



GR10-4ADE

Analog Input Module

User Guide

19011283B03

1

1. Overview

Thank you for purchasing the GR10-4ADE analog input expansion module developed and manufactured independently by Inovance. This 4-channel analog input remote module supports EtherCAT communication and can be used with EtherCAT masters, such as AM600. It is powered by an external 24 VDC power supply. It supports voltage input and current input, with a resolution of up to 16 bits.

This guide describes the specifications, characteristics, and usage instructions of the module. For proper and safe operation, please read this guide carefully before use. Visit our website (www.inovance.com) for the latest version of the guide.

2. Safety Instructions

Safety disclaimer

- Before installation, operation, and maintenance, read through and comply with the safety instructions.
- To ensure personal and equipment safety, follow all the safety instructions marked on the product and described in this guide.
- The "CAUTION", "WARNING", and "DANGER" signs in this guide do not indicate all safety instructions; instead, they are only supplements to the safety instructions.
- Use this product in an environment that meets the design specifications. Malfunctions or damage caused by failure to follow relevant specifications is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety levels and definition

WARNING : "WARNING" indicates that failure to comply with the notice may result in death or severe personal injuries.

CAUTION : "CAUTION" indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Keep this user guide properly for future use and deliver it to the end user.

Control System Design

WARNING

- Provide a safety circuit to ensure that the control system can still work safely when external power failure or PLC fault occurs.
- Add an external fuse or circuit breaker to prevent the module from smoking or catching fire due to long-time overcurrent caused by operation above rated current or load short-circuit.

CAUTION

- Set an emergency stop circuit, a protection circuit, a forward/reverse operation interlocked circuit, and an upper/lower position limit interlocked circuit in the external circuits of PLC to prevent damage to the module.
- To ensure safe operation, use external protection circuits and safety mechanism for the output signals that may cause critical accidents.
- The CPU of the PLC may shut down all outputs upon detecting system abnormalities. When partial circuit faults occur in the PLC, outputs may become uncontrollable. Therefore, it is necessary to design an appropriate external control circuit to ensure normal operation.
- When the output units of the PLC (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 compliant with overvoltage category II. The power supply must have a system-level surge protector to ensure that overvoltage caused by lightning shock cannot be applied to power supply input terminals, signal input terminals, and control output terminals of the PLC, therefore preventing damage to the product.

Installation

2

WARNING

- Installation must be carried out by skilled personal who have undergone specialized electrical training and possess comprehensive electrical expertise.
- Disconnect all external power supplies of the system before installing/removing the module. Failure to do so may result in electric shock, module fault, or malfunction.
- Do not use the controller in environments with dust, greasy smoke, conductive dust, corrosive or combustible gases, exposed to high temperature, condensation, wind & rain, or subject to vibration and shock. Electric shock, fire, and malfunction may also damage the product.
- The PLC is open-type equipment that must be installed in a control cabinet with lock (IP rating of the control cabinet enclosure > IP20). Only qualified professionals who have undergone specialized electrical training and possess comprehensive electrical expertise 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, or malfunction.
- Ensure there are no unwanted matters on ventilation surface. Failure to comply may result in poor ventilation, which may cause fire, fault, or 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.

Wiring

WARNING

- Wiring must be carried out by skilled personnel who have undergone specialized electrical training and possess comprehensive electrical expertise.
- Disconnect all external power supplies of the system before wiring. Failure to comply may result in electric shock, module fault, or malfunction.
- After wiring, install the terminal cover attached to the product before power-on or operation. Failure to comply may result in electric shock.
- Insulate the cable terminals properly to ensure the insulation distance between cables will not be shortened after cables are connected to the terminal block. Failure to comply may result in electric shock or damage to the product.

