Operation Manual

Goodrive600 Series High-performance Multifunction VFD

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Thank you for choosing Goodrive600 series variable-frequency drive (VFD).

If not otherwise specified in this manual, the VFD always indicates Goodrive600 series VFD, which is a high-performance multifunction multi-drive system that INVT develops. The VFD is a common DC bus drive system that consists of rectifier and inverter units, which can realize multi-point driving. Energy can flow between the inverter units, increasing energy recovery and reducing DC voltage fluctuations.

With excellent control performance, the VFD can drive both synchronous motors (SMs) and asynchronous motors (AMs) and supports torque control, speed control, and position control. Using the most advanced vector control technology in the world and the latest digital processor dedicated for motor control, the VFD has enhanced the reliability and environment adaptability and adapted customized and industrial design to improve the functions, make the application more flexible, and optimize the performance.

In order to meet diversified customer demands, the VFD supports various expansion cards including programmable expansion card, PG card, communication card and I/O card to achieve different functions as needed. Each unit can be installed with two expansion cards at most.

The programmable expansion card adopts the mainstream development environment for customers to carry out secondary development easily, fulfilling varied customized needs and reducing customer cost.

The PG card supports a variety of encoders including incremental encoders and resolver-type encoders. In addition, it also supports pulse reference and frequency-division output. The PG card adopts digital filter technology to improve EMC performance and to realize stable transmission of the encoder signal over a long distance. It is equipped with the encoder disconnection detection function to contain the impact of system faults.

The VFD supports a variety of mainstream communication methods and provides powerful communication networking functions to realize complicated system solutions easily. The rectifier unit can function as the CANopen master node, which can convert different types of communication into CANopen communication so that the external control device only needs to communicate with the rectifier unit, reducing the customers' networking cost.

The VFD uses book-typed and high power density design, saving installation space. Through overall EMC design, it can satisfy the low noise and low electromagnetic interference requirements to cope with challenging grid, temperature, humidity and dust conditions, thus greatly improving product reliability.

This manual instructs you how to install, wire, set parameters for, diagnose and remove faults for, and maintain the VFD, and also lists related precautions. Before installing the VFD, read through this manual carefully to ensure the proper installation and running with the excellent performance and powerful functions into full play.

If the end user is a military unit or the product is used for weapon manufacturing, please comply with relevant export control regulations in the Foreign Trade Law of the People's Republic of China, and complete necessary formalities.

The manual is subject to change without prior notice.

Contents

1 Safety precautions

1.1 What this chapter contains

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the product. 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 your or your customers' failure to follow the safety precautions.

1.2 Safety definition

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.

Note: Actions taken to ensure proper running.

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.

1.3 Warning

Warnings caution you about conditions that can result in severe injury or death and/or equipment damage and advice on how to prevent dangers. The following table lists the warning symbols in this manual.

Symbol	Name	Description	Abbreviation
Danger	Danger	Severe personal injury or even death can result if related requirements are not followed.	
Warning	Warning	Personal injury or equipment damage can result if related requirements are not followed.	
Forbid	Electrostatic sensitive	The PCBA may be damaged if related requirements are not followed.	
Hot	Note Hot sides	Do not touch. The VFD base may become hot.	
5 min	Electric shock	As high voltage still presents in the bus capacitor after power off, wait for at least five minutes (or 15 min / 25 min, depending on the warning symbols on the machine) after power off to prevent electric shock.	5 min
	Read manual	Read the operation manual before operating the equipment.	
Note	Note	Actions taken to ensure proper running.	**Note**

1.4 Safety guidelines

<table>
<tr><td></td><td>

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. Ensure all the input power supplies have been disconnected before wiring or inspection, and wait for at least the time designated on the VFD or until the DC bus voltage is less than 36V. The minimum waiting time is listed in the following.

<table>
<tr><th colspan="2">VFD model</th><th>Minimum waiting time</th></tr>
<tr><td>380V</td><td>1.5kW–110kW</td><td>5 minutes</td></tr>
<tr><td>380V</td><td>132kW–315kW</td><td>15 minutes</td></tr>
<tr><td>380V</td><td>> 355kW</td><td>25 minutes</td></tr>
<tr><td>660V</td><td>22kW–132kW</td><td>5 minutes</td></tr>
<tr><td>660V</td><td>160kW–355kW</td><td>15 minutes</td></tr>
<tr><td>660V</td><td>400kW–630kW</td><td>25 minutes</td></tr>
</table>
</td></tr>
<tr><td></td><td>Do not refit the VFD unless authorized; otherwise fire, electric shock or other injury may result.</td></tr>
<tr><td></td><td>The base may become hot when the machine is running. Do not touch. Otherwise, you may get burnt.</td></tr>
<tr><td></td><td>The electrical parts and components inside the VFD are electrostatic sensitive. Take measurements to prevent electrostatic discharge when performing related operations.</td></tr>
</table>

1.4.1 Delivery and installation

<table>
<tr><td></td><td>

Do not install the VFD on inflammables. In addition, prevent the VFD from contacting or adhering to inflammables.
Connect the optional braking parts (such as braking resistors, braking units or feedback units) according to the wiring diagrams.
Do not run the VFD if it is damaged or incomplete.
Do not contact the VFD with damp objects or body parts. Otherwise, electric shock may result.

</td></tr>
</table>

Note:

- Select appropriate tools for VFD delivery and installation to ensure the safe and proper running and avoid physical injury or death. To ensure personal safety, take mechanical protective measures like wearing safety shoes and working uniforms.
- Protect the VFD against physical shock or vibration during the delivery and installation.
- Do not carry the VFD only by its front cover as the cover may fall off.
- The installation site must be away from children and other public places.
- Use the VFD in proper environments. (For details, see section 2.4 Environment checking.)
- Prevent the screws, cables and other conductive parts from falling into the VFD.
- As leakage current of the VFD during running may exceed 3.5mA, ground properly and ensure the grounding resistance is less than 10Ω. The conductivity of PE grounding conductor is the same as that of the phase conductor (with the same cross sectional area).
- R, S and T are the power input terminals, and U, V and W are the output motor terminals. Connect the input power cables and motor cables properly; otherwise, damage to the VFD may occur.

1.4.2 Commissioning and running

	• Cut off all power supplies connected to the VFD before terminal wiring, and wait for at least the time designated on the VFD after disconnecting the power supplies. • High voltage presents inside the VFD during running. Do not carry out any operation on the VFD during running except for keypad setup. • The VFD may start up by itself when power-off restart is enabled (P01.21=1). Do not get close to the VFD and motor. • The VFD cannot be used as an "Emergency-stop device". • The VFD cannot act as an emergency brake for the motor; it is a must to install a mechanical braking device. • During driving a permanent magnet SM, besides above-mentioned items, the following work must be done before installation and maintenance: 1. All input power supplies have been disconnected, including the main power and control power. 2. The permanent-magnet SM has been stopped, and the voltage on output end of the VFD is lower than 36V. 3. After the permanent-magnet SM has stopped, wait for at least the time designated on the VFD, and ensure the voltage between + and - is lower than 36V. 4. During operation, it is a must to ensure the permanent-magnet SM cannot run again by the action of external load; it is recommended to install an effective external braking device or cut off the direct electrical connection between the permanent-magnet SM and the VFD.

Note:

- Do not switch on or switch off the input power supplies of the VFD frequently.
- If the VFD has been stored for a long time without being used, check the capacitors and perform capacitor reforming if necessary (see chapter 10 Maintenance) and carry out pilot run for the VFD before the use.
- Close the VFD front cover before running; otherwise, electric shock may occur.

1.4.3 Maintenance and component replacement

	• Only trained and qualified professionals are allowed to perform maintenance, inspection, and component replacement for the VFD. • Cut off all power supplies connected to the VFD before terminal wiring, and wait for at least the time designated on the VFD after disconnecting the power supplies. • During maintenance and component replacement, take measures to prevent screws, cables and other conductive matters from falling into the internal of the VFD.

Note:

- Use proper torque to tighten screws.
- During maintenance and component replacement, keep the VFD and its parts and components away from combustible materials and ensure they have no combustible materials adhered.
- Do not carry out insulation voltage-endurance test on the VFD, or measure the control circuits of the VFD with a megohmmeter.
- During maintenance and component replacement, take proper anti-static measures on the VFD and its internal parts.

1.4.4 Disposal

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

2 Quick startup

2.1 What this chapter contains

This chapter introduces the basic installation and commissioning rules that you need to follow to realize quick installation and commissioning.

2.2 Unpacking inspection

Check the following after receiving the product.

1. Whether the packing box is damaged or dampened.
2. Whether the model identifier on the exterior surface of the packing box is consistent with the purchased model.
3. Whether the interior surface of the packing box is abnormal, for example, in wet condition, or whether the enclosure of the VFD is damaged or cracked.
4. Whether the VFD nameplate is consistent with the model identifier on the exterior surface of the packing box.
5. Whether the accessories (including the manual, keypad, and expansion card) inside the packing box are complete.

If any problems are found, contact the local INVT dealer or office.

2.3 Checking before use

Check the following before using the VFD.

1. Mechanical type of the load to be driven by the VFD to verify whether the VFD will be overloaded during work. Whether the power class of the VFD needs to be increased.
2. Whether the actual running current of the motor is less than the rated current of the VFD.
3. Whether the control accuracy required by the load is the same as that is provided by the VFD.
4. Whether the grid voltage is consistent with the rated voltage of the VFD.
5. Check whether expansion cards are needed for selected functions.

2.4 Environment checking

Check the following before installing the VFD:

Note: When the VFD is built in a cabinet, the ambient temperature is the temperature of air in the cabinet.

1. Whether the actual ambient temperature exceeds 40°C. When the temperature exceeds 40°C, derate 1% for every increase of 1°C. Do not use the VFD when the ambient temperature exceeds 50°C.
2. Whether the actual ambient temperature is lower than -10°C. If the temperature is lower than -10°C, use heating devices.
3. Whether the installation site altitude exceeds 1000 m. When the installation site altitude exceeds 1000 m, derate 1% for every increase of 100 m; when the installation site altitude exceeds 3000 m, consult the local INVT dealer or office.
4. Whether the actual environment humidity exceeds 90% or condensation occurs. If yes, take additional protective measures.

5. Whether there is direct sunlight or biological invasion in the environment where the VFD is to be used. If yes, take additional protective measures.
6. Whether there is dust or inflammable and explosive gas in the environment where the VFD is to be used. If yes, take additional protective measures.

2.5 Checking after installation

Check the following after the VFD installation is complete.

1. Whether the input power cables and motor cables meet the current-carrying capacity requirements of the actual load.
2. Whether correct accessories are selected for the VFD, the accessories are correctly and properly installed, and the installation cables meet the requirements of all components (including the reactor, input filter, output reactor, output filter, DC reactor, braking unit and braking resistor).
3. Whether the VFD is installed on non-flammable materials and the heat-radiating accessories (such as the reactor and braking resistor) are away from flammable materials.
4. Whether all control cables and power cables are run separately and the routing complies with EMC requirement.
5. Whether all grounding systems are properly grounded according to the requirements of the VFD.
6. Whether all the installation clearances of the VFD meet the requirements in the manual.
7. Whether the installation method conforms to the instructions in the manual. It is recommended that the VFD be installed uprightly.
8. Whether the external connection terminals of the VFD are tightly fastened and the torque is appropriate.
9. Whether there are screws, cables, or other conductive items left in the VFD. If yes, get them out.

2.6 Basic commissioning

Complete the basic commissioning as follows before the actual use of the VFD:

1. According to the actual motor parameters, select the motor type, set motor parameters, and select the VFD control mode.
2. Check whether autotuning is required. If possible, de-couple the VFD from the motor load to start dynamic parameter autotuning. If the VFD cannot be de-coupled from the load, perform static autotuning.
3. Adjust the ACC/DEC time according to the actual work condition of the load.
4. Perform device commissioning by means of jogging and check whether the motor rotational direction is correct. If not, change the rotation direction by swapping any two phase wires of the motor.
5. Set all control parameters and then perform actual run.

3 Product overview

3.1 What this chapter contains

This chapter mainly introduces the operation principles, product features, layouts, nameplates and model designation rules.

3.2 Basic principles

The VFD is used to control asynchronous AC induction motors and permanent magnet synchronous motors. It consists of the rectifier and inverter units. The rectifier unit converts 3PH AC voltage into DC voltage, and the inverter unit converts DC voltage into AC voltage that can be used by an AC motor. The 45kW rectifier unit is embedded with a braking circuit so that the braking pipe connects the external braking resistor to the DC circuit to consume the feedback energy when the DC voltage exceeds the max. value. The following figures show the schematic diagram and main circuit diagram of each unit.

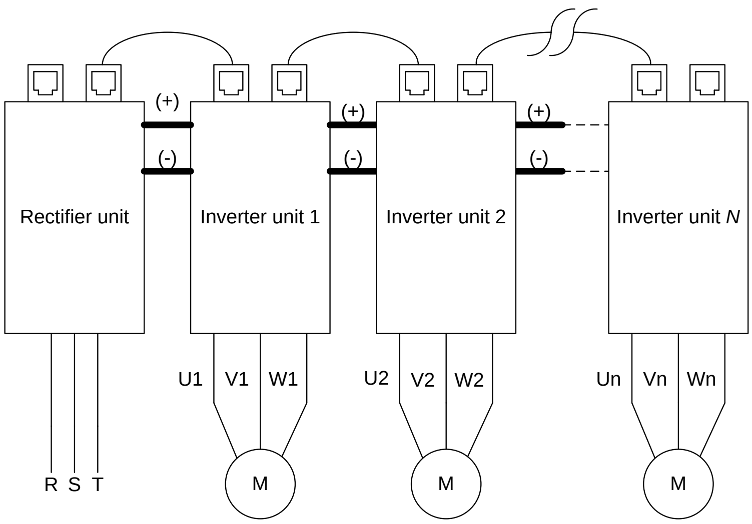


Figure 3-1 Schematic diagram

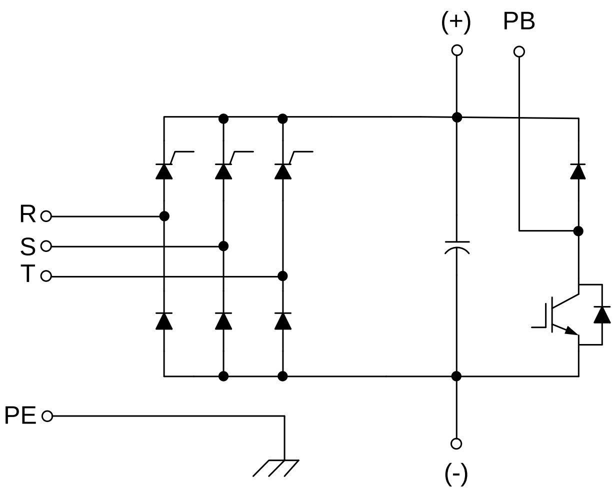


Figure 3-2 Main circuit diagram of the rectifier unit (45kW)

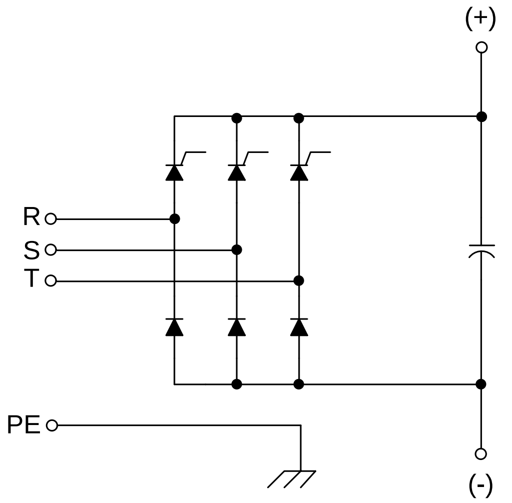


Figure 3-3 Main circuit diagram of the rectifier unit (160kW/355kW)

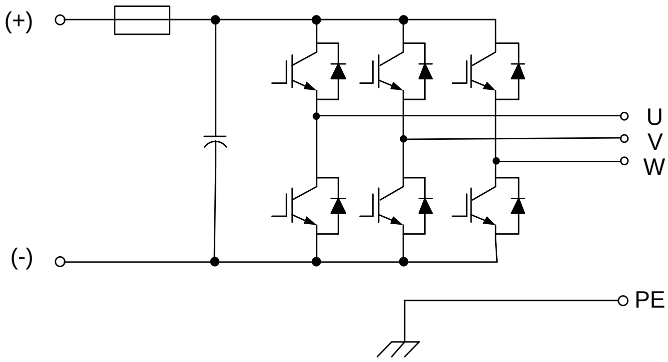


Figure 3-4 Main circuit diagram of the inverter unit

Note: The built-in braking unit is a standard configuration part only for the 45kW rectifier unit, and other rectifier unit models can be configured with optional external braking units.

3.3 Specifications

Table 3-1 Rectifier unit specifications

Item		Specifications
Power input	Input voltage (V)	AC 3PH 380V (-15%)–440V (+10%) Rated voltage: 380V
	Input current (A)	For details, see section 3.6 Product ratings.
	Input frequency (Hz)	50Hz or 60Hz Allowed range: 47–63Hz
Power output	Output voltage (V)	457VDC–684VDC
	Output current (A)	For details, see section 3.6 Product ratings.
	Output power (kW)	For details, see section 3.6 Product ratings.
Protection	Protection against input voltage exceptions	Protection against input voltage exceptions, such as input phase loss, input voltage too high, three-phase imbalance of input voltage
	Braking circuit protection	Protection against braking circuit overcurrent, braking resistor short-circuit, and braking-pipe direct connection
	Other protection functions	Such as protection against overvoltage, undervoltage, and overtemperature

Item		Specifications
Peripheral interface	Digital input	Five regular inputs; max. frequency: 1kHz; internal impedance: 3.3kΩ Resolution: ≤ 2ms
	Relay output	Two programmable relay outputs RO1A: NO; RO1B: NC; RO1C: common RO2A: NO; RO2B: NC; RO2C: common Contact capacity: 3A/AC250V, 1A/DC30V
	Communication interface	One RS485 interface, supporting the Modbus communication protocol Two CAN communication interfaces, of which CAN1 supports the CANopen communication protocol and CAN2 is reserved
	Extended interfaces	Two extended interfaces: SLOT1 and SLOT2 Supporting PG/programmable/communication/IO cards and so on
Other	Installation method	Wall mounting or flange installation
	Temperature of running environment	-10–50°C Derating is required at a temperature higher than 40°C.
	Ingress protection rating	For the 355kW model: IP00 For the 45kW and 160kW models: IP20
	Pollution degree	Degree 2
	Cooling method	Forced air cooling
	Braking unit	Already built in the 45kW model; optional part (externally connected) for other models
	EMC filter	All the series meet the IEC61800-3 C3 requirements. Optional external filters can be used to meet the IEC61800-3 C2 requirements.

Table 3-2 Inverter unit specifications

Item		Specifications
Power input	Input voltage (V)	350VDC–800VDC
	Input current (A)	For details, see section 3.6 Product ratings.
Power output	Output voltage (V)	0–0.7*Input voltage
	Output current (A)	For details, see section 3.6 Product ratings.
	Output power (kW)	For details, see section 3.6 Product ratings.
	Output frequency (Hz)	0–400Hz
Technical control performance	Control mode	Space voltage vector control, sensorless vector control (SVC), and sensor vector control (VC)
	Motor type	Asynchronous motor (AM) and permanent magnetic synchronous motor (SM)
	Speed ratio	For AM1, 1:200 (SVC); for SM1, 1:20 (SVC); 1:1000 (VC)
	Speed control accuracy	± 0.2% (SVC); ± 0.02% (VC)
	Speed fluctuation	± 0.3% (SVC)
	Torque response	< 20ms (SVC); < 10ms (VC)
	Torque control accuracy	10% (SVC); 5% (VC)
	Starting torque	For AMs: 0.25Hz/150% (SVC) For SMs: 2.5Hz/150% (SVC) 0Hz/200% (VC)
	Overload capacity	150% for 1 minute, 180% for 10 seconds, and 200% for 1 second

Item		Specifications
Running control performance	Frequency setting method	Settings can be implemented through digital, analog, pulse frequency, multi-step speed running, simple PLC, PID, Modbus communication, PROFIBUS DP communication and so on. Settings can be combined and the setting channels can be switched.
	Automatic voltage regulation	The output voltage can be kept constant although the grid voltage changes.
	Fault protection	More than 30 protection functions, such as protection against overcurrent, overvoltage, undervoltage, overtemperature, phase loss, and overload
	Speed tracking restart	Used to implement impact-free smooth startup for rotating motors
Peripheral interface	Analog input	Two inputs. AI1: 0(2)–10V/ 0(4)–20mA; AI2: -10–10V Resolution: ≤ 20mV
	Analog output	One output. AO1: 0–10V /0–20mA
	Digital input	Four regular inputs; max. frequency: 1kHz; internal impedance: 3.3kΩ Resolution: ≤ 2ms
	Digital output	One Y terminal open collector output
	Relay output	Two programmable relay outputs RO1A: NO; RO1B: NC; RO1C: common RO2A: NO; RO2B: NC; RO2C: common Contact capacity: 3A/AC250V, 1A/DC30V
	Communication interface	One RS485 interface, supporting the Modbus communication protocol One Communication interface, used for synchronization control
	Extended interfaces	Three extended interfaces: SLOT1 and SLOT2 Supporting PG cards, programmable expansion cards, communication cards, I/O cards and so on
Other	Mounting method	Wall mounting or flange installation
	Temperature of running environment	-10–50°C Derating is required at a temperature higher than 40°C.
	Ingress protection rating	IP20 (built-in)
	Pollution degree	Degree 2
	Cooling method	Forced air cooling

3.4 Product nameplate

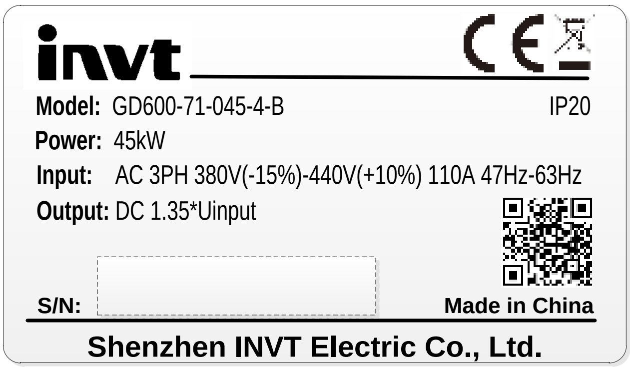


Figure 3-5 Rectifier unit nameplate

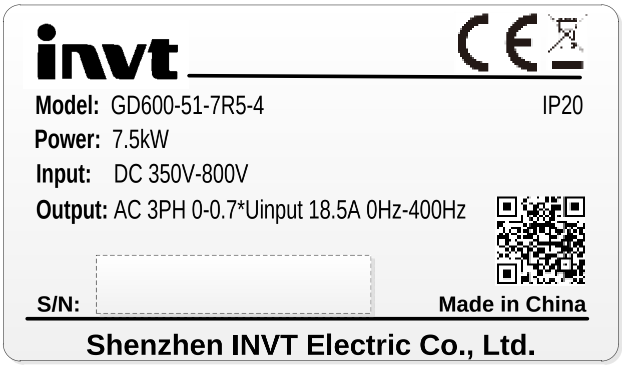


Figure 3-6 Inverter unit nameplate

Note:

- The preceding nameplates are standard product nameplate examples. The marking such as "CE" or "IP20" on the nameplate is marked according to actual the certification result.
- You can scan the QR code on the nameplate to download the product manual.

3.5 Model designation code

A model designation code contains product information. You can find the model designation code on the VFD nameplate and simplified nameplate.

GD600 – 71 – 045 – 4 – B

① ② ③ ④ ⑤

Figure 3-7 Model description

Field	Symbol	Description	Content
Product series abbreviation	①	Product series abbreviation	GD600: Goodrive600 high-performance multifunction VFD
Unit type	②	Unit type code	51: Inverter unit 71: Half-controlled rectifier unit
Rated power	③	Power code	045: 45kW
Voltage class	④	Voltage class code	4: AC 3PH 380V (-15%)–440V (+10%) Rated voltage: 380V
Order management number	⑤	Order management number	B: The braking unit has been built in the VFD as a standard configuration part.

3.6 Product ratings

Table 3-3 Rectifier unit ratings

Model	Rated power (kW)	Power supply capacity (kVA)	Input current AC (A)	Output current DC (A)	Bus bar current-carrying capacity (A)
GD600-71-045-4-B	45	76	110	135	200
GD600-71-160-4	160	215	320	380	200
GD600-71-355-4	355	433	625	766	/

Table 3-4 Inverter unit ratings

Model	Rated power (kW)	Input current DC (A)	Output current AC (A)	Carrier frequency (kHz)	Bus bar current-carrying capacity (A)
GD600-51-1R5-4	1.5	3.6	3.7	1–15 (8)	100
GD600-51-2R2-4	2.2	5.5	5	1–15 (8)	100
GD600-51-004-4	4	9.6	9.5	1–15 (8)	100
GD600-51-5R5-4	5.5	14.2	14	1–15 (8)	100
GD600-51-7R5-4	7.5	19	18.5	1–15 (8)	100
GD600-51-011-4	11	26	25	1–15 (8)	200
GD600-51-015-4	15	33	32	1–15 (4)	200
GD600-51-018-4	18.5	40	38	1–15 (4)	200
GD600-51-022-4	22	47	45	1–15 (4)	200
GD600-51-030-4	30	62	60	1–15 (4)	200
GD600-51-037-4	37	79	75	1–15 (4)	200
GD600-51-045-4	45	97	92	1–15 (4)	200
GD600-51-055-4	55	121	115	1–15 (4)	200
GD600-51-075-4	75	158	150	1–15 (2)	200

Note:

- The input current of the rectifier unit is measured in the scenario where the input voltage is 380V without additional external reactors.
- The rated output current of the inverter unit is the output current when the output voltage is 380V.
- The current-carrying capacity indicates the current-carrying capacity of the DC bus copper bar of a unit.
- Within the allowable input voltage range, the output current/power cannot exceed the rated output current/power.

3.7 Structure

Figure 3-8 shows the rectifier unit structure (taking the 380V 45kW rectifier model as an example).

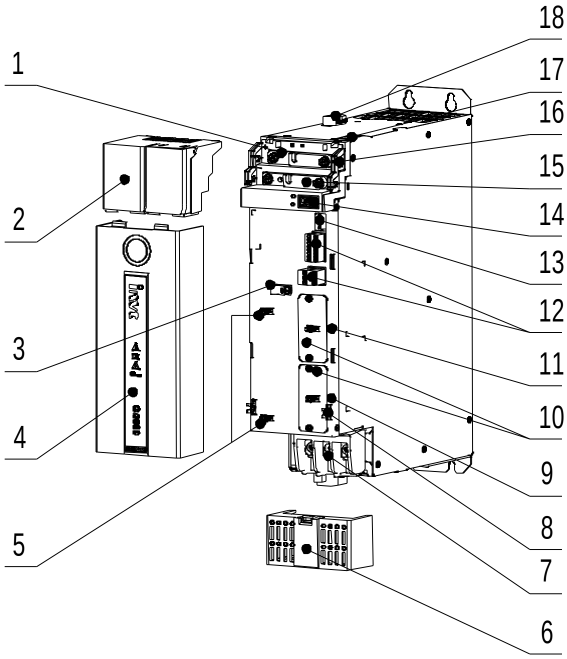


Figure 3-8 Rectifier unit structure

No.	Part	Description
1	DC bus bar	Positive and negative DC bus copper bar
2	Upper cover (including the keypad)	Used to protect the DC high voltage output. For details about keypad operations, see section 5.4 Operating the VFD through the keypad.
3	Shield cable clamp	Used to fix and install the shield layer of the control cable.
4	Middle cover	Used to protect control terminals and expansion cards.
5	Tie seat	Used to fix cables.
6	AC terminal cover	Used to protect AC input to protect electric shock.
7	AC terminals	Entire machine AC inputs (R/S/T)
8	Middle cover snap-fit	Used to fix the middle cover
9	Expansion card slot 2	Expansion card slot 2 (SLOT2)
10	Expansion card slot 1	Expansion card slot 1 (SLOT1)
11	Expansion card slot cover	Plate to seal expansion card slots (since expansion cards have not been configured for standard VFD models)
12	Control circuit terminals	Control circuit terminals on the control board
13	DIP switch	DIP switch on the control board
14	Keypad socket	Socket for connecting the keypad
15	Parallel copper bar	Parallel copper bar of the rectifier unit
16	Copper bar coverplate	Terminal coverplate for the DC bus copper bar
17	RJ45 communication terminal	RJ45 communication terminal on the control board
18	24V power terminal	24V power terminal on the control board

Figure 3-9 shows the inverter unit structure (taking the 380V 37kW model as an example).

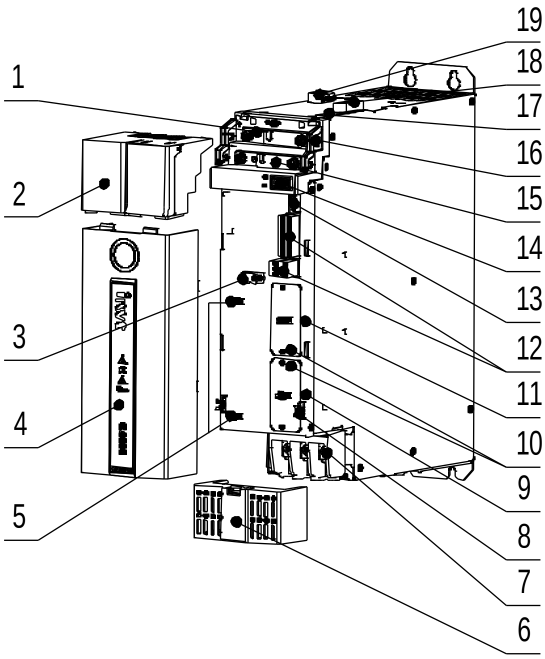


Figure 3-9 Inverter unit structure

No.	Part	Description
1	DC bus bar	Positive and negative DC bus copper bar
2	Upper cover (including the keypad)	Used to protect the DC high voltage output. For details about keypad operations, see section 5.4 Operating the VFD through the keypad.
3	Shield cable clamp	Used to fix and install the shield layer of the control cable.
4	Middle cover	Used to protect control terminals and expansion cards.
5	Tie seat	Used to fix cables.
6	AC terminal cover	Used to protect AC output to protect electric shock.
7	AC terminals	Entire machine AC outputs (U/V/W)
8	Middle cover snap-fit	Used to fix the middle cover
9	Expansion card slot cover	Expansion card slot sealing plate (not available for a standard model)
10	Expansion card slot 2	Expansion card slot 2 (SLOT2)
11	Expansion card slot 1	Expansion card slot 1 (SLOT1)
12	Control circuit terminals	Control circuit terminals on the control board
13	DIP switch	DIP switch on the control board
14	Keypad socket	Socket for connecting the keypad to the upper cover
15	Parallel copper bar	Parallel copper bar of the inverter unit
16	Copper bar coverplate	Terminal coverplate for the DC bus copper bar
17	RJ45 communication terminal	RJ45 communication terminal on the control board
18	STO terminal	STO terminal on the control board
19	24V power terminal	24V power terminal on the control board

4 Installation

4.1 What this chapter contains

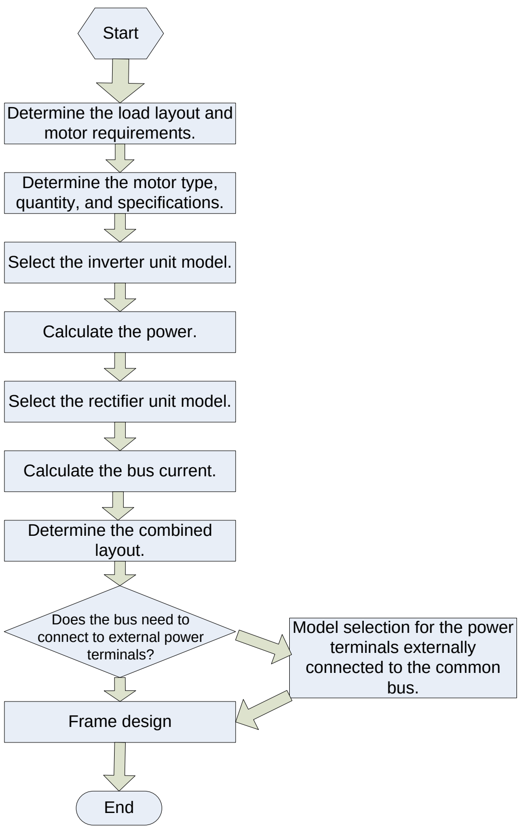
This chapter describes the mechanical installation and electrical installation of the VFD.

	• Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter. Please carry out operations according to instructions presented in chapter 1 Safety precautions. Ignoring these safety precautions may lead to physical injury or death, or equipment damage. • Ensure the VFD power has been disconnected before installation. If the VFD has been powered on, disconnect the VFD power and wait for at least the time specified on the VFD, and ensure the POWER indicator is off. You are recommended to use a multimeter to check and ensure the VFD DC bus voltage is below 36V. • The VFD installation must be designed and done according to applicable local laws and regulations. INVT does not assume any liability whatsoever for any VFD installation which breaches local laws or regulations. If recommendations given by INVT are not followed, the VFD may experience problems that the warranty does not cover.

4.2 System model selection

The VFD adopts the book-type design, making flexible arrangement of units. The units can be placed in a single or double rows. The rectifier units can be placed on the left or in the middle of the inverter units, and multiple rectifier units can also be connected in parallel.

4.2.1 Model selection flowchart



4.2.2 Load and motor selection

1) Determine the type and quantity of the motor according to the load and working method of the mechanical equipment.
2) Determine the requirements of mechanical equipment for the motor power, torque, speed, starting, commissioning, braking, overload, heating and temperature rise.
3) Select the motor rated power, rated voltage, and rated speed according to the motor product catalog.
4) Under the premise of fully satisfying the mechanical equipment load, select the motor capacity economically and reasonably.

$$\mathrm{P_n} = \left(\sqrt{3} \times U_n \times I_n \times \cos\theta \times \eta\right)$$

P_n – Rated power; U_n– *Rated voltage*; I_n – *Rated current*; cosθ– Power factor; η – Efficiency

4.2.3 Inverter unit selection

1) Determine the number of inverter units according to the number of motors, with the prerequisite that one motor needs one inverter unit.
2) Select the power and model for the inverter units according to the motor rated power.
3) For details about inverter unit specifications, see section 3.3 Specifications.

4.2.4 Rectifier unit selection

1) Calculate the total rated power of all inverter units that have been selected.

2) Select the rectifier unit model according to the power of the inverter units in the system. The coefficient varies with the number of inverter units. The rectifier unit model selection formula is as follows.

Inverter unit quantity ≤ 5: $\mathrm{P_{rectifier}} = (P_1 + P_2 + P_3 + P_4 + P_5)$

Inverter unit quantity > 5: $\mathrm{P_{rectifier}} = 0.8 * (P_1 + P_2 + P_3 + \cdots + P_{n-1} + P_n)$

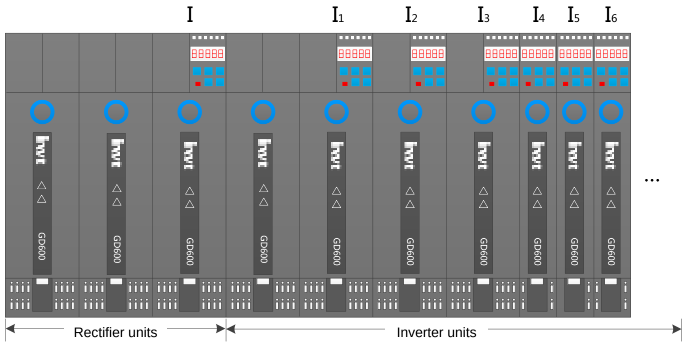
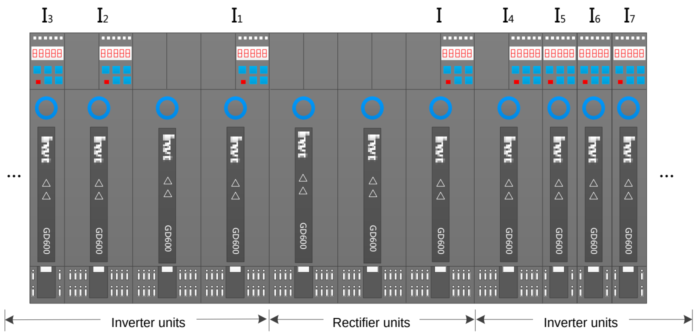
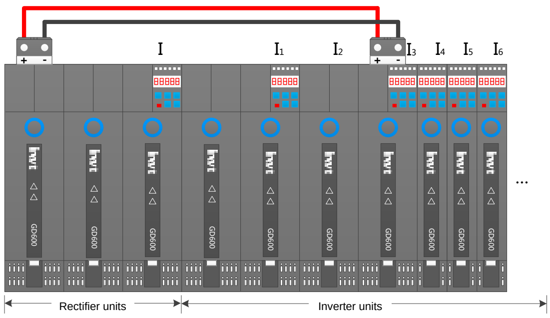
P_1, P_2, ... P_{n-1}, P_n: Inverter power. For details, see the inverter nameplate.

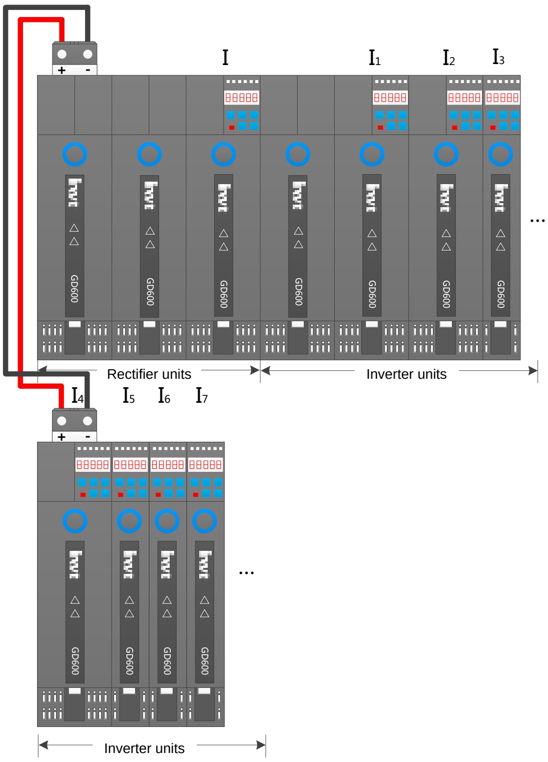
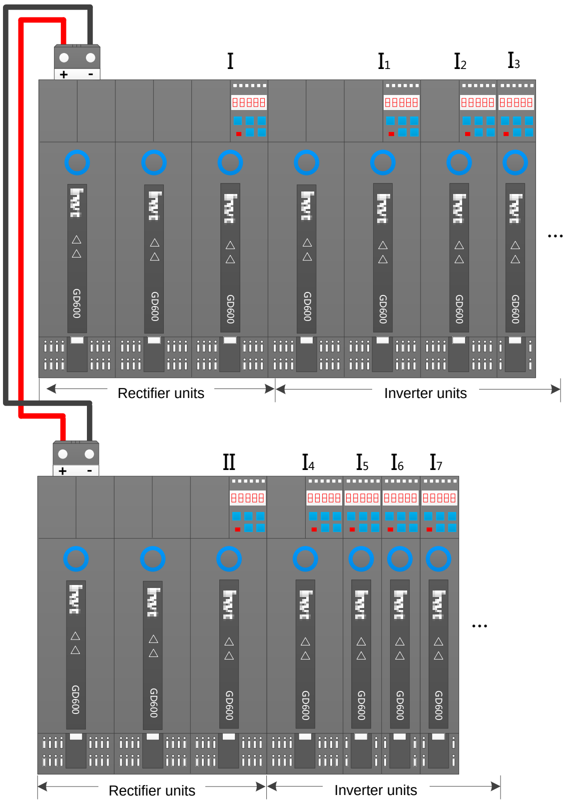
Note:

- When the mechanical equipment has demanding requirement on the load/overload capacity, the coefficient needs to be adjusted to 100–150%; when the equipment overload capacity is low, the $P_{rectifier}$ parameter needs to be adjusted to 60%–80%.
- A maximum of four rectifier units only with the same power can be connected in parallel. If the required power is not met when four rectifier units with the same power have been connected in parallel, use rectifier units with larger power.
- AC reactors (corresponding to the total power) should be configured on the rectifier input side for current balancing.

4.2.5 Combined arrangement

The VFD adopts the book-type design, making flexible arrangement of units. The units can be placed in a single or double rows. The rectifier unit can be placed on the left or in the middle of the inverter units.

Combination method	Presentation	Condition
Placed in a single row (rectifier on the left)		$I \geq 0.8*(I_1+I_2+I_3+I_4+I_5+I_6+\ldots)$ $I_1+I_2+I_3+I_4+I_5+I_6+\ldots \leq 200A$ $I_4+I_5+I_6+\ldots \leq 100A$
Placed in a single row (rectifier at the center)		$I \geq 0.8*(I_1+I_2+I_3+I_4+I_5+I_6+I_7+\ldots)$ $I_1+I_2+I_3+\ldots \leq 200A$ $I_4+I_5+I_6+I_7+\ldots \leq 200A$ $I_5+I_6+I_7+\ldots \leq 100A$ $I_3+\ldots \leq 100A$
Placed in a single row (bus externally connected)		$I \geq 0.8*(I_1+I_2+I_3+I_4+I_5+I_6+\ldots)$ $I_1+I_2 \leq 200A$ $I_3+I_4+I_5+I_6+\ldots \leq 200A$ $I_4+I_5+I_6+\ldots \leq 100A$

Combination method	Presentation	Condition
Placed in double rows (single rectifier unit)		$I \geq 0.8*(I_1+I_2+I_3+I_4+I_5+I_6+I_7+\ldots)$ $I_1+I_2+I_3+\ldots \leq 200A$ $I_4+I_5+I_6+I_7+\ldots \leq 200A$ $I_5+I_6+I_7+\ldots \leq 100A$ $I_3+\ldots \leq 100A$
Placed in double rows (multiple rectifier units in parallel connection)		$I + II \geq 0.8*(I_1+I_2+I_3+I_4+I_5+I_6+I_7+\ldots)$ $I / II \approx (I_1+I_2+I_3+\ldots)/(I_4+I_5+I_6+I_7+\ldots)$ $I_1+I_2+I_3+\ldots \leq 200A$ $I_4+I_5+I_6+I_7+\ldots \leq 200A$ $I_5+I_6+I_7+\ldots \leq 100A$ $I_3+\ldots \leq 100A$

Note:

- The current-carrying capability of the DC bus copper bar of a unit is only 100A or 200A. For details about the specification, see section 3.6 Product ratings. The current on the DC bus copper bar cannot exceed its current-carrying capability.

- There are two types of external bus terminals: 100A and 200A. Please select the terminals according to the current requirements, and note that the current on each terminal cannot exceed its current-carrying capacity.

4.3 Mechanical installation

4.3.1 Installation environment

The installation environment is essential for the VFD to operate with best performance in the long run. Install the VFD in an environment that meets the following requirements.

Environment	Condition
Installation site	Indoor
Ambient temperature	• -10–+50°C • When the temperature exceeds 40°C, derate 1% for every increase of 1°C. • Do not use the VFD when the ambient temperature exceeds 50°C. • In order to improve reliability, do not use the VFD in the places where the temperature changes rapidly. • When the VFD is used in a closed space, such as control cabinet, use a cooling fan or air conditioner for cooling, preventing the internal temperature from exceeding the temperature required. • When the temperature is too low, if you want to use the VFD that has been idled for a long time, install an external heating device before the use to eliminate the freeze inside the VFD. Otherwise, the VFD may be damaged.
Relative humidity (RH)	• RH: less than 90% • Condensation is not allowed. • The max. RH cannot exceed 60% in the environment where there are corrosive gases.
Storage temperature	-30–+60°C
Running environment	Install the VFD in a place: • Away from electromagnetic radiation sources • Away from oil mist, corrosive gases, and combustible gases • Without the chance for foreign objects such as metal powder, dust, oil and water to fall into the VFD (do not install the VFD onto combustible objects such as wood) • Without radioactive substances and combustible objects • Without hazard gases and liquids • With low salt content • Without direct sunlight
Altitude	• Lower than 1000 meters • When the installation site altitude exceeds 1000m, derate 1% for every increase of 100m; when the installation site altitude exceeds 3000m, consult the local INVT dealer or office.
Vibration	The max. acceleration cannot exceed 5.8m/s^2 (0.6g)
Installation direction	Install the VFD vertically to ensure good heat dissipation performance.

Note:

- The units must be installed in a clean and well-ventilated environment based on the housing IP rating.
- The cooling air must be clean enough and free from corrosive gases and conductive dust.

4.3.2 Installation direction

The rectifierand inverter units can be installed on the wall or in cabinets.

The units must be installed vertically. Check the installation position according to following requirements. For details about the outline dimensions, see Appendix D Dimension drawings.

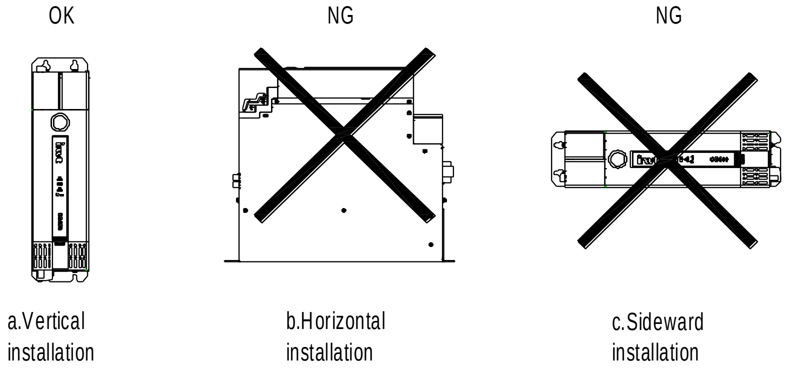


Figure 4-1 Unit installation direction

4.3.3 Installation method

The unit installation method depends on the outline dimensions:

- Wall mounting: applicable to all rectifier units and inverter units
- Flange mounting: applicable to 380V 160kW and lower rectifier units, and to 380V 75kW and lower inverter units

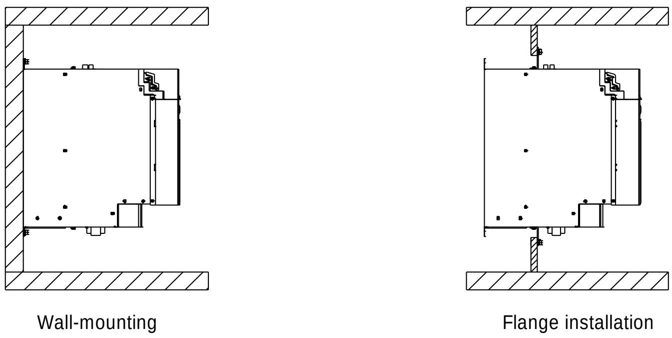


Figure 4-2 Unit installation method

Step 1 Mark the installation hole positions. For details about the installation hole positions, see Appendix D Dimension drawings.

Step 2 Mount the screws or bolts onto the designated positions.

Step 3 Lean the unit against the wall.

Step 4 Tighten the screws.

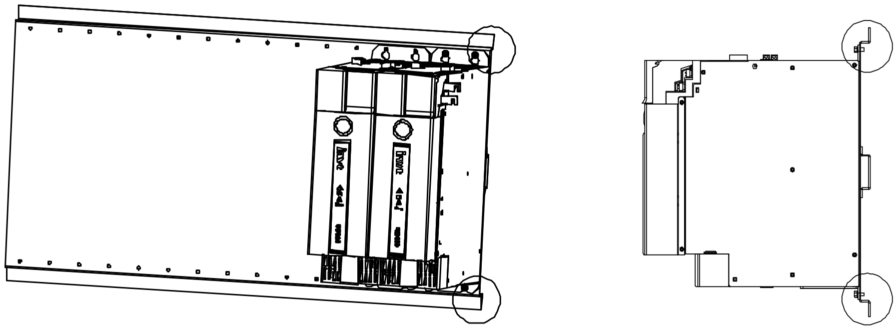
Note: The flange mounting plate must be used for flange mounting.

4.3.4 Installation backplane design requirements

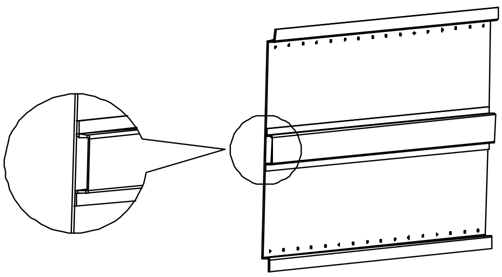
Enhancing the installation backplane thickness and rigidity

To prevent the power unit from being damaged during transportation and to ensure the normal running of the power unit, the power unit installation backplane needs to have sufficient rigidity and strength, and the thickness is not less than 2mm. Backplane enhancing is required for the top and bottom installation feet. The enhancing solutions include:

- Solution 1: Horizontally bend the backplane.



- Solution 2: Weld a transverse reinforcement beam on the back of the backplane.



Rules of making installation holes

The book-type units feature equal height and equal clearance (50mm) for installation holes. The installation holes are prefabricated when the backplane is processed, and the combined installation can also be flexibly configured. For details about the hole positions, see Appendix D Dimension diagrams.

To prevent the power unit from being damaged during transportation, the power unit mounting screws must be tapped and fixed on the mounting backplane; in addition, the mounting screws need rivet nuts or independent nuts for fixing on the back of the backplane.

To ensure a reliable connection of the built-in DC bus of the power unit, the relative positions of the rectifier unit mounting holes must be accurate. You are recommended to drill the mounting holes on the backplane in advance, and but not drill the holes on site.

4.3.5 Installation space and heat dissipation

To ensure that the units are installed reliably and in good heat dissipation, pay attention to the following:

- A unit with the width of 50mm cannot be installed singly. For such units, install at least three in parallel to ensure reliable installation.
- When the units need to be installed in two rows, reserve certain space around the units to ensure good heat dissipation. For details, see Figure 4-3.
- A minimum ventilation clearance must be kept from the top and bottom of each unit to ensure good heat dissipation. For details, see Figure 4-4.

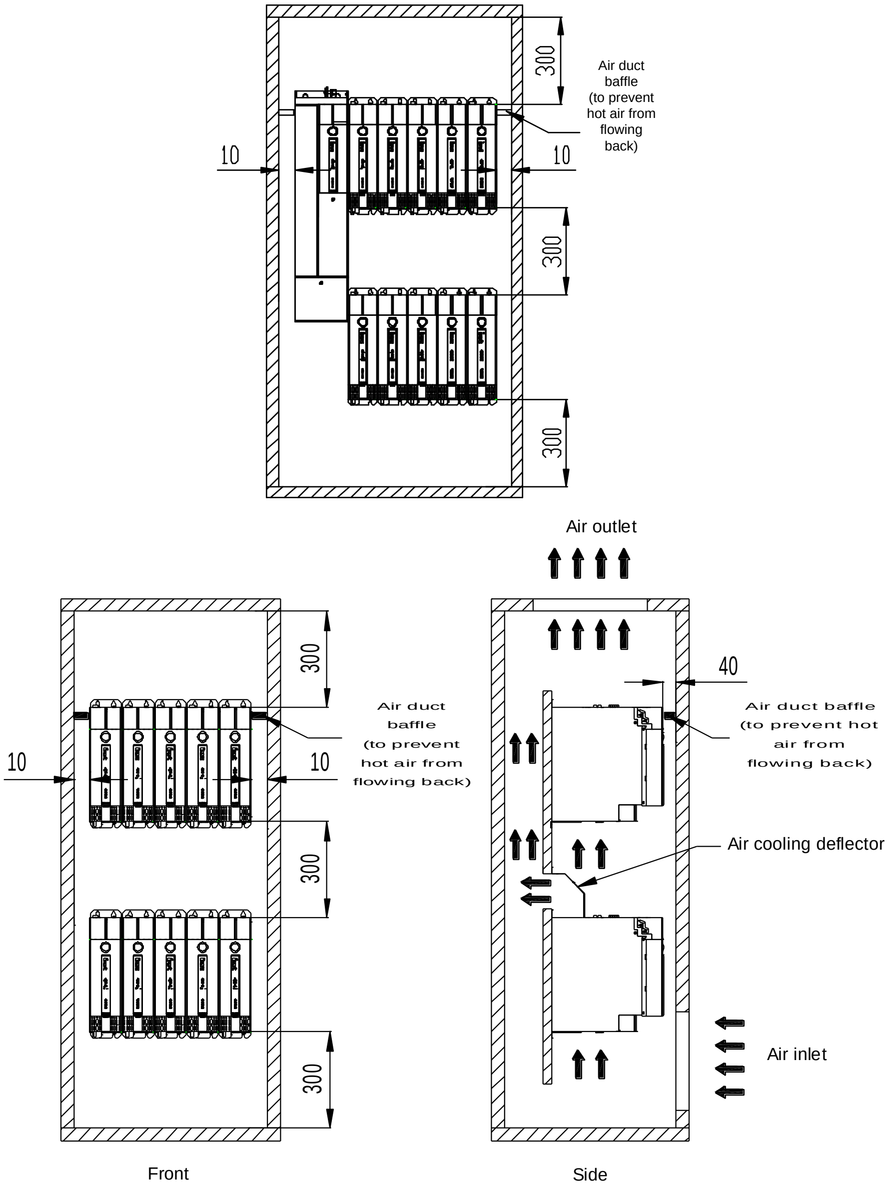


Figure 4-3 Multi-unit parallel installation clearances (the preceding sizes are the minimum, unit: mm)

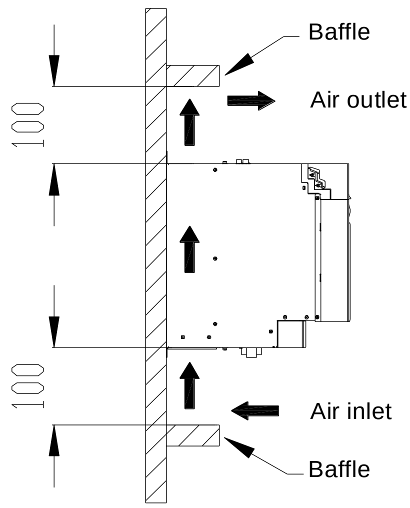


Figure 4-4 Clearances from the upper and lower barriers (the preceding sizes are the minimum, unit: mm)

To ensure good heat dissipation of the units, design the air inlet and outlet as follows:

- Air inlet area formula: S = (Value ranging from 1.5 to 2.0) x ($S_{unit\ 1}$ + $S_{unit\ 2}$ + $S_{unit\ 3}$ + … $S_{unit\ N}$)
  In which, S indicates the system ventilation area while S_{unit} indicates the ventilation area of each unit. For details about the ventilation area of a unit, see Table 4-1.
- Air outlet area formula: S = (Value ranging from 1.2 to 1.5) x Air inlet area
- In the case that the system exhaust fan is installed at the air outlet, the actual total air volume of the fan must not be less than the sum of the air volume required by all units. For details about the air volumes, see Table 4-1.

Table 4-1 Ventilation areas and actual air volumes of units

No.	Model	Ventilation area (cm^2)	Actual air volume (CFM)
1	GD600-51-1R5-4	15	10
2	GD600-51-2R2-4	15	10
3	GD600-51-004-4	15	10
4	GD600-51-5R5-4	15	10
5	GD600-51-7R5-4	15	10
6	GD600-51-011-4	45	40
7	GD600-51-015-4	45	40
8	GD600-51-018-4	45	55
9	GD600-51-022-4	70	65
10	GD600-51-030-4	70	75
11	GD600-51-037-4	70	105
12	GD600-51-045-4	90	150
13	GD600-51-055-4	90	150
14	GD600-51-075-4	90	150
15	GD600-71-045-4-B	50	40
16	GD600-71-160-4	150	285
17	GD600-71-355-4	130	352

Note:

- Ventilation area refers to the actual through-hole area in the cut-out area:
  Ventilation area = Cut-out area x Cut-out rate
- Unit conversion: 1CFM=0.0283185 m^3/min

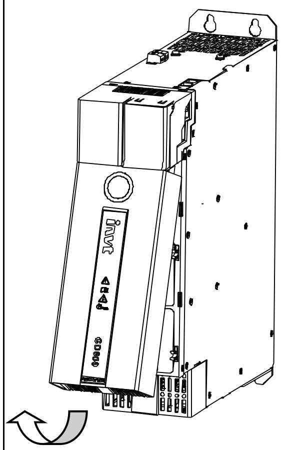
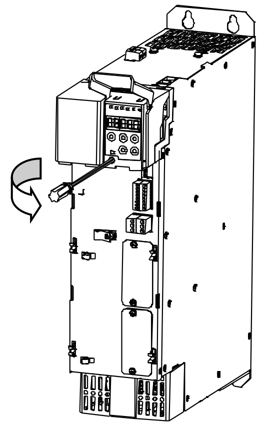
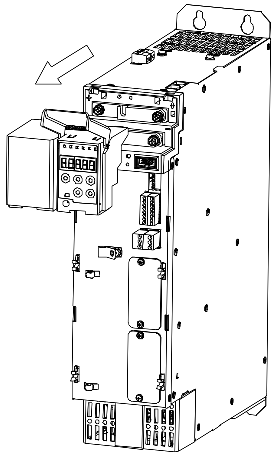
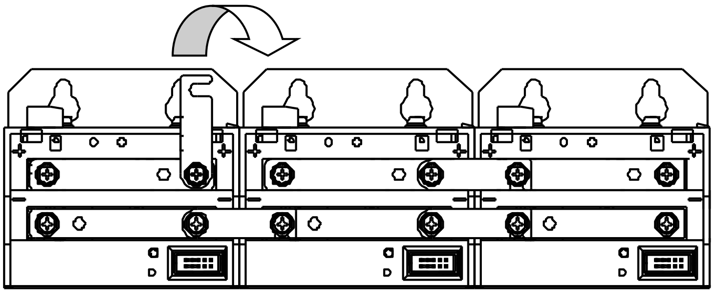
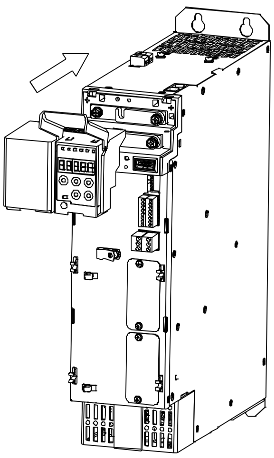
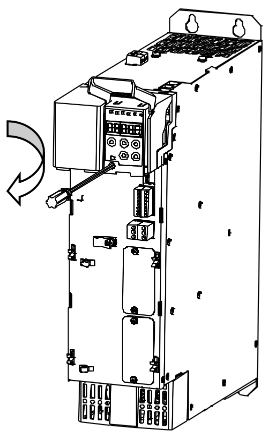
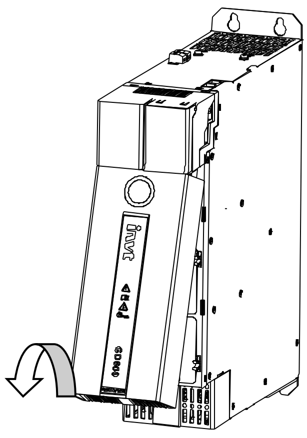
Note:

- Not only the dissipation space for units but also the dissipation for other devices in the cabinet must be fully considered.
- When units need to be installed in two rows, the cooling deflector must be installed. For details, see Figure 4-3.
- In the case of passive exhaust (no system exhaust fan installed at the air outlet), the air duct baffle must be installed to prevent hot air from flowing back.

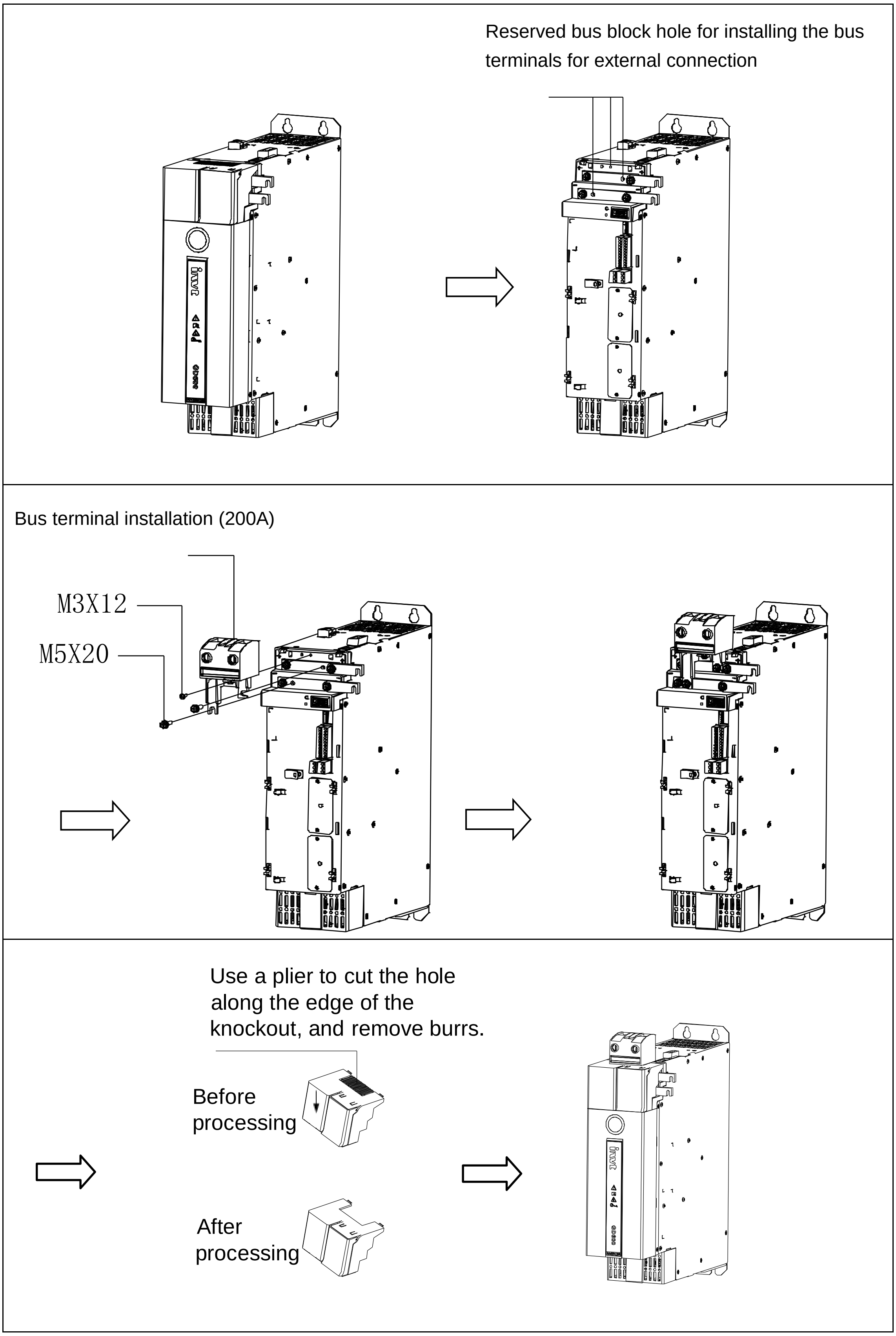
4.3.6 Bus bar connection

You must remove the upper cover to connect the DC bus bars of a unit.

- Ensure the unit has been powered off for more than 5 minutes before disassembling the keypad cover.
- Prevent the cover from dropping off during removing, which may cause equipment damage or personal injuries.

<table>
<tr><td colspan="3">1. Remove the upper cover.</td></tr>
<tr><td>(1) Rotate the middle cover up, and remove it.</td><td>(2) Rotate the translucent keyboard cover up, and loosen the screws fixed on the cover with a straight screwdriver.</td><td>(3) Pull the upper cover straight out.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">2. Connect the bus bars.</td></tr>
<tr><td colspan="3">(1) Loosen the DC bus bar screws (without removing them).</td></tr>
<tr><td colspan="3">(2) Connect the parallel copper bars and fasten the screws.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">3. Install the upper cover.</td></tr>
<tr><td>(1) Insert the upper cover into the bus block.</td><td>(2) Fasten the screws fixed on the upper cover with a straight screwdriver, and close the translucent keyboard cover.</td><td>(3) Insert the two snap-fits of the middle cover into the upper cover, and rotate and buckle it onto the chassis.</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

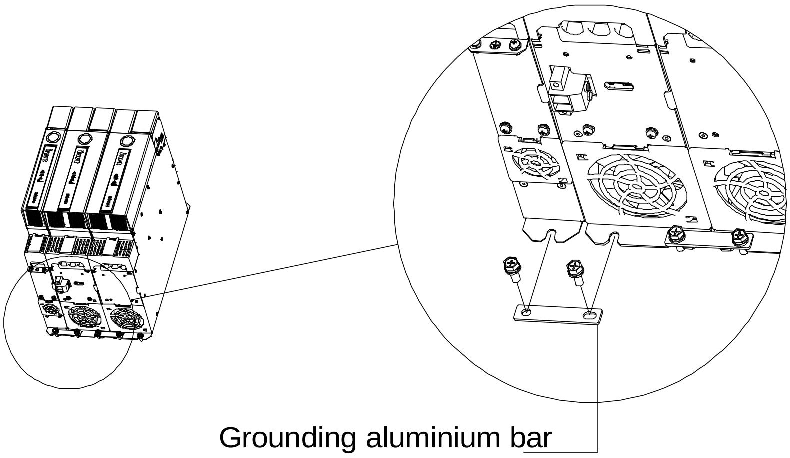
4.3.7 Bus terminal installation



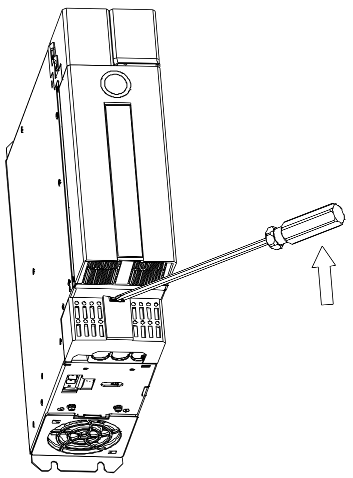
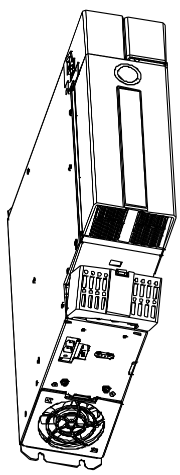
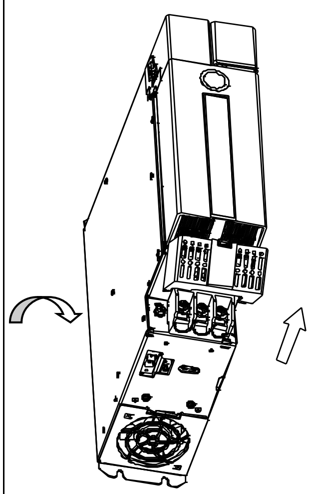
Note: Please tighten the screws with the corresponding torque: M3: 5–6 kgf.cm; M5: 25–28 kgf.cm

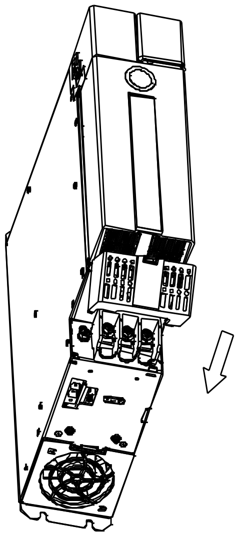
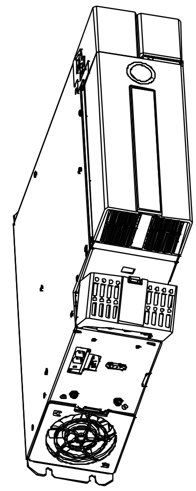
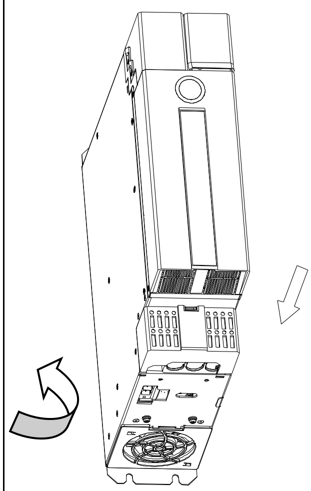
4.3.8 Grounding aluminum bar installation

To achieve good grounding of the entire system and form integration (an equipotential body), add grounding aluminum bars to the mounting holes between the units, and then fix them on the mounting plates to ensure that the units are connected through the grounding aluminum bars.



4.3.9 AC terminal cover disassembly and assembly

1. Disassemble the AC terminal cover.		
(1) Insert a screwdriver into the slot at the center of the AC terminal cover, and push it up to open the snap-fit.	(2) Rotate the AC terminal cover up.	(3) Pull the AC terminal cover straight out.
		

2. Install the AC terminal cover		
(1) Insert the snap-fit at the bottom of the AC terminal cover into the machine card slot.	(2) Rotate the AC terminal cover down.	(3) Press down on the middle of the AC terminal cover to insert the snap-fit into the machine card slot.
		

4.4 Standard wiring of the main circuit

4.4.1 Wiring diagram of the main circuit

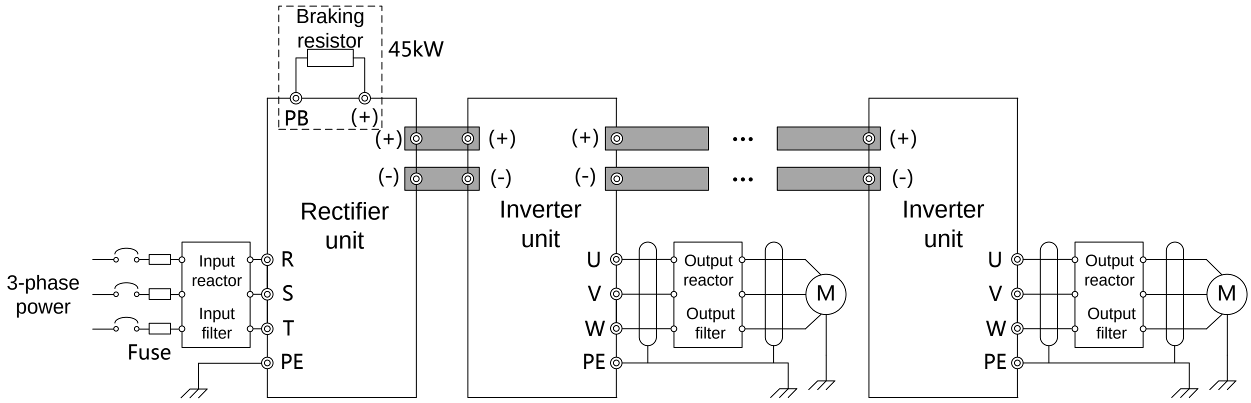


Figure 4-5 Wiring diagram of the main circuit

Note:

- The fuse, braking resistor, input reactor, input filter, output reactor and output filter are optional parts. For details, see Appendix E Optional peripheral accessories.
- The built-in braking unit is a standard configuration part for the 45kW rectifier unit.
- The inverter unit has a built-in fuse, and independent power-on without buffering is prohibited; otherwise, the inverter unit will be damaged.

4.4.2 Terminal diagram of the main circuit

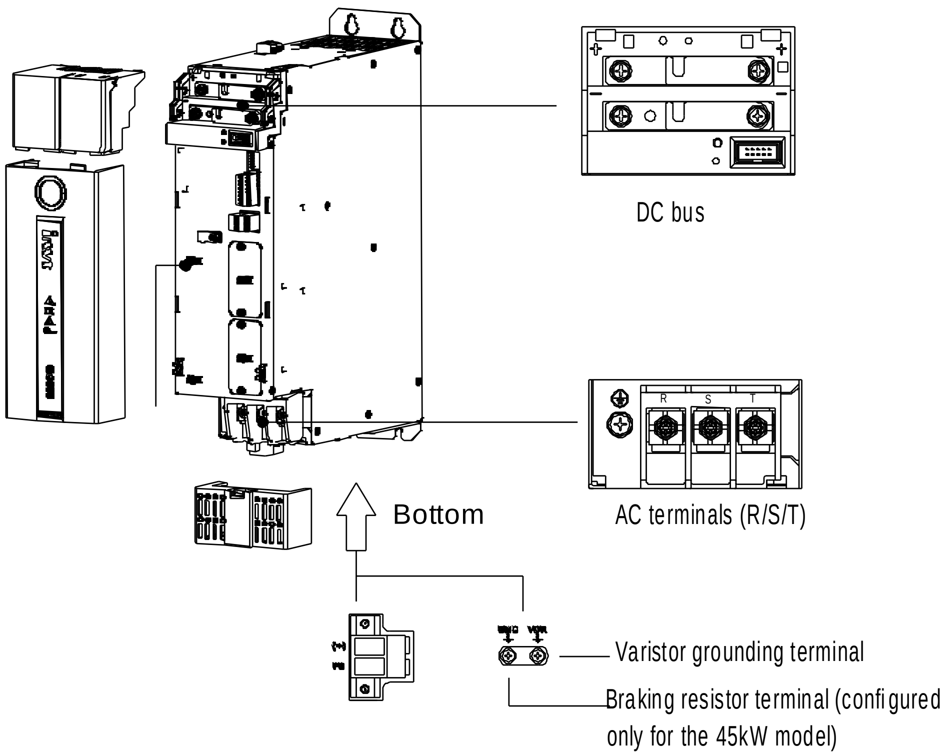


Figure 4-6 Terminal diagram of the rectifier unit main circuit

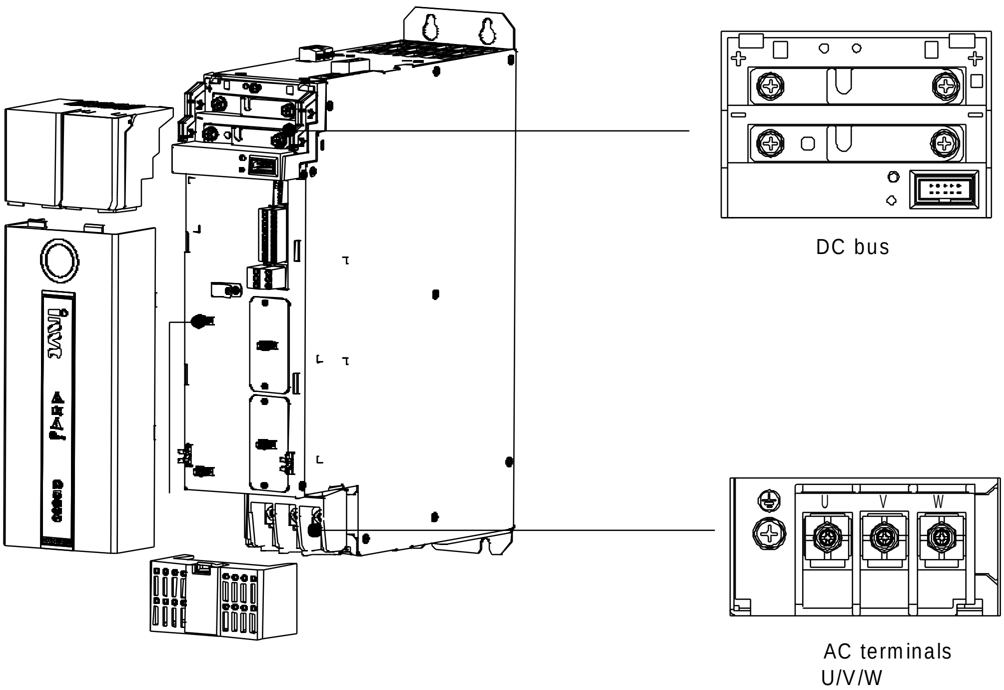


Figure 4-7 Terminal diagram of the inverter unit main circuit

Table 4-2 Main circuit terminals

Terminal symbol	Name	Description
R, S, T	Main circuit power input	3PH AC input terminals, connecting to the grid
U, V, W	VFD outputs	3PH AC output terminals, which connect to the motor in most cases
(+)	Positive bus terminal/Braking resistor terminal 1	(+), (-): connected to the braking unit (+), PB: connected to the braking resistor
(-)	Negative bus terminal	
PB	Braking resistor terminal 2	
PE	Grounding terminal	Grounding terminal for safe protection; each unit must carry one PE terminal and proper grounding is required. The grounding resistance is less than 10 ohm.

Note:

- Do not use asymmetrical motor cables. If there is a symmetrical grounding conductor in the motor cable besides the conductive shielded layer, ground the grounding conductor on the VFD end and motor end.
- Braking resistors and braking units are optional parts.
- Route the motor cable, input power cable and control cable separately.

4.4.3 Wiring procedure

Step 1 Connect the grounding conductor of the input power cable to the grounding terminal (PE) of the rectifier unit, connect the phase conductors to the R, S and T terminals, and tighten up.

Step 2 Strip the motor cable, and connect the shield layer to the grounding terminal of the inverter unit using the 360-degree loop connection method. Connect the phase conductors to the U, V and W terminals, and tighten up.

Step 3 Connect the braking resistor that carries the shielded cable to the designated position using the method introduced in the previous step.

Step 4 Fix all the cables outside the VFD mechanically.

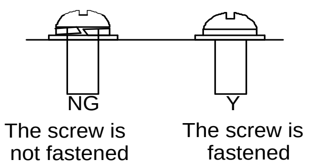


Figure 4-8 Screw installation diagram

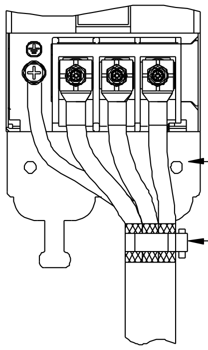
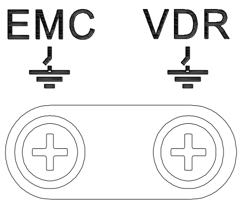


Figure 4-9 360-degree loop connection

4.4.4 Safety capacitor jumper

In an application configured with a leakage protection device, if there is a jump-off protection during start-up, the screw of the rectifier unit safety capacitor to the ground jumper can be removed, that is, the screw labeled EMC in the following figure.



Note: Please tighten the screws with the corresponding torque: M3: 5–6 kgf.cm

4.5 Standard wiring of the control circuit

4.5.1 Control circuit wiring diagram of the rectifier unit

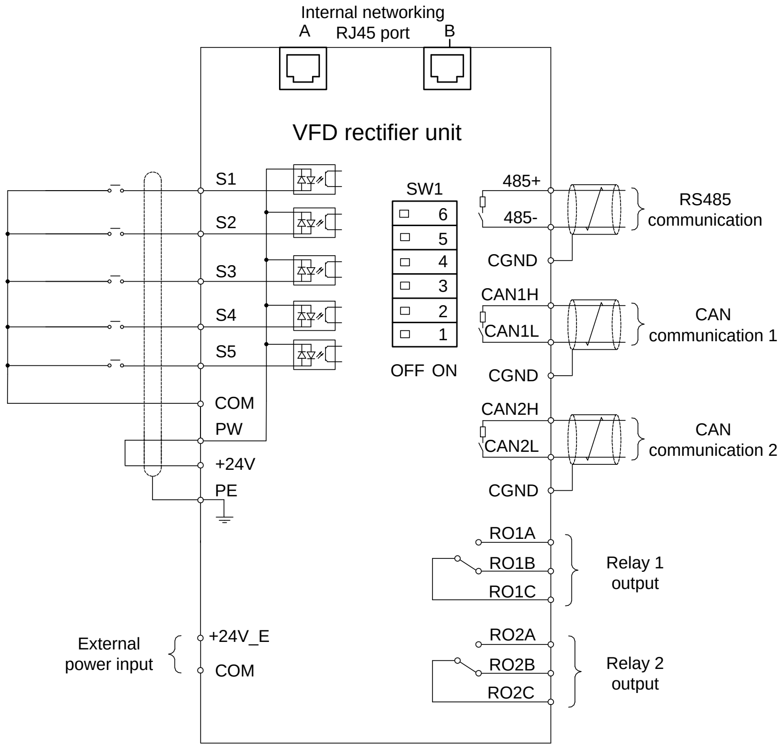


Figure 4-10 Control circuit wiring diagram of the rectifier unit

4.5.2 Control circuit terminal diagram of the rectifier unit

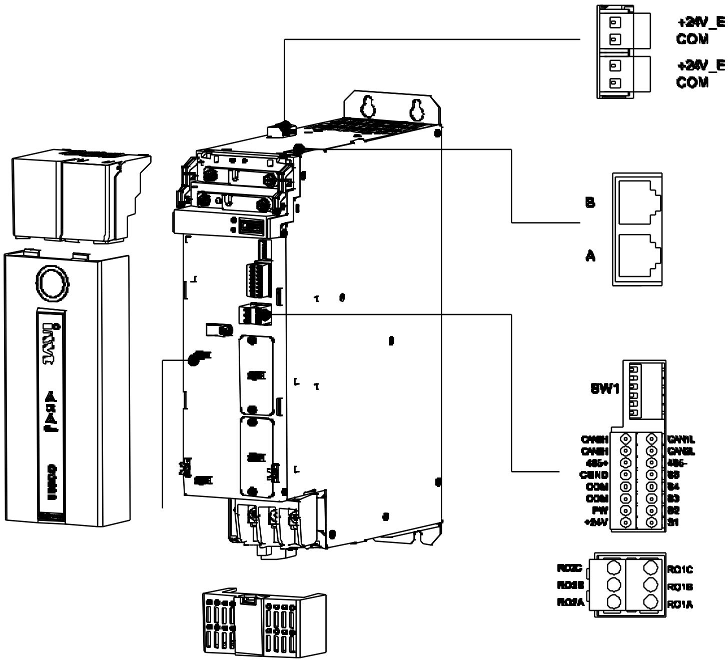


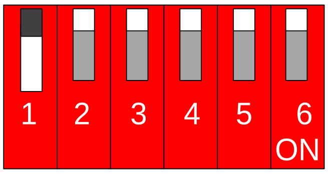
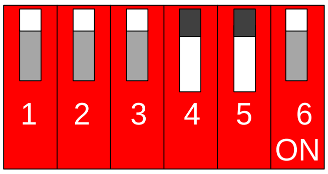
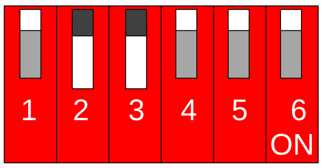
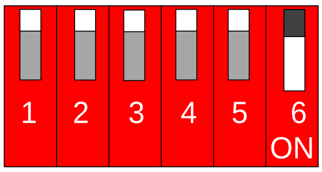
Figure 4-11 Control circuit terminal diagram of the rectifier unit

4.5.3 Control circuit terminal description of the rectifier unit

Terminal type	Name	Description	
Digital input	PW	Used to provide input digital working power from the external to the internal Voltage range: 12–24V	
	+24V	User power supply provided by the VFD. Max. output current: 200mA	
	COM	+24V common terminal	
	S1	Digital input 1	Internal impedance: 3.3kΩ The voltage input of 12–30V is acceptable. Bi-direction input terminal, supporting both NPN and PNP Max. input frequency: 1kHz All are programmable digital input terminals, the functions of which can be set through function codes
	S2	Digital input 2	
	S3	Digital input 3	
	S4	Digital input 4	
	S5	Digital input 5	
Relay output	RO1A	RO1 output; RO1A: NO; RO1B: NC; RO1C: common Contact capacity: 3A/AC250V, 1A/DC30V	
	RO1B		
	RO1C		
	RO2A	RO2 output; RO2A: NO; RO2B: NC; RO2C: common Contact capacity: 3A/AC250V, 1A/DC30V	
	RO2B		
	RO2C		
Communication	485+	For RS485 communication ports, it is recommended to use shielded twisted pair. The terminal matching resistor is connected through switching positions 4 and 5 of DIP switch SW1 to ON.	
	485-		
	CAN1H	For CAN communication port 1, it is recommended to use shielded twisted pair. The terminal matching resistor is connected through switching positions 2 and 3 of the DIP switch SW1 to ON.	
	CAN1L		

Terminal type	Name	Description
	CAN2H	Reserved
	CAN2L	
	CGND	Terminal for connecting the communication-wire shield layer
Power supply	+24V_E	External power input. The range of the input voltage is 24V±15%, and the supply current is at least 1A. The power supply can be disconnected, which does not affect the normal operation of the unit.
	COM	
RJ45 interface	CAN1H	CAN communication port 1. The terminal matching resistor is connected through switching positions 2 and 3 of DIP switch SW1 to ON.
	CAN1L	
	RS485+	RS485 internal bus, used to connect to the external keypad or for PC commissioning. Terminal matching resistor is connected through switching position 1 of the DP switch SW1 to ON.
	RS485-	
	+8V	External keypad power supply
	CGND	
/	PE	Grounding terminal

4.5.4 DIP switch function description of the rectifier unit

Function	Description	Position
Internal 485 terminal matching resistor selection	Switching position 1 to ON indicates the terminal matching resistor is connected.	
Communication 485 terminal matching resistor selection	Switching positions 4 and 5 to ON indicates the terminal matching resistor is connected.	
CAN1 terminal matching resistor selection (CANopen)	Switching positions 2 and 3 to ON indicates the terminal matching resistor is connected.	
CAN2 terminal matching resistor selection (Master/slave CAN)	Switching position 6 to ON indicates the terminal matching resistor is connected.	

4.5.5 Control circuit wiring diagram of the inverter unit

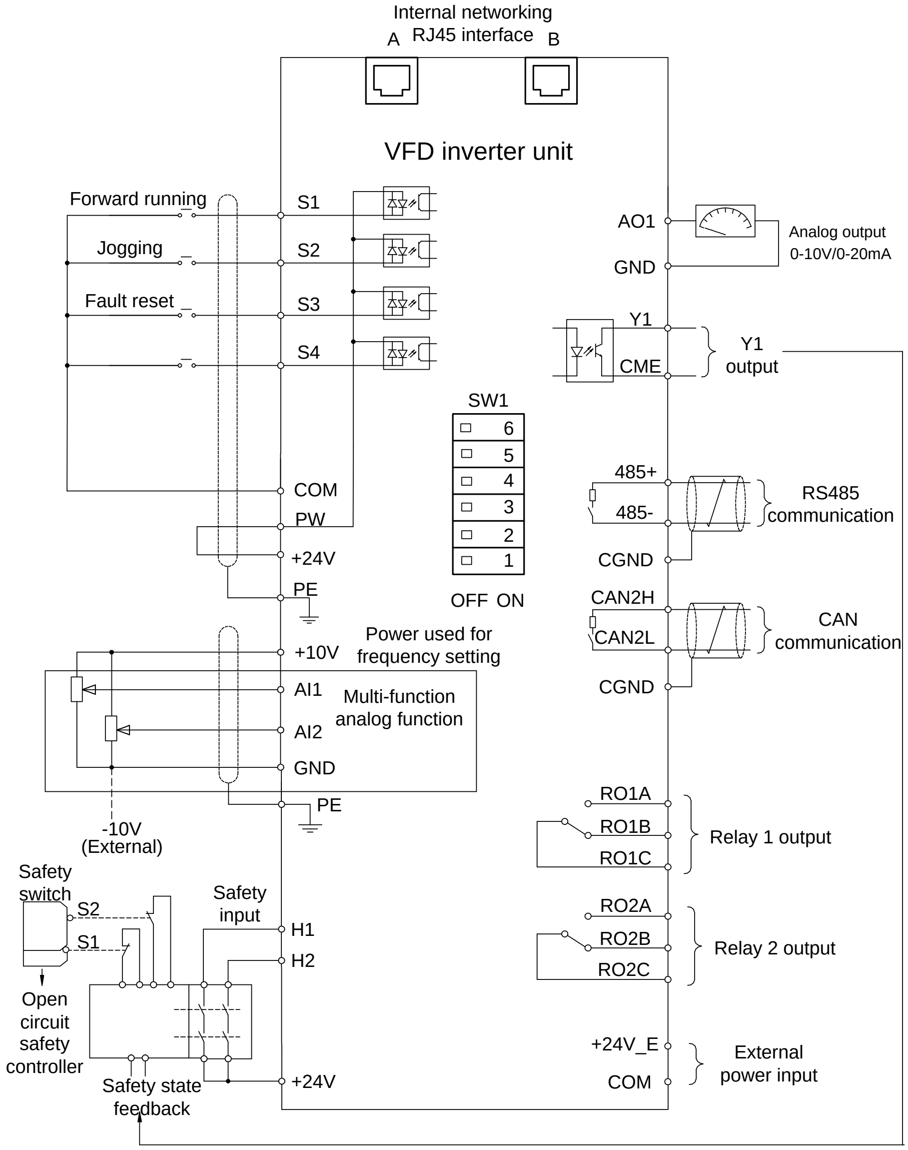


Figure 4-12 Control circuit wiring diagram of the inverter unit

4.5.6 Control circuit terminal diagram of the inverter unit

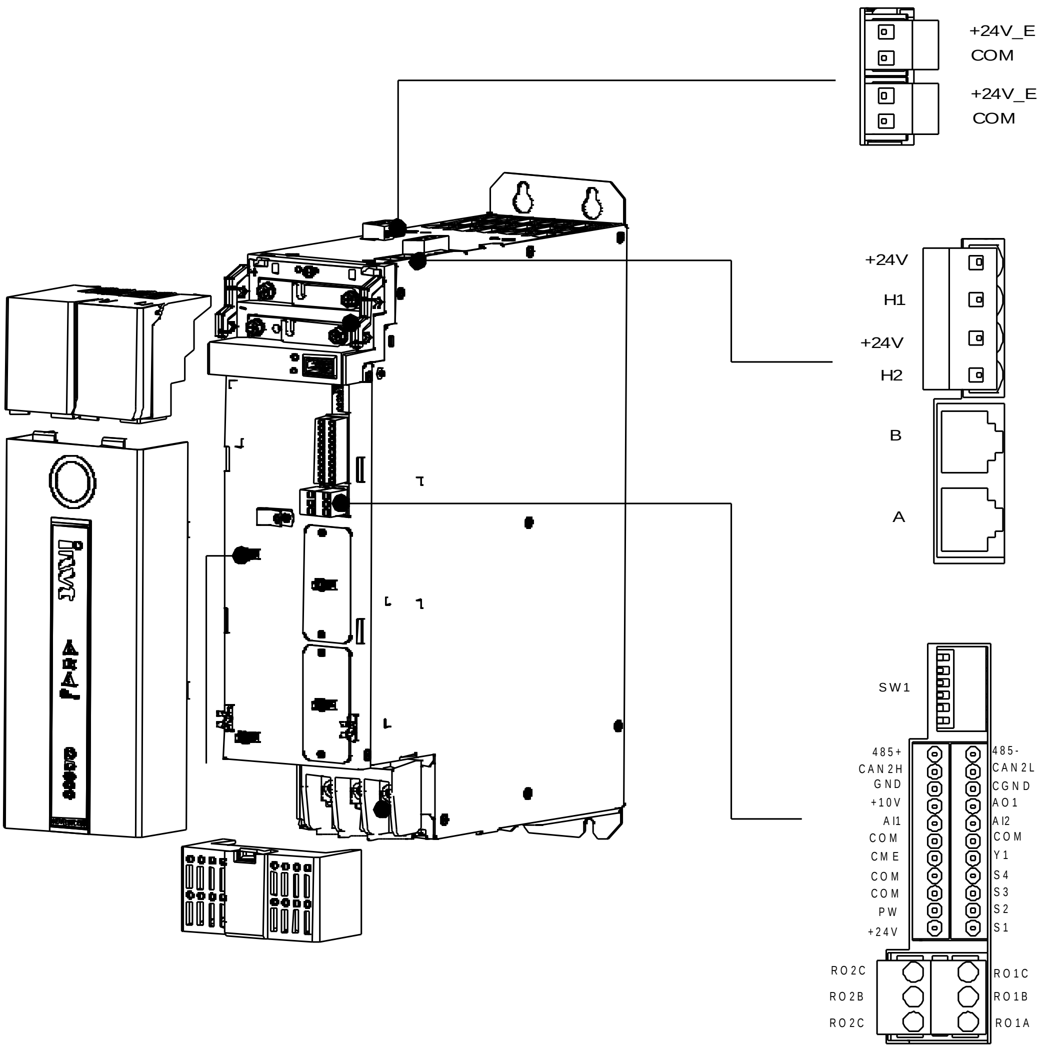


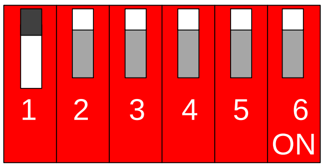
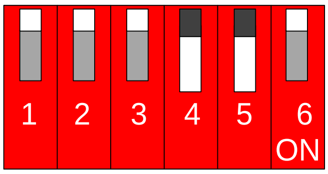
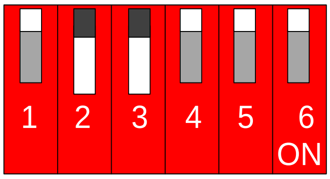
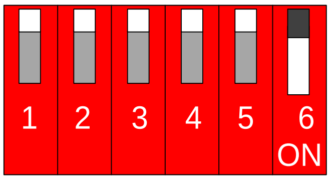
Figure 4-13 Control circuit terminal diagram of the inverter unit

4.5.7 Control circuit terminal description of the inverter unit

Terminal type	Name	Description
Analog input/output	+10V	Locally provided +10.5V power supply
	AI1	Input range: For AI1, 0–10V or 0–20mA; For AI2, -10V–+10V Input impedance: 20kΩ for voltage input or 250Ω for current input Whether voltage or current is used for input of AI1 is set through P05.50 Resolution: 5mV when 10V corresponds to 50Hz Deviation: ±0.5% at 25°C, when input is above 5V/10mA
	AI2	
	GND	Reference zero potential of +10.5V
	AO1	Output range: 0–10V or 0–20mA Whether voltage or current is used for Output of is set through P06.32 Deviation: ±0.5% at 25°C, when output is above 5V/10mA
Digital input/output	PW	Used to provide input digital working power from the external to the internal Voltage range: 12–24V
	+24V	User power supply provided by the VFD. Max. output current: 200mA
	COM	+24V common terminal

Terminal type	Name	Description	
	S1	Digital input 1	Internal impedance: 3.3kΩ The voltage input of 12–30V is acceptable. Bi-direction input terminal, supporting both NPN and PNP Max. input frequency: 1kHz All are programmable digital input terminals, the functions of which can be set through function codes
	S2	Digital input 2	
	S3	Digital input 3	
	S4	Digital input 4	
	H1	STO input 1	Safe torque off (STO) redundant input, connected to the external NC contact. When the contact opens, STO acts and the VFD stops output. Safety input signal wires use shielded wires whose length is within 25m The H1 and H2 terminals are short connected to +24V by default. Remove the short connectors from the terminals before using STO function.
	H2	STO input 2	
	Y1	Switch capacity: 200mA/30V Output frequency range: 0–1kHz	
	CME	Common terminal of open collector output; short connected to COM by default	
Relay Output	RO1A	RO1 output; RO1A: NO; RO1B: NC; RO1C: common Contact capacity: 3A/AC250V, 1A/DC30V	
	RO1B		
	RO1C		
	RO2A	RO2 output; RO2A: NO; RO2B: NC; RO2C: common Contact capacity: 3A/AC250V, 1A/DC30V	
	RO2B		
	RO2C		
Communication	485+	For RS485 communication ports, it is recommended to use shielded twisted pair. The terminal matching resistor is connected through switching positions 4 and 5 of DIP switch SW1 to ON.	
	485-		
	CAN2H	Reserved	
	CAN2L		
	CGND	Terminal for connecting the communication-wire shield layer	
Power supply	+24V_E	External power input, the range of the input voltage is 24V±15%, and the supply current is at least 1A. The power supply can be disconnected, which does not affect the normal operation of the unit.	
	COM		
RJ45 interface	CAN1H	CAN communication port 1 Terminal matching resistor is connected through switching positions 2 and 3 of the DP switch SW1 to ON.	
	CAN1L		
	RS485+	RS485 internal bus, used to connect to the external keypad or for PC commissioning Terminal matching resistor is connected through switching position 1 of the DP switch SW1 to ON.	
	RS485-		
	+8V	External keypad power supply	
	CGND		
/	PE	Grounding terminal	

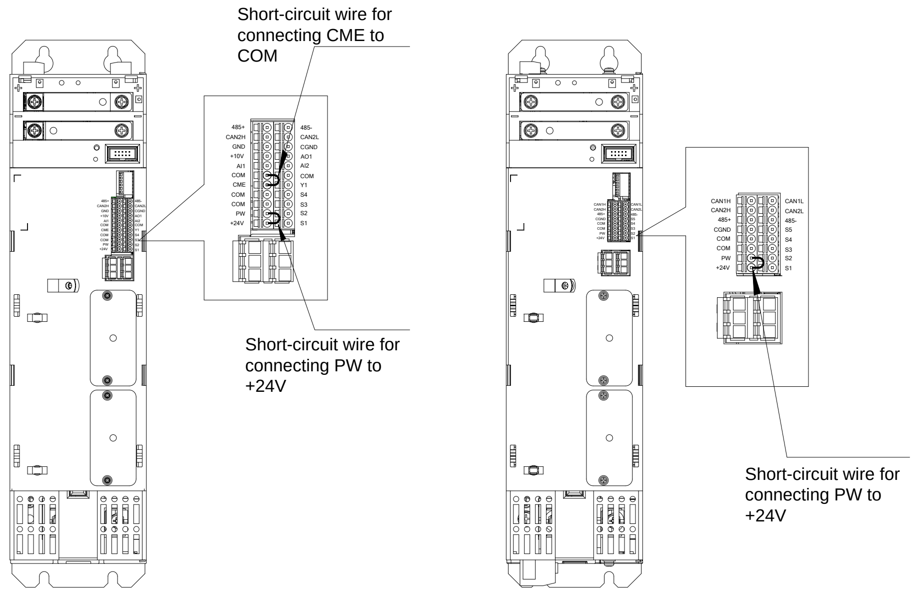
4.5.8 DIP switch function description of the inverter unit

Function	Description	Position
Internal 485 terminal matching resistor selection	Switching position 1 to ON indicates the terminal matching resistor is connected.	
Communication 485 terminal matching resistor selection	Switching positions 4 and 5 to ON indicates the terminal matching resistor is connected.	
CAN1 terminal matching resistor selection (CANopen)	Switching positions 2 and 3 to ON indicates the terminal matching resistor is connected.	
CAN2 terminal matching resistor selection (Master/slave CAN)	Switching position 6 to ON indicates the terminal matching resistor is connected.	

4.5.9 Control circuit wiring description

1. Digital input

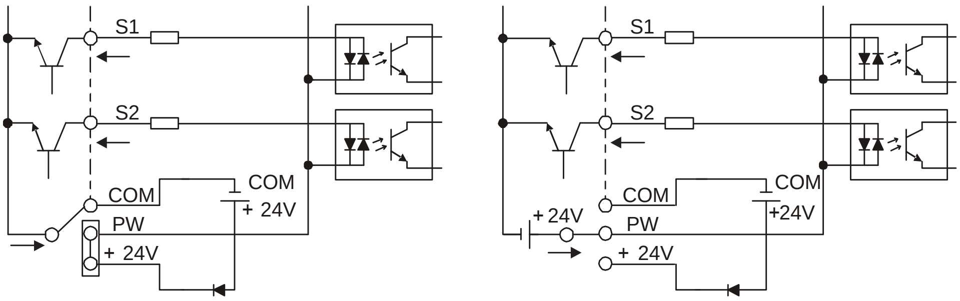
Digital input supports two wiring modes: NPN and PNP, and internal or external power supply can be selected. PW and +24V are shorted before delivery. The default is NPN wiring mode, using the internal power supply.



Short-circuit wires of the inverter unit Short-circuit wires of the rectifier unit

Figure 4-14 Diagram of short-circuit wire position

NPN wiring mode:



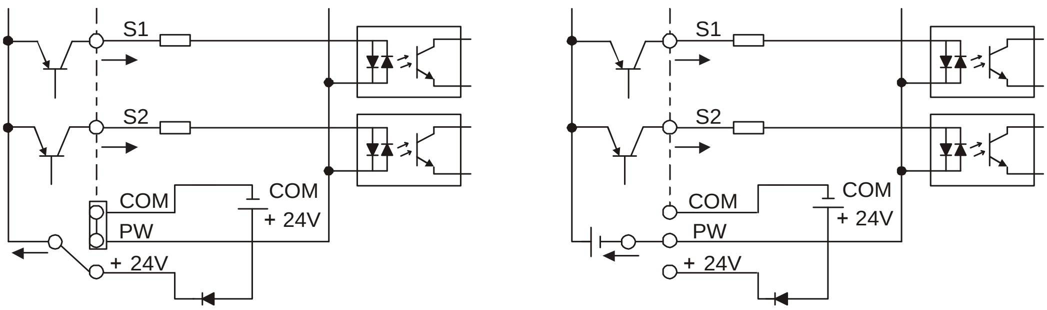
Internal power supply (NPN mode) External power supply (NPN mode)

Figure 4-15 NPN wiring mode diagram

Short PW to +24V, and connect the COM terminal of the VFD to the common terminal of the external controller when the internal 24V power supply of the VFD is used.

Remove the short-circuit wires between the PW and +24V terminals, connect the positive terminal of the external 24V power supply to the PW terminal, and connect the negative terminal of the external 24V power supply to the S terminal through the switch of the external controller when an external 24V power supply is used.

PNP wiring mode:



Internal power supply (PNP mode) External power supply (PNP mode)

Figure 4-16 PNP wiring mode diagram

Remove the short-circuit wires between the PW and +24V terminals, short PW to COM, and connect the +24V terminal of the VFD to the common terminal of the external controller when the internal 24V power supply of the VFD is used.

Remove the short-circuit wires between the PW and +24V terminals, connect the negative terminal of the external 24V power supply to the PW terminal, and connect the positive terminal of the external 24V power supply to the S terminal through the switch of the external controller when an external 24V power supply is used.

2. Digital output

Digital output is an open-collector output. A pull-up resistor must be configured with a resistance of at least 500Ω. The internal power supply or external power supply can be used. CME and COM are shorted before the delivery. The internal power supply is used by default.

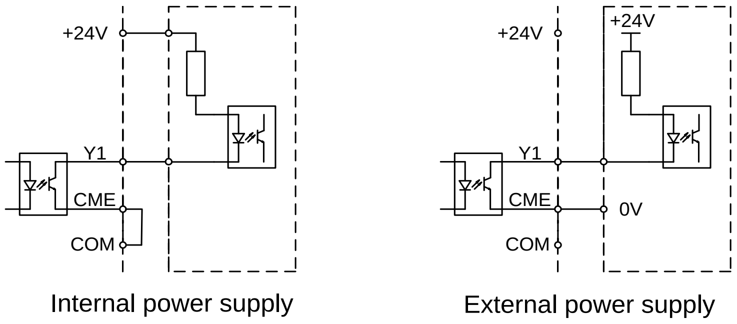


Figure 4-17 Digital output wiring diagram

Short CME to COM, and connect the +24 V terminal of the VFD to the power input end of the external controller when the internal 24V power supply of the VFD is used.

Remove the short-circuit wires between the CME and COM terminals, and connect the CME terminal of the VFD to 0V of the external power supply when an external 24V power supply is used.

3. Relay output

When the relay cuts off the inductive load (such as relay, contactor, and so on) current, a voltage spike occurs and the relay contacts must be protected. When the relay or contactor coil voltage is 220V AC, a varistor needs to be connected in parallel at each end of the relay or contactor coil; when the relay or contactor coil voltage is 24V DC, a flyback diode needs to be connected in parallel at each end of the relay or contactor coil.

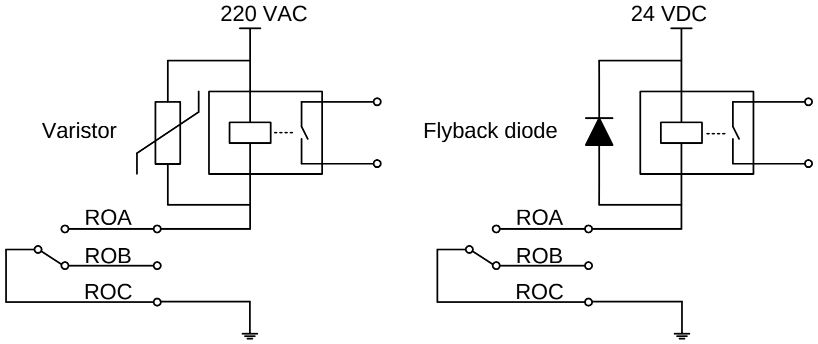


Figure 4-18 Relay output wiring diagram

4. Analog input/output

It is recommended that you use shielded cables for analog input/output cables, with the connection distance as short as possible, 20 meters at most, since the analog voltage signal is susceptible to external interference. The cable shielding layer is connected to the PE terminal of the VFD through the 360-degree loop connection method. In the scenario with severe interference, analog input/output cables need to be configured with magnetic rings.

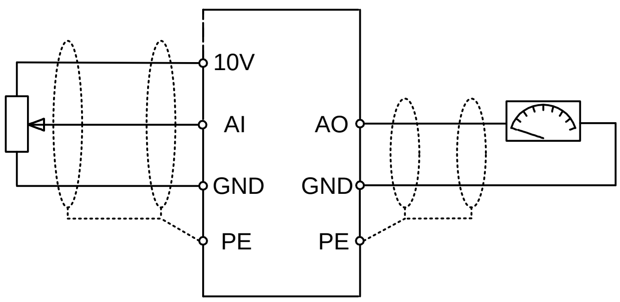


Figure 4-19 Analog input/output wiring diagram

5. 24V external power supply

Each unit is configured with two 24V external power interfaces, which can realize the seial connection of the external power supplies between the units. After accessing the 24V power supply, the control part of the whole system can work without connecting to electricity, and you can set parameters and query information.

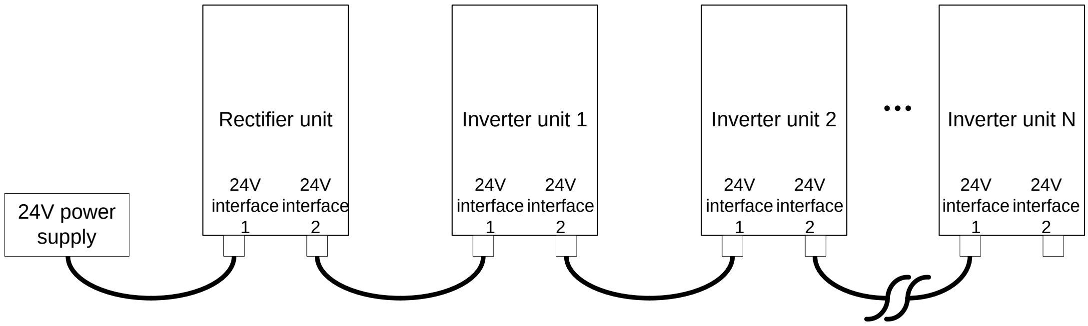


Figure 4-20 Wiring diagram of external power supply

4.6 Wiring protection

4.6.1 Protecting the VFD and input power cable in case of short circuit

The VFD and input power cable can be protected in case of short circuit, avoiding thermal overload.

Carry out protective measures according to the following figure.

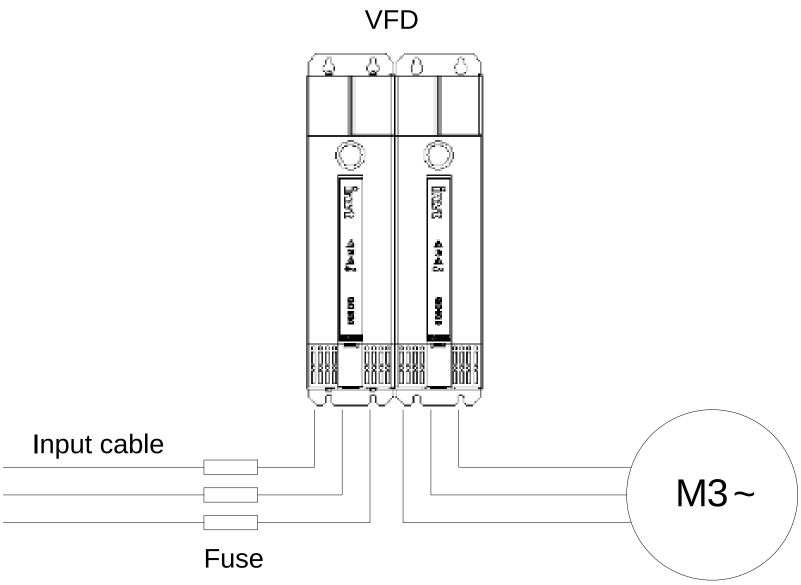


Figure 4-21 Fuse configuration

Note: Select the fuse according to the manual. In case of short circuit, the fuse protects input power cables to avoid damage to the VFD; if internal short-circuit occurs to the VFD, it can protect neighboring equipment from being damaged.

4.6.2 Protecting the motor and motor cable in case of short circuit

If the motor cable is selected based on VFD rated current, the VFD is able to protect the motor cable and motor during short circuit without other protective devices.

	If the VFD is connected to multiple motors, use a separated thermal overload switch or breaker to protect the cable and motor, which may require the fuse to cut off the short circuit current.

4.6.3 Protecting the motor against thermal overload

The motor must be protected against thermal overload. Once overload is detected, current must be cut off. The VFD is equipped with the motor thermal overload protection function, which can block output and cut off the current (if necessary) to protect the motor.

4.6.4 Bypass connection

In some critical scenarios, the power/variable frequency conversion circuit needs to be configured to ensure proper operation of the system when a fault occurs to the VFD.

In some special scenarios, such as in soft startup, power-frequency running is directly performed after the startup, which requires bypass connection.

	Do not connect any power source to the VFD output terminals U, V, and W. The voltage applied to the motor cable may cause permanent damage to the VFD.

If frequent switchover is needed, you can use the switch which carries mechanical interlock or a contactor to ensure motor terminals are not connected to input power cables and VFD output ends simultaneously.

5 Basic operation guidelines

5.1 What this chapter contains

This chapter instructs you how to use the VFD keypad and commission the VFD common functions.

5.2 Keypad introduction

The VFD has a simple LED keypad, which is a standard configuration part and shared by the rectifier and inverter units. You can set the VFD parameters, read state data and perform fault reset through the keypad.

Figure 5-1 Keypad

<table>
<tr><th>No.</th><th>Name</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Status indicator</td><td>RUN/TUNE</td><td>It is on if the VFD is running.
It is off if the VFD is stopped.</td></tr>
<tr><td>FWD/REV</td><td>It is unused in the rectifier state.</td></tr>
<tr><td>TRIP</td><td>Fault indicator.
It is on if the VFD is in fault state.
It is off if the VFD is in normal state.
It is blinking if the VFD is in pre-alarm state.</td></tr>
<tr><td rowspan="5">2</td><td rowspan="5">Unit indicator</td><td>Hz</td><td>Frequency unit</td></tr>
<tr><td>RPM</td><td>Rotation speed unit</td></tr>
<tr><td>A</td><td>Current unit</td></tr>
<tr><td>%</td><td>Percentage</td></tr>
<tr><td>V</td><td>Voltage unit</td></tr>
<tr><td>3</td><td>LED tube</td><td colspan="2">Five-digit LED displays various monitoring data and alarm codes such as the frequency setting and output frequency.
<table>
<tr><th>Display</th><th>Means</th><th>Display</th><th>Means</th><th>Display</th><th>Means</th><th>Display</th><th>Means</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>2</td><td>2</td><td>3</td><td>3</td></tr>
<tr><td>4</td><td>4</td><td>5</td><td>5</td><td>6</td><td>6</td><td>7</td><td>7</td></tr>
<tr><td>8</td><td>8</td><td>9</td><td>9</td><td>A.</td><td>A</td><td>b.</td><td>B</td></tr>
<tr><td>C.</td><td>C</td><td>d.</td><td>D</td><td>E.</td><td>E</td><td>F.</td><td>F</td></tr>
<tr><td>H.</td><td>H</td><td>I.</td><td>I</td><td>L.</td><td>L</td><td>n.</td><td>N</td></tr>
<tr><td>n</td><td>n</td><td>0</td><td>o</td><td>P.</td><td>P</td><td>r</td><td>r</td></tr>
<tr><td>S.</td><td>S</td><td>t</td><td>t</td><td>U.</td><td>U</td><td>u</td><td>v</td></tr>
<tr><td>.</td><td>.</td><td>-</td><td>-</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
</table>

No.	Name	Description		
4	Keys		Programming key	Press it to enter or exit level-1 menus or delete a parameter.
			Confirmation key	Press it to enter menus in cascading mode or confirm the setting of a parameter. In addition, you can press it in the fault interface to implement fault reset.
			UP	Press it to increase data or move upward.
			DOWN	Press it to decrease data or move downward.
			Right-shifting key	Press it to select display parameters rightward in the interface for the VFD in stopped or running state or to select digits to change during parameter setting.

5.3 Keypad display

The VFD keypad displays information such as the stopped-state parameters, running-state parameters, and fault status, and allows you to modify function codes.

