INOVANCE

User Guide

AM600-0808ETNE

EtherCAT Slave I/O Module

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1. Overview

Thank you for purchasing the AM600-0808ETNE EtherCAT communication slave I/O module developed and manufactured independently by Inovance.

This product supports EtherCAT communication. It can be used with the AM600CPU module. It uses external 24 VDC power supply and has 8-point digital NPN output and 8-point digital input.

This guide describes the specifications, characteristics and using methods of AM600-0808ETNE EtherCAT communication digital I/O expansion module. Please read this guide carefully before using to ensure more safe usage. Please refer to the AM600 Series PLC Hardware Manual and the AM600 Series PLC Programming Manual (Motion Control Part) to understand the use of the user program development environment and design method of the user program of the product. You can download the latest materials from our website (www.inovance.com).

2. Safety Information and Precautions

Safety information and precautions are identified into two grades: Warning and Caution. Please make sure to operate properly with adequate safety assurance.

| ⚠ WARNING | Indicates the improper operation which, if not avoided, may cause death or serious injury; |
| ⚠ CAUTION | Indicates the improper operation which, if not avoided, may cause moderate or minor injury, as well as equipment damage. |

In some cases, even failure to follow "Cautions" may also lead to serious consequences. Please make sure to follow both warnings and cautions, otherwise, it may cause death or serious injury, as well as product and relevant equipment and system damage.

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

During control system design

⚠ WARNING

◆ 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 long-time overcurrent caused by operation above rated current or load short-circuit.

⚠ CAUTION

◆ An emergency stop circuit, a protection circuit, a forward/reverse operation interlocked circuit, and a 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 external protection circuit and safety mechanism.
◆ Once the PLC CPU detects abnormality in the system, all outputs may be closed; however, when a fault occurs in the controller circuit, the output may not be under control. 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 indoor electrical environment (overvoltage category II). The power supply must have a system-level lightning protection device, 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, so as to avoid damage to the equipment.

During installation

⚠ WARNING

◆ Installation must be carried out by the specialists who have received the necessary electrical training and understood enough electrical knowledge.
◆ Disconnect all external power supplies of the system before module assembly/disassembly and wiring. Failure to do so may result in electric shock, module fault or malfunction. Failure to do so may result in electric shock, module fault or malfunction.
◆ Do not use the PLC where there are dust, oil smoke, conductive dust, corrosive or combustible gases, or exposed to high temperature, condensation, wind & rain, or subject to vibration and impact. Electric shock, fire and malfunction may also result in damage or deterioration to the product.
◆ The PLC is open-type equipment that must be installed in a control cabinet with lock (cabinet housing protection >IP20). Only the personnel who have received the necessary electrical training and understood enough electrical knowledge can open the cabinet.

⚠ CAUTION

◆ Prevent metal filings and wire ends from dropping into ventilation holes of the PLC during installation. Failure to comply may result in fire, fault and malfunction.
◆ Ensure there are no foreign matters on ventilation surface. Failure to comply may result in poor ventilation, which may cause fire, fault and malfunction.
◆ Ensure the module is connected to the respective connector securely and hook the module firmly. Improper installation may result in malfunction, fault or fall-off.

During wiring

⚠ WARNING

◆ Wiring must be carried out by personnel who have received the necessary electrical training and understood enough electrical knowledge.
◆ Disconnect all external power supplies of the system before wiring. Failure to comply result in electric shock, module fault or malfunction.
◆ Install the terminal cover attached to the product before power-on or operation after wiring is completed. Failure to comply may result in electric shock.
◆ Perform good insulation on 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 dropping metal filings and wire ends drop into ventilation holes of the PLC at wiring. Failure to comply may result in fire, fault 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 sufficient diameter and connect the cables to ground reliably.
◆ Wire the module correctly after making clear of the connector type. Failure to comply may result in module and external equipment fault.
◆ Tighten bolts on the terminal block in the specified torque range. If the terminal is not tight, short-circuit, fire or malfunction may be caused. If the terminal is too tight, fall-off, short-circuit, fire or malfunction may be caused.
◆ If the connector is used to connect with external equipment, perform correct crimping or welding with the tool specified by manufacturer. If connection is in poor contact, short-circuit, fire or malfunction may be caused.
◆ A label on the top of the module is to prevent foreign matters entering the module. Do not remove the label during wiring. Remember to remove it before system operation, facilitating 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 cable for high-frequency signal input/output in applications with serious interference so as to enhance system anti-interference ability.

