

AM400-CPU1608TN
CPU Module (NPN Output)



19010693

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Thank you for purchasing the AM400-CPU1608TN CPU communication module (NPN Output) developed and manufactured independently by Inovance.

AM400 series PLC is a medium-sized PLC developed based on CoDeSys. It fully supports IEC61131-3 programming system, EtherCAT site real-time bus, and cam synchronous movement control. It is provided with unique high-speed I/O interfaces to meet the needs of high-speed applications.

This guide describes the specifications, characteristics and using methods of the AM400-CPU1608TN CPU module (NPN Output). Please read this guide carefully before using to ensure more safe usage. Please refer to the AM400 Series PLC Hardware Manual and the AM400 Series PLC Programming Manual 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 www.inovance.com.

1. Safety 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, 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 the 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 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 and so forth, 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 an open-type that must be installed in a control cabinet with lock (cabinet housing must satisfy protection of over IP20). Only the personnel who have the necessary electrical training and experience can open the cabinet.

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- 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.
 - 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 that 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 the necessary electrical training and experience.
 - Disconnect all external power supplies of the system before wiring. Failure to comply may 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 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.

2. Product Information

Model and Nameplate

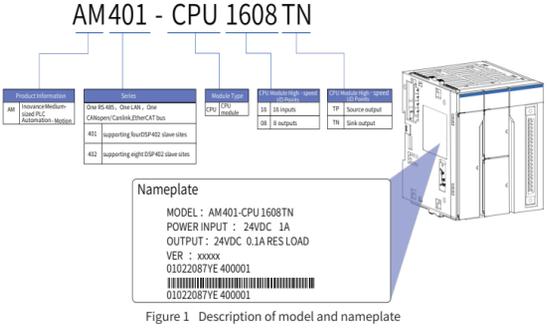


Figure 1 Description of model and nameplate

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Model	Classification	Description	Applicable to
AM401-CPU1608TN	CPU module	10 M program storage space; 20 M data storage space; One RS485; One CANopen/CANlink; One LAN supporting 4-axis motion control; Supporting EtherCAT Built-in 16-input 8-output high-speed I/O Sink type output	AM400
AM402-CPU1608TN	CPU module	10 M program storage space; 20 M data storage space; One RS485; One CANopen/CANlink; One LAN supporting 8-axis motion control; Supporting EtherCAT Built-in 16-input 8-output high-speed I/O Sink type output	AM400

