HIWIN MIKROSYSTEM

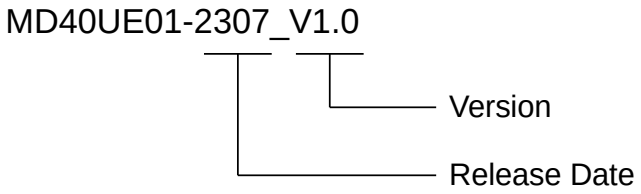
Application Note

E Series EtherCAT Drive Complete Setup with KEYENCE KV STUDIO

www.hiwinmikro.tw
MD40UE01-2307_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. 25th, 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 PLC software KV STUDIO when E series EtherCAT drive is used with KEYENCE KV-7000 series PLC.

Specifications of Software/Hardware

Name	Version of Software/Firmware
E1 Series EtherCAT Drive	Software (Thunder): 1.9.17.0 or above Firmware: 2.8.16 or above ESI file: HIWIN_MIKROSYSTEM_ED1F_20221209 or above
E2 Series EtherCAT Drive	Software (Thunder): 1.9.7.0 or above Firmware: 3.9.16 or above ESI file: HIWIN_MIKROSYSTEM_ED2F_20230614 or above
KEYENCE KV-7500	Software (KV STUDIO): 11.61 or above Firmware: 2.303 or above
KEYENCE KV-XH16EC	Firmware: 1.004 or above

Table of Contents

1. Communication and module setup

1.1 Introduction of hardware device

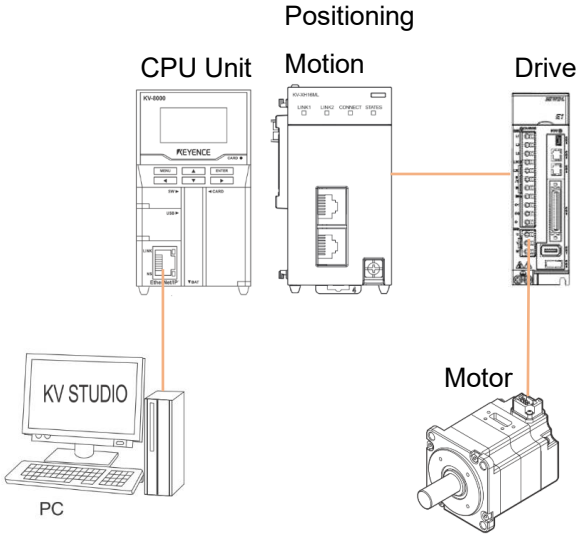


Figure 1.1.1

KEYENCE KV-7500 is a controller composed of a CPU unit and one or more positioning motion units. For the first use, users need to combine CPU unit and positioning motion unit and prepare a 24 VDC 1.8 A power supply for CPU unit. CPU unit is used to connect with the computer, and positioning motion unit is used to connect with the drive.

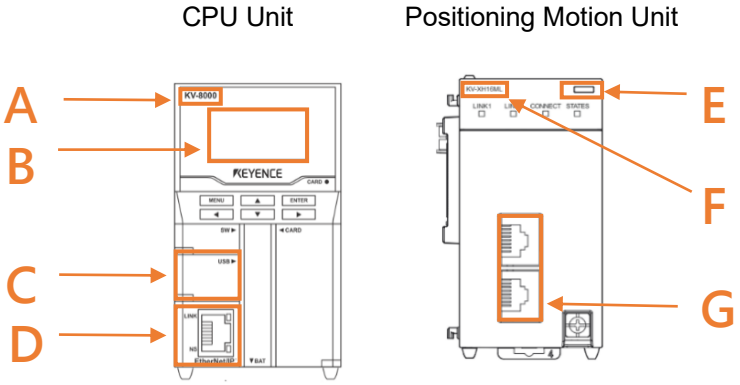


Figure 1.1.2

Table 1.1.1

NO.	Description		
A	Model of CPU unit		
B	LCD screen display		
C	Computer USB port		
D	CPU unit network port		
E	LED display lights	Green light: Successful connection	Red light: Connection failure
F	Model of positioning motion unit		
G	Motion unit network port		

