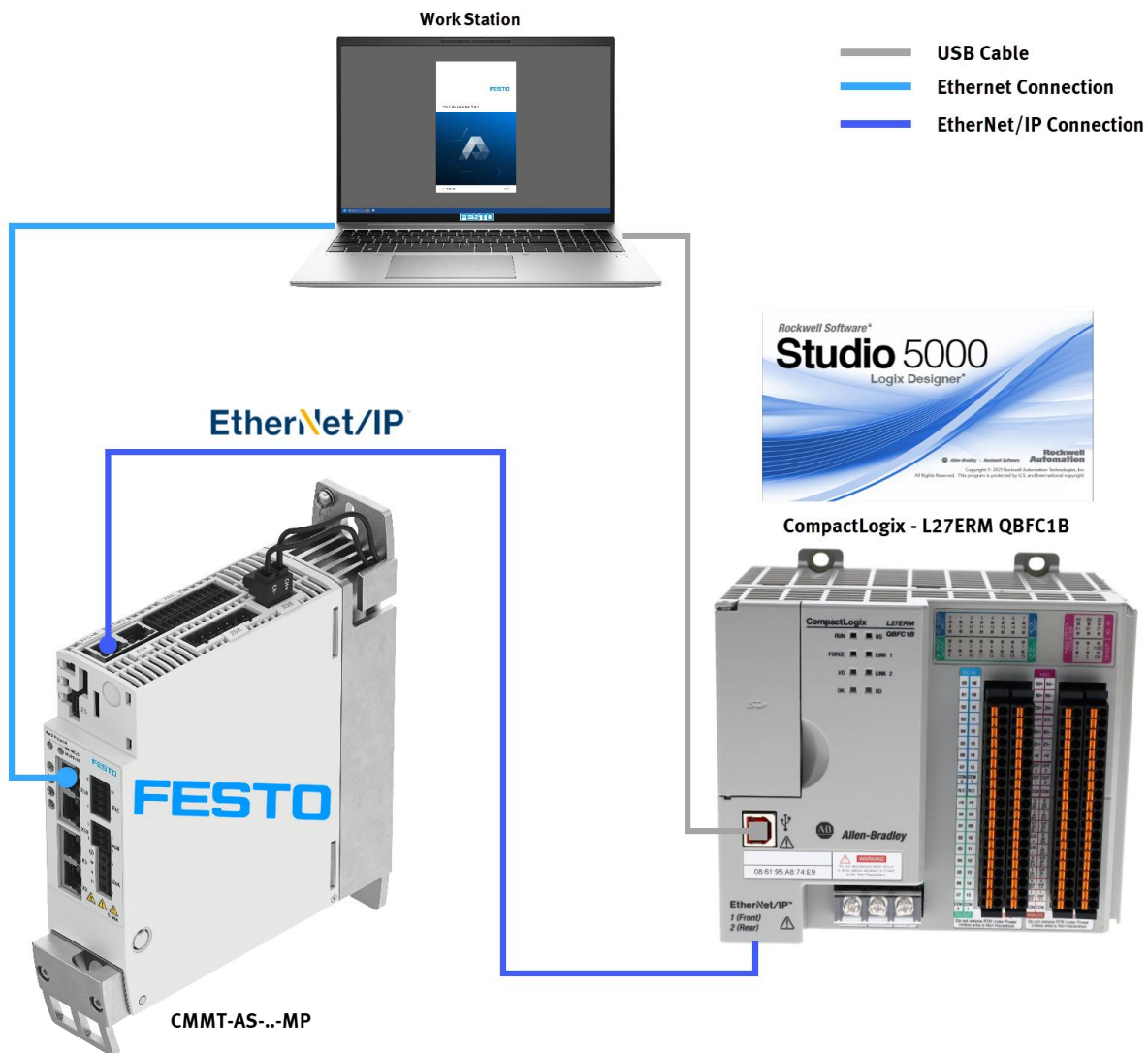
| Product variant | Supported protocol                          |
|-----------------|---------------------------------------------|
| CMMT-AS-...-MP  | EtherCAT, EtherNet/IP, Modbus TCP, PROFINET |

Table 1.3: CMMT-AS protocols

The physical level of the interface fulfils the requirements of IEEE 802.3. The interface is electrically isolated and intended for use with cable lengths of up to 30 m.

The interface [X19] offers 2 ports. – Port 1, labelled on the device with [X19, XF1 IN] – Port 2, labelled on the device with [X19, XF2 OUT] 2 LEDs are integrated into each of the two RJ45 bushings. The behaviour of the LEDs depends on the bus protocol. Both LEDs are not always used.

## 1.5 Topology Overview



### Note

- The above details and topology have been created specifically for this application note. They may vary depending on the user's requirements.

## 2 CIP Synchronization Library

### 2.1 Substitution of Rockwell Motion Instructions with Festo AOIs

To support operation of Festo CMMT drives with **CIP Sync™** protocol-level time synchronization on an **EtherNet/IP** network, Festo has developed dedicated Add-On Instructions (AOIs) that **must be used in place of the standard Rockwell Motion Instructions**.

| Festo Required AOI          | Rockwell Standard Motion Instruction                          |
|-----------------------------|---------------------------------------------------------------|
| <b>Festo_CIP_Init</b>       | No Equal Instruction (The Festo AOI is unique to the library) |
| <b>Festo_CIP_Read</b>       | No Equal Instruction (The Festo AOI is unique to the library) |
| <b>Festo_CIP_Write</b>      | No Equal Instruction (The Festo AOI is unique to the library) |
| <b>Festo_CIP_Reset</b>      | Motion Axis Fault Reset (MAFR)                                |
|                             | Motion Axis Shutdown Reset (MASR)                             |
|                             | Motion Group Shutdown Reset (MGSR)                            |
| <b>Festo_CIP_AxisEnable</b> | Motion Servo On (MSO)                                         |
|                             | Motion Servo Off (MSF)                                        |
|                             | Motion Group Shutdown (MGSD)                                  |
|                             | Motion Redefine Position (MRP)                                |
|                             | Motion Axis Shutdown (MASD)                                   |
| <b>Festo_CIP_Home</b>       | Motion Axis Home (MAH)                                        |

Table 2.1: Festo AOI and Rockwell Standard Motion instructions

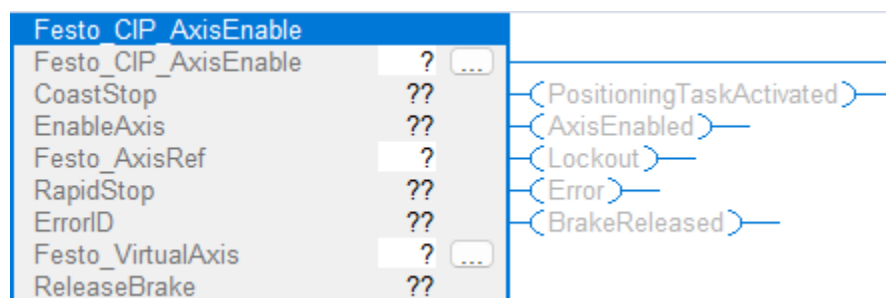


#### Note

- Users must ensure that the **Rockwell Standard Motion Instructions** listed here are **NOT USED** within the project while using the **Festo required AOIs**.

## 2.2 Festo\_CIP\_AxisEnable

The function block **Festo\_CIP\_AxisEnable** switches the drive to the correct state. In this state, the drive is enabled and ready to follow target positions.



### 2.2.1 Festo\_CIP\_AxisEnable Block In-Out Variables

| In-Out Variables  | Data Type     | Description                                             |
|-------------------|---------------|---------------------------------------------------------|
| Festo_AxisRef     | Festo_AxisRef | AxisRef Structure. <a href="#">Refer Chapter 2.8.1.</a> |
| Festo_VirtualAxis | Axis_Virtual  | Virtual axis reference.                                 |

Table 2.2: Festo\_CIP\_AxisEnable Block In-Out Variables descriptions

### 2.2.2 Festo\_CIP\_AxisEnable Block Input Variables

| Input Variables | Data Type | Description                                                                                  |
|-----------------|-----------|----------------------------------------------------------------------------------------------|
| CoastStop       | BOOL      | Controls the STW1.1 coast stop command.<br>1 = Coast stop<br>0 = No coast stop               |
| EnableAxis      | BOOL      | STW1.0 Enables or disables the drive.<br>1 = Enable Drive.<br>0 = Ramp Down & Disable Drive. |
| RapidStop       | BOOL      | Controls the STW1.2 quick stop (rapid stop) command.<br>1 = Quick stop<br>0 = No Quick stop  |
| ReleaseBrake    | BOOL      | STW1.12 Release Holding Brake = 1.<br>0 = Brake engaged<br>1 = Release Holding Brake         |

Table 2.3: Festo\_CIP\_AxisEnable Block Input Variables descriptions

### 2.2.3 Festo\_CIP\_AxisEnable Block Output Variables

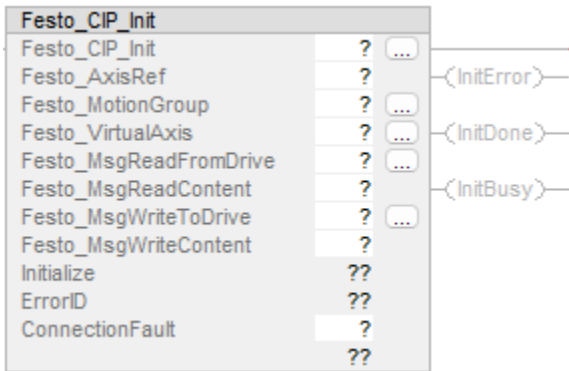
| Output Variables         | Data Type | Description                                                                                                                                            |
|--------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| PositioningTaskActivated | BOOL      | Positioning task activated (ZSW1.12), Power On & CMMT Following Position Setpoint from PLC                                                             |
| AxisEnabled              | BOOL      | Pulses are Enabled (ZSW1.2)                                                                                                                            |
| Lockout                  | BOOL      | Switching ON Inhibited (ZSW1.6)                                                                                                                        |
| Error                    | BOOL      | Indicates presence of an error<br>1 = Error present<br>0 = No error present                                                                            |
| BrakeReleased            | BOOL      | ZSW2.5 Holding Brake Released.                                                                                                                         |
| ErrorID                  | INT       | Error identification code:<br>0–255: for MSG error codes.<br>256: Axis is not initialized.<br>257: Axis can't be enabled while virtual axis is moving. |

Table 2.4: Festo\_CIP\_AxisEnable Block Output Variables descriptions

## 2.3 Festo\_CIP\_Init

The **Festo\_CIP\_Init** AOI configures all necessary preconditions to start the system within the PLC. It writes synchronization objects to the drive and reads essential internal values into the **PLC** for further use.

The system cannot operate unless **Festo\_CIP\_Init** completes successfully. Initialization status can be monitored using the Control tag **Festo\_AxisRef.InitDone** and the **InitDone** output of the AOI. This AOI must be re-initialized after PLC enters run mode or if motion group cycle time is modified.



### 2.3.1 Festo\_CIP\_Init Block In-Out Variables

| In-Out Variables       | Data Type     | Description                                             |
|------------------------|---------------|---------------------------------------------------------|
| Festo_AxisRef          | Festo_AxisRef | AxisRef structure. <a href="#">Refer Chapter 2.8.1.</a> |
| Festo_MotionGroup      | MOTION_GROUP  | Motion Group in the PLC.                                |
| Festo_VirtualAxis      | AXIS_VIRTUAL  | Virtual Axis in the PLC.                                |
| Festo_MsgReadFromDrive | MESSAGE       | Value read from the drive.                              |
| Festo_MsgReadContent   | DINT          | MSG command for reading data.                           |
| Festo_MsgWriteToDrive  | MESSAGE       | MSG command for writing data.                           |
| Festo_MsgWriteContent  | DINT [5]      | Data to be written to the drive.                        |

Table 2.5: Festo\_CIP\_Init Block In-Out Variables descriptions

### 2.3.2 Festo\_CIP\_Init Block Input Variables

| Input Variables   | Data Type | Description                                                                                                                                                                   |
|-------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initialize        | BOOL      | 0 to 1 triggers the start of the initialization process.                                                                                                                      |
| ConnectionFaulted | BOOL      | Monitors the EtherNet/IP communication connection between the PLC EtherNet/IP Master and the CMMT Real-Time Ethernet Port.<br>1 = Communication fault<br>0 = Communication Ok |

Table 2.6: Festo\_CIP\_Init Block Input Variables descriptions

### 2.3.3 Festo\_CIP\_Init Block Output Variables

| Output Variables | Data Type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| InitError        | BOOL      | 1 = Error occurred in routine.<br>0 = No error.                                                                                                                                                                                                                                                                                                                                                                                             |
| InitDone         | BOOL      | 1 = Initialization is complete.<br>0 = Initialization not complete.                                                                                                                                                                                                                                                                                                                                                                         |
| InitBusy         | BOOL      | 1 = Initialization in progress.<br>0 = Initialization not in progress.                                                                                                                                                                                                                                                                                                                                                                      |
| ErrorID          | INT       | 0–255: for MSG error codes<br>256: Axis is not initialized<br>258: Axis is not synchronized<br>Possible cause->Ensure Telegram 908 is configured in the drive<br>Possible cause->Time Sync not configured in EtherNet/IP Master<br>260: Undefined User Unit<br>261: Synchronization Lost<br>262: User unit to factor group mismatch<br>264: Timeout Reinit<br>265: PlugIn control selected<br>266: User unit does not match to virtual axis |

Table 2.7: Festo\_CIP\_Init Block Output Variables descriptions

### 2.3.4 Initializing Festo\_CIP\_Init Upon Parameter Modification

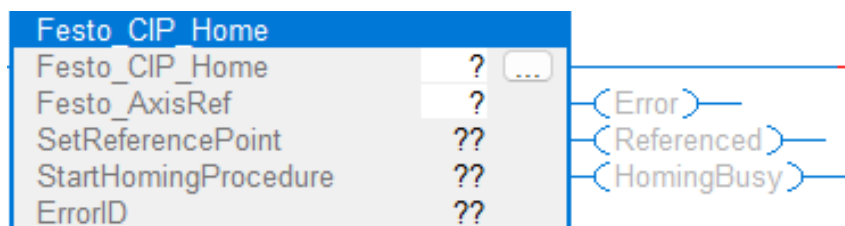
Changing this parameter in FAS requires re-initialization of the Init block and the corresponding parameter in the Init function block to ensure proper operation.

| Parameter   | Name                | Data Type | Description                                                                                                                                                                                                        |
|-------------|---------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P1.7841.0.0 | FactorGroupPosition | SINT      | Factor or index related to group positioning settings.                                                                                                                                                             |
| P1.1150.0.0 | Actual User Unit    | UDINT     | Specifies the user-defined unit for position feedback and motion control.                                                                                                                                          |
| P1.1242.0.0 | Gear Numerator      | UDINT     | The gear ratio, calculated as $\frac{\text{Gear Nominator}}{\text{Gear Denominator}}$ , enables synchronized and proportionally controlled movements, allowing precise coordination between master and slave axes. |
| P1.1243.0.0 | Gear Denominator    | UDINT     |                                                                                                                                                                                                                    |
| P1.11280701 | BaseVelocity        | REAL      | Base velocity value used in motion calculations.                                                                                                                                                                   |

Table 2.8: Festo\_CIP\_Init Upon Parameter Modification descriptions

## 2.4 Festo\_CIP\_Home

The Festo\_CIP\_Home function block sets the drive position to a user-defined reference position. The device must satisfy specific states in the base state machine for homing to proceed:



### 2.4.1 Festo\_CIP\_Home Block In-Out Variables

| In-Out Variables | Data Type     | Description                                             |
|------------------|---------------|---------------------------------------------------------|
| Festo_AxisRef    | Festo_AxisRef | AxisRef Structure. <a href="#">Refer Chapter 2.8.1.</a> |

Table 2.9: Festo\_CIP\_Home Block In-Out Variables descriptions

### 2.4.2 Festo\_CIP\_Home Block Input Variables

| Input Variables      | Data Type | Description                                                                                                                                                                                |
|----------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SetReferencePoint    | BOOL      | STW2.9 SetReferencePoint<br>1 = Home/Reference using Current Position as Reference Point Zero (Also uses/considers Festo Automation Suite Zero Point Offset value)<br>0 = No significance. |
| StartHomingProcedure | BOOL      | STW1.11 Start Homing Procedure<br>1 = Start Home/Reference using Configured Festo Automation Suite Homing Method<br>0 = Stop Homing.                                                       |

Table 2.10: Festo\_CIP\_Home Block Input Variables descriptions

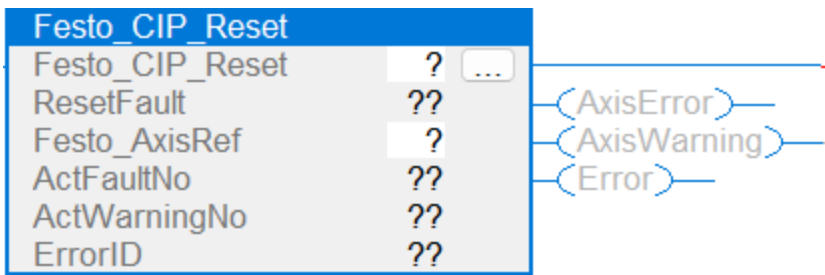
### 2.4.3 Festo\_CIP\_Home Block Output Variables

| Output Variables | Data Type | Description                                                                                                                                                               |
|------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Error            | BOOL      | Indicates presence of an error.<br>1 = Error present<br>0 = No error present                                                                                              |
| Referenced       | BOOL      | Indicates whether the axis Home/Reference has been successful<br>1 = Home/Reference Complete<br>0 = Home/Reference Incomplete                                             |
| HomingBusy       | BOOL      | Indicates if the Home/Reference procedure is in progress.<br>1 = Homing Active<br>0 = Homing not active                                                                   |
| ErrorID          | INT       | Error identification code:<br>0–255: for MSG error codes<br>256: Axis is not initialized<br>259: Axis cannot home while it is not enabled<br>263: Axis error while homing |

Table 2.11: Festo\_CIP\_Home Block Output Variables descriptions

2.5 Festo\_CIP\_Reset

The **Festo\_CIP\_Reset** function block acknowledges drive faults from the PLC using standard control and status bits. Fault clearing is only possible when the drive is in states S1, S2, or S3. The function block supports this behavior by allowing fault reset commands only in these states.



2.5.1 Festo\_CIP\_Reset Block In-Out Variables

| In-Out Variables | Data Type     | Description                                             |
|------------------|---------------|---------------------------------------------------------|
| Festo_AxisRef    | Festo_AxisRef | AxisRef Structure. <a href="#">Refer Chapter 2.8.1.</a> |

Table 2.12: Festo\_CIP\_Reset Block In-Out Variables descriptions

2.5.2 Festo\_CIP\_Reset Block Input Variables

| Input Variables | Data Type | Description                                                                   |
|-----------------|-----------|-------------------------------------------------------------------------------|
| ResetFault      | BOOL      | STW1.7 Fault Acknowledge<br>0 -> 1 = Fault Acknowledge<br>0 = No significance |

Table 2.13: Festo\_CIP\_Reset Block Input Variables descriptions

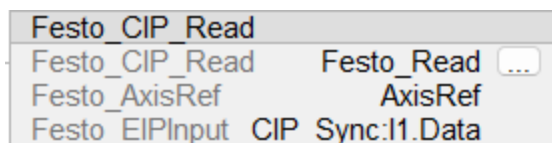
### 2.5.3 Festo\_CIP\_Reset Block Output Variables

| Output Variables | Data Type | Description                                                                                                 |
|------------------|-----------|-------------------------------------------------------------------------------------------------------------|
| AxisError        | BOOL      | ZSW1.3 Axis error status<br>1 = Error present<br>0 = No error present                                       |
| AxisWarning      | BOOL      | ZSW1.7 Axis warning status<br>1 = Warning Active<br>0 = No Warning                                          |
| ActFaultNo       | INT       | Actual fault code reported by the drive.                                                                    |
| ActWarningNo     | INT       | Actual warning code reported by the drive.                                                                  |
| Error            | BOOL      | General Error status<br>1 = Error present<br>0 = No error present                                           |
| ErrorID          | INT       | Error identification code:<br>0–255: for MSG error codes<br>256: Axis is not initialized<br>263: Axis error |

Table 2.14: Festo\_CIP\_Reset Block Output Variables descriptions

## 2.6 Festo\_CIP\_Read

The **Festo\_CIP\_Read** function block enables **EtherNet/IP** communication between the drive and the PLC. It reads all relevant data from the drive and transfers it into dedicated PLC tags. To ensure proper operation and maintain up-to-date data, this AOI must be called cyclically within the **Motion\_Group\_Event** task.



### 2.6.1 Festo\_CIP\_Read Block In-Out Variables

| In-Out Variables | Data Type     | Description                                                                          |
|------------------|---------------|--------------------------------------------------------------------------------------|
| Festo_AxisRef    | Festo_AxisRef | AxisRef Structure. <a href="#">Refer Chapter 2.8.1.</a>                              |
| Festo_EIPInput   | INT [12]      | Array of 12 integer values representing the process data inputs from the CMMT drive. |

Table 2.15: Festo\_CIP\_Read Block In-Out Variables descriptions

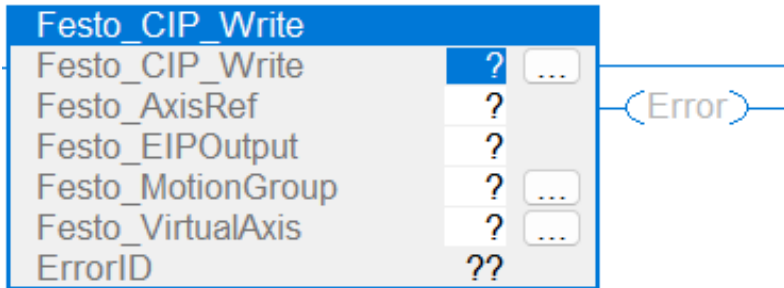
### 2.6.2 Festo\_CIP\_Read Block Output Variables

| Output Variables | Data Type | Description                                                                              |
|------------------|-----------|------------------------------------------------------------------------------------------|
| Error            | BOOL      | General error status:<br>1 = Error present<br>0 = No error present                       |
| ErrorID          | INT       | Error identification code:<br>0–255: See MSG error codes<br>256: Axis is not initialized |

Table 2.16: Festo\_CIP\_Read Block Output Variables descriptions

## 2.7 Festo\_CIP\_Write

The **Festo\_CIP\_Write** function block enables **EtherNet/IP** communication from the PLC to the drive. It writes all relevant data from the PLC to the drive. To ensure proper operation and timely data transfer, this AOI must be called cyclically within the **Motion\_Group\_Event** task.



### 2.7.1 Festo\_CIP\_Write Block In-Out Variables

| In-Out Variables  | Data Type     | Description                                                                          |
|-------------------|---------------|--------------------------------------------------------------------------------------|
| Festo_AxisRef     | Festo_AxisRef | AxisRef Structure. <a href="#">Refer Chapter 2.8.1.</a>                              |
| Festo_VirtualAxis | Axis_Virtual  | Virtual axis reference.                                                              |
| Festo_MotionGroup | MOTION_GROUP  | Motion Group in the PLC.                                                             |
| Festo_EIPInput    | INT [12]      | Array of 12 integer values representing the process data inputs from the CMMT drive. |

Table 2.17: Festo\_CIP\_Write Block In-Out Variables descriptions

### 2.7.2 Festo\_CIP\_Write Block Output Variables

| Output Variables | Data Type | Description                                                                              |
|------------------|-----------|------------------------------------------------------------------------------------------|
| Error            | BOOL      | General error status:<br>1 = Error present<br>0 = No error present                       |
| ErrorID          | INT       | Error identification code:<br>0–255: for MSG error codes<br>256: Axis is not initialized |

Table 2.18: Festo\_CIP\_Write Block Output Variables descriptions

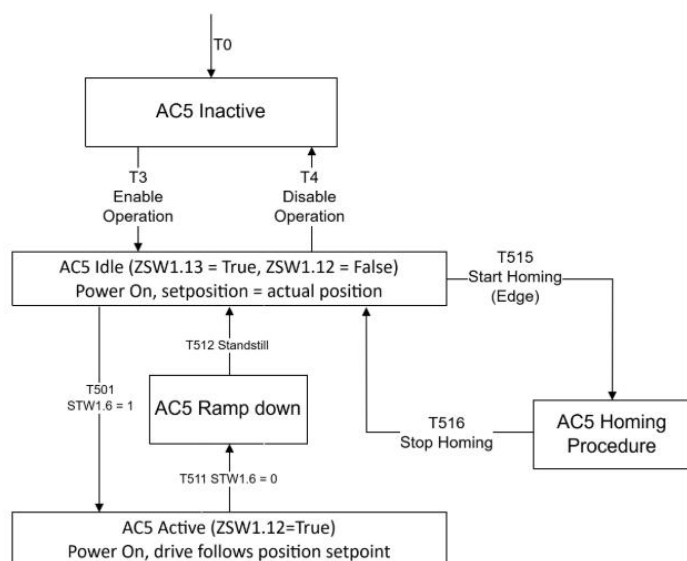
## 2.8 User Defined Data Type

### 2.8.1.1 AxisRef Structure

| Structure Variables      | Data Type                 | Description                                                                                                  |
|--------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------|
| InitDone                 | BOOL                      | Indicates if the initialization process is complete.                                                         |
| InitError                | UINT                      | Error code related to the initialization process.                                                            |
| ReceiveBuffer            | Festo_Telegram908_Status  | Structure containing the status information received from the telegram. <a href="#">Refer Chapter 2.9.</a>   |
| SendBuffer               | Festo_Telegram908_Control | Structure containing the control information to be sent via the telegram. <a href="#">Refer Chapter 2.9.</a> |
| IsSynchronized           | BOOL                      | Indicates if synchronization with the drive is achieved.                                                     |
| CoarseUpdatePeriod       | DINT                      | Time period for coarse update cycles (in milliseconds or system-specific units).                             |
| OverrideVelocityFlag     | BOOL                      | Flag to enable or disable velocity override.                                                                 |
| OverrideVelocityValue    | REAL                      | Value used for velocity override when the flag is enabled.                                                   |
| BaseVelocity             | REAL                      | Base velocity value used in motion calculations.                                                             |
| FactorGroupPosition      | SINT                      | Factor or index related to group positioning settings.                                                       |
| PositionSetpoint         | REAL                      | Target position setpoint for the drive.                                                                      |
| VelocitySetpoint         | REAL                      | Target velocity setpoint for the drive.                                                                      |
| VelocityActual           | REAL                      | Actual current velocity of the drive.                                                                        |
| CW                       | Festo_Controlword         | Control word structure used for sending commands to the drive. <a href="#">Refer Chapter 2.9.1.</a>          |
| SW                       | Festo_Statusword          | Status word structure representing the drive's status. <a href="#">Refer Chapter 2.9.5.</a>                  |
| DriveState               | Festo_DriveState          | Current state of the drive in the state machine. <a href="#">Refer Chapter 2.8.2.</a>                        |
| TimingModel              | INT                       | Timing model parameter or identifier.                                                                        |
| ActUserUnit              | INT                       | Active user unit identifier or code.                                                                         |
| PositioningTaskActivated | BOOL                      | Indicates if the positioning task is currently activated.                                                    |
| GearNumerator            | INT                       | Numerator value of the gear ratio used for electronic gearing.                                               |
| GearDenominator          | INT                       | Denominator value of the gear ratio used for electronic gearing.                                             |
| Rotatory                 | SINT                      | 0 = Linear and 1 = Rotary.                                                                                   |
| PositionUnwind           | DINT                      | Upper limits unwind.                                                                                         |
| PositionActual           | REAL                      | Actual position for rotative axis (with unwind).                                                             |
| ConversionConstant       | REAL                      | Scaling factor that converts between position units and user engineering units.                              |

| Structure Variables | Data Type | Description                                                                 |
|---------------------|-----------|-----------------------------------------------------------------------------|
| UpperLimitUnwind    | DINT      | Upper position limit at which the unwind function wraps the position value. |
| FWVersion           | INT       | Firmware version of the connected drive.                                    |
| HomingRequested     | BOOL      | Homing request status.<br>0 = Homing not requested<br>1 = Homing requested  |

Table 2.19: AxisRef Structure descriptions

**2.8.2 Festo\_DriveState**

| Structure Variables     | Data Type | Description                                                                  |
|-------------------------|-----------|------------------------------------------------------------------------------|
| S1_SwitchingOnInhibited | BOOL      | Indicates whether switching on the device is currently inhibited.            |
| S2_ReadyForSwitchingOn  | BOOL      | Indicates whether the device is ready to be switched on.                     |
| S3_SwitchedOn           | BOOL      | Indicates whether the device is currently switched on.                       |
| S4_Operation            | BOOL      | Indicates whether the device is in operation mode.                           |
| S4_AC5Inactive          | BOOL      | Indicates that the device is inactive in the AC5 state.                      |
| S4_AC5Idle              | BOOL      | Indicates that the device is idle in the AC5 state.                          |
| S4_AC5RampDown          | BOOL      | Indicates that the device is ramping down in the AC5 state.                  |
| S4_AC5Active            | BOOL      | Indicates that the device is active in the AC5 state.                        |
| S4_AC5HomingProcedure   | BOOL      | Indicates that the device is performing a homing procedure in the AC5 state. |
| S5_SwitchingOff         | BOOL      | Indicates whether the device is currently switching off.                     |
| S51_RampStop            | BOOL      | Indicates whether a ramp stop is active.                                     |
| S52_QuickStop           | BOOL      | Indicates whether a quick stop is active.                                    |

Table 2.20: Festo\_DriveState descriptions

## 2.9 Festo Telegram 908

For cyclic communication between the PLC and the motor controller, a Festo-specific telegram named **Telegram 908** is used.

The telegram has a length of **7 Words** and contains the following data:

| IO (Inputs/Outputs)<br>Data Number | Setpoint/Control Value      | Status/Actual Value |
|------------------------------------|-----------------------------|---------------------|
| 1                                  | STW1                        | ZSW1                |
| 2                                  | XSOLL_A                     | XIST_A              |
| 3                                  | XSOLL_A                     | XIST_A              |
| 4                                  | STW2                        | ZSW2                |
| 5                                  | NSOLL_A (Not Used/Reserved) | NIST_A              |
| 6                                  | TIMESTAMP_SETPOINT          | Fault_Code          |
| 7                                  | TIMESTAMP_SETPOINT          | Warn_Code           |

Table 2.21: IO control/actual values

**2.9.1 STW1**

| Bit    | Description                                                                                                                                                                                                                                                                                                                                                                                           |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0      | Output stage enable (ON/OFF, precondition STW1.3 = 1)<br>1: power output stage enabled (ON)<br>0: brake drive to standstill and then deactivate the power output stage (OFF1).<br>If bit STW1.3 is already active, activation of STW1.0 implements a transition to S4 and therefore switches on the output stage. As a rule, however, STW1.0 is active and STW1.3 (output stage enable) is activated. |
| 1      | Coast Stop Disable<br>1: No Coasting<br>0: Coasting. Power output stage is deactivated and the drive coasts to a stop.                                                                                                                                                                                                                                                                                |
| 2      | Quick Stop Disable<br>1: No Quick Stop<br>0: Brake drive to standstill with fast stop and then deactivate the power output stage                                                                                                                                                                                                                                                                      |
| 3      | Enable operation<br>1: enabled<br>0: block                                                                                                                                                                                                                                                                                                                                                            |
| 4      | Reject positioning task<br>1: inactive<br>0: active                                                                                                                                                                                                                                                                                                                                                   |
| 5      | Intermediate stop<br>1: inactive<br>0: active                                                                                                                                                                                                                                                                                                                                                         |
| 6      | Enable Setpoint<br>1: Follow setpoints<br>0: Don't follow setpoints.                                                                                                                                                                                                                                                                                                                                  |
| 7      | Acknowledge malfunction<br>1: active<br>0: inactive (no effect)                                                                                                                                                                                                                                                                                                                                       |
| 8      | Jogging 1 (not implemented yet)<br>1: active (jogging with the dynamic values of jogging 1)<br>0: inactive                                                                                                                                                                                                                                                                                            |
| 9      | Jogging 2 (not implemented yet)<br>1: active (jogging with the dynamic values of jogging 2)<br>0: inactive                                                                                                                                                                                                                                                                                            |
| 10     | Control By PLC<br>1: PLC requests Control Sovereignty. The signal must be set if the process data sent are to be applied and effective.<br>0: No PLC requests for Control                                                                                                                                                                                                                             |
| 11     | Home/Reference Task Start<br>1: Home/Reference Task Start Active<br>0: Home/Reference Task Start Inactive                                                                                                                                                                                                                                                                                             |
| 12     | Release holding brake<br>1: active<br>0: inactive                                                                                                                                                                                                                                                                                                                                                     |
| 13     | Start record change (not implemented yet)<br>1: active<br>0: inactive                                                                                                                                                                                                                                                                                                                                 |
| 14..15 | Reserved                                                                                                                                                                                                                                                                                                                                                                                              |

Table 2.22: STW1 descriptions

## 2.9.2 XSOLL\_A

| Parameter | PNU  | Name    | Data Type | Description                                                         |
|-----------|------|---------|-----------|---------------------------------------------------------------------|
| 11280608  | 27.0 | XSOLL_A | DINT      | Target position value based on the scaling set in the factor group. |

Table 2.23: XSOLL\_A descriptions

## 2.9.3 STW2

| Bit    | Description                                                                                                                                                 |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0..6   | Reserved                                                                                                                                                    |
| 7      |                                                                                                                                                             |
| 8      | Move to fixed stop (not implemented yet)<br>1: activate move to fixed stop (must be set before reaching the fixed stop)<br>0: deactivate move to fixed stop |
| 9      | Set reference point<br>1: Set the reference point without movement<br>0: Don't set reference point                                                          |
| 10..11 | Reserved                                                                                                                                                    |
| 12     | AC4: Master life sign Bit 0 (not implemented yet)                                                                                                           |
| 13     | AC4: Master life sign Bit 1 (not implemented yet)                                                                                                           |
| 14     | AC4: Master life sign Bit 2 (not implemented yet)                                                                                                           |
| 15     | AC4: Master life sign Bit 3 (not implemented yet)                                                                                                           |

Table 2.24: STW2 descriptions

## 2.9.4 Timestamp Setpoint

The **Timestamp Setpoint** is derived from the PLC **WallClockTime** object, specifically from the attribute **WallClockTime.CurrentValue**. This value represents the current time as the number of microseconds elapsed since 00:00 hours on January 1, 1970 (the Unix epoch).

Only the lower 32 bits of this timestamp are transmitted to the drive.

The timestamp value must not be set to a date later than December 29, 2068.

Within the controller, the **CST** and **WALLCLOCKTIME** objects are mathematically related. For example, the sum of the **CST.CurrentValue** and the **WALLCLOCKTIME.CSTOffset** equals the **WALLCLOCKTIME.CurrentValue**.

**2.9.5 ZSW1**

| Bit | Description                                                                                   |
|-----|-----------------------------------------------------------------------------------------------|
| 0   | Ready to Switch on<br>1: Active<br>0: Inactive                                                |
| 1   | Ready to Operate<br>1: Active<br>0: Inactive                                                  |
| 2   | Operation Enabled<br>1: Active<br>0: Inactive (blocked)                                       |
| 3   | Fault Present<br>1: Active<br>0: Inactive                                                     |
| 4   | Coasting Stop NOT Active<br>1: Inactive<br>0: Active                                          |
| 5   | Quick Stop NOT active<br>1: Inactive<br>0: Active                                             |
| 6   | Switch-on Inhibited<br>1: Active<br>0: Inactive                                               |
| 7   | Warning Present<br>1: Active<br>0: Inactive                                                   |
| 8   | Following Error within Tolerance Range<br>1: In Tolerance range<br>0: Outside Tolerance range |
| 9   | PLC Control Requested<br>1: Active<br>0: inactive                                             |
| 10  | Traverse Task Motion Complete<br>1: Traverse Task Motion Complete<br>0: Inactive              |
| 11  | Reference/Home Completed<br>1: Reference/Home Completed<br>0: Inactive                        |
| 12  | Traverse Task Acknowledgement<br>1: Traverse Task Acknowledge<br>0: Inactive                  |
| 13  | Drive Stopped<br>1: Drive Stopped<br>0: Inactive                                              |
| 14  | Axis Accelerating<br>1: Axis Accelerating<br>0: Inactive                                      |
| 15  | Axis decelerating<br>1: Axis decelerating<br>0: Inactive                                      |

Table 2.25: ZSW1 descriptions

## 2.9.6 XIST\_A

| Parameter | PNU  | Name   | Data Type | Description                                                            |
|-----------|------|--------|-----------|------------------------------------------------------------------------|
| 113104    | 28.0 | XIST_A | DINT      | Actual position value is based on the scaling set in the factor group. |

Table 2.26: XIST\_A description

## 2.9.7 ZSW2

| Bit   | Description                                                                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0..4  | Reserved                                                                                                                                                    |
| 5     | Holding brake                                                                                                                                               |
| 6..7  | Reserved                                                                                                                                                    |
| 8     | Move to fixed stop (not implemented yet)<br>1: activate move to fixed stop (must be set before reaching the fixed stop)<br>0: deactivate move to fixed stop |
| 9..10 | Reserved                                                                                                                                                    |
| 11    | Output stage active<br>1: active<br>0: inactive                                                                                                             |
| 12    | AC4: slave life sign Bit 0 (not implemented yet)                                                                                                            |
| 13    | AC4: slave life sign Bit 1 (not implemented yet)                                                                                                            |
| 14    | AC4: slave life sign Bit 2 (not implemented yet)                                                                                                            |
| 15    | AC4: slave life sign Bit 3 (not implemented yet)                                                                                                            |

Table 2.27: ZSW2 bit descriptions

## 2.9.8 NIST\_A

| Parameter | PNU | Name                            | Data Type | Description                                                                                    |
|-----------|-----|---------------------------------|-----------|------------------------------------------------------------------------------------------------|
| 1210      | 6.0 | Actual value of velocity NIST_A | INT       | Rotational speed value A with 16-bit resolution. Standardized similarly to the setpoint value. |

Table 2.28: NIST\_A description

## 2.9.9 Fault and Warn Code

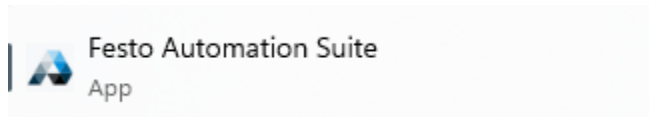
The **Fault\_Code** (P1.11280062) displays the last fault recorded in the fault buffer, and the **Warn\_Code** (P1.11280063) displays the last warning recorded in the warning buffer.

### 3 Festo Automation Suite Configuration Overview

This section contains all information and configuration requirements with the FAS (Festo Automation Suite) software.