CAUTION

- Do not drop metal filings or wire ends into ventilation holes of the PLC during wiring. Failure to comply may result in fire, fault, or malfunction.
- The external wiring specifications 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.
- Ensure that all cables are connected to the correct interface. Failure to comply may result in module fault or external equipment fault.
- Tighten bolts on the terminal block with the specified tightening torque. If the terminal is not tight, short-circuit, fire, or malfunction may occur. If the terminal is too tight, damage to the terminal and module, fall-off, short-circuit, fire, or malfunction may occur.
- If a connector is used to connect to the external equipment, perform press-fitting, crimping, or welding with the tools specified by manufacturer. Improper connection may result in short-circuit, fire, or malfunction.
- A label on the top of the module is to prevent foreign matters entering the module. Do not remove the label during wiring. Remove the label before system operation for ventilation.
- Route control cables, communication cables, main circuit cables, and power cables through different routes with a clearance of at least 100 mm among different types of cables. Failure to comply may result in malfunction caused by noise.
- For scenarios with severe interference, select shielded cable for high-frequency signal input or output to enhance system anti-interference ability.

Operation and Maintenance

WARNING

- Operation and maintenance must be carried out by skilled personnel who have undergone specialized electrical training and possess comprehensive electrical expertise.
- Do not touch the terminals with power 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 the connector. Failure to comply may result in electric shock.
- Disconnect all external power supplies of the system before installing/removing the module or connecting/disconnecting the communication cables. Failure to comply may result in electric shock or malfunction.

CAUTION

- Read through the user guide before operations such as online modification, forced output, RUN, and STOP commands to ensure safety.
- Disconnect the power supply before installing/removing the expansion card.

Disposal

CAUTION

- Dispose of retired batteries as industrial waste according to local laws and regulations.

3. Product Information

- Model and nameplate

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①	Product Family G: Inovance general module	③	Series 10: 10 series	⑤	Module Type AD: Analog input
②	Product Type R: Remote expansion module	④	Number of Input Channels 4: Four input channels	⑥	Auxiliary function E: EtherCAT communication

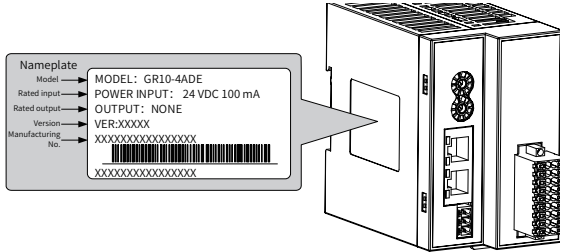
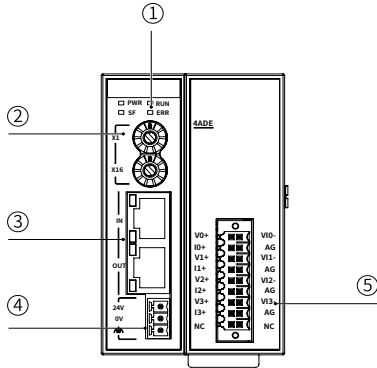


Figure1 Model and nameplate

Model	Type	Description	Applicable Model
GR10-4ADE	EtherCAT analog input module	4-channel AD remote module, supporting voltage/current analog input	AM600 series

- External interfaces



No.	Interface	Description
①	Signal indicator	PWR The power supply indicator turns off when the power supply is disconnected, and turns on when it is connected.
		RUN Operation state indicator. Flashing quickly: boot state; Off: initialization state; Flashing: pre-operational state; Single flashing: safe operational state; Solid on: operational state. The SF indicator flashes and the RUN indicator turns solid on when the network cable is disconnected in the operational state. The SF indicator is solid on when the module is faulty.
		SF The SF indicator flashes and the RUN indicator turns solid on when the network cable is disconnected in the operational state. The SF indicator is solid on when the module is faulty.
		ERR The ERR indicator turns on when the FPGA program is not loaded successfully.
②	Address DIP switch	Slave address setting switch: ADDR1/ADDR0. The slave address is set in hexadecimal format, converted to decimal address as ADDR1*16 + ADDR0*1 (range: 1 to 255).
③	EtherCAT communication interface	X1 IN: EtherCAT input
		X2 OUT: EtherCAT output for connecting back-end EtherCAT slaves
④	24 V power input terminal	For power supply input
⑤	User output terminals	See "Electrical Design" for details.