5.3.1 Displaying stopped-state parameters

When the VFD is in stopped state, the keypad displays stopped-state parameters, as shown in Figure 5-2. In the stopped state, the rectifier unit can display the following parameters: grid frequency, grid voltage, bus voltage, and input current. You can press the SHIFT key to shift selected parameters from left to right. The parameters that the inverter unit can display in the stopped state are specified by P07.07.

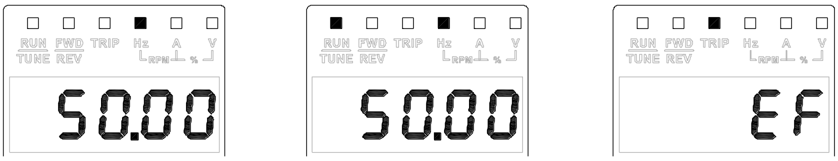


Figure 5-2 Displaying stopped-state parameters

5.3.2 Displaying running-state parameters

After receiving a valid running command, the rectifier/inverter enters the running state, and the keypad displays running-state parameters, with the RUN/TUNE indicator on. See Figure 5-2.

In the running state, the rectifier unit can display the following parameters: grid frequency, grid voltage, bus voltage, and input current. You can press the SHIFT key to shift selected parameters from left to right. The parameters that the inverter unit can display in the running state are specified by P07.05 and P07.06.

5.3.3 Displaying fault information

After detecting a fault signal, the rectifier/inverter unit enters the fault alarm state immediately, the fault code blinks on the keypad, and the TRIP indicator is on. You can perform fault reset by using the DATA/ENT key, control terminals, or communication commands. If the fault persists, the fault code is continuously displayed.

5.3.4 Editing function codes

You can press the PRG/ESC key to enter the editing mode in stopped, running, or fault alarm state (if a user password is used, see the description of P07.00). The editing mode contains two levels of menus in the following sequence: Function code group or function code number → Function code setting. You can press the DATA/ENT key to enter the function parameter display interface. In the function parameter display interface, you can press the DATA/ENT key to save parameter settings or press the PRG/ESC key to exit the parameter display interface.

5.4 Operating the VFD through the keypad

Various operations can be performed on the rectifier/inverter unit through the keypad, including entering/exiting menus, selecting parameters, and setting parameters.

5.4.1 Modifying the function codes of the rectifier unit

The rectifier unit has the menu of three levels, which are:

1. Function code group number (level-1 menu)
2. Function code number (level-2 menu)
3. Function code setting (level-3 menu)

When performing operations on the level-3 menu, you can press the PRG/ESC or DATA/ENT key to return to the level-2 menu. If you press the DATA/ENT key, the set value of the parameter is saved to the control board first, and then the level-2 menu is returned, displaying the next function code. If you press the PRG/ESC key, the level-2 menu is returned directly, without saving the set value of the parameter, and the current function code is displayed.

If you enter the level-3 menu but the parameter does not have a digit blinking, the parameter cannot be modified due to either of the following reasons:

✧ It is read only. Read-only parameters include actual detection parameters and running record parameters.

✧ It cannot be modified in running state and can be modified only in stopped state.

Example: Change the value of P00.01 from 0 to 1.

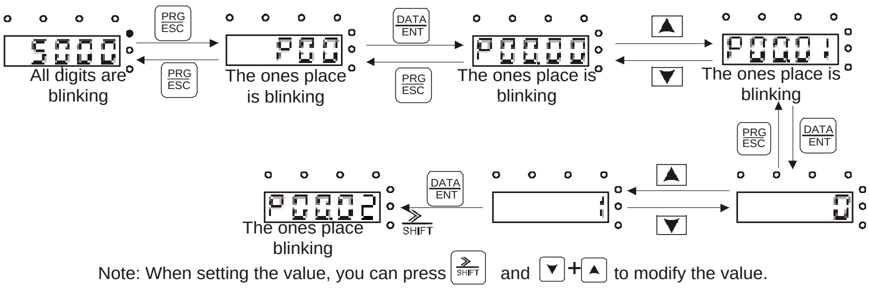


Figure 5-3 Modifying a parameter

5.4.2 Setting the password for the rectifier/inverter unit

The rectifier/inverter unit provides the user password protection function.

When you set P07.00 to a non-zero value, the value is the user password. After you exit the function code editing interface, the password protection function is enabled within 1 minute. If password protection is enabled, "0.0.0.0.0" is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface.

To disable the password protection function, you need only to set P07.00 to 0.

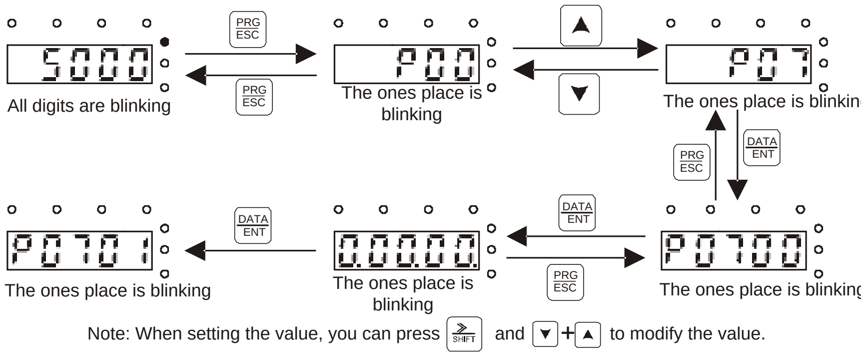


Figure 5-4 Setting a password

5.4.3 Viewing rectifier/inverter unit status

The function code group P17 of the rectifier unit is the status viewing group while the function code groups P17, P18, and P19 of the inverter unit are the status viewing groups. You can enter the related function code group directly to view the status.

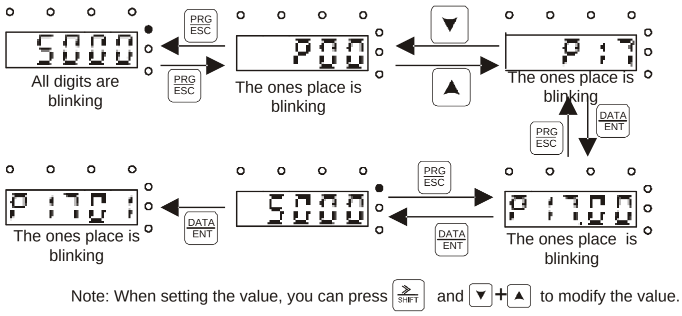


Figure 5-5 Viewing a parameter

5.5 Rectifier unit basic functions

5.5.1 Basic information

Function code	Name	Description	Default	Modify
P00.00	Software version	Software version of the rectifier unit.		●

The rectifier unit version has been determined in the factory and cannot be modified.

5.5.2 Basic function parameter settings

Function code	Name	Description	Default	Modify
P00.03	Undervoltage point for bus voltage	Undervoltage point for bus voltage for protection purpose. When the bus voltage is lower than the value of this function parameter during running, the VFD stops and reports the bus undervoltage fault. Setting range: 0.0V–500.0V	350.0V	◎

When the bus voltage is lower than the value of this function parameter during running, the system considers it is in the undervoltage state, which is not good for the inverter unit to run. Set the value according to the actual application situation.

Function code	Name	Description	Default	Modify
P00.05	Overvoltage point for bus voltage	Overvoltage point for bus voltage for protection purpose. When the bus voltage is higher than the value of this function parameter during running, the VFD stops and reports the bus overvoltage fault. Setting range: 500.0V–850.0V	800.0V	/

When the bus voltage is higher than the value of this function parameter during running, the system considers it is in the overvoltage state. In the overvoltage state, the rectifier unit keypad blinks. In addition, if the motor is running in the power generation state, the bus voltage may continuously increase. Set the value according to the actual application situation.

Function code	Name	Description	Default	Modify
P00.04	Braking start voltage for the braking unit	Voltage at which the braking unit starts braking. When the bus voltage reaches the value of this function parameter during running, the braking pipe starts braking. This function is valid only for the models configured with built-in braking units, invalid for the models connected to external brakes. Setting range: 400.0V–800.0V	700.0V	○
P00.10	Braking pipe direct connection protection	P00.10 specifies the fault protection mode for the braking pipe. Mode of protecting the braking pipe against faults. 0: Disable 1: Enable Ones place: Braking pipe direct connection enabling selection. Tens place: Braking pipe overcurrent enabling selection. Hundreds place: Braking pipe overload enabling selection. **Note: Valid only for the 45kW rectifier unit with the built-in braking unit.**	0x111	◎

If the braking unit has a value higher than P00.04, the braking unit acts to reduce the bus voltage. You need to configure the external braking resistor according to the actual application. P00.10 specifies the fault protection mode for the braking pipe in case of direct connection, overcurrent and overload, and it is valid by default. Set the protection mode according to the actual application.

Function code	Name	Description	Default	Modify
P00.14	Function parameter restore	0: No operation 1: Restore default values 2: Clear fault records	0	◎

After the selected operation is performed, the function code is automatically restored to 0.

Restoring the default values may delete the user password. Exercise caution when using this function.

5.5.3 Start/stop control

The rectifier unit uses semi-controlled rectifier design. The rectifier unit runs automatically when the three-phase 380V is turned on. You need to check whether the grid voltage on the keyboard is normal. In normal cases, the grid voltage is about 380V. Then check whether the grid frequency on the keyboard is about 50.0Hz and check whether the bus voltage is about 560V.

If you want to change to another start control mode, you need to change P01.14 "Enabling auto run" to 0. After re-power on, set P00.01 "Channel of running commands" to select the start mode, such as keypad, terminal, and communication. If you select the terminal control mode, you need to configure related digital terminal functions; if you select the communication control mode, you need to set P00.02 to select a communication mode.

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	Used to select the channel of rectifier unit control commands, including the start, stop, and fault reset commands. 0: Keypad The running commands are controlled through keypad keys, such as RUN and STOP/RST. 1: Terminal The running commands such as run, stop, and fault reset are controlled through multi-function input terminals. 2: Communication The running commands are controlled by the upper computer in communication mode.	1	○
P00.02	Communication mode of running commands	Used to select the mode that the VFD controls communication commands. 0: RS485 1: CANopen 2: PLC 3: PROFIBUS-DP 4: PROFINET/EtherCAT	0	○
P01.14	Enabling auto run	0: Disable auto run at power on. 1: Enable auto run at power on. When the rectifier side detects that run conditions are met at initial power on, it starts running automatically.	1	○

5.5.4 Rectifier-inverter interaction

When the rectifier unit encounters a fault, it sends the information to the inverter unit. The inverter unit acts depending on the received information.

Note: The following interaction functions (P01.00–P01.09) take effect only when the following two conditions are met:

1) The rectifier unit is configured as the CANopen master node.

2) The rectifier unit does not have a communication card or programmable card.

If the rectifier unit has a communication card or programmable card, the system considers the external programmable card (that is connected to the communication card) or the VFD programmable card as the "brain", which will manage the interaction management permission.

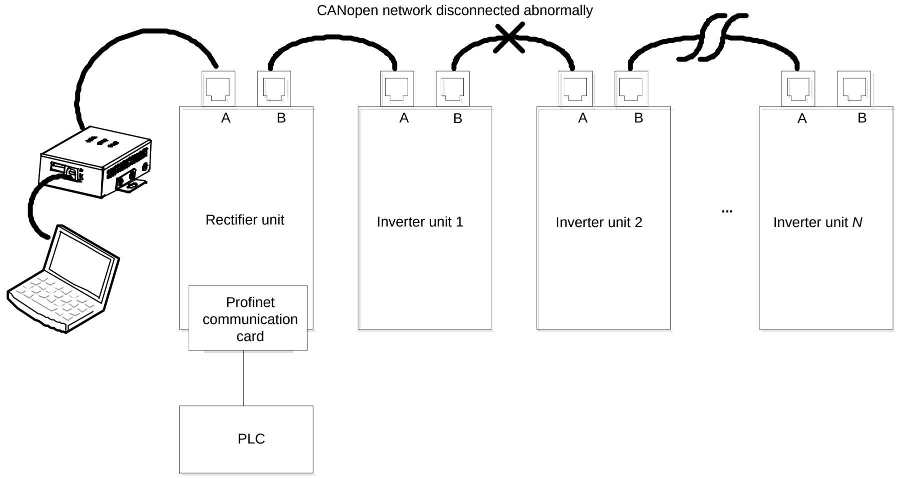
Function code	Name	Description	Default	Modify
P01.00	Inverter protection against grid overvoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When grid overvoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When grid overvoltage is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.01	Inverter protection against grid undervoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When grid undervoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When grid undervoltage is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.03	Inverter protection against input phase loss	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When the grid voltage phase loss is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When the grid voltage phase loss is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.04	Inverter protection against direct connection of the braking pipe	0: Running. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When the direct connection of the braking pipe is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When the direct connection of the braking pipe is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.05	Inverter protection against braking pipe overcurrent	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When braking pipe overcurrent is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When braking pipe overcurrent is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.06	Inverter protection against braking pipe overload	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When braking pipe overload is detected on the rectifier side, the	0	○

Function code	Name	Description	Default	Modify
		inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When braking pipe overload is detected on the rectifier side, the inverter coasts to stop.		
P01.07	Inverter protection against expansion card detection (E-CP) fault	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When a communication fault is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When a communication fault is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.08	Inverter protection against overheating	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When rectifier bridge module overheating is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When rectifier bridge module overheating is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.09	Inverter protection against bus overvoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When bus overvoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When bus overvoltage is detected on the rectifier side, the inverter coasts to stop.	0	○

5.5.5 Protection against networking communication faults

In PROFIBUS-DP-to-CANopen communication networking or PROFINET-to-CANopen communication networking topologies, different protective actions for the inverter units are required in communication failure in different application cases, preventing further damage to machinery or process materials.

The following takes the PROFIBUS-DP-to-CANopen communication networking as an example.



In the event of a CANopen communication fault, some inverter units are online while some are offline. You can set the function code P01.15 of the rectifier unit and the function code P14.32 of each inverter unit so that the rectifier unit triggers an OFFL fault (partial slave offline fault) to send a corresponding stop command to make the online inverter units stop in the set manner, while the offline inverter units trigger an E-CAN fault and stop in the set manner. In general, you need to configure the rectifier and inverter units to stop in the same manner.

In addition to the OFFL fault, the rectifier unit sends a stop command upon communication faults including E-CAN, E-C1, E-C2, E-DP, E-PN, and E-CAT.

Function code	Name	Description	Default	Modify
P01.15	Inverter protection against networking communication faults	Rectifier networking communication faults include E-CAN, OFFL, E-C1, E-C2, E-DP, E-PN, and E-CAT. 0: Run 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○

Function code	Name	Description	Default	Modify
P14.32	CANopen communication fault action selection	0: Run 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○

5.5.6 Digital input

The rectifier unit carries five programmable digital input terminals. The functions of all the digital input terminals can be set through function codes.

Function code	Name	Default	Setting range	Description
P05.01	Function of S1	1	0-9	See the following table.
P05.02	Function of S2	2		
P05.03	Function of S3	0		
P05.04	Function of S4	0		
P05.05	Function of S5	0		

These parameters are used to set the corresponding functions of digital input terminals. The selectable functions are as follows.

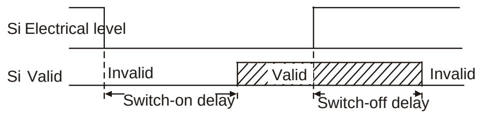
Setting	Function	Description
0	No function	You can set the unused terminals to "no function" to avoid maloperation.
1	Run	The rectifier unit runs.
2	Fault reset	The terminal is used for fault reset. The function can also be achieved by using the RESET key on the keypad.
3	External fault	An external fault occurs, displaying the external fault information.
4	Incoming circuit breaker feedback	The rectifier unit sends a run command to the inverter unit according to this feedback signal.
5	Auxiliary circuit breaker feedback	The rectifier unit sends a run command to the inverter unit according to this feedback signal.
6	Leakage protection switch feedback	The rectifier unit sends a run command to the inverter unit according to this feedback signal.
7	Disable the inverter unit to run	The rectifier unit sends a run prohibition command to the inverter unit according to this feedback signal.
8	Enable the inverter unit to coast to stop	The rectifier unit sends a command of coasting to stop to the inverter unit according to this feedback signal.
9	Enable the inverter unit to stop in the set manner	The rectifier unit sends a command of stopping in the set manner to the inverter unit according to this feedback signal.

Note: Two different multifunction input terminals cannot be configured with a same function.

You can set P05.07 to enhance the anti-interference capability in the application scenarios where maloperation may be caused since input terminals are susceptible to interference. However, increasing the filter time will cause the terminal response slow-down.

Related function codes are as follows.

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P05.06</td><td>Input terminal polarity</td><td>Used to set the polarity of input terminals.
When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative.<table><tr><td>BIT4</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>S5</td><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr></table>Setting range: 0x000–0x1F</td><td>0x000</td><td>○</td></tr>
<tr><td>P05.07</td><td>Digital input filter time</td><td>Used to set the filter time of sampling for terminals S1–S5. In strong interference cases, increase the value to avoid maloperation.
0.000–1.000s</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.13</td><td>S1 switch-on delay</td><td rowspan="7">Used to specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.14</td><td>S1 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.15</td><td>S2 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.16</td><td>S2 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.17</td><td>S3 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.18</td><td>S3 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.19</td><td>S4 switch-on delay</td><td>0.000s</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
P05.20	S4 switch-off delay	 Setting range: 0.000–60.000s	0.000s	○
P05.21	S5 switch-on delay		0.000s	○
P05.22	S5 switch-off delay		0.000s	○

5.5.7 Relay output

The rectifier unit carries two groups of multifunction relay output terminals.

Function code	Function	Default	Setting range	Description
P06.03	RO1 output	1	0-10	See the following table.
P06.04	RO2 output	2		
P06.07	Output terminal polarity selection	0x0	0x0–0xF	When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative. BIT1: RO2 / BIT0: RO1

Relay output function selection:

Setting	Function	Description
0	No output	The output terminal does not have any function.
1	Ready for running	When the rectifier unit works properly and sends the run command to the inverter unit, it outputs the ON signal.
2	Running	When the rectifier unit detects that the bus voltage is in normal state, it outputs the ON signal.
3	Fault output	When the rectifier unit encounters a fault, it outputs the ON signal.
4	Bus overvoltage	When the rectifier unit detects bus overvoltage, it outputs the ON signal.
5	Bus undervoltage	When the rectifier unit detects bus undervoltage, it outputs the ON signal.
6	Three-phase input overvoltage	When the rectifier unit detects three-phase input overvoltage, it outputs the ON signal.
7	Three-phase input undervoltage	When the rectifier unit detects three-phase input undervoltage, it outputs the ON signal.
8	Output of rectifier unit overheating	When the rectifier unit detects rectifier unit overheating, it outputs the ON signal.
9	Output of braking unit overheating	When the rectifier unit detects braking unit overheating, it outputs the ON signal. (It is valid only for the 45kW rectifier model.)
10	Breaker acting	When the three-phase input is excessively high or the braking pipe is directly connected, it outputs the ON signal to make the breaker act.

5.5.8 Communication networking

For details, see chapter 6 Communication networking.

5.6 Inverter unit basic functions

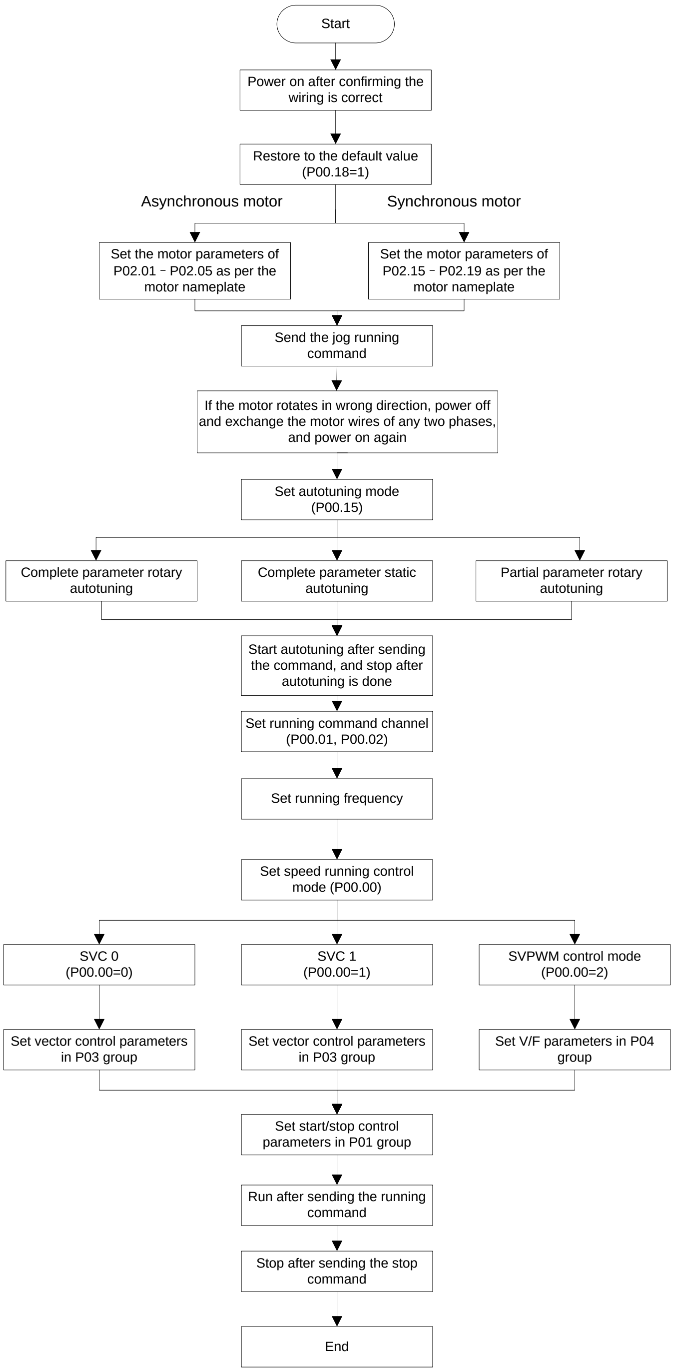
5.6.1 What this section describes

This section describes the internal function modules of the inverter unit.

⚠	• Ensure that all terminals have been securely connected. • Ensure that the motor power matches the inverter unit.

5.6.2 Common commissioning procedure of the inverter unit

The common commissioning procedure is as follows (taking motor 1 as an example).



Note: If a fault occurs, find out the fault cause according to chapter 9 Troubleshooting.

The running command channel can be set through terminal commands in addition to P00.01 and P00.02.

Channel of running commands P00.01	Multifunction terminal function 36 (Switch the running command channel to keypad)	Multifunction terminal function 37 (Switch the running command channel to terminal)	Multifunction terminal function 38 (Switch the running command channel to communication)
Keypad	/	Terminal	Communication
Terminal	Keypad	/	Communication
Communication	Keypad	Terminal	/

Note: "/" means this multifunction terminal is invalid under the present reference channel.

Related parameter list:

Function code	Name	Description	Default
P00.00	Speed control mode	0: Sensorless vector control (SVC) mode 0 1: Sensorless vector control (SVC) mode 1 2: Space voltage vector control mode 3: Closed-loop vector control mode **Note: Before using a vector control mode (0, 1, or 3), enable the inverter unit to perform motor parameter autotuning first.**	2
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication **Note: The keypad indicates the external LCD keypad, since the built-in LED keypad is not equipped with the Run key.**	0
P00.02	Communication mode of running commands	0: Modbus 1: CANopen 2: Ethernet 3: EtherCAT/PROFINET 4: PLC 5: Wireless communication 6: PROFIBUS-DP/DeviceNet **Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.**	0
P00.15	Motor parameter autotuning	0: No operation 1: Rotary autotuning 1 Comprehensive motor parameter autotuning. It is recommended to use rotating autotuning when high control accuracy is needed. 2: Static autotuning 1 (comprehensive autotuning) Static autotuning 1 is used in cases where the motor cannot be disconnected from load. 3: Static autotuning 2 (partial autotuning) When the present motor is motor 1, only P02.06, P02.07 and P02.08 are autotuned; when the	0

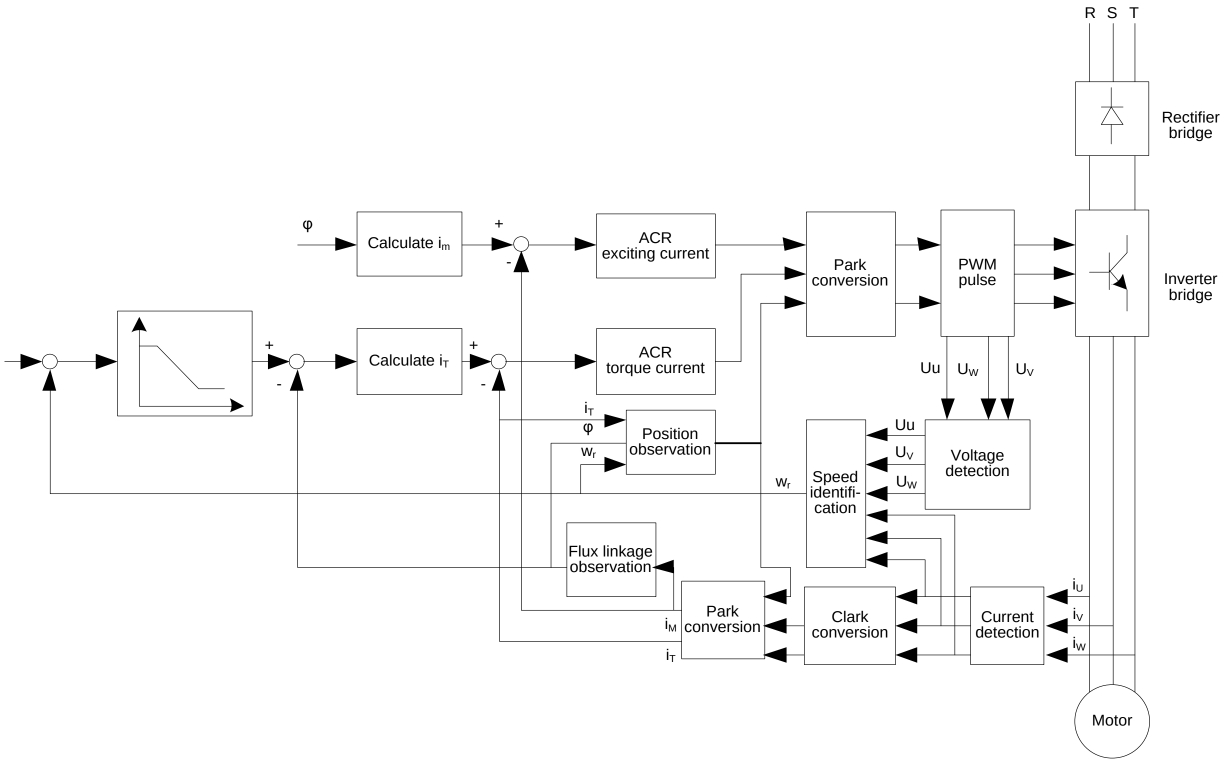
Function code	Name	Description	Default
		present motor is motor 2, only P12.06, P12.07 and P12.08 are autotuned. 4: Rotary autotuning 2, which is similar to rotary autotuning 1 but only valid for AMs 5: Static autotuning 3 (partial autotuning), which is valid only for AMs	
P00.18	Function parameter restore	0: No operation 1: Restore default values (excluding motor parameters) 2: Clear fault records 3: Lock keypad parameters 4: Reserved 5: Restore default values (standard version) 6: Restore default values (including motor parameters) **Note: After the selected operation is performed, the function code is automatically restored to 0. Restoring the default values may delete the user password. Exercise caution when using this function. The option 5 can be used only for factory testing.**	0
P02.00	Type of motor 1	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0
P02.01	Rated power of AM 1	0.1–3000.0kW	Model depended
P02.02	Rated frequency of AM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P02.03	Rated speed of AM 1	1–60000rpm	Model depended
P02.04	Rated voltage of AM 1	0–1200V	Model depended
P02.05	Rated current of AM 1	0.8–6000.0A	Model depended
P02.15	Rated power of SM 1	0.1–3000.0kW	Model depended
P02.16	Rated frequency of SM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P02.17	Number of pole pairs of SM 1	1–50	2
P02.18	Rated voltage of SM 1	0–1200V	Model depended
P02.19	Rated current of SM 1	0.8–6000.0A	Model depended
P05.01–P05.04	Multifunction digital input terminal (S1–S4) function selection	36: Switch the running command channel to keypad 37: Switch the running command channel to terminal 38: Switch the running command channel to communication	/
P07.01	Reserved	/	/

5.6.3 Vector control

AMs feature high order, nonlinearity, strong coupling and multi-variables, which increase difficulty to control AMs during actual application. The vector control technology solves this situation as follows: measures and controls the stator current vector of the AM, and then decomposes the stator current vector into exciting current (current component that generates internal magnet field) and torque current (current component that generates torque) based on field orientation principle, and therefore controls the amplitude values and phase positions of the two components (namely, controls the stator current vector of the AM) to realize decoupled control on exciting current and torque current, thus achieving high-performance speed regulation of the AM.

The inverter unit uses the sensor-less vector control algorithm, which can be used to drive AMs and permanent-magnet SMs simultaneously. As the core algorithm of vector control is based on accurate motor parameter models, the accuracy of motor parameters affects vector control performance. It is recommended to enter accurate motor parameters and autotune motor parameters before executing vector control.

As the vector control algorithm is complicated, exercise caution before modifying vector control function parameters.



Function code	Name	Description	Default
P00.00	Speed control mode	0: Sensorless vector control (SVC) mode 0 1: Sensorless vector control (SVC) mode 1 2: Space voltage vector control mode 3: Closed-loop vector control mode **Note: Before using a vector control mode (0, 1, or 3), enable the inverter unit to perform motor parameter autotuning first.**	2
P00.15	Motor parameter autotuning	0: No operation 1: Rotary autotuning 1. Comprehensive motor parameter autotuning. It is recommended to use rotating autotuning when high	

Function code	Name	Description	Default
		control accuracy is needed. 2: Static autotuning 1 (comprehensive autotuning); static autotuning 1 is used in cases where the motor cannot be disconnected from load. 3: Static autotuning 2 (partial autotuning); when the present motor is motor 1, only P02.06, P02.07 and P02.08 are autotuned; when the present motor is motor 2, only P12.06, P12.07 and P12.08 are autotuned. 4: Rotary autotuning 2, which is similar to rotary autotuning 1 but only valid for AMs. 5: Static autotuning 3 (partial autotuning), which is valid only for AMs.	
P02.00	Type of motor 1	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0
P03.00	Speed-loop proportional gain 1	0–200.0	20.0
P03.01	Speed-loop integral time 1	0.000–10.000s	0.200s
P03.02	Low-point frequency for switching	0.00Hz–P03.05	5.00Hz
P03.03	Speed-loop proportional gain 2	0–200.0	20.0
P03.04	Speed-loop integral time 2	0.000–10.000s	0.200s
P03.05	High-point frequency for switching	P03.02–P00.03 (Max. output frequency)	10.00Hz
P03.06	Speed-loop output filter	0–8 (corresponding to 0–2^8/10ms)	0
P03.07	Electromotive slip compensation coefficient of vector control	50%–200%	100%
P03.08	Braking slip compensation coefficient of vector control	50%–200%	100%
P03.09	Current-loop proportional coefficient P	0–65535	1000
P03.10	Current-loop integral coefficient I	0–65535	1000
P03.11	Torque setting method	0: Keypad (P03.12) 1: Keypad (P03.12) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-step torque 7: Modbus communication 8: CANopen communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET communication 12: Programmable expansion card	0

Function code	Name	Description	Default
		13: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	
P03.12	Torque set through keypad	-300.0%–300.0% (of the motor rated current)	50.0%
P03.13	Torque reference filter time	0.000–10.000s	0.010s
P03.14	Setting source of forward rotation upper-limit frequency in torque control	0: Keypad (P03.16) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step setting 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the max. frequency.**	0
P03.15	Setting source of reverse rotation upper-limit frequency in torque control	0: Keypad (P03.17) 1–12: Same as those for P03.14	0
P03.16	Forward rotation upper-limit frequency set through keypad in torque control	Setting range: 0.00 Hz–P00.03 (Max. output frequency)	50.00Hz
P03.17	Reverse rotation upper-limit frequency set through keypad in torque control		50.00Hz
P03.18	Setting source of electromotive torque upper limit	0: Keypad (P03.20) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved 9: EtherCAT/PROFINET communication 10: PLC 11: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	0
P03.19	Setting source of braking torque upper limit	0: Keypad (P03.21) 1–11: Same as those for P03.18	0
P03.20	Electromotive torque upper limit set through keypad	0.0–300.0% (of the motor rated current)	180.0%
P03.21	Braking torque upper limit set through keypad		180.0%

Function code	Name	Description	Default
P03.22	Weakening coefficient in constant power zone	0.1–2.0	0.3
P03.23	Lowest weakening point in constant power zone	10%–100%	20%
P03.24	Max. voltage limit	0.0–120.0%	100.0%
P03.25	Pre-exciting time	0.000–10.000s	0.300s
P03.32	Enabling torque control	0: Disable 1: Enable	0
P03.33	Flux-weakening integral gain	0–8000	1200
P03.35	Control mode optimization selection	0–0x1111 Ones place: Torque command selection 0: Torque reference 1: Torque current reference Tens place: Reserved 0: Reserved 1: Reserved Hundreds place: indicates whether to enable speed-loop integral separation 0: Disable 1: Enable Thousands place: Reserved 0: Reserved 1: Reserved Range: 0x0000–0x1111 **Note: Valid only in the closed-loop vector control mode (P00.00=3).**	0x0000
P03.36	Speed-loop differential gain	0.00–10.00s	0.00s
P03.37	High-frequency current-loop proportional coefficient	In the closed-loop vector control mode (P00.00=3), when the frequency is lower than the current-loop high-frequency switching threshold (P03.39), the current-loop PI parameters are P03.09 and P03.10; and when the frequency is higher than the current-loop high-frequency switching threshold (P03.39), the current-loop PI parameters are P03.37 and P03.38. P03.37 setting range: 0–65535 P03.38 setting range: 0–65535 P03.39 setting range: 0.0–100.0% (of the max. frequency)	1000
P03.38	High-frequency current-loop integral coefficient		1000
P03.39	Current-loop high-frequency switching threshold		100.0%
P17.32	Motor flux linkage	0.0–200.0%	0.0%

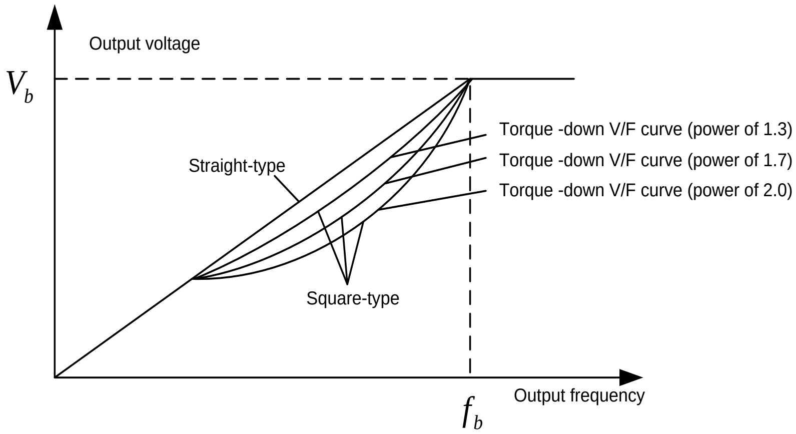
5.6.4 Space voltage vector control mode

The inverter unit also provides the space voltage control function. The space voltage control mode can be used in cases where mediocre control precision is enough and in cases where a VFD needs to drive multiple motors.

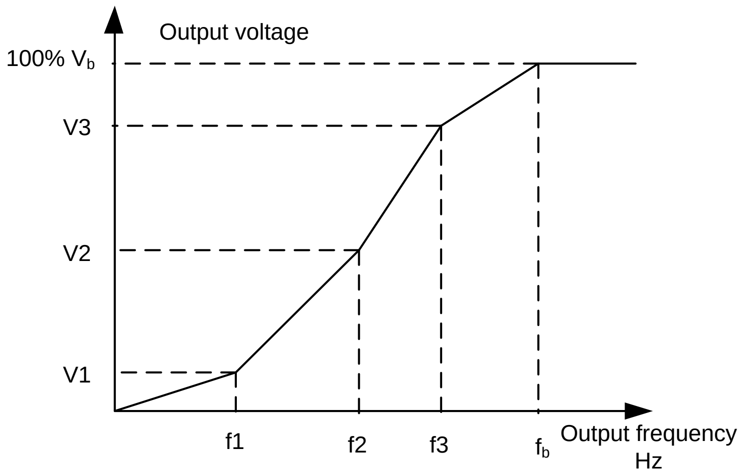
The inverter unit provides multiple V/F curve modes to meet different requirements. You can select V/F curves or set V/F curves as required.

Suggestions:

- For the load featuring constant moment, such as conveyor belt which runs in straight line, as the whole running process requires constant moment, it is recommended to adopt the straight line V/F curve.
- For the load featuring decreasing moment, such as fan and water pumps, as there is a power (square or cube) relation between its actual torque and speed, it is recommended to adopt the V/F curve corresponding to the power of 1.3, 1.7 or 2.0.



The inverter unit also provides multi-point V/F curves. You can change the V/F curves output by the inverter unit by setting the voltage and frequency of the three points in the middle. A whole curve consists of five points starting from (0Hz, 0V) and ending at (motor fundamental frequency, motor rated voltage). During setting, follow the rule: 0 ≤ f1 ≤ f2 ≤ f3 ≤ Motor fundamental frequency, and, 0 ≤ V1 ≤ V2 ≤ V3 ≤ Motor rated voltage



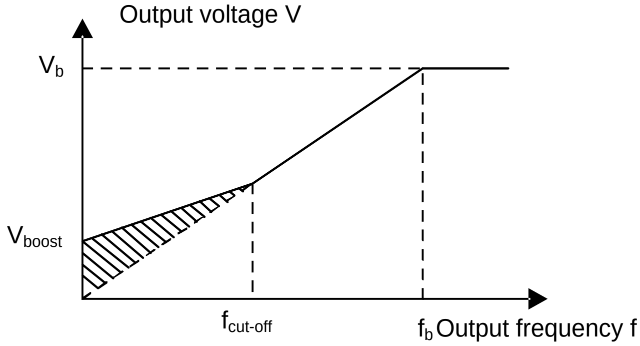
The inverter unit provides dedicated function codes for the space voltage control mode. You can improve the space voltage control performance by means of setting.

1. Torque boost

The torque boost function can effectively compensate for the low-speed torque performance in space voltage control. Automatic torque boost has been set by default, which enables the inverter unit to adjust the torque boost value based on actual load conditions.

Note:

- Torque boost takes effect only at the torque boost cut-off frequency.
- If torque boost is too large, the motor may encounter low-frequency vibration or overcurrent. If such a situation occurs, reduce the torque boost value.



2. Energy-saving run

During actual running, the inverter unit can search for the max. efficiency point to keep the multi-drive system to run in the most efficient state to save energy.

Note:

- This function is generally used in light load or no-load cases.
- This function is no applicable to the cases where sudden load changes often occur.

3. V/F slip compensation gain

Space voltage vector control belongs to an open-loop mode. Sudden motor load changes cause motor speed fluctuation. In cases where strict speed requirements must be met, you can set the slip compensation gain to compensate for the speed change caused by load fluctuation through inverter unit internal output adjustment.

The setting range of slip compensation gain is 0–200%, in which 100% corresponds to the rated slip frequency.

Note: Rated slip frequency = (Rated synchronous rotation speed of motor – Rated rotation speed of motor) x (Number of motor pole pairs)/60

4. Oscillation control

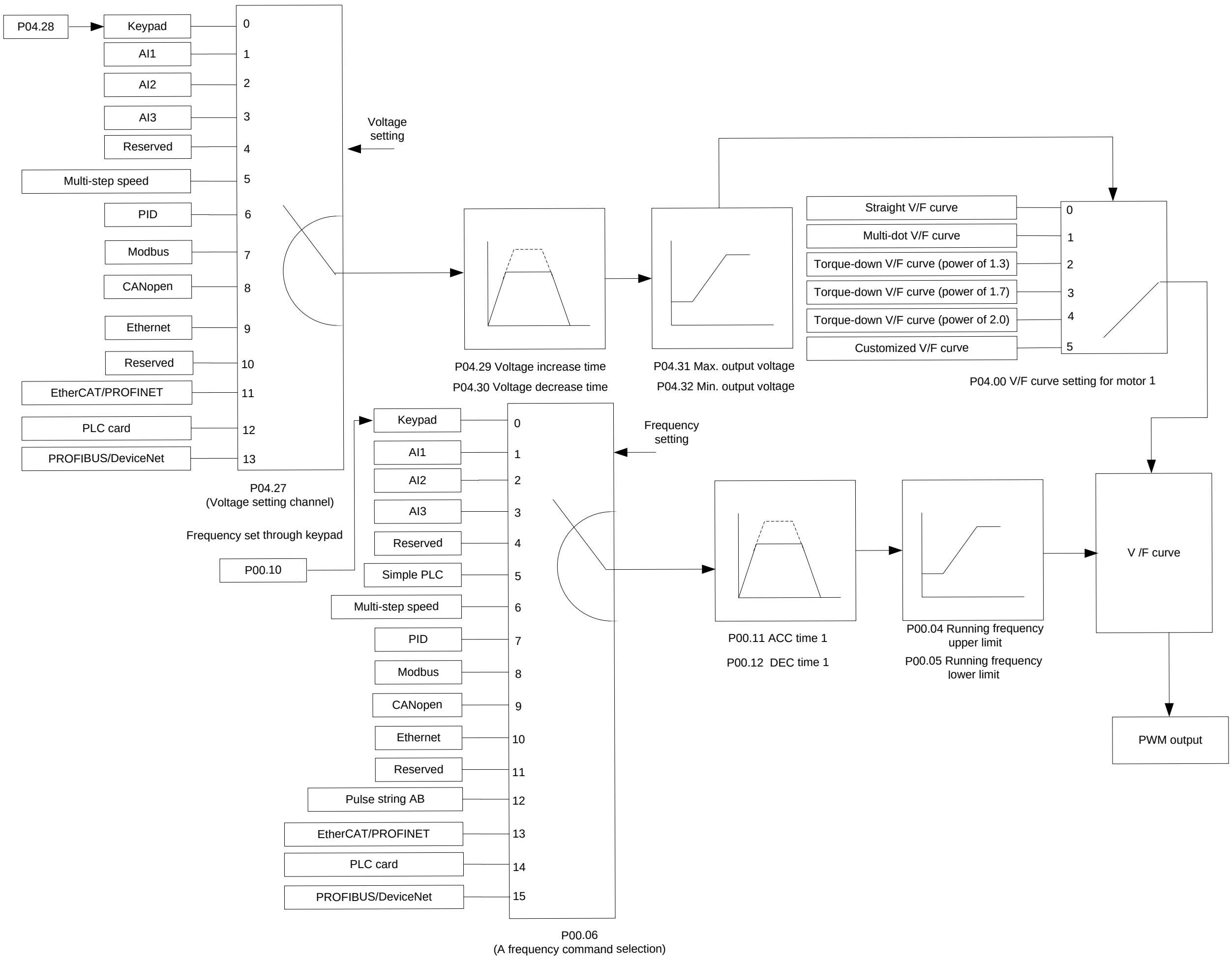
Motor oscillation often occurs in space voltage vector control in large-power driving applications. To solve this problem, the inverter unit provides two oscillation factor function codes. You can set the function codes based on the oscillation occurrence frequency.

Note: A greater value indicates better control effect. However, if the value is too large, the inverter unit output current may be too large.

5. AM IF control

Generally, the IF control mode is valid for AMs. It can be used for SMs only when the frequency is extremely low. Therefore, the IF control mode described in this manual is only involved with AMs. IF control is implemented by performing closed-loop control on the total output current of the inverter unit. The output voltage adapts to the current reference, and open-loop control is separately performed over the frequency of the voltage and current.

Customized V/F curve (V/F separation) function:



When selecting the customized V/F curve function, you can specify the setting channels and acceleration/deceleration time of voltage and frequency respectively, which form a real-time V/F curve in combination manner.

Note: This type of V/F curve separation can be applied in various variable-frequency power sources. However, exercise caution when setting parameters as improper settings may cause equipment damage.

Function code	Name	Description	Default
P00.00	Speed control mode	0: Sensorless vector control (SVC) mode 0 1: Sensorless vector control (SVC) mode 1 2: Space voltage vector control mode 3: Closed-loop vector control mode **Note: Before using a vector control mode (0, 1, or 3), enable the inverter unit to perform motor parameter autotuning first.**	2
P00.03	Max. output frequency	P00.04–400.00Hz	50.00Hz
P00.04	Upper limit of running frequency	P00.05–P00.03	50.00Hz
P00.05	Lower limit of running frequency	0.00Hz–P00.04	0.00Hz
P00.11	ACC time 1	0.0–3600.0s	Model depended
P00.12	DEC time 1	0.0–3600.0s	Model depended

Function code	Name	Description	Default
P02.00	Type of motor 1	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0
P02.02	Rated frequency of AM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P02.04	Rated voltage of AM 1	0–1200V	Model depended
P04.00	V/F curve setting of motor 1	0: Straight-line V/F curve 1: Multi-point V/F curve 2: Torque-down V/F curve (power of 1.3) 3: Torque-down V/F curve (power of 1.7) 4: Torque-down V/F curve (power of 2.0) 5: Customized V/F curve (V/F separation):	0
P04.01	Torque boost of motor 1	0.1%–10.0% 0.0%: Automatic	0.0%
P04.02	Torque boost cut-off of motor 1	0.0%–50.0% (of the rated frequency of motor 1)	20.0%
P04.03	V/F frequency point 1 of motor 1	0.00Hz–P04.05	0.00Hz
P04.04	V/F voltage point 1 of motor 1	0.0%–110.0%	0.0%
P04.05	V/F frequency point 2 of motor 1	P04.03–P04.07	0.00Hz
P04.06	V/F voltage point 2 of motor 1	0.0%–110.0%	0.0%
P04.07	V/F frequency point 3 of motor 1	P04.05–P02.02 or P04.05–P02.16	0.00Hz
P04.08	V/F voltage point 3 of motor 1	0.0%–110.0%	0.0%
P04.09	V/F slip compensation gain of motor 1	0.0–200.0%	100.0%
P04.10	Low-frequency oscillation control factor of motor 1	0–100	10
P04.11	High-frequency oscillation control factor of motor 1	0–100	10
P04.12	Oscillation control threshold of motor 1	0.00Hz–P00.03 (Max. output frequency)	30.00Hz
P04.13	V/F curve setting of motor 2	0: Straight-line V/F curve 1: Multi-point V/F curve 2: Torque-down V/F curve (power of 1.3) 3: Torque-down V/F curve (power of 1.7) 4: Torque-down V/F curve (power of 2.0) 5: Customized V/F curve (V/F separation):	0
P04.14	Torque boost of motor 2	0.1%–10.0% 0.0%: Automatic	0.0%
P04.15	Torque boost cut-off of motor 2	0.0%–50.0% (of the rated frequency of motor 2)	20.0%
P04.16	V/F frequency point 1 of motor 2	0.00Hz–P04.18	0.00Hz

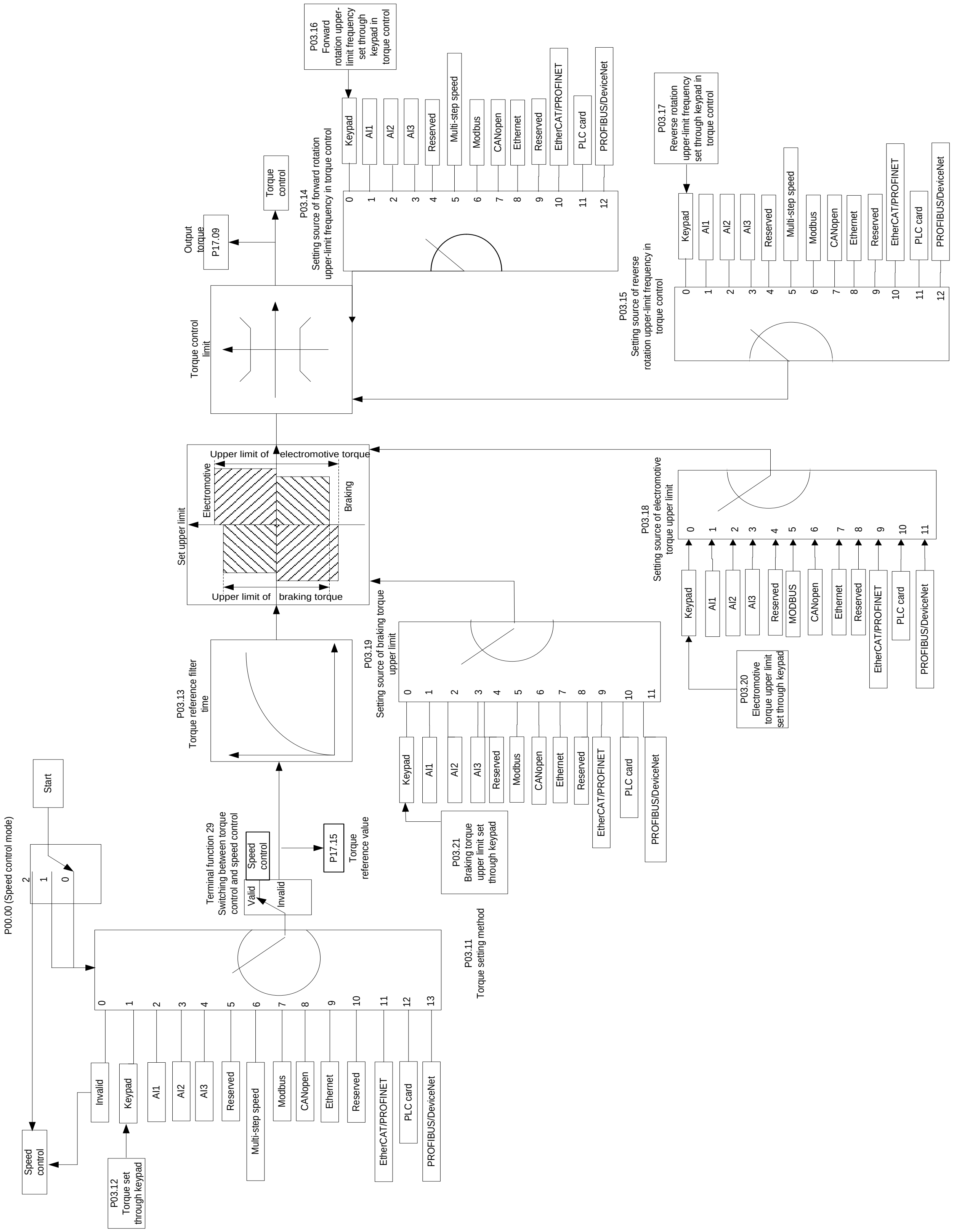
Function code	Name	Description	Default
P04.17	V/F voltage point 1 of motor 2	0.0%–110.0%	0.0%
P04.18	V/F frequency point 2 of motor 2	P04.16– P04.20	0.00Hz
P04.19	V/F voltage point 2 of motor 2	0.0%–110.0%	0.0%
P04.20	V/F frequency point 3 of motor 2	P04.18–P02.02 or P04.18–P02.16	0.00Hz
P04.21	V/F voltage point 3 of motor 2	0.0%–110.0%	0.0%
P04.22	V/F slip compensation gain of motor 2	0.0–200.0%	100.0%
P04.23	Low-frequency oscillation control factor of motor 2	0–100	10
P04.24	High-frequency oscillation control factor of motor 2	0–100	10
P04.25	Oscillation control threshold of motor 2	0.00Hz–P00.03 (Max. output frequency)	30.00Hz
P04.26	Energy-saving run	0: Disable 1: Automatic energy-saving run	0
P04.27	Voltage setting channel	0: Keypad (The output voltage is determined by P04.28.) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step speed running (The setting is determined by group P10.) 6: PID 7: Modbus communication 8: CANopen communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET communication 12: Programmable expansion card 13: PROFIBUS-DP/DeviceNet communication	0
P04.28	Voltage set through keypad	0.0%–100.0% (of the motor rated voltage)	100.0%
P04.29	Voltage increase time	0.0–3600.0s	5.0s
P04.30	Voltage decrease time	0.0–3600.0s	5.0s
P04.31	Max. output voltage	P04.32–100.0% (of the motor rated voltage)	100.0%
P04.32	Min. output voltage	0.0%–P04.31 (Motor rated voltage)	0.0%
P04.34	Injection current 1 in SM V/F control	When the SM VF control mode is enabled, the function parameter is used to set the reactive current of the motor when the output frequency is lower than the frequency specified by P04.36. Setting range: -100.0%–100.0% (of the motor rated current)	20.0%

Function code	Name	Description	Default
P04.35	Injection current 2 in SM V/F control	When the SM VF control mode is enabled, the function parameter is used to set the reactive current of the motor when the output frequency is greater than the frequency specified by P04.36. Setting range: -100.0%–100.0% (of the motor rated current)	10.0%
P04.36	Frequency threshold for injection current switching in SM V/F control	When the SM VF control mode is enabled, the function parameter is used to set the frequency threshold for the switching between pull-in current 1 and pull-in current 2. Setting range: 0.0%–200.0% (of the motor rated frequency)	20.0%
P04.37	Reactive current closed-loop proportional coefficient in SM V/F control	When the SM VF control mode is enabled, the function parameter is used to set the proportional coefficient of reactive current closed-loop control. Setting range: 0–3000	50
P04.38	Reactive current closed-loop integral time in SM V/F control	When the SM VF control mode is enabled, the function parameter is used to set the integral coefficient of reactive current closed-loop control. Setting range: 0–3000	30
P04.39	Reactive current closed-loop output limit in SM VF control	When the SM VF control mode is enabled, the function parameter is used to set the output limit of the reactive current closed-loop control. A greater value indicates a higher reactive closed-loop compensation voltage and higher output power of the motor. In general, you do not need to modify the function code. Setting range: 0–16000	8000
P04.40	Enabling IF mode for AM 1	0: Disable 1: Enable	0
P04.41	Current setting in IF mode for AM 1	When IF control is adopted for AM 1, the function parameter is used to set the output current. The value is a percentage in relative to the rated current of the motor. Setting range: 0.0–200.0%	120.0%
P04.42	Proportional coefficient in IF mode for AM 1	When IF control is adopted for AM 1, the function parameter is used to set the proportional coefficient of the output current closed-loop control. Setting range: 0–5000	650
P04.43	Integral coefficient in IF mode for AM 1	When IF control is adopted for AM 1, the function parameter is used to set the proportional coefficient of the output current closed-loop control. Setting range: 0–5000	350
P04.44	Starting frequency point for switching off IF mode for AM 1	0.00–P04.50	10.00Hz
P04.45	Enabling IF mode for AM 2	0: Disable 1: Enable	0

Function code	Name	Description	Default
P04.46	Current setting in IF mode for AM 2	When IF control is adopted for AM 2, the function parameter is used to set the output current. The value is a percentage in relative to the rated current of the motor. Setting range: 0.0–200.0%	120.0%
P04.47	Proportional coefficient in IF mode for AM 2	When IF control is adopted for AM 2, the function parameter is used to set the output current. The value is a percentage in relative to the rated current of the motor. Setting range: 0–5000	650
P04.48	Integral coefficient in IF mode for AM 2	When IF control is adopted for AM 2, the function parameter is used to set the output current. The value is a percentage in relative to the rated current of the motor. Setting range: 0–5000	350
P04.49	Starting frequency point for switching off IF mode for AM 2	0.00–P04.51	10.00Hz
P04.50	End frequency point for switching off IF mode for AM 1	P04.44–P00.03	25.00Hz
P04.51	End frequency point for switching off IF mode for AM 2	P04.49–P00.03	25.00Hz

5.6.5 Torque control

The inverter unit supports torque control and speed control. Speed control aims to stabilize the speed to keep the set speed consistent with the actual running speed, meanwhile, the max. load-carrying capacity is restricted by the torque limit. Torque control aims to stabilize the torque to keep the set torque consistent with the actual output torque, meanwhile, the output frequency is restricted by the upper and lower limits.


P03.16
Forward rotation upper-limit frequency set through keypad in torque control
P03.14
Setting source of forward rotation upper-limit frequency in torque control
Keypad
AI1
AI2
AI3
Reserved
Multi-step speed
Modbus
CANopen
Ethernet
Reserved
EtherCAT/PROFINET
PLC card
PROFIBUS/DeviceNet
Torque control
Output torque
P17.09
Torque control limit
P03.17
Reverse rotation upper-limit frequency set through keypad in torque control
P03.15
Setting source of reverse rotation upper-limit frequency in torque control
Set upper limit
Upper limit of electromotive torque
Electromotive
Braking
Upper limit of braking torque
P03.18
Setting source of electromotive torque upper limit
MODBUS
P03.20
Electromotive torque upper limit set through keypad
P03.19
Setting source of braking torque upper limit
P03.21
Braking torque upper limit set through keypad
P03.13
Torque reference filter time
Start
P00.00 (Speed control mode)
Terminal function 29
Switching between torque control and speed control
Valid
Invalid
Speed control
P17.15
Torque reference value
P03.11
Torque setting method
Invalid
Speed control
P03.12
Torque set through keypad

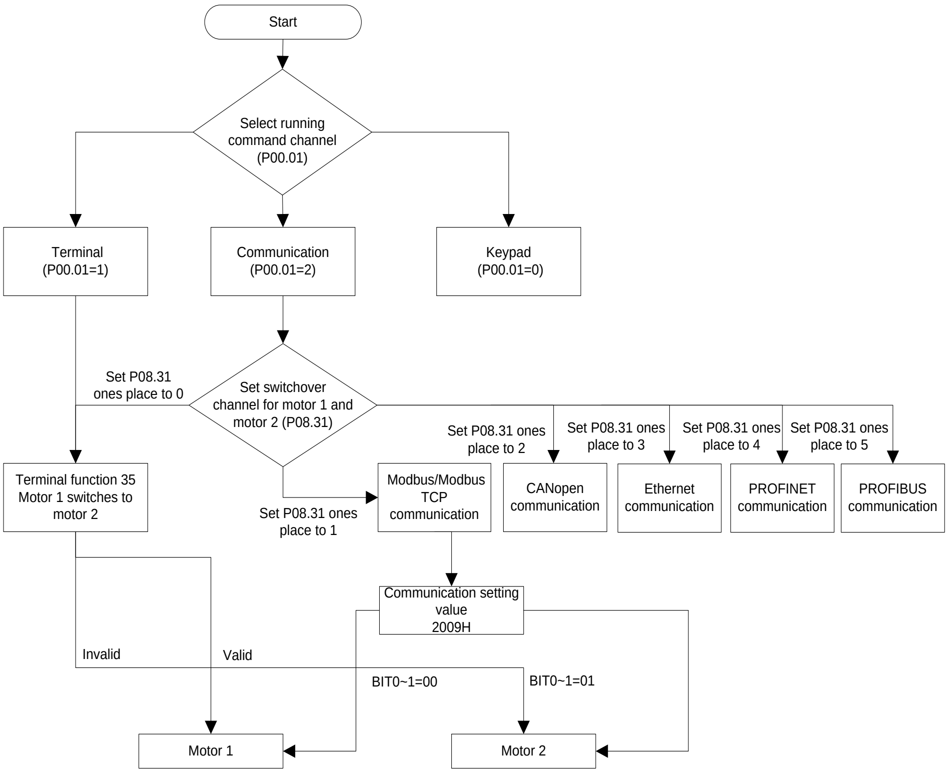
Function code	Name	Description	Default
P00.00	Speed control mode	0: Sensorless vector control (SVC) mode 0 1: Sensorless vector control (SVC) mode 1 2: Space voltage vector control mode 3: Closed-loop vector control mode **Note: Before using a vector control mode (0, 1, or 3), enable the inverter unit to perform motor parameter autotuning first.**	2
P03.11	Torque setting method	0: Keypad (P03.12) 1: Keypad (P03.12) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-step torque 7: Modbus communication 8: CANopen communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET communication 12: Programmable expansion card 13: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	0
P03.12	Torque set through keypad	-300.0%–300.0% (of the motor rated current)	50.0%
P03.13	Torque reference filter time	0.000–10.000s	0.010s
P03.14	Setting source of forward rotation upper-limit frequency in torque control	0: Keypad (P03.16) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step setting 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the max. frequency.**	0
P03.15	Setting source of reverse rotation upper-limit frequency in torque control	0: Keypad (P03.17) 1–12: Same as those for P03.14	0
P03.16	Forward rotation upper-limit frequency set through keypad in torque control	0.00Hz–P00.03 (Max. output frequency)	50.00Hz

Function code	Name	Description	Default
P03.17	Reverse rotation upper-limit frequency set through keypad in torque control	0.00Hz–P00.03 (Max. output frequency)	50.00Hz
P03.18	Setting source of electromotive torque upper limit	0: Keypad (P03.20) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved 9: EtherCAT/PROFINET communication 10: PLC 11: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	0
P03.19	Setting source of braking torque upper limit	0: Keypad (P03.21) 1–11: Same as those for P03.18	0
P03.20	Electromotive torque upper limit set through keypad	0.0–300.0% (of the motor rated current)	180.0%
P03.21	Braking torque upper limit set through keypad	0.0–300.0% (of the motor rated current)	180.0%
P03.32	Enabling torque control	0: Disable 1: Enable	0
P17.09	Output torque	-250.0–250.0%	0.0%
P17.15	Torque reference value	-300.0–300.0% (of the motor rated current)	0.0%

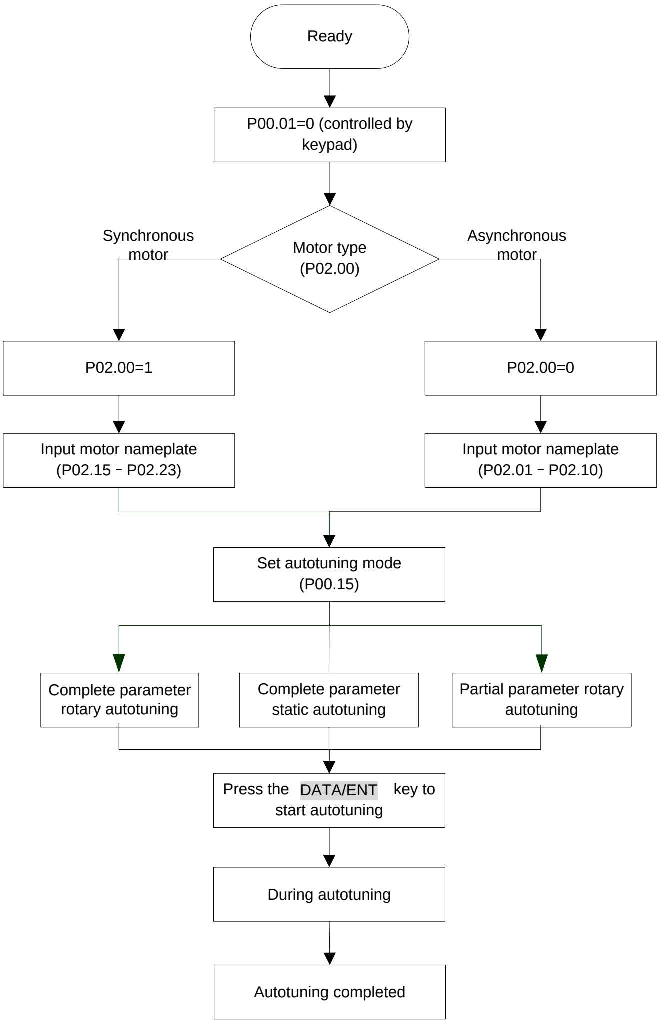
5.6.6 Motor parameter autotuning

	• Check the safety conditions surrounding the motor and load machineries before autotuning as physical injury may occur due to sudden start of motor during autotuning. • Although the motor does not run during static autotuning, the motor is still supplied with power. Do not touch the motor during autotuning; otherwise, electric shock may occur. Do not touch the motor before autotuning is completed.
	If the motor has been connected to a load, do not carry out rotary autotuning. Otherwise, the inverter unit may malfunction or mechanical device may be damaged. If rotary autotuning is carried out on a motor which has been connected to a load, incorrect motor parameter settings and motor action exceptions may occur. Disconnect from the load to carry out autotuning if necessary.

The inverter unit can drive both asynchronous motors and synchronous motors, and it supports two sets of motor parameters, which can be switched over by multifunction digital input terminals or communication modes.



The control performance of the inverter unit is based on accurate motor models. Therefore, you need to carry out motor parameter autotuning before running a motor for the first time (taking motor 1 as an example).



Note:

- Motor parameters must be set correctly according to the motor nameplate.
- After entering P00.15, you can press the DATA/ENT key to enter autotuning and press the PRG/ESC key to exit autotuning, since the inverter unit keypad does not have the RUN or STOP key.
- If rotary autotuning is selected during motor autotuning, disconnect the motor from the load to put the motor in static and no-load state. Otherwise, the motor parameter autotuning results may be incorrect. In this situation, P02.06–P02.10 can be autotuned for AMs, and P02.20–P02.23 can be autotuned for SMs.
- If static autotuning is selected for motor autotuning, there is no need to disconnect the motor from the load, but the control performance may be impacted as only a part of the motor parameters have been autotuned. In this situation, P02.06–P02.10 can be autotuned for AMs, P02.20–P02.22 can be autotuned for SMs, and P02.23 (counter-emf constant of SM 1) can be obtained through calculation.
- Motor autotuning can be carried out on the present motor only. If you need to perform autotuning on another motor, switch the motor by selecting the switch-over channel of motor 1 and motor 2 by setting the ones place of P08.31.

Related parameter list:

Function code	Name	Description	Default
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0
P00.15	Motor parameter autotuning	0: No operation 1: Rotary autotuning 1. Comprehensive motor parameter autotuning. It is recommended to use rotating autotuning when high control accuracy is needed. 2: Static autotuning 1 (comprehensive autotuning); static autotuning 1 is used in cases where the motor cannot be disconnected from load. 3: Static autotuning 2 (partial autotuning); when the present motor is motor 1, only P02.06, P02.07 and P02.08 are autotuned; when the present motor is motor 2, only P12.06, P12.07 and P12.08 are autotuned. 4: Rotary autotuning 2, which is similar to rotary autotuning 1 but only valid for AMs. 5: Static autotuning 3 (partial autotuning), which is valid only for AMs.	0
P02.00	Type of motor 1	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0
P02.01	Rated power of AM 1	0.1–3000.0kW	Model depended
P02.02	Rated frequency of AM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P02.03	Rated speed of AM 1	1–60000rpm	Model depended
P02.04	Rated voltage of AM 1	0–1200V	Model depended
P02.05	Rated current of AM 1	0.8–6000.0A	Model depended

Function code	Name	Description	Default
P02.06	Stator resistance of AM 1	0.001–65.535Ω	Model depended
P02.07	Rotor resistance of AM 1	0.001–65.535Ω	Model depended
P02.08	Leakage inductance of AM 1	0.1–6553.5mH	Model depended
P02.09	Mutual inductance of AM 1	0.1–6553.5mH	Model depended
P02.10	No-load current of AM 1	0.1–6553.5A	Model depended
P02.15	Rated power of SM 1	0.1–3000.0kW	Model depended
P02.16	Rated frequency of SM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P02.17	Number of pole pairs of SM 1	1–50	2
P02.18	Rated voltage of SM 1	0–1200V	Model depended
P02.19	Rated current of SM 1	0.8–6000.0A	Model depended
P02.20	Stator resistance of SM 1	0.001–65.535Ω	Model depended
P02.21	Direct-axis inductance of SM 1	0.01–655.35mH	Model depended
P02.22	Quadrature-axis inductance of SM 1	0.01–655.35mH	Model depended
P02.23	Counter-emf constant of SM 1	0–10000	300
P05.01–P05.04	Multifunction digital input terminal (S1–S4) function selection	35: Switch from motor 1 to motor 2	/
P08.31	Switching between motor 1 and motor 2	0x00–0x14 Ones place: Switchover channel 0: Terminal 1: Modbus communication 2: CANopen communication 3: Ethernet communication 4: PROFINET communication 5: PROFIBUS communication Tens place: indicates whether to enable switchover during running 0: Disable 1: Enable	00
P12.00	Type of motor 2	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0
P12.01	Rated power of AM 2	0.1–3000.0kW	Model depended
P12.02	Rated frequency of AM 2	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P12.03	Rated speed of AM 2	1–60000rpm	Model depended

Function code	Name	Description	Default
P12.04	Rated voltage of AM 2	0–1200V	Model depended
P12.05	Rated current of AM 2	0.8–6000.0A	Model depended
P12.06	Stator resistance of AM 2	0.001–65.535Ω	Model depended
P12.07	Rotor resistance of AM 2	0.001–65.535Ω	Model depended
P12.08	Leakage inductance of AM 2	0.1–6553.5mH	Model depended
P12.09	Mutual inductance of AM 2	0.1–6553.5mH	Model depended
P12.10	No-load current of AM 2	0.1–6553.5A	Model depended
P12.15	Rated power of SM 2	0.1–3000.0kW	Model depended
P12.16	Rated frequency of SM 2	0.01Hz–P00.03 (Max. output frequency)	50.00Hz
P12.17	Number of pole pairs of SM 2	1–50	2
P12.18	Rated voltage of SM 2	0–1200V	Model depended
P12.19	Rated current of SM 2	0.8–6000.0A	Model depended
P12.20	Stator resistance of SM 2	0.001–65.535Ω	Model depended
P12.21	Direct-axis inductance of SM 2	0.01–655.35mH	Model depended
P12.22	Quadrature-axis inductance of SM 2	0.01–655.35mH	Model depended
P12.23	Counter-emf constant of SM 2	0–10000	300

5.6.7 Start/stop control

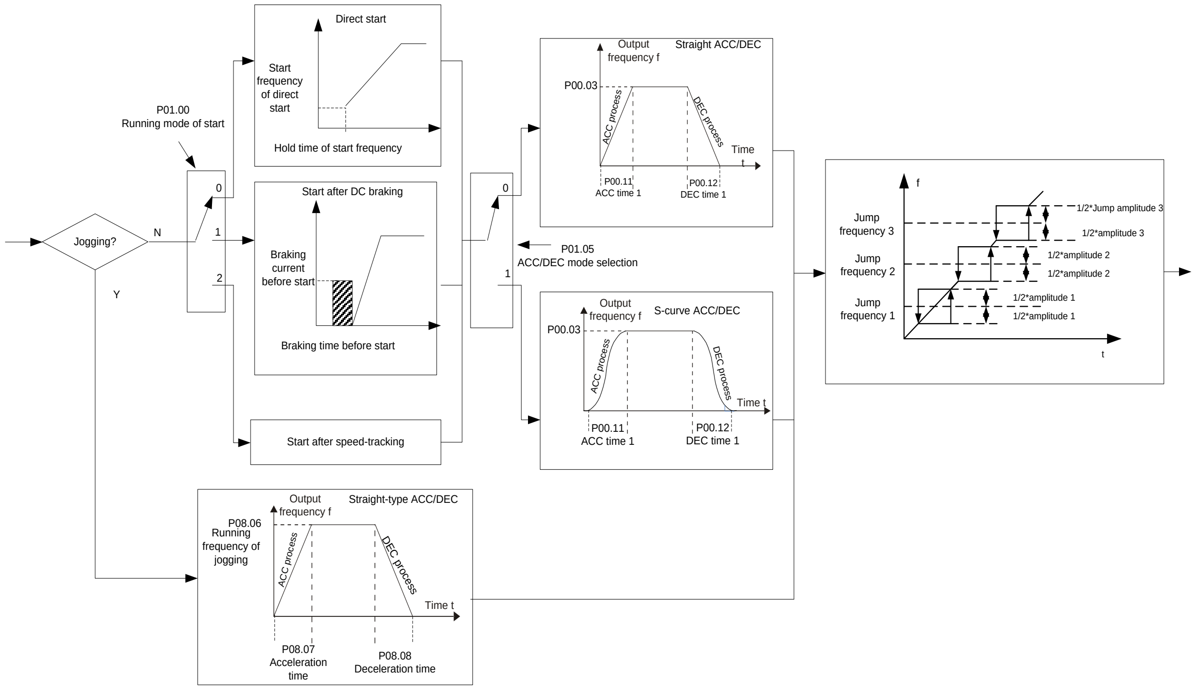
The start/stop control of the inverter unit involves three states: start after a running command is given at power-on; start after power-off restart is effective; start after automatic fault reset. The three start/stop control states are described in the following.

There are three start modes for the inverter unit, which are start at starting frequency, start after DC braking, and start after speed tracking. You can select the proper start mode based on actual conditions.

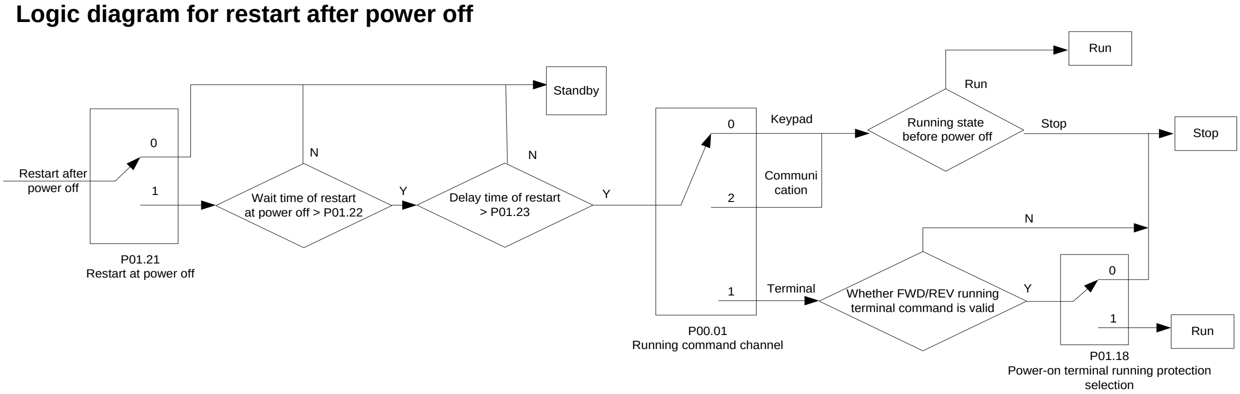
For large-inertia load, especially in cases where reversal may occur, you can choose to start after DC braking or start after speed tracking.

Note: It is recommended to drive SMs in direct start mode.

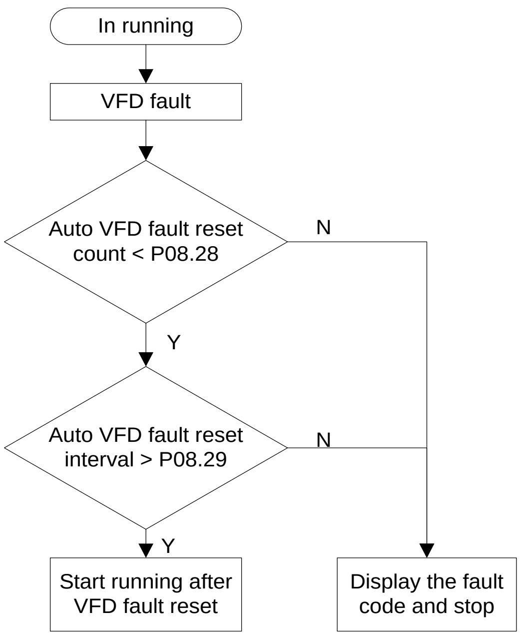
1. Logic diagram for start after a running command is given at power-on



2. Logic diagram for restart after power off



3. Logic diagram for restart after automatic fault reset



Related parameter list:

Function code	Name	Description	Default
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0
P00.11	ACC time 1	0.0–3600.0s	Model depended
P00.12	DEC time 1	0.0–3600.0s	Model depended
P01.00	Start mode	0: Direct start 1: Start after DC braking 2: Speed tracking restart 1 3: Speed tracking restart 2	0
P01.01	Starting frequency of direct start	0.00–50.00Hz	0.50Hz
P01.02	Starting frequency hold time	0.0–50.0s	0.0s
P01.03	Braking current before start	0.0–100.0%	0.0%
P01.04	DC braking time before start	0.00–50.00s	0.00s
P01.05	ACC and DEC mode	0: Linear 1: S curve **Note: If mode 1 is selected, set P01.06, P01.07, P01.27 and P01.08 accordingly.**	0
P01.08	Stop mode	0: Decelerate to stop 1: Coast to stop	0
P01.09	Starting frequency of DC braking for stop	0.00Hz–P00.03 (Max. output frequency)	0.00Hz
P01.10	Wait time before DC braking for stop	0.00–50.00s	0.00s
P01.11	DC braking current for stop	0.0–100.0%	0.0%
P01.12	DC braking time for stop	0.00–50.00s	0.00s
P01.13	FWD/REV running deadzone time	0.0–3600.0s	0.0s
P01.14	FWD/REV running switching mode	0: Switch at zero frequency 1: Switch at the starting frequency 2: Switch after the speed reaches the stop speed with a delay	0
P01.15	Stop speed	0.00–100.00Hz	0.50 Hz
P01.16	Stop speed detection mode	0: Detect by the set speed (unique in space voltage vector control mode) 1: Detect by the feedback speed	1
P01.18	Terminal-based running command protection at power-on	0: The terminal running command is invalid at power-on 1: The terminal running command is valid at power-on	0
P01.19	Action selected when running frequency less than frequency lower limit (valid when frequency lower limit greater than 0)	Ones place: 0: Run at the frequency lower limit 1: Stop 2: Sleep Tens place (Valid when 1 or 2 is selected for ones place):	0

Function code	Name	Description	Default
		0: Coast to stop 1: Decelerate to stop	
P01.20	Wake-up-from-sleep delay	0.0–3600.0s (Valid only when the ones place of P01.19=2)	0.0s
P01.21	Power-off restart selection	0: Disable 1: Enable	0
P01.22	Wait time for restart after power-off	0.0–3600.0s (Valid only when P01.21=1)	1.0s
P01.23	Start delay	0.0–60.0s	0.0s
P01.24	Stop speed delay	0.0–100.0s	0.0s
P01.25	Open-loop 0Hz output selection	0: Output without voltage 1: Output with voltage 2: Output with the DC braking current for stop	0
P01.26	DEC time for emergency stop	0.0–60.0s	2.0s
P01.27	Time of starting segment of DEC S curve	0.0–50.0s	0.1s
P01.28	Time of ending segment of DEC S curve	0.0–50.0s	0.1s
P01.29	Short-circuit braking current	0.0–150.0% (of the inverter unit reated current)	0.0%
P01.30	Hold time of short-circuit braking for start	0.00–50.00s	0.00s
P01.31	Hold time of short-circuit braking for stop	0.00–50.00s	0.00s
P01.32	Pre-exciting time for jogging	0–10.000s	0.000s
P01.33	Starting frequency of braking for stop in jogging	0–P00.03	0.00Hz
P01.34	Sleep delay	0–3600.0s	0.0s
P05.01–P05.04	Digital input function selection	1: Run forward 2: Run reversely 4: Jog forward 5: Jog reversely 6: Coast to stop 7: Reset faults 8: Pause running 21: ACC/DEC time selection 1 22: ACC/DEC time selection 2 30: Disable ACC/DEC	/
P08.00	ACC time 2	0.0–3600.0s	Model depended
P08.01	DEC time 2	0.0–3600.0s	Model depended
P08.02	ACC time 3	0.0–3600.0s	Model depended
P08.03	DEC time 3	0.0–3600.0s	Model depended

Function code	Name	Description	Default
P08.04	ACC time 4	0.0–3600.0s	Model depended
P08.05	DEC time 4	0.0–3600.0s	Model depended
P08.06	Running frequency of jog	0.00Hz–P00.03 (Max. output frequency)	5.00Hz
P08.07	ACC time for jogging	0.0–3600.0s	Model depended
P08.08	DEC time for jogging	0.0–3600.0s	Model depended
P08.19	Switching frequency of ACC/DEC time	0.00–P00.03 (Max. frequency) 0.00Hz: No switchover If the running frequency is greater than P08.19, switch to ACC/DEC time 2.	0
P08.21	Reference frequency of ACC/DEC time	0: Max. output frequency 1: Set frequency 2: 100Hz Note: Valid only for straight-line ACC/DEC	0
P08.28	Auto fault reset count	0–10	0
P08.29	Auto fault reset interval	0.1–3600.0s	1.0s

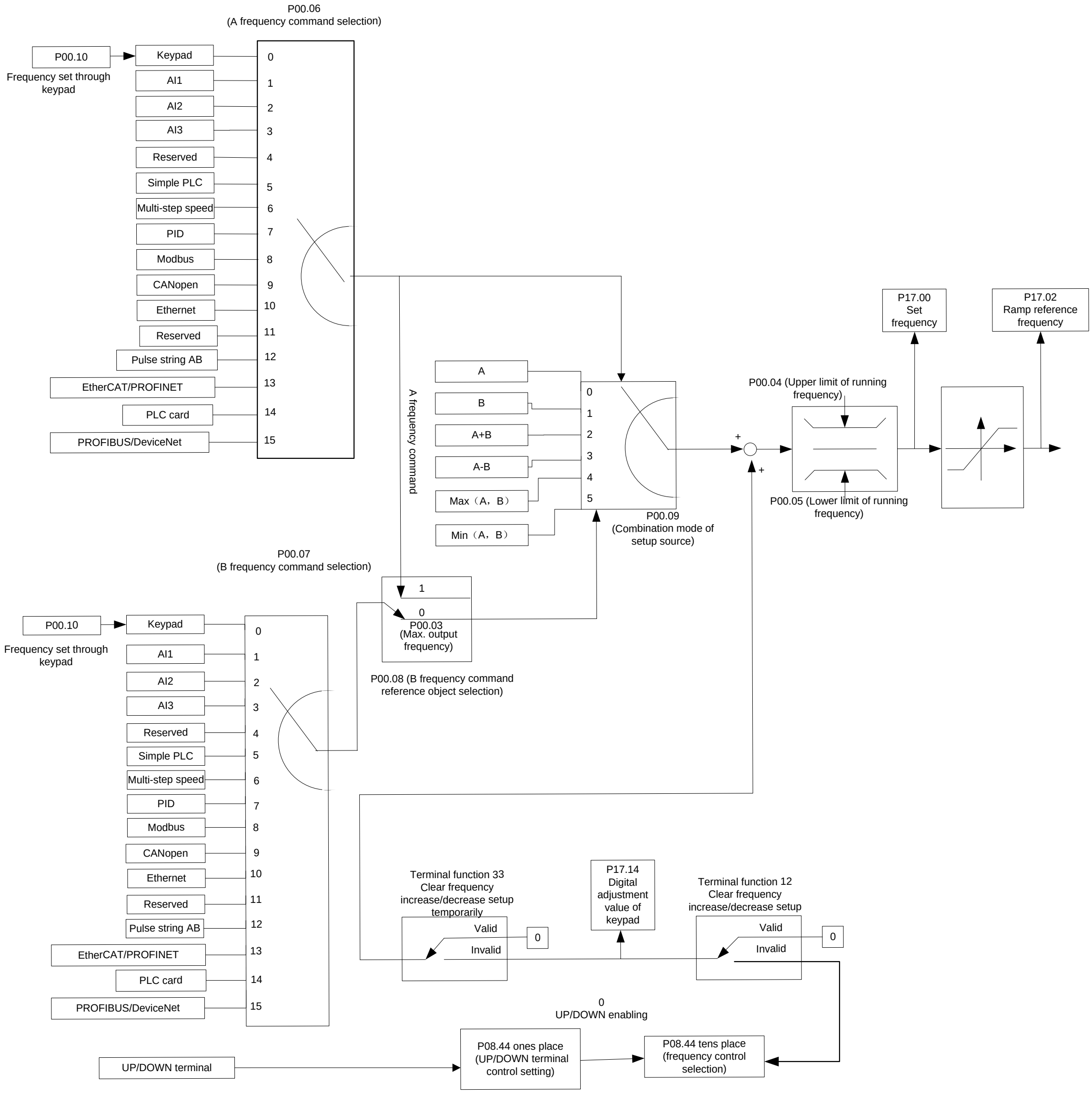
5.6.8 Frequency setting

The inverter unit supports multiple types of frequency reference modes, which can be categorized into: main reference channel and auxiliary reference channel.

There are two main reference channels, namely frequency reference channel A and frequency reference channel B. These two channels support simple arithmetical operation between each other, and they can be switched dynamically by setting multi-function terminals.

There is one input mode for auxiliary reference channel, namely terminal UP/DOWN switch input. By setting function codes, you can enable the corresponding reference mode and the impact made on the inverter frequency reference by this reference mode.

The actual reference of the inverter unit is comprised of the main reference channel and auxiliary reference channel.

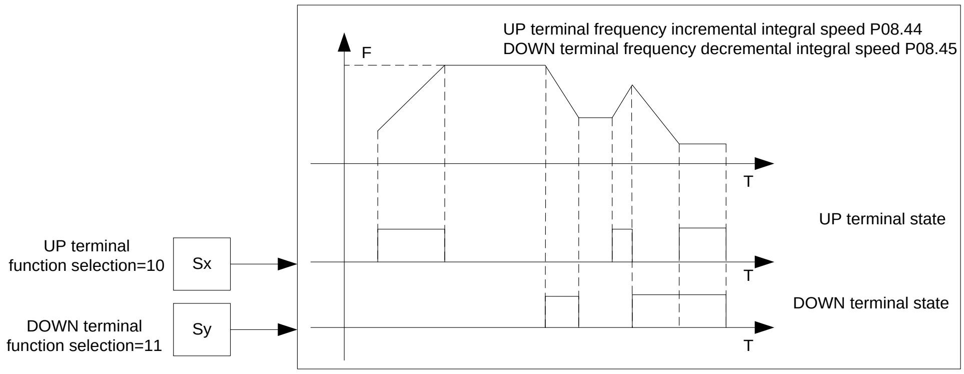


The inverter unit supports switchover between different reference channels, and the rules for channel switchover are shown in the following.

Present reference channel P00.09	Multifunction terminal function 13 (Switch from channel A to channel B)	Multifunction terminal function 14 (Switch from combined setting to channel A)	Multifunction terminal function 15 (Switch from combined setting to channel B)
A	B	/	/
B	A	/	/
A+B	/	A	B
A-B	/	A	B
Max (A,B)	/	A	B
Min (A,B)	/	A	B

Note: "/" indicates this multi-function terminal is invalid under present reference channel.

When setting the auxiliary frequency inside the inverter unit through multi-function terminal UP (10) and DOWN (11), you can increase/decrease the frequency quickly by setting P08.44 (UP terminal frequency incremental change rate) and P08.45 (DOWN terminal frequency decremental change rate).



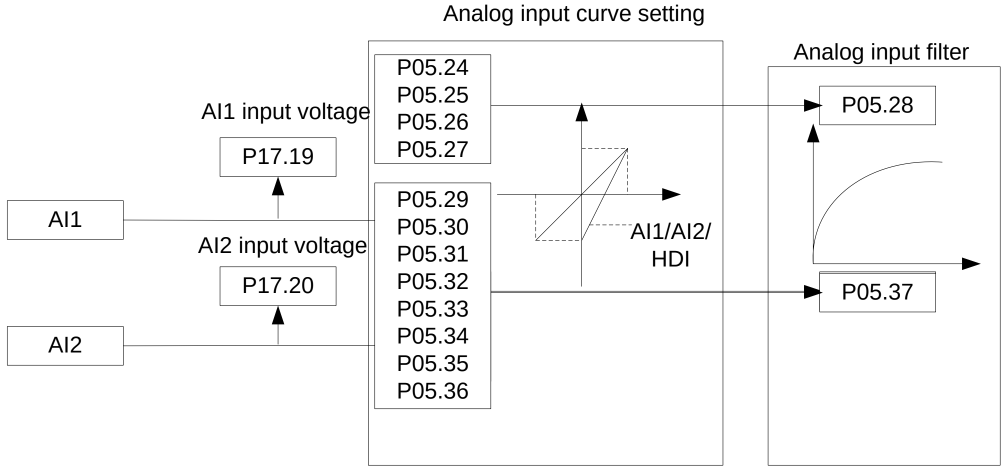
Related parameter list:

Function code	Name	Description	Default
P00.03	Max. output frequency	P00.04–400.00Hz	50.00Hz
P00.04	Upper limit of running frequency	P00.05–P00.03	50.00Hz
P00.05	Lower limit of running frequency	0.00Hz–P00.04	0.00Hz
P00.06	Setting channel of A frequency command	0: Keypad 1: AI1 2: AI2 3: AI3 4: Reserved 5: Simple PLC program 6: Multi-step speed running 7: PID control 8: Modbus communication 9: CANopen communication 10: Ethernet communication 11: Reserved 12: Pulse train AB 13: EtherCAT/PROFINET communication 14: Programmable expansion card 15: PROFIBUS-DP/DeviceNet communication	0
P00.07	Setting channel of B frequency command		15
P00.08	Reference object of B frequency command	0: Max. output frequency 1: A frequency command	0
P00.09	Combination mode of setting source	0: A 1: B 2: (A+B) 3: (A- B) 4: Max(A, B) 5: Min. (A, B)	0
P05.01–P05.04	Multifunction digital input terminal (S1–S4) function selection	10: Increase frequency setting (UP) 11: Decrease frequency setting (DOWN) 12: Clear the frequency increase/decrease setting 13: Switch between A setting and B setting	/

Function code	Name	Description	Default
		14: Switch between combination setting and A setting 15: Switch between combination setting and B setting	
P08.44	UP/DOWN terminal control setting	0x000–0x221 Ones place: Frequency setting selection 0: The setting made through UP/DOWN is valid. 1: The setting made through UP/DOWN is invalid. Ones place: Frequency control selection 0: Valid only when P00.06=0 or P00.07=0 1: Valid for all frequency setting methods 2: Invalid for multi-step speed running when multi-step speed running has the priority Hundreds place: Action selection for stop 0: Setting is valid. 1: Valid during running, cleared after stop 2: Valid during running, cleared after a stop command is received	0x000
P08.45	Frequency increment change rate of the UP terminal	0.01–50.00 Hz/s	0.50 Hz/s
P08.46	Frequency reduce rate of the DOWN terminal	0.01–50.00 Hz/s	0.50 Hz/s
P17.00	Set frequency	0.00Hz–P00.03 (Max. output frequency)	0.00Hz
P17.02	Ramp reference frequency	0.00Hz–P00.03 (Max. output frequency)	0.00Hz
P17.14	Digital adjustment value	0.00Hz–P00.03	0.00Hz

5.6.9 Analog input

The inverter unit carries two analog input terminals, in which AI1 is 0(2)–10V/0(4)–20mA and whether AI1 uses voltage input or current input can be set by P05.50, and AI2 is -10–10V. Each input can be filtered separately, and the corresponding reference curve can be set by adjusting the reference corresponds to the max. value and min. value.

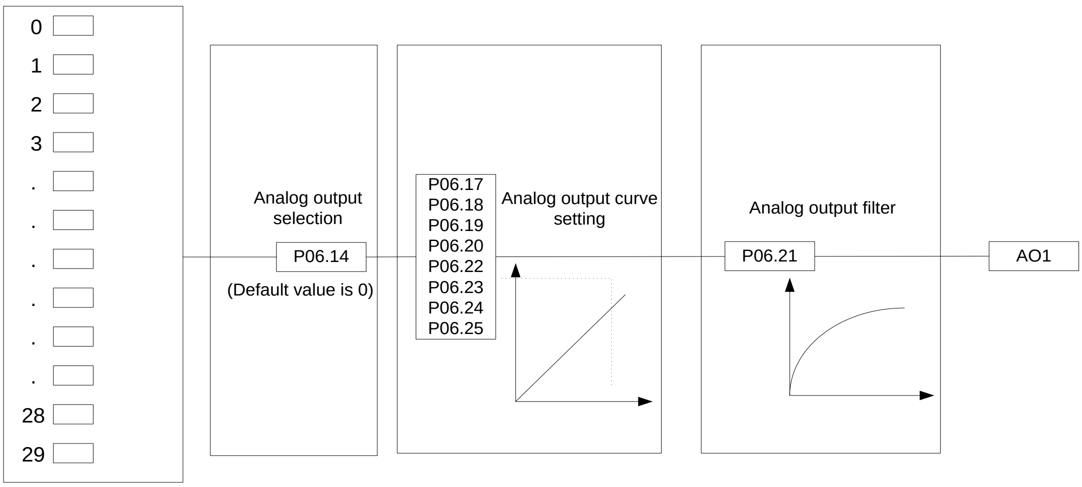


Related parameter list:

Function code	Name	Description	Default
P05.24	AI1 lower limit	0.00V–P05.26	0.00V
P05.25	Corresponding setting of AI1 lower limit	-300.0%–300.0%	0.0%
P05.26	AI1 upper limit	P05.24–10.00V	10.00V
P05.27	Corresponding setting of AI1 upper limit	-300.0%–300.0%	100.0%
P05.28	AI1 input filter time	0.000s–10.000s	0.100s
P05.29	AI2 lower limit	-10.00V–P05.31	-10.00V
P05.30	Corresponding setting of AI2 lower limit	-300.0%–300.0%	-100.0%
P05.31	AI2 middle value 1	P05.29–P05.33	0.00V
P05.32	Corresponding setting of AI2 middle value 1	-300.0%–300.0%	0.0%
P05.33	AI2 middle value 2	P05.31–P05.35	0.00V
P05.34	Corresponding setting of AI2 middle value 2	-300.0%–300.0%	0.0%
P05.35	AI2 upper limit	P05.33–10.00V	10.00V
P05.36	Corresponding setting of AI2 upper limit	-300.0%–300.0%	100.0%
P05.37	AI2 input filter time	0.000s–10.000s	0.100s
P05.50	AI1 input signal type	0–1 0: Voltage 1: Current	0

5.6.10 Analog output

The inverter unit carries one analog output terminal, of which the setting range is 0(2)–10V/0(4)–20mA. Analog output can be configured as voltage or current signals through setting P06.32. Analog output signals can be filtered separately, and the proportional relation can be adjusted by setting the max. value, min. value, and the percentage of their corresponding output. Analog output signal can output motor speed, output frequency, output current, motor torque and motor power at a certain proportion.



AO output relationship description:

(The min. value and max. value of the output correspond to 0.% and 100.00% of the pulse or analog default output. The actual output voltage or pulse frequency corresponds to the actual percentage, which can be set through function codes.)

Setting	Function	Description
0	Running frequency	0–Max. output frequency
1	Set frequency	0–Max. output frequency
2	Ramp reference frequency	0–Max. output frequency
3	Running speed	0–Synchronous speed corresponding to max. output frequency
4	Output current (relative to the inverter unit)	0–Twice the inverter unit rated current
5	Output current (relative to motor)	0–wice the motor rated current
6	Output voltage	0–1.5 times the inverter unit rated voltage
7	Output power	0–Twice the motor rated power
8	Set torque value (bipolar)	0–Twice the motor rated current. A negative value corresponds to 0.0% by default.
9	Output torque (absolute value)	0–±(Twice the motor rated torque)
10	AI1 input	0(2)–10V/0(4)–20mA
11	AI2 input	0V–10V. A negative value corresponds to 0.0% by default.
12	AI3 input	0(2)–10V/0(4)–20mA
13	Reserved	
14	Value 1 set through Modbus communication	0–1000
15	Value 2 set through Modbus communication	0–1000
16	Value 1 set through PROFIBUS-DP/DeviceNet communication	0–1000
17	Value 2 set through PROFIBUS-DP/DeviceNet communication	0–1000
18	Value 1 set through Ethernet communication	0–1000
19	Value 2 set through Ethernet communication	0–1000
20	Reserved	
21	Value 1 set through EtherCAT/PROFINET communication	0–1000. A negative value corresponds to 0.0% by default.
22	Torque current (bipolar)	0–Triple the motor rated current. A negative value corresponds to 0.0% by default.
23	Exciting current	0–Triple the motor rated current. A negative value corresponds to 0.0% by default.
24	Set frequency (bipolar)	0–Max. output frequency. A negative value corresponds to 0.0% by default.
25	Ramp reference frequency (bipolar)	0–Max. output frequency. A negative value corresponds to 0.0% by default.

Setting	Function	Description
26	Rotational speed (bipolar)	0–Synchronous speed corresponding to max. output frequency. A negative value corresponds to 0.0% by default.
27	Value 2 set through EtherCAT/PROFINET communication	0–1000
28	C_AO1 from the PLC	0–1000
29	C_AO2 from the PLC	0–1000
30	Running speed	0–Twice the motor rated synchronous speed.
31	Output torque (bipolar)	0–Twice the motor rated torque. A negative value corresponds to 0.0% by default.
32	Value 1 set through CANopen communication	0–1000
33	Value 2 set through CANopen communication	0–1000
34-47	Reserved	/

Related parameter list:

Function code	Name	Description	Default
P06.14	AO1 output	0: Running frequency (0–Max. output frequency) 1: Set frequency (0–Max. output frequency) 2: Ramp reference frequency (0–Max. output frequency) 3: Rotational speed (0–Speed corresponding to max. output frequency) 4: Output current (0–Twice the inverter unit rated current) 5: Output current (0–Twice the motor rated current) 6: Output voltage (0–1.5 times the inverter unit rated voltage) 7: Output power (0–Twice the motor rated power) 8: Set torque (0–Twice the motor rated torque) 9: Output torque (Absolute value, 0–±Twice the motor rated torque) 10: AI1 input (0(2)–10V/0(4)–20mA) 11: AI2 input (0–10V) 12: AI3 input (0(2)–10V/0(4)–20mA) 13: Reserved 14: Value 1 set through Modbus communication (0–1000) 15: Value 2 set through Modbus communication (0–1000) 16: Value 1 set through PROFIBUS-DP/DeviceNet communication (0–1000) 17: Value 2 set through PROFIBUS-DP/DeviceNet communication (0–1000) 18: Value 1 set through Ethernet communication (0–1000) 19: Value 2 set through Ethernet communication (0–1000) 20: Reserved 21: Value 1 set through EtherCAT/PROFINET communication (0–1000) 22: Torque current (bipolar, 0–Triple the motor rated	0
P06.15	Reserved		0
P06.16	Reserved		0

Function code	Name	Description	Default
		current) 23: Exciting current (bipolar, 0–Triple the motor rated current) 24: Set frequency (bipolar, 0–Max. output frequency) 25: Ramp reference frequency (bipolar, 0–Max. output frequency) 26: Rotational speed (bipolar, 0–Speed corresponding to max. output 27: Value 2 set through EtherCAT/PROFINET communication (0–1000) 28: C_AO1 (Set P27.00 to 1. 0–1000) 29: C_AO2 (Set P27.00 to 1. 0–1000) 30: Rotational speed (0–Twice the motor rated synchronous speed) 31: Output torque (Actual value, 0–Twice the motor rated torque) 32: Value 1 set through CANopen communication (0–1000) 33: Value 2 set through CANopen communication (0–1000) 34–47: Reserved	
P06.17	Voltage-type AO1 output lower limit	-300.0%–P06.19	0.0%
P06.18	AO1 output corresponding to lower limit	0.00V–10.00V	0.00V
P06.19	Voltage-type AO1 output upper limit	P06.17–300.0%	100.0%
P06.20	AO1 output corresponding to upper limit	0.00V–10.00V	10.00V
P06.21	AO1 output filter time	0.000s–10.000s	0.000s
P06.22	Current-type AO1 output lower limit	-300.0%–P06.24	0.0%
P06.23	AO1 output corresponding to lower limit (current type)	0.00mA–20.00mA	0.00–10.00
P06.24	AO1 output upper limit (current type)	P06.22–300.0%	P06.16-100.0
P06.25	AO1 output corresponding to upper limit (current type)	0.00mA–20.00 mA	0.00–20.00
P06.32	AO1 output signal type	0–1 0: Voltage 1: Current	0–1

5.6.11 Motor temperature detection

5.6.11.1 By using an expansion card

Both the VFD IO expansion card (EC-IO702) and 24V simplified incremental PG card (EC-PG707-24) have the temperature sampling module. EC-IO702 supports the connection to temperature sensors of PT100, PT1000, KTY84, and NTC, while EC-PG707-24 supports the connection to temperature sensors of PT100, PT1000, and KTY84. Regardless of which temperature sensors are used, the wiring of the motor temperature detection sensors is the same. The following uses EC-IO702 as an example to describe the wiring method and setting.

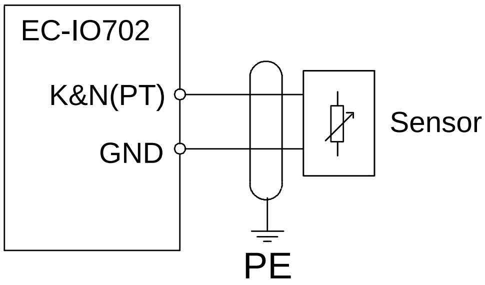


Figure 5-6 Temperature sensor wiring for the IO expansion card

After installing the I/O expansion card to the inverter unit, you can wire the temperature sensor according to the preceding figure. Then set P28.16 (Type of sensor for IO card to detect motor temperature), set P28.17–P28.19 (that is, set IO card detected motor OH protection threshold, Detection time of IO card detected motor OH protection, and Detection time of IO card detected motor OH protection), and set P28.11 (Action to protect against motor overheating during running). If you select a temperature sensor of the NTC type, you need to set B25/85 (P28.20).

Related function parameters:

Function code	Name	Description	Default
P19.12	PG card detected motor temperature	-20.0–175.0°C	0.0°C
P19.13	IO card detected motor temperature	-20.0–175.0°C	0.0°C
P28.11	Action to protect against motor overheating during running	0x00–0x11 Ones place: When the PG card detects overheating 0: Coast to stop 1: Keep running Tens place: When the IO card detects overheating 0: Coast to stop 1: Keep running **Note: The function code is applicable only to temperature detection on the motor in running. If overheating is detected on a stopped motor, a fault is reported.**	0x00
P28.12	Type of sensor for PG card to detect motor temperature	0: No temperature sensor 1: PT100 2: PT1000 3: KTY84	0
P28.13	PG card detected motor OH protection threshold	-20.0–200.0°C	110.0℃

Function code	Name	Description	Default
P28.14	Detection time of PG card detected motor OH protection	0.1–3600.0s	5.0s
P28.15	PG card detected motor OH pre-alarm threshold	-20.0–200.0°C	90.0°C
P28.16	Type of sensor for IO card to detect motor temperature	0: No temperature sensor 1: PT100 2: PT1000 3: KTY84 4: 5K NTC temperature sensor 5: 10K NTC temperature sensor	0
P28.17	IO card detected motor OH protection threshold	-20.0–200.0°C	110.0℃
P28.18	Detection time of IO card detected motor OH protection	0.1–3600.0s	5.0s
P28.19	IO card detected motor OH pre-alarm threshold	-20.0–200.0°C The pre-alarm indicator blinks.	90.0°C
P28.20	B25/85 value of NTC sensor for IO card	0–6000K	0
P28.21	NTC temperature calibration coefficient	0.00–2.00	1.00

5.6.11.2 By using AI/AO

The function of using AI/AO to detect motor temperature supports the use of PT100, PT1000, and KTY84. The wiring can be selected from AI1/AO1 or AI2/AO1 combinations. The following uses the AI1/AO1 combination as an example.

First, you need to set the AI1 input type to voltage (that is, set P05.50 to 0) and set AO1 output type to current (that is, set P06.32 to 1).

During wiring, connect the temperature sensor (thermistor) in series between AO1 and GND, and then connect AO1 and AI1. In this way, the voltage at both ends of the thermistor can be automatically detected, and the detected value of AI1 is the voltage value of both ends of the thermistor. According to Ohm's law, the resistance value of the current thermistor can be calculated, and the temperature value of the motor can be obtained by querying the resistance-and-temperature table. The wiring diagram is as follows.

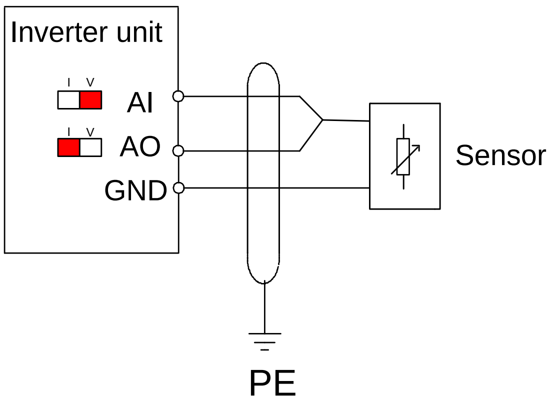


Figure 5-7 Wiring for detecting motor temperature by using AI/AO

The output current of AO1 varies with the temperature sensor type. See the following table.

Temperature sensor type	PT100	PT1000	KTY84
AO1 output (recommended)	10.00mA	1.00mA	2.00mA

Note:

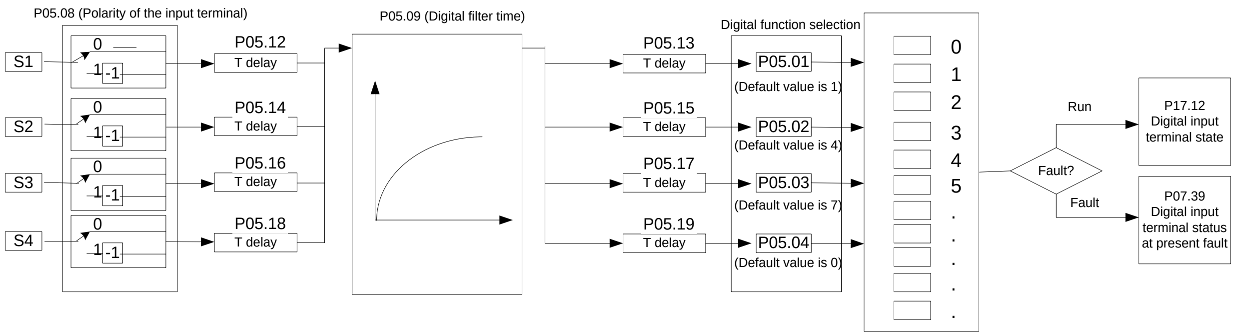
- When using the AI2/AO1 combination, you need to set P05.29 (AI2 lower limit) to 0.00V and P05.30 (Corresponding setting of AI2 lower limit) to 0.0%.
- To improve detection accuracy, you are recommended to perform an analog calibration before the detection.
- When AO1 is used for temperature detection, AO1 output selection (P06.14) is invalid.

Related function codes of detecting motor temperature by using AI/AO:

Function code	Name	Description	Default
P19.11	AI/AO detected motor temperature	-20.0–175.0°C	0.0°C
P28.22	Type of sensor for AI/AO to detect motor temperature	0: No temperature sensor 1: PT100 2: PT1000 3: KTY84 Motor temperature is displayed through P19.11.	0
P28.23	AI/AO detected motor OH protection threshold	P28.14–200.0°C	110.0℃
P28.24	AI/AO detected motor OH pre-alarm threshold	-20.0– P28.13 When the motor temperature exceeds the value, the DO terminal with function 50 (AI detected motor OH pre-alarm) outputs a valid signal.	90.0°C
P28.25	Signal source for AI/AO to detect motor temperature	0: Do not select this function 1: AI1 2: AI2 **Note: AI must be of the voltage type.**	0
P28.26	AO1 output current setting	0.00–20.00mA	1.00mA

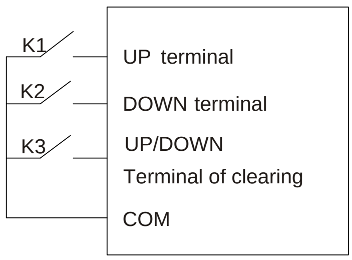
5.6.12 Digital input

The inverter unit carries four programmable digital input terminals. The function of all the digital input terminals can be programmed through function codes.



The function parameters P05.01–P05.04 are used to set the functions of digital multi-function input terminals.

Note: Two different multifunction input terminals cannot be configured with a same function.

