INVT Flex Series I O System EtherCAT Branch Module User Manual

Contents

INVT Flex Series I O System EtherCAT Branch Module

Product Information

Specifications

- **Product:** INVT Flex Series I/O System EtherCAT Branch Module
- **Channels:** 6 (1 input port, 5 output ports)
- **Topology:** Star
- **Target Audience:** Personnel with electrical professional knowledge
- **Version:** V1.0
- **Release Date:** August 2024

Product Usage Instructions

Safety Precautions

Read the manual carefully and follow all safety precautions before moving, installing, operating, and servicing the branch module to avoid equipment damage or physical injury.

Safety Level Definition

To ensure personal safety and avoid property damage, pay attention to warning symbols and tips in the manual. Danger symbol indicates severe personal injury or death risk if requirements are not followed, while warning symbol indicates potential personal injury or equipment damage.

Personnel Requirements

Only trained and qualified professionals should operate the equipment. They must have received professional

electrical and safety training, obtained certificates, and be familiar with all installation, commissioning, running, and maintenance procedures to prevent emergencies.

Safety Guidelines

- Only trained professionals should carry out operations.
- Avoid wiring, inspection, or component replacement when power is on.
- Select appropriate tools for product delivery and wear protective gear to prevent personal injury.
- Protect the product from physical shock or vibration.

Preface

OVERVIEW
Thank you for choosing INVT Flex series I/O system 6-channel EtherCAT branch module.
The INVT Flex series 6-channel EtherCAT branch module has one EtherCAT input port and five EtherCAT output ports, making it suitable for multi-axis complex equipment and production line networking where a star topology is required.

Target audience

Personnel with electrical professional knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

About documentation obtaining

In addition to this user guide, you can also obtain product documentation and technical support from our website: Visit **www.invt.com**, choose Support > Download, enter a keyword, and click Search.

Change history

The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

No.	Change description	Version	Release date
1	First release.	V1.0	August 2024

Safety precautions

What this chapter contains

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the active power filter. Otherwise, equipment damage or physical injury or death may be caused.
We shall not be liable or responsible for any equipment damage or physical injury or death caused due to failure to follow the safety precautions.

Safety level definition

To ensure personal safety and avoid property damage, you must pay attention to the warning symbols and tips in the manual.

Warning symbols	Name	Description
	Danger	Severe personal injury or even death can result if related requirements are not followed.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.

Personnel requirements

Trained and qualified professionals: People operating the equipment must have received professional electrical and safety training and obtained the certificates, and must be familiar with all steps and requirements of equipment installing, commissioning, running and maintaining and capable to prevent any emergencies.

Safety guidelines

General principles	
	Only trained and qualified professionals are allowed to carry out related operations. Do not perform wiring, inspection or component replacement when power supply is applied. Ens ure that all the input power supplies are disconnected before wiring and inspection. The product design is applied to indoor electrical environments at overvoltage category II. Ensur e that the power supply system of the product has lightning protection devices to prevent lightnin g overvoltage from being applied to the power input or signal I/O terminals of the product so as to avoid equipment damage. Do not modify the product unless authorized; otherwise fire, electric shock or other injury may re sult. Prevent cables and other conductive parts from falling into the product. Do not contact the product with damp objects or body parts. Otherwise, electric shock may result .

Moving	
	Select appropriate tools for product delivery, and take mechanical protective measures like weari ng safety shoes and working uniforms to avoid personal injury. Protect the product against physical shock or vibration.

Installation	
	Do not install the product on inflammables. In addition, prevent the product from contacting or ad hering to inflammables. Do not run a damaged or incomplete product.
	Install the product in a lockable control cabinet of at least IP20, which prevents the personnel wit hout electrical equipment related knowledge from touching by mistake, since the mistake may re sult in equipment damage or electric shock. Only personnel who have received related electrical knowledge and equipment operation training can operate the control cabinet. During installation, ensure that the modules are tightly connected and fastened. Insecure connec tion may cause problems such as communication failure and fall-off. After installation, ensure that there are no obstructions on the vents of the product; otherwise, th e chips of the product may be burned due to overheating and poor heat dissipation, which cause s system control failure and misoperation.

Wiring	
	Before wiring, clearly understand the necessary information including interfaces, power supply ty pes, and specifications, and comply with relevant standards and requirements to ensure that the system wiring is correct. To ensure personal safety and equipment use safety, reliably ground the product using cables wit h proper diameters and specifications. Route the control signal and communication signal cables separately from cables with strong int erference such as power cables. Apply fastening means to long-distance or heavy cables.
	Cut off all power supplies connected to the product before performing wiring. Before power-on for running, ensure that each module terminal cover is properly installed in plac e after the installation and wiring are completed. This prevents a live terminal from being touched . Otherwise, physical injury, equipment fault or misoperation may result. Install proper protection components or devices when using external power supplies for the prod uct. This prevents the product from being damaged due to external power supply faults, overvolt age, overcurrent, or other exceptions.

Commissioning and running	
	Before power-on for running, ensure that the working environment of the product meets the requirements, and a protection circuit has been designed to protect the product so that the product can run safely even if an external device fault occurs. When the output units such as relays and transistors of the product are damaged, the output cannot be controlled to be On or Off as configured. For modules or terminals requiring external power supply, configure external safety devices such as fuses or circuit breakers to prevent damage caused due to external power supply or device faults. In the external circuit of the product, configure an emergency braking circuit, a protection circuit, a circuit for interlocking between forward and reverse operations, and an anti-equipment-damage switch for interlocking between the position upper limit and lower limit. To ensure the safe running of equipment, design external protection circuits and safety mechanisms for output signals related to major accidents. Design proper external control circuits to ensure the proper running of equipment, since outputs may be out of control when the control circuit has an exception.