- General specifications

Item	Specification
Power supply	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 port/network cable	Standard network port with Cat 5e network cables below 100 m
Station number range	1 to 255 if set by a DIP switch, or automatically allocated by a network bus

The specific performance indicators are as follows:

Item	Specification
Communication protocol	EtherCAT protocol

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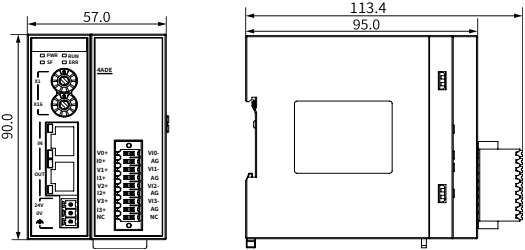
Supported services	CoE (PDO, SDO)
Minimum sync period	500μs (TYP)
Synchronization mode	Input and output synchronization or DC-distributed clock
Physical layer	100BASE-TX
Baud rate	100 Mbps (100Base-TX)
Duplex mode	Full duplex
Topology	Linear
Transmission medium	Network cables. For details, see the "Wiring" section.
Transmission distance	Less than 100 m between two nodes
EtherCAT frame length	44 to 1,498 bytes
Process data	Max. 1,486 bytes per frame
Synchronous jitter of two slaves	< 1 μs
Refresh time	About 500 μs

- Input specifications

Item	Specification
Number of input channels	4
Input connection mode	Leaf spring terminal
Voltage input impedance	≥ 1 MΩ
Current sampling impedance	250 Ω
Voltage input range	Bipolar: ±5 V, ±10 V; Unipolar: +5 V, +10 V
Current input range	0 mA to 20 mA, 4 mA to 20 mA, ±20 mA
Resolution	16 bits
Sampling time	500 μs/4 channels
Accuracy (normal temperature: 25° C)	Voltage: ±0.1%, current: ±0.1% (full range)
Accuracy (ambient temperature: 0° C to +55° C)	Voltage: ±0.15%, current: ±0.8%
Voltage limits	±15 V
Current limits	±30 mA (transient), ±24 mA (average)
Maximum common mode voltage among channels	30 VDC
Isolation mode	Isolation between I/O terminals and power supply; Non-isolation among channels.

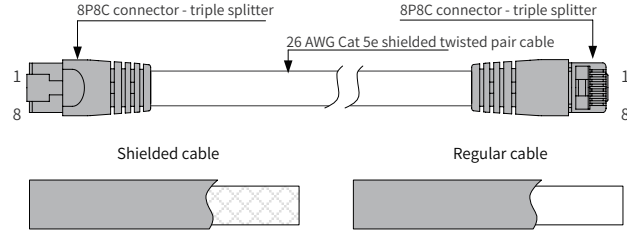
4. Mechanical Design

- Installation dimensions (in mm)



5. Electrical Design

- Cable preparation



Use Cat 5e shielded twisted-pair (STP) cables, with injection molded and iron shelled connectors.

- Signal pin assignment

Pin	Signal	Type	Description
1	TD+	Output	Data transmission +
2	TD-	Output	Data transmission -
3	RD+	Input	Data reception +
4	-	-	Not used

Pin	Signal	Type	Description
5	-	-	Not used
6	RD-	Input	Data reception -
7	-	-	Not used
8	-	-	Not used

Length requirements:

According to FastEthernet technology, when an EtherCAT bus is used, the length of the cable between the devices must not exceed 100 m. Exceeding this length will attenuate the signal and affect communication.

