HIWIN MIKROSYSTEM

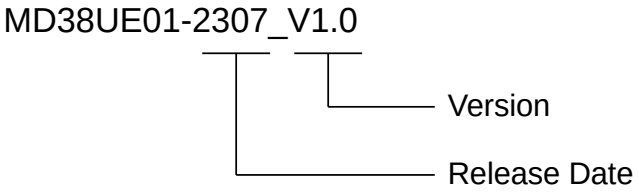
Application Note

E Series EtherCAT Drive Complete Setup with Beckhoff TwinCAT 3

www.hiwinmikro.tw
MD38UE01-2307_V1.0

Revision History

The version of the manual is also indicated on the bottom of the front cover.



Release Date	Version	Applicable Product	Revision Contents
Jul. 15th, 2023	1.0	E series EtherCAT drive	First edition.

Related Documents

Through related documents, users can quickly understand the positioning of this manual and the correlation between manuals and products. Go to HIWIN MIKROSYSTEM's official website → Download → Manual Overview for details (https://www.hiwinmikro.tw/Downloads/ManualOverview_EN.htm).

Preface

This manual provides detailed information on the operation of software TwinCAT 3 when E series EtherCAT drive is used with Beckhoff EtherCAT motion control products. For detailed information on E series servo drive, please refer to the related user manuals.

Specifications of Software/Hardware

Name	Version of Software/Firmware
E1 Series EtherCAT Drive	Software (Thunder): 1.9.16.0 or above Firmware: 2.8.16 or above ESI file: HIWIN_MIKROSYSTEM_ED1F_20230607 or above
E2 Series EtherCAT Drive	Software (Thunder): 1.9.17.0 or above Firmware: 3.9.16 or above ESI file: HIWIN_MIKROSYSTEM_ED2F_20230614 or above
Beckhoff Motion Controller	Software (TwinCAT 3): Build 4024.22 or above (The version must be the same as the firmware's) Firmware: Build 4024.22 or above

Table of Contents

1. Communication and module setup

1.1 Introduction of human machine interface

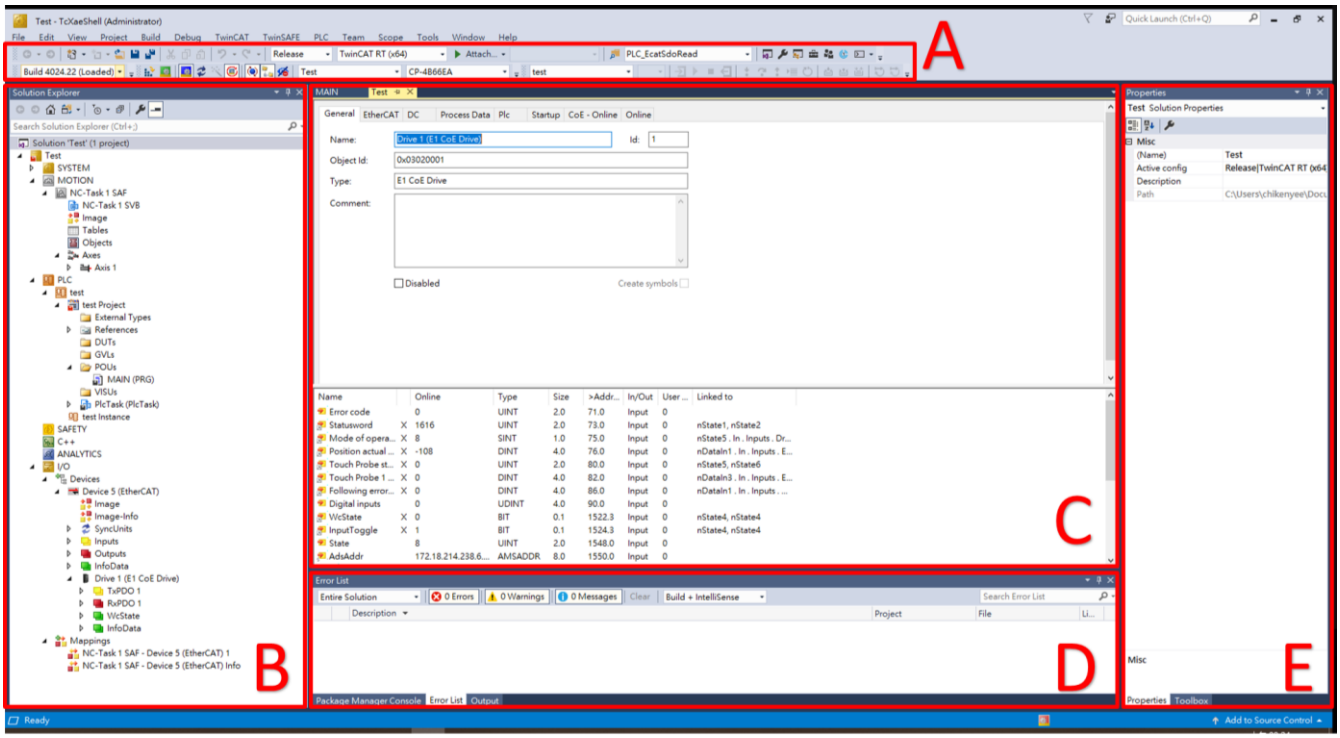


Figure 1.1.1

- **Section A (Toolbar)**

  List of common features, right-click to customize the display of contents.

- **Section B (Solution Explorer)**

  Click object to enter the Editor Window and see the properties.

  Classified as follows:

Table 1.1.1

No	Name	Description
1	SYSTEM	System Manager planning
2	MOTION	SoftMotion NC planning
3	PLC	PLC program
4	SAFETY	Safety PLC program
5	C++	C++ program
6	ANALYTICS	Data analysis planning
7	I/O	I/O communication planning

- **Section C (Editor Window)**
  Display the corresponding Editor Window based on the selected project object.

- **Section D (Message Window)**
  Display various messages, which are divided into Error List, Package Manager Console, and Output.

- **Section E (Properties Window)**
  Display the corresponding Properties Window based on the selected project object.

1.2 Connect to controller

1. Click the drop-down menu of **Target System** on TwinCAT toolbar. If a controller has been assigned before, TwinCAT would record the controller and display it here; if users want to assign a new controller, click "Choose Target System ...".