External Interface

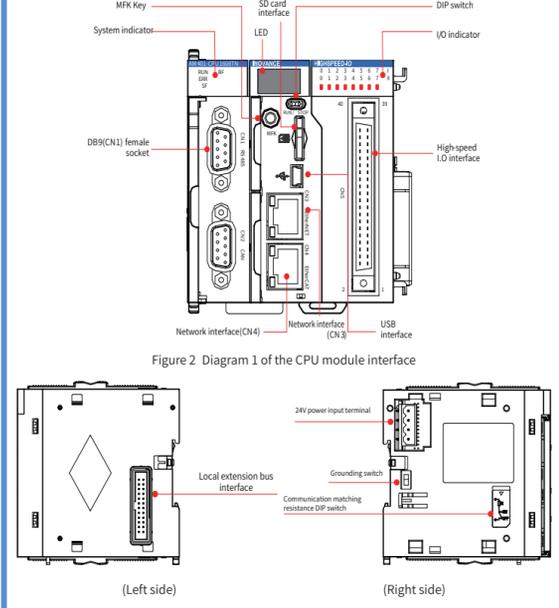


Figure 2 Diagram 1 of the CPU module interface

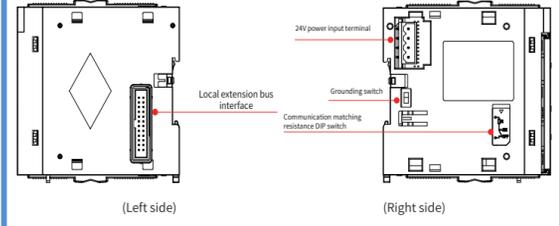


Figure 3 Diagram 2 of the CPU module interface

Interface Name	Function
DB9 (CN1)/Female socket	One RS485 interfaces, supporting the MODBUS protocol
CN2	One CANopen/CANlink
Ethernet port (CN4)	EtherCAT protocol
Ethernet port (CN3)	1. MODBUS TCP 2. Standard Ethernet function 3. System program debugging 4. User program downloading and debugging (only supporting IPv4)
USB	Program downloading and debugging
High-speed I/O	16-point high-speed input 8-point high-speed output
I/O indicator	16-channel input and 8-channel output signal valid indicator
DIP switch	RUN/STOP DIP switch
SD card interface	Stores user programs and data
MFK key	MFK multi-function key Running indicator RUN CPU module running error indicator ERR System error indicator SF Bus error indicator BF
LED	Displays alarm messages and MFK key response prompt messages
Local expansion bus interface	Can expand up to 8 I/O modules. The actual number and configuration depend on each module's power consumption Not supporting hot plugging
24 V power input terminal	24 VDC voltage input. The AM400 power supply module must be used for power supply
Grounding switch	Connection switch providing the system internal digital ground and housing ground. It is not connected by default. It is used only on special occasions where the system internal digital ground must be used as a reference plane. You shall not operate it without authorization, otherwise system stability is affected.

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Interface Name	Function
Communication matching resistance DIP switches	ON indicates matching resistance connection (all OFF by default). 1 and 2 are CAN, 3 and 4 are reserved, 5 and 6 are COM0(RS485), 7 and 8 are reserved:

General Specifications

Item	Specifications
Programming mode	IEC 61131-3 programming languages (LD, FBD, IL, ST, SFC, CFC)
Program execution mode	Compiled execution
User program storage space	10 MBytes
Flash save space upon power failure	512 KBytes
SD memory card capacity	Up to 32 G general SD card
Program save mode upon power failure	Flash hold/SD card hold optional (No save upon power failure is performed if power failure occurs at power-on time of smaller than 35s)
Internal 5 V power output current	1500 mA (rated value)
Interrupt mode	8-point input interrupt (CPU module high-speed DI), supporting rising edge and falling edge interrupt

Input Specifications

Item	Specifications	
Signal Name	High-speed input (differential or single-ended) (Xn0-Xn3)	High-speed input (single-ended) (I4-IF)
	24 V input	Differential input
Rated input voltage	24 VDC (-15% to +20%, pulsation within 5%)	24 VDC (-15% to +20%, pulsation within 5%)
Rated input current	7.3 mA (typical) (at 24 VDC)	7.3 mA (typical) (at 24 VDC)
ON current	More than 5 mA	More than 5 mA
OFF current	Less than 1.5 mA	Less than 1.5 mA
Input resistance	3.3 kΩ	3.3 kΩ
Maximum count speed	800 Kpps (two-phase quadruplicated frequency), 200 kHz (single-phase input)	
Worst duty ratio at two-phase input	(40% : 60%) to (60% : 40%)	
Common mode	Two groups of common terminals	One common terminal per 10 points

Output Specifications

Item	Specifications
Signal Name	Output (Y0-Y7)
Output polarity	Sink type output (low-side output)
Control circuit voltage	5 VDC to 24 VDC
Rated load current	0.1 A / point, 0.5 A / COM
Maximum voltage drop when the module is turned ON	0.2 V (typical value)
Leakage current when the module is turned OFF	Less than 0.1 mA
Output frequency	200 kHz (You must connect an over 12 mA external equivalent load for 200 kHz output.)
Common mode	One common terminal per 4 points

- The total extended distance of the high-speed I/O interface extension cable shall be within 3.0 m.
- The single-phase pulse duty ratio must be greater than 40% when high-speed input is in phases A and B.

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3. Mechanical Design Reference

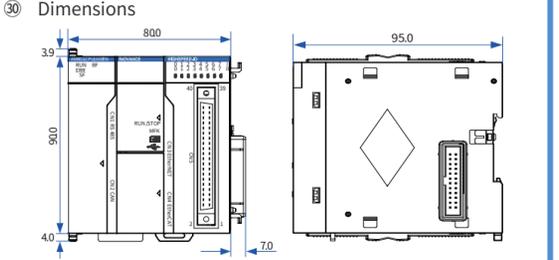


Figure 4 Diagram of CPU module dimensions (unit: mm)

