

A00
19010851

Thank you for buying the AM600-4PME EtherCAT slave station positioning module. This product was developed and produced by Inovance Technology.

This module is an extended module based on the EtherCAT bus. It features 4 pulse output channels, each of which is capable of outputting a pulse in the format of phase A/B 1X frequency, pulse + direction or CW/CCW. It supports up to 200 kHz. Each channel includes 4 digital input terminals and 1 digital output terminal. The digital input terminals function as positive & negative limits, home switches, emergency stop inputs or common inputs, while the digital output terminal functions as a common output or servo enabling signal. The module can be used for the positioning control of a pulse-type servo and a step motor drive.

This User Guide mainly describes the specifications, features and uses of the AM600-4PME EtherCAT slave station positioning module. Users should carefully read these instructions before using this product to ensure the safe and proper use of this product. Please refer to the *AM600 Series PLC Hardware Manual* and the *AM600 Series PLC Programming Manual (Motion Control)* to understand how to use the user program development environment and the design method of the product's user program. You can download the latest materials from our website <http://www.inovance.cn>.

Safety Instructions

There are two levels of safety information and precautions: Warning and Caution. Please take appropriate safety measures when using this product.

- DANGER**: Indicates improper operation which, if not avoided, may cause death or serious injury;
- CAUTION**: Indicates improper operation which, if not avoided, may cause moderate or minor injury, or damage the equipment.

In some cases, failure to follow "Cautions" may also lead to serious consequences. Please make sure to follow both warnings and precautions, otherwise, death, serious injury, or damage to the product or system may result.

Please keep this guide so that it can be read when necessary and forward this guide to the end user.

Control System Design

- DANGER**: Provide a safety circuit outside the PLC so that the control system can still work safely once external power failure or PLC fault occurs.
- Add a fuse or circuit breaker because the module may smoke or catch fire due to extended overcurrent caused by operation above the rated current or load short-circuiting.
- CAUTION**: An emergency stop circuit, a protection circuit, a forward/reverse operation interlocked circuit, and an upper position limit and lower position limit interlocked circuit must be set in the external circuits of PLC to prevent damage to the machine.
- To ensure safe operation, for the output signals that may cause critical accidents, please design an external protection circuit and safety mechanism;
- If the PLC CPU detects an abnormality in the system, all outputs may be closed. However, when a fault occurs in the controller circuit, the user may be unable to control the output. Therefore, it is necessary to design an appropriate external control circuit to ensure normal operation;
- If the PLC's output units such as relays or transistors are damaged, the output may fail to switch between ON and OFF states according to the commands;
- The PLC is designed to be used in an indoor electrical environment (overvoltage category II). The power supply must have a system-level surge protector, assuring that overvoltage due to lightning shock can't be applied to the PLC's power supply input terminals, signal input terminals and output terminals, to prevent damage to the equipment.

Installation

- DANGER**: Installation must be carried out by specialists who have received the necessary electrical training and who have a thorough understanding of electrical knowledge.
- Disconnect all of the system's external power supplies before assembling, disassembling, or wiring the module. Failure to do so may result in electric shock, module breakdown or malfunction.
- Do not use the PLC where there are dust, oil smoke, conductive dust, corrosive or combustible gases, or expose it to high temperature, condensation, wind & rain, vibration or impact. Electric shock, fire and malfunctions may also result in damage or deterioration of the product.
- The PLC is open-type equipment that must be installed in a control cabinet with a lock (cabinet housing protection >IP20). Only the personnel who have received the necessary electrical training and who have a sufficient understanding of electrical knowledge may open the cabinet.
- CAUTION**: Prevent metal filings and wire ends from dropping into the PLC's ventilation holes during installation. Failure to comply may result in fire, equipment breakdown, and malfunction.
- Ensure that there are no foreign objects on the ventilation surface. Failure to comply may result in poor ventilation, which may cause fire, equipment breakdown, and malfunction.
- Ensure the module is securely connected to the respective connector and firmly hook in the module. Improper installation may result in malfunction, equipment breakdown or collapse.