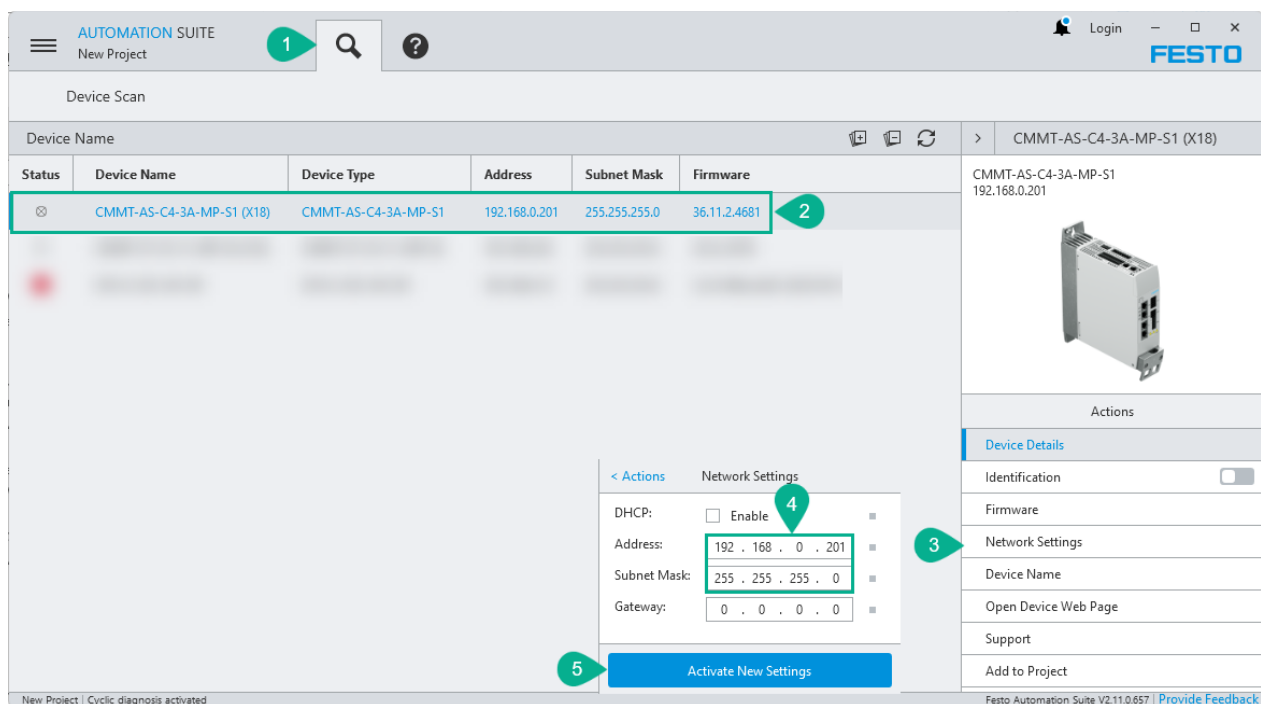
#### 3.1 Setting the IP Address of the CMMT Drive

##### Step 1



Open the **Festo Automation Suite** software (**Windows Start >> Festo Software >> Festo Automation Suite**).

##### Step 2



1. Click on the **Search** icon in the header to ensure the following device is connected.
2. From the **Device Scan** table, select the detected **CMMT-AS-C4-3A-MP-S1(X18)**.
3. In the **Actions** pane on the right, select **Network Settings** under Device Details.
4. In the **Network Settings** window, enter the required static **IP address**, **subnet mask**, and **gateway**.
5. Click **Activate New Settings** to apply the configured network parameters to the CMMT drive.

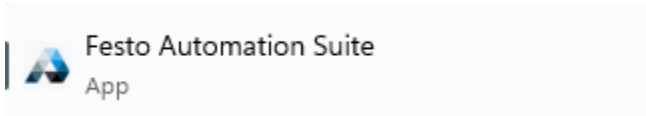


##### Note

- To know detailed information about the connection technology, [Refer Chapter 1.4.1.](#)

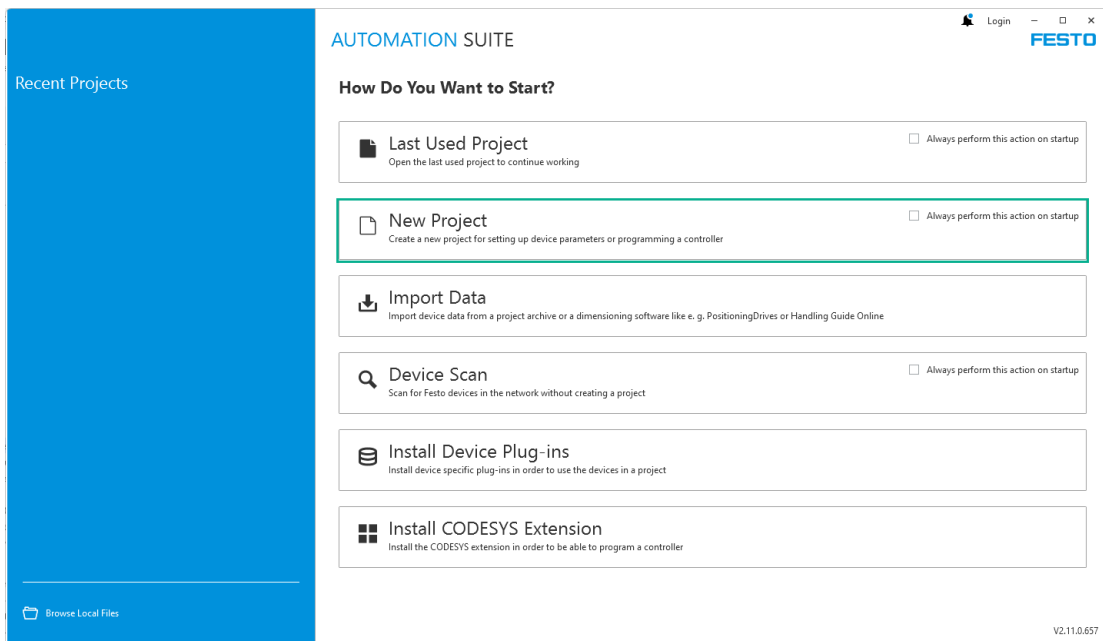
## 3.2 Overview of CMMT Offline Configuration

### Step 1



Open the **Festo Automation Suite** software (**Windows Start >> Festo Software >> Festo Automation Suite**).

### Step 2



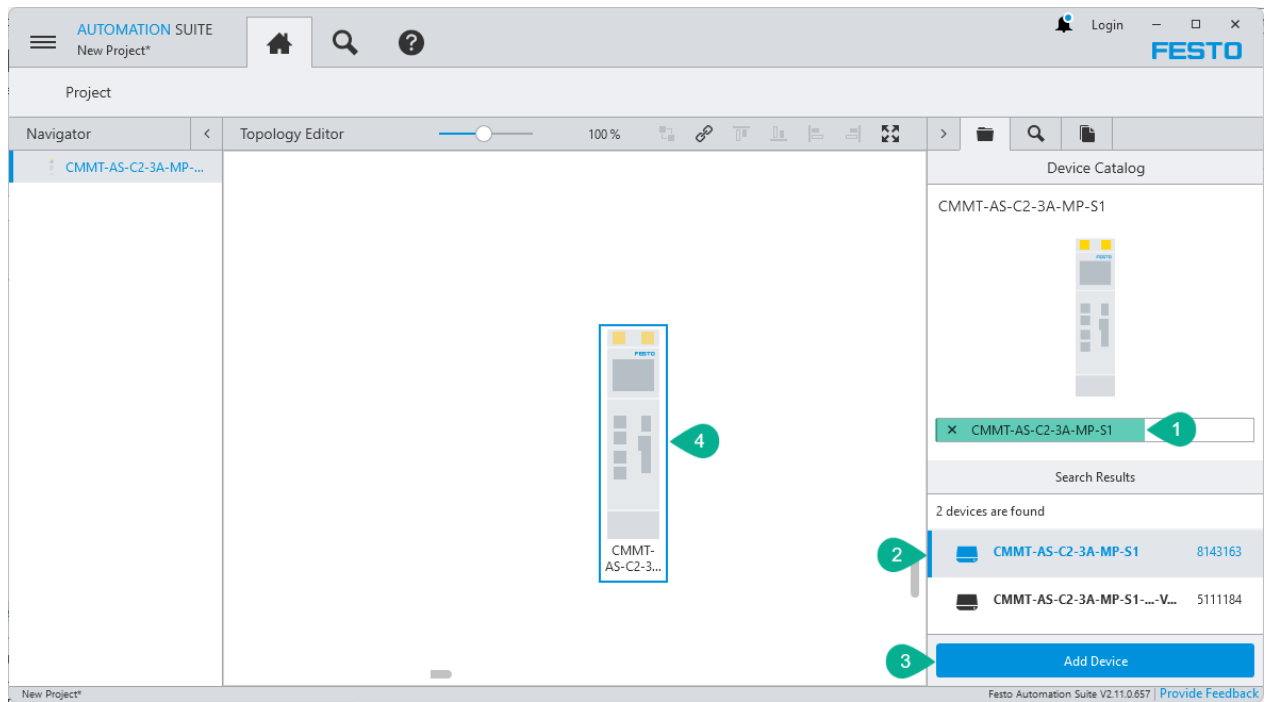
Click on **New Project** and add devices to the current project.



#### Note

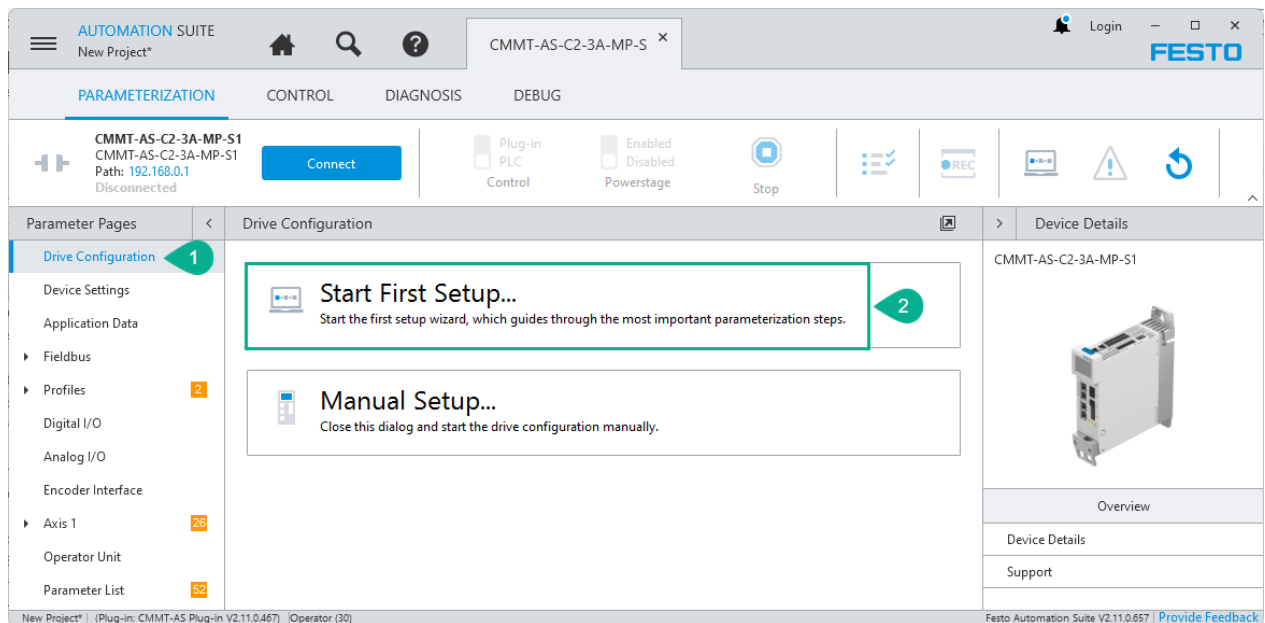
- The steps below show the Offline Configuration of the CMMT drive in Festo Automation Suite.
- If the CMMT drive has already been configured with the initial setup, the user can skip this chapter.

## Step 3



1. Enter the device part number or name in the **Device Catalog** search field.
2. From the **Search Results** list, select the correct device row.
3. Click **Add Device** from the Action options.
4. Double-click the device added to the Topology Editor to open the plug-in.

## Step 4



1. Select **Drive Configuration** from the Parameter Pages menu.
2. Click **Start First Setup...** to launch the initial setup wizard.

**Step 5**

**Please Select the Components of Your Drive System**

|  |                                                |                                  |                                                 |                                          |                                           |                            |                                    |  |
|--|------------------------------------------------|----------------------------------|-------------------------------------------------|------------------------------------------|-------------------------------------------|----------------------------|------------------------------------|--|
|  | <b>CMMT-AS-C2-3A-MP-S1</b><br>8143163 Licenses | <b>Maximum Current</b><br>6.00 A | <b>Intermediate Circuit Voltage</b><br>320.00 V | <b>Supply Voltage</b><br>230.00 V        | <b>Ext. Brake Resistor</b><br>Deactivated |                            |                                    |  |
|  | <b>EMMT-AS-60-M-LS-RS</b><br>5242204           | <b>Type</b><br>Servo motor (2)   | <b>Holding Brake</b><br>No                      | <b>Encoder Protocol</b><br>EnDat 2.2 (5) | <b>Encoder Type</b><br>Single turn (1)    | <b>Voltage</b><br>325.00 V | <b>Virtual Mode</b><br>Deactivated |  |
|  | <b>User Defined Rotative Axis</b>              | <b>Position Range</b><br>1.00 r  |                                                 |                                          |                                           |                            |                                    |  |
|  | <b>User Defined Mounting Kit</b>               | <b>Type</b><br>Axial             | <b>Gear Ratio</b><br>1:1                        |                                          |                                           |                            |                                    |  |

Back **Next** Finish

1. Select **Drive Configuration** from the Parameter Pages menu.
2. Review and confirm the listed drive system components in the component table.
3. Click **Next** to proceed with the First Setup wizard.

**Step 6**

**Enable Servo Drive**

Activation via Fieldbus (2)

**Supply Voltage**

Mains voltage 230.00 V

**External Brake Resistor**

External Brake Resistor None (0)

Resistance 100.00 Ω

Power dissipation 21.00 W

Limit value pulse energy monitoring 0.00 J

Back **Next** Finish

1. Select the **Device Settings** tab from the First setup header.
2. From the Activation via dropdown, select **Fieldbus(2)** (This selection depends on user preference and the specific application).
3. Click **Next** to proceed to the next setup page.

## Step 7

1. Select the **Fieldbus** tab in the First setup header.
2. From the **RTE Configuration** dropdown, choose **EtherNet/IP – ModbusTCP(3)**.
3. From the **Telegram selection** dropdown, choose **Telegram (908)**.
4. Enter the **IP address** and **subnet mask** in the EtherNet/IP configuration fields for the X19 port.
5. Click **Finish** to continue to the next setup page.

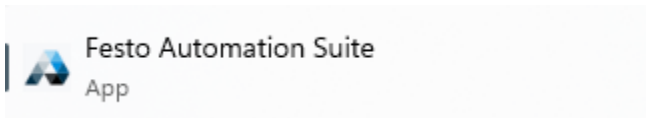


### Note

- To know detailed information about the connection technology, [Refer Chapter 1.4.2.](#)

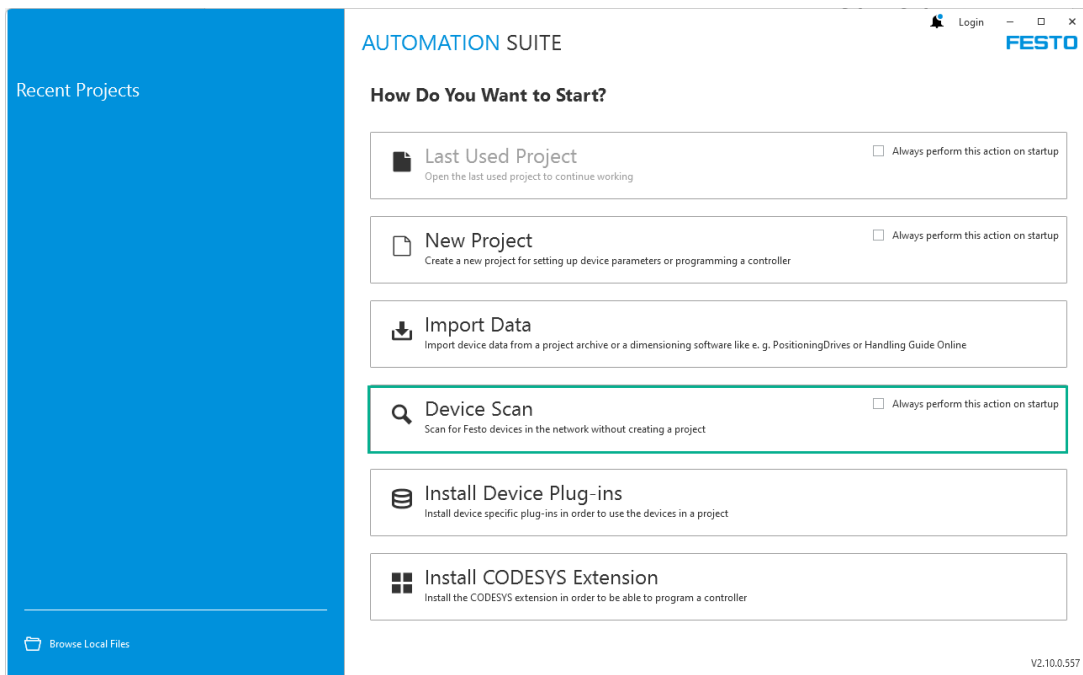
### 3.3 Overview of CMMT Online Configuration

#### Step 1



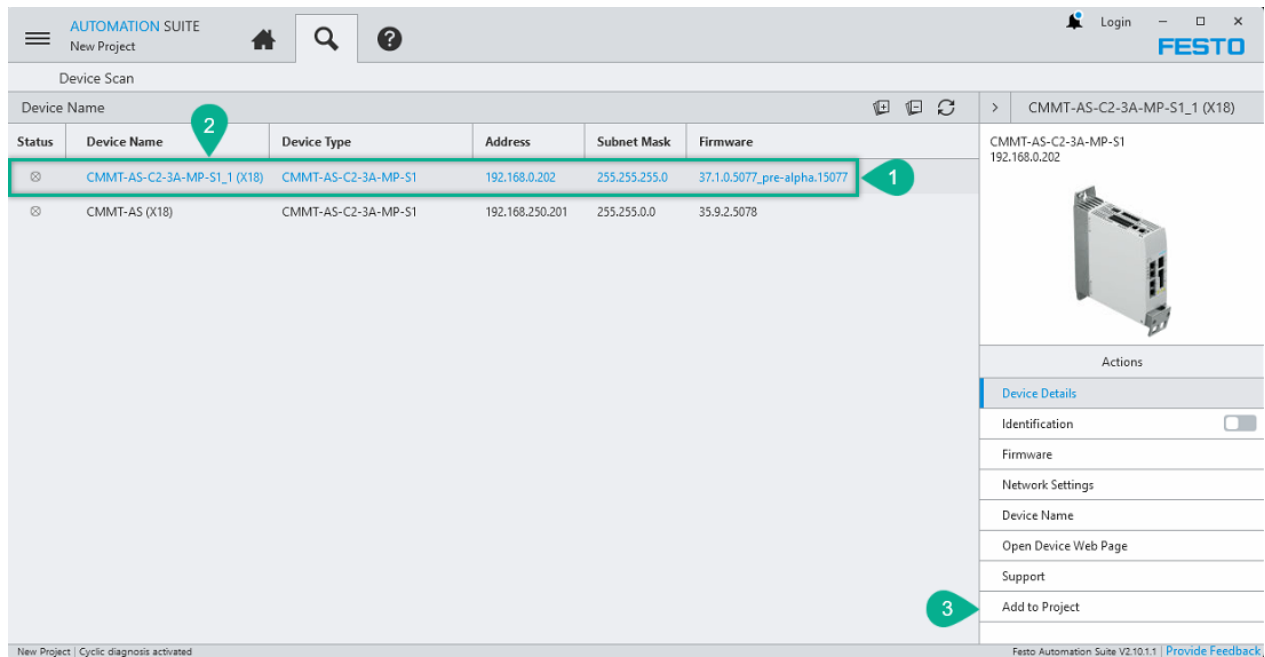
Open the **Festo Automation Suite** software (**Windows Start >> Festo Software >> Festo Automation Suite**).

#### Step 2



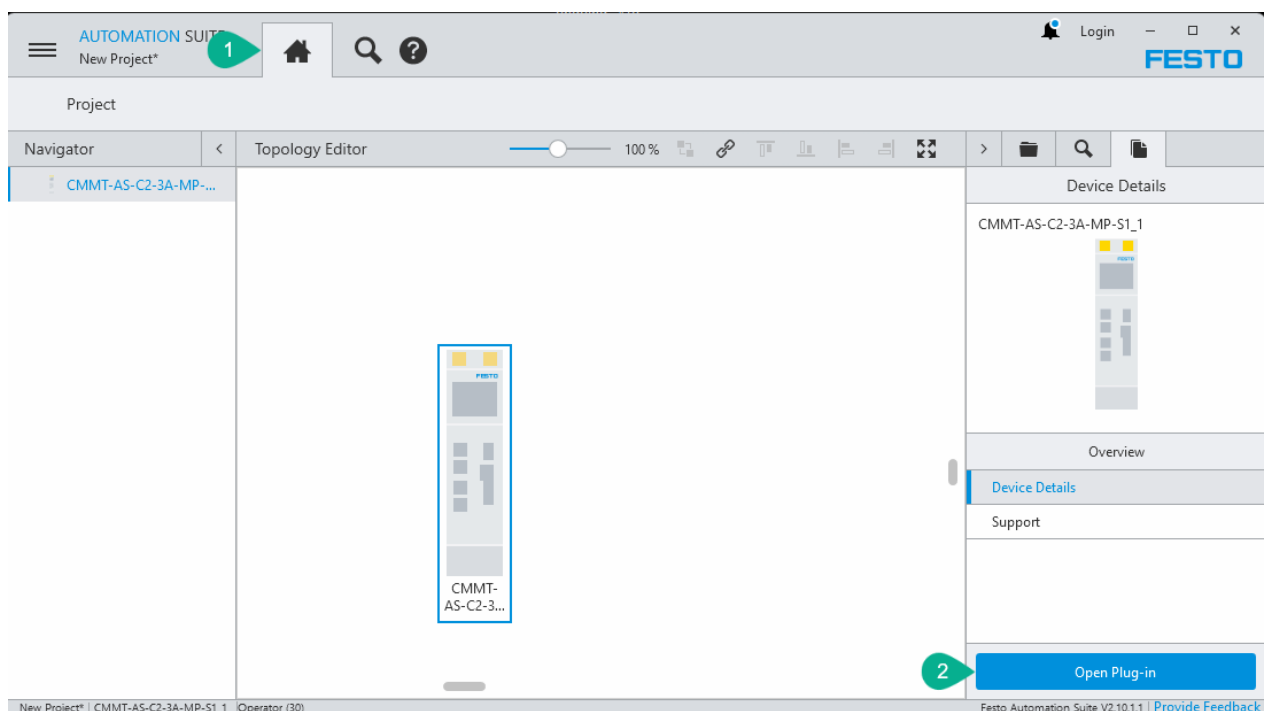
Click on **Device Scan** to detect and add devices to the current project.

## Step 3

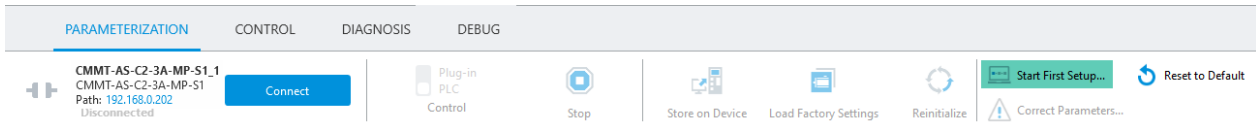


1. After performing the **Device Scan**, the detected device name will appear in the table, as shown in the image above.
2. Select the **X18** port corresponding to the device to be added.
3. Click on **Add to Project** from the Action options to include the selected device in the project.

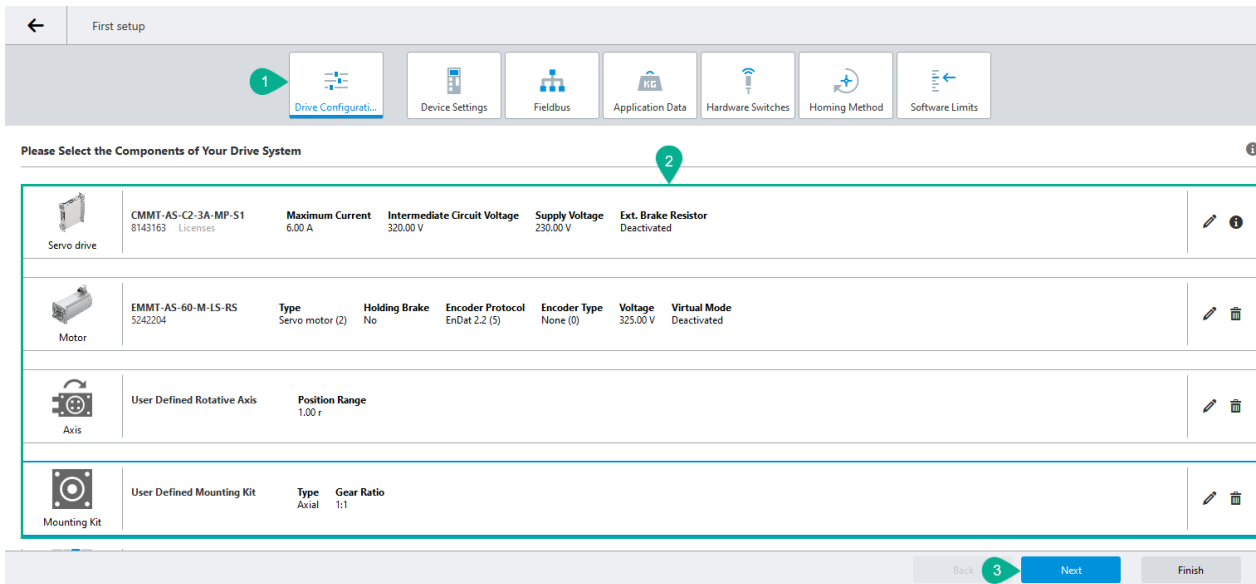
## Step 4



1. Click on the **Home** icon located above the Festo Automation Suite (FAS) interface.
2. Click on **Open Plug-in** to launch the project details.

**Step 5**

Use **Start First Setup...** to begin the initial configuration wizard once connected

**Step 6**

1. Select **Drive Configuration** from the Parameter Pages menu.
2. Review and confirm the listed drive system components in the component table.
3. Click **Next** to proceed with the First Setup wizard.

## Step 7

First setup

Drive Configurati... 1 Device Settings Fieldbus Application Data Hardware Switches Homing Method Software Limits

**Enable Servo Drive** 2

Activation via Fieldbus (2)

**Supply Voltage**

Mains voltage 230.00 V

**External Brake Resistor**

External Brake Resistor None (0)

Resistance 100.00 Ω

Power dissipation 21.00 W

Limit value pulse energy monitoring 0.00 J

Back Next Finish 3

1. Select the **Device Settings** tab from the First setup header.
2. From the Activation via dropdown, select **Fieldbus(2)** (This selection depends on user preference and the specific application).
3. Click **Next** to proceed to the next setup page.

## Step 8

First setup

Drive Configurati... 1 Device Settings Fieldbus Application Data Hardware Switches Homing Method Software Limits

**Fieldbus Configuration** 2

RTE Configuration (user defined) EtherNet/IP - ModbusTCP (3)

**EtherNet/IP - ModbusTCP configuration** 3

Telegram selection Telegram (908)

Activate DHCP ☐ Active

IP address 192 . 168 . 0 . 10 4

Subnet mask 255 . 255 . 255 . 0

Gateway address 0 . 0 . 0 . 0

Back Next Finish 5

1. Select the **Fieldbus** tab in the First setup header.
2. From the **RTE Configuration** dropdown, choose **EtherNet/IP – ModbusTCP(3)**.
3. From the **Telegram selection** dropdown, choose **Telegram (908)**.
4. Enter the **IP address** and **subnet mask** in the EtherNet/IP configuration fields for the X19 port.
5. Click **Finish** to continue to the next setup page.

**Step 9**

1. In the **Parameter Pages**, expand **Axis 1**.
2. Click on **Axis** under **Axis 1** to open the axis configuration settings.
3. In the **Homing Method** section, select the desired **method** from the dropdown menu (e.g., **Negative stop (-17)**).
4. Click on **Connect** to establish a connection with the drive.

**Note**

- The Homing method option shown above corresponds to a linear axis type. Configuration should be based on the specific project requirements.

**Step 10****Parameter Synchronization**

The following parameters mismatch. Please choose whether you want to transfer the parameters from the project to the device or vice versa.

| ID                                                     | Name                | Value in project           | Unit | Value on device | Unit |
|--------------------------------------------------------|---------------------|----------------------------|------|-----------------|------|
| /System/Device interface assignment group[0] (2)       |                     |                            |      |                 |      |
| P0.11306.0.0                                           | Digital input X1C.6 | Negative hardware... (8)   |      | No function (1) |      |
| P0.11307.0.0                                           | Digital input X1C.7 | Positive hardware l... (9) |      | No function (1) |      |
| /System/Router parameterisation interface group[1] (1) |                     |                            |      |                 |      |
| P0.12001.1.0                                           | IP address          | 3232235539                 |      | 3232235540      |      |

**Connected Device**

|                  |                          |
|------------------|--------------------------|
| Identify         | <input type="checkbox"/> |
| Device Name      | CMMT-AS-C2-3A-MP-...     |
| Device Type      | CMMT-AS-C2-3A-MP-...     |
| IP-Address       | 192.168.0.202            |
| Product key      | HXY503XYRS9              |
| Plug-in version  | 2.11.0.467               |
| Firmware version | 37.1.0-pre-alpha.15077   |

Write to device

Read from device

Cancel

Click on **Write to device** to transfer the parameters from the project to the connected device.

**Step 11**

Ensure the CMMT drive is connected and shown with status **Connected**, and in the device header bar, click **Store on Device** to save the current configuration permanently to the CMMT drive.

## 4 RSLinx Classic Configuration Overview

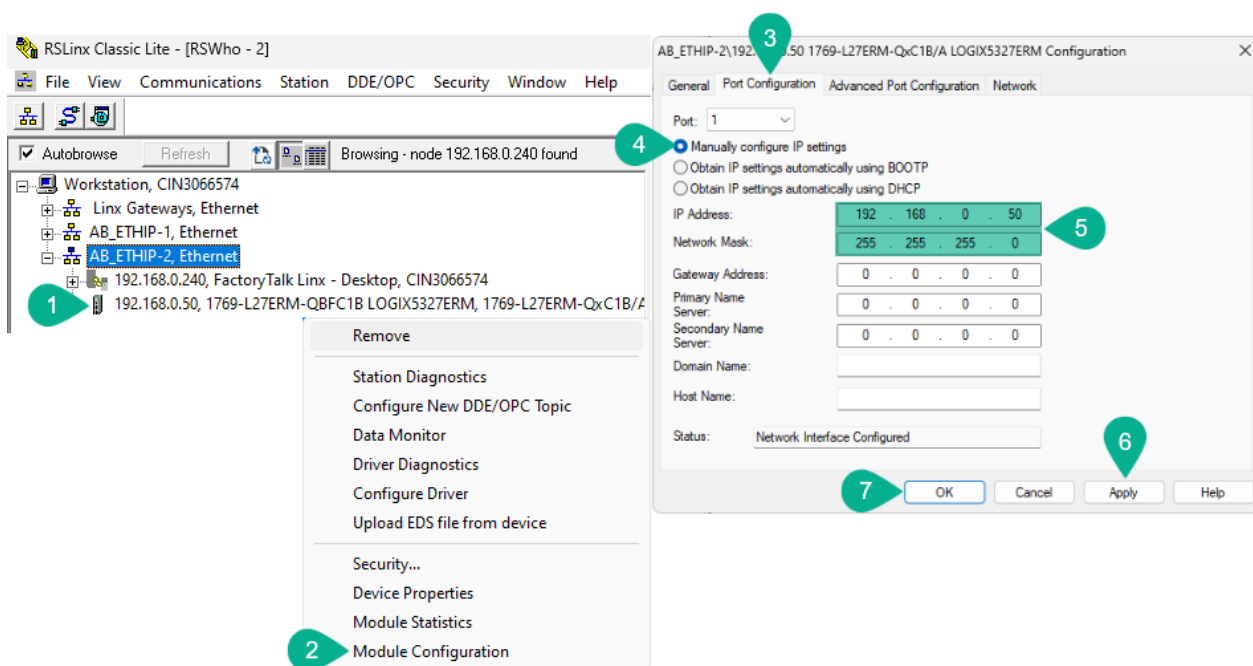
### 4.1 Allen Bradley PLC IP Address Configuration

The IP configuration of the Allen-Bradley PLC can be done using following step:

- Configure through RSLinx by connecting a USB cable (9300-USBCBL-ABHR2) or an Ethernet cable between the PLC and the workstation computer.

#### 4.1.1 IP Configuration of Allen-Bradley PLC through RSLinx

##### Step 1



1. Expand Ethernet/USB on RSLinx software and **Select controller** with right click on mouse. In this case controller is **1769-L27ERM-QBFC1B**.
2. From right click menu select **Module Configuration** option. At this stage new module configuration window will open.
3. Select **Port Configuration** tab.
4. Select **Manually configuration IP setting** option. Once Manual option selected IP Address & Network Mask field will be available for editing.
5. Enter the PLC **IP address** and **network mask**. These are the minimum required settings to establish communication; other addressing options depend on the user's network configuration.
6. Click **Apply** button.
7. Click **OK** button.



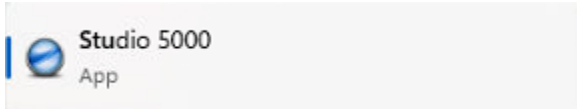
##### Note

- For IP address setting of PLC using USB port, connect the USB cable (**9300-USBCBL-ABHR2**) between PLC port & workstation. Open RSLinx Software. Once USB connection communication is healthy user will see the **USB** symbol on **RSLinx** software.
- In order to set IP Address through Ethernet, PLC must be in same range as Workstation.

## 5 Studio 500 Configuration Overview

### 5.1 Creating a new project in Studio 5000

#### Step 1



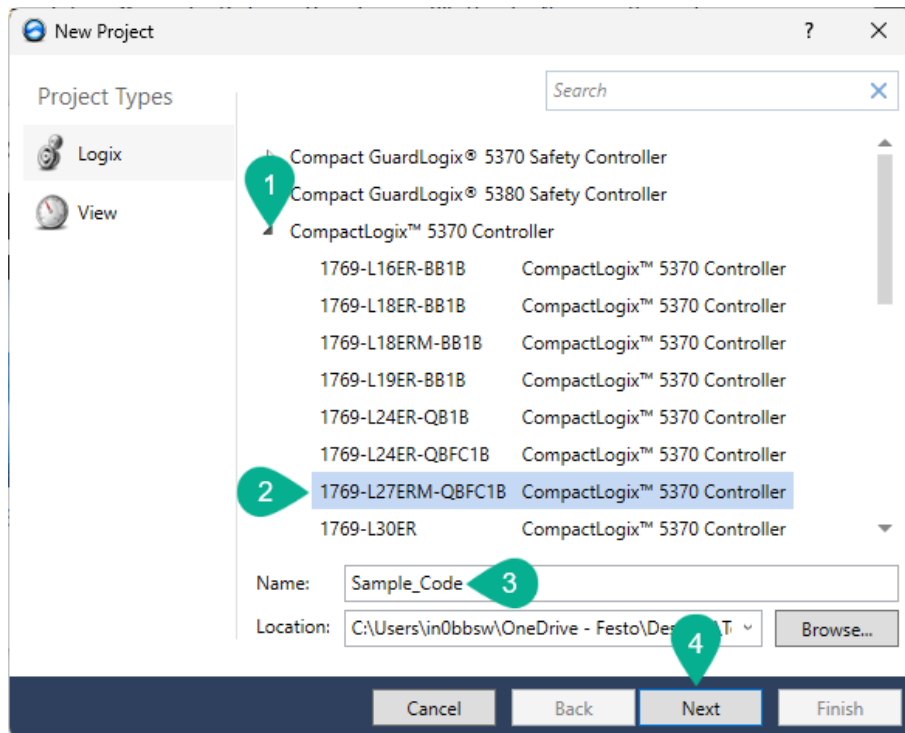
#### Step 2

Open **Studio 5000** software (**Windows Start >> Studio 5000**).



Click on **New Project**.

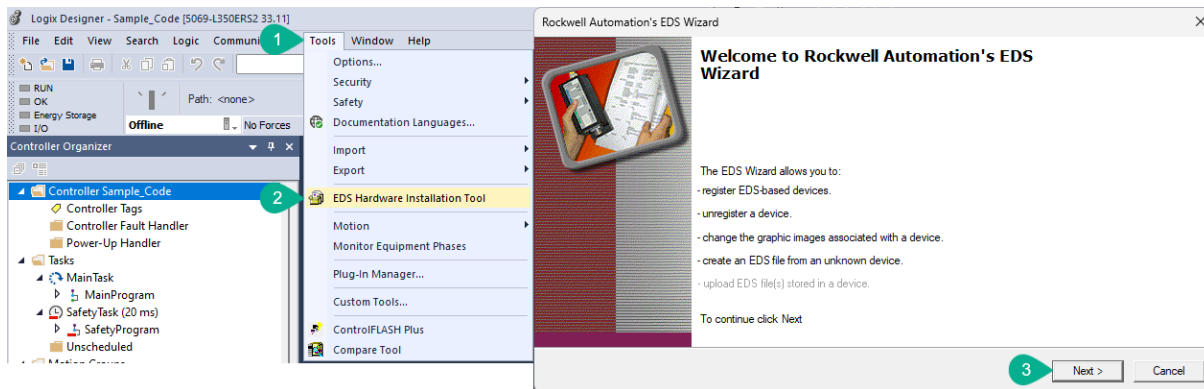
### Step 3



1. Select the controller type category. For this application note, **CompactLogix™ 5370 Controller** has been selected.
2. From the list of available controllers, choose the required model. Here, **1769-L27ERM-QBFC1B** is selected.
3. Enter the project name in the **Name** field. In this example, the project is named **Sample\_Code**.
4. Click on **Next** to proceed with the project creation, then click **Finish** to complete the setup.