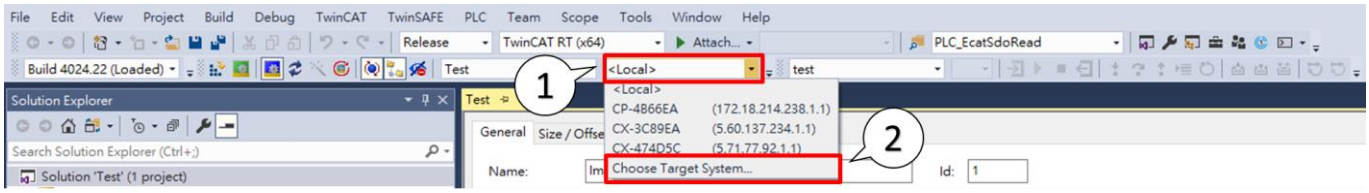


Figure 1.2.1

2. Click "Search Ethernet..." in the **Choose Target System** window.

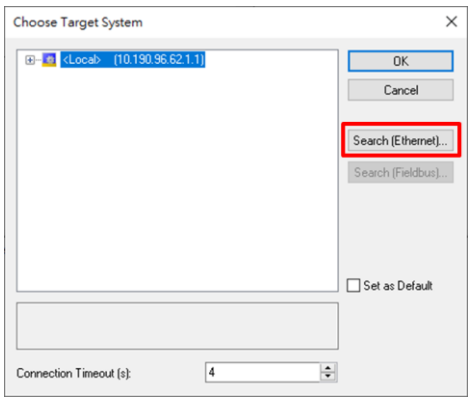


Figure 1.2.2

3. Enter the **Add Route Dialog** window. Click the **Broadcast Search** button and tick the network interface card connected to the controller. Click OK.

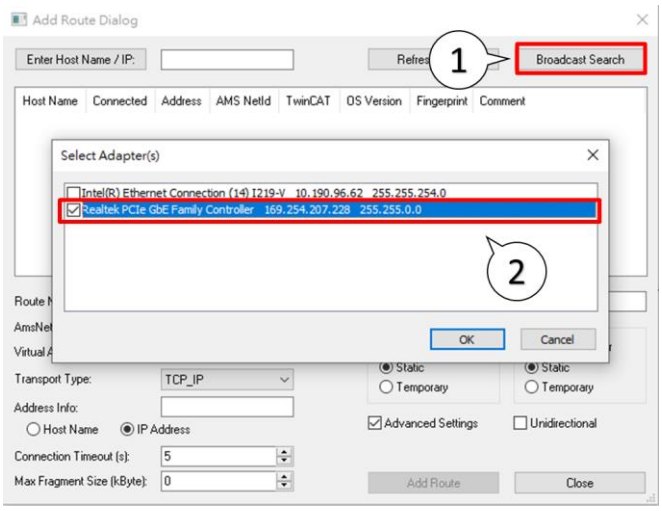


Figure 1.2.3

4. After executing **Broadcast**, click the found device and **Add Route** to open **Add Remote Route** window. Enter User and Password in the **Remote User Credentials** window. After clicking OK, users can see a mark in the **Connected** window of the device, which means the connection has been established.

   Note: The default User of Beckhoff is **Administrator**, and the Password is **1**.

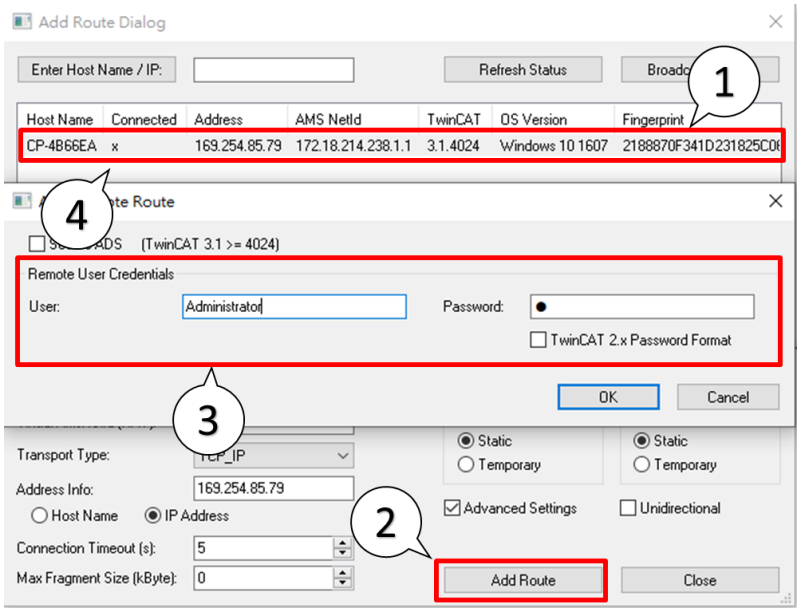


Figure 1.2.4

5. Close the **Add Route Dialog** window and return to the **Choose Target System** window. Select the connected device and click OK to complete the controller connection setting.

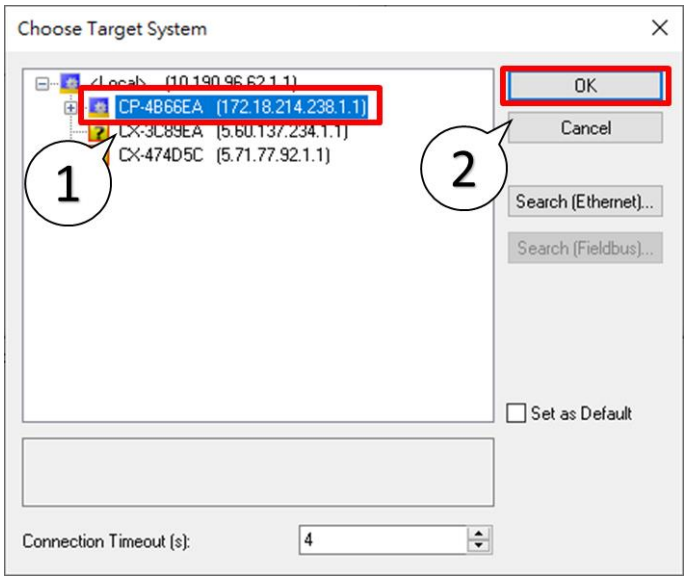


Figure 1.2.5

1.3 Prepare ESI files

1. Open Thunder installation location (default as **C:\ Thunder**) and open **Release Note** in **Thunder\ doc\ ESI Files**.
2. Confirm the firmware version of the drive and copy the corresponding **ESI file (.xml)** according to the **Release Note**.
3. Store the copied **ESI** file in TwinCAT installation directory.
   (The default file path is **C:\ TwinCAT\ 3.1\ Config\ Io\ EtherCAT**)
4. Reload device descriptions in TwinCAT.