1.2 Create new project

1. Open KV STUDIO and click **File→ New project**.

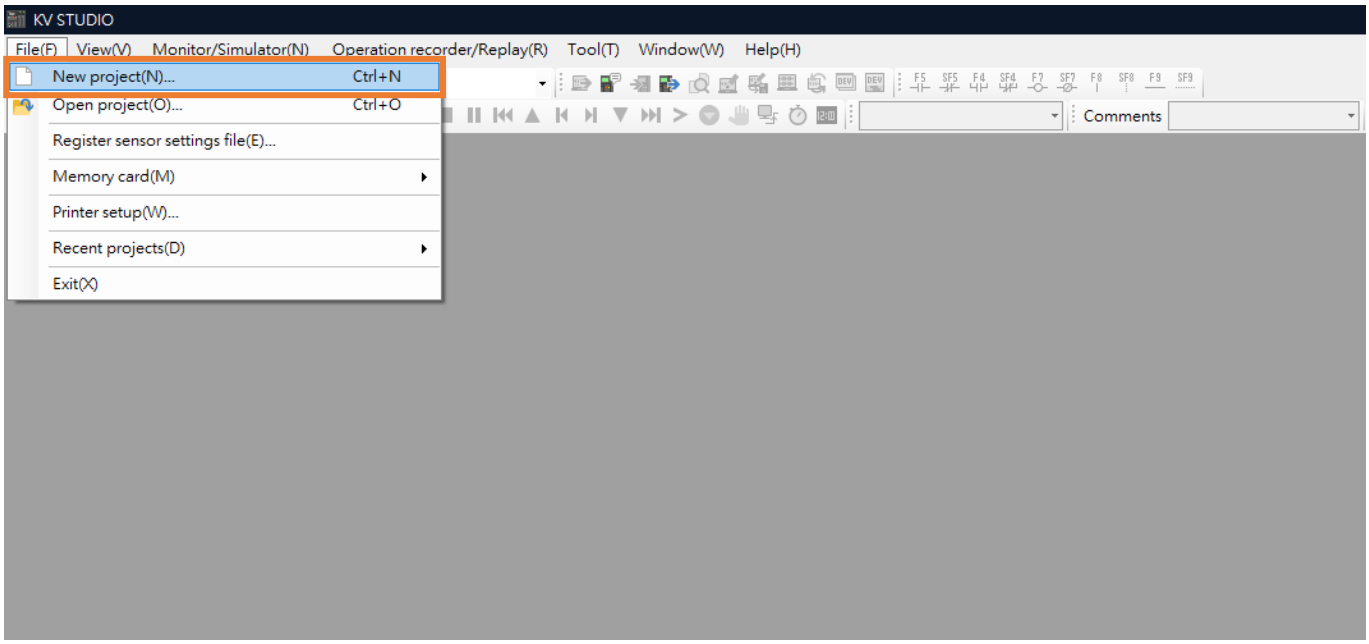


Figure 1.2.1

2. Enter the project name and select a location. Click **OK**.

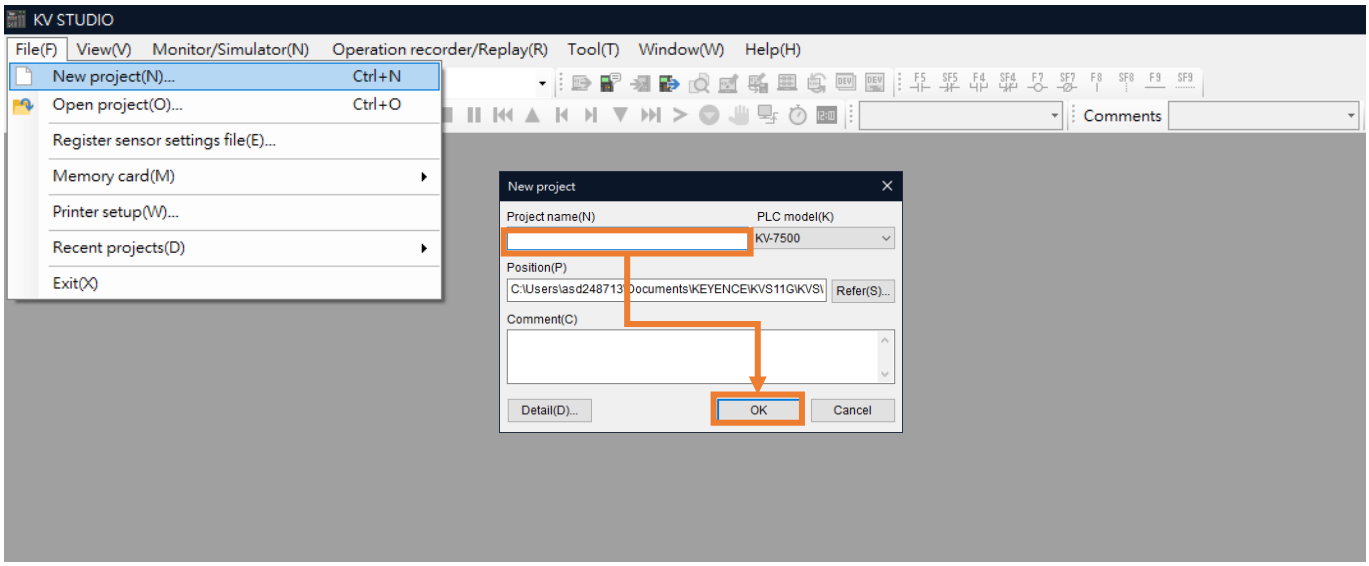


Figure 1.2.2

3. Successfully create a new project.

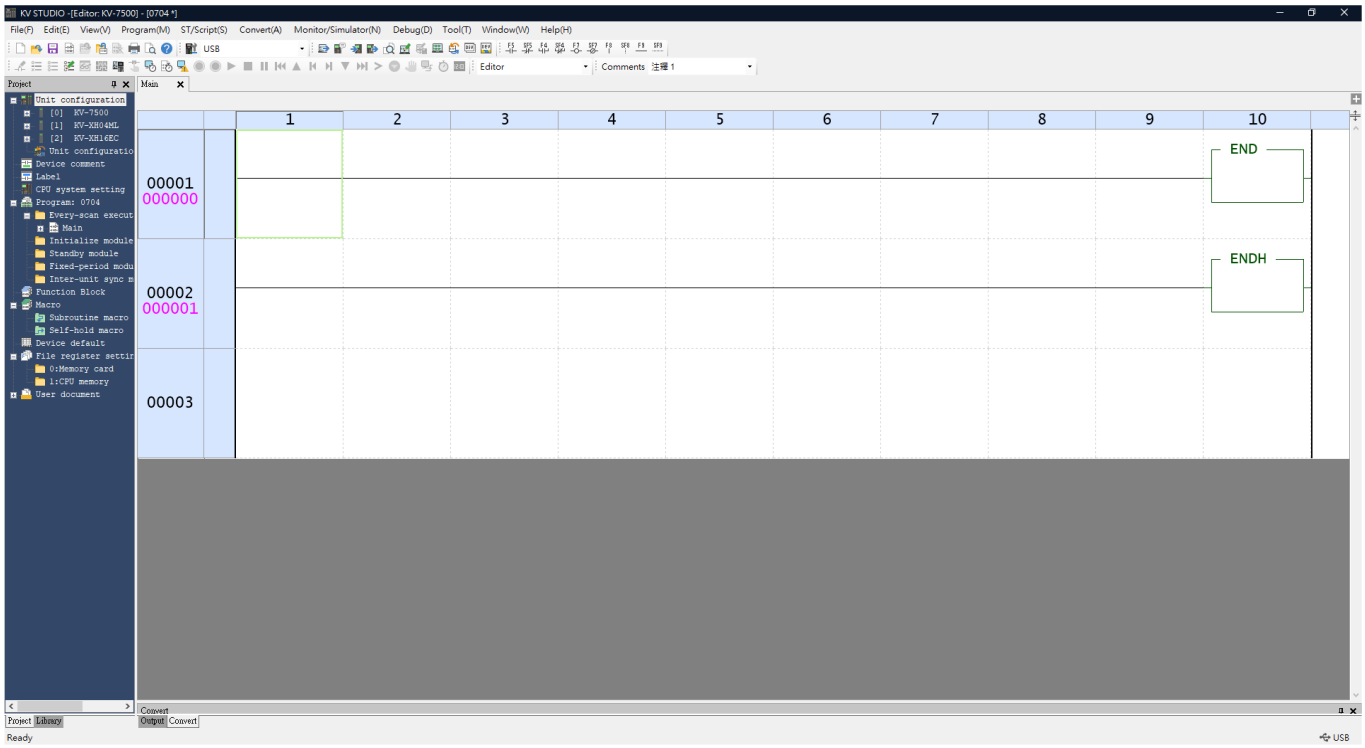


Figure 1.2.3

1.3 Open the project

1. Open KV STUDIO and select **File→ Open project**.

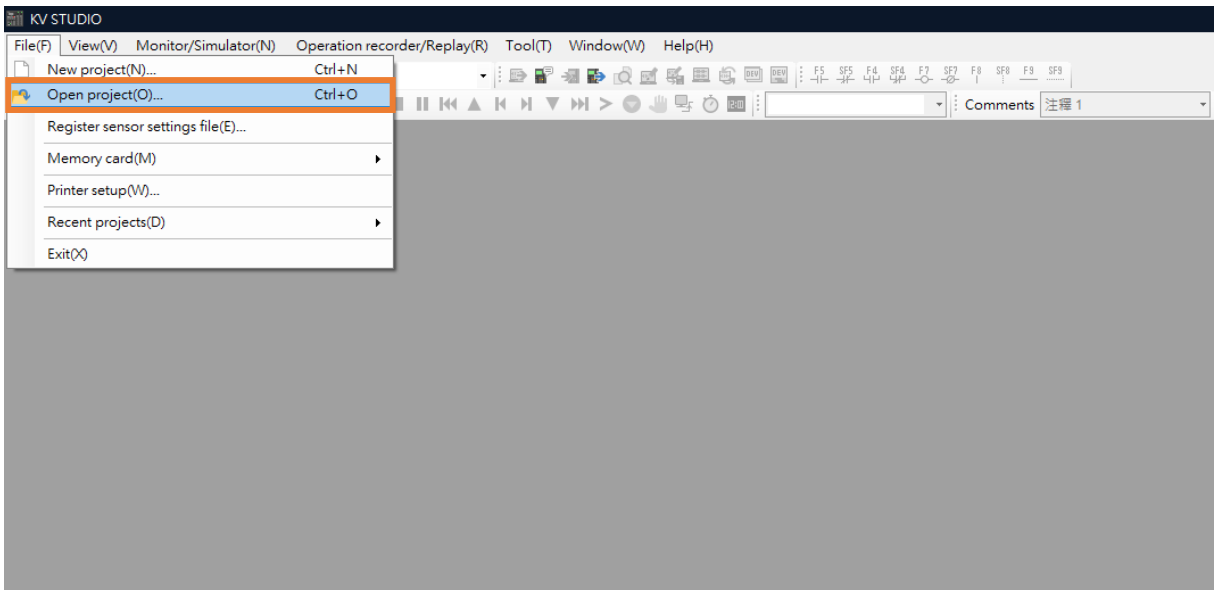


Figure 1.3.1

2. Select the saved project and click **Open**.

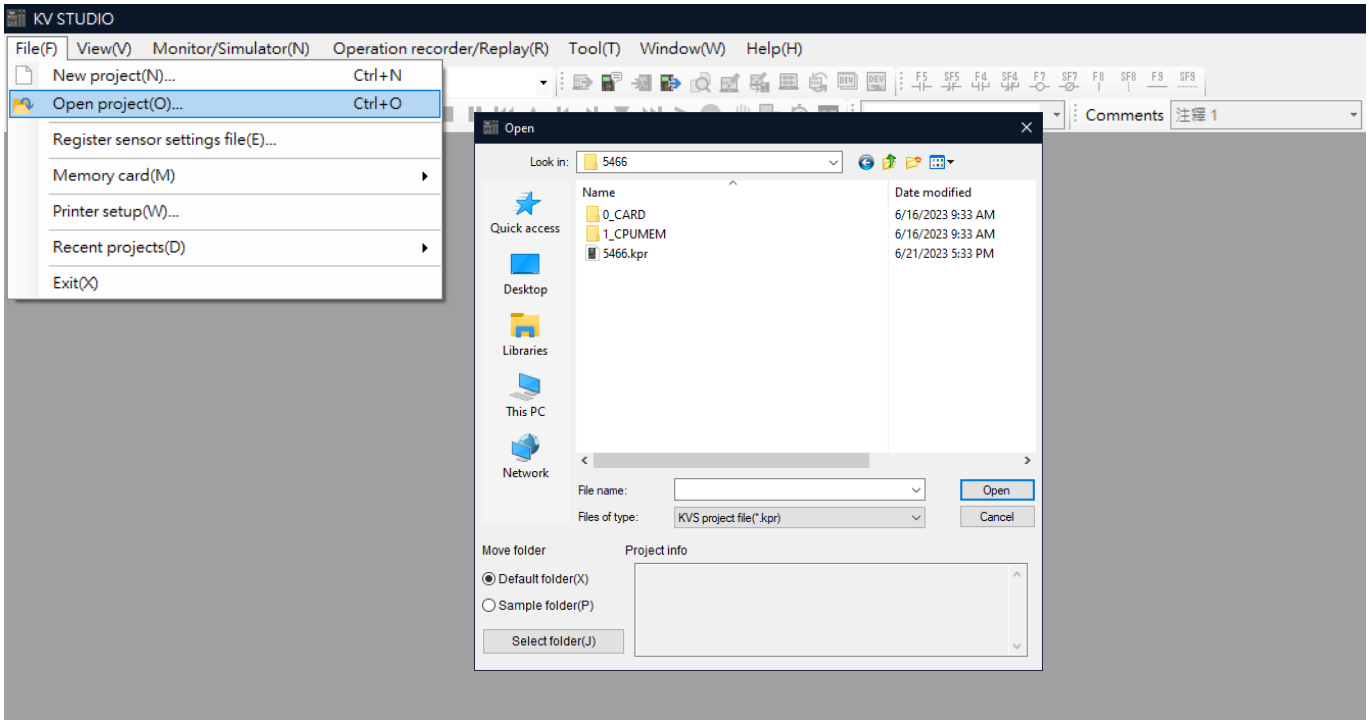


Figure 1.3.2

4. Successfully open a new project.

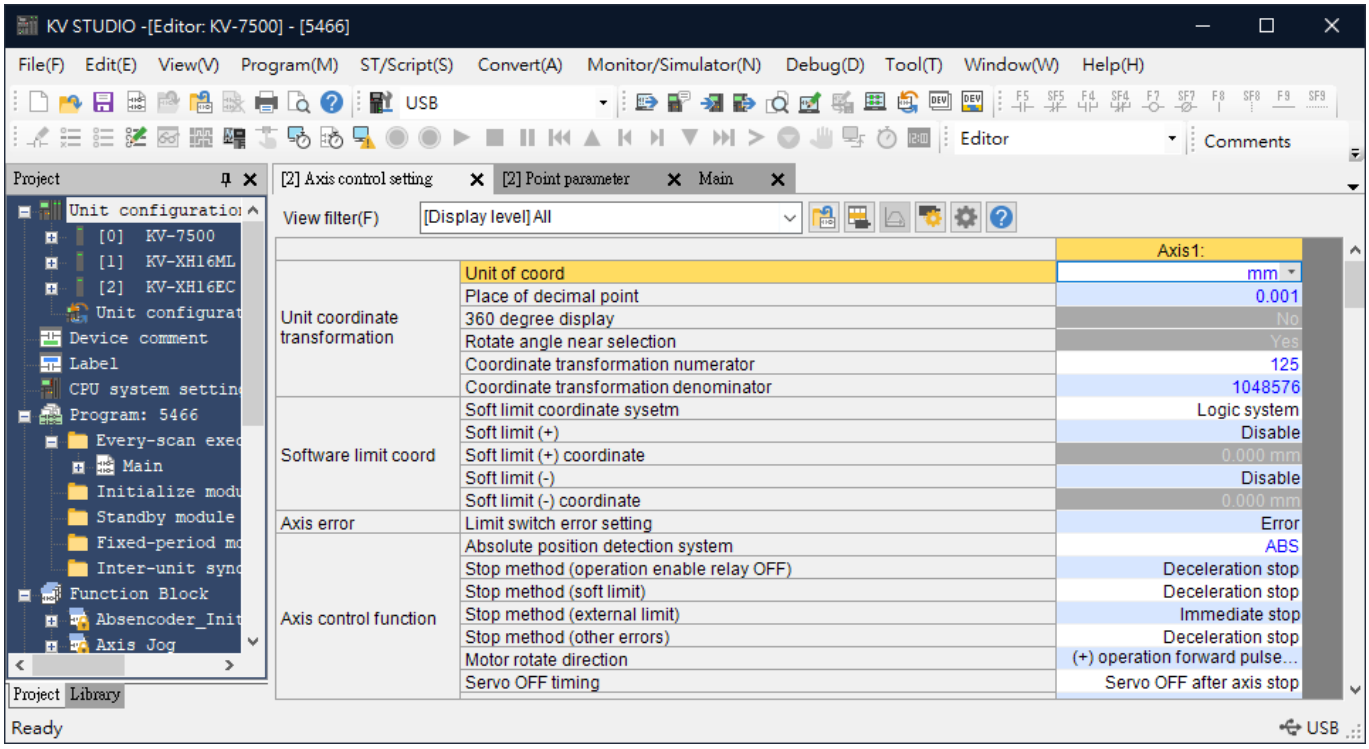


Figure 1.3.3

1.4 Select connection type

1. Click on **communication setting**, select a connection path for the controller and click **OK**.

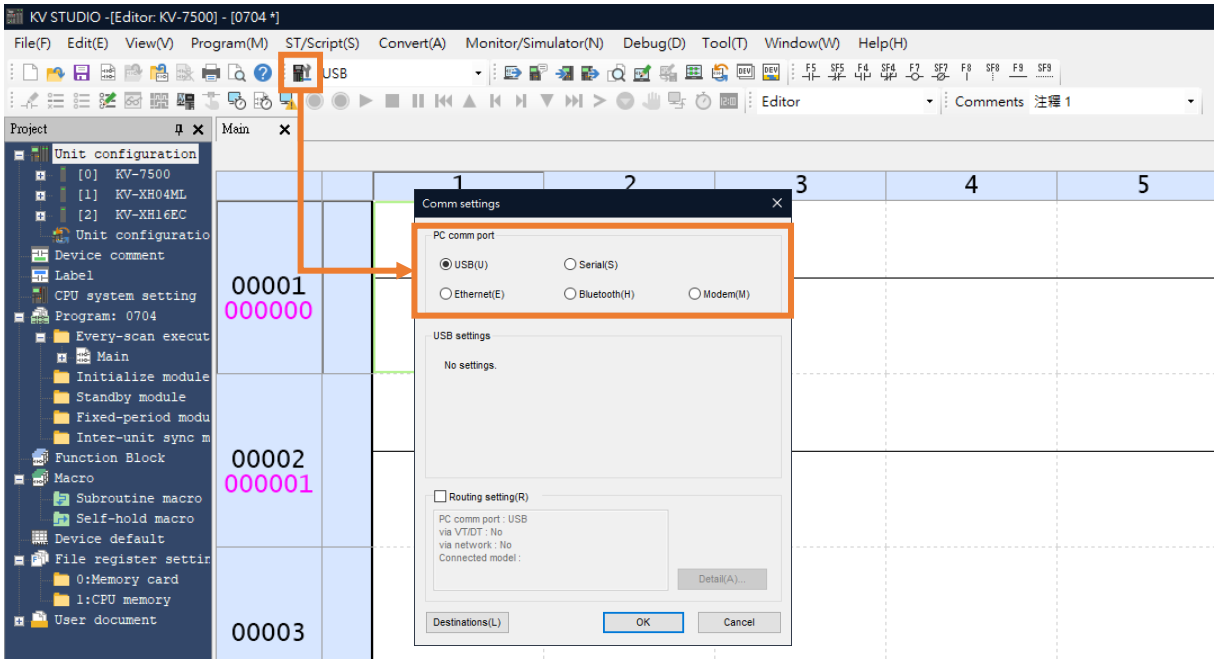


Figure 1.4.1

1.5 IP setting and connection

1. When the controller (CPU unit) is set as default, it is required to use a USB cable for CPU unit connection to open the KV STUDIO software interface. (If the controller is not set as default, skip to step 7).

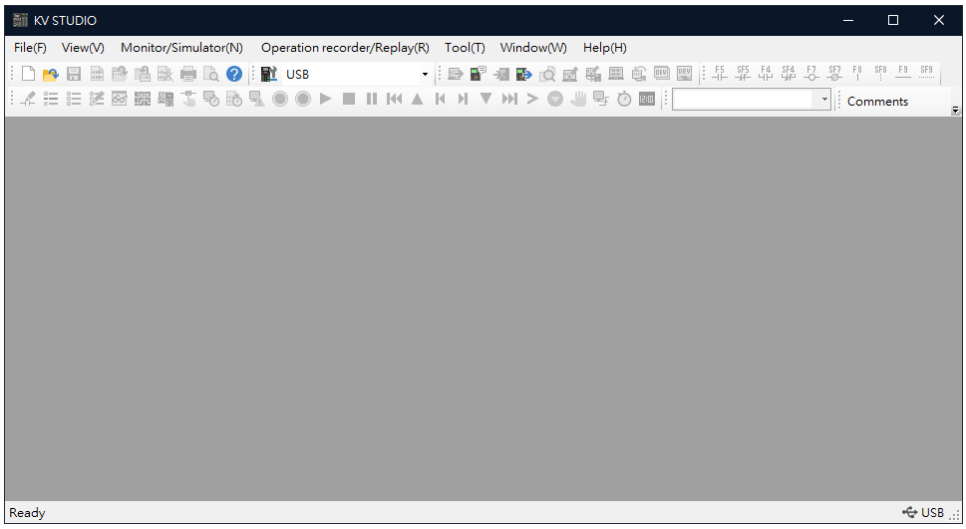


Figure 1.5.1

2. Create a new project.

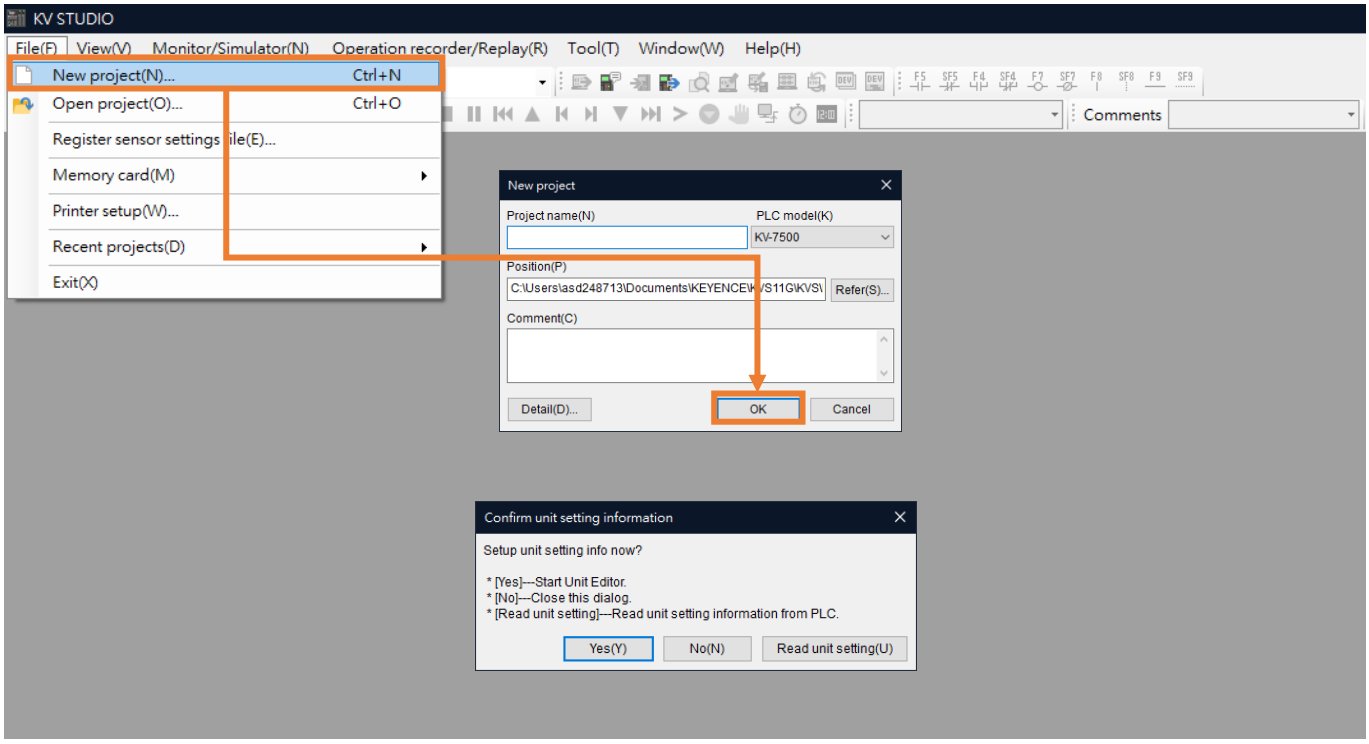


Figure 1.5.2

3. Right-click on the **Unit configuration** to open **Unit Editor**.

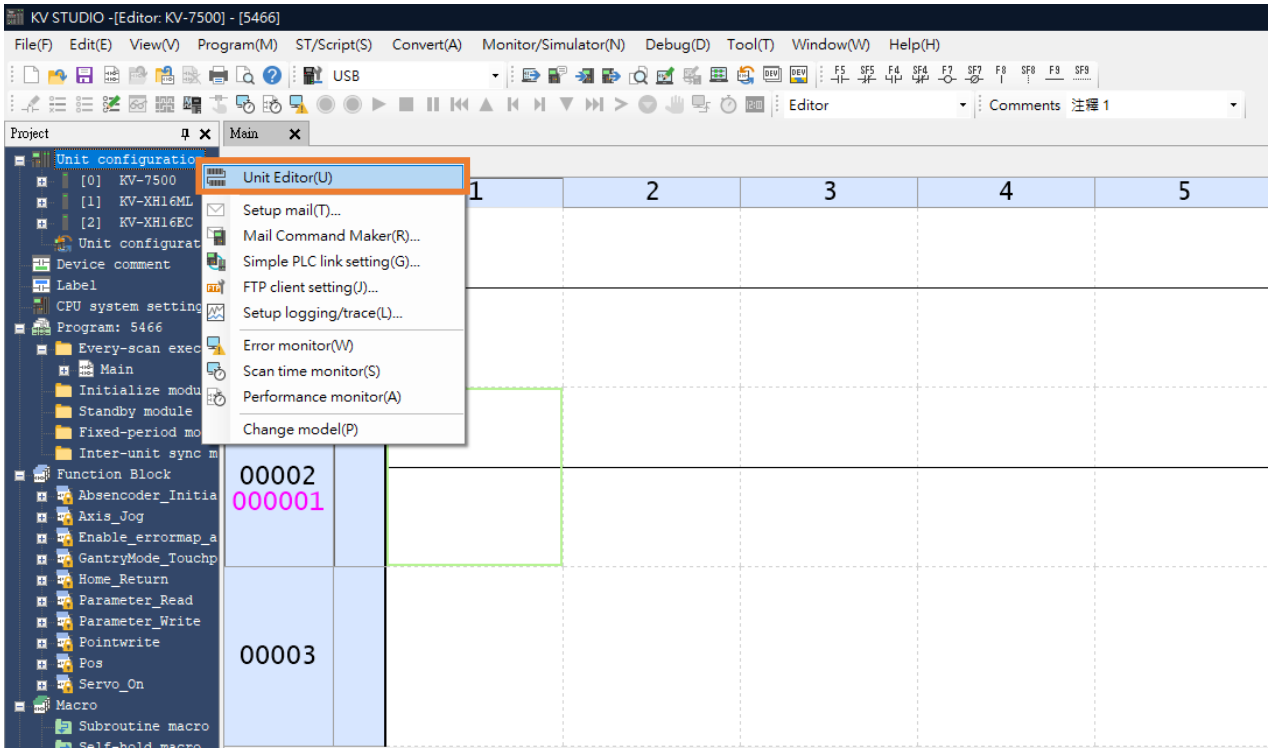


Figure 1.5.3

4. Acquire the configuration information of the unit connected to the PLC to automatically read the existing positioning motion unit model of the user.

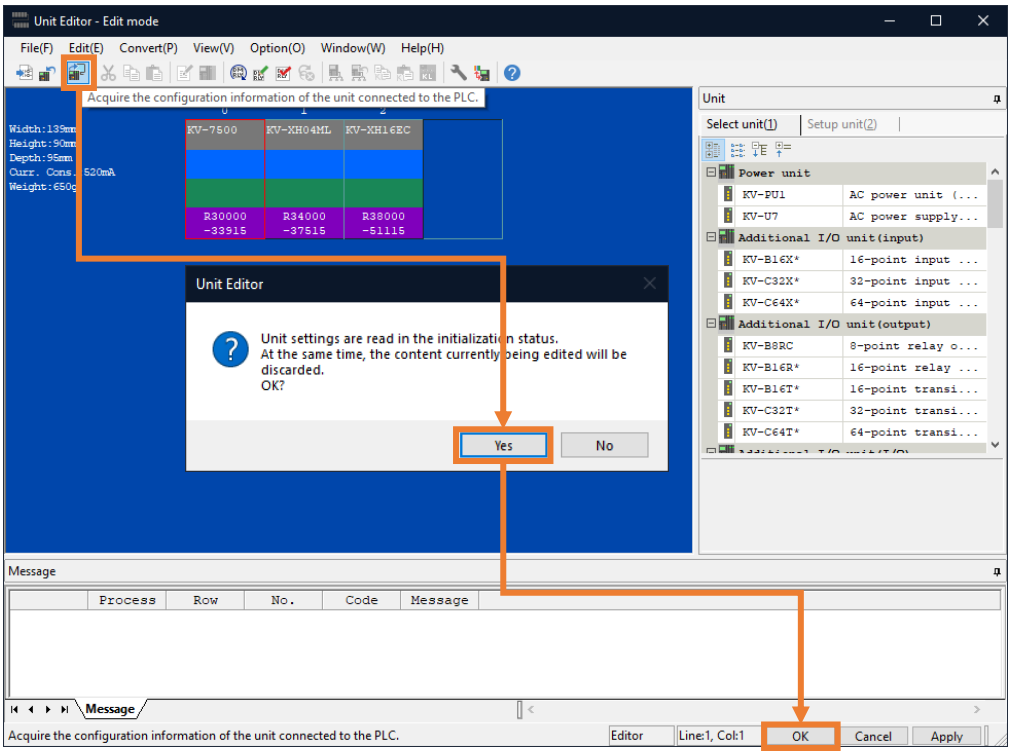


Figure 1.5.4

5. Check if the communication path is **USB**, and click **PLC Transfer** to store the files in PLC. (It is normal if "PLC error" occurs, users can click **Clear** to erase it.)