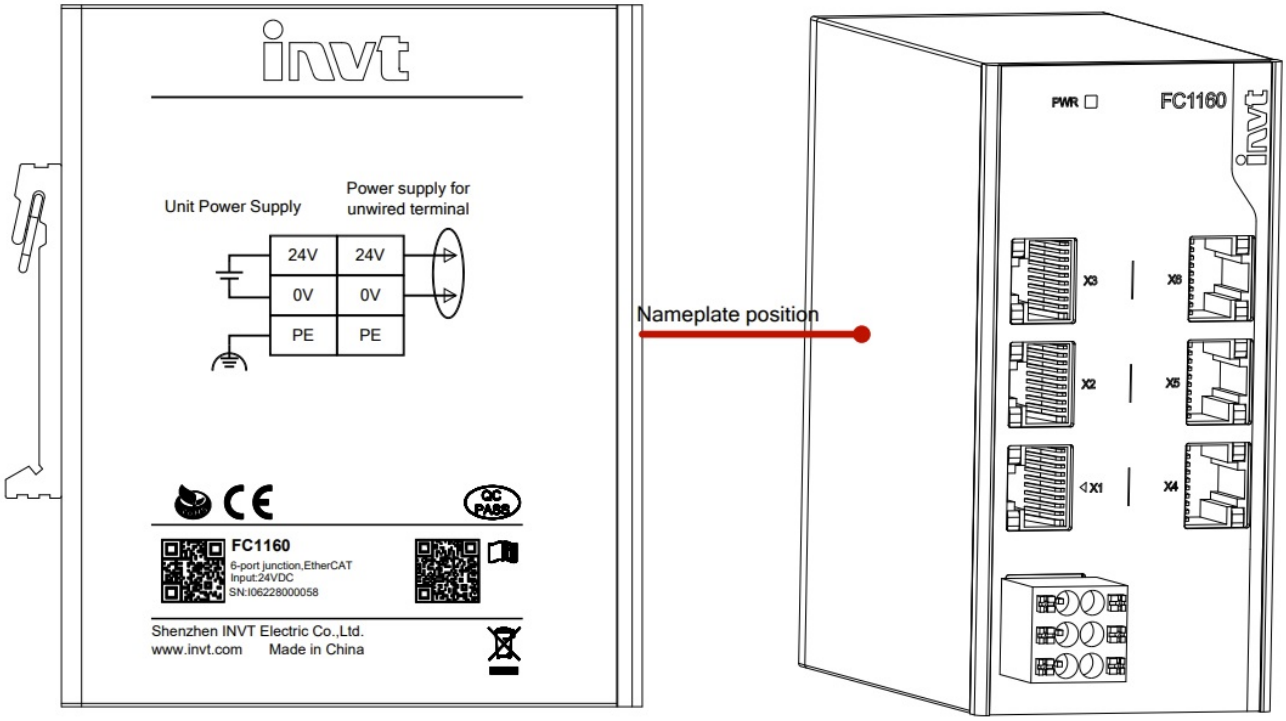
Maintenance and component replacement	
	Keep the product and its parts and components away from combustible materials and ensure they have no combustible materials adhered. Before carrying out product maintenance or component operations, cut off all power supplies connected to the product. Prevent the screws, cables and other conductive parts from falling into the product during maintenance or component replacement. During maintenance and component replacement, take proper anti-static measures on the product and its internal parts.
Note	Use proper torque to tighten screws.

Disposal	
	The product contains heavy metals. Dispose of a scrap product as industrial waste.
	Dispose of a scrap product separately at an appropriate collection point but not place it in the normal waste stream.

Product overview

Basic information

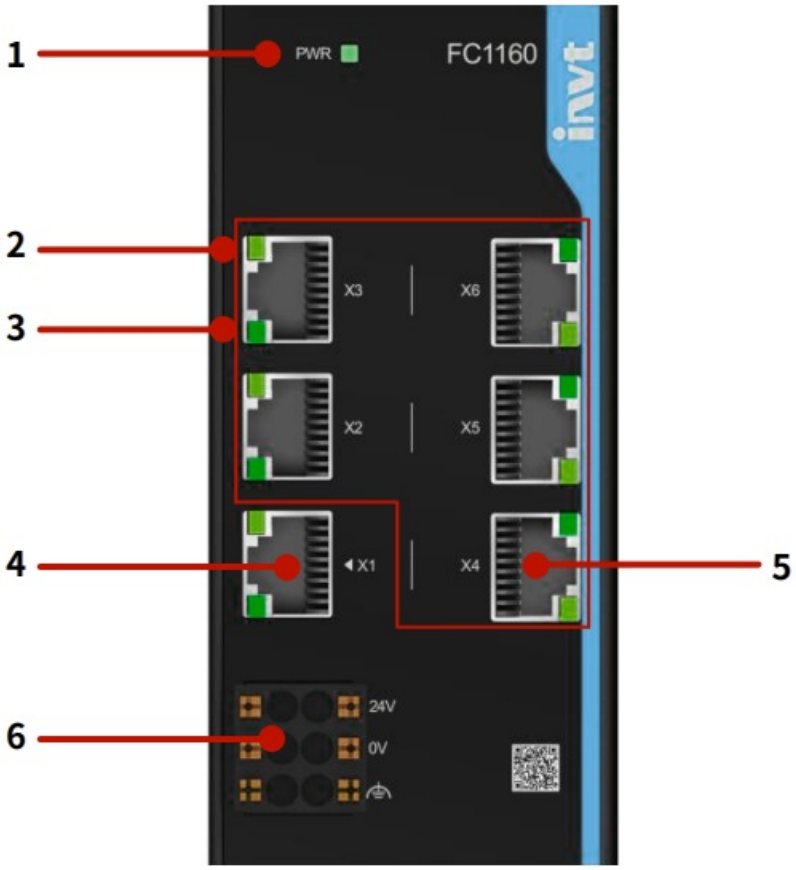
Figure 2-1 Product nameplate



Model	Ordering code	Description	Applicable model
FC1160	11016-00020	Remote EtherCAT branch module, 1 EtherCAT input, 5 EtherCAT outputs	Applicable to INVT and third-party EtherCAT master devices

