INOVANCE

User Guide

GR10-4PME

EtherCAT Slave Positioning Module

19011145A01

Overview

Thank you for purchasing the GR10-4PME EtherCAT slave positioning module developed and manufactured independently by Inovance.

This module is an expansion module based on the EtherCAT bus. It supports 4-channel pulse output. Each channel can output AB phase 1 multiplier, pulse and direction or CW/CCW pulses. The maximum frequency is 200 kHz. Each channel contains 4 digital input terminals and 1 digital output terminal, among which digital input terminals can be used for positive and negative limit, home switch, emergency stop input, and normal input, and the digital output terminal can be used for ordinary output and servo enabling signaling. It can be used for positioning control of pulse servos and stepper motor drives. This guide describes the specifications, characteristics and using methods of the product. Please read this guide carefully before using to ensure safe usage. Visit our website (www. inovance.com) for the latest version of the guide.

Safety Instructions

■ Safety Disclaimer

1) Before installing, using, and maintaining this product, read the safety information and precautions thoroughly, and comply with them during operations.

2) To ensure the safety of humans and products, follow the signs on the product and all the safety instructions in this user guide.

3) The "CAUTION" ,"WARNING" and "DANGER" signs are only supplements to the safety instructions.

4) Use this product according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.

5) Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

■ Safety Levels and Definitions

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

⚠CAUTION indicates that failure to comply with the notice may result in minor or moderate personal injury or damage to the equipment.

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 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 removing/ installing the module. 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 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.
◆ Ensure that all cables are connected to the correct interface. 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 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.
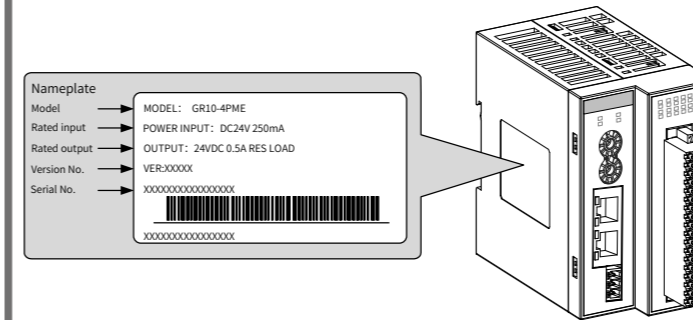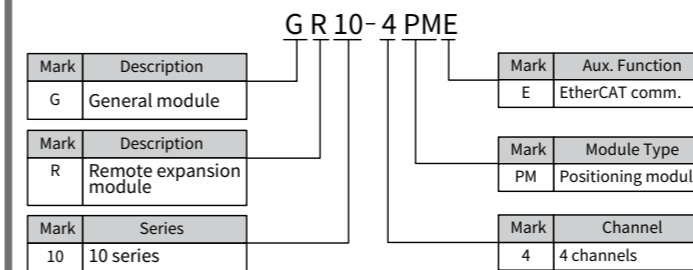
Product Information

■ Model and Nameplate

G R 10 - 4 PME

Mark	Description
G	General module

Mark	Description
R	Remote expansion module

Mark	Series
10	10 series

Mark	Aux. Function
E	EtherCAT comm.

Mark	Module Type
PM	Positioning module

Mark	Channel
4	4 channels

Nameplate
Model
Rated input
Rated output
Version No.
Serial No.

MODEL: GR10-4PME
POWER INPUT: DC24V 250mA
OUTPUT: 24VDC 0.5A RES LOAD
VER:XXXXX
XXXXXXXXXXXXXXX
XXXXXXXXXXXXXX

Figure 1 Description of model and nameplate

Model	Classification	Description
GR10-4PME	EtherCAT slave positioning module	EtherCAT slave 4-channel positioning module

■ External Interface
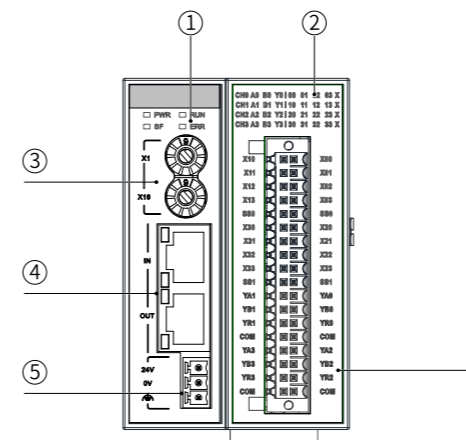
Figure 2 Diagram of module interfaces