Wiring

- DANGER**: Wiring must be carried out by specialists who have received the necessary electrical training and who have a thorough understanding of electrical knowledge.
- Disconnect all of the system's external power supplies before wiring. Failure to comply may result in electric shock, module breakdown or malfunction.
- Install the terminal cover attached to the product before powering-on or operating the device after wiring is completed. Failure to comply may result in electric shock.
- Properly insulate terminals so that insulation distance between cables will not reduce after cables are connected to terminals. Failure to comply may result in electric shock or damage to the equipment.



- CAUTION**: Prevent metal filings and wire ends from dropping into the ventilation holes of the PLC during wiring. Failure to comply may result in fire, equipment breakdown, and malfunction.
- The external wiring specification and installation method must comply with local regulations. For details, see the wiring section in this guide.
- To ensure safety of equipment and operator, use cables with a sufficient diameter and correctly connect the cables to the ground.
- Wire the module correctly after clarifying the connector type. Failure to comply may cause the module and external equipment to break down.
- Tighten bolts on the terminal block in the specified torque range. If the terminal is not tight, short-circuiting, fire or malfunction may occur. If the terminal is too tight, collapse, short-circuiting, fire or malfunction may occur.
- If using the connector to connect with external equipment, ensure that you correctly crimp or weld with the tool specified by the manufacturer. If the connection is makes poor contact, short-circuiting, fire or malfunction may occur.
- A label on the top of the module is to prevent foreign objects from entering the module. Do not remove the label during wiring. Remember to remove the label before system operation, to facilitate ventilation.
- Do not bundle control wires, communication wires and power cables together. They must be run with distance of more than 100 mm. Otherwise, noise may result in malfunction.
- Select shielded cables for high-frequency signal input/output in applications with serious interference so as to enhance system anti-interference abilities.

- Maintenance and Inspection**
- DANGER**: Maintenance & inspection must be carried out by personnel who have the necessary electrical training and experience.
- Do not touch the terminals while the power is on. Failure to comply may result in electric shock or malfunction.
- Disconnect all of the system's external power supplies before cleaning the module or re-tightening screws on the terminal block or screws of the connector. Failure to comply may result in electric shock.
- Disconnect all of the system's external power supplies before removing the module or connecting/removing the communication wiring. Failure to comply may result in electric shock or malfunction.
- CAUTION**: Thoroughly read these instructions and ensure safety before conducting online modification.
- Disconnect the power supply before installing/removing the extension card.

- Disposal**
- CAUTION**: Treat scrapped modules as industrial waste. Dispose of the battery in accordance with local laws and regulations.

Product Information

Model and Nameplate

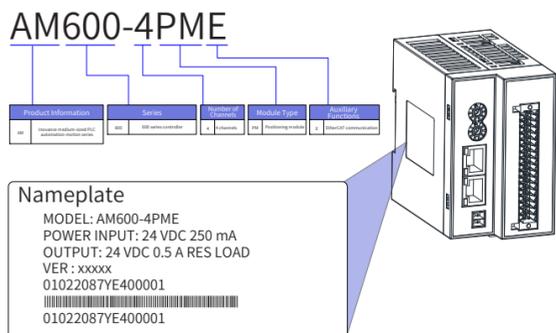


Figure 1 Description of model and nameplate

Model	Classification	Description	Applicable to
AM600-4PME	EtherCAT slave station positioning module	EtherCAT slave station 4-channel positioning module	AM600

External Interfaces

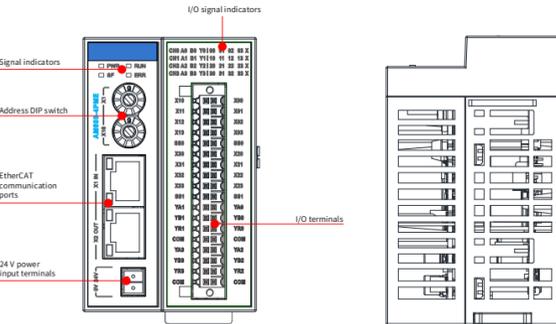


Figure 2 Module interfaces

Interface Name	Function
EtherCAT communication interfaces	X1 IN: EtherCAT input interface X2 OUT: EtherCAT output interface used to connect a back-end EtherCAT slave
Signal indicators	PWR Power indicator Green ON when power supply is switched on
	RUN Run indicator Green ON when the module is in normal operation
	SF Module fault indicator Red ON when the module fails
	ERR State machine error indicator Red ON when state machine error occurs
I/O signal indicators	Corresponding to various I/O signals. ON: I/O active; OFF: I/O inactive.
24 V power input terminal	Module power input
Address DIP switch	Slave address setting switch: ADDR1/ADDR0: site address encoder switch; address being set using hexadecimal system; slave decimal address = ADDR1x16+ADDR0x1 (address: 1 to 255)
I/O terminals	For details, refer to "Electrical Design Reference".