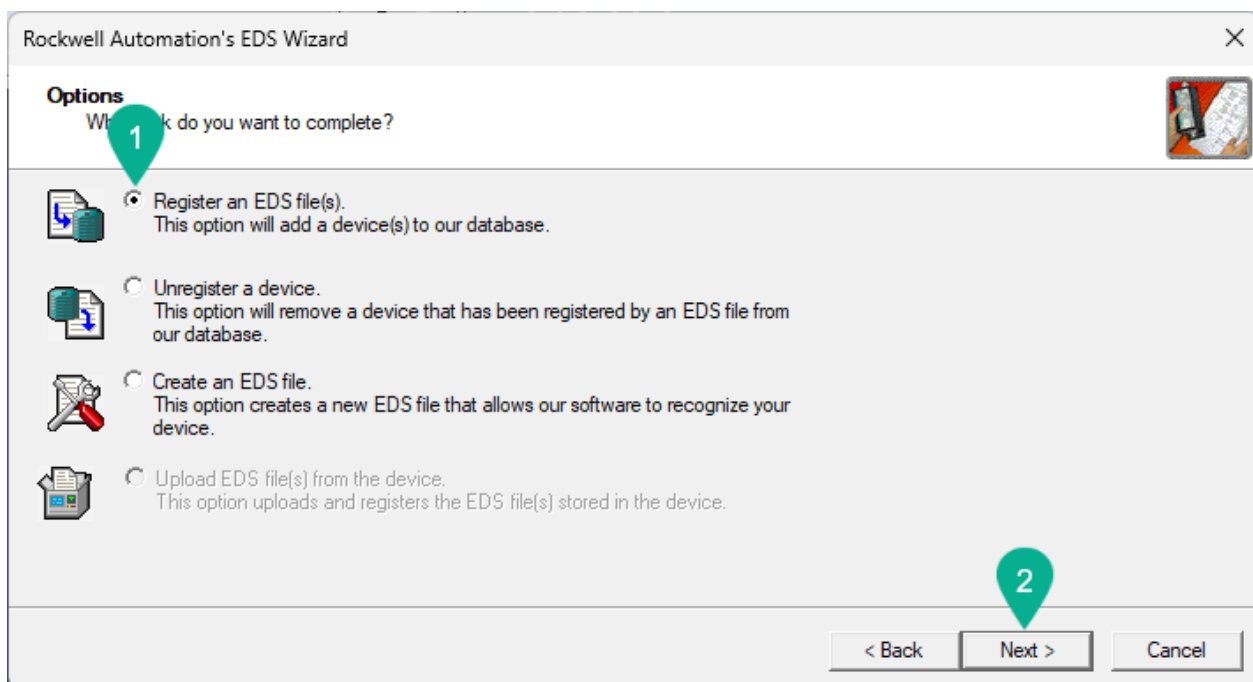
## 5.2 Install the EDS File of CMMT-EP to Studio 5000

### Step 1



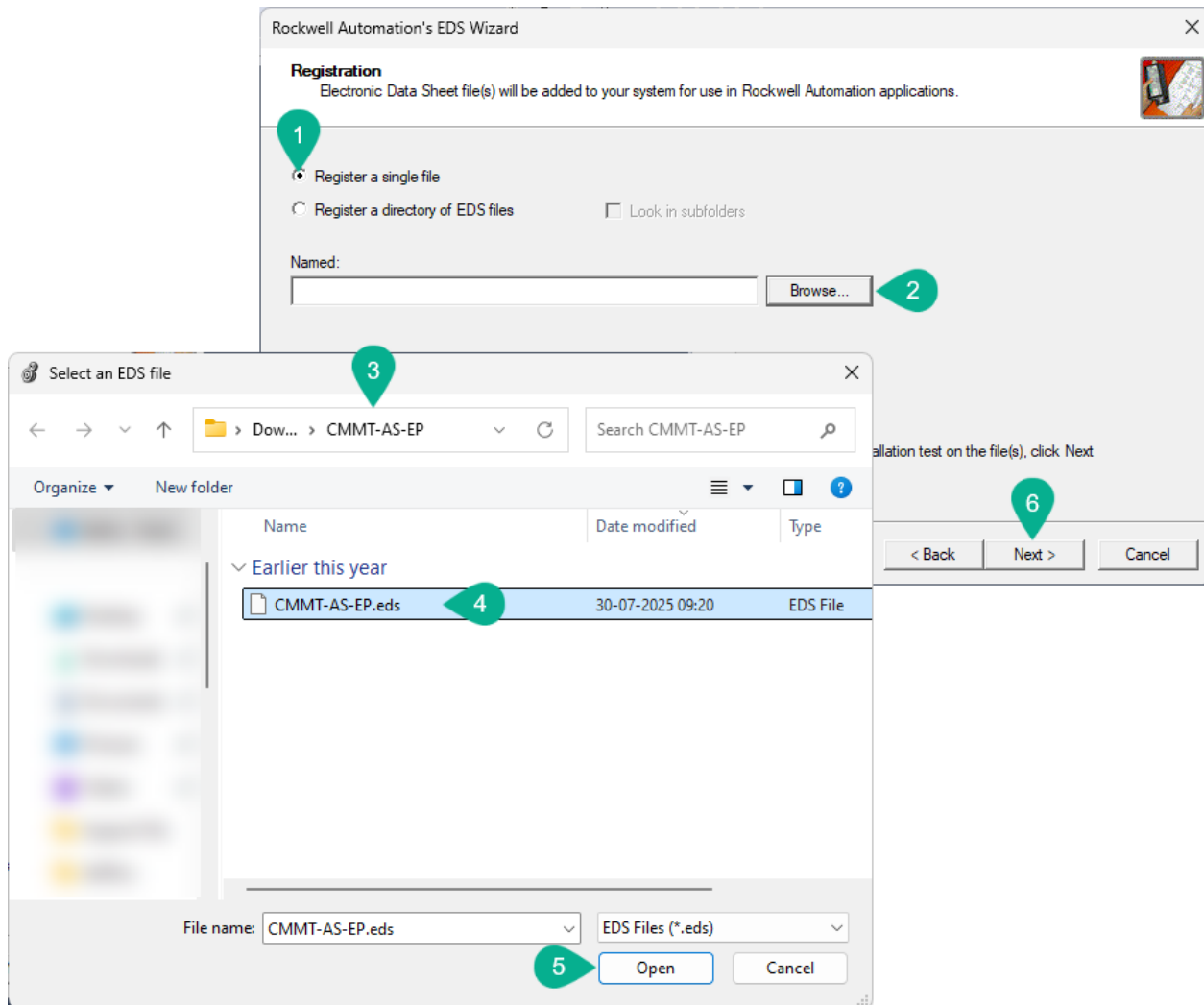
1. Click the **Tools** from tool bar.
2. Select **EDS Hardware Installation Tool** from tools drop-down menu.
3. Click **Next** from EDS installation wizard.

### Step-2



1. Select **Register an EDS file(s)** from the listed options.
2. Select **Next** for next level.

### Step-3

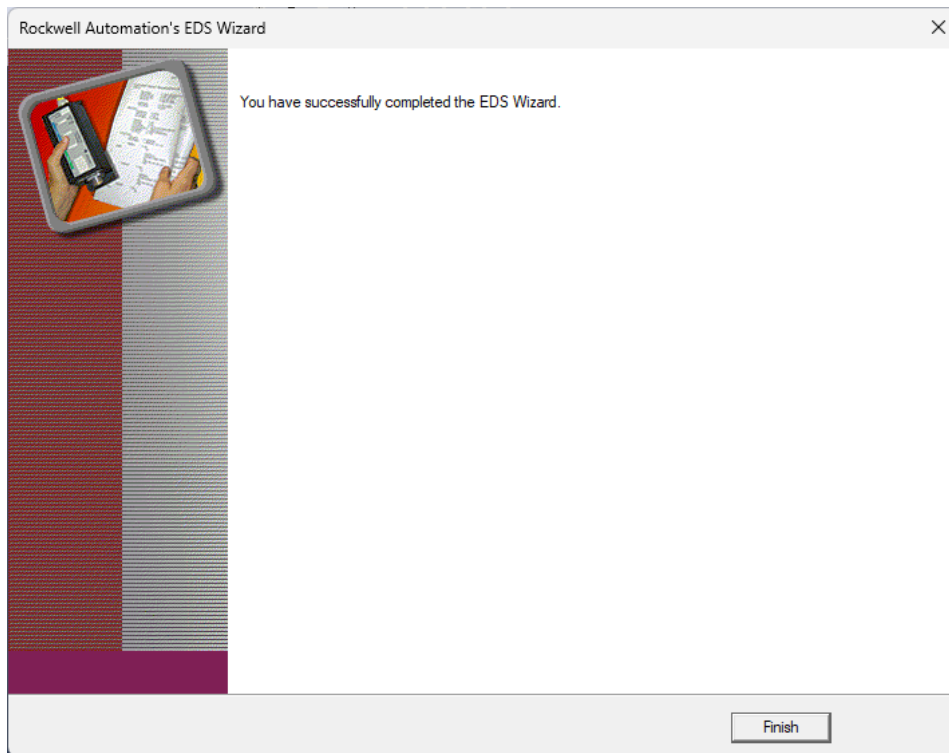


1. Select **Register a single file** option to add an individual EDS file.
2. Click on the **Browse** button to open the file selection window.
3. Navigate to the folder where the EDS file is **located**.
4. Select the required EDS file (e.g., **CMMT-AS-EP.eds**).
5. Click on **Open** to confirm the file selection.
6. Click on **Next** to proceed with the registration process.



#### Note

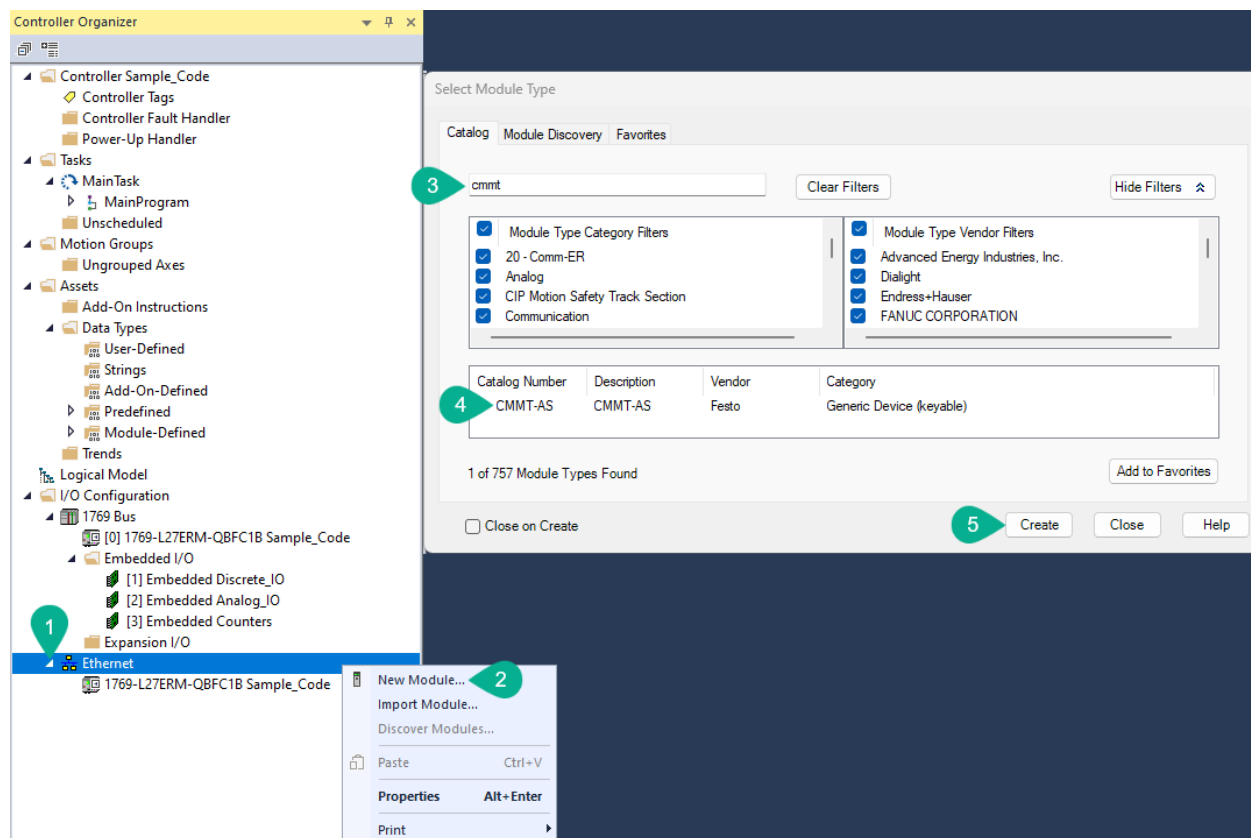
- Simply click the **Next** button in the upcoming configuration wizards to proceed and continue until you reach the final window as shown in the next step.

**Step-4**

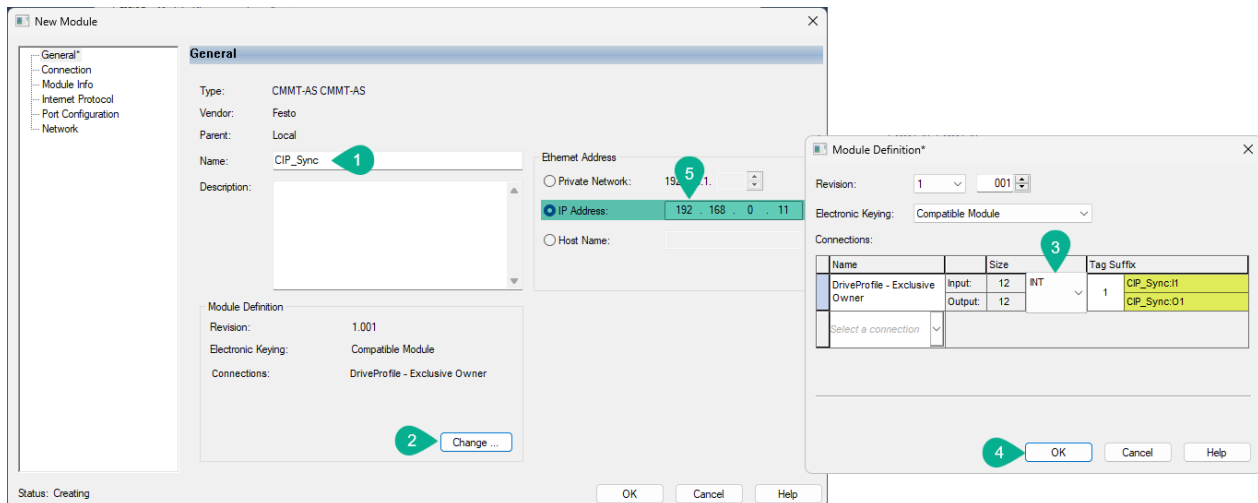
Click **Finish** button to complete the installation of EDS file installation.

## 5.3 Adding CMMT-AS Drive into the network

### Step 1



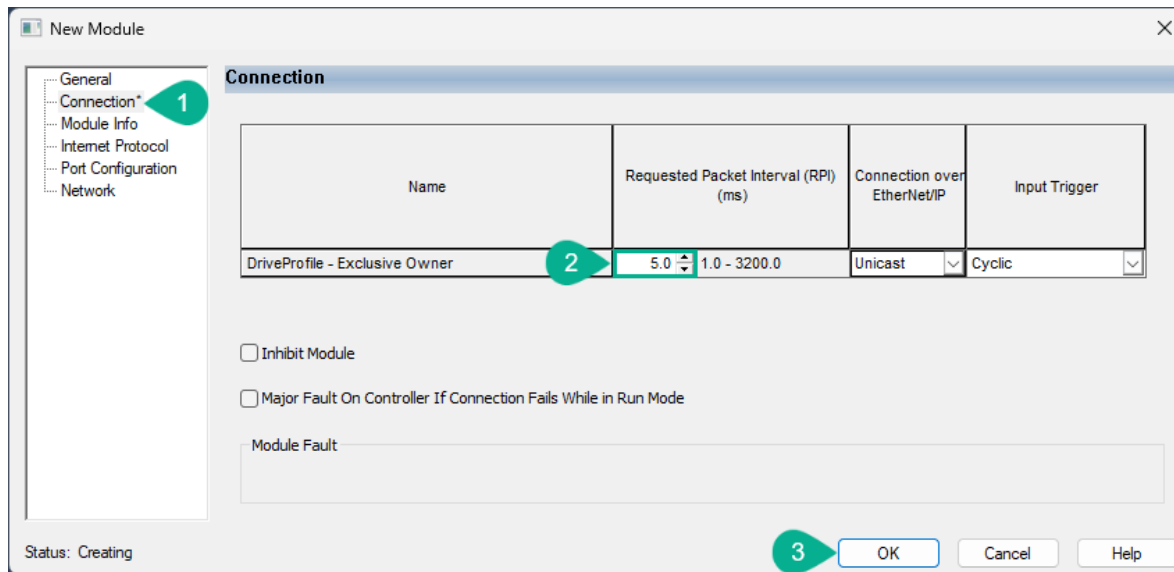
1. Right-click on **Ethernet** under the controller name in the **Controller Organizer** pane.
2. Select **New Module...** from the context menu.
3. In the **Select Module Type** window, enter **cmmt** in the search bar to filter the modules.
4. Select the module **CMMT-AS** from the filtered list.
5. Click on **Create** to add the selected module to user project.

**Step 2**

1. Enter the module **Name** (e.g., **CP\_Sync**) in the General tab.
2. Click on **Change...** to modify the module definition.
3. In the **Module Definition** window, select the appropriate **Connection**, choose the **INT** data type,
4. Click **OK** to confirm the module definition changes.
5. Enter the **IP Address** for the module under the Ethernet Address section.

**Note**

- Select the **Private Network** option for the Ethernet address when the IP series starts with **192.168.1.xx**. For different IP series, select the **IP Address** option.
- The names of the Input and Output tags will be displayed in the controller tags list, highlighted in **yellow**.

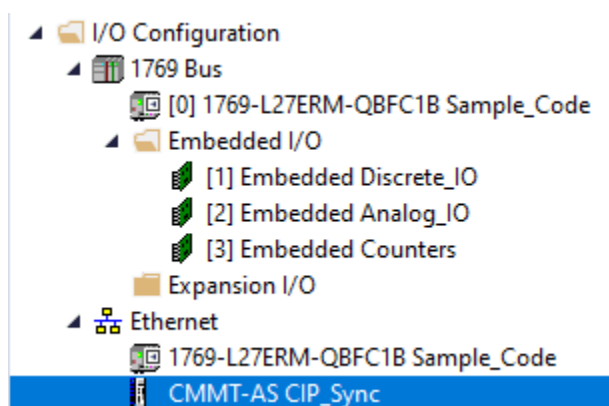
**Step 3**

1. In the **New Module** setup, navigate to the **Connection** tab.
2. Make certain the **Requested Packet Interval (RPI)** value is entered in the designated field based on the calculation **Motion Group Base Update Period + 1ms**.
3. Click **OK** to finalize the module configuration and close the dialog.

**Note**

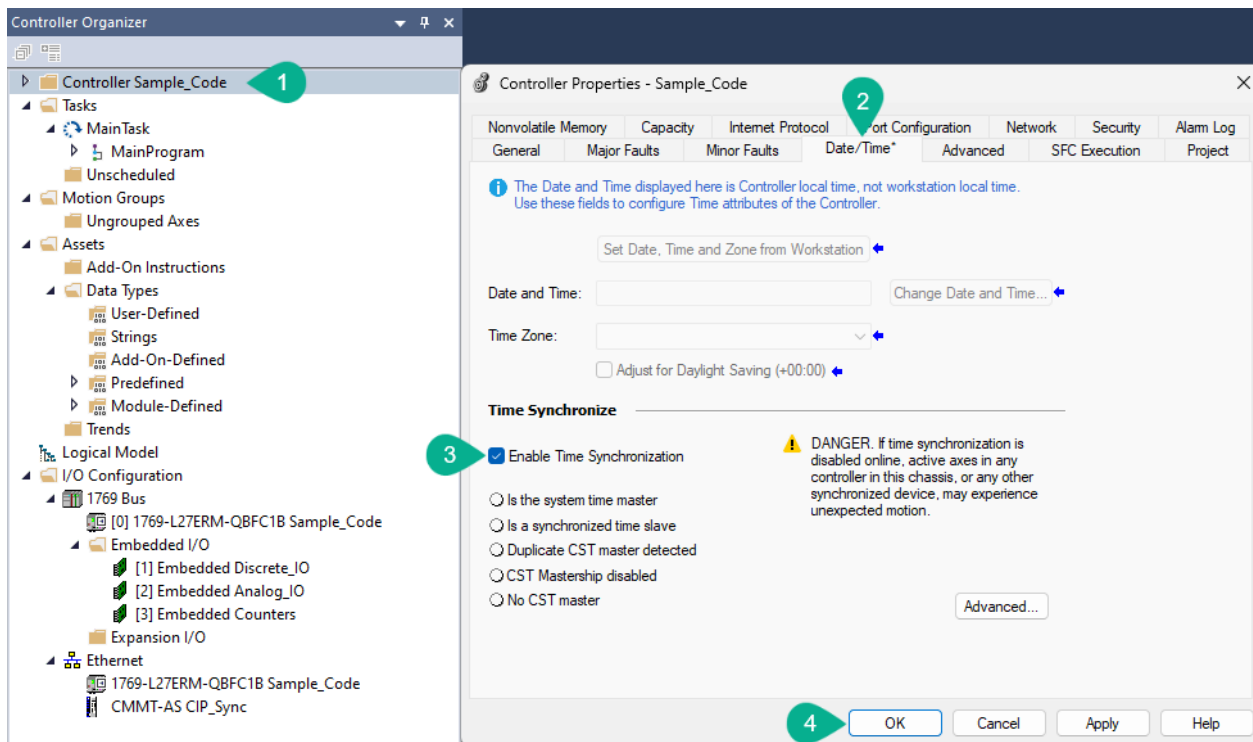
- The Read Process Data is performed by the RPI (Requested Packet Interval) Specified within the connection shown above. The Write Process Data is performed by the **Motion\_Group\_Event** task configured Event and its PLC code at the specified interval of the task. A conflict will be created if a value lower than the **Motion\_Group\_Event** configuration is used.
- Set the **RPI** longer than the Base Update Period. The recommended RPI is the **Motion Group Base Update Period + 1ms**. (e.g., 4ms + 1ms = **5ms**). Reference **Motion Group Base Update Period** [Chapter 5.6.1](#) Step 2.

After completing the EDS file configuration, the new module will appear in the Ethernet tree as shown in the picture below.



## 5.4 Controller Configuration for Motion Control with CIP Synchronize

### 5.4.1 Enable Time Synchronization for CompactLogix PLC



1. Double-click on the **Controller Sample\_Code** in the Controller Organizer pane. The **Controller Properties** window will appear.
2. Select to the **Date/Time** tab under **Controller Properties**.
3. Check the box for **Enable Time Synchronization** under the **Time Synchronize** section.
4. Click **OK** to save the changes and enable timer synchronization.

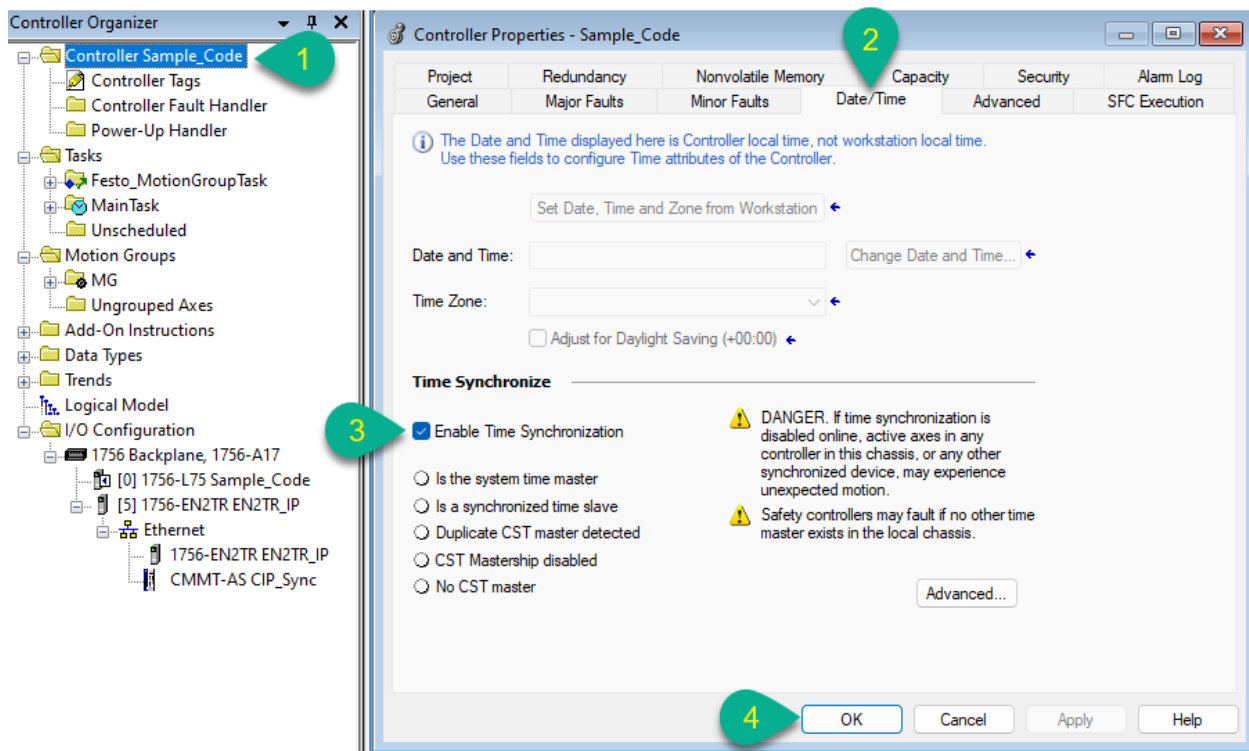


#### Note

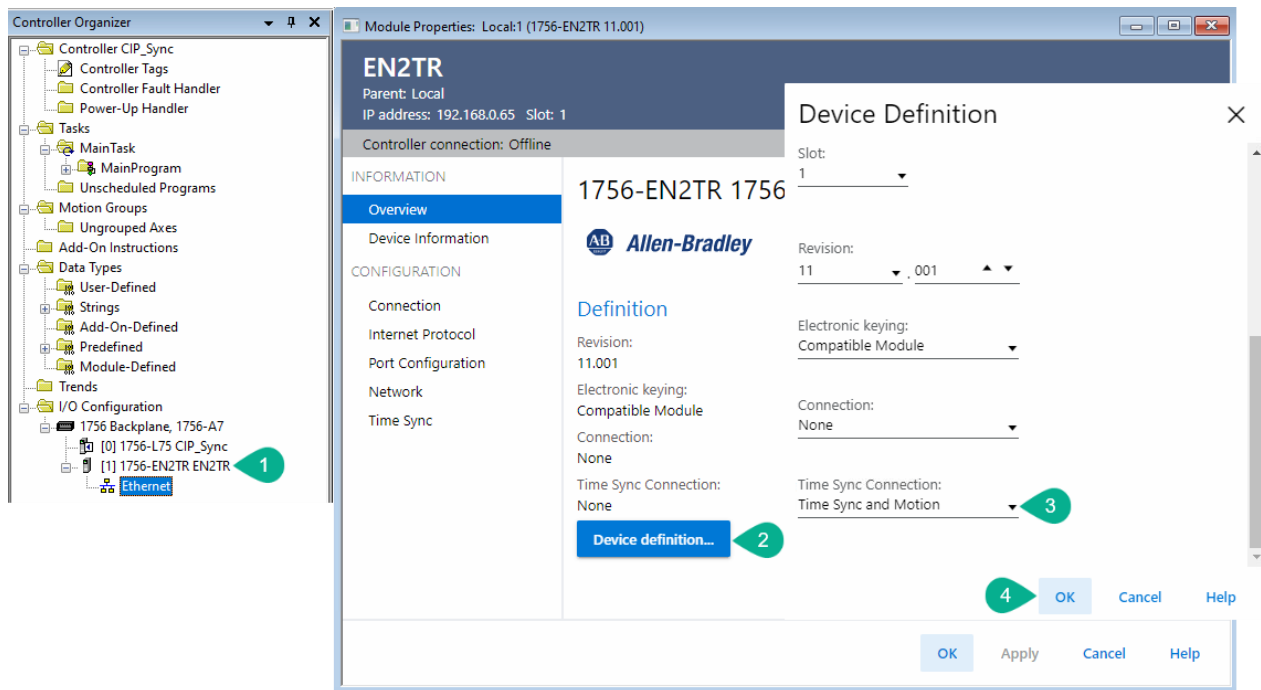
- If using a **ControlLogix** PLC, please follow the procedure below to enable time synchronization.

## 5.4.2 Enable Time Synchronization for a ControlLogix PLC

### Step 1



1. Double-click on the **Controller Sample\_Code** in the Controller Organizer pane. The **Controller Properties** window will appear.
2. Select to the **Date/Time** tab under **Controller Properties**.
3. Check the box for **Enable Time Synchronization** under the **Time Synchronize** section.
4. Click **OK** to save the changes and enable time synchronization.

**Step 2**

In addition to the ControlLogix PLC Controller settings, any EtherNet/IP Master being used for connection to the CMMT devices must also be configured for **Time Sync and Motion**.

1. In the **Controller Organizer**, navigate to the **I/O Configuration** and select the Ethernet module (e.g., [1] **1756-EN2TR EN2TR**) as shown.
2. In the **Module Properties** window, click on **Device definition...** to access the configuration settings for the Ethernet Bridge module.
3. In the **Device Definition** window, set the **Time Sync Connection** parameter to **Time Sync and Motion** from the dropdown menu.
4. Click **OK** to save the configuration.

### Step 3

The image shows two screenshots from the Allen-Bradley Studio 500 configuration software.

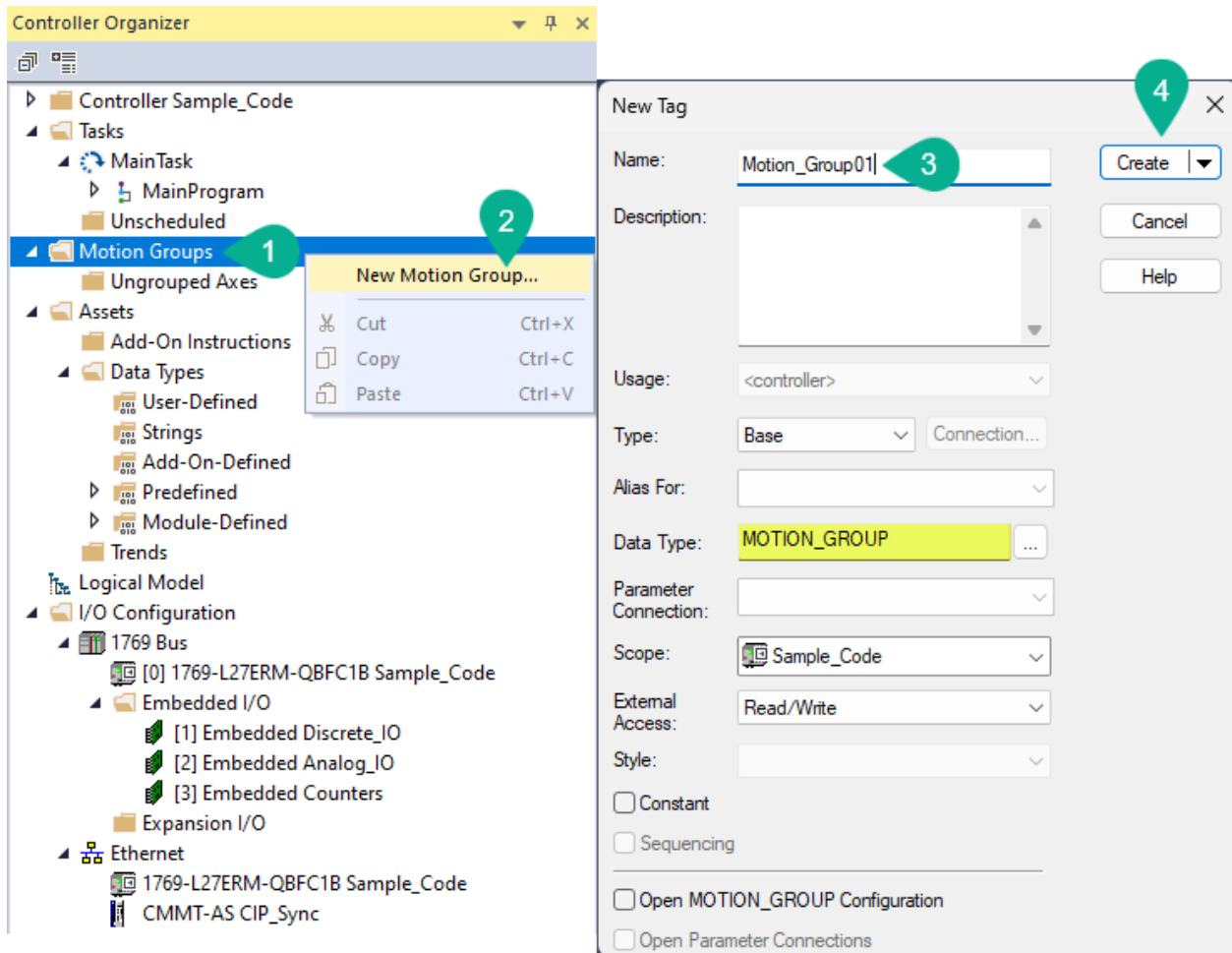
The top screenshot is the 'Controller Properties - Sample\_Code' dialog box. It has tabs for Project, Redundancy, Nonvolatile Memory, Capacity, Security, and Alarm Log. The 'Date/Time' tab is selected. It contains a warning: 'The Date and Time displayed here is Controller local time, not workstation local time. Use these fields to configure Time attributes of the Controller.' Below this are fields for 'Date and Time', 'Time Zone', and a checkbox for 'Adjust for Daylight Saving (+00:00)'. There is a 'Set Date, Time and Zone from Workstation' button. The 'Time Synchronize' section has a checked 'Enable Time Synchronization' button and several radio button options: 'Is the system time master', 'Is a synchronized time slave', 'Duplicate CST master detected', 'CST Mastership disabled', and 'No CST master'. There are also two warning icons with text: 'DANGER. If time synchronization is disabled online, active axes in any controller in this chassis, or any other synchronized device, may experience unexpected motion.' and 'Safety controllers may fault if no other time master exists in the local chassis.' At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

The bottom screenshot is the 'EN2TR' device configuration page. It shows the device name '1756-EN2TR 1756 10/100 Mbps Ethernet Bridge, 2...'. The 'Definition' section shows 'Revision: 11.001', 'Electronic keying: Compatible Module', 'Connection: None', and 'Time Sync Connection: Time Sync and Motion' (highlighted in yellow). There is a 'Device definition...' button. The 'Time Sync' option is also highlighted in yellow. At the bottom are 'OK', 'Apply', 'Cancel', and 'Help' buttons.

Once **Time Sync and Motion** is enabled, the configuration will appear as shown in the image above, highlighted in yellow. Click **OK** to save the changes.

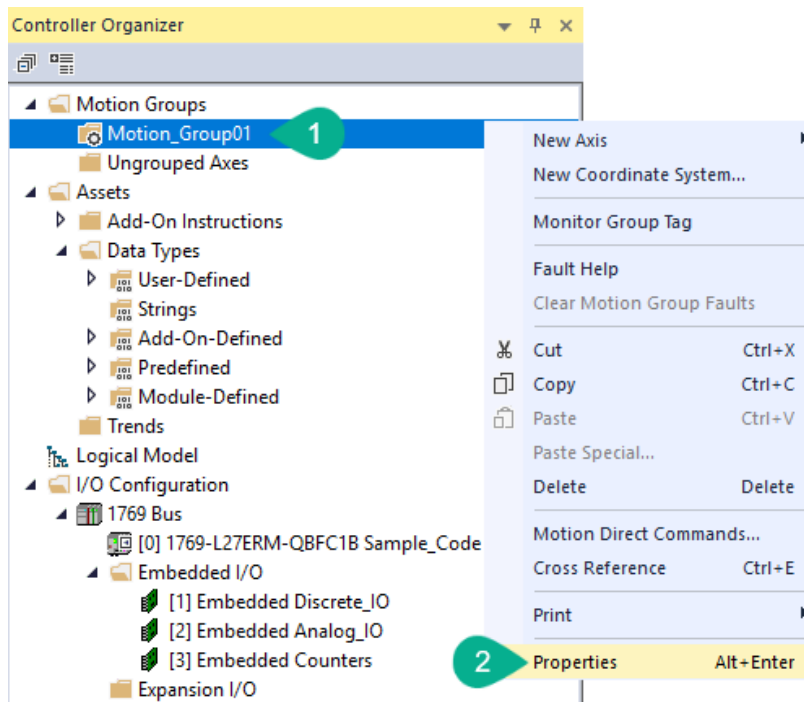
### 5.4.3 Add and Configure Motion Group

#### Step 1



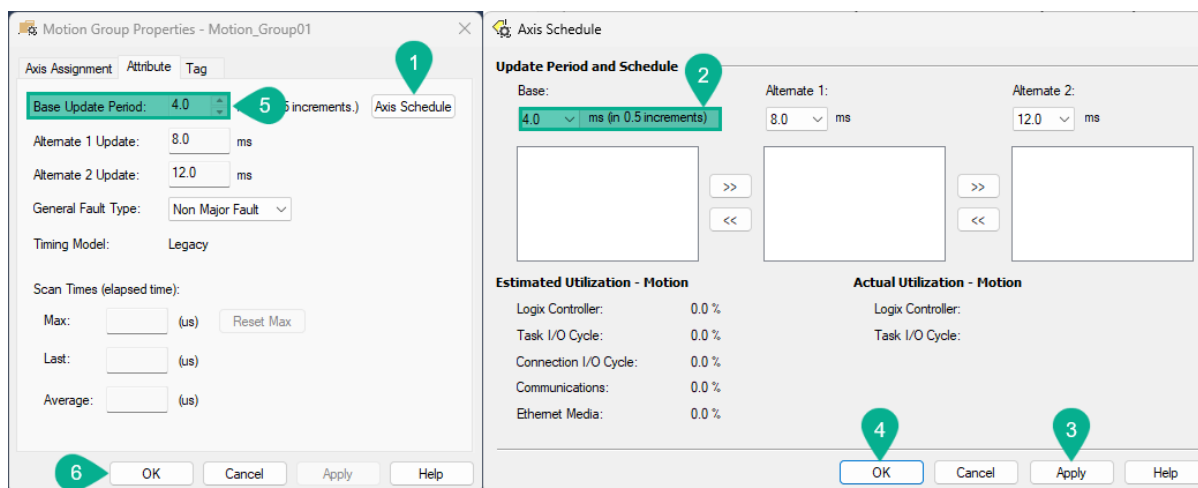
1. In the Controller Organizer pane, right-click on **Motion Groups**.
2. Select **New Motion Group...** from the context menu.
3. In the **New Tag** window, enter the name (e.g., **Motion\_Group01**) and ensure the **Data Type** is set to **MOTION\_GROUP**, as highlighted in yellow.
4. Click **Create** to add the new motion group.

## Step 2



1. In the Controller Organizer pane, right-click on **Motion\_Group01**.
2. Select **Properties** from the context menu.

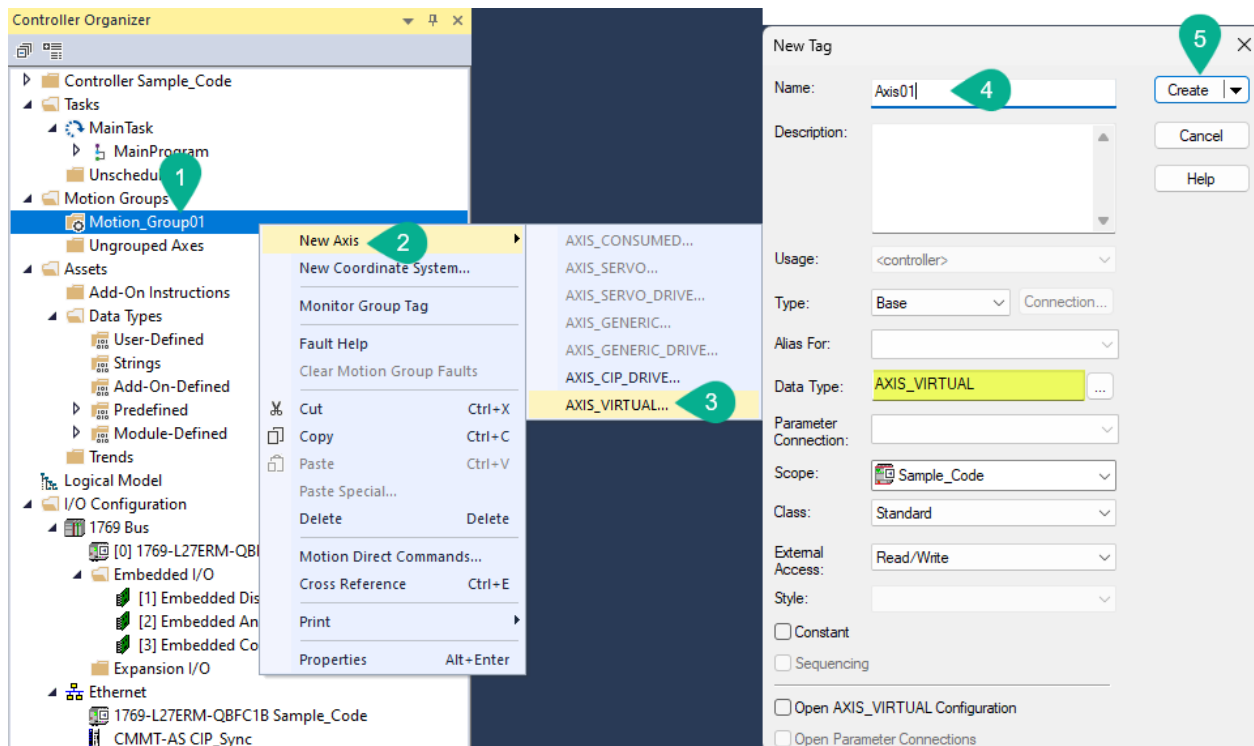
## Step 3



1. On the **Attribute** tab, click the **Axis Schedule** button to open the Axis Schedule dialog.
2. In the **Axis Schedule** dialog, set the **Base update period** from the drop-down to the desired value (in milliseconds).
3. Click **Apply** in the Axis Schedule dialog to save schedule changes without closing the dialog.
4. Click **OK** in the Axis Schedule dialog to return to Motion Group Properties.
5. Verify the Base Update Period field in Motion Group Properties now shows the selected value.
6. Click **OK** in the Motion Group Properties dialog to save and close.