4. Electrical Design Reference

Terminal Arrangement

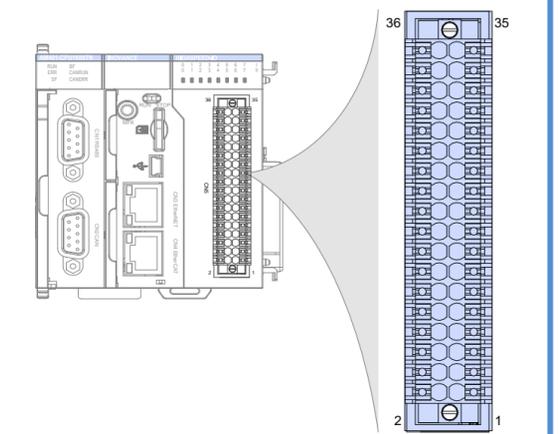
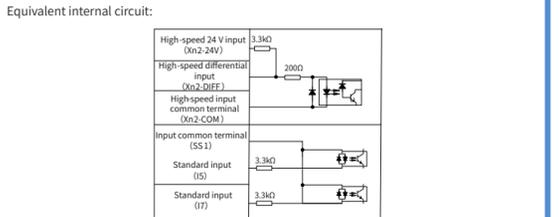


Figure 5 Connection terminal arrangement of the CPU module

External Wiring	Signal Name Column B	CN5 Pin No.	Signal Name Column A	External Wiring
24VDC	High-speed 24 V input (Xn0-24V)	36	High-speed 24 V input (Xn2-24V)	24VDC
24VDC	High-speed differential input (Xn0-DIFF)	34	High-speed differential input (Xn2-DIFF)	24VDC
24VDC	High-speed input common terminal (Xn0-COM)	32	High-speed input common terminal (Xn2-COM)	24VDC
24VDC	High-speed 24 V input (Xn1-24V)	30	High-speed 24 V input (Xn3-24V)	24VDC
24VDC	High-speed differential input (Xn1-DIFF)	28	High-speed differential input (Xn3-DIFF)	24VDC
24VDC	High-speed input common terminal (Xn1-COM)	26	High-speed input common terminal (Xn3-COM)	24VDC
24VDC	Input common terminal (SS 0)	24	Input common terminal (SS 1)	24VDC
Load	Standard input (I4)	22	Standard input (I5)	Load
Load	Standard input (I6)	20	Standard input (I7)	Load
Load	Standard input (I8)	18	Standard input (I9)	Load
Load	Standard input (I A)	16	Standard input (I B)	Load
Load	Standard input (I C)	14	Standard input (I D)	Load
Load	Standard input (I E)	12	Standard input (I F)	Load
Load	Output (Q0)	10	Output (Q1)	Load
Load	Output (Q2)	8	Output (Q3)	Load
Load	Output (Q4)	6	Output (Q5)	Load
Load	Output (Q6)	4	Output (Q7)	Load
Fuse	Output common terminal (COM 0)	2	Output common terminal (COM 1)	Fuse

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*1 All 16-channel inputs of the CPU module support high-speed input. The first 4-channel inputs support 24 V single-ended or differential input. The last 12-channel inputs support 24 V single-ended input.



Wiring Precautions

- The total extended distance of the high-speed I/O interface extension cable shall be within 3.0 m.
 - Do not bundle the extension cable 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 extension cables to enhance anti-interference ability.
 - Ensure that the minimum bending radius of cables is greater than 76 mm when laying extension cables. In the case of 76 mm bending radius, malfunction may occur due to performance degradation and cable breaking.
- Application examples
- The first 4 digital inputs of the high-speed IO support high-speed single-end and differential signals. Before use, ensure that the wiring is correct. The following table explains how to use the high-speed IO, taking Xn0 as an example.

Example	Wiring
1) PNP input, 24 V level	Diagram showing PNP input wiring with 24V supply and internal circuit diagram.
2) NPN input, 24 V level	Diagram showing NPN input wiring with 24V supply and internal circuit diagram.
3) Differential signal input, 5 V level	Diagram showing differential signal input wiring with 5V supply and internal circuit diagram.

5. Communication Connection

Cabling of the CPU Module and Communication Module

- Connection of RJ45 network cable
- Hold and insert the connector with cable into the RJ45 interface of the communication module until a clicking sound is made.

