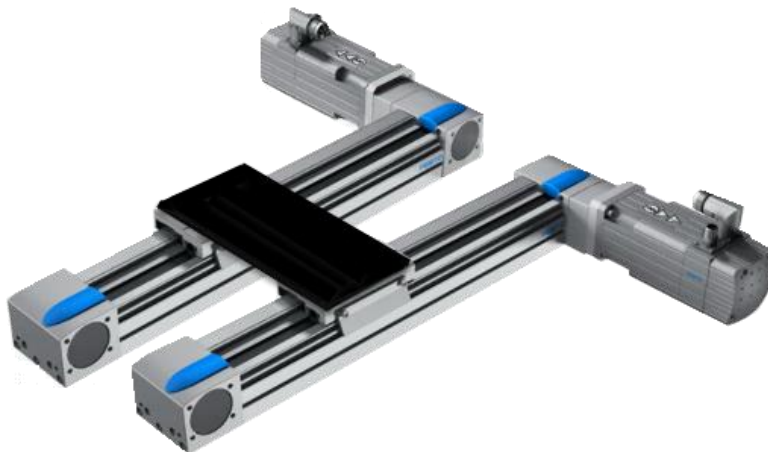


### **CMMT-AS Parallel Axis Synchronous Position Absolute**

When 2 physical axes are rigidly coupled together by the load or other means (examples: gantry system X/X' coupled by a Y-Axis or 2 x ESBF rods attached), then it is necessary to synchronise/Gear these axes with an electronic alignment (Master to Slave).

CMMT-AS-xx

This application note discusses the required settings to control the 2 x parallel linear axes in Synchronous Position Absolute mode using CMMT-AS-xx controllers.



Title ..... CMMT-AS Parallel Axis Synchronous Position Absolute  
Version ..... 1.20  
Document no. .... 100453  
Original .....en  
Author .....Festo  
Last saved ..... 27.01.2025

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

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# 1 Components/Software/Firmware used

Type/ Name	Version Soft- ware/ Firmware	Description
CMMT-AS-C4-3A-MP-S1 (Master)	V31.0.7.10	Firmware
CMMT-AS-C4-3A-MP-S1 (Slave)	V31.0.7.10	Firmware
Festo Automation Suite	V2.4.0.442	Software
CMMT-AS Plug-in	V2.4.1.23	Software
RSLogix 5000/ Logix Designer 5000	V20.04	Rockwell Programming Software
1769-L30ERM	V20.019	CompactLogix 5370 Controller
CMMT_EIP_MotionLib.zip	V2.4	Rockwell RSLogix 5000/LogixDesign AOI (Add-On Instruction) Software Library

Table 1.1: 1 Components/Software used

## 1.1 Recommended Website Downloads



### A) CMMT-AS Software/Function/Fieldbus/Device Profile Manual

	<b>Manual CMMT-AS-SW-EN</b> Servo drive - Bus interface - Function - Device profile - Software	 <b>Manual</b> → File and language versions
---	---	---

Reference:

[https://www.festo.com/net/en\\_ca/SupportPortal/Downloads/648237/725657/CMMT-AS-SW\\_manual\\_2022-04i\\_8173126g1.pdf](https://www.festo.com/net/en_ca/SupportPortal/Downloads/648237/725657/CMMT-AS-SW_manual_2022-04i_8173126g1.pdf)

### B) CMMT-AS Wiring & Installation Manual

	<b>Description CMMT-AS-C2_4-3A-EN</b> Servo drive - Installation - Assembly - Safety function	 <b>Description</b> → File and language versions
---	--	--

Reference:

[https://www.festo.com/net/en\\_ca/SupportPortal/Downloads/648246/720730/CMMT-AS-C2\\_4-3A\\_manual\\_2022-03e\\_8173941g1.pdf](https://www.festo.com/net/en_ca/SupportPortal/Downloads/648246/720730/CMMT-AS-C2_4-3A_manual_2022-03e_8173941g1.pdf)



### C) CMMT-AS Wiring & Installation Safety Function Manual

	<b>Description CMMT-AS-S1-EN</b> Safety function - SBC - SS1 - STO	 <b>Description</b> → File and language versions
--	---	--

Reference:

[https://www.festo.com/net/en\\_ca/SupportPortal/Downloads/648247/720882/CMMT-AS\\_-S1\\_manual\\_2022-03e\\_8173923g1.pdf](https://www.festo.com/net/en_ca/SupportPortal/Downloads/648247/720882/CMMT-AS_-S1_manual_2022-03e_8173923g1.pdf)

### D) CMMT-AS Short Documentation/Quick Guide Manual

	<b>Short documentation CMMT-AS-3A-QUICKGUIDE-EN</b> Servo drive - Quick guide	 <b>Short documentation</b> → File and language versions
---	--	--

Reference:

[https://www.festo.com/net/en-gb\\_gb/SupportPortal/Downloads/629760/696705/CMMT-AS-3A-QUICKGUIDE\\_2019-05\\_8100291g1.pdf](https://www.festo.com/net/en-gb_gb/SupportPortal/Downloads/629760/696705/CMMT-AS-3A-QUICKGUIDE_2019-05_8100291g1.pdf)



## E) Rockwell RSLogix 5000/LogixDesign AOI (Add-On Instruction) Software Library

Home > Products > Industrial automation > Motors and servo drives > Servo Drives > Controllers for servo motors > CMMT-AS > CMMT-AS-C2-3A-EP-S1



### Servo drive ★ CMMT-AS-C2-3A-EP-S1

5340824

GTIN: 4052568459741

CMMT-AS\_ENUS.PDF

Configure your product

Recommended Accessories

Technical Data

Support / Downloads

Product information	27	Document Type	Title	Version
Technical documentation	4	Function blocks	<b>Title:</b> Function blocks Rockwell <b>Subtitle:</b> Function blocks for Rockwell Studio 5000 <b>Description:</b> Point-to-point (PtP) library for servo drives with Ethernet/IP in Studio 5000 from Rockwell. <b>Version changes:</b> Changes compared to the previous version: STW1.6 (StartTask stays TRUE after ExecuteMode) <b>Supported systems:</b> servo drive CMMT-AS-C12-11A-P3-EP-S1 (8133357) servo drive CMMT-AS-C2-11A-P3-EP-S1 (5340826) servo drive CMMT-AS-C2-3A-EP-S1 (5340824) servo drive CMMT-AS-C3-11A-P3-EP-S1 (5340827) servo drive CMMT-AS-C4-3A-EP-S1 (5340825) servo drive CMMT-AS-C5-11A-P3-EP-S1 (5340828) servo drive CMMT-AS-C7-11A-P3-EP-S1 (8133356) servo drive CMMT-ST-C8-1C-EP-S0 (8084006) <b>Document type:</b> Function blocks	2.4
Certificates	3			
<b>Software</b>	<b>8</b>			
Expert knowledge	41			
Training	2			

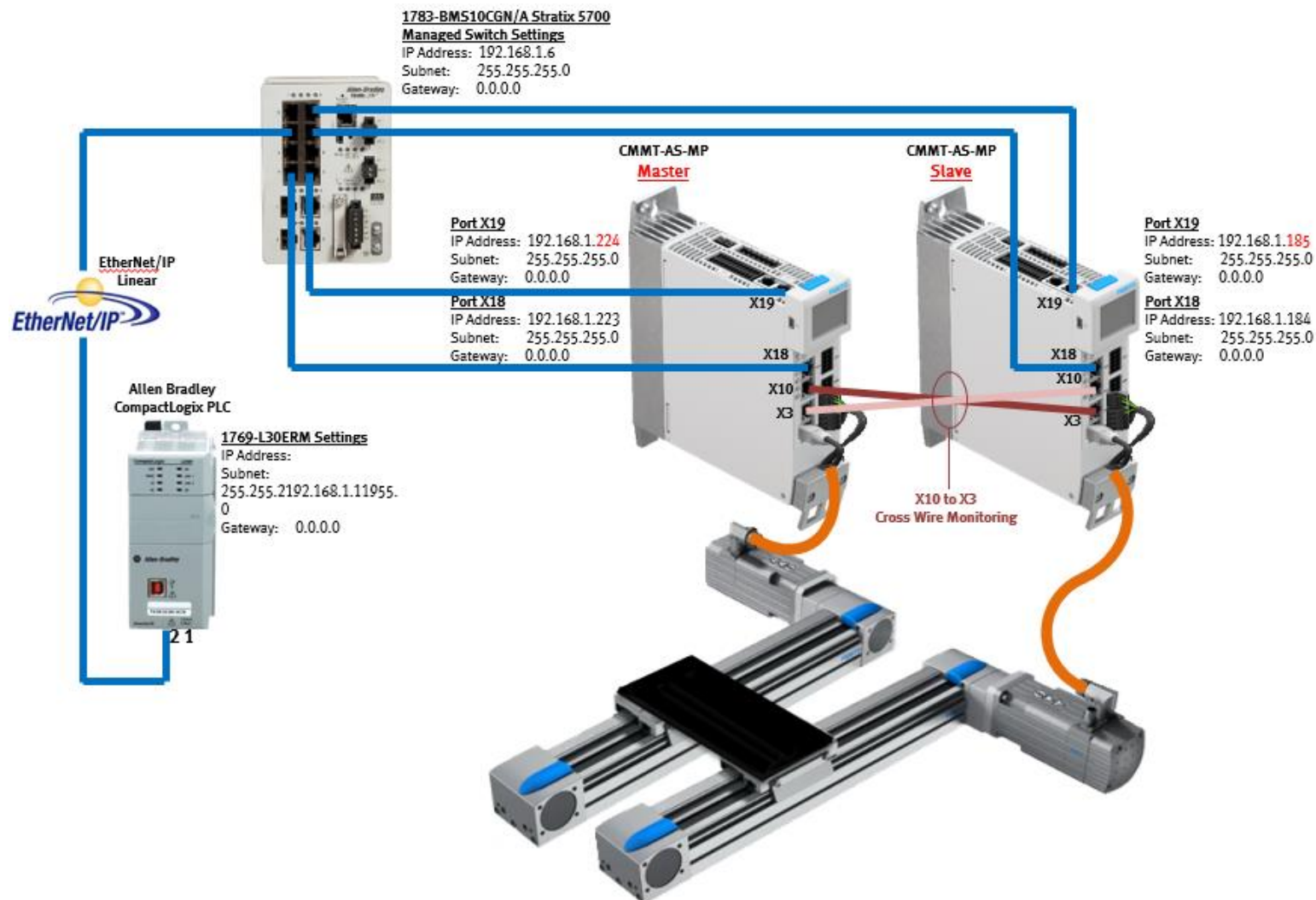
Language	Version	File size	Download
Version 2.4	2.4	21 MB	<a href="#">Show less</a>

- ConfigEPos bit 15 and 30 are now assigned

[https://www.festo.com/net/en-ca\\_ca/SupportPortal/Downloads/654836/724629/CMMT\\_EIP\\_MotionLib%20v2.4.zip](https://www.festo.com/net/en-ca_ca/SupportPortal/Downloads/654836/724629/CMMT_EIP_MotionLib%20v2.4.zip)

## 1.2 Network Topology of the tested system

Please refer to the picture below and make sure all wires are correctly placed and connected. The user manuals (reference provided in section 1.1 Recommended Manuals) will need to be referenced for other wiring not shown here.



## 2 Overview of Required Steps

- Both the **Master and Slave axis must use a multi-turn absolute encoder.**
- Master and Slave axis must be mechanically aligned.
- Reference both axis so they have the same absolute position value (perfect electronic alignment) and the user is not to execute additional references after the initial commissioning (Exception for motor/controller replacement when needing to re-establish this alignment)
- After E-Stop or Control Enable are removed or Supply power is lost or Encoder signal failure is detected, the axes need to be re-synchronised/Geared In (electronic alignment).
- This application guide discusses ways to implement monitoring of Slave faults and Encoder Emulation cable monitoring. Although it is described in this guide how to configure and monitor certain adverse conditions, it is up to the user to program the PLC to monitor these and other fault conditions/status for both Master and Slave and then react according to their design.

Up synchronisation, "synchronous position, absolute" mode

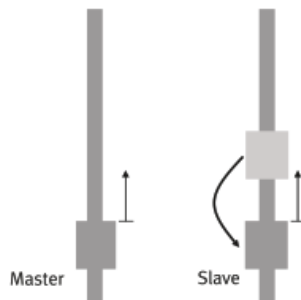


Fig. 115: Synchronous position, absolute (example)

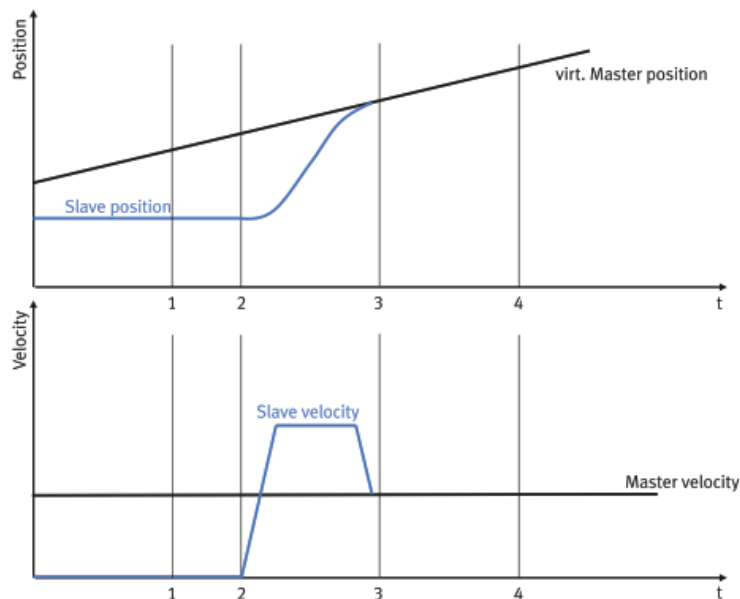


Fig. 116: Up synchronisation, "synchronous position, absolute" mode

Caption	
1	"Synchronous position, absolute" mode is executed.
2	Start Sync Pos (start of up synchronisation)
3	Master Sync Pos (target at which up synchronisation must be completed.)
4	End Sync Pos (start of down synchronisation)

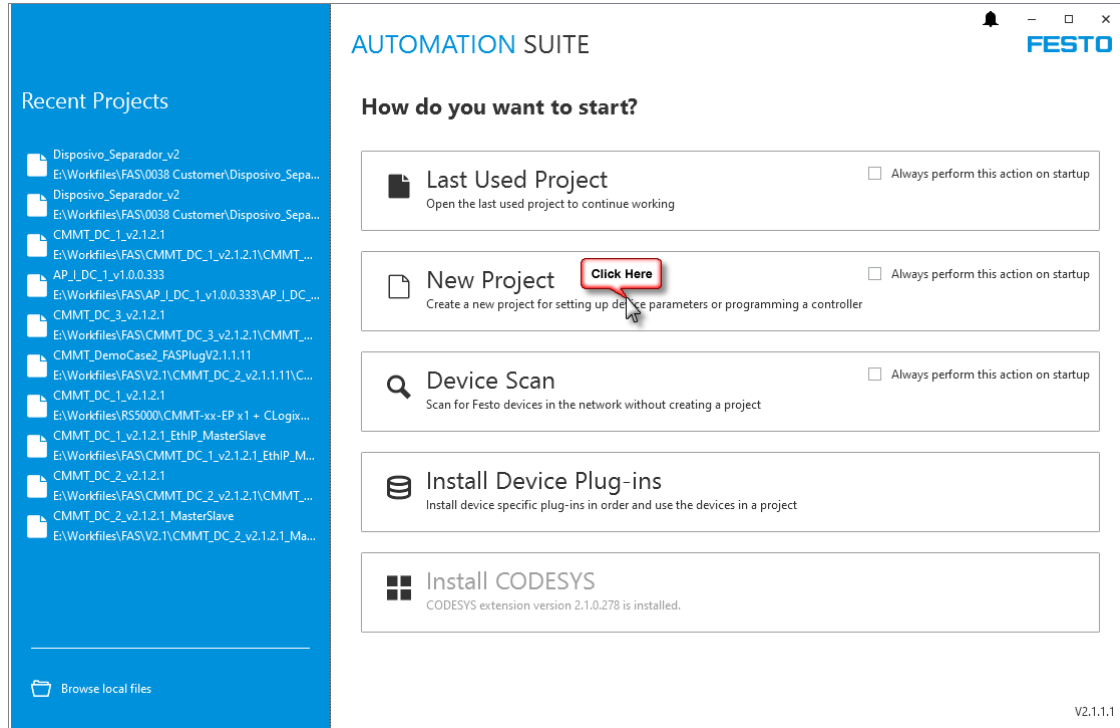
Tab. 669: Legend for up synchronisation, "synchronous position, absolute" mode

The synchronisation mode is executed at the position (1). The virtual master position is not changed. If the virtual master position reaches the position (2) "Start Sync Pos", it is up synchronised to the virtual master position. If up synchronisation is completed, the slave reports the status "Slave synchronous". Up synchronisation must be completed before "Master Sync Pos". Between positions (3) and (4) the slave reports the status "Slave synchronous". If the virtual master position exceeds the position (4) "End Sync Pos", the down synchronisation is initiated.

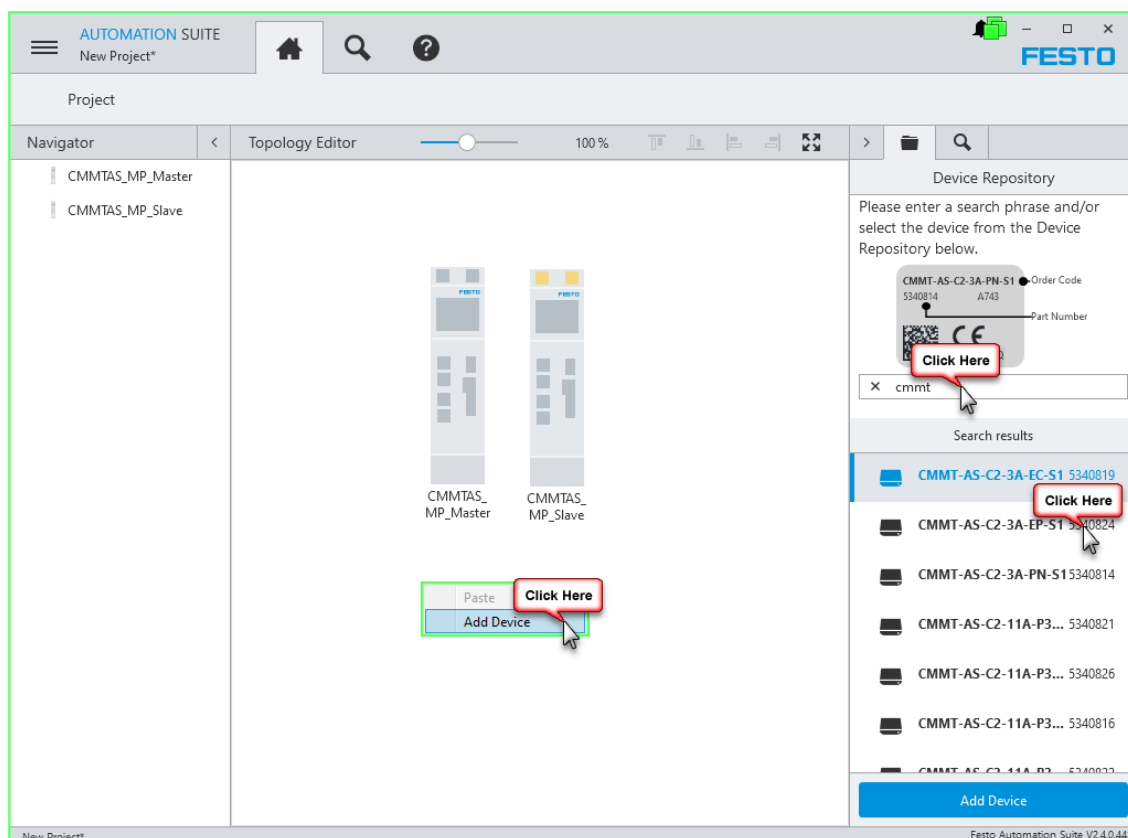
### 3 Project Configuration

#### 3.1 Create New Project

Start a new project

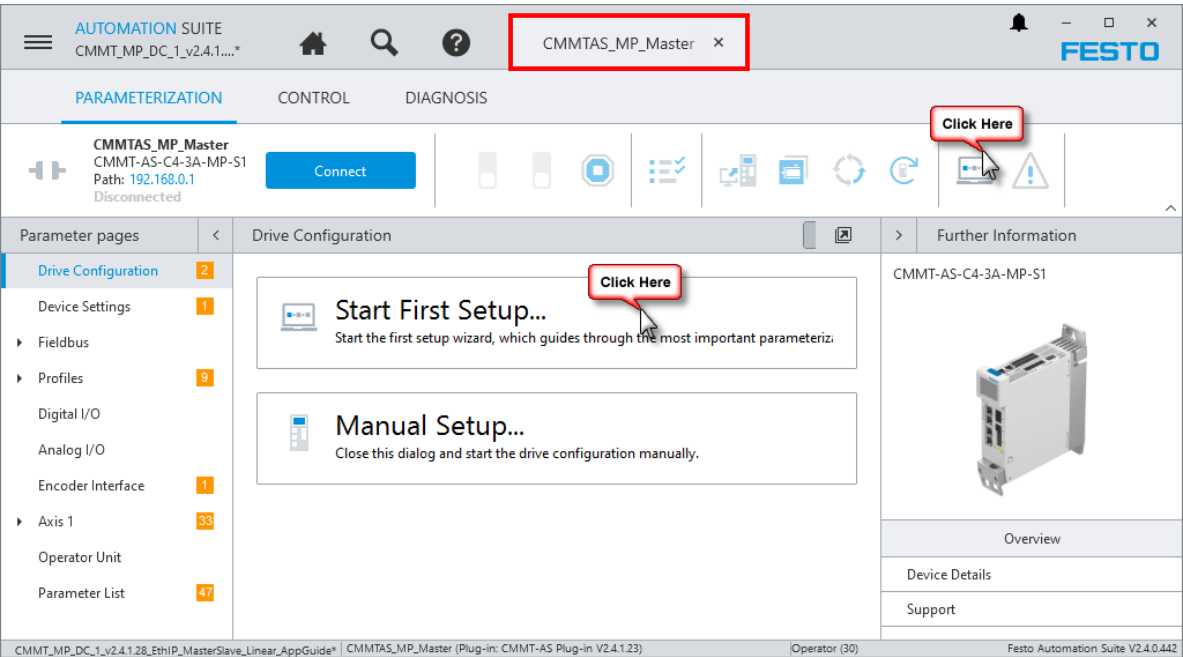


Add the 2 x CMMT-AS-xx-xx-MP controllers you have purchased for the application and name them accordingly