External interfaces

Figure 2-2 6 EtherCAT branch module interfaces



No.	Interface	Sign	Description
1	Power indicator	PWR	On: The power connection is normal.
			Off: The power connection is abnormal.
2	Net port indicator	Green indicator (Link)	On: Physical connection is established.
			Off: Physical connection is not established.
3		Yellow indicator (Act)	Flash: There is data interaction.
			Off: There is no data interaction.
4	EtherCAT input port	X1	Port1, EtherCAT input, connecting to the upstream EtherCAT master.
5	EtherCAT output port	X2	Port2, EtherCAT output port, connecting to the downstream EtherCAT slave.
		X3	Port3, EtherCAT output port, connecting to the downstream EtherCAT slave.
		X4	Port4, EtherCAT output port, connecting to the downstream EtherCAT slave.
		X5	Port5, EtherCAT output port, connecting to the downstream EtherCAT slave.
		X6	Port6, EtherCAT output port, connecting to the downstream EtherCAT slave.
6	24V power interface	24V	DC 24V power supply +
		0V	DC 24V power supply –
		PE	PE

General specifications

Item	Specification
Rated input voltage	24VDC (20.4VDC–28.8VDC)
Rated input current	0.165A (typical value of input current at an input voltage of 24VDC)

Communication protocol	EtherCAT industrial real-time bus protocol
EtherCAT channel	1 input, 5 outputs
Max. communication speed	100Mbps
Working temperature	-20°C–+55°C
Storage temperature	-25°C–+70°C (RH < 90%, no condensation)
Isolation	Input power isolation
Power supply protection	Protection against overcurrent, reverse connection, and surges

EtherCAT communication specifications

Item	Description
Communication protocol	EtherCAT industrial real-time bus protocol
Synchronization method	DC/SM
Duplex mode	Full duplex
Max. communication speed	100Mbps(100Base-TX)
Topology structure	Star topology structure
Transmission medium	Category 5e or higher network cables
Transmission distance	The distance between two nodes is less than 100m
Whether to support the branch module cascading	Supported
Network cable identification	Auto MDI/MDIX

Electrical design

Network cable fabrication requirements

Figure 3-1 EtherCAT network cable fabrication requirements

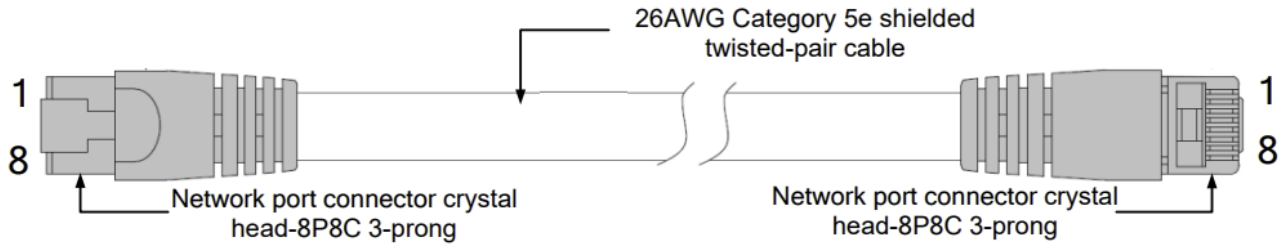
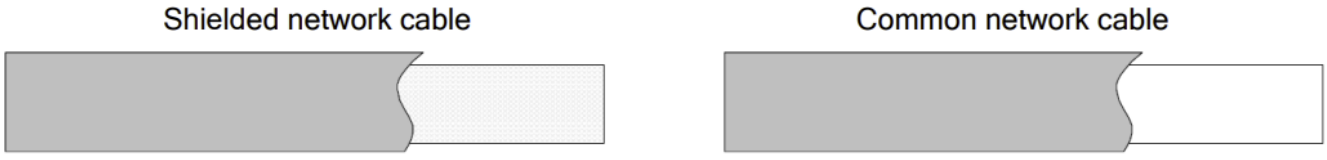


Figure 3-2 Network cable fabrication



Note: Please use shielded twisted-pair cables of category 5, plastic injection moulded and iron shelled.

Signal lead allocation

Pin	Signal	Signal direction	Signal description
1	TD+	Output	Data transmission+
2	TD-	Output	Data transmission-
3	RD+	Input	Data receiving +
4	—	—	Unused
5	—	—	Unused
6	RD-	Input	Data receiving +
7	—	—	Unused
8	—	—	Unused

Length requirement
FastEthernet technology confirms that when using the EtherCAT bus, the cable length between devices must not exceed 100 meters. Exceeding this length can cause signal attenuation, affecting normal communication.

Technical requirements
Perform a 100% conductivity test on the cables, ensuring there are no short circuit, opened circuit, dislocation or poor contact.
The EtherCAT bus uses shielded cables for network data transmission, and the following cable specifications are recommended.