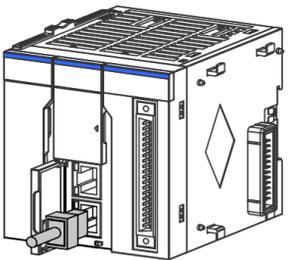


Figure 6 Diagram of network cable connection

- Disassembly procedures: Hold the connector tail mechanism to pull out the connector along a horizontal direction with the module.
 - 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 and CANopen communication, as shown in the following figure:

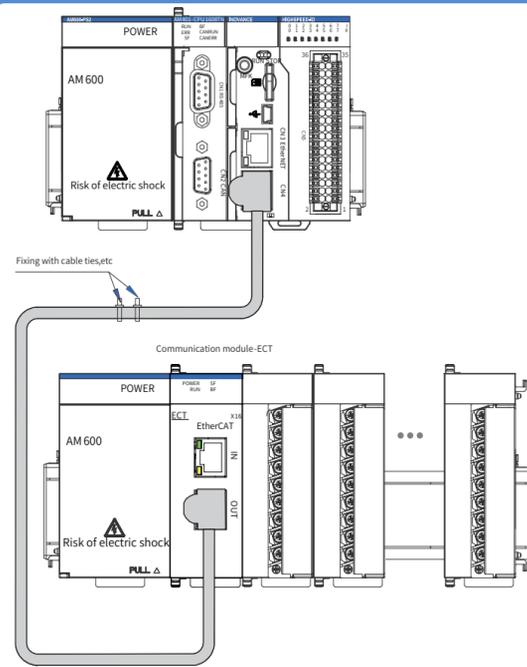


Figure 7 Communication cable must be secured near the equipment

Connection via EtherCAT bus

1) EtherCAT Specifications

EtherCAT Bus Specifications

Item	Specifications
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO)
Minimum synchronization period of 6-axis cam	1250 us (typical value)
Maximum synchronization jitter	120 us (typical value)
Synchronization mode	Servo uses a DC- distributed clock. I/O uses I/O synchronization.
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
Number of slaves	Up to 125
EtherCAT frame length	44 to 1498 bytes
Process data	Single Ethernet frame up to 1486 bytes

2) Wiring

The CPU module implements EtherCAT bus communication via a CN4 port. Its requirements for the communication network cable are as follows:

Requirements for the ECT communication network cable:

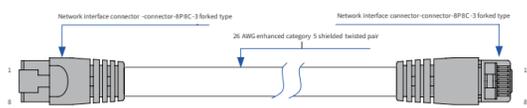


Figure 8 Requirements for EtherCAT network cable preparing

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

Pin	Signal	Signal Direction	Signal Description
5	--	--	Disabled
6	RD-	Input	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. 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/TIA Abulletin TSB, EIA/TIA SB40-A&TSB36
Conductor cross-section	AWG26
Conductor type	Twisted pair
Line pair	4

Serial Communication Connection via RS485

CN1 in the figure shows the RS485 interface.

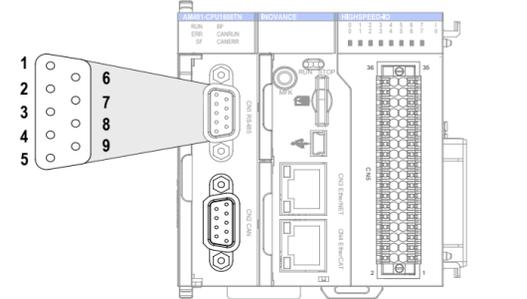


Figure 9 RS485 communication terminal definition on CPU module

Definition of DB9 assignment:

Channel	Pin	Definition	Function
COM0 (RS485)	1	RS485-	COM0 RS485 differential pair negative signal
	2	RS485+	COM0 RS485 differential pair positive signal
	5	GND0	COM0 power ground

Connection via Ethernet Monitoring

1) Diagram of Networking

The Ethernet interface of the CPU module can perform point-to-point connection to a computer, HMI, etc. using an Ethernet cable.

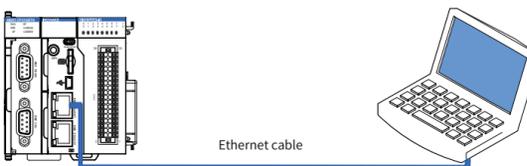


Figure 10 Connection of the CPU module to a PC

It can also be connected to a hub or switch using an Ethernet cable and then to other network equipment via the hub or switch to implement multi-point connection.