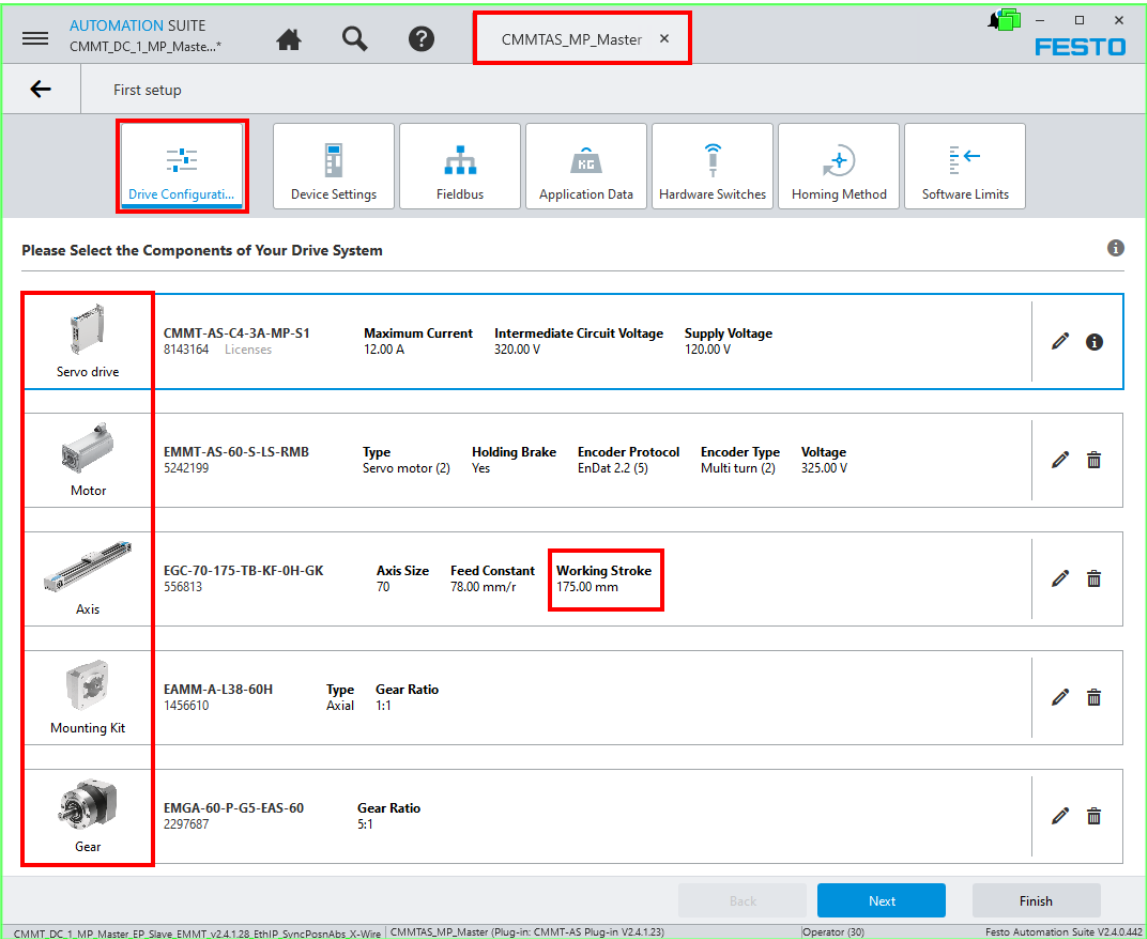
4 Master Axis General Setup

4.1 First setup - Start Wizard



4.2 First setup - Drive Configuration

This application considers the maximum range of 175 mm.



### 4.3 First setup - Device Settings

Consider the application Supply Voltage and modify from default if needed.

The screenshot shows the 'First setup' window in the FESTO Automation Suite. The window title is 'CMMTAS\_MP\_Master'. The 'Device Settings' tab is selected in the top navigation bar. The 'Mains voltage' is set to 120.00 V. A warning message is displayed under 'DC Link' regarding rapid discharge.

**Enable Servo Drive**

Activation via: I/O and fieldbus (0)

**Supply Voltage**

Mains voltage: 120.00 V

**DC Link**

**Warning**  
If the DC circuit is linked to that of another drive, the rapid discharge function needs to be deactivated in order to protect the device.

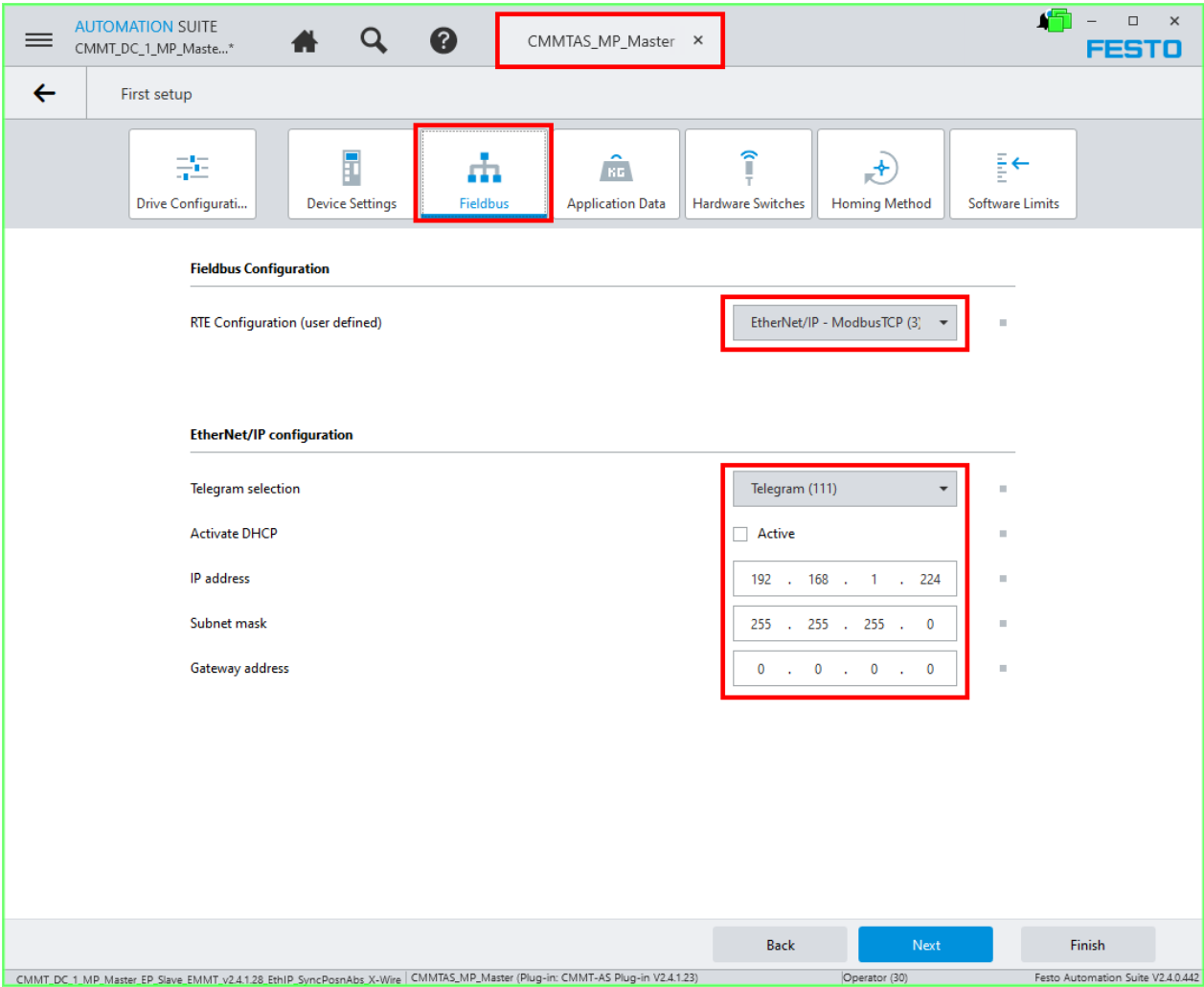
Rapid discharge: ☒ Active

Buttons: Back, Next, Finish

Footer: CMMT\_DC\_1\_MP\_Master\_EP\_Slave\_EMMT\_v2.4.1.28\_EthIP\_SyncPosnAbs\_X-Wire | CMMTAS\_MP\_Master (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

4.4 First setup - Fieldbus

Select EtherNet/IP – Modbus (3) for the RTE ethernet ports and Telegram 111, then modify the IP Address.



## 4.5 First setup - Application Data

Consider the application design

**Application Data**

Axis mass	0.37	kg
Application mass	0.10	kg
Total mass	0.47	kg

**Rotation Polarity**

Please select the mounting position of the motor (viewed from top):

+

←

-

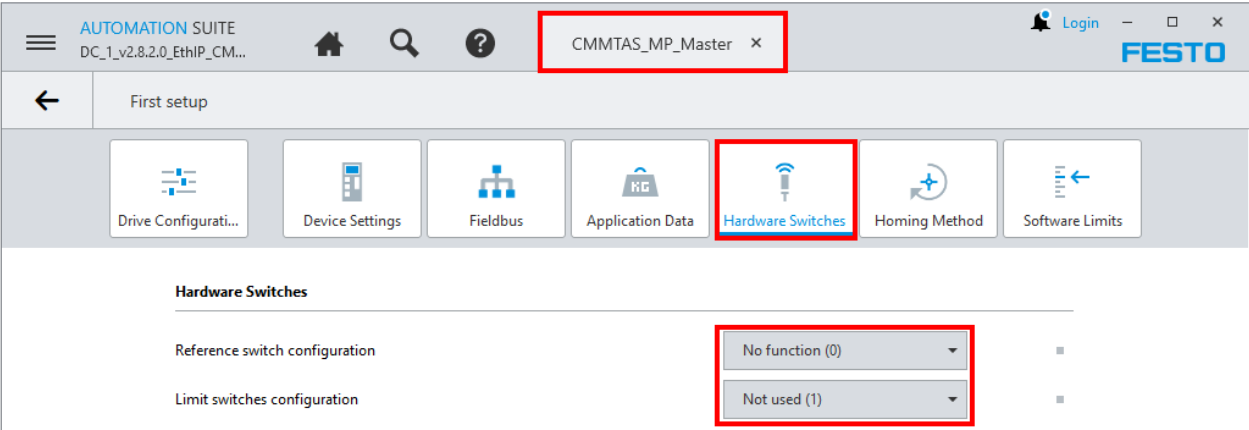
☐ Invert rotation polarity

Back Next Finish

CMMT\_DC\_1\_MP\_Master\_EP\_Slave\_EMMT\_v2.4.1.28\_EthIP\_SyncPosnAbs\_X-Wire | CMMTAS\_MP\_Master (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

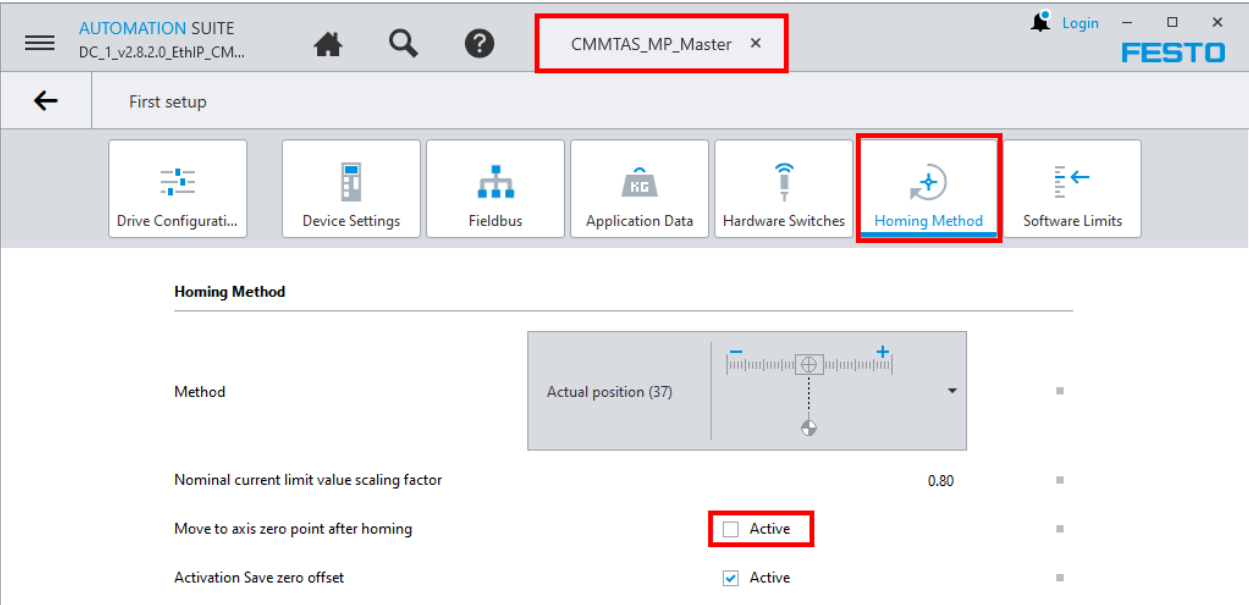


4.6 First setup - Hardware switches



4.7 First setup - Homing Method

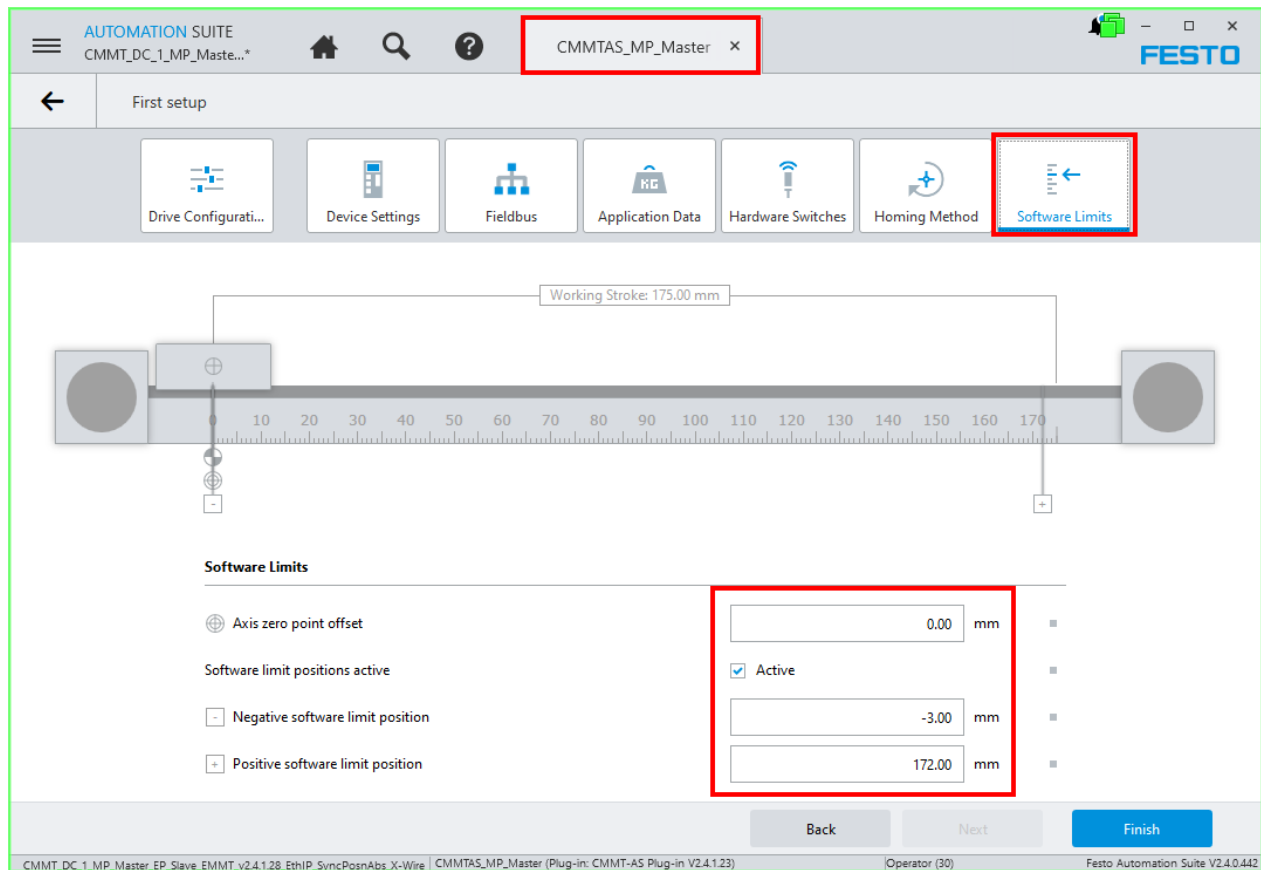
The simplest Homing method is Actual position (37) with no movement. This is because after the mechanical alignment, this allows the axis to reference and store the offset in the existing position **without any movement**.



## 4.8 First setup - Software Limits

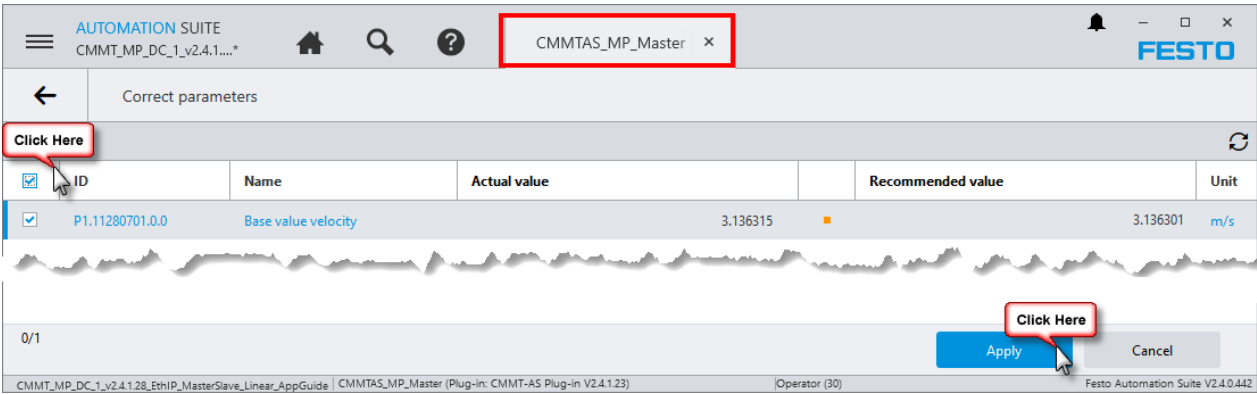
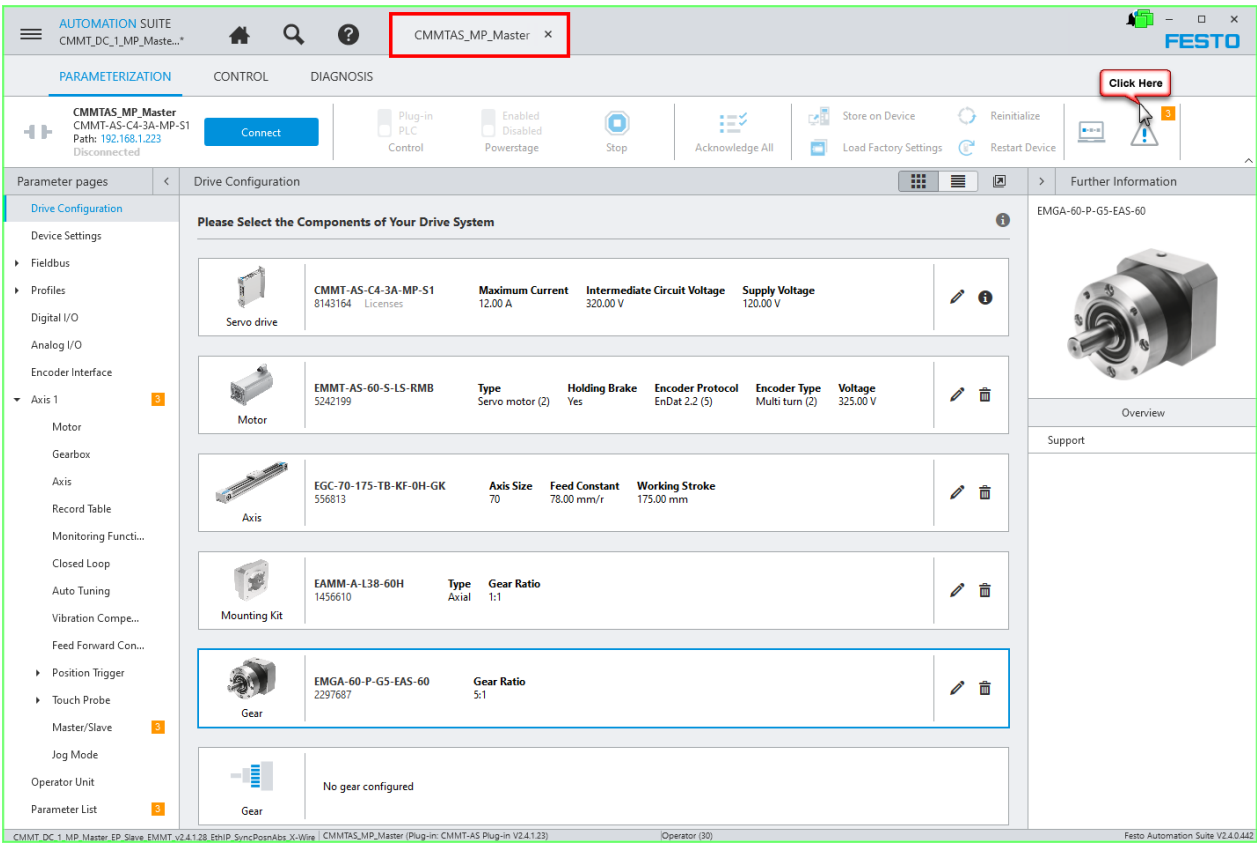
The Axis zero point offset should be configured as 0.00mm because once the axis is physically in place, we don't want to change the zero point.