Setting	Function	Description
0	No function	The inverter unit does not act even if there is signal input. Set unused terminals without functions to avoid misaction.
1	Run forward (FWD)	External terminals are used to control the forward/reverse running of the inverter unit.l
2	Run reversely (FWD)	
3	3: Three-wire running control	The terminal is used to determine the three-wire running control of the inverter unit. For details, see P05.13.
4	Jog forward	For details about frequency of jogging running and ACC/DEC time of jogging running, see the description for P08.06, P08.07, and P08.08.
5	Jog reversely	
6	Jog forward	The inverter unit blocks output, and the motor stop process is uncontrolled by the inverter unit. This mode is applied in the scenarios with large-inertia loads and without stop time requirements. Its definition is the same as P01.08, and it is mainly used in remote control.
7	Fault reset	External fault reset function, which is the same as the reset function implemented by pressing the DATA key on the keypad. You can use this function to reset faults remotely.
8	Pause running	The inverter unit decelerates to stop, however, all the run parameters are in memory state, such as PLC parameter, wobbling frequency, and PID parameter. After this signal disappears, the inverter unit restores to the state before the stop.
9	External fault input	When an external fault signal is transmitted to the inverter unit, the inverter unit reports a fault and stops.
10	Increase frequency setting (UP)	Used to change the frequency increase/decrease command when the frequency is given by external terminals.  The terminal used to clear frequency increase/decrease setting can clear the frequency value of auxiliary channel set by UP/DOWN, thus restoring the reference frequency to the frequency given by main reference frequency command channel.
12	Decrease frequency setting (DOWN)	
12	Clear the frequency increase/decrease setting	
13	Switch between A setting and B setting	The function is used to switch between the frequency setting channels. A frequency reference channel and B frequency reference channel can be switched by function 13; the combination channel set by P00.09 and the A frequency reference channel can be switched by function 14; the combination channel set by P00.09 and the B frequency reference channel can be switched by function 15.
14	Switch between combination setting and A setting	
15	Switch between combination setting and B setting	

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>16</td><td>Multi-step speed terminal 1</td><td rowspan="4">16-step speeds can be set by combining digital states of these four terminals.
Note: Multi-step speed 1 is low-order bit, and multi-step speed 4 is high-order bit.<table><tr><th>Multi-step speed 4</th><th>Multi-step speed 3</th><th>Multi-step speed 2</th><th>Multi-step speed 1</th></tr><tr><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr></table></td></tr>
<tr><td>17</td><td>Multi-step speed terminal 2</td></tr>
<tr><td>18</td><td>Multi-step speed terminal 3</td></tr>
<tr><td>19</td><td>Multi-step speed terminal 4</td></tr>
<tr><td>20</td><td>Pause multi-step speed running</td><td>The multi-step speed selection function can be screened to keep the set value in the present state.</td></tr>
<tr><td>21</td><td>ACC/DEC time selection 1</td><td rowspan="2">The status of the two terminals can be combined to select four groups of ACC/DEC time.<table><tr><th>Terminal 1</th><th>Terminal 2</th><th>ACC/DEC time</th><th>Parameter</th></tr><tr><td>OFF</td><td>OFF</td><td>ACC/DEC time 1</td><td>P00.11/P00.12</td></tr><tr><td>ON</td><td>OFF</td><td>ACC/DEC time 2</td><td>P08.00/P08.01</td></tr><tr><td>OFF</td><td>ON</td><td>ACC/DEC time 3</td><td>P08.02/P08.03</td></tr><tr><td>ON</td><td>ON</td><td>ACC/DEC time 4</td><td>P08.04/P08.05</td></tr></table></td></tr>
<tr><td>22</td><td>ACC/DEC time selection 2</td></tr>
<tr><td>23</td><td>Simple PLC stop reset</td><td>Used to clear the previous PLC state memory information and restart the simple PLC process.</td></tr>
<tr><td>24</td><td>Pause simple PLC</td><td>Used to pause the simple PLC. When the function is revoked, the simple PLC resumes the running.</td></tr>
<tr><td>25</td><td>Pause PID control</td><td>PID is ineffective temporarily, and the inverter unit maintains the present frequency output.</td></tr>
<tr><td>26</td><td>Pause wobbling frequency (stop at current frequency)</td><td>The inverter unit pauses at current output. When the function is revoked, it continues wobbling-frequency operation at current frequency.</td></tr>
<tr><td>27</td><td>Reset wobbling frequency (back to center frequency)</td><td>The set frequency of the inverter unit restores to center frequency.</td></tr>
<tr><td>28</td><td>Reset the counter</td><td>The counter is cleared.</td></tr>
<tr><td>29</td><td>Switch between speed control and torque control</td><td>The inverter unit switches from torque control to speed control, or vice versa.</td></tr>
<tr><td>30</td><td>Disable ACC/DEC</td><td>Used to ensure the inverter unit is not impacted by external signals (except for stop command), and maintains the present output frequency.</td></tr>
<tr><td>31</td><td>Trigger the counter</td><td>Used to enable the counter to count pulses.</td></tr>
<tr><td>33</td><td>Clear the frequency increase/decrease setting temporarily</td><td>When the terminal is closed, the frequency value set by UP/DOWN can be cleared to restore the reference frequency to the frequency given by frequency command channel; when the terminal is opened, it restores to the frequency value after frequency increase/decrease setting.</td></tr>
<tr><td>34</td><td>DC braking</td><td>The inverter unit starts DC braking immediately after the command becomes valid.</td></tr>
<tr><td>35</td><td>Switch between motor 1 and motor 2</td><td>When the function is enabled, you can realize switchover control of two motors.</td></tr>
<tr><td>36</td><td>Switch the running command channel to keypad</td><td>When the function is enabled, the running command channel is switched to keypad. When the function is disabled, the running command channel is restored to the previous setting.</td></tr>
<tr><td>37</td><td>Switch the running command channel to terminal</td><td>When the function is enabled, the running command channel is switched to terminal. When the function is disabled, the running command channel is restored to the previous setting.</td></tr>
</table>

Setting	Function	Description
38	Switch the running command channel to communication	When the function is enabled, the running command channel is switched to communication. When the function is disabled, the running command channel is restored to the previous setting.
39	Pre-exciting command	When the function is enabled, motor pre-exciting is started until the function becomes invalid.
40	Clear power consumption quantity	When the function is enabled, the power consumption quantity of the inverter unit is cleared.
41	Maintain power consumption quantity	When the function is enabled, the present operation of the inverter unit does not impact the power consumption quantity.
42	Switch the setting source of braking torque upper limit to keypad	The torque upper limit is set through the keypad when the command is valid.
56	Emergency stop	When the function is enabled, the motor decelerates to stop in emergency manner according to the time specified by P01.25.
57	Motor overtemperature fault input	When there is motor overtemperature fault input, the motor stops due to the fault.
59	Switch from VC to space voltage vector control	When the function is enabled in stopped state, space voltage vector control is used.
60	Switch to VC control	When the function is enabled in stopped state, VC is used.
61	Switch PID polarities	Used to switch the output polarity of PID. It is used together with P09.03.
62	Reserved	
63	Enable servo	When the thousands place of P21.00 enables servo, the servo enabling terminal is valid, which controls the inverter unit to enter zero servo control. At this time, the start command is not needed.
64	Limit on forward running	Limit on forward running.
65	Limit on reverse running	Limit on reverse running.
66	Clear encoder counting	Used to clear the position counting value.
67	Increase pulses	When the signal is valid, the pulse counting is increased according to the pulse speed set by P21.27.
68	Enable pulse superposition	Pulse increment and pulse decrement can be valid only after pulse superimposition is enabled.
69	Decrease pulses	When the signal is valid, the pulse counting is decreased according to the pulse speed set by P21.27.
70	Electronic gear selection	When the signal is valid, select the numerator of the position command set by P21.30. When it is invalid, the numerator of the position command is decided by P21.11.
71	Switch to the master	When the function is enabled in stopped state, the unit switches to the master mode.
72	Switch to the slave	When the function is enabled in stopped state, the unit switches to the slave mode.
73–79	Reserved	/

Related parameter list:

Function code	Name	Description	Default
P05.01	Function of S1	0: No function 1: Run forward 2: Run reversely	1
P05.02	Function of S2		4
P05.03	Function of S3		7

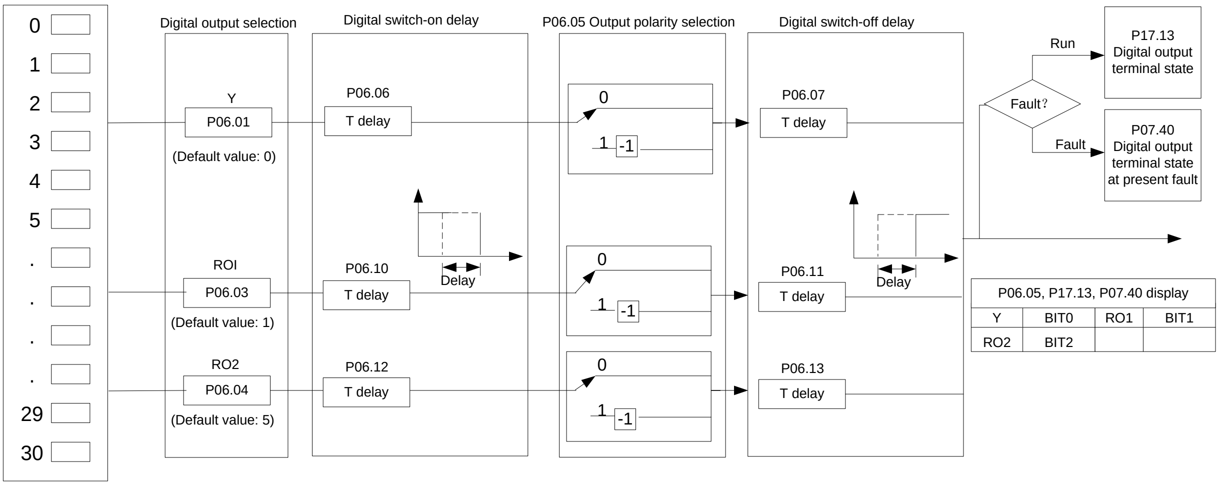
<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th></tr>
<tr><td>P05.04</td><td>Function of S4</td><td rowspan="4">3: Three-wire running control
4: Jog forward
5: Jog reversely
6: Coast to stop
7: Reset faults
8: Pause running
9: External fault input
10: Increase frequency setting (UP)
11: Decrease frequency setting (DOWN)
12: Clear the frequency increase/decrease setting
13: Switch between A setting and B setting
14: Switch between combination setting and A setting
15: Switch between combination setting and B setting
16: Multi-step speed terminal 1
17: Multi-step speed terminal 2
18: Multi-step speed terminal 3
19: Multi-step speed terminal 4
20: Pause multi-step speed running
21: ACC/DEC time selection 1
22: ACC/DEC time selection 2
23: Simple PLC stop reset
24: Pause simple PLC
25: Pause PID control
26: Limit on forward running
27: Limit on reverse running
28: Counter reset
29: Switch between speed control and torque control
30: Disable ACC/DEC
31: Trigger the counter
32: Reserved
33: Clear the frequency increase/decrease setting temporarily
34: DC braking
35: Switch from motor 1 to motor 2
36: Switch the running command channel to keypad
37: Switch the running command channel to terminal
38: Switch the running command channel to communication
39: Pre-exciting command
40: Clear electricity consumption
41: Keep electricity consumption
42: Switch the setting source of braking torque</td><td>0</td></tr>
<tr><td>P05.05</td><td>Reserved</td><td>0</td></tr>
<tr><td>P05.06</td><td>Reserved</td><td>0</td></tr>
<tr><td>P05.07</td><td>Reserved</td><td>0</td></tr>
</table>

Function code	Name	Description	Default
		upper limit to keypad 43: Position reference point input (only valid for S1, S2 and S3) 44: Disable spindle orientation 45: Spindle zeroing / Local positioning zeroing 46: Spindle zeroing position selection 1 47: Spindle zeroing position selection 2 48: Spindle scale division selection 1 49: Spindle scale division selection 2 50: Spindle scale division selection 3 51: Terminal for switching between position control and speed control 52: Disable pulse input 53: Clear position deviation 54: Switch position proportional gains 55: Enable cyclic digital positioning 56: Emergency stop 57: Motor overtemperature fault input 58: Enable rigid tapping 59: Switch to V/F control 60: Switch to VC control 61: Switch PID polarities 62: Reserved 63: Enable servo 64: Limit on forward running 65: Limit on reverse running 66: Clear encoder counting 67: Increase pulses 68: Enable pulse superposition 69: Decrease pulses 70: Electronic gear selection 71: Switch to the master 72: Switch to the slave 73: Reset roll diameter 74: Switch winding/unwinding 75: Pre-drive 76: Stop roll diameter calculation 77: Clear alarm display 78: Manual braking 79: Trigger forced feeding interrupt 80: Initial roll diameter 1 81: Initial roll diameter 2 82: Reserved 83: Switch tension PID 84–95: Reserved	
P05.08	Input terminal polarity	0x00–0x0F BIT3 | BIT2 | BIT1 | BIT0 S4 | S3 | S2 | S1	0x000

Function code	Name	Description	Default
P05.09	Digital input filter time	0.000–1.000s	0.010s
P05.10	Virtual terminal setting	0x000–0x0F (0: Disable; 1: Enable) BIT0: S1 virtual terminal BIT1: S2 virtual terminal BIT2: S3 virtual terminal BIT3: S4 virtual terminal	0x00
P05.11	Terminal control mode	0: Two-wire control mode 1 1: Two-wire control mode 2 2: Three-wire control mode 1 3: Three-wire control mode 2	0
P05.12	S1 switch-on delay	0.000–50.000s	0.000s
P05.13	S1 switch-off delay	0.000–50.000s	0.000s
P05.14	S2 switch-on delay	0.000–50.000s	0.000s
P05.15	S2 switch-off delay	0.000–50.000s	0.000s
P05.16	S3 switch-on delay	0.000–50.000s	0.000s
P05.17	S3 switch-off delay	0.000–50.000s	0.000s
P05.18	S4 switch-on delay	0.000–50.000s	0.000s
P05.19	S4 switch-off delay	0.000–50.000s	0.000s
P07.39	Input terminal status at present fault	/	0
P17.12	Digital input terminal status	/	0

5.6.13 Digital output

The inverter unit carries two groups of relay output terminal, and one open collector Y output terminal. The function of all the digital output terminals can be programmed through function codes.



The following table lists the options of function parameters P06.01–P06.04. A same output terminal function can be repeatedly selected.

Setting	Function	Description
0	Invalid	The output terminal does not have any function.
1	Running	When the inverter unit works properly and there is frequency output, it outputs the ON signal.
2	Running forward	When the inverter runs forward and there is frequency output, it outputs the ON signal.

Setting	Function	Description
3	Running reversely	When the inverter unit runs reversely and there is frequency output, it outputs the ON signal.
4	Jogging	When the inverter unit jogs and there is frequency output, it outputs the ON signal.
5	Inverter unit fault	When the inverter unit encounters a fault, it outputs the ON signal.
6	Frequency level detection FDT1	Refer to the descriptions for P08.32–P08.33.
7	Frequency level detection FDT2	Refer to the descriptions for P08.34–P08.35.
8	Frequency reached	Refer to the description for P08.36.
9	Running in zero speed	When both the inverter unit output frequency and reference frequency are zero, it outputs the ON signal.
10	Upper limit frequency reached	When the running frequency of the inverter unit reaches the upper limit, it outputs the ON signal.
11	Lower limit frequency reached	When the running frequency of the inverter unit reaches the lower limit, it outputs the ON signal.
12	Ready for running	When the main circuit and control circuit powers are established, the inverter unit protection functions do not act, and the inverter unit is ready to run, it outputs the ON signal.
13	Pre-exciting	When the inverter unit is pre-exciting, it outputs the ON signal.
14	Overload pre-alarm	When the pre-alarm time elapsed if the inverter unit pre-alarm threshold is reached, it outputs the ON signal. For details, see the descriptions for P11.08–P11.10.
15	Underload pre-alarm	When the pre-alarm time elapsed if the inverter unit pre-alarm threshold is reached, it outputs the ON signal. For details, see the descriptions for P11.11–P11.12.
16	Simple PLC stage completed	When the present state of the simple PLC is completed, it outputs a signal.
17	Simple PLC cycle completed	When a single cycle of the simple PLC is completed, it outpus a signal.
23	Modbus communication virtual terminal output	A signal is output based on the value set through Modbus communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
24	POROFIBUS/DeviceNet communication virtual terminal output	A signal is output based on the value set through POROFIBUS/DeviceNet communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
25	Ethernet communication virtual terminal output	A signal is output based on the value set through Ethernet communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
26	DC bus voltage established	When the bus voltage is above the inverter undervoltage, the output is valid.
27	Z pulse output	When the encoder Z pulse is reached, the output is valid, which becomes invalid 10 seconds later.
28	Superposing pulses	When the pulse superposition terminal input function is valid, the output is valid.
29	STO action	When an STO fault occurs, the output is valid.
30	Positioning completed	When positioning is completed, the output is valid.

Setting	Function	Description
31	Spindle zeroing completed	When spindle zeroing is completed, the output is valid.
32	Spindle scale division completed	When spindle scale division is completed, the output is valid.
33	In speed limit	When the frequency is limited, the output is valid.
34	EtherCAT/PROFINET communication virtual terminal output	A signal is output based on the value set through EtherCAT/PROFINET. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
35	CANopen communication virtual terminal output	A signal is output based on the value set through CANopen communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
36	Speed/position control switchover completed	When the mode switchover is completed, the output is valid.
37	Any frequency reached	When the set frequency is exceeded, the output is valid.
38–40	Reserved	
41	C_Y1	C_Y1 from PLC (Set P27.00 to 1.)
42	C_Y2	C_Y2 from PLC (Set P27.00 to 1.)
43	C_HDO	C_HDO from PLC (Set P27.00 to 1.)
44	C_RO1	C_RO1 from PLC (Set P27.00 to 1.)
45	C_RO2	C_RO2 from PLC (Set P27.00 to 1.)
46	C_RO3	C_RO3 from PLC (Set P27.00 to 1.)
47	C_RO4	C_RO4 from PLC (Set P27.00 to 1.)
48–63	Reserved	

Related parameter list:

Function code	Name	Description	Default
P06.01	Y1 output	0: Invalid 1: Running 2: Running forward 3: Running reversely 4: Jogging 5: Inverter unit fault 6: Frequency level detection FDT1 7: Frequency level detection FDT2 8: Frequency reached 9: Running in zero speed 10: Upper limit frequency reached 11: Lower limit frequency reached 12: Ready for running 13: Pre-exciting 14: Overload pre-alarm 15: Underload pre-alarm 16: Simple PLC stage completed 17: Simple PLC cycle completed 18: Set counting value reached 19: Designated counting value reached 20: External fault is valid 21: Reserved 22: Running time reached	0
P06.02	Reserved		0
P06.03	RO1 output		1
P06.04	RO2 output		5

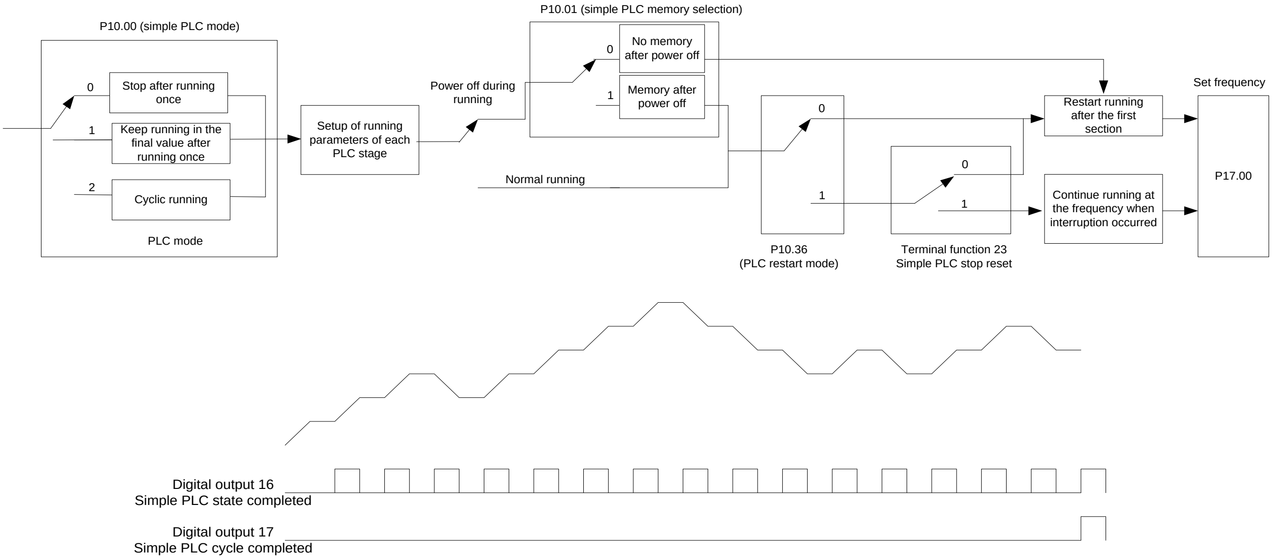
Function code	Name	Description	Default
		23: Modbus communication virtual terminal output 24: PROFIBUS-DP/DeviceNet communication virtual terminal output 25: Ethernet communication virtual terminal output 26: DC bus voltage established 27: Z pulse output 28: Superposing pulses 29: STO action 30: Positioning completed 31: Spindle zeroing completed 32: Spindle scale division completed 33: In speed limit 34: EtherCAT/PROFINET communication virtual terminal output 35: CANopen communication virtual terminal output 36: Speed/position control switchover completed 37: Any frequency reached 38–40: Reserved 41: C_Y1 from PLC (Set P27.00 to 1.) 42–43: Reserved 44: C_R01 from PLC (Set P27.00 to 1.) 45: C_RO2 from PLC (Set P27.00 to 1.) 46: C_RO3 from PLC (Set P27.00 to 1.) 47: C_RO4 from PLC (Set P27.00 to 1.) 51: Stopped or running in zero speed 52: Trigger forced feeding interrupt 53: Reach the roll diameter set value 54: Reach the max. roll diameter 55: Reach the min. roll diameter 56–63: Reserved	
P06.05	Output terminal polarity selection	Range: 0x00–0x07 BIT2 BIT1 BIT0 RO2 RO1 Y1	00
P06.06	Y1 switch-on delay	0.000–50.000s	0.000s
P06.07	Y1 switch-off delay	0.000–50.000s	0.000s
P06.10	RO1 switch-on delay	0.000–50.000s	0.000s
P06.11	RO1 switch-off delay	0.000–50.000s	0.000s
P06.12	RO2 switch-on delay	0.000–50.000s	0.000s
P06.13	RO2 switch-off delay	0.000–50.000s	0.000s
P07.40	Output terminal status at present fault	/	0
P17.13	Digital output terminal status	/	0

5.6.14 Simple PLC

Simple PLC is a multi-step speed generator, and the inverter unit can change the running frequency and direction automatically based on the run time to fulfill process requirements. Previously, such function was realized with external PLC, while now, the inverter unit itself can achieve this function.

The inverter unit can realize 16-step speed control, and provide four groups of ACC/DEC time for you to choose.

After the set PLC completes one cycle (or one step), one ON signal can be output by the multifunction relay.



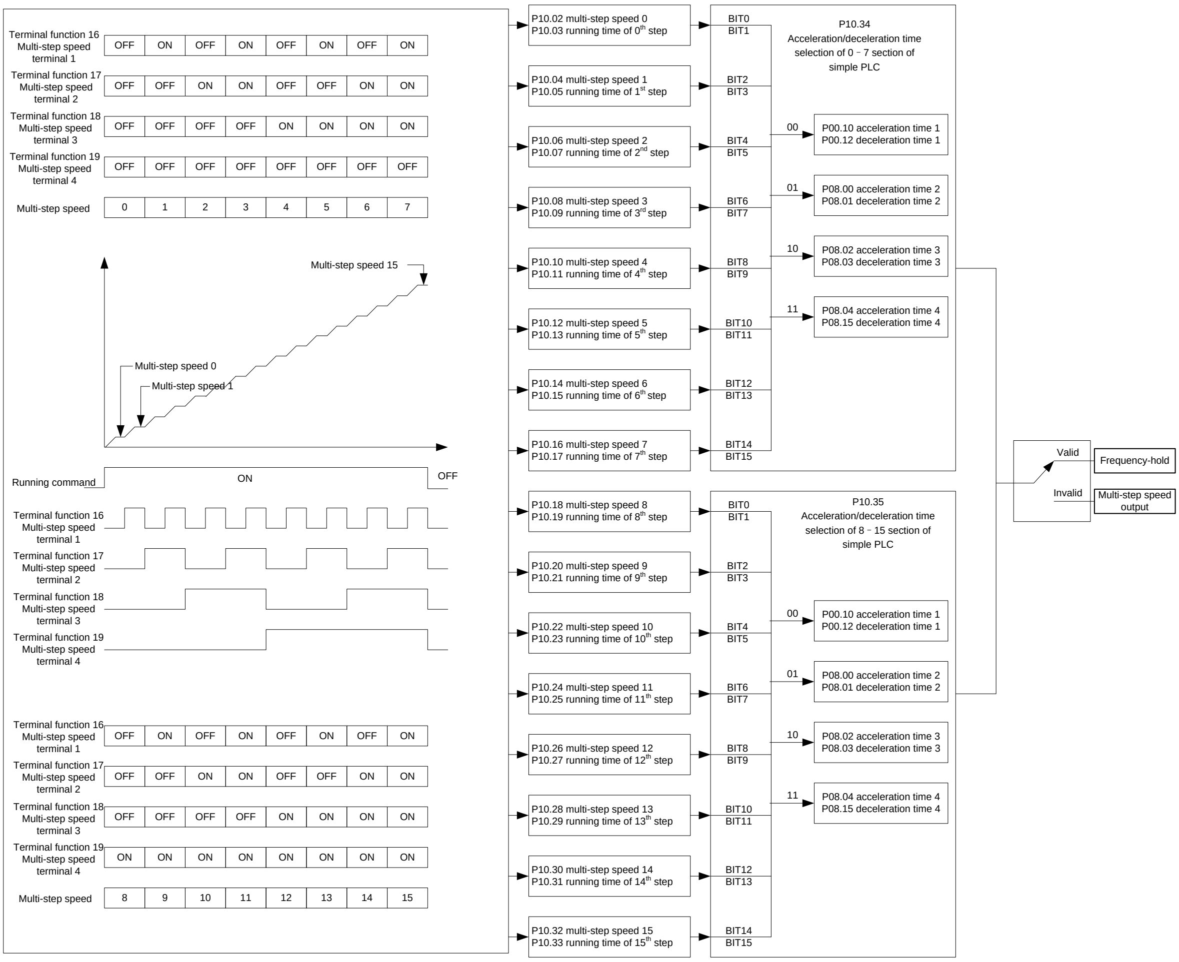
Related parameter list:

Function code	Name	Description	Default
P05.01–P05.04	Digital input function selection	23: Simple PLC stop reset 24: Pause simple PLC 25: Pause PID control	/
P06.01–P06.04	Digital output function selection	16: Simple PLC stage reached 17: Simple PLC cycle reached	/
P10.00	Simple PLC mode	0: Stop after running once 1: Keep running in the final value after running once 2: Cyclic running	0
P10.01	Simple PLC memory selection	0: No memory after power off 1: Memory after power off	0
P10.02	Multi-step speed 0	-100.0–100.0%	0.0%
P10.03	Running time of step 0	0.0–6553.5s (min)	0.0s
P10.04	Multi-step speed 1	-100.0–100.0%	0.0%
P10.05	Running time of step 1	0.0–6553.5s (min)	0.0s
P10.06	Multi-step speed 2	-100.0–100.0%	0.0%
P10.07	Running time of step 2	0.0–6553.5s (min)	0.0s
P10.08	Multi-step speed 3	-100.0–100.0%	0.0%
P10.09	Running time of step 3	0.0–6553.5s (min)	0.0s
P10.10	Multi-step speed 4	-100.0–100.0%	0.0%
P10.11	Running time of step 4	0.0–6553.5s (min)	0.0s
P10.12	Multi-step speed 5	-100.0–100.0%	0.0%
P10.13	Running time of step 5	0.0–6553.5s (min)	0.0s

Function code	Name	Description	Default
P10.14	Multi-step speed 6	-100.0–100.0%	0.0%
P10.15	Running time of step 6	0.0–6553.5s (min)	0.0s
P10.16	Multi-step speed 7	-100.0–100.0%	0.0%
P10.17	Running time of step 7	0.0–6553.5s (min)	0.0s
P10.18	Multi-step speed 8	-100.0–100.0%	0.0%
P10.19	Running time of step 8	0.0–6553.5s (min)	0.0s
P10.20	Multi-step speed 9	-100.0–100.0%	0.0%
P10.21	Running time of step 9	0.0–6553.5s (min)	0.0s
P10.22	Multi-step speed 10	-100.0–100.0%	0.0%
P10.23	Running time of step 10	0.0–6553.5s (min)	0.0s
P10.24	Multi-step speed 11	-100.0–100.0%	0.0%
P10.25	Running time of step 11	0.0–6553.5s (min)	0.0s
P10.26	Multi-step speed 12	-100.0–100.0%	0.0%
P10.27	Running time of step 12	0.0–6553.5s (min)	0.0s
P10.28	Multi-step speed 13	-100.0–100.0%	0.0%
P10.29	Running time of step 13	0.0–6553.5s (min)	0.0s
P10.30	Multi-step speed 14	-100.0–100.0%	0.0%
P10.31	Running time of step 14	0.0–6553.5s (min)	0.0s
P10.32	Multi-step speed 15	-100.0–100.0%	0.0%
P10.33	Running time of step 15	0.0–6553.5s (min)	0.0s
P10.34	ACC/DEC time of steps 0–7 of simple PLC	0x0000–0XFFFF	0000
P10.35	ACC/DEC time of steps 8–15 of simple PLC	0x0000–0XFFFF	0000
P10.36	PLC restart mode	0: Restart from step 1 1: Resume from the paused step	0
P17.00	Set frequency	0.00Hz–P00.03 (Max. output frequency)	0.00Hz
P17.27	Present step of simple PLC	Used to display the present step of the simple PLC function.	0

5.6.15 Multi-step speed running

You can set parameters to enable the inverter unit to run at multiple steps. The inverter unit supports setting 16-step speeds, which are selectable by multi-step speed terminals 1–4, corresponding to multi-step speed 0 to multi-step speed 15.



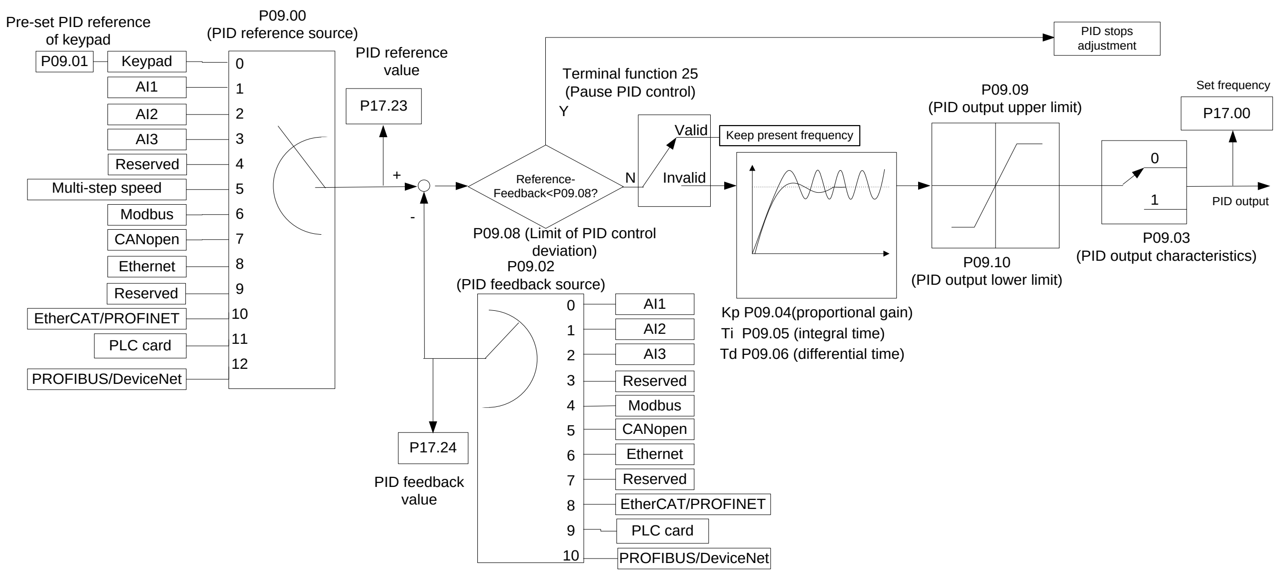
Related parameter list:

Function code	Name	Description	Default
P05.01–P05.04	Digital input function selection	16: Multi-step speed terminal 1 17: Multi-step speed terminal 2 18: Multi-step speed terminal 3 19: Multi-step speed terminal 4 20: Pause multi-step speed running	/
P10.02	Multi-step speed 0	-100.0–100.0%	0.0%
P10.03	Running time of step 0	0.0–6553.5s (min)	0.0s
P10.04	Multi-step speed 1	-100.0–100.0%	0.0%
P10.05	Running time of step 1	0.0–6553.5s (min)	0.0s
P10.06	Multi-step speed 2	-100.0–100.0%	0.0%
P10.07	Running time of step 2	0.0–6553.5s (min)	0.0s
P10.08	Multi-step speed 3	-100.0–100.0%	0.0%
P10.09	Running time of step 3	0.0–6553.5s (min)	0.0s
P10.10	Multi-step speed 4	-100.0–100.0%	0.0%
P10.11	Running time of step 4	0.0–6553.5s (min)	0.0s
P10.12	Multi-step speed 5	-100.0–100.0%	0.0%
P10.13	Running time of step 5	0.0–6553.5s (min)	0.0s
P10.14	Multi-step speed 6	-100.0–100.0%	0.0%
P10.15	Running time of step 6	0.0–6553.5s (min)	0.0s
P10.16	Multi-step speed 7	-100.0–100.0%	0.0%
P10.17	Running time of step 7	0.0–6553.5s (min)	0.0s

Function code	Name	Description	Default
P10.18	Multi-step speed 8	-100.0–100.0%	0.0%
P10.19	Running time of step 8	0.0–6553.5s (min)	0.0s
P10.20	Multi-step speed 9	-100.0–100.0%	0.0%
P10.21	Running time of step 9	0.0–6553.5s (min)	0.0s
P10.22	Multi-step speed 10	-100.0–100.0%	0.0%
P10.23	Running time of step 10	0.0–6553.5s (min)	0.0s
P10.24	Multi-step speed 11	-100.0–100.0%	0.0%
P10.25	Running time of step 11	0.0–6553.5s (min)	0.0s
P10.26	Multi-step speed 12	-100.0–100.0%	0.0%
P10.27	Running time of step 12	0.0–6553.5s (min)	0.0s
P10.28	Multi-step speed 13	-100.0–100.0%	0.0%
P10.29	Running time of step 13	0.0–6553.5s (min)	0.0s
P10.30	Multi-step speed 14	-100.0–100.0%	0.0%
P10.31	Running time of step 14	0.0–6553.5s (min)	0.0s
P10.32	Multi-step speed 15	-100.0–100.0%	0.0%
P10.33	Running time of step 15	0.0–6553.5s (min)	0.0s
P10.34	ACC/DEC time of steps 0–7 of simple PLC	0x0000–0XFFFF	0000
P10.35	ACC/DEC time of steps 8–15 of simple PLC	0x0000–0XFFFF	0000
P17.27	Present step of simple PLC	Used to display the present step of the simple PLC function.	0

5.6.16 PID control

PID control, a common mode for process control, is mainly used to adjust the inverter unit output frequency or output voltage through performing scale-division, integral and differential operations on the difference between feedback signal of controlled variables and signal of the target, thus forming a negative feedback system to keep the controlled variables above the target. It is suitable for flow control, pressure control, temperature control, and so on. The following is the basic schematic block diagram for output frequency regulation.



Introduction to the working principles and control methods for PID control:

Proportional control (Kp): When the feedback is different from the reference, the output will be proportional to the difference. If such a difference is constant, the regulating variable will also be constant. Proportional control can respond to feedback changes rapidly, however, it cannot eliminate the difference by itself. A larger the proportional gain indicates a faster regulating speed, but a too large gain will result in oscillation. To solve this problem, set the integral time to a large value and the differential time to 0, run the system only with proportional control, and then change the reference to observe the difference (that is, static difference) between the feedback signal and reference. If the static difference occurs in the direction of reference change (such as reference increase, where the feedback is always less than the reference after system stabilizes), continue increasing the proportional gain; otherwise, decrease the proportional gain. Repeat this process until the static difference becomes small.

Integral time (Ti): When feedback deviates from reference, the output regulating variable accumulates continuously, if the deviation persists, the regulating variable will increase continuously until deviation disappears. Integral regulator can be used to eliminate static difference; however, too large regulation may lead to repetitive overshoot, which will cause system instability and oscillation. The feature of oscillation caused by strong integral effect is that the feedback signal fluctuates up and down based on the reference variable, and fluctuation range increases gradually until oscillation occurred. Integral time parameter is generally regulated gradually from large to small until the stabilized system speed fulfills the requirement.

Differential time (Td): When the deviation between feedback and reference changes, output the regulating variable which is proportional to the deviation variation rate, and this regulating variable is only related to the direction and magnitude of the deviation variation rather than the direction and magnitude of the deviation itself. Differential control is used to control the feedback signal variation based on the variation trend. Differential regulator should be used with caution as it may easily enlarge the system interferences, especially those with high variation frequency.

When the frequency command selection (P00.06, P00.07) is 7 or the voltage setting channel selection (P04.27) is 6, the inverter unit is process PID controlled.

5.6.16.1 General PID parameter setting procedure

(1) Determining proportional gain P

When determining proportional gain P, first, remove the integral term and derivative term of PID by making Ti=0 and Td=0 (see PID parameter setup for details), thus turning PID into pure proportional control. Set the input to 60%–70% of the max. allowable value, and increase proportional gain P gradually from 0 until system oscillation occurred, and then in turn, decrease proportional gain P gradually from current value until system oscillation disappears, record the proportional gain P at this point and set the proportional gain P of PID to 60%–70% of current value. This is whole commissioning process of proportional gain P.

(2) Determine integral time Ti

After proportional gain P is determined, set the initial value of a larger integral time Ti, and decrease Ti gradually until system oscillation occurred, and then in turn, increase Ti until system oscillation disappears, record the Ti at this point, and set the integral time constant Ti of PID to 150%–180% of current value. This is the commissioning process of integral time constant Ti.

(3) Determining derivative time Td

The derivative time Td is generally set to 0.

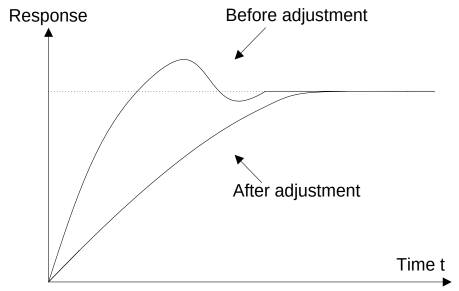
If you need to set Td to another value, set in the same way with P and Ti, namely, set Td to 30% of the value when there is no oscillation.

(4) Empty system load, perform load-carrying joint debugging, and then adjust PID parameters until fulfilling the requirement.

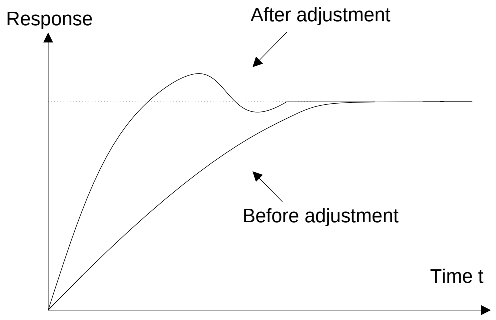
5.6.16.2 PID adjusting method

After setting the parameters controlled by PID, you can adjust these parameters by the following means.

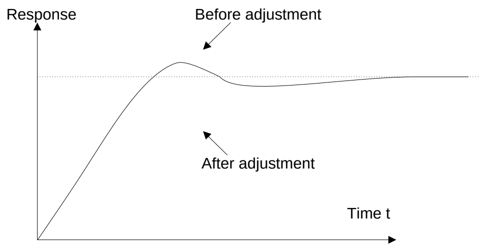
Control overshoot: When overshoot occurred, shorten the derivative time (Td) and prolong integral time (Ti).



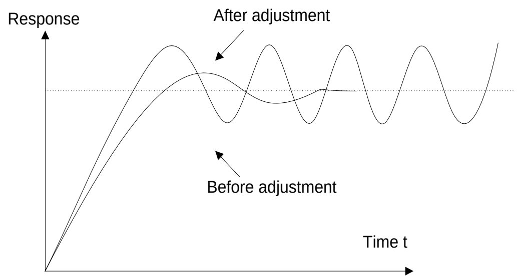
Stabilize the feedback value as fast as possible: when overshoot occurred, shorten integral time (Ti) and prolong derivative time (Td) to stabilize control as fast as possible.



Control long-term vibration: If the cycle of periodic vibration is longer than the set value of integral time (Ti), it indicates the integral action is too strong, prolong the integral time (Ti) to control vibration.



Control short-term vibration: If the vibration cycle is short is almost the same with the set value of derivative time (Td), it indicates derivative action is too strong, shorten the derivative time (Td) to control vibration. When derivative time (Td) is set to 0.00 (namely no derivative control), and there is no way to control vibration, decrease the proportional gain.



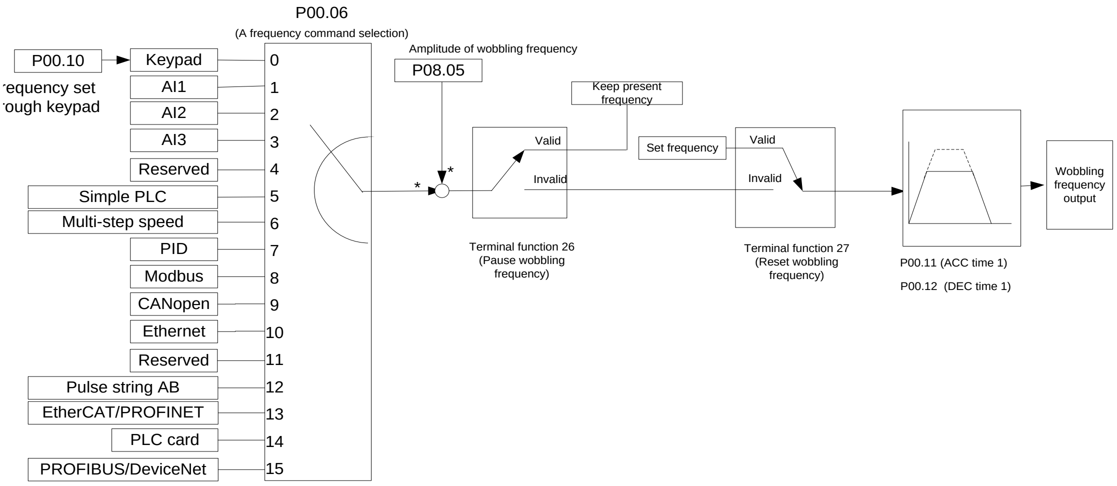
Related parameter list:

Function code	Name	Description	Default
P09.00	PID reference source	0: Keypad (P09.01) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step running 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication	0
P09.01	PID reference preset through keypad	-100.0%–100.0%	0.0%
P09.02	PID feedback source	0: AI1 1: AI2 2: AI3 3: Reserved 4: Modbus communication 5: CANopen communication 6: Ethernet communication 7: Reserved 8: EtherCAT/PROFINET communication 9: Programmable expansion card 10: PROFIBUS-DP/DeviceNet communication	0
P09.03	PID output characteristics selection	0: PID output is positive characteristic 1: PID output is negative characteristic	0
P09.04	Proportional gain (Kp)	0.00–100.00	1.80
P09.05	Integral time (Ti)	0.01–10.00s	0.90s
P09.06	Differential time (Td)	0.00–10.00s	0.00s
P09.07	Sampling cycle (T)	0.000–10.000s	0.100s
P09.08	PID control deviation limit	0.0–100.0%	0.0%
P09.09	PID output upper limit	P09.10–100.0% (of the max. frequency or voltage)	100.0%
P09.10	PID output lower limit	-100.0%–P09.09 (Max. frequency or voltage)	0.0%
P09.11	Feedback offline detection value	0.0–100.0%	0.0%
P09.12	Feedback offline detection time	0.0–3600.0s	1.0s
P09.13	PID control selection	0x0000–0x1111 Ones place: 0: Continue integral control after the frequency reaches upper/lower limit 1: Stop integral control after the frequency reaches	0x0001

Function code	Name	Description	Default
		upper/lower limit Tens place: 0: Same as the main reference direction 1: Contrary to the main reference direction Hundreds place: 0: Limit as per the max. frequency 1: Limit as per A frequency Thousands place: 0: A+B frequency, acceleration /deceleration of main reference A frequency source buffering is invalid 1: A+B frequency, acceleration/ deceleration of main reference A frequency source buffering is valid, acceleration/deceleration is determined by P08.04 (acceleration time 4).	
P09.14	Low frequency proportional gain (Kp)	0.00–100.00	1.00
P09.15	ACC/DEC time of PID command	0.0–1000.0s	0.0s
P09.16	PID output filter time	0.000–10.000s	0.000s
P09.17	Reserved	-100.0–100.0%	0.0%
P09.18	Low frequency integral time (Ti)	0.00–10.00s	0.90s
P09.19	Low frequency differential time (Td)	0.00–10.00s	0.00s
P09.20	Low frequency point for PID parameter switching	0–P09.21	5.00Hz
P09.21	High frequency point for PID parameter switching	P09.20–P00.04	10.00Hz
P17.00	Set frequency	0.00Hz–P00.03 (Max. output frequency)	0.00Hz
P17.23	PID reference value	-100.0–100.0%	0.0%
P17.24	PID feedback value	-100.0–100.0%	0.0%

5.6.17 Run at wobbling frequency

Wobbling frequency is mainly applied in cases where transverse movement and winding functions are needed like textile and chemical fiber industries. The typical working process is shown as follows.



Function code	Name	Description	Default
P00.03	Max. output frequency	P00.03–400.00Hz	50.00Hz
P00.06	Setting channel of A frequency command	0: Keypad 1: AI1 2: AI2 3: AI3 4: Reserved 5: Simple PLC program 6: Multi-step speed running 7: PID control 8: Modbus communication 9: CANopen communication 10: Ethernet communication 11: Reserved 12: Pulse train AB 13: EtherCAT/PROFINET communication 14: Programmable expansion card 15: PROFIBUS-DP/DeviceNet communication	0
P00.11	ACC time 1	0.0–3600.0s	Model depended
P00.12	DEC time 1	0.0–3600.0s	Model depended
P05.01–P05.04	Digital input function selection	26: Pause wobbling frequency (stopped at the present frequency) 27: Reset wobbling frequency (returned to the center frequency)	/
P08.15	Amplitude of wobbling frequency	0.0–100.0% (relative to set frequency)	0.0%
P08.16	Amplitude of sudden jump frequency	0.0–50.0% (relative to amplitude of wobbling frequency)	0.0%
P08.17	Rise time of wobbling frequency	0.1–3600.0s	5.0s
P08.18	Fall time of wobbling frequency	0.1–3600.0s	5.0s

5.6.18 Master/slave control

The inverter unit supports the master/slave control function, which means that multiple inverter units can carry the same load. The master/slave control mode of speed synchronization and power balance is supported.

Function code	Name	Description	Range
P28.00	Master/slave mode	1: The local device is the master. 2: The local device is the slave.	0
P28.01	Master/slave communication data selection	0: CAN2 1: Reserved	0
P28.02	Master/slave control mode	Ones place: Master/slave running mode selection 0: Master/slave mode 0 The master and slave use speed control, with power balanced through droop control. 1: Master/slave mode 1 The master and slave must be in the same type of vector control. When the master is in speed control, the slave is forced into torque control. 2: Combination mode The slave switches from speed mode (master/slave mode 0) to torque mode (master/slave mode 1) at a frequency point. Tens place: Slave start command source 0: Master 1: Determined by P00.01 Hundreds place: Whether to enable master/slave to send/receive data 0: Enable 1: Disable	0x001
P28.03	Slave speed gain	0.0–500.0%	100.0%
P28.04	Slave torque gain	0.0–500.0%	100.0%
P28.05	Frequency point for switching between master/slave mode 2, speed mode, and torque mode	0.00–10.00Hz	5.00
P28.06	Number of slaves	0–15	1
P28.07	Master/slave CAN communication timeout period	0.0 (Invalid); 0.1–60.0s	5.0s
P28.08	Master/slave CAN communication address	0–127	1
P28.09	Master/slave CAN communication baud rate	0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	2
P28.10	Slave torque offset	-100.0%–100.0%	0

5.6.19 Commissioning procedures for closed-loop control, position control and spindle positioning

1. Commissioning procedure for closed-loop vector control on AMs

Step 1 Restore to default value via keypad.

Step 2 Set P00.03, P00.04 and P02 group motor nameplate parameters

Step 3 Perform motor parameter autotuning.

Carry out rotary parameter autotuning or static parameter autotuning through the keypad, if the motor can be disconnected from load, then you can carry out rotary parameter autotuning; otherwise, carry out static parameter autotuning, the parameter obtained from autotuning will be saved in P02 motor parameter group automatically.

Step 4 Verify whether the encoder is installed and set properly.

a) Confirm the encoder direction and parameter setup

Set P20.01 (encoder pulse-per-revolution), set P00.00=2 and P00.10=20Hz, and run the VFD, at this point, the motor rotates at 20Hz, observe whether the speed measurement value of P18.00 is correct, if the value is negative, it indicates the encoder direction is reversed, under such situation, set P20.02 to 1; if the speed measurement value deviates greatly, it indicates P20.01 is set improperly. Observe whether P18.02 (encoder Z pulse count value) fluctuates, if yes, it indicates the encoder suffers interference or P20.01 is set improperly, check the wiring and the shielding layer.

b) Determine Z pulse direction

Set P00.10=20Hz, and set P00.13 (running direction) to forward and reverse direction respectively to observe whether the difference value of P18.02 is less than 5, if the difference value remains to be larger than 5 after setting Z pulse reversal function of P20.02, power off and exchange phase A and phase B of the encoder, and then observe the difference between the value of P18.02 during forward and reverse rotation. Z pulse direction only affects the forward/reverse positioning precision of the spindle positioning carried out with Z pulse.

Step 5 Perform closed-loop vector pilot-run.

Set P00.00=3, and carry out closed-loop vector control, adjust P00.10 and speed loop and current loop PI parameter in P03 group to make it run stably in the whole range.

Step 6 Perform flux-weakening control.

Set flux-weakening regulator gain P03.26=0–8000, and observe the flux-weakening control effect. P03.22–P03.24 can be adjusted as needed.

2. Commissioning procedure for closed-loop vector control on SMs

Step 1 Set P00.18=1, restore to default value

Step 2 Set P00.00=3 (VC), set P00.03, P00.04, and motor nameplate parameters in P02 group.

Step 3 Set P20.01 encoder parameter.

When the encoder is resolver-type encoder, set the encoder pulse count value to (resolver pole pair number × 1024). For example, if pole pair number is 4, set P20.01 to 4096.

Step 4 Ensure the encoder is installed and set correctly.

When motor stops, observe whether P18.21 (resolver angle) fluctuates, if it fluctuates sharply, check the wiring and grounding. Rotates the motor slowly, observe whether P18.21 changes accordingly. If yes, it indicates motor is connected correctly; if the value of P18.02 keeps constant at a non-zero value after rotating for multiple circles, it indicates encoder Z signal is correct.

Step 5 Autotune the initial position of magnetic pole.

Set P20.11=2 or 3 (3: rotary autotuning; 2: static autotuning), press the RUN key to run the VFD.

a) Rotary autotuning (P20.11 = 3)

Detect the position of current magnetic pole when autotuning starts, and then accelerates to 10Hz, autotuning corresponding magnetic pole position of encoder Z pulse, and decelerate to stop.

During running, if ENC1O or ENC1D fault occurred, set P20.02=1 and carry out autotuning again.

After autotuning is done, the angle obtained from autotuning will be saved in P20.09 and P20.10 automatically.

b) Static autotuning

In cases where the load can be disconnected, it is recommended to adopt rotary autotuning (P20.11=3) as it has high angle precision. If the load cannot be disconnected, you can adopt static autotuning (P20.11=2). The magnetic pole position obtained from autotuning will be saved in P20.09 and P20.10.

Step 6 Perform closed-loop vector pilot-run.

Adjust P00.10 and speed loop and current loop PI parameter in P03 group to make it run stably in the whole range. If oscillation occurred, reduce the value of P03.00, P03.03, P03.09 and P03.10. If current oscillation noise occurred during low speed, adjust P20.05.

Note: It is necessary to re-determine P20.02 (encoder direction) and carry out magnetic pole position autotuning again if the wiring of motor or encoder is changed.

3. Commissioning procedure for pulse string control

Pulse input is operated based on closed-loop vector control; speed detection is needed in the subsequent spindle positioning, zeroing operation and division operation.

Step 1 Restore to default value by keypad

Step 2 Set P00.03, P00.04 and motor nameplate parameters in P02 group

Step 3 Motor parameter autotuning: rotary parameter autotuning or static parameter autotuning

Step 4 Verity the installation and settings of encoder. Set P00.00=3 and P00.10=20Hz to run the system, and check the control effect and performance of the system.

Step 5 Set P21.00=0001 to set positioning mode to position control, namely pulse-string control. There are four kinds of pulse command modes, which can be set by P21.01 (pulse command mode).

Under position control mode, you can check high-order bit and low-order bit of position reference and feedback, P18.02 (count value of Z pulse), P18.00 (actual frequency of encoder), P18.17 (pulse command frequency) and P18.19 (position regulator output) via P18, through which you can figure out the relation between P18.08 (position of position reference point) and P18.02, pulse command frequency P18.17, feedforward P18.18 and position regulator output P18.19.

Step 6 The position regulator has two gains, namelyP21.02 and P21.03, and they can be switched by speed command, torque command and terminals.

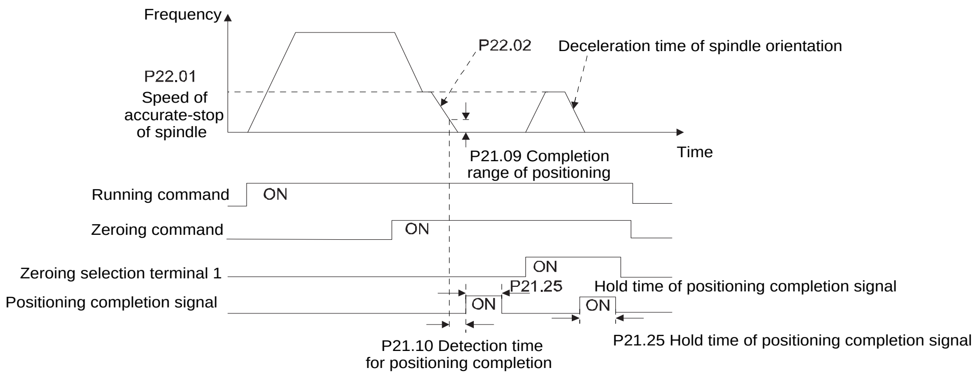
Step 7 When P21.08 (output limit of position controller) is set to 0, the position control will be invalid, and at this point, the pulse string acts as frequency source, P21.13 (position feedforward gain) should be set to 100%, and the speed acceleration/deceleration time is determined by the acceleration /deceleration time of pulse string, the pulse string acceleration/deceleration time of the system can be adjusted. If the pulse string acts as the frequency source in speed control, you can also set P21.00 to 0000, and set the frequency source reference P00.06 or P00.07 to 12 (set by pulse string AB), at this point, the acceleration/deceleration time is determined by the acceleration/deceleration time of the VFD, meanwhile, the parameters of pulse string AB is still set by P21 group. In speed mode, the filter time of pulse string AB is determined by P21.29.

Step 8 The input frequency of pulse string is the same with the feedback frequency of encoder pulse, the relation between them can be changed by altering P21.11 (numerator of position command ratio) and P21.12 (denominator of position command ratio)

Step 9 When running command or servo enabling is valid (by setting P21.00 or terminal function 63), it will enter pulse string servo running mode.

4. Commissioning procedure for spindle positioning

Spindle positioning is to realize orientation functions like zeroing and division based on closed-loop vector control



Steps 1–4: These four steps are the same with the first four steps of the commissioning procedures for closed-loop vector control, which aim to fulfill the control requirements of closed-loop vector control, thus realizing spindle positioning function in either position control or speed control mode.

Step 5 Set P22.00.bit0=1 to enable spindle positioning, set P22.00.bit1 to select spindle zero input. If the system adopts encoder for speed measurement, set P22.00.bit1 to 0 to select Z pulse input; if the system adopts photoelectric switch for speed measurement, set P22.00.bit1 to 1 to select photoelectric switch as zero input; set P22.00.bit2 to select zero search mode, set P22.00.bit3 to enable or disable zero calibration, and select zero calibration mode by setting P22.00.bit7.

Step 6 Perform spindle zeroing operation.

a) Select the positioning direction by setting P22.00.bit4.

b) There are four zero positions in P22 group, you can choose one out of four zeroing positions by setting zeroing input terminal selection (46, 47) in P05 group. When executing zeroing function, the motor will stop accurately at corresponding zeroing position according to the set positioning direction, which can be viewed via P18.10.

c) The positioning length of spindle zeroing is determined by the deceleration time of accurate-stop and the speed of accurate-stop.

Step 7 Perform spindle division.

There are seven scale-division positions in P22 group, you can choose one out of seven scale-division positions by setting scale-division input terminal selection (48, 49, 50) in P05 group. Enable corresponding scale-division terminal after the motor stops accurately, and the motor will check the scale-division position state and switch to corresponding position incrementally, at this point, you can check P18.09.

Step 8 Determine the priority of speed control, position control and zeroing.

The priority level of speed running is higher than that of the scale division, when the system runs in scale-division mode, if spindle orientation is prohibited, the motor will turn to speed mode or position mode.

The priority level of zeroing is higher than that of the scale division.

Scale-division command is valid when the scale-division terminal is from 000 state to non-000 state, such as, in 000–011, the spindle executes scale division 3. The transition time during terminal switchover needs to be less than 10ms; otherwise, wrong scale division command may be executed.

Step 9 Hold positioning.

The position loop gain during positioning is P21.03; while the position loop gain in positioning-completion-hold state is P21.02. In order to keep sufficient position-hold force and ensure no system oscillation occurred, adjust P03.00, P03.01, P20.05, and P21.02.

Step 10 Select the positioning command (bit6 of P22.00).

Electric level signal: Positioning command (zeroing and scale division) can be executed only when there is running command or the servo is enabled.

Step 11 Select the spindle reference point (bit0 of P22.00).

Encoder Z pulse positioning supports the following spindle positioning modes:

a) The encoder is installed on the motor shaft, the motor shaft and spindle is 1:1 rigid connection;

b) The encoder is installed on the motor shaft, the motor shaft and spindle is 1:1 belt connection;

At this point, the belt may slip during high-speed running and cause inaccurate positioning, it is recommended to install proximity switch on the spindle.

c) The encoder is installed on the spindle, and the motor shaft is connected to the spindle with belt, the drive ratio is not necessarily 1:1.

At this point, set P20.06 (speed ratio of the mounting shaft between motor and encoder), and set P22.14 (spindle drive ratio) to 1. As the encoder is not installed on the motor, the control performance of closed-loop vector will be affected.

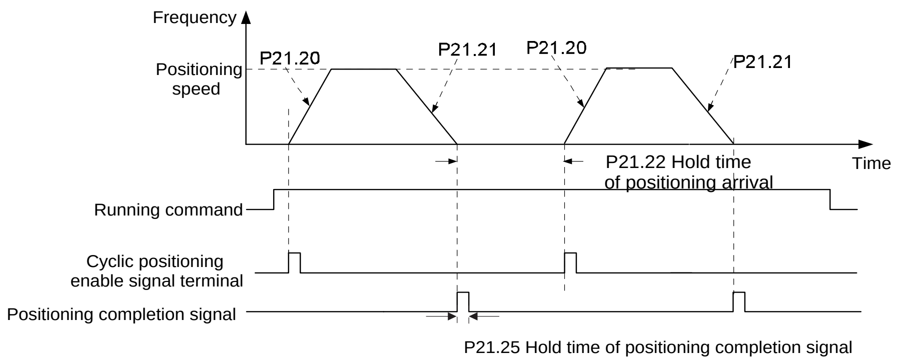
Proximity switch positioning supports the following spindle positioning modes:

a) The encoder is installed on the motor shaft, the drive ratio between motor shaft and spindle is not necessarily 1:1;

At this point, it is required to set P22.14 (spindle drive ratio).

5. Commissioning procedures for digital positioning

The diagram for digital positioning is as follows.



Step 1–4: These four steps are the same with the first four steps of the commissioning procedures for closed-loop vector control, which aim to fulfill the control requirements of closed-loop vector control.

Step 5 Set P21.00=0011 to enable digital positioning. Set P21.17, P21.11 and P21.12 (set positioning displacement) according to actual needs; set P21.18 and P21.19 (set positioning speed); set P21.20 and P21.21 (set acceleration/deceleration time of positioning).

Step 6 Perform a single positioning operation.

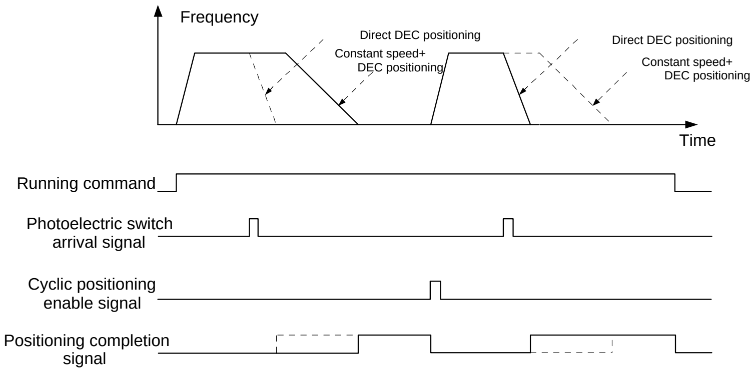
Set P21.16.bit1=0, and the motor will carry out single positioning action and stay in the positioning position according to the setup in step 5.

Step 7 Perform cyclic positioning operation.

Set P21.16.bit1=1 to enable cyclic positioning. The cyclic positioning is divided into continuous mode and repetitive mode; you can also carry out cyclic positioning through terminal function (no. 55, enable digital positioning cycle).

6. Commissioning procedure for positioning of photoelectric switch

Photoelectric switch positioning is to realize positioning function based on closed-loop vector control.



Step 1–4: These four steps are the same with the first four steps of the commissioning procedures for closed-loop vector control, which aim to fulfill the control requirements of closed-loop vector control.

Step 5 Set P21.00=0021 to enable photoelectric switch positioning, the photoelectric switch signal can be connected to S8 terminal only, and set P05.08=43, meanwhile, set P21.17, P21.11 and P21.12 (set positioning displacement) based on actual needs; set P21.21 (deceleration time of positioning), however, when present running speed is too fast or the set positioning displacement is too small, the deceleration time of positioning will be invalid, and it will enter direct deceleration positioning mode.

Step 6 Perform cyclic positioning.

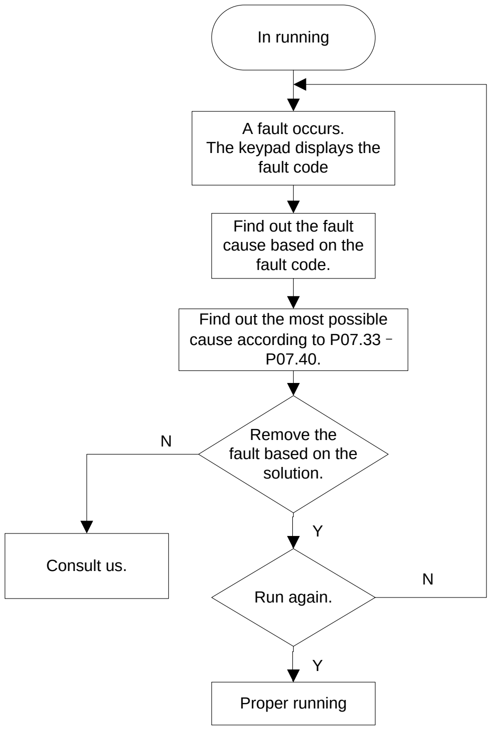
After positioning is done, the motor will stay in current position. You can set cyclic positioning through input terminal function selection (55: enable cyclic digital positioning) in P05 group; when the terminal receives cyclic positioning enable signal (pulse signal), the motor will continue running in the set speed as per the speed mode and re-enter positioning state after encountering photoelectric switch.

Step 7 Hold positioning.

The position loop gain during positioning is P21.03; while the position loop gain in positioning-completion-hold state is P21.02. In order to keep sufficient position-hold force and ensure no system oscillation occurred, adjust P03.00, P03.01, P20.05, and P21.02.

5.6.20 Fault handling

The following describes how to handle inverter unit faults.



Related parameter list:

Function code	Name	Description	Default
P07.27	Type of present fault	0: No fault	0
P07.28	Last fault type	1: Inverter unit U-phase protection (OUt1)	/
P07.29	2nd-last fault type	2: Inverter unit V-phase protection (OUt2)	/
P07.30	3rd-last fault type	3: Inverter unit W-phase protection (OUt3)	/
P07.31	4th-last fault type	4: Overcurrent during acceleration (OC1)	/
P07.32	5th-last fault type	5: Overcurrent during deceleration (OC2) 6: Overcurrent during constant speed running (OC3) 7: Overvoltage during acceleration (OV1) 8: Overvoltage during deceleration (OV2) 9: Overvoltage during constant speed running (OV3) 10: Bus undervoltage fault (UV) 11: Motor overload (OL1) 12: Inverter unit overload (OL2) 13: CAN fault in master/slave synchronization (SECAN) 14: Phase loss on output side (SPO) 15: Reserved 16: Inverter module overheat (OH2) 17: External fault (EF) 18: RS485 communication fault (CE) 19: Current detection fault (ItE) 20: Motor autotuning fault (tE) 21: EEPROM operation error (EEP) 22: PID feedback offline fault (PIDE) 23: CAN slave fault in master/slave synchronization (S-Err) 24: Running time reached (END)	/

Function code	Name	Description	Default
		25: Electronic overload (OL3) 26: Keypad communication error (PCE) 27: Parameter upload error (UPE) 28: Parameter download error (DNE) 29: PROFIBUS communication fault (E_dP) 30: Ethernet communication fault (E_NET) 31: CANopen communication fault (E_CAN) 32: To-ground short-circuit fault 1 (ETH1) 33: To-ground short-circuit fault 2 (ETH2) 34: Speed deviation fault (dEu) 35: Mal-adjustment fault (STo) 36: Underload fault (LL) 37: Encoder disconnection fault (ENC1O) 38: Encoder direction reversal fault (ENC1D) 39: Encoder Z-pulse disconnection fault (ENC1Z) 40: Safe torque off (STO) 41: Channel 1 safety circuit exception (STL1) 42: Channel 2 safety circuit exception (STL2) 43: Exception in both channels 1 and 2 (STL3) 44: Safety code FLASH CRC fault (CrCE) 45: Programmable card customized fault 1 (P-E1) 46: Programmable card customized fault 2 (P-E2) 47: Programmable card customized fault 3 (P-E3) 48: Programmable card customized fault 4 (P-E4) 49: Programmable card customized fault 5 (P-E5) 50: Programmable card customized fault 6 (P-E6) 51: Programmable card customized fault 7 (P-E7) 52: Programmable card customized fault 8 (P-E8) 53: Programmable card customized fault 9 (P-E9) 54: Programmable card customized fault 10 (P-E10) 55: Duplicate expansion card type (E-Err) 56: Encoder UVW lost (ENCUV) 57: PROFINET communication timeout fault (E_PN) 58: Reserved 59: Motor overtemperature fault (OT) 60: Failure to identify the card at slot 1 (F1-Er) 61: Failure to identify the card at slot 2 (F2-Er) 62: Reserved 63: Communication timeout of the card at slot 1 (C1-Er) 64: Communication timeout of the card at slot 2 (C2-Er)	
P07.33	Running frequency at present fault		0.00Hz
P07.34	Ramp reference frequency at present fault		0.00Hz
P07.35	Output current at present fault		0V
P07.36	Output current at present fault		0.0A
P07.37	Bus voltage at present fault		0.0V
P07.38	Max. temperature at present fault		0.0°C

Function code	Name	Description	Default
P07.39	Input terminal status at present fault		0
P07.40	Output terminal status at present fault		0
P07.41	Running frequency at last fault		0.00Hz
P07.42	Ramp reference frequency at last fault		0.00Hz
P07.43	Output voltage at last fault		0V
P07.44	Output current at last fault		0.0A
P07.45	Bus voltage at last fault		0.0V
P07.46	Temperature at last fault		0.0°C
P07.47	Input terminal status at last fault		0
P07.48	Output terminal status at last fault		0
P07.49	Running frequency at 2nd-last fault		0.00Hz
P07.50	Ramp reference frequency at 2nd-last fault		0.00Hz
P07.51	Output voltage at 2nd-last fault		0V
P07.52	Output current at 2nd-last fault		0.0A
P07.53	Bus voltage at 2nd-last fault		0.0V
P07.54	Temperature at 2nd-last fault		0.0°C
P07.55	Input terminal status at 2nd-last fault		0
P07.56	Output terminal status at 2nd-last fault		0

5.7 Workshop introduction

The upper PC software Workshop is the backend software for VFD commissioning.

The Workshop enables you to monitor the VFD, set parameters, and perform oscilloscope and emergency stop on the PC in real time. For details about the Workshop, contact our marketing and technical support personnel.

Note: When connecting to the PC, you need to use the USB-RS485 communication module (model: EC-TM485-USB). For details, see the description for EC-TM485-USB in Appendix E Optional peripheral accessories.

6 Communication networking

6.1 What this chapter contains

This chapter decribes the standard communication protocols of the VFD rectifier/inverter units and the various networking methods between the rectifier and inverter units.

The rectifier and inverter units are equipped with standard RS485 and CAN communication interfaces, and support Modbus and CANopen slave communication protocols.

In addition to supporting Modbus and CANopen slave communication protocols, the rectifier unit also has the CANopen master function. By enabling the CANopen master function of the rectifier unit, it can form a CANopen communication network with the inverter unit.

The rectifier/inverter unit is equipped with two expansion interfaces respectively, which support different types of communication expansion cards. With expansion cards, the rectifier and inverter units can be networked together in a variety of communication networks.

In addition, the rectifier master node has the CANopen master function, which can convert different types of communication protocols into CANopen protocols between the inverter units to form a communication network.

6.2 Standard communication interfaces

The rectifier and inverter units are equipped with standard RS485 and CAN communication interfaces. The communication terminals are decribed in the following.

Table 6-1 Rectifier/inverter unit RJ45 interface definition

Interface type	Network signal	Signal description	Function
RJ45	RS485+ RS485-	RS485 communication	Internal RS485 communication terminals, used to connect the external keypad.
	CAN1H CAN1L	CAN communication	Internal CAN communication terminals. CAN communication supports the CANopen protocol.
	8V CGND	External keypad power supply	Voltage precision 10%, and current 100 mA

Table 6-2 Standard communication terminals for rectifier/inverter control

Interface type	Network signal	Signal description	Function
IO terminal	C485+ C485-	RS485 communication	Terminal for external RS485 communication, supporting the Modbus communication protocol

6.3 Modbus networking

6.3.1 Network topology

The Modbus bus networking wiring is shown in Figure 6-1. It is recommended to use shielded twisted pair cable, with the shield layer connected to CGND, and use 120Ω termination matching resistors at both ends of the bus to prevent signal reflection.

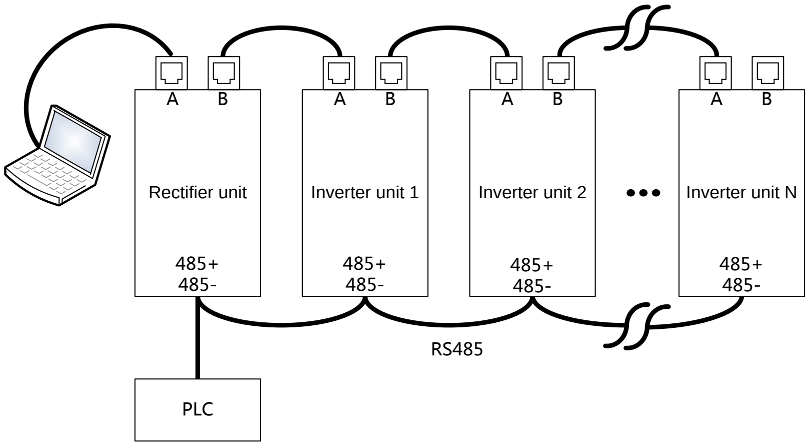


Figure 6-1 Network topology

6.3.2 RTU mode

6.3.2.1 RTU communication frame structure

When a controller is set to use the RTU communication mode on a Modbus network, every byte (8 bits) in the message includes 2 hexadecimal characters (each includes 4 bits). Compared with the ASCII mode, the RTU mode can help to send more data at the same baud rate.

Code system

- 1 start bit
- 7 or 8 data bits; the minimum valid bit is sent first. Each frame domain of 8 bits includes 2 hexadecimal characters (0–9, A–F).
- 1 odd/even check bit; this bit is not provided if no check is needed.
- 1 stop bit (with check performed), or 2 bits (without check)

Error detection domain

- Cyclic redundancy check (CRC)

The following table describes the data format.

11-bit character frame (Bits 1 to 8 are data bits):

Start bit	BIT1	BIT2	BIT3	BIT4	BIT5	BIT6	BIT7	BIT8	Parity bit	Stop bits

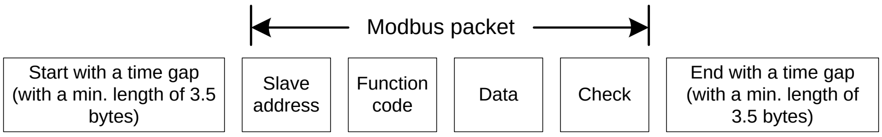
10-bit character frame (Bits 1 to 7 are data bits):

Start bit	BIT1	BIT2	BIT3	BIT4	BIT5	BIT6	BIT7	Parity bit	Stop bits

In a character frame, only the data bits carry information. The start bit, check bit, and stop bit are used to facilitate the transmission of the data bits to the destination device. In practical applications, you must set the data bits, parity check bits, and stop bits consistently.

In RTU mode, a new frame always must be preceded by a time gap with a minimum length of 3.5 bytes. On a network where the transmission rate is calculated based on the baud rate, the transmission time of 3.5 bytes can be easily obtained. After the idle time ends, the data domains are sent in the following sequence: slave address, operation command code, data, and CRC check character. Each byte sent in each domain includes hexadecimal characters (0–9, A–F). The network devices always monitor the communication bus. After receiving the first domain (address information), each network device identifies the byte. After the last byte is sent, a similar transmission interval (with a minimum length of 3.5 bytes) is used to indicate that the frame transmission ends. Then, the transmission of a new frame starts.

RTU data frame format



The information of a frame must be sent in a continuous data flow. If there is an interval greater than the transmission time of 1.5 bytes before the transmission of the entire frame is complete, the receiving device deletes the incomplete information, and mistakes the subsequent byte for the address domain of a new frame. Similarly, if the transmission interval between two frames is shorter than the transmission time of 3.5 bytes, the receiving device mistakes it for the data of the last frame. The CRC check value is incorrect due to the disorder of the frames, and thus a communication fault occurs.

The following table describes the standard structure of an RTU frame.

START (frame header)	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR (slave address domain)	Communication address: 0–247 (in decimal system) (0 indicates the broadcast address)
CMD (function domain)	03H: read slave parameters 06H: write slave parameters
(Data domain) DATA (N-1) ... DATA (0)	Data of 2*N bytes, main content of the communication as well as the core of data exchanging
CRC CHK low-order bits	Detection value: CRC (16 bits)
CRC CHK high-order bits	
END (frame tail)	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

6.3.2.2 RTU communication frame error check modes

During the transmission of data, errors may occur due to various factors. Without check, the data receiving device cannot identify data errors and may make a wrong response. The wrong response may cause severe problems. Therefore, the data must be checked.

The check is implemented as follows: The transmitter calculates the to-be-transmitted data based on a specific algorithm to obtain a result, adds the result to the rear of the message, and transmits them together. After receiving the message, the receiver calculates the data based on the same algorithm to obtain a result, and compares the result with that transmitted by the transmitter. If the results are the same, the message is correct. Otherwise, the message is considered wrong.

The error check of a frame includes two parts, namely, bit check on individual bytes (that is, odd/even check using the check bit in the character frame), and whole data check (CRC check).

Bit check on individual bytes (odd/even check)

You can select the bit check mode as required, or you can choose not to perform the check, which will affect the check bit setting of each byte.

Definition of even check: Before the data is transmitted, an even check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is even, the check bit is set to "0"; and if it is odd, the check bit is set to "1".

Definition of odd check: Before the data is transmitted, an odd check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is odd, the check bit is set to "0"; and if it is even, the check bit is set to "1".

For example, the data bits to be transmitted are "11001110", including five "1". If the even check is applied, the even check bit is set to "1"; and if the odd check is applied, the odd check bit is set to "0". During the transmission of the data, the odd/even check bit is calculated and placed in the check bit of the frame. The receiving device performs the odd/even check after receiving the data. If it finds that the odd/even parity of the data is inconsistent with the preset information, it determines that a communication error occurs.

Cyclical Redundancy Check (CRC) method

A frame in the RTU format includes an error detection domain based on the CRC calculation. The CRC domain checks all the content of the frame. The CRC domain consists of two bytes, including 16 binary bits. It is calculated by the transmitter and added to the frame. The receiver calculates the CRC of the received frame, and compares the result with the value in the received CRC domain. If the two CRC values are not equal to each other, errors occur in the transmission.

During CRC, 0xFFFF is stored first, and then a process is invoked to process a minimum of 6 contiguous bytes in the frame based on the content in the current register. CRC is valid only for the 8-bit data in each character. It is invalid for the start, end, and check bits.

During the generation of the CRC values, the "exclusive or" (XOR) operation is performed on the each 8-bit character and the content in the register. The result is placed in the bits from the low-order bit to the high-order bit, and 0 is placed in the high-order bit. Then, the low-order bit is detected. If the low-order bit is 1, the XOR operation is performed on the current value in the register and the preset value. If low-order bit is 0, no operation is performed. This process is repeated 8 times. After the last bit (8th bit) is detected and processed, the XOR operation is performed on the next 8-bit byte and the current content in the register. The final values in the register are the CRC values obtained after operations are performed on all the bytes in the frame.

The calculation adopts the international standard CRC check rule. You can refer to the related standard CRC algorithm to compile the CRC calculation program as required.

The following example is a simple CRC calculation function for your reference (using the C programming language):

```
unsigned int crc_cal_value (unsigned char*data_value,unsigned char data_length)
{
    int i;
    unsigned int crc_value=0xffff;
    while (data_length--)
    {
        crc_value^=*data_value++;
        for (i=0;i<8;i++)
        {
            if (crc_value&0x0001)
                crc_value= (crc_value>>1)^0xa001;
            else
                crc_value=crc_value>>1;
        }
    }
    return (crc_value);
}
```

In the ladder logic, CKSM uses the table look-up method to calculate the CRC value according to the content in the frame. The program of this method is simple, and the calculation is fast, but the ROM space occupied is large. Use this program with caution in scenarios where there are space occupation requirements on programs.

6.3.3 RTU command code and communication data

6.3.3.1 Command code 03H, reading N words (continuously up to 16 words)

The command code 03H is used by the master to read data from the VFD. The count of data to be read depends on the "data count" in the command. A maximum of 16 pieces of data can be read. The addresses of the read parameters must be contiguous. Each piece of data occupies 2 bytes (that is, one word). The command format is uses the hexadecimal system (a number followed by "H" indicates a hexadecimal value). One hexadecimal value occupies one byte.

The command is used to read the parameters and working status of the VFD.

For example, starting from the data address of 0004H, to read two contiguous pieces of data (that is, to read content from 0004H to 0005H) of the VFD whose address is 01H, the frame structures are described in the following.

RTU master command (sent from the master to the VFD):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR (address)	01H
CMD (command code)	03H
Start address high-order bit	00H
Start address low-order bit	04H
Data count high-order bit	00H
Data count low-order bit	02H
CRC low-order bit	85H
CRC high-order bit	CAH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

"START" and "END" are "T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)", indicating that a time gap with a minimum length of 3.5 bytes must be kept before RS485 communication is executed. The time gap is used to distinguish one message from another so that the two messages are not regarded as one message.

"ADDR" is "01H", indicating that the command is sent to the VFD whose address is 01H. "ADDR" occupies one byte.

"CMD" is "03H", indicating that the command is used to read data from the VFD. "CMD" occupies one byte.

"Start address" indicates that data reading is started from this address. It occupies two bytes, with the high-order bit on the left and low-order bit on the right.

"Data count" indicates the count of data to be read (unit: word). "Start address" is "0004H" and "Data count" is 0002H, indicating that data is to be read from the data addresses of 0004H and 0005H.

CRC check occupies two bytes, with the low-order bit on the left and high-order bit on the right.

RTU slave response (sent from the VFD to the master):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	03H
Number of bytes	04H
High-order bit of data in 0004H	13H
Low-order bit of data in 0004H	88H
High-order bit of data in 0005H	00H
Low-order bit of data in 0005H	00H
CRC low-order bits	7EH
CRC high-order bits	9DH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

The definition of the response information is described as follows:

"ADDR" is "01H", indicating that the message is sent from the VFD whose address is 01H. "ADDR" occupies one byte.

"CMD" is "03H", indicating that the message is a VFD response to the 03H command from the master for reading data. "CMD" occupies one byte.

"Number of bytes" indicates the number of bytes between a byte (not included) and the CRC byte (not included). The value "04" indicates that there are four bytes of data between "Number of bytes" and "CRC low-order bit", that is, "High-order bit of data in 0004H", "Low-order bit of data in 0004H", "High-order bit of data in 0005H", and "Low-order of data in 0005H".

A piece of data is two bytes, with the high-order bits on the left and low-order bit on the right. From the response, the data in 0004H is 1388H, and that in 0005H is 0000H.

CRC check occupies two bytes, with the low-order bit on the left and high-order bit on the right.

6.3.3.2 Command word 06H, writing a word

This command is used by the master to write data to the VFD. One command can be used to write only one piece of data. It is used to modify the parameters and running mode of the VFD.

For example, to write 5000 (1388H) to 0004H of the VFD whose address is 02H, the frame structures are described in the following.

RTU master command (sent from the master to the VFD):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	06H
High-order bit of data writing address	00H
Low-order bit of data writing address	04H
Data content high-order bit	13H
Data content low-order bit	88H
CRC low-order bit	C5H
CRC high-order bit	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

RTU slave response (sent from the VFD to the master):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	06H
High-order bit of data writing address	00H
Low-order bit of data writing address	04H
Data content high-order bit	13H
Data content low-order bit	88H
CRC low-order bit	C5H
CRC high-order bit	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

6.3.3.3 Command code 08H, diagnosis

Sub-function code description:

Sub-function code	Description
0000	Return data based on query requests

For example, to query about the circuit detection information about the VFD whose address is 01H, the query and return strings are the same, and the formats are described in the following tables.

RTU master command:

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code high-order bit	00H
Sub-function code low-order bit	00H
Data content high-order bit	12H
Data content low-order bit	ABH
CRC CHK low-order bit	ADH
CRC CHK high-order bit	14H
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

RTU slave response:

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code high-order bit	00H
Sub-function code low-order bit	00H
Data content high-order bit	12H
Data content low-order bit	ABH
CRC CHK low-order bit	ADH
CRC CHK high-order bit	14H
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

6.3.3.4 Command code 10H, continuous writing

The command code 10H is used by the master to write data to the VFD. The quantity of data to be written is determined by "Data count", and a maximum of 16 pieces of data can be written.

For example, to write 5000 (1388H) and 50 (0032H) respectively to 0004H and 0005H of the VFD whose slave address is 02H, the frame structures are described in the following.

RTU master command (sent from the master to the VFD):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	10H
High-order bit of data writing address	00H
Low-order bit of data writing address	04H
Data count high-order bit	00H
Data count low-order bit	02H
Number of bytes	04H

Content high-order bit of 0004H	13H
Content low-order bit of 0004H	88H
Content high-order bit of 0005H	00H
Content low-order bit of 0005H	32H
CRC low-order bit	C5H
CRC high-order bit	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

RTU slave response (sent from the VFD to the master):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	10H
High-order bit of data writing address	00H
Low-order bit of data writing address	04H
Data count high-order bit	00H
Data count low-order bit	02H
CRC low-order bit	C5H
CRC high-order bit	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

6.3.4 Data address definition

This section describes the address definition of communication data. The addresses are used for controlling the running, obtaining the status information, and setting function parameters of the VFD.

6.3.4.1 Function code address format rules

The address of a function code consists of two bytes, with the high-order bit on the left and low-order bit on the right. The high-order bit ranges from 00 to ffH, and the low-order bit also ranges from 00 to ffH. The high-order bit is the hexadecimal form of the group number before the dot mark, and low-order bit is that of the number behind the dot mark. Take P05.02 as an example: The group number is 05, that is, the high-order bit of the parameter address is the hexadecimal form of 05; and the number behind the dot mark is 02, that is, the low-order bit is the hexadecimal form of 02. Therefore, the function code address is 0502H in the hexadecimal form. For example, the parameter address of P10.01 is 0A01H.

Function code	Name	Description	Default
P10.00	Simple PLC mode	0: Stop after running once 1: Keep running with the final value after running once 2: Cyclic running	0
P10.01	Simple PLC memory selection	0: Without memory after power-off 1: With memory after power-off	0

Note:

- The parameters in the P99 group are set by the manufacturer and cannot be read or modified. Some parameters cannot be modified when the VFD is running; some cannot be modified regardless of the VFD status. Pay attention to the setting range, unit, and description of a parameter when modifying it.
- The service life of the Electrically Erasable Programmable Read-Only Memory (EEPROM) may be reduced if it is frequently used for storage. Some function codes do not need to be stored during communication. The application requirements can be met by modifying the value of the on-chip RAM, that is, modifying the MSB of the corresponding function code address from 0 to 1. For example, if P00.07 is not to be stored in the EEPROM, you need only to modify the value in the RAM, that is, set the address to 8007H. The address can be used only for writing data to the on-chip RAM, and it is invalid when used for reading data.

6.3.4.2 Addresses of other Modbus functions

In addition to modifying the parameters of the VFD, the master can also control the VFD, such as starting and stopping it, and monitoring the operation status of the VFD. The following table describes other function parameters.

Rectifier unit

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Forward running	R/W
		0005H: Stop	
		0006H: Coast to stop	
		0007H: Fault reset	
VFD status word 1	2100H	0001H: Running	R
		0003H: Stopped	
		0004H: Faulty	
		0005H: POFF	
VFD status word 2	2101H	Bit0: =0: Not ready to run =1: Ready to run Bit15–1: Reserved	R
VFD fault code	2102H	See the description of fault types.	R
VFD identification code	2103H	GD600 rectifier unit-----0x01B1 GD600 inverter unit-----0x01B2	R
Bus voltage	3002H	0.0–2000.0V (Unit: 0.1V)	R
Input IO status	3009H	000–1FF	R
Output IO status	300AH	000–1FF	R

Inverter unit

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Forward running	R/W
		0002H: Reverse running	
		0003H: Forward jogging	
		0004H: Reverse jogging	
		0005H: Stop	
		0006H: Coast to stop	
		0007H: Fault reset	
		0008H: Jogging to stop	
Communication-based setting address	2001H	Communication-based frequency setting (0–Fmax, unit: 0.01 Hz)	R/W
	2002H	PID reference (0–1000, in which 1000 corresponds to 100.0%)	
	2003H	PID feedback (0–1000, in which 1000 corresponds to 100.0%)	R/W
	2004H	Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W
	2005H	Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz)	R/W
	2006H	Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz)	R/W
	2007H	Upper limit of the electromotion torque (0–3000, 1000 corresponding to 100.0% of the VFD rated current)	R/W
	2008H	Upper limit of the brake torque (0–3000, 1000 corresponding to 100.0% of the motor rated current)	R/W

<table>
<tr><th>Function</th><th>Address</th><th colspan="2">Data description</th><th>R/W</th></tr>
<tr><td rowspan="6"></td><td>2009H</td><td colspan="2">Special control command word:
Bit0–1: =00: Motor 1 =01: Motor 2
Bit2: =1 Enable speed/torque control switchover
=0: Disable speed/torque control switchover
Bit3: =1 Clear electricity consumption
=0: Not clear electricity consumption
Bit4: =1 Pre-excitation; =0: Disable pre-excitation
Bit5: =1 DC braking =0: Disable DC braking</td><td>R/W</td></tr>
<tr><td>200AH</td><td colspan="2">Virtual input terminal command, range: 0x000–0x3FF
Corresponding to S8/S7/S6/S5/Reserved/ Reserved /S4/ S3/ S2/S1</td><td>R/W</td></tr>
<tr><td>200BH</td><td colspan="2">Virtual output terminal command. Range: 0x00–0x0F
Corresponding to local RO2/RO1/Reserved/Y1</td><td>R/W</td></tr>
<tr><td>200CH</td><td colspan="2">Voltage setting (used for V/F separation)
(0–1000, in which 1000 corresponds to 100% of the motor rated voltage)</td><td>R/W</td></tr>
<tr><td>200DH</td><td colspan="2">AO output setting 1 (-1000–+1000, 1000 corresponding to 100.0%)</td><td>R/W</td></tr>
<tr><td>200EH</td><td colspan="2">AO output setting 2 (-1000–+1000, 1000 corresponding to 100.0%)</td><td>R/W</td></tr>
<tr><td rowspan="6">VFD status word 1</td><td rowspan="6">2100H</td><td colspan="2">0001H: Forward running</td><td rowspan="6">R</td></tr>
<tr><td colspan="2">0002H: Reverse running</td></tr>
<tr><td colspan="2">0003H: Stopped</td></tr>
<tr><td colspan="2">0004H: Faulty</td></tr>
<tr><td colspan="2">0005H: POFF</td></tr>
<tr><td colspan="2">0006H: Pre-excited</td></tr>
<tr><td>VFD status word 2</td><td>2101H</td><td colspan="2">Bit0: =0: Not ready to run =1: Ready to run
Bi1–2: =00: Motor 1 =01: Motor 2
Bit3: =0: Asynchronous motor =1: Synchronous motor
Bit4: =0: No overload pre-alarm
=1: Overload pre-alarm
Bit5–Bit6: =00: Keypad-based control =01: Terminal-based control
=10: Communication-based control
Bit7: Reserved
Bit8: =0: Speed control =1: Torque control
Bit9: =0: Non position control
=1: Position control
Bit11–Bit10: =0: Vector 0 =1: Vector 1
=2: Closed-loop vector
=3: Space voltage vector</td><td>R</td></tr>
<tr><td>VFD fault code</td><td>2102H</td><td colspan="2">See the description of fault types.</td><td>R</td></tr>
<tr><td>VFD identification code</td><td>2103H</td><td colspan="2">GD600 rectifier unit-----0x01B1
GD600 inverter unit-----0x01B2</td><td>R</td></tr>
<tr><td>Running frequency</td><td>3000H</td><td>0–Fmax (Unit: 0.01Hz)</td><td rowspan="7">Compatible with CHF100A and CHV100 communication addresses</td><td>R</td></tr>
<tr><td>Set frequency</td><td>3001H</td><td>0–Fmax (Unit: 0.01Hz)</td><td>R</td></tr>
<tr><td>Bus voltage</td><td>3002H</td><td>0.0–2000.0V (Unit: 0.1V)</td><td>R</td></tr>
<tr><td>Output voltage</td><td>3003H</td><td>0–1200V (Unit: 1V)</td><td>R</td></tr>
<tr><td>Output current</td><td>3004H</td><td>0.0–3000.0A (Unit: 0.1A)</td><td>R</td></tr>
<tr><td>Rotating speed</td><td>3005H</td><td>0–65535 (Unit: 1RPM)</td><td>R</td></tr>
<tr><td>Output power</td><td>3006H</td><td>-300.0–300.0% (Unit: 0.1%)</td><td>R</td></tr>
</table>

Function	Address	Data description		R/W
Output torque	3007H	-250.0–250.0% (Unit: 0.1%)		R
Closed-loop setting	3008H	-100.0–100.0% (Unit: 0.1%)		R
Closed-loop feedback	3009H	-100.0–100.0% (Unit: 0.1%)		R
Input state	300AH	000–1FF		R
Output state	300BH	000–1FF		R
Analog input 1	300CH	0.00–10.00V (Unit: 0.01V)		R
Analog input 2	300DH	0.00–10.00V (Unit: 0.01V)		R
Analog input 3	300EH	-10.00–10.00V (Unit: 0.01V)		R
Analog input 4	300FH	/		R
Read input of high speed pulse 1	3010H	0.00–50.00kHz (Unit: 0.01Hz)		R
Read input of high speed pulse 2	3011H	/		R
Read current step of multi-step speed	3012H	0–15		R
External length	3013H	0–65535		R
External count value	3014H	0–65535		R
Torque setting	3015H	-300.0–300.0% (Unit: 0.1%)		R
Identification code	3016H	/		R
Fault code	5000H	/		R

The Read/Write (R/W) characteristics indicate whether a function can be read and written. For example, "Communication-based control command" can be written, and therefore the command code 06H is used to control the VFD. The R characteristic indicates that a function can only be read, and W indicates that a function can only be written.

Note: Some parameters in the preceding table are valid only after they are enabled. Take the running and stop operations as examples, you need to set "Running command channel" (P00.01) to "Communication", and set "Communication running command channel" (P00.02) to the Modbus communication channel. For another example, when modifying "PID setting", you need to set "PID reference source" (P09.00) to Modbus communication.

The following table describes the encoding rules of device codes (corresponding to the identification code 2103H of the VFD).

Eight high-order bits of code	Meaning	Eight low-order bits of code	Meaning
0x01	Goodrive	0x01B1	GD600 rectifier unit
		0x01B2	GD600 inverter unit

6.3.5 Fieldbus scale

In practical applications, communication data is represented in the hexadecimal form, but hexadecimal values cannot represent decimals. For example, 50.12 Hz cannot be represented in the hexadecimal form. In such cases, we can multiply 50.12 by 100 to obtain an integer 5012, and then 50.12 can be represented as 1394H (5012 in the decimal form) in the hexadecimal form.

In the process of multiplying a non-integer by a multiple to obtain an integer, the multiple is referred to as a fieldbus scale.

The fieldbus scale depends on the number of decimals in the value specified in "Setting range" or "Default". If there are *n* decimals in the value, the fieldbus scale m is the n^{th}-power of 10. Take the following table as an example, m is 10.

Function code	Name	Description	Default
P01.20	Wake-up-from-sleep delay	0.0–3600.0s (Valid when the ones place of P01.19=2)	0.0s
P01.21	Power-off restart selection	0: Disable 1: Enable	0

The value specified in "Setting range" or "Default" contains one decimal, so the fieldbus scale is 10. If the value received by the upper computer is 50, the value of "Wake-up-from-sleep delay" of the VFD is 5.0 (5.0=50/10).

To set the "Wake-up-from-sleep delay" to 5.0s through Modbus communication, you need first to multiply 5.0 by 10 according to the scale to obtain an integer 50, that is, 32H in the hexadecimal form, and then transmit the following write command:

01	**06**	**01 14**	**00 32**	**49 E7**
VFD address	Write command	Parameter address	Parameter data	CRC

After receiving the command, the VFD converts 50 into 5.0 based on the fieldbus scale, and then sets "Wake-up-from-sleep delay" to 5.0s.

For another example, after the upper computer transmits the "Wake-up-from-sleep delay" parameter read command, the master receives the following response from the VFD:

01	**03**	**02**	**00 32**	**39 91**
VFD address	Read command	2-byte data	Parameter data	CRC

The parameter data is 0032H, that is, 50, so 5.0 is obtained based on the fieldbus scale (50/10=5.0). In this case, the master identifies that the "Wake-up-from-sleep delay" is 5.0s.

6.3.6 Error message response

Operation errors may occur in communication-based control. For example, some parameters can only be read, but a write command is transmitted. In this case, the VFD returns an error message response.

Error message responses are transmitted by the VFD to the master. The following table describes the codes and definitions of the error message responses.

Code	Name	Definition
01H	Invalid command	The command code received by the upper computer is not allowed to be executed. The possible causes are as follows: ● The function code is applicable only on new devices and is not implemented on this device. ● The slave is in the faulty state when processing this request.
02H	Invalid data address	For the VFD, the data address in the request of the upper computer is not allowed. In particular, the combination of the register address and the number of the to-be-transmitted bytes is invalid.
03H	Invalid data bit	The received data domain contains a value that is not allowed. The value indicates the error of the remaining structure in the combined request. **Note: It does not mean that the data item submitted for storage in the register includes a value unexpected by the program.**
04H	Operation failure	The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Password error	The password entered in the password verification address is different from that set in P07.00.

Code	Name	Definition
06H	Data frame error	The length of the data frame transmitted by the upper computer is incorrect, or in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the lower computer
07H	Parameter read-only	The parameter to be modified in the write operation of the upper computer is a read-only parameter.
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the upper computer cannot be modified during the running of the VFD.
09H	Password protection	A user password is set, and the upper computer does not provide the password to unlock the system when performing a read or write operation. The error of "system locked" is reported.

When returning a response, the device uses a function code domain and fault address to indicate whether it is a normal response (no error) or exception response (some errors occur). In a normal response, the device returns the corresponding function code and data address or sub-function code. In an exception response, the device returns a code that is equal to a normal code, but the first bit is logic 1.

For example, if the master device transmits a request message to a slave device for reading a group of function code address data, the code is generated as follows:

0 0 0 0 0 0 1 1 (03H in the hexadecimal form)

For a normal response, the same code is returned.

For an exception response, the following code is returned:

1 0 0 0 0 0 1 1 (83H in the hexadecimal form)

In addition to the modification of the code, the slave returns a byte of exception code that describes the cause of the exception. After receiving the exception response, the typical processing of the master device is to transmit the request message again or modify the command based on the fault information.

For example, to set the "Running command channel" (P00.01, the parameter address is 0001H) of the VFD whose address is 01H to 03, the command is as follows:

01	06	00 01	00 03	98 0B
VFD address	Write command	Parameter address	Parameter data	CRC

But the setting range of the "Running command channel" is 0 to 2. The value 3 exceeds the setting range. In this case, the VFD returns an error message response as shown in the following:

01	86	04	43 A3
VFD address	Exception response code	Error code	CRC

The exception response code 86H (generated based on the MSB "1" of the write command 06H) indicates that it is an exception response to the write command (06H). The error code is 04H. From the preceding table, we can see that it indicates the error "Operation failure", which means "The parameter is set to an invalid value in the write operation".

6.3.7 Read/Write operation examples

For the formats of the read and write commands, see sections 6.3.3.1 and 6.3.3.2.

6.3.7.1 Examples of read command 03H

Example 1: Read state word 1 of the VFD whose address is 01H. According to the table of other Modbus function addresses, the parameter address of state word 1 of the VFD is 2100H.

The read command transmitted to the VFD is as follows:

01	03	21 00	00 01	8E 36
VFD address	Read command	Parameter address	Data quantity	CRC

Assume that the following response is returned:

01	03	02	00 03	F8 45
VFD address	Read command	Number of bytes	Data content	CRC

The data content returned by the VFD is 0003H, which indicates that the VFD is in the stopped state.

Example 2: View information about the VFD whose address is 03H, including "Type of current fault" (P07.27) to "Type of 5th-last fault" (P07.32) of which the parameter addresses are 071BH to 0720H (contiguous 6 parameter addresses starting from 071BH).

The command transmitted to the VFD is as follows:

03	03	07 1B	00 06	B5 59
VFD address	Read command	Start address	6 parameters in total	CRC

Assume that the following response is returned:

03	03	0C	00 23	00 23	00 23	00 23	00 23	00 23	5F D2
VFD address	Read command	Number of bytes	Present fault type	Last fault type	2nd-last fault type	3rd-last fault type	4th-last fault type	5th-last fault type	CRC

According to the returned data, all the fault types are 0023H, that is, 35 in the decimal form, which means the maladjustment fault (STo).

6.3.7.2 Examples of write command 06H

Example 1: Set the VFD whose address is 03H to be forward running. According to the table of other Modbus function addresses, the address of "Communication-based control command" is 2000H, and 0001H indicates forward running.

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Forward running	R/W
		0002H: Reverse running	
		0003H: Forward jogging	
		0004H: Reverse jogging	
		0005H: Stop	
		0006H: Coast to stop (emergency stop)	
		0007H: Fault reset	
		0008H: Jogging to stop	

The command transmitted by the master is as follows:

03	**06**	**20 00**	**00 01**	**42 28**
VFD address	Write command	Parameter address	Forward running	CRC

If the operation is successful, the following response is returned (same as the command transmitted from the master):

03	**06**	**20 00**	**00 01**	**42 28**
VFD address	Write command	Parameter address	Forward running	CRC

Example 2: Set the "Max. output frequency" of the VFD whose address is 03H to 100 Hz.

Function code	Name	Description	Default
P00.03	Max. output frequency	P00.04–400.00Hz	50.00Hz

According to the number of decimals, the fieldbus scale of the "Max. output frequency" (P00.03) is 100. Multiply 100 Hz by 100. The value 10000 is obtained, and it is 2710H in the hexadecimal form.

The command transmitted from the master is as follows:

03	**06**	**00 03**	**27 10**	**62 14**
VFD address	Write command	Parameter address	Parameter data	CRC

If the operation is successful, the following response is returned (same as the command transmitted from the master):

03	**06**	**00 03**	**27 10**	**62 14**
VFD address	Write command	Parameter address	Parameter data	CRC

Note: In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

6.3.7.3 Examples of continuously write command 10H

Example 1: Set the VFD whose address is 01H to be forward running at the frequency of 10Hz. According to the table of other Modbus function addresses, the address of "Communication-based control command" is 2000H, 0001H indicates forward running, and the address of "Communication-based value setting" is 2001H, as shown in the following figure. 10Hz is 03E8H in the hexadecimal form.

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Forward running	R/W
		0002H: Reverse running	
		0003H: Forward jogging	
		0004H: Reverse jogging	
		0005H: Stop	
		0006H: Coast to stop	
		0007H: Fault reset	
		0008H: Jogging to stop	
Communication-based value setting	2001H	Communication-based frequency setting (0–Fmax; Unit: 0.01Hz)	R/W
	2002H	PID reference (0–1000, in which 1000 corresponds to 100.0%)	

In the actual operation, set P00.01 to 2 and P00.06 to 8.

The command transmitted from the master is as follows:

01	10	20 00	00 02	04	00 01	03 E8	3B 10
VFD address	Continuous write command	Parameter address	Parameter quantity	Number of bytes	Froward running	10 Hz	CRC

If the operation is successful, the following response is returned:

01	10	20 00	00 02	4A 08
VFD address	Continuous write command	Parameter address	Parameter quantity	CRC

Example 2: Set "ACC time" of the VFD whose address is 01H to 10s, and "DEC time" to 20s.

Function code	Name	Description	Default
P00.11	ACC time 1	0.0–3600.0s	Model depended
P00.12	DEC time 1	0.0–3600.0s	Model depended

The address of P00.11 is 000B, 10s is 0064H in the hexadecimal form, and 20s is 00C8H in the hexadecimal form.

The command transmitted from the master is as follows:

01	10	00 0B	00 02	04	00 64	00 C8	F2 55
VFD address	Continuous write command	Parameter address	Parameter quantity	Number of bytes	10s	20s	CRC

If the operation is successful, the following response is returned:

01	10	00 0B	00 02	30 0A
VFD address	Continuous write command	Parameter address	Parameter quantity	CRC

Note: In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

6.3.7.4 Modbus communication commissioning example

A PC is used as the host, a USB-RS485 converter is used for signal conversion, and the PC serial port used by the converter is COM1 (an RS485 port). The upper computer commissioning software is the serial port commissioning assistant Commix, which can be downloaded from the Internet. Download a version that can automatically execute the CRC check function. The following figure shows the interface of Commix.

First, set the serial port to **COM1**. Then, set the baud rate consistently with P14.01. The data bits, check bits, and end bits must be set consistently with P14.02. If the RTU mode is selected, you need to select the hexadecimal form **Input HEX**. To set the software to automatically execute the CRC function, you need to select **ModbusRTU**, select **CRC16 (MODBUSRTU)**, and set the start byte to **1**. After the auto CRC check function is enabled, do not enter CRC information in commands. Otherwise, command errors may occur due to repeated CRC check.

The commissioning command to set the VFD whose address is 03H to be forward running is as follows:

03	06	20 00	00 01	42 28
VFD address	Write command	Parameter address	Forward running	CRC

Note:

1. Set the VFD address (P14.00) to 03.
2. Set "Channel of running commands" (P00.01) to "Communication", and set "Communication channel of running commands" (P00.02) to the Modbus communication channel.
3. Click **Send**. If the line configuration and settings are correct, a response from the VFD is received as follows:

03	06	20 00	00 01	42 28
VFD address	Write command	Parameter address	Forward running	CRC

6.3.8 Related parameters

Table 6-3 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P20.00	Local communication address	1–247	1	◎
P20.01	Communication baud rate	0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS 6: 57600BPS 7: 115200BPS	4	◎
P20.02	Data bit check	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	1	◎
P20.03	Communication response delay	0–200ms	5	○
P20.04	Communication timeout time	0.0 (invalid); 0.1–60.0s	0.0s	○
P20.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0	○

Function code	Name	Description	Default	Modify
P20.06	Communication processing action	0x00–0x11 LED ones place: 0: Respond to write operations 1: Not respond to write operations LED tens place: 0: Communication password protection is invalid. 1: Communication password protection is valid.	0x00	○

Table 6-4 Inverter unit related parameters

Function code	Name	Description	Default	Modify
P14.00	Local communication address	1–247	1	○
P14.01	Communication baud rate	0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS 6: 57600BPS 7: 115200BPS	4	○
P14.02	Data bit check	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	1	○
P14.03	Communication response delay	0–200ms	5	○
P14.04	Communication timeout time	0.0 (invalid); 0.1–60.0s	0.0s	○
P14.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0	○
P14.06	Communication processing action	0x00–0x11 LED ones place: 0: Respond to write operations 1: Not respond to write operations LED tens place: LED tens place: 0: Communication password protection is invalid. 1: Communication password protection is valid.	0x00	○

6.4 CANopen bus networking

6.4.1 Network topology

When the rectifier unit is located at the beginning or end of the system, the CANopen bus network wiring is as shown as in Figure 6-2. The PLC or another master device connects to the CAN bus terminals of the rectifier unit, and CANopen bus connection between the rectifier and inverter units are implemented through RJ45. It is recommended to use the shielded twisted pair cable with the shield layer to connect the master device and rectifier unit, with the shield layer connected to CGND. Use the network cable as shipped with the product to connect units, and use 120Ω termination matching resistors at both ends of the bus to prevent signal reflection.

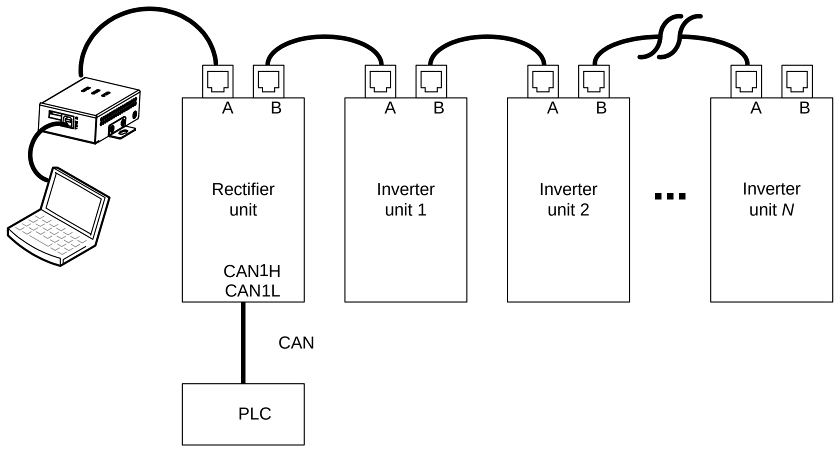


Figure 6-2 Wiring 1 for CANopen bus networking

When the rectifier unit is located at the middle of the CANopen bus, the CANopen bus network wiring is as shown as in Figure 6-3. The CANopen bus connection between the rectifier and inverter units are implemented through RJ45, and the PLC or another master device is connected to the RJ45B port of the beginning or end unit.

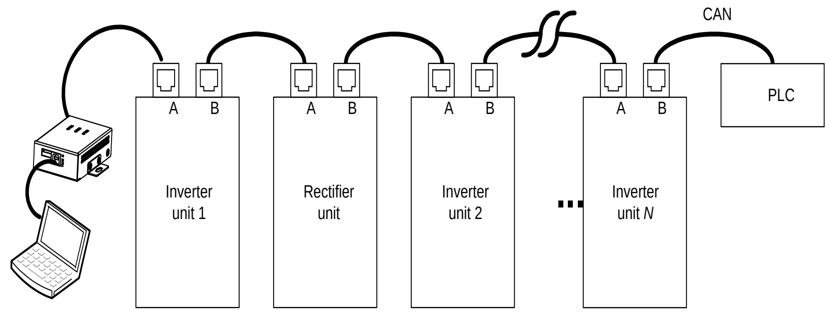


Figure 6-3 Wiring 2 for CANopen bus networking

6.4.2 Interface description

The CANopen bus connection between rectifier unit and inverter unit is made through RJ45 terminals. The following figure shows the terminal interface:

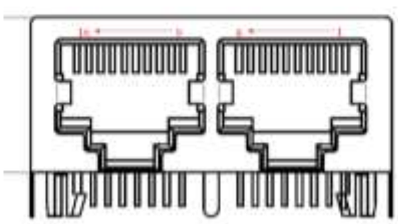


Figure 6-1 CANopen RJ45 terminal

Table 6-1 RJ45 interface definition

PIN No.	Network signal	Description
1, 9	CAN_H	CANopen bus high level signal
2,10	CAN_L	CANopen bus low level signal
3,6,7,11,14	NC	Suspended
4,12	RS485+	Internal RS485 communication terminal for connecting external keypad and PC
5,13	RS485-	
8,16	CGND	Used as external keypad power supply negative and common ground of signal cable
15		Used as external keypad power supply positive

6.4.3 Networking description

In this networking mode, the rectifier unit is configured to work as the CANopen slave node, the PLC is configured as the master node. The CANopen slave node, baud rate, communication disconnection enabling, and PDO interaction data are configured on the rectifier/inverter unit through function codes.

6.4.4 Related parameters

Table 6-5 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P21.01	CANopen communication address	0–127	1	○
P21.13	Sent PZD2	Used when the rectifier unit works as the CANopen slave node or used in PLC-to-CANopen networking. 0: Invalid 1: Fault code 2: DC voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Braker current (* 10, A) 6: Terminal input status 7: Terminal output status 8: Number of online slave nodes 9: Online/offline state of slave nodes 02–17 10: Online/offline state of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20: Reserved	0	○
P21.14	Sent PZD3		0	○
P21.15	Sent PZD4		0	○
P21.16	Sent PZD5		0	○
P21.17	Sent PZD6		0	○
P21.18	Sent PZD7		0	○
P21.19	Sent PZD8		0	○
P21.20	Sent PZD9		0	○
P21.21	Sent PZD10		0	○
P21.22	Sent PZD11		0	○
P21.23	Sent PZD12		0	○

Function code	Name	Description	Default	Modify
P21.29	CANopen communication baud rate	Setting range: 0–5 0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	○
P21.30	CANopen communication timeout time	0.0 (invalid); 0.1–100.0s	0.0s	○

Table 6-6 Inverter unit related parameters

Function code	Name	Description	Default	Modify
P14.07	CANopen communication timeout time	0.0 (invalid); 0.1–60.0s	0.0s	○
P14.08	CANopen communication address	0–127	1	◎
P14.09	CANopen communication baud rate	0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	◎
P14.10	Received PZD2	Used for CANopen networking communication. 0: Disable 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9	0	○
P14.11	Received PZD3		0	○
P14.12	Received PZD4		0	○
P14.13	Received PZD5		0	○
P14.14	Received PZD6		0	○
P14.15	Received PZD7		0	○
P14.16	Received PZD8		0	○
P14.17	Received PZD9		0	○
P14.18	Received PZD10		0	○
P14.19	Received PZD11		0	○
P14.20	Received PZD12		0	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8)
10: Virtual output terminal command. Range: 0x00–0x0F
11: Voltage setting (special for V/F separation)
(0–1000, in which 1000 corresponds to 100% of the motor rated voltage)
12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)
13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)
14: High-order bit of position reference (signed)
15: Low-order bit of position reference (unsigned)
16: High-order bit of position feedback (signed)
17: Low-order bit of position feedback (unsigned)
18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)
19: Function code mapping (PZD2–PZD12 corresponds to P14.49–P14.59)
20–31: Reserved</td><td></td><td></td></tr>
<tr><td>P14.21</td><td>Sent PZD2</td><td rowspan="11">Used for CANopen networking communication.
0: Disable
1: Running frequency (x100, Hz)
2: Set frequency (x100, Hz)
3: Bus voltage (x10, V)
4: Output voltage (×1, V)
5: Output current (x10, A)
6: Actual output torque (x10, %)
7: Actual output power (x10, %)
8: Rotation speed of running (x1, RPM)
9: Linear speed of running (x1, m/s)
10: Ramp reference frequency
11: Fault code
12: AI1 input (* 100, V)
13: AI2 input (* 100, V)
14: AI3 input (* 100, V)
15: Reserved
16: Terminal input status
17: Terminal output status
18: PID reference (x100, %)
19: PID feedback (x100, %)
20: Reserved</td><td>0</td><td>○</td></tr>
<tr><td>P14.22</td><td>Sent PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P14.23</td><td>Sent PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P14.24</td><td>Sent PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P14.25</td><td>Sent PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P14.26</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P14.27</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P14.28</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P14.29</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P14.30</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P14.31</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned) 23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 2 26–30: Reserved 31: Function code mapping (PZD2–PZD12 corresponds to P14.60–P14.70)		

6.4.5 CANopen protocol introduction

1. Supported functions

- CAN2.0A protocol
- CANopen DS301

2. Supported CANopen services

- Supports four pairs of PDO services (PDO1 TX to PDO4 TX, and PDO1 RX to PDO4 RX), where the PDO1 pair is used to read and write parameters of the VFD, and the PDO2 to PDO4 pairs are used to control and obtain the actual parameter values of the VFD in real time.
- SDO: SDO information adopts the "client/server" mode and is used to configure slave nodes and provide access to the object dictionary of each node.
- Supports the emergency service.
- Supports NMT node guarding.
- Supports heartbeat packets (heartbeat producer)
- Supports network management (NMT).
  - ✧ Supports NMT module control.
  - ✧ Supports NMT broadcast addresses.
  - ✧ Supports NMT error control.
  - ✧ Supports boot-up.
- Supports SYNC (1–240).
- Supports asynchronous transmission of 254 and 255.
- Supports time disabling.
- Supports event timers.
- Supports manufacturer-defined object dictionary. You can use the SDO to control and obtain the actual parameter values of the VFD in real time.

3. Non-supported CANopen services

- Saves object dictionary parameters at power outage
- Time stamp service

6.4.6 CANopen packet format

CAN2.0A packets are used to transmit data between the master node and bus nodes by means of data frames.

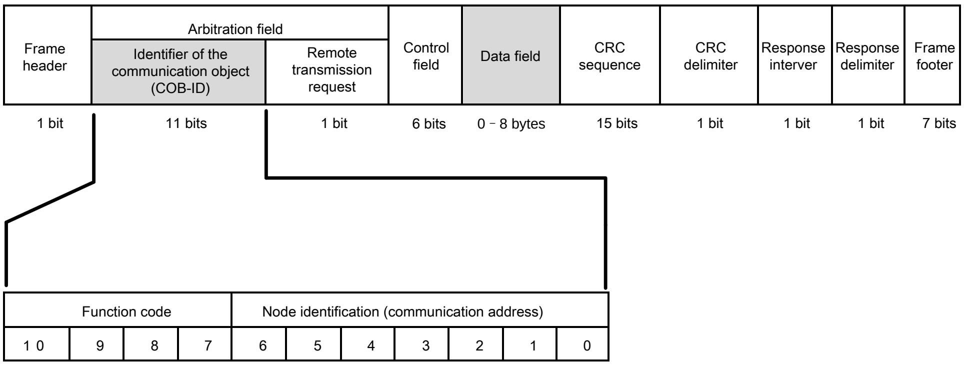


Figure 6-4 Packet structure

Communication object	Function code (binary)	COB-ID (hexadecimal)
NMT	0	0x00
SYNC	1	0x80
EMERGENCY	1	0x81 – 0xFF
PDO1 Tx	11	0x181 – 0x1FF
PDO1 Rx	100	0x201 – 0x27F
PDO2 Tx	101	0x281 – 0x2FF
PDO2 Rx	110	0x301 – 0x37F
PDO3 Tx	111	0x381 – 0x3FF
PDO3 Rx	1000	0x401 – 0x47F
PDO4 Tx	1001	0x481 – 0x4FF
PDO4 Rx	1010	0x501 – 0x57F
SDO Tx	1011	0x581 – 0x5FF
SDO Rx	1100	0x601 – 0x67F
Node protection	1110	0x701 – 0x77F

COB-IDs vary according to communication address, but for one command, the COB-IDs are within a certain range.

Note: The commands described in this manual are all data frames if it is not specified that they are remote frames.

6.4.7 NMT command

This function is used by the master node to control the NMT status of slave nodes.

✧ **Command**

Master node → Slave node

COB-ID	Byte0	Byte1
0x000	Command specifier (CS)	Node-ID (Node ID)

✧ **Description**

In this command, the COB-ID is 0×00. If Node-ID is set to 0, the command is broadcast to all CANopen slave nodes, and each slave node must execute the NMT command. Table 6-7 describes the function of each CS.

Table 6-7 Function of each CS

NMT CS	NMT service (control action)
0x01	Starts a slave node device.

NMT CS	NMT service (control action)
0x02	Stops a slave node device.
0x80	Enables a slave node to enter the pre-operation state.
0x81	Resets a slave node.
0x82	Resets communication of a node.

✧ **Example**

For example, the command to enable EC-TX105, whose node ID is 3, to enter the pre-operation state is described as follow.