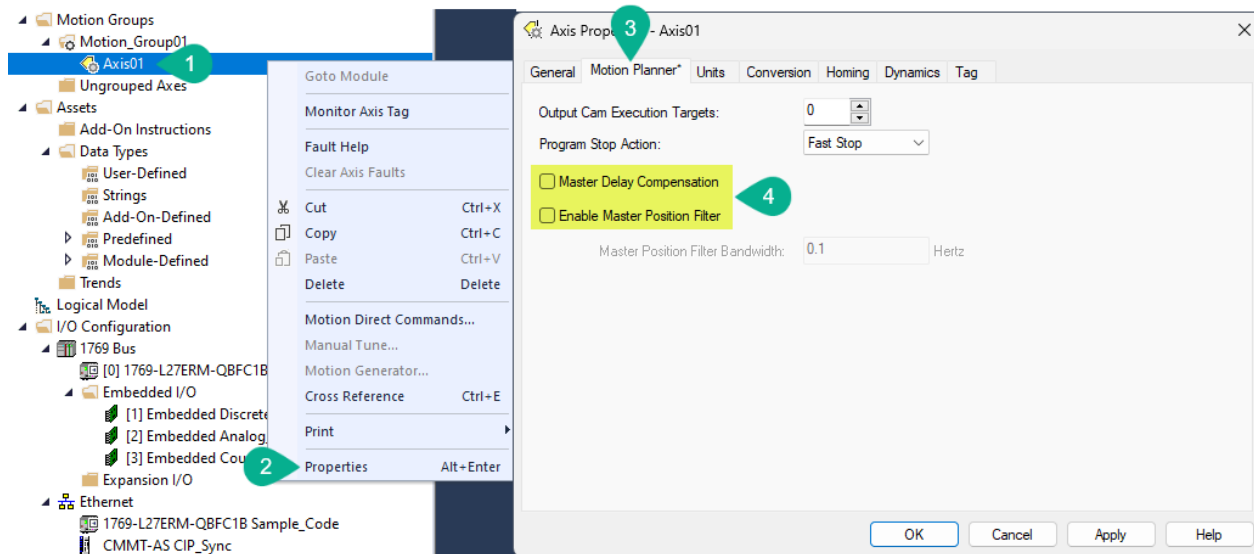
### 5.4.4 Add and Configure Motion Group Axis

#### Step 1



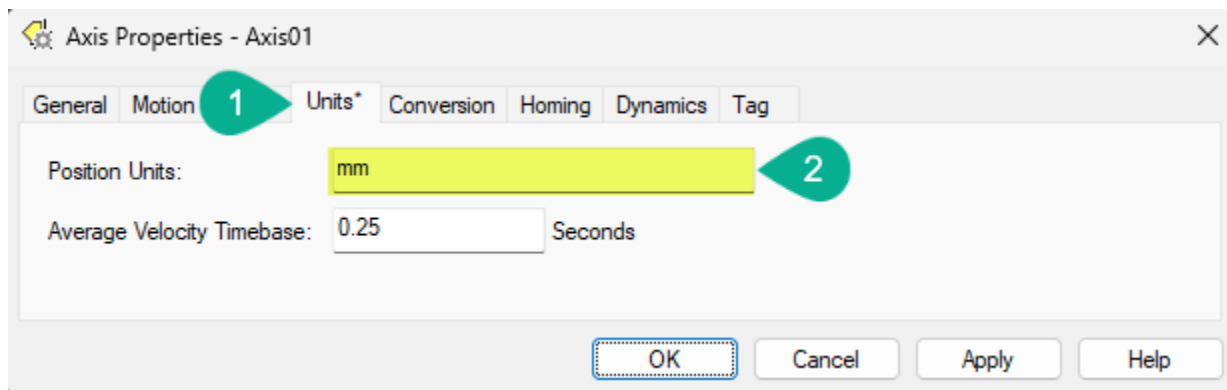
1. In the Controller Organizer, **right-click** on the motion group (e.g., **Motion\_Group01**).
2. Select **New Axis** from the context menu.
3. Choose **AXIS\_VIRTUAL** from the list and ensure the **Data Type** is set to **AXIS\_VIRTUAL**, as highlighted in yellow.
4. In the **New Tag** window, enter the axis name (e.g., **Axis01**).
5. Click **Create** to add the new axis.

## Step 2

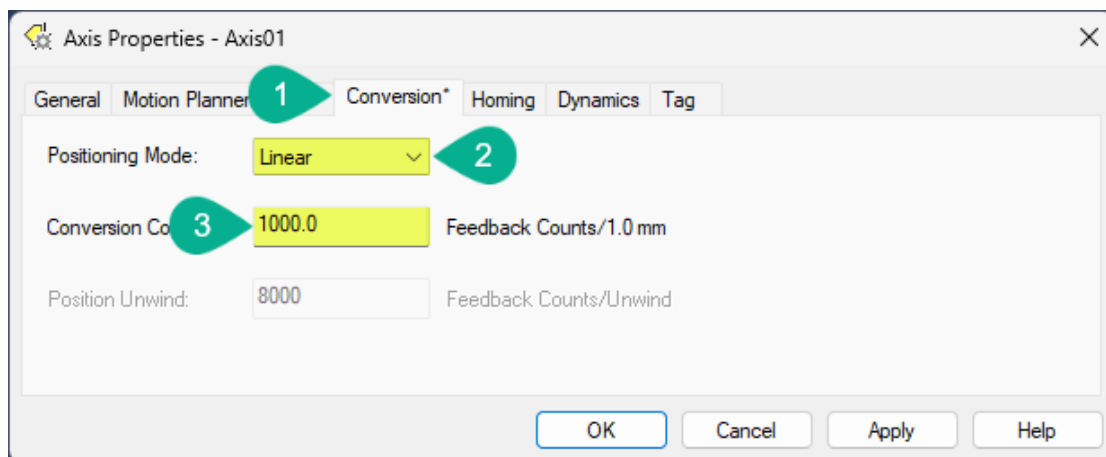


1. In the Controller Organizer pane, **right-click** on the axis (e.g., **Axis01**) under **Motion\_Group01**.
2. Select **Properties** from the context menu.
3. In the **Axis Properties** window, go to the **Motion Planner** tab.
4. Verify that the options **Master Delay Compensation** and **Enable Master Position Filter** are **disabled** by ensuring their corresponding checkboxes remain unchecked, as highlighted in yellow.

## Step 3



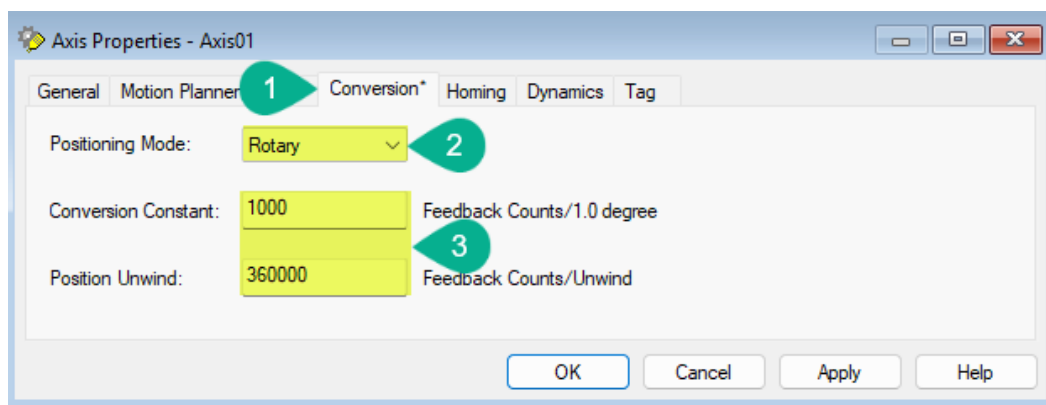
1. In the **Axis Properties** window, navigate to the **Units** tab.
2. Set the **Position Units** to **mm**, as highlighted in yellow, to match the **FAS** (e.g., mm/rev, degree).

**Step 4****Mode: Linear**

1. In the **Axis Properties** window, navigate to the **Conversion** tab.
2. From the **Positioning Mode** dropdown, make the default selection of **Linear** as highlighted in yellow.
3. Confirm the **Conversion Constant** default value is 1000.0 as highlighted in yellow.

**Note**

- When the **Positioning Mode** is set to **Linear**, the maximum total linear travel is 1,000,000,000 feedback counts.

**Mode: Rotary**

1. In the **Axis Properties** window, navigate to the **Conversion** tab.
2. From the **Positioning Mode** dropdown, select the desired mode (e.g., **Rotary**).
3. Verify the conversion parameters highlighted in yellow:
  - **Conversion Constant** is set to **1000.0** (Feedback Counts / 1.0 degree).
  - **Position Unwind** is set to **360000** (Feedback Counts / Unwind).

**Note**

- Calculating the Conversion Constant and Position Unwind will result in the value shown in parameter P.102964.
- $$P.102964 = \frac{\text{Position Unwind}}{\text{Conversion Constant}}$$
- The scaling values shown in this example (e.g. **Conversion Constant = 1000** and **Position Unwind = 360000** for a **360°** revolution) are only reference values. They must be adapted to the actual application, considering the encoder/drive resolution, any gear ratio between motor and load, and the required positioning accuracy and motion range. Always verify the final scaling on the real machine before commissioning.

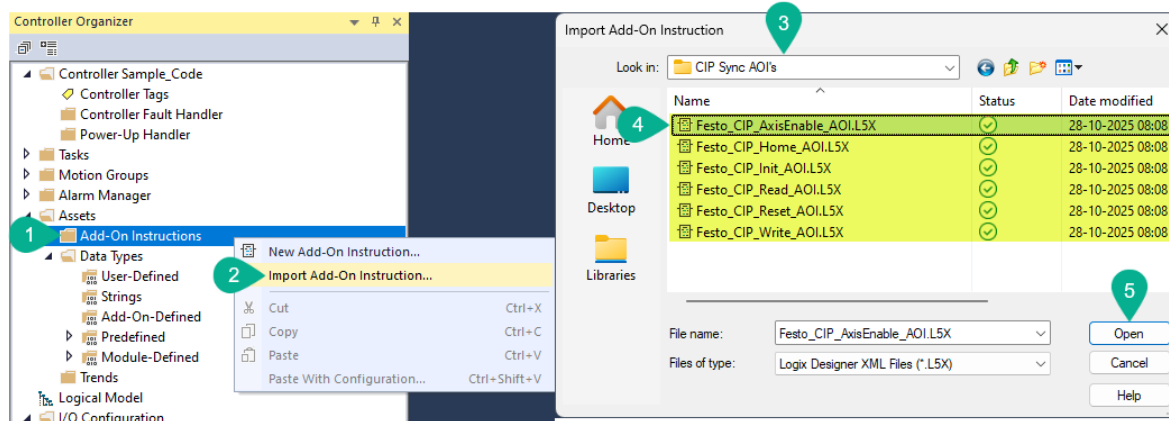
**Step 5**

| Page View                                                                                            |                                                                                                                                      | List View                                                                                                                                                                                                                                                         |  |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Parameter Pages</b><br>Profiles<br>CiA 402<br>PROFdrive<br>Factor Group<br>Telegram               | <b>Dynamic Values</b><br>Acceleration: 5.00 m/s <sup>2</sup><br>Deceleration: 5.00 m/s <sup>2</sup><br>Jerk: 500.00 m/s <sup>3</sup> | <b>Telegram</b><br>ID   Name   Value   Unit<br>/Axis1/PROFdrive motion group[0] (5)<br>P1.11280402.0.0   Acceleration   5.00   m/s <sup>2</sup><br>P1.11280403.0.0   Deceleration   5.00   m/s <sup>2</sup><br>P1.11280404.0.0   Jerk   500.00   m/s <sup>3</sup> |  |
| <b>Parameter Pages</b><br>Axis 1<br>Motor<br>Gearbox<br>Axis<br>Record Table<br>Monitoring Functions | <b>Limit Velocity</b><br>Maximum (v_max): 4.999632 m/s                                                                               | <b>Monitoring Functions</b><br>ID   Name   Value   Unit<br>/Axis1/Movement monitoring group[0] (26)<br>P1.4660.0.0   Maximum velocity   4.999632   m/s                                                                                                            |  |

- In the **Axis Properties** window, navigate to the **Dynamics** tab.
- Adjusted Dynamics to match or correlate the Festo Automation Suite parameter configuration as shown in the above example using either the Page or List view of your project:
  - Maximum Speed:** 4999.632 mm/s
  - Maximum Acceleration:** 5000.0 mm/s<sup>2</sup>
  - Maximum Deceleration:** 5000.0 mm/s<sup>2</sup>
  - Maximum Acceleration Jerk:** 500000.0 mm/s<sup>3</sup>
  - Maximum Deceleration Jerk:** 500000.0 mm/s<sup>3</sup>
- Once all values are entered, click **OK** to save the settings.

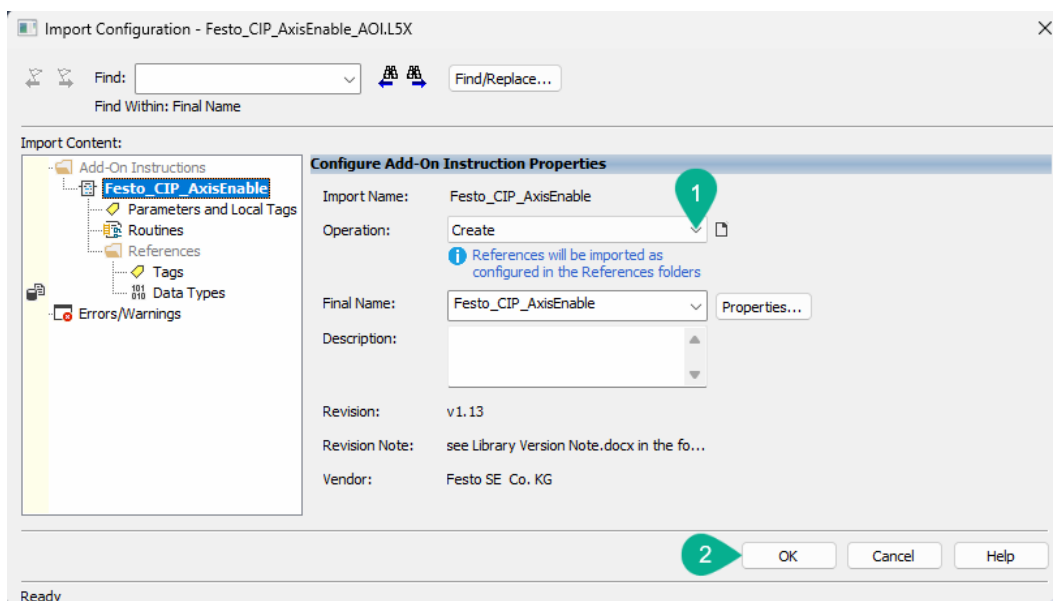
## 5.5 Importing and configuring the CIP\_Sync AOIs

### Step 1



1. In the **Controller Organizer**, right-click on **Add-On Instructions** under the **Assets** folder.
2. From the context menu, select **Import Add-On Instruction...** to begin importing AOIs.
3. In the **Import Add-On Instruction** dialog box, navigate to the folder containing the AOI files (e.g., **CIP Sync AOI's**).
4. Select the AOI file **Festo\_CIP\_AxisEnable\_AOI.L5X** for import into the project.
5. Click the **Open** button to initiate the import of the selected AOI.

### Step 2



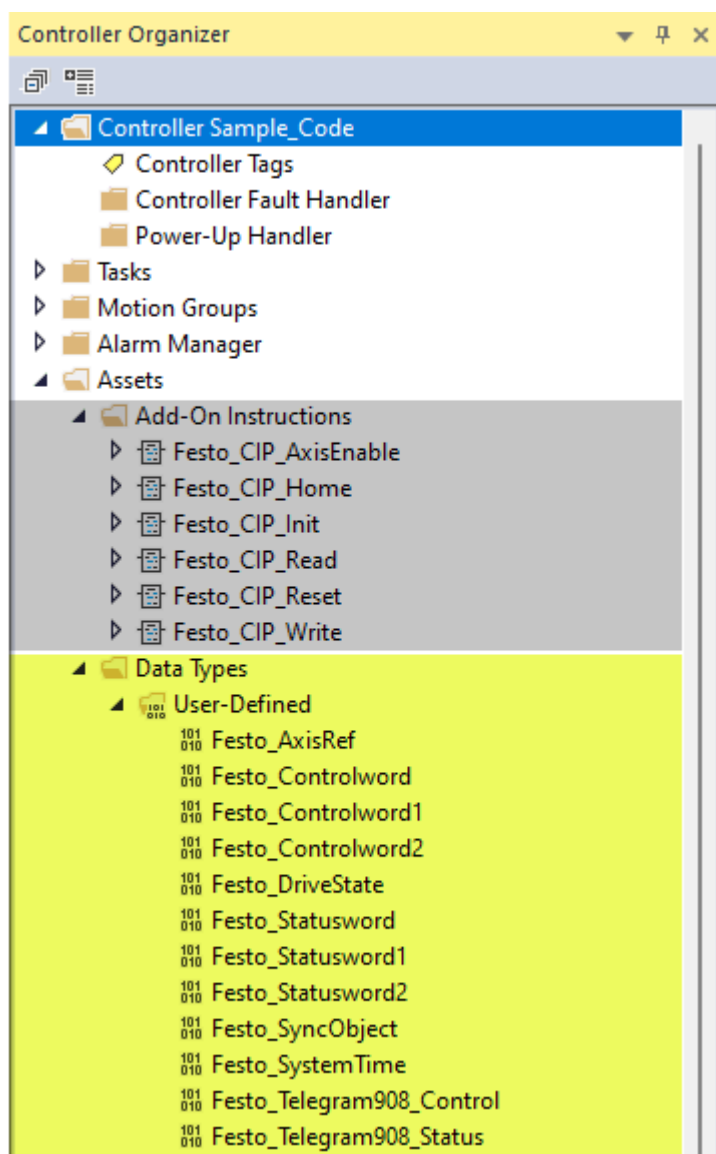
1. In the **Import Configuration** dialog for AOI, review the Add-On Instruction properties as follow:
  - **Operation:** Select **Create** to add the AOI as a new instruction in the project.
2. Click the **OK** button to complete the import process.



#### Note

- Repeat this procedure for each remaining AOI file to ensure all necessary instructions are incorporated, which is essential for the complete and correct configuration of the application.

After all, AOIs have been successfully imported, the **Controller Organizer** will appear as shown in the image below.



### Add-On instruction

The Add-On Instructions section lists the imported AOIs, including **Festo\_CIP\_AxisEnable**, **Festo\_CIP\_Home**, **Festo\_CIP\_Init**, **Festo\_CIP\_Read**, **Festo\_CIP\_Reset**, and **Festo\_CIP\_Write**.

### User Defined Data Type

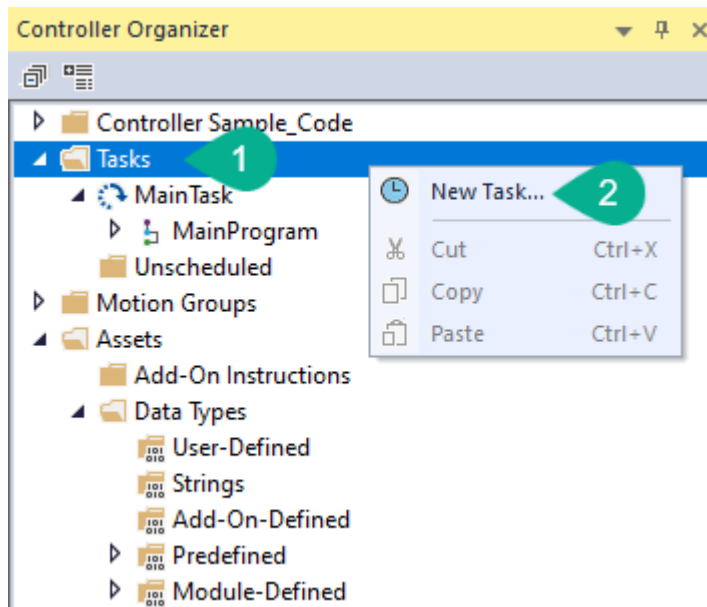
such as **Festo\_AxisRef**, **Festo\_Controlword**, **Festo\_DriveState**, **Festo\_Statusword**, **Festo\_Position**, and **Festo\_Velocity**, among others, are listed as shown in the image above.

## 5.6 Motion\_Task Configuration

The Motion\_Task and its routine are used to Read and Write Process Data to all Festo CMMT drives.

### 5.6.1 Adding a Motion Task

#### Step 1



1. In the Controller Organizer pane, **right-click** on **Tasks** as shown in the image.
2. Select **New Task...** from the context menu that appears.

## Step 2

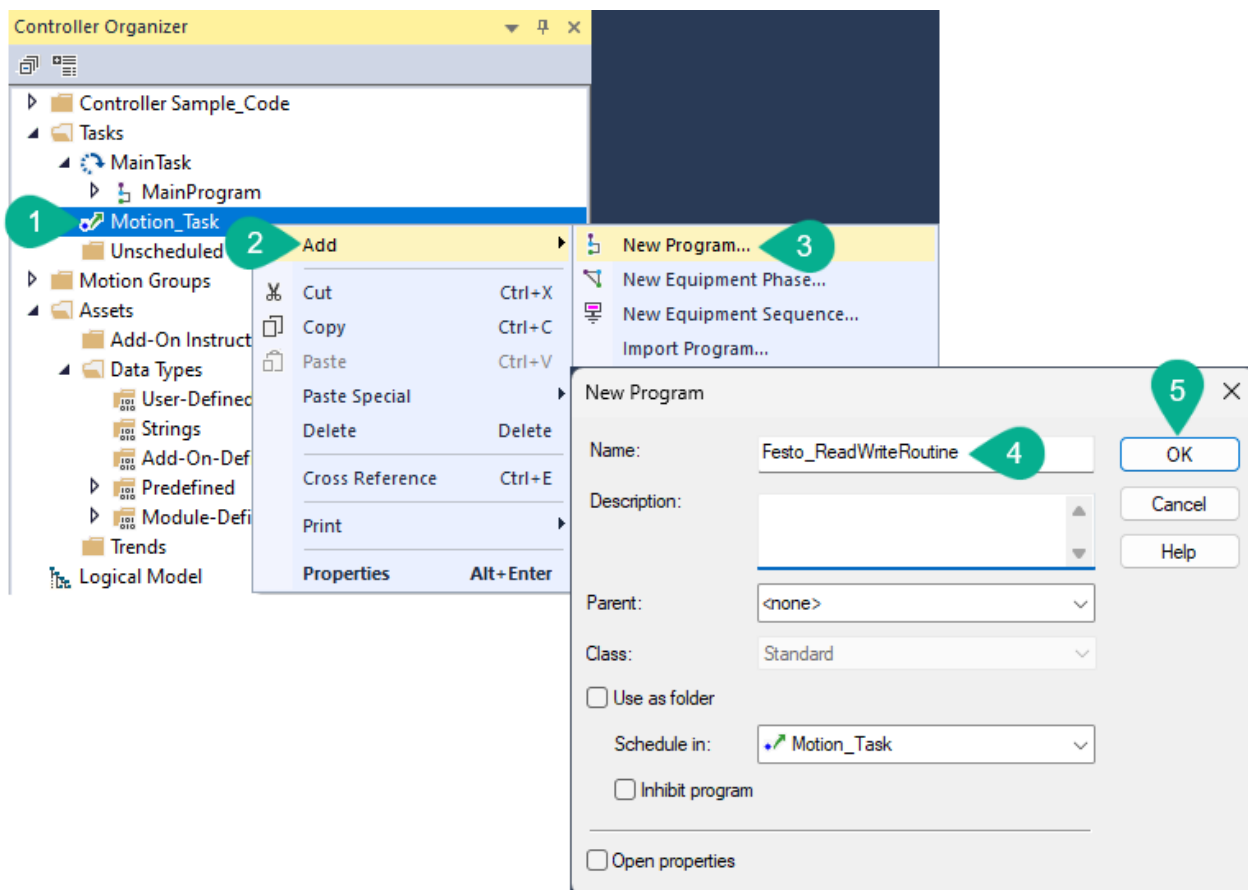
1. In the task configuration window, enter the task name (e.g., **Motion\_Task**) in the **Name** field.
2. Set the **Type** to **Event** from the dropdown menu.
3. Select **Motion Group Execution** as the **trigger** type from the dropdown menu.
4. From the **Tag** dropdown, choose the motion group (e.g., **Motion\_Group01**).
5. Enable the option **Execute task if no event occurs within** and set the time to **4 ms** (This value may be changed later depending on the total number of axes in the project. This value must match the setting for Motion\_Group01; [see chapter 5.4.3](#) Step 3).
6. Set the **Priority** to a value of **1** to achieve the highest priority.
7. Configure the **Watchdog Timeout** to **100.000 ms**.
8. Confirm checkbox **Disable automatic output processing to reduce task overhead** is turned ON.
9. Click **OK** to save and create the task.



### Note

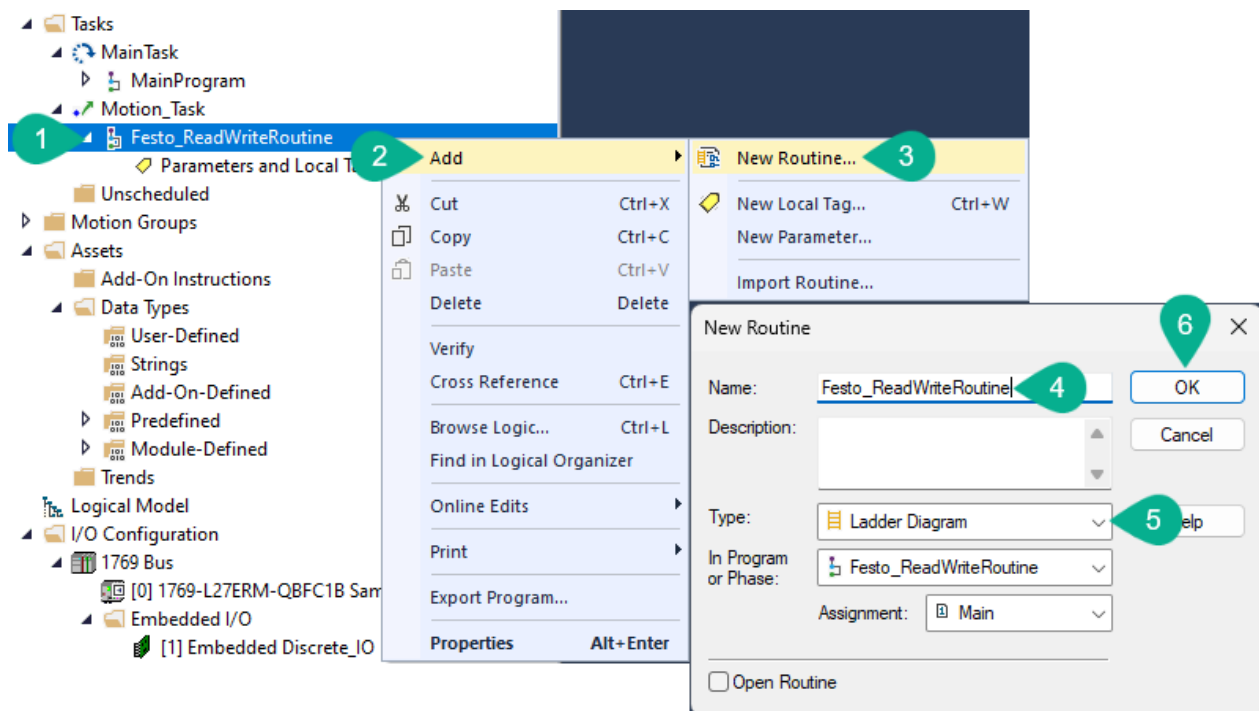
- The time value of **Execute task if no event occurs within Task Event Motion Group** must be set equal to the **Motion Group Base Update Period** time to ensure proper synchronization of the project settings.

### 5.6.2 Add a Motion Group Task Program



1. In the Controller Organizer, right-click on the task (e.g., **Motion\_Task**).
2. From the context menu, select **Add**.
3. Choose **New Program...** from the submenu.
4. In the **New Program** dialog box, enter the program name (e.g., **Festo\_ReadWriteRoutine**) in the **Name** field.
5. Click **OK** to create and add the new program under the selected task.

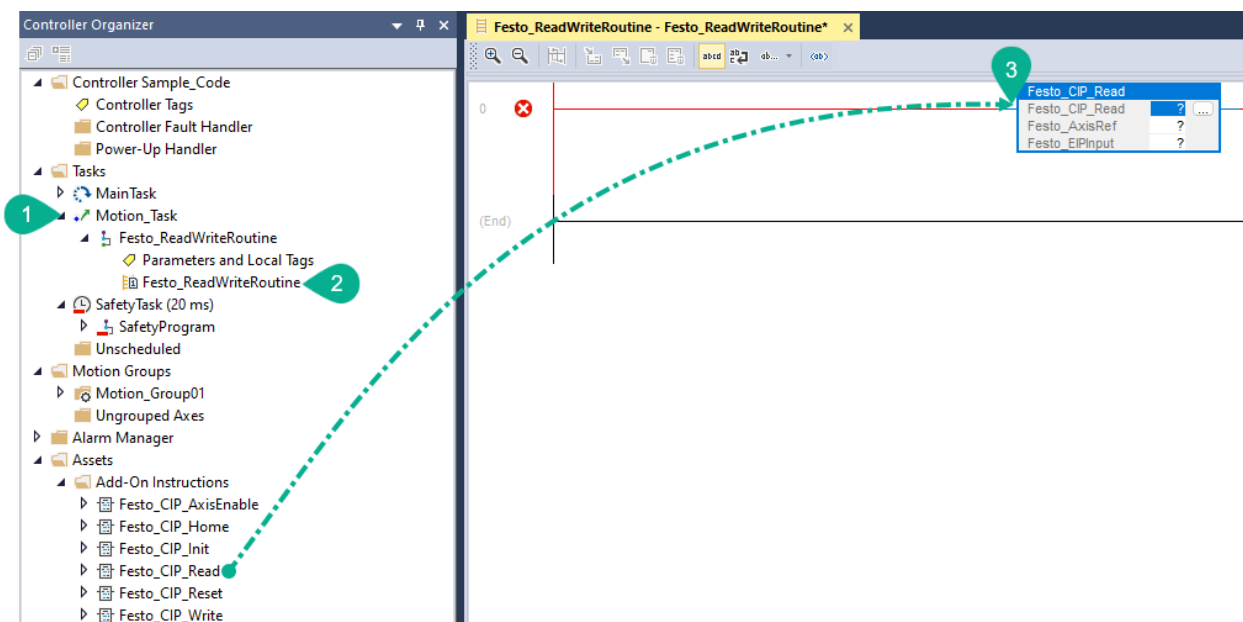
### 5.6.3 Add a Motion Group Task Program Routine



1. In the Controller Organizer, right-click on the program (e.g., **Festo\_ReadWriteRoutine**) under the task (e.g., **Motion\_Task**).
2. From the context menu, select **Add**.
3. Choose **New Routine...** from the submenu.
4. In the **New Routine** dialog box, enter the routine name (e.g., **Festo\_ReadWriteRoutine**) in the **Name** field.
5. Set the **Type** of programming language (e.g., **Ladder Diagram**) from the dropdown menu.
6. Click **OK** to create and add the new routine.

## 5.6.4 Add and Configure the AOI Festo\_CIP\_Read

### Step 1



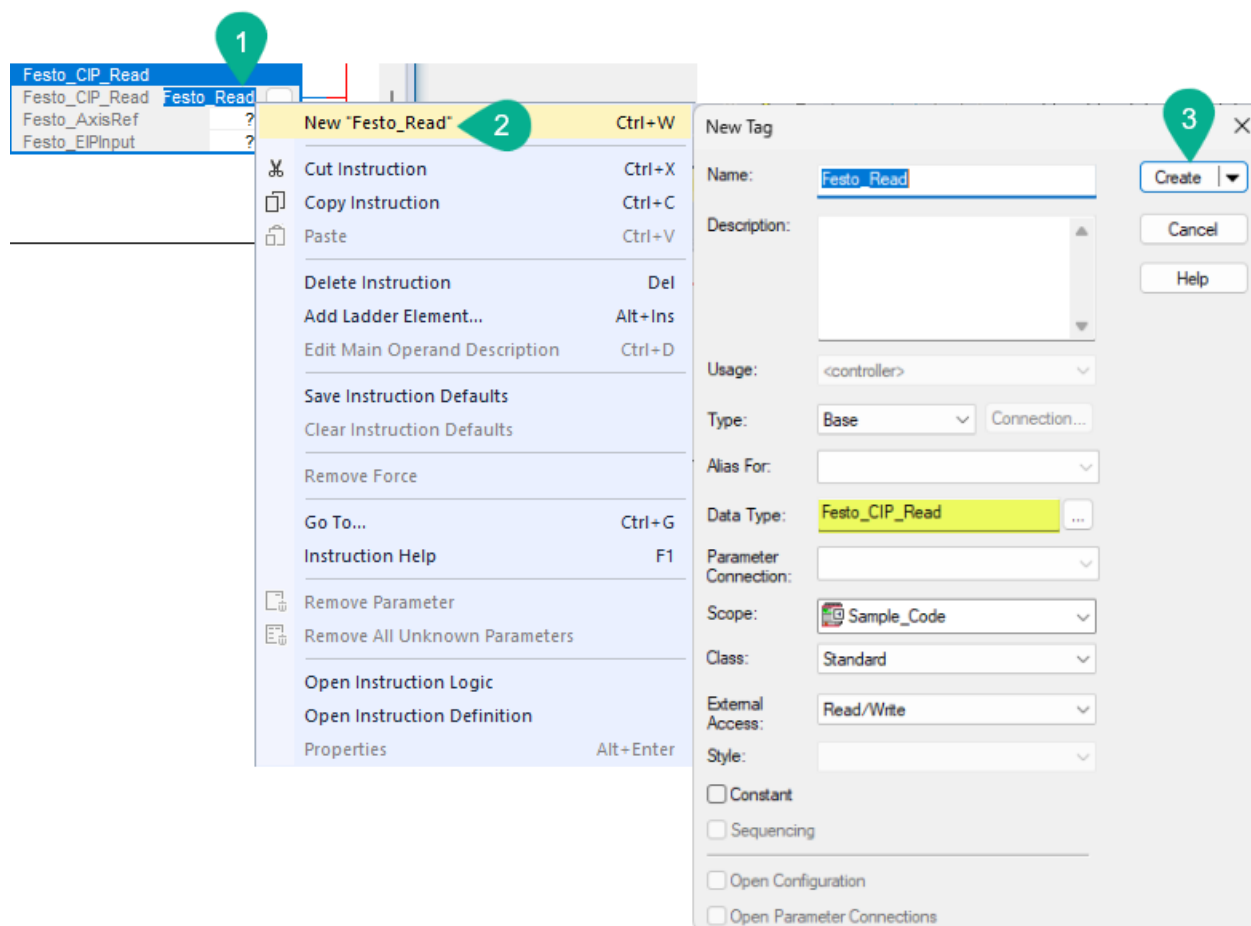
1. In the **Controller Organizer**, expand the **Motion\_Task** folder.
2. Double-click **Festo\_ReadWriteRoutine** under **Motion\_Task** to open it.
3. From the Add-On Instructions folder, drag and drop the **Festo\_CIP\_Read** AOI file into the routine editor as shown above.



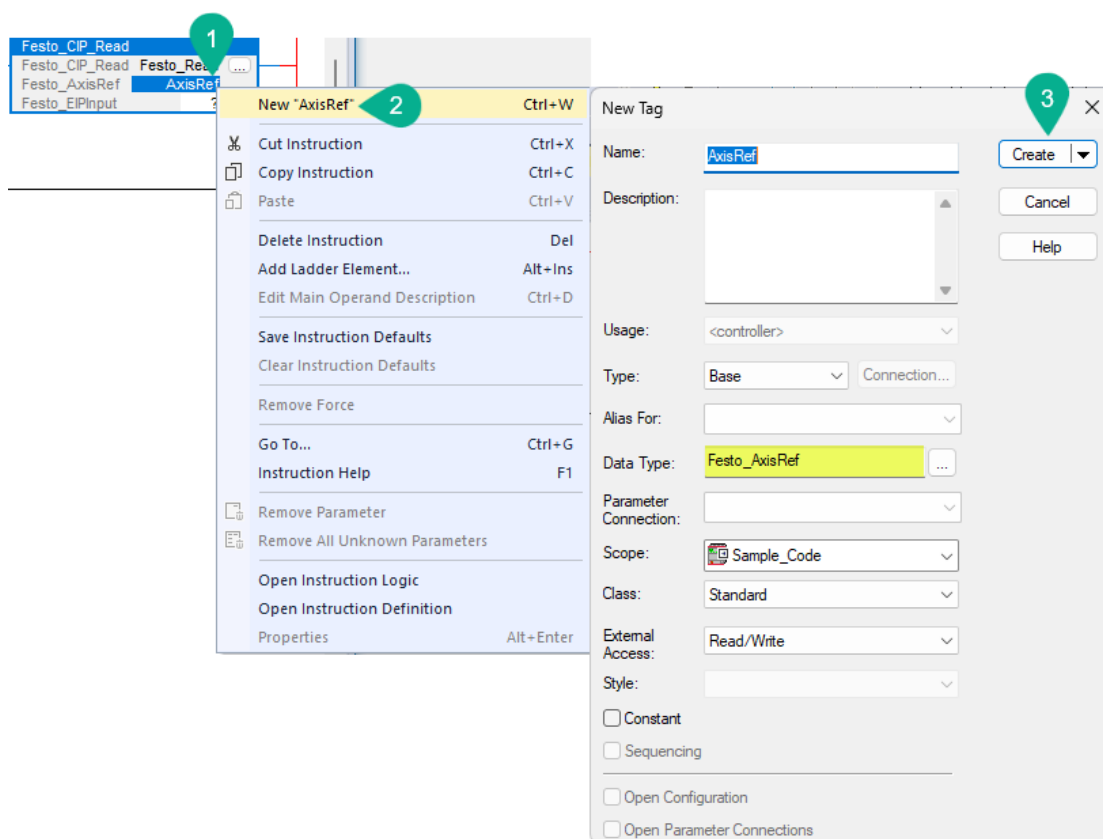
#### Note

- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this may cause the AOI to function incorrectly.