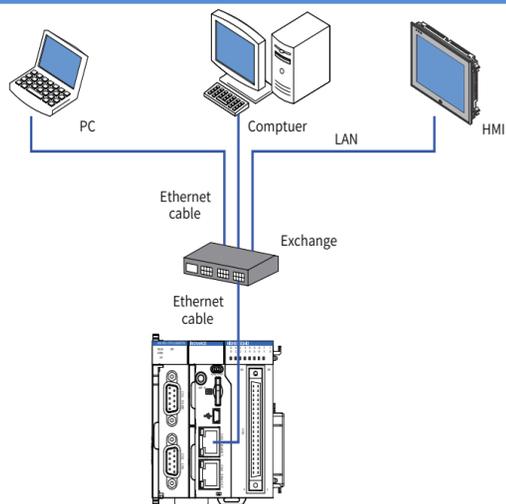


Figure 11 Connection of the CPU module to other equipment via a switch

2) Wiring

To improve equipment communication reliability, the Ethernet cable must be a category 5 shielded twisted pair with iron case molding line.

6. Programming tool downloading

Programming Tool Downloading

The user programming software for Inovance AM400 series medium-sized PLC is a free software. You can obtain a software DVD from an Inovance distributor, or download it from the data downloading webpage at Inovance official website www.inovance.cn or from the Inovance page at www.gongkong.com. You can also download reference data about AM400 series PLC products and applications.

Inovance improves its products and data continuously. It is recommended to update software and refer to any updated and issued reference data to facilitate your application design, if necessary.

Programming Environment and Software Installation

Environment Requirements

Hardware requirements: One desktop PC or portable computer with Windows 7 or later version of the operating system; 2 GB computer RAM contents, over 5 GB remaining space in the hard disk or SSD. It is recommended that the CPU main frequency should be more than 2 GHz, otherwise the running speed is affected.

An LAN network cable can also be used for connection between the PC and the AM400 controller. It is recommended to connect AM400 to the LAN via a router. This allows a greater distance between the PC and the AM400, e.g. performing programming on the AM400 located in the workshop by staying at the office. This also achieves a faster interactive communication rate. Therefore, there must be one idle LAN network interface and one network cable in the local network.

A USB cable can also be used for connection between the PC and the AM400 controller. In this case, one USB cable is needed and a MiniUSB plug must be provided at one end of its cable.

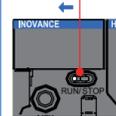
7. Operation and Maintenance

Run and Stop Operations

After a program is written to the CPU module, perform the startup and shutdown operations in the following steps.

After a program is written to the CPU module in STOP state, when running the system:

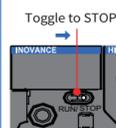
Toggle to RUN



1. Set the RUN/STOP switch to RUN.



2. Check that the RUN indicator is solid on in green.



3. When you need to stop running, set the RUN/STOP switch to STOP. You can also stop the PLC via upper computer background software.

8. Description of Indicators and MFK Key

CPU Module Indicators

Indicator Name	Description
RUN indicator	Indicates the current running state (RUN or stop) of the system ON during running, OFF during shutdown
ERRIndicator	Indicates any system fault
SF indicator	Expansion bus error indicator
BF indicator	Communication error indicator

MFK Key Description

The main function of the MFK key is an IP address reset command key of the PLC main module and is valid when the PLC is in STOP state.

The factory default IP address of the CPU module is 192.168.1.88. If this address is modified, before communication with another PC for networking, communication may fail due to forgetting the last modified IP address. At this moment, set the IP address of the CPU module to the factory default address using the MFK key.

1) Press and hold down the MFK key in STOP state until the LED displays I.P.



(The system prompts that the IP address reset operation is about to be performed.)

2) If you confirm to reset the IP address, press the MFK key once more, and the LED starts to display a countdown starting from 10, 9, 8...



3) When the countdown reaches 0, press the MFK key to finish the reset operation, and the IP address resetting is completed. After the PLC is powered on again, a new IP address is used.

CPU Module LED Display

When the system fails, the fault code information will be displayed through the LED on the CPU. The display mode is "E.r." and fault code" that appear alternatively. Assume that the fault code is 40, the LED display is shown in the following figure:



LED Fault Display Information and Countermeasures:

Local Bus of CPU Module and Diagnosis LED Display of I/O Module	Description	Countermeasures
00	No fault	-
40	Local expansion bus error of the CPU	Check whether connection between local rack modules is normal.
41	Configuration error	Check whether the configurations of local rack modules are consistent with those of the background.
42	Module error	Check whether any fault of local rack modules is detected. Detailed fault information can be viewed on the background interface.