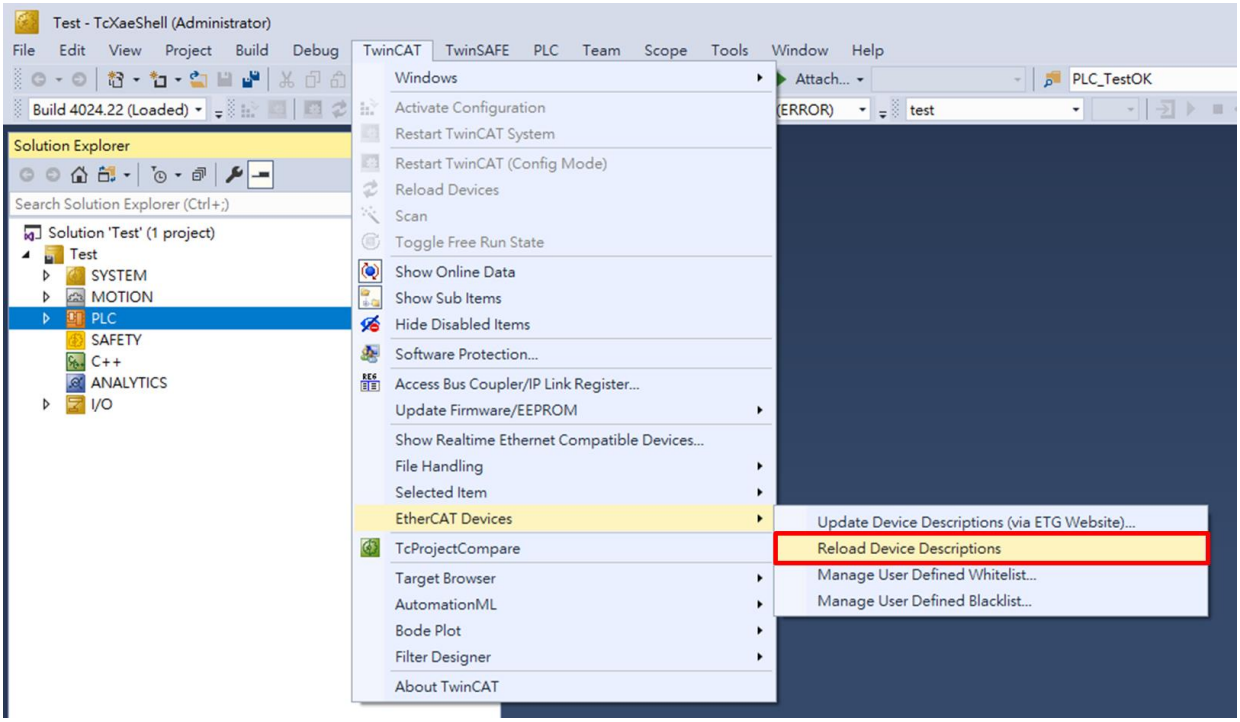


Figure 1.3.1

Note	➢ Please confirm that there is only one ESI file in TwinCAT installation directory. If users need to use other versions of the ESI file, please delete the original ESI file.

1.4 Search for the devices

1. Switch the controller to **Config Mode**.

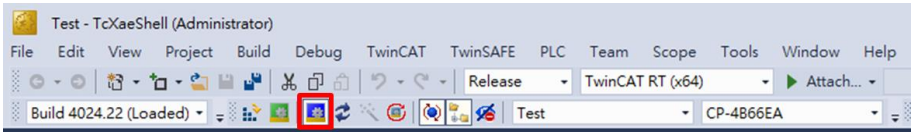


Figure 1.4.1

2. In the **Solution Explorer**, right-click **Devices** and then click **Scan** to scan.

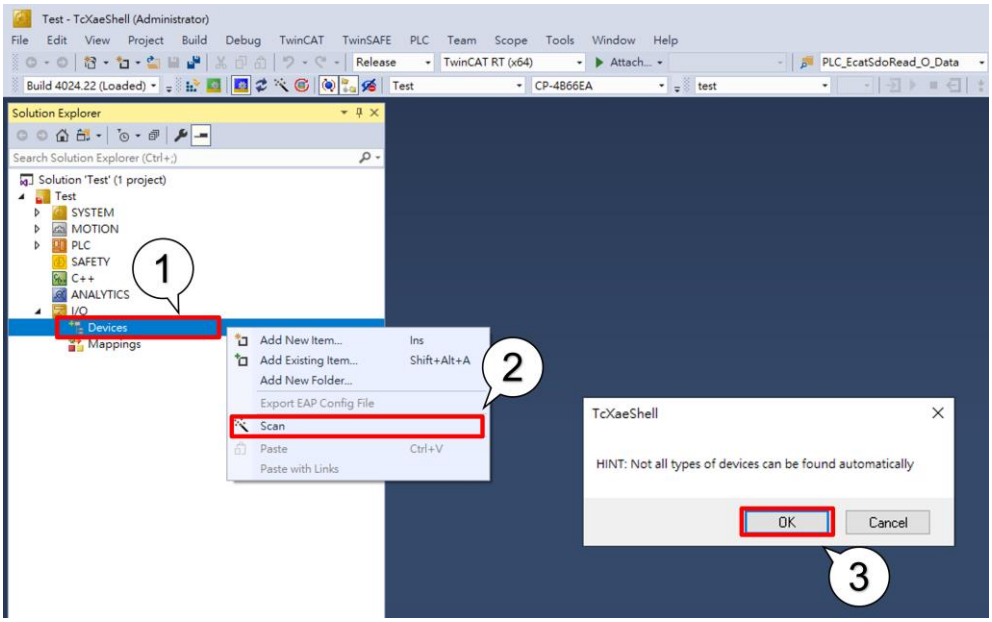


Figure 1.4.2

3. After a few seconds, the scanned devices will be displayed. Tick the devices to be added (only **[EtherCAT]** would be displayed) and click OK. A window will pop up asking if users want to **Scan for boxes**. Click "OK."

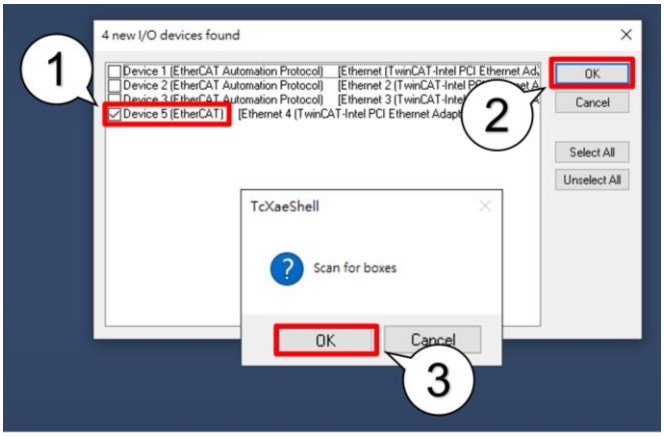


Figure 1.4.3

4. After scanning to the device, select "NC – Configuration" to link to **Axis**.

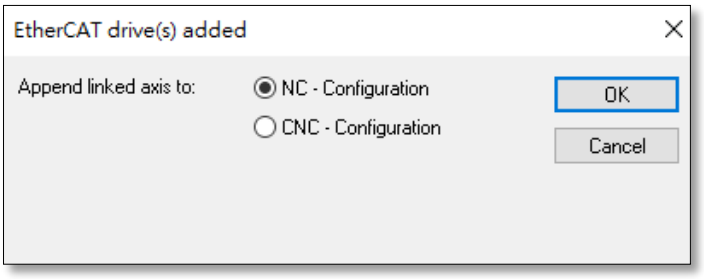


Figure 1.4.4

5. Click “OK” to **Activate Free Run**.

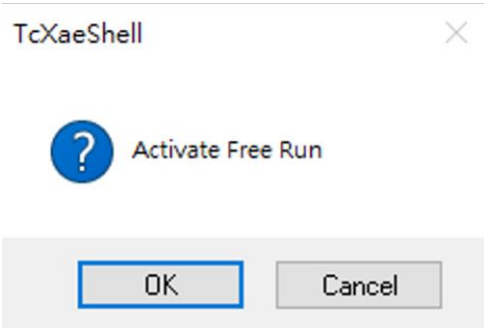


Figure 1.4.5

2. Axis parameters setup

2.1 Set unit

Select the axis whose parameter is to be modified (Motion → NC-Task 1 SAF → Axes → Axis 1). Switch the upper tab to **Settings** and select the unit (mm, m, °, Degree, s) for the device.

