

GR10-2PHE High-Speed

Differential Pulse Positioning Remote Module User Guide



19011286A03

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1. Overview

Thank you for purchasing the GR10-2PHE high-speed differential pulse positioning module developed and manufactured independently by Inovance. This product supports two 4 MHz high-speed differential outputs and multiple pulse output modes (including direction + pulse or CW + CCW). It also supports homing, positioning, and left and right limiting, making it an ideal choice for advanced manufacturing applications requiring a large number of axes.

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



- 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.



- 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 over-voltage 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.

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Installation



- 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 PLC 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.



- 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



- 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.



- 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 bolt is connected improperly, 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 the product with an external equipment, use tools specified by the manufacturer for press-fitting and crimping, or weld properly. 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



- 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.



- 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



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

3. Product Information

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Model and nameplate

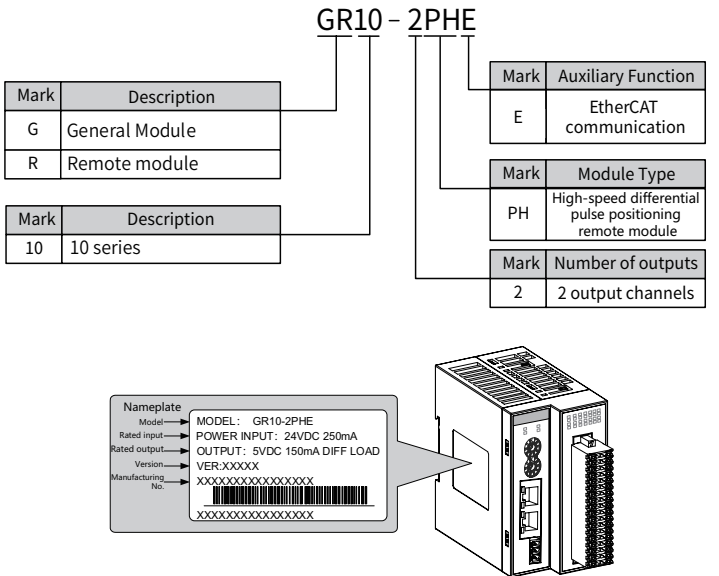
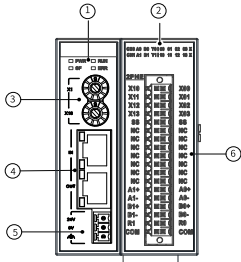


Figure1 Model and nameplate

Model	Type	Description	Applicable Model
GR10-2PHE	EtherCAT high-speed differential pulse positioning module	Supports two high-speed differential pulse outputs and eight inputs	AM600 series

External interfaces



No.	Interface	Description			
①	State 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.		
		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. It flashes when the state machine is faulty.		
②	Signal indicator	CH0/1	Channel indicator	Green	On when channel 0/1 is ready to output
		A/B	Pulse and direction indicator	Green	/
		X0-X3	Digital input indicator	Green	On when the input signal is active
③	Address DIP switch	16-bit address DIP switch. The address is set in hexadecimal format, converted to decimal address as ADDR1*16 + ADDR0*1 (range: 0 to 255).			
④	EtherCAT communication interface	X1 IN: EtherCAT input			
		X2 OUT: EtherCAT output for connecting back-end EtherCAT slaves			
⑤	24 V power input terminal	For power supply input			
⑥	User output terminals	See "Electrical Design" for details.			

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General specifications

Item	Specification
Power supply	24 VDC (20.4 VDC to 28.8 VDC) (-15% to +20%)
Input current	Max. 0.25 A
Number of positioning channels	2
General output signal	Sink output: 24 V, response time: 0.5 ms
Differential pulse output	Pulse + direction, CW/CCW, A/B (output frequency: 4 MHz)
Number of digital inputs	8 (sink and source mode)
System program upgrade method	USB firmware upgrade
Positioning functions	Absolute pulse positioning, relative pulse positioning, speed control, and multiple homing methods
Communication protocol	EtherCAT industrial real-time bus protocol, 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 DIP switch 0 to 65535 if automatically allocated through a network bus
Operating temperature	-5° C to -55° C
Storage temperature	-25 to 70° C
Humidity	10% to 95% RH, without condensing
Protection level	IP20