COB-ID	Byte0	Byte1
0x000	0x80	0x03

For another example, the command to start all EC-TX105 nodes on the CANopen network is described as follows.

COB-ID	Byte0	Byte1
0x000	0x01	0x00

6.4.8 NMT node guarding

By using the node protection service, the NMT master node can detect the current state of each node.

✧ **Command**

Request: Master node (remote frame) → Slave node

COB-ID	No data
0x700 + Node-ID	

Response: Slave node → Master node

COB-ID	Byte0 (status value)
0x700 + Node-ID	Bit7: Triggering bit; Bits 0 to 6: Status

✧ **Description**

The most significant bit (MSB) bit 7 of Byte0 (status value) in the response command is the triggering bit, that is, the value of bit 7 is alternated between 0 and 1 each time when the slave node transmits a response frame to distinguish frames. Bits 0 to 6 indicate the status of the slave node. Table 6-8 describes the state values and their corresponding state.

Table 6-8 Status values and their corresponding status

Status value (Byte0: Bit0–Bit6)	Status
0x00	Initializing
0x04	Stopped
0x05	Operational
0x7F	Pre-operational

✧ **Example**

For example, the command for the master node to detect the status of slave node 3 is as follows.

Master node (remote frame) → Slave node:

COB-ID	No data
0x703	

After receiving the node protection command transmitted from the master node, the slave node transmits the following command response to the master node.

COB-ID	Byte0 (status value)
0x703	0x85

In the command, bit 7 of Byte0 is 1, and the status value is 0×05, indicating that slave node 3 is in the operation status. If receiving another node protection command, the slave node transmits a command frame in which the status value is 0×05 to the master node, and the value of bit 7 is changed to 0.

6.4.9 Heartbeat packet (Heartbeat Producer)

In some cases, the master node requires that a slave node automatically transmits a frame of heartbeat packets at an interval, so that it can learn the status of the slave node in real time. The interval parameter (data length: 16 bits; unit: ms) is defined in the object dictionary 0x1017. A CANopen slave node produces heartbeat packets at the interval of 500ms by default.

✧ **Command**

Slave node → Master node

COB-ID	Byte0
0x700 + Node-ID	Status value

✧ **Description**

The heartbeat packets are in the same format with the node protection response frames. The difference between them is that no triggering bit alternation is performed for heartbeat packets (the triggering bit is always 0). Table 6-8 describes the sStatus values.

✧ **Example**

For example, if slave node 3 is in the operation status and the interval parameter in 0x1017 is set to 100, slave node 3 transmits a frame of heartbeat packets every 100ms.

COB-ID	Byte0
0x703	0x05

SDOs can be used to disable heartbeat packets, transmitting 2B 17 10 00 00 00 00 00 (setting the interval to 0).

Note: On the communication card, node protection and heartbeat packets cannot be used simultaneously.

6.4.10 Start packet (NMT Boot-up)

After being initialized (booted up), the communication card transmits a start packet.

✧ **Command**

Slave node → Master node

COB-ID	Byte0
0x700 +Node-ID	0x00

✧ **Example**

For example, after being initialized, the communication card whose node ID is 3 transmits the following start packet.

COB-ID	Byte0
0x703	0x00

6.4.11 Synchronous packet object (SYNC)

Generally, SYNC signals are transmitted from the CANopen master node cyclically. A SYNC signal does not contain any data and is used mainly to request PDO Tx of a slave node node of the synchronous transmission type. 0x1005 in the object dictionary defines COB-IDs of the objects that receive synchronous packets, and they are set to 0x80 in the CANopen pre-defined connection set. For PDO Tx, the transmission types of 1 to 240 indicate synchronous transmission.

✧ **Command**

Master node → Slave node

COB-ID	No data
0x80	/

6.4.12 Emergency packet object (EMCY)

This packet is transmitted when an internal error occurs on the communication card or VFD, or an error is deleted.

✧ **Command**

Slave node → Master node

<table>
<tr><th>COB-ID</th><th>Byte0</th><th>Byte1</th><th>Byte2</th><th>Byte3</th><th>Byte4</th><th>Byte5</th><th>Byte6</th><th>Byte7</th></tr>
<tr><td rowspan="2">0x80 + Node-ID</td><td colspan="2">Emergency error code</td><td rowspan="2">Error register</td><td colspan="5">VFD error code</td></tr>
<tr><td>LSB</td><td>MSB</td><td>bit7-0</td><td>bit15-8</td><td>bit23-16</td><td>bit31-24</td><td>bit39-32</td></tr>
</table>

✧ **Description**

An emergency error code is two bytes. Byte0 is the low-order byte, and Byte1 is the high-order byte. A VFD error code is five bytes. Byte3 is the low-order byte, and Byte7 is the high-order byte.

An emergency error code indicates the type of the current error, as described in Table 6-9. The error register stores the type of the current error. You can determine the error type indicated by the current emergency packet according to the value stored in the register. Table 6-10 describes the indication of the bits of the error register. The function code P07.27 describes the error codes of the VFD.

Table 6-9 Emergency error codes

Emergency error code (hex)	Description
00xx	Error reset or no error
10xx	Generic Error
20xx	Current
21xx	Current error on the device input side
22xx	Current error inside the device
23xx	Current error on the device output side
30xx	Voltage
31xx	Mains voltage
32xx	Voltage inside the device
33xx	Output voltage
40xx	Temperature
41xx	Ambient temperature
42xx	Device temperature
50xx	Device hardware
60xx	Device software
61xx	Internal software
62xx	User software
63xx	Data set
70xx	Additional modules
80xx	Monitoring
81xx	communication
8110	CAN overrun
8120	Error Passive
8130	Life guard error or heartbeat error
8140	Recovered from Bus-Off
82xx	Protocol error
8210	PDO no processed due to length error
8220	Length exceeded
90xx	External error
F0xx	Additional functions
FFxx	Device specific

Table 6-10 Error register bits

Error register bit	Fault type
0	Generic error or no error
1	Current error
2	Voltage error
3	Temperature error
4	Communication error
5	Device description error
6	Reserved (=0)
7	Manufacturer-defined error

✧ **Example**

For example, if the "inverter unit phase U protection (OUT1)" fault occurs on the VFD whose node ID is 3, and the fault type is 1 (that is, the VFD error code is 1), the communication card transmits the following emergency packet.

COB-ID	Emergency error code		Error register	VFD error code				
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x83	0x00	0x30	0x04	0x01	0x00	0x00	0x00	0x00

As you can see in the command, the emergency error code is 0x3000, indicating a voltage error. The error register is 0x04, that is, the second bit is "1", indicating a voltage error. The device error code is 0x0000000001. You can find that the error code 1 indicates the "inverter unit phase U protection (OUT1)" fault.

After the fault is reset, the communication card transmits the following emergency packet to notify the master node that the slave node is no longer faulty.

COB-ID	Emergency error code		Error register	VFD error code				
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x83	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

6.4.13 Service data object (SDO)

SDOs are mainly used to transmit non-time key data. By using SDOs, the master node can read data from and write data to the object dictionary of a device.

✧ **Command**

Request: Master node → Slave node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x600+NodeID	Request code	Object index		Sub-index	Response data			
		LSB	MSB					

Response: Slave node → Master node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x580+NodeID	Response code	Object index		Sub-index	Response data			
		LSB	MSB					

✧ **Description**

An object index is two bytes. Byte1 is the low-order byte, and Byte2 is the high-order byte. For information about the indexes and subindexes, see the object dictionary in the appendix. Request codes include request codes for reading and those for writing.

Request codes for writing vary according to the character length of items in the object dictionary, and the request code for reading are 0×40. See Table 6-11.

Response codes indicating successful reading vary according to the character length of items in the object dictionary, and the response code indicating successful writing are 0×60. The response codes indicating reading failure and writing failure are both 0x80. See Table 6-12.

Table 6-11 SDO request codes and requested data

Request code type	Request code	Command description	Requested data			
			Byte4	Byte5	Byte6	Byte7
Write	0x23	Writes 4-byte data				
	0x2B	Writes 2-byte data			-	-
	0x2F	Writes 1-byte data		-	-	-
Read	0x40	Reads data	-	-	-	-

Table 6-12 SDO response codes and response data

Response code type	Response code	Command description	Response data			
			Byte4	Byte5	Byte6	Byte7
Read	0x43	Reads 4-byte data				
	0x4B	Reads 2-byte data			-	-
	0x4F	Reads 1-byte data		-	-	-
Write	0x60	Writing succeeds	-	-	-	-
Read/write	0x80	Reading/writing fails	Interruption error code			

Note: The symbol "-" in Table 6-11 and Table 6-12 indicates that the byte is reserved and provides no function.

Table 6-13 describes the interruption error codes.

Table 6-13 Interruption error codes

Interruption code	Description
0503 0000	Triggering bit not alternated
0504 0000	SDO protocol times out
0504 0001	Invalid or unknown client/server
0504 0002	Invalid block size
0504 0003	Invalid sequence number
0504 0004	CRC error
0504 0005	Memory overflow
0601 0000	No access to the object
0601 0001	Attempts to read a write-only object
0601 0002	Attempts to write information to a read-only object
0602 0000	Object cannot be found in the object dictionary
0604 0041	Object cannot be mapped to PDO
0604 0042	Number and length of the object to be mapped exceeds the PDO length
0604 0043	Common parameter incompatibility
0604 0047	Common internal incompatibility of the device
0606 0000	Object access failure caused by hardware error
0607 0010	Data type not matched; service parameter length not matched
0609 0011	Subindex cannot be found in the object dictionary
0609 0030	Parameter value range exceeded
0609 0031	Written parameter value too large

Interruption code	Description
0609 0032	Written parameter value too small
0609 0036	Max. value less than Min. value
0800 0000	Common error
0800 0020	Data failed to be transmitted or stored in the application
0800 0021	Data failed to be transmitted or stored in the application due to device control
0800 0022	Data failed to be transmitted or stored in the application due to the current Status of the device
0800 0023	Error occurs dynamically on the object dictionary or object dictionary cannot be found

✧ **Example**

For example, slave node 3 reads data from and writes data to the object whose index is 0x1801 and subindex is 03. (The object whose index is 0x1801 and subindex is 03 indicates the disabled time of PDO2 Tx.)

Write operation example: To modify the disabled time of PDO2 Tx to 1000 ms, the master node transmits the following write operation command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x01	0x18	0x03	0xe8	0x03	0x00	0x00

After receiving the command transmitted from the master node, the slave node transmits the following command response if the modification is successful.

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x60	0x01	0x18	0x03	0x00	0x00	0x00	0x00

Read operation example: To read the disabled time of PDO2 Tx, the master node transmits the following read operation command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x01	0x18	0x03	0x00	0x00	0x00	0x00

After receiving the command transmitted by the master node, the slave node transmits the following command response if the current disabled time of PDO2 Tx is 1000ms.

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x43	0x01	0x18	0x03	0xe8	0x03	0x00	0x00

Read/write error example: The master node transmits the following read operation command to read an object (whose index is 0x6000 and subindex is 0x00) that cannot be found.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x00	0x60	0x00	0x00	0x00	0x00	0x00

The object cannot be found, and therefore the slave node transmits the following read/write error command response.

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x80	0x00	0x60	0x00	0x00	0x00	0x02	0x06

The error code in the response is 0x06020000, indicating that "Object cannot be found in the object dictionary".

6.4.14 Process data object (PDO)

The communication card provides four PDO Tx commands (whose indexes are 0x1800 to 0x1803) and four PDO Rx commands (whose indexes are 0x1400 to 0x1403). PDO Rx is a PDO command transmitted from the master node to a slave node, that is, it is a master node command. PDO Tx is a PDO command transmitted from a slave node to the master node.

The control word (CW), status word (SW), setting, and return value of each PDO of the communication card are all defined with a "manufacturer-defined object dictionary". In this way, the process data of a VFD can be monitored not only through PDOs but also through SDOs. Each PDO command is labeled with "manufacturer-defined object dictionary" in the format of 0xXXXX.HH, where XXXX indicates an index, HH indicates a subindex, and both are hexadecimal.

6.4.14.1 Triggering mode of PDO Tx

Each PDO Tx is defined with a transmission type, disabled time, and event timer. The corresponding subindex of the transmission type is 0x02, that of the disabled time is 0x03, and that of the event timer is 0x05. Therefore, the object dictionary index corresponding to PDO2 Tx is 0x1801, and the subindex is 0x02. The same principle applies to other PDO Tx commands. The units of disabled time and event timer are millisecond.

Synchronous triggering: When the transmission type is set to 1 to 240, PDO Tx is synchronous transmission. For example, if you set the transmission type of PDO2 Tx to *n* ($1 \le n \le 240$), a slave node transmits one PDO2 Tx command every time after it receives *n* synchronous packet objects. The same principle applies to other PDO Tx commands.

Asynchronous triggering (254): When the value of the event timer is not zero, a slave node transmits PDO Tx commands periodically. For example, if the event timer of PDO2 Tx is set to 200, the slave node transmits a PDO2 Tx command at the interval of 200 ms. When the value of the event timer is zero, the slave node transmits a PDO Tx command once the corresponding PDO Tx data changes, and the transmission interval is subject to the disabled time. A PDO Tx packet can be transmitted only once in the disabled time, which effectively reduces the load of the bus. When the disabled time is set to a period shorter than 50ms, 50ms is used as the disabled time.

Asynchronous triggering (255): When the value of the event timer is not zero, a slave node transmits PDO Tx commands periodically. For example, if the event timer of PDO2 Tx is set to 200, the slave node transmits a PDO2 Tx command at the interval of 200 ms. When the value of the event timer is zero, the slave node transmits a PDO Tx command once a corresponding PDO Rx command is received. For example, after receiving a PDO2 Rx command, the slave node transmits a PDO2 Tx command.

Table 6-14 Triggering modes supported by the CANopen slave node

Triggering mode	Transmission type (decimal)	Event triggering	PDO1 TX	PDO2 TX	PDO3 TX	PDO4 TX
Synchronous	1–240	/	No	Yes	Yes	Yes
Asynchronous	254	Event timer	No	Yes	Yes	Yes
		Disabled time	No	Yes	Yes	Yes
	255	Event timer =0	Yes	Yes	Yes	Yes
		Event timer	No	Yes	Yes	Yes

Table 6-15 Default PDO Tx settings of the CANopen slave node

	PDO1 TX	PDO2 TX	PDO3 TX	PDO4 TX
Transmission type	255	254	254	254
Event timer (ms)	0	0	0	0
Disabled time (ms)	500	500	500	500

For how to set the triggering type of PDO Tx, see the description of SDO commands.

6.4.14.2 PDO1

PDO1 is used to read and write parameters of the VFD. The function of PDO1 is similar to that of an SDO. SDOs are used to read and write objects of an object dictionary, and PDO1 is used to read and write parameters of the VFD.

Note: PDO1 Tx support only the transmission type of asynchronous transmission 255. Do not set it to other transmission types, and do not try to set the event timer to periodically transmits PDO1 Tx to the master node.

PDO1 Rx

✧ **Command**

Request: Master node → Slave node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
0x200+NODE-ID	Request code		Parameter address		Request data	
	0x2100.00		0x2100.01		0x2100.02	

✧ **Description**

A request code is two bytes. Byte0 is the low-order bit, and Byte1 is the high-order bit. The manufacturer defines the index 0x2100 and subindex 0x00 for the request codes. Table 6-16 describes the functions of the request codes.

Table 6-16 Request codes

Request code	Function
0	No task
1	Reading the value of a parameter
2	Modifying a parameter value [modifying the value only on RAM]
4	Modifying a parameter value [modifying the value only on both RAM and EEPROM] (reserved)

A parameter address is two bytes. Byte2 is the low-order byte, and Byte3 is the high-order byte. It indicates the address of the parameter to be read or modified.

VFD function code address representation rules: The high-order byte is the hexadecimal form of the number before the dot mark, and low-order byte is that of the number behind the dot mark. Take P10.01 as an example, the number before the dot mark is 10, that is, the high-order byte of the parameter address is 0×0A; and the number behind the dot mark is 01, that is, the low-order byte is 0×01. Therefore, the function code address is 0×0A01.

Table 6-17 VFD parameter address

Function code	Name	Description	Default
P10.00	Simple PLC mode	0: Stop after running once 1: Keep running with the final value after running once 2: Cyclic running	0
P10.01	Simple PLC memory selection	0: Without memory after power-off 1: With memory after power-off	0

VFD parameter address representation rules: You can see the function code in the function parameter list in the VFD operation manual. The hexadecimal form of the value corresponding to the function code is the parameter address. For example, the value corresponding to the function code P10.01 is 1001, and therefore the parameter address of the function code is 0x3E9 (that is, 1001 in the decimal form).

A piece of requested data is two bytes. Byte4 is the low-order byte, and Byte5 is the high-order byte. It indicates the data to be modified. When the command is transmitted for reading data, the requested data is not used.

Note: The data domain of PDO1 Rx must be six bytes. Otherwise, the communication card reports an emergency packet.

PDO1 Tx

✧ **Command**

Response: Slave node → Master node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x180+NODEID	Response code		Error ID		Response data		0x00	0x00
	0x2000.00		0x2000.01		0x2000.02		-	-

✧ **Description**

Byte6 and Byte7 are reserved and both are 0x00.

A response code is two bytes. Byte0 is the low-order byte, and Byte1 is the high-order byte. Table 6-18 describes the response codes.

Table 6-18 Response codes

Response code	Function
0	No response
1	Reading or writing succeeds
3	A reading or writing error occurs.

A piece of response data is four bytes. Byte4 is the low-order byte, and Byte7 is the high-order byte. When a write command is responded, the response data is the data to be modified; and when a read command is responded, the response data is the data to be read.

An error code is two bytes, indicating the reason of failure to respond to PDO1 Rx. Byte2 is the low-order byte, and Byte3 is the high-order byte. Error codes are valid only when the response code is 3. Table 6-19 describes the error codes.

Table 6-19 Error codes

Code	Name	Meaning
00H	No error	/
01H	Invalid command	The operation corresponding to the request code is not allowed to be executed. The possible causes are as follows: ● The function code is applicable only on new devices and is not implemented on this device. ● The slave node is in the faulty state when processing this request.
02H	Invalid data address	For a slave device, the data address in the request of the master node is not allowed. In particular, the combination of the register address and the number of the to-be-transmitted fromtes is invalid.
03H	Invalid data value	The received data domain contains a value that is not allowed. The value indicates the error of the remaining structure in the combined request. **Note:** It does not mean that the data item submitted for storage in the register includes a value unexpected by the program.
04H	Operation failure	The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Password error	The password entered in the password verification address is different from that is set.
06H	Data frame error	The length of the data frame transmitted from the upper computer is incorrect, or in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the lower computer.
07H	Parameter read-only	The parameter to be modified in the write operation of the master node is a read-only parameter.

Code	Name	Meaning
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the master node cannot be modified during the running of the VFD.
09H	Password protection	A user password is set, and the master node does not provide the password to unlock the system when performing a read or write operation. The error of system locked is reported.

✧ **Example of PDO1**

The slave node address is 3. Assume that you want to set the function code P14.10 of the VFD to 1.

Command analysis: The parameter address of P14.10 is 0x0F02. According to the protocol, the request code of PDO1 Rx is 0×02, the parameter address is 0x0F0D, and the requested data is 0x01, and therefore PDO1 Rx transmitted from the master node is as follows.

COB-ID	Request code		Parameter address		Request data	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
0x203	0x02	0x00	0x0A	0x0E	0x01	0x00

If the VFD parameter is successfully modified, the following PDO1 Tx command is returned.

COB-ID	Response code		Error ID		Response data		-	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x183	0x01	0x00	0x00	0x00	0x01	0x00	0x00	0x00

6.4.14.3 PDO2 Rx

PDO2 Rx is used to modify CWs and real-time process data (setting 1, setting 2, and setting 3) of the VFD. A CW is used to control the start and stop of the VFD, and settings are used to control the real-time running values of the VFD, such as set frequency.

✧ **Command**

Master node → Slave node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x300+NODEID	CW		Setting 1		Setting 2		Setting 3	
	0x2101.00		0x2100.03		0x2100.04		0x2100.05	

✧ **Description**

A CW is two bytes. Byte0 is the low-order byte, and Byte1 is the high-order byte. Table 6-20 describes the VFD inverter unit control word.

Table 6-20 VFD inverter unit CW

Bit	Name	Value	Description
0–7	Communication-based control command	1	Run forward
		2	Run reversely
		3	Jog forward
		4	Jog reversely
		5	Stop
		6	Coast to stop (in emergency manner)
		7	Fault reset
		8	Jog to stop

Bit	Name	Value	Description
8	Reserved	/	/
		/	/
9–10	Motor group selection	00	MOTOR GROUP 1 SELECTION
		01	MOTOR GROUP 2 SELECTION
		02	MOTOR GROUP 3 SELECTION
		03	MOTOR GROUP 4 SELECTION
11	Torque selection	1	Enable torque control
		0	Disable torque control
14	Reserved	1	/
		0	/
15	Reserved	1	/
		0	/

The function of each setting can be set through the corresponding function code of the VFD. The setting method is the same as that for "Received PZD" in PROFIBUS-DP communication. Setting 1, setting 2, and setting 3 correspond to received PZD2, received PZD3, and received PZD4, respectively. To set the function of setting 1 to "Set frequency", you need only to set "Received PZD2" to "1: Set frequency". The same principle applies to other settings. When multiple settings are enabled, the failure to set one setting (for example, the set value exceeds the setting range) does not affect the setting of other settings.

✧ **Example**

Assume that the slave node address is 3, you control the running of the VFD through CANopen communication, and you want to set the running frequency to 50 Hz through CANopen communication.

Command analysis: You need to set the VFD start mode and frequency reference mode to CANopen communication (P00.01=2, P00.02=1) first. In this example, use Setting 2 to set the running frequency (P14.11=1, that is, set Received PZD3 to "1: Set frequency").

When a CW is 0×01, it indicates that the VFD is to be run. To set the frequency to 50 Hz, you need to set Setting 2 to 5000, that is, 0x1388.

The PDO2 Rx command transmitted from the master node is as follows.

COB-ID	CW		Setting 1		Setting 2		Setting 3	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x303	0x01	0x00	0x00	0x00	0x88	0x13	0x00	0x00

6.4.14.4 PDO2 Tx

PDO2 Tx is a command transmitted from the VFD to the master node. It contains a SW and real-time process data (Returned value 1, returned value 2, and returned value 3). A SW is used to notify of the status of the VFD, and returned values are used to transmit the real-time running values of VFD, such as running frequency.

The default transmission type of PDO2 Tx is 254, and therefore PDO2 Tx is transmitted once data corresponding to a SW or returned value changes.

✧ **Command**

Slave node → Master node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x280+NODEID	SW		Returned value 1		Returned value 2		Returned value 3	
	0x2001.00		0x2000.03		0x2000.04		0x2000.05	

✧ **Description**

An SW is two bytes. Byte0 is the low-order byte, and Byte1 is the high-order byte. Table 6-21 describes the VFD inverter unit SW.

Table 6-21 VFD inverter unit status word

Bit	Name	Value	Description
0–7	Running Status	1	In forward running
		2	In reverse running
		3	Stopped
		4	Faulty
		5	POFF
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–10	Motor group feedback	0	Motor 1
		1	Motor 2
		2	Motor 3
		3	No feedback from motor 4
11	Motor type feedback	1	Synchronous motor
		0	Asynchronous motor
12	Overload pre-alarm feedback	1	Overload pre-alarm generated
		0	No overload pre-alarm generated
13	Pre-exciting	1	In pre-exciting process
		0	Magnetic flux established
14	Reserved	1	/
		0	/
15	Reserved	1	/
		0	/

The function of each returned value can be set through the corresponding function code of the VFD. The setting method is the same as that for "Transmitted PZD" in PROFIBUS-DP communication. For details, see the VFD operation manual. Returned value 1, returned value 2, and returned value 3 correspond to transmitted PZD2, transmitted PZD3, and transmitted PZD4, respectively. To set the function of returned value 1 to "Running frequency", you need only to set "Transmitted PZD2" to "1: Running frequency". The same principle applies to other returned values. Multiple returned values can be enabled simultaneously.

✧ **Example**

Assume that the slave node address is 3, the VFD is running, and the running frequency is 50.00 Hz. Returned value 1 is set to "Running frequency", returned value 2 is set to "Output voltage", and returned value 3 is set to no function.

Command analysis: You need to set returned value 1 to the running frequency of the VFD (P14.21=1), returned value 2 to the output voltage of the VFD (P14.22=4), and returned value 3 to invalid (P14.23=0) first.

The VFD is running forward and the bus voltage has been established, and therefore the SW is 0x0101. The running frequency is 50.00 Hz, and therefore returned value 1 is 5000, that is, 0x1388. If the output voltage is 380V, returned value 2 is 0x017C.

The PDO2 Tx command transmitted from the VFD is as follows.

COB-ID	SW		Returned value 1		Returned value 2		Returned value 3	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x283	0x01	0x01	0x88	0x13	0x7C	0x01	0x00	0x00

6.4.14.5 PDO3 Rx and PDO4 Rx

PDO3 Rx and PDO4 Rx are used to modify the real-time process data of the VFD, such as set frequency.

✧ **PDO3 Rx command**

Master node → Slave node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x400+NODEID	Setting 4		Setting 5		Setting 6		Setting 7	
	0x2100.06		0x2100.07		0x2100.08		0x2100.09	

✧ **PDO4 Rx command**

Master node → Slave node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x500+NODEID	Setting 8		Setting 9		Setting 10		Setting 11	
	0x2100.0a		0x2100.0b		0x2100.0c		0x2100.0d	

✧ **Description**

The application methods for PDO3 Rx and PDO4 Rx are the same as that for PDO2 Rx. For the relationship between the settings and PZDs in PROFIBUS-DP communication, see Table 6-22.

6.4.14.6 PDO3 Tx and PDO4 Tx

PDO3 Tx and PDO4 Tx are used by the VFD to transmit real-time process data to the master node, such as running frequency.

The default transmission type of PDO3 Tx and PDO4 Tx is 254, and therefore PDO3 Tx or PDO4 Tx is transmitted once data corresponding to a returned value in the same command changes.

✧ **PDO3 Tx command**

Slave node → Master node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x380+NODEID	Returned value 4		Returned value 5		Returned value 6		Returned value 7	
	0x2000.06		0x2000.07		0x2000.08		0x2000.09	

✧ **PDO4 Tx command**

Slave node → Master node

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x480+NODEID	Returned value 8		Returned value 9		Returned value 10		Returned value 11	
	0x2000.0a		0x2000.0b		0x2000.0c		0x2000.0d	

6.4.14.7 Monitoring process data through SDO commands

You can monitor the VFD by using SDOs to read the manufacturer-defined object dictionary.

For the definition and application of the CWs, SWs, settings, and returned values in the manufacturer-defined object dictionary, see the PDO description. For application of SDOs, see the SDO description section. Do not try to use SDOs to read and write VFD parameters.

Table 6-22 and Table 6-23 describe the manufacturer-defined object dictionary.

Table 6-22 Objects with the control function in the manufacturer-defined object dictionary

Index (hex)	Subindex (hex)	Function	Access permission	Data length	Corresponding to
2100	0	Request code (Do not use)	RW	2 Byte	/
	1	Parameter address (Do not use)	RW	2 Byte	/
	2	Request data (Do not use)	RW	2 Byte	/
	3	Setting1	RW	2 Byte	Received PZD2
	4	Setting2	RW	2 Byte	Received PZD3
	5	Setting3	RW	2 Byte	Received PZD4
	6	Setting4	RW	2 Byte	Received PZD5
	7	Setting5	RW	2 Byte	Received PZD6
	8	Setting6	RW	2 Byte	Received PZD7
	9	Setting7	RW	2 Byte	Received PZD8
	A	Setting8	RW	2 Byte	Received PZD9
	B	Setting9	RW	2 Byte	Received PZD10
	C	Setting10	RW	2 Byte	Received PZD11
	D	Setting11	RW	2 Byte	Received PZD12
	E	Reserved	RW	2 Byte	/
	F	Reserved	RW	2 Byte	/
2101	0	CW	RW	2 Byte	/

Table 6-23 Objects with the monitoring function in the manufacturer-defined object dictionary

Index (hex)	Subindex (hex)	Function	Access permission	Data length	Corresponding to
2000	0	Response code (Do not use)	RO	2 Byte	/
	1	Error code (Do not use)	RO	2 Byte	/
	2	Response data (Do not use)	RO	2 Byte	/
	3	Returned value1	RO	2 Byte	Sent PZD2
	4	Returned value2	RO	2 Byte	Sent PZD3
	5	Returned value3	RO	2 Byte	Sent PZD4
	6	Returned value4	RO	2 Byte	Sent PZD5
	7	Returned value5	RO	2 Byte	Sent PZD6
	8	Returned value6	RO	2 Byte	Sent PZD7
	9	Returned value7	RO	2 Byte	Sent PZD8
	A	Returned value8	RO	2 Byte	Sent PZD9
	B	Returned value9	RO	2 Byte	Sent PZD10
	C	Returned value10	RO	2 Byte	Sent PZD11
	D	Returned value11	RO	2 Byte	Sent PZD12
	E	Reserved	RO	2 Byte	/
	F	Reserved	RO	2 Byte	/
2001	0	SW	RO	2 Byte	/

✧ **Example**

Example 1: To instruct the VFD whose address is 3 to run forwardly, the master node transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x01	0x21	0x00	0x01	0x00	0x00	0x00

Example 2: Assume that the address of the VFD slave node is 3, and the function of setting 1 is defined as "Set frequency". To set the frequency to 50.00 Hz (that is, setting 1=0x1388), the master node transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x00	0x21	0x03	0x88	0x13	0x00	0x00

Example 3: To read the running status of the VFD whose address is 3, the master node transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x01	0x20	0x00	0x00	0x00	0x00	0x00

If the VFD is running forward, the following SDO command is returned to the master node.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x4B	0x01	0x20	0x00	0x01	0x01	0x00	0x00

Example 4: Assume that the address of the VFD slave node is 3, and the function of Returned value 1 is defined as "Running frequency". To read the VFD running frequency, the master node transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x00	0x20	0x03	0x00	0x00	0x00	0x00

If the VFD running frequency is 50.00Hz, the following SDO command is returned to the master node.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x4B	0x00	0x20	0x03	0x88	0x13	0x00	0x00

6.5 PROFIBUS-DP-to-CANopen networking

6.5.1 PROFIBUS-DP communication protocol introduction

PROFIBUS is an international open fieldbus standard that can implement data exchange between various automation components. It is widely applicable to automation in various industries, such as the manufacturing, process, building, transportation, and power industries. It provides effective solutions for implementing integrated automation and intelligentization of field devices.

PROFIBUS consists of three mutually compatible components, namely PROFIBUS-Decentralised Peripherals (DP), PROFIBUS-Process Automation (PA), and PROFIBUS-Fieldbus Message Specification (FMS). It adopts the master/slave mode and is generally used for periodic data exchange between VFD devices. PRNV PROFIBUS-DP adapter modules support only the PROFIBUS-DP protocol.

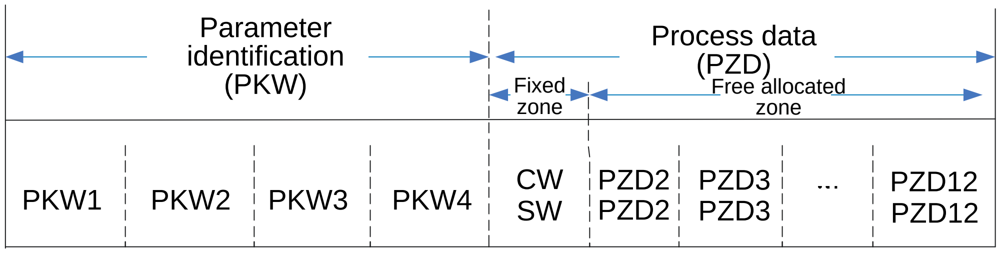
The transmission media of a PROFIBUS field bus are twisted pairs (complying with the RS-485 standard), paired cables, or optical cables. The baud rate ranges from 9.6kbit/s to 12Mbit/s. The maximum length of a fieldbus cable must be within the range of 100 meters to 1200 meters, and the specific length depends on the selected transmission rate (see the chapter of "Technical Data"). A maximum of 31 nodes can be connected to one PROFIBUS network segment when no repeater is used. If repeaters are used, a maximum of 127 nodes (including the repeaters and master nodes) can be connected.

In PROFIBUS communication, tokens are transmitted between master nodes or by master nodes to slave nodes. Single-master or multi-master systems are supported. The node to respond to the command of a master is selected by the master node, generally a programmable logic controller (PLC). For cyclic master/slave user data transmission and non-cyclic master-master data transmission, a master can also transmit commands to multiple nodes in broadcast mode. When the broadcast mode is adopted, the nodes do not need to transmit feedback signals to the master. On PROFIBUS networks, nodes cannot communicate with each other.

The PROFIBUS protocol is described in details in the EN50170 standard. For details, refer to the EN50170 standard.

6.5.2 Communication packet structure

The PROFIBUS-DP communication data frame structure (PKW+PZD) is similar to the PROFINET communication data frame structure. For details, see 6.6.2 Communication packet structure.



6.5.3 Baud rate and communication distance

The max. cable length depends on the transmission rate. The following provides the relationship between transmission rates and transmission distances.

Table 6-24 Relationship between transmission rates and transmission distances

Transmission rate (Kbps)	Type-A cable (m)	Type-B cable (m)
9.6	1200	1200
19.2	1200	1200
93.75	1200	1200
187.5	1000	600
500	400	200
1500	200	-----
12000	100	-----

Table 6-25 Transmission cable specifications

Transmission rate (Kbps)	Type-A cable (m)	Type-B cable (m)
Impedance (ohm)	135–165	100-130
Capacitance per unit length (pF/m)	< 30	< 60
Loop resistance (Ohm/km)	110	--------
Core diameter (mm)	0.64	>0.53
Core section (mm^2)	>0.34	>0.22

In addition to shielded twisted pair copper wire transmission, PROFIBUS can also be used for fiber optic transmission to increase the distance of high-speed transmission especially in environments with high electromagnetic interference. Two types of fiber optic conductors can be used: an inexpensive plastic fiber conductor for transmission in a distance of less than 50 meters and a glass fiber conductor for transmission in a distance of less than 1 kilometer.

6.5.4 Network topology

In this network, the PLC or another master device connects only to the rectifier unit that has been inserted with a PROFIBUS-DP communication card, and the rectifier unit connects to other units through RJ45 since it converts the communication card bus to CANopen bus.

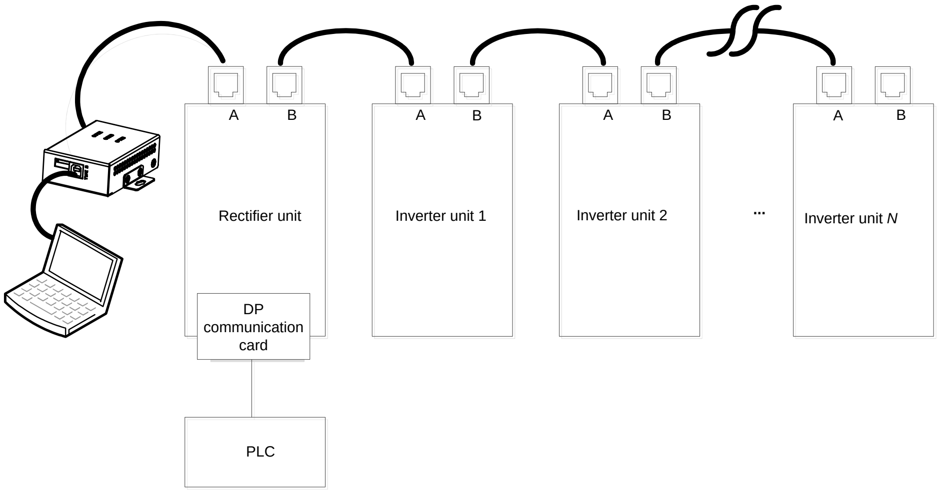


Figure 6-5 PROFIBUS-DP-to-CANopen network topology

Note: In the networking wiring, the RJ45 ports between units must be cross-connected, that is, port A of a unit can only be connected to port B of another unit. If the connection is incorrect, the communication performance of the entire system will be degraded.

6.5.5 Communication performance

One DP bridge unit can support 21 CANopen slave nodes, and the bridge unit itself is also considered as a CANopen slave node. One bridge unit interacts with the PLC up to 128 bytes each time. At the same time, the number of slaves supported by the DP bridge is limited by the number of nodes supported by the PLC. Generally Siemens PLC allows more than 21 slave nodes, and therefore you only need to consider the number limited by the bridge itself.

6.5.6 Commissioning procedure

6.5.6.1 Commissioning flowchart

Figure 6-6 shows the commissioning procedure.

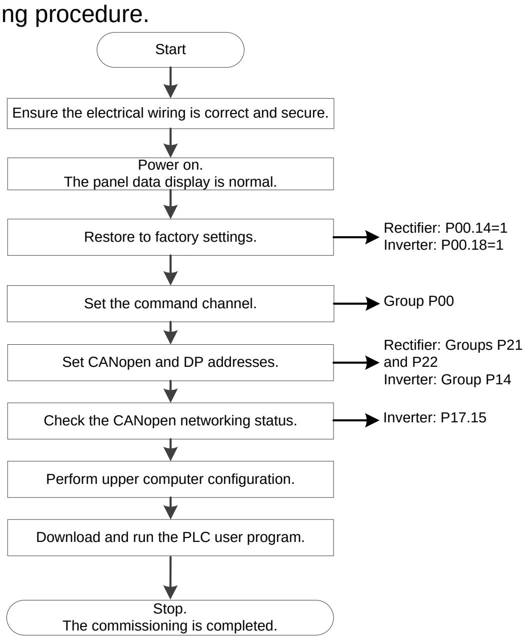


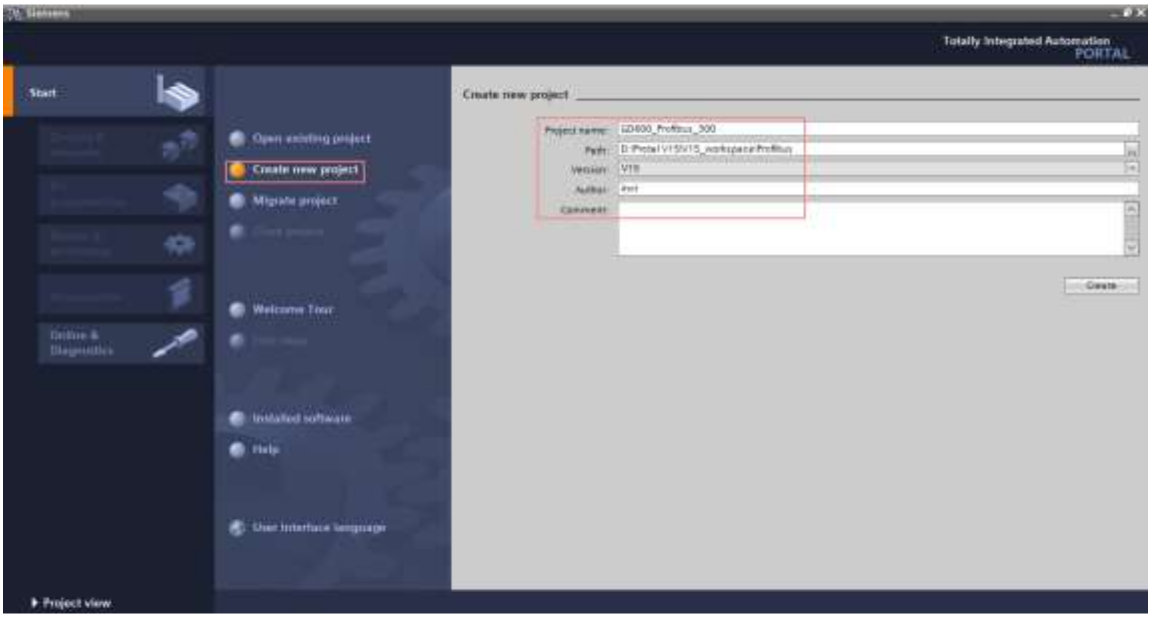
Figure 6-6 Commissioning procedure

6.5.6.2 TIA portal configuration (S7-300)

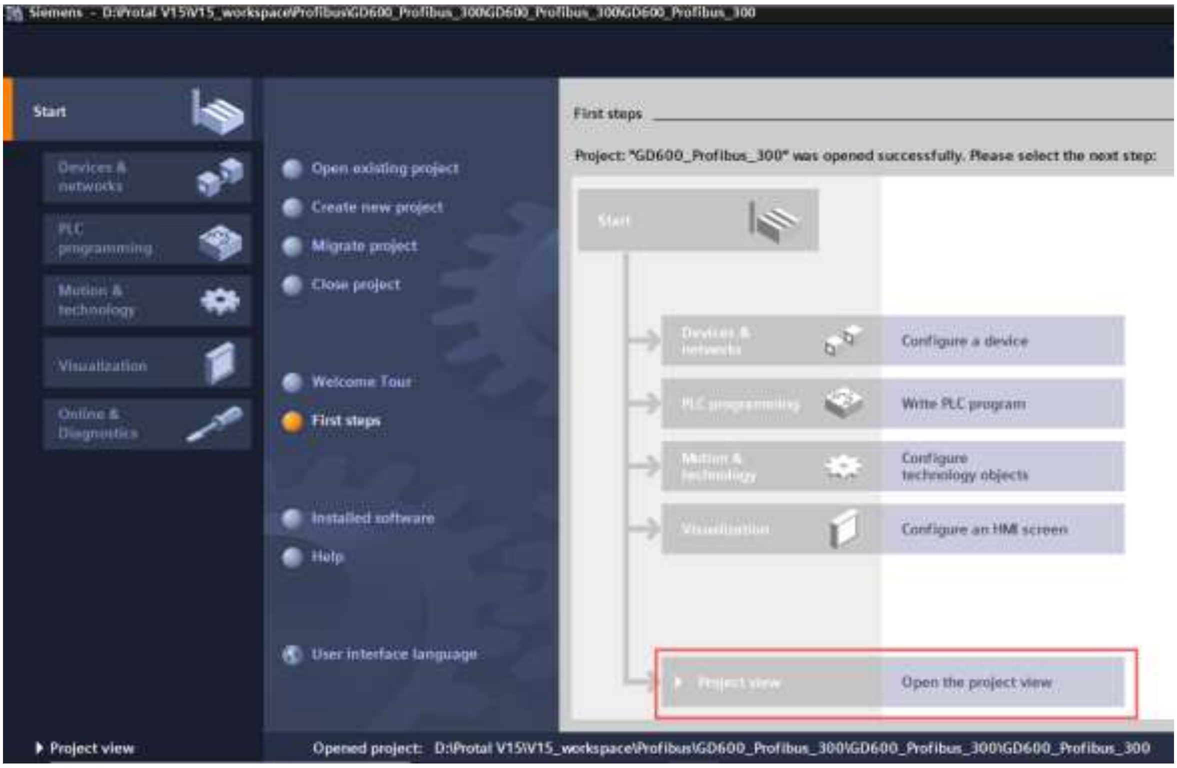
The following uses SIMATIC S7-300 as an example to describe the configuration procedure on TIA Portal.

(1) Create a project.

Double-click the TIA Portal V15 icon to start the TIA Portal V15 project tool. Then choose **Create new project**. On the right of the interface, enter **Project name**, **Path**, **Version**, **Author**, and **Comment**, and click **Create**.

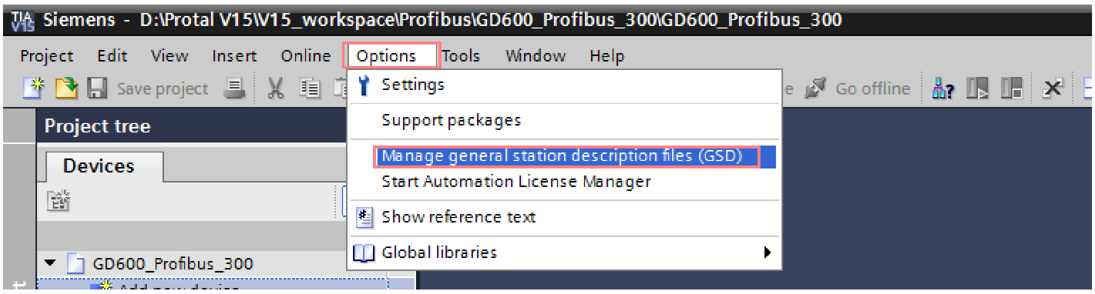


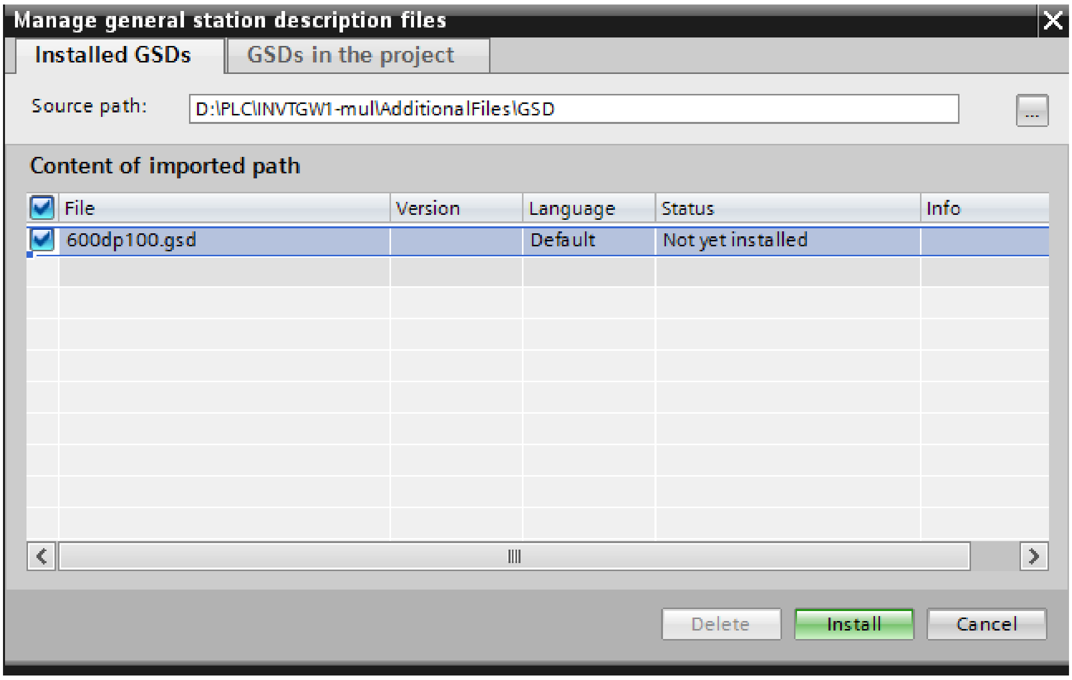
Then double-click to open the project view, as shown in the following figure.



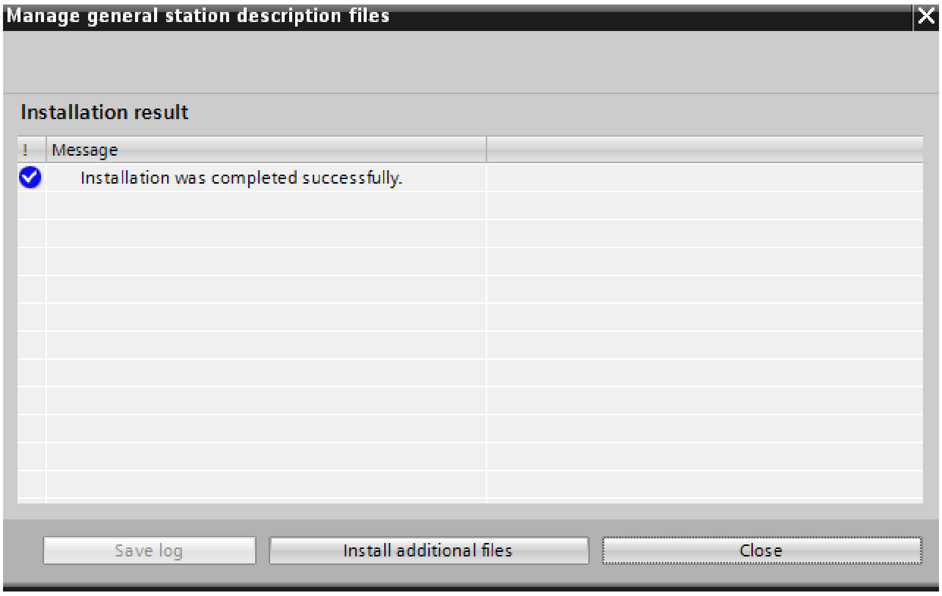
(2) Add the GSD file, similar to the following.

Choose **Options** > **Manage general station description files (GSD)**. In the dialog box that appears, enter the source path of the GSD file, select the GSD file, and click **Install**.





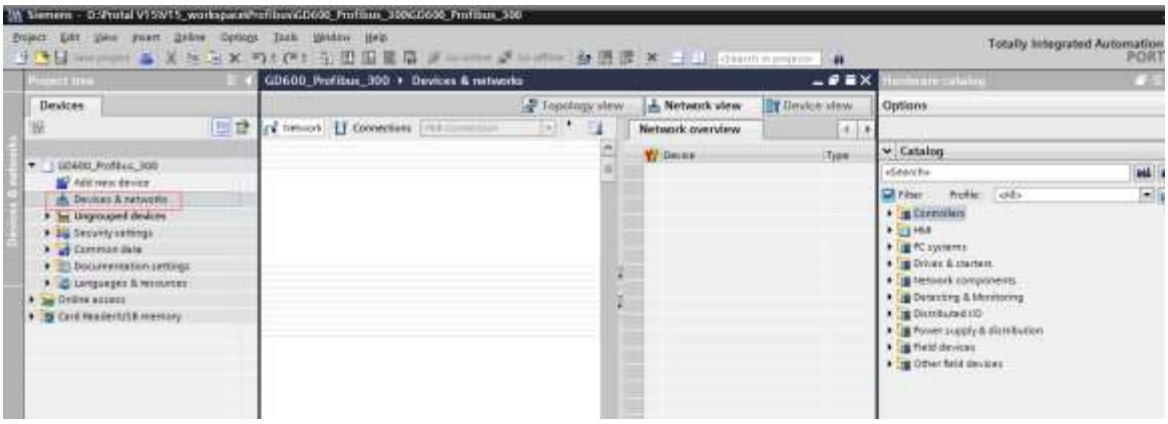
If the installation is successful, the following dialog box appears.



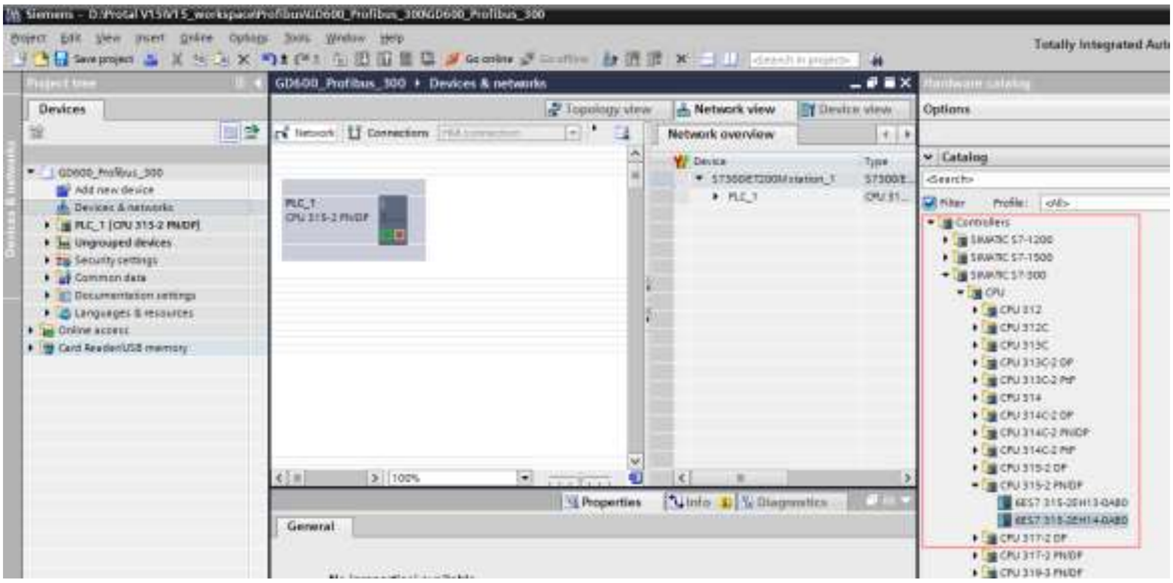
(3) Configure the project information.

To configure project information, do as follows:

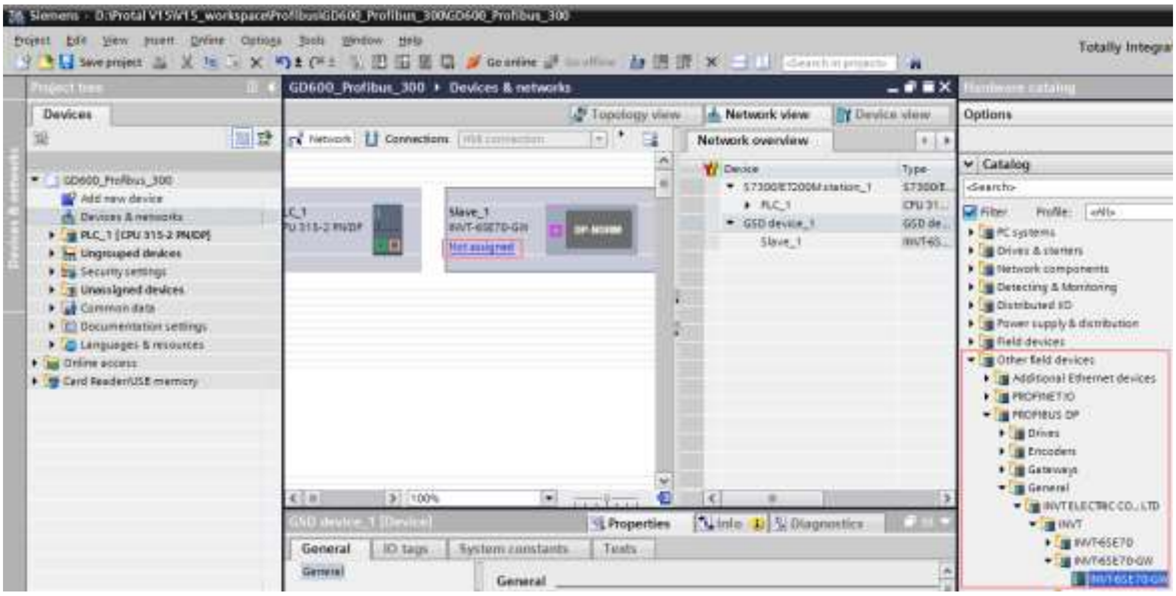
Step 1. Double-click **Devices & networks** in the project view.



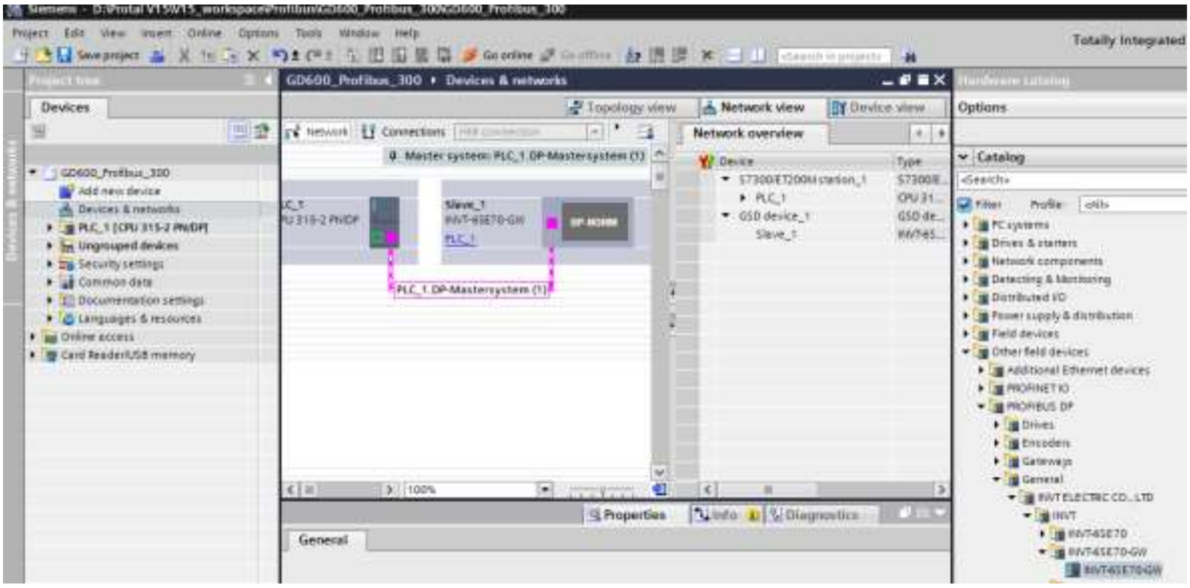
Step 2. Add project devices according to your selected PLC model. For example, if you use SIMATIC S7-300 PLC, choose **Controllers** > **SIMATIC S7-300** > **CPU** > **CPU 315-2 PN/DP** > **6ES7 315-2EH14-0AB0** in the **Hardware catalog** panel on the right, and then double-click or drag the **6ES7 315-2EH14-0AB0** icon to the project.



In the **Hardware catalog** panel on the right, choose **Other field devices** > **PROFIBUS DP** > **General** > **INVT ELECTRIC CO., LTD** > **INVT** > **INVT-6SE70-GW**, and then double-click the **INVT-6SE70-GW** icon to add the GSD file to the project.

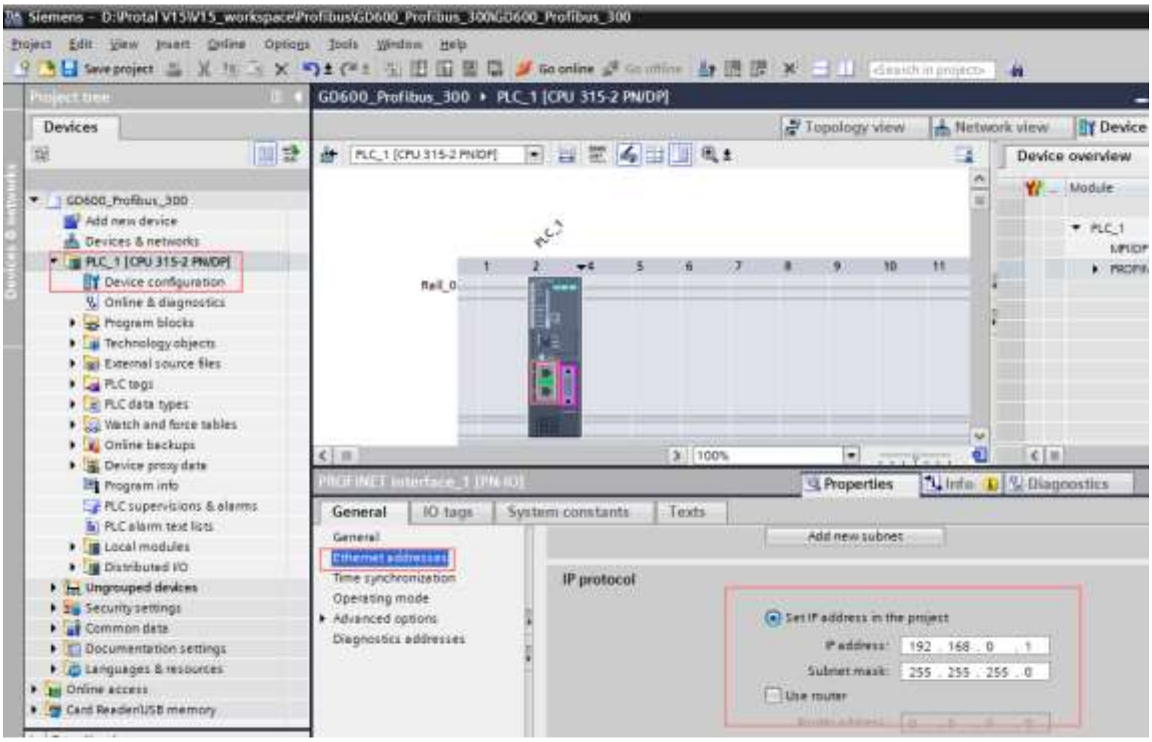


Click the **Not assigned** option of **INVT-6SE70-GW**, and select the IO controller **PLC_1.MPI/DP interface_1**. In the network view, the CPU and INVT-6SE70-GW have been connected to the same PROFIBUS sub network.

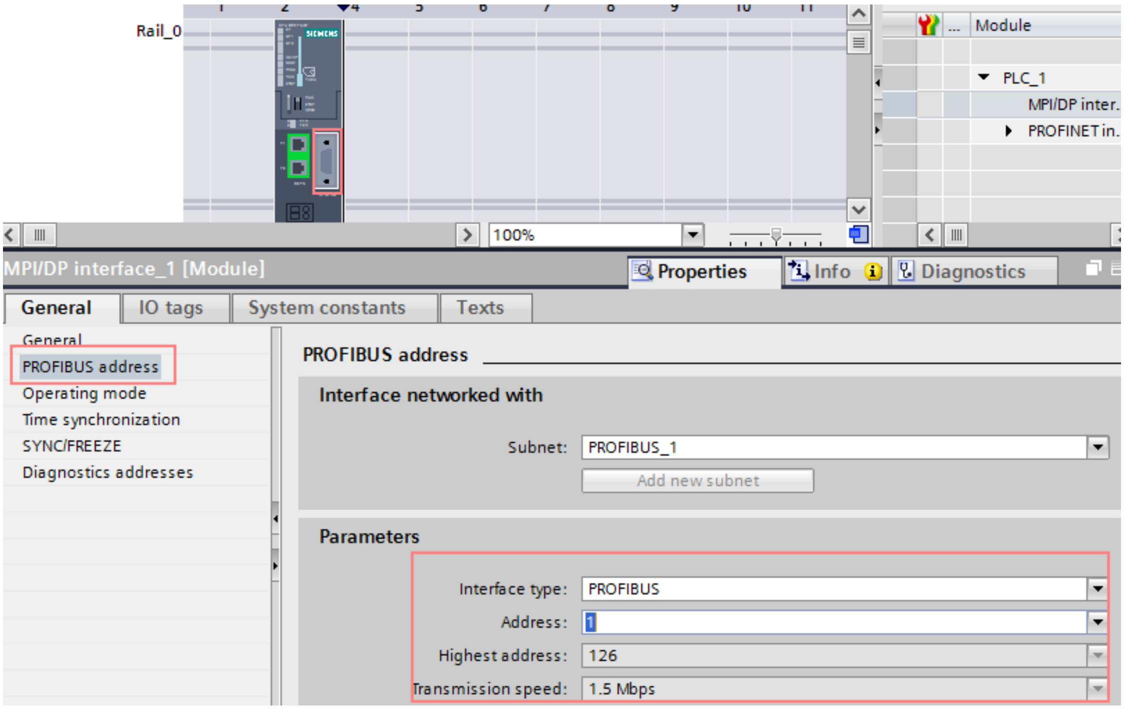


Step 3. Configure the PROFIBUS master node.

Double-click **Devices & networks** to enter the editing interface in the network view. Double-click **PLC_1 CPU 315-2 PN/DP** to enter the device view interface. Double-click the network interface position of the S7-300 icon to enter the PROFINET interface_1 editing interface. Click the **General** tab, choose **Ethernet addresses**, and set parameters.

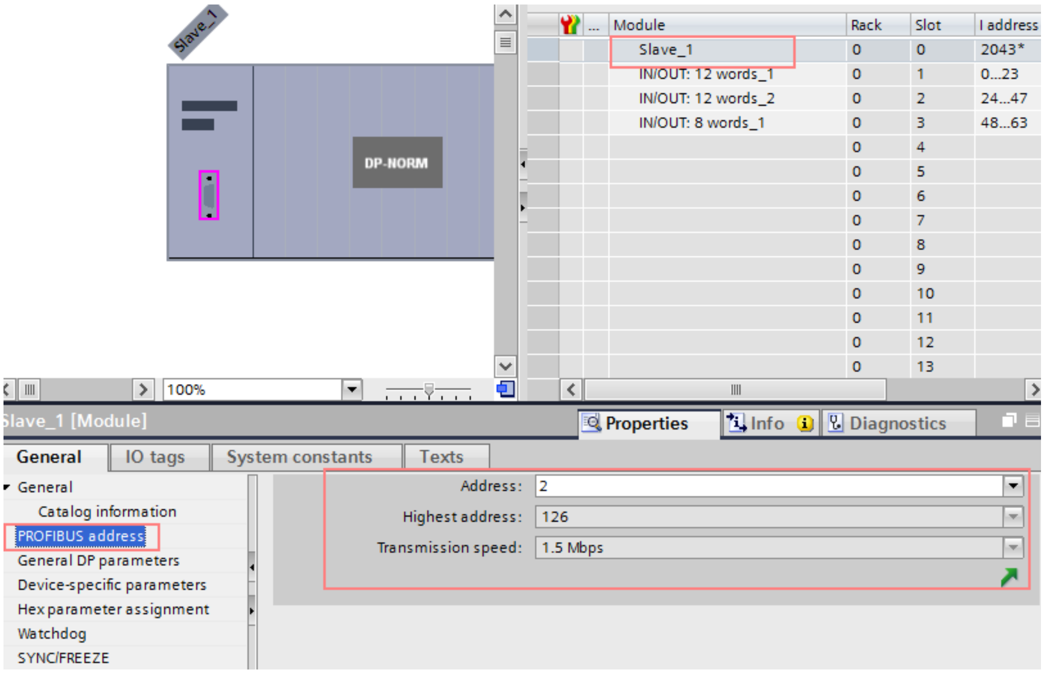


Click **MPI/DP interface_1** to enter the MPI/DP interface_1 editing interface. Click the **General** tab, choose **PROFIBUS addresses**, and set parameters.



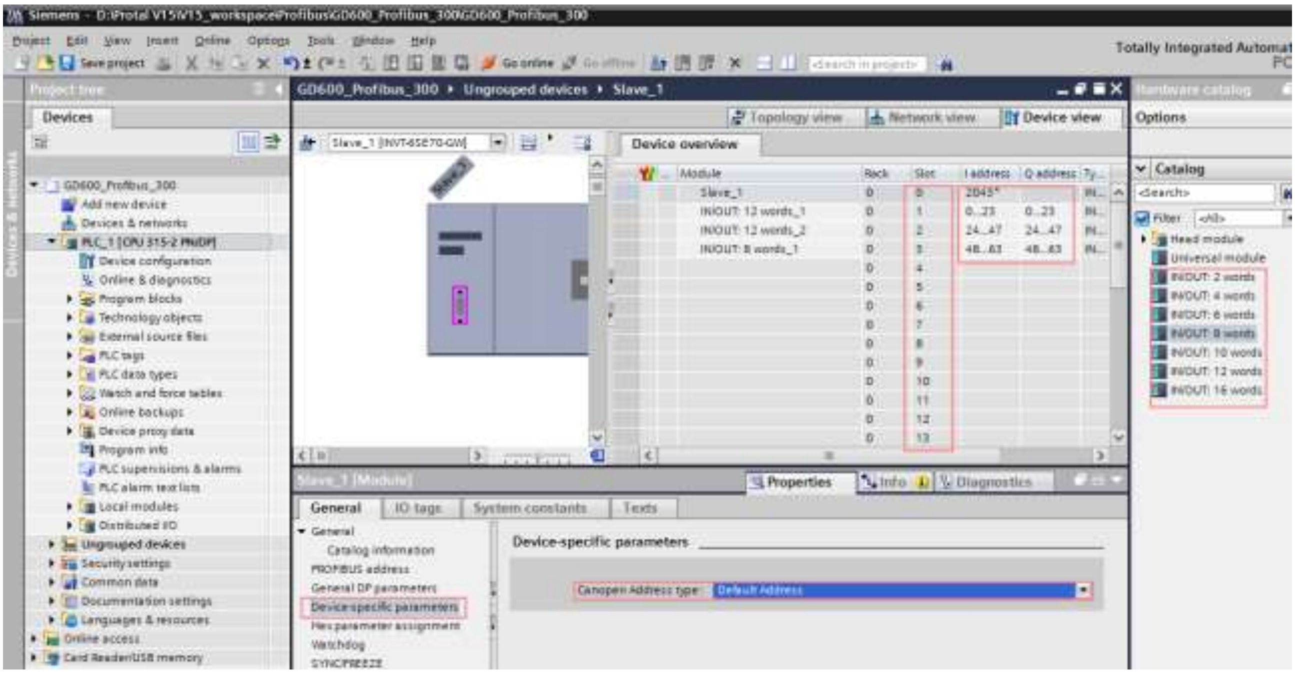
Step 4. Configure the slave node.

Double-click the INVT-6SE70-GW icon in the project to enter the slave node parameter setting view. Click **Slave_1** to enter the PROFIBUS slave node configuration interface. Click the **General** tab, choose **PROFIBUS addresses**, and set parameters.



IO module address types are classified into default and customized address types. To select the default address type, on the **General** tab, click **Device-specific parameters**, select **Default Address** from **CANopen Address type**.

The IO module addresses increase by 1 in ascending order. To be specific, the data of IO module 1 corresponds to CANopen node 1, the data of IO module 2 corresponds to CANopen node 2, and so on. **I address** and **Q address** indicate the receiving and sending addresses of the node. Slot 1 corresponds to the data of the rectifier unit master node, while slots 2 to 21 correspond to the data of inverter unit slave nodes, which means 20 slave nodes can be supported at most. Click **Hardware catalog**, and double-click a module or drag it to the device view to set the data receiving length for the module.



Note:

- IN/OUT module data can be customized. Different IN/OUT modules have different process data. For details, see 6.5.6.3 IN/OUT module mapping.
- The addresses in the variable monitoring table need to correspond to the addresses in the preceding figure.

✧ QW0–QW23 correspond to the PLC output addresses of the rectifier unit (node 1, CANopen master node).

✧ IW0–IW23 correspond to the PLC input addresses of the rectifier unit (node 1, CANopen master node).

✧ QW24–QW47 correspond to the PLC output addresses of the inverter unit (node2, CANopen slave node).

✧ IW24–IW47 corresponds to the PLC input addresses of the inverter unit (node2, CANopen slave node).

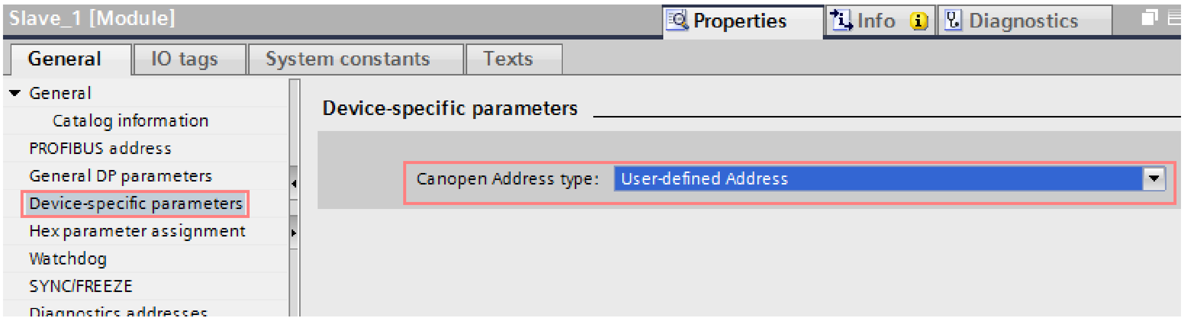
✧ QW48–QW63 correspond to the PLC output addresses of the inverter unit (node3, CANopen slave node).

✧ IW48–IW63 correspond to the PLC input addresses of the inverter unit (node3, CANopen slave node).

The same rule is applied to the other. To ensure the consistency, you are recommended to set the rectifier start address to 1.

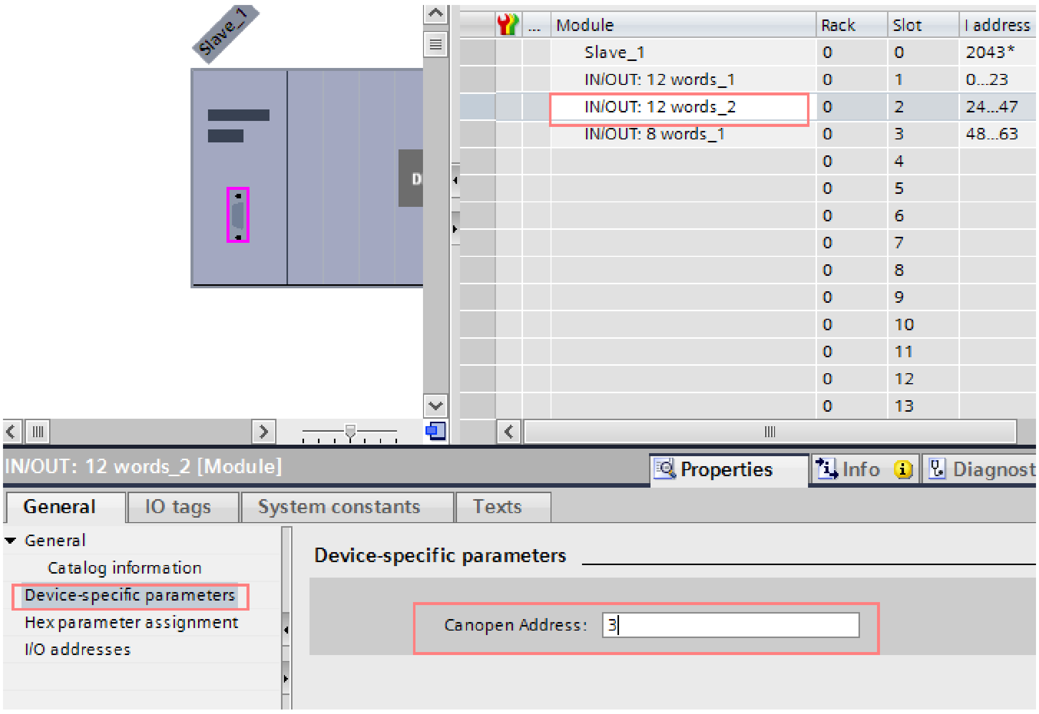
- Due to the limit of TIA Portal, the I addresses and Q addresses of the IO module must ascend from 0 and cannot exceed 127. If the number exceeds 127, data cannot be sent.

To make operations easy, IO module addresses can be customized. On the **General** tab, click **Device-specific parameters**, select **User-defined Address** from the **CANopen Address type** drop-down list box.



Then click the IO module to enter the IO module view. On the **General** tab, click **Device-specific parameters**, set **CANopen Address** to the CANopen node number (for example, 3).

For example, if you want to make the data of IO module 2 correspond to CANopen node 3, click **IN/OUT:12words_2**, click **Device-specific parameters**, set **CANopen Address** to **3**.



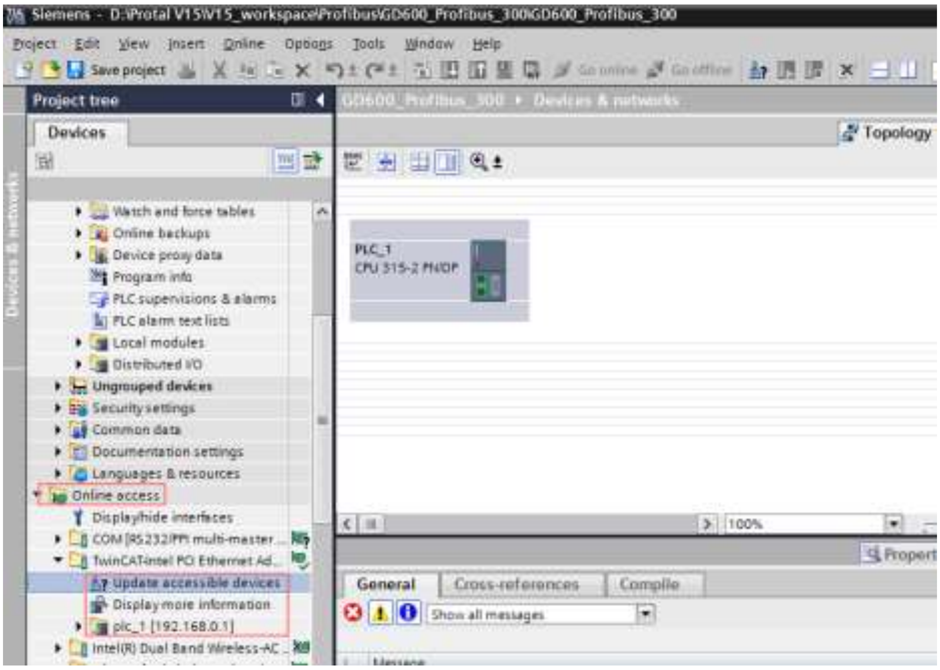
Note:

To ensure that data from different IO modules are not sent to the same rectifier or inverter unit, the data of all IO modules is not sent when there are same settings for **CANopen Address**.

Step 5. Allocate IO devices.

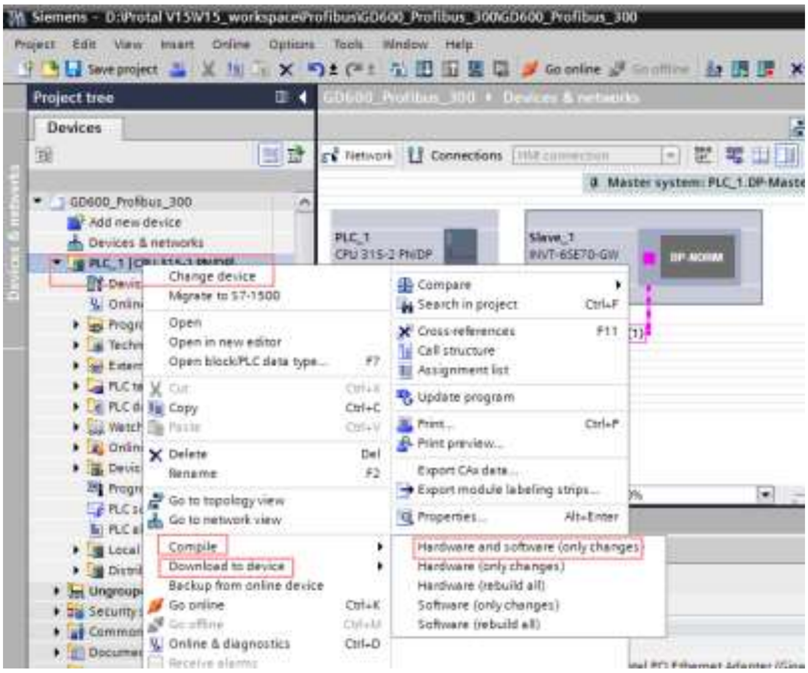
First of all, ensure that the PLC has been connected to your computer through a network cable. Then make settings to ensure your computer Ethernet IP address are in the same sub network as the IP address set for the PROFIBUS master node.

In the project tree, choose **Online access** > **TwinCAT-Intel PCI Ethernet Adapter** > Update accessible devices. Then you can view the device IP address.

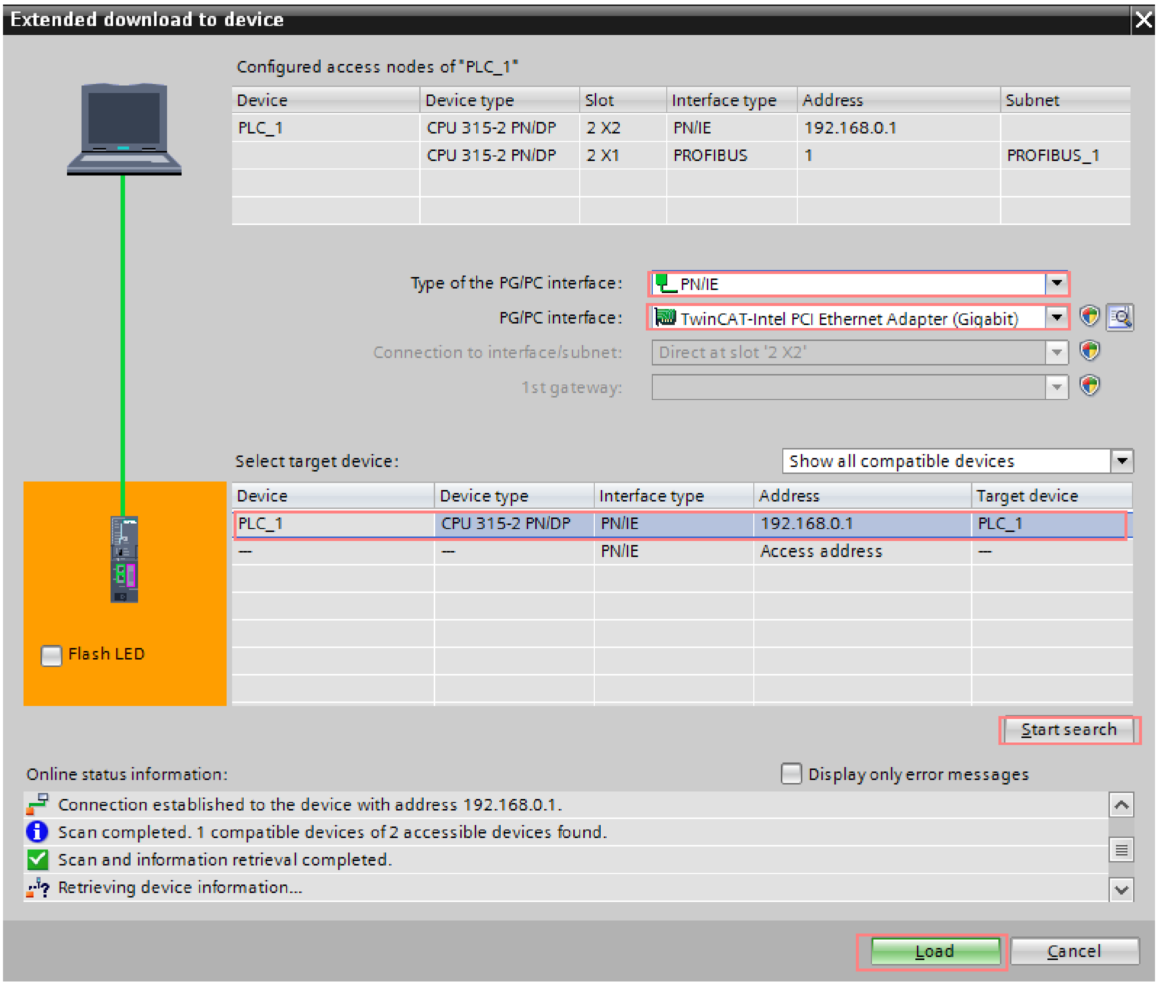


Step 6. Download and compile the project.

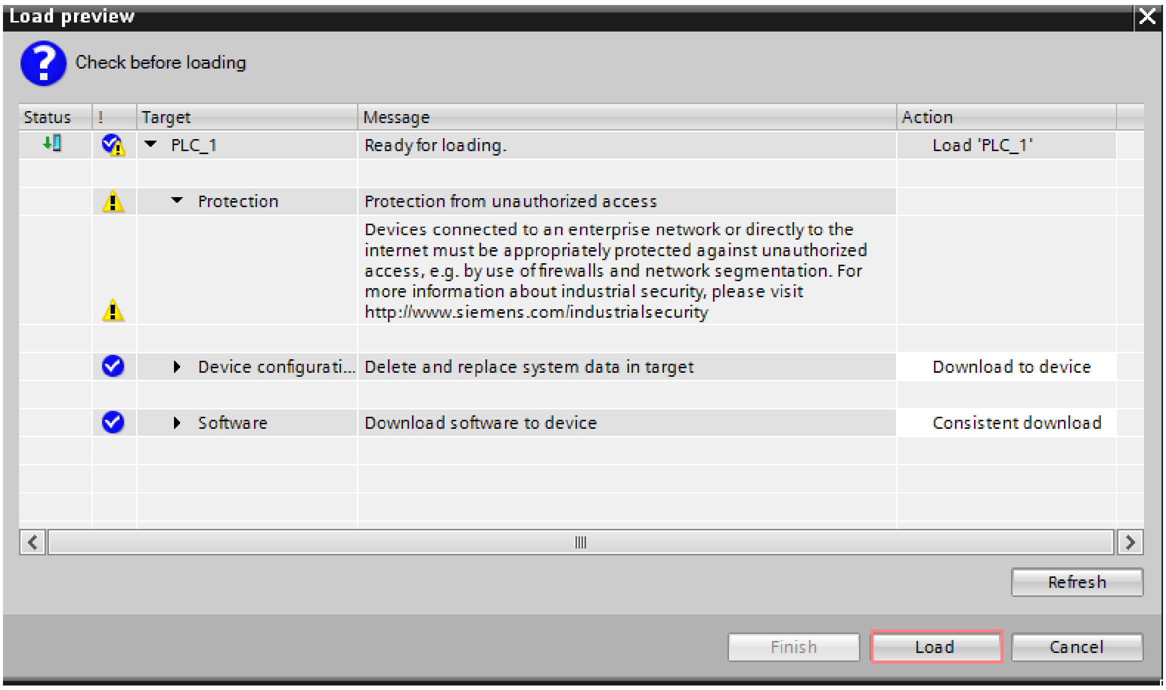
After configuring the project, you need to download the project configuration information to the CPU. After saving the project, right-click **PLC_1 [CPU 315-2 PN/DP]** and choose **Compile** > **Hardware and software (only changes)** > **Download to device**.



After the download is completed, the following interface appears. Select **PN/IE** from the **Type of the PG/PC interface** drop-down list box. Click **Start search** in the lower right corner to start scanning for PLC devices in the detection network.



Select the PLC to download (there is only one PLC in the example). Then click **Load** and then **Finish**.



Step 7 Configure variable table monitoring.

Choose **Watch and force tables** > **Add new watch table** in the project tree on the left.

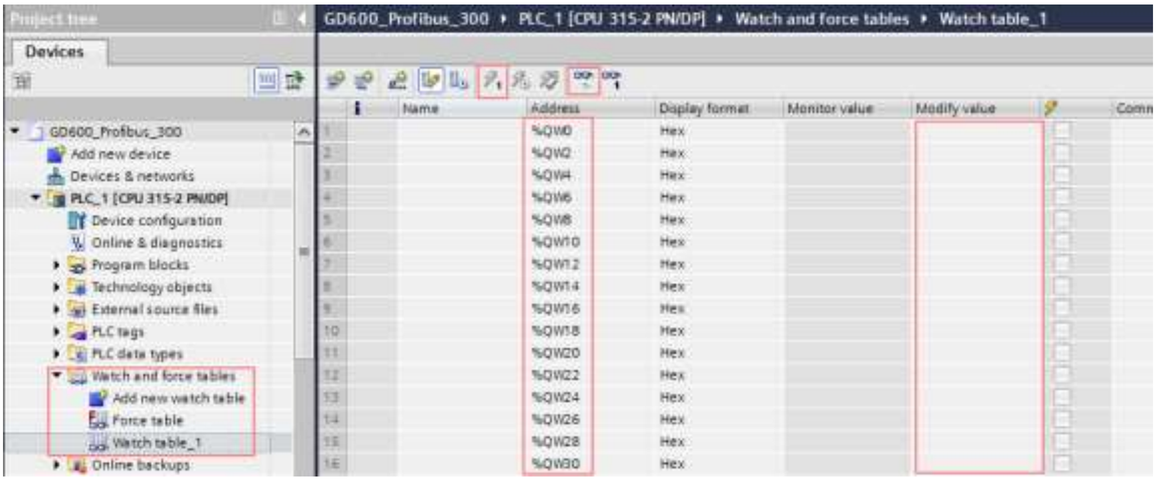
The addresses in the table are consistent with those allocated during IN/OUT module configuration.

QW0–QW23 correspond to the PLC output addresses of the rectifier unit (node 1), consistent with the Q addresses in the configuration, while IW0–IW23 correspond to the PLC input addresses, consistent with the I addresses in the configuration.

QW24–QW47 correspond to the PLC output addresses of the inverter unit (node2), consistent with the Q addresses in the configuration, while IW24–IW47 correspond to the PLC input addresses, consistent with the I addresses in the configuration.

QW48–QW63 correspond to the PLC output addresses of the inverter unit (node3), consistent with the Q addresses in the configuration, while IW48–IW63 correspond to the PLC input addresses, consistent with the I addresses in the configuration.

You can monitor and modify the values.



Finally, you can perform PLC programming.

6.5.6.3 IN/OUT module mapping

In the configuration of PROFIBUS-DP-to-CANopen communication, to ensure the efficiency of CANopen communication, IN/OUT modules can support the selection of 2, 4, 8, 10, 12 words, but not 16 words. Selecting different word types causes data mapping difference.

When the IN/OUT module selects 8 words or more, it supports the reading and writing of function codes. To be specific, mapping from PKW, it also supports data reading and writing of up to 7 PZDs (PZD2–PZD8).

When the IN/OUT module selects 8 words or less, the mapping starts from CW/SW and it supports data reading and writing of up to 7 PZDs, but it does not support reading and writing of PKW function codes.

6.5.7 Related parameters

Table 6-26 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	Used to select the channel of rectifier unit control commands, including the start, stop, and fault reset commands. 0: Keypad	1	○

Function code	Name	Description	Default	Modify
		The running commands are controlled through keypad keys, such as RUN and STOP/RST. 1: Terminal The running commands such as run, stop, and fault reset are controlled through multi-function input terminals. 2: Communication The running commands are controlled by the upper computer in communication mode.		
P00.02	Communication mode of running commands	Used to select the rectifier unit communication command mode. 0: RS485 1: CANopen 2: PLC 3: PROFIBUS-DP 4: PROFINET/EtherCAT	0	○
P17.15	Actual online slave nodes	Number of actual online slave nodes. Range: 0–20	0	●
P17.16	Type of card at slot 1	Used to display the type of card at the slot. Range: 0–18 0: No card 1: PLC 2: I/O 3–4: Reserved 5: Ethernet 6: PROFIBUS-DP 7: Reserved 8: Reserved 9: Reserved 10: Reserved 11–14: Reserved 15: PROFINET 16: Modbus 17: EtherCAT 18: BACnet	0	●
P17.17	Type of card at slot 2		0	●
P17.18	Software version of card at slot 1	Used to display the software version of thecard at slot 1. Range: 0–655.35	0.00	●
P17.19	Software version of card at slot 2	Used to display the software version of thecard at slot 2. Range: 0–655.35	0.00	●
P17.20	Staus of slave nodes 02–17	Used to display the online/offline status of slave nodes 02–17. Range: 0–0xFFFF 0: Offline 1: Online	0	●

Function code	Name	Description	Default	Modify
P17.21	Staus of slave nodes 18–21	Used to display the online/offline status of slave nodes 18–21. Range: 0–0xF 0: Offline 1: Online	0	●
P21.01	CANopen communication address	0–127	1	○
P21.30	CANopen communication timeout time	0.0 (invalid); 0.1–100.0s	0.0s	○
P21.33	Number of CANopen slave nodes	0–20 (Set this parameter only when the master node is valid.)	0	○
P21.34	CANopen master/slave selection	0: Slave 1: Master	0	○
P22.01	DP expansion card module address	0–127	3	◎
P22.13	Sent PZD2	Used only when the rectifier unit has been configured with a PROFIBUS-DP communication card. 0: Disable 1: Fault code 2: DC voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Braker current (* 10, A) 6: Terminal input status 7: Terminal output status 8: Number of online slave nodes 9: Online/offline status of slave nodes 02–17 10: Online/offline status of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20: Reserved	0	○
P22.14	Sent PZD3		0	○
P22.15	Sent PZD4		0	○
P22.16	Sent PZD5		0	○
P22.17	Sent PZD6		0	○
P22.18	Sent PZD7		0	○
P22.19	Sent PZD8		0	○
P22.20	Sent PZD9		0	○
P22.21	Sent PZD10		0	○
P22.22	Sent PZD11		0	○
P22.23	Sent PZD12		0	○
P22.25	PROFIBUS-DP communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○

Table 6-27 Inverter unit related parameters

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0	○
P00.02	Communication mode of running commands	0: Modbus 1: CANopen 2: Ethernet 3: EtherCAT/PROFINET 4: PLC 5: Wireless communication 6: PROFIBUS-DP/DeviceNet **Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.**	0	○
P00.06	Setting channel of A frequency command	0: Keypad 1: AI1 2: AI2 3: AI3 4: Reserved 5: Simple PLC program 6: Multi-step speed running 7: PID control 8: Modbus communication 9: CANopen communication 10: Ethernet communication 11: Reserved 12: Pulse train AB 13: EtherCAT/PROFINET communication 14: Programmable expansion card 15: PROFIBUS-DP/DeviceNet communication	0	○
P07.27	Type of present fault	0: No fault 1: Inverter unit U-phase protection (OUt1) 2: Inverter unit V-phase protection (OUt2) 3: Inverter unit W-phase protection (OUt3) 4: Overcurrent during acceleration (OC1) 5: Overcurrent during deceleration (OC2) 6: Overcurrent during constant speed running (OC3) 7: Overvoltage during acceleration (OV1) 8: Overvoltage during deceleration (OV2) 9: Overvoltage during constant speed running (OV3) 10: Bus undervoltage fault (UV) 11: Motor overload (OL1) 12: Inverter unit overload (OL2)	/	●
P07.28	Last fault type		/	●
P07.29	2nd-last fault type		/	●
P07.30	3rd-last fault type		/	●
P07.31	4th-last fault type		/	●
P07.32	5th-last fault type		/	●

Function code	Name	Description	Default	Modify
		13: CAN fault in master/slave synchronization (SECAN) 14: Phase loss on output side (SPO) 15: Reserved 16: Inverter module overheat (OH2) 17: External fault (EF) 18: RS485 communication fault (CE) 19: Current detection fault (ItE) 20: Motor autotuning fault (tE) 21: EEPROM operation error (EEP) 22: PID feedback offline fault (PIDE) 23: CAN slave fault in master/slave synchronization (S-Err) 24: Running time reached (END) 25: Electronic overload (OL3) 26: Keypad communication error (PCE) 27: Parameter upload error (UPE) 28: Parameter download error (DNE) 29: PROFIBUS-DP communication fault (E_dP) 30: Ethernet communication fault (E_NET) 31: CANopen communication fault (E_CAN) 32: To-ground short-circuit fault 1 (ETH1) 33: To-ground short-circuit fault 2 (ETH2) 34: Speed deviation fault (dEu) 35: Mal-adjustment fault (STo) 36: Underload fault (LL) 37: Encoder disconnection fault (ENC1O) 38: Encoder direction reversal fault (ENC1D) 39: Encoder Z-pulse disconnection fault (ENC1Z) 40: Safe torque off (STO) 41: Channel 1 safety circuit exception (STL1) 42: Channel 2 safety circuit exception (STL2) 43: Exception in both channels 1 and 2 (STL3) 44: Safety code FLASH CRC fault (CrCE) 45: Programmable card customized fault 1 (P-E1) 46: Programmable card customized fault 2 (P-E2) 47: Programmable card customized fault 3 (P-E3) 48: Programmable card customized fault 4 (P-E4)		

Function code	Name	Description	Default	Modify
		49: Programmable card customized fault 5 (P-E5) 50: Programmable card customized fault 6 (P-E6) 51: Programmable card customized fault 7 (P-E7) 52: Programmable card customized fault 8 (P-E8) 53: Programmable card customized fault 9 (P-E9) 54: Programmable card customized fault 10 (P-E10) 55: Duplicate expansion card type (E-Err) 56: Encoder UVW lost (ENCUV) 57: PROFINET communication timeout fault (E_PN) 58: Reserved 59: Motor overtemperature fault (OT) 60: Failure to identify the card at slot 1 (F1-Er) 61: Failure to identify the card at slot 2 (F2-Er) 62: PG card detected motor overtemperature fault (E-OT2) 63: Communication timeout of the card at slot 1 (C1-Er) 64: Communication timeout of the card at slot 2 (C2-Er) 65: IO card detected motor overtemperature fault (E-OT3) 66: EtherCAT card communication fault (E-CAT) 67: BACnet card communication fault (E-BAC) 68: DeviceNet card communication fault (E-DEV) 69: CAN slave fault in master/slave synchronization (S-Err) 70: AI detected motor overtemperature fault (E-OT4) 71: Reserved		
P14.00	Local communication address	Setting range: 1–247 When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the salves on the Modbus bus receive the frame but do not respond to it. The communication addresses on the	1	○

Function code	Name	Description	Default	Modify
		communication network are unique, which is the basis of the point-to-point communication. **Note: The communication address of a slave cannot be set to 0.**		
P14.07	CANopen communication timeout time	0.1–60.0s 0.0: Invalid	0.0s	○
P14.08	CANopen communication address	0–127	1	◎
P14.09	CANopen communication baud rate	0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	◎
P14.10	Received PZD2	Used for CANopen networking communication. 0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9 corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8) 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage)	0	○
P14.11	Received PZD3		0	○
P14.12	Received PZD4		0	○
P14.13	Received PZD5		0	○
P14.14	Received PZD6		0	○
P14.15	Received PZD7		0	○
P14.16	Received PZD8		0	○
P14.17	Received PZD9		0	○
P14.18	Received PZD10		0	○
P14.19	Received PZD11		0	○
P14.20	Received PZD12		0	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)
13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)
14: High-order bit of position reference (signed)
15: Low-order bit of position reference (unsigned)
16: High-order bit of position feedback (signed)
17: Low-order bit of position feedback (unsigned)
18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)
19: Function code mapping (PZD2–PZD12 corresponds to P14.49–P14.59)
20–31: Reserved</td><td></td><td></td></tr>
<tr><td>P14.21</td><td>Sent PZD2</td><td rowspan="11">Used for CANopen networking communication.
0: Invalid
1: Running frequency (x100, Hz)
2: Set frequency (x100, Hz)
3: Bus voltage (x10, V)
4: Output voltage (×1, V)
5: Output current (x10, A)
6: Actual output torque (x10, %)
7: Actual output power (x10, %)
8: Rotation speed of running (x1, RPM)
9: Linear speed of running (x1, m/s)
10: Ramp reference frequency
11: Fault code
12: AI1 input (* 100, V)
13: AI2 input (* 100, V)
14: AI3 input (* 100, V)
15: Reserved
16: Terminal input status
17: Terminal output status
18: PID reference (x100, %)
19: PID feedback (x100, %)
20: Reserved
21: High-order bit of position reference (signed)
22: Low-order bit of position reference (unsigned)
23: High-order bit of position feedback (signed)
24: Low-order bit of position feedback (unsigned)</td><td>0</td><td>○</td></tr>
<tr><td>P14.22</td><td>Sent PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P14.23</td><td>Sent PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P14.24</td><td>Sent PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P14.25</td><td>Sent PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P14.26</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P14.27</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P14.28</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P14.29</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P14.30</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P14.31</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		25: Status word 2 26–30: Reserved 31: Function code mapping (PZD2–PZD12 corresponds to P14.60–P14.70)		
P14.32	communication fault action selection	0: Normal running 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○
P14.33	Number system of control and status words for communication cards	0: Decimal system 1: Binary system Note: The rectifier unit and inverter unit must be the same in the value of the function parameter.	0	○
P19.00	Type of card at slot 1	0: No card 1: Programmable card 2: I/O card 3: Incremental PG card (including 5V/12V/24V) 4: Reserved 5: Ethernet card 6: PROFIBUS-DP card 7: Reserved 8: Rotary PG card 9: Reserved 10: Reserved 11: PROFINET card 12: Sine-cosine PG card without CD signals 13: Sine-cosine PG card with CD signals 14: Reserved 15: Reserved 16: Reserved 17: EtherCAT card 18: Reserved 19: Reserved	0	●
P19.01	Type of card at slot 2		0	●
P19.03	Software version of card at slot 1	0.00–655.35	0.00	●
P19.04	Software version of card at slot 2	0.00–655.35	0.00	●

6.6 PROFINET-to-CANopen networking

6.6.1 PROFINET communication protocol introduction

(1) Supported functions

- Supports the PROFINET protocol, and supports PROFINET I/O devices.
- Provides two PROFINET I/O ports and supports the 100M full-duplex operation.

- Supports the linear network topology and star-shaped network topology.

(2) Supported communication types

- Standard Ethernet channels

  Standard Ethernet channels are non-realtime communication channels that use the TCP/IP protocol, and are mainly used for device parameterization and configuration and to read diagnosis data.

- Real-time (RT) communication channels

  RT channels are optimized channels for real-time communication. They take precedence over TCP (UDP)/IP, which ensures that various stations on a network perform data transmission with high time requirements at a certain interval. The bus period may reach the precision of millisecond. These channels are used to transmit data such as process data and alarm data.

- Isochronous real-time (IRT) communication channels

  IRT channels are implemented through the built-in Switch-ASIC IRT chip. IRT communication can further shorten the processing time of the communication stack software, synchronizing data transmission of the program and device. The transmission delay is less than 1 ms, and the jitter is less than 1 μs. The typical application is motion control.

6.6.2 Communication packet structure

6.6.2.1 PROFINET packet format

Table 6-28 describes the structure of an RT frame (non-synchronous).

Table 6-28 RT frame structure

Data header	Ethernet type	VLAN	Ethernet type	Frame identifier	RT user data	Period counter	Data state	Transmission state	FCS
	2 bytes	2 bytes	2 bytes	2 bytes	36–1440 bytes	2 bytes	1 byte	1 byte	4 bytes
	0x8100		0x8892						
	VLAN flag					APDU state			

Data header			
7-byte preamble	1-byte synchronization information	6-byte source MAC address	6-byte destination MAC address

Table 6-29 describes the structure of the IRT frame (synchronous).

Table 6-29 IRT frame structure

Data header				Ethernet type	VLAN	Ethernet type	Frame identifier	IRT user data	FCS
7-byte preamble	1-byte synchronization	6-byte source MAC address	6-byte destination MAC address	2 bytes	2 bytes	2 bytes	2 bytes	36–1440 bytes	4 bytes

6.6.2.2 PROFINET packet data structure

The PROFINET communication card supports 16-word input/output. Figure 6-7 shows the packet format for transmitting data with the VFD

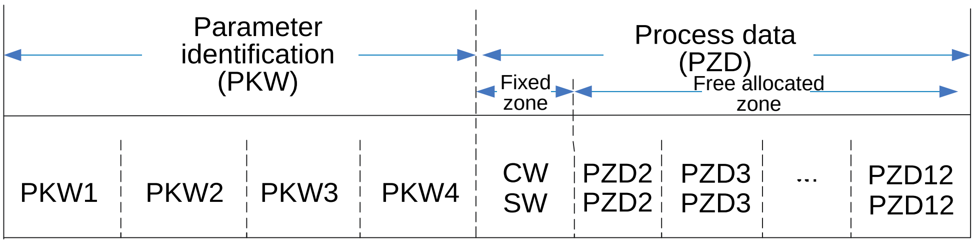


Figure 6-7 Packet structure

By using the 32 inputs/outputs, you can set the reference parameters of the rectifier/inverter unit, monitor the state values, transmit control commands, monitor the running state, and read/write the function parameters. For specific operations, see the following description.

Parameter zone:

PKW1—Parameter identification

PKW2—Array index number

PKW3—Parameter value 1

PKW4—Parameter value 2

Process data:

CW—Control word (from the master to a slave.)

SW—State word (from a slave to the master.)

PZD—Process data (user defined)

PZD zone (process data zone): The PZD zone in a communication packet is designed for controlling and monitoring a VFD. The master and slave stations always process the received PZD with the highest priority. The processing of PZD takes priority over that of PKW, and the master and slave nodes always transmit the latest valid data on the interfaces.

CWs and SWs:

Using CWs is the basic method of the fieldbus system to control the VFD. A CW is transmitted by the fieldbus master node to the VFD. In this case, the adapter module functions as a gateway. The VFD responds to the bit code information of the CW and feeds state information back to the master through an SW.

Reference value: The VFD may receive control information in multiple channels, including analog and digital input terminals, VFD control panel, and communication modules (such as RS485 and CH-PA01 adapter modules). To enable the control over the VFD through PROFINET, you need to set the communication module as the controller of the VFD.

Actual value: An actual value is a 16-bit word that includes information about VFD operation. The monitoring function is defined through VFD parameters. The conversion scale of an integer transmitted as an actual value from the VFD to the master depends on the set function. For more description, see the related VFD operation manual.

Note: The VFD always checks the bytes of a CW and reference value.

- **PKW description**

In periodic communication, the PKW zone consists of four words (each contains 16 bits).

Table 6-30 Each word in the PKW zone

First word PKW 1 (16 bits)		
Bits 15–00	Task or response identification flag	0–7
Second word PKW2 (16 bits)		
Bits 15–00	Basic parameter address	0–65535

Third word PKW3 (16 bits)		
Bits 15–00	Value (high-order word) of a parameter or error code of the returned value	00
Fourth word PKW4 (16 bits)		
Bits 15–00	Value (low-order word) of a parameter	0–65535

Note: If the master node requests the value of a parameter, the values in PKW3 and PKW4 of the packet that the master node transmits to the VFD are no longer valid.

Task request and response: When transmitting data to a slave node, the master node uses a request number, and the slave node uses a response number to accept or reject the request. Table 6-31 and Table 6-32 describe the request and response functions.

Table 6-31 Task identification flag PKW1

Request No. (from the master to a slave)		Response signal	
Request No.	**Function**	**Acceptance**	**Rejection**
0	No task	0	–
1	Requesting the value of a parameter	1, 2	3
2	Modifying a parameter value (one word) [modifying the value only on RAM]	1	3 or 4
3	Modifying a parameter value (two words) [modifying the value only on RAM]	2	3 or 4
4	Modifying a parameter value (one word) [modifying the value on both RAM and EEPROM]	1	3 or 4
5	Modifying a parameter value (two words) [modifying the value on both RAM and EEPROM]	2	3 or 4

Requests 2, 3, and 5 are not supported currently.

Table 6-32 Response identification flag PKW1

Response No. (from a slave to the master)	
Response No.	**Function**
0	No response
1	Transmitting the value of a parameter (one word)
2	Transmitting the value of a parameter (two words)
3	The task cannot be executed and one of the following error number is returned: 1: Invalid command 2: Invalid data address 3: Invalid data value 4: Operation failure 5: Password error 6: Data frame error 7: Parameter read only 8: Parameter cannot be modified during VFD running 9: Password protection

PKW examples

Example 1: Reading the value of a parameter

You can set PKW1 to 1 and PKW2 to 10 to read a frequency set through keypad (the address of the frequency set through keypad is 10), and the value is returned in PKW4.

Request (master node → VFD)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
Request	00	01	00	10	00	00	00	00	xx	xx	xx	xx	xx	xx	...	xx	xx

0010: Parameter address

0001: Request for parameter value reading

Response (VFD → master node)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
Response	00	01	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	...	xx	xx

5000: Parameter value in address 10

0001: Response (parameter value updated)

Example 2: Modifying the value of a parameter (on both RAM and EEPROM)

You can set PKW1 to 4 and PKW2 to 10 to modify a frequency set through keypad (the address of the frequency set through keypad is 10), and the value to be modified (50.00) is in PKW4.

Request (master node → VFD)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
Request	00	04	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	...	xx	xx

5000: Parameter address in address 10

0004: Request for parameter value modifying

Response (VFD → master node)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
Response	00	01	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	...	xx	xx

0001: Response (parameter value updated)

- **PZD description of the rectifier unit**

The first word in a task packet that the rectifier unit receives or sends is a CW or SW. You can specify whether to use binary or decimal by setting P01.16.

Table 6-33 Rectifier unit CW in decimal format

Bit	Name	Value	Description
0–7	Communication-based control command	1	Running
		2	/
		3	/
		4	/
		5	Stopped
		6	/
		7	Fault reset
		8	/
8	Enabling Read/Write	1	Enable function code reading/writing (PKW1–PKW4)
		0	Disable function code reading/writing (PKW1–PKW4)

Table 6-34 Rectifier unit CW in binary format

Bit	Name	State to be entered/description	Priority
0	Communication-based control command	0: Stop 1: Run	1
1		Reserved	Reserved
2		0: None 1: Fault reset	3
3		Reserved	Reserved
4		Reserved	Reserved
5		Reserved	Reserved
6		Reserved	Reserved
7		Reserved	Reserved
8	Enabling Read/Write	1	Enable function code reading/writing (PKW1–PKW4)
		0	Disable function code reading/writing (PKW1–PKW4)

Table 6-35 Rectifier unit SW in decimal format

Bit	Name	Value	Description
0–7	Byte of running status	1	Running
		2	Reserved
		3	Stopped
		4	Faulty
		5	POFF
		6	Reserved
		7	Reserved
		8	Reserved

Table 6-36 Rectifier unit SW in binary format

Bit	Name	State to be entered/description	Priority
0	Byte of running status	0: None 1: Running	0
1		Reserved	1
2		0: None 1: Stopping	2
3		0: None 1: Faulty	3
4		0: None 1: POFF	4
5		Reserved	Reserved
6		Reserved	Reserved
7		Reserved	Reserved

Reference value (REF): For the rectifier unit, received PZDs are invalid.

Actual value (ACT): The second to twelfth words (PZD2–PZD12) in a PZD task packet from the rectifier unit are the main actual values.

- **PZD description of the inverter unit**

The first word in a task packet that the inverter unit receives or sends is a CW or SW. You can specify whether to use binary or decimal by setting P14.33.

Table 6-37 Inverter unit CW in decimal format

Bit	Name	Value	Description
0–7	Communication-based control command	1	Run forward
		2	Run reversely
		3	Jog forward
		4	Jog reversely
		5	Stop
		6	Coast to stop
		7	Fault reset
		8	Jog to stop
		9	Stop in emergency manner
8	Enabling Read/Write	1	Enable function code reading/writing (PKW1–PKW4)
		0	Disable function code reading/writing (PKW1–PKW4)

Table 6-38 Inverter unit CW in binary format

Bit	Name	State to be entered/description	Priority
0–7	Communication-based control command	0: Decelerate to stop 1: Run forward	1
		0: Decelerate to stop 1: Run reversely	2

Bit	Name	State to be entered/description	Priority
		0: None 1: Reset faults	3
		0: None 1: Coast to stop	4
		0: None 1: Jog forward	5
		0: None 1: Jog reversely	6
		0: None 1: Stop jogging	7
		0: None 1: Pre-exciting	8
8	Enabling Read/Write	1	Enable function code reading/writing (PKW1–PKW4)
		0	Disable function code reading/writing (PKW1–PKW4)
9	Reserved	Reserved	Reserved
10	Emergency stop selection	0: None 1: Decelerate to stop in emergency manner	0: Highest priority

Table 6-39 Inverter unit SW in decimal format

Bit	Name	Value	Description
0–7	Byte of running status	1	Running forward
		2	Running reversely
		3	Stopped
		4	Faulty
		5	POFF
		6	Pre-exciting
8	Bus voltage established	1	Ready for running
		0	Not ready for running
9–10	Motor group selection	00	Motor 1
		01	Motor 2
11	Motor type feedback	1	Synchronous motor
		0	Asynchronous motor
12	Overload pre-alarm feedback	1	Overload pre-alarm generated
		0	No overload pre-alarm generated
13–14	Running mode selection	00	Keypad
		01	Terminal
		10	Communication
		11	Reserved
15	Heartbeat feedback	1	Heartbeat feedback
		0	No heartbeat feedback

Table 6-40 Inverter unit SW in binary format

Bit	Name	State to be entered/description	Priority
0–7	Byte of running status	0: None 1: Running forward	0: Highest priority
		0: None 1: Running reversely	1
		0: None 1: Stopped	2
		0: None 1: VFD in fault	3
		0: None 1: POFF	4
		0: None 1: Pre-exciting	5
		Reserved	Reserved
		Reserved	Reserved
9–10	Motor group selection	1	Motor 1
		0	Motor 2
11	Motor type feedback	1	Synchronous motor
		0	Asynchronous motor
12	Overload pre-alarm feedback	1	Overload pre-alarm generated
		0	No overload pre-alarm generated
13–14	Running mode selection	00	Keypad
		01	Terminal
		10	Communication
		11	Reserved
15	Heartbeat reference	1	Enable heartbeat
		0	Disable heartbeat

Reference value (REF): The main reference values are the second to twelfth words in a PZD task packet that the inverter unit receives.

Actual value (ACT): The main actual values are the second to twelfth words in a PZD response packet that the inverter unit sends.

6.6.3 Network topology

In this network, the PLC or another master device connects only to the rectifier unit that has been inserted with a PROFINET communication card, and the rectifier unit connects to other units through RJ45 since it converts the communication card bus to CANopen bus.