Item	Specification
Cable standard	Elastic crossover cable, S-FTP, Category 5e

Requirement	EIA/TIA568A, EN50173, ISO/IEC11801 EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Cross-sectional area of wire	AWG26
Conductor type	Twisted pair
Number of pairs	4

Communication connection

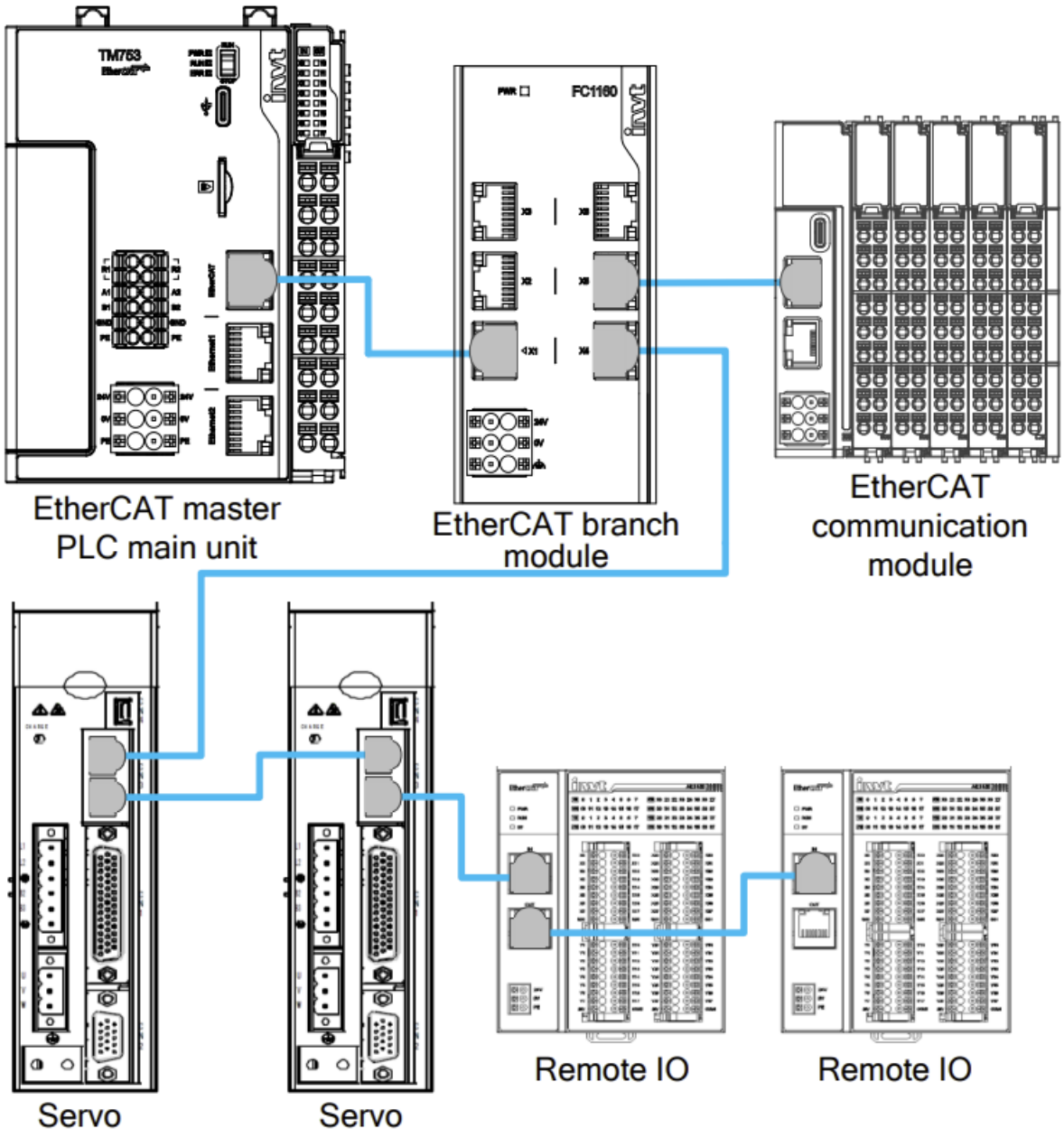
EtherCAT connection

- When connecting the network cable, hold the crystal head of the cable and insert it into the Ethernet interface of the branch module until it makes a click sound.
- When removing the installed network cable, press the tail mechanism of the crystal head and pull out it from the product horizontally.

Communication system wiring

The EtherCAT branch module can connect multiple EtherCAT slave devices. The system wiring diagram is shown below.

Figure 3-3 Communication system wiring

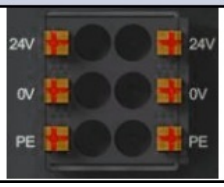


Configuration and usage Instruction

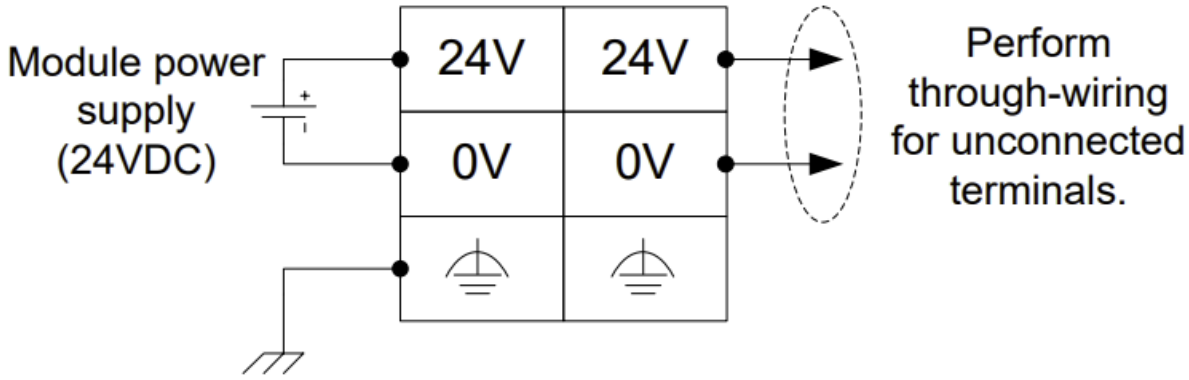
- When using this branch module, all EtherCAT slaves (including the four stations of the branch module) need to be configured to run in station alias mode. Otherwise, a failure in one branch may affect the normal operation of other branches.
- The port data flow priority of the 6-channel branch module is X2 > X3 > X4 > X5 > X6, indicating that any slave on the X2 branch takes priority over all slaves on the X3 branch.
- The branch module has DC mode enabled by default, indicating that the branch module is set to be an EtherCAT slave in DC mode.
- The branch module supports cascading, and the number of cascades is unrelated to the functionality of the branch module itself.
- Each branch module occupies four EtherCAT slave numbers.