The specific performance indicators are as follows:

Item	Specification
Communication protocol	EtherCAT protocol
Supported services	CoE (PDO, SDO)
Minimum sync period	500 us (TYP)
Synchronization mode	Input and output synchronization or DC-distributed clock
Physical layer	100Base-TX
Baud rate	100 Mbit/s (100Base-TX)
Duplex mode	Full duplex
Topology	Linear
Transmission medium	Network cables, see "Electrical Design"
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 us
Update time	Approx. 500 us

Output specifications

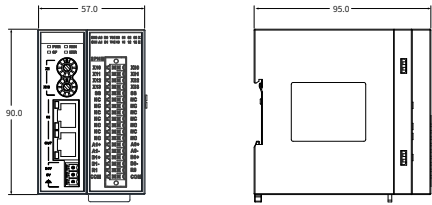
Item	Sink output	Item	Differential output
Output type	Transistor NPN	Output type	5 V differential output
ON response time	Less than 0.5 ms	Circuit insulation	Optocoupler isolation
Circuit insulation	Optocoupler isolation	Maximum output frequency	4 MHz
Leakage current upon open circuit	Less than 0.1 mA/30 VDC	Output mode	Pulse + direction, A/B phase single frequency, CW/CCW
Minimum load	5 mA (5 VDC to 24VDC)	Number of channels	2
Maximum load	Resistive load: 0.5 A/point Inductive load: 7.2 W/24 V Lamp load: 0.9 W/24 V	-	-

Input specifications

Item	Specification
Input type	Sink/source input
Input voltage	24 VDC
Input impedance	3.3 KΩ
Input current upon ON	Above 3.5 mA
Input current upon OFF	Below 1.5 mA

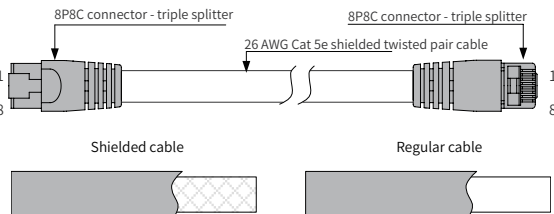
4. Mechanical Design

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
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.

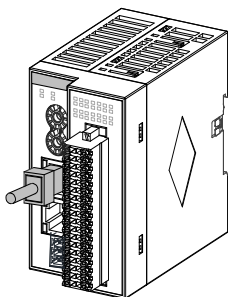
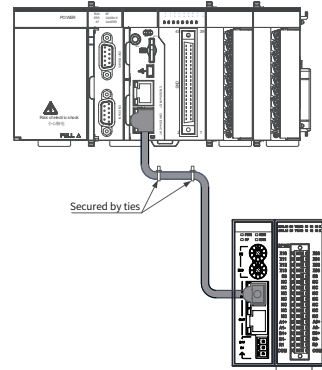


Figure2 Network cable connection

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 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. For details, see the application manual of the module.

Cable selection

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

Cable preparation:

Remove the cable insulation to expose 11 to 14 mm of the conductor. Pass the cable through a cable marking sleeve.

Insert the exposed conductor into the hole of the cable lug, and then crimp it with recommend crimping tool.

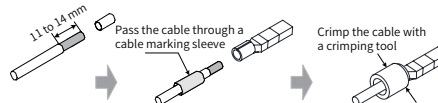
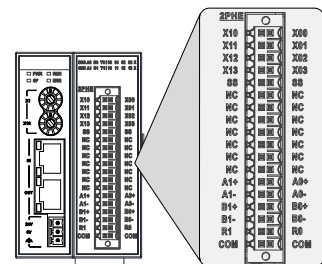


