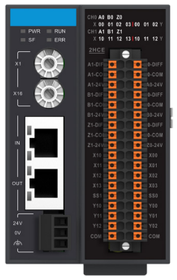
INOVANCE



GR10-2HCE EtherCAT Slave

Counter Module User Guide

19011104A03

Overview

Thank you for purchasing the GR10 series EtherCAT slave counter module developed and manufactured independently by Inovance.

This is an expansion module based on the EtherCAT bus communication and supports 2-channel single-ended (or differential) pulse input. The module is designed to count phase A/B (1x, 2x, 4x), pulse+ direction, and CW/CCW pulses at a frequency of up to 2 Mhz (GR10-2HCE-2M). Each channel includes two high-speed inputs (probe function), two high-speed outputs (comparison output), two common inputs, and one common output. The module can be used as an encoder shaft to read the position and speed data, and also as a general counter to read the number of pulses or other data. 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 must not 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 and power cable.
- Select 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 - 2 HC E-2M

Code	Description
G	General module

Code	Description
R	Remote expansion module

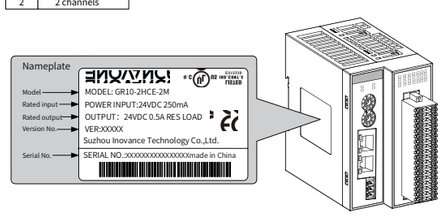
Code	Series No.
10	Series 10

Code	Number of channels
2	2 channels

Code	Input frequency
Null	200kHz
2M	2MHz
ZG	200kHz, customerized comparison input function

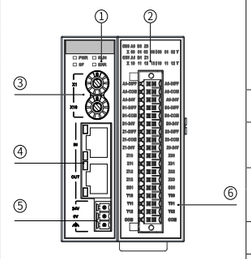
Code	Auxiliary function
E	EtherCAT communication

Code	Module type
HC	High-speed counter module



Model	Description	Code	Applicable device types
GR10-2HCE	EtherCAT slave 2-channel counter module (200 kHz)	01440072	All small and medium PLCs (supporting the basic comparison function in medium PLCs)
GR10-2HCE-2M	EtherCAT slave 2-channel counter module (200 MHz)	01440297R	
GR10-2HCE-ZG	EtherCAT slave 2-channel counter module(200 kHz, supporting the customized output comparison function)	01440933	All small and medium PLCs (supporting the basic comparison function in medium PLCs and advanced 1D and 2D comparison functions in small PLCs)

External terminals



Terminal				
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 I/O 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 (Address: 1-255)			
④ EtherCAT interface	X1 IN: EtherCAT input port			
	X2 OUT: EtherCAT output port for connecting the downstream EtherCAT slave			
⑤ 24 V power supply	Module power input terminal			
⑥ User output terminal	See the Electrical Design Reference section for details			

General specifications

Item	Specification
Power supply voltage	24 V DC (20.4 V DC to 28.8 V DC) (–15% to +20%); external power supply supported
Communication protocol with CPU module	EtherCAT; speed: 100 M
EtherCAT communication speed	Up to 100 M; adapt to the EtherCAT master communication speed
Network port/cable	Standard Ethernet port with standard Ethernet cables (Cat 5e cables)
Station number range	1–255; the internal addresses are automatically assigned according to the connection sequence of the network bus.

Performance indicator	Specification
Communication protocol	EtherCAT protocol
Service supported	CoE (PDO, SDO), FoE
Synchronization mode	Servo: distributed clock (DC); IO: synchronized input and output
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 to 1,498 bytes
Process data	Max. 1,486 bytes per Ethernet frame
Synchronous jitter of two slaves	< 1 μs

Input specifications

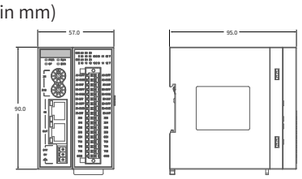
Item	Specification		
Signal type	High speed input signal (single-ended or differential input); see the following for details		Common input signal
Wiring method	Single-ended input	Differential input	--
Rated input voltage	24 V DC (+20% to –15%)	EIA standard RS-422-A Differential line drive level (equivalent to AM26LS31)	24 V DC (+20% to –15%)
Rated input current	7.3 mA (typical value @ 24 V DC)		5.6 mA (typical value @ 24 V DC)
ON current	5 mA or higher		3.5 mA or higher
OFF current	1.5 mA or lower		1.5 mA or lower
Input resistance	3.3 kΩ		4.3 kΩ
Max. input frequency	GR10-2HCE: 200 kHz GR10-2HCE-2M: 2 MHz		--
Least ideal duty cycle of 2-phase input	(40%: 60%) to (60%: 40%)		--
Common terminal mode	Each point has a separate common terminal.	--	A common terminal is shared by 4 points.