No.	Interface Name		Function		
①	Signal indicators	PWR	Power indicator	Green	ON when power supply is switched on.
		RUN	Running status indicator	Green	ON when the module is in normal operation
		SF	Fault indicator	Red	Is ON when the module is faulty
		ERR	State machine error indicator	Red	Is ON when an error occurs in the state machine
②	I/O signal indicator		For input and output signals ON: signal active OFF: signal inactive		
③	Address DIP switch		Slave address setting switch: ADDR1/ ADDR0: address DIP switch, address is set in hexadecimal, slave decimal address = ADDR1*16+ADDR0*1 (address: 1-255)		
④	EtherCAT communication port		X1 IN: EtherCAT input		
			X2 OUT: EtherCAT output for connecting back-end EtherCAT slaves		
⑤	24 V power input terminal		For module power supply input		
⑥	User output terminals		See "Electrical Design Reference" for details		

■ General Specifications

Item	Specifications
Power supply voltage	24 VDC(20.4 VDC–28.8 VDC) (-15% to +20%), can be externally provided by the user
Communication protocol with the CPU module	EtherCAT; speed: 100 M
EtherCAT communication speed	Up to 100 M to adapt to EtherCAT master communication speed
Network port/network cable	Standard Ethernet port with standard Ethernet cables (Cat 5e cable)
Station number range	1–255, the internal address is automatically arranged by the network bus connection sequence

The specific performance indicators are as follows:

Item	Specifications
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO), FoE
Min. synchronization period of the 6-axis cam	1250 us (TYP)
Synchronization mode	The servo adopts an DC-distributed clock and input and output synchronization
Physical layer	100BASE-TX
Baud rate	100 Mbit/s (100Base-TX)
Duplex mode	Full duplex
Topological structure	Linear topological structure
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	Maximum 1,486 bytes per Ethernet frame
Synchronization jitter of two slave stations	< 1us
Update time	About 30 us for 1,000 digital inputs and outputs; about 100 us for 32 servo axes

■ Input specification

Item	Specifications
Signal	Normal input (left and right limits, homing, emergency stop input)
	24 V input
Rated input voltage	24 VDC (+20% to -15%)
Rated input current	7.3 mA (typical) (@24 VDC)
ON current	More than 3.5 mA
OFF current	Less than 1.5 mA
Input resistance	3.3 kΩ
Common terminal	A common terminal is shared by 4 points

■ Output specification

Item	Specifications
Signal	High speed output (A, B phases and enable signal YR)
	SINK output
Voltage of the control circuit	DC5V-24V
Rated load current	0.5 A/point
ON response time	1 us
OFF response time	1 us
Output frequency	200kHz (external load of 20 mA or more is required when output is above 50 kHz)
Common terminal	A common terminal is shared by 3 points

Mechanical Design Reference
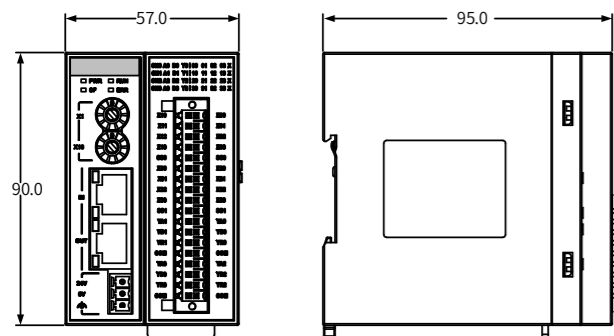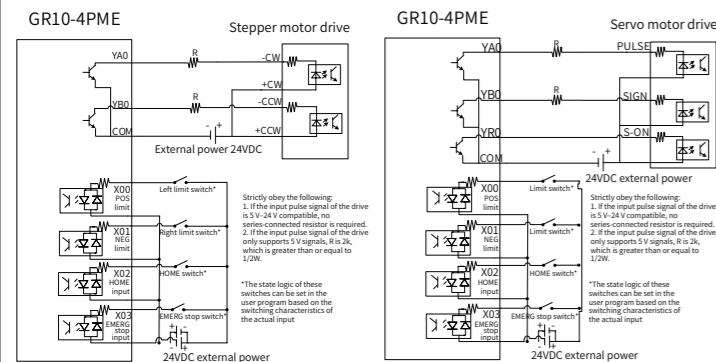
■ Mounting Dimensions