General Specifications

Item	Specifications
Power supply voltage	24 VDC (20.4 VDC to 28.8 VDC) (-15% to +20%), an external power supply provided by a user is allowed
The protocol used when communicating with the CPU module	EtherCAT; 100 Mbps
EtherCAT baud rate	Up to 100 m to adapt to the baud rate of EtherCAT master station
Network interface/ Network cable	Standard Ethernet and standard Ethernet cable (CAT 5e)
Station number range	1 to 255. An internal address is automatically assigned according to the connection sequence of the network bus.

Specific performance indexes reached are shown in the following table:

Item	Specifications
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO), FoE
Minimum synchronization period of 6-shaft cam	1250 μs (TYP)
Synchronization mode	The servo uses a DC-distributed clock while I/O uses synchronous input and output.
Physical layer	100BASE-TX
Baud rate	100 Mbit/s (100Base-TX)
Duplex mode	Full duplex
Topological structure	Linear topological structure
Transmission medium	For the network cable, refer to the "Wiring" section.
Transmission distance	Less than 100 m between two nodes
EtherCAT frame length	44 bytes to 1498 bytes
Process data	Single frame up to 1486 bytes
Synchronization jitter of two slaves	< 1 μs
Refresh time	1000 digital inputs/outputs: approximately 30 μs; 32 servo axes: approximately 100 μs

Input Specifications

Item	Specifications
Signal name	Common inputs (left and right limits, home and emergency stop inputs) 24 V input
Rated input voltage	24 VDC (+20% to -15%)
Rated input current	7.3 mA (typical) (at 24 VDC)
ON current	3.5 mA or higher
OFF current	1.5 mA or lower
Input resistance	3.3 kΩ
Common terminal mode	4 points share one common terminal.

Output Specifications

Item	Specifications
Signal name	High speed output (phase A & B and enable signal YR) Sink output
Control circuit voltage	5 VDC to 24 VDC
Rated load current	0.5 A/point
Response time when the module is turned ON	1 μs
Response time when the module is turned OFF	1 μs
Output frequency	200 kHz (An equivalent external load of 20 mA and above is required at the output of 50 kHz and above)
Common terminal mode	Every 3 points shares one common terminal.

Mechanical Design Reference

Mounting Dimensions

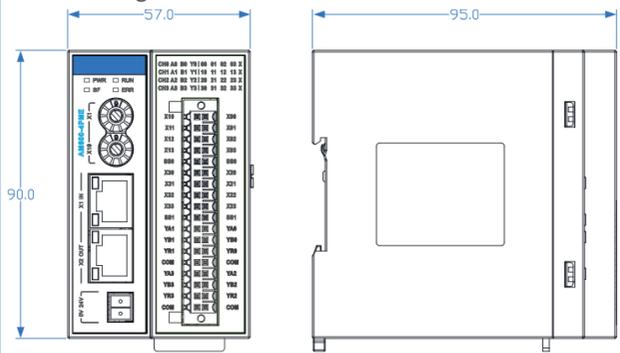
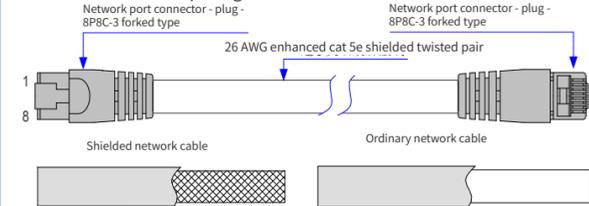


Figure 3 Mounting dimensions (in mm)

Electrical Design Reference

EtherCAT Cable Selection

Network Cable Preparing



* Please use enhanced cat 5e shielded twisted pair with iron case molding line.