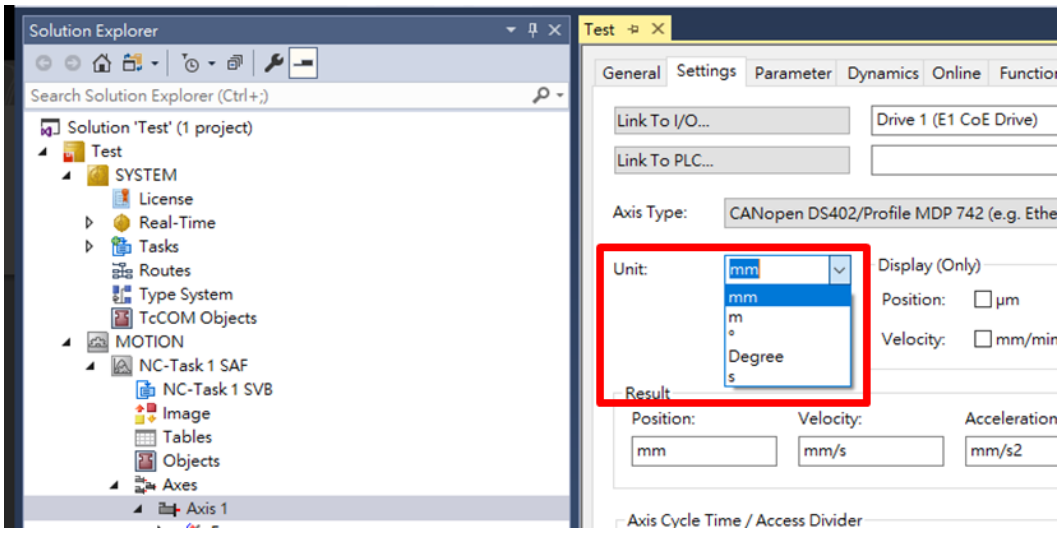


Figure 2.1.1

2.2 Set encoder parameter

1. Select the encoder whose parameter is to be modified (Motion → NC-Task 1 SAF → Axes → Axis 1 →Enc). Switch the upper tab to **Parameter** and expand **Encoder Evaluation**.

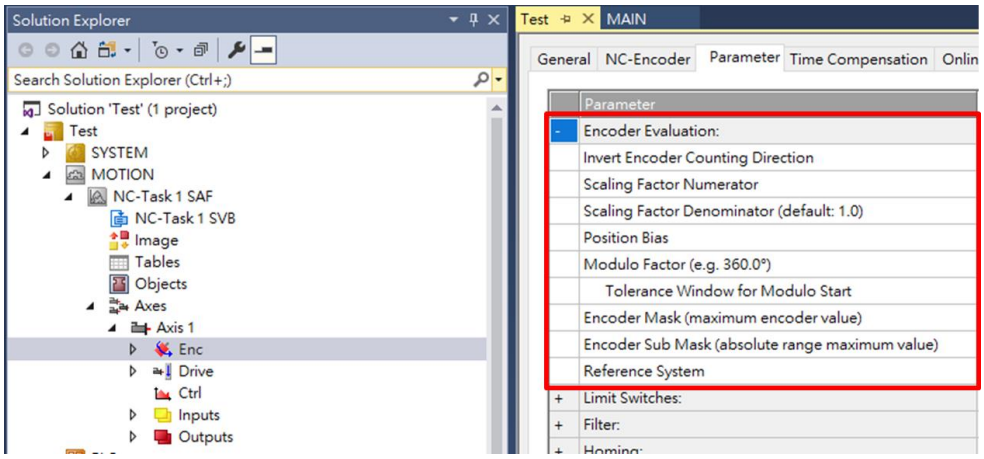


Figure 2.2.1

2. Set **Scaling Factor** according to the unit on the right. The controller uses **Scaling Factor** to calculate the relationship between the physical motion and **Increment**. While setting, users need to refer to the actual motor's encoder resolution, electronic gear ratio, pitch, etc. It is recommended that users refer to section 4.3.6.3 in "E Series Servo Drive Thunder Software Operation Manual" for electronic gear ratio and set **Scaling Factor** based on the displayed control units.

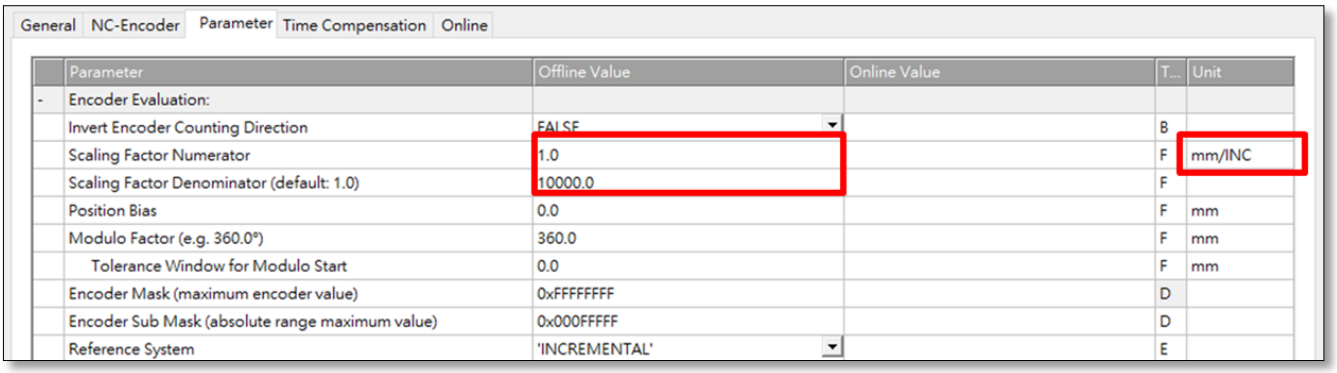


Figure 2.2.2

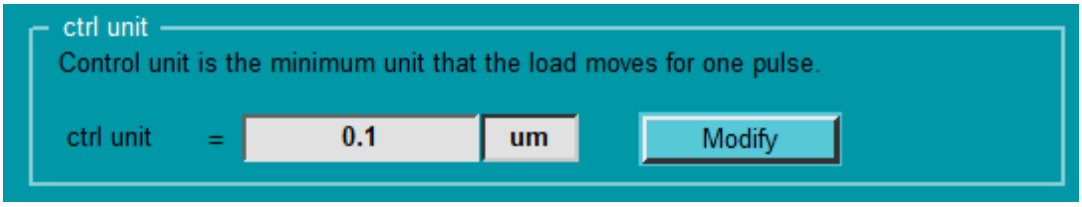


Figure 2.2.3

2.3 Set Touch Probe homing parameter

1. Select the encoder whose parameter is to be modified (Motion → NC-Task 1 SAF → Axes → Axis 1 →Enc). Expand **Homing** and select **Reference Mode** to determine home position latch method. The current supported **Reference Mode** is shown in table 2.3.1.