Wiring of power supply terminals

- Terminal definition

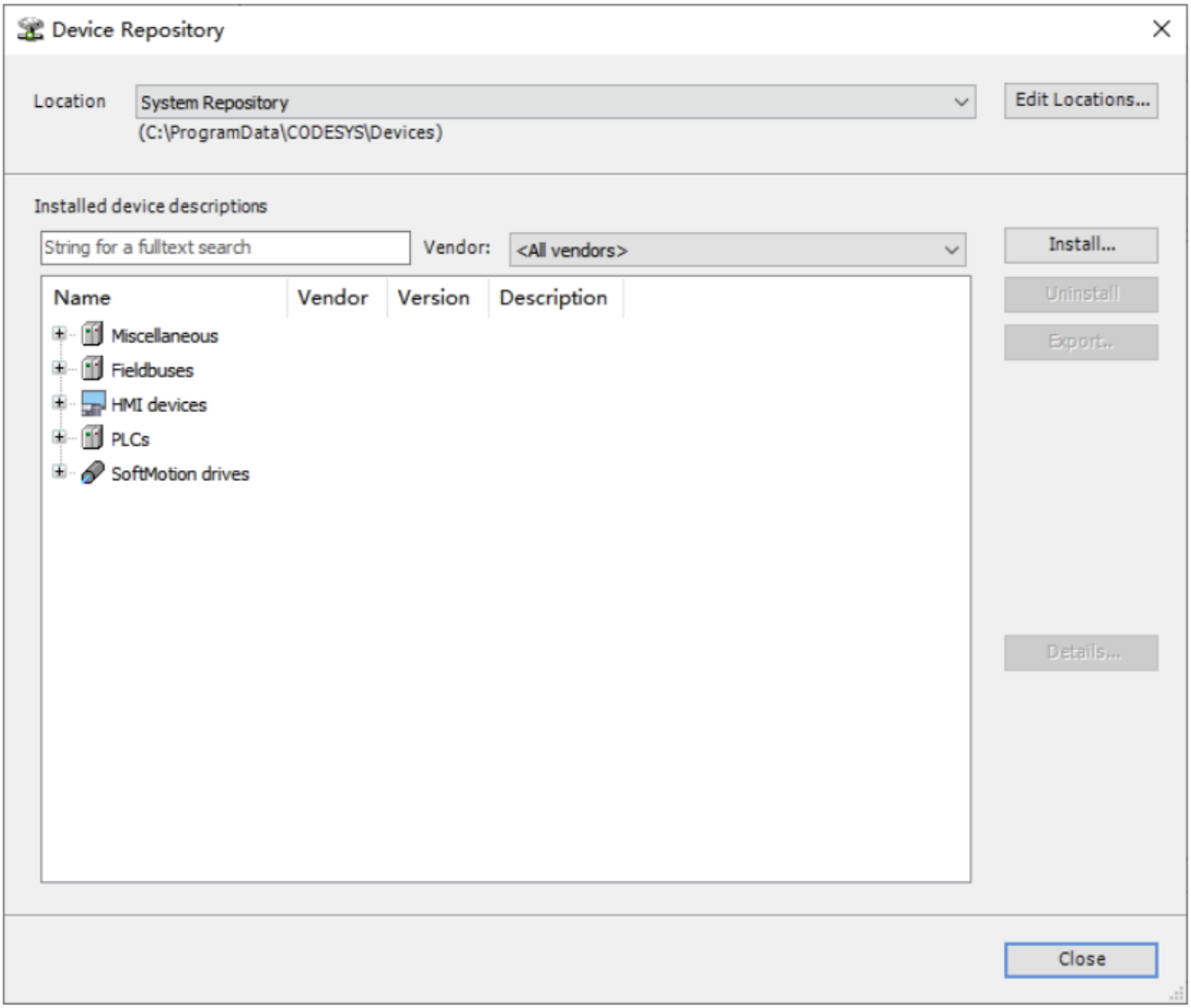
Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	24V	24V	24V
	0V	0V	0V	0V
	⏚	PE	PE	⏚

