



GR10-1616ETPE-KA

EtherCAT Slave Module User Guide



19011513A01

Overview

Thank you for purchasing the GR10-1616ETPE-KA EtherCAT communication slave I/O module developed and manufactured independently by Inovance.

This product is designed for EtherCAT communication with an external power supply of 24 VDC, providing 16-channel digital NPN output and 16-channel digital input.

This guide mainly covers the specifications, features, and instructions for use of the module. Before using the product, read this guide carefully to fully understand and ensure the safe use. The latest version of the guide can be available from the Inovance website (www.inovance.com).

Safety Precautions

- Safety statements
1. Read the following safety precautions before installation, use, and maintenance of this product.
 2. Follow all the precautions on the product and in this guide to ensure the personal and equipment safety during installation, use, and maintenance of the product.
 3. The "Caution" and "Warning" signs are only supplements to the precautions, and do not reflect all safety instructions to be followed.
 4. Use this product in the environment specified in this guide. Using this product in the environment not satisfying all the specifications can cause malfunction or damage to parts not covered by the gratis warranty range.
 5. Inovance shall not be held responsible for any personal injury or loss of property caused by improper use.

Level of precautions

Warning : "Warning" indicates that dangerous situations will lead to death or serious injury if the right procedures are not followed.

Caution : "Caution" indicates that dangerous situations will lead to light injury or the loss of property if the right procedures are not followed.

Keep this guide properly at hand in order to read at any time and have it available for the end user.

Design

- Warning**
- ◆ Provide this product with external safety circuits so that the control system still works safely even if the external power supply malfunctions or the programmable controller breaks down.
 - ◆ If an overcurrent continues to flow for an extended period of time due to a rating error or short-circuited load, the module may smoke or burn. Provide an external safety circuit such as a fuse or circuit breaker.
- Caution**
- ◆ Configure the circuits outside the programmable controller that include an emergency stop circuit, a protection circuit, an interlock circuit with contrary operations such as normal/reverse rotations, and an interlock circuit for preventing a machine from breaking beyond the upper or lower positioning limit.
 - ◆ To ensure safe operation, provide this product with an external fail-safe circuit or mechanism for the output signals that suggest major accidents.
 - ◆ If the programmable controller CPU detects any abnormality in the system itself, all of the outputs may be turned off; when partial circuit fault occurs in the controller, the output may be out of control, for which an appropriate external control circuit must be designed to ensure normal operation.
 - ◆ Depending on the fault of a relay or transistor in an output module, the output may not remain ON or OFF.
 - ◆ The programmable controller is designed for use in an indoor electrical environment (overvoltage category II). The system-level power supply must have a lightning protection device, assuring that overvoltage due to lightning shock is not applied to the controller's terminals such as power supply input terminals, signal input terminals, and control output terminals, to prevent damage to the equipment.

Installation

- Warning**
- ◆ Installation must be performed by skilled maintenance personnel who have received the trainings on electrical devices and have sufficient electrical knowledge.
 - ◆ Before attaching or detaching this product, be sure to turn the external power supply off for all phases. Failure to turn it off for all phases may cause an electric shock, module damage, or malfunction.
 - ◆ Never use the controller in locations where there is dust, greasy smoke, conductive dust, corrosive or flammable gas, or locations that are exposed to high temperature, condensation, wind & rain, or subject to vibration or shock. Electric shock, fire, and malfunction may also result in product damage or deterioration.
 - ◆ The programmable controller is of open type and must be installed in a control cabinet with lock (IP rating of the control cabinet enclosure > IP20), which can be opened only by the personnel who have received the trainings on electrical devices and have sufficient electrical knowledge.

- Caution**
- ◆ Keep the vent of the controller away from metal chips or wire tailings during installation. It may cause a fire, fault, and malfunction.
 - ◆ Ensure that there are no foreign matters on ventilation surface after installation; otherwise, it may result in poor heat dissipation and then cause a fire, fault, and malfunction.
 - ◆ Use the module fixing hook to fasten this module securely to appropriate connectors. Failure to mount this module correctly can allow the module to malfunction, break down, or fall.