The Software Limits should be observed however, this depends on your application. A software limit larger than that of -3.00mm may be required to avoid mechanical limitations with the Slave alignment.



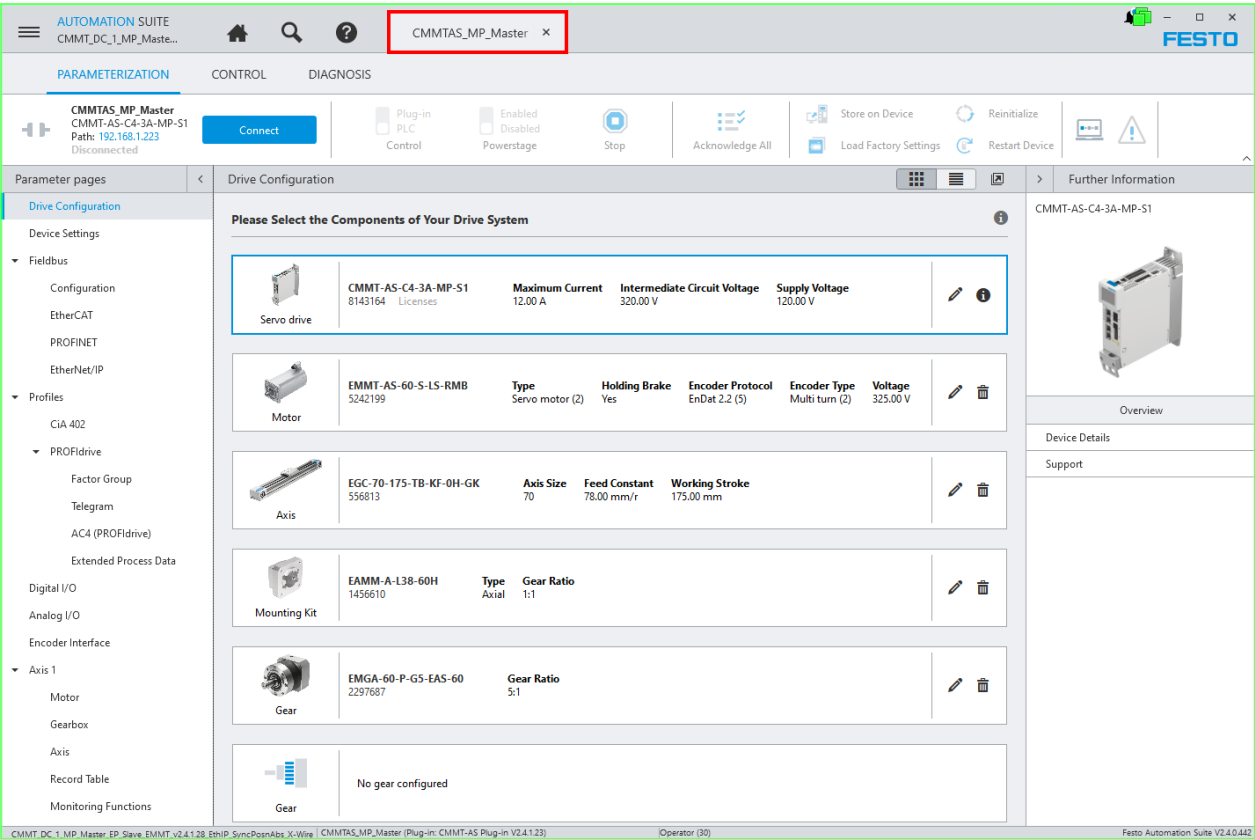
4.9 Correct Parameters

If you find orange adorners/indicators, these are warning to indicate unfavorable or inconsistent values and these may need to be modified. It is recommended to use the “Correct Parameters” function to modify the parameters with recommended values as shown below.



4.10 Setup Complete

Master axis general configuration is now complete.



## 5 Master Axis Changes Required for Synchronous Position Absolute

### 5.1 Extended Process Data (EPD)

Configure all Sent/Received data as shown here in the **EXACT** order shown (Do NOT use editor to modify order):

Sent Data	P1.4643.0.0 P1.128.0.0 P0.11601.1.0
Received Data	Not Used

**Automation Suite**  
CMMT\_DC\_1\_EP\_Master...\*

**CMMTAS\_MP\_Master** x

**PARAMETERIZATION** CONTROL DIAGNOSIS

**CMMTAS\_MP\_Master**  
CMMT-AS-C4-3A-MP-S1  
Path: 192.168.1.223  
Disconnected

**Connect**

Parameter pages < Extended Process Data

Drive Configuration  
Device Settings  
Fieldbus  
Configuration  
Interface  
**Extended Process Data**  
Digital I/O  
Analog I/O  
Encoder Interface  
Axis 1  
Motor  
Gearbox  
Axis  
Record Table  
Monitoring Functions  
Closed Loop  
Auto Tuning  
Vibration Compensation  
Feed Forward Control  
Position Trigger  
Touch Probe  
Master/Slave  
Jog Mode  
Operator Unit  
Parameter List

**Status**

Extended process data (EtherNet/IP) ☒ Active

Extended process data active ☐ Active

**Sent Data**

ID	Parameter	Type	Byte position
0	P1.4643.0.0 Monitoring window encoder monitoring	FLOAT32	0
1	P1.128.0.0 Actual position value encoder channel 1	SINT64	4
2	P0.11601.1.0 Absolute position in user units	SINT64	12

Add process channel

Number of bytes Tx 0

Number of bytes Tx (Offline) 20

**Received Data**

Add process channel

Number of bytes Rx 0

Number of bytes Rx (Offline) 0

CMMT\_DC\_1\_EP\_Master\_MP\_Slave.EMMT.v2.4.1.28.EthIP\_SyncPosnAbs.X-Wire | CMMTAS\_MP\_Master (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

## 5.2 Encoder Interface

**Parameterization** | CONTROL | DIAGNOSIS

Parameter pages < Encoder Interface

**Encoder Selection of Position Control**

Encoder channel: Encoder interface 1 (0)

**Feed Constant**

Encoder interface 1: 78.00 mm/r

Encoder interface 2 (user defined): 1000.00 mm/r

**Encoder 1 (X2)**

Encoder selection: EnDat 2.2 (5)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**Encoder 2 (X3)**

Encoder selection: Without encoder (7)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**X10**

Selection of sync mode: Master (0)

Encoder emulation source: Encoder 1 (0)

Activate encoder emulation output: ☒ Active

Deactivate encoder emulation during homing: ☒ Active

Increments per revolution: 4096

Offset position: 0.00 mm

Activation counting direction reversal: ☐ Active

**CHANGES**

Encoder channel: Encoder interface 1 (0)

**Feed Constant**

Encoder interface 1: 78.00 mm/r

Encoder interface 2 (user defined): 78.00 mm/r **I31**

**Encoder 1 (X2)**

Encoder selection: EnDat 2.2 (5)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**Encoder 2 (X3)**

Encoder selection: Incremental (4) **P0.11616.1.0**

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Resolution: 16382 **P0.10040.1.0**

**X10**

Selection of sync mode: Master (0) **P0.5812.0.0**

Encoder emulation source: Encoder 1 (0) **P1.581.0.0**

Activate encoder emulation output: ☒ Active **P1.583.0.0**

Deactivate encoder emulation during homing: ☒ Active **P1.8421.0.0**

Increments per revolution: 16382 **P1.586.0.0**

Offset position: 0.00 mm **P1.586846.0.0**

Activation counting direction reversal: ☐ Active **P1.586847.0.0**

**Annotations:**

- This Feed Constant is applied to Master Encoder Interface (X10) Encoder Emulation. Therefore the Slave Encoder Interface 2 (X3) requires the same Feed Constant.
- The feed constant for Encoder Interface 2 (X3) must match the feed constant of the Slave Encoder Interface 3 (X10) which is derived from Encoder Interface 1 (X2).

See section 8.4 (Master and Slave X10 to X3 physical connections) for an overview about Encoder interfaces.

### I31 Encoder Interface 2

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation

The feed constant for Master Encoder Interface 2 (X3) must match the feed constant of the Slave Encoder Interface 3 (X10) which is derived from Slave Encoder Interface 1 (X2)

### P0.11616.1.0 Encoder Selection

Set Encoder 2 [X3] encoder selection to incremental (4) which is used for X10 and X3 cross wiring monitoring. The Slave axis interface X10 will be configured to emulate differential A,B,N signals which will be received by this Encoder 2 [X3] interface for the purpose of position difference monitoring.

**P0.10040.1.0 Resolution**

The Slave axis Encoder 3[X10] will be set as 16382 so the Master Encoder 2[X3] should be set to the same value. See the caution note 2 on this page.

**P0.5812.0.0 Selection of Sync Mode**

Here we configure as Master(0) so Encoder 3[X10] will emulate/transmit Encoder 1[X2] Actual Position in the form of differential A,B,N signals. The Slave axis will be synchronised/Geared to this Master Position.

**P1.581.0.0 Encoder Emulation Source**

Encoder 1 (0) refers to the Primary Motor Encoder at connection X2

Encoder 2 (1) refers to a secondary Encoder at connection X3

Setpoint position (2) will transmit setpoint position signal (normally less noise is observed), however when the Master is disabled, no setpoint is changed and therefore if the shaft changes, the Slave will not observe this.

**Caution 1**

**If actual values are transmitted to the slave as position signals (P1.581 Encoder Emulation Source = Encoder 1 or Encoder 2), increased noise may occur due to the torque feed forward control in the synchronous phase. The torque feed forward control is switched off by setting parameter Px.968 to 0.**

**P1.8421.0.0 Deactivate Encoder Emulation During Homing**

If enabled, whilst a reference/home routine is executed, X10 Encoder Emulation will be inhibited.

With this application, it is expected the axis are referenced/homed only once during commissioning and are NOT to be not referenced/homed repeatedly. Among many reasons, it is expected the [Master and Slave axis both have Multi-Turn Absolute Encoders](#). Due to the fact this application has Master and Slave axes rigidly coupled and due to the encoder difference monitoring, it should be decided by the user if encoder signals are always transmitted even during a home routine.

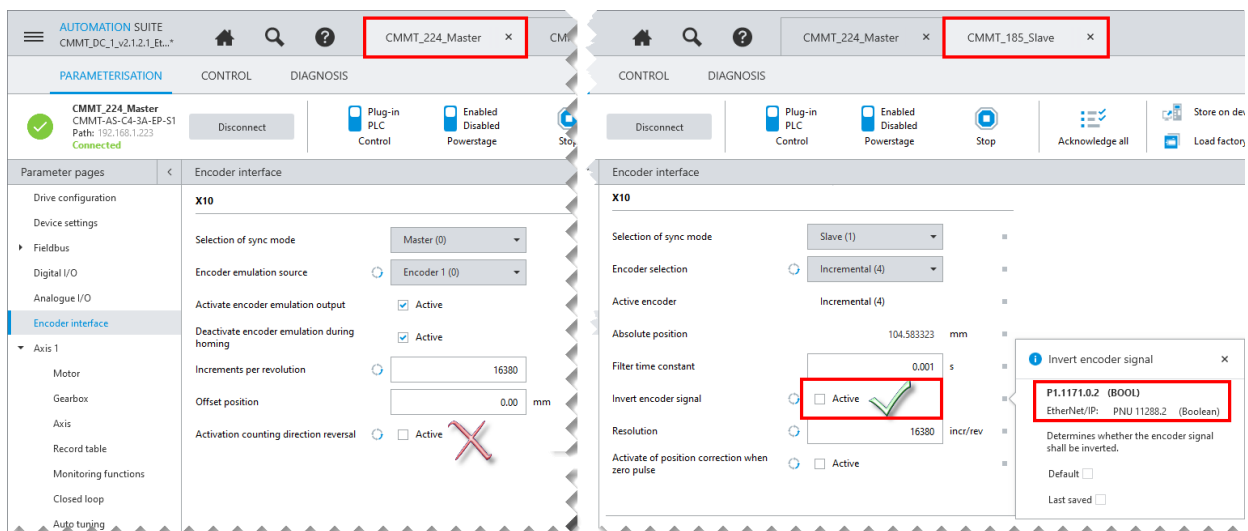
**P1.586.0.0 Increments per revolution**

The Slave axis Encoder 3[X10] will be set as 16382 so the Master Encoder 2 [X3] should be set to the same value. 16382 Increments per revolution also allows for better tuning when in Synchronisation. (The greater the selected value the lower the resulting noise on the connected slave axes).

**Caution 2**


- **The same increments per revolution should be set on the opposing encoder connections of the Master and Slave drives.**
- **DO NOT USE THE VALUE "16384" for Increments per revolution. This will result with an exception in the firmware when re-initializing the drive (div/0) and the hardware will need to be replaced (cannot be fixed onsite). The firmware release V19.0.4.72 is supposed to address this issue.**

When it is necessary to adjust the [direction of rotation](#) in an application, the Px.1171 [direction reversal](#) should be used in the slave drive.



5.3 Record Table

There are no records configured, however, please consider the important facts.



**NOTE:**

**Within the required PLC program, a "Method" is used to Set Master Gear In Position instead of using a record. This is because before a record table task can be executed, the controller **MUST BE ENABLED WITHOUT FAULTS** and so, for error recovery, the "Method" is much more convenient with this application.**

5.4 Master/Slave

Choose Encoder interface 2 [X3] (2) as source selection because this will be used for the encoder emulation cross-wire cable monitoring.

AUTOMATION SUITE

CMMT\_DC\_1\_MP\_Maste...

⌵

🏠

🔍

?

CMMTAS\_MP\_Master

PARAMETERIZATION

CONTROL

DIAGNOSIS

⏮

⏭

CMMTAS\_MP\_Master

CMMT-AS-C4-3A-MP-S1

Path: 192.168.1.223

Disconnected

Connect

Plug-in PLC Control

Enabled Disabled Powerstage

Stop

Acknowledge All

Store on Device

Load Factory Settings

Parameter pages

<

Master/Slave

Drive Configuration

Device Settings

Fieldbus

Profiles

Digital I/O

Analog I/O

Encoder Interface

Axis 1

- Motor
- Gearbox
- Axis
- Record Table
- Monitoring Functions
  - Closed Loop
  - Auto Tuning
  - Vibration Compensation
  - Feed Forward Control
- Position Trigger
- Touch Probe
- Master/Slave

Prepared Values

General Parameters

Source selectionInactive (0)

Gear Out Target position0.00 mm

StatusInactive (0)

General Parameters

Source selectionEncoder interface 2 [X3] (2)

Gear Out Target position0.00 mm

StatusInactive (0)

Gear In Tolerance

Tolerance Position19.50 mm

Tolerance Velocity0.006500001 m/s

Gear In Tolerance

Tolerance Position19.50 mm

Tolerance Velocity0.006500001 m/s



## 5.5 Parameter List

### 5.5.1 P1.4643.0.0 Monitoring Window Encoder Monitoring

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation

In order for Encoder 1 [X2] and Encoder 2 [X3] position difference monitoring to function, configure these group parameters (Axis1/movement monitoring group):

- P1.4642 Damping time encoder monitoring
- P1.4643 Monitoring window encoder monitoring

The screenshot shows the FAS Parameter List for the 'Axis1/movement monitoring group'. The parameters are as follows:

ID	Name	Value	Unit
P1.460.0.0	Movement monitoring status	0	
P1.461.0.0	Configuration word movement monitoring	0	
P1.462.0.0	Damping time position: following error	0.10	s
P1.463.0.0	Monitoring window position: following error	0.001	m
P1.464.0.0	Monitoring window velocity: following error	0.04	m/s
P1.465.0.0	Standstill damping time	0.10	s
P1.4639.0.0	Storage option: Limitation positive direction	Save (1)	
P1.4642.0.0	Damping time encoder monitoring	0.05s = 50ms	s
P1.4643.0.0	Monitoring window encoder monitoring	0.001m = 1.0mm	m
P1.4617.0.0	Storage option: Target torque reached	Do not save (0)	
P1.4618.0.0	Diagnostic category: Standstill reached	Information (4)	

PLC (Programmable Logic Controller) Code will also need to be modified in the following Routine: E031\_Master\_PNU02940\_0\_R\_LINT\_X3\_ActPos

The PLC code routine E031\_Master\_PNU02940\_0\_R\_LINT\_X3\_ActPos includes the following comments and formulas:

===== ENCODER DIFFERENCE MONITORING =====

The user must MANUALLY set the value of Master\_EncoderMonitorWindow\_mm\_LINT = Master\_EncoderMonitorWindow\_mm but represented as LINT data type  
Due to lack of instructions with LINT data Types in RS5000 prior to v32, the user needs to calculate (without use of PLC) the value of Master\_EncoderMonitorWindow\_mm\_LINT

Formula: Master\_EncoderMonitorWindow\_mm\_LINT = Whole Number of Master\_EncoderMonitorWindow\_mm \* 10<sup>7</sup> (10,000,000)

Example#1  
Master\_EncoderMonitorWindow\_mm = 0.5 (mm)  
0.5 \* 10<sup>7</sup> = 5,000,000

Example#2  
Master\_EncoderMonitorWindow\_mm = 1.0 (mm)  
1.0 \* 10<sup>7</sup> = 10,000,000

Calculate the Absolute difference between Slave axis Encoder 1 [X2] Motor Actual Position vs Slave axis Encoder2 [X3] Emulated Actual Position Within Tolerance  
Calculate the Absolute difference between Master axis Encoder 1 [X2] Motor Actual Position vs Slave axis Encoder2 [X3] Emulated Actual Position Within Tolerance  
If any difference is larger than the tolerance of Parameter P1.4643.0.0 Monitoring Window Encoder Monitoring,  
then the Synchronise sequence will execute additional steps and execute a Set Master Position Gear In/Out prior to Synchronisation

The diagram shows the MOV instruction for Master\_EncoderMonitorWindow\_mm and the COP instruction for Master\_EncoderMonitorWindow\_mm\_LINT.

## 5.6 Error Classification

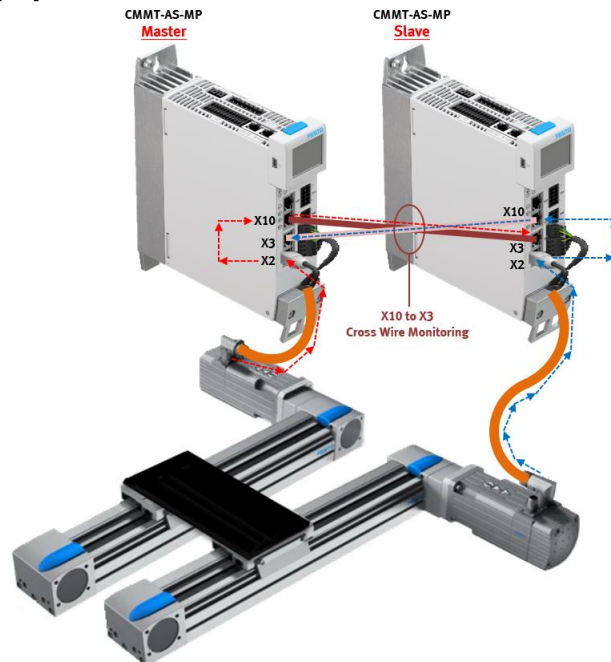
### 5.6.1 D1.07I02I00133.0 Position Difference Encoder 1 to Encoder 2 too Large

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation



Both the Master and Slave will provide an emulated encoder signal (differential A,B,N signals) from Encoder 3[X10] to the opposite controller at Encoder 2[X3]. The Master and Slave use the Encoder 2[X3] emulated encoder signal for the purpose of position difference monitoring.