Table 2.3.1

Reference Mode	Description
Homing Sensor Only	Use homing sensor as a basis for homing.
Hardware Sync	Use Z-phase signal as a basis for homing.
Hardware Latch 1 (pos. edge)	Use the rising edge of external signal as a basis for homing.
Hardware Latch 1 (neg. edge)	Use the falling edge of external signal as a basis for homing.

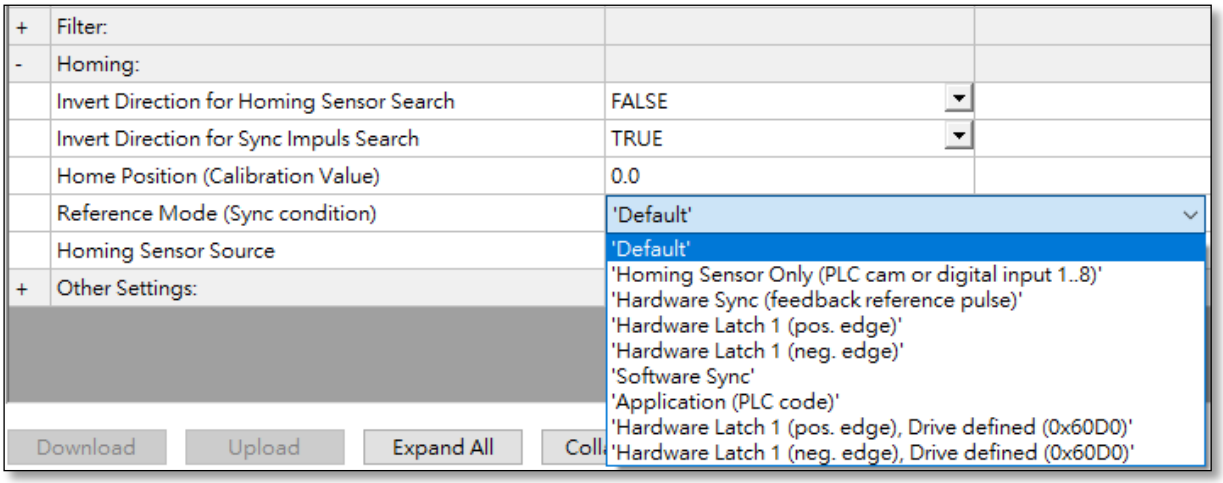


Figure 2.3.1

2. Select **Homing Sensor Source**.

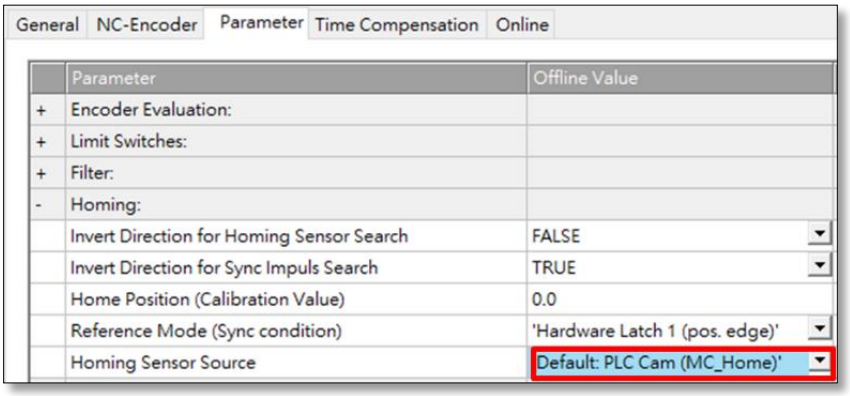


Figure 2.3.2

3. Set the motor rotation direction for searching for home position based on the user scenarios.

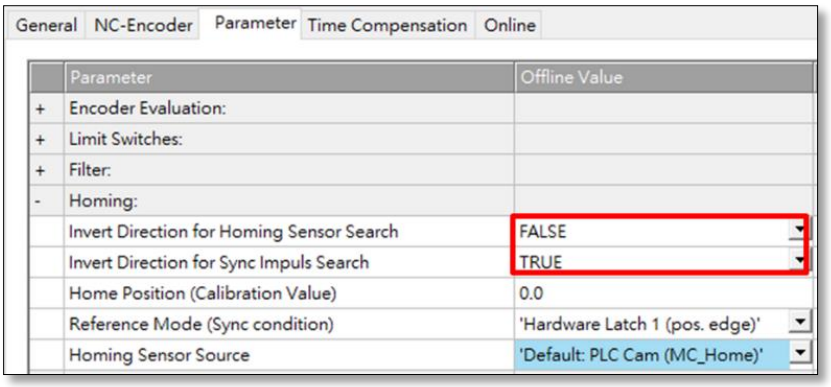


Figure 2.3.3

4. Select the axis whose parameter is to be modified (Motion → NC-Task 1 SAF → Axes → Axis 1) and switch the upper tab to **Parameter**. Expand **Manual Motion and Homing** and modify **Homing Velocity** according to the requirements.

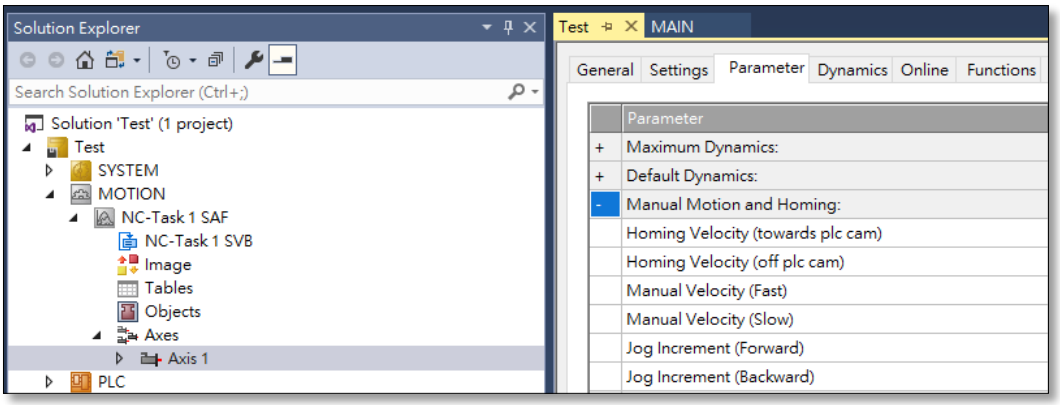


Figure 2.3.4

2.4 Set motion parameter

This section describes the relevant parameter setting for test run, please be aware of the unit while setting.