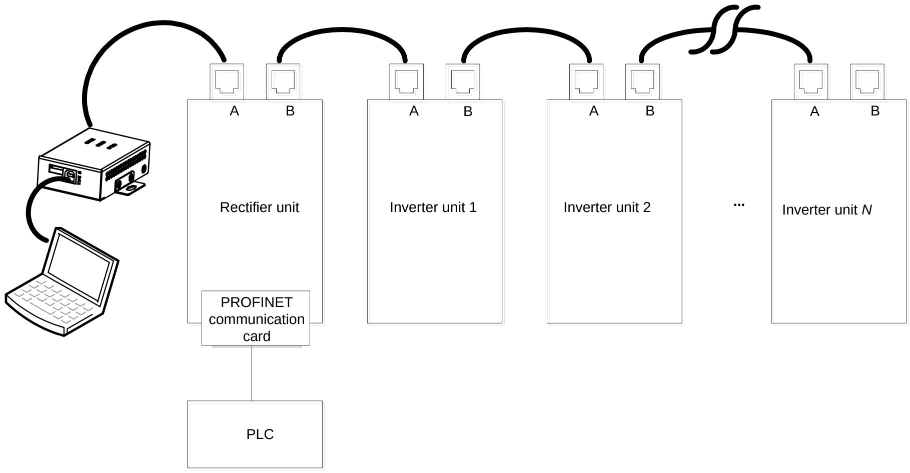


Figure 6-8 PROFINET-to-CANopen network topology

Note: In the networking wiring, the RJ45 ports between units must be cross-connected, that is, port A of a unit can only be connected to port B of another unit. If the connection is incorrect, the communication performance of the entire system will be degraded.

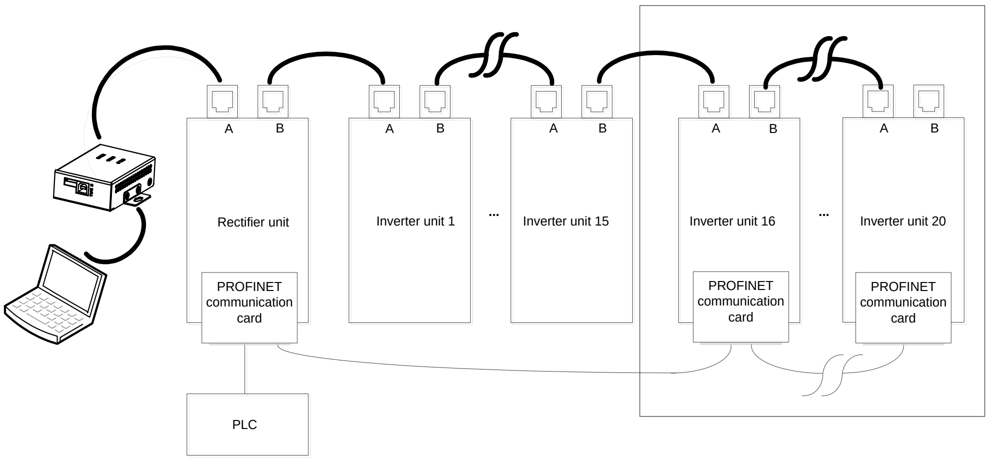
6.6.4 Communication performance

In this network, a PROFINET bridge unit can support 21 nodes, and the bridge unit itself is also considered as a CANopen slave node. A CANopen slave node (usually an inverter unit) can be defined as an IO sub-module, while the number of IO sub-modules is limited by the number of connection resources supported by the PLC. The following takes SIMATIC PLC as an example.

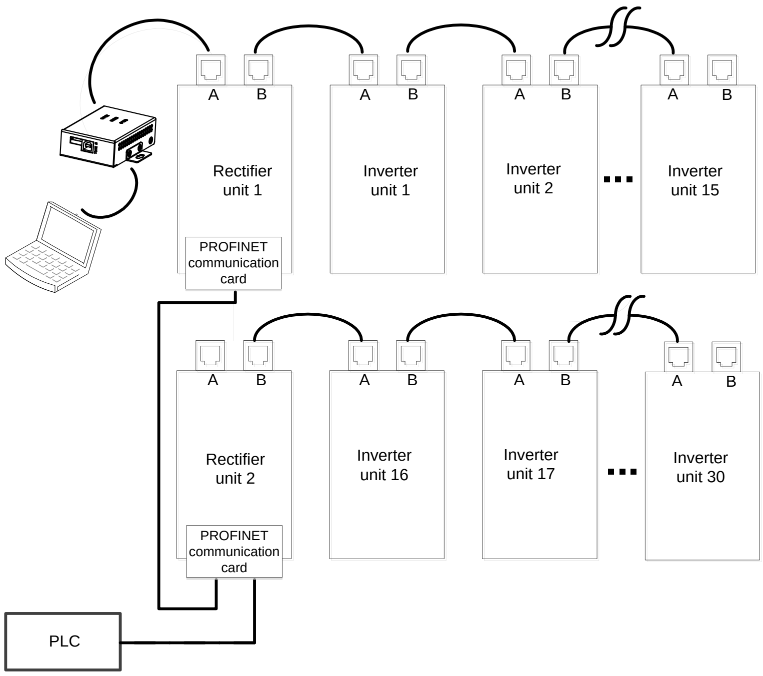
PLC model	PROFINET		PROFIBUS-DP		
	IO modules	IO sub-modules	Master nodes	Slave nodes	Sub-modules
S7-1200	16	16*16	3	32*3	32*16

The system using S7-1200 can support up to 15 modules since the bridge unit itself is also considered as an IO module (for which 16 sub-modules can be configured), that is 15 CANopen slave nodes (rectifier or inverter). You can add slave nodes by using the following method.

- Add PROFINET communication cards. Then the system uses the hybrid networking (PROFINET bus networking + PROFINET-to-CANopen bridge networking) to implement data interaction. The topology is as follows.



- If there are multiple rectifier unit, configure PROFINET communication cards for other rectifier units. The sysem uses multiple PROFINET-to-CANopen bridge networking to implement data interaction. The topology is as follows.



Note: The PROFINET-to-CANopen bridge networks for different rectifier units must be mutually independently. Otherwise, CANopen addresses may conflict.

6.6.5 Commissioning procedure

6.6.5.1 Commissioning flowchart

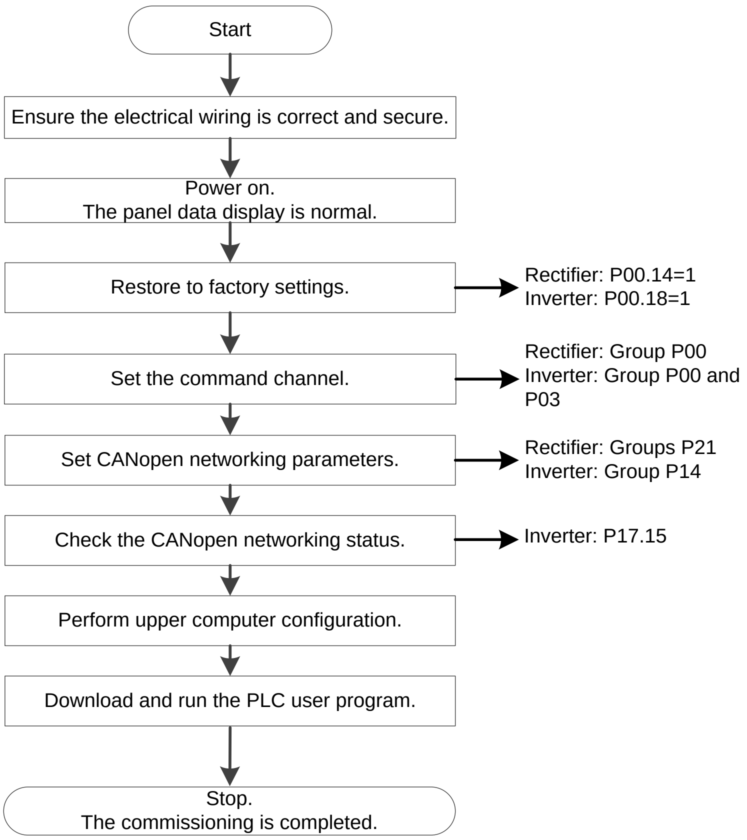


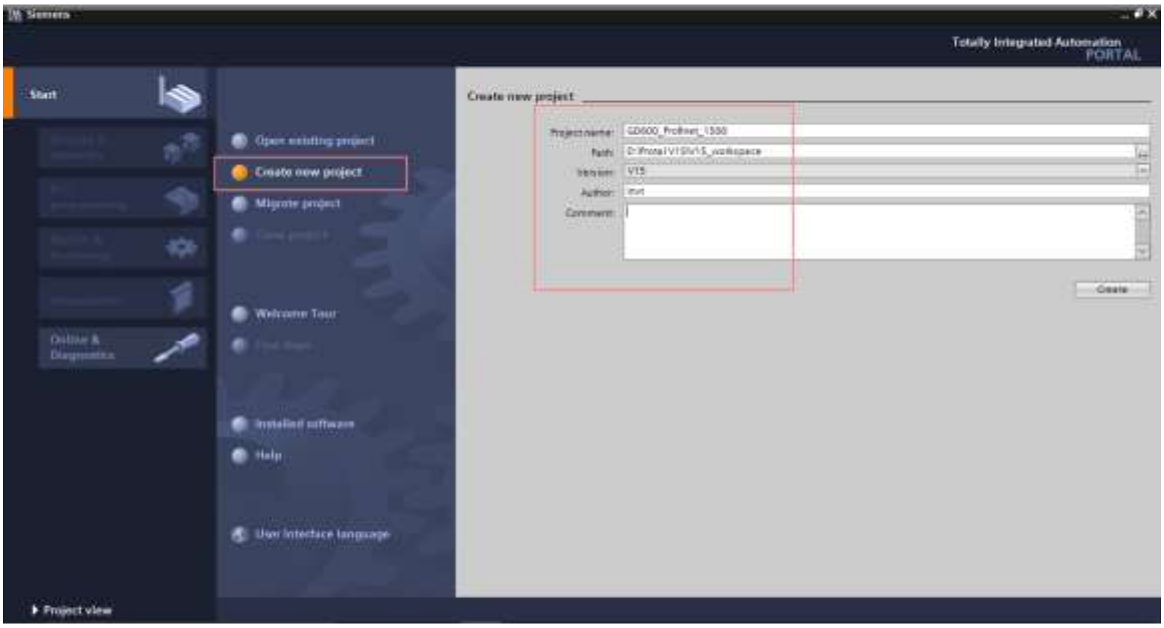
Figure 6-9 Commissioning procedure

6.6.5.2 TIA portal configuration (S7-1500)

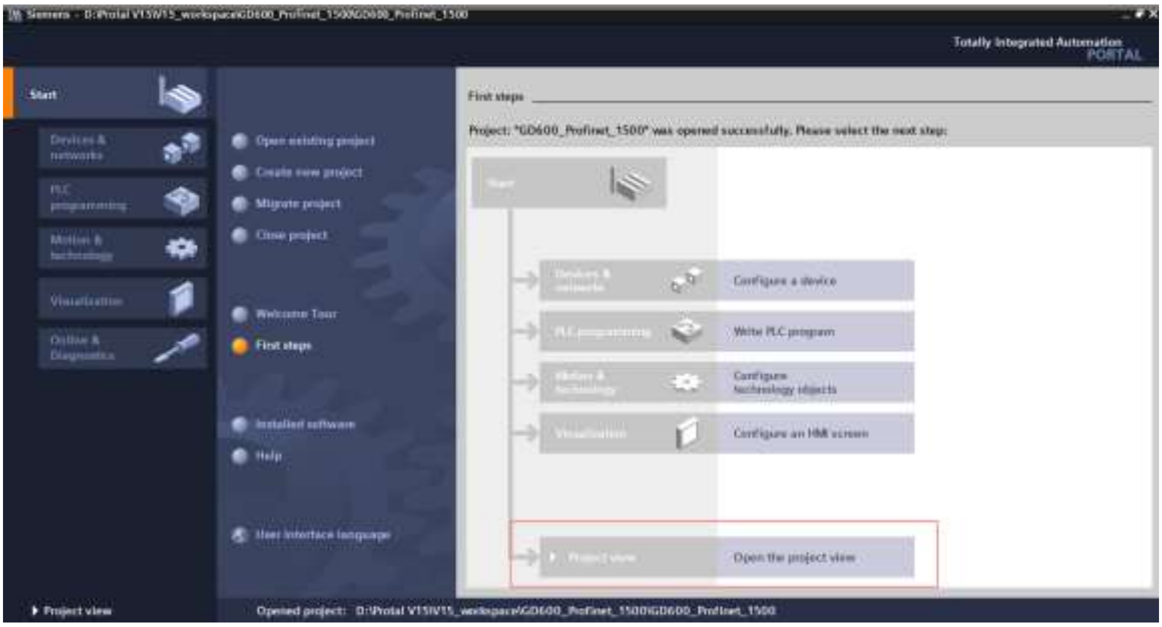
The following uses S7-1511 PLC of SIMATIC S7-1500 series as an example to describe the configuration procedure on TIA Portal.

(1) Create a project.

Double-click the TIA Portal V15 icon to start the TIA Portal V15 project tool. Then choose **Create new project**. On the right of the interface, enter **Project name**, **Path**, **Version**, **Author**, and **Comment**, and click **Create**.



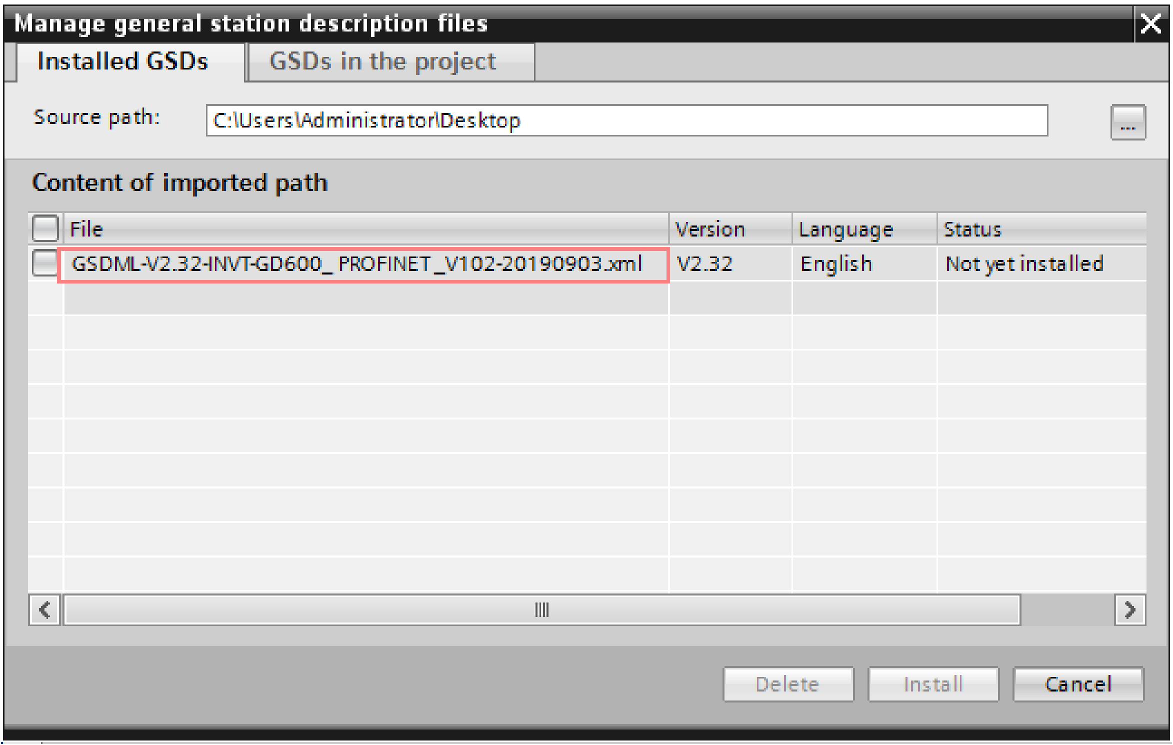
Then double-click to open the project view, as shown in the following figure.



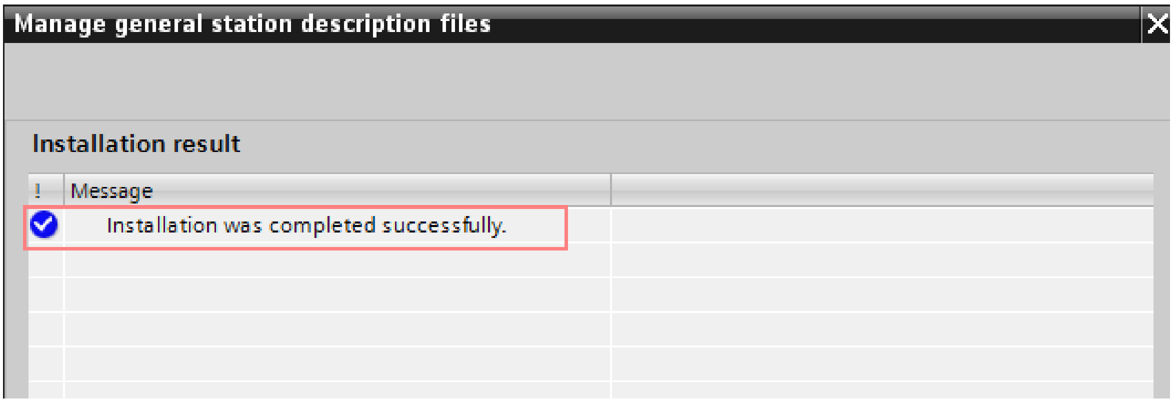
(2) Add the GSD file, similar to the following.

GSDML-V2.32-INVT-GD600_ PROFINET _V102-20190903.xml

Choose **Options** > **Manage general station description files (GSD)**. In the dialog box that appears, enter the source path of the GSD file, select the GSD file, and click **Install**.



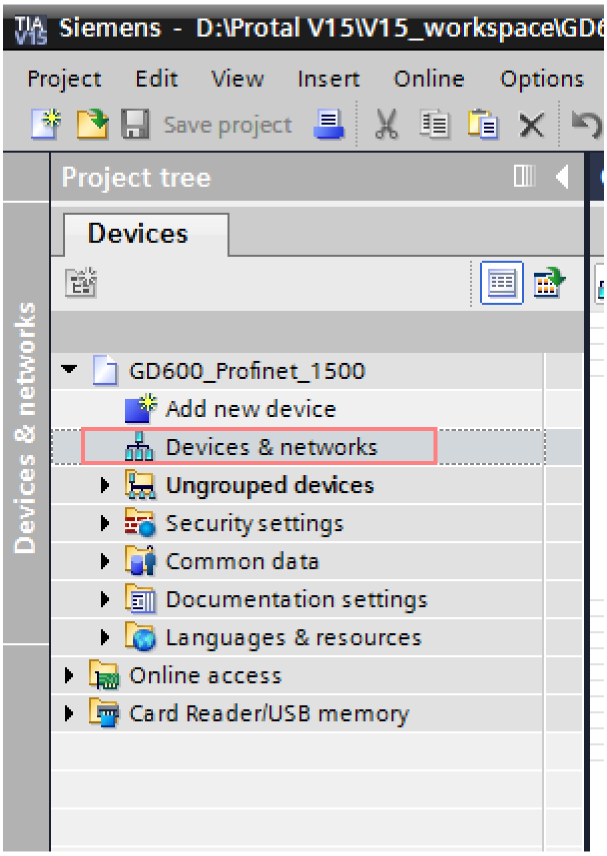
If the installation is successful, the following dialog box appears.



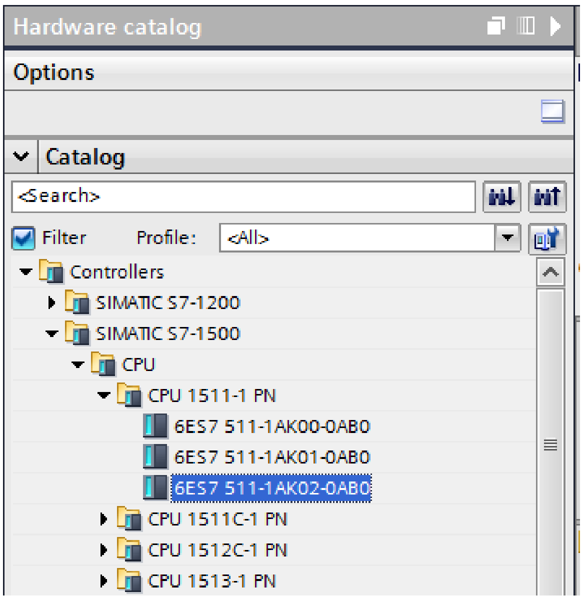
(3) Configure the project information.

To configure project information, do as follows:

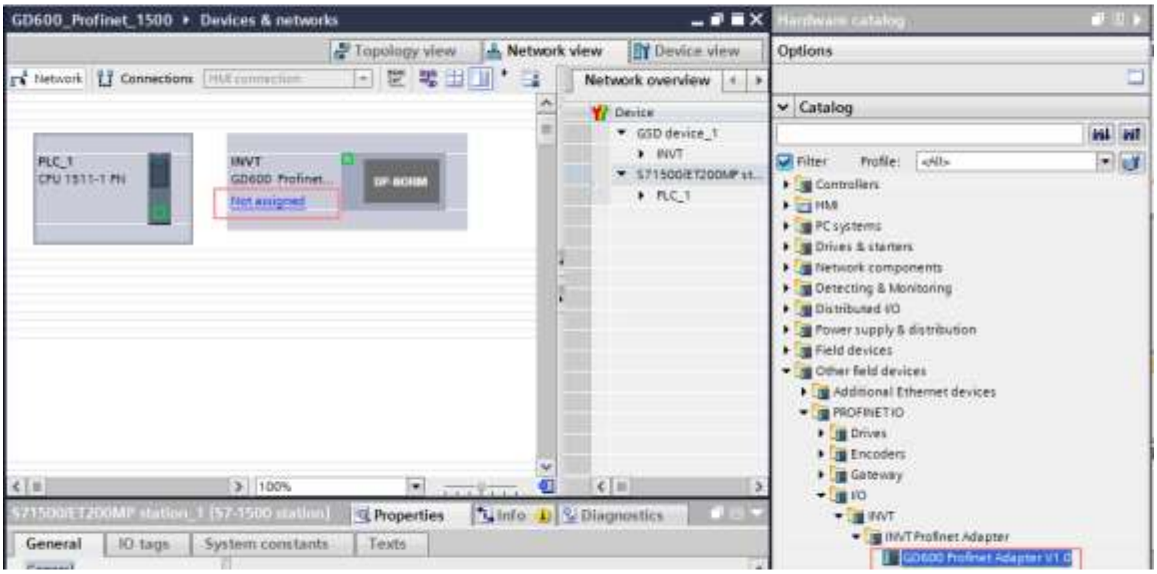
Step 1. Double-click **Devices & networks** in the project view.



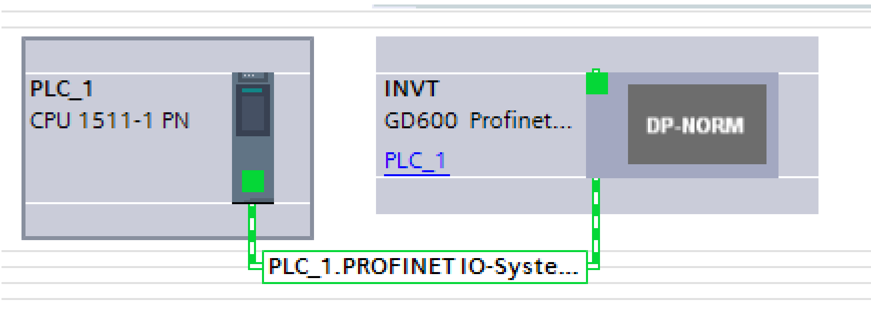
Step 2. Add project devices according to your selected PLC model. For example, if you use SIMATIC S7-1500 PLC, choose **Controllers** > **SIMATIC S7-1500** > **CPU** > **CPU 1511-1 PN** > **6ES7 511-1AK02-0AB0** in the **Hardware catalog** panel on the right, and then double-click or drag the **6ES7 511-1AK02-0AB0** icon to the project.



In the **Hardware catalog** panel on the right, choose **Other field devices** > **PROFIBUS IO** > **IO** > **INVT** > **INVT Profinet Adapter** > **GD600 Profinet Adapter V1.0**, and then double-click the **GD600 Profinet Adapter V1.0** icon to add the GSD file to the project.

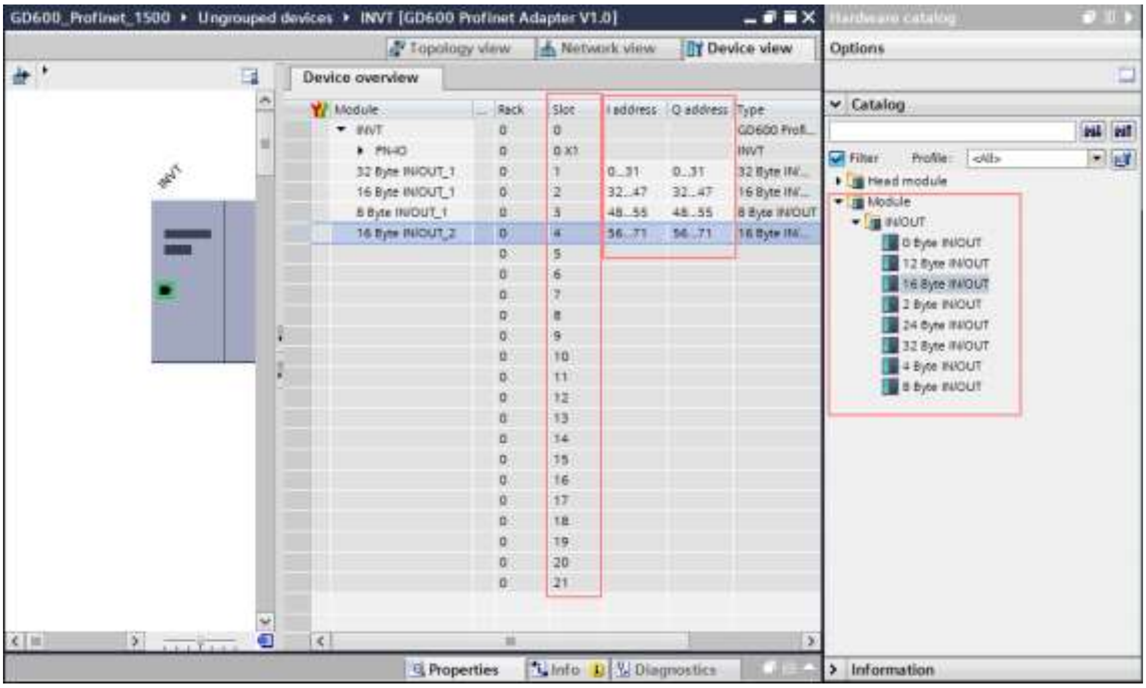


Click the **Not assigned** option of **GD600 Profinet Adapter V1.0**, and select the IO controller **PLC_1.PROFINET interface_1**. In the network view, the CPU and INVT Profinet have been connected to the same PROFINET sub network.



Step 3. Configure PROFINET slave nodes.

Configure PROFINET slave nodes depending on the number of nodes on the network. Double-click the **GD600 Profinet Adapter V1.0** icon in the project to enter the slave node parameter setting view. A slot number corresponds to a CANopen node number, while the I address and Q address correspond to the receiving address and sending address of the node. Slot 1 corresponds to the rectifier unit master node, while slots 2 to 21 correspond to the inverter unit slave nodes, which means a maximum of 20 slave nodes are supported. Choose **Hardware catalog** > **Module** > **IN/OUT**, and double-click or drag a module to the device overview. Then you can assign the received data length for the node.

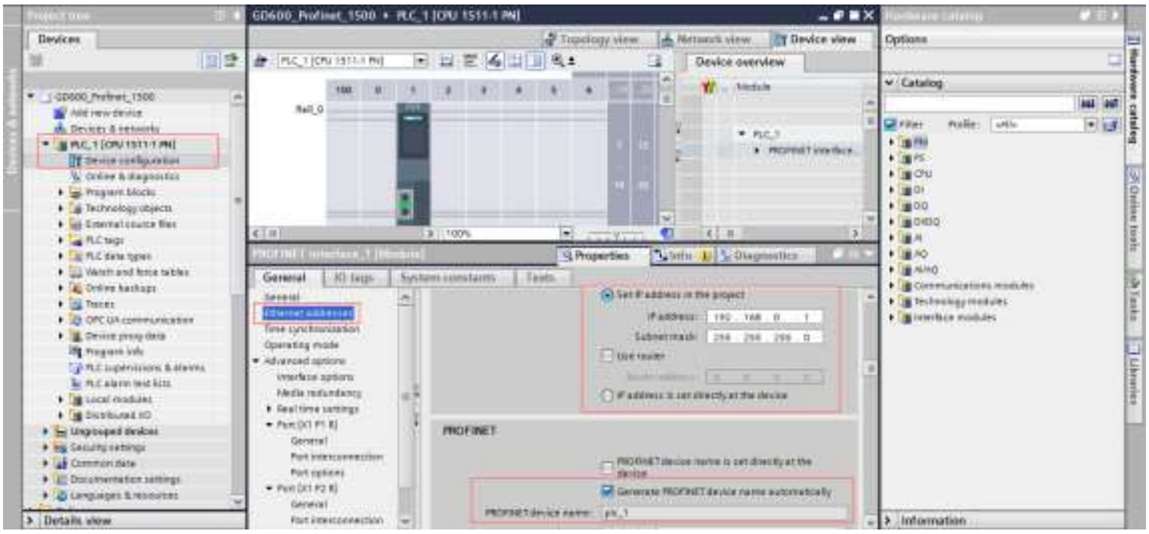


Note:

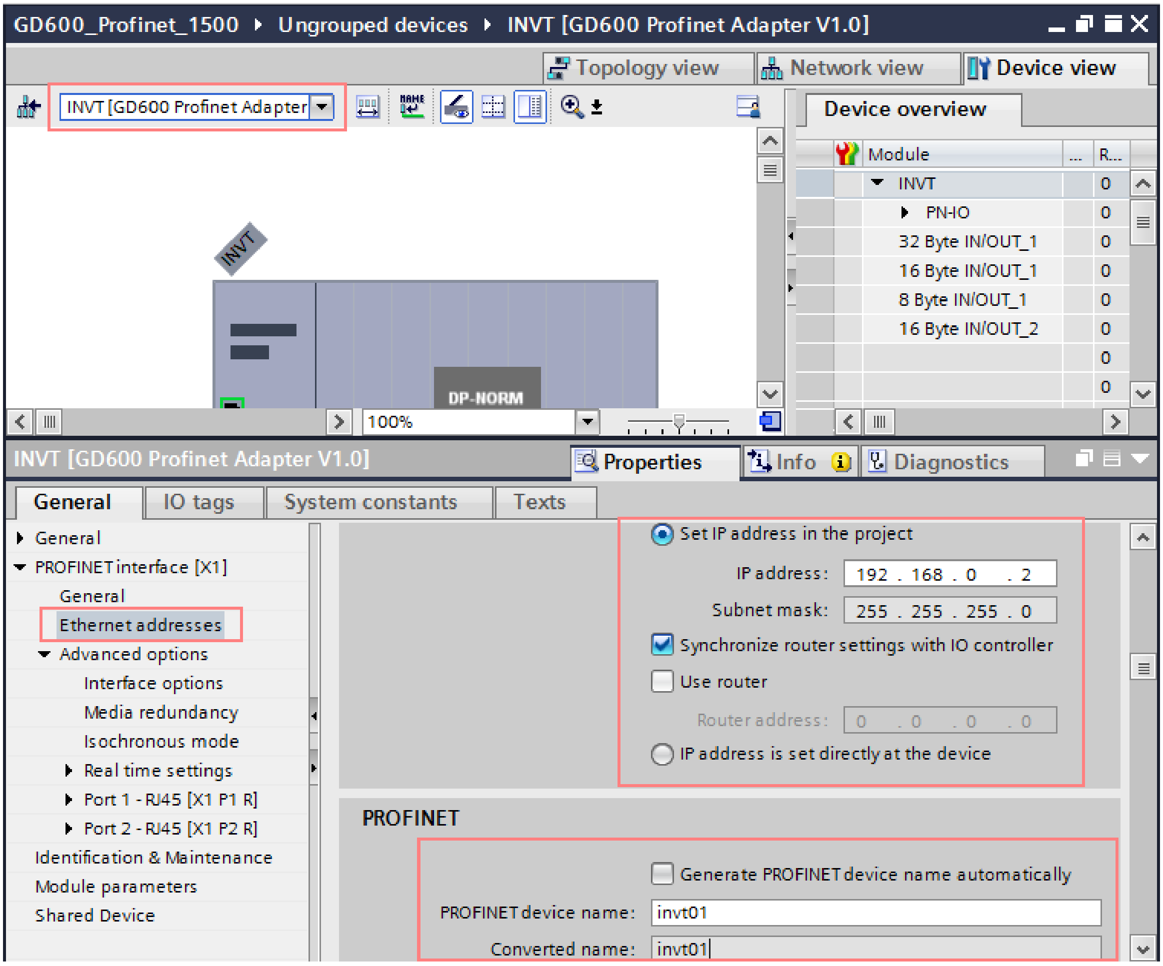
- IN/OUT module data can be customized. Different IN/OUT modules have different process data. For details, see 6.6.5.3 IN/OUT module mapping.
- The addresses in the variable monitoring table need to correspond to the addresses in the preceding figure.
  - ✧ QW0–QW31 correspond to the PLC output addresses of the rectifier unit (node 1, CANopen master node).
  - ✧ IW0–IW31 correspond to the PLC input addresses of the rectifier unit (node 1, CANopen master node).
  - ✧ QW32–QW47 correspond to the PLC output addresses of the inverter unit (node2, CANopen slave node).
  - ✧ IW32–IW47 correspond to the PLC input addresses of the inverter unit (node2, CANopen slave node).
  - ✧ QW48–QW55 correspond to the PLC output addresses of the inverter unit (node3, CANopen slave node).
  - ✧ IW48–IW55 correspond to the PLC input addresses of the inverter unit (node3, CANopen slave node).

The same rule is applied to the other. To ensure the consistency, you are recommended to set the rectifier start address to 1.

Double-click **Devices & networks** to enter the editing interface in the network view. Double-click the **PLC_1 CPU 1511-1PN** module to enter the device view. Double-click the network interface position of the S7-1511 to enter the PROFINET interface_1 editing interface. Click the **General** tab, choose **Ethernet addresses**, and set parameters.



Double-click **Devices & networks** to enter the editing interface in the network view. Double-click the **INVT GD600 Profinet…** module to enter the device view. Double-click the network interface position of the **INVT Profinet** icon to enter the PROFINET interface editing interface. Click the **General** tab, choose **PROFINET interface [X1]** > **Ethernet addresses**, and set parameters.



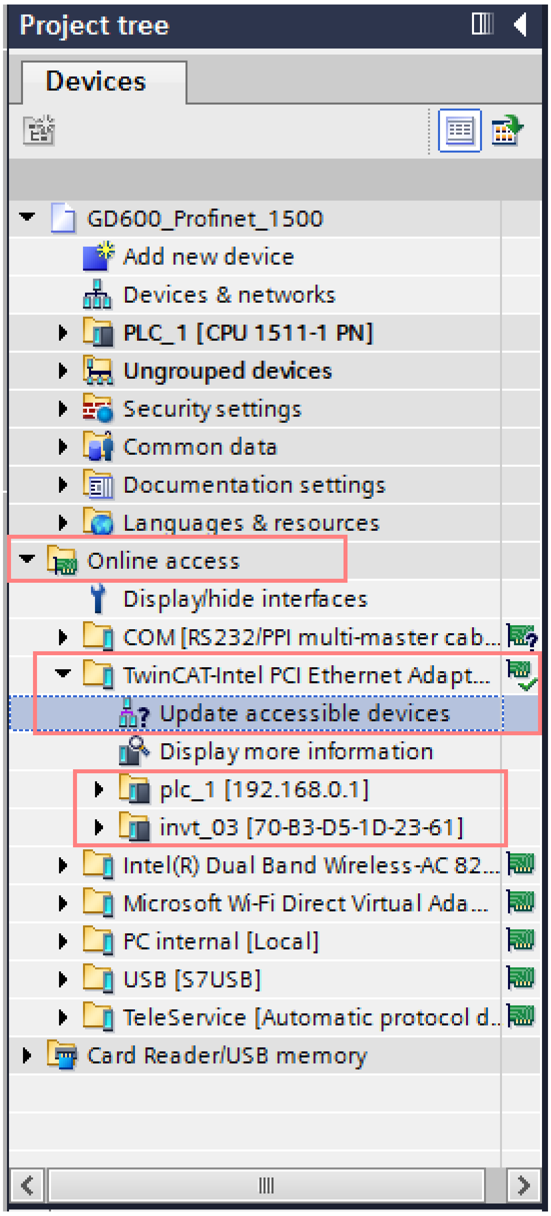
Step 4 Allocate IO devices.

First of all, ensure that the CPU and INVT PROFINET communication card have been connected to your computer through a network cable.

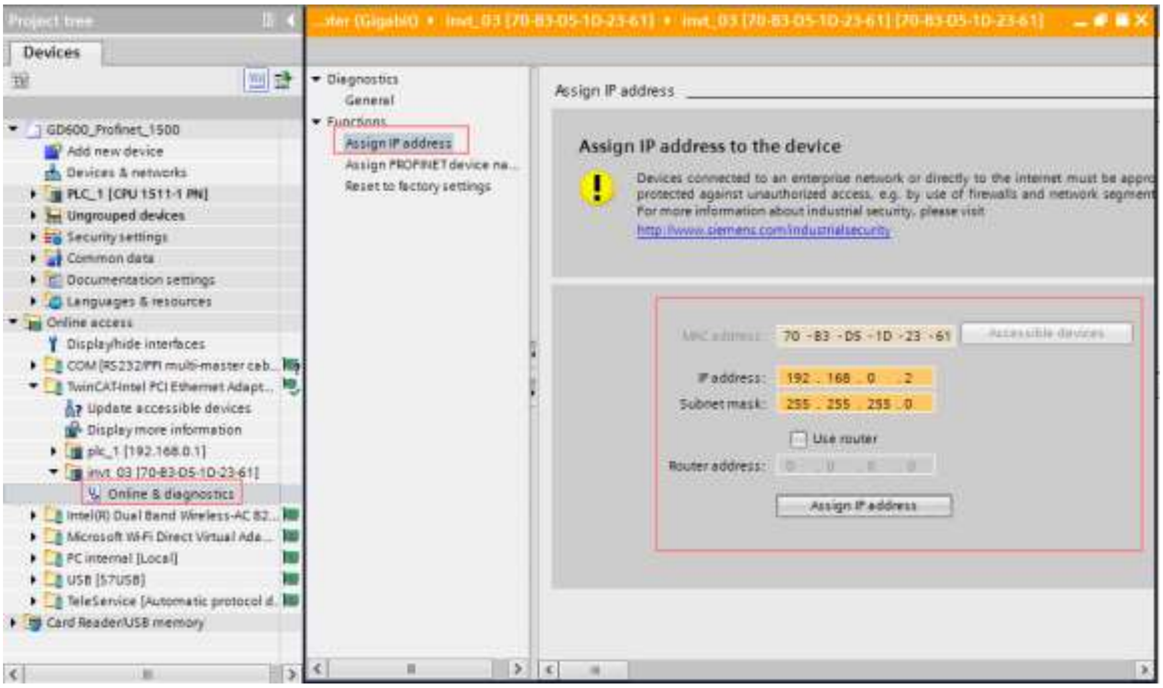
In the project tree, choose **Online access**, find the network card corresponding to your computer, double-click **Update accessible devices**, and wait for a period of time.

All the devices scanned in the network are displayed.

Find and click the option corresponding to INVT communication card.

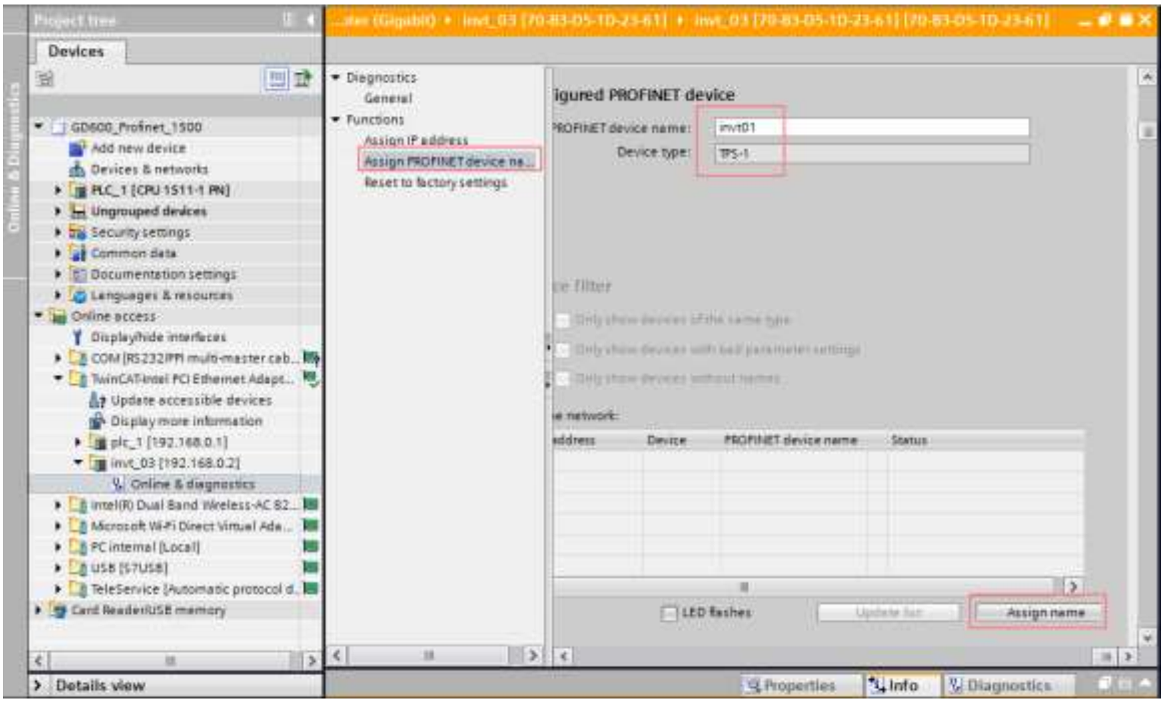


Double-click **Online & diagnostics** to enter the online commissioning state.



Note: If the communication card is used for the first time, the device name cannot be found, and only the default IP address can be found.

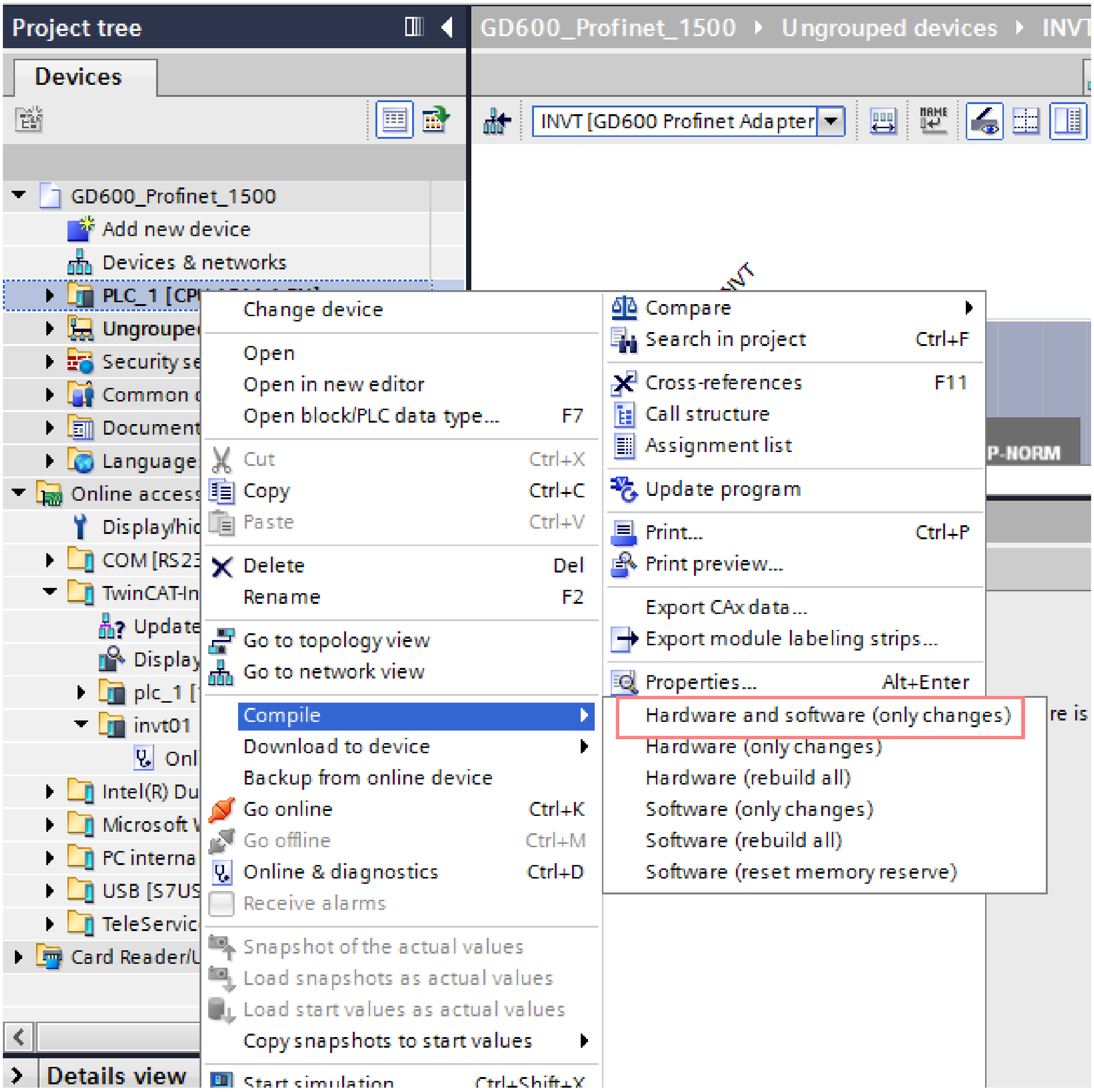
Choose **Functions** > **Assign PROFINET device name**, set parameters, and click **Assign name** (invt01 for example).



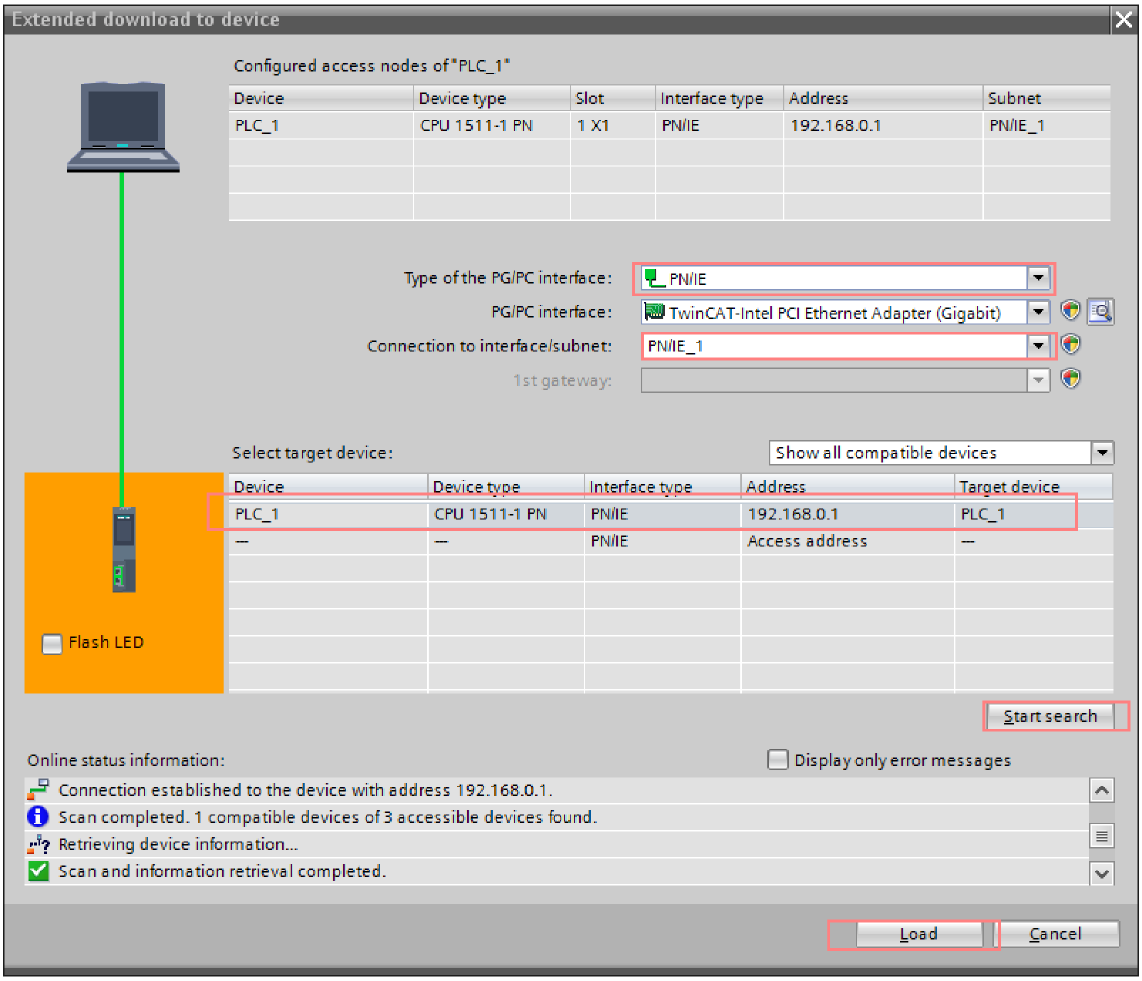
Note: The PROFINET communication card name that is online set must be the same as the PROFINET communication card name that is set during project configuration. Otherwise, devices cannot communicate through PROFINET. In addition, your computer Ethernet IP address needs to be in the same network segment, such as 192.168.0.55.

Step 5. Save, compile, and download the project configuration information.

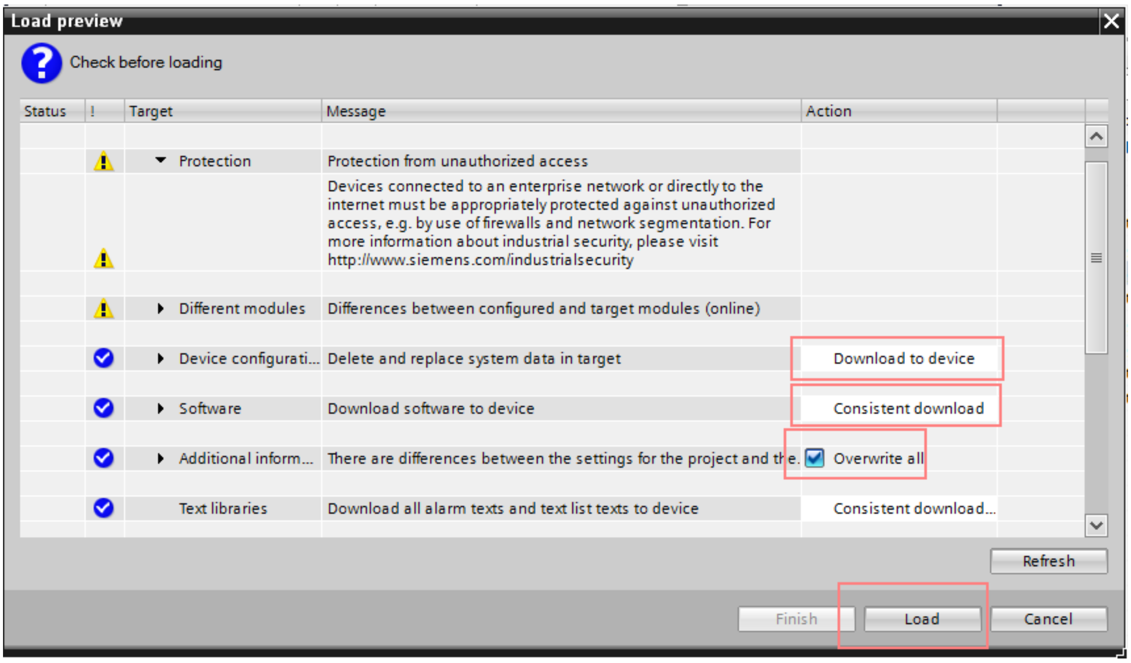
After configuring the project, you need to download the project configuration information to the CPU. After saving the project, right-click **PLC_1 [CPU 1511-1 PN]** and choose **Compile** > **Hardware and software (only changes)** > **Download to device**.



After the download is completed, the following interface appears. Select **PN/IE_1** from the **Connection to interface/subnet** drop-down list box. Click **Start search** in the lower right corner to start scanning for PLC devices in the detection network.

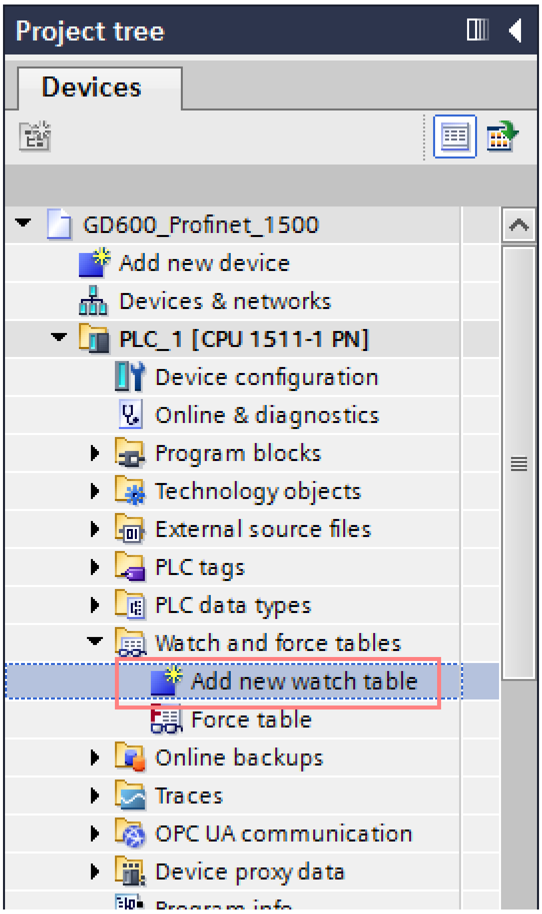


Select the PLC to download (there is only one PLC in the example), and click **Download**. Then click **Load** and then **Finish**.



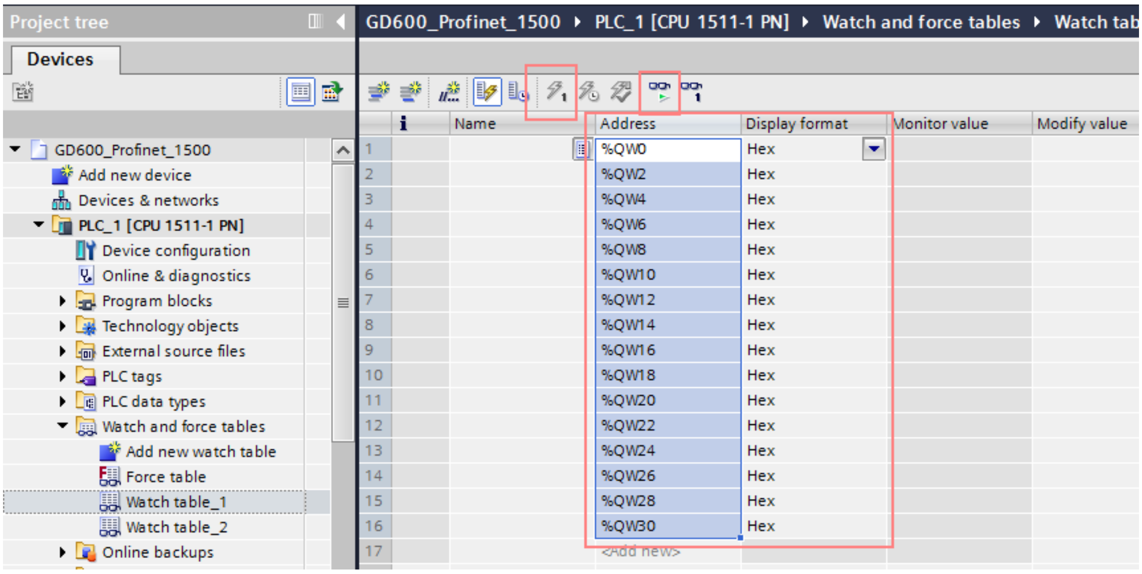
Step 6. Configure variable table monitoring.

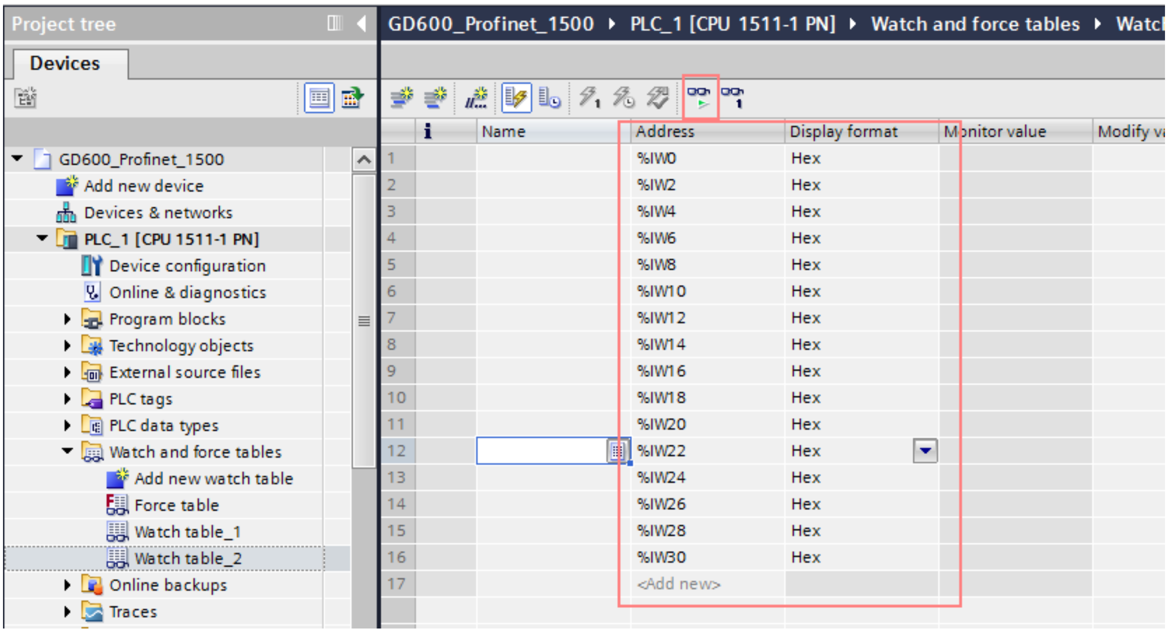
Choose **Watch and force tables** > **Add new watch table** in the project tree on the left.



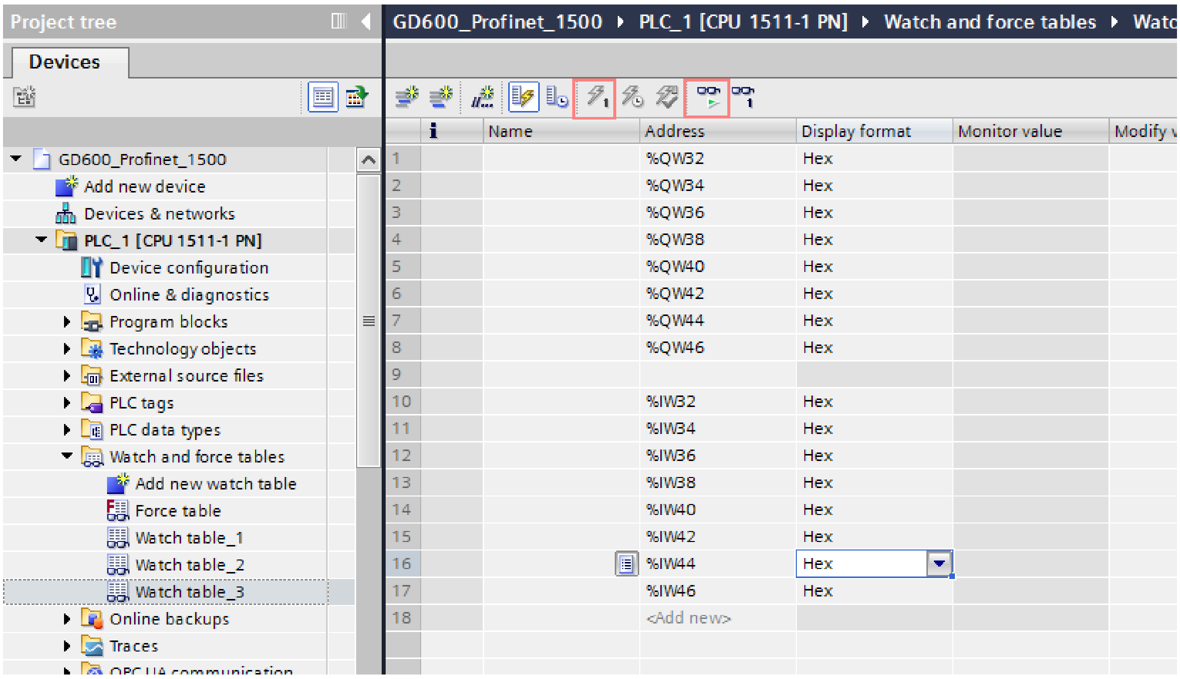
The addresses in the table are consistent with those allocated during IN/OUT module configuration.

QW0–QW31 correspond to the PLC output addresses of the rectifier unit (node 1), consistent with the Q addresses in the configuration, while IW0–IW31 correspond to the PLC input addresses, consistent with the I addresses in the configuration. You can monitor and modify the values.





QW32–QW47 correspond to the PLC output addresses of the inverter unit (node2), consistent with the Q addresses in the configuration, while IW32–IW47 correspond to the PLC input addresses, consistent with the I addresses in the configuration. You can monitor and modify the values.



Step 7. Perform PLC programming.

6.6.5.3 IN/OUT module mapping

In the configuration of PROFINET-to-CANopen communication, you can select different IN/OUT modules according to your needs. IN/OUT modules can support the selection of 2, 4, 6, 8, 10, 12, and 16 words. Selecting different word types causes data mapping difference.

When the IN/OUT module selects 8 words or more, it supports the reading and writing of function codes. To be specific, mapping from PKW, it also supports data reading and writing of up to 7 PZDs (PZD2–PZD8).

When the IN/OUT module selects 8 words or less, the mapping starts from CW/SW and it supports data reading and writing of up to 7 PZDs, but it does not support reading and writing of PKW function codes.

6.6.6 Related parameters

Table 6-41 Rectifier unit related parameters

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P00.01</td><td>Channel of running commands</td><td>Used to select the channel of rectifier unit control commands,
including the start, stop, and fault reset commands.
0: Keypad
The running commands are controlled through keypad keys, such as RUN and STOP/RST.
1: Terminal
The running commands such as run, stop, and fault reset are controlled through multi-function input terminals.
2: Communication
The running commands are controlled by the upper computer in communication mode.</td><td>1</td><td>○</td></tr>
<tr><td>P00.02</td><td>Communication mode of running commands</td><td>Used to select the rectifier unit communication command mode.
0: RS485
1: CANopen
2: PLC
3: PROFIBUS-DP
4: PROFINET/EtherCAT</td><td>0</td><td>○</td></tr>
<tr><td>P17.15</td><td>Actual online slave nodes</td><td>Number of actual online slave nodes.
Range: 0–20</td><td>0</td><td>●</td></tr>
<tr><td>P17.16</td><td>Type of card at slot 1</td><td rowspan="2">Used to display the type of card at the slot.
Range: 0–18
0: No card
1: PLC
2: I/O
3–4: Reserved
5: Ethernet
6: PROFIBUS-DP
7: Reserved
8: Reserved
9: Reserved
10: Reserved
11–14: Reserved
15: PROFINET
16: Modbus
17: EtherCAT
18: BACnet</td><td>0</td><td>●</td></tr>
<tr><td>P17.17</td><td>Type of card at slot 2</td><td>0</td><td>●</td></tr>
<tr><td>P17.18</td><td>Software version of card at slot 1</td><td>Used to display the software version of the card at slot 1.
Range: 0–655.35</td><td>0.00</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
P17.19	Software version of card at slot 2	Used to display the software version of thecard at slot 2. Range: 0–655.35	0.00	●
P17.20	Staus of slave nodes 02–17	Used to display the online/offline status of slave nodes 02–17. Range: 0–0xFFFF 0: Offline 1: Online	0	●
P17.21	Staus of slave nodes 18–21	Used to display the online/offline status of slave nodes 18–21. Range: 0–0xF 0: Offline 1: Online	0	●
P17.23	CANopen bus load rate	Used to display the CANopen bus load rate. Range: 0.0–100.0%	0.0%	●
P19.00	Present fault type	Common fault type: 0: No fault 1: Grid undervoltage (LvI) 2: Grid overvoltage (ovI) 3: Grid phase-A loss (SPI1) 4: Grid phase-B loss (SPI2) 5: Grid phase-C loss (SPI3) 6: Phase lock failure (PLLF) 7: DC undervoltage (Lv) 8: DC overvoltage (ov) 9: Reserved 10: EEPROM operation error (EEP) 11: Braker direct connection fault (bCE) 12: External fault (EF) 13: Braker overload fault (bOL) 14: Braker overcurrent fault (bOC) 15: RS485 communication fault (E-485) 16: CANopen communication fault (E-CAN) 17: Reserved 18: DP communication fault (E-DP) 19: Reserved 20: Reserved 21: Rectifier bridge module overheat (oH1) 22: Brake overheat fault (bOH) 23: Reserved 24: PROFINET communication timeout fault (E-PN) 25: Reserved 26: Communication fault of expansion card 1 (E-C1) 27: Communication fault of expansion card 2 (E-C2) 28: Reserved 29: Failure to identify the card at slot 1 (E-F1)	/	●
P19.01	Last fault type			●
P19.02	2nd-last fault type			●
P19.03	3rd-last fault type			●
P19.04	4th-last fault type			●
P19.05	5th-last fault type			●

Function code	Name	Description	Default	Modify
		30: Failure to identify the card at slot 2 (E-F2) 31: Reserved 32: Expansion card detection exception (E-CP) 33–54: Reserved 55: Parameter download error (E-DNE) 56: Some inverter units are offline (OFFL) 57: EtherCAT communication timeout (E-CAT) 58–60: Reserved		
P21.01	CANopen communication address	0–127	1	○
P21.29	CANopen communication baud rate	Setting range: 0–5 0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	○
P21.30	CANopen communication timeout time	0.0 (invalid); 0.1–100.0s	0.0s	○
P21.31	Power-on delay for networking	0.0 (invalid); 0.1–100.0s When there is a large number of bus-sharing inverter units, the power-on time becomes longer. The CANopen master node communication has been ready for communication, while the slave nodes are not powered on and not initialization, which will cause the E-CAN or OFFL communication fault reporting. In such a situation, you can set the parameter to a large value.	20.0s	○
P21.32	Auto control on data interaction period	Indicates whether to automatically adjust the CANopen data interaction period according to the bus load rate. 0: Disable 1: Enable	0	◎
P21.33	Number of CANopen slave nodes	0–20 (Set this parameter only when the master node is valid.)	0	○
P21.34	CANopen master/slave selection	0: Slave 1: Master	0	○
P21.51	Enabling PDO receiving	Range: 0–0x0F 0: Disable 1: Enable Bit0: PDO1_RX Bit1: PDO2_RX Bit2: PDO3_RX Bit3: PDO4_RX Bit4–bit15: Reserved	0x07	○

Function code	Name	Description	Default	Modify
P21.52	Enabling PDO sending	Range: 0–0x0F 0: Disable 1: Enable Bit0: PDO1_TX Bit1: PDO2_TX Bit2: PDO3_TX Bit3: PDO4_TX Bit4–bit15: Reserved	0x07	○
P22.26	PROFINET communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○
P22.43	Time to identify expansion card 1	0.01–30.00s	0	○
P22.44	Time to identify expansion card 2	0.01–30.00s	0	○
P22.45	Communication timeout time of expansion card 1	0.01–30.00s	0	○
P22.46	Communication timeout time of expansion card 2	0.01–30.00s	0	○
P23.28	Sent PZD2	Used only when the rectifier unit has been configured with a PROFINET or EtherCAT communication card. 0: Disable 1: Fault code 2: Bus voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Braking current (* 10, A) 6: Input terminal status 7: Output terminal status 8: Number of online slave nodes 9: Online/offline state of slave nodes 02–17 10: Online/offline state of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20–31: Reserved	0	
P23.29	Sent PZD3		0	
P23.30	Sent PZD4		0	
P23.31	Sent PZD5		0	
P23.32	Sent PZD6		0	
P23.33	Sent PZD7		0	
P23.34	Sent PZD8		0	

Table 6-42 Inverter unit related parameters

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P00.01</td><td>Channel of running commands</td><td>0: Keypad
1: Terminal
2: Communication</td><td>0</td><td>○</td></tr>
<tr><td>P00.02</td><td>Communication mode of running commands</td><td>0: Modbus
1: CANopen
2: Ethernet
3: EtherCAT/PROFINET
4: PLC
5: Wireless communication
6: PROFIBUS-DP/DeviceNet
Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.</td><td>0</td><td>○</td></tr>
<tr><td>P00.06</td><td>Setting channel of A frequency command</td><td rowspan="2">0: Keypad
1: AI1
2: AI2
3: AI3
4: Reserved
5: Simple PLC program
6: Multi-step speed running
7: PID control
8: Modbus communication
9: CANopen communication
10: Ethernet communication
11: Reserved
12: Pulse train AB
13: EtherCAT/PROFINET communication
14: Programmable expansion card
15: PROFIBUS-DP/DeviceNet communication</td><td>0</td><td>○</td></tr>
<tr><td>P00.07</td><td>Setting channel of B frequency command</td><td>14</td><td>○</td></tr>
<tr><td>P07.27</td><td>Type of present fault</td><td rowspan="6">0: No fault
1: Inverter unit U-phase protection (OUt1)
2: Inverter unit V-phase protection (OUt2)
3: Inverter unit W-phase protection (OUt3)
4: Overcurrent during acceleration (OC1)
5: Overcurrent during deceleration (OC2)
6: Overcurrent during constant speed running (OC3)
7: Overvoltage during acceleration (OV1)
8: Overvoltage during deceleration (OV2)
9: Overvoltage during constant speed running (OV3)
10: Bus undervoltage fault (UV)
11: Motor overload (OL1)
12: Inverter unit overload (OL2)
13: CAN fault in master/slave synchronization (SECAN)</td><td>/</td><td>●</td></tr>
<tr><td>P07.28</td><td>Last fault type</td><td>/</td><td>●</td></tr>
<tr><td>P07.29</td><td>2nd-last fault type</td><td>/</td><td>●</td></tr>
<tr><td>P07.30</td><td>3rd-last fault type</td><td>/</td><td>●</td></tr>
<tr><td>P07.31</td><td>4th-last fault type</td><td>/</td><td>●</td></tr>
<tr><td>P07.32</td><td>5th-last fault type</td><td>/</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
		14: Phase loss on output side (SPO) 15: Reserved 16: Inverter module overheat (OH2) 17: External fault (EF) 18: RS485 communication fault (CE) 19: Current detection fault (ItE) 20: Motor autotuning fault (tE) 21: EEPROM operation error (EEP) 22: PID feedback offline fault (PIDE) 23: CAN slave fault in master/slave synchronization (S-Err) 24: Running time reached (END) 25: Electronic overload (OL3) 26: Keypad communication error (PCE) 27: Parameter upload error (UPE) 28: Parameter download error (DNE) 29: PROFIBUS-DP communication fault (E_dP) 30: Ethernet communication fault (E_NET) 31: CANopen communication fault (E_CAN) 32: To-ground short-circuit fault 1 (ETH1) 33: To-ground short-circuit fault 2 (ETH2) 34: Speed deviation fault (dEu) 35: Mal-adjustment fault (STo) 36: Underload fault (LL) 37: Encoder disconnection fault (ENC1O) 38: Encoder direction reversal fault (ENC1D) 39: Encoder Z-pulse disconnection fault (ENC1Z) 40: Safe torque off (STO) 41: Channel 1 safety circuit exception (STL1) 42: Channel 2 safety circuit exception (STL2) 43: Exception in both channels 1 and 2 (STL3) 44: Safety code FLASH CRC fault (CrCE) 45: Programmable card customized fault 1 (P-E1) 46: Programmable card customized fault 2 (P-E2) 47: Programmable card customized fault 3 (P-E3) 48: Programmable card customized fault 4 (P-E4) 49: Programmable card customized fault 5 (P-E5) 50: Programmable card customized fault 6 (P-E6) 51: Programmable card customized fault 7 (P-E7) 52: Programmable card customized fault 8 (P-E8) 53: Programmable card customized fault 9 (P-E9) 54: Programmable card customized fault 10 (P-E10) 55: Duplicate expansion card type (E-Err) 56: Encoder UVW lost (ENCUV) 57: PROFINET communication timeout fault (E_PN) 58: Reserved		

Function code	Name	Description	Default	Modify
		59: Motor overtemperature fault (OT) 60: Failure to identify the card at slot 1 (F1-Er) 61: Failure to identify the card at slot 2 (F2-Er) 62: PG card detected motor overtemperature fault (E-OT2) 63: Communication timeout of the card at slot 1 (C1-Er) 64: Communication timeout of the card at slot 2 (C2-Er) 65: IO card detected motor overtemperature fault (E-OT3) 66: EtherCAT card communication fault (E-CAT) 67: BACnet card communication fault (E-BAC) 68: DeviceNet card communication fault (E-DEV) 69: CAN slave fault in master/slave synchronization (S-Err) 70: AI detected motor overtemperature fault (E-OT4) 71: Reserved		
P14.07	CANopen communication timeout time	0.0 (invalid); 0.1–60.0s	0.0s	○
P14.08	CANopen communication address	0–127	1	◎
P14.09	CANopen communication baud rate	0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	◎
P14.10	Received PZD2	Used for CANopen networking communication. 0: Disable 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which	0	○
P14.11	Received PZD3		0	○
P14.12	Received PZD4		0	○
P14.13	Received PZD5		0	○
P14.14	Received PZD6		0	○
P14.15	Received PZD7		0	○
P14.16	Received PZD8		0	○
P14.17	Received PZD9		0	○
P14.18	Received PZD10		0	○
P14.19	Received PZD11		0	○
P14.20	Received PZD12		0	○

Function code	Name	Description	Default	Modify
		1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9 corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8) 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: High-order bit of position reference (signed) 15: Low-order bit of position reference (unsigned) 16: High-order bit of position feedback (signed) 17: Low-order bit of position feedback (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function code mapping (PZD2–PZD12 corresponds to P14.49–P14.59) 20–31: Reserved		
P14.21	Sent PZD2	Used for CANopen networking communication. 0: Disable 1: Running frequency (x100, Hz) 2: Set frequency (x100, Hz) 3: Bus voltage (x10, V) 4: Output voltage (×1, V) 5: Output current (x10, A) 6: Actual output torque (x10, %) 7: Actual output power (x10, %) 8: Rotation speed of running (x1, RPM) 9: Linear speed of running (x1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (* 100, V) 13: AI2 input (* 100, V) 14: AI3 input (* 100, V) 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (x100, %) 19: PID feedback (x100, %) 20: Reserved 21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned)	0	○
P14.22	Sent PZD3		0	○
P14.23	Sent PZD4		0	○
P14.24	Sent PZD5		0	○
P14.25	Sent PZD6		0	○
P14.26	Sent PZD7		0	○
P14.27	Sent PZD8		0	○
P14.28	Sent PZD9		0	○
P14.29	Sent PZD10		0	○
P14.30	Sent PZD11		0	○
P14.31	Sent PZD12		0	○

Function code	Name	Description	Default	Modify
		23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 2 26–30: Reserved 31: Function code mapping (PZD2–PZD12 corresponds to P14.60–P14.70)		
P14.32	Action at CANopen communication fault	0: Normal running 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○
P14.33	Number system of control and status words for communication cards	0: Decimal system 1: Binary system **Note: The rectifier unit and inverter unit must be the same in the value of the function parameter.**	0	○
P19.00	Type of card at slot 1	0: No card	0	●
P19.01	Type of card at slot 2	1: Programmable card 2: I/O card 3: Incremental PG card (including 5V/12V/24V) 4: Reserved 5: Ethernet card 6: PROFIBUS-DP card 7: Reserved 8: Rotary PG card 9: Reserved 10: Reserved 11: PROFINET card 12: Sine-cosine PG card without CD signals 13: Sine-cosine PG card with CD signals 14: Reserved 15: Reserved 16: Reserved 17: EtherCAT card 18: Reserved 19: Reserved	0	●
P19.03	Software version of card at slot 1	0–655.35	0.00	●
P19.04	Software version of card at slot 2	0–655.35	0.00	●

6.7 EtherCAT-to-CANopen networking

6.7.1 EtherCAT communication protocol introduction

Ethernet for Control Automation Technology (EtherCAT) is a real-time industrial field bus communication protocol of Ethernet-based development architecture. It was introduced in 2003 and has been an international standard since 2007. EtherCAT sets new standards for real-time performance and topology flexibility.

1) EtherCAT is one of the fastest industrial Ethernet technology, but it also synchronizes with nanosecond accuracy. The EtherCAT system architecture typically reduces the load on the CPU by 25 – 30 % in comparison to other bus systems (given the same cycle time).

2) EtherCAT networks have no practical limitations regarding topology – line, star, tree, redundant ring and all those combined with up to 65535 nodes per segment.

When compared to a classic fieldbus system, EtherCAT node addresses can be set automatically. There's no need for network tuning, and onboard diagnostics with fault localization make pinpointing errors a snap. In addition, there are no switches to configure, and no complicated handling of MAC or IP addresses is required.

4) The master device doesn't require a special interface card and the slave devices use highly-integrated, cost-effective chips available from a variety of suppliers.

5) The accurate alignment of distributed clocks enables EtherCAT synchronization solution. With EtherCAT, the data exchange is fully based on a pure hardware machine. Since the communication utilizes a logical (and thanks to full-duplex Fast Ethernet also physical) ring structure, the master clock can determine the propagation delay offset to the individual slave clocks simply and accurately - and vice versa. The distributed clocks are adjusted based on this value, which means that a very precise network-wide time base with a jitter of significantly less then 1 microsecond is available.

In general, EtherCAT features include high performance, flexible topology, easy to use, low cost, high precision device synchronization, cable redundancy options and a functional safety protocol, and Hot Swap for devices.

6.7.1.1 CANopen over EtherCAT (CoE) model reference

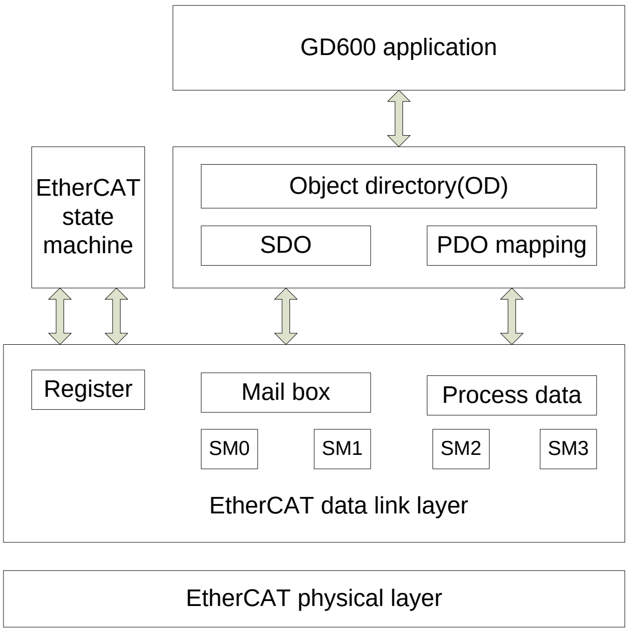


Figure 6-10 CoE model reference

EtherCAT (CoE) network model is composed of two parts: data link layer and application layer. Data link layer is mainly in charge of EtherCAT communication protocol. Application layer is mainly oriented to CANOpen drive profiles (DS402) communication protocol. Object dictionary in CoE includes parameters, application data and PDO mapping configuration information.

Process data object (PDO) is composed of objects in the object dictionary that could operate PDO mapping. The content of PDO data is defined by PDO mapping. PDO data is periodically read and written, which does not require searching the object dictionary. However, mail box communication (SDO) is not periodic, which requires searching the object dictionary.

Note: To parse SDO and PDO data correctly on the EtherCAT data link layer, configure FMMU and Sync Manager as follows:

Table 6-43 EtherCAT sync manager configuration

Synchronization manager	Assignment	Size	Start address
Sync Manager 0	Assigned to receive SDO	512 Bytes	0x1000
Sync Manager 1	Assigned to send SDO	512 Bytes	0x1200
Sync Manager 2	Assigned to Receive PDO	1536 Bytes	0x1400
Sync Manager 3	Assigned to Send PDO	1536 Bytes	0x1A00

6.7.1.2 EtherCAT slave site information

EtherCAT slave site information (.xml) is read by the master to construct the master-slave configuration. The XML file contains mandatory information about EtherCAT communication settings. INVT provides this file GD600-EtherCAT_XML_100.xml.

6.7.1.3 EtherCAT state machine

EtherCAT state machine is used to describe the states and state change of slave site applications. Generally, the master site sends a state change request, while the slave site responds. The state change flow is shown in the following figure.

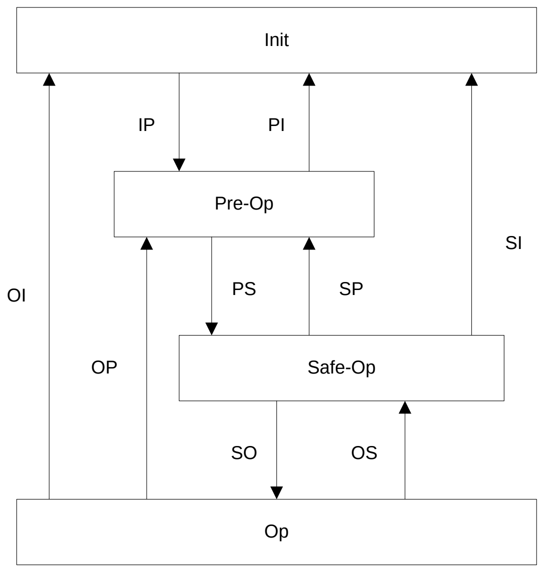


Figure 6-11 EtherCAT state machine flowchart

Table 6-44 EtherCAT state machine description

Status	Description
Init	Neither SDO or PDO communication unavailable.
Init to Pre-Op	The master configures the data link layer address and SM channel for SDO communication. The master initializes DC synchronization information. The master requests to change into Pre-Op status. The master configures the application layer control register. The slave checks whether the mailbox is initialized properly.

Status	Description
Pre-Op	SDO communication available but PDO unavailable.
Pre-Op to Safe-Op	The master configures the SM and FMMU channels for PDO communication. The master configures PDO mapping through SDO communication. The master requests to change into Safe-Op status. The slave checks whether the PDO and DC are configured properly.
Safe-Op	SDO communication available; Communication of receiving PDOs available, but that of sending PDOs unavailable, in the Safe state.
Safe-Op to Op	The master requests to change into Op status.
Op	Both SDO and PDO communication available.

6.7.1.4 PDO process data mapping

The process data of an EtherCAT slave site is composed of SM channel objects. Each SM channel object describes the consistent area of the EtherCAT process data and includes multiple PDOs. An EtherCAT slave site with the application control function shall support PDO mapping and reading of SM PDO assigned objects.

The master site can select objects from the object dictionary to perform PDO mapping. PDO mapping configuration is located in the range 1600h–1603h (RxPDOs: receiving PDOs) and range 1A00h–1A03h (TxPDOs: sending PDOs) in the object dictionary. The PDO mapping method is shown in the following figure.

Index	Sub-index	Object content
0x1600	0	16
	1	0x70010010
	2	0x70020010
	…	…
	16	0x70100010
0x1601	0	12
	1	0x70810010
	…	…
	12	0x708c0010
…	…	…
0x1614	0	12
	1	0x7a010010
	…	…
	12	0x7a0c0010
0x1a00	0	16
	1	0x60010010
	2	0x60020010
	…	…
	16	0x60100010
…	…	…
0x1a14	0	12
	1	0x7a010010
	…	…
	12	0x7a0c0010
0x6001	0	Receive object 1 of module 1 (16 bits)

Index	Sub-index	Object content
0x6002	0	Receive object 2 of module 1 (16 bits)
…	…	…
0x6010	0	Receive object 16 of module 1 (16 bits)
0x6081	0	Receive object 16 of module 2 (16 bits)
…	…	…
0x608c	0	Receive object 12 of module 2 (16 bits)
0x6101	0	Receive object 1 of module 3 (16 bits)
…	…	…
0x6a0c	0	Receive object 1 of module 21 (16 bits)
0x7001	0	Send object 1 of module 1 (16 bits)
0x7002	0	Send object 2 of module 1 (16 bits)
…	…	…
0x7a0c	0	Send object 12 of module 21 (16 bits)

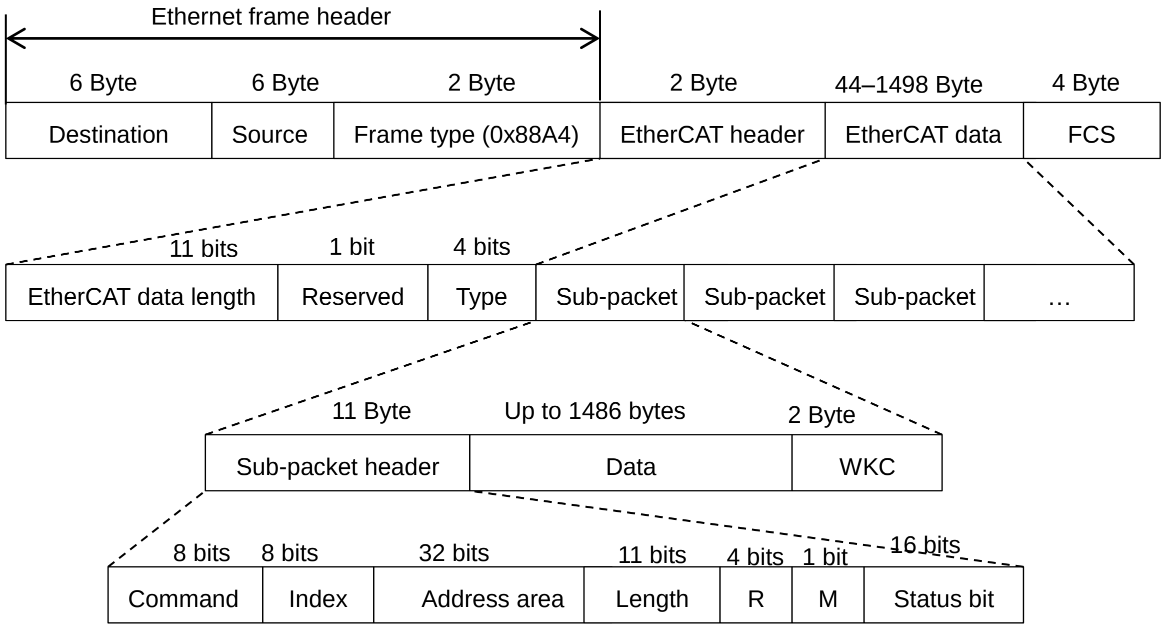
In addition to PDO mapping, EtherCAT process data switching needs to assign PDOs to SM channels. The relationship between PDOs and SM channels is established through SM PDO assigned objects (1C12h and 1C13h). The mapping between SM channels and PDOs is shown in the following figure.

Index	Sub-index	Object contents
1C12h	0	21
	1	0x1600
	2	0x1601
	…	…
	21	0x1614
1C13h	0	21
	1	0x1a00
	2	0x1a01
	…	…
	21	0x1a14

6.7.2 Communication packet structure

6.7.2.1 EtherCAT packet format

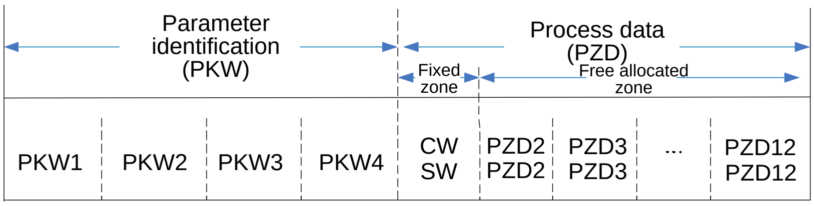
The following figure describes the structure of EtherCAT frame:



Each sub-packet contains the data of one EtherCAT slave. The data in the sub-packet is a combination of several data frames as described in 6.7.2.2, depending on the number of CANopen stations (CANopen master + all CANopen slaves) at the time of the switch to CANopen networking.

6.7.2.2 EtherCAT packet data structure

The EtherCAT communication data frame structure (PKW+PZD) is similar to the PROFINET communication data frame structure. For details, see 6.6.2.2.



6.7.3 Network topology

In this network, the PLC or another master device connects only to the rectifier unit that has been inserted with an EtherCAT communication card, and the rectifier unit connects to other units through RJ45 since it converts the communication card bus to CANopen bus.

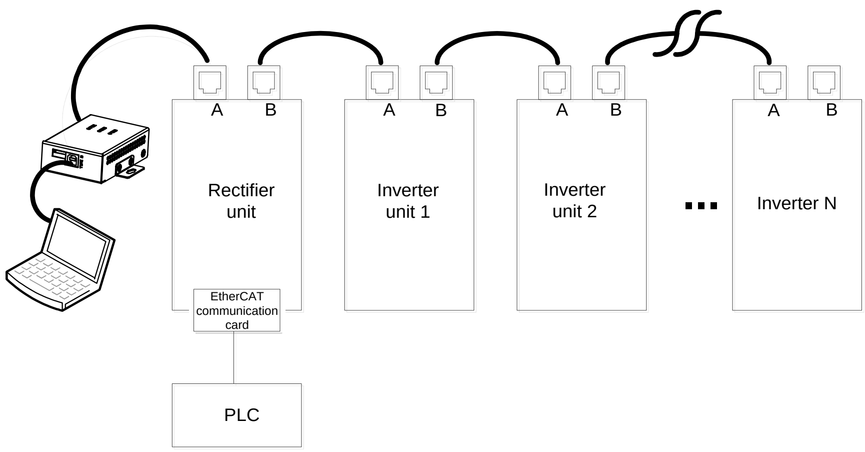


Figure 6-12 EtherCAT-to-CANopen networking topology

Note: In the networking wiring, the RJ45 ports between units must be cross-connected, that is, port A of a unit can only be connected to port B of another unit. If the connection is incorrect, the communication performance of the entire system will be degraded.

6.7.4 Communication performance

In this network, an EtherCAT bridge unit can support 21 CANopen slave nodes, and the bridge unit itself is also considered as a CANopen slave node. One bridge unit interacts with the PLC up to 512 bytes each time. At the same time, the number of slaves supported by the EtherCAT bridge is limited by the number of nodes supported by the PLC. Generally, the Beckhoff PLC allows more than 21 slave nodes, and therefore you only need to consider the number limited by the bridge itself.

6.7.5 Commissioning procedure

6.7.5.1 Commissioning flowchart

See the following figure.

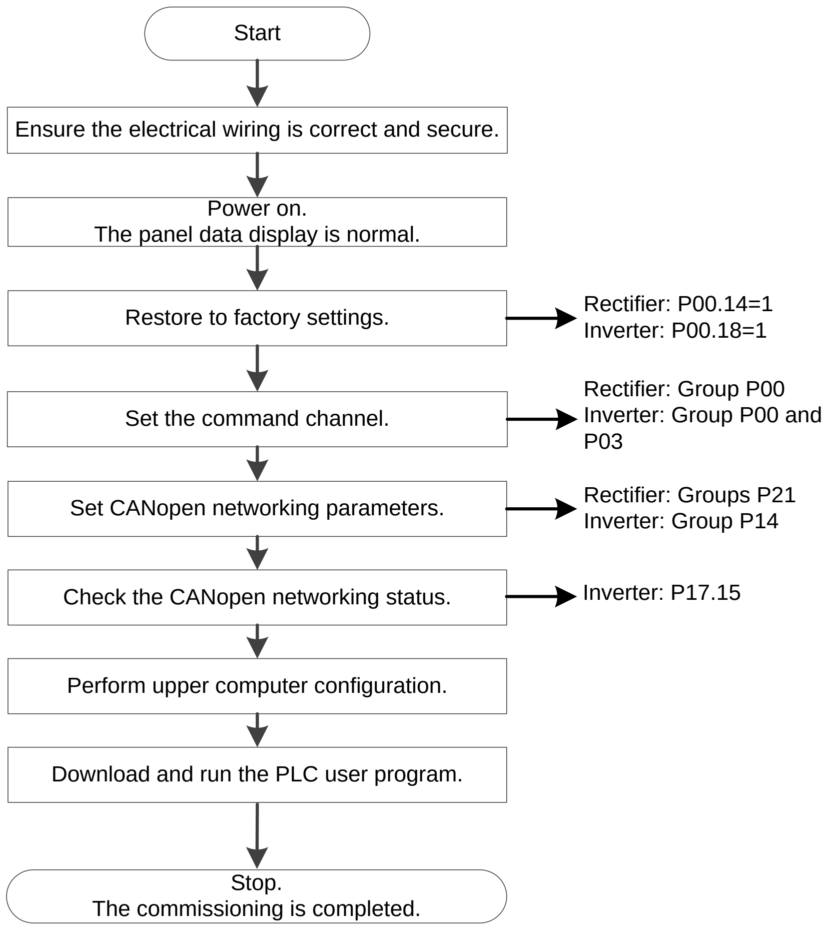


Figure 6-13 Commissioning procedure of EtherCAT-to-CANopen networking

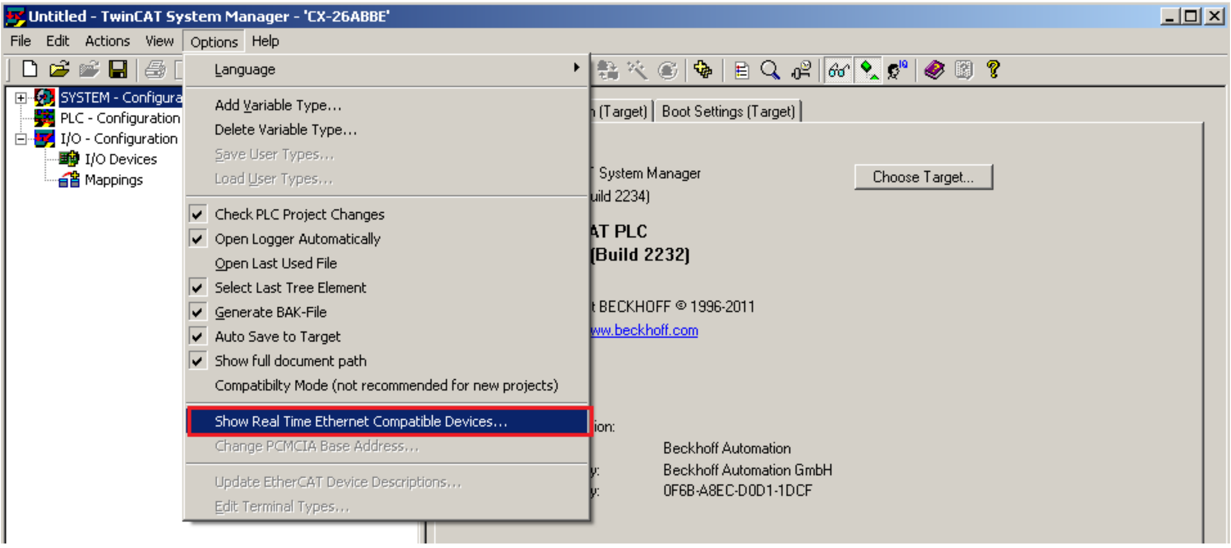
6.7.5.2 TwinCAT portal configuration (PLC model: Beckhoff CX5010)

The following uses TwinCAT 2 software and Beckhoff CX5010 as an example to describe the configuration procedure on TwinCAT portal.

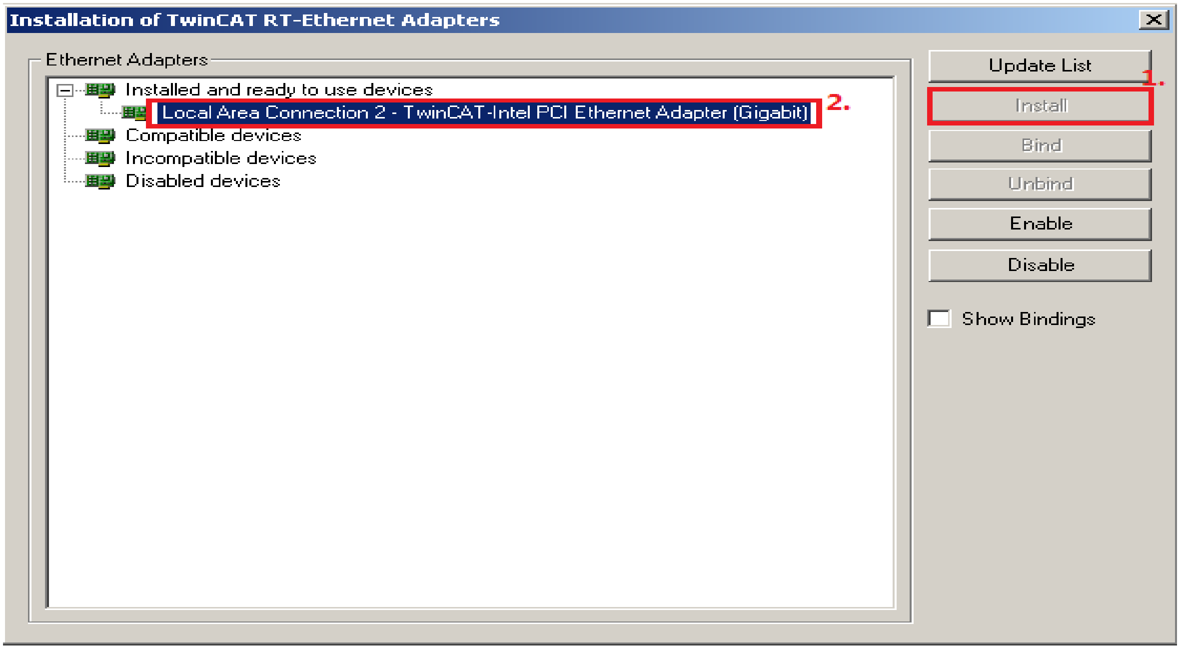
1. Install TwinCAT 2 software

2. Copy the EtherCAT configuration file (GD600-EtherCAT_XML_100.xml) and paste it to the TwinCAT2 installation directory: C:\TwinCAT\Io\EtherCAT.

3. Double-click the **TwiCAT System Manager** icon to open the configuration interface. The driver program should be installed at the first installation of the software. Click **Option** on the toolbar, as shown in the following figure:

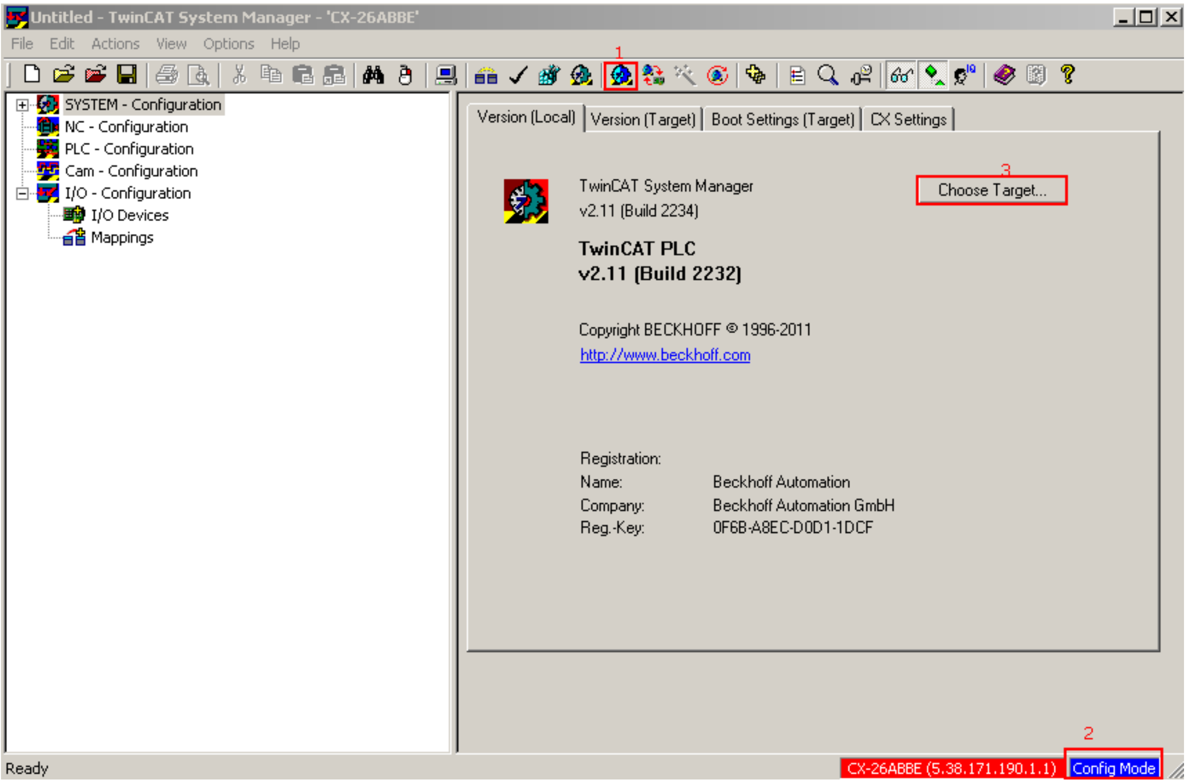


Select **Show Realtime Ethernet Compatible Devices…** from the menu, select the local area network card, and then click **Install**. After the installation, it will be displayed in the **Installed and ready to use devices** menu. (Note: Please use the network card with an Intel chip.)



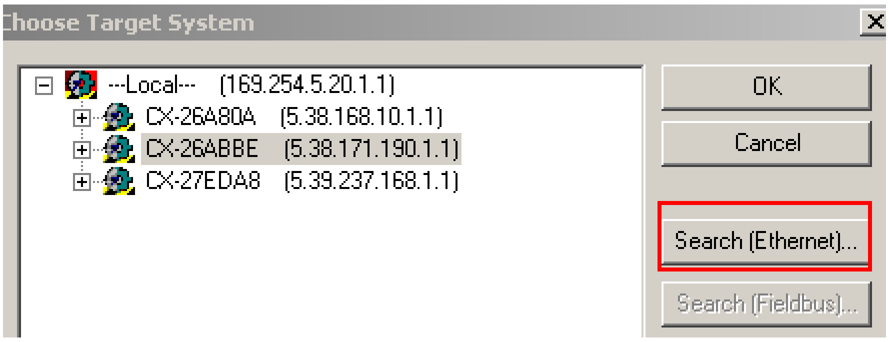
4. Connect CX5010.

Connect the CX5010 to the PC with TwinCAT2 through a network cable. Meanwhile, connect the CX5010 to the EK1110 module, and then to the GD600 EtherCAT card on the rectifier through the module interface. In the following example, a connection between the rectifier and an inverter is needed. After the network card is installed, the interface of TwinCAT2 is displayed as follows:

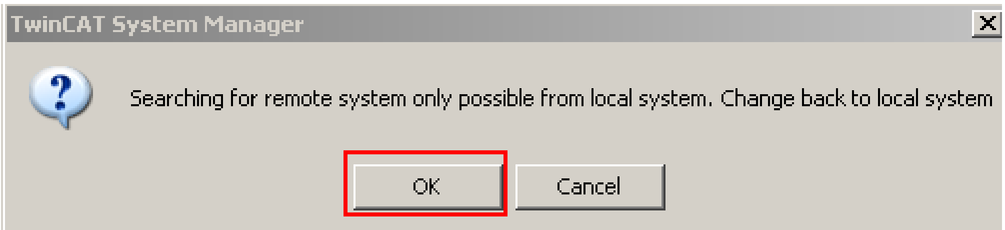


If **Config Mode** is not displayed in the mark 2 on the above figure, click **Restart TwinCAT System in Config Mode** (mark 1), and then click **Choose Target…** (mark 3).

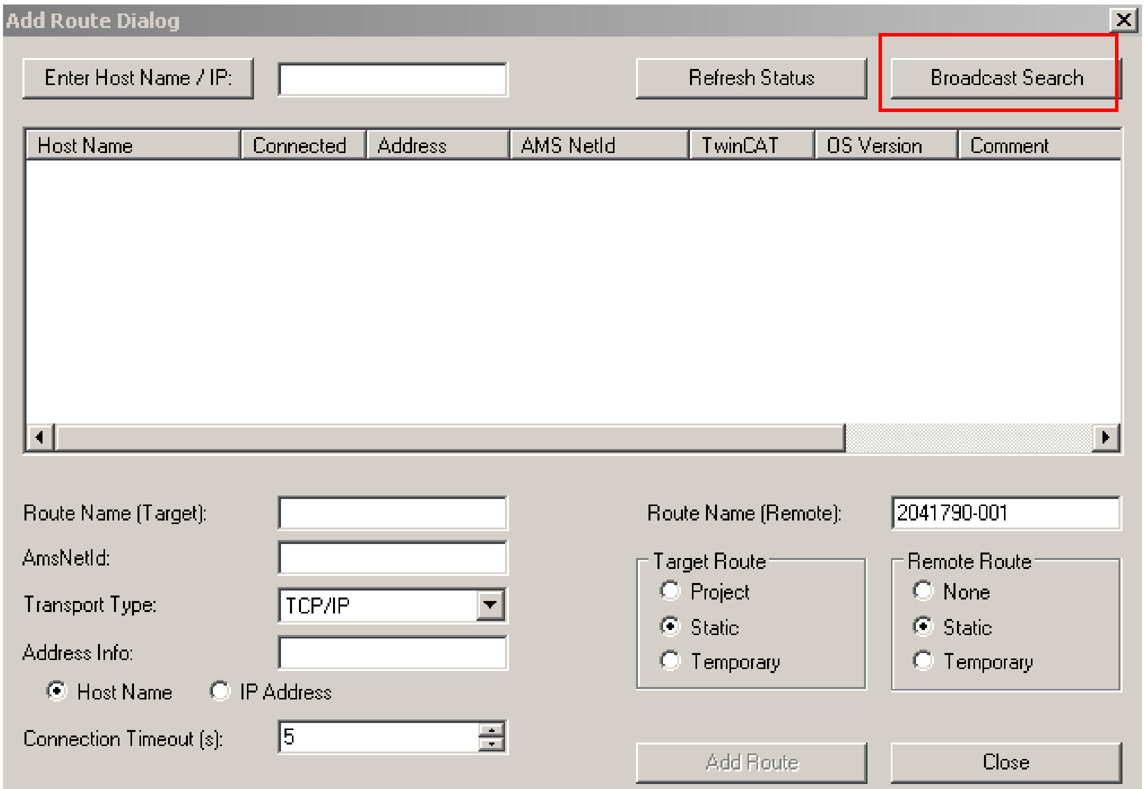
For the first time using a new PLC, click **Search [Ethernet]…**.



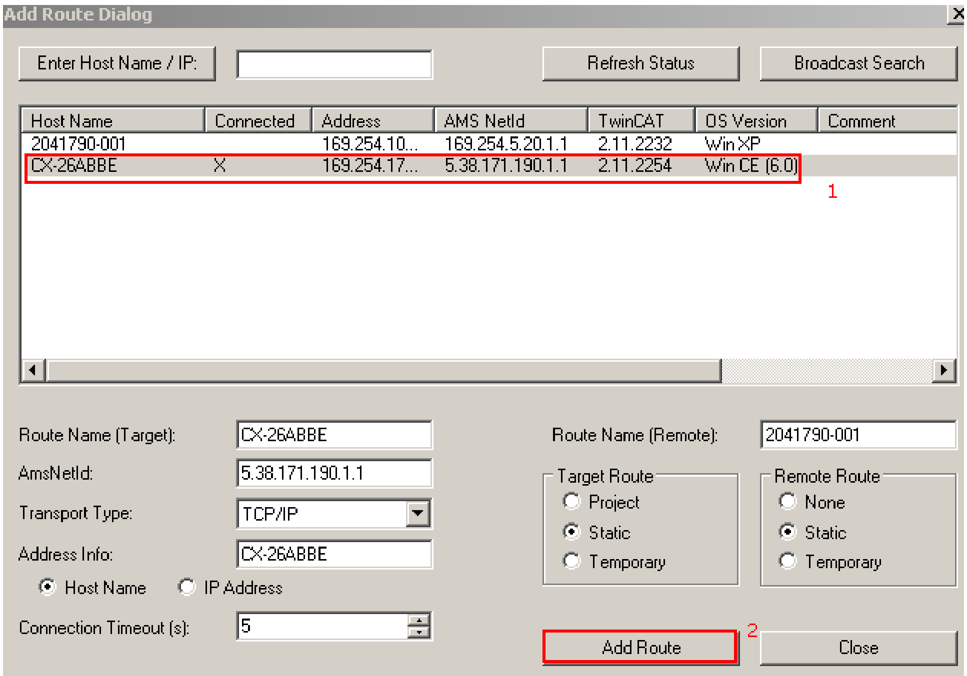
The following pop-up is displayed: Click **OK**.



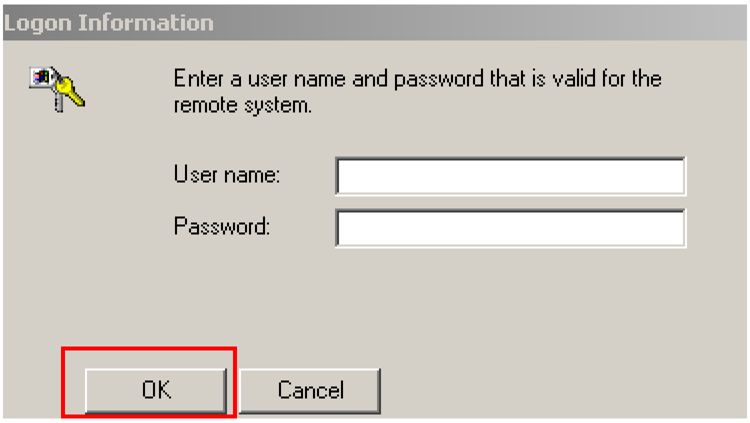
In the displayed dialog box, select **Broadcast Search**.



The found devices will be shown in the list. The "X" in the **Connected** column indicated that the device has been connected before and has been automatically connected currently. For a new device, this column is left blank. Select a PLC that you need (for example, CX-26ABBE), and click **Add Route** to add the device.

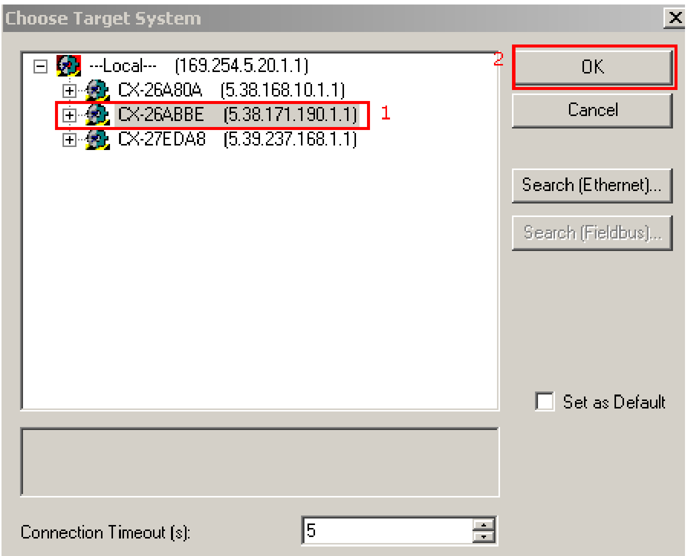


Click **OK** after entering the user name and password . The default user name and password are both empty.



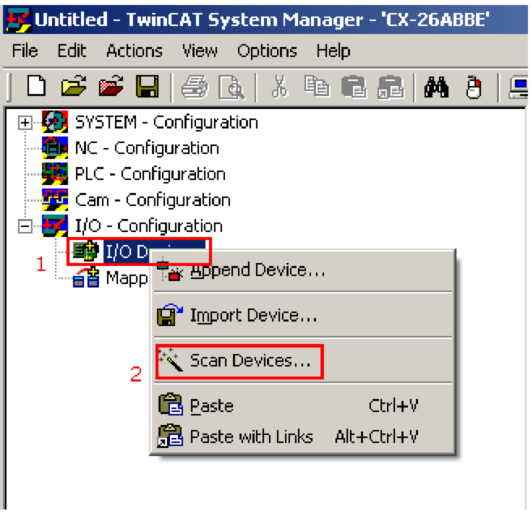
On the **Add Route Dialog** page, a "**X**" will appears under the **Connected** column of the device CX-26ABBE, indicating that the device is connected. Click **Close** to go back to the **Choose Target System** page.

Select the required PLC (for example, CX-26ABBE) and click **OK**. If a PLC has been connected before, you can directly select it from this list.