During maintenance & inspection

⚠ WARNING

◆ Maintenance & inspection must be carried out by personnel who have received 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 external power supplies of the system 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 external power supplies of the system before removing the module or connecting/removing the communication wirings. Failure to comply may result in electric shock or malfunction.

⚠ CAUTION

◆ Get acquainted with the guide and ensure safety before online modification, forcible output, and RUN/STOP operation.
◆ Disconnect the power supply before installing/removing the extension card.

At disposal

⚠ CAUTION

◆ Treat scrapped module as industrial waste. Dispose the battery according to local laws and regulations.

3. Product Information
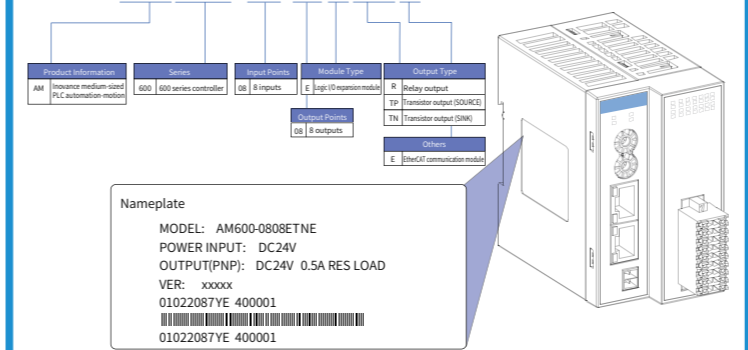
■ Model and Nameplate

AM600-0808ETNE

Nameplate

MODEL: AM600-0808ETNE
POWER INPUT: DC24V
OUTPUT(PNP): DC24V 0.5A RES LOAD
VER: xxxxx
01022087YE 400001
01022087YE 400001

Figure 1　Description of model and nameplate

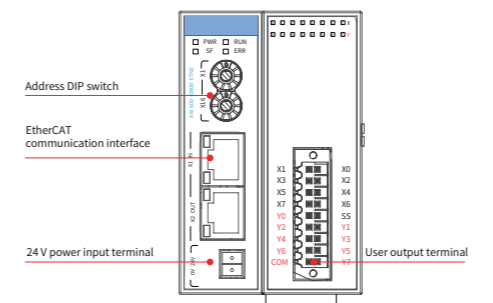| Model	Classification	Description	Applicable to
AM600-0808ETNE	EtherCAT communication slave module	8-point digital output, transistor output (SINK); 8-point digital input (SOURCE)	AM600

■ External Interface

Figure 2　Diagram of digital input module interface

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 = ADDR1*16+ADDR0*1 (address: 1-255)
User output terminals		For details of definition, refer to "Electrical Design Reference".

■ General Specifications

Item	Specifications
Power supply specifications	24 VDC (20.4 VDC to 28.8 VDC) (–15% to +20%)
Communication protocol	EtherCAT industrial real-time bus protocol
Maximum communication speed	100 Mbps
Network interface/ Network cable	Standard Ethernet interface and enhanced category 5 network cable with a cable length of less than 100 m
Station number range	Set the station number to 1 to 255 with DIP switches or perform automatic assignment with a 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 us (TYP)
Synchronization mode	I/O uses I/O synchronization or a DC- distributed clock.
Physical layer	100BASE-TX
Baud rate	100 Mbit/s (100Base-TX)