1. Select the axis whose parameter is to be modified (Motion → NC-Task 1 SAF → Axes → Axis 1) and switch the upper tab to **Parameter**. Expand **Maximum Dynamics** and set the reference velocity (rated velocity) and maximum velocity according to the motor specification; expand **Default Dynamics** and set acceleration/deceleration, maximum acceleration/deceleration, etc. according to the requirements.

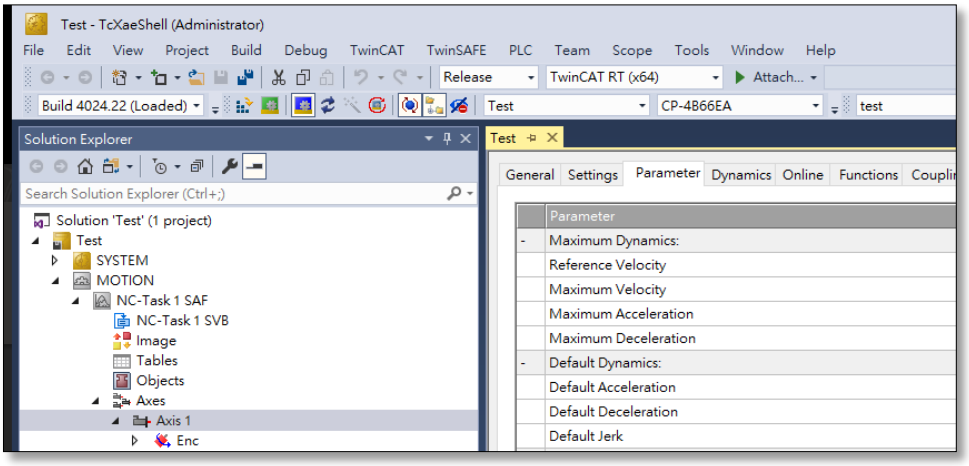


Figure 2.4.1

2. Expand **Manual Motion and Homing**, modify **Manual Velocity** and **Jog Increment** according to the requirements.

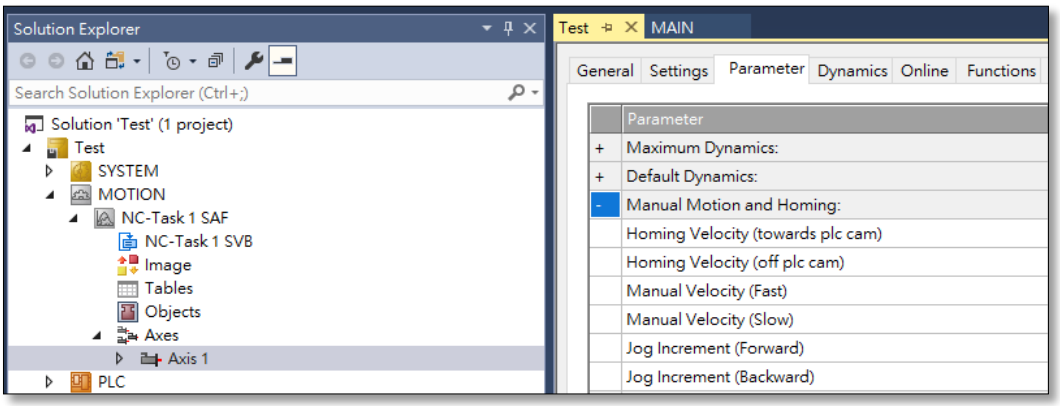


Figure 2.4.2

2.5 Set monitor parameter

Set monitor parameter in the **Monitoring**, while setting, please set an appropriate range based on the user scenarios. If it is too small, the controller would easily trigger an alarm; if it is too large, the controller would have no effect in exception handling.

-	Monitoring:				
	Position Lag Monitoring	TRUE	TRUE	B	
	Maximum Position Lag Value	5.0	5.0	F	mm
	Maximum Position Lag Filter Time	0.02	0.02	F	s
	Position Range Monitoring	TRUE	TRUE	B	
	Position Range Window	5.0	5.0	F	mm
	Target Position Monitoring	TRUE	TRUE	B	
	Target Position Window	2.0	2.0	F	mm
	Target Position Monitoring Time	0.02	0.02	F	s
	In-Target Alarm	FALSE	FALSE	B	
	In-Target Timeout	5.0	5.0	F	s
	Motion Monitoring	FALSE	FALSE	B	
	Motion Monitoring Window	0.1	0.1	F	mm
	Motion Monitoring Time	0.5	0.5	F	s

Figure 2.5.1

2.6 Update controller setting

1. Click **Activate Configuration** to update the settings to the controller.

Figure 2.6.1

2. Click “OK” to **restart TwinCAT System in Run Mode**.

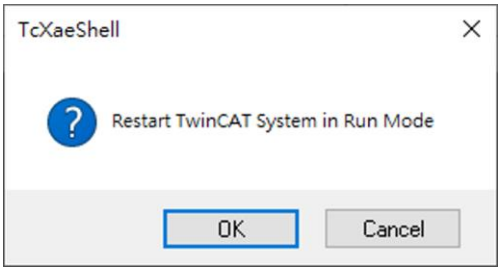


Figure 2.6.2

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3. Test run

3.1 NC: Online

NC: Online interface in TwinCAT provides simple forward/backward motion and point-to-point motion. The feedback status can be observed in this interface.