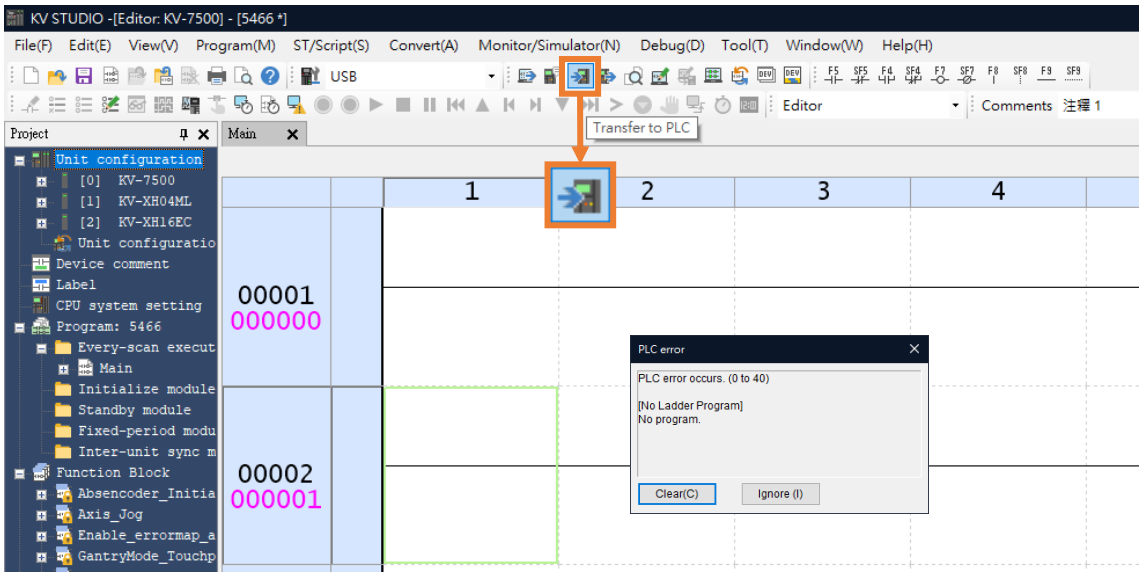


Figure 1.5.5

6. Execute **PLC Transfer**, and the display light of the positioning motion unit will turn from red to green, indicating the successful setting of the CPU unit and the positioning motion unit.

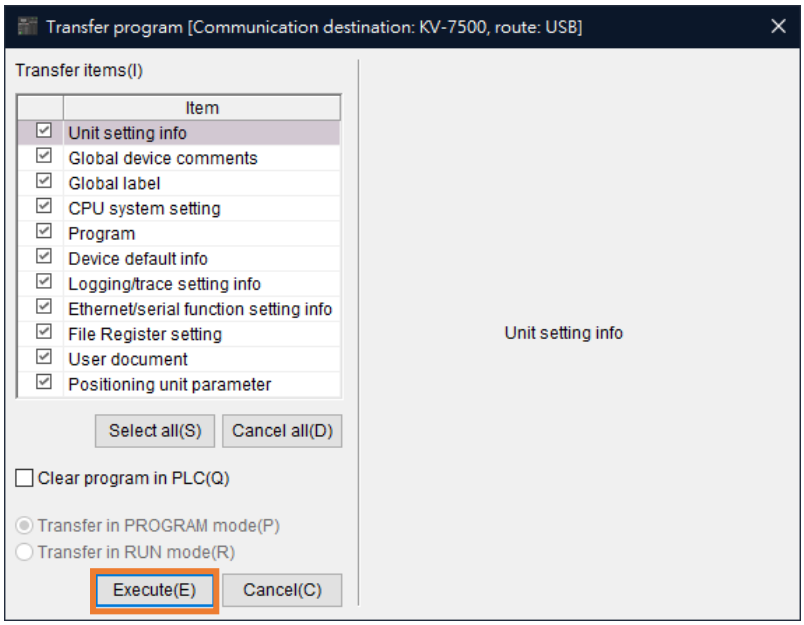


Figure 1.5.6

7. Set computer IP address to 192.168.0.100, which is in the same network domain as the controller (192.168.0.10) and use **Ethernet cable** to connect. If the CPU unit is not set as default, users can use a network cable or USB to connect to the CPU unit.

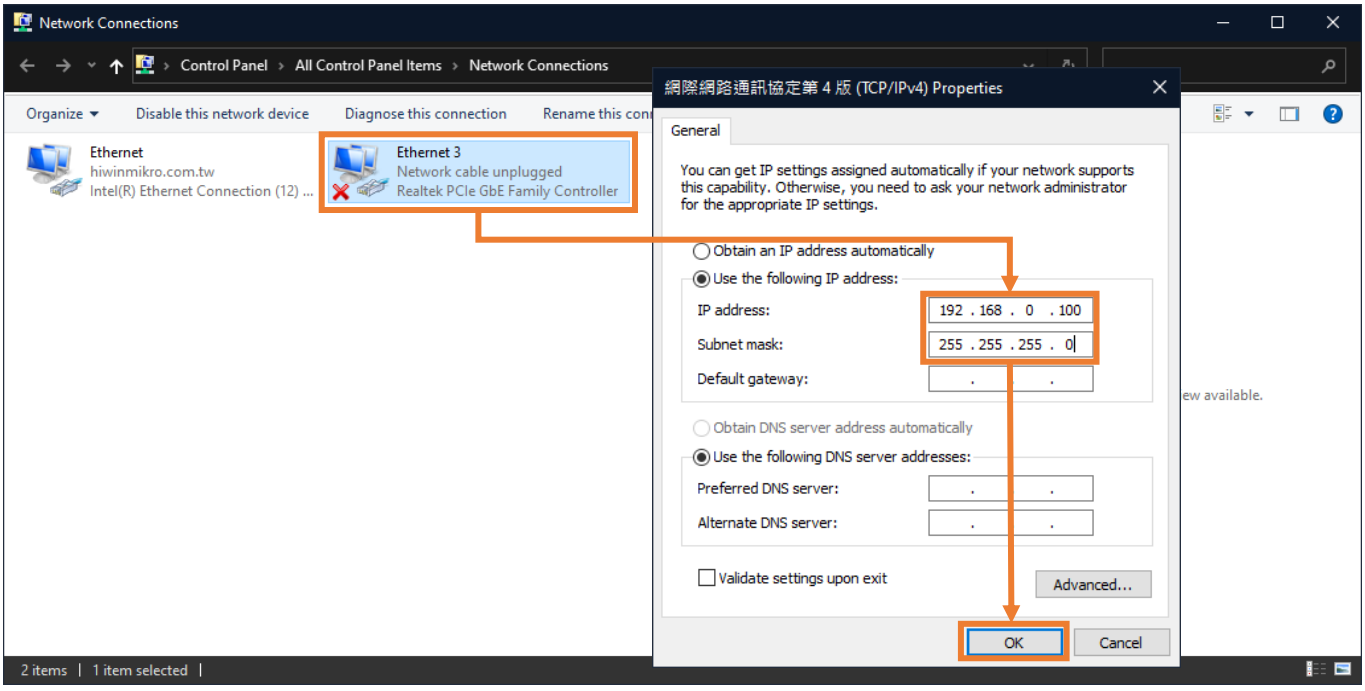


Figure 1.5.7

8. Create a new project. (This step can be skipped if the project has already been created.)

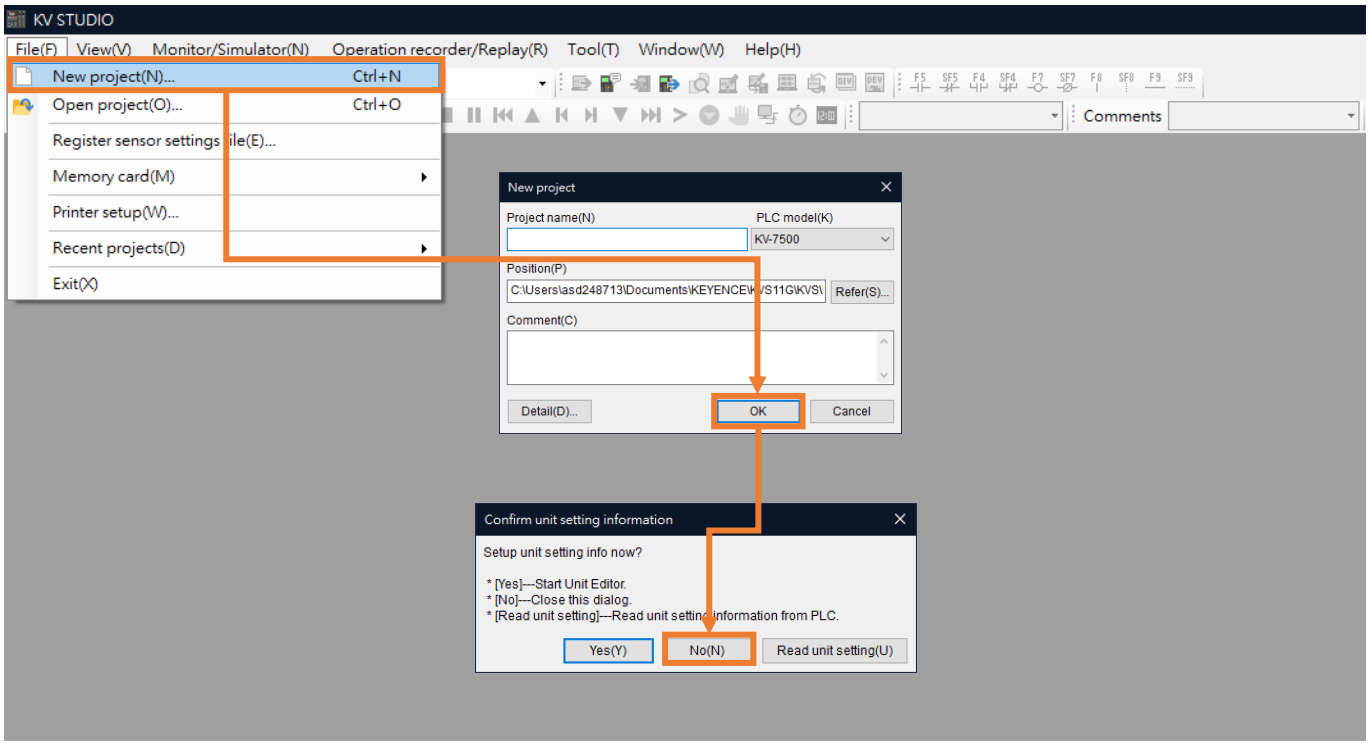


Figure 1.5.8

9. Click the **communication setting** and switch to the **Ethernet**. Enter 192.268.0.100 in the **IP address** of the computer. (Users can skip to step 12 if using a **USB** for communication).