Figure3 Cable preparation

Terminal layout



User output terminal wiring

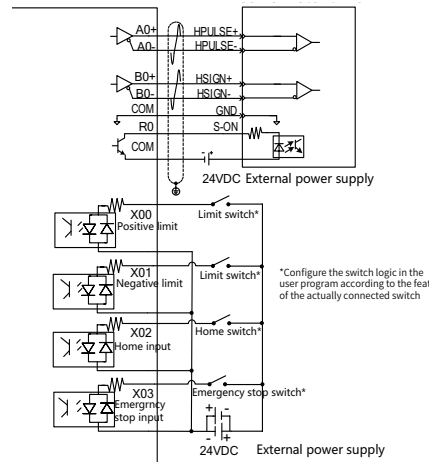
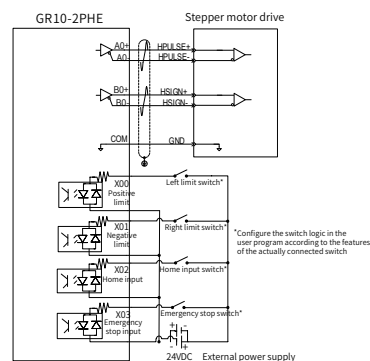


Figure4 Output terminal wiring

* The common GND of the module must be connected to the GND terminal of the drive to reduce noise interference.

External wiring

External Wiring	Signal Column B	Terminal No.	Signal Column A	External Wiring
	Input (X10)	36	Input (X00)	
	Input (X11)	34	Input (X01)	
	Input (X12)	32	Input (X02)	
	Input (X13)	30	Input (X03)	
	SS COM (SS)	28	SS COM (SS)	
	Unconnected (NC)	26	Unconnected (NC)	
	Unconnected (NC)	24	Unconnected (NC)	
	Unconnected (NC)	22	Unconnected (NC)	
	Unconnected (NC)	20	Unconnected (NC)	
	Unconnected (NC)	18	Unconnected (NC)	
	Unconnected (NC)	16	Unconnected (NC)	
	Unconnected (NC)	14	Unconnected (NC)	
	Pulse output (A1+)	12	Pulse output (A0+)	
	Pulse output (A1-)	10	Pulse output (A0-)	
	Pulse output (B1+)	8	Pulse output (B0+)	
	Pulse output (B1-)	6	Pulse output (B0-)	
	Enable output (R1)	4	Enable output (R0)	
	Common ground (COM)	2	Common ground (COM)	

Figure5 Module wiring

*1 4-core shielded twisted pair cables are used for differential output to reduce noise interference;

*2 The common GND for differential output must be connected to the GND terminal of the servo drive to reduce noise interference.

*3 Ensure that the metal spring piece at the bottom of the module is securely installed. Mount the module on a well-grounded metal bracket and ensure that the spring piece is in good contact with the bracket.

*4 The Y1 indicator displays the output state of R1 and the Y0 indicator displays the output state of R0.

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. Software Troubleshooting

The faulty code of the four axes can be obtained respectively from 0x603F, 0x683F, 0x703F, and 0x783F.

The common fault code and solutions are as follows.

Fault code	Cause	Solution
0x0001	Emergency stop fault: The DI terminal is configured for emergency stop function and the DI terminal input is active.	Check whether the DI terminal is configured for the emergency stop function. Check whether the emergency stop input is active.

0x0002	Following deviation: The deviation between the target position and current position is too large.	Check whether there is an abrupt change in the target position in the PLC program. Check whether the following deviation threshold is set too small.
0x0003	Overfrequency: The target output frequency exceeds the maximum frequency.	Check the PLC program and ensure the target speed does not exceed the maximum output frequency.
0x7500	EtherCAT synchronization loss	Check whether the EtherCAT bus is subject to severe interference

The common alarm code and solutions are as follows.

Alarm Code	Cause	Solution
0x0101	Limit active: The DI terminal is configured as a limit switch, and the input is active.	Check whether the DI terminal is configured for limit function. Check whether the limit switch is active.
0x0102	The output frequency reaches the maximum limit.	Check the PLC program and ensure the target speed does not exceed the maximum output frequency.
0x0104	Target position synchronization failed due to a deviation between the target position and the internal target position.	Check whether the limit switch is triggered during operation and whether the system continues operating in the same direction after the switch becomes invalid.

INOVANCE Product Warranty Card

Customer information	Company address:	
	Company name:	Contact:
	Post code:	Tel.:
Product information	Product model:	
	Product barcode (attached here):	
	Agent name:	
Fault information	(Service date and description):	
	Served by:	

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