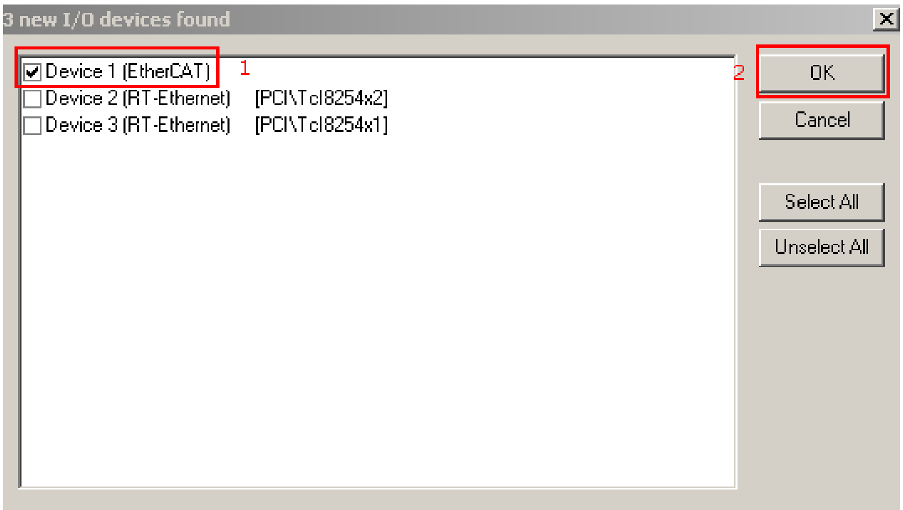


5. Search and configure the PLC device.

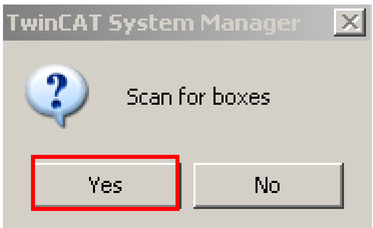
Right-click **I/O Devices** and select **Scan Devices…** from the menu. Please note that this option is only available in Config Mode.



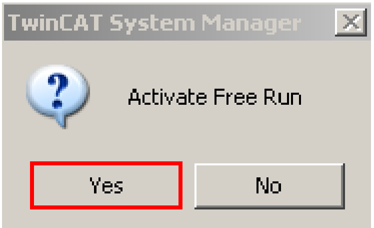
The following dialog box is displayed. By default, the currently connected PLC device is selected. Click **OK**.



In the displayed dialog box, select **Yes**.



In the displayed dialog box, select **Yes** again to complete the CX5010 device configuration and connection.

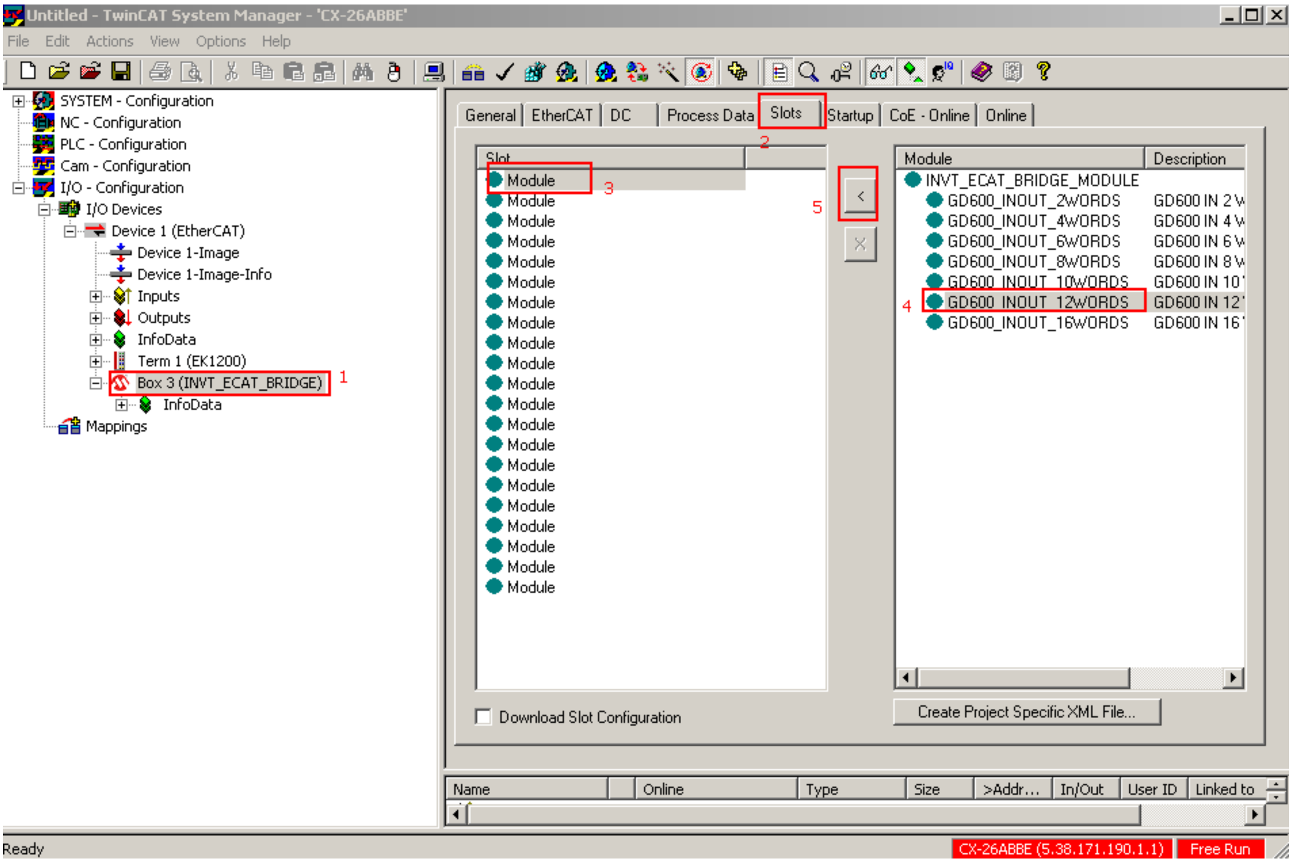


6. Add CANopen node module.

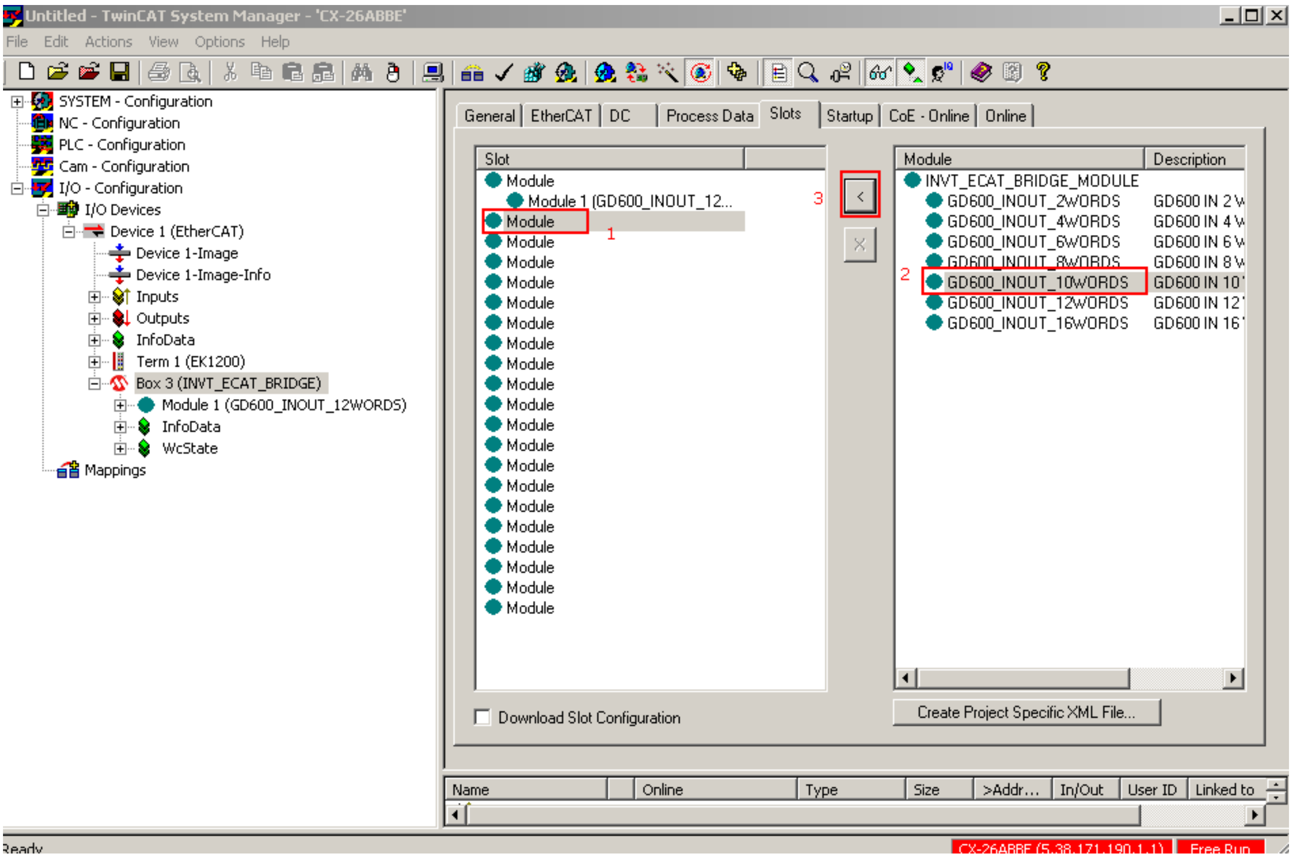
On the left panel, double-click **Box3(INVT_ECAT_BRIDGE)** wherein “INVT_ECAT_BRIDGE” is determined by the device profile “GD600-EtherCAT_XML_100.xml” and the box number is not necessarily 3.

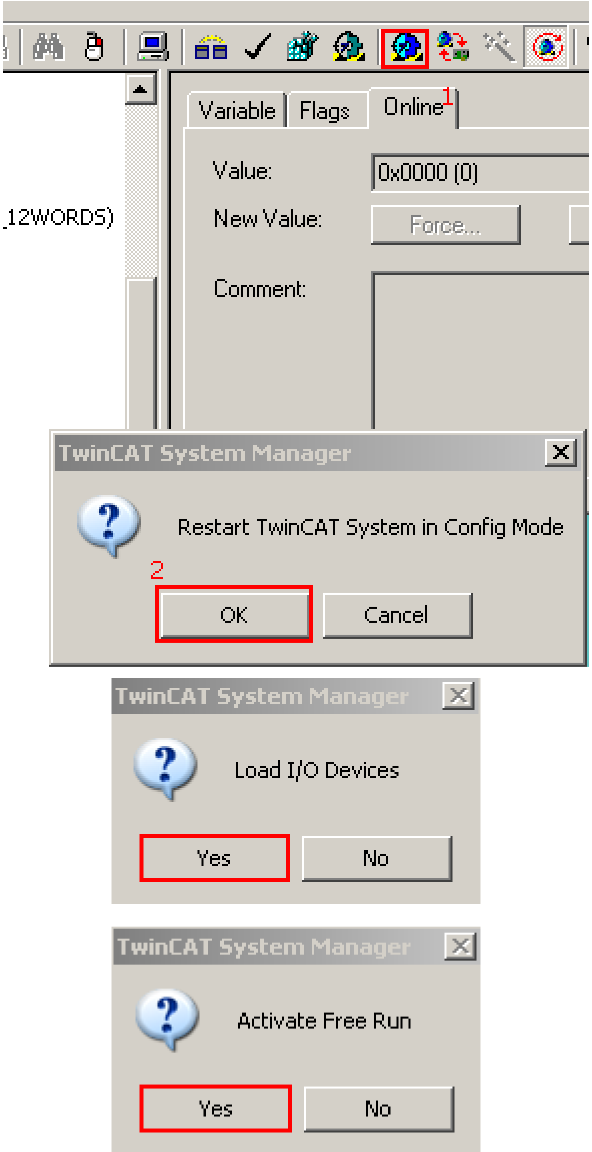
On the right panel, select **Slots** tab. Select the first **Module** from the left list, select a module (for example “GD600_INOUT_12WORDS”) from the right list, and click “<”.

Note: The module GD600_INOUT_16WORDS is only available for EtherCAT bus networking.



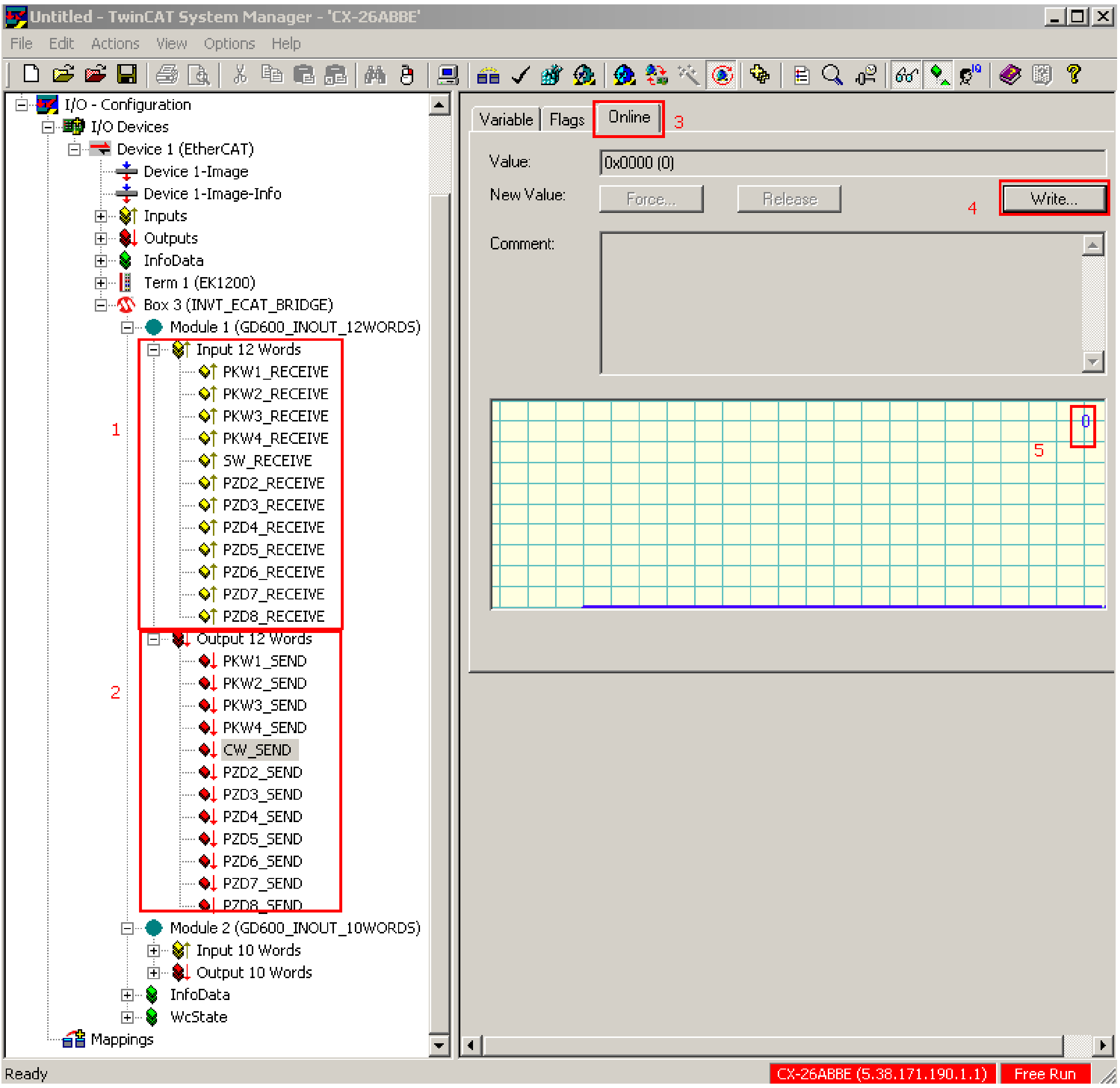
Repeat the above steps to add the module GD600_INOUT_10WORDS to the second Module. Click **Restart TwinCAT System in Config Mode** button and select **OK** or **Yes** on the displayed dialog boxes to update the information.



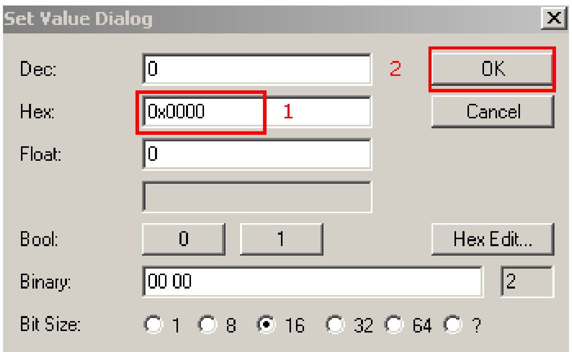


After the setup, the following page appears, showing the EtherCAT-to-CANopen networking configuration for TwinCAT2 connecting to GD600 that equipped with a rectifier and an inverter through CX5010.

On this page, area 1 shows the data received by TwinCAT, area 2 shows the data sent by TwinCAT. You can debug and modify the parameters by selecting a variable from area 1 or area 2 and selecting **Online** on area 3. For example, select **CW_SEND** > **Online** > **Write** to open the **Set Value Dialog** box. The default value is 0.

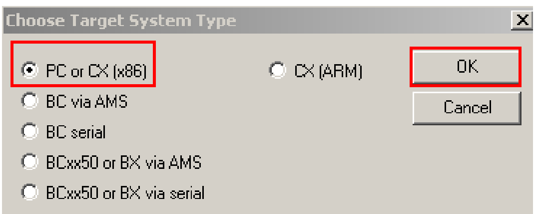


On the **Set Value Dialog** box, modify the value in Dec or Hex format and click **OK**.

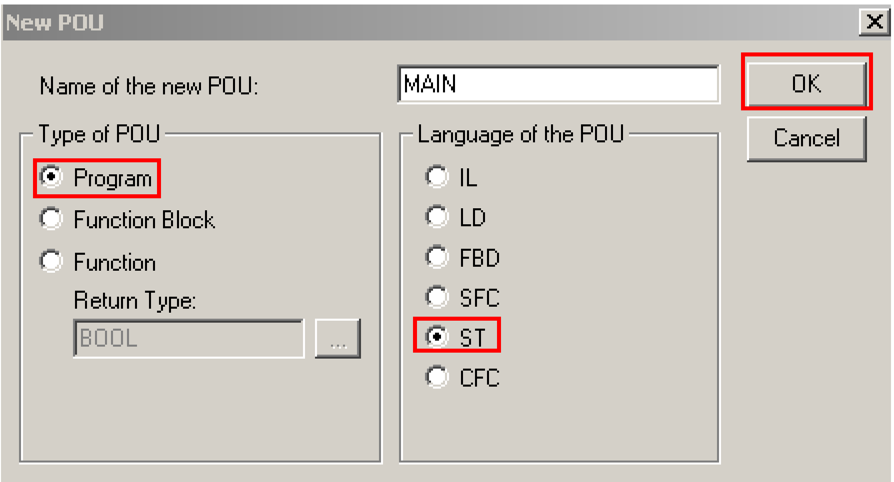


7. Compile and download the PLC program and link variables.

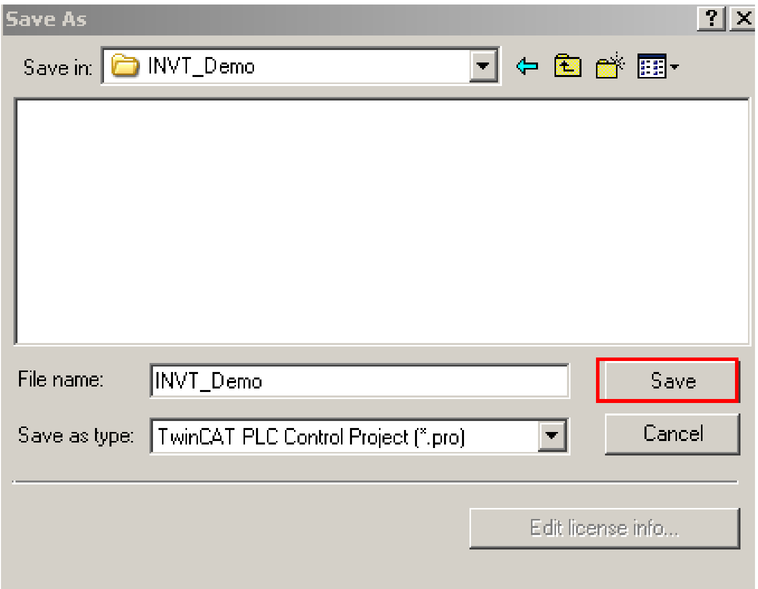
Double-click the TwinCAT PLC Control icon and select **File** > **New**. On the displayed dialog box, click **OK**.



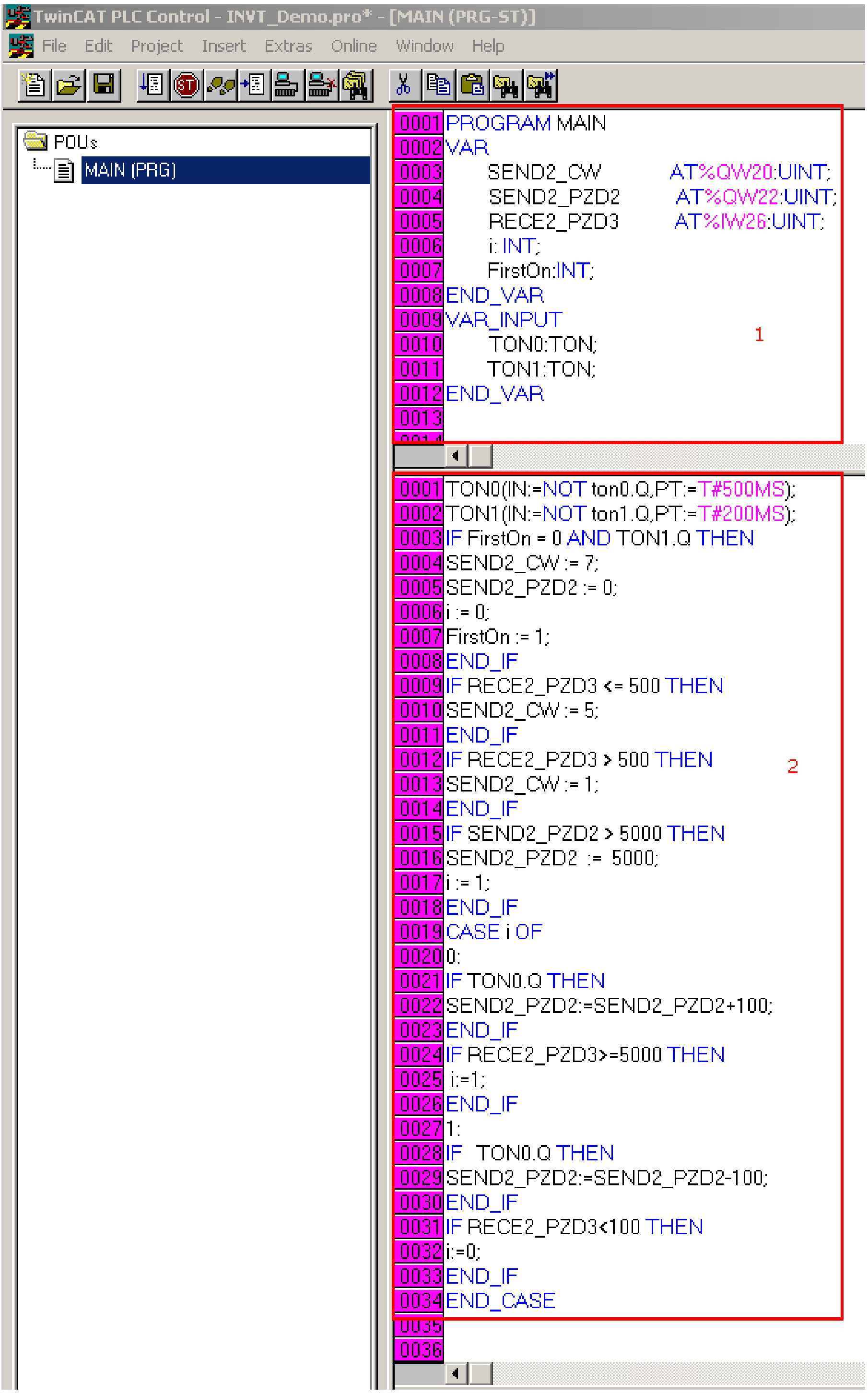
Select a programming language according to your programming preference and click **OK**.



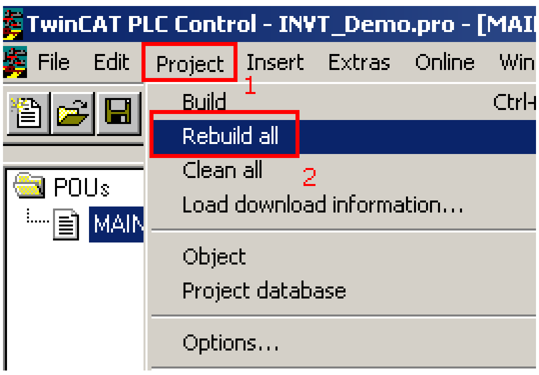
After creating a new project, choose a path to save the project.



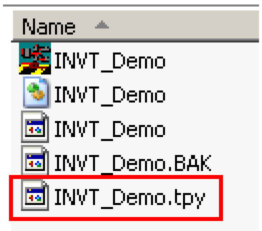
Write a program in the shown interface, where area 1 is the variable definition area and area 2 is the programming area. The example program sends commands to the inverter module through PLC to increase 1Hz every 0.5s until 50Hz and then decrease 1Hz until 0, and repeat the cycle. Meanwhile, when the frequency increases to more than 5Hz, the inverter module receives a run command; when it decreases to less than 5Hz, the inverter module receives a stop command. Configure the EtherCAT-to-CANopen networking as described in 6.7.5.1 and set the following function codes for the inverter module: P00.00=2, P00.01=2, P00.02=1, P00.06=9, P14.10=1 (set frequency), P14.22=2 (set frequency).



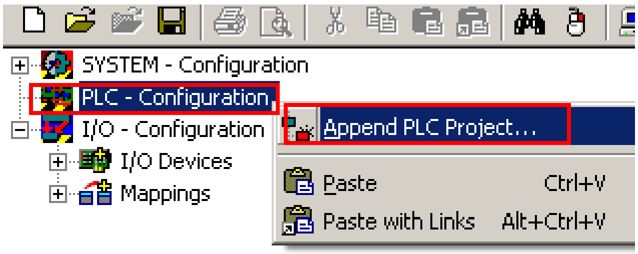
Compile the program as shown in the following figure.



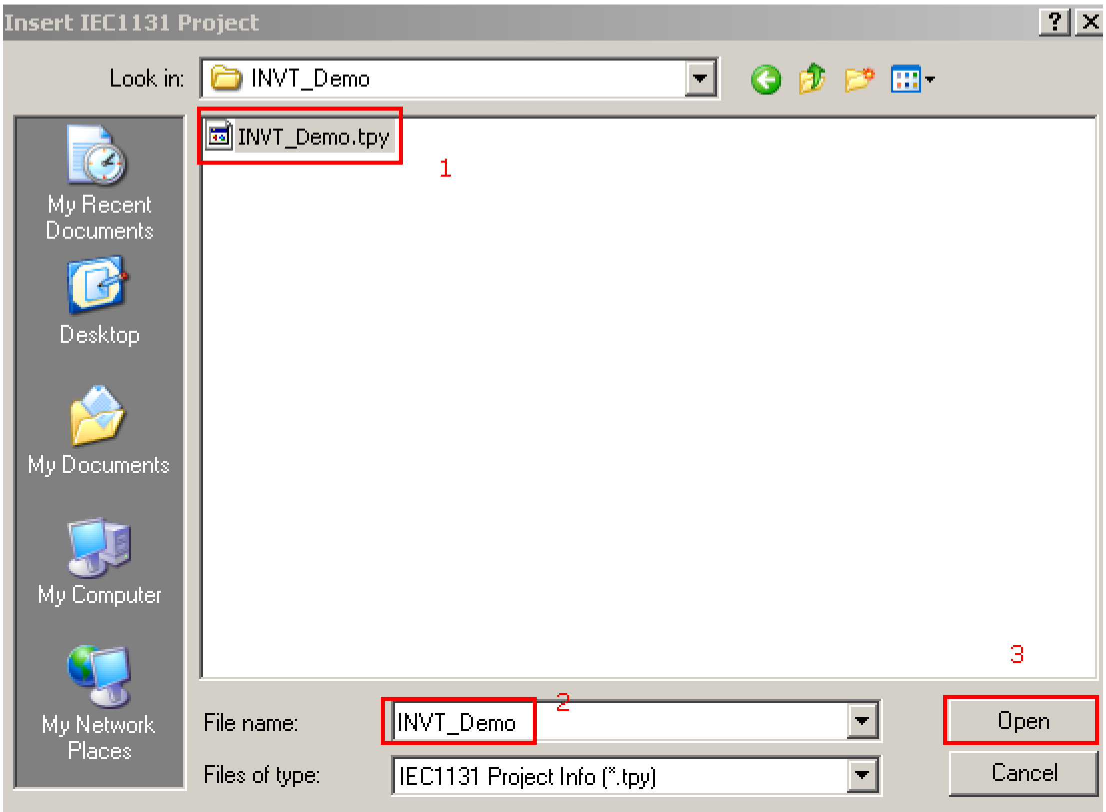
After compilation, a ".tpy" file is generated and stored in the save directory. The file is important for linking to the configuration.



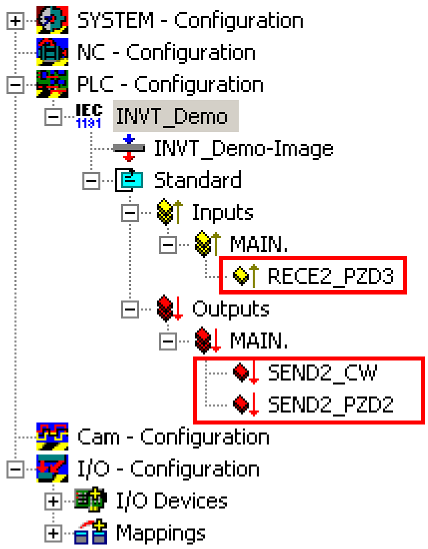
On TwinCAT System Manager, select **PLC-Configuration** > **Append PLC Project...** for the new-created configuration to load the PLC project.



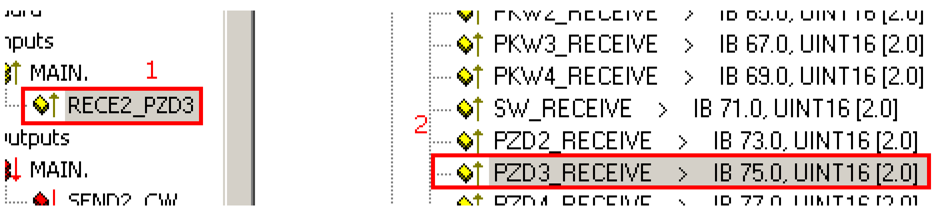
Select the .tpy file.



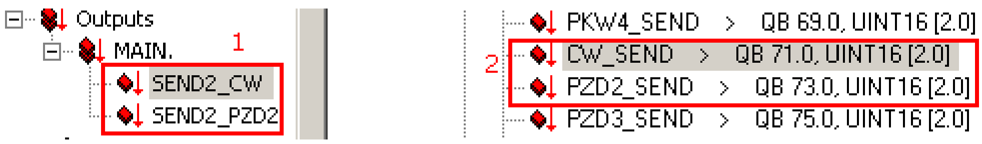
The user variables defined in the PLC program are displayed as follows.



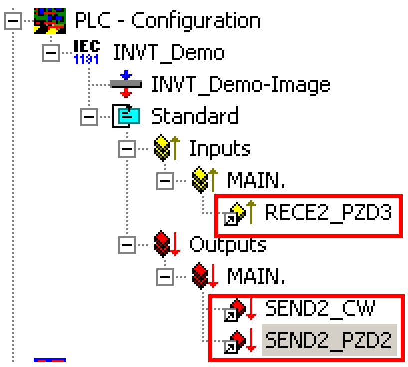
Select a variable and then select the object as shown in the following figure to link the input variable.



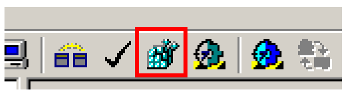
Repeat the step for the output variable.

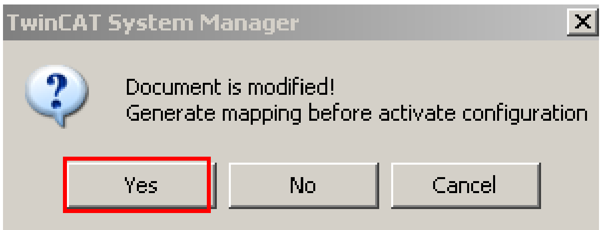


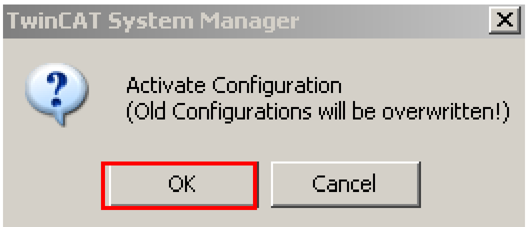
An arrow icon will be displayed for the linked variables.

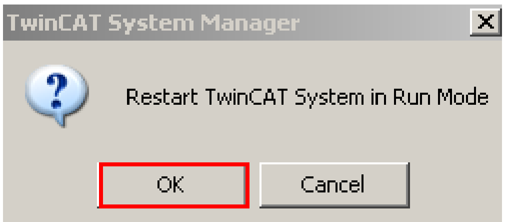


Click the icon in the following figure and select **Yes/OK** in the displayed dialog box to activate the configuration.

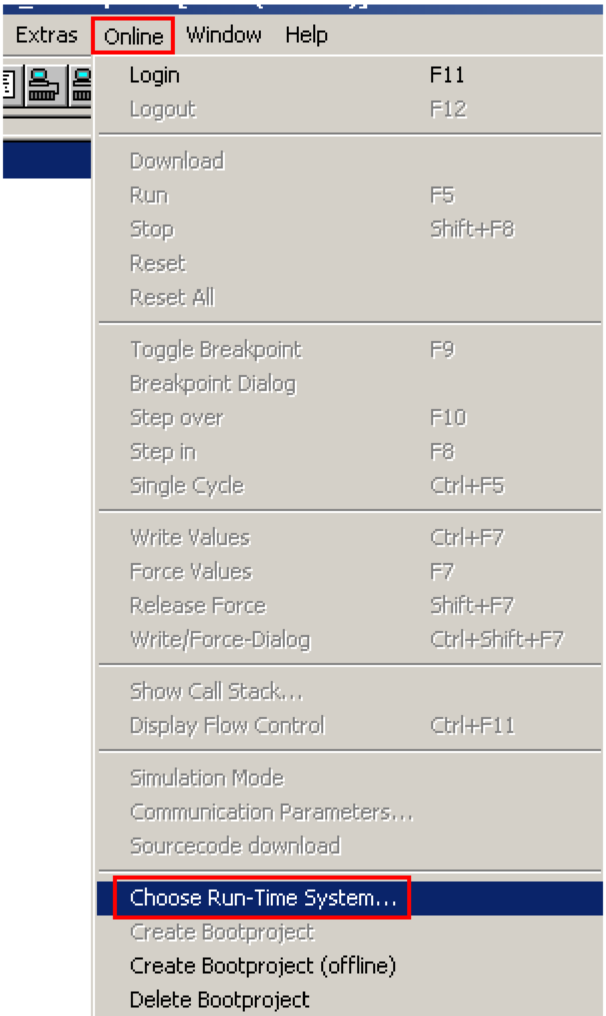




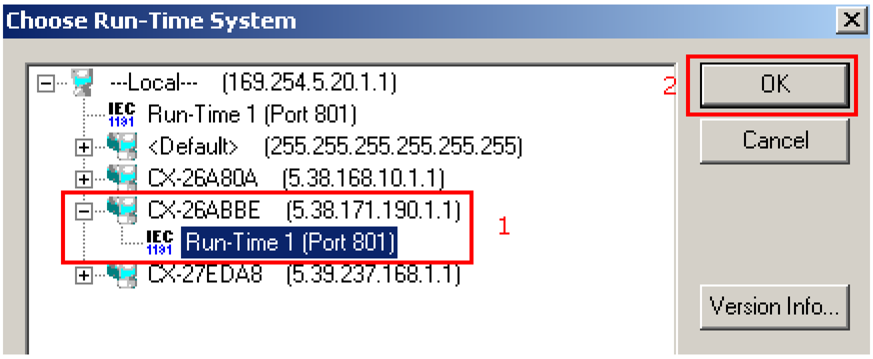




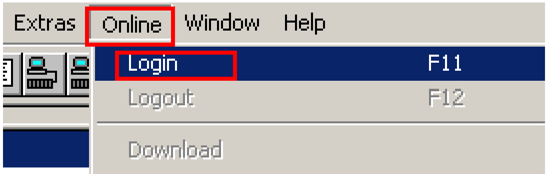
On the TwinCAT PLC Control page, select **Online** > **Choose Run-Time System**.



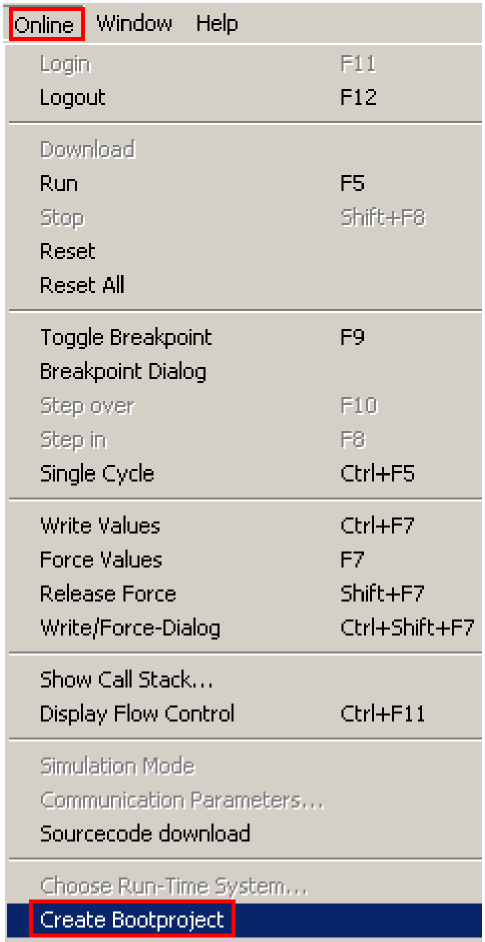
Select the connected PLC.



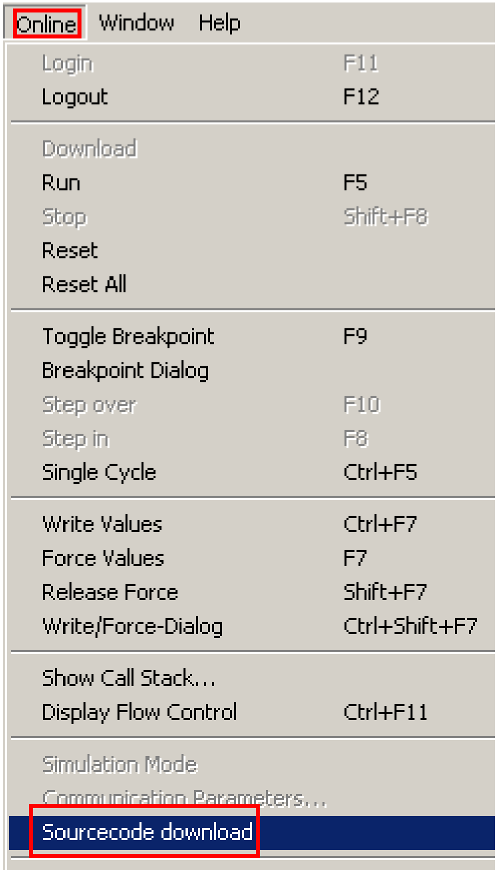
Select **Online** > **Login.**



Select **Online** > **Create Bootproject** to create a boost project before you download the PLC program.



Select **Online** > **Sourcecode download** to download the sourcecode.



Now, the PLC program is downloaded to the PLC. Re-power on the PLC to automatically run the program. To conduct online commissioning, use the "Login" option to log the PLC into the system.

6.7.5.3 IN/OUT module mapping description

In the configuration of EtherCAT-to-CANopen communication, to ensure the efficiency of CANopen communication, IN/OUT modules can support the selection of 2, 4, 8, 10, 12 words, but not 16 words. Selecting different word types causes data mapping difference.

When the IN/OUT module selects 8 words or more, it supports the reading and writing of function codes. To be specific, mapping from PKW, it also supports data reading and writing of up to 7 PZDs (PZD2–PZD8).

When the IN/OUT module selects 8 words or less, the mapping starts from CW/SW and it supports data reading and writing of up to 7 PZDs, but it does not support reading and writing of PKW function codes.

6.7.6 Related parameters

Since our EtherCAT communication shares one channel with the PROFINET communication, the related parameters are the same. For more information, see section 6.6.6. Only the EtherCAT-exclusive function codes are listed in the following table.

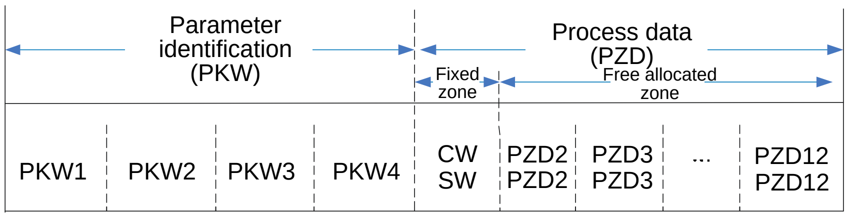
Table 6-45 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P22.24	EtherCAT communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○

6.8 PROFIBUS-DP bus networking

6.8.1 Communication packet structure

The PROFIBUS-DP communication data frame structure (PKW+PZD) is similar to the PROFINET communication data frame structure. For details, see 6.6.2.2 PROFINET packet data structure.



6.8.2 Network topology

In this network, each unit is inserted with a PROFIBUS-DP communication card so that the PLC or another master device can connect to the rectifier and inverter units.

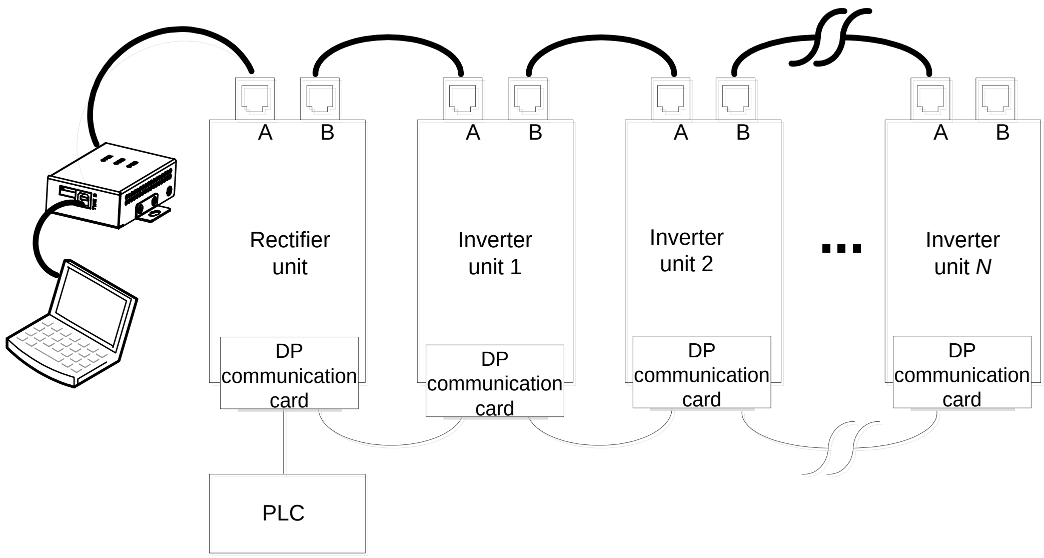


Figure 6-14 PROFIBUS-DP network topology

6.8.3 Communication performance

The number of nodes in the PROFIBUS-DP bus communication network depends on the number of nodes supported by the PLC CPU. When there are more than 32 nodes in the network, repeaters are needed for relaying. A maximum of 32 nodes (including repeaters) can be connected in a segment consisting of two repeaters.

6.8.4 Commissioning procedure

6.8.4.1 Commissioning flowchart

Figure 6-15 shows the commissioning procedure.

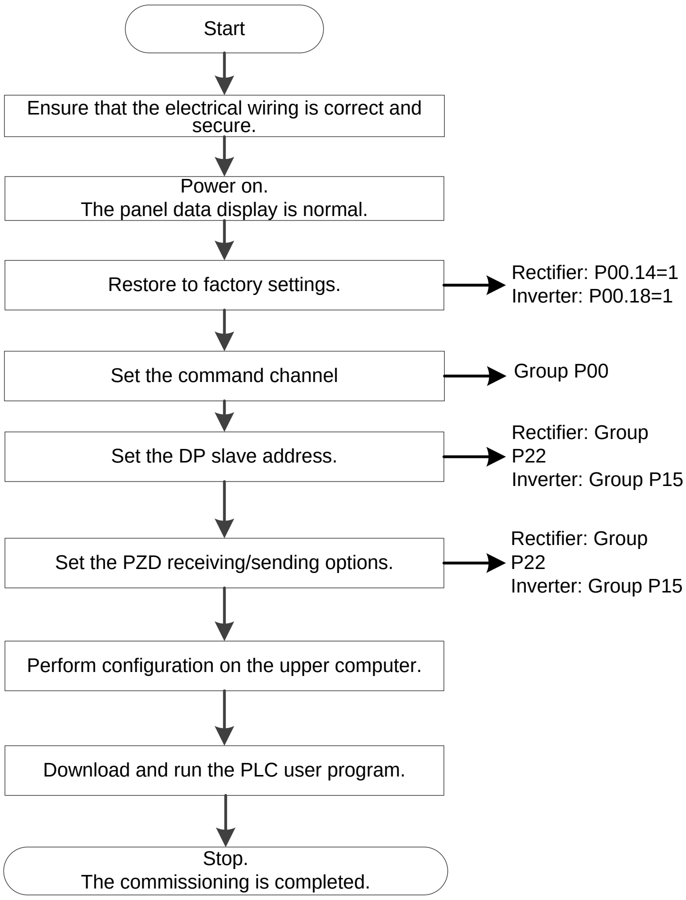


Figure 6-15 Commissioning procedure

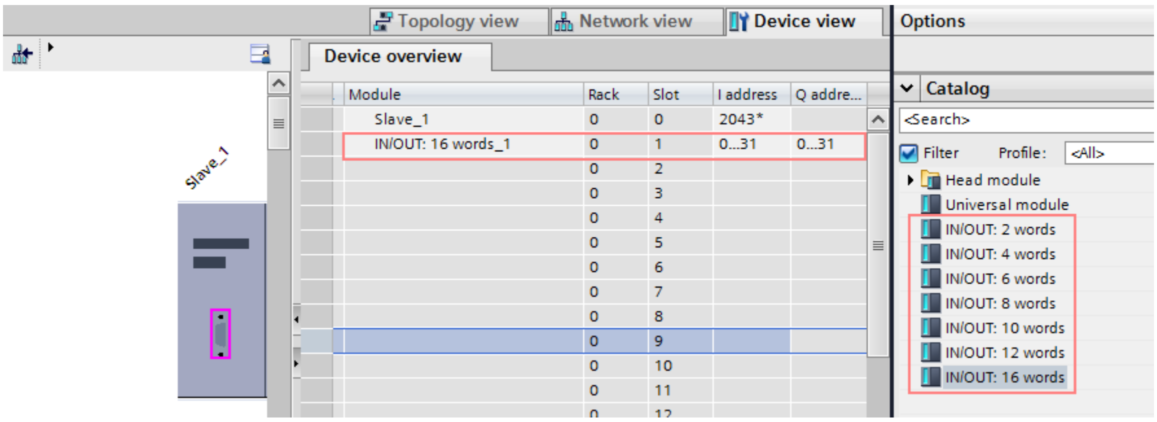
6.8.4.2 TIA portal configuration (S7-300)

For details, see 6.5.6.2 TIA portal configuration (S7-300).

Note:

There is difference in the salve device configuration between the PROFIBUS-DP bus networking and PROFIBUS-DP-to-CANopen networking:

In the PROFIBUS-DP-to-CANopen network, each device needs to be configured with a certain number of slots, which depends on the number of CANopen slave nodes. In the PROFIBUS-DP bus network, many PROFIBUS-DP devices are added, and only a slot module needs to be configured for each of the device.



6.8.4.3 IN/OUT module mapping

In the configuration of PROFIBUS-DP bus communication, you can select different IN/OUT modules according to your needs. IN/OUT modules can support the selection of 2, 4, 6, 8, 10, 12, and 16 words.

When an IN/OUT module selects 8 words or more, it supports the reading and writing of function codes. To be specific, mapping from PKW, it supports data reading and writing of up to 11 PZDs (PZD2–PZD12).

When an IN/OUT module selects 8 words or less, the mapping starts from CW/SW and it supports data reading and writing of up to 7 PZDs (PZD2–PZD8), but it does not support reading and writing of PKW function codes.

6.8.5 Related parameters

Table 6-46 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	Used to select the channel of rectifier unit control commands, including the start, stop, and fault reset commands. 0: Keypad The running commands are controlled through keypad keys, such as RUN and STOP/RST. 1: Terminal The running commands such as run, stop, and fault reset are controlled through multi-function input terminals. 2: Communication The running commands are controlled by the upper computer in communication mode.	1	○
P00.02	Communication mode of running commands	Used to select the rectifier unit communication command mode. 0: RS485 1: CANopen 2: PLC 3: PROFIBUS-DP 4: PROFINET/EtherCAT	0	○
P17.16	Type of card at slot 1	Used to display the type of card at the slot. Range: 0–18 0: No card 1: PLC 2: I/O 3–4: Reserved 5: Ethernet 6: PROFIBUS-DP 7: Reserved 8: Reserved 9: Reserved 10: Reserved 11–14: Reserved 15: PROFINET 16: Modbus 17: EtherCAT 18: BACnet	0	●
P17.17	Type of card at slot 2		0	●

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P17.18</td><td>Software version of card at slot 1</td><td>Used to display the software version of thecard at slot 1.
Range: 0–655.35</td><td>0.00</td><td>●</td></tr>
<tr><td>P17.19</td><td>Software version of card at slot 2</td><td>Used to display the software version of thecard at slot 2.
Range: 0–655.35</td><td>0.00</td><td>●</td></tr>
<tr><td>P20.00</td><td>Local communication address</td><td>Setting range: 1–247
When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the salves on the Modbus bus receive the frame but do not respond to it.
The communication addresses on the communication network are unique, which is the basis of the point-to-point communication.
Note: The communication address of a slave cannot be set to 0.</td><td>1</td><td>◎</td></tr>
<tr><td>P22.01</td><td>DP expansion card module address</td><td>0–127</td><td>3</td><td>◎</td></tr>
<tr><td>P22.13</td><td>Sent PZD2</td><td rowspan="11">Used only when the rectifier unit has been configured with a PROFIBUS-DP communication card.
0: Disable
1: Fault code
2: DC voltage (* 10, V)
3: Grid voltage (* 1, V)
4: Grid frequency (* 10, Hz)
5: Braker current (* 10, A)
6: Terminal input status
7: Terminal output status
8: Number of online slave nodes
9: Online/offline status of slave nodes 02–17
10: Online/offline status of slave nodes 18–21
11: CANopen bus load rate
12: Type of card at slot 1
13: Type of card at slot 2
14: Software version of card at slot 1
15: Software version of card at slot 2
16: R-phase current
17: S-phase current
18: T-phase current
19: Node number of first CANopen offline unit
20: Reserved</td><td>0</td><td>○</td></tr>
<tr><td>P22.14</td><td>Sent PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P22.15</td><td>Sent PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P22.16</td><td>Sent PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P22.17</td><td>Sent PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P22.18</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P22.19</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P22.20</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P22.21</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P22.22</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P22.23</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
</table>

Table 6-47 Inverter unit related parameters

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P00.01</td><td>Channel of running commands</td><td>0: Keypad
1: Terminal
2: Communication</td><td>0</td><td>○</td></tr>
<tr><td>P00.02</td><td>Communication mode of running commands</td><td>0: Modbus
1: CANopen
2: Ethernet
3: EtherCAT/PROFINET
4: PLC
5: Wireless communication
6: PROFIBUS-DP/DeviceNet
Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.</td><td>0</td><td>○</td></tr>
<tr><td>P00.06</td><td>Setting channel of A frequency command</td><td>0: Keypad
1: AI1
2: AI2
3: AI3
4: Reserved
5: Simple PLC program
6: Multi-step speed running
7: PID control
8: Modbus communication
9: CANopen communication
10: Ethernet communication
11: Reserved
12: Pulse train AB
13: EtherCAT/PROFINET communication
14: Programmable expansion card
15: PROFIBUS-DP/DeviceNet communication</td><td>0</td><td>○</td></tr>
<tr><td>P15.01</td><td>Module address</td><td>0–127</td><td>2</td><td>◎</td></tr>
<tr><td>P15.02</td><td>Received PZD2</td><td rowspan="11">0: Disable
1: Set frequency (0–Fmax (Unit: 0.01Hz))
2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%)
3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%)
4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current)
5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz)
6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz)
7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)</td><td rowspan="11">0</td><td rowspan="11">○</td></tr>
<tr><td>P15.03</td><td>Received PZD3</td></tr>
<tr><td>P15.04</td><td>Received PZD4</td></tr>
<tr><td>P15.05</td><td>Received PZD5</td></tr>
<tr><td>P15.06</td><td>Received PZD6</td></tr>
<tr><td>P15.07</td><td>Received PZD7</td></tr>
<tr><td>P15.08</td><td>Received PZD8</td></tr>
<tr><td>P15.09</td><td>Received PZD9</td></tr>
<tr><td>P15.10</td><td>Received PZD10</td></tr>
<tr><td>P15.11</td><td>Received PZD11</td></tr>
<tr><td>P15.12</td><td>Received PZD12</td></tr>
</table>

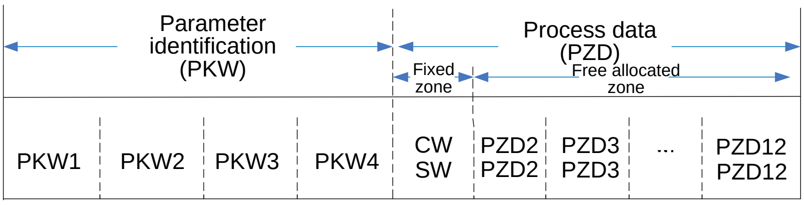
Function code	Name	Description	Default	Modify
		8: Upper limit of braking torque (0–2000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9 corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8) 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–1000, in which 1000 corresponds to 100.0%) 14: High-order bit of position reference (signed) 15: Low-order bit of position reference (unsigned) 16: High-order bit of position feedback (signed) 17: Low-order bit of position feedback (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function parameter mapping (PZD2–PZD12 corresponds to P14.49–P14.59) 20–31: Reserved		
P15.13	Sent PZD2	0: Disable 1: Running frequency (x100, Hz) 2: Set frequency (x100, Hz) 3: Bus voltage (x10, V) 4: Output voltage (×1, V) 5: Output current (x10, A) 6: Actual output torque (x10, %) 7: Actual output power (x10, %) 8: Rotation speed of running (x1, RPM) 9: Linear speed of running (x1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (* 100, V) 13: AI2 input (* 100, V) 14: AI3 input (* 100, V) 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (x100, %) 19: PID feedback (x100, %) 20: Reserved 21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned)	0	○
P15.14	Sent PZD3			
P15.15	Sent PZD4			
P15.16	Sent PZD5			
P15.17	Sent PZD6			
P15.18	Sent PZD7			
P15.19	Sent PZD8			
P15.20	Sent PZD9			
P15.21	Sent PZD10			
P15.22	Sent PZD11			
P15.23	Sent PZD12			

Function code	Name	Description	Default	Modify
		23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 26: Reserved 27: High-order bit of PG card count value 28: Low-order bit of PG card count value 29: High-order bit of PG card pulse count value 30: Low-order bit of PG card pulse count value 31: Function parameter mapping (PZD2–PZD12 corresponds to P14.60–P14.70)		
P19.00	Type of card at slot 1	0: No card	0	●
P19.01	Type of card at slot 2	1: Programmable card 2: I/O card 3: Incremental PG card (including 5V/12V/24V) 4: Reserved 5: Ethernet card 6: PROFIBUS-DP card 7: Reserved 8: Rotary PG card 9: Reserved 10: Reserved 11: PROFINET card 12: Sine-cosine PG card without CD signals 13: Sine-cosine PG card with CD signals 14: Reserved 15: Reserved 16: Reserved 17: EtherCAT card 18: Reserved 19: Reserved	0	●
P19.03	Software version of card at slot 1	0.00–655.35	0.00	●
P19.04	Software version of card at slot 2	0.00–655.35	0.00	●

6.9 PROFINET bus networking

6.9.1 Communication packet structure

The PROFIBUS-DP communication data frame structure (PKW+PZD) is similar to the PROFINET communication data frame structure. For details, see 6.6.2 Communication packet structure.



6.9.2 Network topology

PROFINET communication cards uses the standard RJ45 interface, and the networking can use the line-type network topology and star-type network topology, which are shown in Figure 6-16 and Figure 6-17. By inserting a PROFINET communication card into each unit, the PROFINET communication cards and PLC form a PROFINET communication network.

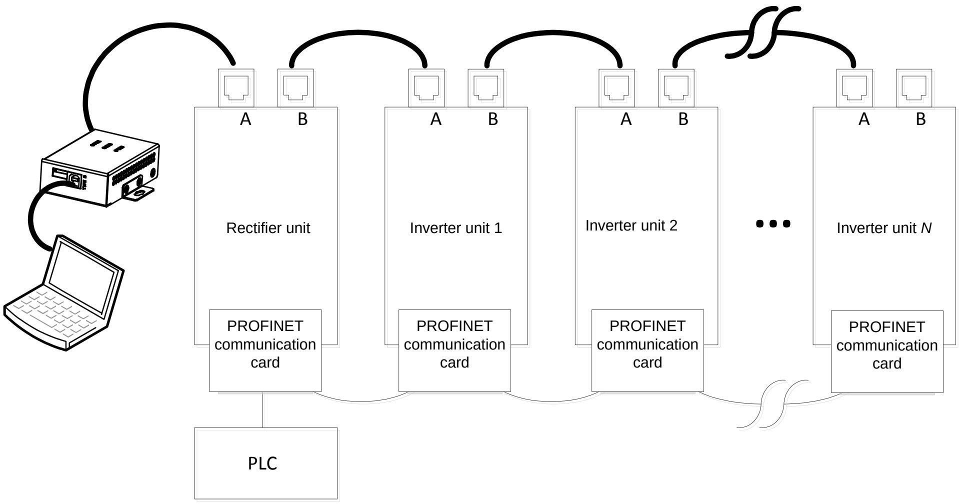


Figure 6-16 PROFINET line-type network topology

Note: For a star-type network topology, you need to prepare PROFINET switches.

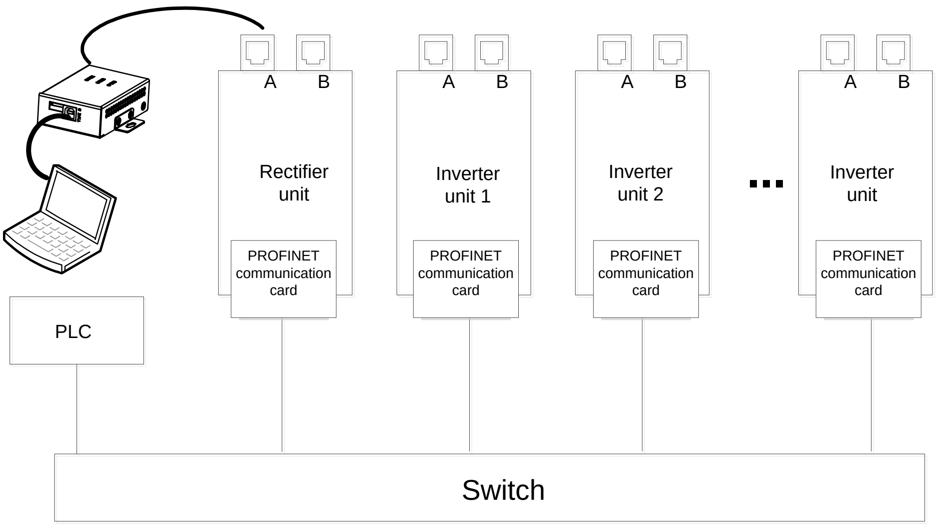


Figure 6-17 PROFINET star-type network topology

6.9.3 Communication performance

The number of nodes in the PROFINET bus network depends on the number of nodes supported by the PLC CPU. Take SIMATIC S7-1200 PLC as an example: One PROFINET communication card occupies only one IO node, while S7-1200 supports only 16 nodes, and therefore the network can contain only 15 PROFINET communication cards (since the PLC occupies one onde).

PLC model	PROFINET	
	IO nodes	Submodules
S7-1200	16	16*16

6.9.4 Commissioning procedure

6.9.4.1 Commissioning flowchart

Figure 6-18 shows the commissioning procedure.

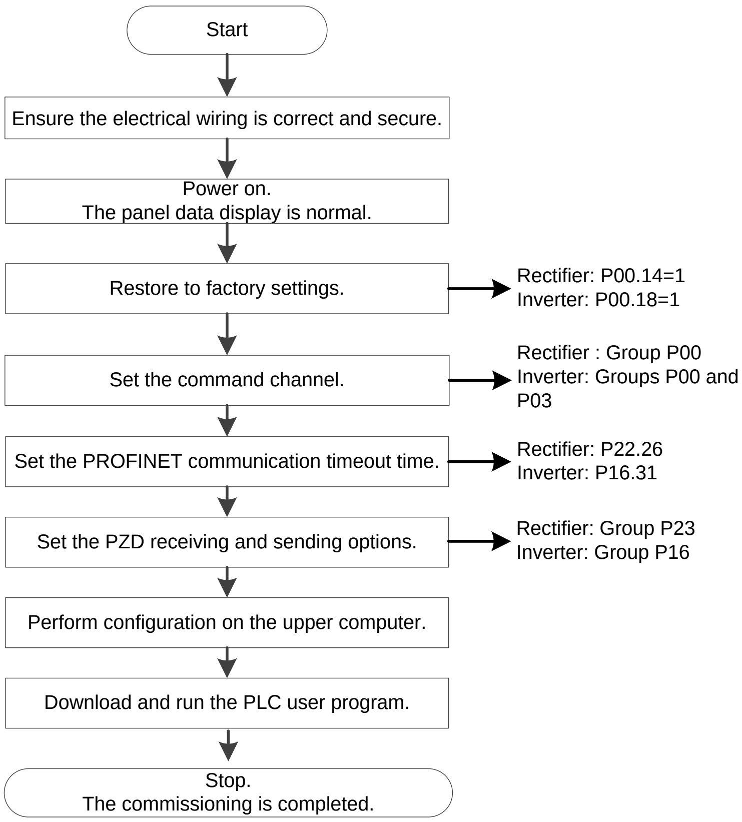


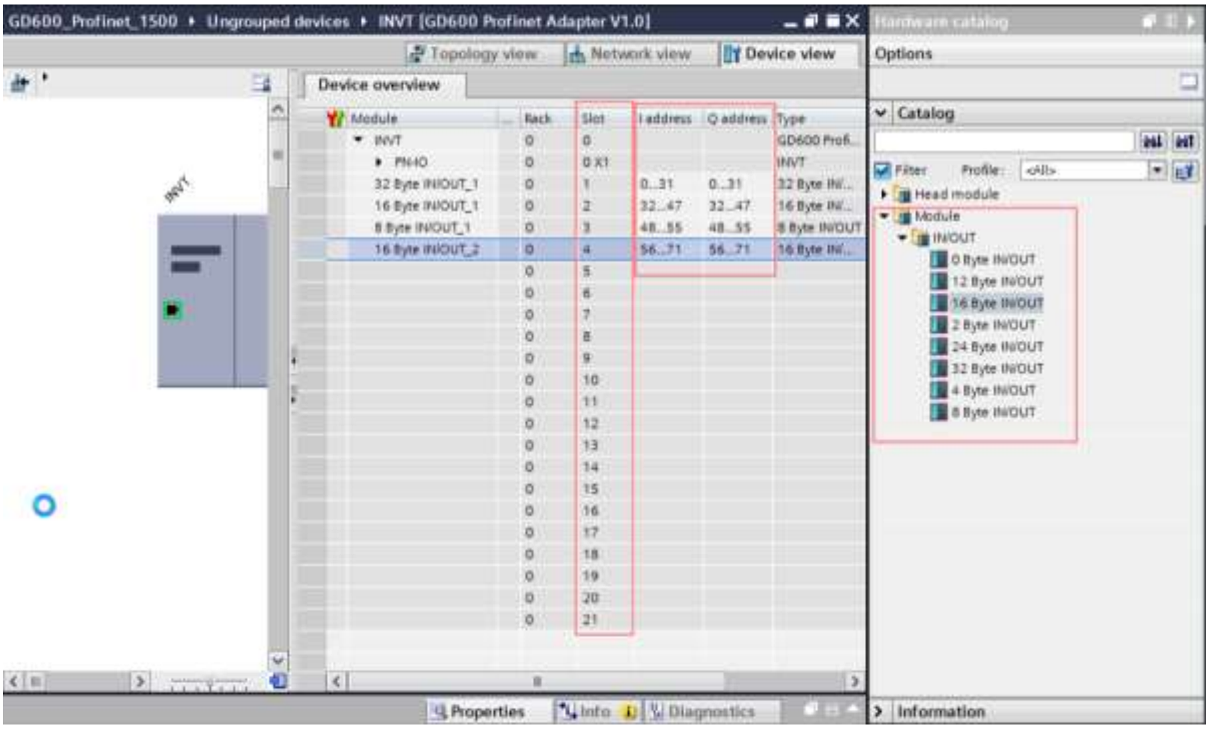
Figure 6-18 Commissioning procedure

6.9.4.2 TIA portal configuration (S7-1500)

For details, see 6.6.5.2 TIA portal configuration (S7-1500).

Note: There is difference in the salve device configuration between the PROFINET bus networking and PROFINET-to-CANopen networking:

In the PROFINET-to-CANopen network, each device needs to be configured with a certain number of slots, which depends on the number of CANopen slave nodes. In the PROFINET bus network, many PROFINET devices are added, and only a slot module needs to be configured for each of the device.



6.9.4.3 IN/OUT module mapping

In the configuration of PROFINET bus communication, IN/OUT modules can support the selection of only 16 words, which support the reading and writing of function codes. To be specific, mapping from PKW, an IN/OUT module supports data reading and writing of up to 11 PZDs (PZD2–PZD12).

6.9.5 Related parameters

Table 6-48 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	Used to select the channel of rectifier unit control commands, including the start, stop, and fault reset commands. The running commands are controlled through keypad keys, such as RUN and STOP/RST. 1: Terminal The running commands such as run, stop, and fault reset are controlled through multi-function input terminals. 2: Communication The running commands are controlled by the upper computer in communication mode.	1	○
P00.02	Communication mode of running commands	Used to select the rectifier unit communication command mode. 0: RS485 1: CANopen 2: PLC 3: PROFIBUS-DP 4: PROFINET/EtherCAT	0	○

Function code	Name	Description	Default	Modify
P17.16	Type of card at slot 1	Used to display the type of card at the slot. Range: 0–18 0: No card 1: PLC 2: I/O 3–4: Reserved 5: Ethernet 6: PROFIBUS-DP 7: Reserved 8: Reserved 9: Reserved 10: Reserved 11–14: Reserved 15: PROFINET 16: Modbus 17: EtherCAT 18: BACnet	0	●
P17.17	Type of card at slot 2		0	●
P17.18	Software version of card at slot 1	Used to display the software version of thecard at slot 1. Range: 0–655.35	0.00	●
P17.19	Software version of card at slot 2	Used to display the software version of thecard at slot 2. Range: 0–655.35	0.00	●
P19.00	Present fault type	Common fault type: 0: No fault 1: Grid undervoltage (LvI) 2: Grid overvoltage (ovI) 3: Grid phase-A loss (SPI1) 4: Grid phase-B loss (SPI2) 5: Grid phase-C loss (SPI3) 6: Phase lock failure (PLLF) 7: DC undervoltage (Lv) 8: DC overvoltage (ov) 9: Reserved 10: EEPROM operation error (EEP) 11: Braker direct connection fault (bCE) 12: External fault (EF) 13: Braker overload fault (bOL) 14: Braker overcurrent fault (bOC) 15: RS485 communication fault (E-485) 16: CANopen communication fault (E-CAN) 17: Reserved 18: DP communication fault (E-DP) 19: Reserved 20: Reserved 21: Rectifier bridge module overheat (oH1) 22: Brake overheat fault (bOH) 23: Reserved	/	●
P19.01	Last fault type			●
P19.02	2nd-last fault type			●
P19.03	3rd-last fault type			●
P19.04	4th-last fault type			●
P19.05	5th-last fault type			●

Function code	Name	Description	Default	Modify
		24: PROFINET communication timeout fault (E-PN) 25: Reserved 26: Communication fault of expansion card 1 (E-C1) 27: Communication fault of expansion card 2 (E-C2) 28: Reserved 29: Failure to identify the card at slot 1 (E-F1) 30: Failure to identify the card at slot 2 (E-F2) 31: Reserved 32: Expansion card detection exception (E-CP) 33–54: Reserved 55: Parameter download error (E-DNE) 56: Some inverter units are offline (OFFL) 57: EtherCAT communication timeout (E-CAT) 58–60: Reserved		
P22.26	PROFINET communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○
P22.43	Time to identify expansion card 1	0.01–30.00s	0	○
P22.44	Time to identify expansion card 2	0.01–30.00s	0	○
P22.45	Communication timeout time of expansion card 1	0.01–30.00s	0	○
P22.46	Communication timeout time of expansion card 2	0.01–30.00s	0	○
P23.28	Sent PZD2	Used only when the rectifier unit has been configured with a PROFINET or EtherCAT communication card. 0: Disable 1: Fault code 2: Bus voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Braking current (* 10, A) 6: Input terminal status 7: Output terminal status 8: Number of online slave nodes 9: Online/offline state of slave nodes 02–17 10: Online/offline state of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1	0	
P23.29	Sent PZD3		0	
P23.30	Sent PZD4		0	
P23.31	Sent PZD5		0	
P23.32	Sent PZD6		0	
P23.33	Sent PZD7		0	
P23.34	Sent PZD8		0	
P23.35	Sent PZD9		0	
P23.36	Sent PZD10		0	
P23.37	Sent PZD11		0	
P23.38	Sent PZD12		0	

Function code	Name	Description	Default	Modify
		15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20–31: Reserved		

Table 6-49 Inverter unit related parameters

Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0	○
P00.02	Communication mode of running commands	0: Modbus 1: CANopen 2: Ethernet 3: EtherCAT/PROFINET 4: PLC 5: Wireless communication 6: PROFIBUS-DP/DeviceNet **Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.**	0	○
P00.06	Setting channel of A frequency command	0: Keypad 1: AI1 2: AI2 3: AI3 4: Reserved 5: Simple PLC program 6: Multi-step speed running 7: PID control 8: Modbus communication 9: CANopen communication 10: Ethernet communication 11: Reserved 12: Pulse train AB 13: EtherCAT/PROFINET communication 14: Programmable expansion card 15: PROFIBUS-DP/DeviceNet communication	0	○
P00.07	Setting channel of B frequency command		14	○
P07.27	Type of present fault	0: No fault 1: Inverter unit U-phase protection (OUt1) 2: Inverter unit V-phase protection (OUt2) 3: Inverter unit W-phase protection (OUt3) 4: Overcurrent during acceleration (OC1) 5: Overcurrent during deceleration (OC2) 6: Overcurrent during constant speed running (OC3)	/	●
P07.28	Last fault type		/	●
P07.29	2nd-last fault type		/	●
P07.30	3rd-last fault type		/	●
P07.31	4th-last fault type		/	●
P07.32	5th-last fault type		/	●

Function code	Name	Description	Default	Modify
		7: Overvoltage during acceleration (OV1) 8: Overvoltage during deceleration (OV2) 9: Overvoltage during constant speed running (OV3) 10: Bus undervoltage fault (UV) 11: Motor overload (OL1) 12: Inverter unit overload (OL2) 13: CAN fault in master/slave synchronization (SECAN) 14: Phase loss on output side (SPO) 15: Reserved 16: Inverter module overheat (OH2) 17: External fault (EF) 18: RS485 communication fault (CE) 19: Current detection fault (ItE) 20: Motor autotuning fault (tE) 21: EEPROM operation error (EEP) 22: PID feedback offline fault (PIDE) 23: CAN slave fault in master/slave synchronization (S-Err) 24: Running time reached (END) 25: Electronic overload (OL3) 26: Keypad communication error (PCE) 27: Parameter upload error (UPE) 28: Parameter download error (DNE) 29: PROFIBUS communication fault (E_dP) 30: Ethernet communication fault (E_NET) 31: CANopen communication fault (E_CAN) 32: To-ground short-circuit fault 1 (ETH1) 33: To-ground short-circuit fault 2 (ETH2) 34: Speed deviation fault (dEu) 35: Mal-adjustment fault (STo) 36: Underload fault (LL) 37: Encoder disconnection fault (ENC1O) 38: Encoder direction reversal fault (ENC1D) 39: Encoder Z-pulse disconnection fault (ENC1Z) 40: Safe torque off (STO) 41: Channel 1 safety circuit exception (STL1) 42: Channel 2 safety circuit exception (STL2) 43: Exception in both channels 1 and 2 (STL3) 44: Safety code FLASH CRC fault (CrCE) 45: Programmable card customized fault 1 (P-E1) 46: Programmable card customized fault 2 (P-E2) 47: Programmable card customized fault 3 (P-E3) 48: Programmable card customized fault 4 (P-E4) 49: Programmable card customized fault 5 (P-E5) 50: Programmable card customized fault 6 (P-E6) 51: Programmable card customized fault 7 (P-E7)		

Function code	Name	Description	Default	Modify
		52: Programmable card customized fault 8 (P-E8) 53: Programmable card customized fault 9 (P-E9) 54: Programmable card customized fault 10 (P-E10) 55: Duplicate expansion card type (E-Err) 56: Encoder UVW lost (ENCUV) 57: PROFINET communication timeout fault (E_PN) 58: Reserved 59: Motor overtemperature fault (OT) 60: Failure to identify the card at slot 1 (F1-Er) 61: Failure to identify the card at slot 2 (F2-Er) 62: PG card detected motor overtemperature fault (E-OT2) 63: Communication timeout of the card at slot 1 (C1-Er) 64: Communication timeout of the card at slot 2 (C2-Er) 65: IO card detected motor overtemperature fault (E-OT3) 66: EtherCAT card communication fault (E-CAT) 67: BACnet card communication fault (E-BAC) 68: DeviceNet card communication fault (E-DEV) 69: CAN slave fault in master/slave synchronization (S-Err) 70: AI detected motor overtemperature fault (E-OT4) 71: Reserved		
P16.24	Time to identify expansion card 1	0.0–600.0s The value 0.0 indicates not detecting identification faults.	0.0	○
P16.25	Time to identify expansion card 2	0.0–600.0s The value 0.0 indicates not detecting identification faults.	0.0	○
P16.27	Communication timeout time of card at slot 1	0.0–600.0s The value 0.0 indicates not detecting disconnection faults.	0	○
P16.28	Communication timeout time of card at slot 2	0.0–600.0s The value 0.0 indicates not detecting disconnection faults.	0	○
P16.31	PROFINET communication timeout time	0.0 (invalid)–60.0s	5.0s	○
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%)	0	○
P16.33	Received PZD3		0	○
P16.34	Received PZD4		0	○
P16.35	Received PZD5		0	○
P16.36	Received PZD6		0	○
P16.37	Received PZD7		0	○

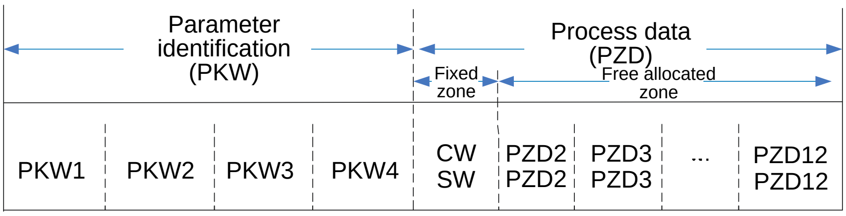
<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P16.38</td><td>Received PZD8</td><td rowspan="5">4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current)
5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz)
6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz)
7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)
8: Upper limit of braking torque (0–2000, in which 1000 corresponds to 100% of the motor rated current)
9: Virtual input terminal command. Range:0x000–0x1FF
10: Virtual output terminal command. Range: 0x00–0x0F
11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage)
12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)
13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)
14: High-order bit of position reference (signed)
15: Low-order bit of position reference (unsigned)
16: High-order bit of position feedback (signed)
17: Low-order bit of position feedback (unsigned)
18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)
19: Function parameter mapping (PZD2–PZD12 corresponds to P14.49–P14.59)
20–31: Reserved</td><td>0</td><td>○</td></tr>
<tr><td>P16.39</td><td>Received PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P16.40</td><td>Received PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P16.41</td><td>Received PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P16.42</td><td>Received PZD12</td><td>0</td><td>○</td></tr>
<tr><td>P16.43</td><td>Sent PZD2</td><td rowspan="11">0: Invalid
1: Running frequency (x100, Hz)
2: Set frequency (x100, Hz)
3: Bus voltage (x10, V)
4: Output voltage (×1, V)
5: Output current (x10, A)
6: Actual output torque (x10, %)
7: Actual output power (x10, %)
8: Rotation speed of running (x1, RPM)
9: Linear speed of running (x1, m/s)
10: Ramp reference frequency
11: Fault code
12: AI1 input (* 100, V)
13: AI2 input (* 100, V)</td><td>0</td><td>○</td></tr>
<tr><td>P16.44</td><td>Sent PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P16.45</td><td>Sent PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P16.46</td><td>Sent PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P16.47</td><td>Sent PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P16.48</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P16.49</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P16.50</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P16.51</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P16.52</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P16.53</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		14: AI3 input (* 100, V) 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (x100, %) 19: PID feedback (x100, %) 20: Motor rated torque 21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned) 23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 26: Reserved 27: High-order bit of PG card count value 28: Low-order bit of PG card count value 29: High-order bit of PG card pulse count value 30: Low-order bit of PG card pulse count value 31: Function parameter mapping (PZD2–PZD12 corresponds to P14.60–P14.70)		
P19.00	Type of card at slot 1	0: No card 1: Programmable card 2: I/O card 3: Incremental PG card (including 5V/12V/24V) 4: Reserved 5: Ethernet card 6: PROFIBUS-DP card 7: Reserved 8: Rotary PG card 9: Reserved 10: Reserved 11: PROFINET card 12: Sine-cosine PG card without CD signals 13: Sine-cosine PG card with CD signals 14: Reserved 15: Reserved 16: Reserved 17: EtherCAT card 18: Reserved 19: Reserved	0	●
P19.01	Type of card at slot 2		0	●
P19.03	Software version of card at slot 1	0.00–655.35	0.00	●
P19.04	Software version of card at slot 2	0.00–655.35	0.00	●

6.10 EtherCAT bus communication networking

6.10.1 Communication packet structure

The EtherCAT communication data frame structure (PKW+PZD) is similar to the PROFINET communication data frame structure. For details, see 6.6.2.2.



6.10.2 Network topology

In this network, each unit is inserted with a EtherCAT communication card so that the PLC or another master device can connect to the rectifier and inverter units. The EtherCAT RJ45 ports are differentiated for input and output. The PLC is connected to the IN port of the first unit, and the OUT port of the first unit is connected to the IN port of the second unit, as shown in the following figure.

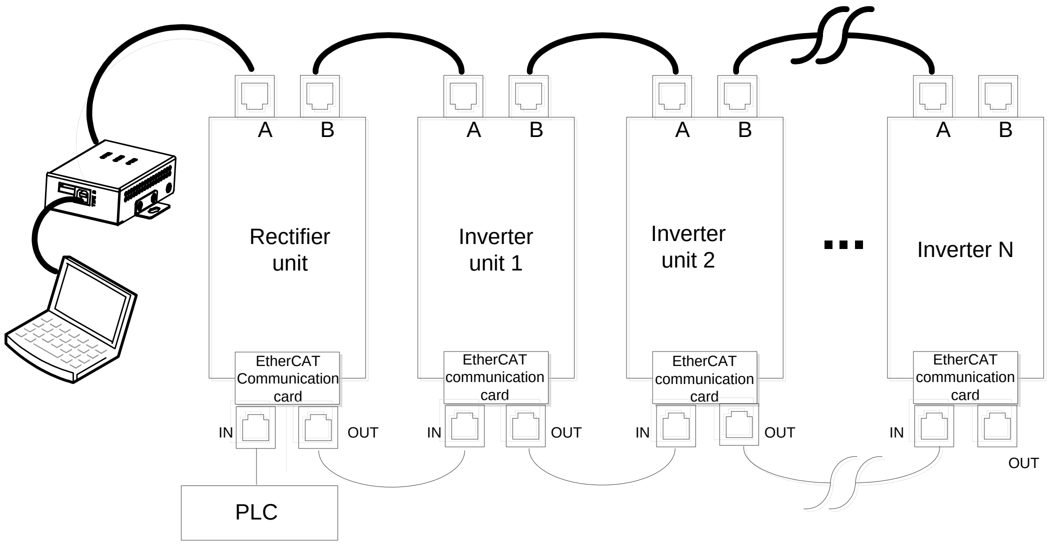


Figure 6-19 EtherCAT communication networking topology

6.10.3 Communication performance

In the GD600 EtherCAT bus communication networking, the number of nodes is determined by the number of nodes supported by the PLC. A maximum of 32 nodes (including the repeaters) are allowed to be connected in a segment consisting of two repeaters. If there are more than 32 nodes, a repeater is required for relaying.

6.10.4 Commissioning procedure

6.10.4.1 Commissioning flowchart

The following figure describes the commissioning procedure:

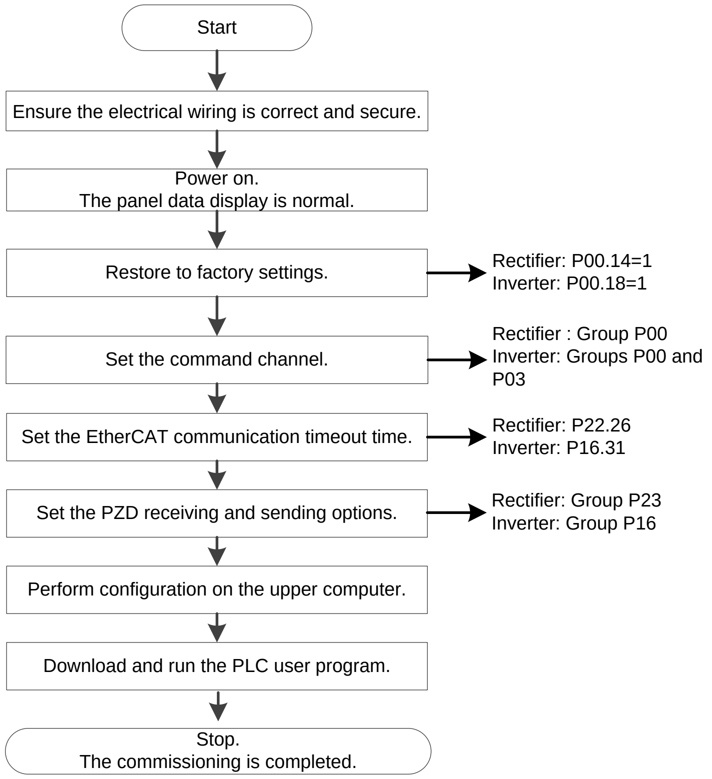


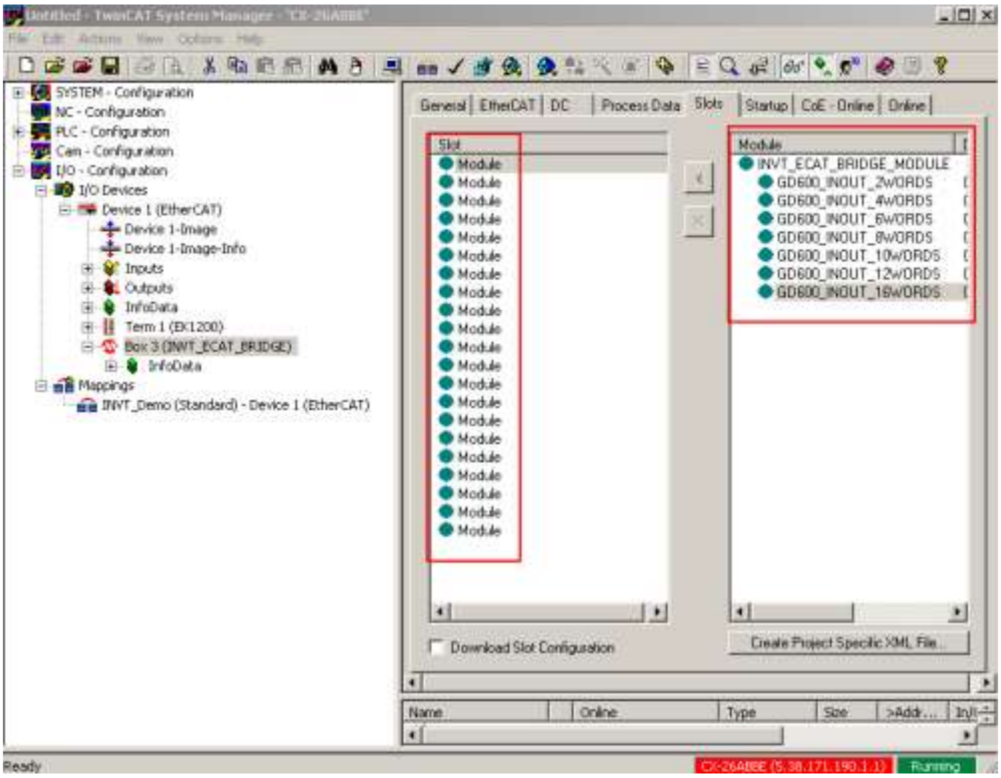
Figure 6-20 Commissioning procedure of EtherCAT networking

6.10.4.2 TIA portal configuration (S7-300)

For details, see section 6.6.5.2.

Note: There is a difference in the salve device configuration between the EtherCAT bus communication networking and the EtherCAT-to-CANopen networking:

In the EtherCAT-to-CANopen network, each device needs to be configured with a certain number of slots, which depends on the number of CANopen slave nodes. In the EtherCAT bus network, many EtherCAT devices are added, and only a slot module needs to be configured for each of the device.



6.10.4.3 IN/OUT module mapping description

In the configuration of EtherCAT bus communication, you can select different IN/OUT modules according to your needs. IN/OUT modules can support the selection of 2, 4, 6, 8, 10, 12, and 16 words.

When the IN/OUT module selects 8 words or more, it supports the reading and writing of function codes. To be specific, mapping from PKW, it also supports data receiving and sending of up to 11 PZDs (PZD2-PZD12).

When the IN/OUT module selects 8 words or less, the mapping starts from CW/SW and it supports data reading and writing of up to 7 PZDs (PZD2-PZD8), but it does not support reading and writing of PKW function codes.

6.10.5 Related parameters

Since our EtherCAT communication shares one channel with the PROFINET communication, the related parameters are the same. For more information, see section 6.9.5. Only the EtherCAT-exclusive function codes are listed in the following table.

Table 6-50 Rectifier unit related parameters

Function code	Name	Description	Default	Modify
P22.24	EtherCAT communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○

Table 6-51 Inverter unit related parameters

Function code	Name	Description	Default	Modify
P16.30	EtherCAT communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○

Function code	Name	Description	Default	Modify
P16.58	Industrial Ethernet communication card IP address 1	0–255	192	◎
P16.59	Industrial Ethernet communication card IP address 2	0–255	168	◎
P16.60	Industrial Ethernet communication card IP address 3	0–255	0	◎
P16.61	Industrial Ethernet communication card IP address 4	0–255	1	◎
P16.62	Industrial Ethernet communication card subnet mask 1	0–255	255	◎
P16.63	Industrial Ethernet communication card subnet mask 2	0–255	255	◎
P16.64	Industrial Ethernet communication card subnet mask 3	0–255	255	◎
P16.65	Industrial Ethernet communication card subnet mask 4	0–255	0	◎
P16.66	Industrial Ethernet communication card gateway 1	0–255	192	◎
P16.67	Industrial Ethernet communication card gateway 2	0–255	168	◎
P16.68	Industrial Ethernet communication card gateway 3	0–255	0	◎
P16.69	Industrial Ethernet communication card gateway 4	0–255	1	◎

7 Tension control function

7.1 What this chapter contains

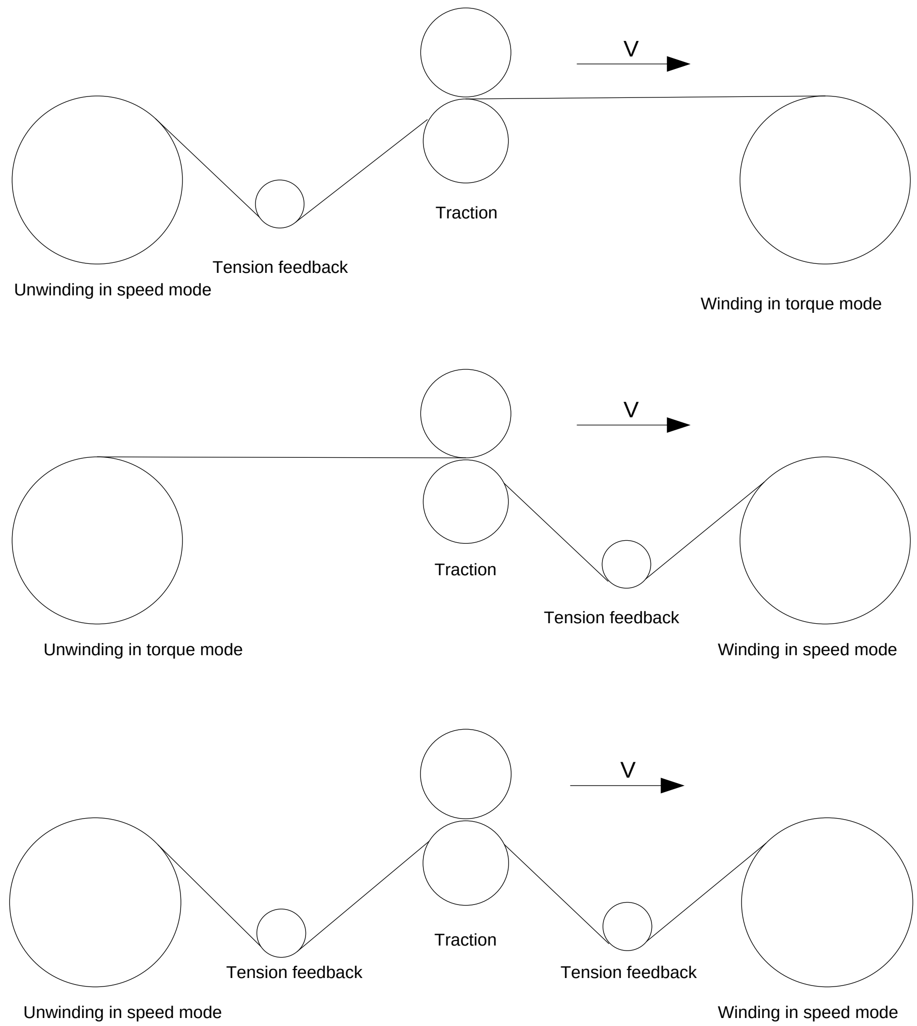
This chapter describes the VFD function special for tension control.

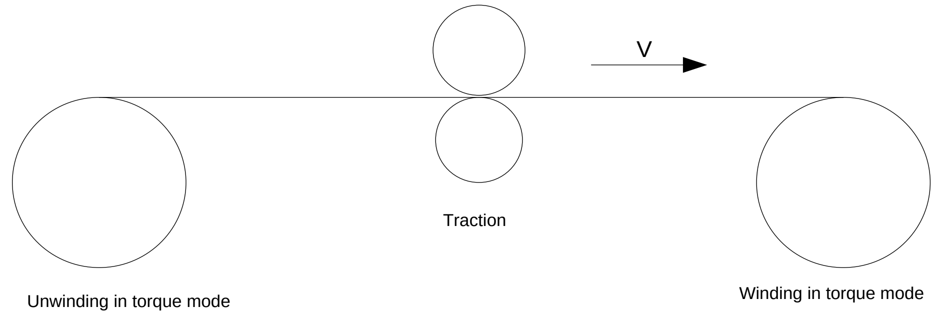
7.2 Tension control solutions

In many fields of industrial production, precise tension control is needed to maintain a constant output tension of the drive equipment, in order to improve the quality of the products. In the winding and unwinding of some industries such as paper processing, printing and dyeing, packing, wire and cable manufacturing, textile, fiber, optic cable, leather, metal foil material processing and so on, tension needs to keep constant.

The VFD controls the tension through by regulating the motor output torque or speed of the motor. There are three kinds of control modes to control the tension: tension speed control mode, open open-loop tension torque control mode and closed-loop tension torque control mode.

7.2.1 Sketch map of tension control



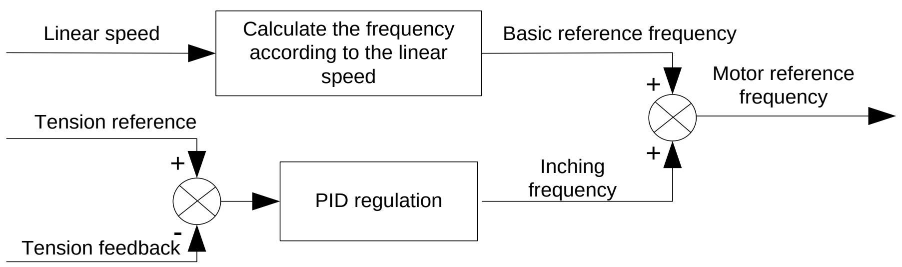


In some special situations, if the roll diameter can be counted through thickness, the following applications can be implemented:

7.2.2 Speed control

The detection feedback signal is needed in the closed-loop adjustment. PID calculation is carried out according to the feedback signal for the motor speed regulation, linear speed and stable tension control. If the tension rocker or floating roller is used for feedback, changing the set value (PID reference) may change the actual tension, and at the same time, changing the mechanical configuration such as the tension rocker or floating roller weight can also change the tension.

The control principle is as follows:



Related modules:

(1) Linear speed input module: It is important for the calculation of the basic setting frequency according to the linear speed and the calculation of roll diameter according to the linear speed.

(2) Real-time roll diameter calculation module: The calculation accuracy of roll diameter determines the control performance. The roll diameter can be calculated according to the VFD output frequency and the linear speed. In addition, it can also be calculated through the thickness or sensor. The linear speed is widely used for the calculation. If the set linear speed is used for the calculation, you you choose whether to enable the function of roll diameter change limiting.

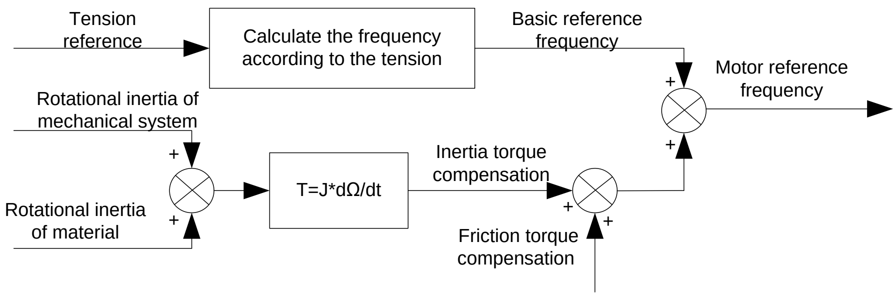
(3) PID regulation module: There are two groups of PID parameters in P09. The linear speed synchronization and stable tension can be kept through PID regulation. PID parameters can be modified based on site commissioning. The two groups of PID parameters can be switched for PID regulation improvement.

(4) Material feeding interrupt detection and processing module: The function is valid when material feeding interrupt detection has been enabled.

(5) Pre-drive: This function is applied to automatic reel change. After the VFD is started if the pre-drive function terminal is valid, the roller runs at the set linear speed. When the terminal is invalid, the VFD will automatically switch to the corresponding control mode after a period of time.

7.2.3 Open-loop tension torque control

Open loop means there is no tension feedback signal. In this mode, stable tension can be achieved by means of motor torque control. The rotation speed automatically changes with the linear speed of material. The control basis is as follows: For a reel control system, the relationship between the tension F of the roller with materials, present roll diameter D and output torque of the shaft is: T = F × D /2. If the output torque can be adjusted according to the variation of roll diameter, the tension can be controlled. In order to ensure the constant tension in the process of acceleration and deceleration, the internal friction compensation module and inertia compensation module have been built in the VFD to calculate the real time rotation inertia, and compensate the torque according to the actual speed change rate. The control principle is shown in the following figure.



Relevant modes:

(1) Linear speed input module: It has two functions: calculating the synchronous frequency in torque control according to the linear speed, and calculating the roll diameter according to the linear speed.

(2) Tension setting module: Used to set the tension adapting to the control system. It needs to be adjusted according to the actual situation. After confirmation, the value remains the same. In some scenarios where the forming effect after winding needs to be improved, the tension taper function can be used so that the tension decreases as the roll diamter increases.

(3) Real-time roll diameter calculation module: The calculation accuracy of roll diameter determines the control performance. The roll diameter can be calculated according to the VFD output frequency and the linear speed. In addition, it can also be calculated through the thickness or sensor. The linear speed is widely used for the calculation. If the set linear speed is used for the calculation, you you choose whether to enable the function of roll diameter change limiting.

(4) Torque compensation module: Torque compensation includes friction torque compensation and inertia torque compensation. Friction torque compensation is used to eliminate the impact of friction on tension, and it needs to be

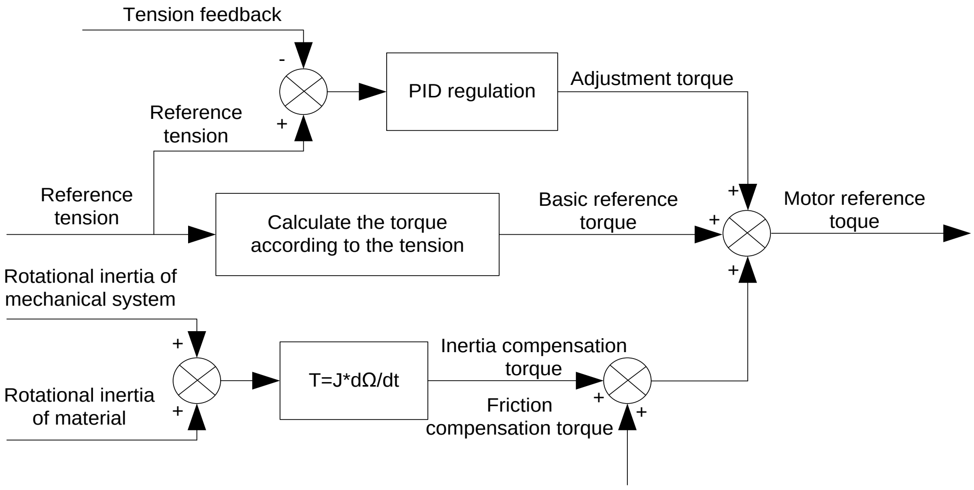
adjusted according to actual requirements. Rotation inertia includes inertial of mechanical systems and that of materials. In order to keep the tension stable in ACC/DEC, compensation torque is required. In some cases without strict tension control requirements, disabling rotation inertia torque compensation can also achieve the control.

(5) Material feeding interrupt detection and processing module: The function is valid when material feeding interrupt detection has been enabled.

(6) This function is applied to automatic reel change. After the VFD is started if the pre-drive function terminal is valid, the roller runs at the set linear speed. When the terminal is invalid, the VFD will automatically switch to the corresponding control mode after a period of time.

7.2.4 Closed-loop tension torque control mode

Similar to the open-loop torque mode, the closed-loop torque mode has only the difference that tension detection sensors are installed on the winding/unwinding side. In addition to all the function modules supported in open-loop torque mode, this mode supports an additional tension feedback PID closed-loop regulation module. The control principle is shown in the following figure.



8 Function parameter list

8.1 What this chapter contains

This chapter lists and briefly describes the function codes of the rectifier and inverter units of the VFD.

8.2 Function parameter list

The function parameters of the rectifier and inverter units are divided into groups by function. Take the inverter unit function parameters for example: among the function parameter groups, the P98 group is the analog input and output calibration group, while the P99 group contains the factory function parameters, which are user inaccessible. Each group includes several function codes (each function code identifies a function parameter). A three-level menu style is applied to function codes. For example, "P08.08" indicates the 8th function code in the P08 group.

The function group numbers correspond to the level-1 menus, the function codes correspond to the level-2 menus, and the function parameters correspond to the level-3 menus.

1. The content of the function code table is as follows:

Column 1 "Function code": Code of the function group and parameter

Column 2 "Name": Full name of the function parameter

Column 3 "Description": Detailed description of the function parameter

Column 4 "Default": Initial value set in factory

Column 5 "Modify": Whether the function parameter can be modified, and conditions for the modification

"○" indicates that the value of the parameter can be modified when the power unit is in stopped or running state.

"◎" indicates that the value of the parameter cannot be modified when the power unit is in running state.

"●" indicates that the value of the parameter is detected and recorded, and cannot be modified.

(The power unit automatically checks and constrains the modification of parameters, which helps prevent incorrect modifications.)

2. The parameters adopt the decimal system (DEC). If the hexadecimal system is adopted, all bits are mutually independent on data during parameter editing, and the setting ranges at some bits can be hexadecimal (0–F).

3. "Default" indicates the factory setting of the function parameter. If the value of the parameter is detected or recorded, the value cannot be restored to the factory setting.

4. To better protect parameters, the VFD provides the password protection function. After a password is set (that is, P07.00 is set to a non-zero value), "0.0.0.0.0" is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct user password to enter the interface. For the factory parameters, you need to enter the correct factory password to enter the interface. (You are not advised to modify the factory parameters. Incorrect parameter setting may cause operation exceptions or even damage to the power unit.) If password protection is not in locked state, you can change the password any time. You can set P07.00 to 0 to cancel the user password. When P07.00 is set to a non-zero value during power-on, parameters are prevented from being modified by using the user password function. When you modify function parameters through serial communication, the user password protection function is also applicable and compliant with the same rule.

8.2.1 Rectifier function parameter list

P00 group—Basic functions

Function code	Name	Description	Default	Modify
P00.00	Software version	Software version of the rectifier unit.		●
P00.01	Channel of running commands	Used to select the channel of rectifier unit control commands, including the start, stop, and fault reset commands. 0: Keypad The running commands are controlled through keypad keys, such as RUN and STOP/RST. 1: Terminal The running commands such as run, stop, and fault reset are controlled through multi-function input terminals. 2: Communication The running commands are controlled by the upper computer in communication mode.	1	○
P00.02	Communication mode of running commands	Used to select the rectifier unit communication command mode. 0: RS485 1: CANopen 2: PLC 3: PROFIBUS-DP 4: PROFINET/EtherCAT	0	○
P00.03	Undervoltage point for bus voltage	Undervoltage point for bus voltage for protection purpose. When the bus voltage is lower than the value of this function parameter during running, the VFD stops and reports the bus undervoltage fault. Setting range: 0.0V–500.0V	350.0V	◎
P00.04	Braking start voltage for the braking unit	Voltage at which the braking unit starts braking. When the bus voltage reaches the value of this function parameter during running, the braking pipe starts braking. This function is valid only for the models configured with built-in braking units, invalid for the models connected to external brakes. Setting range: 400.0V–800.0V	700.0V	○
P00.05	Overvoltage point for bus voltage	Overvoltage point for bus voltage for protection purpose. When the bus voltage is higher than the value of this function parameter during running, the VFD stops and reports the bus overvoltage fault. Setting range: 500.0V–850.0V	800.0V	/
P00.06–P00.08	Reserved			

Function code	Name	Description	Default	Modify
P00.09	Cooling-fan running mode	0: Normal mode In the mode, the fan starts to run when the rectifier unit is in the running state. In addition, in the situation where the rectifier bridge temperature is more than 55 degrees or the rectifier bridge current is more than 30% of the rated current, the fan also runs although the rectifier unit is stopped. 1: Run at power-on When the main power supply is powered on, and the rectifier unit detects that the grid voltage is normal, the fan starts to run.	0	○
P00.10	Braking pipe direct connection protection	P00.10 specifies the fault protection mode for the braking pipe. Mode of protecting the braking pipe against faults. 0: Disable 1: Enable Ones place: Braking pipe direct connection enabling selection. Tens place: Braking pipe overcurrent enabling selection. Hundreds place: Braking pipe overload enabling selection. **Note: Valid only for the 45kW rectifier unit with the built-in braking unit.**	0x111	◎
P00.11	Enabling protection against three-phase input voltage exception	Used to select the mode of protection against grid voltage detection faults. 0: Disable 1: Enable Ones place: indicates whether to enable input phase loss protection Tens place: indicates whether to enable grid overvoltage protection Hundreds place: indicates whether to enable grid undervoltage protection **Note: Exercise caution before modifying the function parameter.**	0x111	◎
P00.12	Enabling energy-consumption braking	0: Disable 1: Enable	1	○
P00.13	Reserved			/
P00.14	Function parameter restore	0: No operation 1: Restore default values 2: Clear fault records **Note: After the selected operation is performed, the function code is automatically restored to 0. Restoring the default values may delete the user password. Exercise caution when using this function.**	0	◎

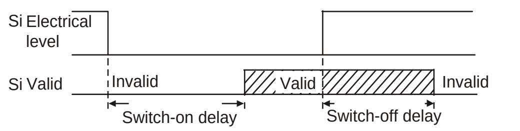
P01 group—Rectifier and inverter interaction

Function code	Name	Description	Default	Modify
P01.00	Inverter protection against grid overvoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When grid overvoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When grid overvoltage is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.01	Inverter protection against grid undervoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When grid undervoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When grid undervoltage is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.02	Reserved			
P01.03	Inverter protection against input phase loss	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When the grid voltage phase loss is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When the grid voltage phase loss is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.04	Inverter protection against direct connection of the braking pipe	0: Running. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When the direct connection of the braking pipe is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When the direct connection of the braking pipe is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.05	Inverter protection against braking pipe overcurrent	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When braking pipe overcurrent is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When braking pipe overcurrent is detected on the rectifier side, the inverter coasts to stop.	0	○

Function code	Name	Description	Default	Modify
P01.06	Inverter protection against braking pipe overload	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When braking pipe overload is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When braking pipe overload is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.07	Inverter protection against expansion card detection (E-CP) fault	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When a communication fault is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When a communication fault is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.08	Inverter protection against overheating	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When rectifier bridge module overheating is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When rectifier bridge module overheating is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.09	Inverter protection against bus overvoltage	0: Run. The inverter continues to run regardless of the rectifier fault. 1: Decelerate to stop. When bus overvoltage is detected on the rectifier side, the inverter decelerates to stop according to the set DEC time. 2: Coast to stop. When bus overvoltage is detected on the rectifier side, the inverter coasts to stop.	0	○
P01.11–P01.13	Reserved			
P01.14	Enabling auto run	0: Disable auto run at power on. 1: Enable auto run at power on. When the rectifier side detects that run conditions are met at initial power on, it starts running automatically.	1	○
P01.15	Inverter protection against networking communication faults	Rectifier networking communication faults include E-CAN, OFFL, E-C1, E-C2, E-DP, E-PN, and E-CAT. 0: Run 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○

Function code	Name	Description	Default	Modify
P01.16	Number system for CW and SW	0: Decimal 1: Binary **Note: The rectifier unit and inverter unit must be the same in the value of the function parameter.**	0	◎

P05 group—Input terminals

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P05.00</td><td>Reserved</td><td></td><td>0</td><td>◎</td></tr>
<tr><td>P05.01</td><td>Function of S1</td><td rowspan="5">0: No function
1: Run
2: Reset faults
3: External fault
4: Incoming circuit breaker feedback
5: Auxiliary circuit breaker feedback
6: Leakage protection switch feedback
7: Disable the inverter unit to run
8: Enable the inverter unit to coast to stop
9: Enable the inverter unit to stop in the set manner
10–15: Reserved</td><td>1</td><td>◎</td></tr>
<tr><td>P05.02</td><td>Function of S2</td><td>2</td><td>◎</td></tr>
<tr><td>P05.03</td><td>Function of S3</td><td>0</td><td>◎</td></tr>
<tr><td>P05.04</td><td>Function of S4</td><td>0</td><td>◎</td></tr>
<tr><td>P05.05</td><td>Function of S5</td><td>0</td><td>◎</td></tr>
<tr><td>P05.06</td><td>Input terminal polarity</td><td>Used to set the polarity of input terminals.
When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative.
<table><tr><td>BIT4</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>S5</td><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr></table>Setting range: 0x000–0x1F</td><td>0x000</td><td>○</td></tr>
<tr><td>P05.07</td><td>Digital input filter time</td><td>Used to set the filter time of sampling for terminals S1–S5. In strong interference cases, increase the value to avoid maloperation.
0.000–1.000s</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.13</td><td>S1 switch-on delay</td><td rowspan="10">Used to specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.