Figure 3　Mounting dimensions (in mm)

Electrical Design Reference

■ Connection of User Output Terminals

NOTE During wiring, follow the specifications of the corresponding servo drive or stepper motor drive.

◆ 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 this module, and the cable rated temperature is required to be above 75℃.

■ Cable Preparing Procedures

◆ Remove the insulation of the cable so that a length of 11–14 mm of the conductor is exposed, and put the cable through a cable marking sleeve.

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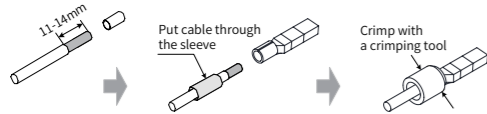

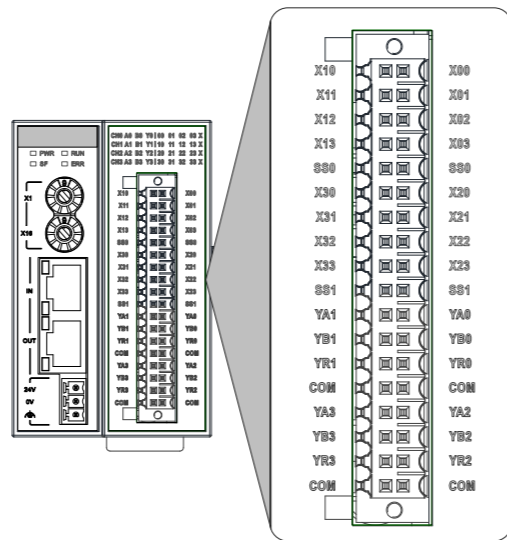Figure 4　Diagram of cable preparing

■ Terminal Layout

Figure 5　Terminal layout

■ External Wiring

External Wiring

Ext. Wiring	Signal Name Column B	Terminal No.	Signal Name Column A	Ext. Wiring
	CH1 input 0 (X10 POS limit)	2	CH0 input 0 (X00 POS limit)	
	CH1 input 1 (X11 NEG limit)	4　3	CH0 input 1 (X01 NEG limit)	
	CH1 input 2 (X12 home SW)	6　5	CH0 input 2 (X02 home SW)	
24VDC	CH1 input 3 (X13 INTRPT input)	8　7	CH0 input 3 (X03 INTRPT input)	24VDC
	CH1 input COM (SS0)	10　9	CH0 input COM (SS0)	
	CH3 input 0 (X30 POS limit)	12　11	CH2 input 0 (X20 POS limit)	
	CH3 input 1 (X31 NEG limit)	14　13	CH2 input 1 (X21 NEG limit)	
24VDC	CH3 input 2 (X32 home SW)	16　15	CH2 input 2 (X22 home SW)	
	CH3 input 3 (X33 INTRPT input)	18　17	CH2 input 3 (X23 INTRPT input)	24VDC
	CH3 input COM (SS1)	20　19	CH2 input COM (SS1)	
Load	CH1 output A (YA1)	22　21	CH0 output A (YA0)	Load
Load	CH1 output B (YB1)	24　23	CH0 output B (YB0)	Load
Load	CH1 output R (YR1)	26　25	CH0 output R (YR0)	Load
24VDC	CH1 output COM (COM)	28　27	CH0 output COM (COM)	24VDC
Load	CH3 output A (YA3)	30　29	CH2 output A (YA2)	Load
Load	CH3 output B (YB3)	32　31	CH2 output B (YB2)	Load
Load	CH3 output R (YR3)	34　33	CH2 output R (YR2)	Load
24VDC	CH3 output COM (COM)	36　35	CH2 output COM (COM)	24VDC

### internal equivalent circuit

◆ 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 figure.