Wiring

- Warning**
- ◆ Wiring must be performed by skilled maintenance personnel who have received the trainings on electrical devices and have sufficient electrical knowledge.
 - ◆ Before wiring, be sure to turn the external power supply off for all phases. Failure to turn it off for all phases may cause an electric shock, product damage, or malfunction.
 - ◆ After wiring, install the terminal cover packed with the product before power-on, or it may cause an 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; otherwise, it may cause an electric shock or product damage.
- Caution**
- ◆ Be careful not to let metal chips and wire tailings enter into the vent of the controller, which may cause a fire, fault, or malfunction.
 - ◆ The external wiring specifications and installation method must comply with local wiring regulations. See the Wiring section in this guide for details.
 - ◆ To ensure the safety of equipment and operators, use the cables with sufficient diameter for secure grounding. See the wiring section in the hardware guide for details.
 - ◆ Wire each product to the module correctly after checking the terminal types to be connected. Connecting an improper terminal or miswiring may cause damage to the module or external devices.
 - ◆ Tighten the bolts on the terminal block within the specified tightening torque range. Tightening a terminal bolt loosely may result in a short circuit, fire, or malfunction. Tightening a terminal bolt excessively can break the bolt or the module, also resulting in a fall, short circuit, fire, or malfunction.
 - ◆ The connectors for external connection must be crimped, welded with pressure, or soldered correctly with the tools specified by the manufacturer. Improper connection can cause a short circuit, fire, or malfunction.
 - ◆ A label is attached to the top of the module to prevent foreign matters, such as wire chips, from entering the module during wiring. Do not remove the label during wiring. Remove it for heat dissipation before system operation.
 - ◆ Any control cable or communication cable cannot be bundled with the main circuit or power cable. The control cable and communication cable must be at least 100 mm away from the main circuit or power cable.
 - ◆ Select the shielded cable for high-frequency signal input/output in applications with serious interference so as to enhance system anti-interference ability.

Operation and maintenance

- Warning**
- ◆ Operation and maintenance must be performed by skilled maintenance personnel who have received the trainings on electrical devices and have sufficient electrical knowledge.
 - ◆ Never touch any terminal with the module powered, or it may cause an electric shock or malfunction.
 - ◆ Before cleaning this module or tightening up the bolts on the terminal block or the bolts for connector installation, be sure to turn the external power supply off for all phases. Failure to turn it off for all phases may result in an electric shock.
 - ◆ Before attaching/detaching the module or connecting/disconnecting the communication cables, be sure to turn the external power supply off for all phases. Failure to turn it off for all phases may result in an electric shock or malfunction.
- Caution**
- ◆ Read through this guide and check the entire system sufficiently for safety before performing relevant operations (for example, online program change, forced output, and operation status change to RUN/STOP).
 - ◆ Be sure to turn the power supply off before installing/removing the expansion card.

Disposal

- Caution**
- ◆ When disposing of the product, treat it as industrial waste. When disposing of a used battery, trash it separately under the local relevant laws.

Product Information

Model and nameplate

G R 10 - 16 16 E TP E - KA

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

① Product family G: Inovance general module	③ Series No. 10: Series 10	⑤ Number of output channels 16: 16 channels	⑦ Output type TP: Transistor output (SOURCE)
② Product type R: Remote expansion module	④ Number of input channels 16: 16 channels	⑥ Module type E: Logic I/O expansion module	⑧ Version mark E: EtherCAT communication module
⑨ Custom model			

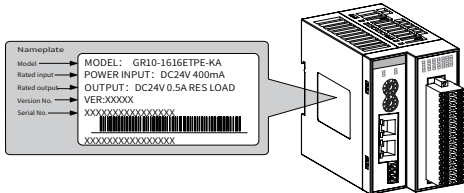


Figure 1 Description of model and nameplate

Model	Type	Description
GR10-1616ETPE-KA	EtherCAT communication slave module	16-channel digital output, transistor output (SOURCE); 16-channel digital input (SOURCE and SINK)

External terminals

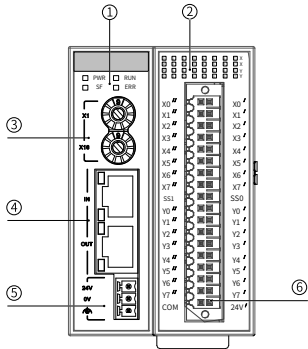


Figure 2 Diagram of module terminals

Terminal	Function definition			
① Signal indicator	PWR	Power indicator	Green	Steady ON when the power supply is turned on
	RUN	Operation indicator	Green	Steady ON when the module is functioning normally
	SF	Fault indicator	Red	Steady ON when the module malfunctions
	ERR	State machine error indicator	Red	Steady ON when an error occurs in the state machine
② IO signal indicator	Indicates the input and output signals; steady ON for active input or output signals and OFF in the other cases			
③ Address DIP switch	Slave address setting switch. ADDR1/ADDR0: address DIP switch; the address is set in hexadecimal format; decimal address of the slave = ADDR1*16+ADDR0*1 (1-255)			
④ EtherCAT communication interface	X1 IN: EtherCAT input terminal X2 OUT: EtherCAT output terminal for connecting the downstream EtherCAT slave			
⑤ 24 V power input terminal	Module power input			
⑥ User output terminal	See the Electrical Design Reference section for details			