Technical requirements:

100% continuity test without short circuit, open circuit, misalignment, or poor contact. Use a shielded cable as the EtherCAT bus for network data transmission, with the following recommended specifications:

Item	Specification
Cable type	Flexible crossover cable, S-FTP, Cat 5e
Standard	EIA/TIA568A, EN50173, ISO/IEC11801 EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Cross sectional area	AWG26
Conductor type	Twisted pair
Number of pairs	4

Communication wiring

1) EtherCAT connection

Insert the registered jack of the cable into the EtherCAT port of the communication module until you hear a click.

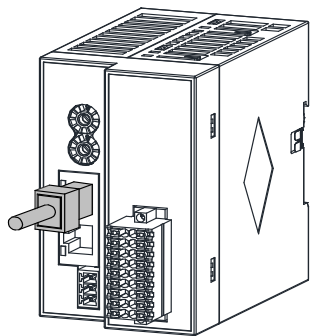
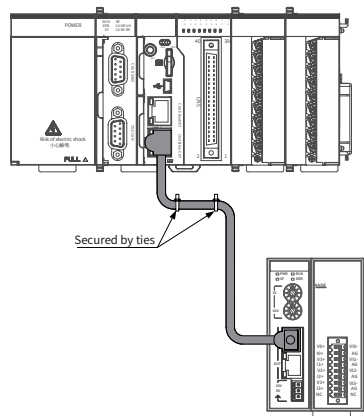


Figure2 Network cable connection

2) Requirements for securing communication cable

To protect the communication cable from any tension and to ensure communication stability, fix the cable end which is near the device before EtherCAT communication, as shown below:



3) Fault Indication and troubleshooting for EtherCAT remote communication expansion module

EtherCAT slave station:

LED Indicator	Description	Solution
RUN	Off	There is no connection between EtherCAT master and slave Check the configuration and parameter assignment; Check the communication address; Ensure the length and other specifications of the network cable are as specified.
	Flashing	The EtherCAT slave is in a non-OP state. Check slave configuration for any missing, faulty, or unconfigured module.

ERR	Flashing	There is no data exchange between the EtherCAT master and slave.	Check that the cable connector is inserted correctly; Check that the network cable is intact; Restart the power supply.
SF	Solid on	The output channel encounters a fault.	Check the output channel for short circuit or overtemperature.

Cable selection

Material Name	Model	Applicable Diameter		Manufacturer	Crimping Tool
		MM ²	AWG		
Tubular lug	GTVE07512	0.75	21	Suzhou Yuanli	YAC-5

Cable preparation:

- 1) Remove the cable insulation to expose 11 to 14 mm of the conductor. Pass the cable through a cable marking sleeve.
- 2) Insert the exposed conductor into the hole of the cable lug and then crimp it with a crimping tool recommended by the lug manufacturer.

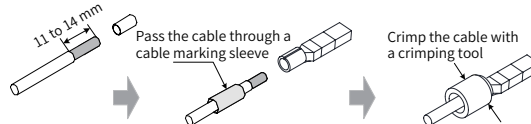
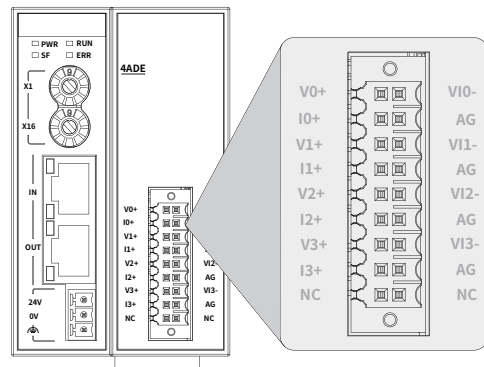