Contact protection in the case of 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, you can use a parallel flywheel diode with the load to extend the lifetime of the product. The freewheel diode must satisfy: ① reverse voltage is 5 to 10 times of load voltage; ② forward current is larger than load current.

1) 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.

2) Use recommended cables and adapter boards. It is recommended to use shielded cables as terminal cables for increased anti-interference ability.

■ EtherCAT Cable Selection

◆ Cable Preparation
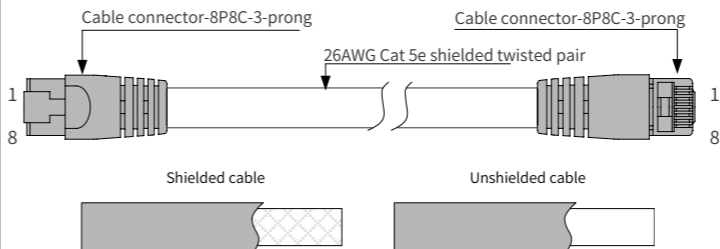
* Use Cat 5e shielded twisted pair (STP) cables, injection molded, with iron shell.

◆ Signal pins

Pin	Signal	Signal Direction	Signal Description	Pin	Signal	Signal Direction	Signal Description
1	TD+	Output	Data transmission+	5	--	--	Not used
2	TD-	Output	Data transmission-	6	RD-	Input	Data receival–
3	RD+	Input	Data receive+	7	--	--	Not used
4	--	--	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 meters. Exceeding this length will attenuate the signal and affect communication.

Technical requirements:

100% continuity test, no short circuit, open circuit, misalignment and poor contact; use a shielded cable as the EtherCAT bus for network data transmission, with the following recommended specifications:

Item	Specifications
Cable type	Flexible crossover cable, S-FTP, Cat 5e
Complied standards:	EIA/TIA568A, EN50173, ISO/IEC11801
	EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Conductor type	Twisted pair cable
Pair	4

■ Communication Wiring

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

◆ Wiring diagram of the communication system
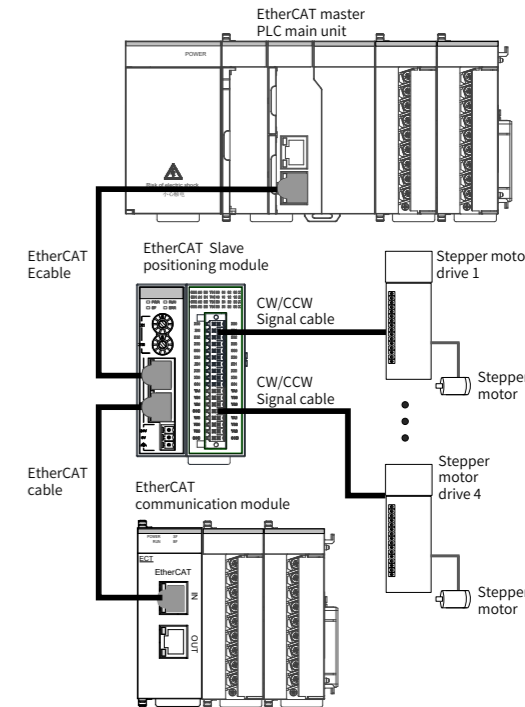
Note: To avoid the influence on the communication cable due to other stresses and ensure the stability of communication, secure the cable near the equipment before communication.

■ Fault Indication and Troubleshooting for EtherCAT Slave Station Module

LED indicator		Meaning	Solution
RUN	OFF	EtherCAT master and slaves are initialized	Check configuration and parameter assignment; check communication address
			Check that the length and other specifications of the network cable are as specified.
	Blinking	EtherCAT slave is in a state other than OP	Check the slave configuration to for any missing, faulty or unconfigured module.
ERR	Blinking	Communication error between EtherCAT master and slave	Check that the master and slave parameter configurations are correct
SF	Steady ON	Output channel is faulty	Find out the specific fault type according to object dictionaries including 0x603F, 0x683F, 0x703F and 0x783F.

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.

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