- Terminal wiring

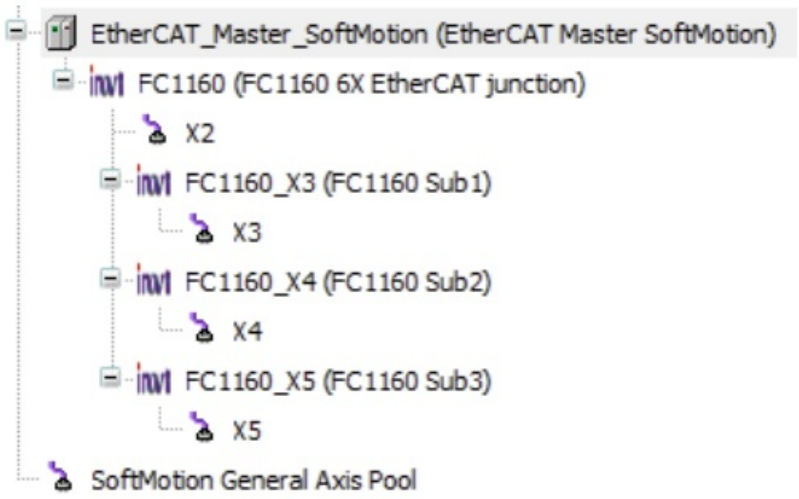


Codesys usage example

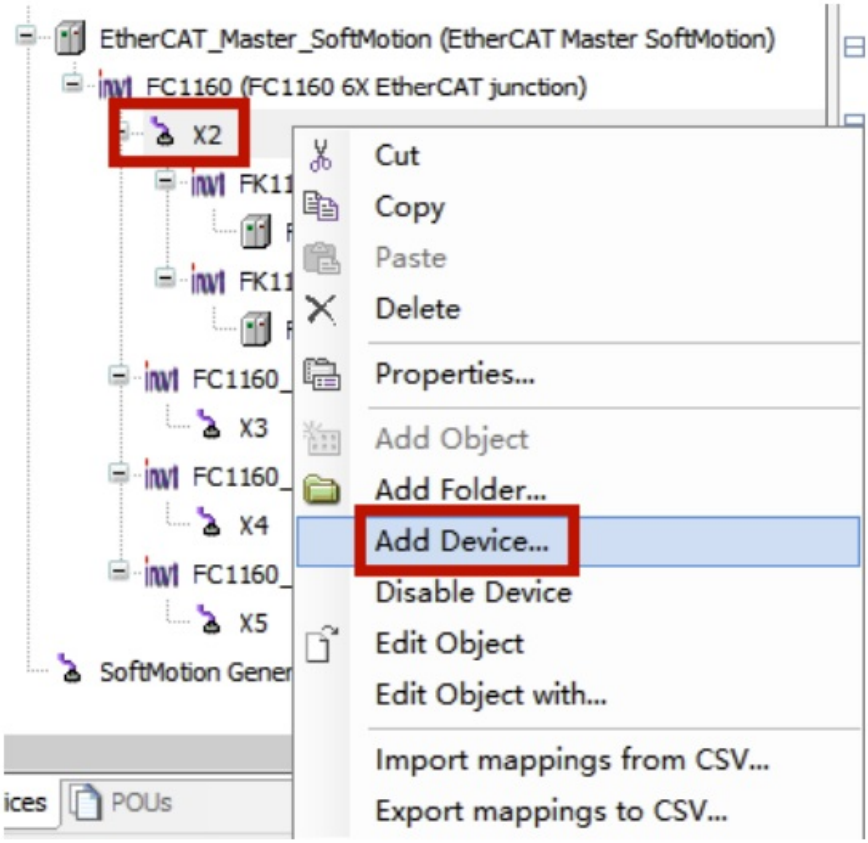
Step 1
Install the device description file “FC1160_1.x.x.x.xml” in the “Device Repository.”



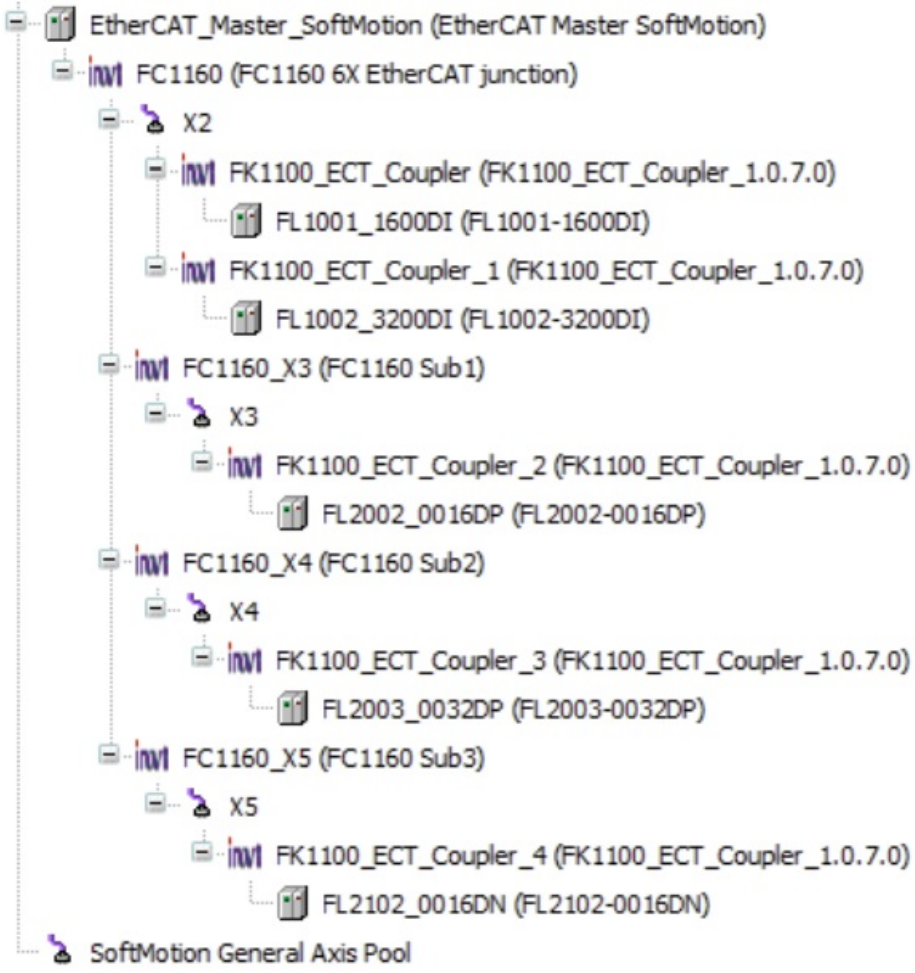
Step 2
Complete the device connections, adding the EtherCAT master and network configuration.