Output specifications

Item	Specification	
Signal name	High-speed output (comparison output)	Common output
	Sink output	Sink output
Voltage of control circuit	5 V DC to 24 V DC	5 V DC to 24 V DC
Rated load current	0.5 A/point	0.5 A/point
ON response time	1 μs	0.5 ms
OFF response time	1 μs	0.5 ms
Output frequency	200 kHz (external load of 20 mA or more is required when the output frequency is above 50 kHz)	--
Common terminal mode	A common terminal is shared by 3 points.	
Comparison output signal response speed	< 10 μs; this parameter is supported for GR10-2HCE-ZG only.	

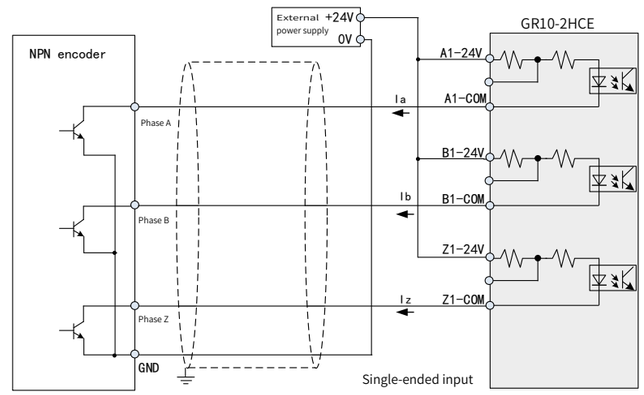
Mechanical Design Reference

Installation dimensions (in mm)

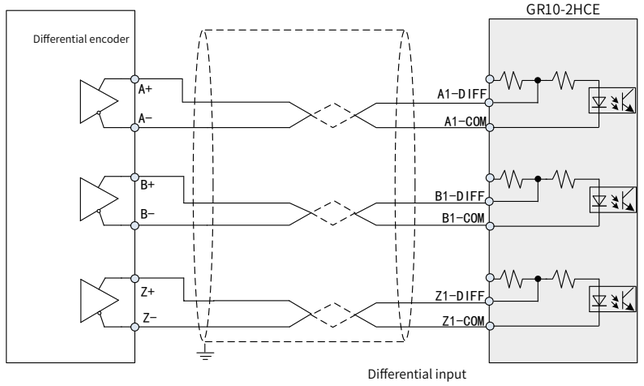


Electrical Design Reference

■ User terminal connection



Single-ended input



Differential input

· Cable selection

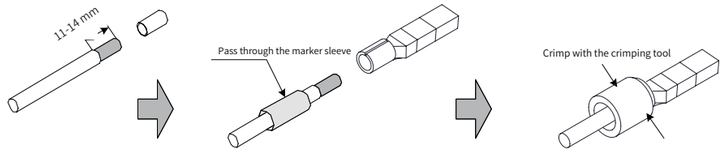
Supporting material	Model	Cable diameter		Manufacturer	Crimping tool
		MM^2	AWG		
Tubular lug	GTVE07512	0.75	21	Suzhou Yuanli	YAC-5

Those cable lugs are applicable to this module, and the rated temperature must be above 75°C.

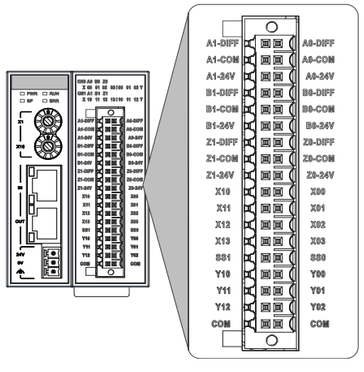
■ Cable preparation

◆ Strip the cable insulation layer to expose 11–14 mm of copper, and then pass the cable through the cable marker sleeve.

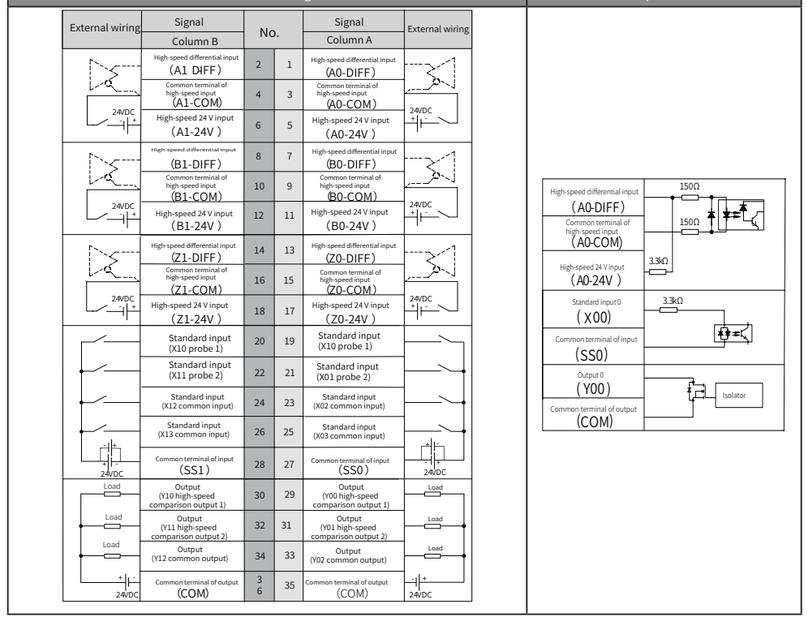
◆ Insert the exposed conductor into the hole of the cable lug, and then crimp it with the crimping tool recommended by the cable lug manufacturer.