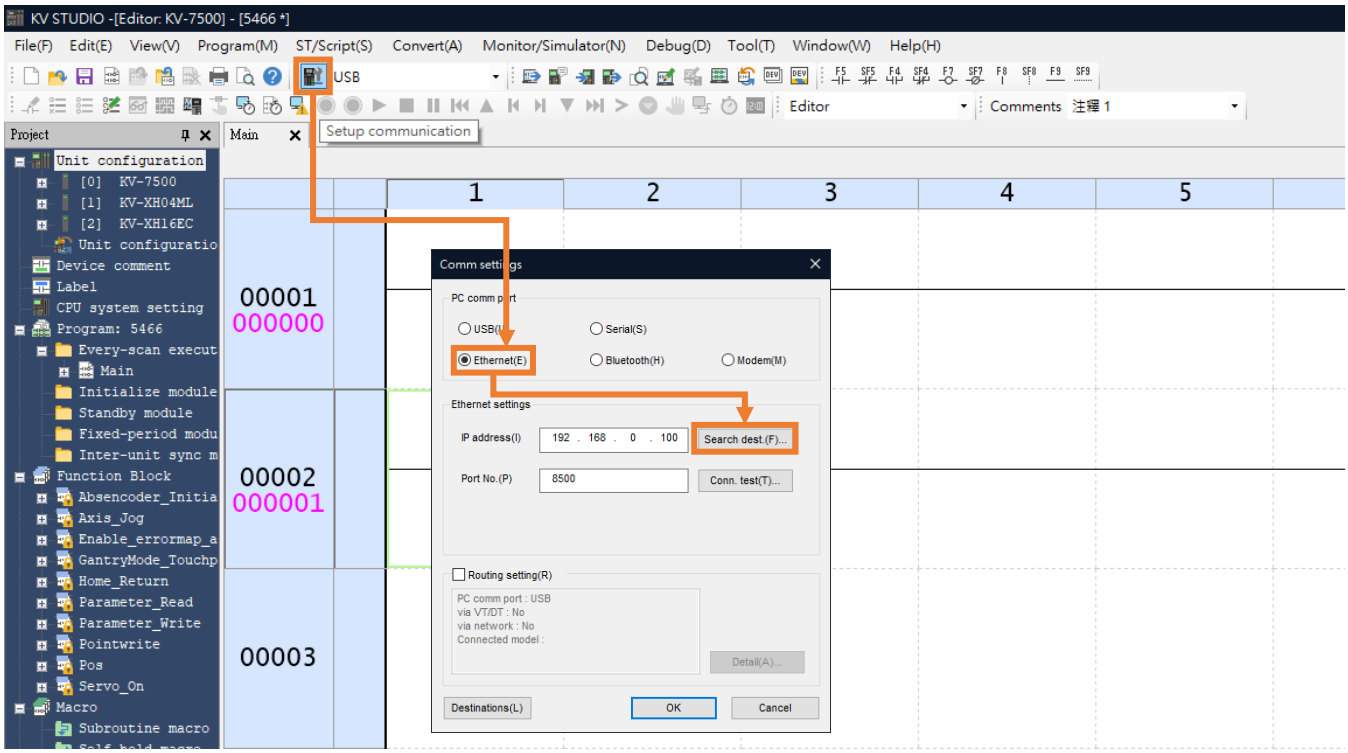


Figure 1.5.9

10. Select the **Network card** that is connected to the controller and click on **Execute**.

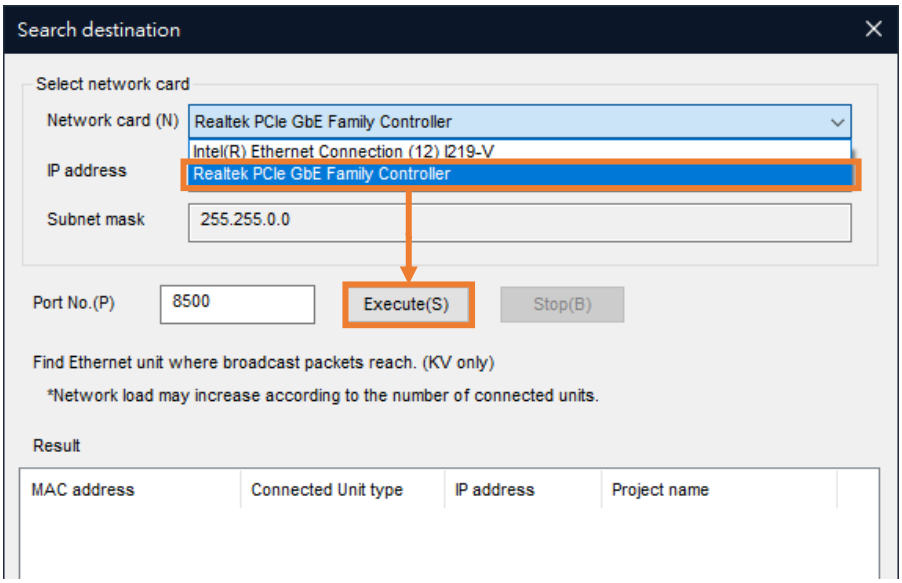


Figure 1.5.10

11. After successful execution, select the **Search results** below and click **Select**.

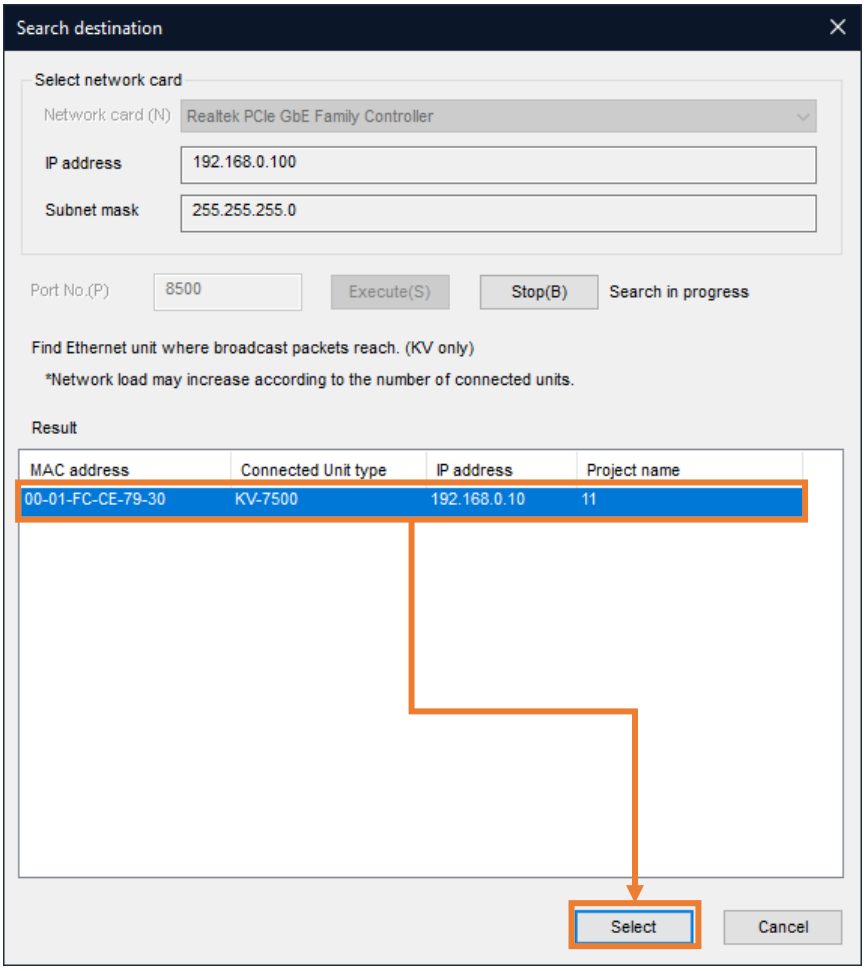


Figure 1.5.11

12. Right-click on the **Unit configuration** to open **Unit Editor**.

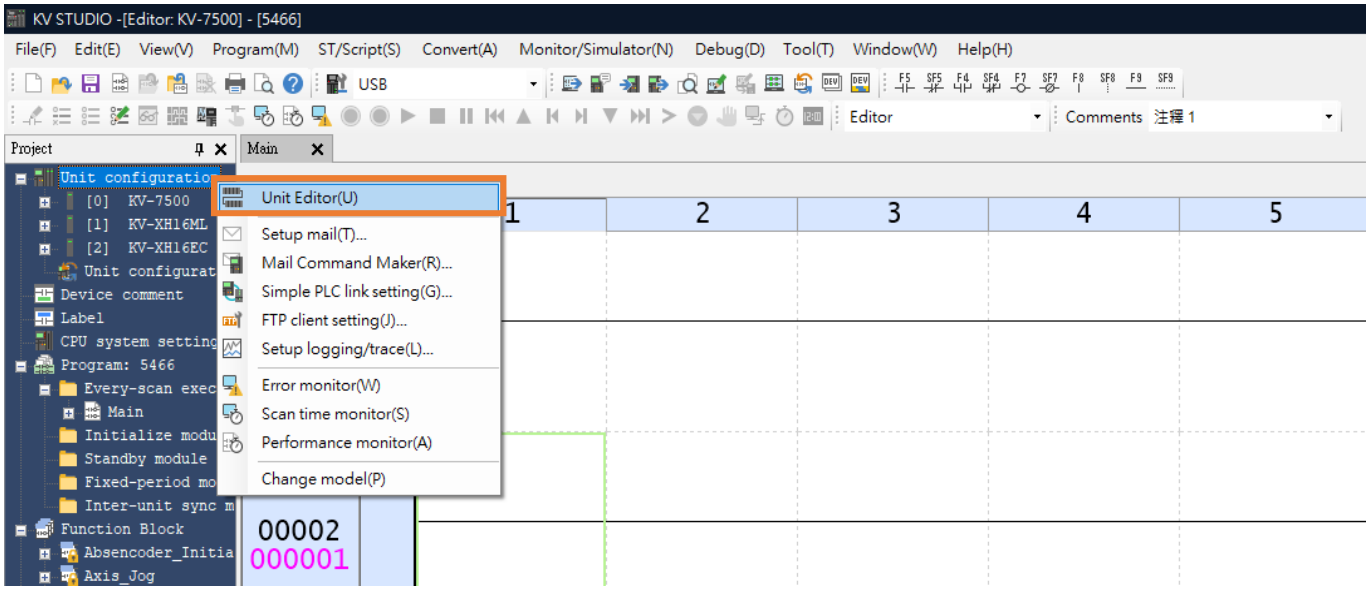


Figure 1.5.12

13. Acquire the configuration information of the unit connected to the PLC to automatically read the existing positioning motion unit model of the user.

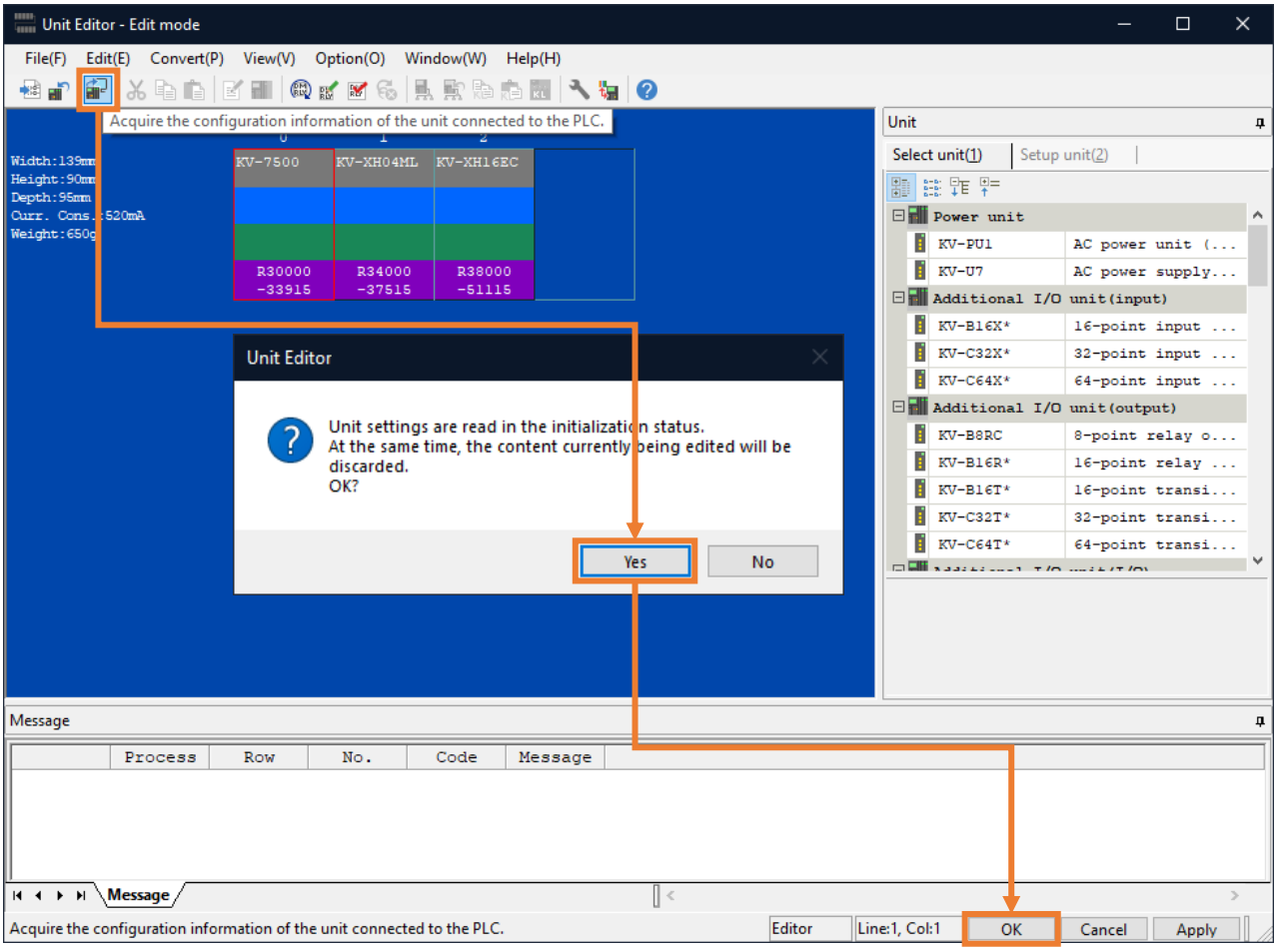


Figure 1.5.13

14. Click **PLC Transfer** to store the files in PLC. (It is normal if "PLC error" occurs, users can click **Clear** to erase it.)

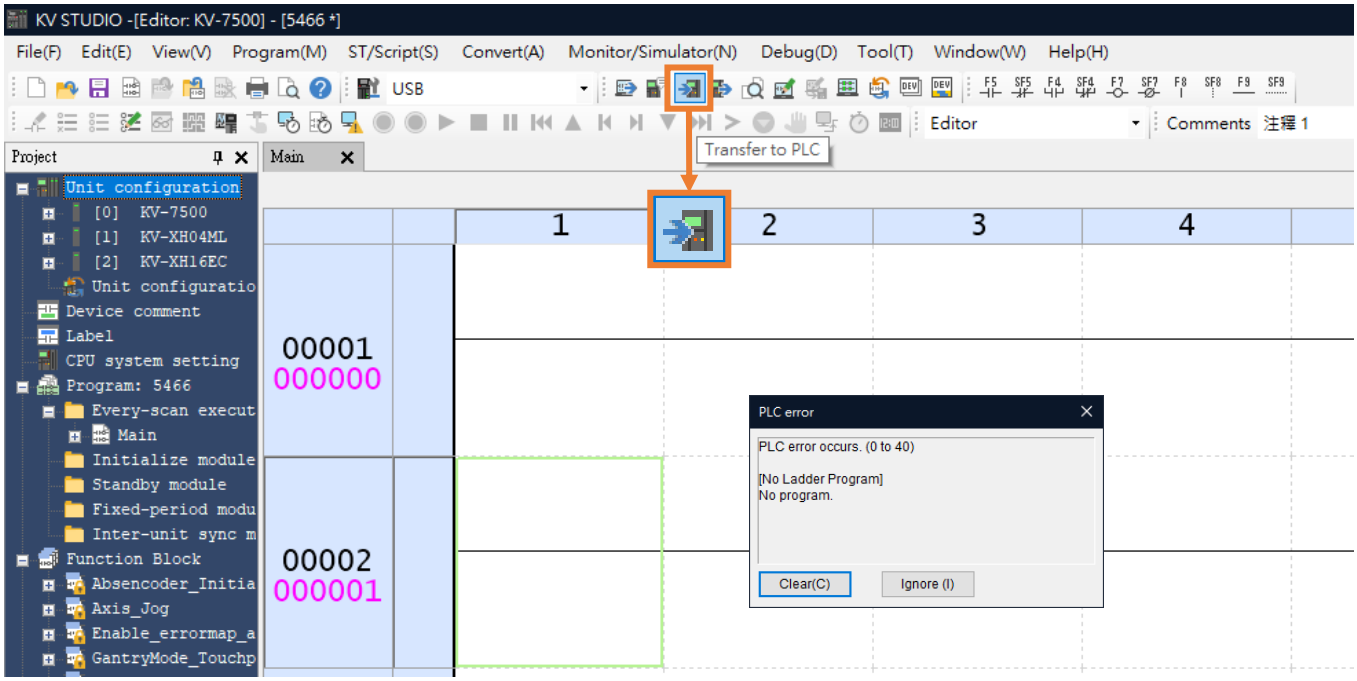


Figure 1.5.14

15. Execute **PLC Transfer**.

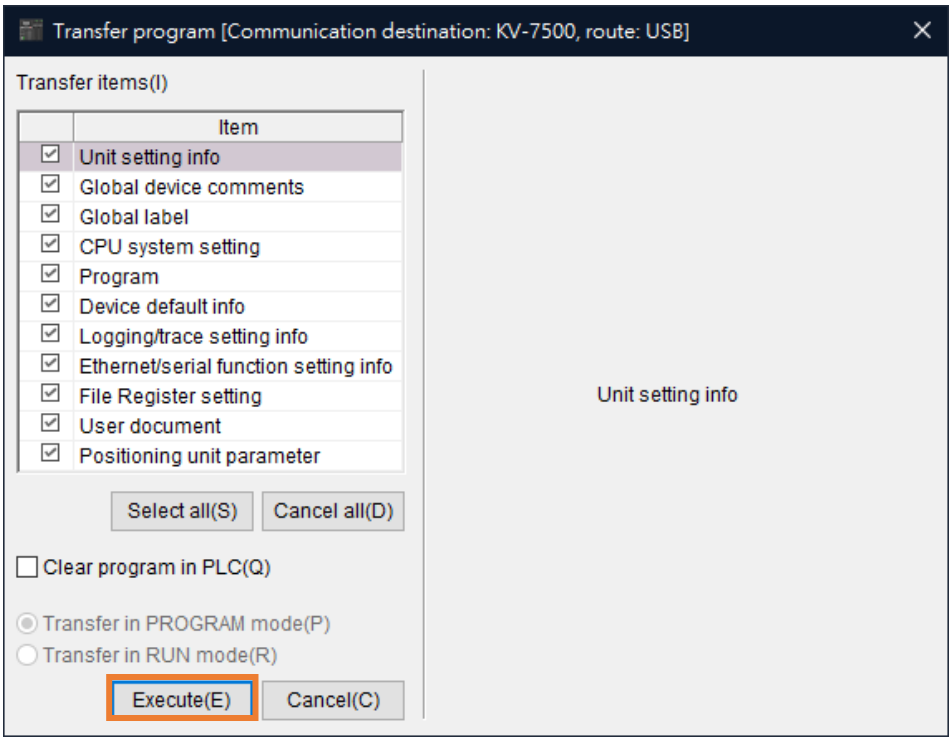


Figure 1.5.15

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2. Parameters setup

2.1 Axis configuration setting

2.1.1 Install ESI files

1. Expand the default positioning motion unit and double-click the **Axis configuration setting**.

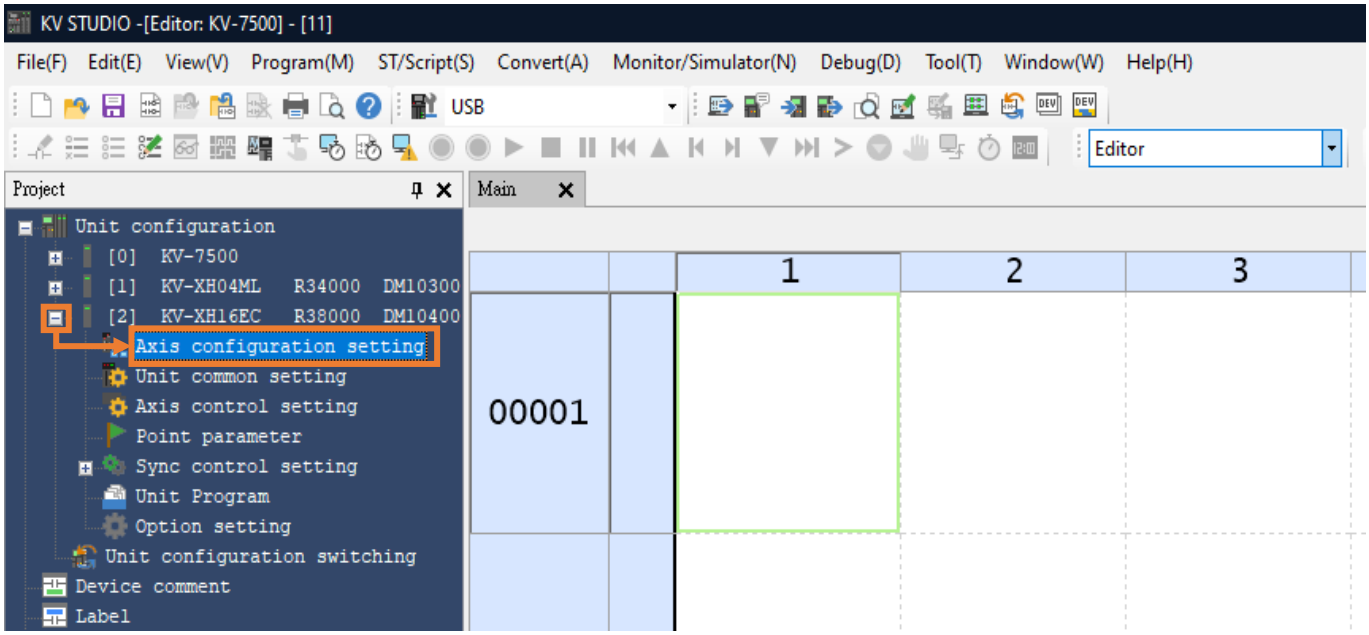

Figure 2.1.1.1

2. Click the **Register ESI file** and select the latest ESI file for E series drives.
   (Path: **C:\Thunder\doc\ESI Files**).

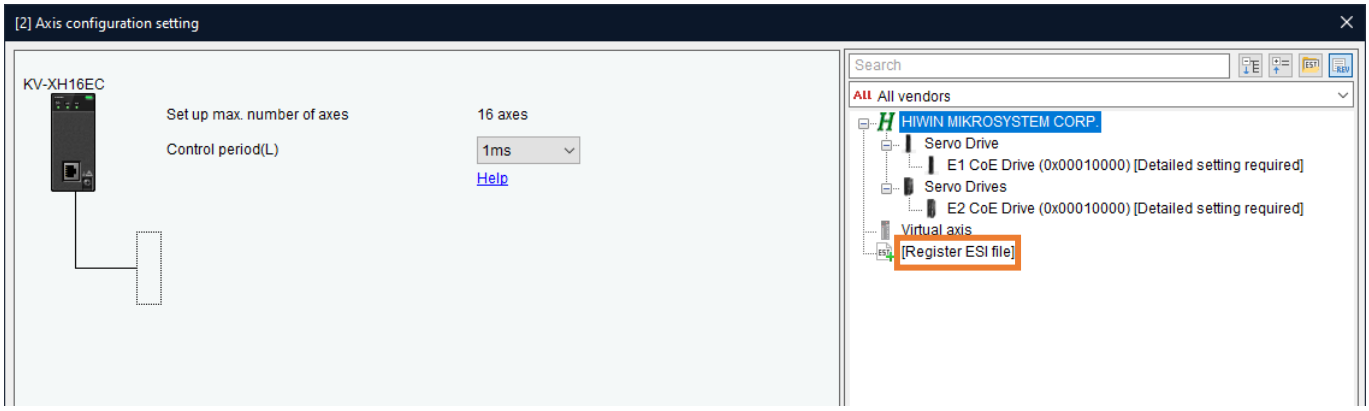

Figure 2.1.1.2

2.1.2 PDO setting

1. Double-click or drag the drive to be selected, and the **Slave detailed setting** window will pop up.

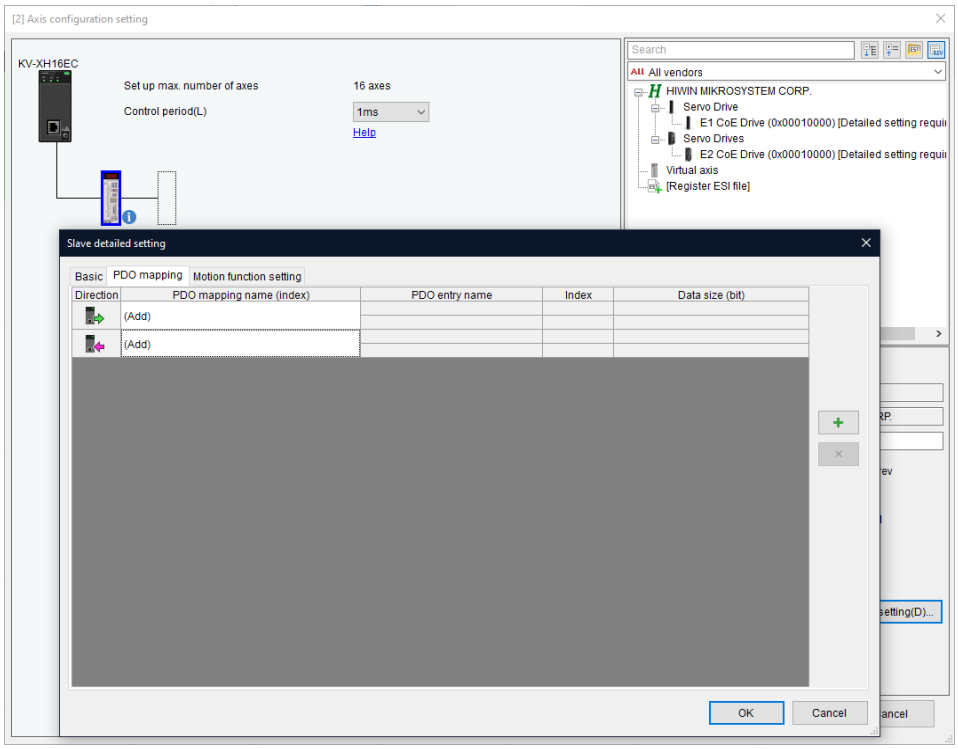

Figure 2.1.2.1

2. On the **PDO mapping** tab, set the PDO according to the requirement. (Users can first select the PDO combination and click add or delete afterwards.)