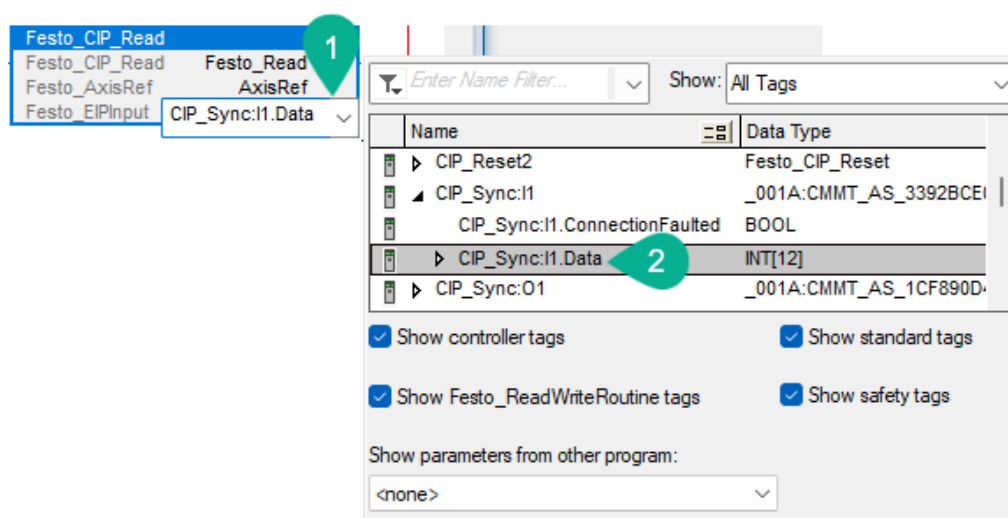
## Step 2



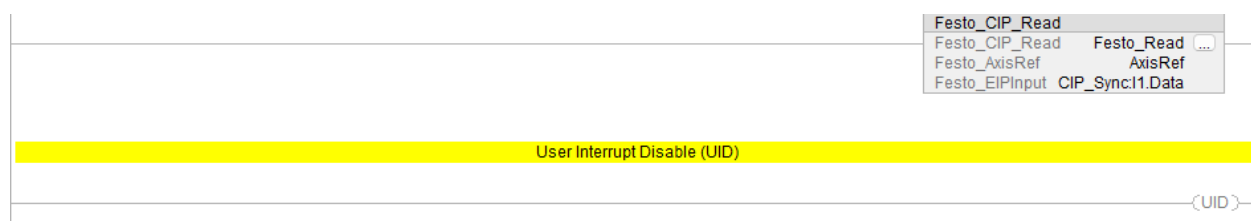
1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select New **Festo\_Read** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **Festo\_Read**.
  - Set the Data Type to **Festo\_CIP\_Read** (highlighted in yellow).

**Step 3**

1. Enter the name of the **Festo\_AxisRef** tag and **right-click** on the entered name (e.g., **AxisRef**).
2. Select New **AxisRef** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows:
  - Enter the tag name, e.g., **AxisRef**.
  - Set the Data Type to **Festo\_AxisRef** (highlighted in yellow).

**Step 4**

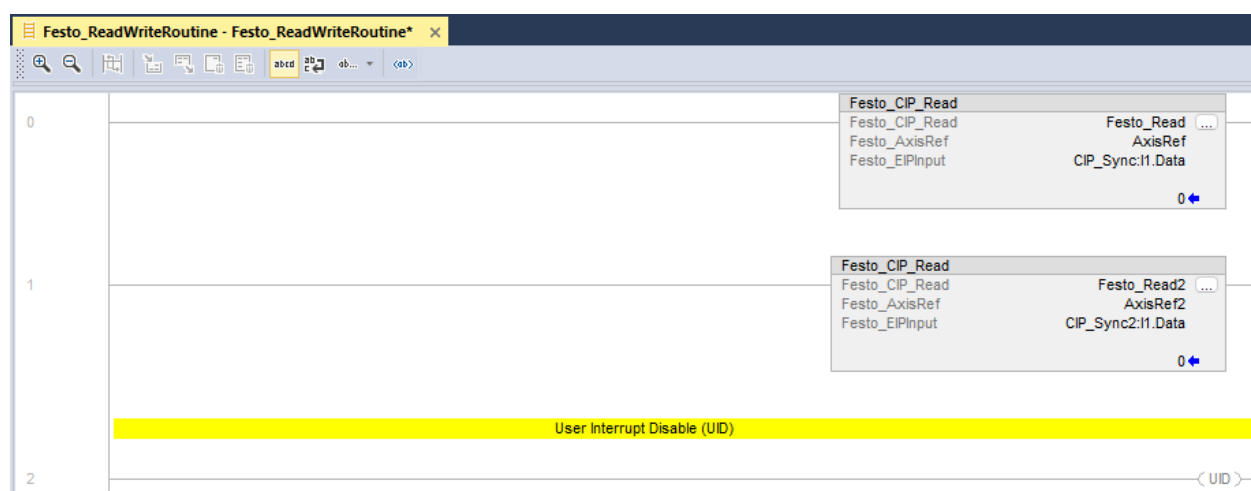
1. Click the dropdown arrow next to the **Festo\_EIPInput** parameter in the AOI interface.
2. From the tag selection window, expand the **CIP\_Sync:I1** folder and select the **CIP\_SYNC:I1.Data** tag.

**Step 5**

Once all the tags are configured, the user needs to add the **User Interrupt Disable (UID)** on the next rung immediately after the **Festo\_CIP\_Read** instruction, as shown in the image above.

**Note**

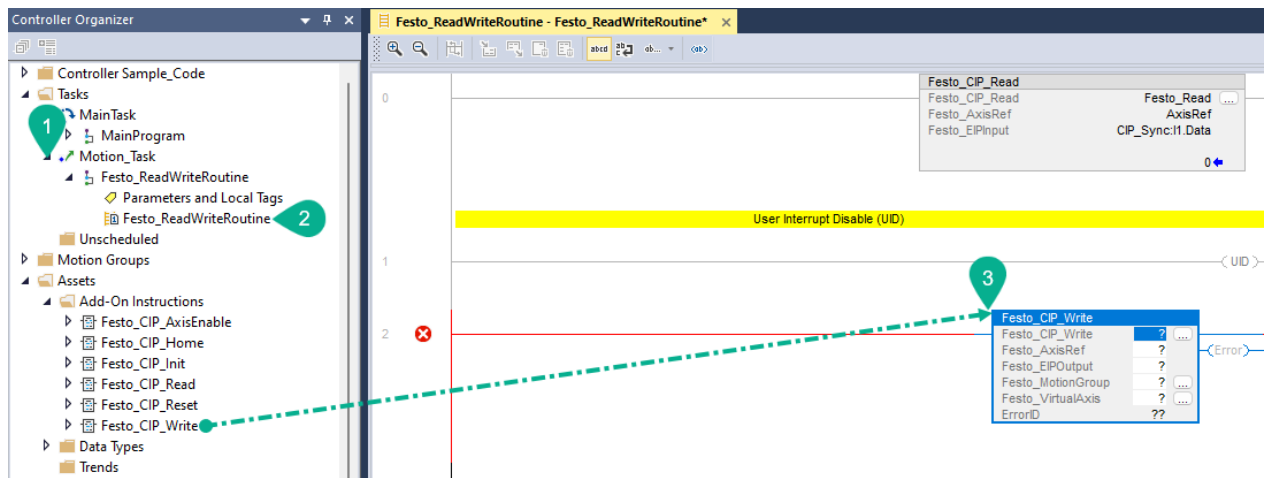
- When multiple axes are used for motion control, please follow the procedure as shown below.

**Step 6**

When using multiple Axis Motion, the **Festo\_CIP\_Read** block must be called once for each axis. However, the **User Interrupt Disable (UID)** should be configured **only once** after all **Festo\_CIP\_Read** blocks have been called, as shown in the image above.

## 5.6.5 Add and Configure the AOI Festo\_CIP\_Write

### Step 1



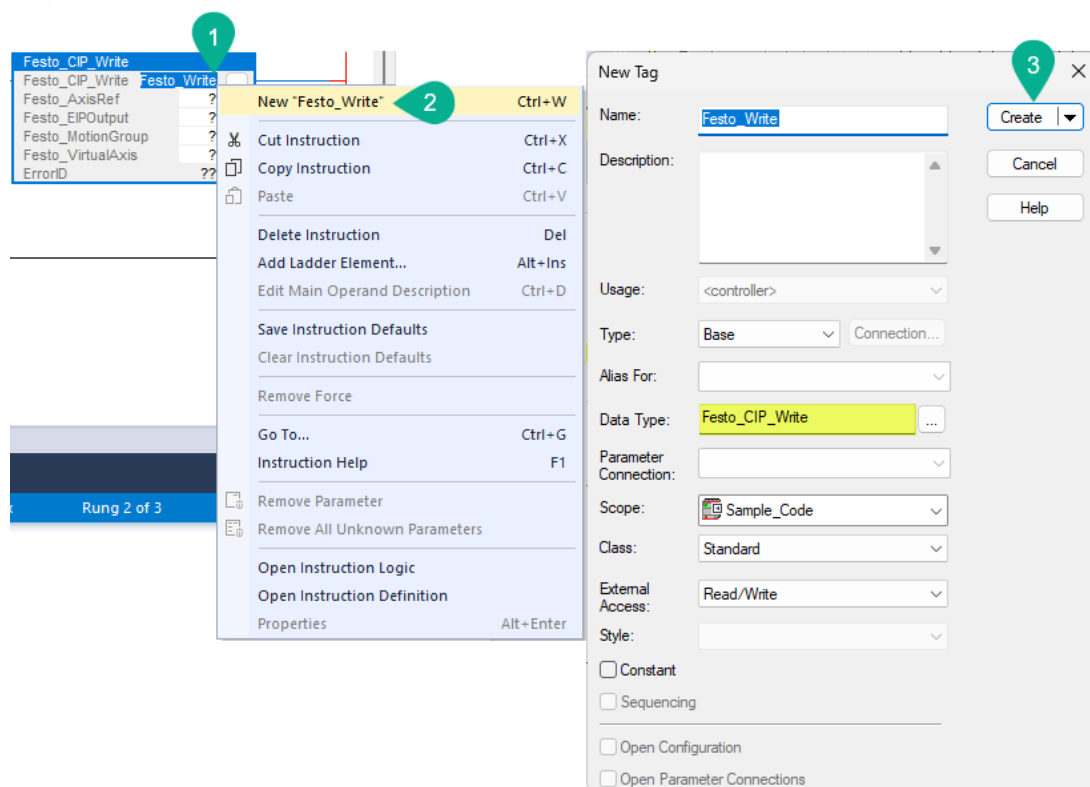
1. In the **Controller Organizer**, expand the **Motion\_Task** folder.
2. Double-click **Festo\_ReadWriteRoutine** under **Motion\_Task** to open it.
3. From the Add-On Instructions folder, drag and drop the **Festo\_CIP\_Write** AOI file into the routine editor as shown above.



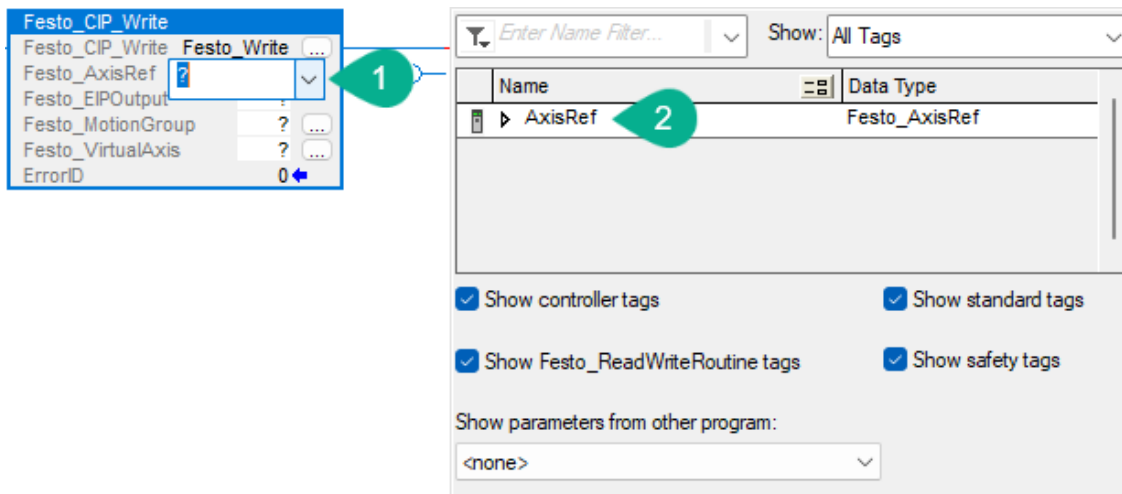
#### Note

- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this may cause the AOI to function incorrectly.

## Step 2



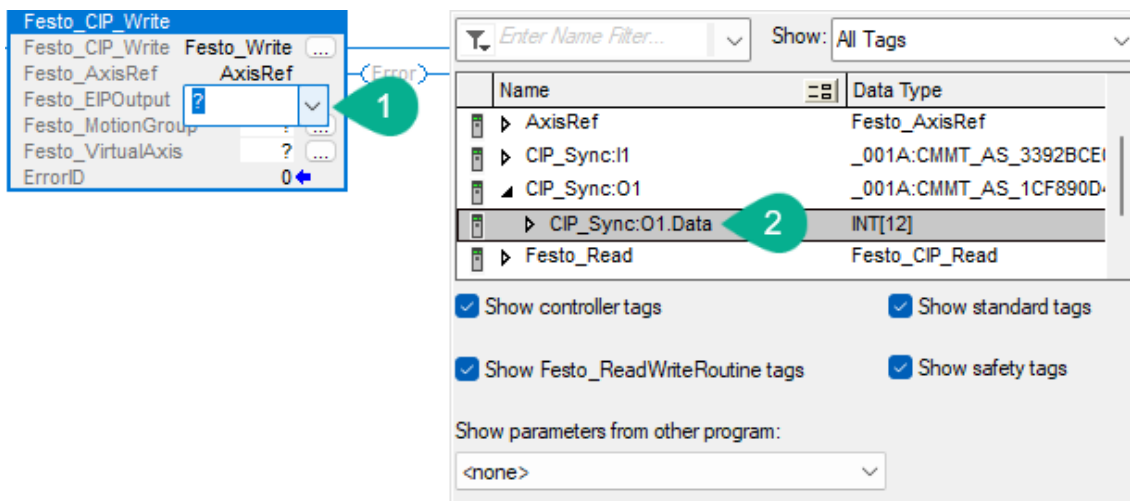
1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select New **Festo\_Write** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **Festo\_Write**.
  - Set the Data Type to **Festo\_CIP\_Write** (highlighted in yellow).

**Step 3**

1. Click the dropdown arrow next to the **Festo\_AxisRef** parameter in the AOI interface.
2. From the tag selection window, select the **AxisRef** tag that was created in section [5.6.4 Festo\\_AxisRef](#) Step 3 for the Festo\_CIP\_Read AOI.

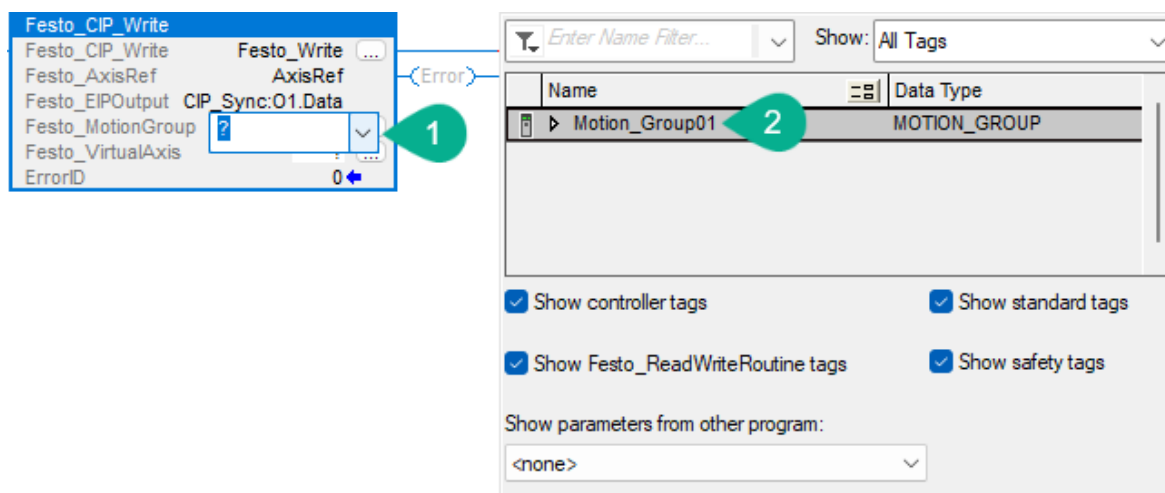
**Note**

- Users do not need to create a new **Festo\_AxisRef** tag separately; assign the same tag used in the **Festo\_CIP\_Read** block, as this **Festo\_AxisRef** tag is common to all blocks.

**Step 4**

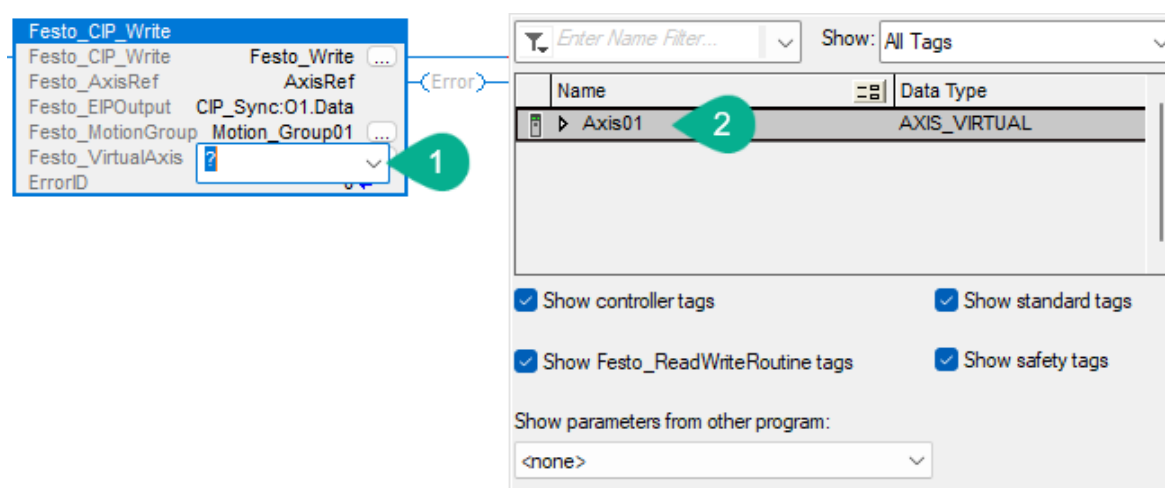
1. Click the dropdown arrow next to the **Festo\_EIPOutput** parameter in the AOI interface.
2. From the tag selection window, expand the **CIP\_Sync:01** folder and select the **CIP\_SYNC:01.Data** tag.

## Step 5

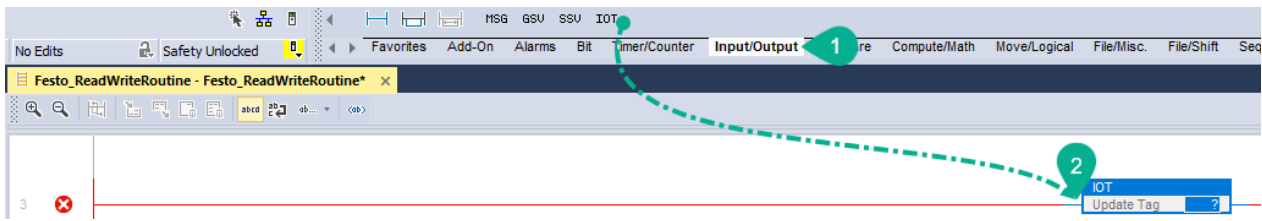


1. Click the dropdown arrow next to the **Festo\_MotionGroup** parameter in the **Festo\_CIP\_Write** AOI interface.
2. In the tag selection window, select the (e.g., **Motion\_Group01**) tag.

## Step 6



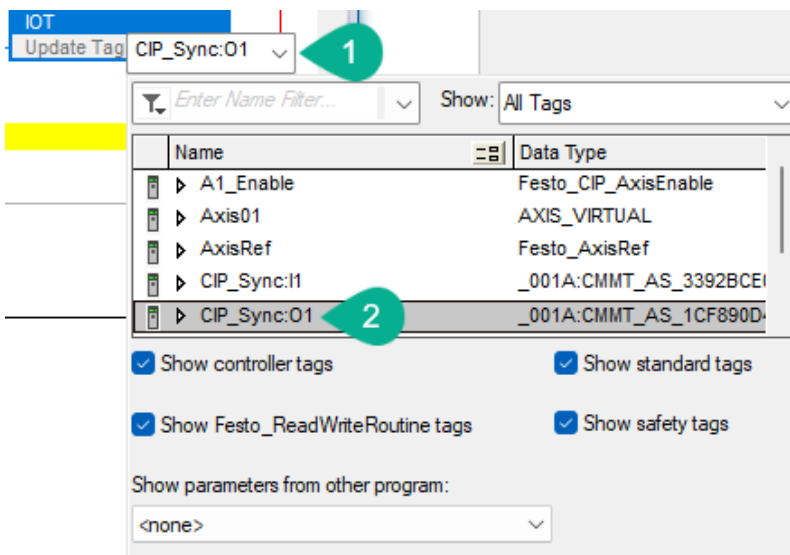
1. Click the dropdown arrow next to the **Festo\_VirtualAxis** parameter in the **Festo\_CIP\_Write** AOI interface.
2. In the tag selection window, select the (e.g., **Axis01**) tag.

**Step 7**

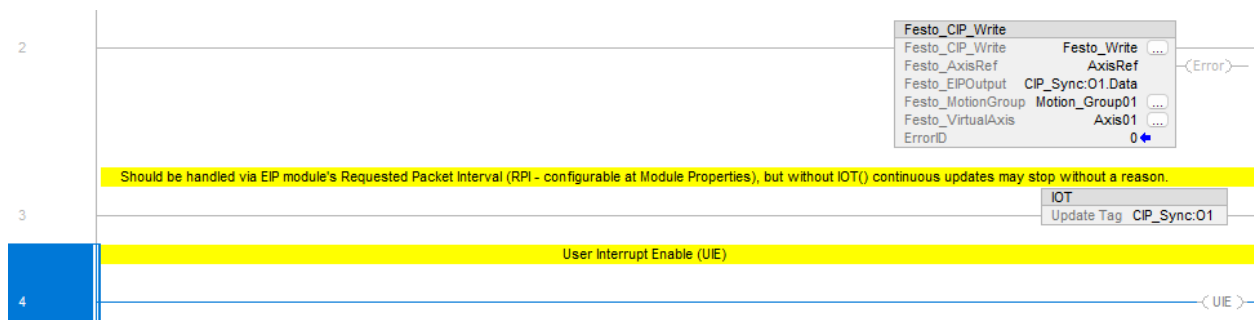
1. Click the **Input/Output** tab in the instruction toolbar.
2. Drag and drop the **IOT** instruction from the toolbar as shown in the image above.

**Note**

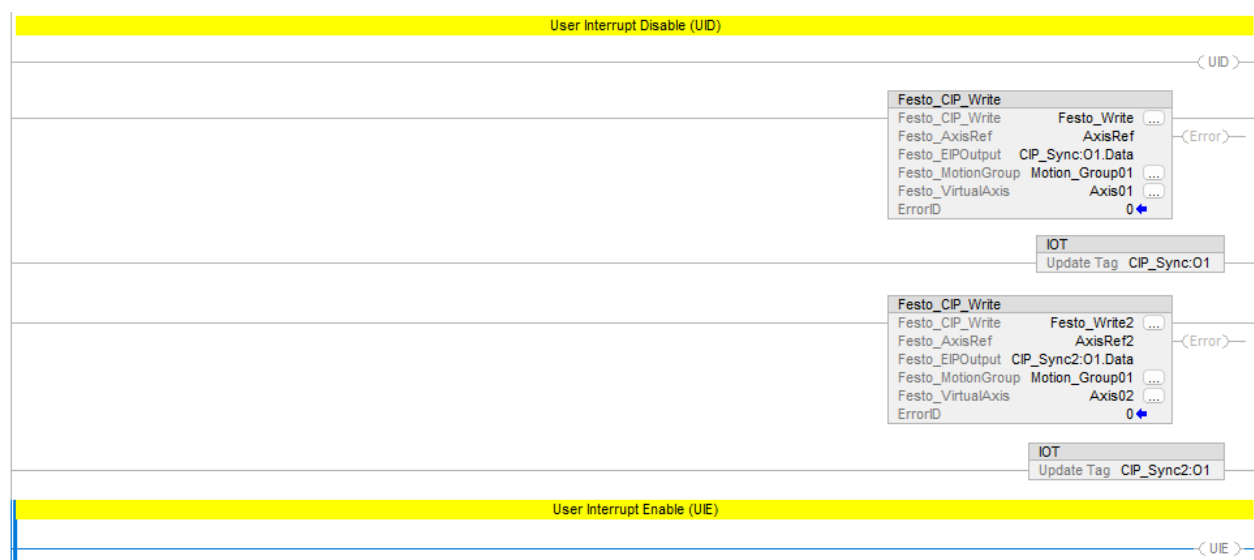
- When multiple axis motions are used, ensure that the **IOT** instruction is called once for each configured **Festo\_CIP\_Write** block.

**Step 8**

1. Click the dropdown arrow next to the **Update Tag (IOT)** parameter.
2. From the tag selection window, select the **CIP\_Sync:01** tag.

**Step 9**

Once all the tags are configured, the user needs to add the **User Interrupt Enable (UIE)** on the next rung immediately after the **Festo\_CIP\_Write** instruction, as shown in the image above.

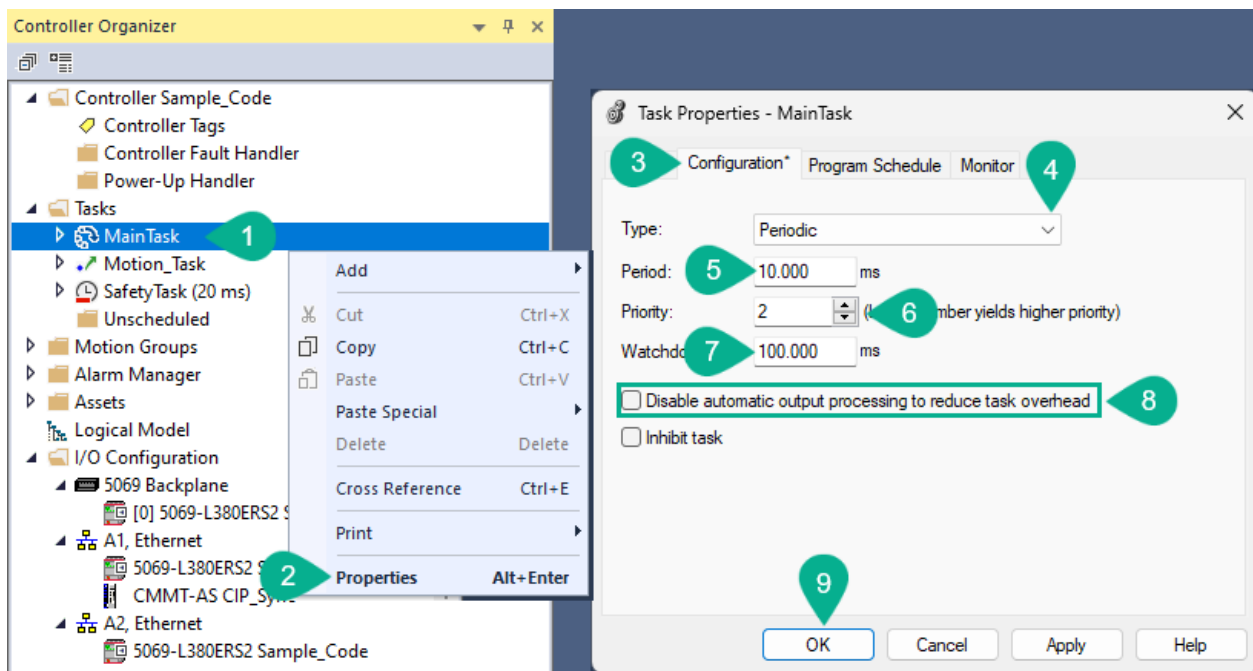
**Step 10**

When using multiple Axis Motion, the **Festo\_CIP\_Write** block must be called once for each axis motion. The **IOT** instruction should also be called once for each configured **Festo\_CIP\_Write** block. The **User Interrupt Enable (UIE)** must be configured **only once** after all **Festo\_CIP\_Write** blocks and corresponding **IOT** instructions have been called, as shown in the image above.

## 5.7 Main Task Configuration

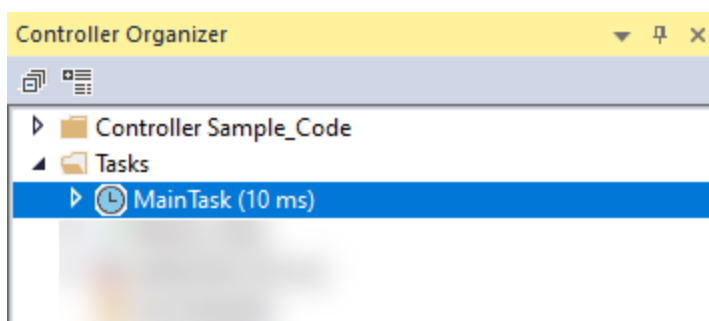
The MainTask and its routines are used to control all Festo CMMT drives.

### 5.7.1 Configuration of MainTask Properties



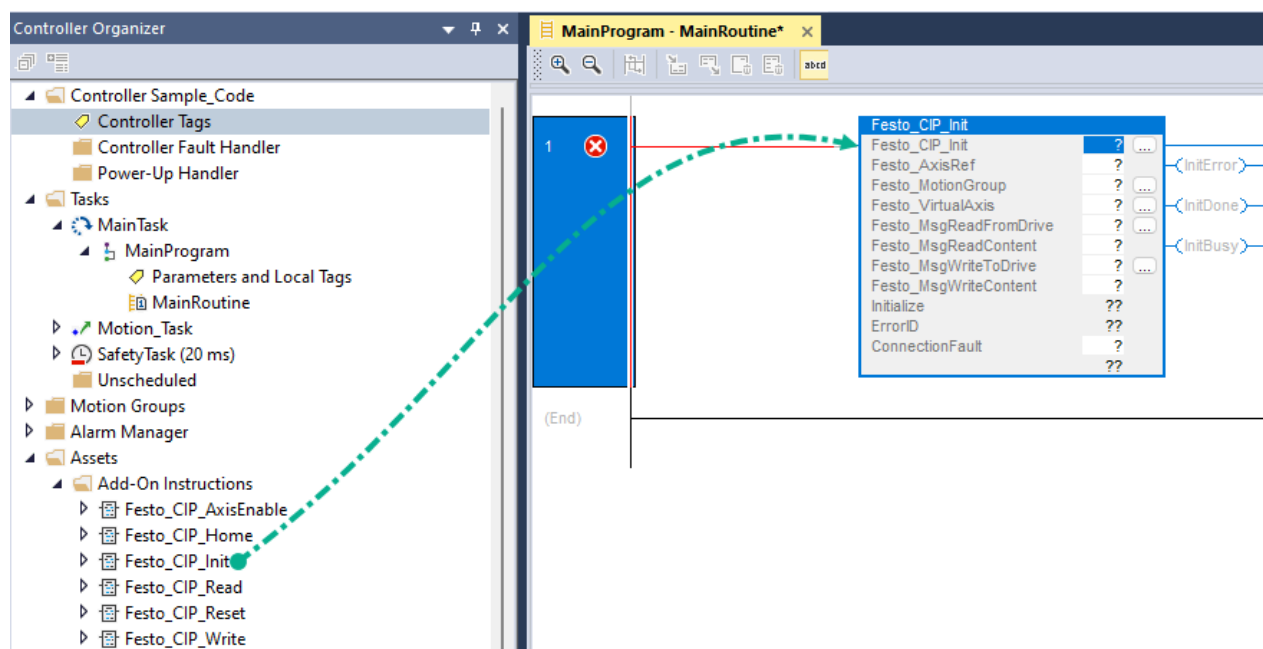
1. In the Controller Organizer, right-click **MainTask** under Tasks folder.
2. Select **Properties** from the context menu.
3. In the Task Properties – MainTask window, select the **Configuration** tab.
4. From the Type dropdown, select **Periodic**.
5. Modify Period to **10 ms** (This may need to be optimized later to accommodate multiple axes while balancing the PLC CPU usage).
6. Set the **Priority** to a value of **2** to achieve the 2<sup>nd</sup> highest priority.
7. Set the **Watchdog** time (e.g. **100 ms**).
8. Confirm checkbox **Disable automatic output processing to reduce task overhead** is turned OFF.
9. Click **OK** to apply the settings.

After completing the MainTask configuration, the **MainTask** will appear as shown in the image below.



## 5.7.2 Add and Configure the AOI Festo\_CIP\_Init

### Step 1

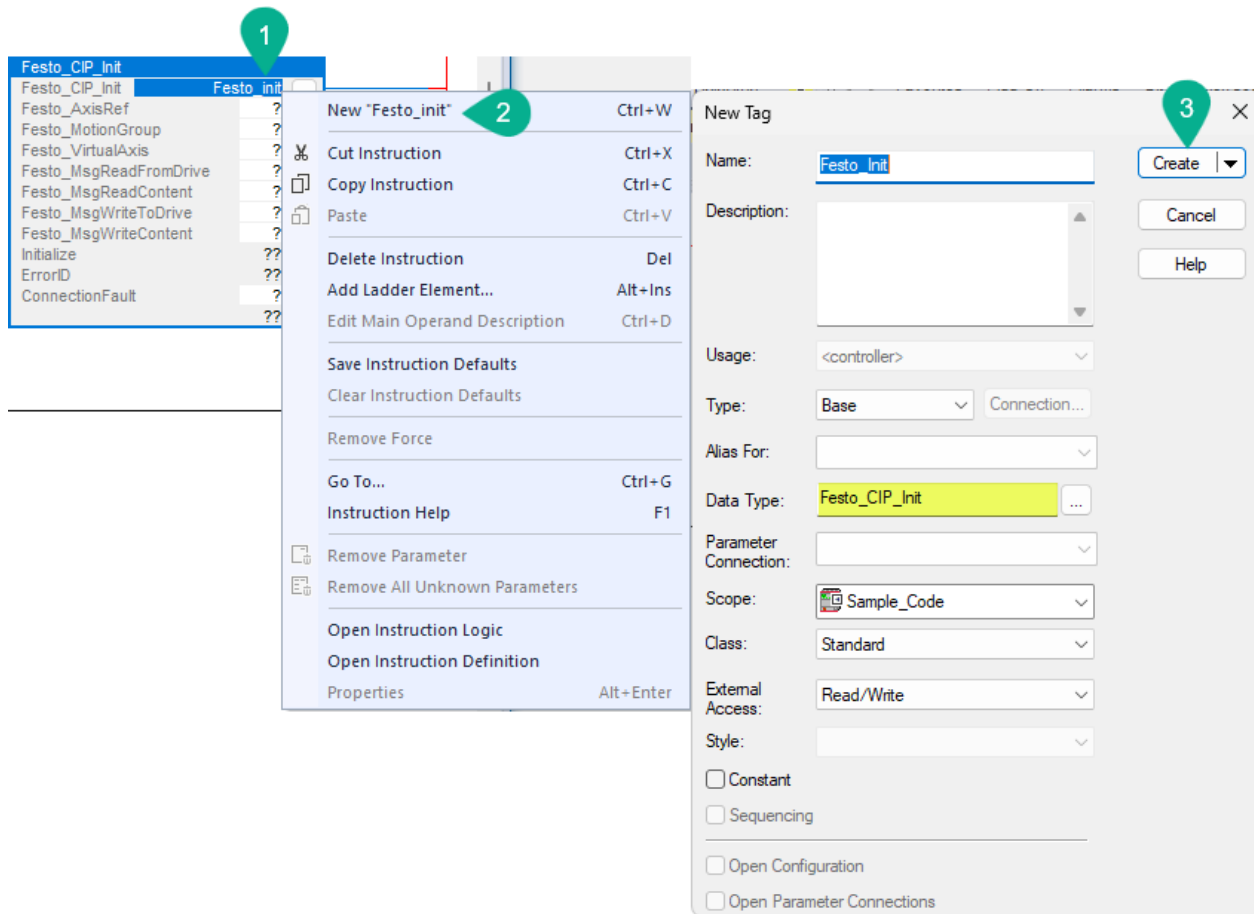


Add a new ladder rung and drag and drop the **Festo\_CIP\_Init** AOI file from the Add-On Instructions folder as shown above.



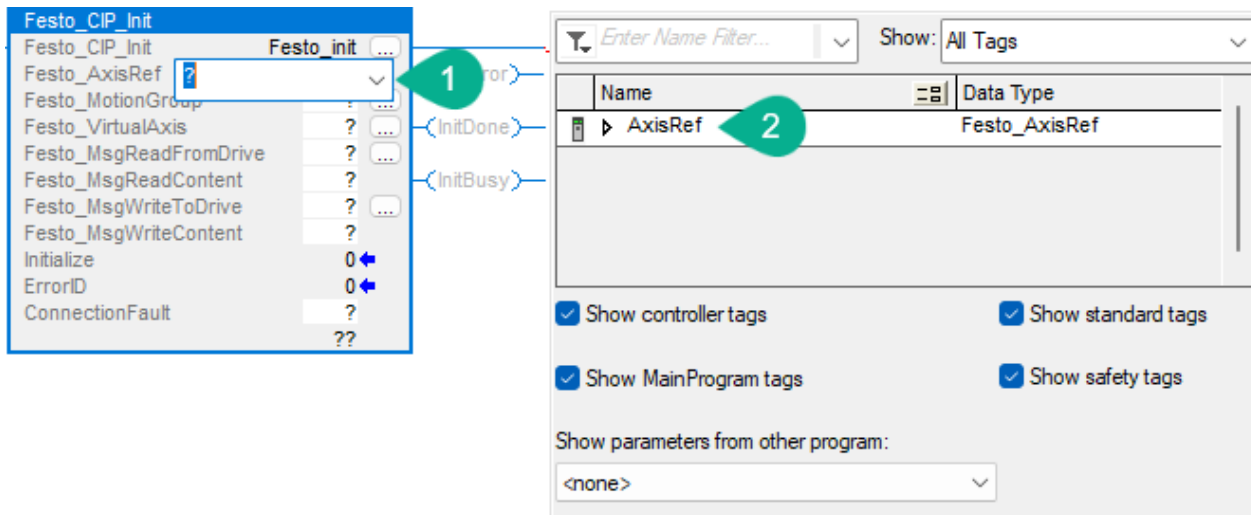
#### Note

- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this may cause the AOI to function incorrectly.

**Step 2**

1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select **New Festo\_Init** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **Festo\_Init**.
  - Set the Data Type to **Festo\_CIP\_Init** (highlighted in yellow).

### Step 3



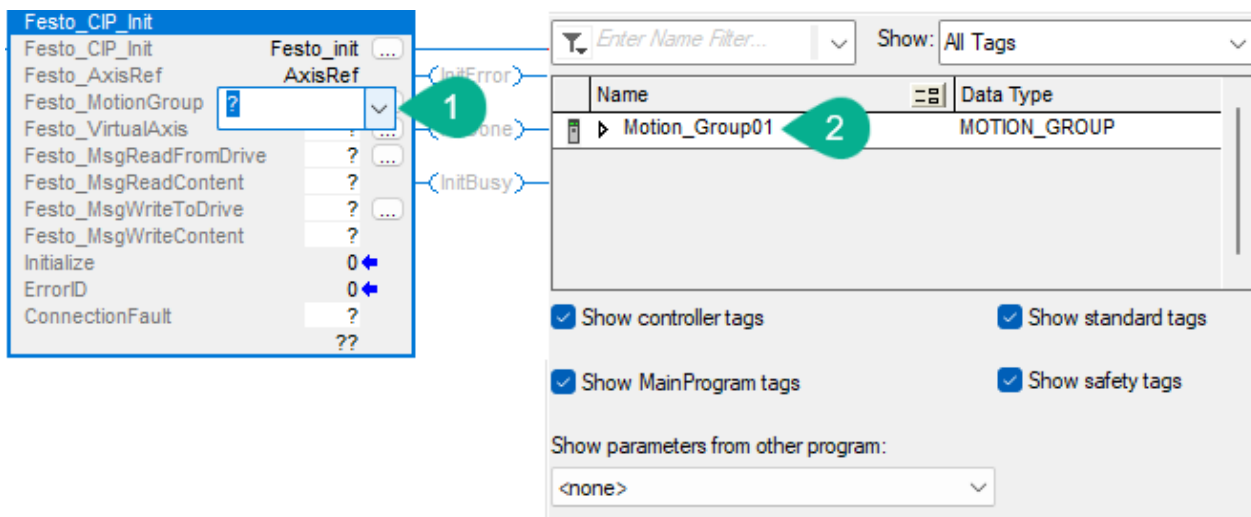
1. Click the dropdown arrow next to the **Festo\_AxisRef** parameter in the AOI interface.
2. From the tag selection window, select the **AxisRef** tag that was created in section [5.6.4 Festo\\_AxisRef](#) Step 3 for the Festo\_CIP\_Read AOI.