1. Switch the controller to **Run Mode**.

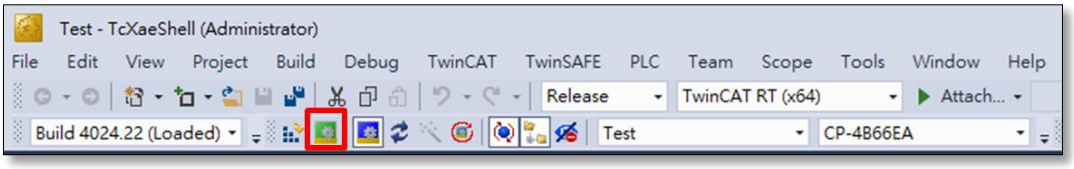

Figure 3.1.1

2. After selecting the device to perform test run (Devices → Device → Drive 1), switch the upper tab to **NC: Online**.

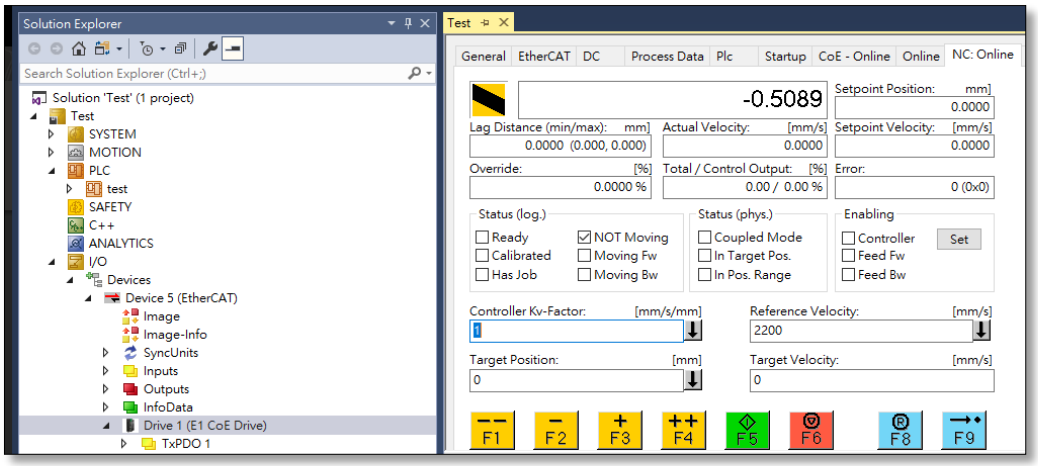

Figure 3.1.2

3. Click **Set** in **Enabling**. Tick **Controller**, **Feed Fw**, **Feed Bw** and click OK, and the motor will be enabled.

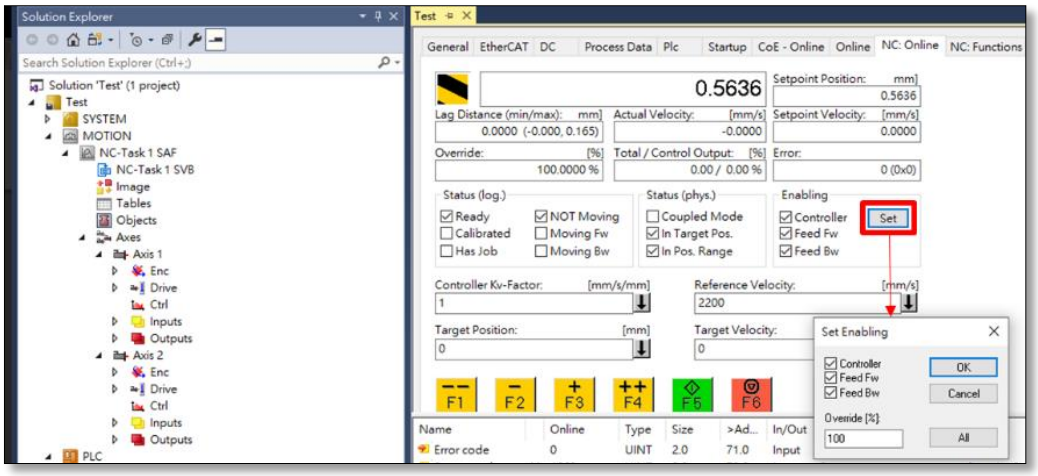

Figure 3.1.3

4. Use the buttons to perform test run. For functions of the buttons, refer to the table below.

Table 3.1.1

Button	Description
F1	Fast backward motion, move with **Manual Velocity (Fast)** set in section 2.4.
F2	Slow backward motion, move with **Manual Velocity (Slow)** set in section 2.4.
F3	Slow forward motion, move with **Manual Velocity (Slow)** set in section 2.4.
F4	Fast forward motion, move with **Manual Velocity (Fast)** set in section 2.4.
F5	Perform point motion according to **Target Position** and **Target Velocity** set on **NC: Online** page.
F6	Stop the motion.
F8	Reset.

3.2 NC: Function

NC: Function interface in TwinCAT provides various motion functions such as jog, point-to-point motion, etc.

1. Continue step 3 in section 3.1.

2. Switch the upper tab to **NC: Functions**.

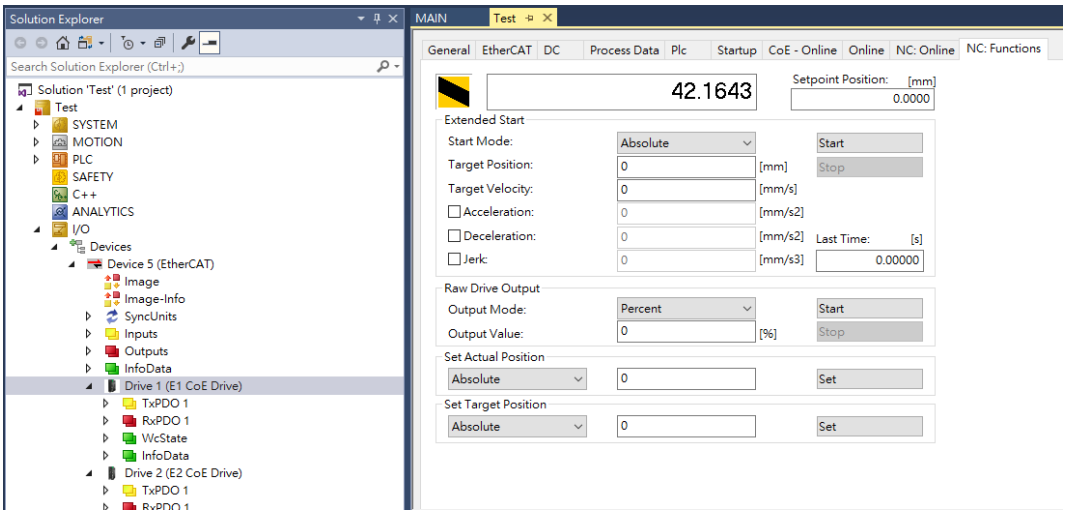

Figure 3.2.1

3. Select the motion function, enter the motion parameters and click **Start** to start the test run.

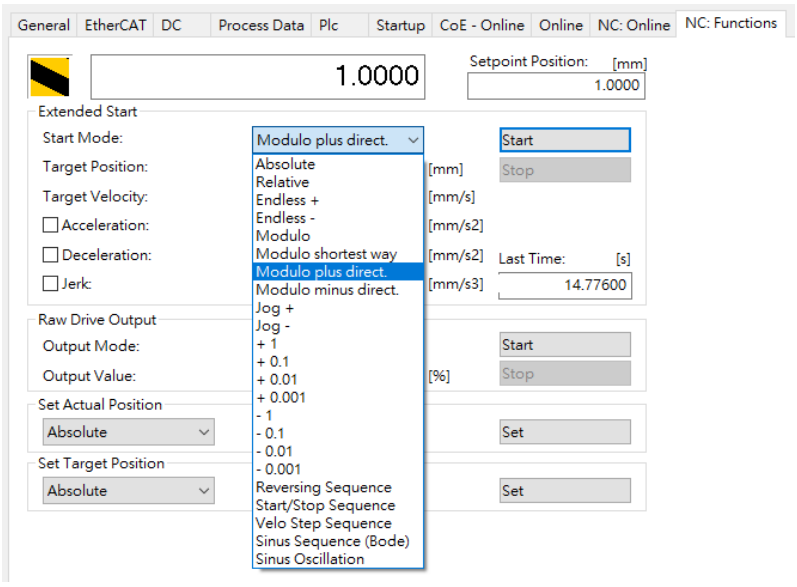

Figure 3.2.2

Common features are described as follows:

Table 3.2.1

Name	Description
Absolute	Absolute motion, moves to an absolute position at the speed set on **NC: Functions** page.
Relative	Relative motion, moves to a relative position at the speed set on **NC: Functions** page.
Endless +/-	Endless rotation in forward/backward direction, moves at the speed set on **NC: Function** page.
Jog +/-	Jog in forward/backward direction, its moving speed is set on **NC: Function** page and its moving distance is set to **Jog increment** in section 2.4.
Reversing Sequence	Point to point motion, moves back and forth between two absolute positions at the speed set on **NC: Functions** page.