Signal Pin Assignment

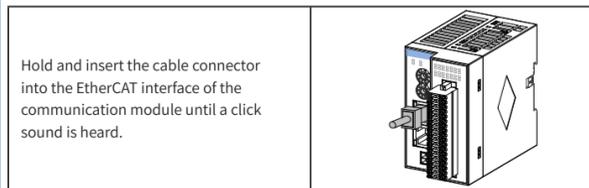
Pin	Signal	Signal Direction	Signal Description
1	TD+	Output	Data transfer+
2	TD-	Output	Data transfer-
3	RD+	Input	Data receive+
4	--	--	Disabled
5	--	--	Disabled
6	RD-	Input	Data receive-
7	--	--	Disabled
8	--	--	Disabled

Length requirements: FastEthernet technology demonstrates the cable length between devices can not exceed 100 m when the EtherCAT bus is used. Otherwise, signal attenuation will occur, affecting normal communication.

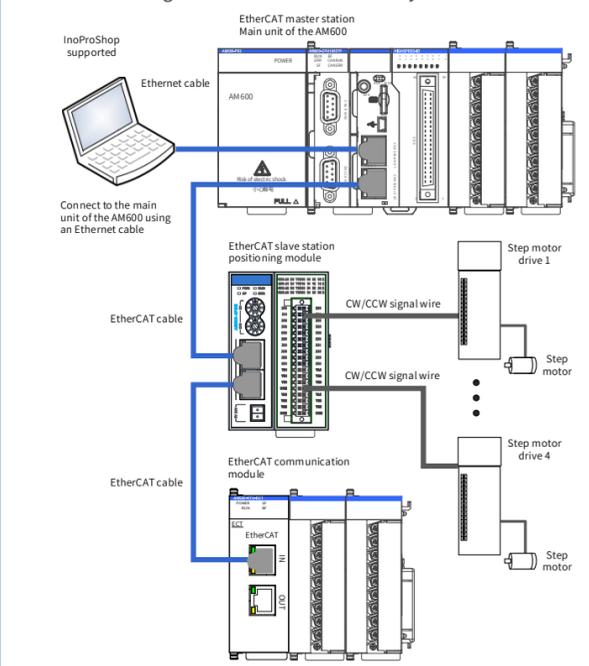
Technical requirements: Short circuit, open circuit, displacement and poor contact during the 100% continuity test. The EtherCAT bus uses shielded cables to perform network data transfer. Cables with the following specifications are recommended:

Item	Specifications
Cable type	Elastic crossover cable, S-FTP, enhanced cat 5e
Standards compliance	EIA/TIA568A, EN50173, ISO/IEC11801 EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Conductor type	Twisted pair
Line pair	4

Communication Connection



Connection Diagram of the Communication System



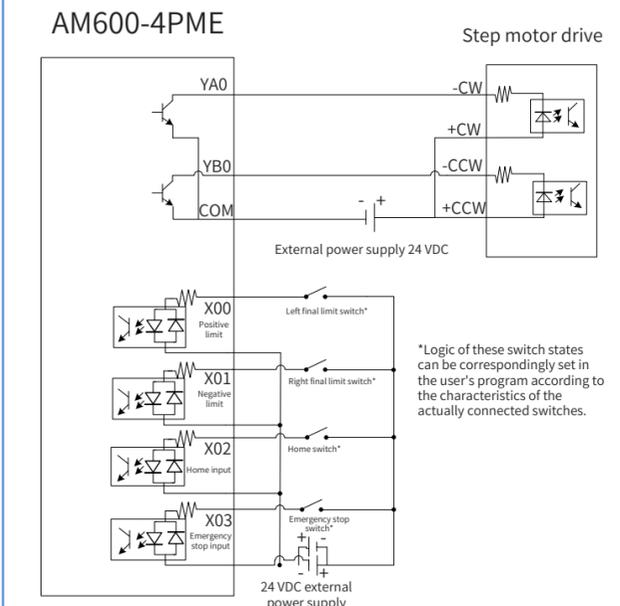
Note: To avoid the influence on the communication cable due to other tension and ensure the stability of communication, secure the cable near the equipment.