Setting range: 0.000–60.000s</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.14</td><td>S1 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.15</td><td>S2 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.16</td><td>S2 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.17</td><td>S3 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.18</td><td>S3 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.19</td><td>S4 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.20</td><td>S4 switch-off delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.21</td><td>S5 switch-on delay</td><td>0.000s</td><td>○</td></tr>
<tr><td>P05.22</td><td>S5 switch-off delay</td><td>0.000s</td><td>○</td></tr>
</table>

P06 group—Output terminals

Function code	Name	Description	Default	Modify
P06.00–P06.02	Reserved			/
P06.03	RO1 output	0: No output 1: Ready for running 2: Running 3: Fault output 4: Bus overvoltage 5: Bus undervoltage 6: Three-phase input overvoltage 7: Three-phase input undervoltage 8: Module overheat output 9: Radiator overheat output 10: Breaker action 11–31: Reserved	0	○
P06.04	RO2 output		0	○
P06.05	Reserved			
P06.07	Output terminal polarity selection	Used to set the polarity of output terminals. When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative. BIT1: RO2; BIT0: RO1 Setting range: 0x0–0xF	0x0	○
P06.10	Relay RO1 switch-on delay	/	0.000s	○
P06.11	Relay RO1 switch-off delay		0.000s	○
P06.12	Relay RO2 switch-on delay		0.000s	○
P06.13	Relay RO2 switch-off delay		0.000s	○

P07 group—Human-machine interface

Function code	Name	Description	Default	Modify
P07.00	User password	0–65535 When you set the function code to a non-zero number, password protection is enabled. If you set the function code to 00000, the previous user password is cleared and password protection is disabled. After the user password is set and takes effect, you cannot enter the parameter menu if you enter an incorrect password. Please remember your password and save it in a secure place. After you exit the function code editing interface, the password protection function is enabled within 1 minute. If password protection is	0	○

Function code	Name	Description	Default	Modify
		enabled, "0.0.0.0.0" is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface. **Note: Restoring the default values may delete the user password. Exercise caution when using this function.**		
P07.01	Local accumulative running time (h)	Used to display the accumulated running hours. Range: 0–65535 h	0	◎
P07.02	Local accumulative running time (min)	Used to display the accumulated running minutes. Range: 0–59 min	0	●
P07.03	Factory bar code 1	0x0000–0xFFFF	/	●
P07.04	Factory bar code 2	0x0000–0xFFFF	/	●
P07.05	Factory bar code 3	0x0000–0xFFFF	/	●
P07.06	Factory bar code 4	0x0000–0xFFFF	/	●
P07.07	Factory bar code 5	0x0000–0xFFFF	/	●
P07.08	Factory bar code 6	0x0000–0xFFFF	/	●

P17 group—Status viewing

Function code	Name	Description	Default	Modify
P17.00	Rated power of the rectifier unit	Used to display the rated power of the rectifier unit. Range: 0.00–3000.0kW	0.0kW	●
P17.01	Rated current of the rectifier unit	Used to display the rated current of the rectifier unit. Range: 0.00–600.00A	0.0A	●
P17.02	CW for the braking unit	Used to display whether the current control word for the braking unit is run or stop. Range: 0–1 0: Stop 1: Run	0	●
P17.03	CW for the fan	Used to display whether the current control word for the fan is run or stop. Range: 0–1 0: Stop 1: Run	0	●
P17.04	CW for rectifier and inverter interaction	Used to display whether the control word of rectifier and inverter interaction is run or stop. Range: 0–1 0: Run 1: Decelerate to stop 2: Coast to stop	0	●
P17.05	Bus voltage	Used to display the present DC bus voltage. Range: 0.0–2000.0 V	0 .0V	●

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P17.06</td><td>Grid frequency</td><td>Used to display the present grid frequency of the rectifier unit.
Range: 0.0–120.0 Hz</td><td>0.0Hz</td><td>●</td></tr>
<tr><td>P17.07</td><td>Grid voltage</td><td>Used to display the present grid voltage of the inverter.
Range: 0.0–2000.0 V</td><td>0.0V</td><td>●</td></tr>
<tr><td>P17.08</td><td>3PH voltage unbalance factor</td><td>Used to display the factor of imbalanced three-phase voltage of the grid.
Range: 1.00–10.0</td><td>0.0</td><td>●</td></tr>
<tr><td>P17.09</td><td>Braking pipe module temperature</td><td>Used to display the braking pipe module temperature.
Range: -20.0–120.0°C
Note: Valid only for the 45kW rectifier unit model.</td><td>0.0°C</td><td>●</td></tr>
<tr><td>P17.10</td><td>Rectifier bridge temperature</td><td>Used to display the rectifier bridge temperature.
Range: -20.0– 120.0°C</td><td>0.0°C</td><td>●</td></tr>
<tr><td>P17.11</td><td>3PH AC voltage</td><td>Used to display the AC input current of the rectifier unit.
Range: 0.0–1000.0A
The 160kW and 355kW rectifier unit models support the use of the optional current detection module.</td><td>0.0A</td><td>●</td></tr>
<tr><td>P17.12</td><td>Digital input terminal status</td><td>Used to display the present digital input terminal status of the rectifier unit.
Range: 0000–00FF<table><tr><td>BIT4</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>S5</td><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr></table></td><td>0</td><td>●</td></tr>
<tr><td>P17.13</td><td>Digital output terminal status</td><td>Used to display the present digital output terminal status of the rectifier unit.
Range: 0000–0003<table><tr><td>BIT1</td><td>BIT0</td></tr><tr><td>RO2</td><td>RO1</td></tr></table></td><td>0</td><td>●</td></tr>
<tr><td>P17.14</td><td>Brake current</td><td>Used to display the current of the brake.
Range: 0.0–6000.0A
Only the 45kW rectifier unit model has the built-in braking unit. Other rectifier unit models support only external braking units, and the displayed value is invalid for these models.</td><td>0.0A</td><td>●</td></tr>
<tr><td>P17.15</td><td>Actual online slave nodes</td><td>Number of actual online slave nodes.
Range: 0–20</td><td>0</td><td>●</td></tr>
<tr><td>P17.16</td><td>Type of card at slot 1</td><td rowspan="2">Used to display the type of card at the slot.
Range: 0–18
0: No card
1: PLC
2: I/O
3–4: Reserved
5: Ethernet</td><td>0</td><td>●</td></tr>
<tr><td>P17.17</td><td>Type of card at slot 2</td><td>0</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
		6: PROFIBUS-DP 7: Reserved 8: Reserved 9: Reserved 10: Reserved 11–14: Reserved 15: PROFINET 16: Modbus 17: EtherCAT 18: BACnet		
P17.18	Software version of card at slot 1	Used to display the software version of thecard at slot 1. Range: 0–655.35	0.00	●
P17.19	Software version of card at slot 2	Used to display the software version of thecard at slot 2. Range: 0–655.35	0.00	●
P17.20	Staus of slave nodes 02–17	Used to display the online/offline status of slave nodes 02–17. Range: 0–0xFFFF 0: Offline 1: Online	0	●
P17.21	Staus of slave nodes 18–21	Used to display the online/offline status of slave nodes 18–21. Range: 0–0xF 0: Offline 1: Online	0	●
P17.22	Reserved			
P17.23	CANopen bus load rate	Used to display the CANopen bus load rate. Range: 0.0–100.0%	0.0%	●
P17.24	R-phase current	Used to display the R-phase current. Range: 0.0–1000.0A	0.0A	●
P17.25	S-phase current	Used to display the S-phase current. Range: 0.0–1000.0A	0.0A	●
P17.26	T-phase current	Used to display the T-phase current. Range: 0.0–1000.0A	0.0A	●

P19 group—Fault information

Function code	Name	Description	Default	Modify
P19.00	Present fault type	Common fault type: 0: No fault 1: Grid undervoltage (LvI) 2: Grid overvoltage (ovI) 3: Grid phase-A loss (SPI1) 4: Grid phase-B loss (SPI2) 5: Grid phase-C loss (SPI3) 6: Phase lock failure (PLLF)	/	●
P19.01	Last fault type			●
P19.02	2nd-last fault type			●
P19.03	3rd-last fault type			●
P19.04	4th-last fault type			●
P19.05	5th-last fault type			●

Function code	Name	Description	Default	Modify
		7: DC undervoltage (Lv) 8: DC overvoltage (ov) 9: Reserved 10: EEPROM operation error (EEP) 11: Braker direct connection fault (bCE) 12: External fault (EF) 13: Braker overload fault (bOL) 14: Braker overcurrent fault (bOC) 15: RS485 communication fault (E-485) 16: CANopen communication fault (E_CAN) 17: Reserved 18: DP communication fault (E-DP) 19: Reserved 20: Reserved 21: Rectifier bridge module overheat (oH1) 22: Brake overheat fault (bOH) 23: Reserved 24: PROFINET communication timeout fault (E-PN) 25: Reserved 26: Communication fault of expansion card 1 (E-C1) 27: Communication fault of expansion card 2 (E-C2) 28: Reserved 29: Failure to identify the card at slot 1 (E-F1) 30: Failure to identify the card at slot 2 (E-F2) 31: Reserved 32: Expansion card detection exception (E-CP) 33–54: Reserved 55: Parameter download error (E-DNE) 56: Some inverter units are offline (OFFL) 57: EtherCAT communication timeout (E-CAT) 58–60: Reserved		
P19.06	Grid frequency at present fault		0.0Hz	●
P19.07	DC voltage at present fault		0.0V	●
P19.08	Grid voltage at present fault		0V	●
P19.09	Brake current at present fault		0.0A	●
P19.10	Brake temperature at present fault		0.0°C	●
P19.11	Rectifier bridge temperature at present fault		0.0°C	●
P19.12	Input terminal status at present fault		0	●
P19.13	Output current status at present fault		0	●
P19.14	Node number of first CANopen offline unit			
P19.15	Reserved			
P19.16	Grid frequency at last fault		0.0Hz	●
P19.17	DC voltage at last fault		0.0V	●
P19.18	Grid voltage at last fault		0V	●

Function code	Name	Description	Default	Modify
P19.19	Brake current at last fault		0.0A	●
P19.20	Brake temperature at last fault		0.0°C	●
P19.21	Rectifier bridge temperature at last fault		0.0°C	●
P19.22	Input terminal status at last fault		0	●
P19.23	Output terminal status at last fault		0	●
P19.26	Grid frequency at 2nd-last fault		0.0Hz	●
P19.27	DC voltage at 2nd-last fault		0.0V	●
P19.28	Grid voltage at 2nd-last fault		0V	●
P19.29	Brake current at 2nd-last fault		0.0A	●
P19.30	Brake temperature at 2nd-last fault		0.0°C	●
P19.31	Rectifier bridge temperature at 2nd-last fault		0.0°C	●
P19.32	Input terminal status at 2nd-last fault		0	●
P19.33	Output terminal status at 2nd-last fault		0	●
P19.34	Reserved			
P19.35	Parameter download error	Used to display the function code of the parameter in the parameter download error for you to check the corresponding value and range.	0	●

P20 group—Serial communication

Function code	Name	Description	Default	Modify
P20.00	Local communication address	Setting range: 1–247 When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the salves on the Modbus bus receive the frame but do not respond to it. The communication addresses on the communication network are unique, which is the basis of the point-to-point communication. **Note: The communication address of a slave cannot be set to 0.**	1	◎
P20.01	Communication baud rate	Used to set the rate of data transmission between the upper computer and rectifier unit. 0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS 6: 57600BPS 7: 115200BPS **Note: The baud rate set on the rectifier unit must be consistent with that on the upper computer. Otherwise, the communication fails. A greater baud rate indicates faster communication.**	4	◎

Function code	Name	Description	Default	Modify
P20.02	Data bit check	The data format set on the rectifier unit must be consistent with that on the upper computer. Otherwise, the communication fails. 0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	1	◎
P20.03	Communication response delay	0–200ms Used to indicate the communication response delay, that is, the interval from when the rectifier unit completes receiving data to when it sends response data to the upper computer. If the response delay is shorter than the rectifier processing time, the rectifier sends response data to the upper computer after processing data. If the delay is longer than the rectifier processing time, the rectifier does not send response data to the upper computer until the delay is reached although data has been processed.	5ms	○
P20.04	Communication timeout time	0.0 (invalid); 0.1–60.0s When the function code is set to 0.0, the communication timeout time is invalid. When the function code is set to a non-zero value, the system reports the "485 communication fault" (CE) if the communication interval exceeds the value. In general, the function code is set to 0.0. When continuous communication is required, you can set the function code to monitor communication status.	0.0s	○
P20.05	Transmission error processing	0: Report an alarm and stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0	○
P20.06	Communication processing action	0x000–0x11 LED ones place: 0: Respond to write operations. The rectifier unit responds to both read and write commands from the upper computer. 1: Do not respond to write operations. The rectifier unit does not respond to the write commands, but responds only to the read commands from the upper computer. This setting can improve the communication efficiency. LED tens place:	0x00	○

Function code	Name	Description	Default	Modify
		0: Communication password protection is invalid. 1: Communication password protection is valid.		

P21 group—CANopen communication

Function code	Name	Description	Default	Modify
P21.00	Reserved			
P21.01	CANopen communication address	0–127	1	○
P21.02–P21.12	Reserved			
P21.13	Sent PZD2	Used when the rectifier unit works as the CANopen slave node or used in PLC-to-CANopen networking. 0: Invalid 1: Fault code 2: DC voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Brake current (* 10, A) 6: Terminal input status 7: Terminal output status 8: Number of online slave nodes 9: Online/offline state of slave nodes 02–17 10: Online/offline state of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20: Reserved	0	○
P21.14	Sent PZD3		0	○
P21.15	Sent PZD4		0	○
P21.16	Sent PZD5		0	○
P21.17	Sent PZD6		0	○
P21.18	Sent PZD7		0	○
P21.19	Sent PZD8		0	○
P21.20	Sent PZD9		0	○
P21.21	Sent PZD10		0	○
P21.22	Sent PZD11		0	○
P21.23	Sent PZD12		0	○
P21.24–P21.28	Reserved			
P21.29	CANopen communication baud rate	Setting range: 0–5 0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	○
P21.30	CANopen communication timeout time	0.0 (invalid); 0.1–100.0s	0.0s	○

Function code	Name	Description	Default	Modify
P21.31	Power-on delay for networking	0.0 (invalid); 0.1–100.0s When there is a large number of bus-sharing inverter units, the power-on time becomes longer. The CANopen master node communication has been ready for communication, while the slave nodes are not powered on and not initialization, which will cause the E-CAN or OFFL communication fault reporting. In such a situation, you can set the parameter to a large value.	20.0s	○
P21.32	Auto control on data interaction period	Indicates whether to automatically adjust the CANopen data interaction period according to the bus load rate. 0: Disable 1: Enable	0	◎
P21.33	Number of CANopen slave nodes	0–20 (Set this parameter only when the master node is valid.)	0	○
P21.34	CANopen master/slave selection	0: Slave 1: Master	0	○
P21.35	Sending interval of PDO1	1–3000ms	6	○
P21.36	Sending interval of PDO2	1–3000ms	2	○
P21.37	Sending interval of PDO3	1–3000ms	18	○
P21.38	Sending interval of PDO PDO4	1–3000ms	32	○
P21.39	Mode for triggering the slave node to send PDO1	1–255	255	○
P21.40	Mode for triggering the slave node to send PDO2	1–255	255	○
P21.41	Mode for triggering the slave node to send PDO3	1–255	255	○
P21.42	Mode for triggering the slave node to send PDO4	1–255	255	○
P21.43	CANopen heartbeat monitoring time	1–3000ms	500	○
P21.44	Event timer for the slave node to send PDO2	0–3000ms	500	○
P21.45	Event timer for the slave node to send PDO3	0–3000ms	500	○
P21.46	Event timer for the slave node to send PDO4	0–3000ms	500	○

Function code	Name	Description	Default	Modify
P21.47	Disabled time for the slave node to send PDO2	0–3000ms	0	○
P21.48	Disabled time for the slave node to send PDO3	0–3000ms	0	○
P21.49	Disabled time for the slave node to send PDO4	0–3000ms	0	○
P21.50	Reserved			
P21.51	Enabling PDO receiving	Range: 0–0x0F 0: Disable 1: Enable Bit0: PDO1_RX Bit1: PDO2_RX Bit2: PDO3_RX Bit3: PDO4_RX Bit4–bit15: Reserved	0x07	○
P21.52	Enabling PDO sending	Range: 0–0x0F 0: Disable 1: Enable Bit0: PDO1_TX Bit1: PDO2_TX Bit2: PDO3_TX Bit3: PDO4_TX Bit4–bit15: Reserved	0x07	○

P22 group—Extended communication function group 1 (PROFIBUS-DP)

Function code	Name	Description	Default	Modify
P22.00	Reserved	0–65535	0	●
P22.01	DP expansion card module address	0–127	3	◎
P22.02–P22.12	Reserved	0–65535	0	●
P22.13	Sent PZD2	Used only when the rectifier unit has been configured with a PROFIBUS-DP communication card. 0: Disable 1: Fault code 2: DC voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Brake current (* 10, A) 6: Terminal input status 7: Terminal output status 8: Number of online slave nodes 9: Online/offline status of slave nodes 02–17	0	○
P22.14	Sent PZD3		0	○
P22.15	Sent PZD4		0	○
P22.16	Sent PZD5		0	○
P22.17	Sent PZD6		0	○
P22.18	Sent PZD7		0	○
P22.19	Sent PZD8		0	○
P22.20	Sent PZD9		0	○
P22.21	Sent PZD10		0	○
P22.22	Sent PZD11		0	○
P22.23	Sent PZD12		0	○

Function code	Name	Description	Default	Modify
		10: Online/offline status of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20: Reserved		
P22.24	EtherCAT communication timeout time	0.0 (invalid); 0.1–60.0s	5.0s	○
P22.25	PROFIBUS-DP communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○
P22.26	PROFINET communication timeout time	0.0 (invalid); 0.1–60.0s	5.0	○
P22.27–P22.42	Reserved			
P22.43	Time to identify expansion card 1	0.01–30.00s	0	○
P22.44	Time to identify expansion card 2	0.01–30.00s	0	○
P22.45	Communication timeout time of expansion card 1	0.01–30.00s	0	○
P22.46	Communication timeout time of expansion card 2	0.01–30.00s	0	○
P22.48–P22.59	Reserved	0–255	192	●

P23 group—Extended communication function group 2 (Ethernet/PROFINET/EtherCAT)

Function code	Name	Description	Default	Modify
P23.00	Ethernet communication rate	0: Self adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0	○
P23.01	Ethernet IP address 1	0–255	192	◎
P23.02	Ethernet IP address 2		168	○
P23.03	Ethernet IP address 3		0	○
P23.04	Ethernet IP address 4		1	◎

Function code	Name	Description	Default	Modify
P23.05	Ethernet subnet mask 1	0–255	255	◎
P23.06	Ethernet subnet mask 2		255	○
P23.07	Ethernet subnet mask 3		255	◎
P23.08	Ethernet subnet mask 4		0	◎
P23.09	Ethernet gateway address 1	0–255	192	○
P23.10	Ethernet gateway address 2		168	○
P23.11	Ethernet gateway address3		1	○
P23.12	Ethernet gateway address 4		1	◎
P23.13	Ethernet monitoring address 1	0–0xffff **Note: Used for software debugging.**	0	○
P23.14	Ethernet monitoring address 2		0	○
P23.15	Ethernet monitoring address 3		0	○
P23.16	Ethernet monitoring address 4		0	○
P23.17–P23.27	Reserved			
P23.28	Sent PZD2	Used only when the rectifier unit has been configured with a PROFINET or EtherCAT communication card. 0: Disable 1: Fault code 2: Bus voltage (* 10, V) 3: Grid voltage (* 1, V) 4: Grid frequency (* 10, Hz) 5: Braking current (* 10, A) 6: Input terminal status 7: Output terminal status 8: Number of online slave nodes 9: Online/offline state of slave nodes 02–17 10: Online/offline state of slave nodes 18–21 11: CANopen bus load rate 12: Type of card at slot 1 13: Type of card at slot 2 14: Software version of card at slot 1 15: Software version of card at slot 2 16: R-phase current 17: S-phase current 18: T-phase current 19: Node number of first CANopen offline unit 20–31: Reserved	0	
P23.29	Sent PZD3		0	
P23.30	Sent PZD4		0	
P23.31	Sent PZD5		0	
P23.32	Sent PZD6		0	
P23.33	Sent PZD7		0	
P23.34	Sent PZD8		0	
P23.35	Sent PZD9		0	
P23.36	Sent PZD10		0	
P23.37	Sent PZD11		0	
P23.38	Sent PZD12		0	

P24 group—Programmable card functions

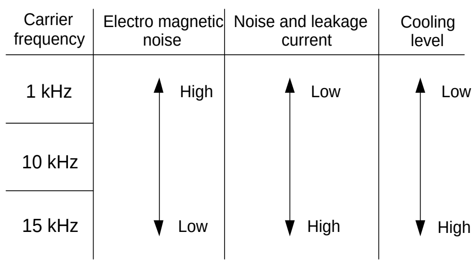
Function code	Name	Description	Default	Modify
P24.00	Enabling Programmable card functions	0–1 0: Disable 1: Enable	0	◎
P24.01	C_WrP1	0–65535 Used to write a value to WrP1 of the PLC.	0	○
P24.02	C_WrP2	Used to write a value to WrP2 of the PLC.	0	○
P24.03	C_WrP3	Used to write a value to WrP3 of the PLC.	0	○
P24.04	C_WrP4	Used to write a value to WrP4 of the PLC.	0	○
P24.05	C_WrP5	Used to write a value to WrP5 of the PLC.	0	○
P24.06	C_WrP6	Used to write a value to WrP6 of the PLC.	0	○
P24.07	C_WrP7	Used to write a value to WrP7 of the PLC.	0	○
P24.08	C_WrP8	Used to write a value to WrP8 of the PLC.	0	○
P24.09	C_WrP9	Used to write a value to WrP9 of the PLC.	0	○
P24.10	C_WrP10	Used to write a value to WrP10 of the PLC.	0	○
P24.11	Programmable card status	0: Stopped 1: Running	0	●
P24.12	C_MoP1	Used to monitor/view the MoP1 value of the PLC.	0	●
P24.13	C_MoP2	Used to monitor/view the MoP2 value of the PLC.	0	●
P24.14	C_MoP3	Used to monitor/view the MoP3 value of the PLC.	0	●
P24.15	C_MoP4	Used to monitor/view the MoP4 value of the PLC.	0	●
P24.16	C_MoP5	Used to monitor/view the MoP5 value of the PLC.	0	●
P24.17	C_MoP6	Used to monitor/view the MoP6 value of the PLC.	0	●
P24.18	C_MoP7	Used to monitor/view the MoP7 value of the PLC.	0	●
P24.19	C_MoP8	Used to monitor/view the MoP8 value of the PLC.	0	●
P24.20	C_MoP9	Used to monitor/view the MoP9 value of the PLC.	0	●
P24.21	C_MoP10	Used to monitor/view the MoP10 value of the PLC.	0	●
P24.22	Programmable card digital input	Bit3–Bit0: S4/S3/S2/S1	0	●
P24.23	Programmable card digital output	Bit1–0: PR2A/PR1A	0	●
P24.24	Programmable card save function at power failure	0–1 0: Disable 1: Enable	1	◎

8.2.2 Inverter function parameter list

P00 group—Basic functions

Function code	Name	Description	Default	Modify
P00.00	Speed control mode	0: Sensorless vector control (SVC) mode 0 1: Sensorless vector control (SVC) mode 1 2: Space voltage vector control mode 3: Closed-loop vector control mode **Note: Before using a vector control mode (0, 1, or 3), enable the VFD to perform motor parameter autotuning first.**	2	◎

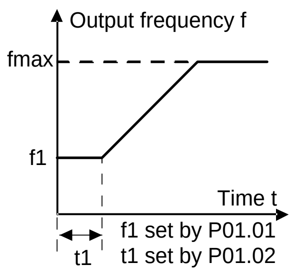
Function code	Name	Description	Default	Modify
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0	○
P00.02	Communication mode of running commands	0: Modbus 1: CANopen 2: Ethernet 3: EtherCAT/PROFINET 4: PLC 5: Wireless communication 6: PROFIBUS-DP/DeviceNet **Note: The options 2, 3, 4, 5, and 6 are add-on functions and are available only when corresponding expansion cards are configured.**	0	○
P00.03	Max. output frequency	Used to set the max. output frequency of the inverter unit. Pay attention to the function code because it is the foundation of the frequency setting and the speed of acceleration (ACC) and deceleration (DEC). Setting range: Max (P00.04,10.00)–630.00Hz	50.00Hz	◎
P00.04	Upper limit of running frequency	The upper limit of the running frequency is the upper limit of the output frequency of the inverter unit, which is lower than or equal to the max. output frequency. When the set frequency is higher than the upper limit of the running frequency, the upper limit of the running frequency is used for running. Setting range: P00.05–P00.03 (Max. output frequency)	50.00Hz	◎
P00.05	Lower limit of running frequency	The lower limit of the running frequency is the lower limit of the output frequency of the inverter unit. When the set frequency is lower than the lower limit of the running frequency, the lower limit of the running frequency is used for running. **Note: Max. output frequency ≥ Upper limit of frequency ≥ Lower limit of frequency** Setting range: 0.00Hz–P00.04 (Upper limit of running frequency)	0.00Hz	◎
P00.06	Setting channel of A frequency command	0: Keypad 1: AI1 2: AI2 3: AI3 4: Reserved 5: Simple PLC program 6: Multi-step speed running 7: PID control	0	○
P00.07	Setting channel of B frequency command		14	○

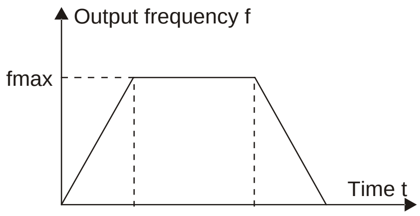
Function code	Name	Description	Default	Modify
		8: Modbus communication 9: CANopen communication 10: Ethernet communication 11: Reserved 12: Pulse train AB 13: EtherCAT/PROFINET communication 14: Programmable expansion card 15: PROFIBUS-DP/DeviceNet communication		
P00.08	Reference object of B frequency command	0: Max. output frequency 1: A frequency command	0	○
P00.09	Combination mode of setting source	0: A 1: B 2: (A+B) 3: (A- B) 4: Max(A, B) 5: Min. (A, B)	0	○
P00.10	Frequency set through keypad	When A and B frequency commands select the keypad for setting, the value of the function code is the original setting one of the frequency data of the inverter unit. Setting range: 0.00 Hz–P00.03 (Max. output frequency)	50.00Hz	○
P00.11	ACC time 1	ACC time means the time needed if the inverter unit speeds up from 0Hz to the max. output frequency (P00.03). DEC time means the time needed if the inverter unit speeds down from the max. output frequency (P00.03) to 0Hz. The inverter unit has four groups of ACC/DEC time, which can be selected by P05. The default ACC/DEC time of the inverter unit is the first group. P00.11 and P00.12 setting range: 0.0–3600.0s	Model depended	○
P00.12	DEC time 1		Model depended	○
P00.13	Running direction	0: Run at the default direction. 1: Run at the opposite direction. 2: Disable reverse running	0	○
P00.14	Carrier frequency	 The relationship between models and carrier frequencies is as follows:	Model depended	○

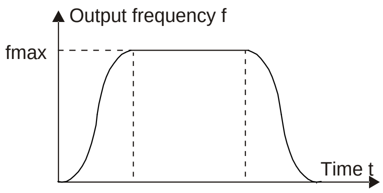
<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th colspan="2">Model</th><th>Default carrier frequency</th></tr>
<tr><td rowspan="3">380V</td><td>1.5–11kW</td><td>8kHz</td></tr>
<tr><td>15–55kW</td><td>4kHz</td></tr>
<tr><td>> 75kW</td><td>2kHz</td></tr>
<tr><td rowspan="2">660V</td><td>22–55kW</td><td>4kHz</td></tr>
<tr><td>> 75kW</td><td>2kHz</td></tr>
</table>
Advantage of high carrier frequency: ideal current waveform, little current harmonic wave and motor noise.
Disadvantage of high carrier frequency: increasing the switch loss, increasing inverter unit temperature and the impact to the output capacity. The inverter unit needs to derate on high carrier frequency. At the same time, the leakage and electrical magnetic interference will increase.
On the contrary, an extremely-low a carrier frequency may cause unstable operation at low frequency, decrease the torque, or even lead to oscillation.
The carrier frequency has been properly set in the factory before the inverter unit is delivered from the factory. In general, you do not need to modify it.
When the frequency used exceeds the default carrier frequency, the VFD needs to derate by 10% for each increase of 1k carrier frequency.
Setting range: 1.2–15.0kHz</td><td></td><td></td></tr>
<tr><td>P00.15</td><td>Motor parameter autotuning</td><td>0: No operation
1: Rotary autotuning 1.
Comprehensive motor parameter autotuning. It is recommended to use rotating autotuning when high control accuracy is needed.
2: Static autotuning 1 (comprehensive autotuning); static autotuning 1 is used in cases where the motor cannot be disconnected from load.
3: Static autotuning 2 (partial autotuning); when the present motor is motor 1, only P02.06, P02.07, and P02.08 are autotuned; when the present motor is motor 2, only P12.06, P12.07, and P12.08 are autotuned.
4: Rotary autotuning 2, which is similar to rotary autotuning 1 but only valid for AMs.
5: Static autotuning 3 (partial autotuning), which is valid only for AMs.</td><td>0</td><td>◎</td></tr>
</table>

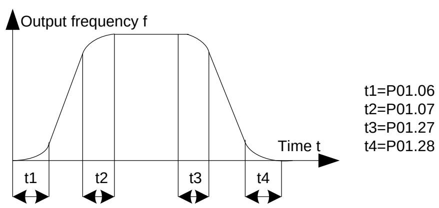
Function code	Name	Description	Default	Modify
P00.16	AVR function selection	0: Invalid 1: Valid during the whole procedure Automatic voltage regulation function is used to eliminate the bus voltage fluctuation impact on the inverter unit output voltage.	1	○
P00.18	Function parameter restore	0: No operation 1: Restore default values (excluding motor parameters) 2: Clear fault records 3: Lock keypad parameters 4: Reserved 5: Restore default values (standard version) 6: Restore default values (including motor parameters) **Note: After the selected operation is performed, the function code is automatically restored to 0. Restoring the default values may delete the user password. Exercise caution when using this function. The option 5 can be used only for factory testing.**	0	◎

P01 group—Start and stop control

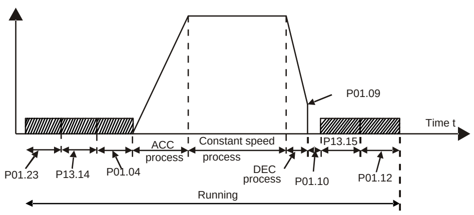
Function code	Name	Description	Default	Modify
P01.00	Start mode	0: Direct start 1: Start after DC braking 2: Speed tracking restart 1 3: Speed tracking restart 2	0	◎
P01.01	Starting frequency of direct start	Used to indicate the initial frequency during inverter unit start. See P01.02 (Starting frequency hold time) for detailed information. Setting range: 0.00–50.00Hz	0.50Hz	◎
P01.02	Starting frequency hold time	 Setting a proper starting frequency can increase the torque during VFD start. During the hold time of the starting frequency, the output frequency of the inverter unit is the starting frequency. And then, the inverter unit runs from the starting frequency to the set frequency. If the set frequency is lower than the starting frequency, the inverter unit stops running and keeps in the	0.0s	◎

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>standby state. The starting frequency is not limited in the lower limit frequency.
Setting range: 0.0–50.0s</td><td></td><td></td></tr>
<tr><td>P01.03</td><td>Braking current before start</td><td rowspan="2">The inverter unit performs DC braking with the braking current before start and it speeds up after the DC braking time. If the set DC braking time is 0, DC braking is invalid.
Stronger braking current indicates larger braking power. The DC braking current before start is a percentage of the inverter unit rated output current.
P01.03 setting range: 0.0–100.0%
P01.04 setting range: 0.00–50.00s</td><td>0.0%</td><td>◎</td></tr>
<tr><td>P01.04</td><td>Braking time before start</td><td>0.00s</td><td>◎</td></tr>
<tr><td>P01.05</td><td>ACC and DEC mode</td><td>Used to indicate the changing mode of the frequency during start and running.
0: Linear type. The output frequency increases or decreases linearly.


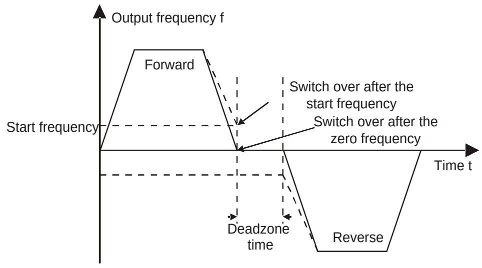
1: S curve. The output frequency increases or decreases according to the S curve.
The S curve is generally applied to elevators, conveyors, and other application scenarios where smoother start or stop is required.


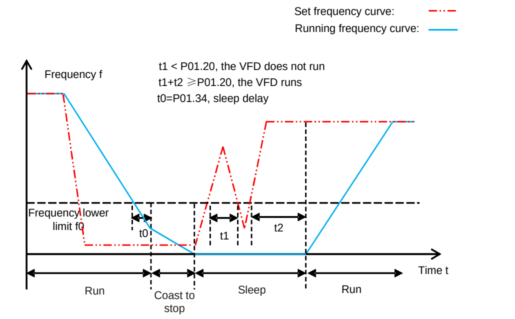
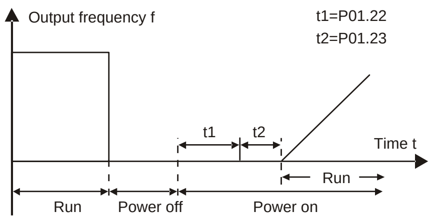
Note: When the function parameter is set to 1, you also need to set P01.06, P01.07, P01.27, and P01.28.</td><td>0</td><td>◎</td></tr>
<tr><td>P01.06</td><td>Time of starting segment of ACC S curve</td><td rowspan="2">The curvature of S curve is determined by the ACC range and ACC/DEC time.


Setting range: 0.0–50.0s</td><td>0.1s</td><td>◎</td></tr>
<tr><td>P01.07</td><td>Time of ending segment of ACC S curve</td><td>0.1s</td><td>◎</td></tr>
</table>

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P01.08</td><td>Stop mode</td><td>0: Decelerate to stop. After a stop command takes effect, the inverter unit lowers output frequency based on the DEC mode and the defined DEC time; after the frequency drops to the stop speed (P01.15), the inverter unit stops.
1: Coast to stop. After a stop command takes effect, the inverter unit stops output immediately. and the load coasts to stop according to mechanical inertia.</td><td>0</td><td>○</td></tr>
<tr><td>P01.09</td><td>Starting frequency of DC braking for stop</td><td rowspan="4">Starting frequency of DC braking for stop: During the deceleration to stop, the VFD starts DC braking for stop when running frequency reaches the starting frequency determined by P01.09.
Wait time before DC braking: The inverter unit blocks the output before starting DC braking. After this wait time, DC braking is started so as to prevent overcurrent caused by DC braking at high speed.
DC braking current for stop: It indicates the applied DC braking energy. Stronger current indicates greater DC braking effect.
DC braking time for stop: It indicates the hold time of DC braking. If the time is 0, DC braking is invalid, and the inverter unit decelerates to stop within the specified time.


P01.09 setting range: 0.00Hz–P00.03 (Max. output frequency)
P01.10 setting range: 0.00–30.00s
P01.11 setting range: 0.0–100.0% (corresponding to the rated output current of the inverter unit)
P01.12 setting range: 0.0–50.0s</td><td>0.00Hz</td><td>○</td></tr>
<tr><td>P01.10</td><td>Demagnetization time</td><td>0.00s</td><td>○</td></tr>
<tr><td>P01.11</td><td>DC braking current for stop</td><td>0.0%</td><td>○</td></tr>
<tr><td>P01.12</td><td>DC braking time for stop</td><td>0.00s</td><td>○</td></tr>
<tr><td>P01.13</td><td>FWD/REV running deadzone time</td><td>Used to indicate the transition time specified in P01.14 during FWD/REV rotation switching. See the figure.</td><td>0.0s</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		 Setting range: 0.0–3600.0s		
P01.14	FWD/REV running switching mode	0: Switch at zero frequency 1: Switch at the starting frequency 2: Switch after the speed reaches the stop speed with a delay	1	◎
P01.15	Stop speed	0.00–100.00Hz	0.50Hz	◎
P01.16	Stop speed detection mode	0: Detect by the set speed (unique in space voltage vector control mode) 1: Detect by the feedback speed	0	◎
P01.17	Stop speed detection time	0.00–100.00s	0.50s	◎
P01.18	Terminal-based running command protection at power-on	When the channel of running commands is terminal control, the system detects the state of the running terminal during power-on. 0: The terminal running command is invalid at power-on. Even the running command is considered as valid during power-on, the inverter unit does not run and it keeps the protection state until the running command is canceled and enabled again. 1: The terminal running command is valid at power-on. If the running command is considered as valid during power-on, the inverter unit is started automatically after the initialization. **Note: Exercise caution before using this function. Otherwise, serious result may follow.**	0	○
P01.19	Action selected when running frequency less than frequency lower limit (valid when frequency lower limit greater than 0)	The function code determines the running state of the inverter unit when the set frequency is lower than the lower-limit one. Ones place: 0: Run at the frequency lower limit 1: Stop 2: Sleep Tens place (Valid when 1 or 2 is selected for ones place): 0: Coast to stop 1: Decelerate to stop The inverter unit coasts to stop when the set frequency is lower than the lower-limit one. If the set frequency exceeds the lower limit one again and it lasts for the time set by P01.20, the inverter unit resumes the running state automatically.	0x00	◎

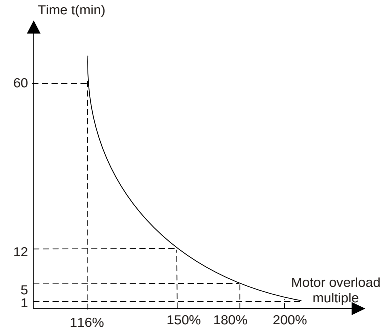
Function code	Name	Description	Default	Modify
P01.20	Wake-up-from-sleep delay	Used to set the wake-up-from-sleep delay time. When the running frequency of the inverter unit is lower than the lower limit, the inverter unit becomes standby. When the set frequency exceeds the lower limit once again and it lasts for the time set by P01.20, the inverter unit runs automatically.  Setting range: 0.0–3600.0s (Valid only when the ones place of P01.19=2)	0.0s	○
P01.21	Power-off restart selection	Used to indicate whether the inverter unit automatically runs after re-power on. 0: Disable 1: Enable. If the restart condition is met, the inverter unit will run automatically after waiting the time defined by P01.22.	0	○
P01.22	Wait time for restart after power-off	Used to indicate the wait time before the automatic running of the inverter unit that is re-powered on.  Setting range: 0.0–3600.0s (Valid only when P01.21=1)	1.0s	○
P01.23	Start delay	After an inverter unit running command is given, the inverter unit is in standby state and restarts with the delay defined by P01.23 to implement brake release. Setting range: 0.0–600.0s	0.0s	○
P01.24	Stop speed delay	0.0–600.0s	0.0s	○
P01.25	Open-loop 0Hz output selection	0: Output without voltage 1: Output with voltage 2: Output with the DC braking current for stop	0	○
P01.26	DEC time for emergency stop	0.0–60.0s	2.0s	○
P01.27	Time of starting segment of DEC S curve	0.0–50.0s	0.1s	◎

Function code	Name	Description	Default	Modify
P01.28	Time of ending segment of DEC S curve	0.0–50.0s	0.1s	◎
P01.29	Short-circuit braking current	When the inverter unit starts in direct start mode (P01.00=0), set P01.30 to a non-zero value to enter short-circuit braking. During stop, if the running frequency of the inverter unit is lower than the starting frequency of brake for stop (P01.09), set P01.31 to a non-zero value to enter short-circuit braking for stop, and then carry out DC braking in the time set by P01.12. (See descriptions for P01.09–P01.12.) P01.29 setting range: 0.0–150.0% (of the rated output current of the inverter unit) P01.30 setting range: 0.0–50.0s P01.31 setting range: 0.0–50.0s	0.0%	○
P01.30	Hold time of short-circuit braking for start		0.00s	○
P01.31	Hold time of short-circuit braking for stop		0.00s	○
P01.32	Pre-exciting time for jogging	0–10.000s	0.000s	○
P01.33	Starting frequency of braking for stop in jogging	0–P00.03	0.00Hz	○
P01.34	Sleep delay	0–3600.0s	0.0s	○

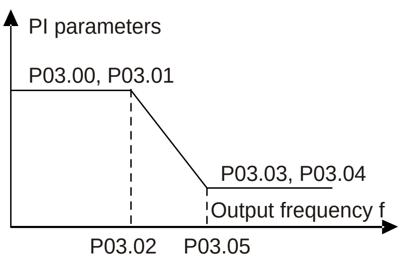
P02 group—Parameters of motor 1

Function code	Name	Description	Default	Modify
P02.00	Type of motor 1	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0	◎
P02.01	Rated power of AM 1	0.1–3000.0kW	Model depended	◎
P02.02	Rated frequency of AM 1	0.01Hz–P00.03 (Max. output frequency)	50.00Hz	◎
P02.03	Rated speed of AM 1	1–60000rpm	Model depended	◎
P02.04	Rated voltage of AM 1	0–1200V		◎
P02.05	Rated current of AM 1	0.8–6000.0A		◎
P02.06	Stator resistance of AM 1	0.001–65.535Ω		○
P02.07	Rotor resistance of AM 1	0.001–65.535Ω		○
P02.08	Leakage inductance of AM 1	0.1–6553.5mH		○
P02.09	Mutual inductance of AM 1	0.1–6553.5mH		○
P02.10	No-load current of AM 1	0.1–6553.5A		○
P02.11	Magnetic saturation coefficient 1 of iron core of AM 1	0.0–100.0%	80.0%	○
P02.12	Magnetic saturation coefficient 2 of iron core of AM 1	0.0–100.0%	68.0%	○

Function code	Name	Description	Default	Modify
P02.13	Magnetic saturation coefficient 3 of iron core of AM 1	0.0–100.0%	57.0%	○
P02.14	Magnetic saturation coefficient 4 of iron core of AM 1	0.0–100.0%	40.0%	○
P02.15	Rated power of SM 1	0.1–3000.0kW	Model depended	◎
P02.16	Rated frequency of SM 1	0.01Hz–P00.03 (Max. frequency)	50.00Hz	◎
P02.17	Number of pole pairs of SM 1	1–128	2	◎
P02.18	Rated voltage of SM 1	0–1200V	Model depended	◎
P02.19	Rated current of SM 1	0.8–6000.0A		◎
P02.20	Stator resistance of SM 1	0.001–65.535Ω		○
P02.21	Direct-axis inductance of SM 1	0.01–655.35mH		○
P02.22	Quadrature-axis inductance of SM 1	0.01–655.35mH		○
P02.23	Counter-emf of SM 1	0–10000	300	○
P02.24	Reserved	0x0000–0Xffff	0	●
P02.25	Identification current of SM 1	0%–50% (of the motor rated current)	10%	●
P02.26	Overload protection of motor 1	0: No protection 1: Common motor protection (with low-speed compensation). As the cooling effect of a common motor is degraded at low speed running, the corresponding electronic thermal protection value needs to be adjusted properly, the low compensation indicates lowering the overload protection threshold of the motor whose running frequency is lower than 30Hz. 2: Variable-frequency motor protection (without low speed compensation). Because the heat dissipation function for a variable-frequency motor is not impacted by the rotation speed, it is not necessary to adjust the protection value at low speed running.	2	◎
P02.27	Overload protection coefficient of motor 1	Motor overload multiples M=Iout/(In*K) "In" is rated motor current, "Iout" is inverter unit output current, and "K" is motor overload protection coefficient. A smaller value of "K" indicates a bigger value of "M". When M=116%, protection is performed after motor overload lasts for 1 hour; when M=150%, protection is performed after motor overload lasts for 12 minutes; when M=200%, protection	100.0%	○

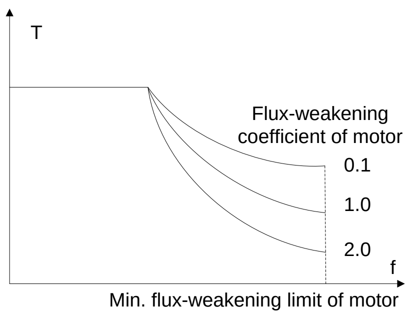
Function code	Name	Description	Default	Modify
		is performed after motor overload lasts for 60 seconds; and when M≥400%, protection is performed immediately.  Setting range: 20.0%–150.0%		
P02.28	Power display calibration coefficient of motor 1	The function code can be used to adjust the power display value of motor 1. However, it does not affect the control performance of the inverter unit. Setting range: 0.00–3.00	1.00	○
P02.29	Parameter display of motor 1	0: Display by motor type. In this mode, only parameters related to the present motor type are displayed. 1: Display all. In this mode, all the motor parameters are displayed.	0	○
P02.30	System inertia of motor 1	0–30.000kgm^2	0	○
P02.31–P02.32	Reserved	0–65535	0	○

P03 group—Vector control of motor 1

Function code	Name	Description	Default	Modify
P03.00	Speed-loop proportional gain 1	P03.00–P03.05 are applicable only to vector control. When switching frequency 1 (P03.02) is not reached, the speed-loop PI parameters are: P03.00 and P03.01. When switching frequency 2 (P03.05) is exceeded, the speed-loop PI parameters are: P03.03 and P03.04. PI parameters are obtained according to the linear change of two groups of parameters. See the following figure: 	20.0	○
P03.01	Speed-loop integral time 1		0.200s	○
P03.02	Low-point frequency for switching		5.00Hz	○
P03.03	Speed-loop proportional gain 2		20.0	○
P03.04	Speed-loop integral time 2		0.200s	○
P03.05	High-point frequency for switching		10.00Hz	○

Function code	Name	Description	Default	Modify
		The speed loop dynamic response characteristics of vector control can be adjusted by setting the proportional coefficient and integral time of speed regulator. Increasing proportional gain or reducing integral time can accelerate dynamic response of speed loop; however, if the proportional gain is too large or integral time is too small, system oscillation and overshoot may occur; if proportional gain is too small, stable oscillation or speed offset may occur. PI parameters have a close relationship with the inertia of the system. Adjust PI parameters depending on different loads to meet various demands. P03.00 setting range: 0.0–200.0 P03.01 setting range: 0.000–10.000s P03.02 setting range: 0.00Hz–P03.05 P03.03 setting range: 0.0–200.0 P03.04 setting range: 0.000–10.000s P03.05 setting range: P03.02–P00.03 (Max. output frequency)		
P03.06	Speed-loop output filter	0–8 (corresponding to 0–2^8/10ms)	0	○
P03.07	Electromotive slip compensation coefficient of vector control	Slip compensation coefficient is used to adjust the slip frequency of the vector control and improve the speed control accuracy of the system. Adjusting the parameter properly can control the speed steady-state error. Setting range: 50–200%	100%	○
P03.08	Braking slip compensation coefficient of vector control		100%	○
P03.09	Current-loop proportional coefficient P	**Note:** ✧ The two function parameters impact the dynamic response speed and control accuracy of the system. Generally, you do not need to modify the two function parameters. ✧ Applicable to SVC mode 0 (P00.00=0), SVC mode 1 (P00.00=1) and closed-loop VC mode (P00.00=3). Setting range: 0–65535	1000	○
P03.10	Current-loop integral coefficient I		1000	○
P03.11	Torque setting method	0: Keypad (P03.12) 1: Keypad (P03.12) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-step torque 7: Modbus communication	0	○

Function code	Name	Description	Default	Modify
		8: CANopen communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET communication 12: Programmable expansion card 13: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**		
P03.12	Torque set through keypad	-300.0%–300.0% (of the motor rated current)	20.0%	○
P03.13	Torque reference filter time	0.000–10.000s	0.010s	○
P03.14	Setting source of forward rotation upper-limit frequency in torque control	0: Keypad (P03.16) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step setting 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the max. frequency.**	0	○
P03.15	Setting source of reverse rotation upper-limit frequency in torque control	0: Keypad (P03.17) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step setting 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the max. frequency.**	0	○
P03.16	Forward rotation upper-limit frequency set through keypad in torque control	Used to set the frequency upper limits. 100% corresponds to the max. frequency. P03.16 specifies the value when P03.14=1, while P03.17 specifies the value when P03.15=1. Setting range: 0.00Hz–P00.03 (Max. output frequency)	50.00Hz	○
P03.17	Reverse rotation upper-limit frequency set through keypad in torque control		50.00Hz	○

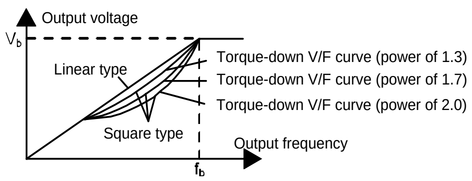
Function code	Name	Description	Default	Modify
P03.18	Setting source of electromotive torque upper limit	0: Keypad (P03.20) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved 9: EtherCAT/PROFINET communication 10: Programmable expansion card 11: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	0	○
P03.19	Setting source of braking torque upper limit	0: Keypad (P03.21) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved 9: EtherCAT/PROFINET communication 10: Programmable expansion card 11: PROFIBUS-DP/DeviceNet communication **Note: 100% corresponds to the motor rated current.**	0	○
P03.20	Electromotive torque upper limit set through keypad	Used to set torque limits. Setting range: 0.0–300.0% (of the motor rated current)	180.0%	○
P03.21	Braking torque upper limit set through keypad		180.0%	○
P03.22	Weakening coefficient in constant power zone	Used when the AM is in flux-weakening control.	0.3	○
P03.23	Lowest weakening point in constant power zone	 The function codes P03.22 and P03.23 are valid at constant power. The motor enters the flux-weakening state when the motor runs above the rated speed. Change the flux-weakening curvature by modifying the flux-weakening	20%	○

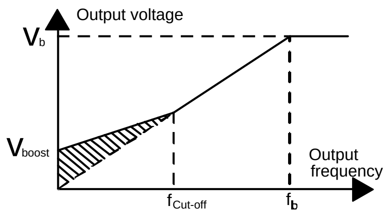
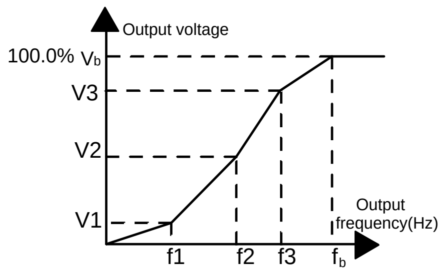
Function code	Name	Description	Default	Modify
		control coefficient. The larger the coefficient, the steeper the curve, the smaller the coefficient, the smoother the curve. P03.22 setting range: 0.1–2.0 P03.23 setting range: 10%–100%		
P03.24	Max. voltage limit	P03.24 sets the max. output voltage of the inverter unit, which is a percentage of the motor rated voltage. Set the value according to onsite conditions. Setting range: 0.0–120.0%	100.0%	○
P03.25	Pre-exciting time	Pre-exciting is performed for the motor when the inverter unit starts. A magnetic field is built inside the motor to improve the torque performance during the start process. Setting range: 0.000–10.000s	0.300s	○
P03.26	Flux-weakening proportional gain	0–8000	1000	○
P03.27	Speed display selection in vector control	0: Display the actual value 1: Display the set value	0	○
P03.28	Static friction compensation coefficient	0.0–100.0%	0.0%	○
P03.29	Corresponding frequency point of static friction	0.50– P03.31	1.00Hz	○
P03.30	High speed friction compensation coefficient	0.0–100.0%	0.0%	○
P03.31	Corresponding frequency of high speed friction torque	P03.29–400.00Hz	50.00Hz	○
P03.32	Enabling torque control	0: Disable 1: Enable	0	◎
P03.33	Flux-weakening integral gain	0–8000	1200	○
P03.34	Flux-weakening control mode	Ones place: Control mode 0: Mode 0 1: Mode 1 2: Mode 2 Tens place: Compensation of inductance saturation coefficient 0: Enable 1: Disable Hundreds place: Current-loop feedforward compensation 0: Enable 1: Disable	0	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P03.35</td><td>Control mode optimization selection</td><td>0–0x1111
Ones place: Torque command selection
0: Torque reference
1: Torque current reference
Tens place: Reserved
0: Reserved
1: Reserved
Hundreds place: indicates whether to enable speed-loop integral separation
0: Disable
1: Enable
Thousands place: Reserved
0: Reserved
1: Reserved
Range: 0x0000–0x1111
Note: Valid only in the closed-loop vector control mode (P00.00=3).</td><td>0x0000</td><td>○</td></tr>
<tr><td>P03.36</td><td>Speed-loop differential gain</td><td>0.00–10.00s</td><td>0.00s</td><td>○</td></tr>
<tr><td>P03.37</td><td>High-frequency current-loop proportional coefficient</td><td rowspan="3">In the closed-loop vector control mode (P00.00=3), when the frequency is lower than the current-loop high-frequency switching threshold (P03.39), the current-loop PI parameters are P03.09 and P03.10; and when the frequency is higher than the current-loop high-frequency switching threshold, the current-loop PI parameters are P03.37 and P03.38.
P03.37 setting range: 0–65535
P03.38 setting range: 0–65535
P03.39 setting range: 0.0–100.0% (of the max. frequency)</td><td>1000</td><td>○</td></tr>
<tr><td>P03.38</td><td>High-frequency current-loop integral coefficient</td><td>1000</td><td>○</td></tr>
<tr><td>P03.39</td><td>Current-loop high-frequency switching threshold</td><td>100.0%</td><td>○</td></tr>
<tr><td>P03.40</td><td>Enabling inertia compensation</td><td>0: Disable
1: Enable</td><td>0</td><td>○</td></tr>
<tr><td>P03.41</td><td>Upper limit of inertia compensation torque</td><td>The max. inertia compensation torque is limited to prevent inertia compensation torque from being too large.
Setting range: 0.0–150.0% (of the motor rated torque)</td><td>10.0%</td><td>○</td></tr>
<tr><td>P03.42</td><td>Inertia compensation filter times</td><td>Filter times of inertia compensation torque, used to smooth inertia compensation torque.
Setting range: 0–10</td><td>7</td><td>○</td></tr>
<tr><td>P03.43</td><td>Inertia identification torque</td><td>Due to friction force, it is required to set certain identification torque for the inertia identification to be performed properly.
0.0–100.0% (of the motor rated torque)</td><td>10.0%</td><td>○</td></tr>
<tr><td>P03.44</td><td>Enabling inertia identification</td><td>0: No operation
1: Enable</td><td>0</td><td>◎</td></tr>
</table>

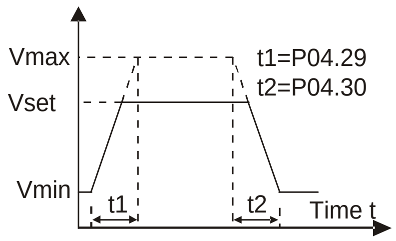
Function code	Name	Description	Default	Modify
P03.45–P03.61	Reserved			

P04 group—V/F control

Function code	Name	Description	Default	Modify
P04.00	V/F curve setting of motor 1	This group of function code defines the V/F curve of motor 1 to meet the needs of different loads. 0: Straight-line V/F curve, applicable to constant torque loads 1: Multi-point V/F curve 2: Torque-down V/F curve (power of 1.3) 3: Torque-down V/F curve (power of 1.7) 4: Torque-down V/F curve (power of 2.0) Curves 2–4 are applicable for torque-variable loads such as fan, pump and similar equipment. You can make adjustment based on load characteristics to achieve optimal energy-saving effect. 5: Customized V/F (V/F separation); in this mode, V can be separated from F and F can be adjusted through the frequency setting channel set by P00.06 or the voltage setting channel set by P04.27 to change the characteristics of the curve. **Note: In the following figure, V_b is the motor rated voltage and f_b is the motor rated frequency.** 	0	◎
P04.01	Torque boost of motor 1	In order to compensate for low-frequency torque characteristics, you can make some boost compensation for the output voltage. P04.01 is relative to the max. output voltage V_b. P04.02 defines the percentage of cut-off frequency of manual torque boost to the rated motor frequency f_b. Torque boost can improve the low-frequency torque characteristics of V/F. You need to select torque boost based on the load. For example, larger load requires larger torque boost, however, if the torque boost is too large, the motor will run at over-excitation, which may cause increased output current and motor overheating, thus decreasing the efficiency.	0.0%	○
P04.02	Torque boost cut-off of motor 1		20.0%	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>When torque boost is set to 0.0%, the inverter unit uses automatic torque boost.
Torque boost cut-off threshold: Below this frequency threshold, torque boost is valid; exceeding this threshold will invalidate torque boost.

P04.01 setting range: 0.0%: Automatic, 0.1%–10.0%
P04.02 setting range: 0.0%–50.0%</td><td></td><td></td></tr>
<tr><td>P04.03</td><td>V/F frequency point 1 of motor 1</td><td rowspan="6">When P04.00=1 (multi-dot V/F curve), you can set the V/F curve through P04.03–P04.08.
The V/F curve is generally set according to the load characteristics of the motor.
Note: V1 < V2 < V3, f1 < f2 < f3. Too high voltage for low frequency will cause motor overheat or damage and cause VFD overcurrent stall or overcurrent protection.

P04.03 setting range: 0.00Hz–P04.05
P04.04 setting range: 0.0%–110.0% (of the rated voltage of motor 1)
P04.05 setting range: P04.03–P04.07
P04.06 setting range: 0.0%–110.0% (of the rated voltage of motor 1)
P04.07 setting range: P04.05–P02.02 (Rated frequency of AM 1) or P04.05– P02.16 (Rated frequency of SM 1)
P04.08 setting range: 0.0%–110.0% (of the rated voltage of motor 1)</td><td>0.00Hz</td><td>○</td></tr>
<tr><td>P04.04</td><td>V/F voltage point 1 of motor 1</td><td>00.0%</td><td>○</td></tr>
<tr><td>P04.05</td><td>V/F frequency point 2 of motor 1</td><td>0.00Hz</td><td>○</td></tr>
<tr><td>P04.06</td><td>V/F voltage point 2 of motor 1</td><td>0.0%</td><td>○</td></tr>
<tr><td>P04.07</td><td>V/F frequency point 3 of motor 1</td><td>0.00Hz</td><td>○</td></tr>
<tr><td>P04.08</td><td>V/F voltage point 3 of motor 1</td><td>00.0%</td><td>○</td></tr>
<tr><td>P04.09</td><td>V/F slip compensation gain of motor 1</td><td>Used to compensate for the motor rotating speed change caused by load change in the space voltage vector mode, and thus improve the rigidity of the mechanical characteristics of the motor. You need to calculate the rated slip</td><td>0.0%</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		frequency of the motor as follows: $\Delta f=f_b-n*p/60$ Of which, f_b is the rated frequency of the motor, corresponding to function code P02.02. n is the rated rotating speed of the motor, corresponding to function code P02.03. p is the number of pole pairs of the motor. 100.0% corresponds to the rated slip frequency Δf of the motor. Setting range: 0.0–200.0%		
P04.10	Low-frequency oscillation control factor of motor 1	In space voltage vector control mode, the motor, especially the large-power motor, may experience current oscillation at certain frequencies, which may cause unstable motor running, or even inverter unit overcurrent. You can adjust the two function parameters properly to eliminate such phenomenon. P04.10 setting range: 0–100 P04.11 setting range: 0–100 P04.12 setting range: 0.00Hz–P00.03 (Max. output frequency)	10	○
P04.11	High-frequency oscillation control factor of motor 1		10	○
P04.12	Oscillation control threshold of motor 1		30.00Hz	○
P04.13	V/F curve setting of motor 2	0: Straight-line V/F curve 1: Multi-point V/F curve 2: Torque-down V/F curve (power of 1.3) 3: Torque-down V/F curve (power of 1.7) 4: Torque-down V/F curve (power of 2.0) 5: Customized V/F curve (V/F separation)	0	◎
P04.14	Torque boost of motor 2	0.0%: Automatic 0.1%–10.0%	0.0%	○
P04.15	Torque boost cut-off of motor 2	0.0%–50.0% (of the rated frequency of motor 2)	20.0%	○
P04.16	V/F frequency point 1 of motor 2	0.00Hz–P04.18	0.00Hz	○
P04.17	V/F voltage point 1 of motor 2	0.0%–110.0% (of the rated voltage of motor 2)	00.0%	○
P04.18	V/F frequency point 2 of motor 2	P04.16– P04.20	0.00Hz	○
P04.19	V/F voltage point 2 of motor 2	0.0%–110.0% (of the rated voltage of motor 2)	00.0%	○
P04.20	V/F frequency point 3 of motor 2	P04.18–P12.02 (Rated frequency of AM 2) or P04.18–P12.16 (Rated frequency of SM 2)	0.00Hz	○
P04.21	V/F voltage point 3 of motor 2	0.0%–110.0% (of the motor rated voltage)	00.0%	○
P04.22	V/F slip compensation gain of motor 2	0.0–200.0%	0.0%	○
P04.23	Low-frequency oscillation control factor of motor 2	0–100	10	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P04.24</td><td>High-frequency oscillation control factor of motor 2</td><td>0–100</td><td>10</td><td>○</td></tr>
<tr><td>P04.25</td><td>Oscillation control threshold of motor 2</td><td>0.00Hz–P00.03 (Max. frequency)</td><td>30.00Hz</td><td>○</td></tr>
<tr><td>P04.26</td><td>Energy-saving run</td><td>0: Disable
1: Automatic energy-saving run
In light-load state, the motor can adjust the output voltage automatically to achieve energy saving.</td><td>0</td><td>◎</td></tr>
<tr><td>P04.27</td><td>Voltage setting channel</td><td>0: Keypad (The output voltage is determined by P04.28.)
1: AI1
2: AI2
3: AI3
4: Reserved
5: Multi-step speed running (The setting is determined by group P10.)
6: PID
7: Modbus communication
8: CANopen communication
9: Ethernet communication
10: Reserved
11: EtherCAT/PROFINET communication
12: Programmable expansion card
13: PROFIBUS-DP/DeviceNet communication</td><td>0</td><td>○</td></tr>
<tr><td>P04.28</td><td>Voltage set through keypad</td><td>The function parameter is the voltage digital setting when "keypad" is selected as the voltage setting channel.
Setting range: 0.0%–100.0%</td><td>100.0%</td><td>○</td></tr>
<tr><td>P04.29</td><td>Voltage increase time</td><td rowspan="2">Voltage increase time means the time needed for the inverter unit to accelerate from min. output voltage to the max. output frequency.
Voltage decrease time means the time needed for the inverter unit to decelerate from the max. output frequency to min. output voltage.
Setting range: 0.0–3600.0s</td><td>5.0s</td><td>○</td></tr>
<tr><td>P04.30</td><td>Voltage decrease time</td><td>5.0s</td><td>○</td></tr>
<tr><td>P04.31</td><td>Max. output voltage</td><td rowspan="2">Used to set the upper and lower limits of output voltage.


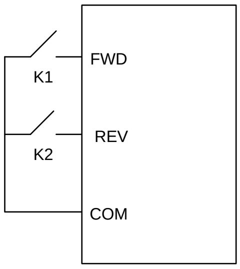
P04.31 setting range: P04.32–100.0% (of the motor rated voltage)
P04.32 setting range: 0.0%–P04.31</td><td>100.0%</td><td>◎</td></tr>
<tr><td>P04.32</td><td>Min. output voltage</td><td>0.0%</td><td>◎</td></tr>
</table>

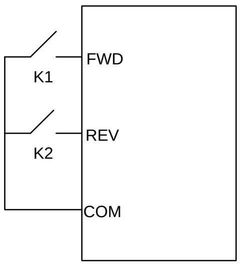
Function code	Name	Description	Default	Modify
P04.33	Weakening coefficient in constant power zone	1.00–1.30	1.00	○
P04.34	Pull-in current 1 in SM VF control	-100.0%–100.0% (of the motor rated current)	20.0%	○
P04.35	Pull-in current 2 in SM VF control	-100.0%–100.0% (of the motor rated current)	10.0%	○
P04.36	Frequency threshold for pull-in current switching in SM V/F control	0.0%–200.0% (of the rated motor frequency)	20.0%	○
P04.37	Reactive current closed-loop proportional coefficient in SM V/F control	0–3000	50	○
P04.38	Reactive current closed-loop integral time in SM V/F control	0–3000	30	○
P04.39	Reactive current closed-loop output limit in SM VF control	0–16000	8000	○
P04.40	Enabling IF mode for AM 1	0–1	0	◎
P04.41	Current setting in IF mode for AM 1	0.0–200.0%	120.0%	○
P04.42	Proportional coefficient in IF mode for AM 1	0–5000	350	○
P04.43	Integral coefficient in IF mode for AM 1	0–5000	150	○
P04.44	Starting frequency point for switching off IF mode for AM 1	0.00–P04.50	10.00Hz	○
P04.45	Enabling IF mode for AM 2	0–1	0	◎
P04.46	Current setting in IF mode for AM 2	0.0–200.0%	120.0%	○
P04.47	Proportional coefficient in IF mode for AM 2	0–5000	350	○
P04.48	Integral coefficient in IF mode for AM 2	0–5000	150	○
P04.49	Starting frequency point for switching off IF mode for AM 2	0.00–P04.51	10.00Hz	○
P04.50	End frequency point for switching off IF mode for AM 1	P04.44–P00.03	25.00Hz	○
P04.51	End frequency point for switching off IF mode for AM 2	P04.49–P00.03	25.00Hz	○

P05 group—Input terminals

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P05.00</td><td>Reserved</td><td></td><td></td><td></td></tr>
<tr><td>P05.01</td><td>Function of S1</td><td rowspan="6">0: No function
1: Run forward
2: Run reversely
3: Three-wire running control
4: Jog forward
5: Jog reversely
6: Coast to stop
7: Reset faults
8: Pause running
9: External fault input
10: Increase frequency setting (UP)
11: Decrease frequency setting (DOWN)
12: Clear the frequency increase/decrease setting
13: Switch between A setting and B setting
14: Switch between combination setting and A setting
15: Switch between combination setting and B setting
16: Multi-step speed terminal 1
17: Multi-step speed terminal 2
18: Multi-step speed terminal 3
19: Multi-step speed terminal 4
20: Pause multi-step speed running
21: ACC/DEC time selection 1
22: ACC/DEC time selection 2
23: Simple PLC stop reset
24: Pause simple PLC
25: Pause PID control
26: Limit on forward running
27: Limit on reverse running
28: Counter reset
29: Switch between speed control and torque control
30: Disable ACC/DEC
31: Trigger the counter
32: Reserved
33: Clear the frequency increase/decrease setting temporarily
34: DC braking
35: Switch from motor 1 to motor 2
36: Switch the running command channel to keypad
37: Switch the running command channel to terminal
38: Switch the running command channel to communication</td><td>1</td><td>◎</td></tr>
<tr><td>P05.02</td><td>Function of S2</td><td>4</td><td>◎</td></tr>
<tr><td>P05.03</td><td>Function of S3</td><td>7</td><td>◎</td></tr>
<tr><td>P05.04</td><td>Function of S4</td><td>0</td><td>◎</td></tr>
<tr><td>P05.05</td><td>Reserved</td><td>0</td><td>●</td></tr>
<tr><td>P05.06</td><td>Reserved</td><td>0</td><td>●</td></tr>
</table>

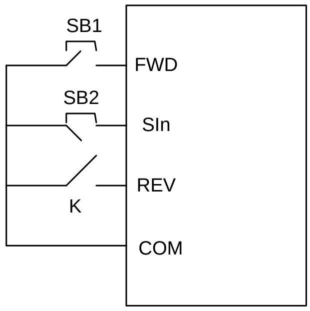
Function code	Name	Description	Default	Modify
		39: Pre-exciting command 40: Clear electricity consumption 41: Keep electricity consumption 42: Switch the setting source of braking torque upper limit to keypad 43: Position reference point input (only valid for S1, S2 and S3) 44: Disable spindle orientation 45: Spindle zeroing / Local positioning zeroing 46: Spindle zeroing position selection 1 47: Spindle zeroing position selection 2 48: Spindle scale division selection 1 49: Spindle scale division selection 2 50: Spindle scale division selection 3 51: Terminal for switching between position control and speed control 52: Disable pulse input 53: Clear position deviation 54: Switch position proportional gains 55: Enable cyclic digital positioning 56: Emergency stop 57: Motor overtemperature fault input 58: Enable rigid tapping 59: Switch to V/F control 60: Switch to VC control 61: Switch PID polarities 62: Reserved 63: Enable servo 64: Limit on forward running 65: Limit on reverse running 66: Clear encoder counting 67: Increase pulses 68: Enable pulse superposition 69: Decrease pulses 70: Electronic gear selection 71: Switch to the master 72: Switch to the slave 73: Reset roll diameter 74: Switch winding/unwinding 75: Pre-drive 76: Stop roll diameter calculation 77: Clear alarm display 78: Manual braking 79: Trigger forced feeding interrupt 80: Initial roll diameter 1 81: Initial roll diameter 2 82: Reserved 83: Switch tension PID 84–95: Reserved		
P05.07	Reserved			

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P05.08</td><td>Input terminal polarity</td><td>Used to set the polarity of input terminals.
When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative.
0x000–0x0F
<table><tr><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr></table></td><td>0x000</td><td>○</td></tr>
<tr><td>P05.09</td><td>Digital input filter time</td><td>Used to specify the filter time of S1–S4 terminal sampling. In strong interference cases, increase the value to avoid maloperation.
0.000–1.000s</td><td>0.010s</td><td>○</td></tr>
<tr><td>P05.10</td><td>Virtual terminal setting</td><td>0x000–0x0F (0: Disable; 1: Enable)
BIT0: S1 virtual terminal
BIT1: S2 virtual terminal
BIT2: S3 virtual terminal
BIT3: S4 virtual terminal</td><td>0x00</td><td>◎</td></tr>
<tr><td>P05.11</td><td>Terminal control mode</td><td>Used to set the mode of terminal control.
0: Two-wire control 1, the enabling consistent with the direction. This mode is widely used. The defined FWD/REV terminal command determines the motor rotation direction.


<table><tr><td>FWD</td><td>REV</td><td>Running command</td></tr><tr><td>OFF</td><td>OFF</td><td>Stop</td></tr><tr><td>ON</td><td>OFF</td><td>Forward running</td></tr><tr><td>OFF</td><td>ON</td><td>Reverse running</td></tr><tr><td>ON</td><td>ON</td><td>Hold</td></tr></table>
1: Two-wire control 2, the enabling separated from the direction. In this mode, FWD is the enabling terminal. The direction depends on the defined REV state.


<table><tr><td>FWD</td><td>REV</td><td>Running command</td></tr><tr><td>OFF</td><td>OFF</td><td>Stop</td></tr><tr><td>ON</td><td>OFF</td><td>Forward running</td></tr><tr><td>OFF</td><td>ON</td><td>Stop</td></tr><tr><td>ON</td><td>ON</td><td>Reverse running</td></tr></table>
2: Three-wire control 1. This mode defines Sin as the enabling terminal, and the running command is generated by FWD, while the direction is controlled by REV. During inverter unit running, the Sin terminal needs to be closed. The terminal FWD generates a rising edge signal, and then the inverter unit starts to run in the direction set by the state of terminal REV; the inverter unit</td><td>0</td><td>◎</td></tr>
</table>

Function code	Name	Description	Default	Modify
		needs to be stopped by disconnecting terminal Sin.		

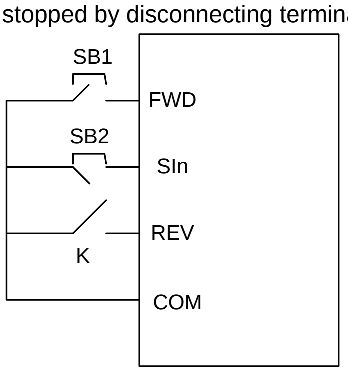


The direction control is as follows during running:

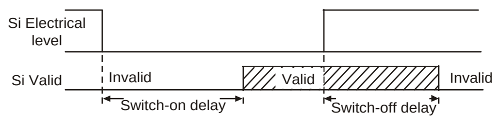
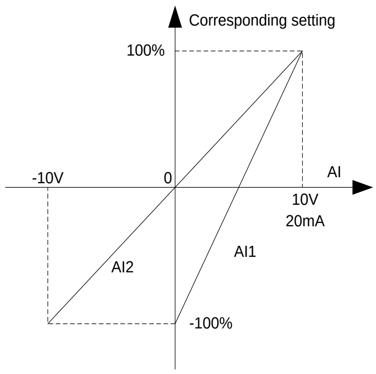
Sin	REV	Previous direction	Present direction
ON	OFF→ON	FWD run	REV run
		REV run	FWD run
ON	ON→OFF	REV run	FWD run
		FWD run	REV run
ON→OFF	ON	Decelerate to stop	
	OFF		

Sin: Three-wire control; FWD: Forward running; REV: Reverse running

3: Three-wire control 2. This mode defines Sin as the enabling terminal, and the running command is generated by FWD or REV, but the direction is controlled by both FWD and REV. During inverter unit running, the Sin terminal needs to be closed. The terminal FWD or REV generates a rising edge signal to control the running and direction of the inverter unit; the inverter unit needs to be stopped by disconnecting terminal Sin.



Sin	FWD	REV	Running direction
ON	OFF→ON	ON	FWD run
		OFF	FWD run
ON	ON	OFF→ON	REV run
	OFF		REV run
ON→OFF	/	/	Decelerate to stop
	/	/	

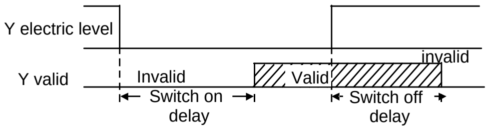
Function code	Name	Description	Default	Modify
		Sin: Three-wire control; FWD: Forward running; REV: Reverse running **Note: For two-wire controlled running mode, when the FWD/REV terminal is valid, if the inverter unit stops due to a stop command given by another source, the inverter unit does not run again after the stop command disappears even if the control terminal FWD/REV is still valid. To make the inverter unit run, you need to trigger FWD/REV again.**		
P05.12	S1 switch-on delay	Used to specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.  Setting range: 0.000–50.000s	0.000s	○
P05.13	S1 switch-off delay		0.000s	○
P05.14	S2 switch-on delay		0.000s	○
P05.15	S2 switch-off delay		0.000s	○
P05.16	S3 switch-on delay		0.000s	○
P05.17	S3 switch-off delay		0.000s	○
P05.18	S4 switch-on delay		0.000s	○
P05.19	S4 switch-off delay		0.000s	○
P05.20–P05.23	Reserved			
P05.24	AI1 lower limit	Used to define the relationship between the analog input voltage and its corresponding setting. When the analog input voltage exceeds the range from the upper limit to the lower limit, the upper limit or lower limit is used. When the analog input is current input, 0mA–20mA current corresponds to 0V–10V voltage. In different applications, 100.0% of the analog setting corresponds to different nominal values. See the descriptions of each application section for details. The following figure illustrates the cases of several settings:  Input filter time: to adjust the sensitivity of analog input. Increasing the value properly can enhance analog input anti-interference but may reduce the sensitivity of analog input.	0.00V	○
P05.25	Corresponding setting of AI1 lower limit		0.0%	○
P05.26	AI1 upper limit		10.00V	○
P05.27	Corresponding setting of AI1 upper limit		100.0%	○
P05.28	AI1 input filter time		0.030s	○
P05.29	AI2 lower limit		-10.00V	○
P05.30	Corresponding setting of AI2 lower limit		-100.0%	○
P05.31	AI2 middle value 1		0.00V	○
P05.32	Corresponding setting of AI2 middle value 1		0.0%	○
P05.33	AI2 middle value 2		0.00V	○
P05.34	Corresponding setting of AI2 middle value 2		0.0%	○
P05.35	AI2 upper limit		10.00V	○
P05.36	Corresponding setting of AI2 upper limit		100.0%	○
P05.37	AI2 input filter time		0.030s	○

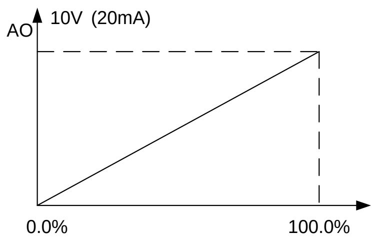
Function code	Name	Description	Default	Modify
		Note: AI1 supports the 0(2)–10V/0(4)–20mA input. When AI1 selects the 0–20mA input, the corresponding voltage of 20mA is 10V. AI2 supports the -10–+10V input. P05.24 setting range: 0.00V–P05.26 P05.25 setting range: -300.0%–300.0% P05.26 setting range: P05.24–10.00V P05.27 setting range: -300.0%–300.0% P05.28 setting range: 0.000s–10.000s P05.29 setting range: -10.00V–P05.31 P05.30 setting range: -300.0%–300.0% P05.31 setting range: P05.29– P05.33 P05.32 setting range: -300.0%–300.0% P05.33 setting range: P05.31– P05.35 P05.34 setting range: -300.0%–300.0% P05.35 setting range: P05.33–10.00V P05.36 setting range: -300.0%–300.0% P05.37 setting range: 0.000s–10.000s		
P05.38–P05.49	Reserved			
P05.50	AI1 input signal type	0–1 0: Voltage 1: Current	0	◎
P05.51–P05.52	Reserved			

P06 group—Output terminals

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P06.00</td><td>Reserved</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P06.01</td><td>Y1 output</td><td rowspan="4">0: Disable
1: Running
2: Running forward
3: Running reversely
4: Jogging
5: Inverter unit fault
6: Frequency level detection FDT1
7: Frequency level detection FDT2
8: Frequency reached
9: Running in zero speed
10: Upper limit frequency reached
11: Lower limit frequency reached
12: Ready for running
13: Pre-exciting
14: Overload pre-alarm
15: Underload pre-alarm
16: Simple PLC stage completed</td><td>0</td><td>○</td></tr>
<tr><td>P06.02</td><td>Reserved</td><td>0</td><td>●</td></tr>
<tr><td>P06.03</td><td>RO1 output</td><td>1</td><td>○</td></tr>
<tr><td>P06.04</td><td>RO2 output</td><td>5</td><td>○</td></tr>
</table>

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>17: Simple PLC cycle completed
18: Set counting value reached
19: Designated counting value reached
20: External fault is valid
21: Reserved
22: Running time reached
23: Modbus communication virtual terminal output
24: PROFIBUS-DP/DeviceNET communication virtual terminal output
25: Ethernet communication virtual terminal output
26: DC bus voltage established
27: Z pulse output
28: Superposing pulses
29: STO action
30: Positioning completed
31: Spindle zeroing completed
32: Spindle scale division completed
33: In speed limit
34: EtherCAT/PROFINET communication virtual terminal output
35: CANopen communication virtual terminal output
36: Speed/position control switchover completed
37: Any frequency reached
38–40: Reserved
41: C_Y1 from PLC (Set P27.00 to 1.)
42–43: Reserved
44: C_RO1 from PLC (Set P27.00 to 1.)
45: C_RO2 from PLC (Set P27.00 to 1.)
46: C_RO3 from PLC (Set P27.00 to 1.)
47: C_RO4 from PLC (Set P27.00 to 1.)
48: PG card detected motor OH pre-alarm
49: IO card detected motor OH pre-alarm
50: AO detected motor OH pre-alarm
51: Stopped or running in zero speed
52: Trigger forced feeding interrupt
53: Reach the roll diameter set value
54: Reach the max. roll diameter
55: Reach the min. roll diameter
56–63: Reserved</td><td></td><td></td></tr>
<tr><td>P06.05</td><td>Output terminal polarity selection</td><td>Used to set the polarity of output terminals.
When a bit is 0, the input terminal is positive;
when a bit is 1, the input terminal is negative.<table><tr><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>RO2</td><td>RO1</td><td>Y1</td></tr></table>Setting range: 0x00–0x07</td><td>00</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
P06.06	Y1 switch-on delay	The function parameters specify the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off.  Setting range: 0.000–50.000s	0.000s	○
P06.07	Y1 switch-off delay		0.000s	○
P06.08	Reserved			
P06.09	Reserved			
P06.10	RO1 switch-on delay		0.000s	○
P06.11	RO1 switch-off delay		0.000s	○
P06.12	RO2 switch-on delay		0.000s	○
P06.13	RO2 switch-off delay		0.000s	○
P06.14	AO1 output	0: Running frequency (0–Max. output frequency) 1: Set frequency (0–Max. output frequency) 2: Ramp reference frequency (0–Max. output frequency) 3: Rotational speed (0–Speed corresponding to max. output frequency) 4: Output current (0–Twice the inverter unit rated current) 5: Output current (0–Twice the motor rated current) 6: Output voltage (0–1.5 times the inverter unit rated voltage) 7: Output power (0–Twice the motor rated power) 8: Set torque (0–Twice the motor rated torque) 9: Output torque (Absolute value, 0–±Twice the motor rated torque) 10: AI1 input (0(2)–10V/0(4)–20mA) 11: AI2 input (0–10V) 12: AI3 input (0(2)–10V/0(4)–20mA) 13: Reserved 14: Value 1 set through Modbus communication (0–1000) 15: Value 2 set through Modbus communication (0–1000) 16: Value 1 set through PROFIBUS-DP/DeviceNet communication (0–1000) 17: Value 2 set through PROFIBUS-DP/DeviceNet communication (0–1000) 18: Value 1 set through Ethernet communication (0–1000) 19: Value 2 set through Ethernet communication (0–1000) 20: Reserved 21: Value 1 set through EtherCAT/PROFINET communication (0–1000) 22: Torque current (bipolar, 0–Triple the motor	0	○
P06.15	Reserved		0	○
P06.16	Reserved		0	○

Function code	Name	Description	Default	Modify
		rated current) 23: Exciting current (bipolar, 0–Triple the motor rated current) 24: Set frequency (bipolar, 0–Max. output frequency) 25: Ramp reference frequency (bipolar, 0–Max. output frequency) 26: Rotational speed (bipolar, 0–Speed corresponding to max. output 27: Value 2 set through EtherCAT/PROFINET communication (0–1000) 28: C_AO1 (Set P27.00 to 1. 0–1000) 29: C_AO2 (Set P27.00 to 1. 0–1000) 30: Rotational speed (0–Twice the motor rated synchronous speed) 31: Output torque (Actual value, 0–Twice the motor rated torque) 32: Value 1 set through CANopen communication (0–1000) 33: Value 2 set through CANopen communication (0–1000) 34–47: Reserved		
P06.17	Voltage-type AO1 output lower limit	Used to define the relationship between the output value and analog output. When the output value exceeds the allowed range, the output uses the lower limit or upper limit. When the analog output is current output, 1mA equals 0.5V. In different cases, the corresponding analog output of 100% of the output value is different.  P06.17 setting range: -300.0%–P06.19 P06.18 setting range: 0.00V–10.00V P06.19 setting range: P06.17–300.0% P06.20 setting range: 0.00V–10.00V P06.21 setting range: 0.000s–10.000s	0.0%	○
P06.18	AO1 output corresponding to lower limit		0.00V	○
P06.19	Voltage-type AO1 output upper limit		100.0%	○
P06.20	AO1 output corresponding to upper limit		10.00V	○
P06.21	AO1 output filter time		0.000s	○
P06.22	Current-type AO1 output lower limit	-300.0%–P06.24	0.0%	○
P06.23	AO1 output corresponding to lower limit (Current type)	0.00mA–20.00mA	0.00mA	○

Function code	Name	Description	Default	Modify
P06.24	Current-type AO1 output upper limit	P06.22–300.0%	100.0%	○
P06.25	AO1 output corresponding to upper limit (Current type)	0.00mA–20.00mA	20.00mA	○
P06.26–P06.31	Reserved	0–65535	0	●
P06.32	AO1 output signal type	0–1 0: Voltage 1: Current	0	◎
P06.33	Detection value for frequency being reached	0–P00.03	1.00Hz	○
P06.34	Frequency reaching detection time	0–3600.0s	0.5s	○

P07 group—Human-machine interface

Function code	Name	Description	Default	Modify
P07.00	User password	0–65535 When you set the function code to a non-zero number, password protection is enabled. If you set the function code to 00000, the previous user password is cleared and password protection is disabled. After the user password is set and takes effect, you cannot enter the parameter menu if you enter an incorrect password. Please remember your password and save it in a secure place. After you exit the function code editing interface, the password protection function is enabled within 1 minute. If password protection is enabled, "0.0.0.0.0" is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface. **Note: Restoring the default values may delete the user password. Exercise caution when using this function.**	0	○
P07.01	Reserved			
P07.02	Function of QUICK/JOG	Range: 0x00–0x27 Ones place: Function of QUICK/JOG 0: No function 1: Jog 2: Reserved 3: Switch between forward and reverse rotating	0x01	◎

Function code	Name	Description	Default	Modify
		4: Clear the UP/DOWN setting 5: Coast to stop 6: Switch command channels in sequence 7: Reserved Tens place: Reserved		
P07.03	Reserved			
P07.04	Stop function validity of STOP/RST	0: Valid only for keypad control 1: Valid both for keypad and terminal control 2: Valid both for keypad and communication control 3: Valid for all control modes	0	○
P07.05	Selection 1 of parameters to be displayed in the running state	0x0000–0xFFFF Bit 0: Running frequency (Hz on) Bit 1: Set frequency (Hz blinking) Bit 2: Bus voltage (V on) Bit 3: Output voltage (V on) Bit 4: Output current (A on) Bit 5: Running speed (rpm on) Bit 6: Output power (% on) Bit 7: Output torque (% on) Bit 8: PID reference value (% blinking) Bit 9: PID feedback value (% on) Bit 10: Input terminal state Bit 11: Output terminal state Bit 12: Set torque (% on) Bit 13: Count value Bit 14: Motor overload percentage (% on) Bit 15: PLC and current step number of multi-step speed	0x03FF	○
P07.06	Selection 2 of parameters to be displayed in the running state	0x0000–0xFFFF Bit 0: AI1 (V on) Bit 1: AI1 (V on) Bit 2: AI3 (V on) Bit 3: Reserved Bit 4: Reserved Bit 5: Inverter overload percentage (% on) Bit 6: Ramp frequency reference (Hz on) Bit 7: Linear speed Bit 8: AC incoming current Bit 9–15: Reserved	0x0000	
P07.07	Selection of parameters to be displayed in the stop state	0x0000–0xFFFF BIT0: Set frequency (Hz on, blinking slowly) Bit 1: Bus voltage (V on) Bit 2: Input terminal state Bit 3: Output terminal state Bit 4: PID reference value (% blinking) Bit 5: PID feedback value (% on) Bit 6: Set torque (% on)	0x00FF	○

Function code	Name	Description	Default	Modify
		Bit 7: AI1 (V on) Bit 8: AI2 (V on) Bit 9: AI3 (V on) Bit 10: Reserved Bit 11: Reserved Bit 12: Count value Bit 13: PLC and current step number of multi-step speed Bit 14–15: Reserved		
P07.08	Frequency display coefficient	0.01–10.00 Display frequency = Running frequency * P07.08	1.00	○
P07.09	Rotational speed display coefficient	0.1–999.9% Mechanical rotation speed = 120 * (Displayed running frequency) * P07.09/(Motor pole pairs)	100.0%	○
P07.10	Linear speed display coefficient	0.1–999.9% Linear speed=(Mechanical rotation speed) * P07.10	1.0%	○
P07.11	Heat sink temperature	-20.0–120.0°C	/	●
P07.12	Inverter temperature	-20.0–120.0°C	/	●
P07.13	Control board software version	1.00–655.35	/	●
P07.14	Local accumulative running time	0–65535h	/	●
P07.15	Inverter unit electricity consumption high-order bits	Used to display the electricity consumption of the inverter unit. Inverter unit electricity consumption =P07.15*1000+P07.16 P07.15 setting range: 0–65535 kWh (*1000) P07.16 setting range: 0.0–999.9 kWh	/	●
P07.16	Inverter unit electricity consumption low-order bits		/	●
P07.17	Reserved		/	
P07.18	Inverter unit rated power	0.4–3000.0kW	/	●
P07.19	Inverter unit rated voltage	50–1200V	/	●
P07.20	Inverter unit rated current	0.1–6000.0A	/	●
P07.21	Factory bar code 1	0x0000–0xFFFF	/	●
P07.22	Factory bar code 2	0x0000–0xFFFF	/	●
P07.23	Factory bar code 3	0x0000–0xFFFF	/	●
P07.24	Factory bar code 4	0x0000–0xFFFF	/	●
P07.25	Factory bar code 3	0x0000–0xFFFF	/	●
P07.26	Factory bar code 4	0x0000–0xFFFF	/	●
P07.27	Type of present fault	0: No fault 1: Inverter unit U-phase protection (OUt1) 2: Inverter unit V-phase protection (OUt2) 3: Inverter unit W-phase protection (OUt3) 4: Overcurrent during acceleration (OC1) 5: Overcurrent during deceleration (OC2)	/	●
P07.28	Last fault type		/	●
P07.29	2nd-last fault type		/	●
P07.30	3rd-last fault type		/	●
P07.31	4th-last fault type		/	●
P07.32	5th-last fault type		/	●

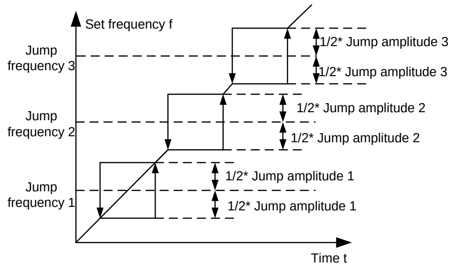
Function code	Name	Description	Default	Modify
		6: Overcurrent during constant speed running (OC3) 7: Overvoltage during acceleration (OV1) 8: Overvoltage during deceleration (OV2) 9: Overvoltage during constant speed running (OV3) 10: Bus undervoltage fault (UV) 11: Motor overload (OL1) 12: Inverter unit overload (OL2) 13: CAN fault in master/slave synchronization (SECAN) 14: Phase loss on output side (SPO) 15: Reserved 16: Inverter module overheat (OH2) 17: External fault (EF) 18: RS485 communication fault (CE) 19: Current detection fault (ItE) 20: Motor autotuning fault (tE) 21: EEPROM operation error (EEP) 22: PID feedback offline fault (PIDE) 23: CAN slave fault in master/slave synchronization (S-Err) 24: Running time reached (END) 25: Electronic overload (OL3) 26: Keypad communication error (PCE) 27: Parameter upload error (UPE) 28: Parameter download error (DNE) 29: PROFIBUS communication fault (E_dP) 30: Ethernet communication fault (E_NET) 31: CANopen communication fault (E_CAN) 32: To-ground short-circuit fault 1 (ETH1) 33: To-ground short-circuit fault 2 (ETH2) 34: Speed deviation fault (dEu) 35: Mal-adjustment fault (STo) 36: Underload fault (LL) 37: Encoder disconnection fault (ENC1O) 38: Encoder direction reversal fault (ENC1D) 39: Encoder Z-pulse disconnection fault (ENC1Z) 40: Safe torque off (STO) 41: Channel 1 safety circuit exception (STL1) 42: Channel 2 safety circuit exception (STL2) 43: Exception in both channels 1 and 2 (STL3) 44: Safety code FLASH CRC fault (CrCE) 45: Programmable card customized fault 1 (P-E1) 46: Programmable card customized fault 2 (P-E2)		

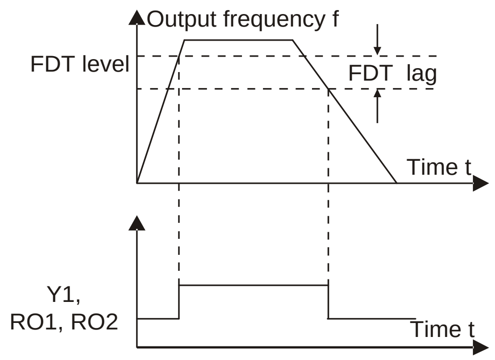
Function code	Name	Description	Default	Modify
		47: Programmable card customized fault 3 (P-E3) 48: Programmable card customized fault 4 (P-E4) 49: Programmable card customized fault 5 (P-E5) 50: Programmable card customized fault 6 (P-E6) 51: Programmable card customized fault 7 (P-E7) 52: Programmable card customized fault 8 (P-E8) 53: Programmable card customized fault 9 (P-E9) 54: Programmable card customized fault 10 (P-E10) 55: Duplicate expansion card type (E-Err) 56: Encoder UVW lost (ENCUV) 57: PROFINET communication timeout fault (E_PN) 58: Reserved 59: Motor overtemperature fault (OT) 60: Failure to identify the card at slot 1 (F1-Er) 61: Failure to identify the card at slot 2 (F2-Er) 62: PG card detected motor overtemperature fault (E-OT2) 63: Communication timeout of the card at slot 1 (C1-Er) 64: Communication timeout of the card at slot 2 (C2-Er) 65: IO card detected motor overtemperature fault (E-OT3) 66: EtherCAT card communication fault (E-CAT) 67: BACnet card communication fault (E-BAC) 68: DeviceNet card communication fault (E-DEV) 69: CAN slave fault in master/slave synchronization (S-Err) 70: AI detected motor overtemperature fault (E-OT4) 71: Reserved		
P07.33	Running frequency at present fault		0.00Hz	●
P07.34	Ramp reference frequency at present fault		0.00Hz	●
P07.35	Output current at present fault		0V	●
P07.36	Output current at present fault		0.0A	●
P07.37	Bus voltage at present fault		0.0V	●
P07.38	Max. temperature at present fault		0.0°C	●
P07.39	Input terminal status at present fault		0	●
P07.40	Output terminal status at present fault		0	●

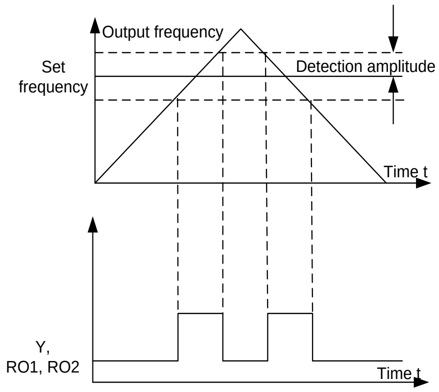
Function code	Name	Description	Default	Modify
P07.41	Running frequency at last fault		0.00Hz	●
P07.42	Ramp reference frequency at last fault		0.00Hz	●
P07.43	Output voltage at last fault		0V	●
P07.44	Output current at last fault		0.0A	●
P07.45	Bus voltage at last fault		0.0V	●
P07.46	Temperature at last fault	-20.0–120.0°C	0.0°C	●
P07.47	Input terminal status at last fault		0	●
P07.48	Output terminal status at last fault		0	●
P07.49	Running frequency at 2nd-last fault		0.00Hz	●
P07.50	Ramp reference frequency at 2nd-last fault		0.00Hz	●
P07.51	Output voltage at 2nd-last fault		0V	●
P07.52	Output current at 2nd-last fault		0.0A	●
P07.53	Bus voltage at 2nd-last fault		0.0V	●
P07.54	Temperature at 2nd-last fault	-20.0–120.0°C	0.0°C	●
P07.55	Input terminal status at 2nd-last fault		0	●
P07.56	Output terminal status at 2nd-last fault		0	●

P08 group—Enhanced functions

Function code	Name	Description	Default	Modify
P08.00	ACC time 2	For details, see P00.11 and P00.12. The inverter unit has four groups of ACC/DEC time, which can be selected by P05. The default ACC/DEC time of the inverter unit is the first group. Setting range: 0.0–3600.0s	Model depended	○
P08.01	DEC time 2			○
P08.02	ACC time 3			○
P08.03	DEC time 3			○
P08.04	ACC time 4			○
P08.05	DEC time 4			○
P08.06	Running frequency of jog	Used to define the reference frequency of the inverter unit during jogging. Setting range: 0.00Hz–P00.03 (Max. output frequency)	5.00Hz	○
P08.07	ACC time for jogging	ACC time for jogging means the time needed if the inverter unit speeds up from 0Hz to the max. output frequency (P00.03). DEC time for jogging means the time needed if the inverter unit speeds down from the max. output frequency (P00.03) to 0Hz. Setting range: 0.0–3600.0s	Model depended	○
P08.08	DEC time for jogging			○
P08.09	Jump frequency 1	When the set frequency is within the range of jump frequency, the inverter unit runs at the boundary of jump frequency. The inverter unit can avoid mechanical resonance points by setting jump frequencies. The inverter unit supports the setting of three jump frequencies. If the jump frequency points are set to 0, this function is invalid.	0.00Hz	○
P08.10	Jump frequency amplitude 1		0.00Hz	○
P08.11	Jump frequency 2		0.00Hz	○
P08.12	Jump frequency amplitude 2		0.00Hz	○
P08.13	Jump frequency 3		0.00Hz	○
P08.14	Jump frequency amplitude 3		0.00Hz	○

Function code	Name	Description	Default	Modify
		 Setting range: 0.00Hz–P00.03 (Max. output frequency)		
P08.15	Amplitude of wobbling frequency	0.0–100.0% (of the set frequency)	0.0%	○
P08.16	Amplitude of sudden jump frequency	0.0–50.0% (of the amplitude of wobbling frequency)	0.0%	○
P08.17	Rise time of wobbling frequency	0.1–3600.0s	5.0s	○
P08.18	Fall time of wobbling frequency	0.1–3600.0s	5.0s	○
P08.19	Switching frequency of ACC/DEC time	0.00–P00.03 (Max. frequency) 0.00Hz: No switchover If the running frequency is greater than P08.19, switch to ACC/DEC time 2.	0.00Hz	○
P08.20	Frequency threshold of the start of droop control	0.00–50.00Hz	2.00Hz	○
P08.21	Reference frequency of ACC/DEC time	0: Max. output frequency 1: Set frequency 2: 100Hz **Note: Valid only for straight-line ACC/DEC**	0	◎
P08.22	Reserved	0–65535	0	○
P08.23	Number of decimal points of frequency	0: Two 1: One	0	○
P08.24	Number of decimal places of linear speed	0: No decimal place 1: One 2: Two 3: Three	0	○
P08.25	Set counting value	P08.26-65535	0	○
P08.26	Designated counting value	0–P08.25	0	○
P08.27	Set running time	0–65535min	0min	○
P08.28	Auto fault reset count	Auto fault reset count: When the inverter unit uses automatic fault reset, the function parameter is used to set the number of automatic fault reset times. When the number of continuous reset times exceeds the value, the inverter unit reports a fault and stops. Auto fault reset interval: Time interval from when a fault occurred to when automatic fault reset takes effect.	0	○
P08.29	Auto fault reset interval		1.0s	○

Function code	Name	Description	Default	Modify
		If no fault occurred within 60s after the inverter unit starts, the number of automatic fault reset times is cleared. P08.28Setting range: 0–10 P08.29Setting range: 0.1–3600.0s		
P08.30	Frequency decrease ratio in drop control	The output frequency of the inverter unit changes as the load changes. The function code is mainly used to balance the power when several motors drive a same load. Setting range: 0.00–50.00Hz	0.00Hz	○
P08.31	Channel for switching between motor 1 and motor 2	0x00–0x15 LEDOnes place: Switchover channel 0: Terminal 1: Modbus communication 2: CANopen communication 3: Ethernet communication 4: EtherCAT/PROFINET communication 5: PROFIBUS-DP/DeviceNet communication LED tens place: indicates whether to enable switchover during running 0: Disable 1: Enable	0x00	◎
P08.32	FDT1 electrical level detection value	When the output frequency exceeds the corresponding frequency of FDT electrical level, the multifunction digital output terminal continuously outputs the signal of "Frequency level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the frequency corresponding to (FDT electrical level—FDT lagging detection value).  P08.32 setting range: 0.00Hz–P00.03 (Max. output frequency) P08.33 setting range: 0.0–100.0% (FDT1 electrical level) P08.34 setting range: 0.00Hz–P00.03 (Max. output frequency)	50.00Hz	○
P08.33	FDT1 lagging detection value		5.0%	○
P08.34	FDT2 electrical level detection value		50.00Hz	○
P08.35	FDT2 lagging detection value		5.0%	○

Function code	Name	Description	Default	Modify
		P08.35 setting range: 0.0–100.0% (FDT2 electrical level)		
P08.36	Detection value for frequency being reached	When the output frequency is within the detection range, the multifunction digital output terminal outputs the signal of "Frequency reached".  Setting range: 0.00Hz–P00.03 (Max. output frequency)	0.00Hz	○
P08.37	Reserved	0–65535	0	●
P08.38	Reserved	0–65535	0	●
P08.39	Cooling-fan running mode	0: Normal mode 1: Permanent running after power-on 2: Run mode 2	0	○
P08.40	PWM selection	0x0000–0x1121 Ones place: PWM mode selection 0: PWM mode 1, 3PH modulation and 2PH modulation 1: PWM mode 2, 3PH modulation Tens place: PWM low-speed carrier frequency limit 0: Low-speed carrier frequency limit mode 1 1: Low-speed carrier frequency limit mode 2 2: No limit on low-speed carrier frequency Hundreds place: Deadzone compensation method 0: Compensation method 1 1: Compensation method 2 Thousands place: PWM loading mode selection 0: Interruptive loading 1: Normal loading	0x1101	◎
P08.41	Overmodulation selection	0x00–0x1111 Ones place: 0: Disable 1: Enable Tens place: 0: Mild overmodulation	0001	◎

Function code	Name	Description	Default	Modify
		1: Deepened overmodulation Hundreds: Carrier frequency limit 0:Yes 1:No Thousands: Output voltage compensation 0:No 1:Yes		
P08.42	Keypad data control	0x0000–0x1221 Ones place: Frequency control enabling selection 0: Control through the ∧/∨ key is valid. 1: Control through the ∧/∨ key is invalid. Tens place: Frequency control selection 0: Valid only when P00.06=0 or P00.07=0 1: Valid for all frequency setting methods 2: Invalid for multi-step speed running when multi-step speed running has the priority Hundreds place: Action selection for stop 0: Setting is valid. 1: Valid during running, cleared after stop 2: Valid during running, cleared after a stop command is received Thousands place: Indicates whether to enable the integral function through the ∧/∨ key 0: Enable the integral function 1: Disable the integral function	0x0001	○
P08.43	Integral ratio controlled through keypad	1–65535	0	○
P08.44	UP/DOWN terminal control setting	0x000–0x221 Ones place: Frequency setting selection 0: The setting made through UP/DOWN is valid. 1: The setting made through UP/DOWN is invalid. Ones place: Frequency control selection 0: Valid only when P00.06=0 or P00.07=0 1: Valid for all frequency setting methods 2: Invalid for multi-step speed running when multi-step speed running has the priority Hundreds place: Action selection for stop 0: Setting is valid. 1: Valid during running, cleared after stop 2: Valid during running, cleared after a stop command is received	0x000	○
P08.45	Frequency increment integral rate of the UP terminal	0.01–50.00Hz/s	0.50 Hz/s	○
P08.46	Frequency integral rate of the DOWN terminal	0.01–50.00Hz/s	0.50 Hz/s	○

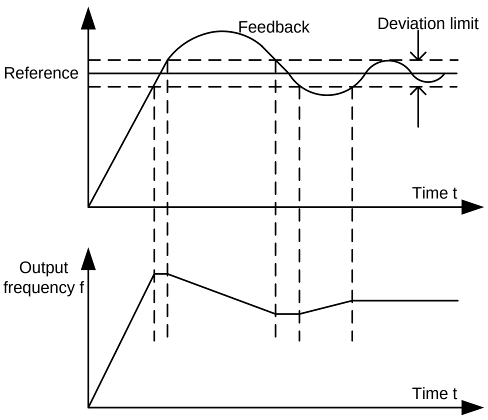
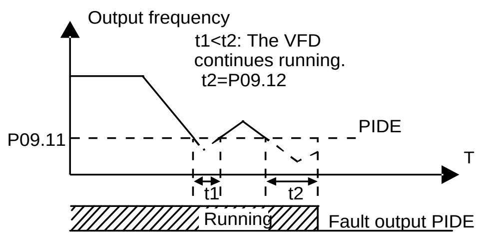
Function code	Name	Description	Default	Modify
P08.47	Action selection at power-off during frequency setting	0x000–0x111 Ones place: Action selection at power-off during frequency adjusting through digitals. 0: Save the setting at power-off. 1: Clear the setting at power-off. Action selection at power-off during frequency adjusting through Modbus communication 0: Save the setting at power-off. 1: Clear the setting at power-off. Hundreds place: Action selection at power-off during frequency adjusting through CANopen communication 0: Save the setting at power-off. 1: Clear the setting at power-off.	0x000	○
P08.48	Initial electricity consumption high-order bits	Used to set the initial electricity consumption. Initial electricity consumption = P08.48*1000 + P08.49 kWh P08.48 setting range: 0–59999 P08.49 setting range: 0.0–999.9	0kWh	○
P08.49	Initial electricity consumption low-order bits		0.0kWh	○
P08.50	Magnetic flux braking	Used to enable magnetic flux braking. 0: Disable 100–150: A larger coefficient indicates stronger braking. The inverter unit can quickly slow down the motor by increasing the magnetic flux. The energy generated by the motor during braking can be transformed into heat energy by increasing the magnetic flux. The inverter unit monitors the state of the motor continuously even during the magnetic flux period. Magnetic flux braking can be used for motor stop, as well as for motor rotation speed change. The other advantages include: Braking is performed immediately after the stop command is given. The braking can be started without waiting for magnetic flux weakening. The cooling is better. The current of the stator other than the rotor increases during magnetic flux braking, while the cooling of the stator is more effective than the rotor.	0	○
P08.51	Reserved			
P08.52	STO lock selection	0: Lock upon STO alarm Lock upon STO alarm indicates resetting is required after state restoration if STO occurs. 1: No lock on STO alarm No lock on STO alarm indicates STO alarm disappears automatically after state restoration if STO occurs.	0	○

Function code	Name	Description	Default	Modify
P08.53	Upper limit frequency bias value in torque control	0.00 Hz–P00.03 (Max. frequency)	0.00Hz	○
P08.54	Upper limit frequency ACC/DEC selection in torque control	0: No limit on acceleration or deceleration 1: ACC/DEC time 1 2: ACC/DEC time 2 3: ACC/DEC time 3 4: ACC/DEC time 4	0	○

P09 group—PID control

Function code	Name	Description	Default	Modify
P09.00	PID reference source	When the frequency command selection (P00.06, P00.07) is 7 or the voltage setting channel selection (P04.27) is 6, the inverter unit is process PID controlled. The function code determines the target given channel during the PID process. 0: Keypad (P09.01) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step running 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: Programmable expansion card 12: PROFIBUS-DP/DeviceNet communication The set target of process PID is a relative value, for which 100% equals 100% of the feedback signal of the controlled system. The system always performs calculation by using a relative value (0–100.0%).	0	○
P09.01	PID reference preset through keypad	The function code is mandatory when P09.00=0. The base value of The function code is the feedback of the system. Setting range: -100.0%–100.0%	0.0%	○
P09.02	PID feedback source	Used to select PID feedback channel. 0: AI1 1: AI2 2: AI3 3: Reserved 4: Modbus communication 5: CANopen communication 6: Ethernet communication	0	○

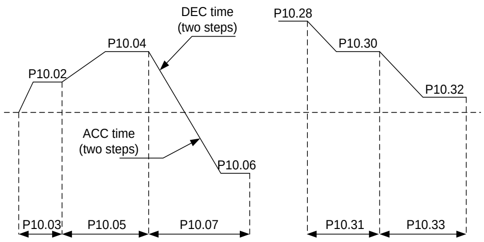
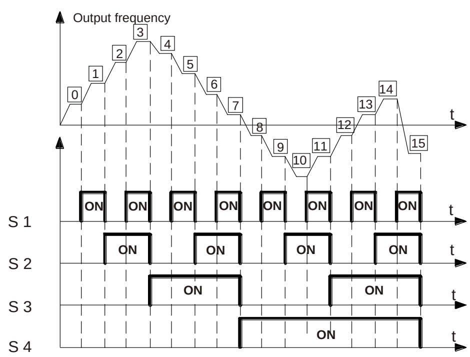
Function code	Name	Description	Default	Modify
		7: Reserved 8: EtherCAT/PROFINET communication 9: Programmable expansion card 10: MAX(AI1,AI2) 11: PROFIBUS-DP/DeviceNet communication **Note: The reference channel and feedback channel cannot be duplicate. Otherwise, effective PID control cannot be achieved.**		
P09.03	PID output characteristics selection	0: PID output is positive. When the feedback signal is greater than the PID reference value, the output frequency of the inverter unit will decrease to balance the PID. Example: PID control on strain during unwinding. 1: PID output is negative. When the feedback signal is greater than the PID reference value, the output frequency of the inverter unit will increase to balance the PID. Example: PID control on strain during unwinding	0	○
P09.04	Proportional gain (Kp)	The function is applied to the proportional gain P of PID input. P determines the strength of the whole PID adjuster. The value 100 indicates that when the difference between the PID feedback value and given value is 100%, the range within which the PID regulator can regulate the output frequency command is the max. frequency (ignoring integral function and differential function). Setting range: 0.00–100.00	1.80	○
P09.05	Integral time (Ti)	Used to determine the speed of the integral adjustment on the deviation of PID feedback and reference from the PID regulator. When the deviation of PID feedback and reference is 100%, the integral adjuster works continuously during the time (ignoring proportional and differential function) to achieve the max. output frequency (P00.03) or the max. voltage (P04.31). Shorter integral time indicates stronger adjustment. Setting range: 0.00–10.00s	0.90s	○
P09.06	Differential time(Td)	Used to determine the strength of the change ratio adjustment on the deviation of PID feedback and reference from the PID regulator. If the PID feedback changes 100% during the time, the adjustment of the differential regulator (ignoring proportional and integral function) is the max. output frequency (P00.03) or the max. voltage (P04.31). Longer differential time indicates stronger adjustment. Setting range: 0.00–10.00s	0.00s	○

Function code	Name	Description	Default	Modify
P09.07	Sampling cycle (T)	Used to indicate the sampling cycle of feedback. The regulator calculates in each sampling cycle. A longer sampling cycle indicates slower response. Setting range: 0.001–10.000s	0.001s	○
P09.08	PID control deviation limit	The output of the PID system is relative to the max. deviation of the closed loop reference. As shown in the following figure, the PID regulator stops regulating in the range of deviation limit. Set the function parameter properly to adjust the accuracy and stability of the PID system.  Setting range: 0.0–100.0%	0.0%	○
P09.09	PID output upper limit	Used to set the upper and lower limits of PID regulator output values. 100.0% corresponds to the max. output frequency (P00.03) or max. voltage (P04.31). P09.09 setting range: P09.10–100.0% P09.10 setting range: -100.0%–P09.09	100.0%	○
P09.10	PID output lower limit		0.0%	○
P09.11	Feedback offline detection value	Used to set the PID feedback offline detection value. When the feedback value is smaller than or equal to the feedback offline detection value, and the duration exceeds the value specified by P09.12, the inverter unit reports "PID feedback offline fault" and the keypad displays PIDE.  Setting range: 0.0–100.0%	0.0%	○
P09.12	Feedback offline detection time	Setting range: 0.0–3600.0s	1.0s	○
P09.13	PID control selection	0x0000–0x1111 Ones place:	0x0001	○

Function code	Name	Description	Default	Modify
		0: Continue integral control after the frequency reaches upper/lower limit 1: Stop integral control after the frequency reaches upper/lower limit Tens place: 0: Same as the main reference direction 1: Contrary to the main reference direction Hundreds place: 0: Limit as per the max. frequency 1: Limit as per A frequency Thousands place: 0: A+B frequency, acceleration /deceleration of main reference A frequency source buffering is invalid 1: A+B frequency, acceleration/ deceleration of main reference A frequency source buffering is valid, acceleration/deceleration is determined by P08.04 (acceleration time 4).		
P09.14	Low frequency proportional gain (Kp)	0.00–100.00	1.00	○
P09.15	ACC/DEC time of PID command	0.0–1000.0 s	0.0s	○
P09.16	PID output filter time	0.000–10.000 s	0.000s	○
P09.17	Reserved	-100.0–100.0%	0.0%	○
P09.18	Low frequency integral time (Ti)	0.00–10.00 s	0.90s	○
P09.19	Low frequency differential time (Td)	0.00–10.00 s	0.00s	○
P09.20	Low frequency point for PID parameter switching	0–P09.21	5.00Hz	○
P09.21	High frequency point for PID parameter switching	P09.20–P00.04	10.00Hz	○

P10 group—Simple PLC and multi-step speed control

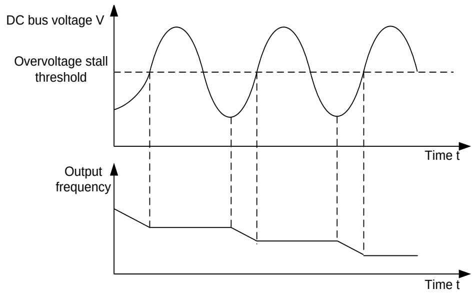
Function code	Name	Description	Default	Modify
P10.00	Simple PLC mode	0: Stop after running once; the inverter unit stops automatically after running for one cycle, and it can be started only after receiving the running command. 1: Keep running in the final value after running for one cycle. The inverter unit keeps the running frequency and direction of the last section after a single cycle. 2: Cyclic running. The inverter unit enters the next cycle after completing one cycle until receiving the stop command.	0	○

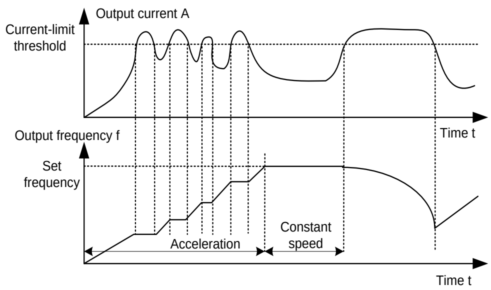
Function code	Name	Description	Default	Modify
P10.01	Simple PLC memory selection	0: No memory after power-off 1: Memory after power-off. The PLC memories its running stage and running frequency before power-off.	0	○
P10.02	Multi-step speed 0	Frequency setting range for steps from step 0 to step 15: -100.0–100.0%. 100.0% corresponds to the max. output frequency P00.03. Running time setting range for steps from step 0 to step 15: 0.0–6553.5s(min). The time unit is specified by P10.37. When simple PLC operation is selected, it is required to set P10.02–P10.33 to determine the running frequency and running time of each step. **Note: The symbol of multi-step speed determines the running direction of simple PLC, and the negative value means reverse running.**  When selecting multi-step speed running, the multi-step speed is within the range of -fmax–fmax, and it can be set continuously. The start/stop of multi-step stop running is also determined by P00.01. The inverter unit supports the setting of speeds of 16 steps, which are set by combined codes of multi-step terminals 1–4 (set by S terminals, corresponding to function code P05.01–P05.04) and correspond to multi-step speed 0 to multi-step speed 15.	0.0%	○
P10.03	Running time of step 0		0.0s (min)	○
P10.04	Multi-step speed 1		0.0%	○
P10.05	Running time of step 1		0.0s (min)	○
P10.06	Multi-step speed 2		0.0%	○
P10.07	Running time of step 2		0.0s (min)	○
P10.08	Multi-step speed 3		0.0%	○
P10.09	Running time of step 3		0.0s (min)	○
P10.10	Multi-step speed 4		0.0%	○
P10.11	Running time of step 4		0.0s (min)	○
P10.12	Multi-step speed 5		0.0%	○
P10.13	Running time of step 5		0.0s (min)	○
P10.14	Multi-step speed 6		0.0%	○
P10.15	Running time of step 6		0.0s (min)	○
P10.16	Multi-step speed 7		0.0%	○
P10.17	Running time of step 7		0.0s (min)	○
P10.18	Multi-step speed 8		0.0%	○
P10.19	Running time of step 8		0.0s (min)	○
P10.20	Multi-step speed 9		0.0%	○
P10.21	Running time of step 9		0.0s (min)	○
P10.22	Multi-step speed 10		0.0%	○
P10.23	Running time of step 10		0.0s (min)	○
P10.24	Multi-step speed 11		0.0%	○
P10.25	Running time of step 11		0.0s (min)	○
P10.26	Multi-step speed 12		0.0%	○
P10.27	Running time of step 12		0.0s (min)	○
P10.28	Multi-step speed 13		0.0%	○
P10.29	Running time of step 13		0.0s (min)	○
P10.30	Multi-step speed 14		0.0%	○
P10.31	Running time of step 14		0.0s (min)	○
P10.32	Multi-step speed 15		0.0%	○
P10.33	Running time of step 15	 When terminal 1, terminal 2, terminal 3 and terminal 4 are OFF, the frequency input mode is	0.0s (min)	○