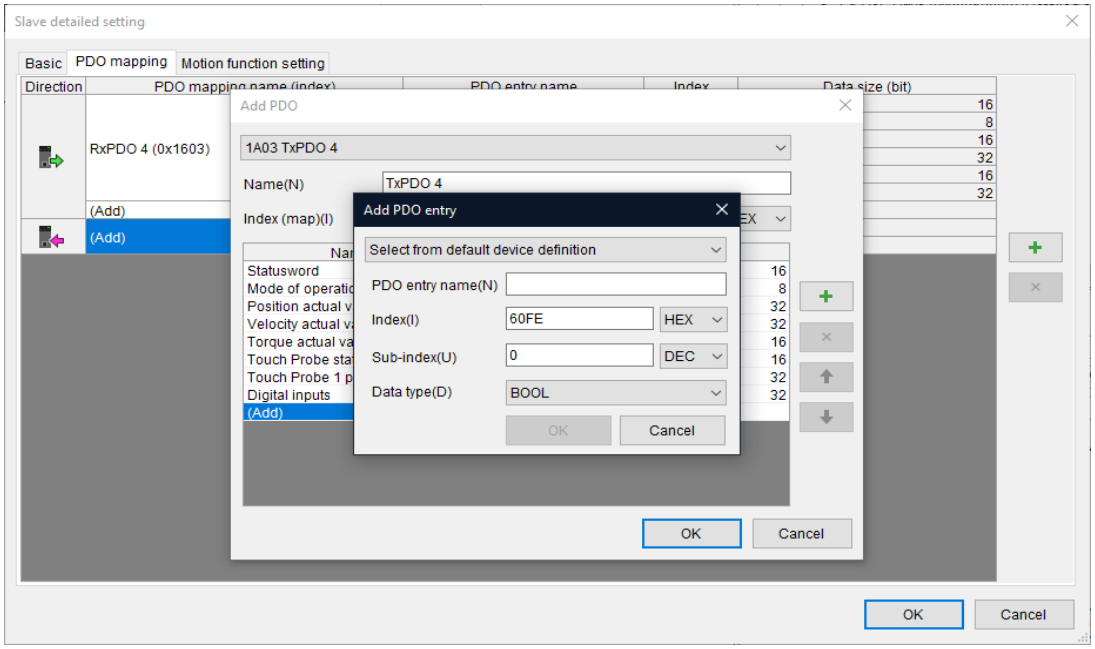

Figure 2.1.2.2

Note: The number of **PDO Read** and **PDO Write** is limited to 8 each.

3. On the **Motion function setting** tab, right-click and select the **Automatic assignment** option and click **OK**.

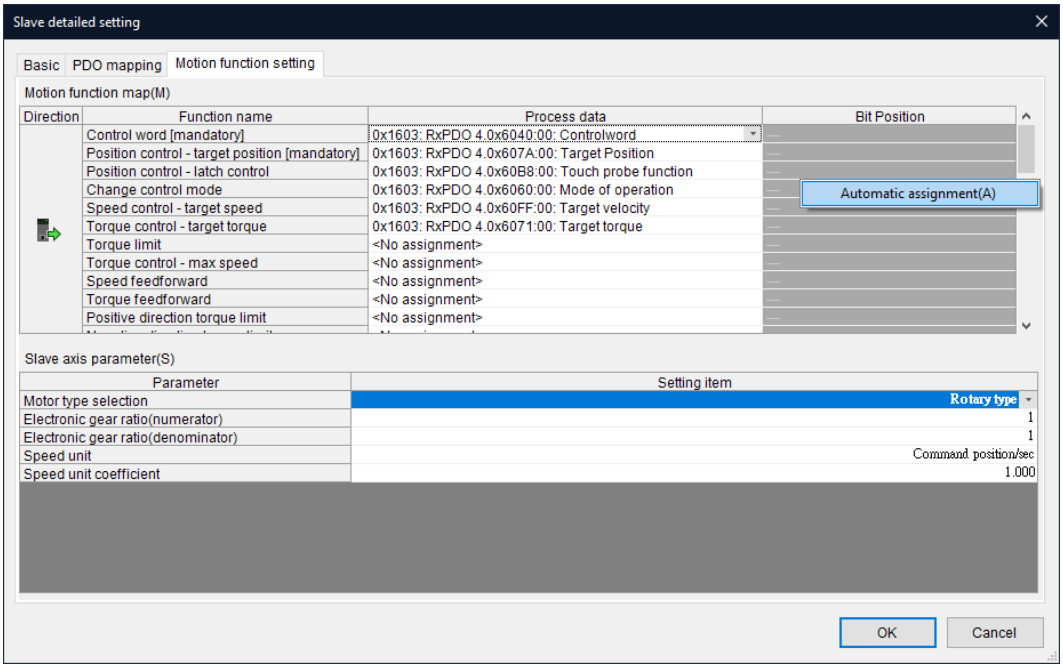

Figure 2.1.2.3

4. After the PDO setting is completed, users need to enter the relevant information of the motor in the lower right corner. Click **OK** after the setting is completed.

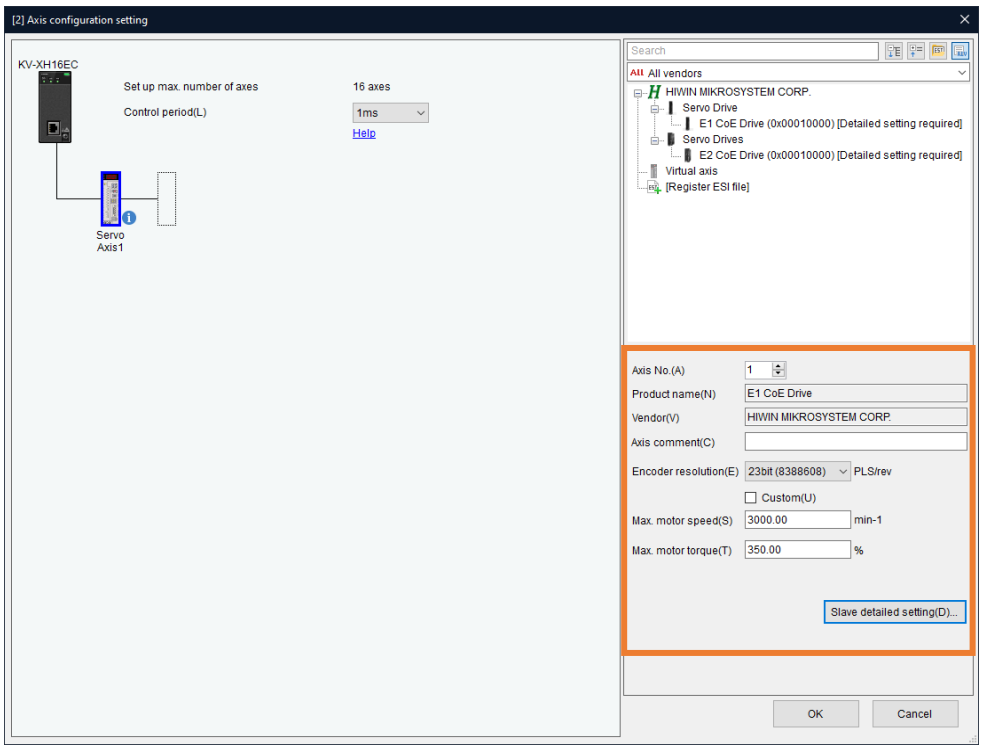

Figure 2.1.2.4

Note: If the **Axis configuration setting** is completed, click **OK** and **Yes**. The **coordinate transformation calculation** that pops up at this time can be ignored, which would be set in the subsequent steps.

2.1.3 Object setting (N-OT, P-OT, DOG)

For detailed information on the object **0x60FDh**, please refer to section 3.2 **Standardized device profile area** in "E Series Servo Drive EtherCAT(CoE) Communications Command Manual."

◆ Method 1: According to the user I/O setting, set N-OT, P-OT, and DOG signals to Input 16 (I1), Input 17 (I2), and Input 18 (I3) in object **0x60FDh**.

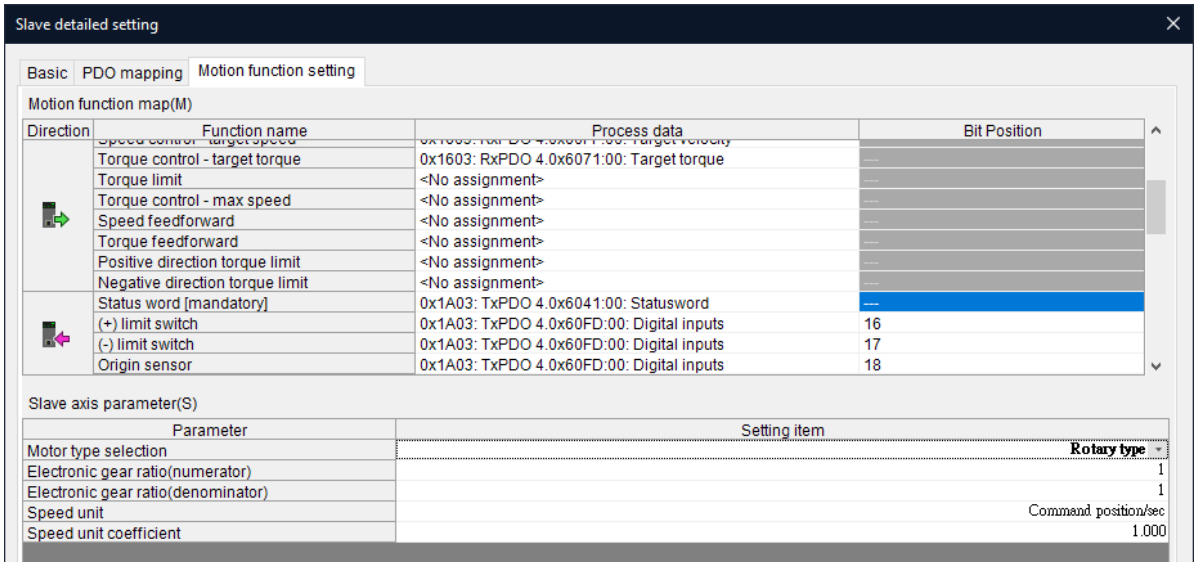

Figure 2.1.3.1

In the IO setting interface in Thunder, tick **User defined** and set all the **Input** to **Not configure**.

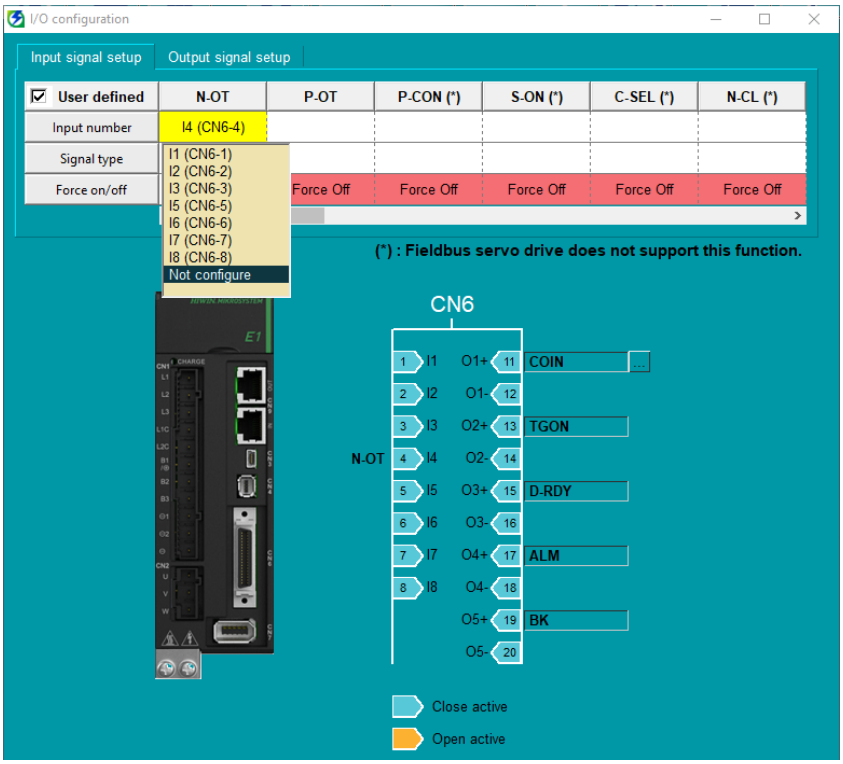

Figure 2.1.3.2

◆ Method 2: According to the pin definition of **0x60FDh**, set the N-OT, P-OT, and DOG signals as bit 0, bit 1, and bit 2 in object **0x60FDh**.

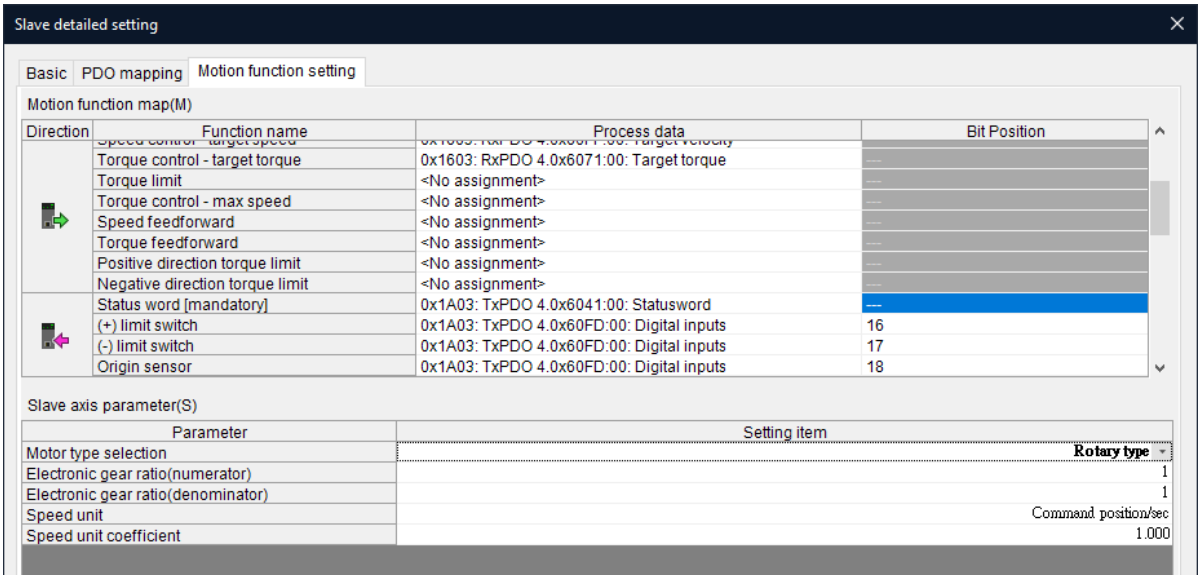

Figure 2.1.3.3

In the IO setting interface in Thunder, tick **User defined** and set the **Input** pins for N-OT, P-OT, and DOG signals.