General specifications

Item	Specification
Power supply specification	24 VDC (20.4 VDC to 28.8 VDC) (–15% to +20%)
Communication protocol	EtherCAT industrial real-time bus protocol
Max. communication speed	100 Mbps
Network port/cable	Standard network port with Cat 5e network cables of < 100 m
Station number range	1 to 255 if set by a DIP switch, or automatically assigned with a network bus

The specific performance indicators are as follows:

Item	Specification
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO), FoE
Min. synchronization period of the 6-axis cam	1250 μs (TYP)
Synchronization mode	IO: synchronized or distributed clock (DC)
Physical layer	100Base-TX
Baud rate	100 Mbps (100Base-TX)
Duplex mode	Full duplex
Topology	Linear
Transmission medium	Network cables; see the Wring section
Transmission distance	Less than 100 m between two nodes
EtherCAT frame length	44–1,498 bytes
Process data	Max. 1486 bytes per frame
Synchronous jitter of two slaves	< 1 μs
Refresh time	30 μs for 1,000 digital inputs and outputs; 100 μs for 32 servo axes

Output specifications

Item		Specification
Number of output channels		16 channels
Output connection mode		Spring clamp terminal
Output type		Transistor, NPN
Power supply voltage		24 VDC (–15% to +20%)
Output voltage		24 VDC (–15% to +20%)
Max. leakage current at OFF		Less than 0.5 mA
ON response time		Less than 0.5 ms (for hardware)
OFF response time		Less than 0.5 ms (for hardware)
Max. load	Resistive load	0.5 A/point; 2 A/common terminal ^[4]
	Inductive load	12 W/24 VDC (total)
	Lamp load	2 W/24 VDC (total)
Isolation mode		Optocoupler isolation
Output action display		Output indicator ON when the optocoupler drive is activated
Short circuit-proof output		Supported

Input specifications

Item	Specification
Number of input channels	16 channels
Input connection mode	Spring clamp terminal
Input type	Digital input
Input mode	SOURCE/SINK
Input voltage	24 VDC (up to 30 VDC)
Input current (typical)	4 mA
ON voltage	> 15 VDC
OFF voltage	< 5 VDC
Hardware filter time constant of the terminal	10 ms
Input Impedance	4.3K
Input signal form	DC voltage input, supporting SINK input and SOURCE input
Isolation mode	Optocoupler isolation
Input action display	Input indicator ON when the input is active

Mechanical Design Reference

Installation dimensions

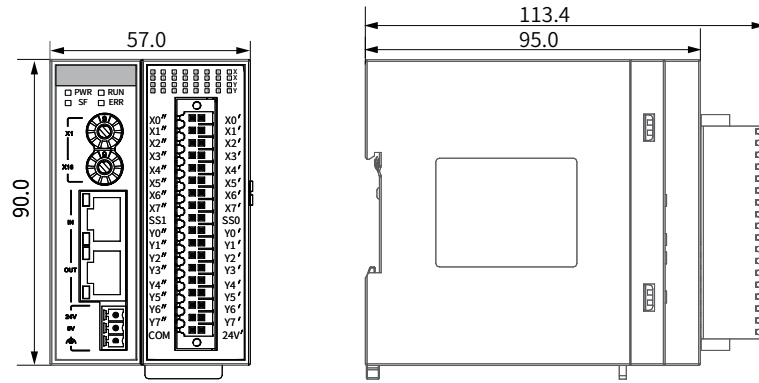
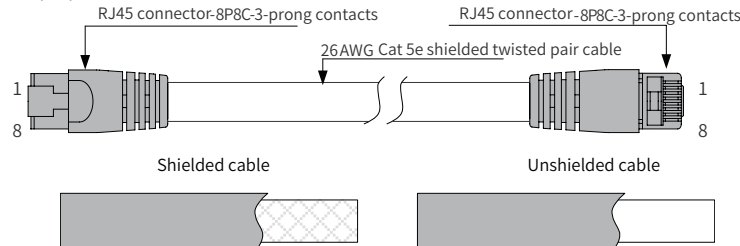


Figure 3 Installation dimensions (in mm)

Electrical Design Reference

EtherCAT cable selection

Network cable preparation



* Use the Cat 5e shielded twisted pair cables with iron shelled molded connector.