Item	Specifications
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 to 1498 bytes
Process data	Single frame up to 1486 bytes
Synchronization jitter of two slaves	< 1 us
Refresh time	1000 digital inputs/outputs: approximately 30 us; 32 servo axes: approximately 100 us

■ Output Specifications

Item		Specifications
Output channel		8
Output connecting mode		Bellows wiring terminal
Output type		Transistor, low-side output
Power supply voltage		24 VDC (–15% to +20%)
Output voltage class		24 VDC (–15% to +20%)
Maximum leakage current when the module is turned OFF		Less than 0.5 mA
Response time when the module is turned ON		Less than 0.5 ms (for hardware)
Response time when the module is turned OFF		Less than 0.5 ms (for hardware)
Maximum load	Resistive load	0.5 A/point; 2 A/common terminal
	Inductive load	12 W/24 VDC (total)
	Lamp load	2 W/24 VDC (total)
Isolation method		Opto-couplers isolation
Output action display		Output indicator ON when opto-coupler driving is applied
Short circuit-proof output		Yes

■ Input Specifications

| Item	Specifications
Input channel	8
Input connecting mode	Bellows wiring terminal
Input type	Digital input
Input mode	SINK/SOURCE
Input voltage class	24 VDC (max.: 30 V)
Input current (typical)	4 mA
ON voltage	> 15 VDC
OFF voltage	< 5 VDC
Interface hardware filter time constant	10 ms
Input resistance	4.3 K
Input signal form	DC voltage input, supporting SINK/SOURCE input
Isolation method	Opto-couplers isolation
Input action display	Input indicator ON when the input is in the driving state

4. Mechanical Design Reference

■ Mounting Dimensions
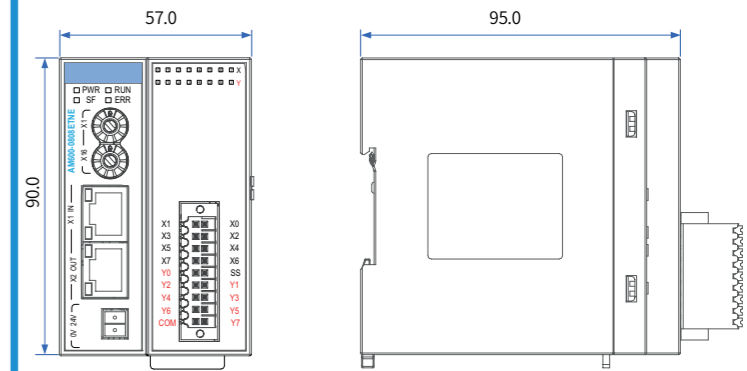
Figure 3　Mounting dimensions (in mm)

5. Electrical Design Reference

■ EtherCAT Cable Selection

◆ Network cable preparing
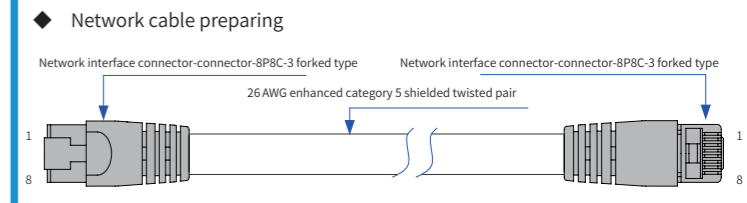
Shielded network cable   Ordinary network cable

* Please use enhanced category 5 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+	Characteristic impedance of input and output port	Data receive+
4	--	--	Disabled
5	--	--	Disabled
6	RD-	Characteristic impedance of input and output port	Data receive−
7	--	--	Disabled
8	--	--	Disabled

◆ Length requirements:

FastEthernet technology demonstrates the cable length between devices shall not exceed 100 m when the EtherCAT bus is used. Otherwise, it will cause signal attenuation, affecting normal communication.
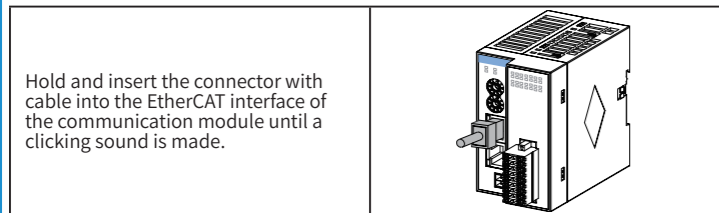
◆ Technical requirements:

There is no evidence of 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 category 5
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

Hold and insert the connector with cable into the EtherCAT interface of the communication module until a clicking sound is made.

◆ Requirements for securing communication cable

To avoid the influence on the communication cable due to other stresses and ensure the stability of communication, please secure the cable near the equipment before EtherCAT communication, as shown in the following figure:

Fixing with cable ties, etc.
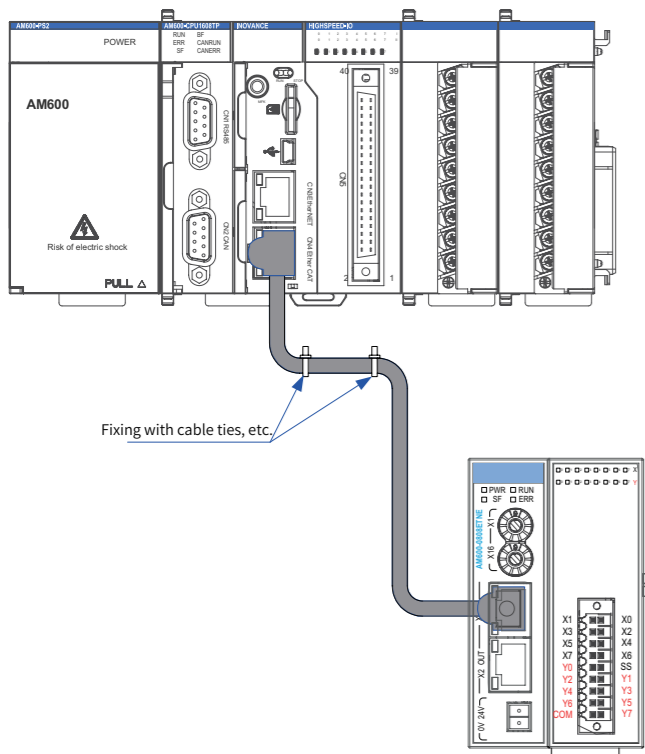
■ Fault Indication and Countermeasures for EtherCAT Communication Slave Module

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.
	Flashing	The EtherCAT slave is in a state other than OP.	Check slave configurations. Check whether the module is lost and fails or any unconfigured module exists.
ERR	Flashing	Communication error between the EtherCAT master and slave occurs.	Check whether master and slave parameter configurations are correct.
SF	Solid ON	The output channel fails.	Check whether the output channel is short-circuited or shows the evidence of overtemperature fault.

■ User Output Terminal Connection

◆ Cable Selection

Cable Name	Model	Applicable Cable Diameter		Manufacturer	Crimping Tool
		MM²	AWG		
Tubular lug	GTVE07512	0.75	21	Suzhou Yuanli	YAC-5

Those cable lugs are applicable to AM600-0808ETNE modules, and the cable rated temperature is required to be above 75 °C.

■ Cable Preparing Procedures

◆ Strip back the wire outer coating by 11-14 mm. Pass the cable through the tube of proper wire size.

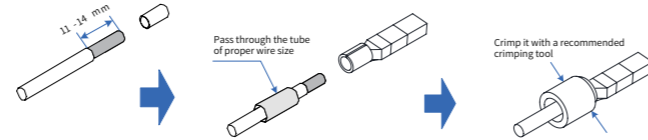◆ Insert the exposed end into the hole of the cable lug, and then crimp it with recommended crimping tool.