Figure3 Cable preparation

Terminal layout



Terminal assignment

No.	Name	Type	Function	Remark
1	V0+	Input	V+ of channel 0	Voltage input
2	VI0-	Input	V-/I- of channel 0	Voltage/current input
3	I0+	Input	I+ of channel 0	Current input
4	AG	-	Analog ground	Internal analog ground
5	V1+	Input	V+ of channel 1	Voltage input
6	VI1-	Input	V-/I- of channel 1	Voltage/current input
7	I1+	Input	I+ of channel 1	Current input
8	AG	-	Analog ground	Internal analog ground
9	V2+	Input	V+ of channel 2	Voltage input
10	VI2-	Input	V-/I- of channel 2	Voltage/current input
11	I2+	Input	I+ of channel 2	Current input
12	AG	-	Analog ground	Internal analog ground
13	V3+	Input	V+ of channel 3	Voltage input
14	VI3-	Input	V-/I- of channel 3	Voltage/current input
15	I3+	Input	I+ of channel 3	Current input
16	AG	-	Analog ground	Internal analog ground
17	NC	-	-	-
18	NC	-	-	-

External wiring

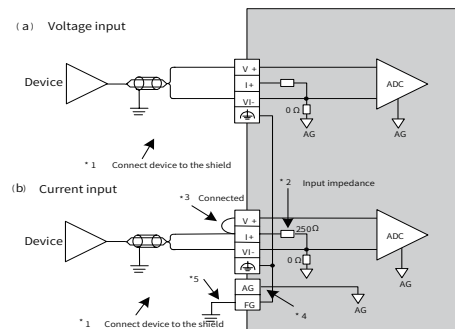


Figure4 Module wiring

*1 Use 2-core shielded twisted pair cable for analog signal.

*2 Input impedance of 4ADE

*3 For current input, terminals V+ and I+ must be connected.

*4 When the input signal is a differential signal, AG can be connected to analog ground of compatible devices to eliminate the common mode voltage difference between devices and ensure module sampling accuracy.

*5 The module should be mounted on a well-grounded metal bracket. The metal spring piece at the bottom of the module must be in good contact with the bracket.

Wiring precautions

Do not bundle the cable together with AC cables, main lines, and high voltage cables, otherwise it may result in an increased noise, surge, and induction.

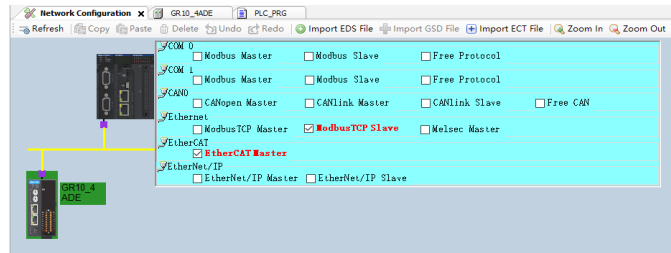
Apply single-point grounding for the shielding of shielded cable and solder sealed cable.

Tubed and solderless crimp terminal cannot be used with terminal block. It is recommended to use a marking sleeve or insulation sleeve to cover the cable connector part of the crimp terminals.

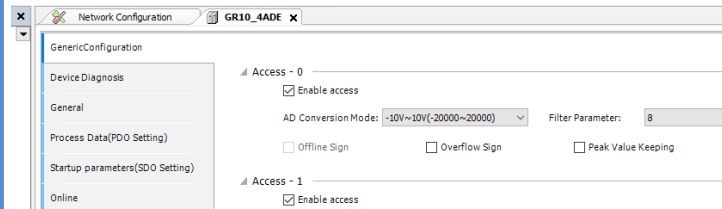
6. Programming Example

The following is an example where the AM600 series PLC is used as the main control module and the channel 0 of the GR10-4ADE module is used to sample the voltage. The sampled value is assigned to the corresponding variable.