Fault Indication and Countermeasures for EtherCAT Communication Slave Module

LED Indicators	Description	Solution
RUN	OFF	The EtherCAT master and slave are in initialized state. Check configurations and parameter allocation. Check the communication address. Check whether the network cable specifications and length are consistent with the recommendations.
RUN	Flashing	The EtherCAT slave is in a state other than OP. Check slave configurations. Check whether the module is lost or fails or any unconfigured module exists.
	Flashing	A communication error between the EtherCAT master and slave occurs. Check whether master and slave parameter configurations are correct.
ERR	Flashing	Search for the actual failure type against object dictionaries including 0x603F, 0x683F, 0x703F and 0x783F.
SF	Solid ON	The output channel fails.

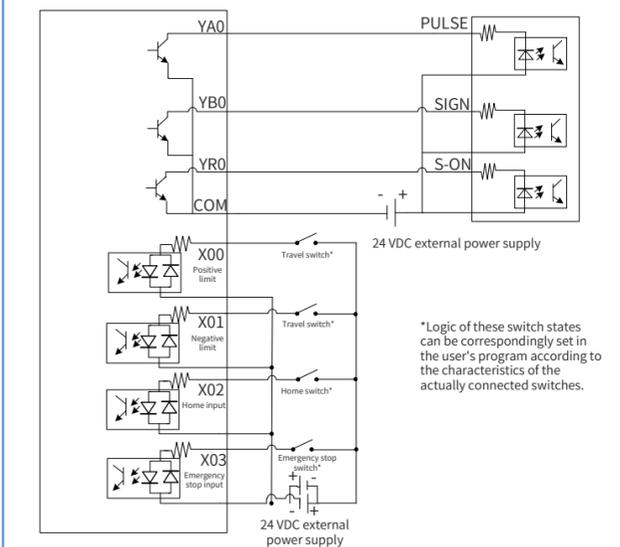
User Output Terminal Connection

Connection Diagram of Signal Terminals



*Logic of these switch states can be correspondingly set in the user's program according to the characteristics of the actually connected switches.

AM600-4PME Servo motor drive



*Logic of these switch states can be correspondingly set in the user's program according to the characteristics of the actually connected switches.

Cable Selection

Cable Name	Model	Applicable Cable Diameter		Manufacturer	Crimping Tool
		Chinese Standard/mm ²	American Standard/AWG		
Tubular lug	GTVE07512	0.75	21	Suzhou Yuanli	YAC-5

Those cable lugs are applicable to this module, and the cable rated temperature is required must be above 75°C.

Cable Preparing Procedures

- Strip back the wire outer coating by 11 to 14 mm. Pass the cable through the tube of proper wire size.
- Insert the exposed end into the hole of the cable lug, and then crimp the cable with a recommended crimping tool.

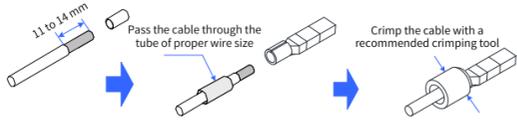


Figure 4 Cable preparing

Terminal Arrangement

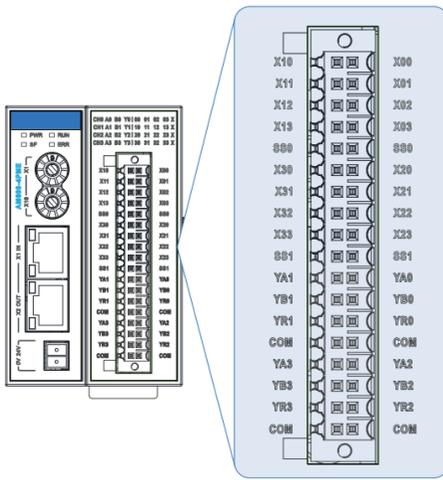
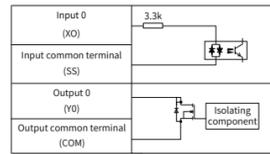