High-speed I/O LED Display	Description	Countermeasures
60	High-speed input error	Detailed fault information can be viewed on the background interface.
61	High-speed input alarm	Detailed fault information can be viewed on the background interface.
62	High-speed output error	Detailed fault information can be viewed on the background interface.
63	High-speed output alarm	Detailed fault information can be viewed on the background interface.

ModBus LED Display	Description	Countermeasures
70	ModBus COM0 error	Detailed fault information can be viewed on the background interface.
90	ModBusTcp error	Detailed fault information can be viewed on the background interface.

CANopen LED Display	Description	Countermeasures
C0	Slave error	Check whether connection between slave rack modules is normal.

CANopen LED Display	Description	Countermeasures
C1	Slave hardware configuration error	Check whether the configurations of slave rack modules are consistent with those of the background.
C2	Slave module error	Check whether any fault of slave rack modules is detected. Detailed fault information can be viewed on the background interface.
CF	CANopen master bus off	Check whether the master closes the CANopen function or check the possibility of master CANopen communication abnormality.

CANlink LED display	Description	Countermeasures
d0	Bus error (BUS OFF)	Check whether the bus connection is normal. Detailed fault information can be viewed via the background.
d1	Address conflict	Check whether address configurations are correct.
d2	No slave online (in the master)	Check whether slave connection is normal or check the possibility of configuration parameter error.
d3	All slave stations disconnected (in the master)	Check all slave connections are normal.
d4	Configuration or command frame error	Check whether bus configuration parameters are correct.

9. Module Connection

Connecting the Power, CPU and Expansion Modules

Connection between modules is mainly fixed using a module connection interface, fixed lock catch, etc. Take as a sample the connection of the CPU module to the power module.

1) Slide the lock catch on the CPU module in the direction as shown in the figure.

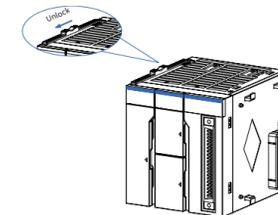


Figure 12 Unlocking by sliding a lock catch in a direction

2) Connect the connectors on the CPU and power modules fully and tightly.

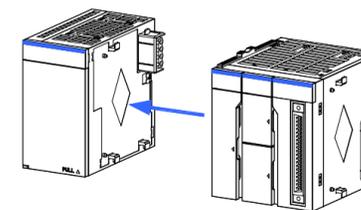


Figure 13 Connecting the connector on the power module

3) Slide the lock catch on the CPU module in the direction as shown in the figure to finish the connection and locking of both modules.

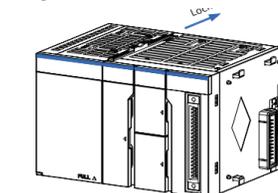


Figure 14 Locking by sliding a lock catch in a direction

Connecting the Power, CPU and Expansion Modules

1) Pull out downwards all DIN guide rail mounting hooks on the back of the module (as shown in the following local diagram) until a clicking sound is made.

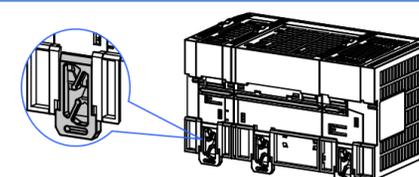


Figure 15 Pulling down hooks on the modules

2) Hang the fixed jaw on the upper side of the module to the upper side of the DIN guide rail in direction A as shown in the figure. Press the module group hard in direction B as shown in the figure until it is fully embedded into the guide rail.

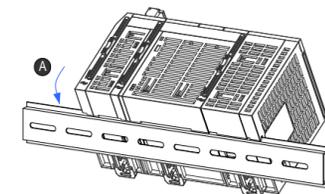


Figure 16 Clamping the module into the DIN rail

3) After locking the DIN guide rail mounting hooks on the module, embed the module to the DIN guide rail. Press upwards until a clicking sound is made. In addition, tools such as screwdrivers shall be used in the case that no finger can reach the DIN guide rail mounting hooks.

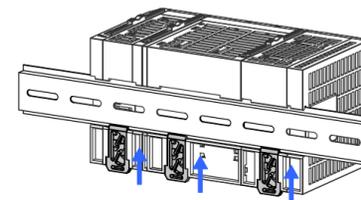


Figure 17 Clamping hooks on the modules in the arrow direction

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.

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