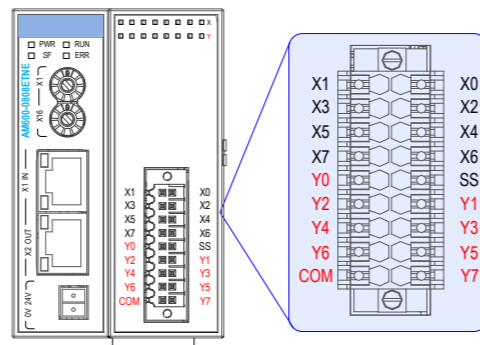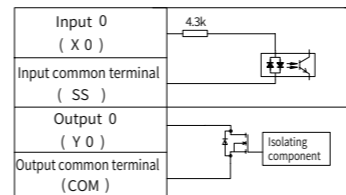Figure 4 Diagram of cable preparing

■ Terminal Arrangement

Figure 5 Diagram of terminal arrangement

■ External Wiring

External Wiring	Signal Name Column B	Terminal No.		Signal Name Column A	External Wiring
	Input common terminal				
24VDC	Input 1 (X 1)	2	1	Input 0 (X 0)	
	Input 3 (X 3)	4	3	Input 2 (X 2)	
	Input 5 (X 5)	6	5	Input 4 (X 4)	
	Input 7 (X 7)	8	7	Input 6 (X 6)	
Load	Output 0 (Y 0)	10	9	Input common terminal (SS)	24VDC
Load	Output 2 (Y 2)	12	11	Output 1 (Y 1)	Load
Load	Output 4 (Y 4)	14	13	Output 3 (Y 3)	Load
Load	Output 6 (Y 6)	16	15	Output 5 (Y 5)	Load
24VDC	Output common terminal (COM)	18	17	Output 7 (Y 7)	24VDC
				Output common terminal	

Internal equivalent circuit:


* Wiring Precautions
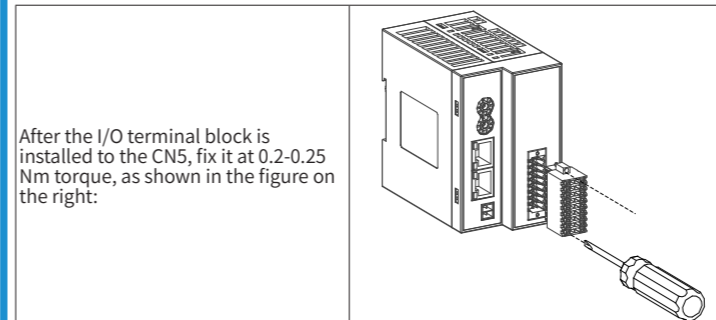
After the I/O terminal block is installed to the CN5, fix it at 0.2-0.25 Nm torque, as shown in the figure on the right:

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 which have built-in relay protection circuit. The freewheel diode must satisfy: ① reverse voltage is 5 to 10 times of load voltage; ② forward current is larger than load current.
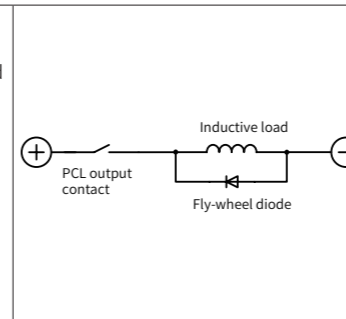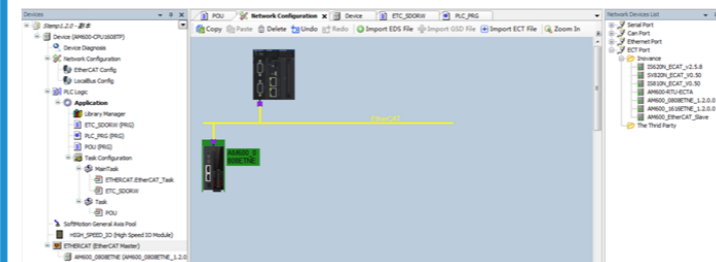

6. Programming Examples

■ Programming Example for AM600 main module + AM600-0808ETNE module

Use AM600 CPU as main control module, set the first two output channels of the AM600-0808ETNE module to active, and assign sampling values of the first two input channels to different variables.