Figure 5 Terminal arrangement

External Wiring

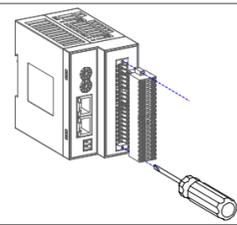
External Wiring	Signal Name	Terminal NO.	Signal Name	External Wiring
	Column B		Column A	
	CH1 input 0 (X10 positive limit)	2	CH0 input 0 (X00 positive limit)	
	CH1 input 1 (X11 negative limit)	4	CH0 input 1 (X01 negative limit)	
	CH1 input 2 (X12 home switch)	6	CH0 input 2 (X02 home switch)	
	CH1 input 3 (X13 input interrupted)	8	CH0 input 3 (X03 input interrupted)	
	CH1 input common terminal (SS0)	10	CH0 input common terminal (SS0)	
	CH3 input 0 (X30 positive limit)	12	CH2 input 0 (X20 positive limit)	
	CH3 input 1 (X31 negative limit)	14	CH2 input 1 (X21 negative limit)	
	CH3 input 2 (X32 home switch)	16	CH2 input 2 (X22 home switch)	
	CH3 input 3 (X33 input interrupted)	18	CH2 input 3 (X23 input interrupted)	
	CH3 input common terminal (SS1)	20	CH2 input common terminal (SS1)	
	CH1 output A (YA1)	22	CH0 output A (YA0)	
	CH1 output B (YB1)	24	CH0 output B (YB0)	
	CH1 output R (YR1)	26	CH0 output R (YR0)	
	CH1 output common terminal (COM)	28	CH0 output common terminal (COM)	
	CH3 output A (YA3)	30	CH2 output A (YA2)	
	CH3 output B (YB3)	32	CH2 output B (YB2)	
	CH3 output R (YR3)	34	CH2 output R (YR2)	
	CH3 output common terminal (COM)	36	CH2 output common terminal (COM)	

Internal Equivalent Circuit



Wiring Precautions

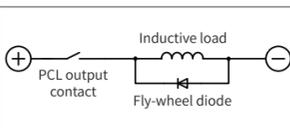
After the I/O terminal block is installed to the CNS, fix it with 0.2 to 0.25 Nm torque, as shown in the figure on the right:



Do not bundle the terminal connection cables together with power cables (high voltage, large current) which produce strong interference signals. Separate it from other cables and avoid cabling in parallel. Select recommended cables and pinboards for connection. It is recommended that shielded cables be used as terminal connection cables to enhance capacity of resisting interference.

Electric Shock Protection When Using Inductive Load

When the inductive load is applied, large back EMF will be produced between contacts and arc discharge is also caused when the inductive load stops. This may result in contact failure or contact sag, shortening the contact lifetime. Therefore, it is recommended to use the products with a built-in relay protection circuit. The freewheel diode must meet the following conditions: ① reverse voltage is 5 to 10 times of load voltage; ② forward current is larger than load current.

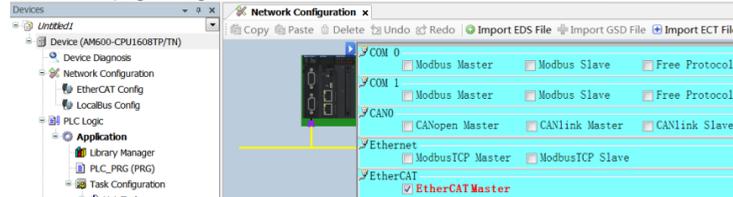


Programming Examples

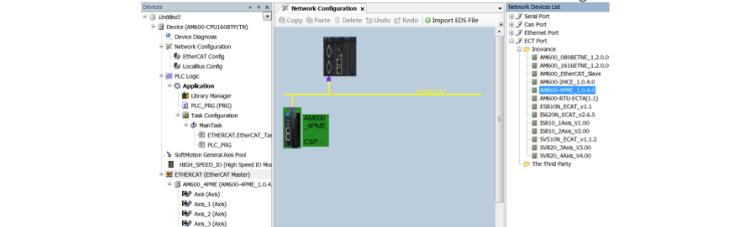
This example mainly implements the following functions:

Send 50000 pulses in "phase A&B" format through channel Ch0 in the frequency of 10 K. Connect Ch1 to a step motor which will turn each time the step motor receives 5000 pulses in the form of "pulse + direction". The load travels 50 mm for each turn of the motor, and the load is controlled by the PLC program to travel 100 mm in a forward direction at the rate of 10 mm/s. In addition, X10 is connected to the positive limit switch and X11 is connected to the negative limit switch to provide limit protection.

- Start the AM600 programming software to enable the functions of AM600 EtherCAT master station.