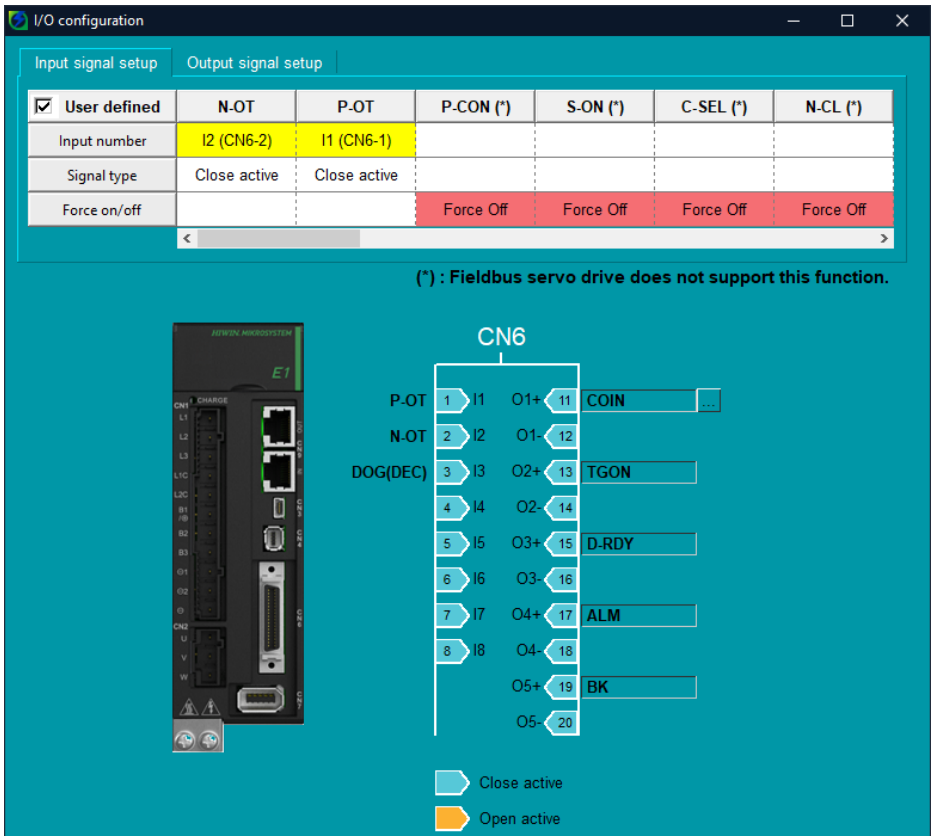

Figure 2.1.3.4

2.2 Axis control setting

1. Double-click the **Axis control setting**, set the **coordinate unit** and the **place of the decimal point**, and then click the **coordinate transformation calculation** at the top.

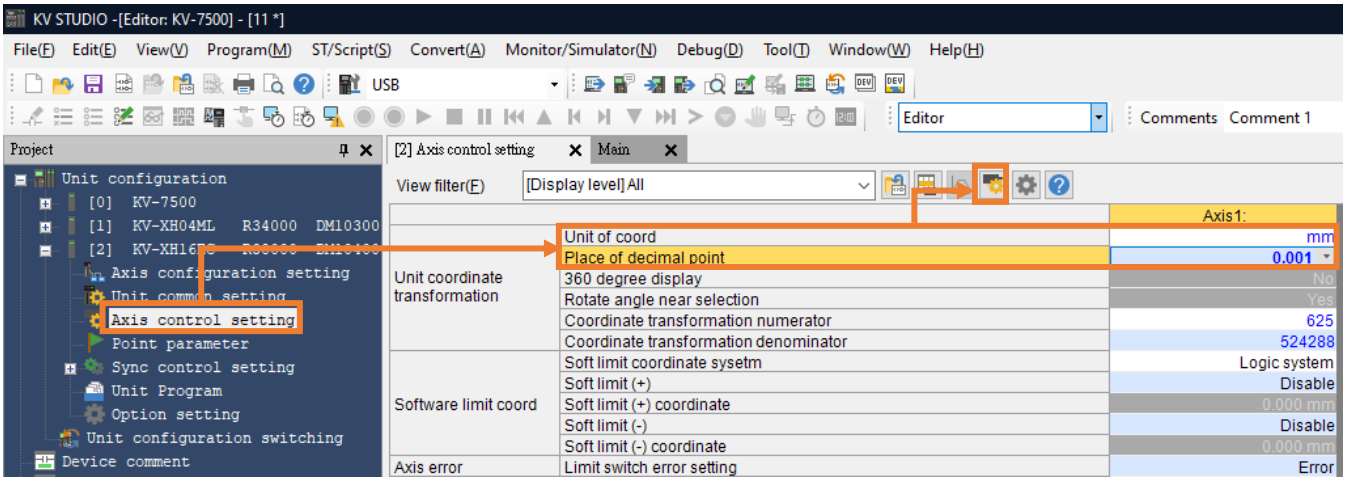

Figure 2.2.1

Table 2.2.1

Category	Name	Description
Unit coordinate transformation	Unit of coordinate	Unit: mm, inch, deg, PLS
	Place of decimal point	When the coordinate unit is set to PLS (pulse), the setting is invalid.

2. After the relevant parameters are set, click **execute the calculation**. Then, click **OK** and click **Yes**.

Note: The setting is based on the resolution of 8388608 pulse/rev for one motor revolution (1mm) and 1:1 electronic gear ratio as an example. If the speed is 1 mm/s, the motor speed will be 60 rpm.

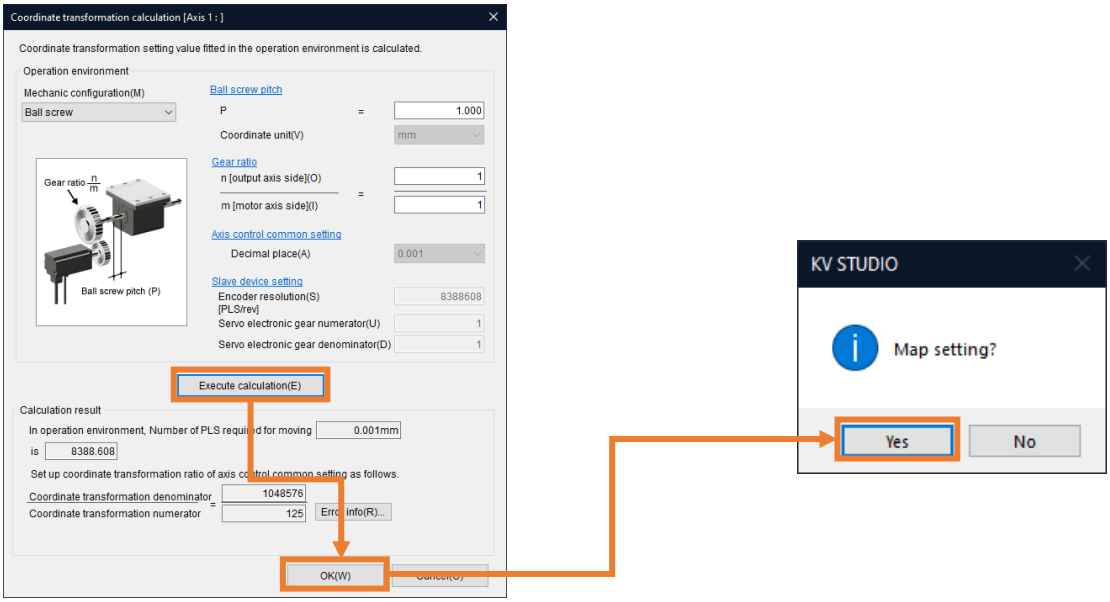

Figure 2.2.2

3. Axis parameter setting. (Set the parameters in table 2.2.2).

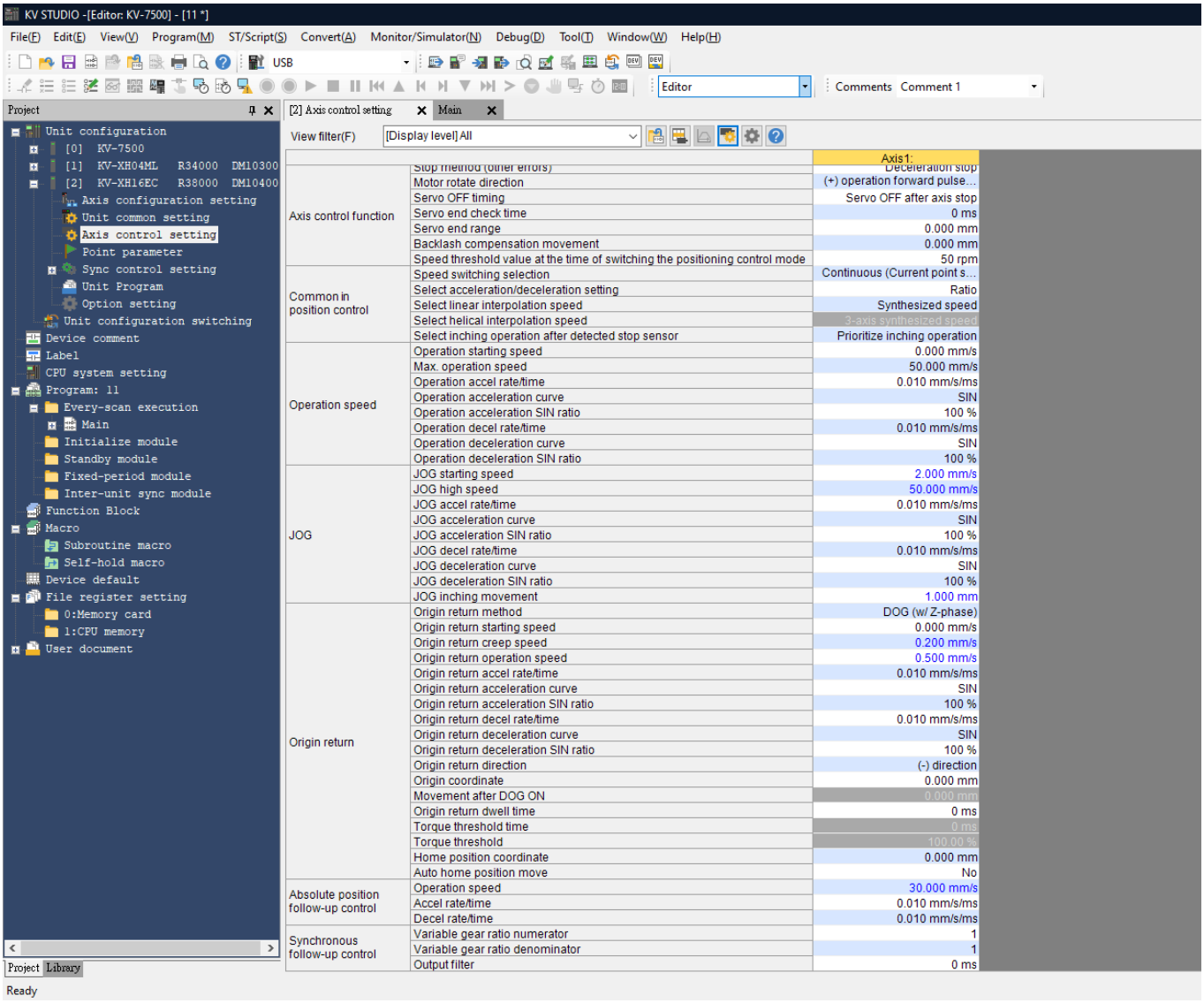

Figure 2.2.3

Table 2.2.2

Category	Name	Description
Operation speed	Operation starting speed	In positioning control, the momentary starting speed which starts from a static state is the operation starting speed.
	Max. operation speed	Set the upper limit of the position control speed and enter the rated speed of the motor.
	Operation acceleration rate/time	Unit: ms, coordinate unit/s/ms
	Operation deceleration rate/time	Unit: ms, coordinate unit/s/ms
JOG	JOG starting speed	Unit: coordinate unit/s
	JOG high speed	Unit: coordinate unit/s
	JOG acceleration rate/time	Unit: ms, coordinate unit/s/ms
	JOG deceleration rate/time	Unit: ms, coordinate unit/s/ms
	JOG inching movement	The moving speed is set as the JOG starting speed.
Origin return	Origin return method	Set origin return method.
	Origin return starting speed	Set the starting speed for origin return and the starting speed moving to the home position.
	Origin return creep speed	The speed when motor reaches the final origin during origin return.
	Origin return acceleration rate/time	Unit: ms, coordinate unit/s/ms
	Origin return deceleration rate/time	Unit: ms, coordinate unit/s/ms
	Origin return direction	Select the start direction for origin return and the operating direction before origin return is completed.
	Origin coordinate	Set the current coordinates when origin return is completed.
	Movement after DOG ON	Do not set the parameter to 0 when the origin return method is selected as "DOG type inching (with Z-phase)" or "DOG type inching (without Z-phase)."
Absolute position follow-up control	Operation speed	Set the operation speed for the absolute position follow-up control.
	Acceleration rate/time	Unit: ms, coordinate unit/s/ms
	Deceleration rate/time	Unit: ms, coordinate unit/s/ms

4. Click **PLC Transfer** to store the files in PLC. (It is normal if "PLC error" occurs, users can click **Clear** to erase it.)