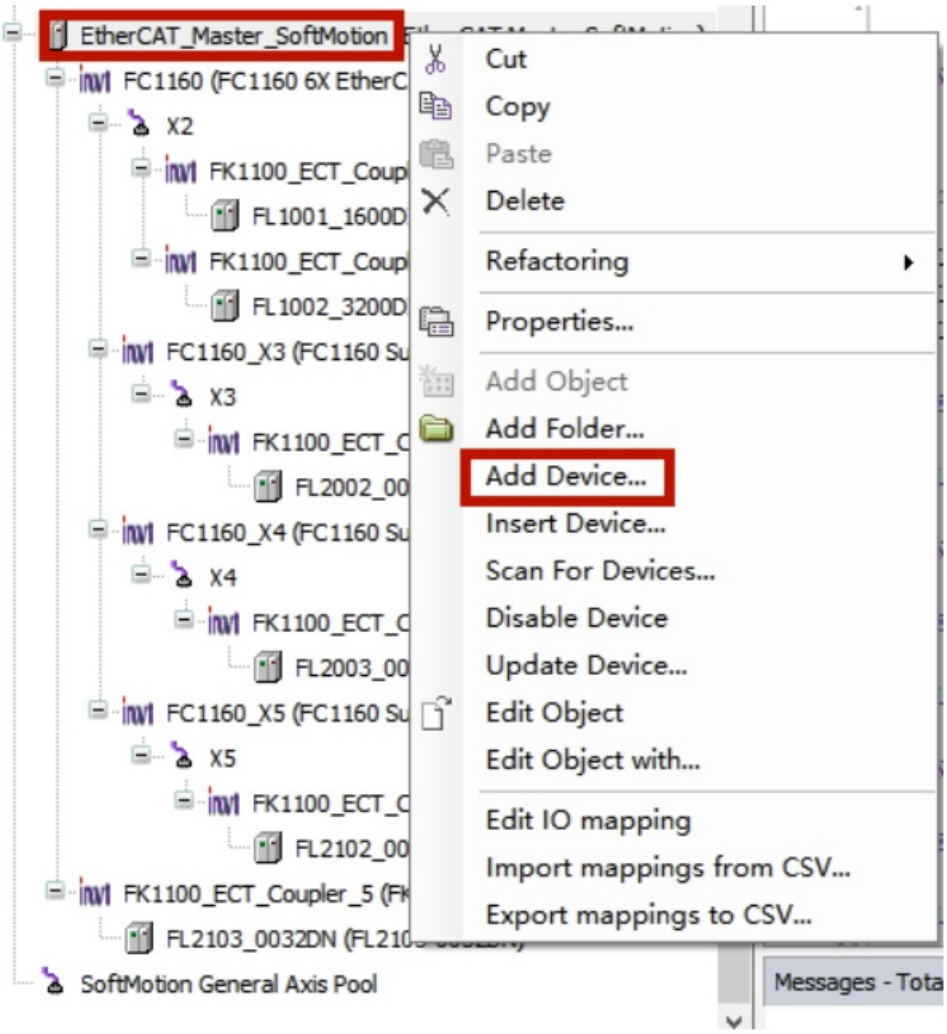
- Add the devices behind X2 under the X2 interface.



- Repeat the same steps for the devices behind X3/X4/X5 by adding them to their corresponding interfaces, as shown in the figure below.



- Add the devices behind X6 OUT in the items after the FC1160.

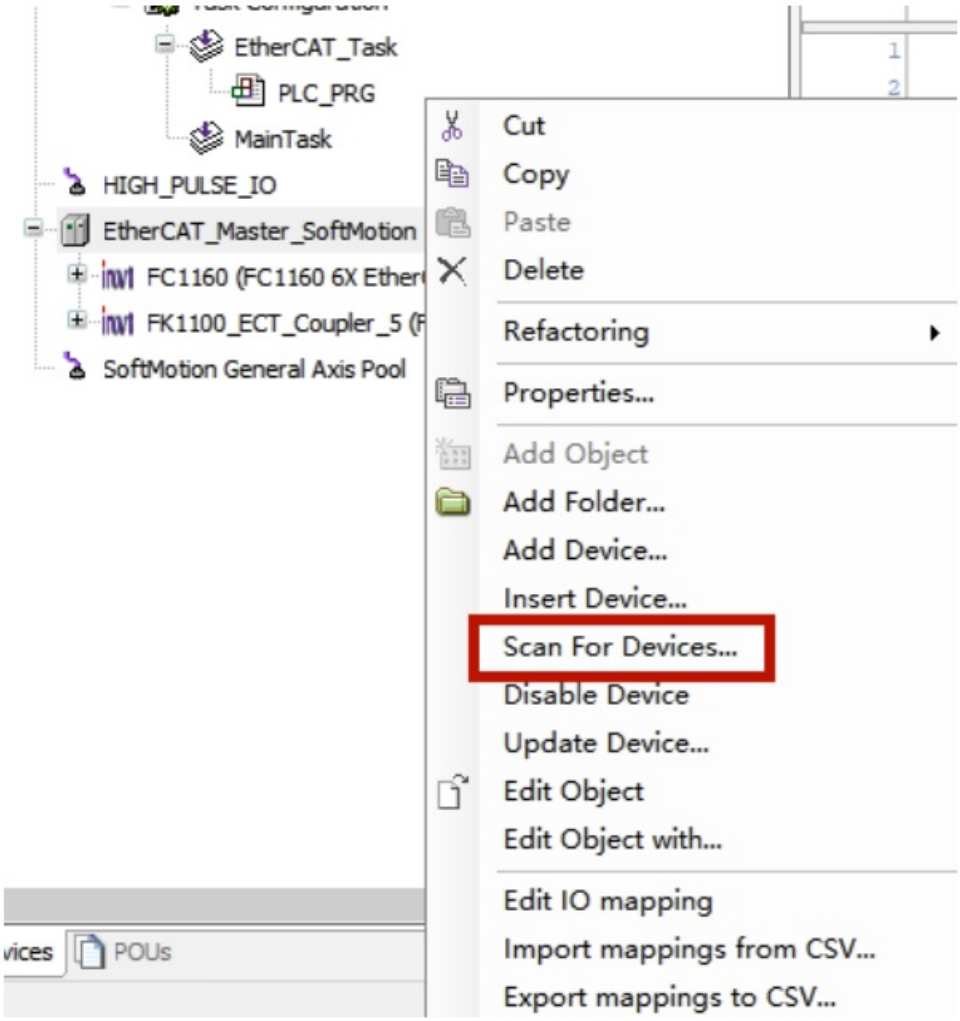


After adding, the result is shown in the following figure.