- 1) Create a project and set the hardware configuration as follows:



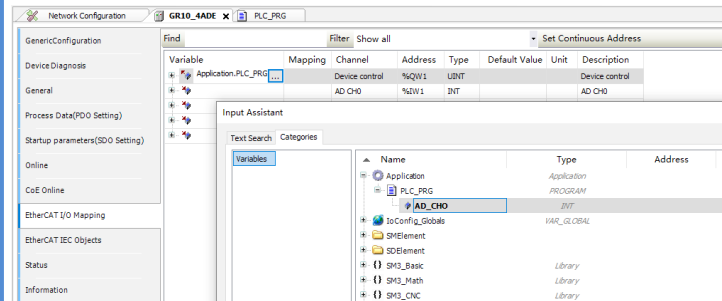
- 2) In the "General Configuration" interface of the GR10-4ADE module, enable channel 0, and configure the "AD Conversion Mode" as "-10 V~10 V" voltage input. "Filter parameter" and other functions can also be configured in this interface.



- 3) Define a variable AD_CHO with the ST programming language as shown below.



- 4) Map AD_CHO to channel 0 of the configured GR10-4ADE module.



- 5) After successful compiling, download the project and run it.

7. Software Troubleshooting

When the GR10-4ADE module encounters a fault, the fault code can be obtained through the object dictionary with index 0xA004. For details, see the following table.

Subindex	Name	Data Type	Access Mode	Mapping	Default Value
Index: 0xA004 (4AD module status)					
0	SubIndex 000	UINT	RO	NO	3
1	Basic information	UINT	RO	NO	0
2	Module information	UINT	RO	NO	0
3	Channel information	UDINT	RO	NO	0

SubIndex 1: "Basic information" is the basic state of the module, where Bit0 to Bit15 are reserved for future use.

SubIndex 2: "Module information" is a summary of module faults. The specific faults related to each bit are shown in the following table.

Bit	Cause	Solution
Index: 0xA004 (4AD module status)		
Bit0 to Bit7	Reserved	-
Bit8	Ch0 channel fault	Check whether the channel 0 is faulty through subindex 3
Bit9	Ch1 channel fault	Check whether the channel 1 is faulty through subindex 3
Bit10	Ch2 channel fault	Check whether the channel 2 is faulty through subindex 3
Bit11	Ch3 channel fault	Check whether the channel 3 is faulty through subindex 3
Bit12 to Bit15	Reserved	-

SubIndex 3: "Channel information" is a detailed definition of channel faults. The specific faults related to each bit are shown in the following table.

Bit	Cause	Solution
Index: 0xA004 (4AD module status)		
Bit0 to Bit2	Reserved	-
Bit3	Channel 0 exceeds the upper limit or is disconnected.	Check whether the input value of the channel exceeds the limit or the channel is disconnected.
Bit4	Channel 0 exceeds the lower limit.	Check whether the input value of the channel exceeds the lower limit or whether there is an abnormal strong interference.
Bit5 to Bit7	Reserved	-
Bit8 to Bit15	Channel 1 fault.The specific faults are the same to channel 0.	
Bit16 to Bit23	Channel 2 fault.The specific faults are the same to channel 0.	
Bit24 to Bit31	Channel 3 fault.The specific faults are the same to channel 0.	



NOTE

When the GR10-4ADE module reports an overlimit fault, check whether the input value exceeds the limits or whether the channel is disconnected.

INVANCE Warranty Agreement

Invance provides an 18-month free warranty (subject to information indicated by the barcode on the equipment) 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 following damage:

- 1) Damage caused by improper use and unauthorized disassembly, repair, or retrofit;
- 2) Damage caused by fire, flood, abnormal voltage, other disasters, or secondary disasters;
- 3) Hardware damage caused by equipment fall-off or that caused during transportation;
- 4) Damage caused by failure to operate the product according to the user guide provided by Invance;
- 5) Faults and damage caused by external factors, such as peripheral devices;

If the equipment is faulty or damaged, fill in the Product Warranty Card correctly. Maintenance is charged according to the latest Maintenance Price List of Invance.

The Product Warranty Card is not re-issued. Keep the card and present it to the maintenance personnel during maintenance.

If there is any problem during the service, contact Invance or Invance agents.

You are assumed to agree on terms and conditions of this warranty agreement by purchase of the product. This agreement shall be interpreted by Suzhou Invance Technology Co., Ltd.

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