In the Error Classification, change the error "D1.07I02I00133.0 Position Difference Encoder 1 to Encoder 2 too Large" category from Ignore (2) to [Stop Category 2 \(64\)](#). This setting will demand a Stop Category 2 (detail shown below) by the Master axis during a position deviation larger than parameter P1.4643. The Slave reaction for error 133 will be set to warning so that it will remain following the master in this situation.

**AUTOMATION SUITE**  
CMMT\_DC\_1\_MP\_Maste...\*

PARAMETERIZATION CONTROL **DIAGNOSIS**

CMMTAS\_MP\_Master  
CMMT-AS-C4-3A-MP-S1  
Path: 192.168.1.223  
Disconnected

Connect

Plug-in PLC Control Enabled Disabled Powerstage Stop Acknowledge All Store on Device Reinitialize Restart

Diagnosis pages < Error Classification

Device State  
I/O State  
Error Log  
**Error Classification**  
Trace Configuration  
Trace Display  
Auto Tuning

Go to diagnosis page "Error Log"  
Store warnings to error log ☒ Active

ID	Name	Category (actual configured)
D1.07I02I00127.0	Velocity: following error	Stop category 1 (256)
D1.07I02I00128.0	Velocity too high	Stop category 1 (256)
D1.07I02I00129.0	Out of target range	Warning (16)
D1.07I02I00130.0	Reverse feed monitoring	Information (4)
D1.07I02I00131.0	Residual distance too low	Information (4)
D1.07I02I00132.0	Trajectory completed	Information (4)
<b>D1.07I02I00133.0</b>	<b>Position difference encoder 1 to encoder 2 too large</b>	<b>Stop category 2 (64)</b>

Error Stop Level definition:

Tab. 411: Error level, stop category 2

Classification (level)	Reactions
Error, stop category 2	<p>Stop category 2</p> <p>General error response</p> <ul style="list-style-type: none"> <li>Generation of the message and entry in the message directory</li> <li>The device switches to the error status.</li> <li>Status LED indicates the error (flashing red).</li> <li>The normally open contact RDY-C1/2 is opened (ready = open).</li> <li>Depending on the configuration, an entry is added to the error memory</li> </ul> <p>Specific error response of category 2</p> <ul style="list-style-type: none"> <li>The drive is decelerated using the parameterised stop ramp as soon as the error occurs.</li> <li>When the drive has reached speed 0, the closed-loop controller maintains the drive at the position achieved upon completion of the stop ramp.</li> </ul>

The screenshot shows the 'Reactions' tab in the SINAMICS Drive Manager. A pink box highlights the parameters for the selected reaction group '/Axis1/Stop mode group[0] (3)'. The parameters are:

ID	Name	Value	Unit
P1.12101.0.0	Deceleration Stop ramp	20.00	m/s <sup>2</sup>
P1.12111.0.0	Jerk Stop ramp	1000.00	m/s <sup>3</sup>
P1.12112.0.0	Stop ramp velocity	0.05	m/s

To the right of this table, other parameters like P1.12112.0.0 (Jerk Stop ramp) and P1.12111.0.0 (Stop ramp velocity) are visible, along with their EtherNet/IP addresses and data types (FLOAT32).

**1. Parameterised Decel**

**2. Closed-Loop remains enabled**

**4. Output Stage remains enabled**

Tab. 412: Error level, stop category 1

Classification (level)	Reactions
Error, stop category 1	<p>Stop category 1</p> <p>General error response</p> <ul style="list-style-type: none"> <li>▪ The same as with stop category 2</li> </ul> <p>Specific error response of category 1</p> <ul style="list-style-type: none"> <li>▪ The drive is decelerated using the defined stop ramp as soon as the error occurs. When the drive is at a standstill, the brake engages and the closed-loop controller is switched off upon expiry of the deceleration delay. If there is no brake, the drive is deactivated directly when at a standstill.</li> </ul>

**1. Parameterised Decel**

**2. Physical Brake Engaged**

**3. Closed-Loop disabled**

**4. Output Stage Disabled**

Tab. 413: Error level, stop category 0

Classification (level)	Reactions
Error, stop category 0	<p>Stop category 0</p> <p>General response</p> <ul style="list-style-type: none"> <li>▪ The same as with stop category 2</li> </ul> <p>Specific error response of category 0</p> <ul style="list-style-type: none"> <li>▪ The output stage is switched off immediately after the error has occurred. The brake is engaged on drives with a brake. The drive runs down if there is no brake.</li> </ul> <p><b>1. Output Stage Disabled (Run-away)</b>  <b>2. Physical Brake Engaged</b></p>

## 5.7 Trace Configuration

The following are suggestions for troubleshooting/monitoring of Gear In Functions

Channel Data:

P0.11601.1.0

P1.90.0.0

P1.1837.0.0

P1.112819.0.0

P1.1147061.0.0

P1.1145121.0.0

P1.171.0.0

Trigger

P1.1147070.0.0

**Trace Channels**

ID	Active	ID	Signal
0	<input checked="" type="checkbox"/>	P0.11601.1.0	Absolute position in user units
1	<input checked="" type="checkbox"/>	P1.90.0.0	Setpoint position
2	<input checked="" type="checkbox"/>	P1.1837.0.0	Current record table index
3	<input checked="" type="checkbox"/>	P1.112819.0.0	Error active
4	<input checked="" type="checkbox"/>	P1.1147061.0.0	STW1.6 Traverse Task Active
5	<input checked="" type="checkbox"/>	P1.1145121.0.0	ZSW1.12 Traversing Task Acknowledgement
6	<input checked="" type="checkbox"/>	P1.171.0.0	Motion Manager status

**Record Settings**

Trace duration: 4.001875 s

Trace resolution: 0.0011875 s

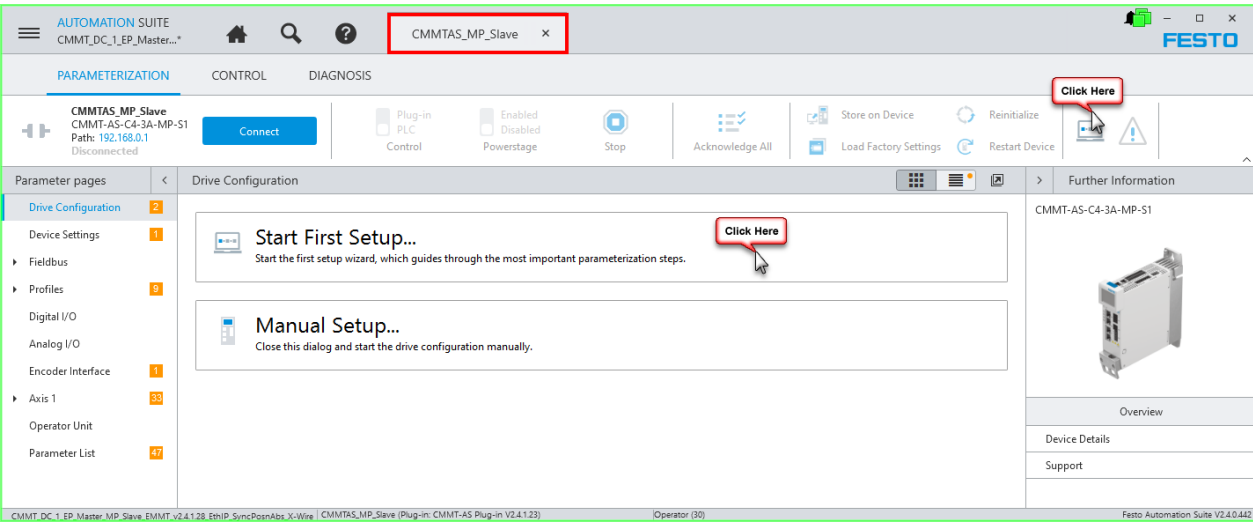
**Trigger Preferences**

Type	Value mode	Condition	Parameters	Threshold
Data trigger (1)	Threshold (3)	Rising edge (1)	P1.1147070.0.0: STW1.7 Fault Acknowledge	Value: <input checked="" type="checkbox"/>

Trace delay: 0.501125 s

## 6 Slave Axis General Setup

### 6.1 First setup - Start Wizard



## 6.2 First setup - Drive Configuration

Configure the hardware selected for the application.

**NOTE: Working Stroke** -> In this example, the Master and Slave physical axis stroke are both 175mm, however, it is recommended to configure the value of the Slave Working Stroke slightly larger (200mm which provides a physical 15mm buffer). This concept is to avoid the Slave from entering an software overtravel status and losing the synchronisation at any time.



### Caution

The Slave axis should not be able to encounter a software or hardware limit otherwise it can lose synchronisation which could cause an issue depending on the monitoring and reaction of the higher order PLC (Programmable Logic Controller).

**AUTOMATION SUITE**  
CMMT\_DC\_1\_EP\_Master...\*

CMMTAS\_MP\_Slave

First setup

Drive Configurati...

Device Settings

Fieldbus
















Application Data

Hardware Switches

Homing Method

Software Limits

Please Select the Components of Your Drive System

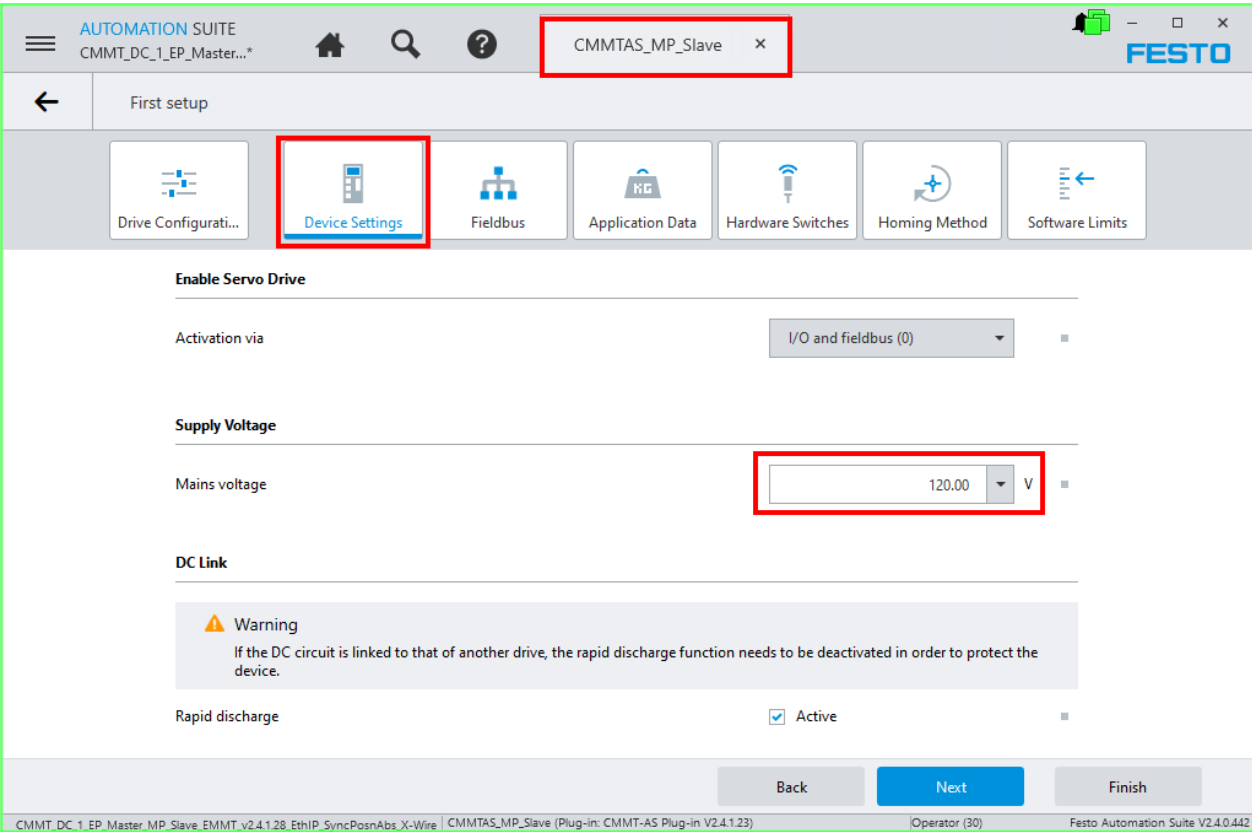
 Servo drive	CMMT-AS-C4-3A-MP-S1 8143164 Licenses	Maximum Current 12.00 A	Intermediate Circuit Voltage 320.00 V	Supply Voltage 230.00 V	 		
 Motor	EMMT-AS-60-S-LS-RMB 5242199	Type Servo motor (2)	Holding Brake Yes	Encoder Protocol EnDat 2.2 (5)	Encoder Type Multi turn (2)	Voltage 325.00 V	 
 Axis	EGC-70-200-TB-KF-0H-GK 556813	Axis Size 70	Feed Constant 78.00 mm/r	Working Stroke 200.00 mm	 		
 Mounting Kit	EAMM-A-L38-60H 1456610	Type Axial	Gear Ratio 1:1	 			
 Gear	EMGA-60-P-G5-EAS-60 2297687	Gear Ratio 5:1	 				

Back Next Finish

CMMT\_DC\_1\_EP\_Master\_MP\_Slave\_EMMT\_v2.4.1.28\_EthIP\_SyncPosnAbs\_X-Wire | CMMTAS\_MP\_Slave (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

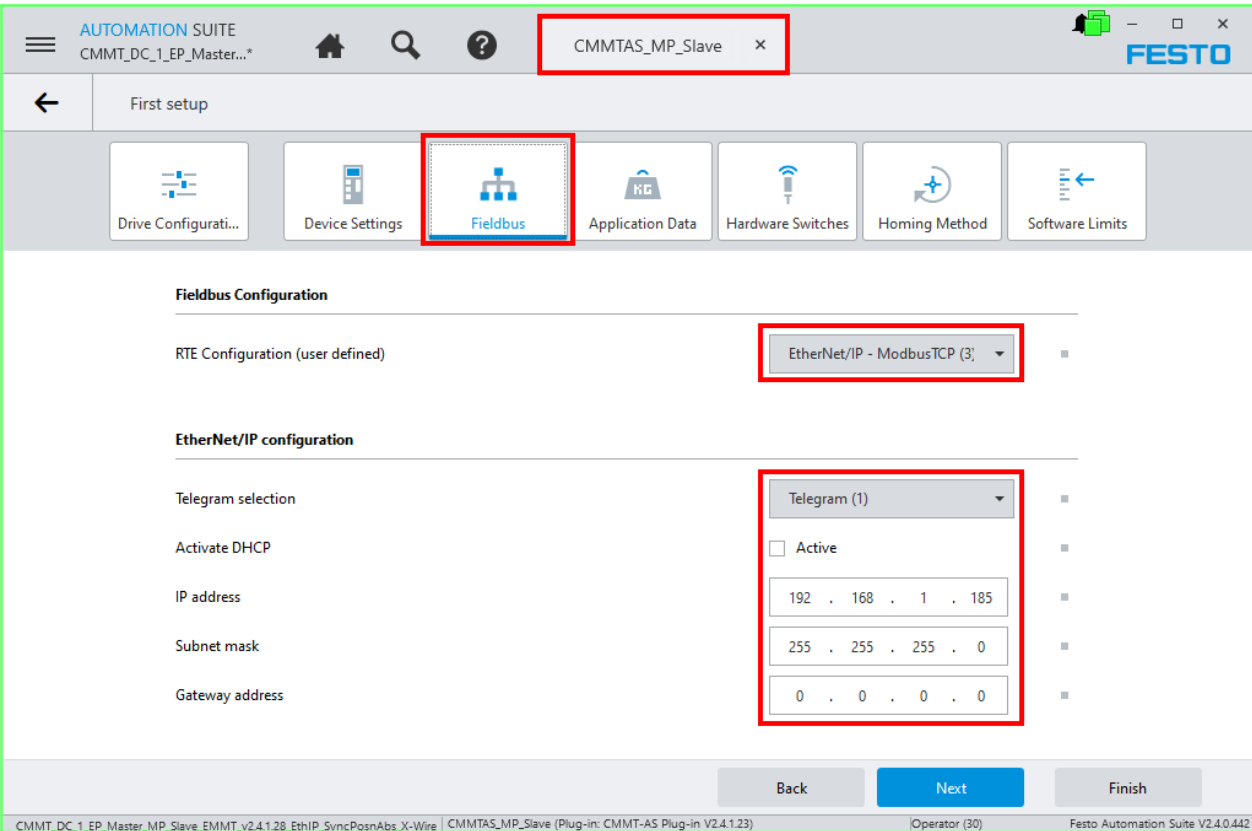
6.3 First setup - Device Settings

Consider the application Supply Voltage and modify from default if needed.



6.4 First setup - Fieldbus

Select EtherNet/IP – Modbus (3) for the RTE ethernet ports and Telegram 111, then modify the IP Address



## 6.5 First setup - Application Data

Consider the application design.

The screenshot shows the 'Application Data' configuration screen in the FESTO Automation Suite. The window title is 'CMMTAS\_MP\_Slave'. The 'Application Data' tab is selected in the top navigation bar. The 'Application Data' section contains three mass input fields: 'Axis mass' (0.37 kg), 'Application mass' (0.10 kg), and 'Total mass' (0.47 kg). The 'Application mass' field is highlighted with a red box. Below this is the 'Rotation Polarity' section, which includes a diagram of a motor with a blue square indicating the mounting position. A checkbox labeled 'Invert rotation polarity' is also present and highlighted with a red box. At the bottom, there are 'Back', 'Next', and 'Finish' buttons.

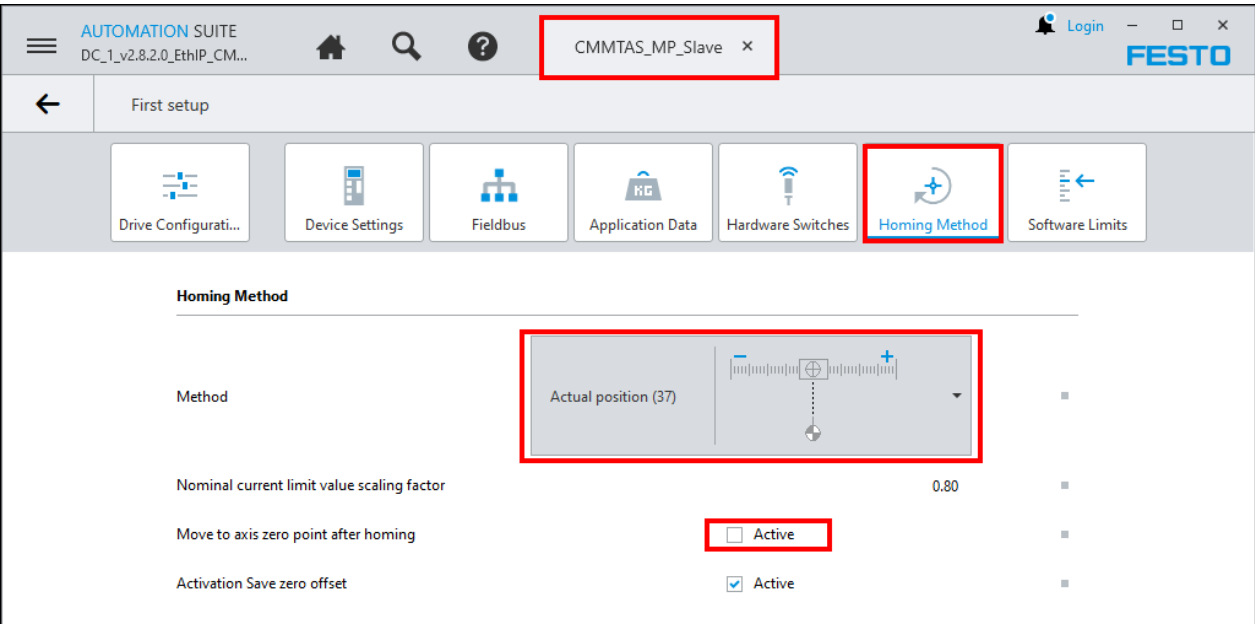
## 6.6 First setup - Hardware switches

The screenshot shows the 'Hardware Switches' configuration screen in the FESTO Automation Suite. The window title is 'CMMTAS\_MP\_Slave'. The 'Hardware Switches' tab is selected in the top navigation bar. The 'Hardware Switches' section contains two dropdown menus: 'Reference switch configuration' (set to 'No function (0)') and 'Limit switches configuration' (set to 'Not used (1)'). Both dropdown menus are highlighted with a red box. At the bottom, there are 'Back', 'Next', and 'Finish' buttons.