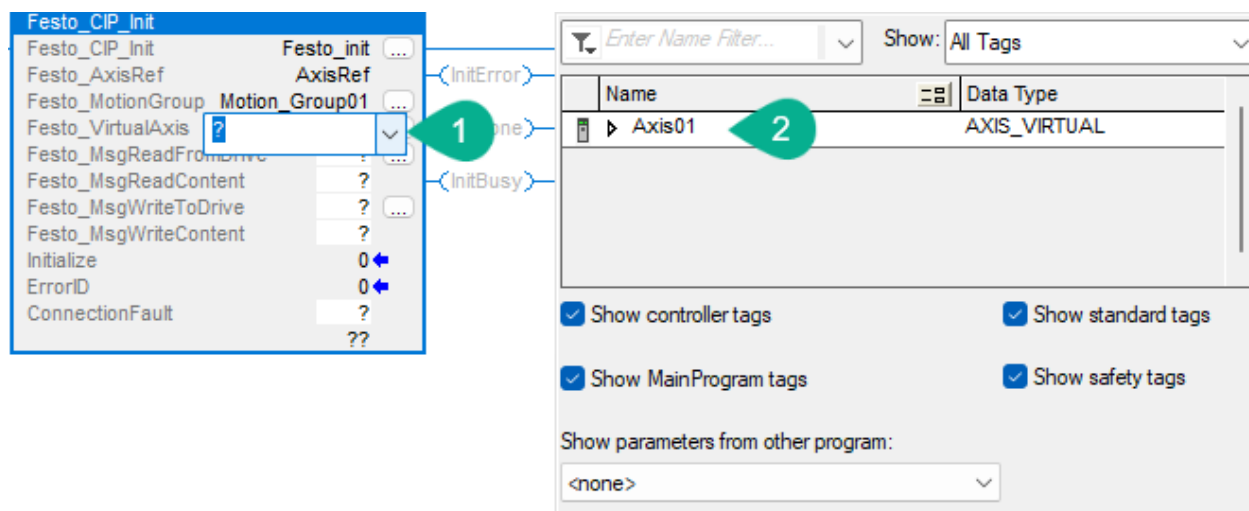
#### Note

- Users do not need to create a new **Festo\_AxisRef** tag separately; assign the same tag used in the **Festo\_CIP\_Read** block, as this **Festo\_AxisRef** tag is common to all blocks.

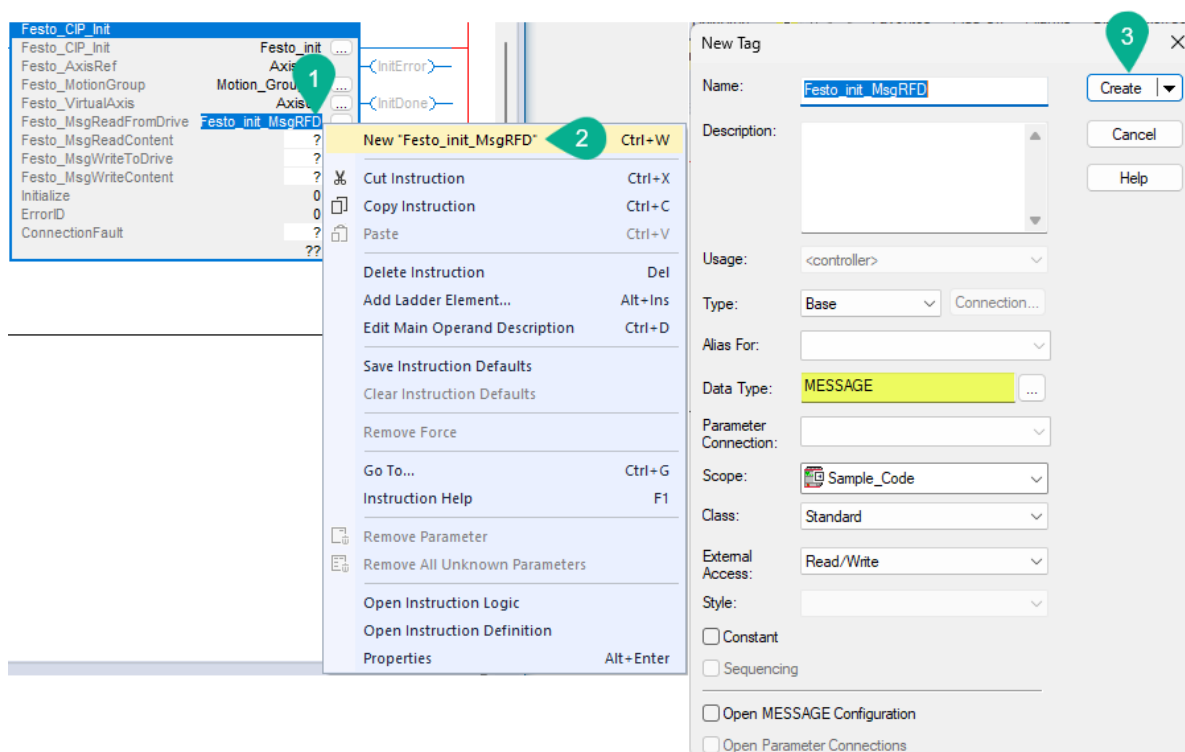
### Step 4



1. Click the dropdown arrow next to the **Festo\_MotionGroup** parameter in the **Festo\_CIP\_Init** AOI interface.
2. In the tag selection window, select the (e.g., **Motion\_Group01**) tag.

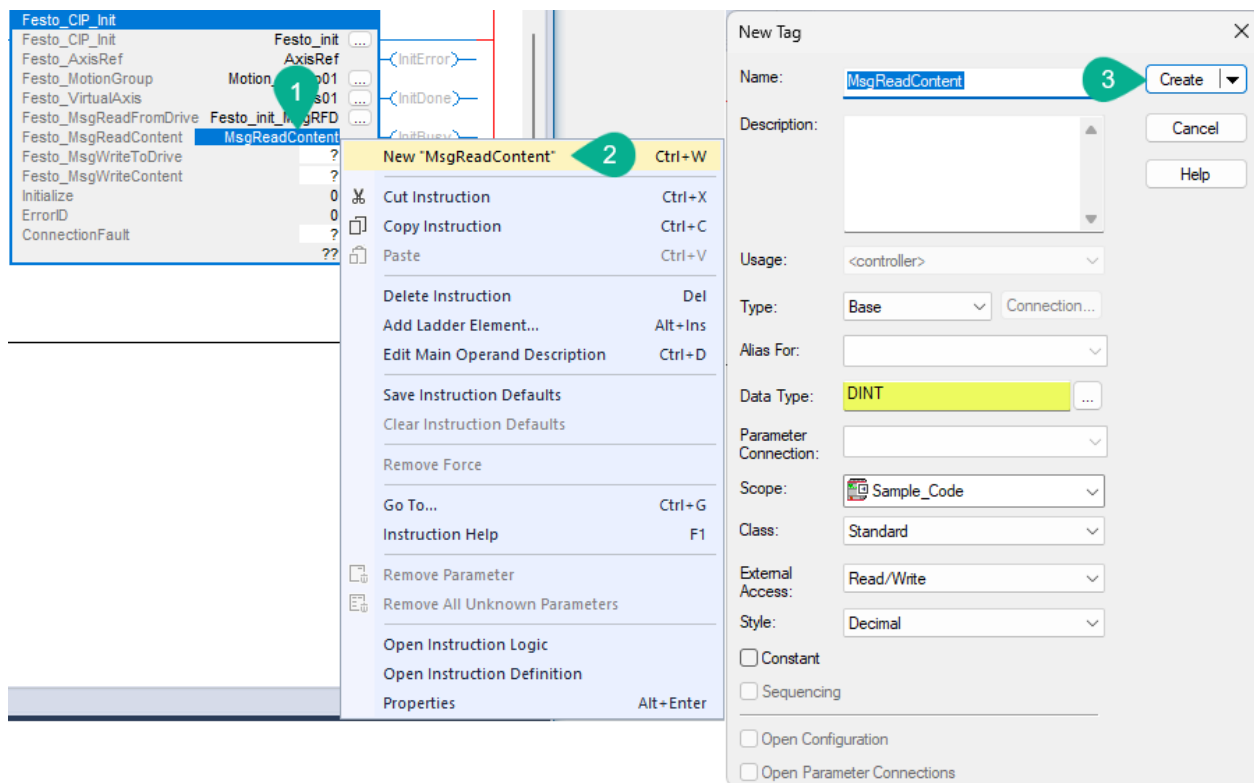
**Step 5**

1. Click the dropdown arrow next to the **Festo\_VirtualAxis** parameter in the **Festo\_CIP\_Init** AOI interface.
2. In the tag selection window, select the (e.g., **Axis01**) tag.

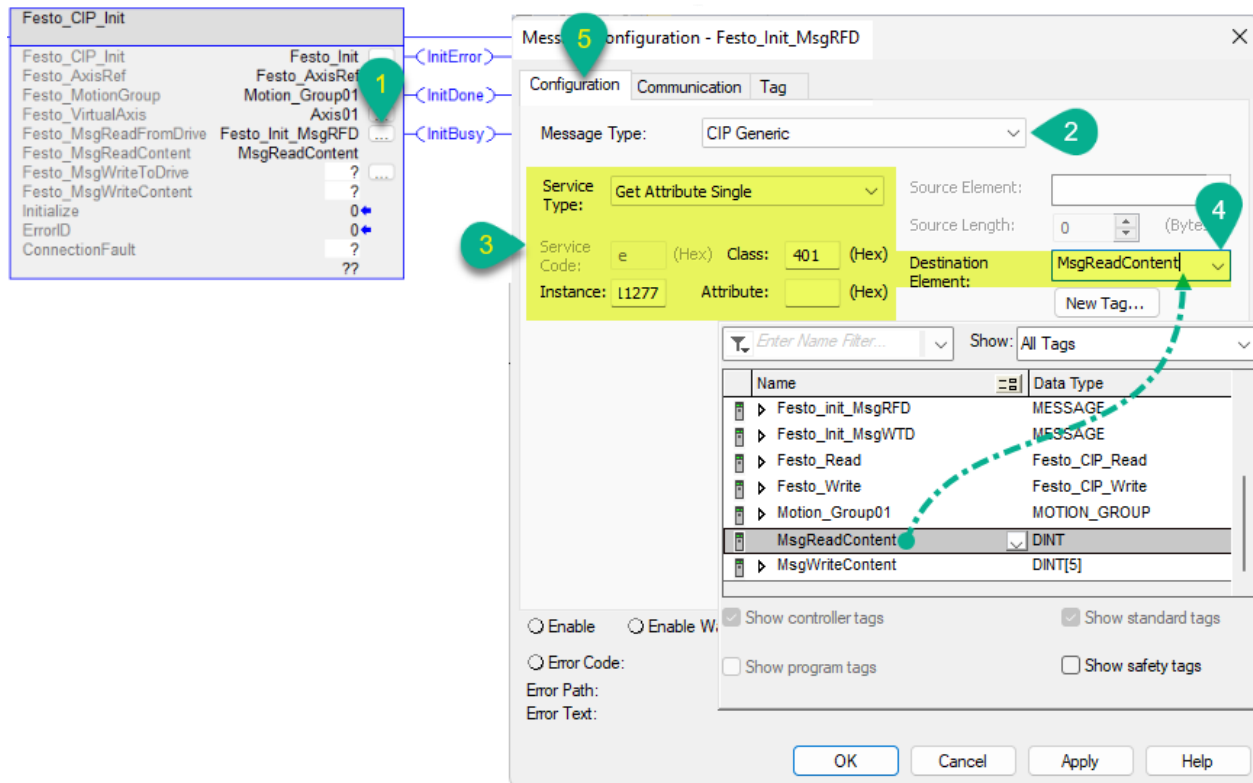
**Step 6**

1. Enter the name of the **Festo\_MsgReadFromDrive** tag and **right-click** on the entered name (e.g., **Festo\_Init\_MsgRFD**).
2. From the context menu, select **New Festo\_Init\_MsgRFD**.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **Festo\_Init\_MsgRFD**.
  - Set the Data Type to **MESSAGE** (highlighted in yellow).

## Step 7

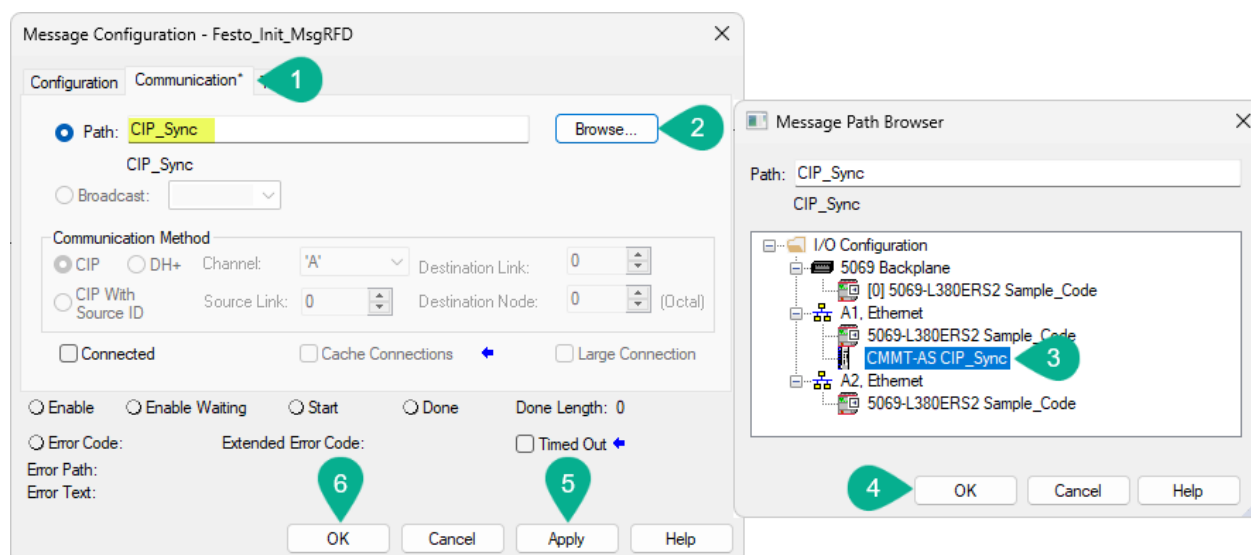


1. Enter the name of the **Festo\_MsgReadContent** tag and **right-click** on the entered name (e.g., **MsgReadContent**).
2. From the context menu, select **New MsgReadContent**.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **MsgReadContent**.
  - Set the Data Type to **DINT** (highlighted in yellow).

**Step 8**

1. Click the ellipsis button (...) next to the **Festo\_MsgReadFromDrive** parameter.
2. In the **Message** Configuration window, go to the **Configuration** tab and set the **Message Type** to **CIP Generic**.
3. In the highlighted section, configure the following:
  - Service Type: **Select Get Attribute Single**.
  - Class value: e.g., **401** (hexadecimal).
  - Instance value: e.g., **11277**.
4. In the **Destination** Element dropdown, select the tag **MsgReadContent**. Ensure this tag has the correct data type, typically **DINT**.
5. Click **Communication** to assign destination device.

## Step 9

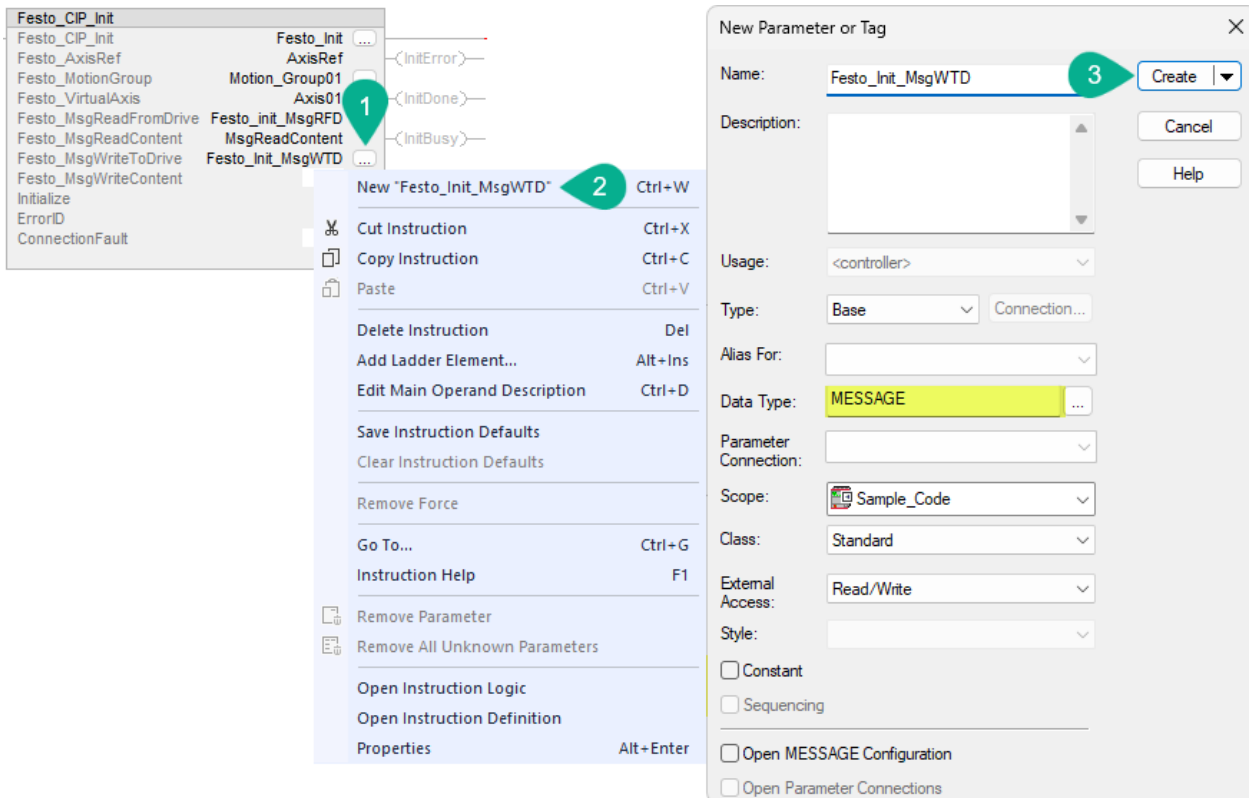


1. In the **Message Configuration** dialog, select the **Communication** tab.
2. Click **Browse...** to open the Message Path Browser.
3. In the Message Path Browser, select the path **CIP\_Sync**.
4. Click **OK** to confirm the path selection (highlighted in yellow).
5. Click **Apply** to save the configuration.
6. Click **OK** to close the Message Configuration dialog



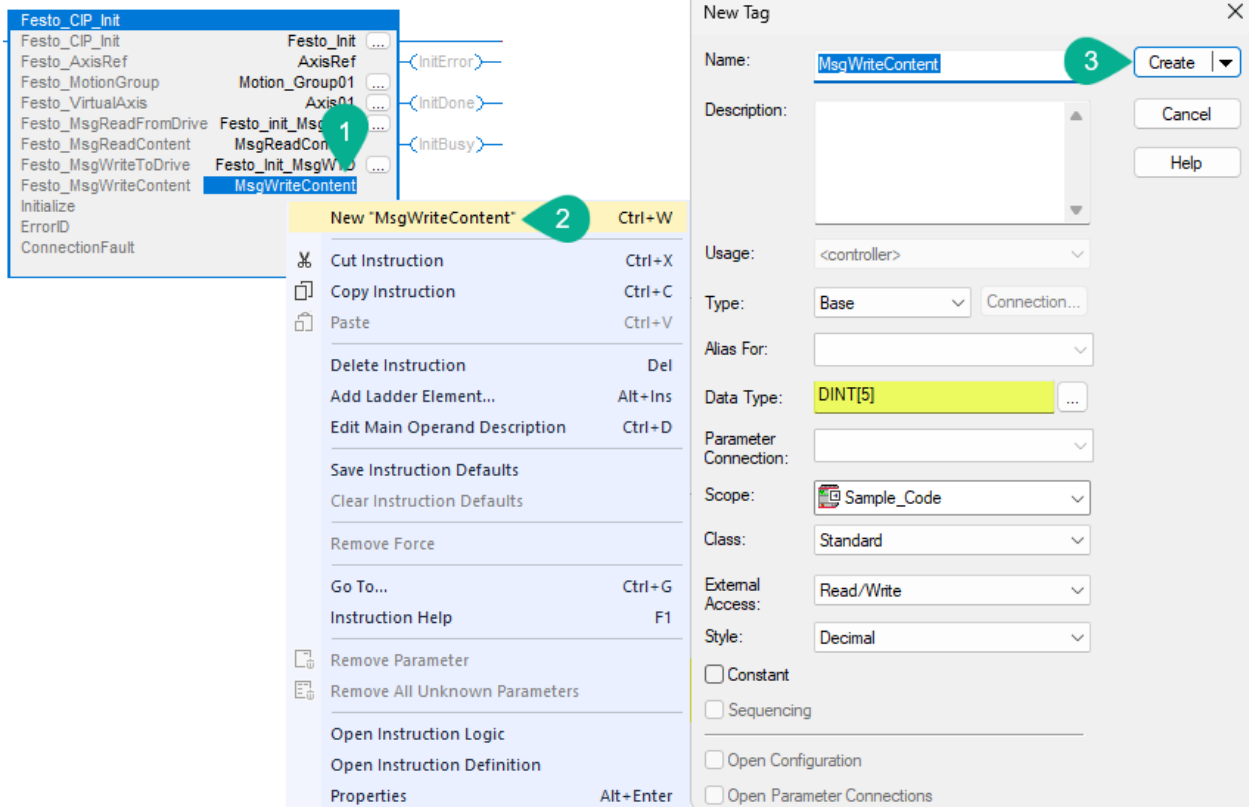
### Note

- For the alternative path connection method, [Refer Chapter 5.7.10.](#)

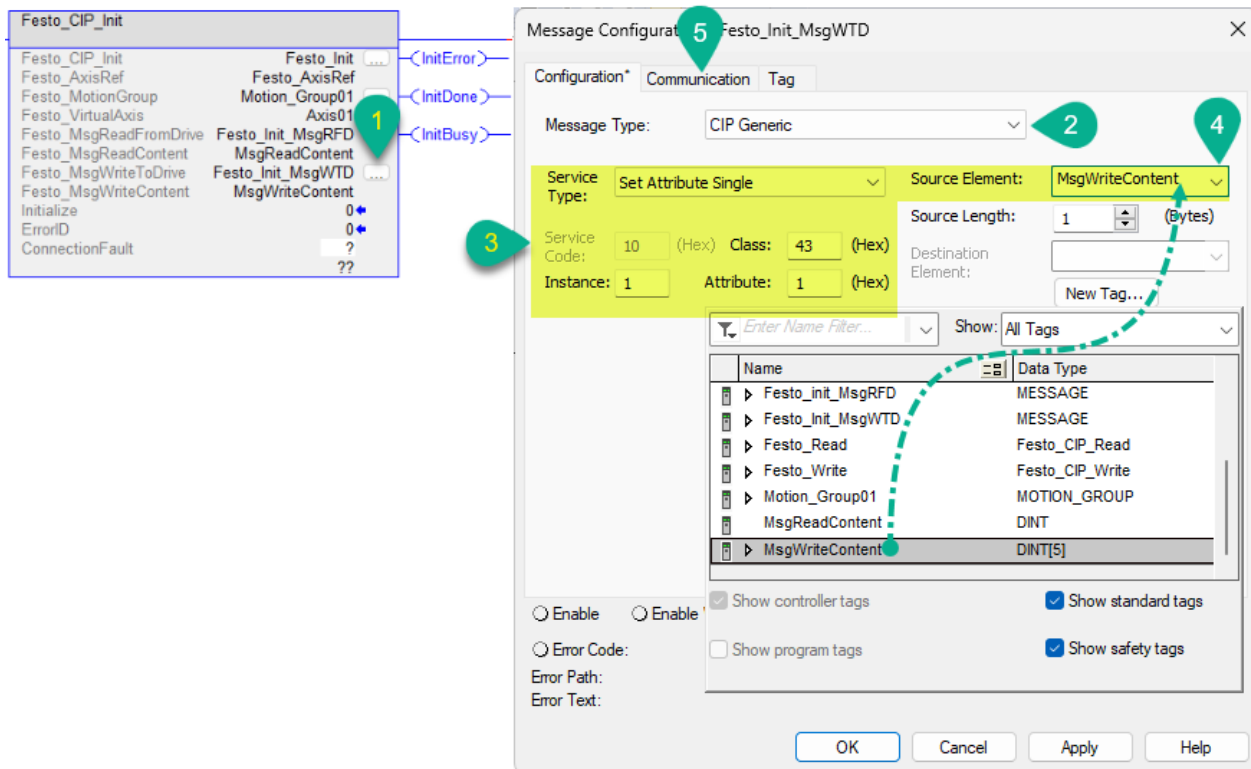
**Step 10**

1. Enter the name of the **Festo\_MsgWriteToDrive** tag and **right-click** on the entered name (e.g., **Festo\_Init\_MsgWTD**).
2. From the context menu, select **New Festo\_Init\_MsgWTD**.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **Festo\_Init\_MsgRFD**.
  - Set the Data Type to **MESSAGE** (highlighted in yellow).

## Step 11

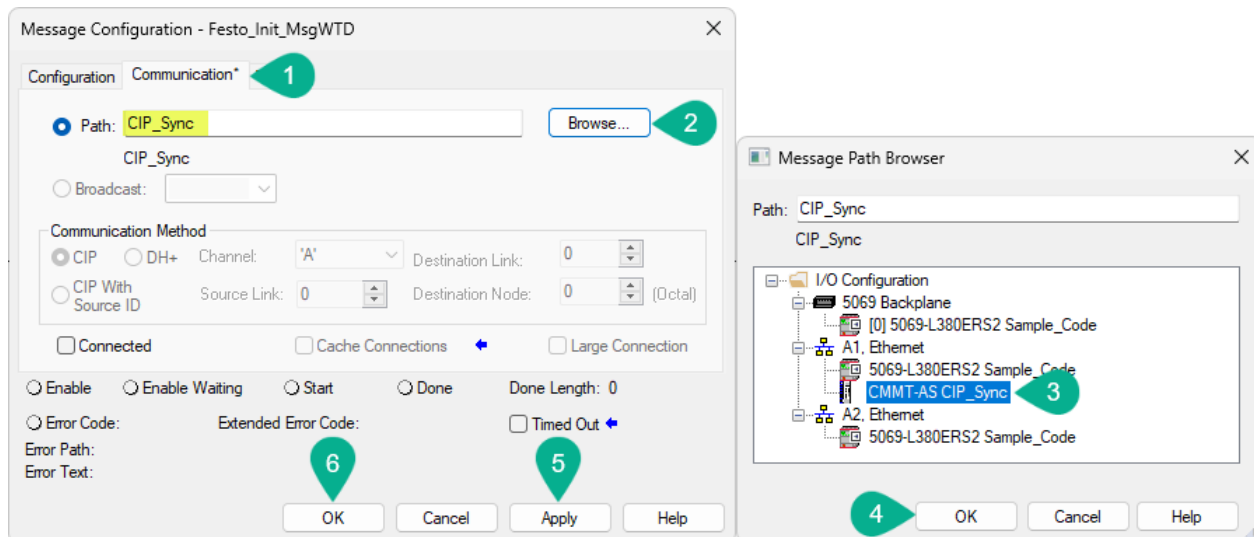


1. Enter the name of the **Festo\_MsgWriteContent** tag and **right-click** on the entered name (e.g., **MsgWriteContent**).
2. From the context menu, select New **MsgWriteContent**.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **MsgWriteContent**.
  - Set the Data Type to **DINT** (highlighted in yellow).

**Step 12**

1. Click the ellipsis button (...) next to the **Festo\_MsgWriteToDrive** parameter.
2. In the **Message** Configuration window, go to the **Configuration** tab and set the **Message Type** to **CIP Generic**.
3. In the highlighted section, configure the following:
  - Service Type: **Set Attribute Single**.
  - Class value: e.g., **43** (Hex).
  - Instance value: e.g., **1**.
  - Attribute value: e.g., **1** (Hex).
4. In the **Destination** Element dropdown, select the tag **MsgWriteContent**. Ensure this tag has the correct data type, typically **DINT[5]**.
5. Click **Communication** to assign destination device.

### Step 13

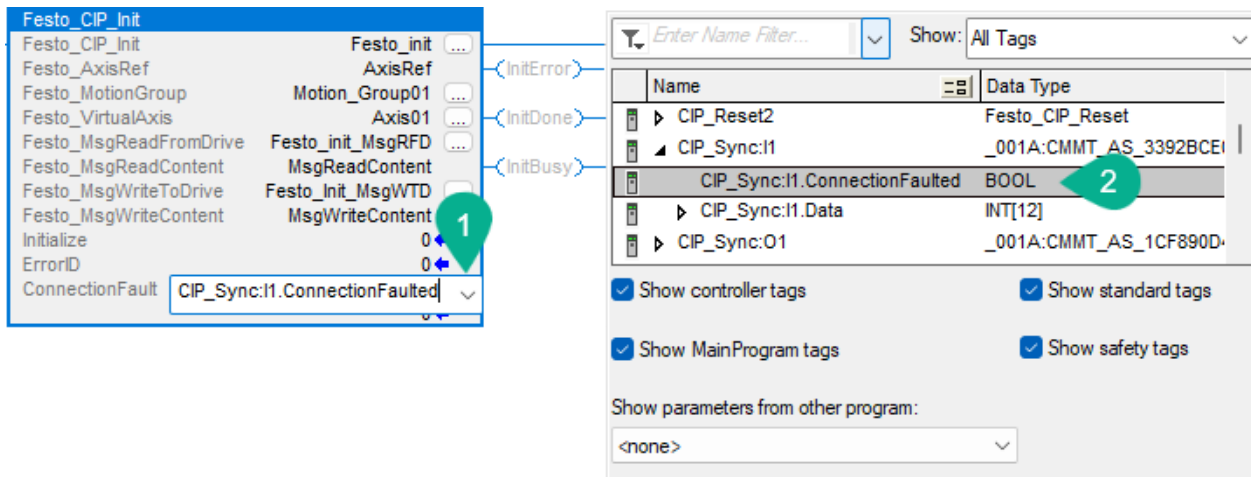


1. In the **Message Configuration** dialog, select the **Communication** tab.
2. Click **Browse...** to open the Message Path Browser.
3. In the Message Path Browser, select the path **CIP\_Sync**.
4. Click **OK** to confirm the path selection (highlighted in yellow).
5. Click **Apply** to save the configuration.
6. Click **OK** to close the Message Configuration dialog.



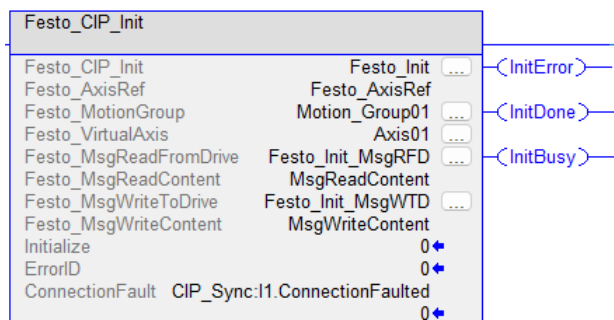
#### Note

- For the alternative path connection method, [Refer Chapter 5.7.10.](#)

**Step 14**

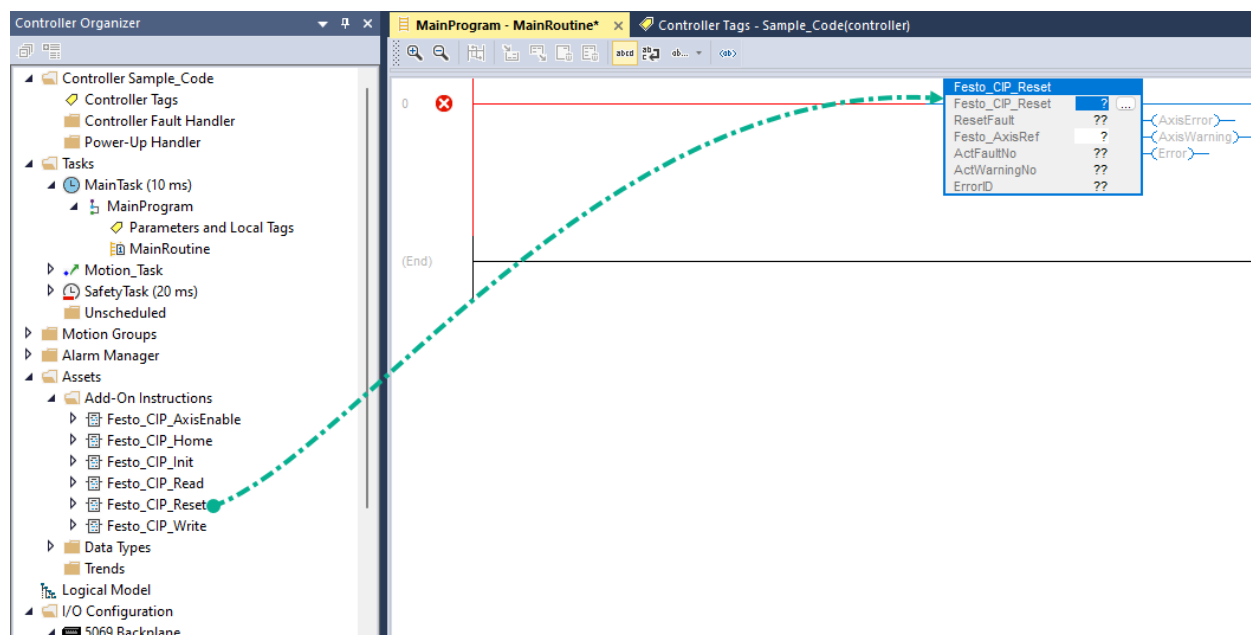
1. Click the dropdown arrow next to the **ConnectionFaulted** parameter in the AOI interface.
2. From the tag selection window, select the **CIP\_Sync:I1.ConnectionFaulted** tag.

Once all the required tags are configured, the AOI will appear as shown in the image below.



### 5.7.3 Add and Configure the AOI Festo\_CIP\_Reset

#### Step 1

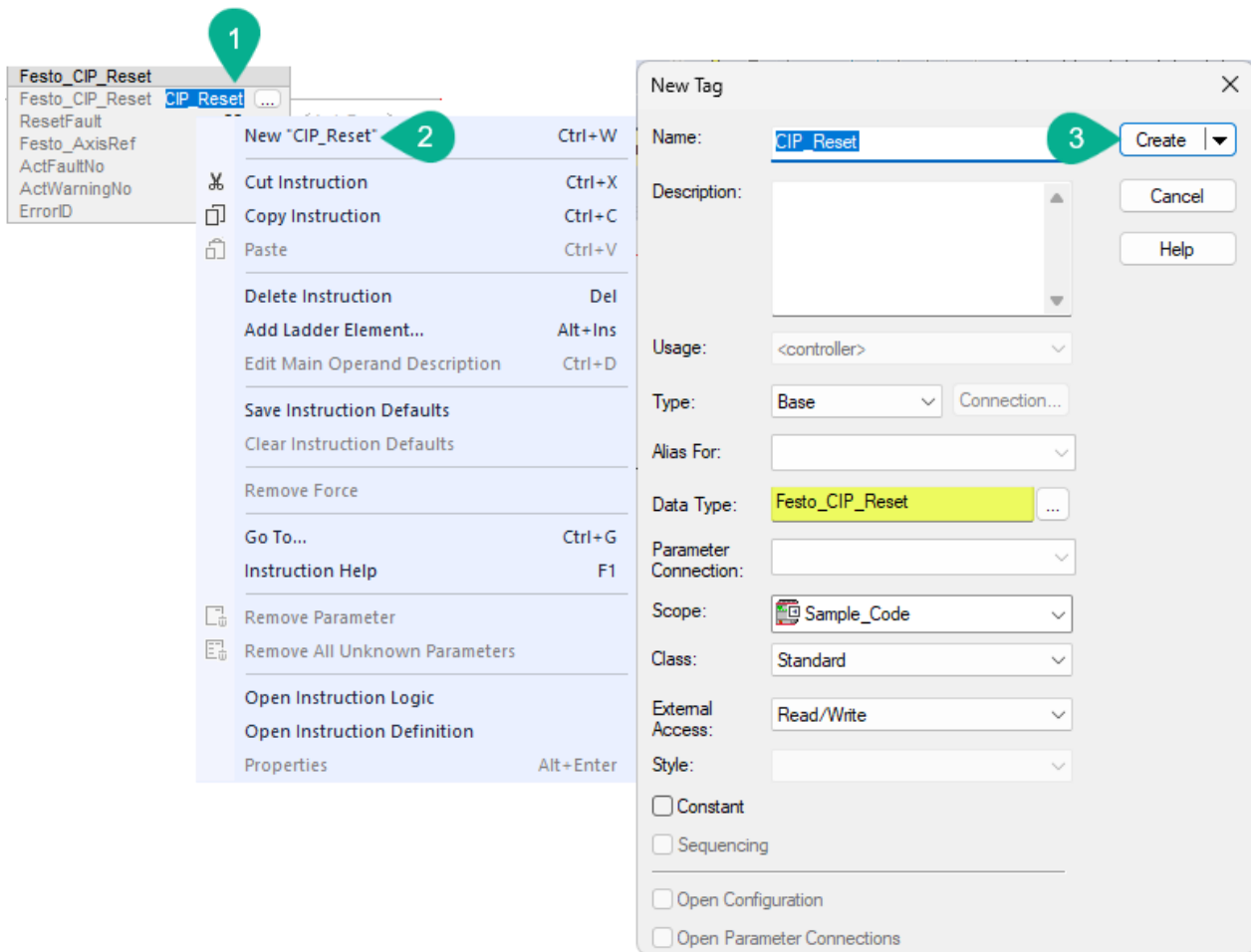


Add a new ladder rung and drag and drop the **Festo\_CIP\_Reset** AOI file from the Add-On Instructions folder as shown above.



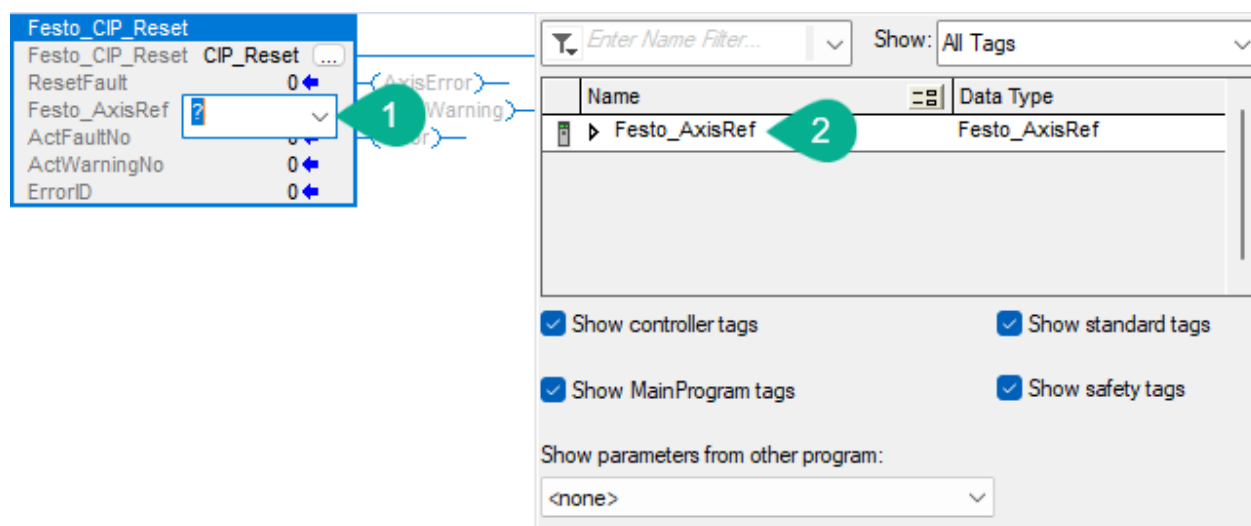
#### Note

- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this will cause the AOI to function incorrectly.