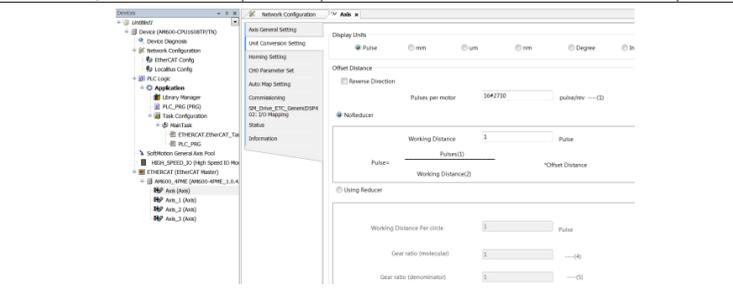


- Double click the AM600-4PME module in the Network Devices List to add it to the configuration.

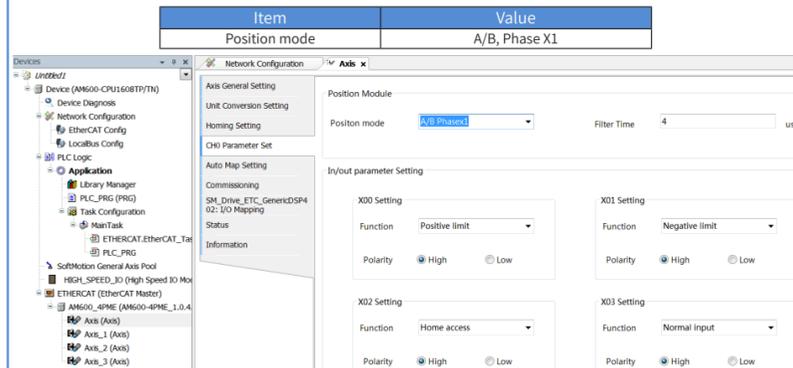


- Set the configuration parameters of Axis and Axis_1 according to the actual application scenario. First, set the parameters of Axis as follows by double clicking "Axis" to select this axis and selecting the "Unit Conversion Setting" page on the right:

Item	Value	Item	Value
Display unit	Pulse	Reducer	Disabled
Number of instruction pulses after the motor performs a turn	1	The operating stroke after a motor performs a turn	1

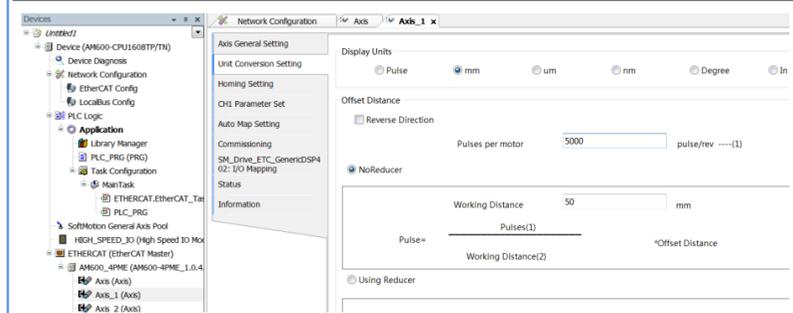


Double click "Axis" to select this axis, select the "CH0 Parameter Set" page on the right and set the parameters as follows:



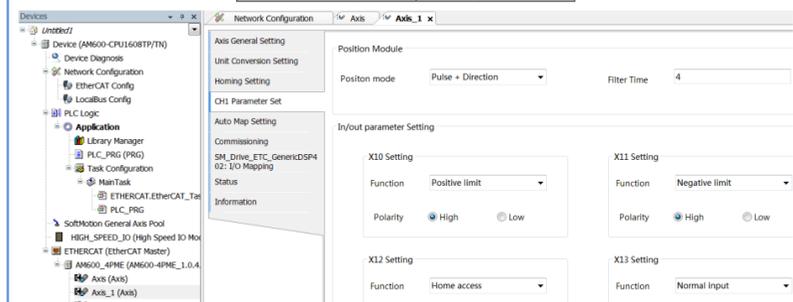
Then, set the parameters of Axis_1 as follows by double clicking "Axis_1" to select this axis and selecting the "Unit Conversion Setting" page on the right:

Item	Value	Item	Value
Display unit	mm	Reducer	Disabled
Number of instruction pulses after the motor performs a turn	5000	Operating stroke after a motor performs a turn	50



Double click "Axis_1" to select this axis, select the "CH1 Parameter Set" page on the right and set the parameters as follows:

Item	Value
Position mode	Pulse + Direction
X10 setting	Positive limit
X11 setting	Negative limit



- PLC programming

This module uses the 402 protocol, allowing all positioning functions to be implemented in CSP mode. Therefore, all operations on channels are implemented according to the servo axis.