6.7 First setup - Homing Method

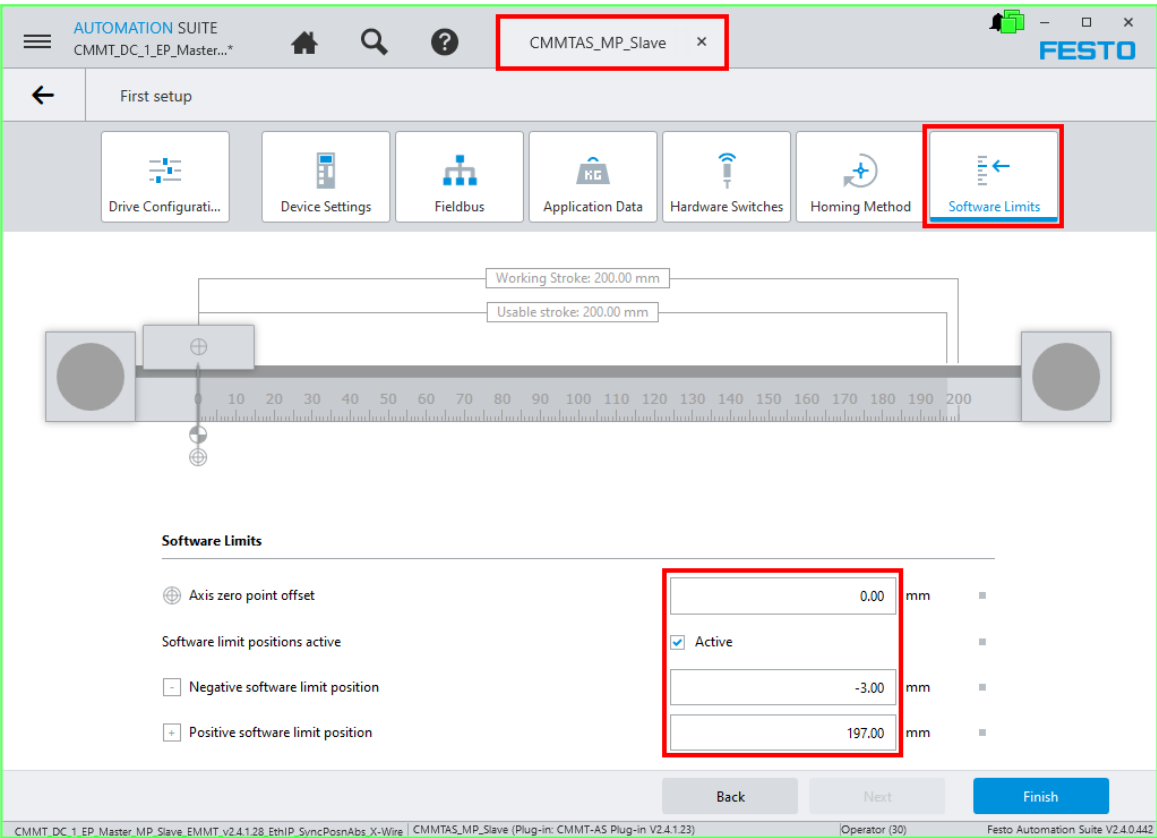
The simplest Homing method is Actual position (37) with no movement. This is because after the mechanical alignment, this allows the axis to reference and store the offset in the existing position **without any movement**.



6.8 First setup - Software Limits

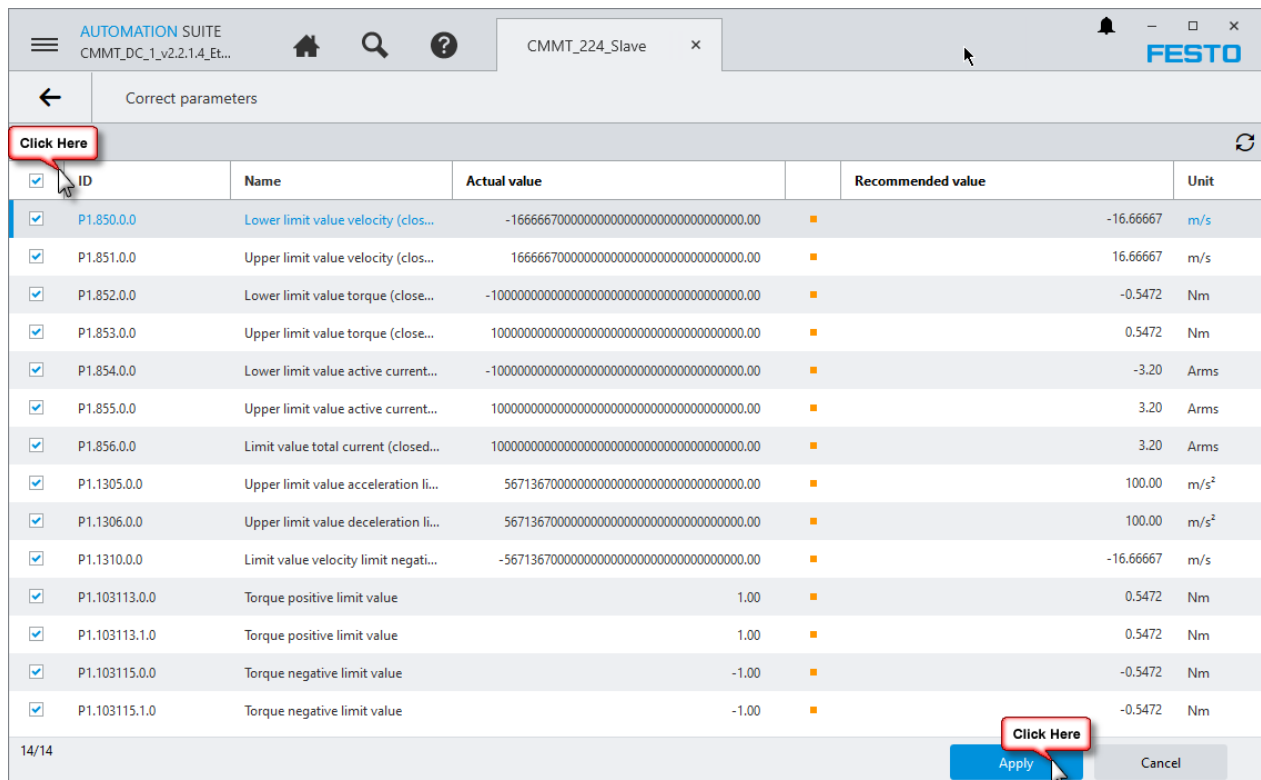
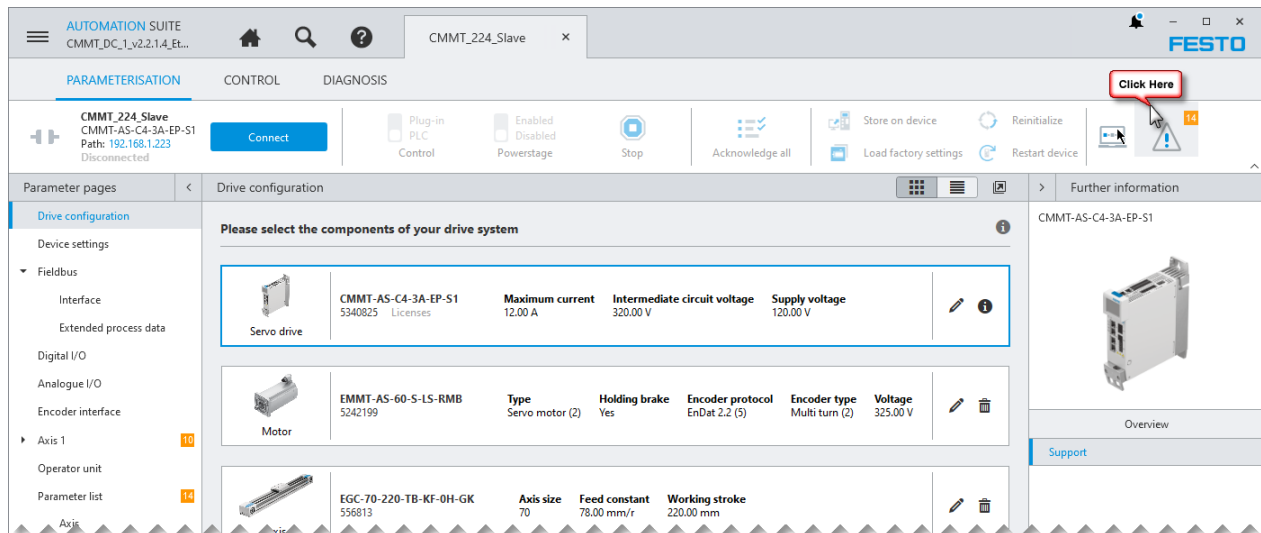
The Axis zero point offset should be configured as 0.00mm because during the execution of reference/homing, The Master position will already be at 0.00mm and the slave needs to match this position.

The Software Limits should be observed however, this depends on your application. The default values for negative/positive position limits should be adequate because the values of the slave should be beyond the physical stroke at either end of the axis (this was discussed earlier in section “First setup - Drive Configuration”).



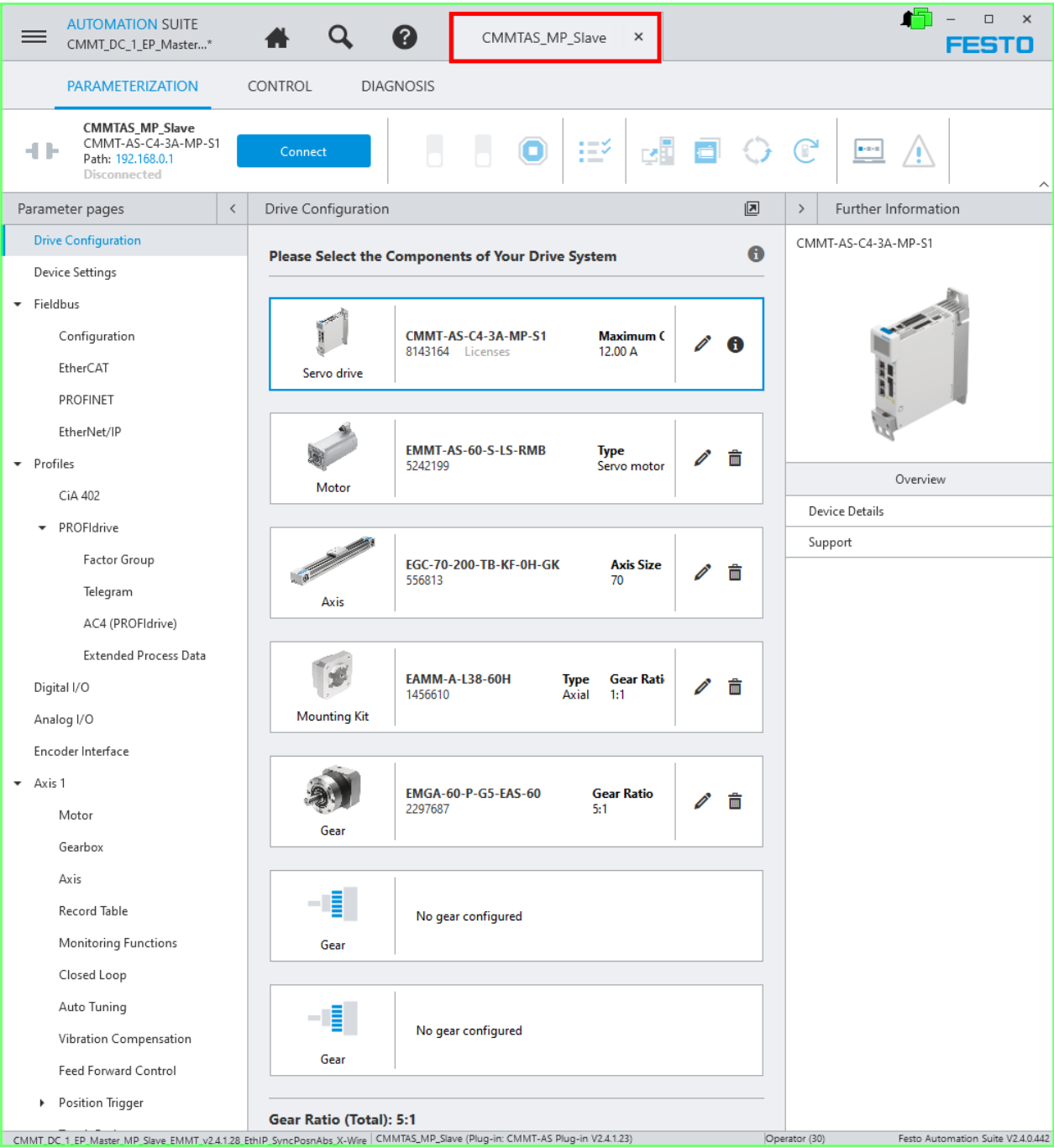
## 6.9 Correct Parameters

If you find orange adorners/indicators (example shown here), these are warning to indicate unfavorable or inconsistent values and these may need to be modified. It is recommended to use the “Correct Parameters” function to modify the parameters with recommended values as shown below.



6.10 Setup Complete

Slave axis general configuration is now complete.



## 7 Slave Axis Changes Required for Synchronous Position Absolute

### 7.1 Extended Process Data (EPD)

Configure all Sent/Received data as shown here in the **EXACT** order shown (Do NOT use editor to modify order):

Sent Data	P1.4643.0.0 P1.128.0.0 P0.11601.1.0 P1.85607.0.0
Received Data	Not Used

The screenshot shows the FESTO Automation Suite interface for configuring the CMMTAS\_MP\_Slave. The 'Extended Process Data' section is highlighted with a red box. It displays a table of sent data parameters:

ID	Parameter	Type	Byte position
0	P1.4643.0.0 Monitoring window encoder monitoring	FLOAT32	0
1	P1.128.0.0 Actual position value encoder channel 1	SINT64	4
2	P0.11601.1.0 Absolute position in user units	SINT64	12
3	P1.85607.0.0 Status	Status Gear In	20

Below the table, there are fields for 'Number of bytes Tx' (0) and 'Number of bytes Tx (Offline)' (21). The 'Received Data' section is also visible, showing 'Number of bytes Rx' (0) and 'Number of bytes Rx (Offline)' (0).

## 7.2 Encoder Interface

**Parameterization** | CMMTAS\_MP\_Slave

**Encoder Interface**

**DEFAULT**

**Encoder Selection of Position Control**

Encoder channel: Encoder interface 1 (0)

**Feed Constant**

Encoder interface 1: 78.00 mm/r

Encoder interface 2 (user defined): 1000.00 mm/r

**Encoder 1 (X2)**

Encoder selection: EnDat 2.2 (5)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**Encoder 2 (X3)**

Encoder selection: Without encoder (7)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**X10**

Selection of sync mode: Master (0)

Encoder emulation source: Encoder 1 (0)

Activate encoder emulation output: ☒ Active

Deactivate encoder emulation during homing: ☒ Active

Increments per revolution: 4096

Offset position: 0.00 mm

Activation counting direction reversal: ☐ Active

**CHANGES**

**Encoder Selection of Position Control**

Encoder channel: Encoder interface 1 (0)

**Feed Constant**

Encoder interface 1: 78.00 mm/r

Encoder interface 2 (user defined): 78.00 mm/r **I31**

**Encoder 1 (X2)**

Encoder selection: EnDat 2.2 (5)

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

**Encoder 2 (X3)**

Encoder selection: Incremental (4) **P0.11616.1.0**

Active encoder: Without encoder (7)

Absolute position: 0.00 mm

Filter time constant: 0.001 s

Invert encoder signal: ☐ Active

Resolution: 16382 inc/rev **P0.10040.1.0**

**X10**

Selection of sync mode: Master (0) **P0.5812.0.0**

Encoder emulation source: Encoder 1 (0) **P1.581.0.0**

Activate encoder emulation output: ☒ Active **P1.583.0.0**

Deactivate encoder emulation during homing: ☒ Active **P1.8421.0.0**

Increments per revolution: 16382 **P1.586.0.0**

Offset position: 0.00 mm **P1.586846.0.0**

Activation counting direction reversal: ☐ Active **P1.586847.0.0**

**Annotations:**

- This Feed Constant is applied to Slave Encoder Interface (X10) Encoder Emulation. Therefore the Master Encoder Interface 2 (X3) requires the same Feed Constant.
- The feed constant for Encoder Interface 2 (X3) must match the feed constant of the Master Encoder Interface 3 (X10) which is derived from Encoder Interface 1 (X2).

See section 8.4 (Master and Slave X10 to X3 physical connections) for an overview about Encoder interfaces.

### I31 Encoder Interface 2

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation

The feed constant for Slave Encoder Interface 2 (X3) must match the feed constant of the Master Encoder Interface 3 (X10) which is derived from Master Encoder Interface 1 (X2)

### P0.11616.1.0 Encoder Selection

Set Encoder 2 [X3] encoder selection to incremental (4) which is used for X10 and X3 cross wiring monitoring.

The Slave axis interface X10 will be configured to emulate differential A,B,N signals which will be received by this Encoder 2 [X3] interface for the purpose of position difference monitoring as well as Virtual Master Position.

### P0.10040.1.0 Resolution

The Master axis Encoder 3[X10] will be set as 16382 so the Slave Encoder 2 [X3] should be set to the same value. See the caution note on this page.

### P0.5812.0.0 Selection of Sync Mode

Here we configure as Master(0) so Encoder 3[X10] will emulate/transmit Encoder 1[X2] Actual Position in the form of differential A,B,N signals. The Master axis will use this signal for encoder difference monitoring.

### P1.581.0.0 Encoder Emulation Source

Encoder 1 (0) refers to the Primary Motor Encoder at connection X2

Encoder 2 (1) refers to a secondary Encoder at connection X3

Setpoint position (2) will transmit setpoint position signal (normally less noise is observed), however when the Master is disabled, no setpoint is changed and therefore if the shaft changes, the Slave will not observe this.



#### Caution 1

**If actual values are transmitted to the slave as position signals (P1.581 Encoder Emulation Source = Encoder 1 or Encoder 2), increased noise may occur due to the torque feed forward control in the synchronous phase. The torque feed forward control is switched off by setting parameter Px.968 to 0.**

### P1.8421.0.0 Deactivate Encoder Emulation During Homing

If enabled, whilst a reference/home routine is executed, Encoder 3[X10] emulation will be inhibited.

With this application, it is expected the axis are referenced/homed only once during commissioning and NOT to be not referenced/homed repeatedly. Among many reasons, it is expected the [Master and Slave axis both have Multi-Turn Absolute Encoders](#). Due to the fact this application has Master and Slave axes rigidly coupled and due to the encoder difference monitoring, it should be decided by the user if encoder signals are always transmitted even during a home routine.

### P1.586.0.0 Increments per revolution

The Master axis Encoder 3[X10] will be set as 16382 so the Slave Encoder 2 [X3] should be set to the same value. 16382 Increments per revolution also allows for better tuning when in Synchronisation. (The greater the selected value the lower the resulting noise on the connected slave axes).



#### Caution 2

- **The same increments per revolution should be set on the opposing encoder connections of the Master and Slave drives.**
- **DO NOT USE THE VALUE "16384" for Increments per revolution.**  
**This will result with an exception in the firmware when re-initializing the drive (div/0) and the hardware will need to be replaced (cannot be fixed onsite).**  
**The firmware release V19.0.4.72 is supposed to address this issue.**

### 7.3 Record Table

The Record Table needs to have the associated Gear In record as shown here and this will be used to activate the Slave axis synchronisation.



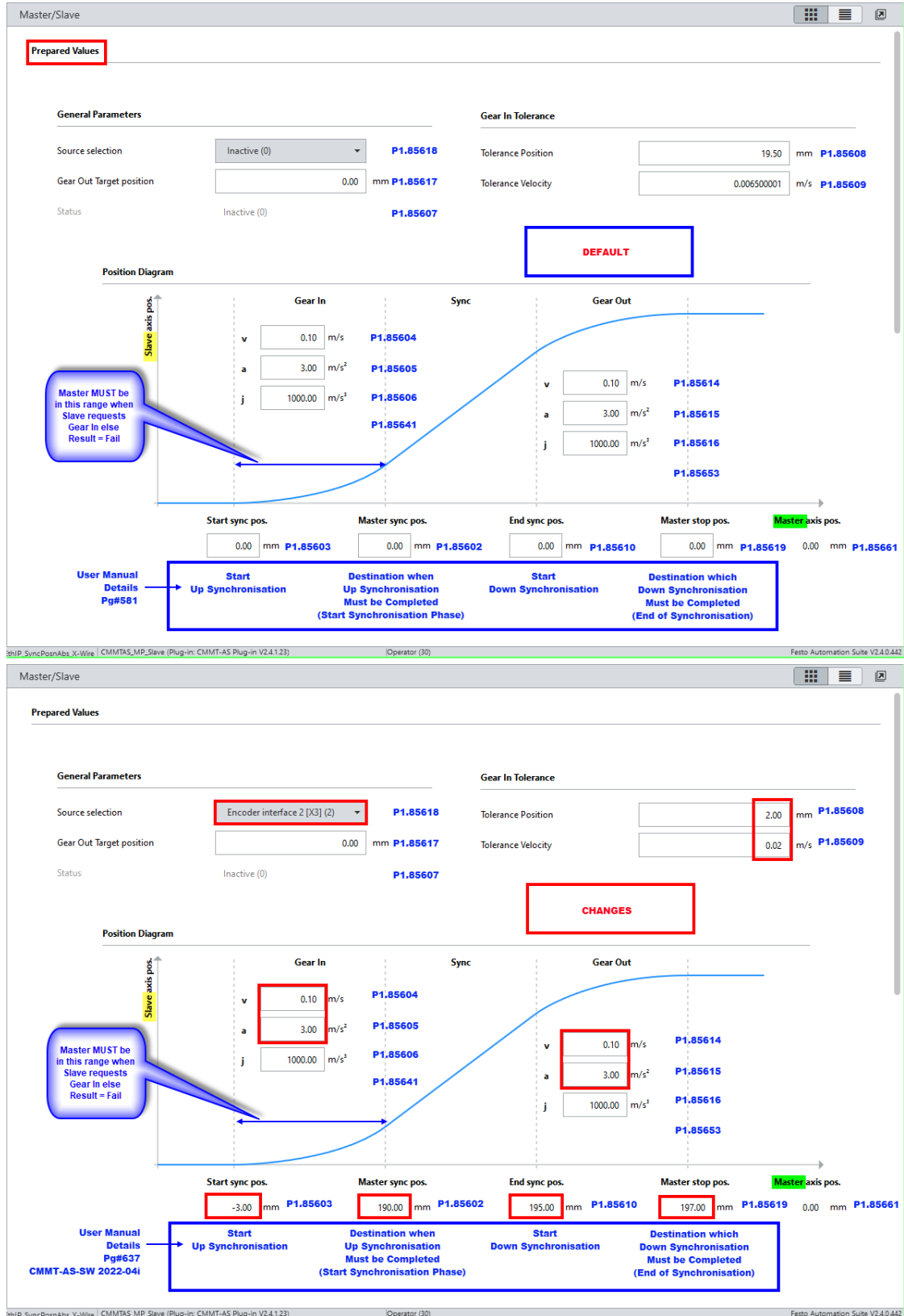
#### NOTE:

Within the required PLC program, a "Method" is used to Set Master Gear In Position instead of using a record. This is because before a record table task can be executed, the controller **MUST BE ENABLED WITHOUT FAULTS** and so, for error recovery, the "Method" is much more convenient with this application.