1) Create a project, set AM600 to an EtherCAT host, and add an AM600-0808ETNE module.

2) Program the AM600-0808ETNE module using the ST language. Define the DO_CH0_0 and DO_CH0_1 mapping output tags and set corresponding channels of mapping output tags to active. Define the DI_CH0_0 and DI_CH0_1 input channel mapping tags and assign states of corresponding channels of input mapping tags to END_IO_0 and END_IO_1.
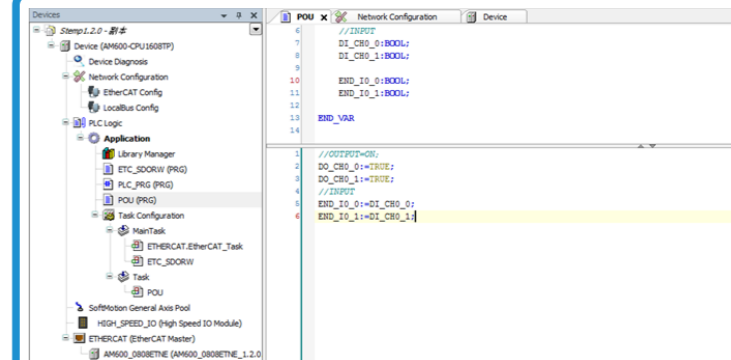
3) Map DO_CH0_0, DO_CH0_1, DI_CH0_0 and DI_CH0_1 defined during programming to the first two output channels and the first two input channels of the AM600-0808ETNE module respectively.
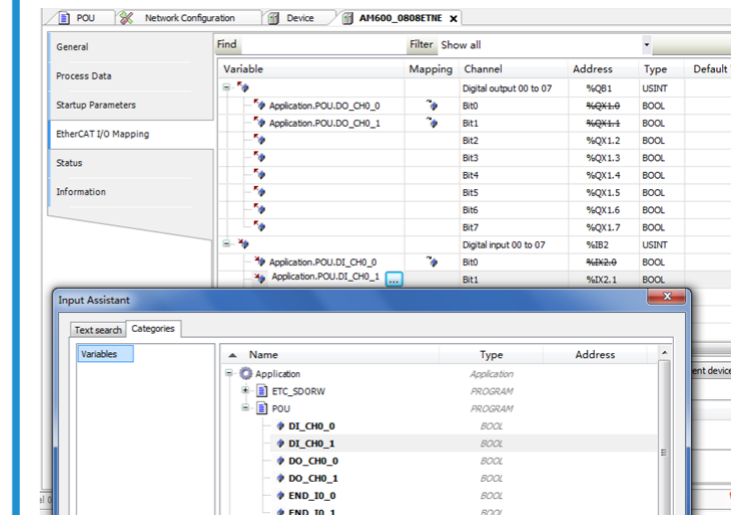
4) After successful compiling, download the project and run it.

INOVANCE Warranty Agreement

1) Inovance provides an 18-month free warranty to the equipment itself from the date of manufacturing for the failure or damage under normal use conditions.

2) Within the warranty period, maintenance will be charged for the damage caused by the following reasons:

a. Improper use or repair/modification without prior permission

b. Fire, flood, abnormal voltage, natural disasters and secondary disasters

c. Hardware damage caused by dropping or transportation after procurement

d. Operations not following the user instructions

e. Damage out of the equipment (for example, external device factors)

3) The maintenance fee is charged according to the latest Maintenance Price List of Inovance.

4) If there is any problem during the service, contact Inovance's agent or Inovance directly.

5) Inovance reserves the rights for explanation of this agreement.

Suzhou Inovance Technology Co., Ltd.

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