Signal pin assignment

Pin	Signal	Direction	Description	Pin	Signal	Direction	Description
1	TD+	Output	Data transmission+	5	--	--	Not used
2	TD-	Output	Data transmission-	6	RD-	Input	Data reception-
3	RD+	Input	Data reception+	7	--	--	Not used
4	--	--	Not used	8	--	--	Not used

Length requirements:

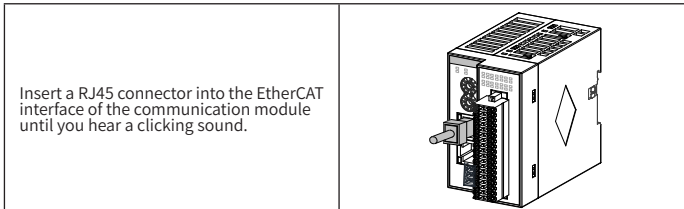
According to FastEthernet technology, the length of an EtherCAT bus (if used) between devices cannot exceed 100 m; otherwise, it can result in signal attenuation and thus affect normal communication.

Technical requirements:

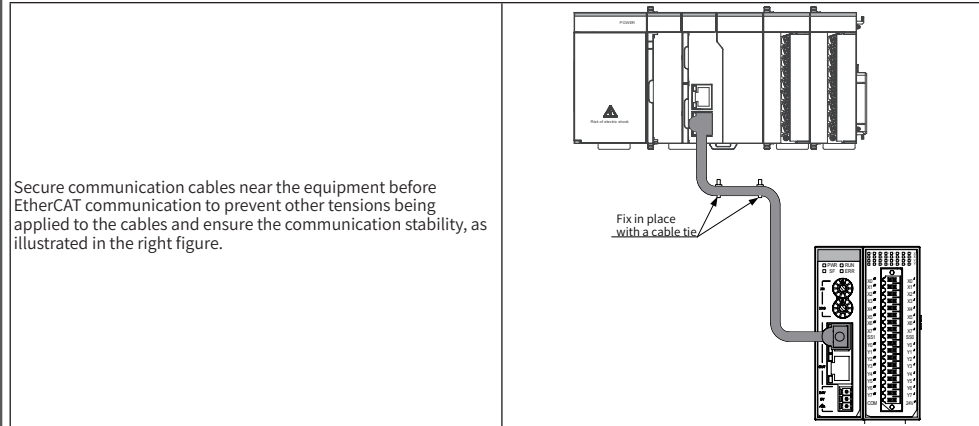
100% continuity test must be performed to eliminate the risks of short circuit, open circuit, miswiring, and improper contact. The shielded cable meeting the following specifications is recommended to be used as the EtherCAT bus for network data transmission.

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

Communication connection



Requirements for securing communication cables



Fault indication and troubleshooting for EtherCAT slave module

LED indicator		Description	Solution
RUN	OFF	EtherCAT master and slave are in the initialization state.	Check the configuration and parameter assignment; check the communication address; Check whether the length and other specifications of the network cable are consistent with the recommended values.
	Flashing	EtherCAT slave is in a state other than OP.	Check the slave configuration for any missing, faulty or unconfigured module.
ERR	Flashing	Communication error between EtherCAT master and slave	Check whether the parameter configurations of the master and slave are correct.
SF	Steady ON	An error occurs in the output channel.	Check the output channel for short circuit or overtemperature.

Connection of user output terminals

Cable selection

Supporting material	Model	Cable diameter		Manufacturer	Crimping tool
		MM ²	AWG		
Tubular lug	GTVE07512	0.75	21	Suzhou Yuanli	YAC-5

Those cable lugs are applicable to GR10-1616ETPE-KA module, and the rated temperature must be above 75°C.

Cable preparation

- Strip the cable insulation layer to expose 11-14 mm of copper, and then pass the cable through the cable marker sleeve.
- Insert the exposed conductor into the hole of the cable lug, and then crimp it with the crimping tool recommended by the cable lug manufacturer.