## 7.4 Master/Slave

The Slave axis Master/Slave page needs to be configured based on the Device Configuration Axis Working Stroke. In this example, the Master and Slave physical axis stroke are both 175mm. The Slave is configured with 200mm (197mm Software Limit) to avoid loss of synchronisation. In order to correlate with the Slave Software limit and avoid losing synchronisation, the Master Sync Pos./End Sync Pos. and Master Stop Pos. are all configured with values greater than the Master axis physical stroke up to the unachievable Slave Stroke including the positive software limit.

The Encoder Interface 2[X3] (2) needs to be selected so the Slave considers this as the Virtual Master Position.

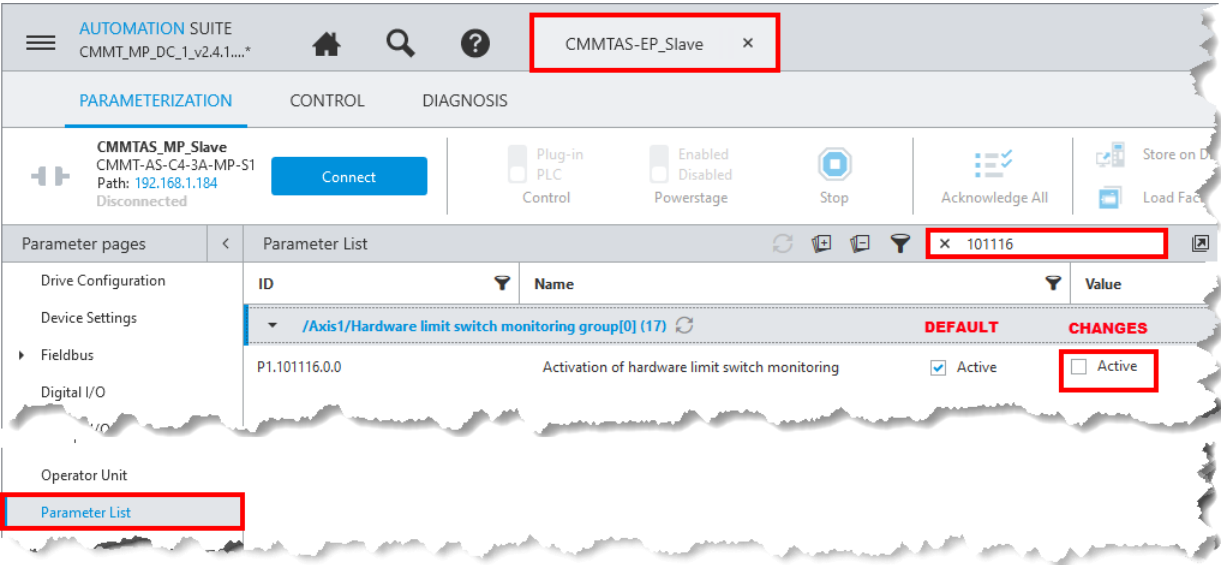




7.5 Parameter List

7.5.1 P1.101116.0.0 Hardware Limits Disabled

This option should be disabled to prevent undesirable behavior while in sync.



Caution

If the Slave axis is in synchronisation to the Master and a Hardware limit is encountered, the slave will be inhibited by the limit and will NOT follow the Master.

## 7.5.2 P1.4643.0.0 Monitoring Window Encoder Monitoring

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation

In order for Encoder 1 [X2] and Encoder 2 [X3] position difference monitoring to function, configure these group parameters (Axis1/movement monitoring group):

- P1.4642 Damping time encoder monitoring
- P1.4643 Monitoring window encoder monitoring

ID	Name	Value	Unit
/Axis1/Movement monitoring group[0] (89)			
P1.460.0.0	Movement monitoring status	0	
P1.461.0.0	Configuration word movement monitoring	0	
P1.462.0.0	Damping time position: following error	0.10	s
P1.463.0.0	Monitoring window position: following error	0.001	m
P1.464.0.0	Monitoring window velocity: following error	0.04	m/s
P1.465.0.0	Standstill damping time	0.10	s
P1.4639.0.0	Storage option: Limitation positive direction	Save (1)	
P1.4642.0.0	Damping time encoder monitoring	0.05s = 50ms	s
P1.4643.0.0	Monitoring window encoder monitoring	0.001m = 1.0mm	m
P1.4617.0.0	Storage option: Target torque reached	Do not save (0)	
P1.4618.0.0	Diagnostic category: Standstill reached	Information (4)	

PLC (Programmable Logic Controller) Code will also need to be modified in the following Routine:  
E031\_Master\_PNU02940\_0\_R\_LINT\_X3\_ActPos

#####  
ENCODER DIFFERENCE MONITORING  
#####

The user must MANUALLY set the value of Master\_EncoderMonitorWindow\_mm\_LINT = Master\_EncoderMonitorWindow\_mm but represented as LINT data type  
Due to lack of instructions with LINT data Types in RS5000 prior to v32, the user needs to calculate (without use of PLC) the value of Master\_EncoderMonitorWindow\_mm\_LINT

Formula: Master\_EncoderMonitorWindow\_mm\_LINT = Whole Number of Master\_EncoderMonitorWindow\_mm \* 10^7 (10,000,000)

Example#1  
Master\_EncoderMonitorWindow\_mm = 0.5 (mm)  
0.5 \* 10^7 = 5,000,000

Example#2  
Master\_EncoderMonitorWindow\_mm = 1.0 (mm)  
1.0 \* 10^7 = 10,000,000

Calculate the Absolute difference between Slave axis Encoder 1 [X2] Motor Actual Position vs Slave axis Encoder2 [X3] Emulated Actual Position Within Tolerance  
Calculate the Absolute difference between Master axis Encoder 1 [X2] Motor Actual Position vs Slave axis Encoder2 [X3] Emulated Actual Position Within Tolerance  
If any difference is larger than the tolerance of Parameter P1.4643.0.0 Monitoring Window Encoder Monitoring,  
then the Synchronise sequence will execute additional steps and execute a Set Master Position Gear In/Out prior to Synchronisation

SLAVE AXIS  
Encoder Monitor  
Position Window  
Unit:mm

SLAVE AXIS  
Encoder Monitor  
Window (mm)  
0.5mm = 5,000,000  
1.0mm = 10,000,000

CustomerSetupRequired

Move  
Source Slave1\_EncoderMonitorWindow\_mm 1.0  
Dest Slave1\_EncoderMonitorWindow\_mm\_LINT 1.0

Copy File  
Source Slave1\_EncoderMonitorWindow\_mm\_LINT  
Dest Slave1\_EncoderMonitorWindow\_mm\_LINT  
Length Tag: Slave1\_EncoderMonitorWindow\_mm\_LINT  
Data Type: LINT  
Scope: Controller  
Value: 10000000

E031\_Slave1\_PNU02940\_0\_R\_LINT\_X3\_ActPos  
MainProgram

## 7.6 Error Classification

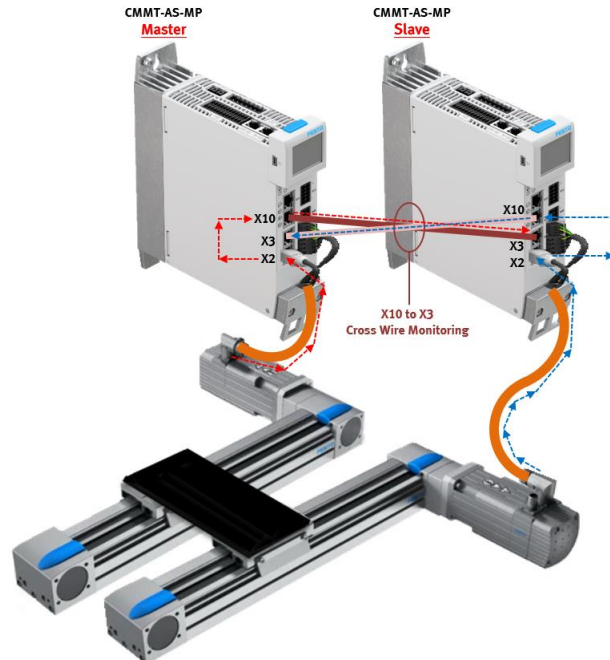
### 7.6.1 D1.07|02|00133.0 Position Difference Encoder 1 to Encoder 2 too Large

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation



Both the Master and Slave will provide an emulated encoder signal (differential A,B,N signals) from Encoder 3[X10] to the opposite controller at Encoder 2[X3].

The Master and Slave use the Encoder 2[X3] emulated encoder signal for the purpose of position difference monitoring.

In the Error Classification, change the error "D1.07|02|00133.0 Position Difference Encoder 1 to Encoder 2 too Large" category from Ignore (2) to **Warning (16)**. This setting allows the Slave axis to remain in synchronisation and provide a warning during a position deviation larger than parameter P1.4643.

**AUTOMATION SUITE**  
CMMT\_DC\_1\_EP\_Master...\*

PARAMETERIZATION CONTROL **DIAGNOSIS**

CMMTAS\_MP\_Slave  
CMMT-AS-C4-3A-MP-S1  
Path: 192.168.0.1  
Disconnected

Connect

Plug-in PLC Control Enabled Disabled Powerstage Stop Acknowledge All Store on Device Reinitialize

Diagnosis pages < Error Classification

Go to diagnosis page "Error Log"

Store warnings to error log ☒ Active

ID	Name	Category (actual configured)
D1.07 02 00128.0	Velocity too high	Stop category 1 (255)
D1.07 02 00129.0	Out of target range	Warning (16)
D1.07 02 00130.0	Reverse feed monitoring	Information (4)
D1.07 02 00131.0	Residual distance too low	Information (4)
D1.07 02 00132.0	Trajectory completed	Information (4)
<b>D1.07 02 00133.0</b>	<b>Position difference encoder 1 to encoder 2 too large</b>	<b>Warning (16)</b>

## 7.7 Trace Configuration

The following are suggestions for troubleshooting/monitoring of Gear In Functions

Channel Data:

P0.11601.1.0

P1.90.0.0

P1.1837.0.0

P1.112819.0.0

P1.1147061.0.0

P1.1145121.0.0

P1.171.0.0

Trigger

P1.1147070.0.0

**Automation Suite**  
CMMT\_DC\_1\_EP\_Master...\*

**CMMTAS\_MP\_Slave** x

PARAMETERIZATION CONTROL **DIAGNOSIS**

**CMMTAS\_MP\_Slave**  
CMMT-AS-C4-3A-MP-S1  
Path: 192.168.1.184  
Disconnected

Connect

Diagnosis pages < Trace Configuration Delete All

Device State  
I/O State  
Error Log  
Error Classification  
**Trace Configuration**  
Trace Display  
Auto Tuning

**Trace Channels**

ID	Active	Signal
0	<input checked="" type="checkbox"/>	P0.11601.1.0 Absolute position in user units
1	<input checked="" type="checkbox"/>	P1.90.0.0 Setpoint position
2	<input checked="" type="checkbox"/>	P1.1837.0.0 Current record table index
3	<input checked="" type="checkbox"/>	P1.112819.0.0 Error active
4	<input checked="" type="checkbox"/>	P1.1147061.0.0 STW1.6 Traverse Task Active
5	<input checked="" type="checkbox"/>	P1.1145121.0.0 ZSW1.12 Traversing Task Acknowledgement
6	<input checked="" type="checkbox"/>	P1.171.0.0 Motion Manager status

Add Trace Channel

**Record Settings**

Trace duration: 4.00 s

Trace resolution: 0.0003125 s

**Trigger Preferences**

Type	Value mode	Condition	Parameters	Threshold
Data trigger (1)	Threshold (3)	Rising edge (1)	P1.1147070.0.0: STW1.7 Fault Acknowledge	Value: <input checked="" type="checkbox"/>

Trace delay: 0.500625 s

CMMT\_DC\_1\_EP\_Master\_MP\_Slave\_EMMT\_v2.4.1.28\_EthIP\_SyncPosnAbs\_X-Wire | CMMTAS\_MP\_Slave (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

## 8 Commissioning Steps

### 8.1 Download both axis configurations

The motor controller should have factory defaults, however, if a parameter synchronisation window appears, make certain to select “Write to Device”

**Parameter synchronisation**

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
P0.902.0.0	Device name	CMMTAS_MP_Master		CMMTAS_MP_Linear_M	
P0.12001.1.0	IP address	3232236000		0	
P0.12002.1.0	Subnet mask	4294967040		0	
P1.1813.0.1	Record table field 2	1650000000		1700000000	

**Connected Device**

- Identify: ☐
- Device Name: CMMTAS\_MP\_Linear\_Ma
- Device Type: CMMT-AS-C4-3A-MP-S
- IP-Address: 192.168.1.223
- Product key: B0BL3Q13JD9
- Plug-in version: 2.4.1.23
- Firmware version: V031.0.7.10\_Release

**Buttons:** Write to Device, Read from device, Cancel

**Parameter synchronisation**

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
P0.341.0.0	Trigger type	Data trigger (1)		Record immediately (0)	
P0.557.0.0	Trace delay	1715		2002	
P0.558.0.0	Recording length	2287		8000	
P0.559.0.0	Down sampling factor	14		8	
P0.902.0.0	Device name	CMMTAS_EP_Slave		CMMTAS_EP_185_Linear	
P0.5812.0.0	Selection of sync mode	Slave (1)		Master (0)	

**Connected Device**

- Identify: ☐
- Device Name: CMMTAS\_EP\_185\_Linear
- Device Type: CMMT-AS-C2-3A-EP-S1
- IP-Address: 192.168.1.184
- Product key: 357PP8BDG4Y
- Plug-in version: 2.4.1.23
- Firmware version: V22.0.3.88\_release

**Buttons:** Write to Device, Read from device, Cancel

### 8.2 Telegram

Please be certain that after download, the Telegram selection is set correct with Telegram (111)

The image shows two screenshots of the CMMTAS software interface, illustrating the Telegram configuration for Master and Slave units.

**Top Screenshot (Master Unit):**

- The title bar shows "CMMTAS\_MP\_Master".
- The "PARAMETERIZATION" tab is active.
- The left sidebar shows "Telegram" selected under "Profiles".
- The main area displays "Telegram - PROFINET" and "Telegram - EtherNet/IP".
- Under "Telegram - EtherNet/IP", the "Telegram selection" dropdown is set to "Telegram (111)".
- A red callout bubble points to the dropdown with the text: "Confirm Telegram 111 after download".

**Bottom Screenshot (Slave Unit):**

- The title bar shows "CMMTAS\_MP\_Slave".
- The "PARAMETERIZATION" tab is active.
- The left sidebar shows "Telegram" selected under "Profiles".
- The main area displays "Telegram - PROFINET" and "Telegram - EtherNet/IP".
- Under "Telegram - EtherNet/IP", the "Telegram selection" dropdown is set to "Telegram (111)".
- A red callout bubble points to the dropdown with the text: "Confirm Telegram 111 after download".

### 8.3 Store both axis configurations

The image shows two screenshots of the CMMTAS software interface, illustrating the "Store on Device" button for Master and Slave units.

**Top Screenshot (Master Unit):**

- The title bar shows "CMMTAS\_MP\_Master".
- The "PARAMETERIZATION" tab is active.
- The left sidebar shows "Telegram" selected under "Profiles".
- The main area displays "Telegram - PROFINET" and "Telegram - EtherNet/IP".
- Under "Telegram - EtherNet/IP", the "Telegram selection" dropdown is set to "Telegram (111)".
- A red callout bubble points to the "Store on Device" button with the text: "Click Here".

**Bottom Screenshot (Slave Unit):**

- The title bar shows "CMMTAS\_MP\_Slave".
- The "PARAMETERIZATION" tab is active.
- The left sidebar shows "Telegram" selected under "Profiles".
- The main area displays "Telegram - PROFINET" and "Telegram - EtherNet/IP".
- Under "Telegram - EtherNet/IP", the "Telegram selection" dropdown is set to "Telegram (111)".
- A red callout bubble points to the "Store on Device" button with the text: "Click Here".

## 8.4 Cross-Wiring Encoder Emulation X10 to X3

In Festo Automation Suite (FAS) and in general for this application, the encoder interfaces have the following meaning:

Encoder 1[X2] = Actual Position of Motor Encoder

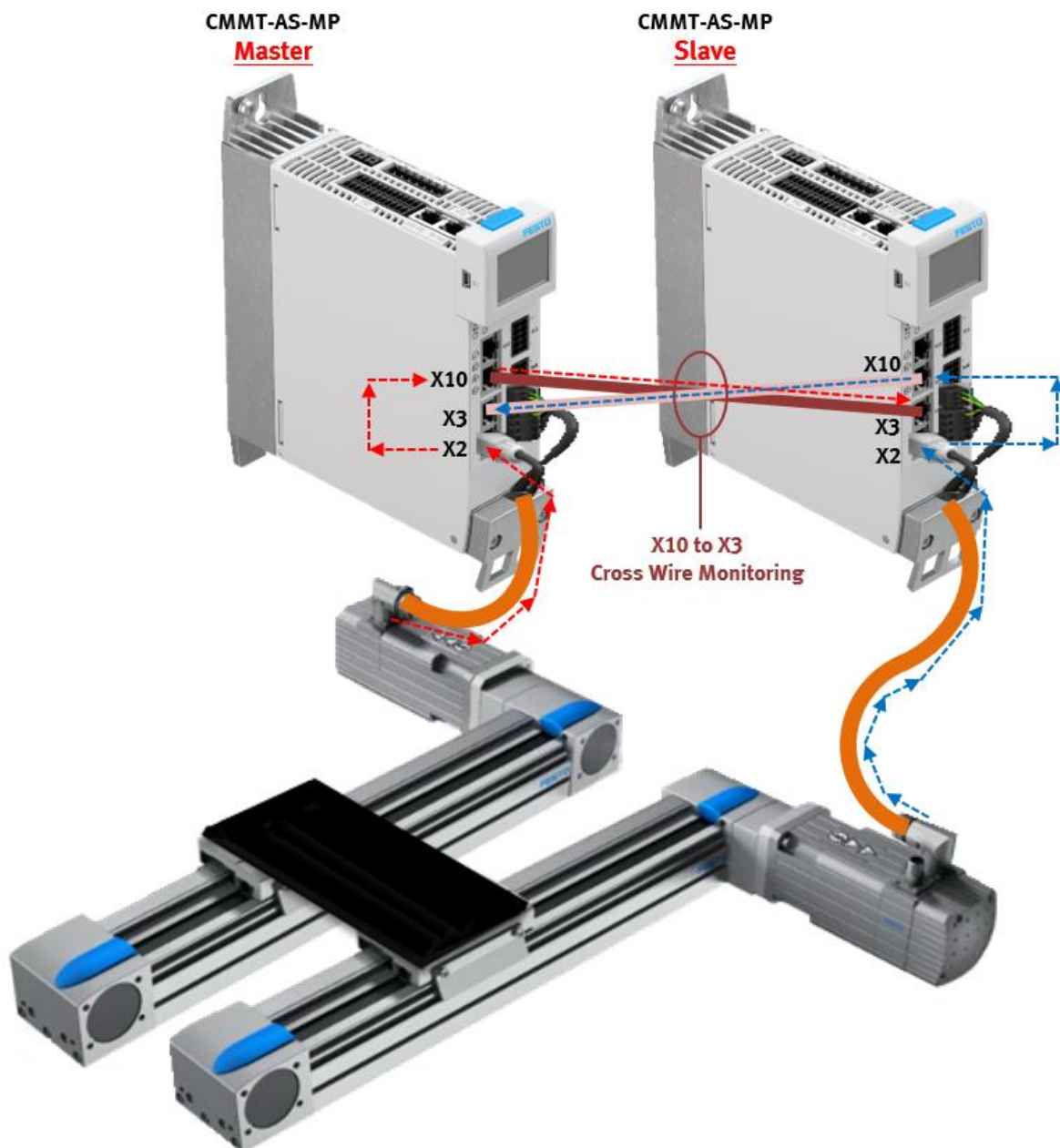
Encoder 2[X3] = Actual Position Emulated by opposite Controller

Encoder 3[X10] = Encoder 1[X2] Actual Position Emulation

Cables must be installed between the controller Encoder 3[X10] and Encoder 2[X3] interfaces as shown here. It is recommended to use a RJ45 patch cable of ethernet category 5e with a maximum length of 25 cm. Festo cables can be purchased (Part: 8082383, Type: NEBC-R3G8-KS-0.2-N-S-R3G8-ET).