**Step 2**

1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select **New CIP\_Reset** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **CIP\_Reset**.
  - Set the Data Type to **Festo\_CIP\_Reset** (highlighted in yellow).

### Step 3



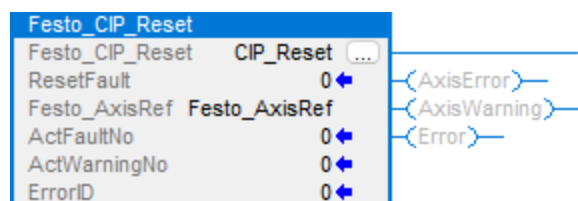
1. Click the dropdown arrow next to the **Festo\_AxisRef** parameter in the AOI interface.
2. From the tag selection window, select the **AxisRef** tag that was created in section [5.6.4 Festo AxisRef](#) Step 3 for the Festo\_CIP\_Read AOI.



#### Note

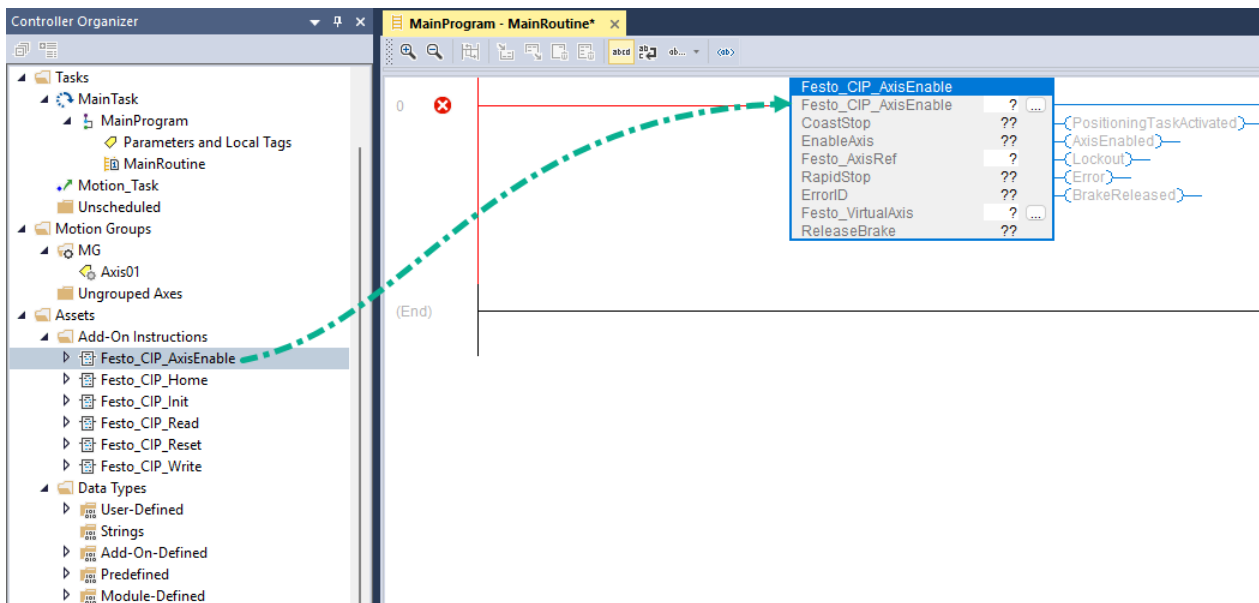
- Users do not need to create a new **Festo\_AxisRef** tag separately; assign the same tag used in the **Festo\_CIP\_Read** block, as this **Festo\_AxisRef** tag is common to all blocks.

Once all the required tags are configured, the AOI will appear as shown in the image below.



## 5.7.4 Add and Configure the AOI Festo\_CIP\_AxisEnable

### Step 1



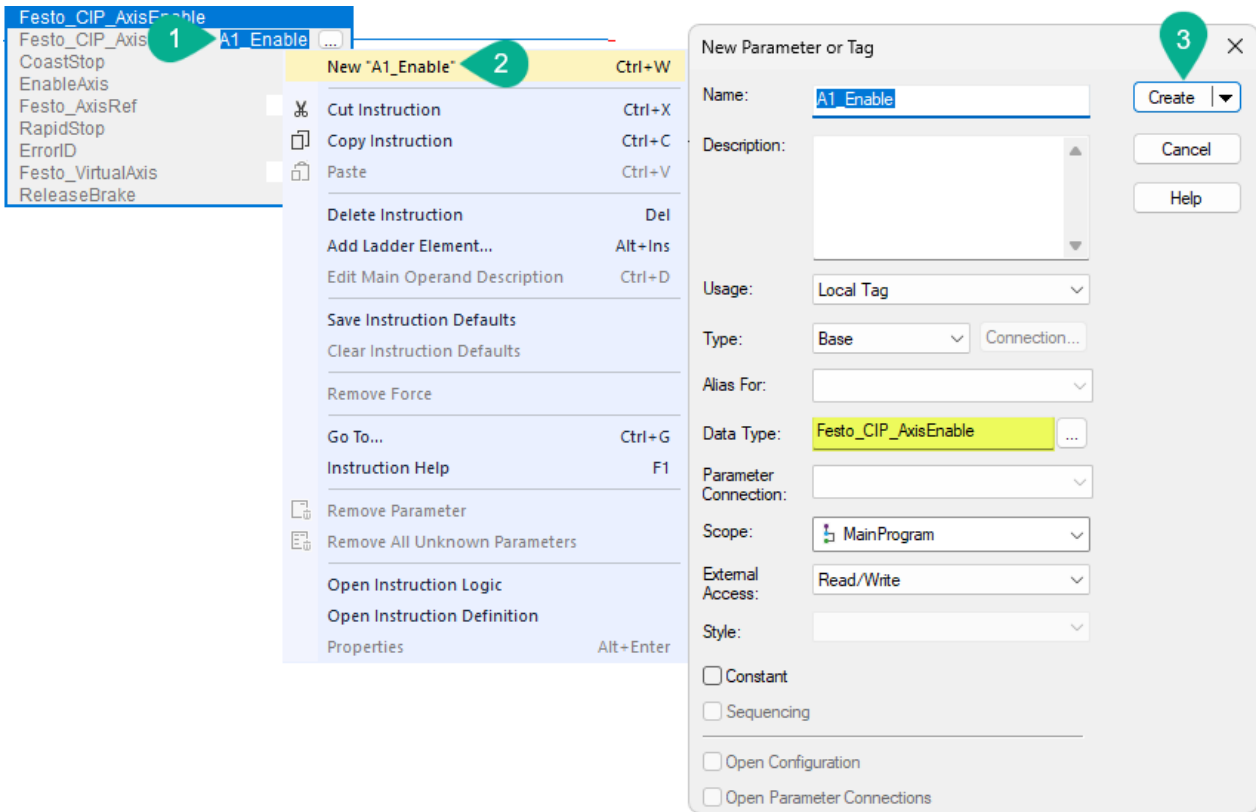
Drag and drop the **Festo\_CIP\_AxisEnable** AOI file from the Add-On Instructions folder as shown above.



#### Note

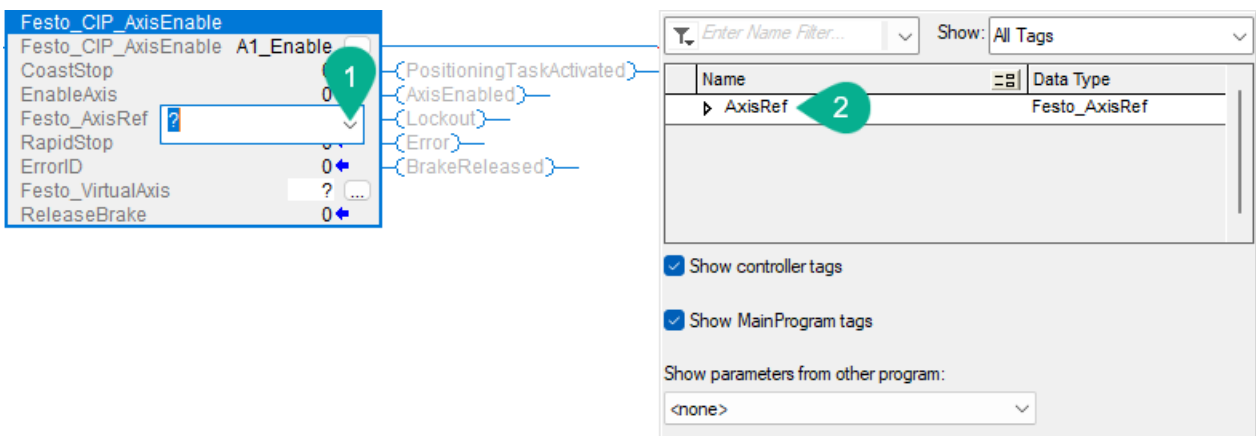
- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this may cause the AOI to function incorrectly.

## Step 2



1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select **New A1\_Enable** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **A1\_Enable**.
  - Set the Data Type to **Festo\_CIP\_AxisEnable** (highlighted in yellow).

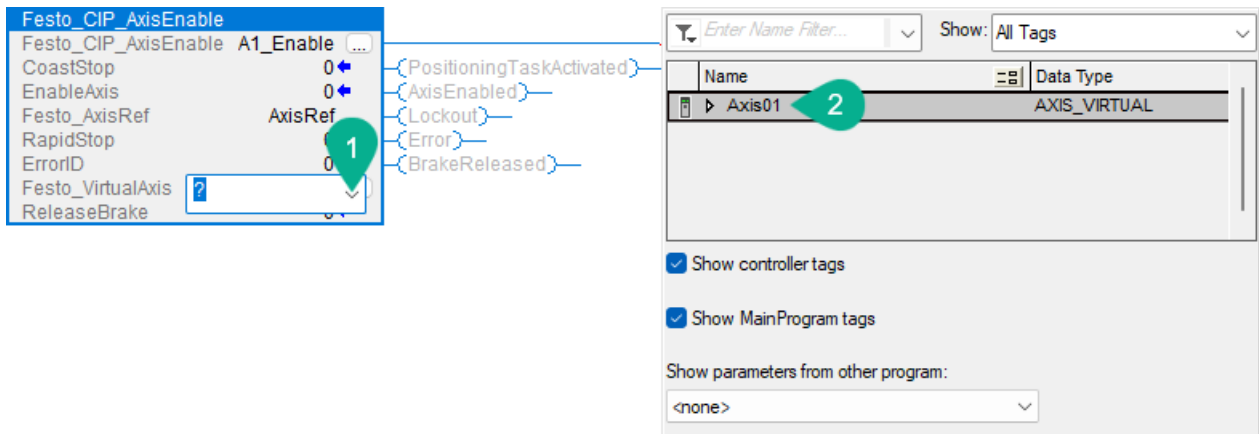
## Step 3



1. Click the dropdown arrow next to the **Festo\_AxisRef** parameter in the AOI interface.
2. From the tag selection window, select the **AxisRef** tag that was created in section [5.6.4 Festo AxisRef](#) Step 3 for the Festo\_CIP\_Read AOI.

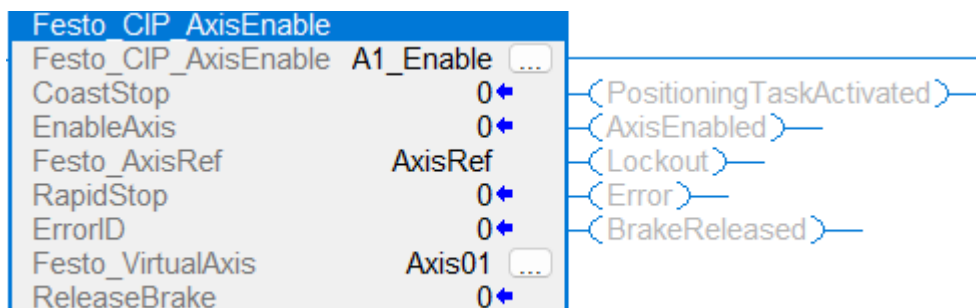
**Note**

- Users do not need to create a new **Festo\_AxisRef** tag separately; assign the same tag used in the **Festo\_CIP\_Read** block, as this **Festo\_AxisRef** tag is common to all blocks.

**Step 4**

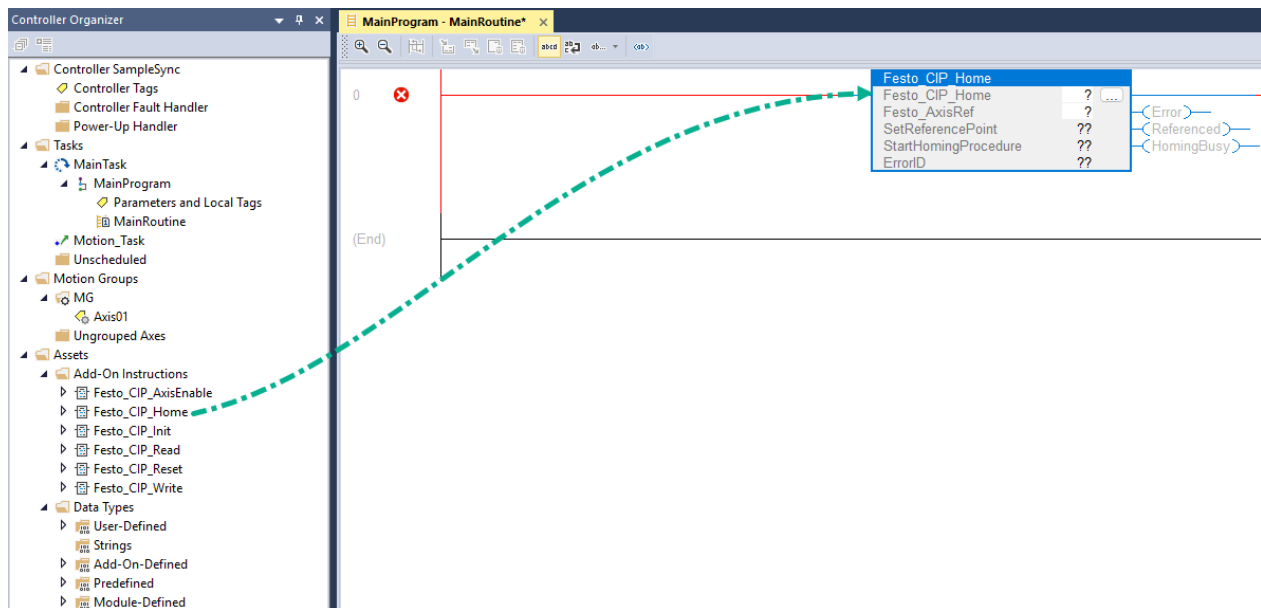
1. Click the dropdown arrow next to the **Festo\_VirtualAxis** parameter.
2. From the tag selection window, choose the appropriate axis tag, e.g., **Axis01**.

Once all the required tags are configured, the AOI will appear as shown in the image below.



## 5.7.5 Add and Configure the AOI Festo\_CIP\_Home

### Step 1

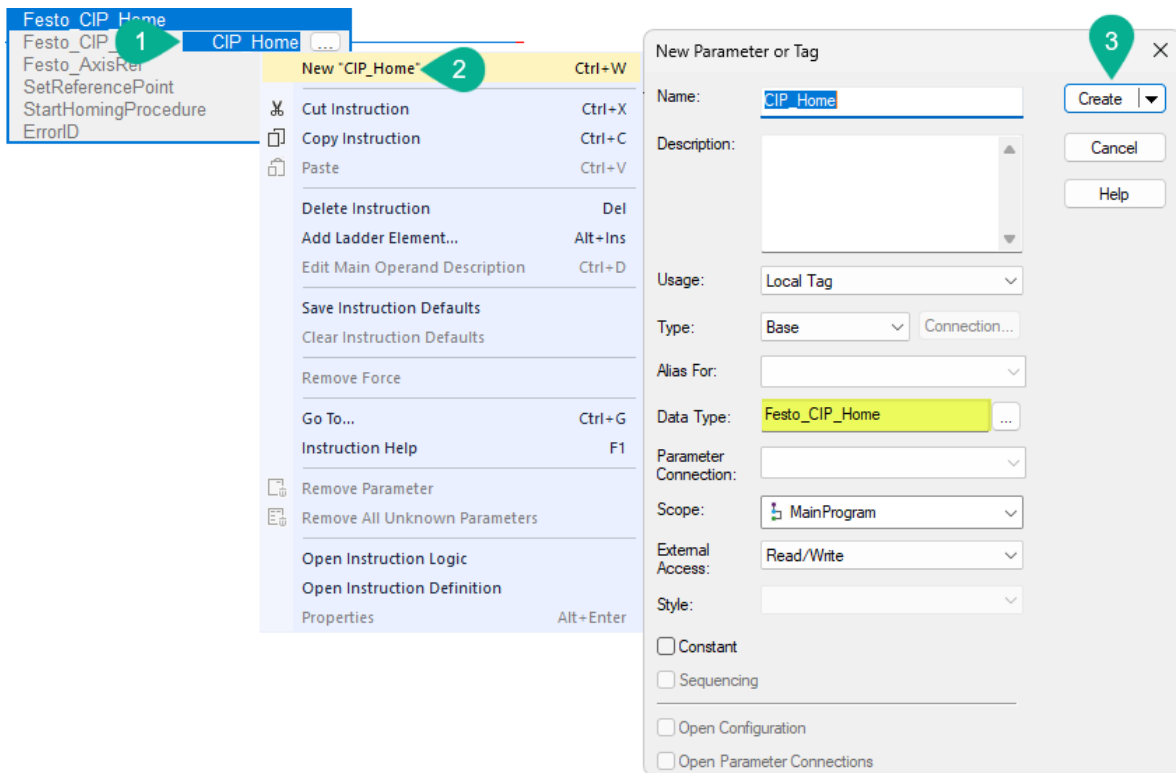


Add a new ladder rung and drag and drop the **Festo\_CIP\_Home** AOI file from the Add-On Instructions folder as shown above.

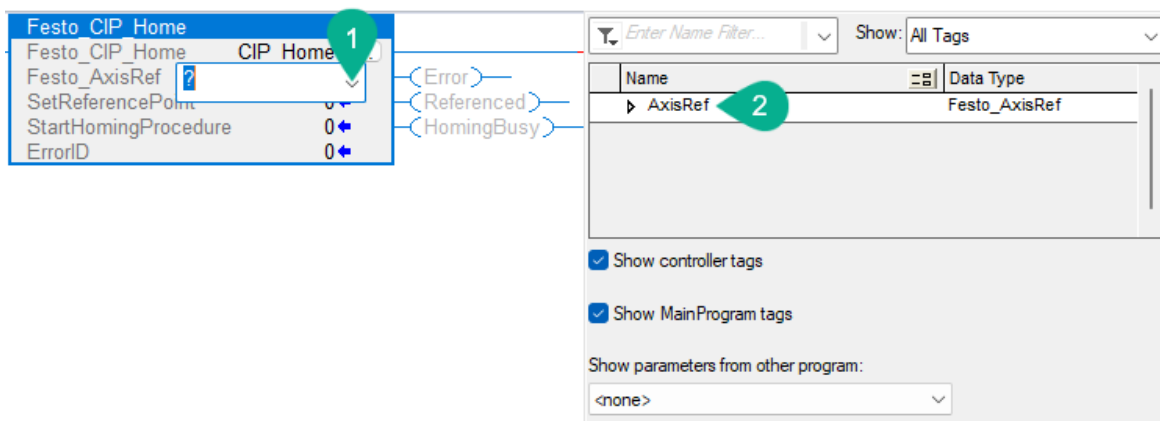


#### Note

- Users must ensure that no other conditions exist in the same rung where the AOI is configured, as this will cause the AOI to function incorrectly.

**Step 2**

1. Enter the **name** of the AOI and **Right click** on the entered name.
2. Select **New CIP\_Home** from the context menu.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **CIP\_Home**.
  - Set the Data Type to **Festo\_CIP\_Home** (highlighted in yellow).

**Step 3**

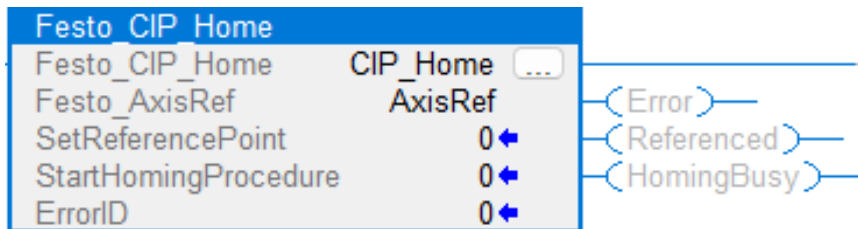
1. Click the dropdown arrow next to the **Festo\_AxisRef** parameter in the AOI interface.
2. From the tag selection window, select the **AxisRef** tag that was created in section [5.6.4 Festo AxisRef](#) Step 3 for the Festo\_CIP\_Read AOI.



#### Note

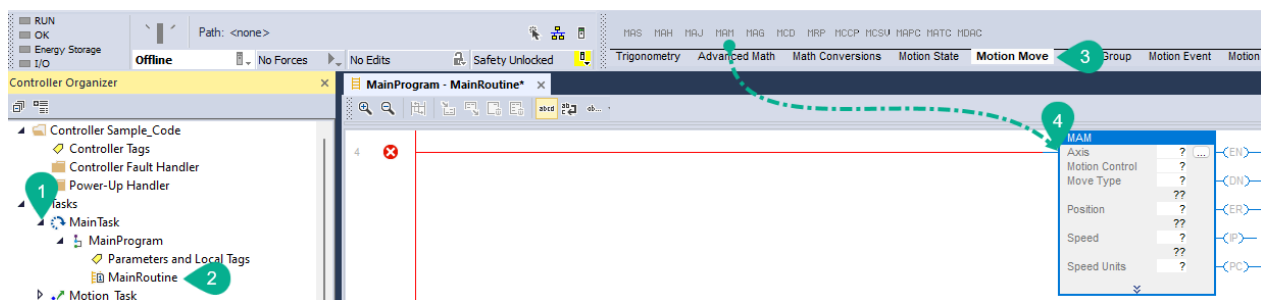
- Users do not need to create a new **Festo\_AxisRef** tag separately; assign the same tag used in the **Festo\_CIP\_Read** block, as this **Festo\_AxisRef** tag is common to all blocks.

Once all the required tags are configured, the AOI will appear as shown in the image below.

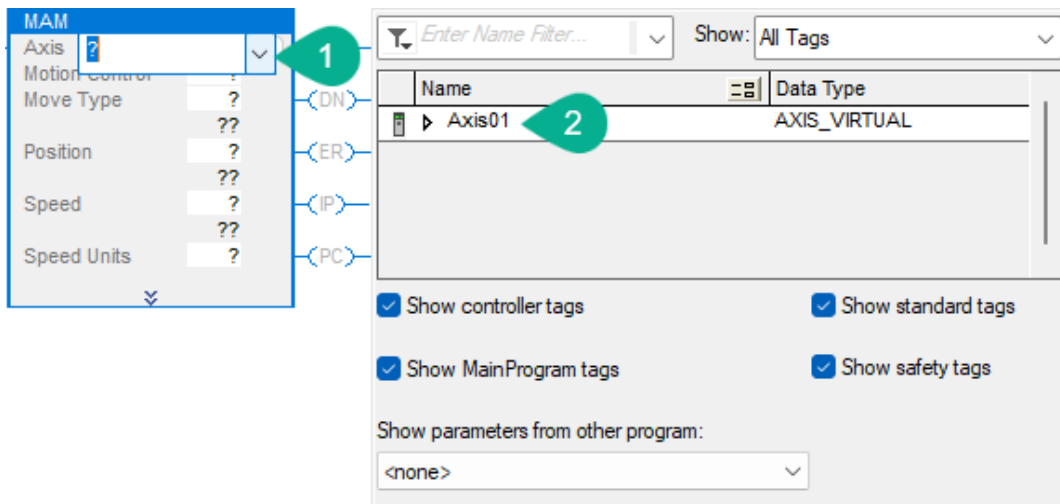


### 5.7.6 Add and Configure Rockwell Instruction MAM

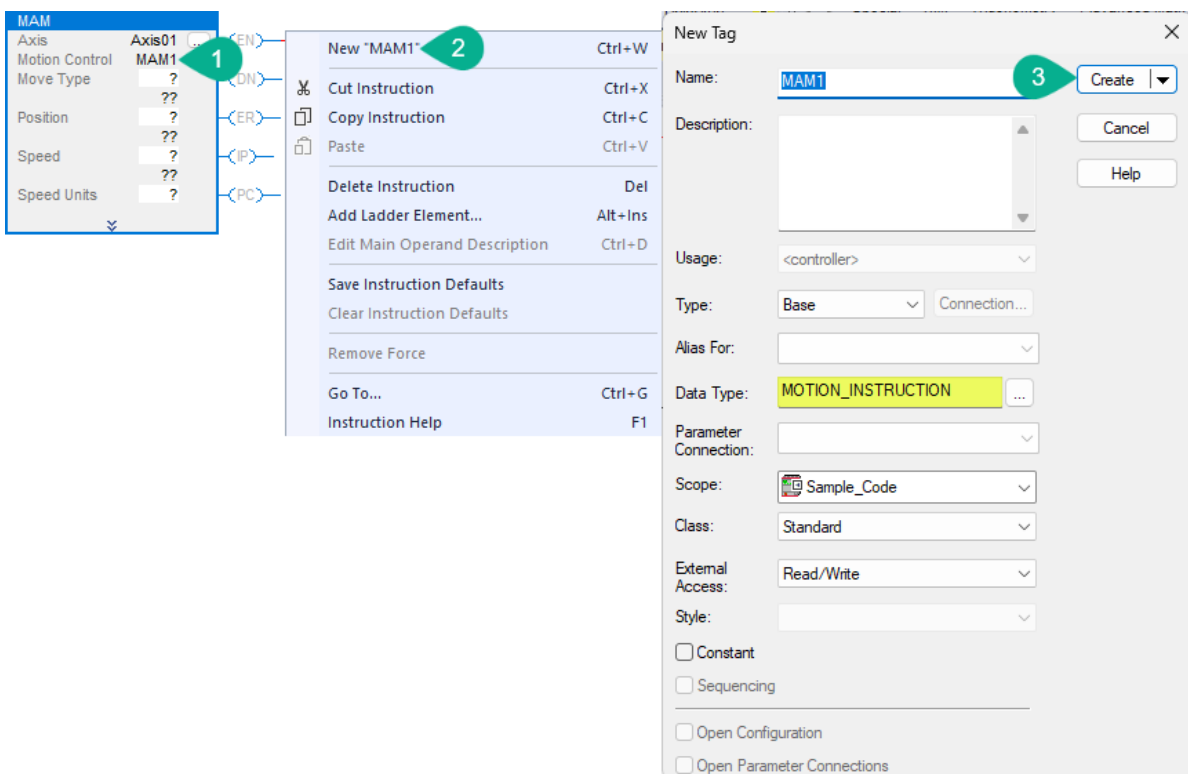
#### Step 1



1. In the **Controller Organizer**, expand the Tasks folder and select the task named **MainTask**.
2. Within **MainTask**, open the program **MainRoutine**.
3. Navigate to the **Motion** tab on the toolbar.
4. Drag and drop the **MAM** instruction into the programming rung.

**Step 2**

1. Click the dropdown arrow next to the **Axis** parameter in the **MAM** interface.
2. In the tag selection window, select the (e.g., **Axis01**) tag.

**Step 3**

1. Enter the name of the **Motion Control** tag and **right-click** on the entered name (e.g., **MAM1**).
2. From the context menu, select **New MAM1**.
3. Click the **Create** button in the **New Tag** pop-up window and ensure the details are as follows
  - Enter the tag name, e.g., **MAM1**.
  - Set the Data Type to **MOTION\_INSTRUCTION** (highlighted in yellow).

Step 4

|                  |                  |      |
|------------------|------------------|------|
| MAM              |                  |      |
| Motion Axis Move |                  | (EN) |
| Axis             | Axis01           | (DN) |
| Motion Control   | MAM1             | (ER) |
| Move Type        | 0                | (IP) |
| Position         | MAM1_TargetValue | (PC) |
|                  | 125.0            |      |
| Speed            | MAM1_Speed       |      |
|                  | 700.0            |      |
| Speed Units      | Units per sec    |      |
| Accel Rate       | MAM1_Accel       |      |
|                  | 0.0              |      |
| Accel Units      | Units per sec2   |      |
| Decel Rate       | MAM1_Decel       |      |
|                  | 0.0              |      |
| Decel Units      | Units per sec2   |      |
| Profile          | Trapezoidal      |      |
| Accel Jerk       | 10000            |      |
| Decel Jerk       | 10000            |      |
| Jerk Units       | Units per sec3   |      |
| Merge            | Disabled         |      |
| Merge Speed      | 0                |      |
| Lock Position    | 0                |      |
| Lock Direction   | 0                |      |
| Event Distance   | 0                |      |
| Calculated Data  | 0                |      |

➔

**Note**

- To configure the MAM instruction, refer to the table [MAM Instruction Operands and Configuration](#) for detailed information.

### 5.7.7 Instruction MAM Operands and Configuration

| Operand        | CompactLogix                    | ControlLogix                                                                               | Format           | Description                                                                                                               |
|----------------|---------------------------------|--------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------|
| Axis           | AXIS_CIP_DRIVE,<br>AXIS_VIRTUAL | AXIS_CIP_DRIVE,<br>AXIS_VIRTUAL,<br>AXIS_GENERIC_DRIVE,<br>AXIS_SERVO,<br>AXIS_SERVO_DRIVE | Tag              | Name of the axis. For Absolute or Incremental Master Offset moves, enter the slave axis.                                  |
| Motion Control | MOTION_INSTRUCTION              | MOTION_INSTRUCTION                                                                         | Tag              | Control tag for the instruction.                                                                                          |
| Move type      | DINT                            | DINT                                                                                       | Immediate or Tag | Specifies the type of move. See <a href="#">Chapter 5.7.8</a> detailed move types below.                                  |
| Position       | REAL                            | REAL                                                                                       | Immediate or Tag | Absolute position or incremental distance for the move. <a href="#">Refer Chapter 5.7.9</a> for more details.             |
| Speed          | REAL                            | REAL                                                                                       | Immediate or Tag | Speed to move the axis in Speed Units.                                                                                    |
| Speed Units    | DINT                            | DINT                                                                                       | Immediate        | Units for speed: Units per sec (0), % of Maximum (1), Time (3), Units per MasterUnit (4), Master Units (7).               |
| Accel Rate     | REAL                            | REAL                                                                                       | Immediate or Tag | Acceleration rate of the axis in Accel Units.                                                                             |
| Accel Units    | DINT                            | DINT                                                                                       | Immediate        | Units for acceleration rate (same options as Speed Units).                                                                |
| Decel Units    | REAL                            | REAL                                                                                       | Immediate or Tag | Deceleration rate of the axis in Deceleration Units.                                                                      |
| Decel Units    | DINT                            | DINT                                                                                       | Immediate        | Units for deceleration rate (same options as Speed Units).                                                                |
| Profile        | DINT                            | DINT                                                                                       | Immediate        | Velocity profile for the move: Trapezoidal (0) or S-Curve (1).                                                            |
| Accel Jerk     | REAL                            | REAL                                                                                       | Immediate or Tag | Acceleration jerk rate for the axis (used only if Profile is S-Curve).                                                    |
| Decel Jerk     | REAL                            | REAL                                                                                       | Immediate or Tag | Deceleration jerk rate for the axis (used only if Profile is S-Curve).                                                    |
| Jerk Units     | DINT                            | DINT                                                                                       | Immediate        | Units for jerk: Units per sec <sup>3</sup> (0), % of Maximum (1), % of Time (2), Time (3), Units per MasterUnit (4), etc. |
| Merge          | DINT                            | DINT                                                                                       | Immediate        | Enable merging of current axis motion into a pure move: NO (0) or YES (1).                                                |

| Operand         | CompactLogix       | ControlLogix       | Format           | Description                                                                                              |
|-----------------|--------------------|--------------------|------------------|----------------------------------------------------------------------------------------------------------|
| Merge Speed     | DINT               | DINT               | Immediate        | If merging enabled, select speed: Programmed (0) or Current axis speed (1).                              |
| Lock Position   | REAL               | REAL               | Immediate or Tag | Position on the Master Axis where the Slave axis should start following after the move is initiated.     |
| Lock Direction  | UINT32             | UINT32             | Immediate        | Conditions for Lock Position usage. Valid values 0–4; default is None. Not allowed in Time Driven modes. |
| Event Distance  | REAL or ARRAY of 0 | REAL or ARRAY of 0 | Array Tag        | Position(s) on a move measured from the end of the move.                                                 |
| Calculated data | REAL or ARRAY of 0 | REAL or ARRAY of 0 | Array Tag        | Master Distance(s) or time(s) needed from the beginning of the move to the Event Distance point(s).      |

Table 5.1: Instruction MAM Operands and Configuration descriptions

### 5.7.8 Move Type Details

| Move Type                 | Value | Description                                                            |
|---------------------------|-------|------------------------------------------------------------------------|
| Absolute                  | 0     | Move an axis to an absolute position.                                  |
| Incremental               | 1     | Move an axis a specified distance from its current position.           |
| Rotary Shortest Path      | 2     | Move a rotary axis to an absolute position via the shortest direction. |
| Rotary Positive           | 3     | Move a rotary axis to an absolute position in the positive direction.  |
| Rotary Negative           | 4     | Move a rotary axis to an absolute position in the negative direction.  |
| Absolute Master Offset    | 5     | Offset the master value of a position cam to an absolute position.     |
| Incremental Master Offset | 6     | Offset the master value of a position cam by an incremental distance.  |

Table 5.2: Move Type Details descriptions

### 5.7.9 Position Values Based on Move Type

| Move Type                 | Description                                                                              |
|---------------------------|------------------------------------------------------------------------------------------|
| Absolute                  | Position to Move to                                                                      |
| Incremental               | Distance to Move                                                                         |
| Rotary Shortest Path      | Position to move to. Enter a positive value that is less than the Position Unwind value. |
| Rotary Positive           |                                                                                          |
| Rotary Negative           |                                                                                          |
| Absolute Master Offset    | Absolute Offset Position                                                                 |
| Incremental Master Offset | Incremental offset distance.                                                             |

Table 5.3: Move Type descriptions

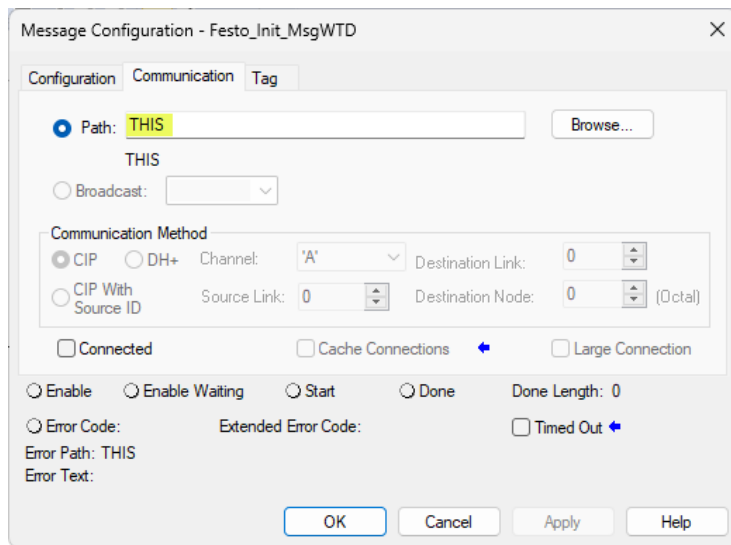
### 5.7.10 Message (MSG) Communication Path

To configure the communication path, the following steps are alternative methods to those described earlier in this document; [refer to chapter 5.7.2](#) (see steps 9 and 13) for the previously described method.

### CompactLogix controllers

For CompactLogix controllers, the path is 1 and the slot is 0.

**Alternatively**, for ControlLogix 5580 controllers with firmware version 28.11 or later, you can also use the path **THIS**.

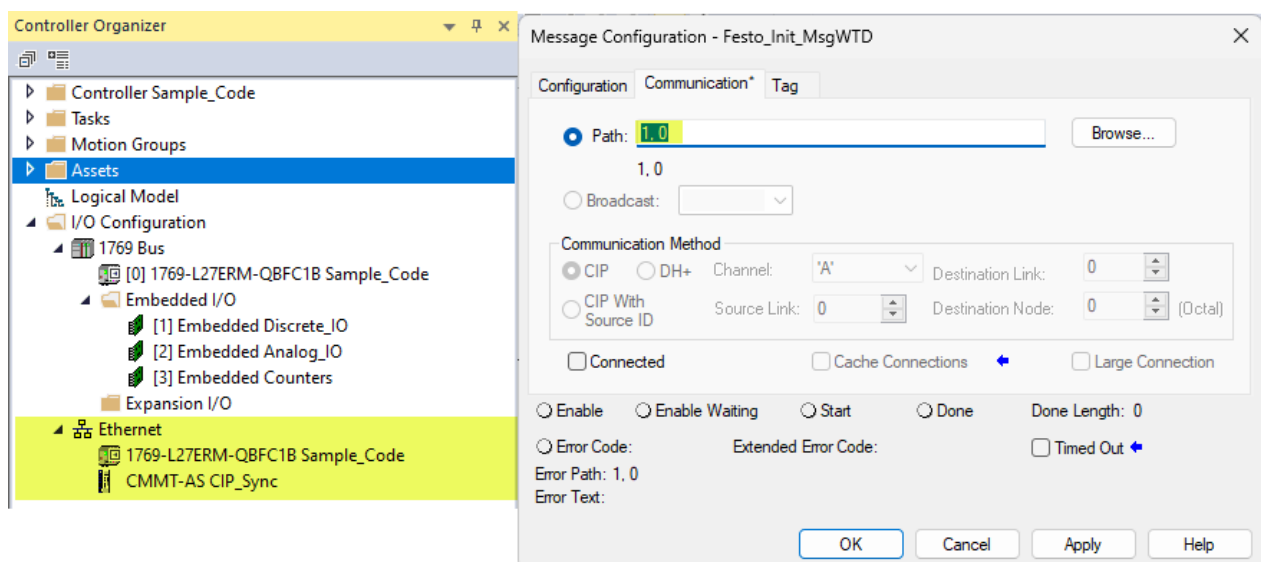


### ControlLogix controllers

For ControlLogix 5580 controllers and communication modules, the communication path is defined as **1, x**, where **x** represents the slot number of the communication module. If the front Ethernet port of a ControlLogix 5580 controller is used; **x** corresponds to the slot number of that controller.

### Method – 1

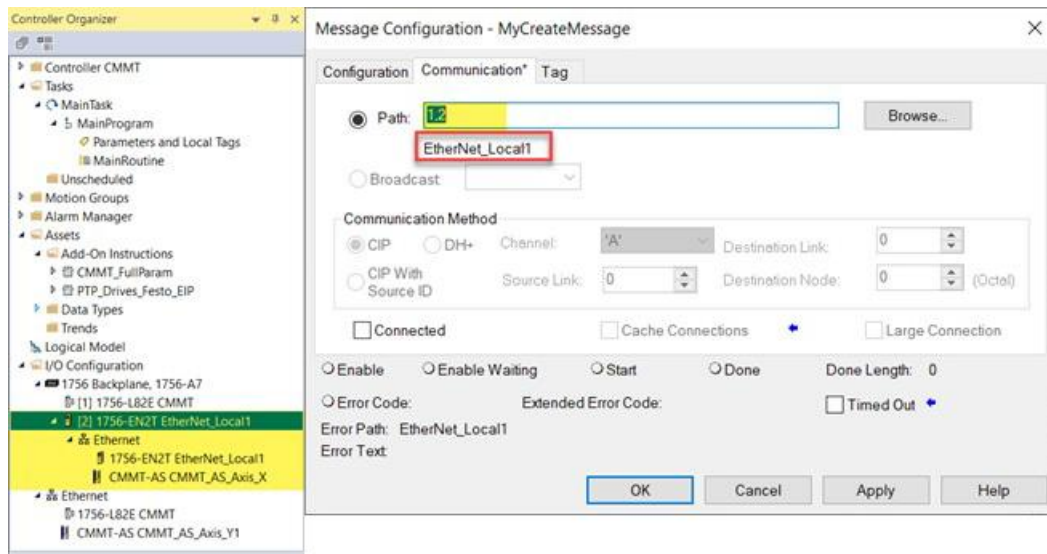
If a CMMT module is added under the Controller Ethernet Port, then follow **Method 1**.