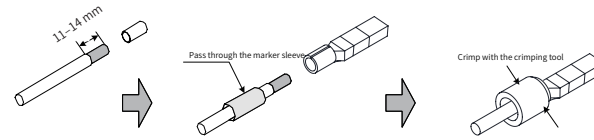


Figure 4 Diagram of cable preparation

Terminal arrangement

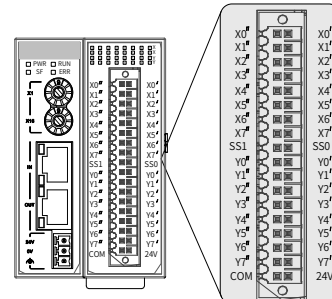


Figure 5 Terminal layout

External wiring

Wiring precautions

After the IO terminal block is mounted to CN5, fix it with a torque of 0.2-0.25 N m, as shown in the right figure.	
Contact protection in the case of inductive load: Stopping an inductive load generates a high back electromotive force between contacts and produces arc discharge, which may result in contact failure or contact sag and shorten the contact lifetime. When necessary, a flywheel diode can be connected in parallel with the load to extend the product lifetime. The diode must satisfy the following requirements: ① The reverse voltage is 5 to 10 times of the on-load voltage; ② The forward current is larger than the on-load current.	

- Do not bundle the terminal connection cables with power cables (high voltage, large current) that produce strong interference signals. Separate the terminal connection cables from power cables or other aforementioned cables and avoid cabling in parallel.
- Select the recommended cables and adapter boards for connection. It is recommended to use shielded cables as terminal connection cables for increased anti-interference ability.

External wiring					Internal equivalent circuits	
External wiring	Signal	Terminal No.	Signal	External wiring	Internal circuit	
	Column B		Column A			
	CH1 input 0 (CH1-X0)	2	1	CH0 input 0 (CH0-X0)		Input Xn
	CH1 input 1 (CH1-X1)	4	3	CH0 input 1 (CH0-X1)		SS
	CH1 input 2 (CH1-X2)	6	5	CH0 input 2 (CH0-X2)		24V
	CH1 input 3 (CH1-X3)	8	7	CH0 input 3 (CH0-X3)		Output Yn
	CH1 input 4 (CH1-X4)	10	9	CH0 input 4 (CH0-X4)		COM
	CH1 input 5 (CH1-X5)	12	11	CH0 input 5 (CH0-X5)		
	CH1 input 6 (CH1-X6)	14	13	CH0 input 6 (CH0-X6)		
	CH1 input 7 (CH1-X7)	16	15	CH0 input 7 (CH0-X7)		
	CH1 common terminal (SS1)	18	17	CH0 common terminal (SS0)		
Load	CH1 output 0 (CH1-Y0)	20	19	CH0 output 0 (CH0-Y0)	Load	
Load	CH1 output 1 (CH1-Y1)	22	21	CH0 output 1 (CH0-Y1)	Load	
Load	CH1 output 2 (CH1-Y2)	24	23	CH0 output 2 (CH0-Y2)	Load	
Load	CH1 output 3 (CH1-Y3)	26	25	CH0 output 3 (CH0-Y3)	Load	
Load	CH1 output 4 (CH1-Y4)	28	27	CH0 output 4 (CH0-Y4)	Load	
Load	CH1 output 5 (CH1-Y5)	30	29	CH0 output 5 (CH0-Y5)	Load	
Load	CH1 output 6 (CH1-Y6)	32	31	CH0 output 6 (CH0-Y6)	Load	
Load	CH1 output 7 (CH1-Y7)	34	33	CH0 output 7 (CH0-Y7)	Load	
	CH1 common terminal (COM)	36	35	CH0 common terminal (24V)	24VDC	

INOVANCE Warranty Agreement

Inovance provides an 18-month gratis warranty term from the date of manufacturing (subject to information indicated by the barcode on the product, or the purchase contract terms if otherwise specified) for any failure or damage under normal use conditions given in the user guide.

Even within the gratis warranty term, maintenance will be charged for the following damage:

- Damage caused by improper use and unauthorized disassembly, repair, or retrofit
- Damage caused by fire, flood, abnormal voltage, other disasters, and secondary disasters
- Hardware damage caused by equipment fall-off or caused during transportation
- Damage caused by failure to operate the product according to the user guide from Inovance
- Faults and damage caused by the factors other than the equipment itself (for example, external device factors)

If there is any failure or damage to the product, properly fill out the Product Warranty Card.

Maintenance will be charged according to the latest Maintenance Price List of Inovance.

This card is not re-issued. Keep the card properly and present it to the maintenance personnel for future maintenance needs.

Contact Inovance or Inovance agents for any issues arising during the service.

The customers who purchase the product are assumed to agree on this agreement. The interpretation of this agreement shall be at the sole discretion of Inovance.

INOVANCE Product Warranty Card

Customer Information	Company address:	
	Company name:	Contact:
	Postcode:	Tel.:
Product Information	Product model:	
	Product barcode (attached here):	
	Agent name:	
Fault Information	(Maintenance date and description):	
	Maintained by:	

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