Step 3
Compile and download the program to run.

Note:

- If there is no device, you can manually add the configuration. If there are devices, it is recommended to use the “Scan For Devices” to automatically scan the configuration.



- If communication fails, it is recommended to use the “Scan device” function to compare the physical configuration with the configured network configuration to verify their consistency.

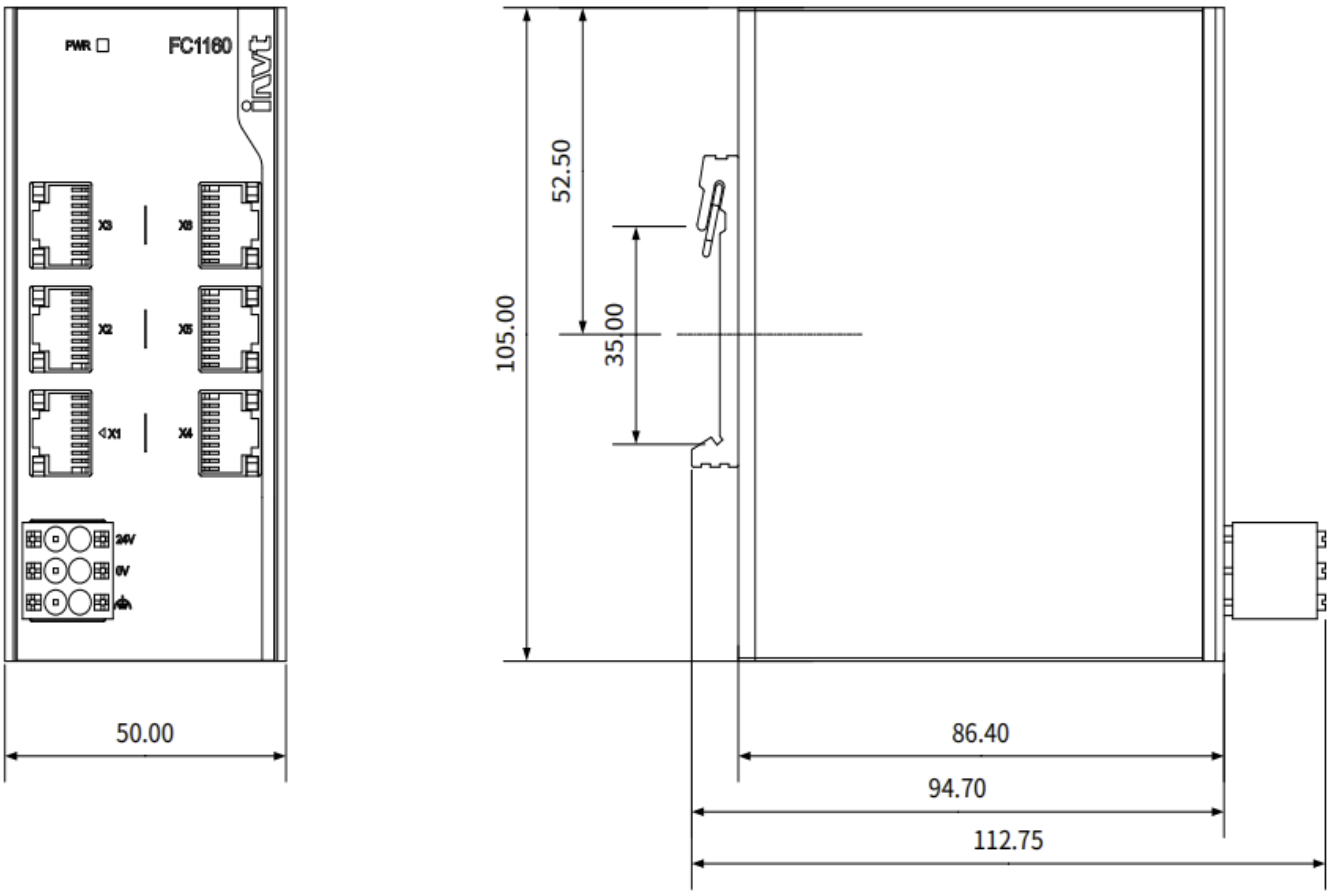
Fault handling

When the module encounters a fault, you can check the signal state through the LED indicators and take corrective actions. Common fault states and their solutions are described below.

LED indicator	Net port indicator		Meaning	Cause	Solution
PWR	Link	Act			
Off	Off	Off	Abnormal power supply	No power supply, or power supply is not connected.	Ensure that the power supply and wiring are normal.
				Internal circuit fault.	Replace the branch module.
On	Off	Off	Network port is not connected.	The communication cables may be detached, disconnected or short-circuited.	Check the connection of communication cables. If there are disconnections or short circuits, replace the communication cable.
				Branch module hardware fault	Replace the branch module.
				Master is not started.	Check the status of the master.
On	On	No flashing	No data Interaction	The master is in communication stop state.	Ensure that the master is in running mode.
				Master exception, data transmission stopped.	

Dimensional drawing

Figure A-1 Installation dimensions (unit: mm)



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Frequently Asked Questions

Q: Where can I obtain additional product documentation and technical support?
A: You can visit **www.invt.com**, choose Support > Download, enter a keyword, and click Search for product documentation and technical support.

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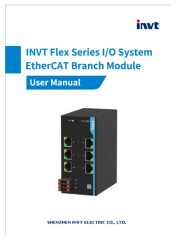
Documents / Resources

	**INVT Flex Series I O System EtherCAT Branch Module** [pdf] User Manual Flex Series I O System EtherCAT Branch Module, Flex Series, I O System EtherCAT Branch Module, EtherCAT Branch Module, Branch Module, Module

References

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- User Manual