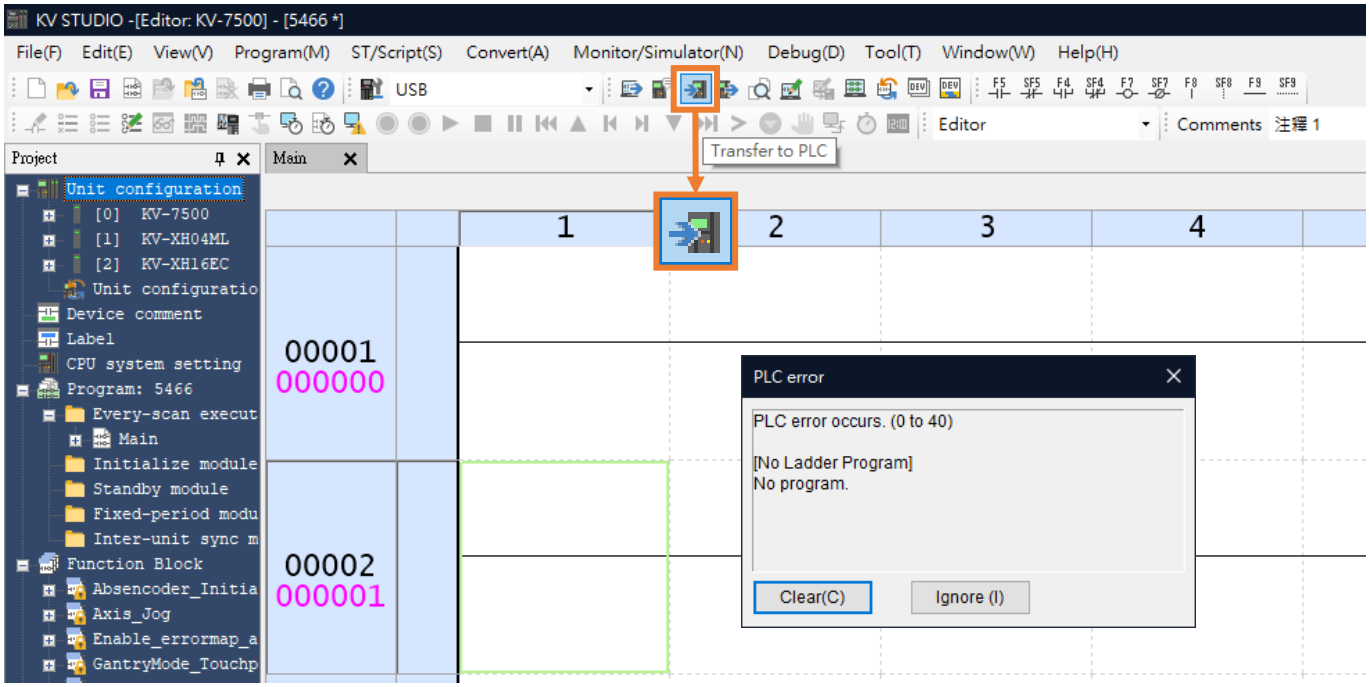

Figure 2.2.4

4. Save the project.

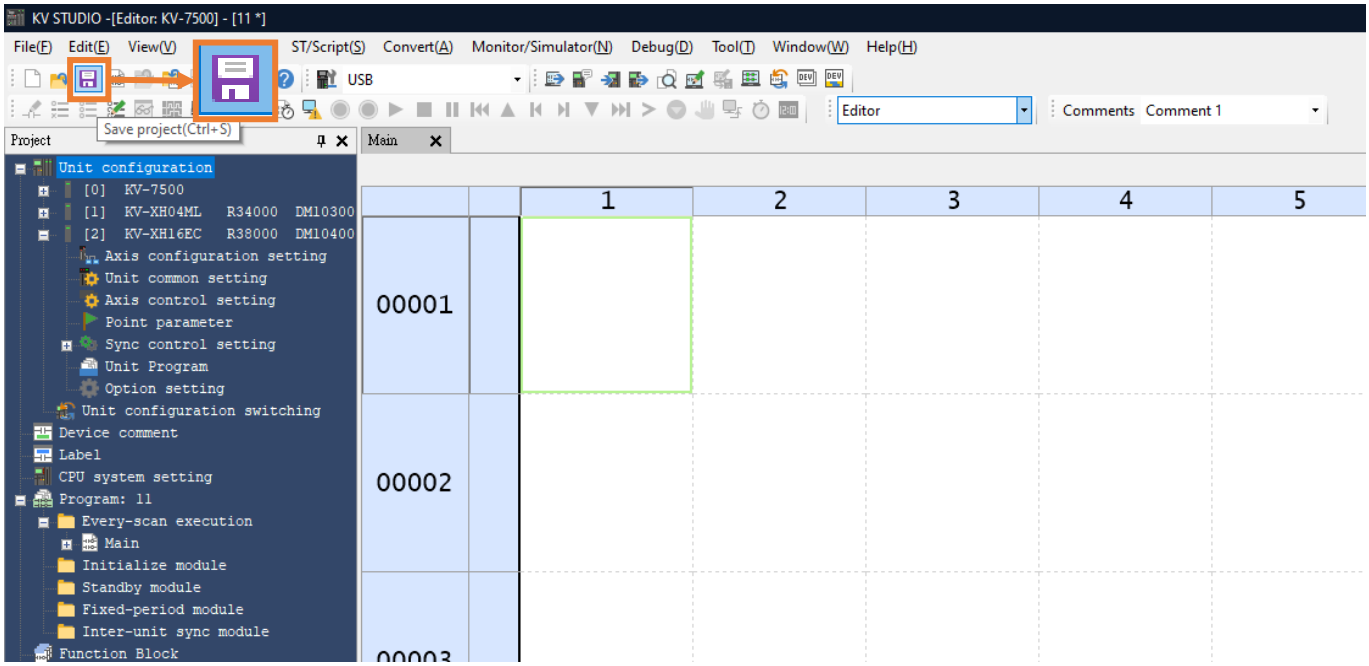

Figure 2.2.5

3. Trial run

3.1 Homing

1. Click **PLC Transfer** to store the files in PLC.

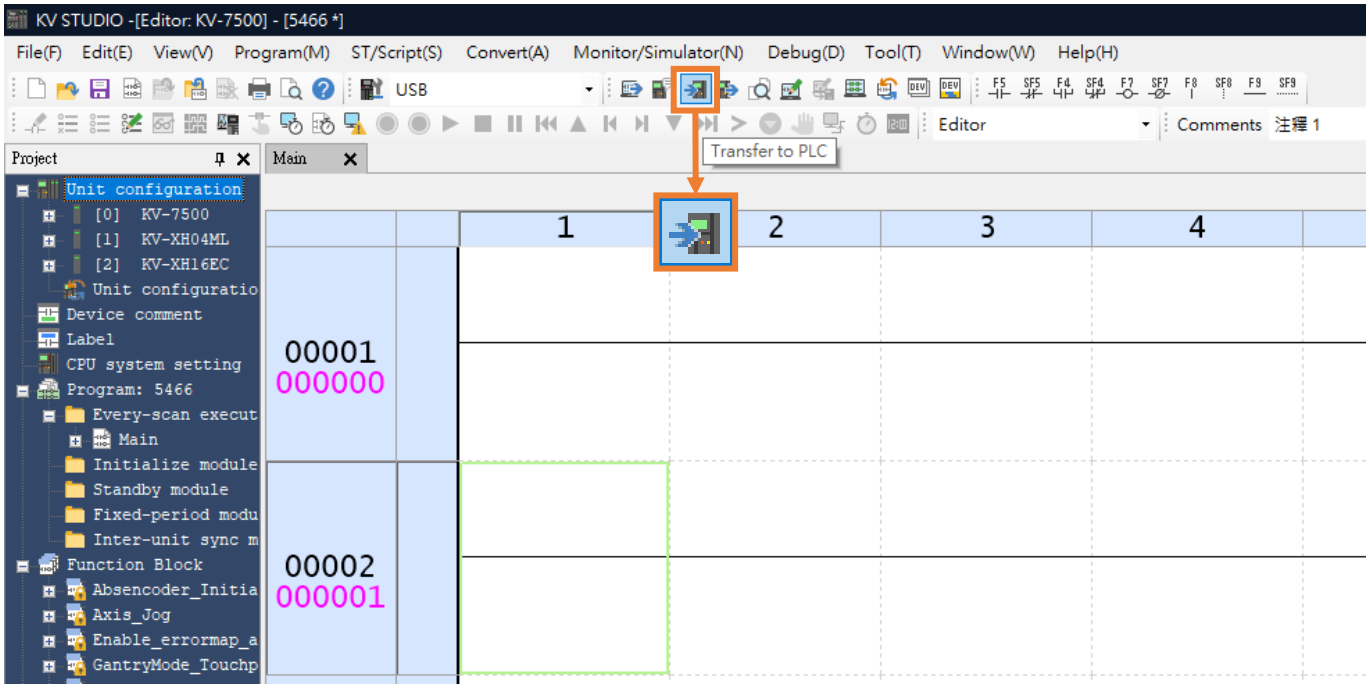

Figure 3.1.1

2. Switch the KV STUDIO mode to **Monitor**.

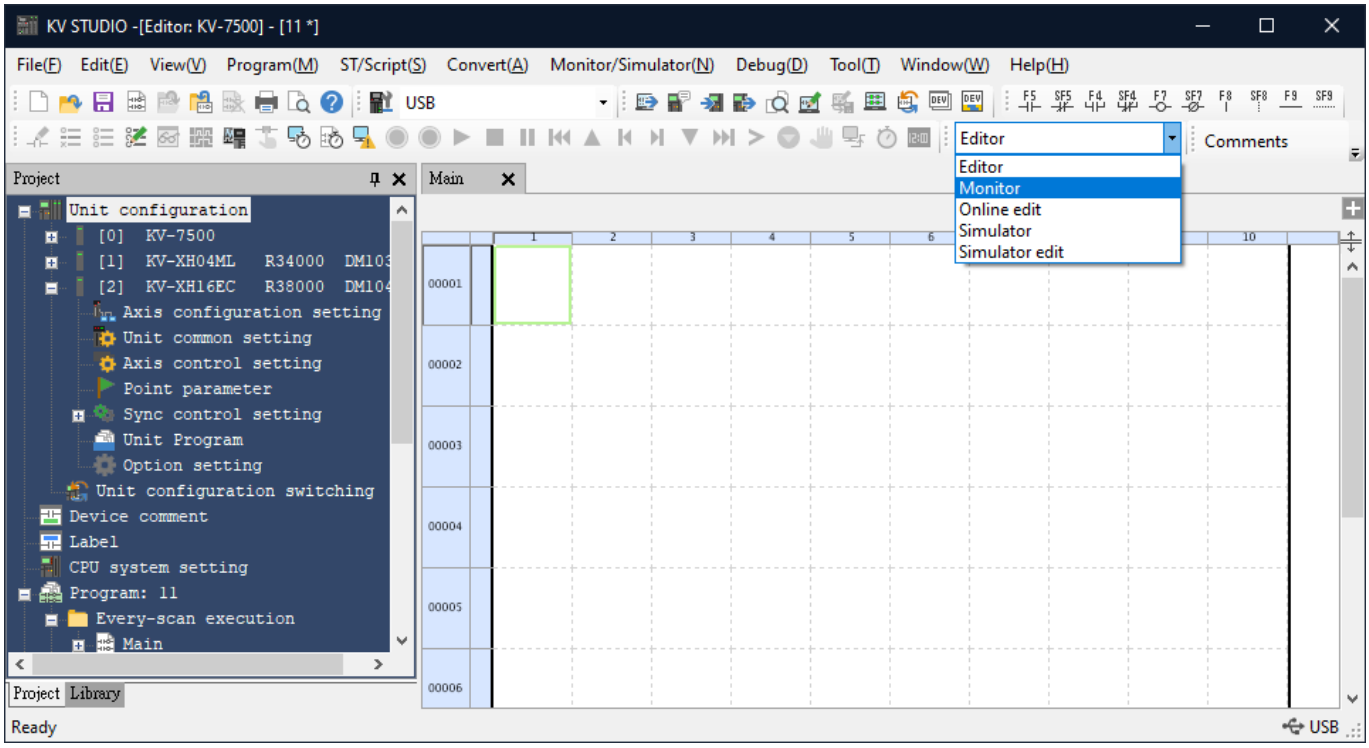

Figure 3.1.2

3. Click the adopted positioning motion unit. Right-click and select **Trial run→ Positioning control→ Axis**.

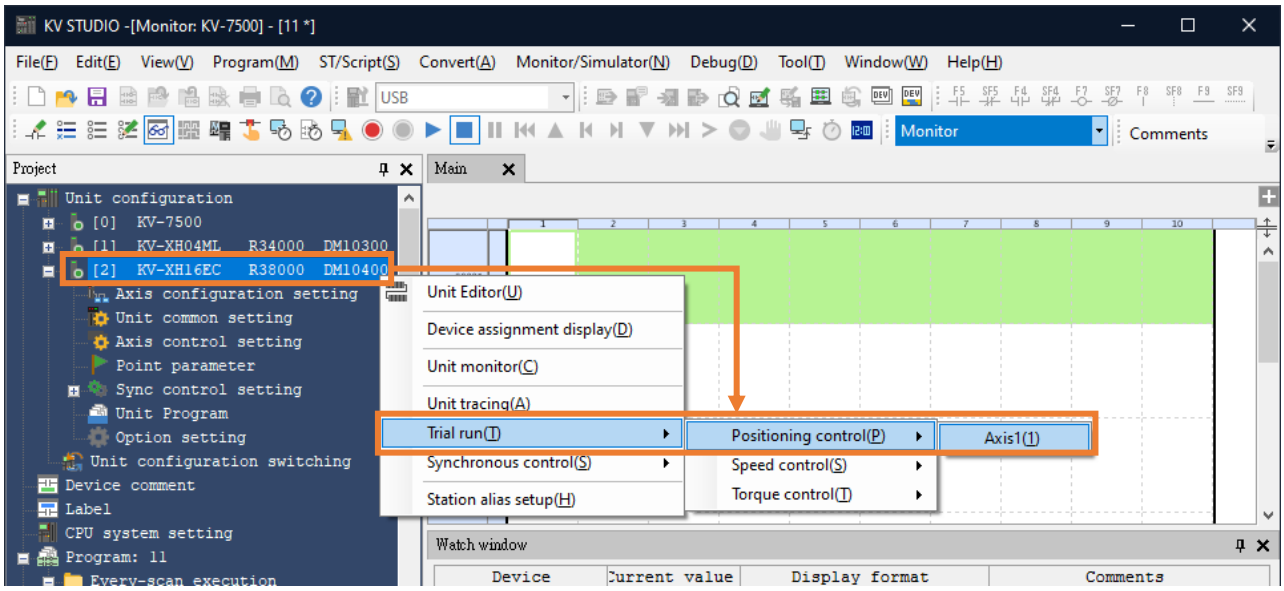

Figure 3.1.3

4. Check if “Axis error” turns to red light. If there is an error, click **Error clear** first; if there is no error, click **OP. Enable**. When "Operation ready" turns to green light, click **servo ON** and wait for “Servo ready” light to turn green. After completing "Servo ready," users can execute **Origin return**.

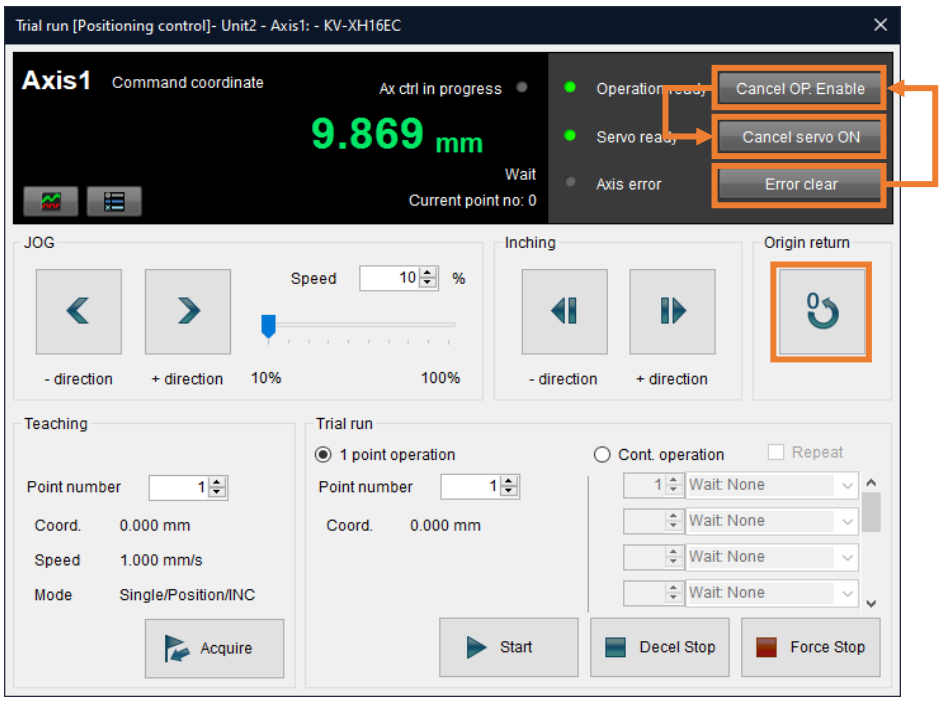

Figure 3.1.4

Note:

1. The above is the operational method for homing. For detailed information, please refer to section 8.4 **Origin Return Operation Trajectory** in the Positioning/Motion Unit "KV-XH64EC/XH32EC/XH16EC User’s Manual."

2. For the limit switch setting for homing, please refer to section 2.1.2 **PDO setting**.

3.2 Positioning control

1. Switch the KV STUDIO mode to **Monitor**.

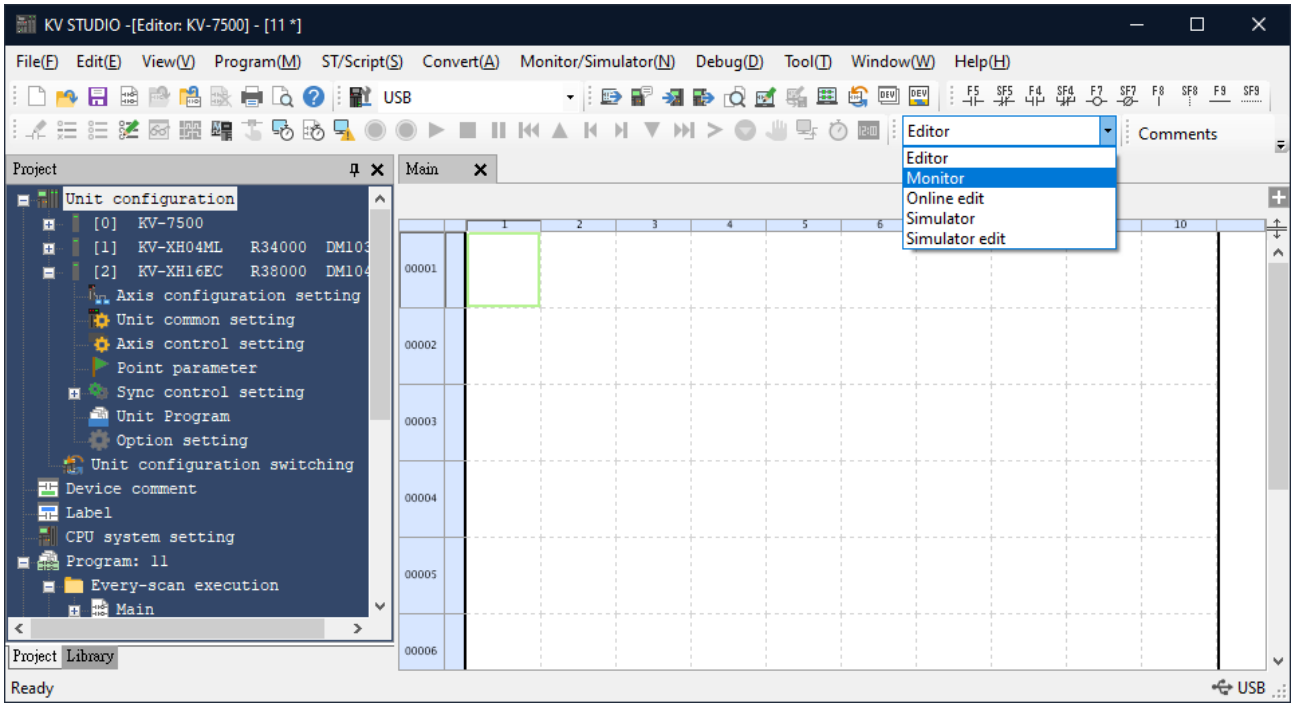

Figure 3.2.1

2. Click the positioning motion unit to be used, right click and select **Trial run→ Positioning control→ Axis**.

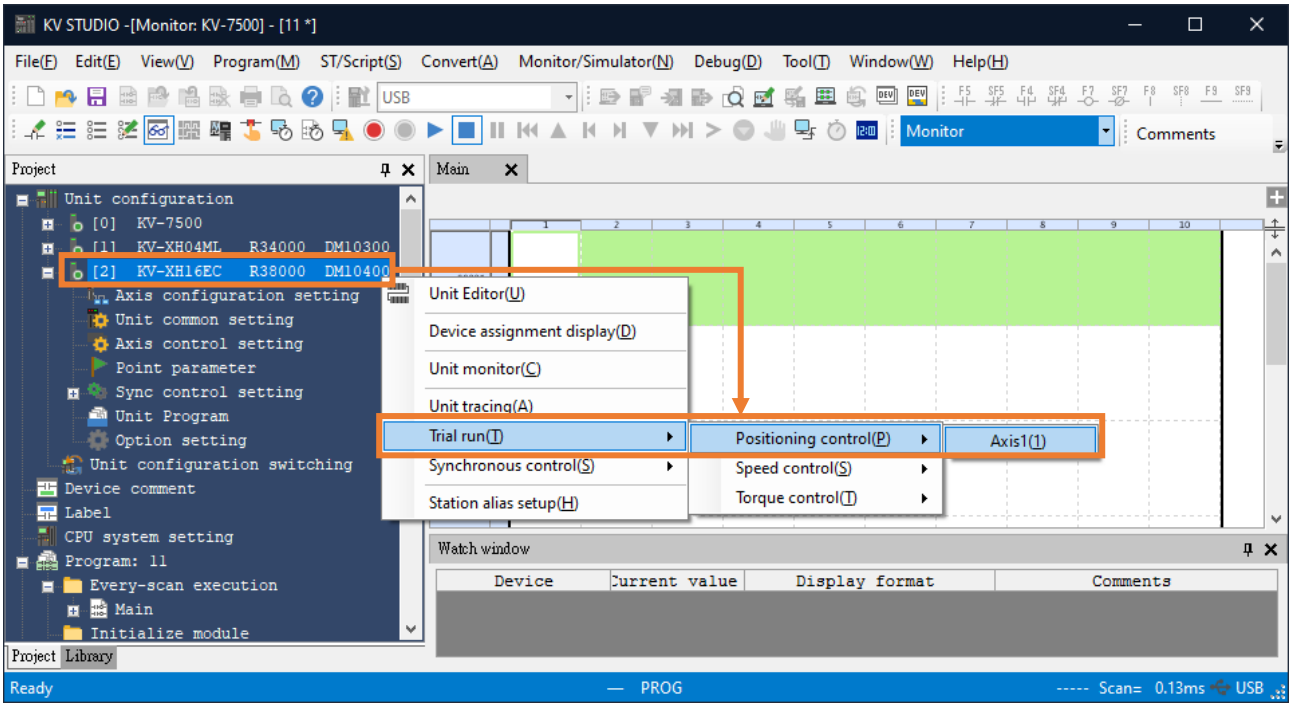

Figure 3.2.2

3. Check if “Axis error” turns to red light. If there is an error, click **Error clear** first; if there is no error, click **OP. Enable**. When "Operation ready" turns to green light, click **servo ON** and wait for “Servo ready” light to turn green. After completing "Servo ready", users can execute **JOG** in forward/backward direction.