■ Terminal arrangement



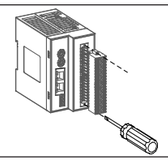
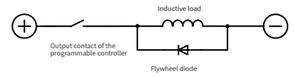
■ External wiring



Internal equivalent circuits

* The first 10 input terminals of the module support high-speed input, among which the first 6 terminals support 24 V single-ended input or 5 V differential input, and the other 4 terminals support 24 V single-ended input.

· Wiring precautions

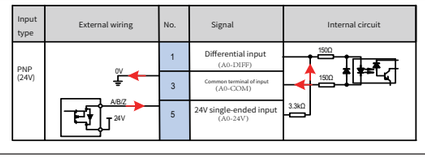
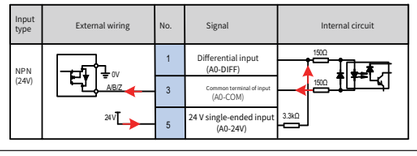
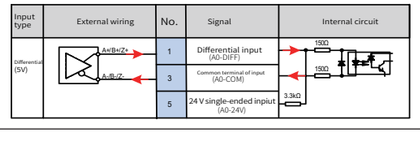
After the IO terminal block is mounted to CN5, fix it with a torque of 0.2–0.25 N m, as shown in the right figure.	
Contact protection in the case of inductive load: Stopping an inductive load generates a high back electromotive force between contacts and produces arc discharge, which may result in contact 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.	

1) Do not bundle the terminal connection cables with power cables (high voltage, large current) and other cables that produce strong interference signals. Separate the terminal connection cables from power cables or other aforementioned cables and avoid cabling in parallel.

2) 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.

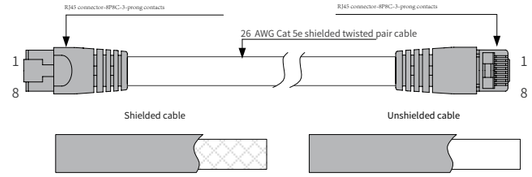
· Instances

The module supports input of high-speed single-ended and differential A, B, and Z signals. Perform wiring correctly before using the module. Take A0 as an example in the following table.

Example	Wiring
24 V input, PNP output	
24 V input, NPN output	
5 V input, differential output	

■ EtherCAT cable selection

· Network cable preparation



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

· Signal pin assignment

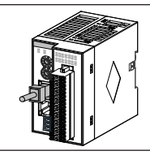
Pin	Signal	Direction	Description	Pin	Signal	Direction	Description
1	TD+	Output	Data transmission+	5	--	--	Not used
2	TD-	Output	Data transmission-	6	RD-	Input	Data reception-
3	RD+	Input	Data reception+	7	--	--	Not used
4	--	--	Not used	8	--	--	Not used

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

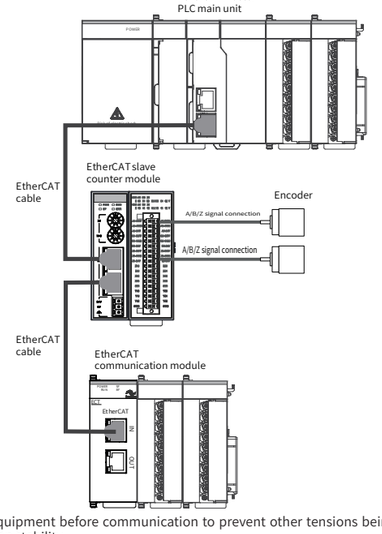
. Technical requirements: 100% continuity test must be performed to eliminate the risks of short circuit, open circuit, miswiring, and improper contact. The shielded cable meeting the following specifications is recommended to be used as the EtherCAT bus for network data transmission.

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

Insert a RJ45 connector into the EtherCAT interface of the communication module until you hear a clicking sound.	

· Communication system wiring



Note: Secure the cable near the equipment before communication to prevent other tensions being applied on the communication cable and ensure the communication stability.

■ Fault indication and troubleshooting for EtherCAT slave module

LED indicator		Description	Solution
RUN	Steady 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	See the application guide of the module for details.