The dashed lines shown here represent actual encoder signal or emulated encoder signal between the servo controllers. Both the Master and Slave will provide an emulated encoder signal (differential A,B,N signals) from Encoder 3[X10] to the opposite controller at Encoder 2[X3].

The Master uses the Encoder 2[X3] emulated encoder signal for the purpose of position difference monitoring. The Slave uses the Encoder 2[X3] emulated encoder signal for the purpose of position difference monitoring as well as Virtual Master Position.

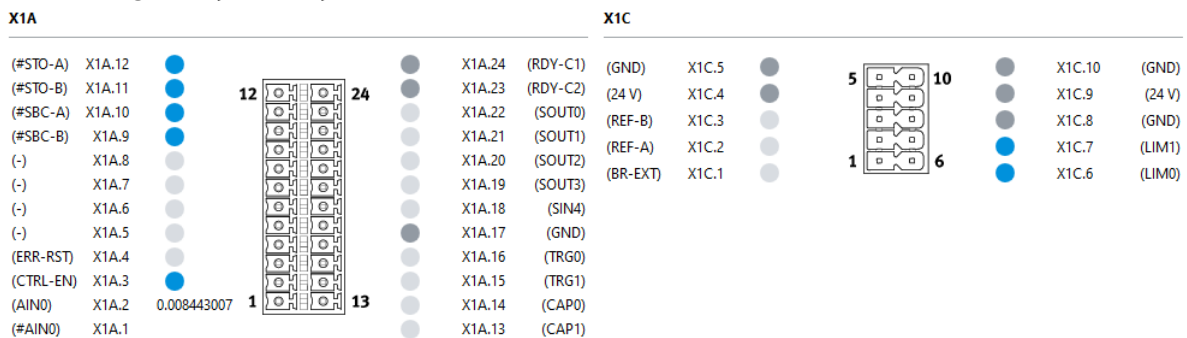




## 8.5 Cross-Wiring Control Enable

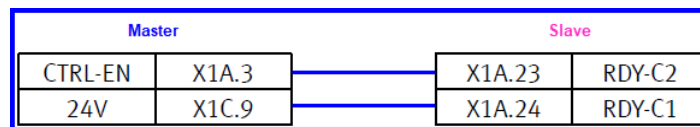
- In applications with rigid mechanical coupling, an offset between master and slave can lead to distortion, even mechanical destruction of the system. To avoid such risk, a reliable solution must be deployed.
- In the event of an error of the Slave, the Master should stop as soon as possible, in the best case with the delay dynamics of the Slave. Such a shutdown via the higher-level controller is usually subject to the update time of the fieldbus system and the cycle time of the controller. Therefore, hardware control enable cross-wiring is recommended in this case. The Master can be enabled by a ready signal, physically via the potential-free contact RDY-C1/C2 of the Slave. If the Slave now goes into error state, the CNTRL-EN of the Master will be removed, which leads to a stop ramp and following stop. The Master can also be enabled again only if there is no more error in the Slave. If the hardware cross-wiring shown here conflicts with the safety circuit of the Master (CTRL-EN), the Master can also be disabled in the event of an error via a digital input and using the event table.
- In case of error to the Master, the Slave still will follow the Master's position. It must be ensured that Slave drive can follow the dynamics of the Master's stop ramp.

### 8.5.1 Wiring IO (Inputs/Outputs) Connector Function



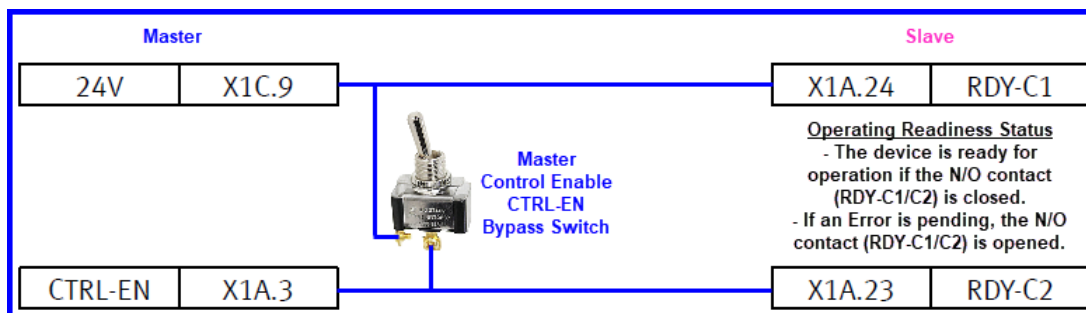
### 8.5.2 Wiring Example

The wiring shown here is very simple and will react very fast to an error on the Slave. It is also common that the 24V (X1C.9) is replaced by a voltage supply from a safety relay. The idea is application dependent (up to designer) and the idea is the RDY-C1/C2 contact is simply in series with any other conditions required to disable the controller.



### 8.5.3 Wiring Example With Bypass

If the user feels they will need to bypass this condition in certain circumstances, they could wire as follows:

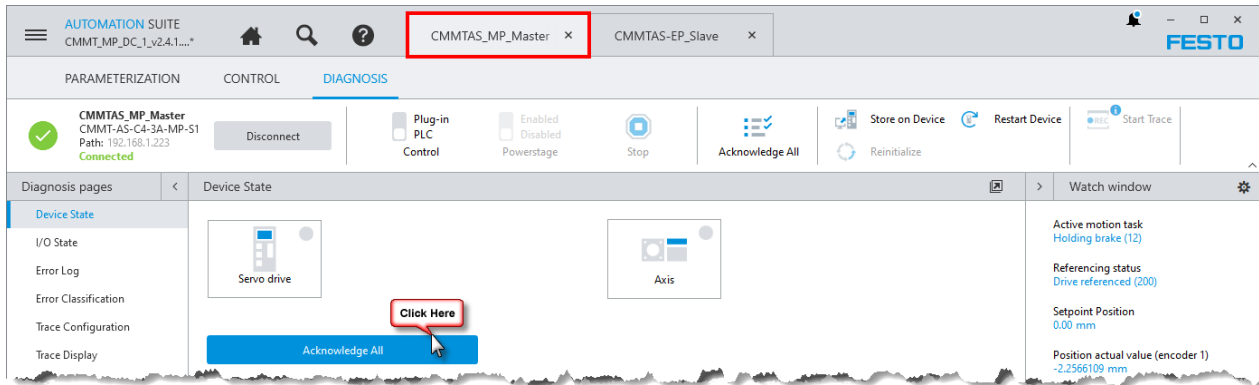




## 8.6 Master and Slave cycle power

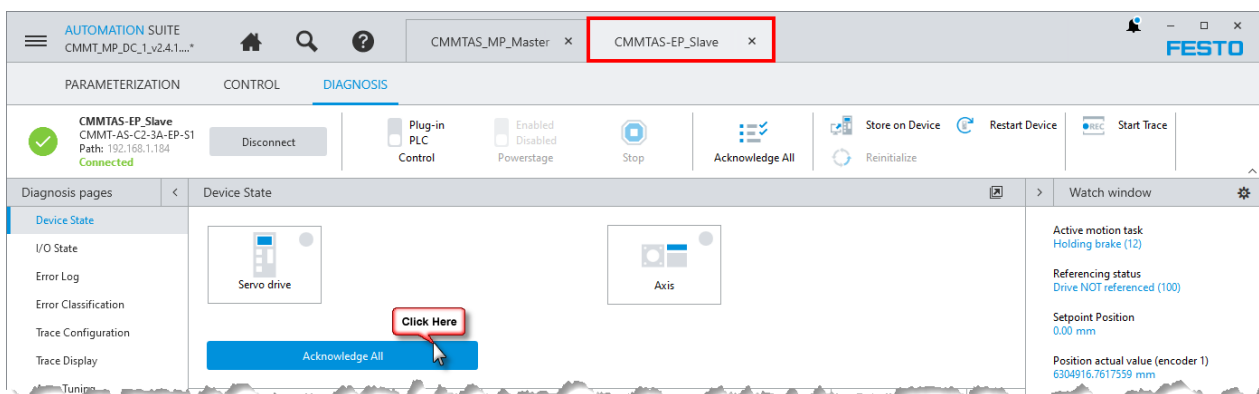
## 8.7 Master axis Acknowledge Faults

Go online with the CMMT Master axis and acknowledge any faults



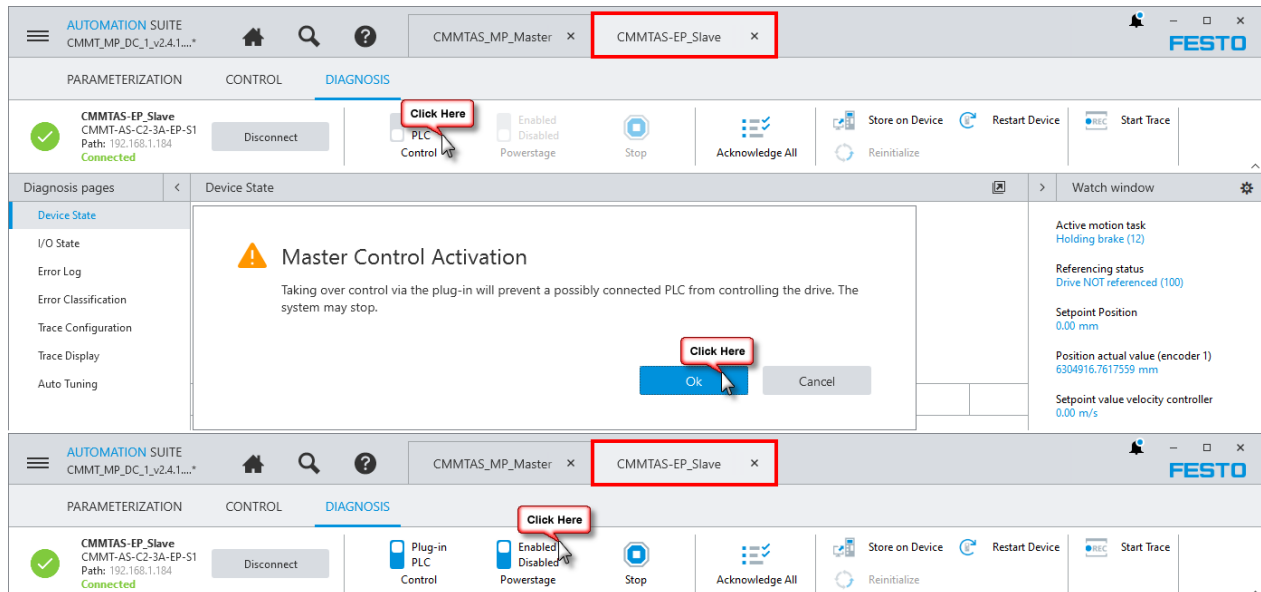
## 8.8 Slave axis Acknowledge Faults

Go online with the CMMT Slave axis and acknowledge any faults



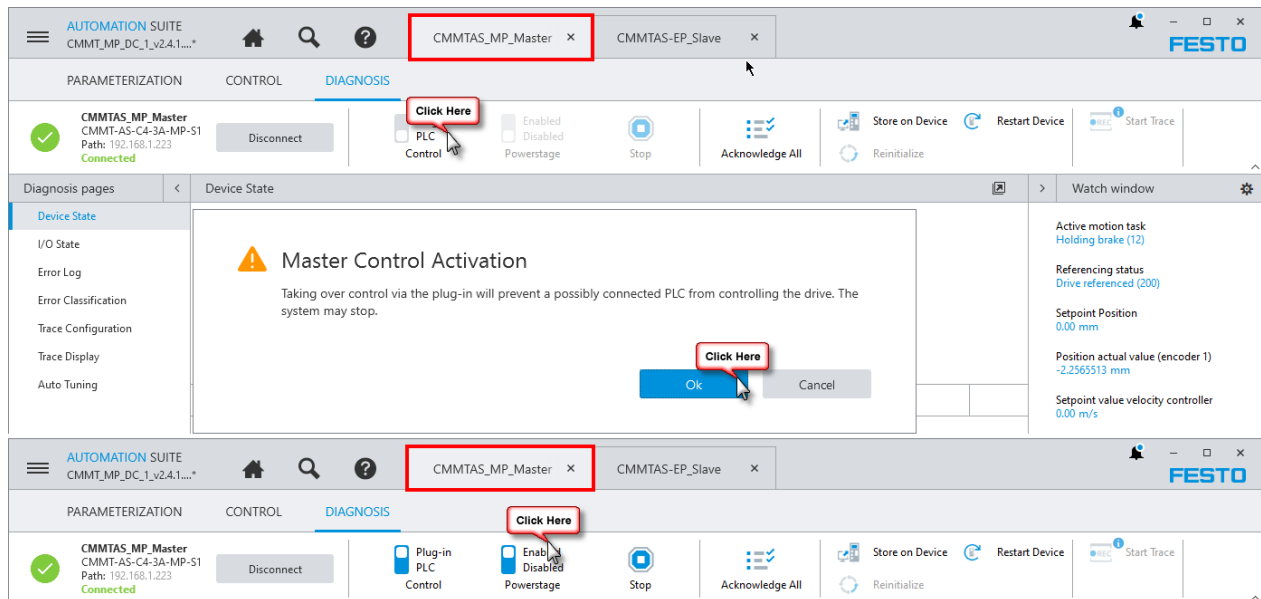
### 8.9 Slave Enable Plug-in PLC Control and Powerstage

The Slave Axis must be enabled and clear of faults prior to enable of the Master due to the Cross-Wiring Control Enable.



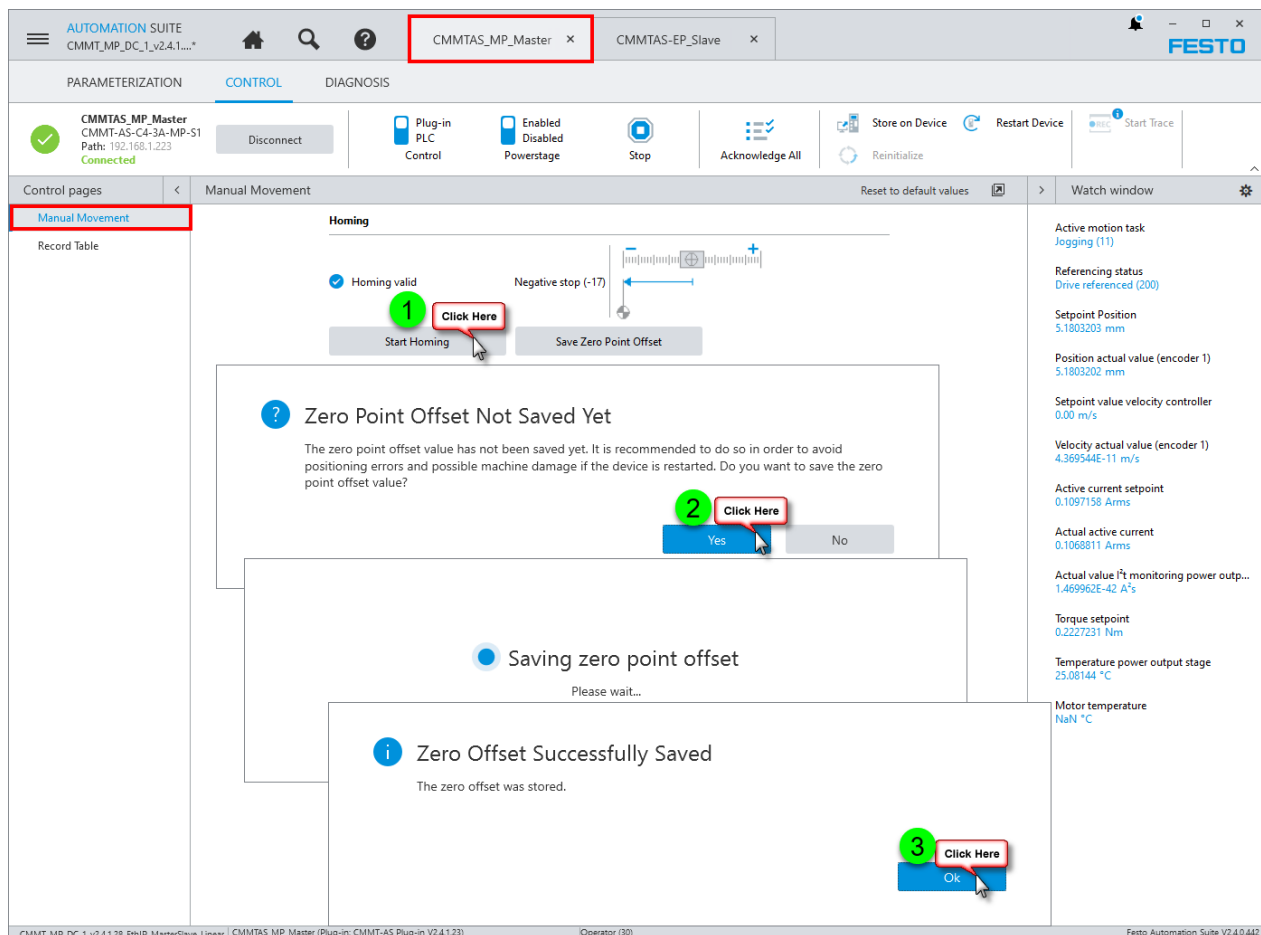
## 8.10 Master Enable Plug-in PLC Control and Powerstage

The Slave Axis must be enabled and clear of faults prior to enable of the Master due to the Cross-Wiring Control Enable.



## 8.11 Master Homing

As mentioned earlier, a different reference method may be required for the application.



## 8.12 Master Rotation Polarity

Check if the axis is moving in the desired/correct direction as a standalone axis. This can be modified via the Start First Setup → Application Data – Rotation Polarity as shown here

**Application Data**

Axis mass 0.37 kg

Application mass 0.10 kg

Total mass 0.47 kg

**Rotation Polarity**

Please select the mounting position of the motor (viewed from top):

☐ Invert rotation polarity

**Parameter List**

ID	Name	Value
/Axis1/Direction of rotation manager group[0] (5)		
P1.1170.0.0	Reversing the direction of rotation	<input checked="" type="checkbox"/> Active

**P1.1170.0.0 Reversing the direction of rotation**

**Reversing the direction of rotation**

**P1.1170.0.0 (BOOL)**

EtherCAT: CoE 0x607E.0 (USINT)  
CoE 0x217D.1 (BOOL)

EtherNet/IP: CIP 11287.0 (BOOL)

PROFINET: PNU 11287.0 (BOOL)

Determines whether the reversal of the direction of rotation shall be activated.

Default ☐

Last saved ☒

## 8.13 Master Slave Mechanical Alignment



### Caution

- At this point, the mechanical alignment between the Master and Slave axis should be carried out. Depending on the application, this may include moving the Master and Slave axes before or after they are enabled.
- Only after the Slave axes has been aligned perfectly to the Master should the Slave axis now be referenced/homed and have the encoder position offset stored at their existing aligned positions!

## 8.14 Slave Homing

As mentioned earlier, a different reference method may be required for the application.

The screenshot shows the FESTO Automation Suite interface for the 'CMMTAS-EP\_Slave' device. The 'CONTROL' tab is selected, and the 'Manual Movement' section is active. The 'Homing' section displays a 'Start Homing' button and a 'Save Zero Point Offset' button. A 'Zero Point Offset Not Saved Yet' dialog box is shown, asking if the user wants to save the zero point offset value. A 'Saving zero point offset' dialog box is also present. A 'Zero Offset Successfully Saved' dialog box is shown at the bottom. The right sidebar displays various system parameters and status indicators.

**Top Bar:** AUTOMATION SUITE, CMMT\_MP\_DC\_1\_v2.4.1..., CMMTAS\_MP\_Master, CMMTAS-EP\_Slave (highlighted).

**Navigation:** PARAMETERIZATION, CONTROL (selected), DIAGNOSIS.

**Device Status:** CMMTAS-EP\_Slave, CMMT-AS-C2-3A-EP-S1, Path: 192.168.1.184, Connected.

**Buttons:** Disconnect, Plug-in PLC, Enabled Disabled Powerstage, Stop, Acknowledge All, Store on Device, Restart Device, Start Trace.

**Control pages:** Manual Movement (selected), Watch window.

**Homing Section:** Homing, Homing invalid, Current position (37), Start Homing, Save Zero Point Offset.

**Dialogs:**

- Zero Point Offset Not Saved Yet:** The zero point offset value has not been saved yet. It is recommended to do so in order to avoid positioning errors and possible machine damage if the device is restarted. Do you want to save the zero point offset value? (Yes/No buttons).
- Saving zero point offset:** Please wait...
- Zero Offset Successfully Saved:** The zero offset was stored. (Ok button).