- Invoking the MC_Power functional block will separately enable the two axes.

The variables xenable and ienable are initialized by default. Axis and Axis_1 are enabled after EtherCAT communication is established. The "Status" signal of two functional blocks are effective. At the same time, the Y output terminals of axes Ch0 and Ch1 output effective levels.

```

PROGRAM PMEpower
VAR
  xenable: BOOL := 1;
  ienable: BOOL := 1;
  MC_Power_0: MC_Power;
  MC_Power_1: MC_Power;
END_VAR
  
```

Invoke the relative positioning functional block "MC_MoveRelative" to cause Ch0 corresponding to Axis to send 50000 pulses. Enabling variable axis_enable starts sending pulses, and sending completes when the Done signal is effective.

```

PROGRAM PLC_PRG
VAR
  MC_MoveRelative_0: MC_MoveRelative;
  axis_enable: LREAL := 50000;
  axis_distance: LREAL := 10000;
  axis_velocity: LREAL := 10000;
  axis_acc: LREAL := 10000;
  axis_dec: LREAL := 10000;
END_VAR
  
```

Invoke the relative positioning functional block "MC_MoveRelative" to cause Ch1 corresponding to Axis_1 to travel 100 mm in a forward direction. Pulses are sent when the signal is valid and sending completes when the signal is valid.

```

PROGRAM PME_relative
VAR
  MC_MoveRelative_1: MC_MoveRelative;
  axis_1_enable0: BOOL;
  axis_1_distance0: LREAL := 100;
  axis_1_velocity: LREAL := 10;
  axis_1_acc: LREAL := 10;
END_VAR
  
```

Failures and Alarms

The failure type of Ch0 can be found from object dictionary 603Fh. Ch1 failures, Ch2 failures, and Ch3 failures can be obtained from object dictionary 683Fh, 703Fh, and 783Fh, respectively.

- Failure codes and Solutions

Failure Code	Description	Solution
0x0001	Emergency stop failure The DI terminal is configured as emergency stop and input from the DI terminal is valid.	Check whether the DI terminal is configured as emergency stop. Check whether the emergency stop input is valid.
0x0002	Following error The given target position is significantly deviated from the current position	Check whether the target position of the PLC program is suddenly changed. Check whether the following error window is set too small.
0x0003	Frequency too high The target output frequency exceeds 200 K.	Check whether the PLC program's target speed exceeds 200 K.

- Alarm codes and Solutions

Alarm Code	Description	Solution
0x0101	Limit valid The DI terminal is configured as limit switch and input is valid.	Check whether the DI terminal is configured as limit switch. Check whether the limit switch is valid.
0x0102	Maximum output frequency reached, i.e. 200 K The target output frequency is 200 K.	Check whether the limit switch is valid. Check whether the PLC program's target speed is 200 K.
0x0104	Error when synchronizing the target position The target position is deviated from the internal target position.	Check whether the limit switch is touched during operation. After the limit switch is invalid, continue to travel in this direction.

INOVANCE Warranty Agreement

- Inovance provides 18-month free warranty to the equipment itself from the date of manufacturing for the failure or damage under normal use conditions.
- Within the warranty period, maintenance will be charged for the damages caused by the following reasons:
 - Improper use or repair/modification without prior permission
 - Fire, flood, abnormal voltage, other disasters and secondary disasters
 - Hardware damage caused by dropping or transportation after procurement
 - Improper operations
 - Damage out of the equipment (for example, external device factors)
- The maintenance fee is charged according to the latest Maintenance Price List of Inovance.
- If there is any problem during the service, contact Inovance's agent or Inovance directly.
- Inovance reserves the rights for explanation of this agreement.

Suzhou Inovance Technology Co., Ltd.
Address: No.16, Youxiang Road, Yuexi Town, Wuzhong District, Suzhou 215104, P.R. China
Website: <http://www.inovance.cn>