3.3 Coupling

When using multiple axes, the **Coupling** function can make the motion planning of one axis follow the other axis.

1. Switch the controller to **Run Mode**.

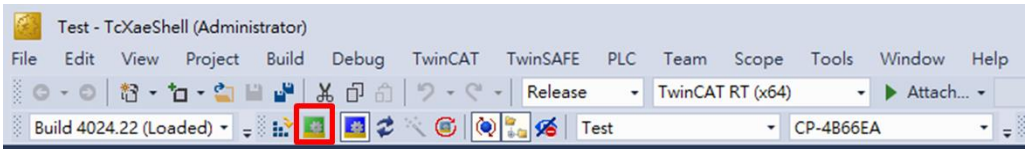

Figure 3.3.1

2. Click the axis parameter (Motion → NC-Task 1 SAF → Axes → Axis 2) and switch the upper tab to **Coupling**.

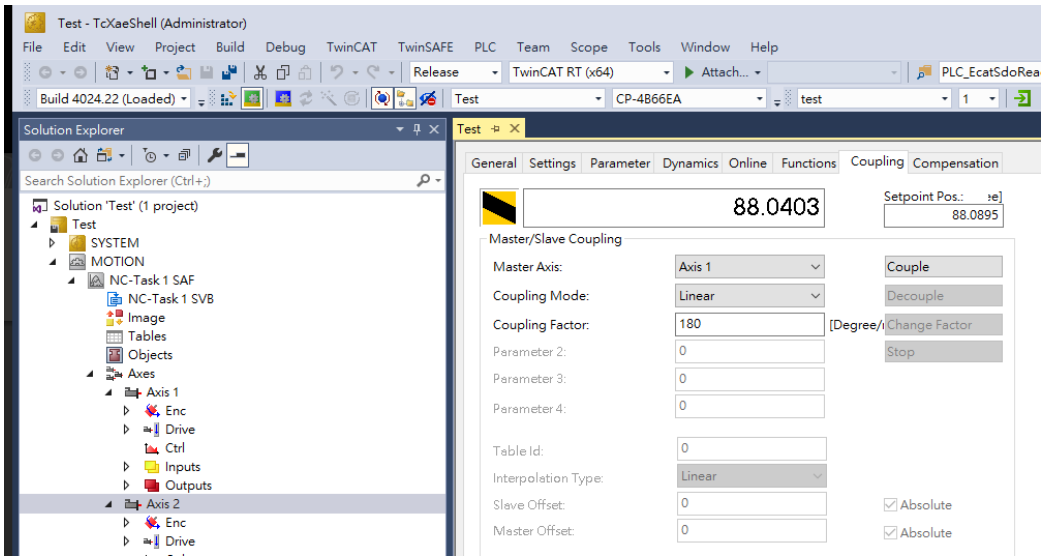

Figure 3.3.2

3. Set the axis to be coupled in **Master Axis.** Select **Coupling mode** and set the relevant parameters. Click **Couple** to complete axis coupling.
4. Enable all axes (refer to step 3 in section 3.1).
5. When Axis 1 is used for **NC: Online**/**NC: Function**, **Axis 2** will move together in coupling mode.

4. Touch Probe homing

This chapter introduces the setting of **MC_Home** homing with **Touch Probe** and limit switches. When using this method for homing, **PLC** programming is required. Please refer to the related documents of TwinCAT for **PLC** programming and **MC_Home** settings and methods.

1. Add object 60FD (Digital Input) to **TxPDO** and link the object to the **PLC** variable.
2. According to section 2.3, set the homing parameters of **Touch Probe**.
3. According to the motor direction of **Homing Sensor** search, please configure the 60FD **PLC** variables **Bit0** or **Bit1** to **bCalibrationCam** in **MC_Home**. If the motor direction is positive, please configure **Bit 1 (P_OT signal)**; if the motor direction is negative, please configure **Bit 0 (N_OT signal)**.

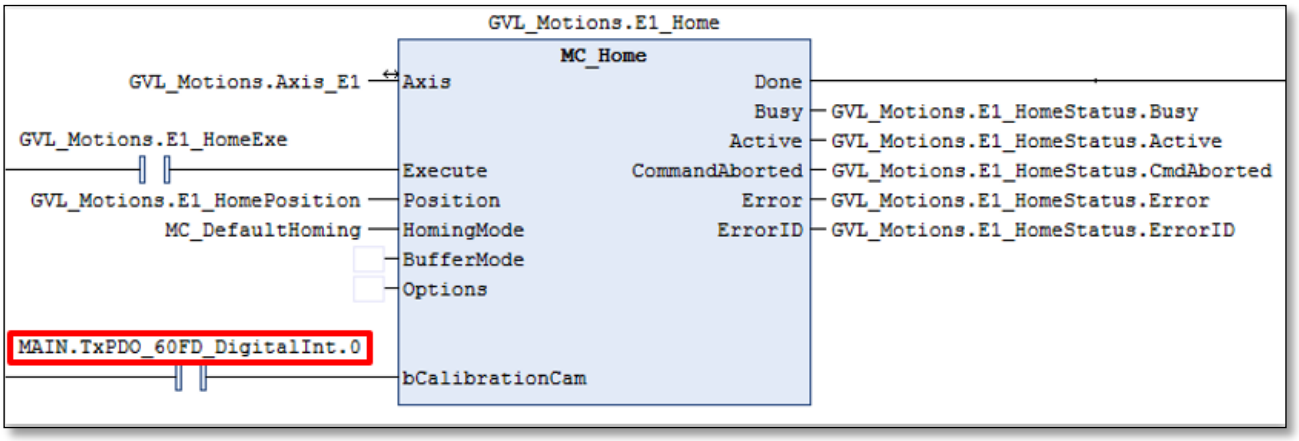

Figure 4.1

4. Execute **MC_Home** and the motor will search for **Homing Sensor** at **Homing Velocity (towards plc cam)**. After touching limit switch, motor will search for the home position at **Homing Velocity (off plc cam)** and latch it according to the **Reference mode**.

Note

- If the velocity for **Homing Sensor** search is too fast, the motor might be disabled after touching limit switch, which is a normal phenomenon. Please reduce the **Homing Velocity (towards plc cam)** and try again.
- In firmware version 2.8.8~2.8.10, there might be a failure when using **Touch Probe** homing with limit switch. Please configure **bCalibrationCam** with other signals or using internal homing for homing.