**Right Sidebar (Status Indicators):**

- Active motion task: Power on (1)
- Referencing status: Drive NOT referenced (100)
- Setpoint Position: 6304916.7617559 mm
- Position actual value (encoder 1): 6304916.7617559 mm
- Setpoint value velocity controller: 0.00 m/s
- Velocity actual value (encoder 1): 1.429853E-06 m/s
- Active current setpoint: 0.006072152 Arms
- Actual active current: 0.0002698599 Arms
- Actual value I<sup>2</sup>t monitoring power outp...: 1.469962E-42 A<sup>2</sup>s
- Torque setpoint: 0.01246185 Nm
- Temperature power output stage: 20.21774 °C
- Motor temperature: 38.75001 °C

**Bottom Bar:** CMMT\_MP\_DC\_1\_v2.4.1.28\_EthIP\_MasterSlave\_Linear | CMMTAS-EP\_Slave (Plug-in: CMMT-AS Plug-in V2.4.1.23) | Operator (30) | Festo Automation Suite V2.4.0.442

### 8.15 System Ready for Synchronisation

Once the previous steps of commissioning are completed, the system configuration is ready for Synchronisation/Gear In.

At this point the following implementations are active with the application:

- Cross-Wiring Hardware Control Enable (section 8.5) and
- Cross-Wiring Encoder X10 to X3 (section 8.4) and
- Master axis Active Error of Position Difference Encoder 1 to Encoder 2 too Large (section 5.5.1) and
- Slave axis Active Warning of Position Difference Encoder 1 to Encoder 2 too Large (section 7.5.2)

These implementations need to be considered prior to achieving a Gear In and during Gear In to avoid experiencing issues.

For example, incorrect tuning or high move velocity can effect and could nuisance trigger the error of "Position Difference Encoder 1 to Encoder 2 too Large". Testing needs to be completed in order to understand the limits of the application design and the configuration may need to change

In other words, in order to achieve the smallest position error and quickest response time, the following group parameters (Axis1/movement monitoring group) may need to be adjusted on both Master/Slave axis:

- P1.4642 Damping time encoder monitoring
- P1.4643 Monitoring window encoder monitoring

## 8.16 Slave Record Table Gear In Synchronous Position Absolute

Execute the Record Table Record "Gear In Synchronous Position Absolute (1)" that was previously programmed.

The image displays two screenshots of the FESTO AUTOMATION SUITE software interface, showing the steps to execute a Record Table record.

**Top Screenshot:**

- The **CONTROL** tab is selected.
- The **Record Table** is displayed, showing a record named "1 Gear in Position Absolute".
- The **Record type** is "Gear In/out (35)".
- The **Gear In Mode** is "Synchronous Position Absolute (1)".
- The **Gear Out Mode** is "Stop (0)".
- The **Offset** is "0.00 mm".
- A red box highlights the **Click Here** button next to the record.
- The **Watch window** on the right shows the active motion task "Homing (3)".

**Bottom Screenshot:**

- The **Record Table** is displayed, showing the same record "1 Gear in Position Absolute".
- The **Record type** is "Gear In/out (35)".
- The **Gear In Mode** is "Synchronous Position Absolute (1)".
- The **Gear Out Mode** is "Stop (0)".
- The **Offset** is "0.00 mm".
- A red box highlights the **Click Here** button next to the record.
- The **Watch window** on the right shows the active motion task "Gear In/out (35)".

## 8.17 Slave Synchronisation is now Complete

While Gear In/Synchronisation is active/complete, the Encoder Interface page of both Master and Slave axes, Encoder 1[X2] Actual Position of Motor Encoder & Encoder 2[X3] Actual Position Emulated by opposite controller should always show the same value (within a tolerance) for both Master and Slave axes as shown here.

The top screenshot shows the Encoder Interface for both Master and Slave axes. The Master axis (Encoder 1 X2) has an absolute position of 99.9994278 mm. The Slave axis (Encoder 2 X3) has an absolute position of 99.997878 mm. The Motion Manager status is Ready (10).

The bottom screenshot shows the Master/Slave Active Values page. The status is Slave synchronisation completed (3). The position diagram shows the gear in, sync, and gear out phases. The Master axis position is 99.998831 mm.

As described in section 8.14, now the axis is Geared in, testing should be done to determine system limits and configuration changes. This can be done using the features of Festo Automation Suite (FAS), or you can use PLC (Programmable Logic Controller) programming code to execute all Gear In functions along with the monitoring features of Festo Automation Suite (FAS).



## 9 PLC (Programmable Logic Controller)

The use of a higher order PLC (Programmable Logic Controller) to monitor and control the Master Slave Synchronisation/Gear In will have configuration bits/words that can activate/deactivate Software and hardware limits. These PLC tags need to be considered during the configuration of the system. The next sections 9.x Show an example of what to consider in a Rockwell software environment and similar tags can be found in other PLC types.

### 9.1 Rockwell AOI (Add-On Instruction) Software Library

If the end user plans to use an Allen Bradley as higher order PLC, section 1.1 (Recommended Website Downloads) describes a download of the Rockwell RSLogix 5000/LogixDesign AOI Software Library. This library would/should be used in this situation along with this application guide.

### 9.2 Rockwell AOI (Add-On Instruction) ConfigEPos

As discussed previously in this application guide, the Software Limits should be observed however, this depends on your application. Depending on the decisions of the user, make certain the settings previously made within the Festo Automation Suite (FAS) project MATCH the configuration bits shown here in the PLC code for each axis because the PLC will take priority and will override the Software or Hardware limits in the controllers.

**These are by default on. For BOTH Master and Slave AOI's in program, make certain to match the Festo Automation Suite Configuration**

**CONFIGURE EPOS FUNCTIONS**

STW1.1 Coast Stop FAS P1.1147010 Master\_FB.ConfigEPos.0

STW1.2 Quick Stop FAS P1.1147020 Master\_FB.ConfigEPos.1

POS\_STW2.14 Software Limits Enable FAS=P1.112414140 Master\_FB.ConfigEPos.2

POS\_STW2.15 Hardware Limits Enable FAS=P1.112414150 Master\_FB.ConfigEPos.3

POS\_STW2.11 Touch Probe Edge FAS=P1.112414110 Master\_FB.ConfigEPos.4

POS\_STW2.10 Select Touch Probe FAS=P1.112414100 Master\_FB.ConfigEPos.5

External Block Change (Via BUS) Master\_FB.ConfigEPos.6

STW1.13 Start Block Change FAS P1.1147131 Master\_FB.ConfigEPos.7

POS\_STW1.12 Continuous Position Setpoint Transfer Enable ConfigEPos.8 FAS P1.112411120 Master\_FB.ConfigEPos.8

STW1.12 Release Holding Brake ConfigEPos.15 FAS P1.1147120 Master\_FB.ConfigEPos.15

STW2.8 Travel to Fixed EndStop Enable ConfigEPos.30 FAS P1.1148080 Master\_FB.ConfigEPos.30

**PTP\_Drives\_Festo\_EP AOI**

ModePos Meaning:

- 1 = Direct mode, Relative position control
- 2 = Direct mode, Absolute position control
- 3 = Setup Mode (Velocity)
- 4 = Reference point approach (Execute FAS Configured Routine)
- 5 = Set Reference Point (Set Current Position to Zero with FAS zero point offset)
- 6 = Traversing block (Record selection)
- 7 = Jog Mode
- 8 = Incremental Jogging / Inching (Relative Positions FAS=P1.214530.0.0 and P1.214538.0.0)

**PTP\_Drives\_Festo\_EP**

PTP\_Drives\_Festo\_EP Master\_FB

IO\_L\_e\_r\_a\_c\_e 0+ <AxisEnabled>

DRV\_Status CMMTAS\_EP\_Master:11.Data 0+ <AxisPosOk>

DRV\_Control CMMTAS\_EP\_Master:01.Data 0+ <AxisSpFixed>

C\_o\_n\_t\_r\_o\_l\_A\_r\_e\_a 0+ <AxisAckSetpoint>

ModePos 2+ <AxisRe>

EnableAxis 1+ <AxisWarn>

CancelTraversing 1+ <AxisError>

IntermediateStop 1+ <Lockout>

Positive 0+ <Error>

Negative 0+

Jog1 0+

Jog2 0+

AckError 0+

ReleaseBrake 0+

TravelToFixedStop 0+

ExecuteMode 0+

Position 170000+ <Position>

Velocity 120+ <Velocity>

OverV 100+ <OverV>

OverAcc 100+ <OverAcc>

Speed 100+ <Speed>

**ConfigEPos** 3+ <ConfigEPos>

BasePosition 3105.0+ <BasePosition>

ConnectionFaulted PLC.EthIP\_Device\_Faulted[18] 0+ <ConnectionFaulted>

M\_o\_n\_i\_t\_o\_r\_A\_r\_e\_a 0+ <MonitorArea>

ActVelocity 118.62232+ <ActVelocity>

ActPosition 135121+ <ActPosition>

ActMode 2+ <ActMode>

EposZSW1 -32768+ <EposZSW1>

EposZSW2 -32752+ <EposZSW2>

ActWarn 0+ <ActWarn>

ActFault 0+ <ActFault>

Status 16#7002+ <Status>

## 10 Error Recovery

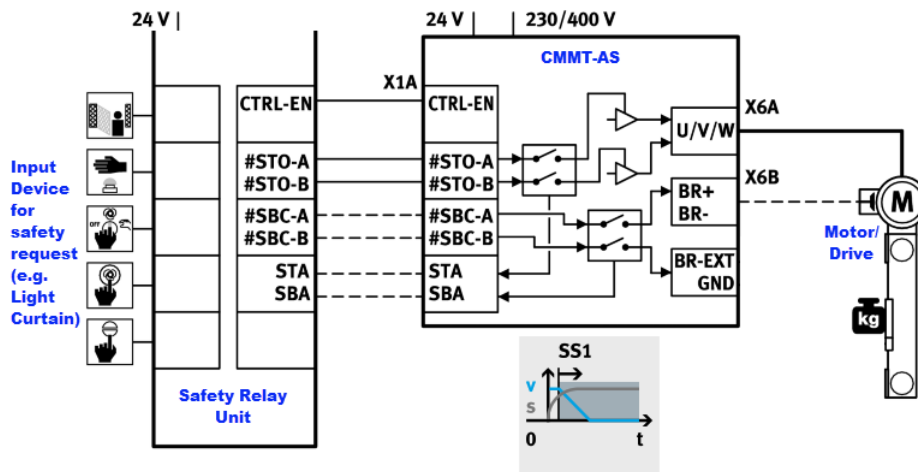
[Gear In Synchronous Position Absolute mode](#) will be considered the [normal working state](#) of this application.

Error Recovery is the term used in this guide to describe situations this application can encounter and methods to recover to a [normal working state](#) afterward.

With the application of Gear In Synchronous Position Absolute mode, there can be many error recovery situations and a some common situations are detailed in this guide.

## 10.1 E-Stop or Control Enable

Shown here is sub-function SS1 safety wiring (This is an example only and not an actual certified design).



The **normal working state** of **Gear In Synchronous Position Absolute mode** can be compromised by some of the following causes:

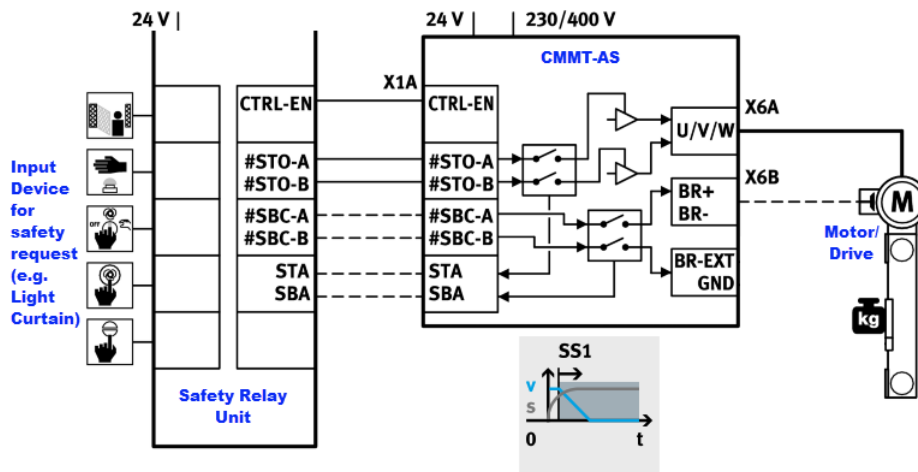
- CMMT-AS Slave axis STO-A or STO-B disconnected
- CMMT-AS Slave axis SBC-A or SBC-B disconnected
- CMMT-AS Slave axis CTRL-EN disconnected from 24Vdc source

The error recovery and re-synchronisation/Gear In (electronic alignment) for these causes are accomplished as follows:

1. The **normal working state** of **Gear In Synchronous Position Absolute mode** is active
2. Synchronisation/Gear In is lost due to one of the causes described in this section
3. Synchronisation/Gear In is now required
4. All safeties and any other cause for the loss of synchronisation are restored
5. Slave axis reset faults
6. Slave axis enable
7. Slave axis execute Record#1 "Gear In with Synchronous Position Absolute"
8. Master axis reset faults
9. Master axis enable. NOTE: the Slave Axis Synchronisation must be active prior to enable
10. Synchronisation/Gear In Sequence now Complete

## 10.2 Supply Power

Shown here is sub-function SS1 safety wiring (This is an example only and not an actual certified design).



The **normal working state** of **Gear In Synchronous Position Absolute mode** can be compromised by some of the following causes:

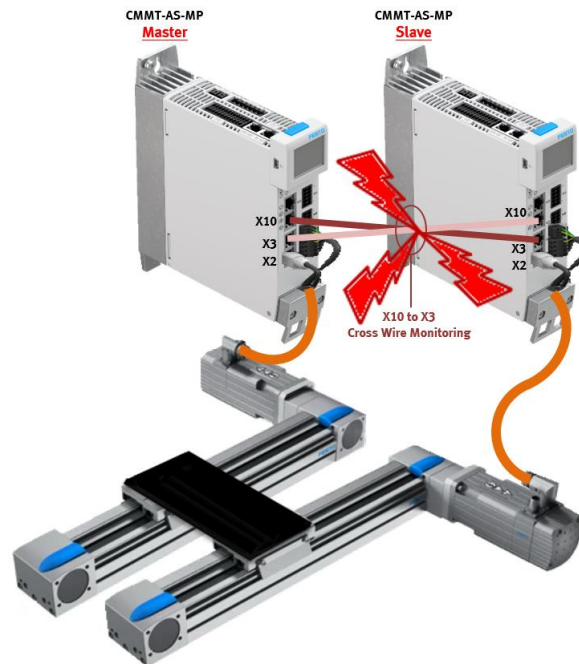
- CMMT-AS Master or Slave axis 24Vdc disconnected
- CMMT-AS Master or Slave axis 230/400Vac disconnected
- CMMT-AS Master or Slave axis other unforeseen circumstances

The error recovery and re-synchronisation/Gear In (electronic alignment) for these causes are accomplished as follows:

1. The **normal working state** of **Gear In Synchronous Position Absolute mode** is active
2. Synchronisation/Gear In is lost due to one of the causes described in this section
3. Synchronisation/Gear In is now required
4. All supply voltages previously removed are restored
5. All safeties are restored
6. It has been determined that "Set Master Position Gear In" is required by a compare of the following:
  - Master axis Encoder 1[X2] vs Master axis Encoder2 [X3] is within Tolerance
  - Slave axis Encoder 1[X2] vs Slave axis Encoder2 [X3] is within Tolerance
  - Master axis Encoder 1 [X2] vs Slave Axis Encoder2 [X3] is Within Tolerance
7. Slave axis reset faults
8. Slave axis set Gear In Master Position Value = Master axis actual position (to perform this function, use the METHOD [e.g. PNU 10002] as described in user manual)
9. Slave axis enable
10. Slave axis execute Record#1 "Gear In with Synchronous Position Absolute"
11. Master axis reset faults
12. Master axis set Gear In Master Position Value = Master axis actual position (to perform this function, use the METHOD [e.g. PNU 10002] as described in user manual)
13. Master axis enable. NOTE: the Slave Axis Synchronisation must be active prior to enable
14. Synchronisation/Gear In Sequence now Complete

### 10.3 Encoder Emulation Cable X10 to X3 Failure

Encoder signal loss between X10 to X3 (sections 5.5.1 and 5.6.1 and 7.5.2 and 7.6.1 and 8.4) is implemented in this application. Shown here is an example of a cable failure.



The [normal working state](#) of [Gear In Synchronous Position Absolute mode](#) can be compromised by the following cause:

- CMMT-AS Master axis D1.07l02l00133.0 Position Difference Encoder 1 to Encoder 2 too Large

The error recovery and re-synchronisation/Gear In (electronic alignment) for these causes are accomplished as follows:

1. The [normal working state](#) of [Gear In Synchronous Position Absolute mode](#) is active
2. Master axis detects a error Position Difference between Encoder 1 vs Encoder 2
3. Synchronisation/Gear In is lost due the Stop Category 2 reaction (category reaction details in section 5.6.1)
4. Synchronisation/Gear In is now required
5. All safeties are restored (This step and remaining steps are identical to Supply Power section 10.2 Step 5)
6. It has been determined that "Set Master Position Gear In" is required by a compare of the following:
  - Master axis Encoder 1[X2] vs Master axis Encoder2 [X3] is within Tolerance
  - Slave axis Encoder 1[X2] vs Slave axis Encoder2 [X3] is within Tolerance
  - Master axis Encoder 1 [X2] vs Slave Axis Encoder2 [X3] is Within Tolerance
7. Slave axis reset faults
8. Slave axis set Gear In Master Position Value = Master axis actual position (to perform this function, use the METHOD [e.g. PNU 10002] as described in user manual)
9. Slave axis enable
10. Slave axis execute Record#1 "Gear In with Synchronous Position Absolute"
11. Master axis reset faults
12. Master axis set Gear In Master Position Value = Master axis actual position (to perform this function, use the METHOD [e.g. PNU 10002] as described in user manual)
13. Master axis enable. NOTE: the Slave Axis Synchronisation must be active prior to enable
14. Synchronisation/Gear In Sequence now Complete

### 10.3.1 Slave Encoder 2[X3] Cable Failure Errors

Slave Encoder 2[X3] cable provides the Actual Position Emulated by Master.

Typical errors observed when the Slave Encoder 2[X3] cable fails are as follows:

- Error 00133 Position difference encoder 1 to encoder 2 too large
- Error 00235 Incremental encoder analysis invalid

The first screenshot shows the 'CMMTAS\_MP\_Master' window. The 'Device State' section displays a 'Servo drive' icon and an 'Axis' icon. A red box highlights the error message: 'Position difference encoder 1 to encoder 2 too large D1.07|02|00133.0'. Below this, a table lists the error details.

Status	Category	ID	Name	Timestamp
Information (4)	Information (4)	D1.07 02 00121.0	Target position reached	34.02:45:14.684
Information (4)	Information (4)	D1.07 02 00125.0	Standstill reached and in standstill window	34.02:45:14.709
Information (4)	Information (4)	D1.07 02 00124.0	Standstill reached	34.02:45:14.709
Stop category 2 (64)	Stop category 2 (64)	D1.07 02 00133.0	Position difference encoder 1 to encoder 2 too large	34.02:45:27.723
Information (4)	Information (4)	D1.07 02 00122.0	Target velocity reached	34.02:45:27.840

The second screenshot shows the 'CMMTAS\_MP\_Slave' window. The 'Device State' section displays a 'Servo drive' icon and an 'Axis' icon. A red box highlights the error message: 'Incremental encoder analysis invalid D0.18|03|00235.1'. Below this, a table lists the error details.

Status	Category	ID	Name	Timestamp
Information (4)	Information (4)	D1.07 02 00125.0	Standstill reached and in standstill window	09.22:07:58.786
Information (4)	Information (4)	D1.07 02 00124.0	Standstill reached	09.22:07:58.786
Stop category 0 (4096)	Stop category 0 (4096)	D0.18 03 00235.1	Incremental encoder analysis invalid	09.22:08:07.013

### 10.3.2 Master Encoder 2[X3] Cable Failure Errors

Master Encoder 2[X3] cable provides the Actual Position Emulated by Slave.

Typical errors observed when the Master Encoder 2[X3] cable fails are as follows:

- Error 00133 Position difference encoder 1 to encoder 2 too large
- Error 00235 Incremental encoder analysis invalid

The screenshot displays the FESTO CMMTAS software interface, showing the status of the Master Encoder 2[X3] cable failure. The top window, titled 'CMMTAS\_MP\_Master', shows two error messages: 'Incremental encoder analysis invalid' (D0.18|03|00235.1) and 'Position difference encoder 1 to encoder 2 too large' (D1.07|02|00133.0). The bottom window, titled 'CMMTAS\_MP\_Slave', shows a message 'Standstill reached and in standstill window' (D1.07|02|00125.0).

Status	Category	ID	Name	Timestamp
Information (4)	Information (4)	D1.07 02 00125.0	Standstill reached and in standstill window	34.02:49:12.389
Information (4)	Information (4)	D1.07 02 00124.0	Standstill reached	34.02:49:12.389
Information (4)	Information (4)	D1.07 02 00121.0	Target position reached	34.03:00:00.652
Stop category 2 (64)	Stop category 2 (64)	D1.07 02 00133.0	Position difference encoder 1 to encoder 2 too large	34.03:00:11.675
Information (4)	Information (4)	D1.07 02 00122.0	Target velocity reached	34.03:00:11.792
Stop category 0 (4096)	Stop category 0 (4096)	D0.18 03 00235.1	Incremental encoder analysis invalid	34.03:00:12.620