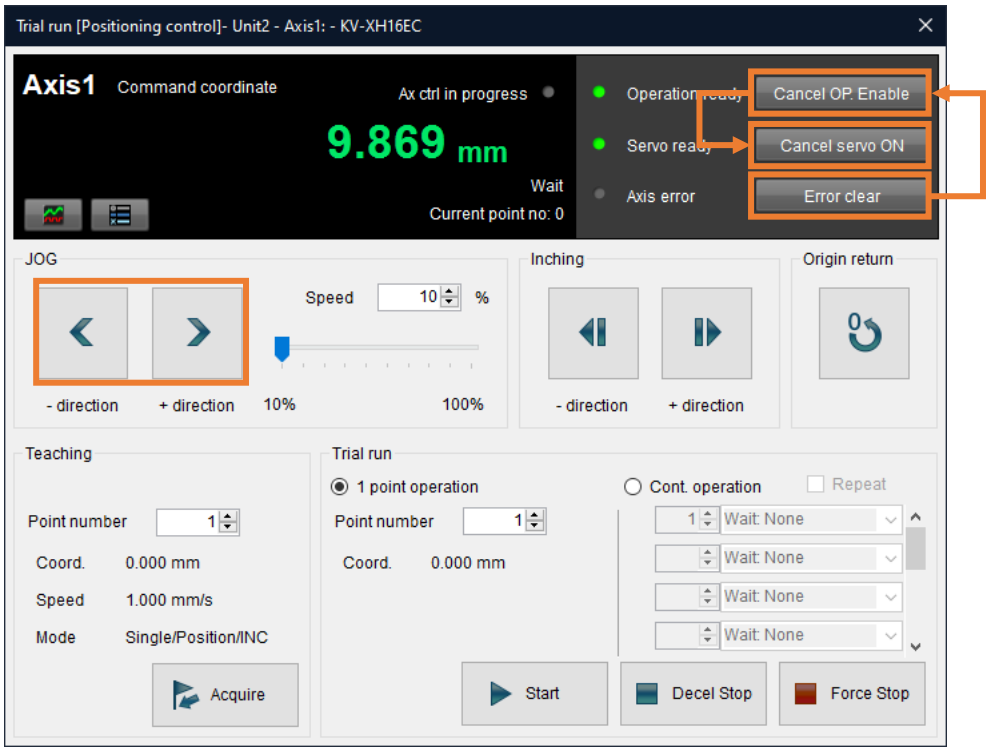

Figure 3.2.3

4. When **JOG** is moving, open Scope in Thunder to monitor the feedback velocity of the motor (Observe physical quantity: **7-Motor velocity**) and check if the velocity command of the controller is consistent with the actual feedback velocity of the motor. For example, when the **JOG** high speed is set to 10.00 mm/s, the motor velocity can be obtained as 600 rpm when the unit is converted into rpm according to the setting of **coordinate transformation calculation**.

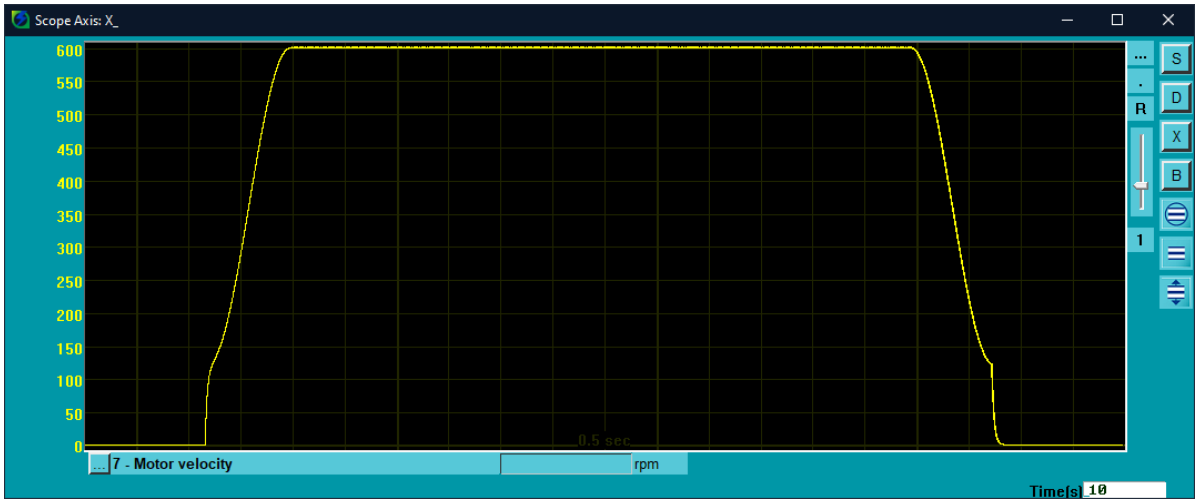

Figure 3.2.4

3.3 Starting speed, acceleration and deceleration rate/time, acceleration curve

1. Complete the parameter setting in Figure 3.3.1 with the above-mentioned setting method.

JOG	JOG starting speed	2.000 mm/s
	JOG high speed	50.000 mm/s
	JOG accel rate/time	0.010 mm/s/ms
	JOG acceleration curve	SIN
	JOG acceleration SIN ratio	100 %
	JOG decel rate/time	0.010 mm/s/ms
	JOG deceleration curve	SIN
	JOG deceleration SIN ratio	100 %
	JOG inching movement	1.000 mm

Figure 3.3.1

2. Open Thunder, click **Tools→ Real-time data collection**. Then, input the position command velocity "dPosVelCmd" and click **Start (F5)** to capture the data.

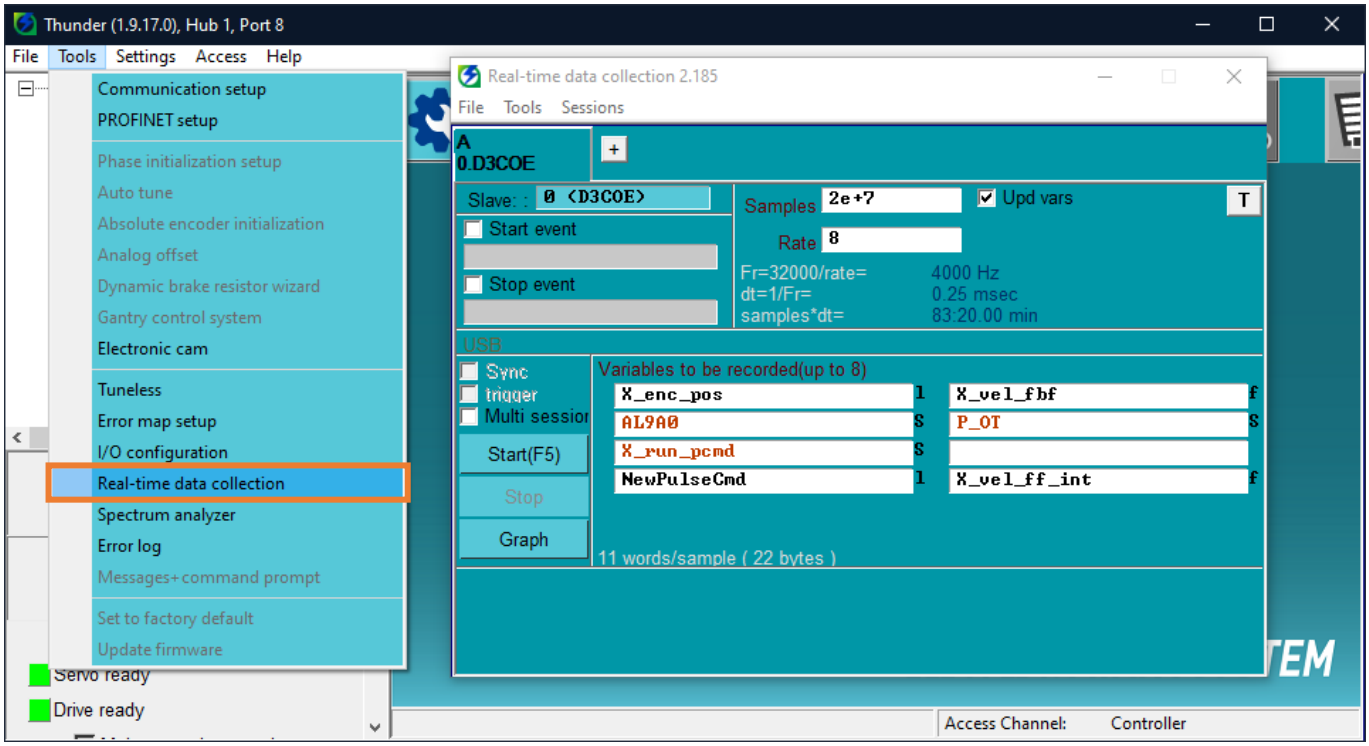

Figure 3.3.2

3. Press and hold **JOG** to move the motor for a certain distance and release it. Wait for the motor to stop.

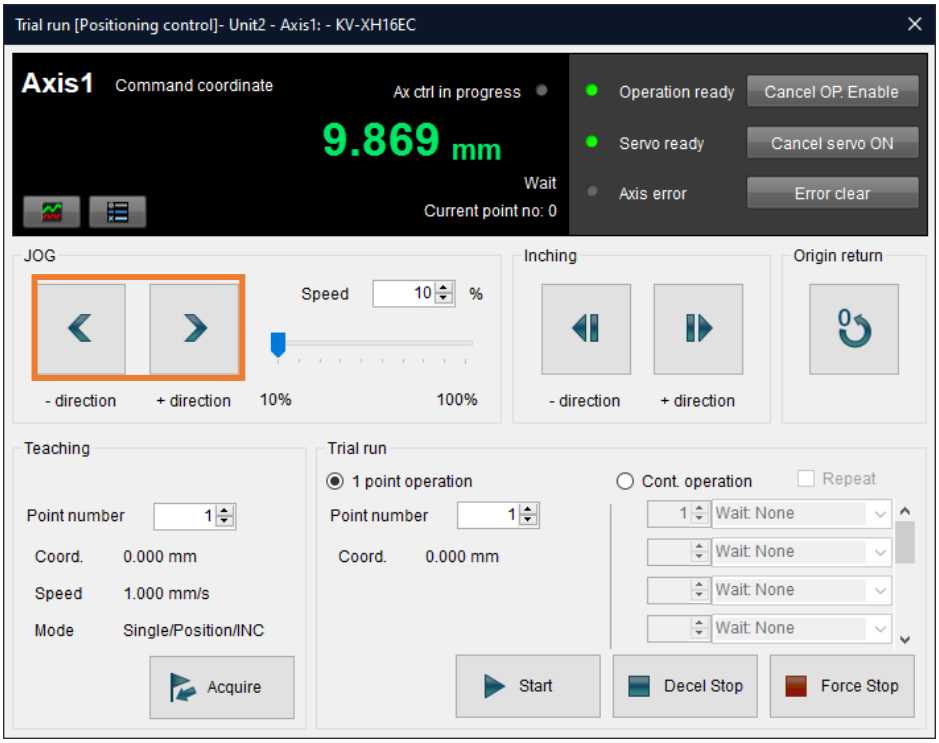

Figure 3.3.3

4. Open Thunder→ **Real-time data collection**, click **Stop** and then click **Graph** (refer to Figure 3.3.2) to generate Figure 3.3.4.

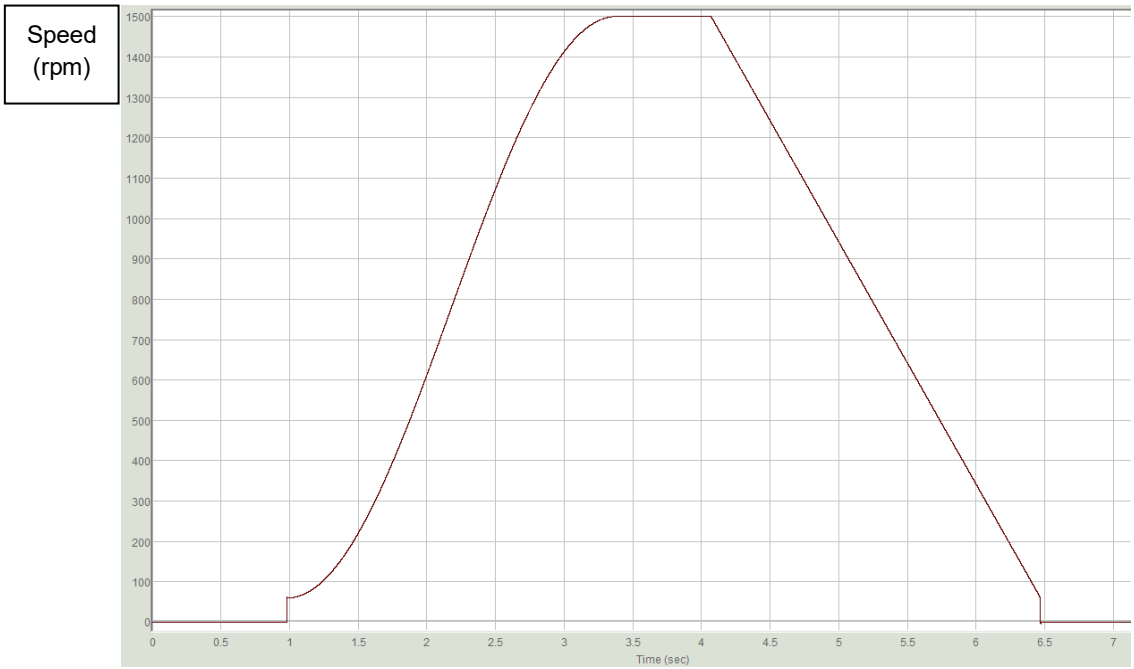

Figure 3.3.4

5. According to the setting in chapter 2 that the resolution for one motor revolution (1mm) is 8388608 pulse/rev, 1.00 mm/s starting speed corresponds to 60 rpm actual speed; 25.00 mm/s **JOG** high speed corresponds to 1500 rpm actual speed. Choose SIN for acceleration curve since the speed command from starting speed to high speed is in a curved shape; choose a straight line for deceleration curve since the speed command from high speed to starting speed is in a straight line. The acceleration/deceleration time of 0.010 mm/s/ms corresponds to the actual acceleration of 0.6 rpm/ms, indicating that the speed increases by 0.6 rpm every 1 ms.

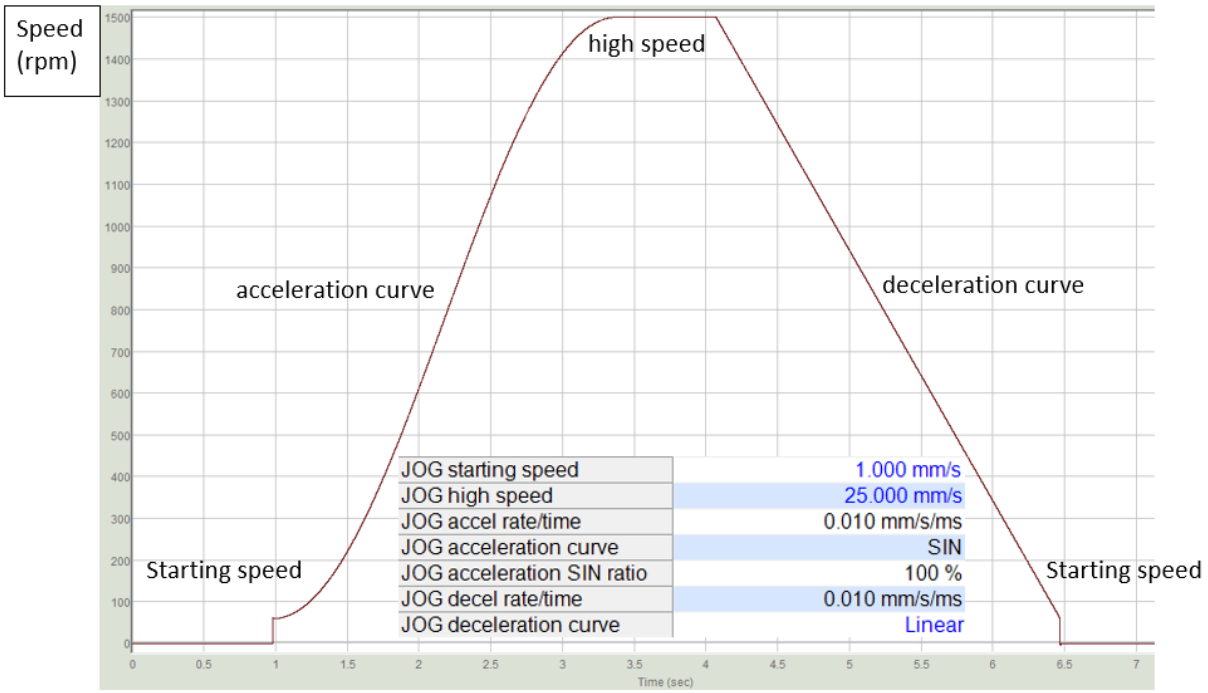

Figure 3.3.5