Alternatively, for ControlLogix 5580 controllers with firmware version 28.11 or later, you can also use the path **THIS**.

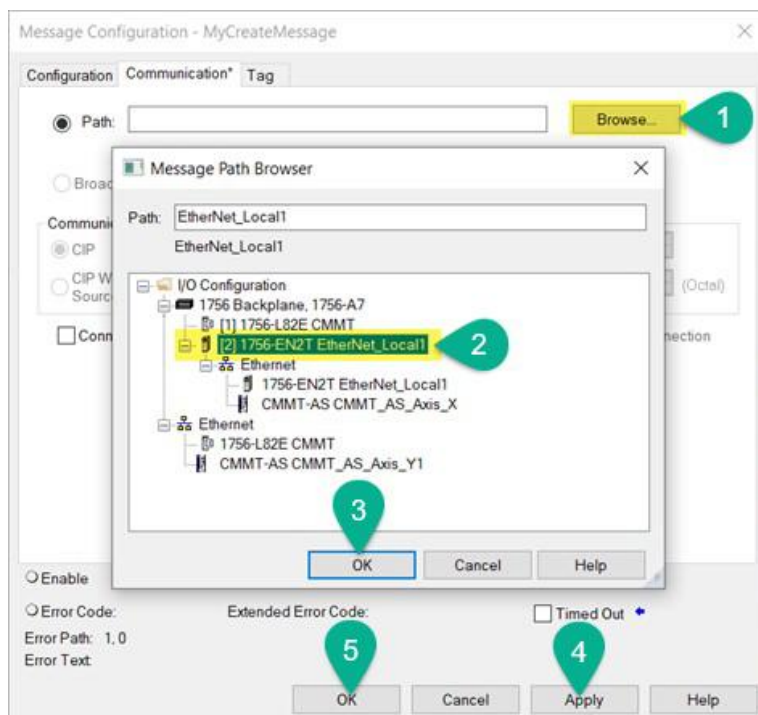
## Method – 2

If a CMMT module is added under the Ethernet Module, then follow **Method 2**.



The communication path is **1, 2**, where **1** represents the fixed path segment and **2** is the slot number of the communication module.

**Alternatively**, the option described below may be used.



1. Click on the **Browse...** button.
2. Select the **Ethernet Module** (1756-EN2T).
3. Click the **OK** button to confirm.
4. Click the **Apply** button to confirm the configuration.
5. Click the **OK** button to confirm.

## 5.8 Procedure for Importing a Routine Program in Studio 5000

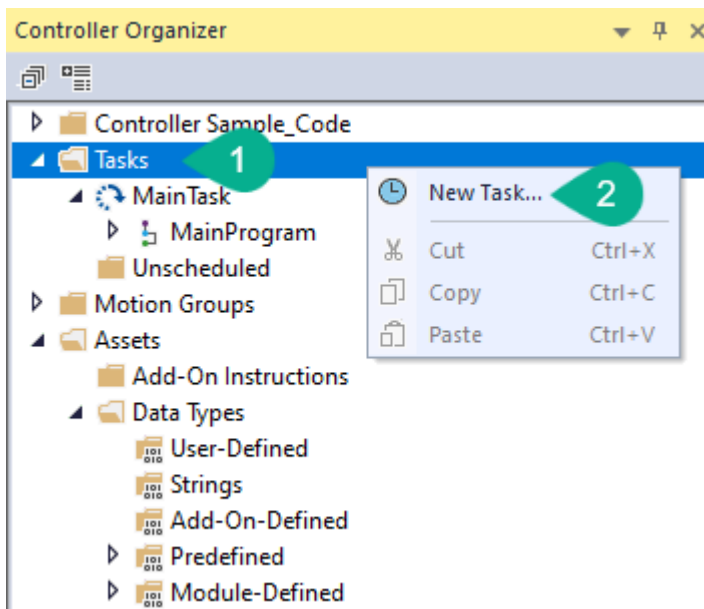


### Note

- This step provides guidance for importing the complete configuration, which includes all necessary and reliable AOIs.
- The subsequent steps are optional and depend on the user's specific requirements; they outline additional available options for customization or modification.
- By using this import option, users can bring in the entire program at once, avoiding the need to install AOIs or perform other configuration steps separately. This streamlines the setup process and ensures consistency, as the imported program matches the provided sample code.

### 5.8.1 Adding a Motion Task

#### Step 1



1. In the Controller Organizer pane, **right-click** on **Tasks** as shown in the image.
2. Select **New Task...** from the context menu that appears.

**Step 2**

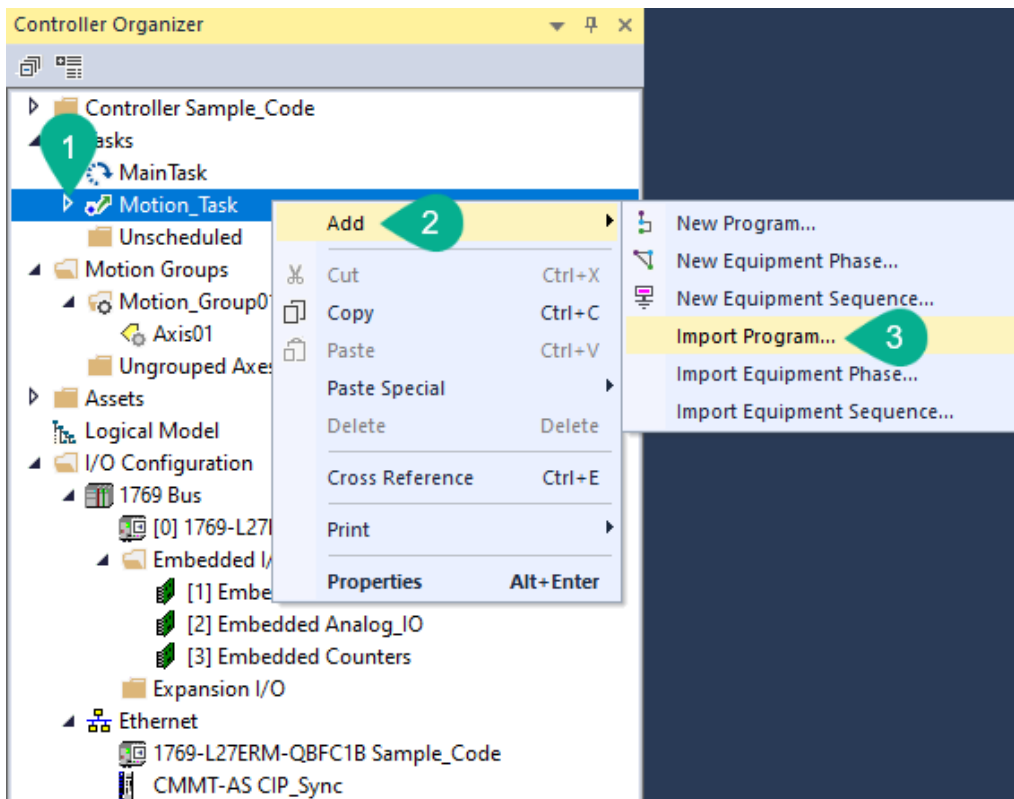
1. In the task configuration window, enter the task name (e.g., **Motion\_Task**) in the **Name** field.
2. Set the **Type** to **Event** from the dropdown menu.
3. Select **Motion Group Execution** as the **trigger** type from the dropdown menu.
4. From the **Tag** dropdown, choose the motion group (e.g., **Motion\_Group01**).
5. Enable the option **Execute task if no event occurs within** and set the time to **4 ms** (This value may be changed later depending on the total number of axes in the project. This value must match the setting for Motion\_Group01; [see chapter 5.4.3](#) Step 3).
6. Set the **Priority** to a value of **1** to achieve the highest priority.
7. Configure the **Watchdog Timeout** to **100.000 ms**.
8. Confirm checkbox **Disable automatic output processing to reduce task overhead** is turned ON.
9. Click **OK** to save and create the task.

**Note**

- The time value of **Execute task if no event occurs within Task Event Motion Group** must be set equal to the **Motion Group Base Update Period** time to ensure proper synchronization of the project settings.

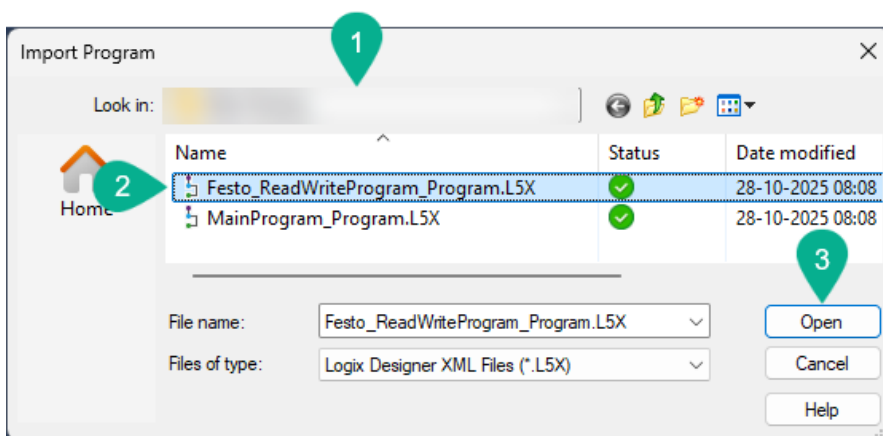
## 5.8.2 Importing the Festo\_ReadWriteProgram\_L5X Routines

### Step 1

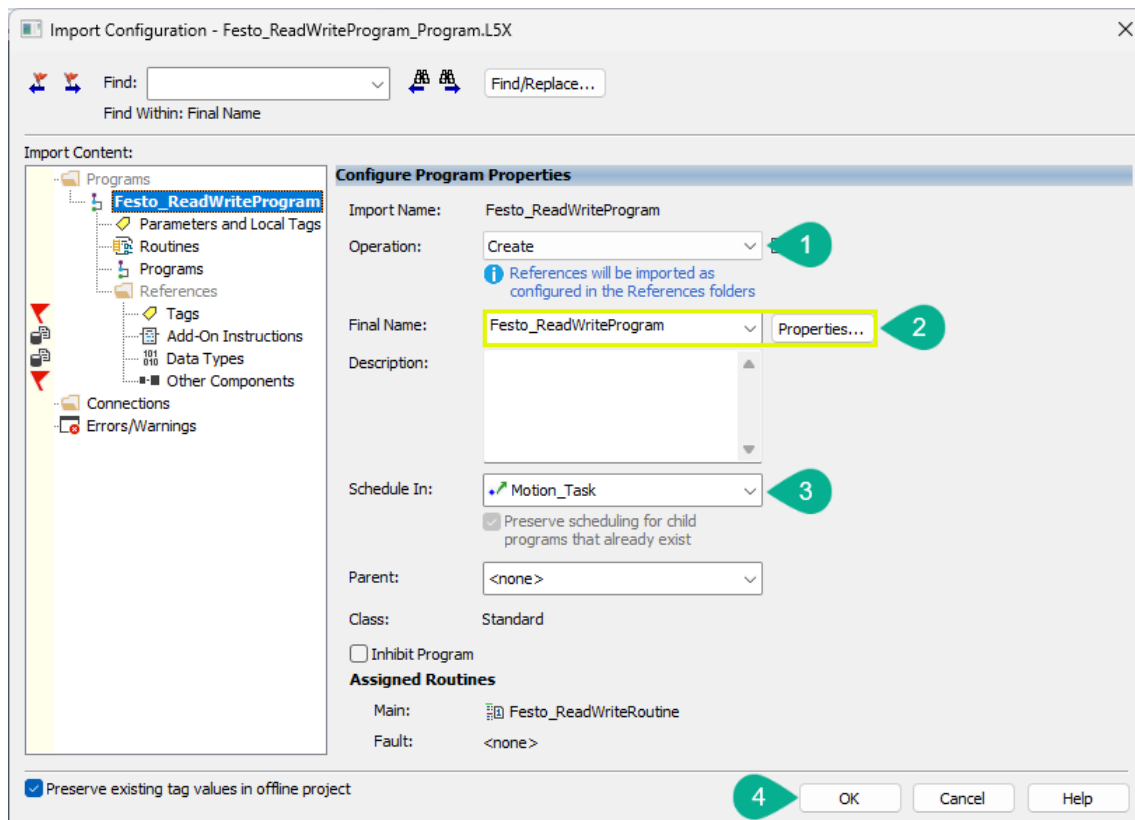


1. In the **Controller Organizer**, right-click on the task (e.g., **Motion\_Task**) under the **Tasks**.
2. From the context menu, select **Add**.
3. Choose **Import Routine...** from the submenu to import an existing routine into the program.

### Step 2

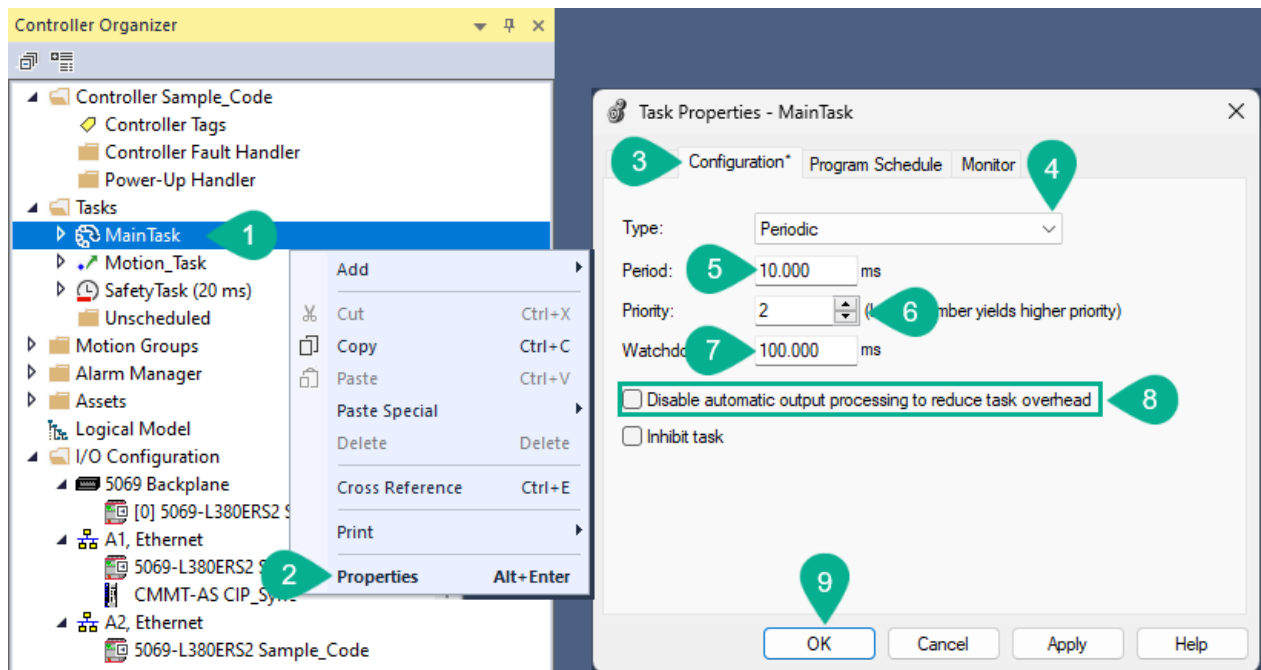


1. In the **Import Routine** dialog box, navigate to the folder containing the routine file.
2. Select the routine file to import (e.g., **FestoReadWriteProgram\_Program.L5X**).
3. Click the **Open** button to proceed with importing the selected routine.

**Step 3**

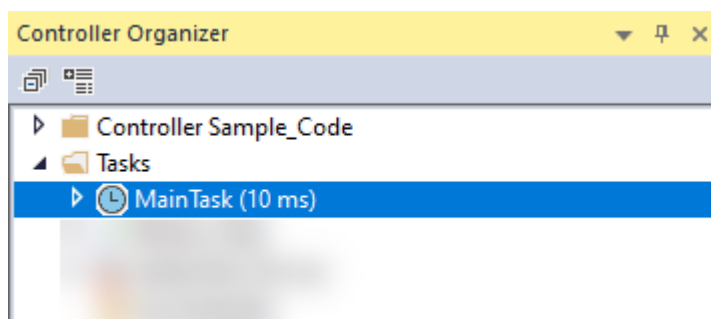
1. In the **Import Configuration** window, set the **operation** to (e.g., **Create**) to specify how the program will be imported.
2. Confirm the **Final Name** of the program (e.g., **Festo\_ReadWriteProgram**) by clicking Properties... if adjustments are required.
3. From the **Schedule In** dropdown, select the task where the program will be scheduled (for synchronization, the recommended option is **Motion\_Task**).
4. Click **OK** to finalize and import the program.

### 5.8.3 Configuration of MainTask Properties



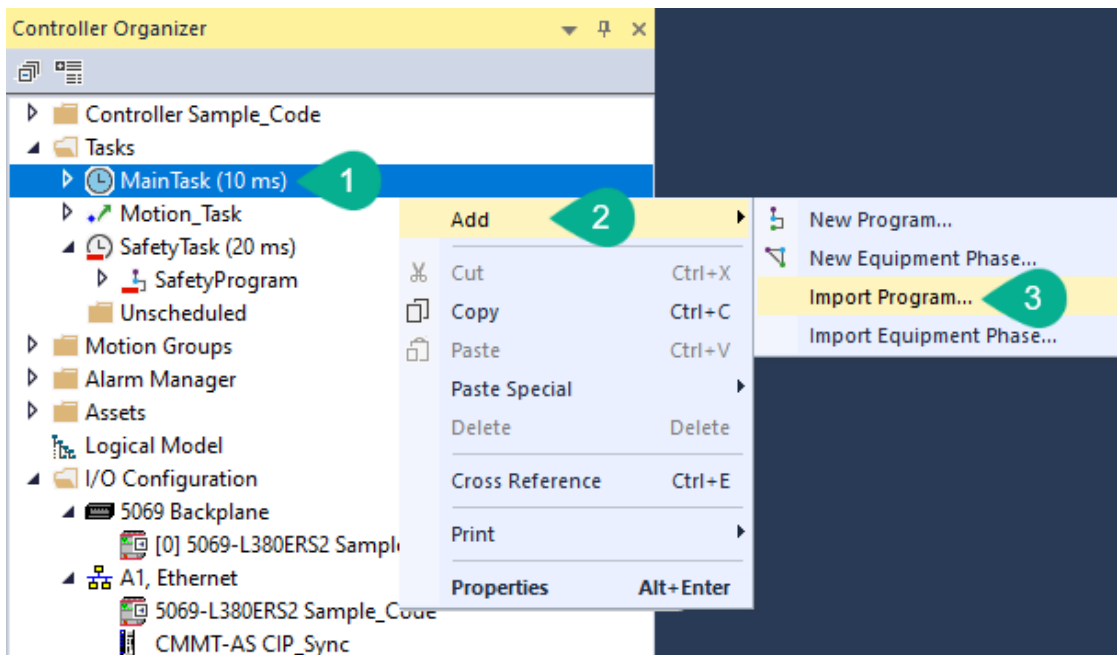
1. In the Controller Organizer, right-click **MainTask** under Tasks folder.
2. Select **Properties** from the context menu.
3. In the Task Properties – MainTask window, select the **Configuration** tab.
4. From the Type dropdown, select **Periodic**.
5. Modify Period to **10 ms** (This may need to be optimized later to accommodate multiple axes while balancing the PLC CPU usage).
6. Set the **Priority** to a value of **2** to achieve the 2<sup>nd</sup> highest priority.
7. Set the **Watchdog** time (e.g. **100 ms**).
8. Confirm checkbox **Disable automatic output processing to reduce task overhead** is turned OFF.
9. Click **OK** to apply the settings.

After completing the MainTask configuration, the **MainTask** will appear as shown in the image below.



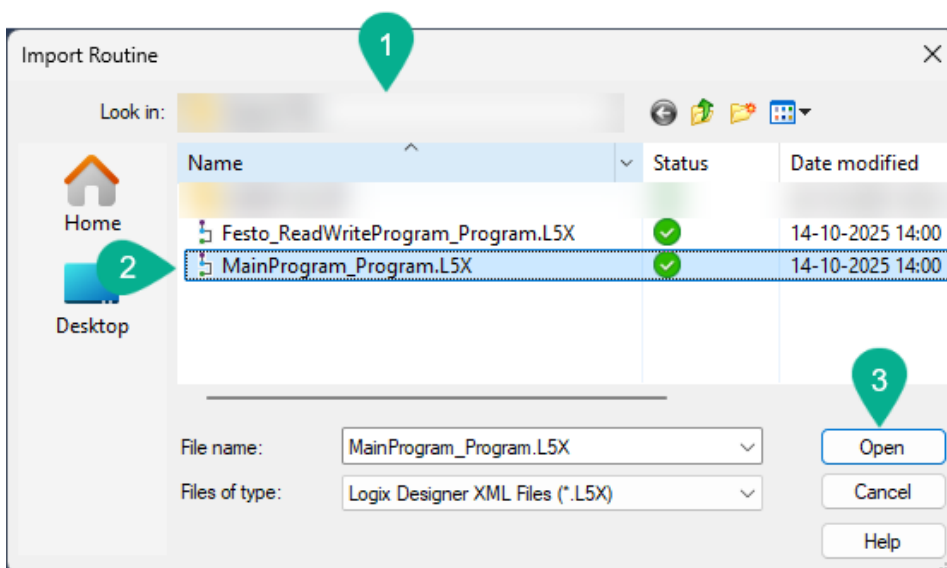
### 5.8.4 Importing the Festo\_MainProgram\_L5X Routines

#### Step 1



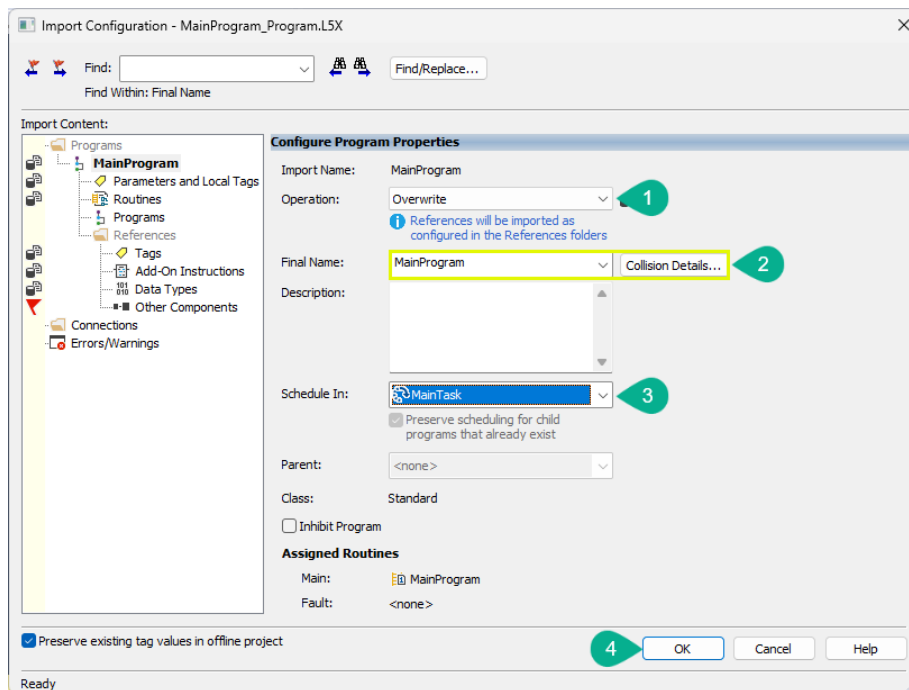
1. In the **Controller Organizer**, right-click on the task (e.g., **MainTask**) under the **Tasks**.
2. From the context menu, select **Add**.
3. Choose **Import Program...** from the submenu to import an existing routine into the program.

#### Step 2



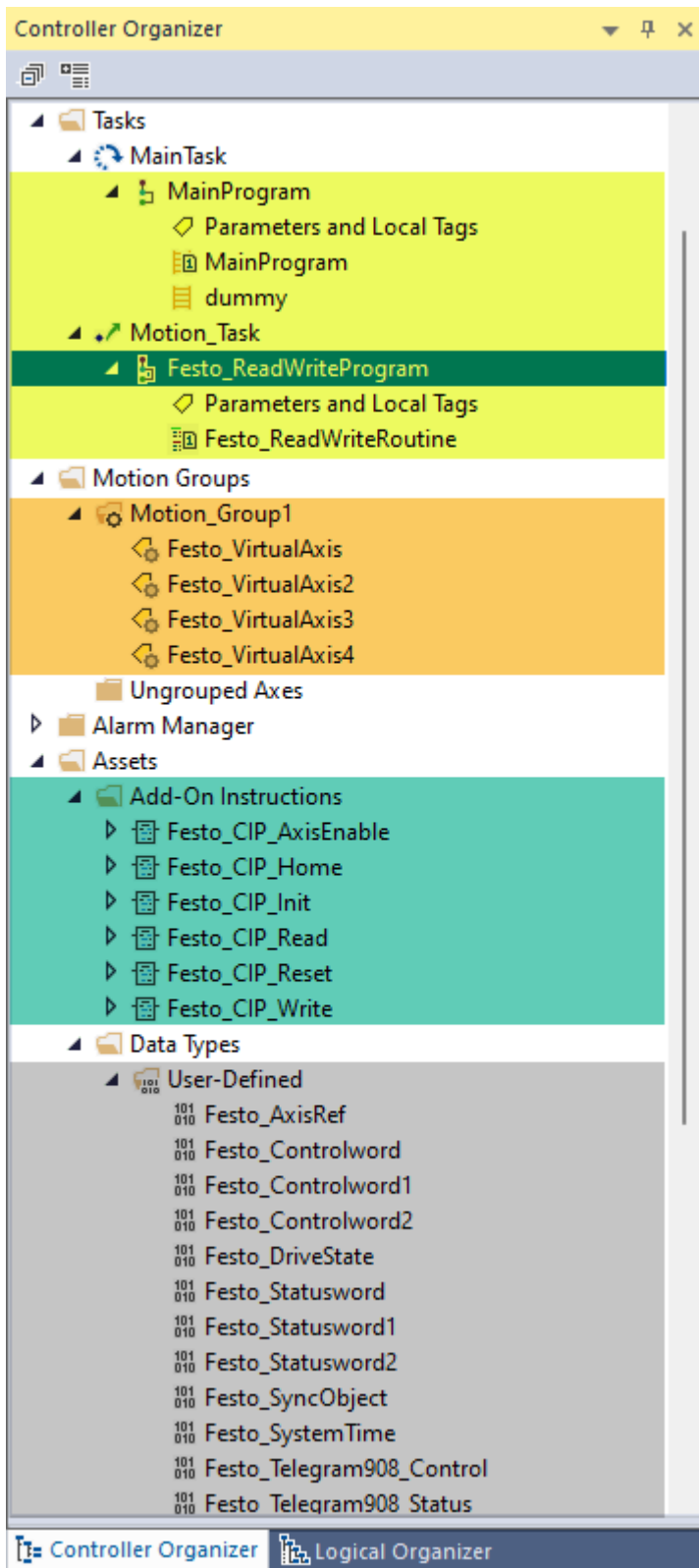
1. In the **Import Routine** dialog box, navigate to the folder containing the routine file.
2. Select the routine file to import (e.g., **MainProgram\_Program.L5X**).
3. Click the **Open** button to proceed with importing the selected routine.

### Step 3



1. In the **Import Configuration** window, set the **operation** to (e.g., **Overwrite**) to define how the imported program will interact with existing content.
2. Confirm the **Final Name** for the program (e.g., **MainProgram**).
3. From the **Schedule In** dropdown, select the task where the program will be scheduled (e.g., **MainTask**).
4. Click **OK** to complete the import process.

Once both routine programs have been successfully added, the **Controller Organizer** will display as shown in the image below.



## 6 Sample Code: CIP Synchronization AOI Blocks

### 6.1 Initialization of the AOI Festo\_CIP\_Init

**Before**

**After**

| Name                                    | Value             | Force Mask | Style   |
|-----------------------------------------|-------------------|------------|---------|
| AxisRef                                 | {...}             | {...}      |         |
| AxisRef.InitDone                        | 1                 |            | Decimal |
| AxisRef.InitError                       | 0                 |            | Decimal |
| AxisRef.ReceiveBuffer                   | {...}             | {...}      |         |
| AxisRef.SendBuffer                      | {...}             | {...}      |         |
| AxisRef.SendBuffer.STW1                 | 1030              |            | Decimal |
| AxisRef.SendBuffer.XSOLL_A              | 1248              |            | Decimal |
| AxisRef.SendBuffer.XSOLL_A_2            | 7                 |            | Decimal |
| AxisRef.SendBuffer.STW2                 | 0                 |            | Decimal |
| AxisRef.SendBuffer.NSOLL_A              | 0                 |            | Decimal |
| AxisRef.SendBuffer.TIMESTAMP_SETPOINT   | 23741             |            | Decimal |
| AxisRef.SendBuffer.TIMESTAMP_SETPOINT_2 | 28667             |            | Decimal |
| AxisRef.IsSynchronized                  | 1                 |            | Decimal |
| AxisRef.CoarseUpdatePeriod              | 2000              |            | Decimal |
| AxisRef.OverrideVelocityFlag            | 0                 |            | Decimal |
| AxisRef.OverrideVelocityValue           | 0.0               |            | Float   |
| AxisRef.BaseVelocity                    | 0.315             |            | Float   |
| AxisRef.FactorGroupPosition             | -6                |            | Decimal |
| AxisRef.PositionSetpoint                | 0.0               |            | Float   |
| AxisRef.PositionActual                  | 257.572           |            | Float   |
| AxisRef.VelocitySetpoint                | 0.0               |            | Float   |
| AxisRef.VelocityActual                  | -3.84533232e-0... |            | Float   |
| AxisRef.CW                              | {...}             | {...}      |         |
| AxisRef.CW.STW1                         | {...}             | {...}      |         |
| AxisRef.CW.STW2                         | {...}             | {...}      |         |
| AxisRef.SW                              | {...}             | {...}      |         |
| AxisRef.DriveState                      | {...}             | {...}      |         |
| AxisRef.TimingModel                     | 0                 |            | Decimal |
| AxisRef.ActUserUnit                     | 6                 |            | Decimal |
| AxisRef.PositioningTaskActivated        | 0                 |            | Decimal |

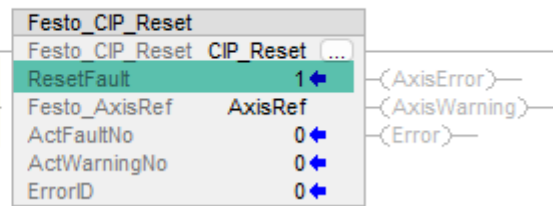
Toggle the **Initialize** control tag from **0** to **1**. Once the function block is **enabled**, the **InitBusy** status will change to **True**. Upon successful initialization, the **InitDone** status will turn **True**, and the **AxisRef** structure will be updated and displayed as shown in the image above, highlighted in yellow.

## 6.2 Sample Code of AOI Festo\_CIP\_Reset

**Before**



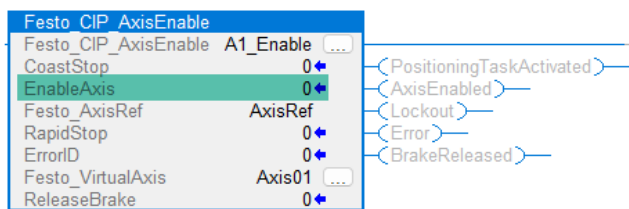
**After**



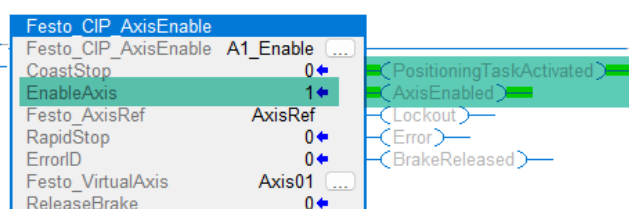
- Initially, the **ResetFault** input is set to **0** (inactive), so any existing error or warnings remain active.
- To clear faults, toggle the **ResetFault** input to **1**.
- After resetting, the fault such as **ActFaultNo**, **ActWarningNo**, and **ErrorID** update to **0**, indicating that faults and warnings have been cleared.
- Corresponding status outputs like **AxisError**, **AxisWarning**, and **Error** will also reset.

## 6.3 Sample Code of AOI Festo\_CIP\_AxisEnable

**Before**



**After**



- Initially, the **EnableAxis** input is set to **0** (disabled).
- To enable the axis, toggle the **EnableAxis** input to **1**.
- After enabling, the status outputs like **PositioningTaskActivated** and **AxisEnabled** will update accordingly, indicating the axis is **active**.
- When **CoastStop** is set to **1** (true), the **Lockout** status will become true, indicating that the drive is locked out and disabled from operation until the lockout condition is cleared.

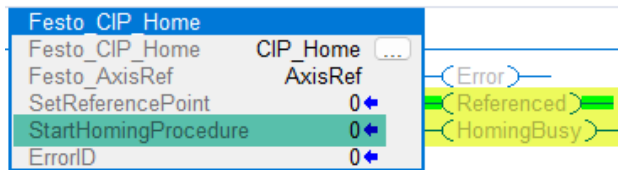


### Note

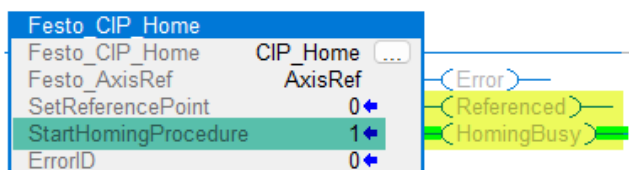
- Verify that **EnableAxis** is set to **1** and that the **AxisEnabled** output is **true**. A true status on AxisEnabled confirms the drive is in closed-loop control with the PLC, allowing further operations.
- When PositioningActivated is **True**, the drive is ready to receive position commands.

## 6.4 Sample Code of AOI Festo\_CIP\_Home

### Before

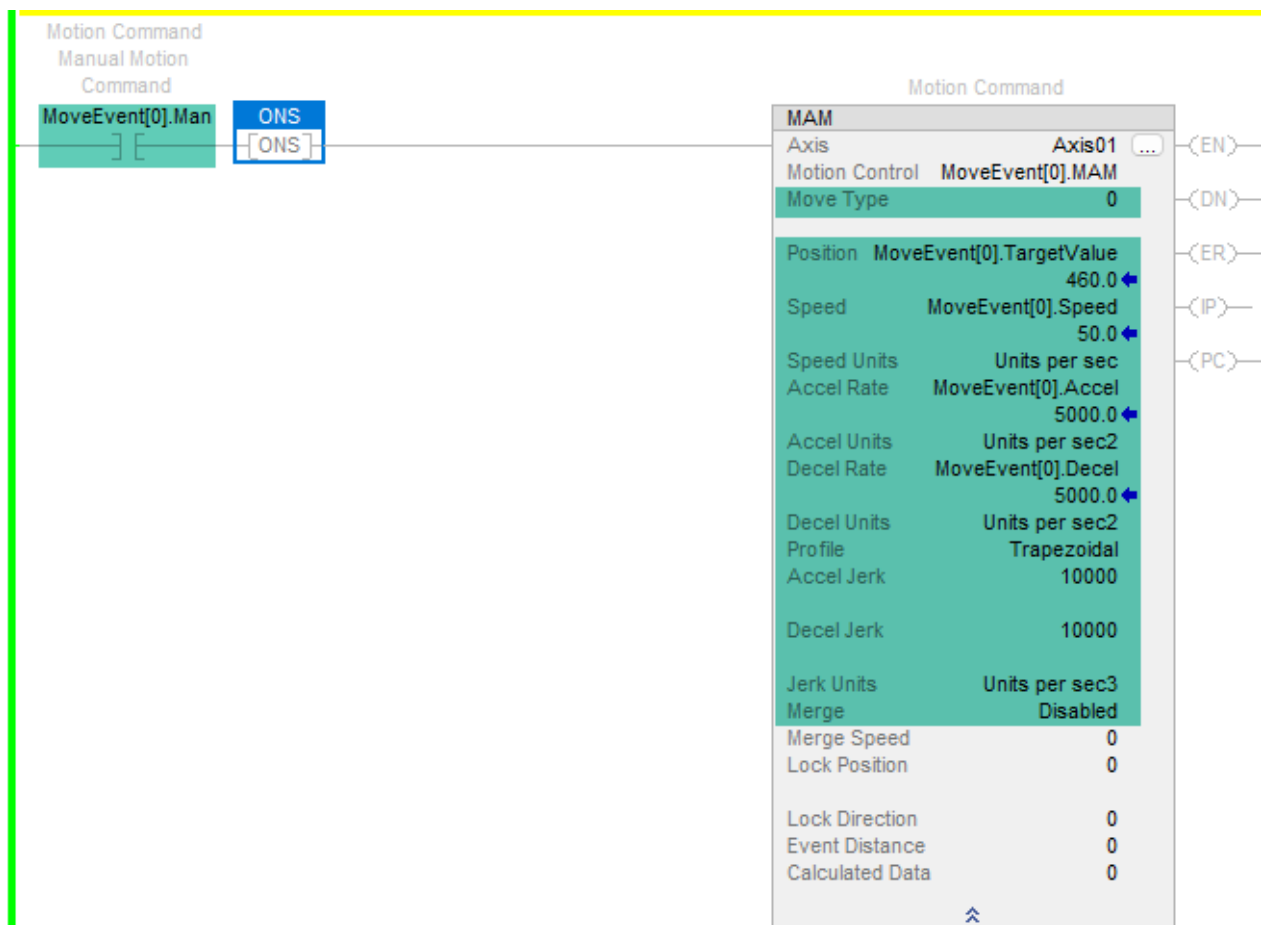


### After



1. Initially, the **StartHomingProcedure** input is set to **0** (inactive).
2. To start the homing process, toggle the **StartHomingProcedure** input to **1**.
3. Upon starting, the status output **HomingBusy** will update to **True**, indicating the axis is actively performing the referencing operation.
4. Once homing completes successfully, **Referenced** will become **True** and **HomingBusy** will return to **False**.
5. Axis homing is performed according to the Factory Automation Suite (FAS) settings. For detailed configuration, [Refer Chapter 3.3](#) Step 9.

## 6.5 Sample Code of Rockwell Instruction MAM



1. The **MoveEvent[0].Man** input is used as a trigger to start the move command logically.
2. When **MoveEvent[0].Man** is activated (set to **TRUE**).
3. The **MAM** (Motion Command) block is then executed with the following parameters:
  - Axis: **Axis01**
  - Move Type: **0** (indicating a specific type of move, e.g., **absolute**)
  - Position: Target position from **MoveEvent[0].TargetValue** (e.g., 460.0)
  - Speed: 50 units per second
  - Acceleration and Deceleration Rates: (e.g., **5000**) units per second squared
  - Motion Profile: **Trapezoidal**
  - Jerk: (e.g., **10000**) units per second cubed
  - Other parameters such as **Merge**, **Lock Position**, and **Lock Direction** are set to zero.
4. The **MAM** block outputs status signals including **EN** (enable), **DN** (done), **ER** (error), **IP** (in position), and **PC** (position command), which can be used for monitoring and control logic.