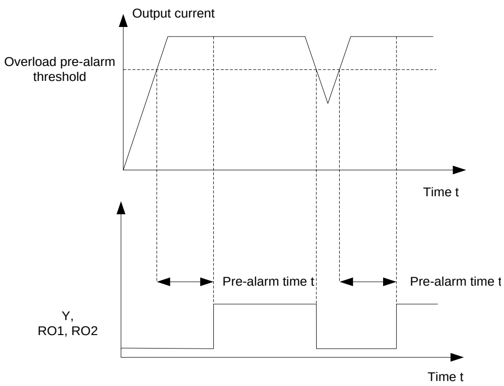
<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>set by P00.06 or P00.07. When terminal 1, terminal 2, terminal 3 and terminal 4 are not all OFF, the frequency set by multi-step speed will prevail, and the priority of multi-step setting is higher than that of the keypad, analog, high-speed pulse, PID, and communication settings.
The relation between terminal 1, terminal 2, terminal 3 and terminal 4 are shown in the following (T indicates terminal):
<table>
<tr><td>T1</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>T2</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>T3</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>T4</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>Step</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>T1</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>T2</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>T3</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>T4</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>Step</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>P10.34</td><td>ACC/DEC time of steps 0–7 of simple PLC</td><td rowspan="2">The description is as follows (St indicates step):
<table>
<tr><th>Code</th><th colspan="2">Binary</th><th>St</th><th>ACC/DEC T1</th><th>ACC/DEC T 2</th><th>ACC/DEC T3</th><th>ACC/DEC T4</th></tr>
<tr><td rowspan="8">P10.34</td><td>BIT1</td><td>BIT0</td><td>0</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT3</td><td>BIT2</td><td>1</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT5</td><td>BIT4</td><td>2</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT7</td><td>BIT6</td><td>3</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT9</td><td>BIT8</td><td>4</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT11</td><td>BIT10</td><td>5</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT13</td><td>BIT12</td><td>6</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT15</td><td>BIT14</td><td>7</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td rowspan="8">P10.35</td><td>BIT1</td><td>BIT0</td><td>8</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT3</td><td>BIT2</td><td>9</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT5</td><td>BIT4</td><td>10</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT7</td><td>BIT6</td><td>11</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT9</td><td>BIT8</td><td>12</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT11</td><td>BIT10</td><td>13</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT13</td><td>BIT12</td><td>14</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>BIT15</td><td>BIT14</td><td>15</td><td>00</td><td>01</td><td>10</td><td>11</td></tr>
</table>
Select corresponding acceleration/deceleration time, and then convert 16-bit binary number into hexadecimal number, finally, and then set corresponding function codes.
ACC/DEC time 1 is set by P00.11 and P00.12;
ACC/DEC time 2 is set by P08.00 and P08.01;
ACC/DEC time 3 is set by P08.02 and P08.03;</td><td>0x0000</td><td>○</td></tr>
<tr><td>P10.35</td><td>ACC/DEC time of steps 8–15 of simple PLC</td><td>0x0000</td><td>○</td></tr>
</table>

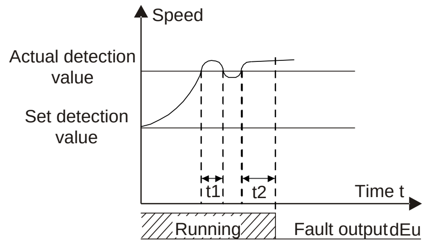
Function code	Name	Description	Default	Modify
		ACC/DEC time 4 is set by P08.04 and P08.05. Setting range: 0x0000–0xFFFF		
P10.36	PLC restart mode	0: Restart from the first step, namely if the VFD stops during running (caused by stop command, fault or power down), it will run from the first step after restart. 1: Continue running from the step frequency when interruption occurred, namely if the VFD stops during running (caused by stop command or fault), it will record the running time of current step, and enters this step automatically after restart, then continue running at the frequency defined by this step in the remaining time.	0	◎
P10.37	Multi-step time unit	0: second; the running time of each step is counted in seconds 1: minute; the running time of each step is counted in minutes	0	◎

P11 group—Protection parameters

Function code	Name	Description	Default	Modify
P11.00	Phase-loss protection	0x000–0x010 Ones place: Reserved Tens place: Output phase loss protection selection 0: Disable output phase loss protection 1: Enable output phase loss protection Hundreds place: Reserved	0x010	○
P11.01	Frequency drop at transient power-off	0: Disable 1: Enable	0	○
P11.02	Reserved	0–65535	0	○
P11.03	Overvoltage stall protection	0: Disable 1: Enable 	1	○
P11.04	Overvoltage stall protection voltage	120–150% (standard bus voltage) (380V)	136%	○
P11.05	Current limit selection	During accelerated running, as the load is too large, the actual acceleration rate of motor is lower than that of output frequency, if no measures are taken, the inverter unit may trip	01	◎

Function code	Name	Description	Default	Modify
		due to overcurrent during acceleration. 0x00–0x11 Ones place: Current limit action selection 0: Invalid 1: Always valid Tens place: Hardware current limit overload alarm selection 0: Valid 1: Invalid		
P11.06	Automatic current limit level	Current limit protection function detects output current during running, and compares it with the current-limit level defined by P11.06, if it exceeds the current-limit level, the inverter unit will run at stable frequency during accelerated running, or run in decreased frequency during constant-speed running; if it exceeds the current-limit level continuously, the inverter unit output frequency will drop continuously until reaching lower limit frequency. When the output current is detected to be lower than the current-limit level again, it will continue accelerated running.  P11.06 setting range: 50.0–200.0% (corresponding to the rated output current of the inverter unit) P11.07 setting range: 0.00–50.00Hz/s	160.0%	◎
P11.07	Frequency drop rate during current limit		10.00 Hz/s	◎
P11.08	Pre-alarm selection for inverter unit/motor OL/UL	0x000–0x1132 Ones place: 0: Motor overload/underload pre-alarm, relative to rated motor current. 1: Inverter unit overload/underload pre-alarm, relative to rated inverter unit output current. 2: Motor output torque overload/underload pre-alarm, relative to rated motor torque. Tens place: 0: The inverter unit continues running after overload/underload alarm. 1: The inverter unit continues running after underload alarm, and stops running after	0x000	○

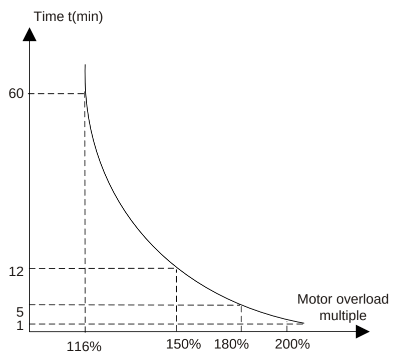
Function code	Name	Description	Default	Modify
		overload fault. 2: The inverter unit continues running after overload alarm, and stops running after underload fault. 3: The inverter unit stops running after overload/underload fault. Hundreds place: 0: Always detect 1: Detect during constant-speed running Thousands place: Inverter unit overload current reference selection 0: Related to current calibration coefficient 1: Irrelated to current calibration coefficient		
P11.09	Overload pre-alarm detection level	If the inverter unit or motor output current is larger than the overload pre-alarm detection level (P11.09), and the duration exceeds the overload pre-alarm detection time (P11.10), overload pre-alarm signal will be outputted.	150%	○
P11.10	Overload pre-alarm detection time	 P11.09 setting range: P11.11–200% (relative value determined by the ones place of P11.08) P11.10 setting range: 0.1–3600.0 s	1.0s	○
P11.11	Underload pre-alarm detection level	Underload pre-alarm signal will be outputted if the output current of the inverter unit or motor is lower than underload pre-alarm detection level (P11.11), and the duration exceeds underload pre-alarm detection time (P11.12).	50%	○
P11.12	Underload pre-alarm detection time	P11.11 setting range: 0–P11.09 (relative value determined by the ones place of P11.08) P11.12 setting range: 0.1–3600.0 s	1.0s	○
P11.13	Fault output terminal action upon fault occurring	Used to set the action of fault output terminals at undervoltage and fault reset. 0x00–0x11 Ones place: 0: Act at undervoltage 1: Do not act at undervoltage Tens place:	0x00	○

Function code	Name	Description	Default	Modify
		0: Act at fault reset 1: Do not act at fault reset		
P11.14	Speed deviation detection value	0.0–50.0% Used to set the speed deviation detection value.	10.0%	○
P11.15	Speed deviation detection time	0.0–10.0 s **Note: Speed deviation protection is invalid when P11.15=0.0.**  t1<t2: The VFD continues running t2=P11.15 Setting range: 0.0–10.0 s	2.0s	○
P11.16	Automatic frequency-reduction during voltage drop	0–1 0: Disable 1: Valid	0	○
P11.17	Proportional coefficient of voltage regulator during undervoltage stall	0–1000	100	○
P11.18	Integral coefficient of voltage regulator during undervoltage stall	0–1000	40	○
P11.19	Proportional coefficient of current regulator during undervoltage stall	0–1000	25	○
P11.20	Integral coefficient of current regulator during undervoltage stall	0–2000	150	○
P11.21	Proportional coefficient of voltage regulator during overvoltage stall	0–1000	60	○
P11.22	Integral coefficient of voltage regulator during overvoltage stall	0–1000	10	○
P11.23	Proportional coefficient of current regulator during overvoltage stall	0–1000	60	○
P11.24	Integral coefficient of current regulator during overvoltage stall	0–2000	250	○
P11.25	Enabling the inverter overload integral	0: Disable 1: Enable	0	○
P11.26	ITE fault detection delay	0–65.535 s	3.000s	○

Function code	Name	Description	Default	Modify
P11.27	VF oscillation control method	0x00–0x11 Ones place: 0: Method 1 1: Method 2 Tens place: 0: Reserved 1: Reserved	0x00	◎
P11.28	SPO switch-on detection delay time	0.0–60.0	3.0	○
P11.29	SPO unbalance factor	0–10	6	○

P12 group—Parameters of motor 2

Function code	Name	Description	Default	Modify
P12.00	Type of motor 2	0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0	◎
P12.01	Rated power of AM 2	0.1–3000.0kW	Model depended	◎
P12.02	Rated frequency of AM 2	0.01Hz–P00.03 (Max. output frequency)	50.00Hz	◎
P12.03	Rated speed of AM 2	1–60000rpm	Model depended	◎
P12.04	Rated voltage of AM 2	0–1200V		◎
P12.05	Rated current of AM 2	0.8–6000.0A		◎
P12.06	Stator resistance of AM 2	0.001–65.535Ω		○
P12.07	Rotor resistance of AM 2	0.001–65.535Ω		○
P12.08	Leakage inductance of AM 2	0.1–6553.5mH		○
P12.09	Mutual inductance of AM 2	0.1–6553.5mH		○
P12.10	No-load current of AM 2	0.1–6553.5A		○
P12.11	Magnetic saturation coefficient 1 of iron core of AM 2	0.0–100.0%	80%	○
P12.12	Magnetic saturation coefficient 2 of iron core of AM 2	0.0–100.0%	68%	○
P12.13	Magnetic saturation coefficient 3 of iron core of AM 2	0.0–100.0%	57%	○
P12.14	Magnetic saturation coefficient 4 of iron core of AM 2	0.0–100.0%	40%	○
P12.15	Rated power of SM 2	0.1–3000.0kW	Model depended	◎
P12.16	Rated frequency of SM 2	0.01Hz–P00.03 (Max. frequency)	50.00Hz	◎

Function code	Name	Description	Default	Modify
P12.17	Number of pole pairs of SM 2	1–128	2	◎
P12.18	Rated voltage of SM 2	0–1200V	Model depended	◎
P12.19	Rated current of SM 2	0.8–6000.0A		◎
P12.20	Stator resistance of SM 2	0.001–65.535Ω		○
P12.21	Direct-axis inductance of SM 2	0.01–655.35mH		○
P12.22	Quadrature-axis inductance of SM 2	0.01–655.35mH		○
P12.23	Counter-emf constant of SM 2	0–10000V	300	○
P12.24	Initial pole position of SM 2 (reserved)	0–0xFFFF	0x0000	●
P12.25	Identification current of SM 2 (reserved)	0%–50% (of the motor rated current)	10%	●
P12.26	Overload protection selection of motor 2	0: No protection 1: Common motor (with low-speed compensation) 2: Frequency-variable motor (without low-speed compensation)	2	◎
P12.27	Overload protection coefficient of motor 2	Motor overload multiples M=Iout/(In*K) "In" is rated motor current, "Iout" is inverter unit output current, and "K" is motor overload protection coefficient. A smaller value of K indicates a bigger value of M. When M=116%, protection is performed after motor overload lasts for 1 hour; when M=150%, protection is performed after motor overload lasts for 12 minutes; when M=200%, protection is performed after motor overload lasts for 60 seconds; and when M≥400%, protection is performed immediately.  Setting range: 20.0%–120.0%	100.0%	○
P12.28	Power display calibration coefficient of motor 2	0.00–3.00	1.00	○

Function code	Name	Description	Default	Modify
P12.29	Parameter display selection of motor 2	0: Display by motor type. In this mode, only parameters related to the present motor type are displayed. 1: Display all. In this mode, all the motor parameters are displayed.	0	○
P12.30	System inertia of motor 2	0.000–30.000kgm^2	0.000	○
P12.31–P12.32	Reserved			

P13 group—SM control

Function code	Name	Description	Default	Modify
P13.00	Reduction rate of the injection current of SM	Setting range: 0.0%–100.0% (of the motor rated current)	80.0%	○
P13.01	Detection mode of initial pole	0: Not detect 1: High-frequency superposition 2: Pulse superposition	0	◎
P13.02	Pull-in current 1	Pull-in current is the pole position orientation current; pull-in current 1 is valid within the lower limit of pull-in current switch-over frequency threshold. If you need to increase the start torque, increase the value of this function parameter properly. Setting range: 0.0%–100.0% (of the motor rated current)	20.0%	○
P13.03	Pull-in current 2	Pull-in current is orientation current of the pole position; pull-in current 2 is valid within the upper limit of pull-in current switch-over frequency threshold, and you do not need to change pull-in current 2 under common situations. Setting range: 0.0%–100.0% (of the motor rated current)	10.0%	○
P13.04	Switch-over frequency of pull-in current	0.0%–200.0% (of rated motor frequency)	20.0%	○
P13.05	Reserved	200Hz-1000Hz	500Hz	◎
P13.06	High-frequency superposition voltage	Setting range: 0.0–300.0% (of the motor rated voltage)	100.0%	◎
P13.07	Reserved	0.0–400.0	0.0	○
P13.08	Control parameter 1	0–0xFFFF	0	○
P13.09	Control parameter 2	Used to set the frequency threshold for enabling the counter-electromotive force phase-locked loop in SVC 0. When the running frequency is lower than the value of the function code, the phase-locked loop is disabled; and when the running frequency is higher than that, the phase-locked loop is enabled. Setting range: 0–655.35	50.00	○
P13.10	Angle compensation	0.0–359.9	0.0	○

Function code	Name	Description	Default	Modify
P13.11	Maladjustment detection time	Used to adjust the responsiveness of anti-maladjustment function. If the load inertia is large, increase the value of this parameter properly, however, the responsiveness may slow down accordingly. Setting range: 0.0–10.0 s	0.5s	○
P13.12	High-frequency compensation coefficient of SM	Valid when the motor speed exceeds the rated speed. If oscillation occurred to the motor, adjust this parameter properly. Setting range: 0.0–100.0%	0.0%	○
P13.13	High-frequency current-loop	0–200.0% (corresponding to the rated output current of the inverter unit)	20.0%	○
P13.19	Reserved			

P14 group—Communication

Function code	Name	Description	Default	Modify
P14.00	Local communication address	Setting range: 1–247 When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the salves on the Modbus bus receive the frame but do not respond to it. The communication addresses on the communication network are unique, which is the basis of the point-to-point communication. **Note: The communication address of a slave cannot be set to 0.**	1	○
P14.01	Communication baud rate	Used to set the data transmission speed between the upper computer and the inverter unit. 0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS 6: 57600BPS 7: 115200BPS **Note: The baud rate of the upper computer must be the same as the inverter unit; otherwise, communication cannot be performed. A greater baud rate indicates faster communication.**	4	○
P14.02	Data bit check	The data format of the upper computer must be the same as the inverter unit; otherwise, communication cannot be performed.	1	○

Function code	Name	Description	Default	Modify
		0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU		
P14.03	Communication response delay	0–200ms Used to indicate the communication response delay, that is, the interval from when the inverter unit completes receiving data to when it sends response data to the upper computer. If the response delay is shorter than the rectifier processing time, the rectifier sends response data to the upper computer after processing data. If the delay is longer than the rectifier processing time, the rectifier does not send response data to the upper computer until the delay is reached although data has been processed.	5	○
P14.04	Communication timeout time	0.0 (invalid)–60.0s When the function code is set to 0.0, the communication timeout time is invalid. When the function code is set to a non-zero value, the system reports the "485 communication fault" (CE) if the communication interval exceeds the value. In general, the function code is set to 0.0. When continuous communication is required, you can set the function code to monitor communication status.	0.0s	○
P14.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop according to the stop mode without generating alarms (only in the communication-based control mode) 3: Stop according to the stop mode without generating alarms (in all control modes)	0	○
P14.06	Communication processing action	0x00–0x11 Ones place: 0: Respond to write operations 1: Not respond to write operations Tens place: LED tens place: 0: Communication password protection is invalid. 1: Communication password protection is valid.	0x00	○
P14.07	CANopen communication timeout time	0.0 (invalid); 0.1–60.0s	0.0s	○

Function code	Name	Description	Default	Modify
P14.08	CANopen communication address	0–127	1	◎
P14.09	CANopen communication baud rate	0: 50Kbps 1: 100 Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	3	◎
P14.10	Received PZD2	Used for CANopen networking communication. 0: Disable 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9 corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8) 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: High-order bit of position reference (signed) 15: Low-order bit of position reference (unsigned) 16: High-order bit of position feedback (signed) 17: Low-order bit of position feedback (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)	0	○
P14.11	Received PZD3		0	○
P14.12	Received PZD4		0	○
P14.13	Received PZD5		0	○
P14.14	Received PZD6		0	○
P14.15	Received PZD7		0	○
P14.16	Received PZD8		0	○
P14.17	Received PZD9		0	○
P14.18	Received PZD10		0	○
P14.19	Received PZD11		0	○
P14.20	Received PZD12		0	○

Function code	Name	Description	Default	Modify
		19: Function code mapping (PZD2–PZD12 corresponds to P14.49–P14.59) 20–31: Reserved		
P14.21	Sent PZD2	Used for CANopen networking communication. 0: Disable 1: Running frequency (x100, Hz) 2: Set frequency (x100, Hz) 3: Bus voltage (x10, V) 4: Output voltage (×1, V) 5: Output current (x10, A) 6: Actual output torque (x10, %) 7: Actual output power (x10, %) 8: Rotation speed of running (x1, RPM) 9: Linear speed of running (x1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (* 100, V) 13: AI2 input (* 100, V) 14: AI3 input (* 100, V) 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (x100, %) 19: PID feedback (x100, %) 20: Reserved 21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned) 23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 2 26–30: Reserved 31: Function code mapping (PZD2–PZD12 corresponds to P14.60–P14.70)	0	○
P14.22	Sent PZD3		0	○
P14.23	Sent PZD4		0	○
P14.24	Sent PZD5		0	○
P14.25	Sent PZD6		0	○
P14.26	Sent PZD7		0	○
P14.27	Sent PZD8		0	○
P14.28	Sent PZD9		0	○
P14.29	Sent PZD10		0	○
P14.30	Sent PZD11		0	○
P14.31	Sent PZD12		0	○
P14.32	communication fault action selection	0: Normal running 1: Decelerate to stop 2: Coast to stop 3: Decelerate to stop in emergency manner	2	○
P14.33	Number system of control and status words for communication cards	0: Decimal system 1: Binary system Note: The rectifier unit and inverter unit must be the same in the value of the function parameter.	0	○
P14.35	Enabling the jog mode through local keypad	0: Disable 1: Enable **Note: Invalid when a LCD keypad is connected.**	0	○
P14.35–P14.47	Reserved	0–65535	0	●

Function code	Name	Description	Default	Modify
P14.48	Mapping channel selection	0x00–0x13 Ones place: 0: Invalid 1: CANopen 2: PROFIBUS-DP 3: PROFINET Tens place: 0: Save to RAM only 1: Save to RAM and EEPROM	0x00	◎
P14.49	Received PZD2 function code address	Valid when P14.48 is not 0. The function code address is determined based on the channel selected on P14.48. Replacing the original channel PZD, this PZD can be mapped to a function code. It is set in hexadecimal, where the MSB indicates the group number and the LSB indicates the code number. For example, 0x1011 indicates P16.17.	0x0000	○
P14.50	Received PZD3 function code address		0x0000	○
P14.51	Received PZD4 function code address		0x0000	○
P14.52	Received PZD5 function code address		0x0000	○
P14.53	Received PZD6 function code address		0x0000	○
P14.54	Received PZD7 function code address		0x0000	○
P14.55	Received PZD8 function code address		0x0000	○
P14.56	Received PZD9 function code address		0x0000	○
P14.57	Received PZD10 function code address		0x0000	○
P14.58	Received PZD11 function code address		0x0000	○
P14.59	Received PZD12 function code address		0x0000	○
P14.60	Sent PZD2 function code address	Valid when P14.48 is not 0. The function code address is determined based on the channel selected on P14.48. Replacing the original channel PZD, this PZD can be mapped to a function code. It is set in hexadecimal, where the MSB indicates the group number and the LSB indicates the code number. For example, 0x1011 indicates P16.17.	0x0000	○
P14.61	Sent PZD3 function code address		0x0000	○
P14.62	Sent PZD4 function code address		0x0000	○
P14.63	Sent PZD5 function code address		0x0000	○
P14.64	Sent PZD6 function code address		0x0000	○
P14.65	Sent PZD7 function code address		0x0000	○
P14.66	Sent PZD8 function code address		0x0000	○
P14.67	Sent PZD9 function code address		0x0000	○
P14.68	Sent PZD10 function code address		0x0000	○

Function code	Name	Description	Default	Modify
P14.69	Sent PZD11 function code address		0x0000	○
P14.70	Sent PZD12 function code address		0x0000	○

P15 group—Functions of communication card 1 (PROFIBUS-DP)

Function code	Name	Description	Default	Modify
P15.00	Reserved	0–65535	0	●
P15.01	Module address	0–127	2	◎
P15.02	Received PZD2	0: Disable 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–2000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x3FF (BIT0–BIT9 corresponds to S1/S2/S3/S4/HDIA/HDIB/S5/S6/S7/S8) 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–1000, in which 1000 corresponds to 100.0%) 14: High-order bit of position reference (signed) 15: Low-order bit of position reference (unsigned) 16: High-order bit of position feedback (signed) 17: Low-order bit of position feedback (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1	0	○
P15.03	Received PZD3			
P15.04	Received PZD4			
P15.05	Received PZD5			
P15.06	Received PZD6			
P15.07	Received PZD7			
P15.08	Received PZD8			
P15.09	Received PZD9			
P15.10	Received PZD10			
P15.11	Received PZD11			
P15.12	Received PZD12			

Function code	Name	Description	Default	Modify
		and then to 0) 19: Function parameter mapping (PZD2–PZD12 corresponds to P14.49–P14.59) 20–31: Reserved		
P15.13	Sent PZD2	0: Disable 1: Running frequency (x100, Hz) 2: Set frequency (x100, Hz) 3: Bus voltage (x10, V) 4: Output voltage (x1, V) 5: Output current (x10, A) 6: Actual output torque (x10, %) 7: Actual output power (x10, %) 8: Rotation speed of running (x1, RPM) 9: Linear speed of running (x1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (x100, V) 13: AI2 input (x100, V) 14: AI3 input (x100, V) 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (x100, %) 19: PID feedback (x100, %) 20: Reserved 21: High-order bit of position reference (signed) 22: Low-order bit of position reference (unsigned) 23: High-order bit of position feedback (signed) 24: Low-order bit of position feedback (unsigned) 25: Status word 26: Reserved 27: High-order bit of PG card count value 28: Low-order bit of PG card count value 29: High-order bit of PG card pulse count value 30: Low-order bit of PG card pulse count value 31: Function parameter mapping (PZD2–PZD12 corresponds to P14.60–P14.70)	0	○
P15.14	Sent PZD3			
P15.15	Sent PZD4			
P15.16	Sent PZD5			
P15.17	Sent PZD6			
P15.18	Sent PZD7			
P15.19	Sent PZD8			
P15.20	Sent PZD9			
P15.21	Sent PZD10			
P15.22	Sent PZD11			
P15.23	Sent PZD12			
P15.24	Reserved	0–65535	0	●
P15.25	DP communication timeout time	0.0 (invalid); 0.1–60.0s	5.0s	○
P15.25–P15.69	Reserved	0–65535	0	●

P16 group—Functions of communication card 2 (Ethernet/PROFINET/EtherCAT)

Function code	Name	Description	Default	Modify
P16.00	Reserved	0–65535	0	●
P16.01	Ethernet communication rate	0: Self adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0	◎
P16.02	IP address 1	0–255	192	◎
P16.03	IP address 2	0–255	168	◎
P16.04	IP address 3	0–255	0	◎
P16.05	IP address 4	0–255	1	◎
P16.06	Ethernet subnet mask 1	0–255	255	◎
P16.07	Ethernet subnet mask 2	0–255	255	◎
P16.08	Ethernet subnet mask 3	0–255	255	◎
P16.09	Ethernet subnet mask 4	0–255	0	◎
P16.10	Ethernet gateway 1	0–255	192	◎
P16.11	Ethernet gateway 2	0–255	168	◎
P16.12	Ethernet gateway 3	0–255	1	◎
P16.13	Ethernet gateway 4	0–255	1	◎
P16.14	Ethernet monitoring variable address 1	0–0xFFFF	0	○
P16.15	Ethernet monitoring variable address 2	0–0xFFFF	0	○
P16.16	Ethernet monitoring variable address 3	0–0xFFFF	0	○
P16.17	Ethernet monitoring variable address 4	0–0xFFFF	0	○
P16.18–P16.23	Reserved	0–65535	0	●
P16.24	Time to identify expansion card 1	0.0–600.0 s The value 0.0 indicates not detecting identification faults.	0.0	○
P16.25	Time to identify expansion card 2	0.0–600.0 s The value 0.0 indicates not detecting identification faults.	0.0	○
P16.26	Reserved	0–65535	0	●
P16.27	Communication timeout time of card at slot 1	0.0–600.0 s The value 0.0 indicates not detecting disconnection faults.	0	○
P16.28	Communication timeout time of card at slot 2	0.0–600.0 s The value 0.0 indicates not detecting disconnection faults.	0	○
P16.29	Reserved			
P16.30	EtherCAT communication timeout time	0.0 (invalid)–60.0s	5.0s	○

Function code	Name	Description	Default	Modify
P16.31	PROFINET communication timeout time	0.0 (invalid)–60.0s	5.0s	○
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax (Unit: 0.01Hz)) 2: PID reference (-1000–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (-1000–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–2000, in which 1000 corresponds to 100% of the motor rated current) 9: Virtual input terminal command. Range:0x000–0x1FF 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: High-order bit of position reference (signed) 15: Low-order bit of position reference (unsigned) 16: High-order bit of position feedback (signed) 17: Low-order bit of position feedback (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function parameter mapping (PZD2–PZD12 corresponds to P14.49–P14.59) 20–31: Reserved	0	○
P16.33	Received PZD3		0	○
P16.34	Received PZD4		0	○
P16.35	Received PZD5		0	○
P16.36	Received PZD6		0	○
P16.37	Received PZD7		0	○
P16.38	Received PZD8		0	○
P16.39	Received PZD9		0	○
P16.40	Received PZD10		0	○
P16.41	Received PZD11		0	○
P16.42	Received PZD12		0	○
P16.43	Sent PZD2	0: Invalid 1: Running frequency (x100, Hz) 2: Set frequency (x100, Hz) 3: Bus voltage (x10, V)	0	○
P16.44	Sent PZD3		0	○
P16.45	Sent PZD4		0	○
P16.46	Sent PZD5		0	○

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P16.47</td><td>Sent PZD6</td><td rowspan="7">4: Output voltage (×1, V)
5: Output current (x10, A)
6: Actual output torque (x10, %)
7: Actual output power (x10, %)
8: Rotation speed of running (x1, RPM)
9: Linear speed of running (x1, m/s)
10: Ramp reference frequency
11: Fault code
12: AI1 input (* 100, V)
13: AI2 input (* 100, V)
14: AI3 input (* 100, V)
15: Reserved
16: Terminal input status
17: Terminal output status
18: PID reference (x100, %)
19: PID feedback (x100, %)
20: Motor rated torque
21: High-order bit of position reference (signed)
22: Low-order bit of position reference (unsigned)
23: High-order bit of position feedback (signed)
24: Low-order bit of position feedback (unsigned)
25: Status word
26: Reserved
27: High-order bit of PG card count value
28: Low-order bit of PG card count value
29: High-order bit of PG card pulse count value
30: Low-order bit of PG card pulse count value
31: Function parameter mapping (PZD2–PZD12 corresponds to P14.60–P14.70)</td><td>0</td><td>○</td></tr>
<tr><td>P16.48</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P16.49</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P16.50</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P16.51</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P16.52</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P16.53</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
<tr><td>P16.54–P16.67</td><td>Reserved</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P16.58</td><td>Industrial Ethernet communication card IP address 1</td><td>0–255</td><td>192</td><td>◎</td></tr>
<tr><td>P16.59</td><td>Industrial Ethernet communication card IP address 2</td><td>0–255</td><td>168</td><td>◎</td></tr>
<tr><td>P16.60</td><td>Industrial Ethernet communication card IP address 3</td><td>0–255</td><td>0</td><td>◎</td></tr>
<tr><td>P16.61</td><td>Industrial Ethernet communication card IP address 4</td><td>0–255</td><td>1</td><td>◎</td></tr>
<tr><td>P16.62</td><td>Industrial Ethernet communication card subnet mask 1</td><td>0–255</td><td>255</td><td>◎</td></tr>
</table>

Function code	Name	Description	Default	Modify
P16.63	Industrial Ethernet communication card subnet mask 2	0–255	255	◎
P16.64	Industrial Ethernet communication card subnet mask 3	0–255	255	◎
P16.65	Industrial Ethernet communication card subnet mask 4	0–255	0	◎
P16.66	Industrial Ethernet communication card subnet mask 1	0–255	192	◎
P16.67	Industrial Ethernet communication card subnet mask 2	0–255	168	◎
P16.68	Industrial Ethernet communication card subnet mask 3	0–255	0	◎
P16.69	Industrial Ethernet communication card subnet mask 4	0–255	1	◎

P17 group—Status viewing

Function code	Name	Description	Default	Modify
P17.00	Set frequency	Displays the current set frequency of the inverter unit. Range: 0.00Hz–P00.03	50.00Hz	●
P17.01	Output frequency	Displays the current output frequency of the inverter unit. Range: 0.00Hz–P00.03	0.00Hz	●
P17.02	Ramp reference frequency	Displays the current ramp reference frequency of the inverter unit. Range: 0.00Hz–P00.03	0.00Hz	●
P17.03	Output voltage	Displays current output voltage of the inverter unit. Range: 0–1200V	0V	●
P17.04	Output current	Displays the valid value of current output current of the inverter unit. Range: 0.0–3000.0A	0.0A	●
P17.05	Motor speed	Displays the current motor speed. Range: 0–65535RPM	0 RPM	●
P17.06	Torque current	Displays the current torque current of the inverter unit. Range: -3000.0–3000.0A	0.0A	●
P17.07	Exciting current	Displays the current exciting current of the inverter unit. Range: -3000.0–3000.0 A	0.0A	●

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P17.08</td><td>Motor power</td><td>Displays the current motor power; 100% relative to the rated motor power. The positive value is the motoring state while the negative value is the generating state.
Range: -300.0–300.0% (relative to the rated motor power)</td><td>0.0%</td><td>●</td></tr>
<tr><td>P17.09</td><td>Motor output torque</td><td>Displays the current output torque of the inverter unit; 100% relative to the rated motor torque. During forward running, the positive value is the motoring state while the negative value is generating state. During reverse running, the positive value is the generating state while the negative value is the motoring state.
Range: -250.0–250.0%</td><td>0.0%</td><td>●</td></tr>
<tr><td>P17.10</td><td>Estimated motor frequency</td><td>Displays the estimated motor rotor frequency under the open-loop vector condition.
Range: 0.00–P00.03</td><td>0.00Hz</td><td>●</td></tr>
<tr><td>P17.11</td><td>DC bus voltage</td><td>Displays current DC bus voltage of the inverter unit.
Range: 0.0–2000.0V</td><td>0V</td><td>●</td></tr>
<tr><td>P17.12</td><td>Digital input terminal status</td><td>Displays the present digital input terminal state of the inverter unit.
0x0000–0x000F<table><tr><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr></table></td><td>0</td><td>●</td></tr>
<tr><td>P17.13</td><td>Digital output terminal status</td><td>Displays the present digital output terminal state of the inverter unit.
0x0000–0x000F<table><tr><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>RO2</td><td>RO1</td><td>Reserved</td><td>Y1</td></tr></table></td><td>0</td><td>●</td></tr>
<tr><td>P17.14</td><td>Frequency adjustment</td><td>Displays the adjustment on the inverter unit through the UP/DOWN terminal.
Range: 0.00Hz–P00.03</td><td>0.00Hz</td><td>●</td></tr>
<tr><td>P17.15</td><td>Torque reference value</td><td>Relative to the percentage of the rated torque of the present motor, displaying the torque reference.
Range: -300.0%–300.0% (of the motor rated current)</td><td>0.0%</td><td>●</td></tr>
<tr><td>P17.16</td><td>Linear speed</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P17.17</td><td>Reserved</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P17.18</td><td>Count value</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P17.19</td><td>AI1 input voltage</td><td>Displays the AI1 input signal.
Range: 0.00–10.00V</td><td>0.00V</td><td>●</td></tr>
<tr><td>P17.20</td><td>AI2 input voltage</td><td>Displays the AI2 input signal.
Range: -10.00–10.00V</td><td>0.00V</td><td>●</td></tr>
<tr><td>P17.21</td><td>Reserved</td><td>0–65535</td><td>0</td><td>●</td></tr>
<tr><td>P17.22</td><td>Reserved</td><td>0–65535</td><td>0</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
P17.23	PID reference value	Displays the PID reference value. Range: -100.0–100.0%	0.0%	●
P17.24	PID feedback value	Displays the PID feedback value. Range: -100.0–100.0%	0.0%	●
P17.25	Motor power factor	Displays the power factor of the current motor. Range: -1.00–1.00	1.00	●
P17.26	Duration of this run	Displays the duration of this run of the inverter unit. Range: 0–65535min	0m	●
P17.27	Present step of simple PLC	Used to display the present step of the simple PLC function.	0	●
P17.28	Motor ASR controller output	Displays the ASR controller output value under the vector control mode, relative to the percentage of rated motor torque. Range: -300.0%–300.0% (of the motor rated current)	0.0%	●
P17.29	Pole angle of open-loop SM	Displays the initial identification angle of SM. Range: 0.0–360.0	0.0	●
P17.30	Phase compensation of SM	Displays the phase compensation of SM. Range: -180.0–180.0	0.0	●
P17.31	High-frequency superposition current of SM	0.0%–200.0% (of the motor rated current)	0.0	●
P17.32	Motor flux linkage	0.0%–200.0%	0.0%	●
P17.33	Exciting current reference	Displays the exciting current reference value under the vector control mode. Range: -3000.0–3000.0A	0.0A	●
P17.34	Torque current reference	Displays the torque current reference value under the vector control mode. Range: -3000.0–3000.0A	0.0A	●
P17.35	AC incoming current	Displays the valid value of incoming current on AC side. Range: 0.0–5000.0A	0.0A	●
P17.36	Output torque	Displays the output torque value. During forward running, the positive value is the motoring state while the negative value is generating state. During reverse running, the positive value is the generating state while the negative value is the motoring state. Range: -3000.0Nm–3000.0Nm	0.0Nm	●
P17.37	Motor overload count value	0–65535	0	●
P17.38	Process PID output	-100.0%–100.0%	0.00%	●
P17.39	Parameter download error	0.00–99.00	0.00	●
P17.40	Motor control mode	Ones place: Control mode 0: Vector 0 1: Vector 1	0x2	●

Function code	Name	Description	Default	Modify
		2: V/F control 3: Closed-loop vector control Tens place: Control status 0: Speed control 1: Torque control 2: Position control Hundreds place: Motor number 0: Motor 1 1: Motor 2		
P17.41	Electromotive torque upper limit	0.0%–300.0% (of the motor rated current)	180.0%	●
P17.42	Braking torque upper limit	0.0%–300.0% (of the motor rated current)	180.0%	●
P17.43	Forward rotation upper-limit frequency in torque control	0.00–P00.03	50.00Hz	●
P17.44	Reverse rotation upper-limit frequency in torque control	0.00–P00.03	50.00Hz	●
P17.45	Inertia compensation torque	-100.0%–100.0%	0.0%	●
P17.46	Friction compensation torque	-100.0%–100.0%	0.0%	●
P17.47	Motor pole pairs	0–65535	0	●
P17.48	Inverter unit overload count value	0–65535	0	●
P17.49	Frequency set by A source	0.00–P00.03	0.00Hz	●
P17.50	Frequency set by B source	0.00–P00.03	0.00Hz	●
P17.51	PID proportional output	-100.0%–100.0%	0.0%	●
P17.52	PID integral output	-100.0%–100.0%	0.0%	●
P17.53	PID differential output	-100.0%–100.0%	0.0%	●
P17.54	PID present proportional gain	0.00–100.00	0.00	●
P17.55	PID present integral gain	0.00–10.00 s	0.0s	●
P17.56	PID present differential time	0.00–10.00 s	0.0s	●
P17.57	Multi-step speed terminal input status	0–0xffff	0	●
P17.58	CANopen CW viewed value	When the CW is in binary format (P14.33=1): 0 (0x00): Decelerate to stop 1 (0x01): Run forward 2 (0x02): Run reversely 4 (0x04): Fault reset	0	●

Function code	Name	Description	Default	Modify
		8 (0x08): Coast to stop 16 (0x10): Jog forward 32 (0x20): Jog reversely 64 (0x40): Jog to stop 1024(0x400): Decelerate to stop in emergency manner When the CW is in decimal format (P14.33=0): 1 (0x01): Run forward 2 (0x02): Run reversely 3 (0x03): Jog forward 4 (0x04): Jog reversely 5 (0x05): Decelerate to stop 6 (0x06): Coast to stop 7 (0x07): Fault reset 8 (0x08): Jog to stop 9 (0x09): Decelerate to stop in emergency manner		
P17.59	CANopen SW viewed value	Low-order byte (SW1): When the SW is in binary format (P14.33=1): Bit0: Running forward Bit1: Running reversely Bit2: Stopped Bit3: Faulty Bit4: POFF Bit5: Pre-exciting When the SW is in decimal format (P14.33=0): 1: Running forward 2: Running reversely 3: Stopped 4: Faulty 5: POFF 6: Pre-exciting High-order byte (SW2): Bit0: 0: Not ready to run 1: Ready to run Bit1–2: 00: Motor1; 01: Motor2 Bit3: 0: Asynchronous motor (AM) 1: Synchronous motor (SM) Bit4: 0: No pre-alarm upon overload 1: Pre-alarm upon overload Bit5–Bit6: 00: Keypad control 01: Terminal control 10: Communication control Bit7: 0: No pre-alarm upon motor temperature 1: Pre-alarm upon motor temperature	0	●
P17.60	Inverter unit SW 1	1: Running forward 2: Running reversely 3: Stopped	0	●

Function code	Name	Description	Default	Modify
		4: Faulty 5: POFF 6: Pre-exciting		
P17.61–P17.63	Reserved	0–65535	0	●

P18 group—Status viewing in closed-loop control

Function code	Name	Description	Default	Modify
P18.00	Actual frequency of encoder	Used to indicate the actual-measured encoder frequency. The value of forward running is positive; the value of reverse running is negative.Range: -999.9–3276.7Hz	0.0Hz	●
P18.01	Encoder position count value	Encoder count value, quadruple frequency. Range: 0–65535	0	●
P18.02	Encoder Z pulse count value	Corresponding count value of encoder Z pulse. Range: 0–65535	0	●
P18.03	High-order bit of position reference value	High-order bit of position reference value, zero out after stop. Range: 0–30000	0	●
P18.04	Low-order bit of position reference value	It is cleared after stop. Range: 0–65535	0	●
P18.05	High-order bit of position feedback value	It is cleared after stop. Range: 0–30000	0	●
P18.06	Low-order bit of position feedback value	It is cleared after stop. Range: 0–65535	0	●
P18.07	Position deviation	Deviation between the reference position and actual running position. Range: -32768–32767	0	●
P18.08	Position of position reference point	Position of reference point of Z pulse when the spindle stops accurately. Range: 0–65535	0	●
P18.09	Present position setting of spindle	Present position setup when the spindle stops accurately. Range: 0–359.99	0.00	●
P18.10	Present position when spindle stops accurately	Present position when the spindle stops accurately. Range: 0–65535	0	●
P18.11	Encoder Z pulse direction	Z pulse direction display. When the spindle stops accurately, there may be a couple of pulses' error between the position of forward and reverse orientation, which can be eliminated by adjusting Z pulse direction of P20.02 or exchanging phase AB of encoder. 0: Forward 1: Reverse	0	●

Function code	Name	Description	Default	Modify
P18.12	Encoder Z pulse angle	Reserved. Range: 0.00–359.99	0.00	●
P18.13	Encoder Z pulse error times	Reserved. Range: 0–65535	0	●
P18.14	High-order bit of encoder pulse count value	Encoder pulse count value. The count value is accumulated only if the VFD is powered on. Range: 0–65535	0	●
P18.15	Low-order bit of encoder pulse count value		0	●
P18.16	Speed measured by main control board	-3276.8–3276.7Hz	0.0Hz	●
P18.17	Pulse command frequency	Pulse command (A2/B2 terminal) is converted to the set frequency, and it is valid under the pulse position mode and pulse speed mode. Range: -3276.8–3276.7Hz	0.00Hz	●
P18.18	Pulse command feedforward	Pulse command (A2/B2 terminal) is converted to the set frequency, and it is valid under the pulse position mode and pulse speed mode. Range: -3276.8–3276.7Hz	0.00Hz	●
P18.19	Position regulator output	-327.68–327.67Hz	0.00Hz	●
P18.20	Count value of resolver	Range: 0–65535	0	●
P18.21	Resolver angle	Pole position angle read by the resolver-type encoder. Range: 0.00–359.99	0.00	●
P18.22	SM pole angle in closed loop	Present pole position. Range: 0.00–359.99	0.00	●
P18.23	SW 2	0–65535 Bit0: 0: Not ready to run; 1: Ready to run Bit1–Bit2: 00: Motor1; 01: Motor2 Bit3: 0: Asynchronous motor (AM) 1: Synchronous motor (SM) Bit4: 0: No pre-alarm upon overload 1: Pre-alarm upon overload Bit5–Bit6: 00: Keypad control 01: Terminal control 10: Communication control Bit7: 0: No pre-alarm upon motor temperature 1: Pre-alarm upon motor temperature Bit8: 0: Speed mode 1: Torque mode Bit9: 0: Non-position mode 1: Position mode Bit10–Bit11: 00: Open-loop vector control 0 01: Open-loop vector control 1 10: Closed-loop vector control 11: VF Bit12: 0: No running protection 1: Running protection Bit13–Bit15: Reserved	0	●

Function code	Name	Description	Default	Modify
P18.24	High-order bit of count value of pulse reference	Pulse command (A2,B2) count value. The count value is accumulated only if the inverter unit is powered on. Range: 0–65535	0	●
P18.25	Low-order bit of count value of pulse reference		0	●
P18.26	Speed measured by PG card	-3276.8–3276.7Hz	0.0Hz	●
P18.27	Encoder UVW sectors	0–7	0	●
P18.28	Encoder PPR display	0–65535	0	●
P18.29	Angle compensation value of SM	-180.0–180.0	0.0	●
P18.30	Z pulse angle of SM	0–65535	0	●
P18.31	Z pulse value of pulse reference	0–65535	0	●
P18.32	Main control board measured value of pulse reference	-3276.8–3276.7Hz	0.0Hz	●
P18.33	PG card measured value of pulse reference	-3276.8–3276.7Hz	0.0Hz	●
P18.34	Present encoder filter width	0–63	0	●
P18.35	Reserved			

P19 group—Expansion card status viewing

Function code	Name	Description	Default	Modify
P19.00	Type of card at slot 1	0: No card 1: Programmable card 2: I/O card 3: Incremental PG card (including 5V/12V/24V) 4: Reserved 5: Ethernet card 6: PROFIBUS-DP card 7: Reserved 8: Rotary PG card 9: Reserved 10: Reserved 11: PROFINET card 12: Sine-cosine PG card without CD signals 13: Sine-cosine PG card with CD signals 14: Reserved 15: Reserved 16: Reserved 17: EtherCAT card 18: Reserved 19: Reserved	0	●
P19.01	Type of card at slot 2		0	●
P19.02	Reserved	0–65535	0	●

Function code	Name	Description	Default	Modify
P19.03	Software version of card at slot 1	0.00–655.35	0.00	●
P19.04	Software version of card at slot 2	0.00–655.35	0.00	●
P19.05	Reserved	0–65535	0	●
P19.06	Terminal input status of I/O card	0–0x0003 BIT1 | BIT0 S6 | S5	0	●
P19.07	Terminal output status of I/O card	0–0X0001 BIT0 RO3	0	●
P19.08	Reserved			
P19.09	AI3 input voltage of I/O card	0.00–10.00V	0.00V	●
P19.10	Reserved			
P19.11	AI/AO detected motor temperature	-20.0–175.0°C (PT100, PT1000, KTY84)	0.0°C	●
P19.12	PG card detected motor temperature	-20.0–175.0°C (PT100, PT1000, KTY84)	0.0°C	●
P19.13	IO card detected motor temperature	-20.0–175.0°C (PT100, PT1000, KTY84, NTC)	0.0°C	●
P19.14	CW of card at slot 1	When the CW is in decimal format (P14.33=1): 0 (0x00): Decelerate to stop 1 (0x01): Run forward 2 (0x02): Run reversely 4 (0x04): Fault reset 8 (0x08): Coast to stop 16 (0x10): Jog forward 32 (0x20): Jog reversely 64 (0x40): Jog to stop 1024(0x400): Decelerate to stop in emergency manner When the CW is in decimal format (P14.33=0): 1 (0x01): Run forward 2 (0x02): Run reversely 3 (0x03): Jog forward 4 (0x04): Jog reversely 5 (0x05): Decelerate to stop 6 (0x06): Coast to stop 7 (0x07): Fault reset 8 (0x08): Jog to stop 9 (0x09): Decelerate to stop in emergency manner	0	●
P19.15	SW of card at slot 1	Low-order byte (SW1): When the SW is in binary format (P14.33=1): Bit0: Running forward Bit1: Running reversely	0	●

Function code	Name	Description	Default	Modify
		Bit2: Stopped Bit3: Faulty Bit4: POFF Bit5: Pre-exciting When the SW is in decimal format (P14.33=0): 1: Running forward 2: Running reversely 3: Stopped 4: Faulty 5: POFF 6: Pre-exciting High-order byte (SW2): Bit0: 0: Not ready to run 1: Ready to run Bit1–Bit2: 00: 00: Motor1; 01: Motor2 Bit3: 0: Asynchronous motor (AM) 1: Synchronous motor (SM) Bit4: 0: No pre-alarm upon overload 1: Pre-alarm upon overload Bit5–Bit6: 00: Keypad control 01: Terminal control 10: Communication control Bit7: 0: No pre-alarm upon motor temperature 1: Pre-alarm upon motor temperature		
P19.16	CW of card at slot 2	When the CW is in decimal format (P14.33=1): 0 (0x00): Decelerate to stop 1 (0x01): Run forward 2 (0x02): Run reversely 4 (0x04): Fault reset 8 (0x08): Coast to stop 16 (0x10): Jog forward 32 (0x20): Jog reversely 64 (0x40): Jog to stop 1024(0x400): Decelerate to stop in emergency manner When the CW is in decimal format (P14.33=0): 1 (0x01): Run forward 2 (0x02): Run reversely 3 (0x03): Jog forward 4 (0x04): Jog reversely 5 (0x05): Decelerate to stop 6 (0x06): Coast to stop 7 (0x07): Fault reset 8 (0x08): Jog to stop 9 (0x09): Decelerate to stop in emergency manner	0	●
P19.17	SW of card at slot 2	Low-order byte (SW1): When the SW is in binary format (P14.33=1):	0	●

Function code	Name	Description	Default	Modify
		Bit0: Running forward Bit1: Running reversely Bit2: Stopped Bit3: Faulty Bit4: POFF Bit5: Pre-exciting When the SW is in decimal format (P14.33=0): 1: Running forward 2: Running reversely 3: Stopped 4: Faulty 5: POFF 6: Pre-exciting High-order byte (SW2): Bit0: 0: Not ready to run 1: Ready to run Bit1–Bit2: 00: 00: Motor1; 01: Motor2 Bit3: 0: Asynchronous motor (AM) 1: Synchronous motor (SM) Bit4: 0: No pre-alarm upon overload 1: Pre-alarm upon overload Bit5–Bit6: 00: Keypad control 01: Terminal control 10: Communication control Bit7: 0: No pre-alarm upon motor temperature 1: Pre-alarm upon motor temperature		
P19.18–P19.39	Reserved			

P20 group—Encoder of motor 1

Function code	Name	Description	Default	Modify
P20.00	Encoder type display	0: Incremental encoder 1: Resolver-type encoder 2: Sin/Cos encoder 3: Endat absolute encoder	0	●
P20.01	Encoder pulse number	Number of pulses generated when the encoder revolves for one circle. Setting range: 0–60000	1024	◎
P20.02	Encoder direction	Ones place: AB direction 0: Forward 1: Reverse Tens place: Z pulse direction (reserved) 0: Forward 1: Reverse Hundreds: CD/UVW pole signal direction 0: Forward 1: Reverse	0x000	◎

Function code	Name	Description	Default	Modify
P20.03	Detection time of encoder offline fault	0.0–10.0 s	2.0s	○
P20.04	Detection time of encoder reversal fault	0.0–100.0 s	0.8s	○
P20.05	Filter times of encoder detection	Setting range: 0x00–0x99 Ones place: Low-speed filter time, corresponding to 2^ (0–9)*125μs Tens place: High-speed filter times, corresponding to 2^ (0–9)*125μs	0x33	○
P20.06	Speed ratio between encoder mounting shaft and motor	You need to set the function parameter when the encoder is not installed on the motor shaft and the drive ratio is not 1. Setting range: 0.001–65.535	1.000	○
P20.07	Control parameters of SM	Bit0: Enable Z pulse calibration Bit1: Enable encoder angle calibration Bit2: Enable SVC speed measurement Bit3: Reserved Bit4: Reserved Bit5: Do not detect the encoder initial angle in v/f control Bit6: Enable the CD signal calibration Bit7: Reserved Bit8: Do not detect encoder faults during autotuning Bit9: Enable Z pulse detection optimization Bit10: Enable the initial Z pulse calibration optimization Bit12: Clear the Z pulse arrival signal after stop Bit13: Reserved Bit14: Detect Z pulse after one rotation	0x3	○
P20.08	Enable Z pulse offline detection	0x00–0x11 Ones place: Z pulse detection 0: Disable 1: Enable Tens place: UVW pulse detection (for SM) 0: Disable 1: Enable	0x10	○
P20.09	Initial angle of Z pulse	Relative electric angle between the encoder Z pulse and the motor pole position. Setting range: 0.00–359.99	0.00	○
P20.10	Pole initial angle	Relative electric angle between the encoder position and the motor pole position. Setting range: 0.00–359.99	0.00	○
P20.11	Autotuning pole initial angle	Range: 0–3 1: Rotary autotuning (DC braking) 2: Static autotuning (suitable for resolver-type encoder, sin/cos with CD signal feedback) 3: Rotary autotuning (initial angle identification) The pole initial angle obtained through rotary	0	◎

Function code	Name	Description	Default	Modify
		autotuning 1 is accurate. Rotary autotuning is recommended in most cases, in which the motor needs to be decoupled from the load or the motor load is light.		
P20.12	Speed measurement optimization selection	0: No optimization 1: Optimization mode 1 2: Optimization mode 2	1	◎
P20.13	CD signal zero offset gain	0–65535	0	○
P20.14	Encoder type selection	Ones place: Incremental encoder 0: without UVW 1: with UVW Tens place: Sin/Cos encoder 0: without CD signal 1: with CD signal	0x00	◎
P20.15	Speed measurement mode	0: PG card 1: Locally measured through HDIA and HDIB. Only the 24V incremental encoders are supported.	0	◎
P20.16	Frequency division coefficient	0–255 When the function parameter is set to 0 or 1, frequency division of 1:1 is implemented.	0	○
P20.17	Pulse filter handling selection	0x0000–0xFFFF Bit0: Enable/disable encoder input filter 0: No filter 1: Filter Bit1: Encoder signal filter mode 0: Self-adaptive filter 1: Use P20.18 filter parameter Bit2: Enable/disable encoder frequency-division output filter 0: No filter 1: Filter Bit3: Reserved Bit4: Enable/disable pulse reference filter 0: No filter 1: Filter Bit5: Pulse reference filter mode (valid when Bit4 is set to 1) 0: Self-adaptive filter 1: Use P20.19 filter parameter Bit6: Frequency-divided output source setting 0: Encoder signals 1: Pulse reference signals Bit7–15: Reserved	0x0033	○
P20.18	Encoder pulse filter width	Range: 0–63 The filter time is P20.18*0.25μs. The value 0 or 1 indicates 0.25μs.	2	○

Function code	Name	Description	Default	Modify
P20.19	Pulse reference filter width	Range: 0–63 The filter time is P20.19*0.25μs. The value 0 or 1 indicates 0.25μs.	2	○
P20.20	Pulse number of pulse reference	0–65535	1024	◎
P20.21	Enabling SM angle compensation	0–1	0	○
P20.22	Frequency point of speed measurement mode switchover	Range: 0–630.00Hz **Note: Valid only when P20.12=0.**	1.00Hz	○
P20.23	SM angle compensation coefficient	-200.0–200.0%	100.0%	○
P20.24	Pole pairs in SM pole initial angle autotuning	0–128	2	○

P21 group—Position control

Function code	Name	Description	Default	Modify
P21.00	Positioning mode	Ones place: Control mode selection (only for closed-loop vector control) 0: Speed control 1: Position control Tens place: Position command source 0: Pulse string, using PG card terminal (A2, B2) pulse giving signal for position control 1: Digital position, using the setting of P21.17 for position control, while the positioning mode can be set through P21.16 2: Positioning of photoelectric switch during stop. When a terminal receives a photoelectric switch signal (selection terminal function 43), the VFD starts positioning for stop, and the stop distance can be set through P21.17. Hundred place: Position feedback source 0: Encoder signal 1: Reserved Thousands: Servo mode Bit0: Position deviation mode 0: No deviation 1: With deviation Bit1: Enable/disable servo 0: Disable (The servo can be enabled by terminals.) 1: Enable Bit2: Reserved **Note:** In the pulse string or spindle positioning mode, the inverter unit enters the servo operation mode when there is a valid servo	0x0000	○

Function code	Name	Description	Default	Modify
		enabling signal. If there is no servo enabling signal, the inverter unit enter the servo operation mode only after it receives a forward running or reverse running command.		
P21.01	Pulse command mode	Ones place: Pulse mode 0: A/B quadrature pulse; A leads B 1: A is PULSE and B is SIGN If channel B is of low electric level, the edge counts up; if channel B is of high electric level, the edge counts down. 2: A is positive pulse Channel A is positive pulse; channel B needs no wiring 3: A/B dual-channel pulse; channel A pulse edge counts up, channel B pulse edge counts down Tens place: Pulse direction Bit0: Set pulse direction 0: Forward 1: Reverse Bit1: Set pulse direction by running direction 0: Disable, and BIT0 is valid 1: Enable Hundreds place: Frequency multiplication selection for pulse +direction (reserved) 0: No frequency multiplication 1: Frequency multiplication Thousands place: Pulse control selection Bit0: Pulse filter selection 0: Inertia filter 1: Moving average filter Bit1: Overspeed control 0: No control 1: Control	0x0000	◎
P21.02	APR gain 1	The two automatic position regulator (APR) gains are switched based on the switching mode set through P21.04. When the spindle orientation function is used, the gains are switched automatically, regardless of the setting of P21.04. P21.03 is used for dynamic running, and P21.02 is used for maintaining the locked state. Setting range: 0.0–400.0	20.0	○
P21.03	APR gain 2		30.0	○
P21.04	APR gain switchover mode	Used to select the mode for switching between APR gains. To use torque command-based switching, you need to set P21.05; and to use speed command-based switching, you need to set P21.06. 0: No switchover 1: Torque command	0	○

Function code	Name	Description	Default	Modify
		2: Speed command 3–5: Reserved		
P21.05	APR gain switchover threshold in torque command	Setting range: 0.0–100.0% (of the motor rated torque)	10.0%	○
P21.06	APR gain switchover threshold in speed commmand	0.0–100.0% (of the motor rated speed)	10.0%	○
P21.07	Smooth filter coefficient for gain switchover	Smooth filter coefficient for APR gain switchover. Setting range: 0–15	5	○
P21.08	APR output limit	When the APR output limit is 0, the APR is invalid, and no position control can be performed, however, speed control is valid. Setting range: 0.0–100.0% (of max. output frequency P00.03)	20.0%	○
P21.09	Positioning completion zone	When the position deviation is less than P21.09, and the duration is greater than P21.10, positioning completion signal will be outputted. Setting range: 0–1000	10	○
P21.10	Detection time for positioning completion	0.0–1000.0ms	10.0ms	○
P21.11	Numerator of position command ratio	lectronic gear ratio, used to adjust the corresponding relation between position command and actual running displacement. Setting range: 1–65535	1000	○
P21.12	Denominator of position command ratio	Setting range: 1–65535	1000	○
P21.13	Position feedforward gain	0.00–120.00% For pulse string reference only (position control)	100.00	○
P21.14	Position feedforward filter time constant	0.0–3200.0ms For pulse string reference only (position control)	3.0ms	○
P21.15	Position command filter time constant	Position feedforward filter time constant during the pulse string positioning. 0.0–3200.0ms	0.0ms	◎
P21.16	Digital positioning mode	Bit 0: Positioning mode 0: Relative position 1: Absolute position (Origin mode. This function is reserved.) Bit 1: Cyclic positioning setting. You can enable positioning through a terminal (function 55) or choose automatic cyclic positioning. Terminals support only the enabling of continuous positioning, and automatic cyclic positioning can be set to cyclic positioning or reciprocating positioning through bit 2 of P21.16. 0: Terminal-based cyclic positioning 1: Automatic cyclic positioning	0	○

Function code	Name	Description	Default	Modify
		Bit 2: Cyclic mode 0: Continuous 1: Reciprocating (support the automatic cyclic positioning) Bit 3: P21.17 digital setting mode. You can select incremental or position type. The incremental type indicates that P21.17 needs to be conducted again after each positioning is enabled. When the position reference bit command is enabled, the displacement is set through P21.17. When P21.17 is changed, new position is be positioned automatically. 0: Incremental 1: Position type (do not support the continuous mode) Bit 4: Origin searching mode. This function is reserved. 0: Search for the origin only for once 1: Search for the origin in every time of running Bit 5: Origin calibration mode. This function is reserved. 0: Calibration in real time 1: One-time calibration Bit 6: Positioning completion signal setting. You can set the positioning completion signal in the pulse or electrical level form. The positioning completion signal is valid in the positioning completion signal holding time set in P21.25. 0: Valid in the positioning completion signal holding time (P21.25) 1: Always valid Bit 7: First positioning setting. You can set whether the first positioning is performed when a running command is received. If no, the first positioning is performed only after the positioning enabling terminal or automatic cyclic positioning is enabled. 0: Disable 1: Enable Bit 8: Positioning enabling signal setting (for terminal-based cyclic positioning). In the pulse form, after positioning is completed or in the first positioning, the jump edge of the positioning enabling terminal needs to be detected for performing positioning. In the electrical level mode, after positioning is completed or in the first positioning, positioning is performed after it is detected that the positioning enabling terminal is		

Function code	Name	Description	Default	Modify
		switched on. 0: Pulse signal 1: Electrical level signal Bit 9: Position source 0: Set by P21.17 1: PROFIBUS-DP/CANopen setting Bit 10: Indicates whether to save encoder pulse count value at power-off 0: No 1: Yes Bit 11: Reserved Bit 12: Positioning curve setting (Reserved) 0: Straight line 1: S curve		
P21.17	Position set in digital mode	Used to set the position for digital positioning. Actual position = P21.17*P21.11/P21.12 0–65535	0	○
P21.18	Positioning speed setting	0: Set by P21.19 1: AI1 2: AI2 3: AI3 4: High-speed pulse HDIA 5: High-speed pulse HDIB	0	○
P21.19	Positioning speed set in digital mode	0–100.0% (of the max. frequency)	20.0%	○
P21.20	Positioning ACC time	Used to set the ACC/DEC time in the positioning process. P21.20 indicates the time the inverter takes to accelerate from 0 Hz to the maximum output frequency (P00.03). P21.21 indicatesthe time the inverter takes to decelerate from the maximum output frequency (P00.03) to 0 Hz. P21.20 setting range: 0.01–300.00 s P21.21 setting range: 0.01–300.00 s	3.00s	○
P21.21	Positioning DEC time		3.00s	○
P21.22	Positioning holding time	Used to se the holding time after the destination position is reached. Setting range: 0.000–60.000 s	0.100s	○
P21.23	Origin searching speed	0.00–50.00Hz	2.00Hz	○
P21.24	Origin bias	0–65535	0	○
P21.25	Positioning completion signal holding time	Time for holding the positioning completion signal. This parameter is also valid for the positioning in spindle orientation. Setting range: 0.000–60.000 s	0.200s	○
P21.26	Pulse superposition	P21.26: -9999–32767	0	○
P21.27	Pulse superposition rate	P21.27: 0–3000.0/ms	8.0/ms	○
P21.28	ACC/DEC time after pulse inhibition	The function is valid in the pulse speed reference (P00.06=12) or pulse position mode (P21.00=1).	5.0s	○

Function code	Name	Description	Default	Modify
		1. Input terminal function 68 (Enable the pulse superimposition) When the rising edge of the terminal is detected, add the value set in P21.26 to the set pulse value, and compensate to the pulse reference channel based on the pulse superposition speed set in P21.27. 2. Input terminal function 67 (pulse increase) When the terminal is valid, superpose the pulse value to the pulse reference channel based on the pulse superposition speed set in P21.27. **Note:** Terminal filter P05.09 may affect the actual superposed value. For example: P21.27 = 1.0/ms P05.05 = 67 When the S5 ternimal input signal is 0.5 s, the actual superposed pulses = 500 pulses 3. Input terminal function 69 (pulse decrease) The time sequence of this function is same as the above. The difference is that this terminal is the pulse number that is superposed degressively. **Note:** The pulses mentioned above are superposed to A2 and B2 of pulse reference channel. Functions such as filtering and electronic gear are still valid for superposed pulses. 4. Output terminal function 28 (during pulse superposition) During the pulse superposition, the output terminal is valid. After the pulse superposition is completed, the output terminal is invalid.		
P21.29	Speed feedforward filtering time constant (pulse string-based speed mode)	Filter time constant detected by the pulse string when the speed reference source is set to the pulse string (P00.06=12 or P00.07=12). Setting range: 0–3200.0ms	10.0ms	○
P21.30	Numberator of the 2nd command ratio	1–65535	1000	○
P21.31–P21.33	Reserved			

P22 group—Spindle positioning

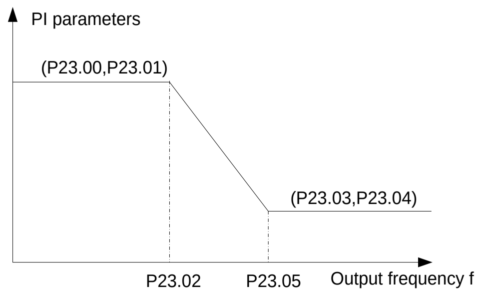
Function code	Name	Description	Default	Modify
P22.00	Spindle positioning mode selection	Bit0: Indicates whether to enable spindle positioning 0: Disable	0	○

Function code	Name	Description	Default	Modify
		1: Enable Bit1: Select spindle positioning reference point 0: Z pulse input 1: S2/S3/S4 terminal input Bit2: Search for reference point 0: Search the reference point only once 1: Search the reference point every time Bit3: Indicates whether to enable reference point calibration 0: Disable 1: Enable Bit4: Positioning mode selection 1 0: Set direction positioning 1: Near-by direction positioning Bit5: Positioning mode selection 2 0: Forward positioning 1: Reverse positioning Bit6: Zeroing command selection 0: Electric level mode 1: Pulse mode Bit7: Reference point calibration mode 0: Calibrate at the first time 1: Calibrate in real time Bit8: Action selection after zeroing signal cancellation (electric level type) 0: Switch to speed mode 1: Position lock mode Bit9: Positioning completion signal selection 0: Electric level signal 1: Pulse signal Bit10: Z pulse signal source 0: Motor 1: Spindle Bit11–15: Reserved		
P22.01	Speed of spindle orientation	During spindle orientation, the speed of the position point of orientation will be searched, and then it will switch to position control orientation. Setting range: 0.00–100.00Hz	10.00Hz	○
P22.02	DEC time of spindle orientation	Spindle orientation deceleration time means the time needed for the VFD to decelerate from Max. output frequency (P00.03) to 0Hz. Setting range: 0.0–100.0 s	3.0s	○
P22.03	Spindle zeroing position 0	You can select four spindle zeroing positions by terminals (functions 46 and 47). Setting range: 0–65535	0	○
P22.04	Spindle zeroing position 1	Setting range: 0–65535	0	○
P22.05	Spindle zeroing position 2	Setting range: 0–65535	0	○

Function code	Name	Description	Default	Modify
P22.06	Spindle zeroing position 3	Setting range: 0–65535	0	○
P22.07	Spindle scale-division angle 1	You can select seven spindle scale-division angles by terminals (functions 48, 49, and 50). Setting range: 0.00–359.99	15.00	○
P22.08	Spindle scale-division angle 2	Setting range: 0.00–359.99	30.00	○
P22.09	Spindle scale-division angle 3	Setting range: 0.00–359.99	45.00	○
P22.10	Spindle scale-division angle 4	Setting range: 0.00–359.99	60.00	○
P22.11	Spindle scale-division angle 5	Setting range: 0.00–359.99	90.00	○
P22.12	Spindle scale-division angle 6	Setting range: 0.00–359.99	120.00	○
P22.13	Spindle scale-division angle 7	Setting range: 0.00–359.99	180.00	○
P22.14	Spindle drive ratio	Used to set the reduction ratio of the spindle and the mounting shaft of the encoder. Setting range: 0.000–30.000	1.000	○
P22.15	Spindle zero-point communication setting	Used to set spindle zero-point offset, if the selected spindle zero point is P22.03, the final spindle zero point will be the sum of P22.03 and P22.15. Setting range: 0–39999	0	○
P22.16	Reserved	0–65535	0	○
P22.17	Reserved	0–65535	0	○
P22.18	Rigid tapping selection	Ones place: Enabling selection 0: Disable (This function can be enabled through a terminal (configured with function 58) 1: Enable (internally) Tens place: Analog port selection 0: Invalid 1: AI1 2: AI2 3: AI3	0x00	◎
P22.19	Analog filter time of rigid tapping	0.0ms–1000.0ms	1.0ms	○
P22.20	Max. frequency of rigid tapping	0.00–400.00Hz	50.00Hz	○
P22.21	Corresponding frequency of analog zero drift of rigid tapping	0.00–10.00Hz	0.00Hz	○
P22.22	Speed measuring method of pulse reference	0: By main control board 1: By PG card 2: Hybrid method	0	○
P22.23	Reserved	0–65535	0	●

Function code	Name	Description	Default	Modify
P22.24	Setting of encoder count value clearing	0–65535	0	○

P23 group—Vector control of motor 2

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P23.00</td><td>Speed-loop proportional gain 1</td><td rowspan="6">P23.00–P23.05 are applicable only to vector control mode. When switching frequency 1 (P23.02) is not reached, the speed-loop PI parameters are: P23.00 and P23.01. When switching frequency 2 (P23.05) is exceeded, the speed-loop PI parameters are: P23.03 and P23.04. PI parameters are obtained according to the linear change of two groups of parameters. See the following figure:


The speed loop dynamic response characteristics of vector control can be adjusted by setting the proportional coefficient and integral time of speed regulator. Increasing proportional gain or reducing integral time can accelerate dynamic response of speed loop; however, if the proportional gain is too large or integral time is too small, system oscillation and overshoot may occur; if proportional gain is too small, stable oscillation or speed offset may occur.
PI parameters have a close relationship with the inertia of the system. Adjust PI parameters depending on different loads to meet various demands.
P23.00 setting range: 0.0–200.0
P23.01 setting range: 0.000–10.000 s
P23.02 setting range: 0.00Hz–P23.05
P23.03 setting range: 0.0–200.0
P23.04 setting range: 0.000–10.000 s
P23.05 setting range: P23.02–P00.03 (Max. output frequency)</td><td>20.0</td><td>○</td></tr>
<tr><td>P23.01</td><td>Speed-loop integral time 1</td><td>0.200s</td><td>○</td></tr>
<tr><td>P23.02</td><td>Low-point frequency for switching</td><td>5.00Hz</td><td>○</td></tr>
<tr><td>P23.03</td><td>Speed-loop proportional gain 2</td><td>20.0</td><td>○</td></tr>
<tr><td>P23.04</td><td>Speed-loop integral time 2</td><td>0.200s</td><td>○</td></tr>
<tr><td>P23.05</td><td>High-point frequency for switching</td><td>10.00Hz</td><td>○</td></tr>
<tr><td>P23.06</td><td>Speed-loop output filter</td><td>0–8 (corresponding to 0–2^8/10ms)</td><td>0</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
P23.07	Electromotive slip compensation coefficient of vector control	Slip compensation coefficient is used to adjust the slip frequency of the vector control and improve the speed control accuracy of the system. Adjusting the parameter properly can control the speed steady-state error. Setting range: 50–200%	100%	○
P23.08	Power-generation slip compensation coefficient of vector control		100%	○
P23.09	Current-loop proportional coefficient P	**Note:** ✧ The two function parameters impact the dynamic response speed and control accuracy of the system. Generally, you do not need to modify the two function parameters. ✧ Applicable to SVC mode 0 (P00.00=0) and closed-loop VC mode (P00.00=3). ✧ The values of the two function parameters are updated automatically after SM parameter autotuning is completed. Setting range: 0–65535	1000	○
P23.10	Current-loop integral coefficient I		1000	○
P23.11	Speed-loop differential gain	0.00–100.00 s	0.00s	○
P23.12	High-frequency current-loop proportional coefficient	In the closed-loop vector control mode (P00.00=3), when the frequency is lower than the current-loop high-frequency switching threshold (P23.14), the current-loop PI parameters are P23.09 and P23.10; and when the frequency is higher than the current-loop high-frequency switching threshold, the current-loop PI parameters are P23.12 and P23.13. P23.12Setting range: 0–65535 P23.13Setting range: 0–65535 P23.14Setting range: 0.0–100.0% (of the max. frequency)	1000	○
P23.13	High-frequency current-loop integral coefficient		1000	○
P23.14	Current-loop high-frequency switching threshold		100.0%	○
P23.15–P23.19	Reserved			

P24 group—Encoder parameters of motor 2

Function code	Name	Description	Default	Modify
P24.00	Encoder type display	0: Incremental encoder 1: Resolver-type encoder 2: Sin/Cos encoder 3: Endat absolute encoder	0	●
P24.01	Encoder pulse number	Number of pulses generated when the encoder revolves for one circle. Setting range: 0–60000	1024	◎

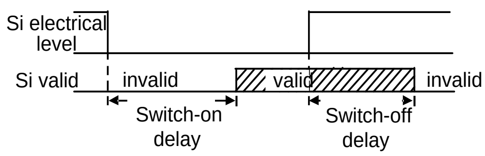
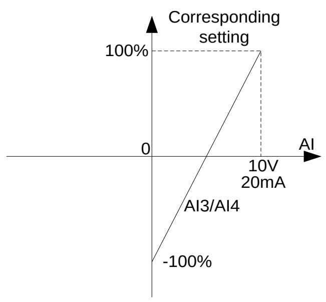
Function code	Name	Description	Default	Modify
P24.02	Encoder direction	Ones place: AB direction 0: Forward 1: Reverse Tens place: Z pulse direction (reserved) 0: Forward 1: Reverse Hundreds: CD/UVW pole signal direction 0: Forward 1: Reverse	0x000	◎
P24.03	Detection time of encoder offline fault	0.0–10.0 s	2.0s	○
P24.04	Detection time of encoder reversal fault	0.0–100.0 s	0.8s	○
P24.05	Filter times of encoder detection	Setting range: 0x00–0x99 Ones place: Low-speed filter time, corresponding to 2^ (0–9)*125μs Tens place: High-speed filter times, corresponding to 2^ (0–9)*125μs	0x33	○
P24.06	Speed ratio between encoder mounting shaft and motor	You need to set the function parameter when the encoder is not installed on the motor shaft and the drive ratio is not 1. Setting range: 0.001–65.535	1.000	○
P24.07	Control parameters of SM	Bit0: Enable Z pulse calibration Bit1: Enable encoder angle calibration Bit2: Enable SVC speed measurement Bit3: Reserved Bit4: Reserved Bit5: Do not detect the encoder initial angle in v/f control Bit6: Enable the CD signal calibration Bit7: Reserved Bit8: Do not detect encoder faults during autotuning Bit9: Enable Z pulse detection optimization Bit10: Enable the initial Z pulse calibration optimization Bit12: Clear the Z pulse arrival signal after stop Bit13: Reserved Bit14: Detect Z pulse after one rotation	0x3	○
P24.08	Enabling Z pulse offline detection	0x00–0x11 Ones place: Z pulse detection 0: Disable 1: Enable Tens place: UVW pulse detection (for SM) 0: Disable 1: Enable	0x10	○
P24.09	Initial angle of Z pulse	Relative electric angle between the encoder Z pulse and the motor pole position. Setting range: 0.00–359.99	0.00	○

Function code	Name	Description	Default	Modify
P24.10	Pole initial angle	Relative electric angle between the encoder position and the motor pole position. Setting range: 0.00–359.99	0.00	○
P24.11	Autotuning pole initial angle	Range: 0–3 1: Rotary autotuning (DC braking) 2: Static autotuning (suitable for resolver-type encoder, sin/cos with CD signal feedback) 3: Rotary autotuning (initial angle identification) The pole initial angle obtained through rotary autotuning 1 is accurate. Rotary autotuning is recommended in most cases, in which the motor needs to be decoupled from the load or the motor load is light.	0	◎
P24.12	Speed measurement optimization selection	0: No optimization 1: Optimization mode 1 2: Optimization mode 2	1	◎
P24.13	CD signal zero offset gain	0–65535	0	○
P24.14	Encoder type selection	Ones place: Incremental encoder 0: without UVW 1: with UVW Tens place: Sin/Cos encoder 0: without CD signal 1: with CD signal	0x00	◎
P24.15	Speed measurement mode	0: PG card 1: Locally measured through HDIA and HDIB. Only the 24V incremental encoders are supported.	0	◎
P24.16	Frequency division coefficient	0–255 When the function parameter is set to 0 or 1, frequency division of 1:1 is implemented.	0	○
P24.17	Pulse filter handling selection	0x0000–0xFFFF Bit0: Enable/disable encoder input filter 0: No filter 1: Filter Bit1: Encoder signal filter mode 0: Self-adaptive filter 1: Use P20.18 filter parameter Bit2: Enable/disable encoder frequency-division output filter 0: No filter 1: Filter Bit3: Reserved Bit4: Enable/disable pulse reference filter 0: No filter 1: Filter Bit5: Pulse reference filter mode (valid when Bit4	0x0033	○

Function code	Name	Description	Default	Modify
		is set to 1) 0: Self-adaptive filter 1: Use P20.19 filter parameter Bit6: Frequency-divided output source setting 0: Encoder signals 1: Pulse reference signals Bit7–15: Reserved		
P24.18	Encoder pulse filter width	Range: 0–63 The filter time is P20.18*0.25μs. The value 0 or 1 indicates 0.25μs.	2	○
P24.19	Pulse reference filter width	Range: 0–63 The filter time is P20.19*0.25μs. The value 0 or 1 indicates 0.25μs.	2	○
P24.20	Pulse number of pulse reference	0–65535	1024	◎
P24.21	Enabling SM angle compensation	0–1	0	○
P24.22	Frequency point of speed measurement mode switchover	0–630.00Hz	1.00Hz	○
P24.23	SM angle compensation coefficient	-200.0–200.0%	100.0%	○
P24.24	Pole pairs in SM pole initial angle autotuning	0–128	2	○

P25 group—I/O card input

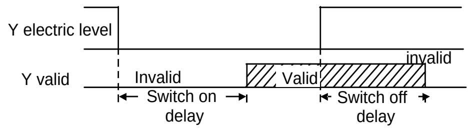
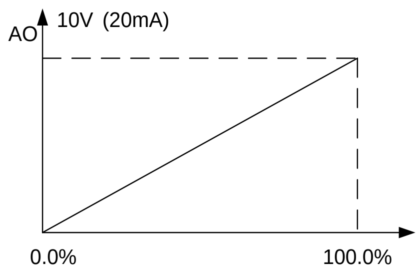
Function code	Name	Description	Default	Modify
P25.00	HDI1 input type selection	0: High-speed pulse input 1: Digital input	0	◎
P25.01	Function of S5	Same as those in P05	0	◎
P25.02	Function of S6		0	◎
P25.03	Function of S7		0	◎
P25.04	Function of S8		0	◎
P25.05	Function of S9		0	◎
P25.06	Function of S10		0	◎
P25.07	Function of HDI1		0	◎
P25.08	Expansion card input terminal polarity selection	0x00–0x7F BIT0: S5 virtual terminal BIT1: S6 virtual terminal BIT2: S7 virtual terminal BIT3: S8 virtual terminal BIT4: S9 virtual terminal BIT5: S10 virtual terminal BIT6: HDI1 virtual terminal	0x00	○
P25.09	Virtual terminal setting of expansion card	0x000–0x7F (0: Disable; 1: Enable) BIT0: S5 virtual terminal	0x00	◎

Function code	Name	Description	Default	Modify
		BIT1: S6 virtual terminal BIT2: S7 virtual terminal BIT3: S8 virtual terminal BIT4: S9 virtual terminal BIT5: S10 virtual terminal BIT6: HDI1 virtual terminal		
P25.10	HDI1 switch-on delay	Used to specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.  Setting range: 0.000–50.000 s	0.000s	○
P25.11	HDI1 switch-off delay		0.000s	○
P25.12	S5 switch-on delay		0.000s	○
P25.13	S5 switch-off delay		0.000s	○
P25.14	S6 switch-on delay		0.000s	○
P25.15	S6 switch-off delay		0.000s	○
P25.16	S7 switch-on delay		0.000s	○
P25.17	S7 switch-off delay		0.000s	○
P25.18	S8 switch-on delay		0.000s	○
P25.19	S8 switch-off delay		0.000s	○
P25.20	S9 switch-on delay		0.000s	○
P25.21	S9 switch-off delay		0.000s	○
P25.22	S10 switch-on delay		0.000s	○
P25.23	S10 switch-off delay		0.000s	○
P25.24	AI3 lower limit	Used to define the relationship between the analog input voltage and its corresponding setting. When the analog input voltage exceeds the range from the upper limit to the lower limit, the upper limit or lower limit is used. When the analog input is current input, 0mA–20mA current corresponds to 0V–10V voltage. In different applications, 100.0% of the analog setting corresponds to different nominal values. See the descriptions of each application section for details. The following figure illustrates the cases of several settings:  Input filter time: to adjust the sensitivity of analog input. Increasing the value properly can enhance analog input anti-interference but may reduce the sensitivity of analog input. **Note: AI3 and AI4 can support 0(2)–10V/0(4)–20mA input. When AI3 and AI4**	0.00V	○
P25.25	Corresponding setting of AI3 lower limit		0.0%	○
P25.26	AI3 upper limit		10.00V	○
P25.27	Corresponding setting of AI3 upper limit		100.0%	○
P25.28	AI3 input filter time		0.030s	○
P25.29	AI4 lower limit		0.00V	○
P25.30	Corresponding setting of AI4 lower limit		0.0%	○
P25.31	AI4 upper limit		10.00V	○
P25.32	Corresponding setting of AI4 upper limit		100.0%	○
P25.33	AI4 input filter time		0.030s	○

Function code	Name	Description	Default	Modify
		select 0–20mA input, the corresponding voltage of 20mA is 10V. P25.24 setting range: 0.00V–P25.26 P25.25 setting range: -300.0%–300.0% P25.26 setting range: P25.24–10.00V P25.27 setting range: -300.0%–300.0% P25.28 setting range: 0.000s–10.000s P25.29 setting range: 0.00V–P25.31 P25.30 setting range: -300.0%–300.0% P25.31 setting range: P25.29–10.00V P25.32 setting range: -300.0%–300.0% P25.33 setting range: 0.000s–10.000s		
P25.34	HDI1 high-speed pulse input function selection	0: Input set through frequency 1: Counting	0	◎
P25.35	HDI1 lower limit frequency	0.000kHz – P25.37	0.000 kHz	○
P25.36	Corresponding setting of HDI1 lower limit frequency	-300.0%–300.0%	0.0%	○
P25.37	HDI1 upper limit frequency	P25.35–50.000kHz	50.000 kHz	○
P25.38	Corresponding setting of HDI1 upper limit frequency	-300.0%–300.0%	100.0%	○
P25.39	HDI1 frequency input filter time	0.000s–10.000s	0.030s	○
P25.40	AI3 input signal type	Range: 0–1 0: Voltage 1: Current	0	○
P25.41–P25.45	Reserved			

P26 group—I/O card output

Function code	Name	Description	Default	Modify
P26.00	Reserved	0–65535	0	●
P26.01	Reserved	Same as the description for P06.01		
P26.02	Reserved			
P26.03	Reserved			
P26.04	RO3 output		0	○
P26.05	Reserved			
P26.06	Reserved			
P26.07	Reserved			
P26.08	Reserved			
P26.09	Reserved			
P26.10	Reserved			
P26.11	Reserved			

Function code	Name	Description	Default	Modify
P26.12	Expansion card output terminal polarity	0x0000–0x7FF RO10, RO9…RO3, HDO, Y3, Y2 in sequence	0x000	○
P26.13	Reserved	Used to specify the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off.  Setting range: 0.000–50.000 s **Note: P26.13 and P26.14 are valid only when P26.00=1.**		
P26.14	Reserved			
P26.15	Reserved			
P26.16	Reserved			
P26.17	Reserved			
P26.18	Reserved			
P26.19	RO3 switch-on delay		0.000s	○
P26.20	RO3 switch-off delay		0.000s	○
P26.21	Reserved			
P26.22	Reserved			
P26.23	Reserved			
P26.24	Reserved			
P26.25	Reserved			
P26.26	Reserved			
P26.27	Reserved			
P26.28	Reserved			
P26.29	Reserved			
P26.30	Reserved			
P26.31	Reserved			
P26.32	Reserved			
P26.33	Reserved			
P26.34	Reserved			
P26.35	AO2 output	Same as the description for P06.14	0	○
P26.36	Reserved		0	●
P26.37	Reserved		0	●
P26.38	AO2 output lower limit	Used to define the relationship between the output value and analog output. When the output value exceeds the allowed range, the output uses the lower limit or upper limit. When the analog output is current output, 1mA equals 0.5V. In different cases, the corresponding analog output of 100% of the output value is different.  P26.38 setting range: -300.0%–P26.40 P26.39 setting range: 0.00V–10.00V P26.40 setting range: P26.38–300.0% P26.41 setting range: 0.00V–10.00V	0.0%	○
P26.39	AO2 output corresponding to lower limit		0.00V	○
P26.40	AO2 output upper limit		100.0%	○
P26.41	AO2 output corresponding to upper limit		10.00V	○
P26.42	AO2 output filter time		0.000s	○
P26.43	Reserved		0.0%	●
P26.44	Reserved		0.00V	●
P26.45	Reserved		100.0%	●
P26.46	Reserved		10.00V	●
P26.47	Reserved		0.000s	●

Function code	Name	Description	Default	Modify
		P26.42 setting range: 0.000s–10.000s P26.43 setting range: -300.0%–P26.45 P26.44 setting range: 0.00V–10.00V P26.45 setting range: P26.43–300.0% P26.46 setting range: 0.00V–10.00V P26.47 setting range: 0.000s–10.000s		
P26.48–P26.52	Reserved			

P27 group––Programmable card functions

Function code	Name	Description	Default	Modify
P27.00	Enabling programmable card functions	Used to set whether to enable programmable card functions. 0: Disable 1: Enable When programmable card functions are enabled, the programming interfaces and data related to the inverter unit can be valid. Setting range: 0–1	0	◎
P27.01	C_WrP1	0–65535 Used to write a value to WrP1 of the PLC.	0	○
P27.02	C_WrP2	Used to write a value to WrP2 of the PLC.	0	○
P27.03	C_WrP3	Used to write a value to WrP3 of the PLC.	0	○
P27.04	C_WrP4	Used to write a value to WrP4 of the PLC.	0	○
P27.05	C_WrP5	Used to write a value to WrP5 of the PLC.	0	○
P27.06	C_WrP6	Used to write a value to WrP6 of the PLC.	0	○
P27.07	C_WrP7	Used to write a value to WrP7 of the PLC.	0	○
P27.08	C_WrP8	Used to write a value to WrP8 of the PLC.	0	○
P27.09	C_WrP9	Used to write a value to WrP9 of the PLC.	0	○
P27.10	C_WrP10	Used to write a value to WrP10 of the PLC.	0	○
P27.11	Programmable card status	0: Stopped 1: Running	0	●
P27.12	C_MoP1	Used to monitor/view the MoP1 value of the PLC.	0	●
P27.13	C_MoP2	Used to monitor/view the MoP2 value of the PLC.	0	●
P27.14	C_MoP3	Used to monitor/view the MoP3 value of the PLC.	0	●
P27.15	C_MoP4	Used to monitor/view the MoP4 value of the PLC.	0	●
P27.16	C_MoP5	Used to monitor/view the MoP5 value of the PLC.	0	●
P27.17	C_MoP6	Used to monitor/view the MoP6 value of the PLC.	0	●
P27.18	C_MoP7	Used to monitor/view the MoP7 value of the PLC.	0	●
P27.19	C_MoP8	Used to monitor/view the MoP8 value of the PLC.	0	●

Function code	Name	Description	Default	Modify
P27.20	C_MoP9	Used to monitor/view the MoP9 value of the PLC.	0	●
P27.21	C_MoP10	Used to monitor/view the MoP10 value of the PLC.	0	●
P27.22	Programmable card digital input	Bit0: PS1 Bit1: PS2 Bit2: PS3 Bit3: PS4 Bit4–Bit15: Reserved	0	●
P27.23	Programmable card digital output	Bit0: PR01A Bit1: PR02A Bit2–Bit15: Reserved	0	●
P27.24–P27.26	Reserved			
P27.27	Programmable card save function at power failure	0–1 0: Disable 1: Enable	1	◎
P27.28–P27.29	Reserved	0–65535	0	●

P28 group—Master/slave control

Function code	Name	Description	Default	Modify
P28.00	Master/slave mode	0: Master/slave control is invalid. 1: The local device is the master. 2: The local device is the slave.	0	◎
P28.01	Master/slave communication data selection	0: CAN2 1: Reserved	0	◎
P28.02	Master/slave control mode	Ones place: Master/slave running mode 0: Master/slave mode 0 The master and slave use speed control, with power balanced through droop control. 1: Master/slave mode 1 The master and slave must be in the same type of vector control. When the master is in speed control, the slave is forced into torque control. 2: Combination mode The slave switches from speed mode (master/slave mode 0) to torque mode (master/slave mode 1) at a frequency point. Tens place: Slave start command source 0: Master 1: Determined by P00.01 Hundreds place: Whether to enable master/slave to send/receive data 0: Enable 1: Disable	0x001	◎

Function code	Name	Description	Default	Modify
P28.03	Slave speed gain	0.0–500.0%	100.0%	○
P28.04	Slave torque gain	0.0–500.0%	100.0%	○
P28.05	Frequency point for switching between master/slave mode 2, speed mode, and torque mode	0.00–10.00Hz	5.00	○
P28.06	Number of slaves	0–15	1	◎
P28.07	Master/slave CAN communication timeout period	0.0 (invalid); 0.1–60.0s	0.0s	○
P28.08	Master/slave CAN communication address	0–127	1	◎
P28.09	Master/slave CAN communication baud rate	0: 50Kbps 1: 100Kbps 2: 125Kbps 3: 250Kbps 4: 500Kbps 5: 1M bps	2	◎
P28.10	Slave torque offset	-100.0%–100.0%	0	◎
P28.11	Action to protect against motor overheating during running	0x00–0x11 Ones place: When the PG card detects overheating 0: Coast to stop 1: Keep running Tens place: When the IO card detects overheating 0: Coast to stop 1: Keep running Note: The function code is applicable only to temperature detection on the motor in running. If overheating is detected on a stopped motor, a fault is reported.	0x00	○
P28.12	Type of sensor for PG card to detect motor temperature	0: No temperature sensor 1: PT100	0	○
P28.13	PG card detected motor OH protection threshold	-20.0–200.0°C	110.0℃	○
P28.14	Detection time of PG card detected motor OH protection	0.1–3600.0 s	5.0s	○
P28.15	PG card detected motor OH pre-alarm threshold	-20.0–200.0°C	90.0°C	○
P28.16	Type of sensor for IO card to detect motor temperature	0: No temperature sensor 1: PT100	0	○
P28.17	IO card detected motor OH protection threshold	-20.0–200.0°C	110.0℃	○

Function code	Name	Description	Default	Modify
P28.18	Detection time of IO card detected motor OH protection	0.1–3600.0 s	5.0s	○
P28.19	IO card detected motor OH pre-alarm threshold	-20.0–200.0°C The pre-alarm indicator blinks.	90.0°C	○
P28.20	B25/85 value of NTC sensor for IO card	0–6000K	0	○
P28.21	NTC temperature calibration coefficient	0.00–2.00	1.00	○
P28.22	Type of sensor for AI/AO to detect motor temperature	0: No temperature sensor 1: PT100 Motor temperature is displayed through P19.11.	0	◎
P28.23	AI/AO detected motor OH protection threshold	P28.14–200.0°C	110.0℃	○
P28.24	AI/AO detected motor OH pre-alarm threshold	-20.0– P28.13 When the motor temperature exceeds the value, the DO terminal with function 50 (AI detected motor OH pre-alarm) outputs a valid signal.	90.0°C	○
P28.25	Signal source for AI/AO to detect motor temperature	0: Do not select this function 1: AI1 2: AI2 Note: AI must be of the voltage type when this function is enabled. If you select AI2, you need to set P05.29 (AI2 lower limit) to 0.00V and P05.30 set to 0.0%.	0	◎
P28.26	AO1 output current setting	0.00–20.00mA	1.00mA	○
P28.27–P28.29	Reserved	0–65535	0	○

P90 group—Tension control in speed mode

Function code	Name	Description	Default	Modify
P90.00	Tension control mode	0: Disable 1: Close-loop tension speed control 2: Open loop tension torque control 3: Close-loop tension torque control **Note:** Closed loop means that there is a feedback signal from an external sensor. Using closed loop requires the settings for the PID function group.	0	◎
P90.01	Winding/unwinding mode	0: Winding 1: Unwinding **Note:** The winding and unwinding are related to the running direction and the direction of the reel diameter calculation.	0	○

Function code	Name	Description	Default	Modify
P90.02	Reel mechanical transmission rate	0.01–600.00 =Motor motor rotation speed/reel rotation speed=Reel diameter/motor shaft diameter	1.00	○
P90.03	Max. linear speed	0.0–6000.0m/min	1000.0m/min	○
P90.04	Input source of linear speed	0: Keypad 1: AI1 2: AI2 3: AI3 4: High-speed pulse HDI 5: Main traction encoder frequency-division input	0	◎
P90.05	Linear speed set through keypad	0.0–100.0% (of the max. linear speed)	20.0%	○
P90.06	Diameter of main traction	0–6000.0mm	99.0mm	○
P90.07	Main traction drive ratio	0–60.000 =Motor rotation speed/rotation speed of main traction roller =Diameter of main traction roller/motor shaft diameter	1.000	○
P90.08	Linear speed ACC time	0.00–600.00s	0.00s	○
P90.09	Linear speed DEC time	0.00–600.00s	0.00s	○
P90.10	Tension setting	0x00–0x14 Ones place: Tension setting source 0: Keypad 1: AI1 2: AI2 3: AI3 4: High-speed pulse HDI Tens place: Multiplier of maximum tension P90.12 0: 1 1: 10	0x00	◎
P90.11	Tension set through keypad	0.0–100.0% (of the max. tension)	10.0%	○
P90.12	Max. tension	Related to the tens place of P90.10. When the tens place of P90.10 is 0, the setting range is 0–60000N. When the tens place of P90.10 is 1, the setting range is (0–60000)*10N.	1000N	○
P90.13	Roll diameter calculation mode	0: Not calculated 1: AI1 2: AI2 3: AI3 4: High-speed pulse HDI 5: Linear speed 6: Thickness (of wire) 7: Thickness (of strip)	0	◎

Function code	Name	Description	Default	Modify
P90.14	Roll diameter calculation delay time	0.0–100.0s After start-up, no roll diameter calculation is performed during the delay time.	1.0s	○
P90.15	Min. roll diameter	0.0–P90.16 Select the winding mode and reset the default roll diameter to the minimum roll diameter.	50.0 mm	○
P90.16	Max. roll diameter	P90.15–5000.0 mm Select the unwinding mode and reset the default roll diameter to the maximum roll diameter.	1000.0 mm	○
P90.17	Initial roll diameter 1	P90.15–P90.16 (mm) **Note:** When multiple sizes of empty rolls are applied, the initial roll diameter can be switched through the S terminal combination: 01 for selecting initial roll diameter 1, 10 for selecting initial roll diameter 2, and 11 for selecting initial roll diameter 3.	100.0 mm	○
P90.18	Initial roll diameter 2		100.0 mm	○
P90.19	Initial roll diameter 3		100.0 mm	○
P90.20	Linear speed roll diameter calculation filter time	0.000–60.000s	2.000s	○
P90.21	Linear speed roll diameter calculation restriction	Ones place: 0:No 1: Restrict changes in reverse direction Tens place: 0:No 1: Automatic restriction according to running frequency and material thickness	0x00	○
P90.22	Material thickness	0.001–65.535mm	0.010 mm	○
P90.23	Number of coils per layer	1–10000 Applicable to wires.	1	◎
P90.24	Revolution counting function selection	0: Digital terminal input 1: PG card input Applicable to thickness calculation method 2: Running frequency No input automatic revolution counting	0	◎
P90.25	Number of pulses per revolution	1–60 Applies to P90.32=0, reflecting the number of pulses per turn at the digital terminal input	1	◎
P90.26	Roll diameter set value	0.0–100.0% (of the max. roll diameter)	80.0%	○
P90.27	Roll diameter reset setting	0x00–0x111 Ones place: At stop 0: Remain current roll diameter 1: Restore to initial roll diameter Tens place: Power off at running 0: Remain current roll diameter 1: Restore to initial roll diameter Hundreds place: Reach the roll diameter set value 0: Remain current roll diameter	0x1000	○

Function code	Name	Description	Default	Modify
		1: Restore to initial roll diameter Thousands place: Terminal reset limitation 0: Reset allowed at running 1: Reset only allowed at stop		
P90.28	Tension PID output reference	0–1 0: Maximum value Means the max. output frequency at speed mode, and the max. torque at torque mode 1: Given value Means the main given frequency at speed mode, and the main given torque at torque mode	0	○
P90.29	Tension PID parameter source	0: First group of P90 1: Roll diameter (max. roll diameter) 2: Main reference frequency (max. Frequency) 3: Running linear speed (max. linear speed) 4: Deviation (Reference 100%) 5: Terminal	0	○
P90.30	Group 1 proportional gain	0.000–30.000	0.030	○
P90.31	Group 1 integral time	0.000–30.00s	5.00s	○
P90.32	Group 1 differential time	0.000–10.00s	0.00s	○
P90.33	Group 2 proportional gain	0.000–30.000	0.100	○
P90.34	Group 2 integral time	0.000–30.00s	5.00s	○
P90.35	Group 2 differential time	0.000–10.00s	0.00s	○
P90.36	PID parameter adjustment reference point 1	0.0–100.0%	10.0%	○
P90.37	PID parameter adjustment reference point 2	0.0–100.0%	50.0%	○
P90.38	Reserved	0-65535	0	●
P90.39	Reserved	0-65535	0	●

P91 group—Tension control in torque mode

Function code	Name	Description	Default	Modify
P91.00	Tension control zero speed reference	0: Max. linear speed 1: Max. frequency	0	◎
P91.01	Tension control zero speed threshold	0.00–50.0%	3.0%	○
P91.02	Zero speed offset	0–50.0% Zero speed offset when PID reference source is main reference	2.0%	○
P91.03	Upper-limit frequency source of torque control	0: P03.14, P03.15 1: Forward rotation limit set by line speed	3	◎

Function code	Name	Description	Default	Modify
		2: Reverse rotation limit set by line speed 3: Forward and reverse rotations limit set by line speed		
P91.04	Running frequency upper limit offset of tension control	0.0–100.0% (of the max. frequency)	5.0%	○
P91.05	Differential separation threshold	0.0–100.0% The differentiation does not work when the quotient of the current error deviation divided by the reference value is less than this threshold.	5.0%	○
P91.06	PID restricts reverse limit at zero speed	0: Enable 1: Disable	0	◎
P91.07	Torque compensation selection	Ones place: Frictional torque compensation 0: No 1: Yes Tens place: Inertia compensation 0: No 1: Yes Hundreds place: Compensation direction 0: In line with torque direction 1: Different from torque direction	0	◎
P91.08	System mechanical parameters identification	0: No operation 1: Enabling system mechanical inertia identification 2: Enabling mechanical friction torque identification	0	◎
P91.09	Static friction torque compensation coefficient	0.0–100.0% (of the motor rated torque)	0.0%	○
P91.10	Sliding friction torque compensation coefficient 1	0.0–100.0% (of the motor rated torque)	0.0%	○
P91.11	Sliding friction torque compensation coefficient 2	0.0–100.0% (of the motor rated torque)	0.0%	○
P91.12	Sliding friction torque compensation coefficient 3	0.0–100.0% (of the motor rated torque)	0.0%	○
P91.13	High speed torque compensation coefficient	0.0–100.0% (of the motor rated torque)	0.0%	○
P91.14	Compensation frequency point of static friction torque	0.0–100.0% (of the max. frequency)	1.0%	○
P91.15	Compensation frequency point of sliding friction torque 1	0.0–100.0% (of the max. frequency)	20.0%	○

Function code	Name	Description	Default	Modify
P91.16	Compensation frequency point of sliding friction torque 2	0.0–100.0% (of the max. frequency)	50.0%	○
P91.17	Compensation frequency point of sliding friction torque 3	0.0–100.0% (of the max. frequency)	80.0%	○
P91.18	High-speed friction torque compensation frequency point	0.0–100.0% (of the max. frequency)	100.0%	○
P91.19	Rotational inertia frequency source	0: Linear speed 1: Running frequency	0	◎
P91.20	Material density	0–30000kg/m^3 Used fro online calculation of material inertia	0 kg/m^3	○
P91.21	Reel width	0.000–60.000m Used fro online calculation of material inertia	0.000m	○
P91.22	ACC inertia compensation coefficient	0.0–100.0% (of inertia torque compensation)	10.0%	○
P91.23	DEC inertia compensation coefficient	0.0–100.0% (of inertia torque compensation)	10.0%	○
P91.24	Tension taper coefficient source	0: Keypad 1: AI1 2: AI2 3: AI3 4: High-speed pulse HDI	0	◎
P91.25	Tension taper set through keypad	0.0–100.0% (of the given tension)	30.0%	○
P91.26	Tension taper compensation correction	0.0–5000.0mm	0.0mm	○
P91.27	Tension taper curve selection	0: Inverse proportional curve **Note:** The empty roll diameter D0 means the tension decreases by 0%; the full roll diameter Dmax means the tension decreases by the value based on the setting in P91.26. 1: Multi-point curve **Note:** The empty roll diameter D0 means the tension decreases by 0%; the roll diameter value 1 (P91.28) means the tension decreases by the value of P91.29; the roll diameter value 2 (P91.30) means the tension decreases by the value of P91.31; the full roll diameter Dmax means the tension decreases by the value based on the setting in P91.26.	0	◎
P91.28	Roll diameter value 1	0.0–5000.0mm	200.0mm	○
P91.29	Tension taper coefficient for roll diameter value 1	0.0–50.0% (of the set tension)	3.0%	○
P91.30	Roll diameter value 2	0.0–5000.0mm	500.0mm	○

Function code	Name	Description	Default	Modify
P91.31	Tension taper coefficient for roll diameter value 2	0.0–50.0% (of the set tension)	7.0%	○
P91.32–P91.39	Reserved			

P92 group—Customized tension control functions

Function code	Name	Description	Default	Modify
P92.00	Pre-drive speed gain	0.0–100.0%	100.0%	○
P92.01	Pre-drive torque limit	0: Set based on P03.20, P03.21 1: Set based on P93.02 2: Set based on the set tension	2	○
P92.02	Pre-drive torque limit setting	0.0–200.0%	100.0%	○
P92.03	Zero bit conversion enabling	0: Disable 1: Enable	0	◎
P92.04	Initial zero bit	0.0–100.0%	10.0%	○
P92.05	Final zero bit	0.0–100.0%	50.0%	○
P92.06	Conversion time from initial zero bit to final zero bit	0.00–60.00s	5.00s	○
P92.07	Conversion time from final zero bit to initial zero bit	0.00–60.00s	5.00s	○
P92.08	Feeding interrupt detection mode	0: Not detect 1: Detect based on digital value 2: Detect based on roll diameter calculation value 3: Detect based on feedback position	0	○
P92.09	Feeding interrupt detection start delay time	0.00–200.0s	10.0s	○
P92.10	Frequency lower limit of feeding interrupt detection	0.00–300.00Hz	10.00Hz	○
P92.11	Error range of feeding interrupt detection	0.1–50.0% (of the max. roll diameter)	10.0%	○
P92.12	Determination delay time of feeding interrupt detection	0.1–60.0s	1.0s	○
P92.13	Handling mode of feeding interrupt	0x000–0x111 Ones place: Stop mode 0: Decelerate to stop in emergency manner 1: Coast to stop Tens place: Alarm mode 0: Stop in enabled stop mode without reporting an alarm	0x000	◎

Function code	Name	Description	Default	Modify
		1: Report an alarm and coast to stop Hundreds place: Roll diameter memory function of feeding interrupt 0: Disable 1: Enable		
P92.14	Stop braking frequency	0.00–300.00Hz	1.50Hz	○
P92.15	Stop braking time	0.0–600.0s	0.0s	○
P92.16–P92.39	Reserved	0-65535	0	●

P93 group—Tension control status viewing

Function code	Name	Description	Default	Modify
P93.00	Actual control mode	0: Invalid tension control 1: Close-loop tension speed control 2: Open loop tension torque control 3: Close-loop tension torque control	0	●
P93.01	Actual winding/unwinding mode	0: Winding 1: Unwinding	0	●
P93.02	Initial roll diameter	0.0–5000.0mm	0.0 mm	●
P93.03	Reset roll diameter	0.0–5000.0mm	0.0 mm	●
P93.04	Roll diameter change rate	0.0–655.35mm/s	0.00mm/s	●
P93.05	Present roll diameter	0.0–5000.0mm	0.0 mm	●
P93.06	Roll diameter for linear speed calculation	0.0–5000.0mm Applicable to the roll diameter restriction in the reverse direction	0.0 mm	●
P93.07	Set linear speed	0.0–6000.0m/min	0.0m/min	●
P93.08	Present linear speed	0.0–6000.0m/min	0.0m/min	●
P93.09	Main reference frequency	0.00–600.00Hz Calculated from the linear speed and the present roll diameter, without using the maximum frequency limit	0.00Hz	●
P93.10	Actual proportional gain	0.000–30.000	0.000	●
P93.11	Actual integral time	0.000–30.00s	0.00s	●
P93.12	Proportional output value	0–65535	0	●
P93.13	Integral output value	0–65535	0	●
P93.14	PID upper limit	-100.0%–100.0% (Max. frequency or voltage)	0.0	●
P93.15	PID lower limit	-100.0%–100.0% (Max. frequency or voltage)	0.0	●
P93.16	PID output frequency	-99.99–99.99Hz	0.00Hz	●
P93.17	Main traction running frequency	-300.0–300.0Hz	0.0Hz	●
P93.18	Set tension	0–30000N	0N	●
P93.19	Tension taper coefficient	0.0–100.0%	0.0%	●

Function code	Name	Description	Default	Modify
P93.20	Actual tension	0–30000N Tension reference calculated from the tension offset and taper	0N	●
P93.21	Basic torque reference value	-300.0–300.0% (of the rated motor torque) Torque calculated from the actual tension reference and the present roll diameter	0.0%	●
P93.22	Friction compensation torque value	-300.0–300.0% (of the rated motor torque)	0.0%	●
P93.23	System rotational inertia	0–655.35 $kg.m^2$ System mechanical inertia + present material inertia	0.00 $kg.m^2$	●
P93.24	Frequency change rate	-99.99–327.67Hz	0.00Hz	●
P93.25	Torque compensation value of system rotational inertia	-300.0–300.0% (of the rated motor torque)	0.0%	●
P93.26	Reference value after torque compensation	-300.0–300.0% (of the rated motor torque)	0.0%	●
P93.27	PID output torque	-300.0–300.0% (of the rated motor torque)	0.0%	●
P93.28	Final output torque	-300.0% –300.0% (of the rated motor torque)	0	●
P93.29	Measured tension	0–30000N Applicable to the applications with tension detection sensors	0N	●
P93.30	Number of material turns on the reel	-100–32767	0	●
P93.31	Length of material on the reel	0–65535m Length recording function	0m	●
P93.32	Length increment	0.0–6553.5m	0.0m	●
P93.33–P93.38	Reserved	0-65535	0	●

P94 group—Customized function group 1

Function code	Name	Description	Default	Modify
P94.00–P94.39	Reserved	0-65535	0	○

P95 group—Customized function group 2

Function code	Name	Description	Default	Modify
P95.00–P95.39	Reserved	0-65535	0	○

P98 group—AI/AO calibration

Reserved

P99 group—Factory parameters

Reserved

9 Troubleshooting

9.1 What this chapter contains

The chapter tells you how to reset faults and check faults history of rectifier and inverter units. A complete list of alarms and fault information as well as possible causes and corrective measures are presented in this chapter.

	• Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter. Please carry out operations according to instructions presented in chapter 1 Safety precautions.

9.2 Indications of alarms and faults

The fault is indicated by indicators (refer to the "Basic operation guidelines"). When the TRIP indicator is on, the alarm or fault code displayed in the keypad indicates the power unit is in exception state. This chapter covers most of the alarms and faults, and their possible causes and corrective measures, if you cannot figure out the alarm or fault causes, contact local INVT office.

9.3 Fault reset

9.3.1 Rectifier fault reset

On the fault interface, you can reset the rectifier unit through DATA/ENT key on the keypad, digital inputs, or by cutting off the rectifier unit power. After faults are removed, the rectifier unit can be started again.

9.3.2 Inverter fault reset

On the fault interface, you can reset the inverter unit through DATA/ENT key on the keypad, digital inputs, or by cutting off the inverter unit power. After faults are removed, the motor can be started again.

9.4 Fault history

For the inverter unit, P07.27–P07.32 record the types of the most recent six faults, and P07.33–P07.40, P07.41–P07.48, and P07.49–P07.56 record the running data of the inverter unit when the most recent three faults occur.

For the rectifier unit, P19.00–P19.05 record the types of the most recent six faults, and P19.06–P19.13, P19.16–P19.23, and P19.26–P19.33 record the running data of the rectifier unit when the most recent three faults occur.

9.5 Faults and solutions

9.5.1 Rectifier faults and solutions

When a fault occurred to the rectifier unit, handle the fault as follows:

1. Check whether keypad display is improper. If yes, contact INVT or its local office.

2. If the keypad works properly, check the function codes in P19 group to check the fault record parameters to determine the real state when the fault occurred.

3. Check the following table to see whether the exception state exists by solution.

4. Rule out the fault or ask for help from professionals.

5. After confirming the fault is removed, perform fault reset, and start running.

Recifier fault code	Fault type	Possible cause	Solution
LV1	Input grid undervoltage	The grid voltage is 20% lower than the general value, or the internal hardware circuit of the rectifier unit is abnormal.	Check the grid input power.
OV1	Grid voltage	The grid voltage is 20% lower than the general value, or the internal hardware circuit of the rectifier unit is abnormal.	Check the grid input power; Check the related function code settings.
SPI1	A phase loss on the input side	A phase on the input side is lost, please check the wiring of A phase.	Check the wiring of A phase and grid voltage.
SPI2	B phase loss on the input side	B phase on the input side is lost, please check the wiring of B phase.	Check the wiring of B phase and grid voltage.
SPI3	C phase loss on the input side	C phase on the input side is lost, please check the wiring of C phase.	Check the wiring of C phase and grid voltage.
PLLF	Phase-locked failed	The grid voltage is abnormal.	Check the input wiring and grid voltage.
OH1	Bridge rectifier module overheating	Air duct is blocked or fan is damaged; Ambient temperature is too high; Long-time overload running.	Ventilate the air duct or replace the fan; Lower the ambient temperature.
OH2	Heat sink module overheating		
EF	External fault	SI external fault input terminal acts.	Check external device input.
E-485	485 communication fault	Baud rate is set improperly; Communication line fault; Communication address error; Communication suffers from strong interference.	Set proper baud rate; Check the wiring of communication interfaces; Set the proper communication address; Replace or change the wiring to enhance the anti-interference capacity.
LV	Bus undervoltage	Bus undervoltage occurs during operation; Detect the actual bus voltage.	Check the bus voltage; Change the undervoltage threshold parameter; Replace the main control board.
OV	Bus overvoltage	Bus overvoltage occurs during operation; Detect the actual bus voltage.	Check the bus voltage; Change the overvoltage threshold parameter; Replace the main control board.
EEP	EEPROM operation fault	R/W error occurred to the control parameters; EEPROM is damaged.	Press STOP/RST to reset; Replace the main control board.

Recifier fault code	Fault type	Possible cause	Solution
OL	Rectifier unit overload fault	The rectifier unit releases overload pre-alarm based on the set value.	Check the load and overload pre-alarm threshold.
bCE	Braking unit direct connection fault	Fault occurred to the brake circuit or the braking pipe is damaged;	Check the braking unit, and replace with new braking pipe. Increase the brake resistance.
bOL	Braking pipe overload	Fault occurred to the brake circuit or the braking pipe is damaged; Resistance of the external braking resistor is small.	Check the braking unit, and replace with new braking pipe. Increase the brake resistance.
bOC	Brake overcurrent	Fault occurred to the brake circuit or the braking pipe is damaged; Resistance of the external braking resistor is small.	Check the braking unit, and replace with new braking pipe. Increase the brake resistance.
E-DP	PROFIBUS communication fault	The communication address is incorrect; The matching resistor is not switched on improperly; The GSD file of the master station is set improperly; The peripheral interference is too large.	Check the related settings; Check the surrounding environment, and eliminate interference effects.
E-NET	Ethernet communication fault	The address of Ethernet is set improperly; Ethernet communication mode is selected improperly; The peripheral interference is too large.	Check the related settings; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
E-CAN	CANopen communication fault	Line contact is poor; The matching resistor is not switched on; Communication baud rates do not match; The peripheral interference is too large.	Check the line; Switch on the matching resistor; Set the same baud rate; Check the surrounding environment, and eliminate interference effects.
OFFL	Certain slave units offline	The number of actual slave nodes (P17.15) conflicts with the number of set slave nodes (P21.33); Line contact is poor; The matching resistor is not switched on. Communication baud rates do not match; The master/slave addresses conflict.	Check the values of P17.15 and P21.33. Switch on the matching resistor; Set the same baud rate; Check all master/slave addresses; Check CANopen network parameters.

Recifier fault code	Fault type	Possible cause	Solution
PCE	Programmable card communication fault	The communication address is incorrect; The matching resistor is not switched on improperly; The GSD file of the master station is set improperly; The peripheral interference is too large.	Check the related settings; Check the surrounding environment, and eliminate interference effects.
E-C1	Communication fault occurred to the expansion card slot 1	The communication state of communication card in the expansion card slot 1 is abnormal. The peripheral interference is too large.	Check whether the expansion card in card slot 1 is contacted well; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
E-C2	Communication fault occurred to the expansion card slot 2	The communication state of communication card in the expansion card slot 2 is abnormal. The peripheral interference is too large.	Check whether the expansion card in card slot 2 is contacted well; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
E-F1	Identification fault occurred to the expansion card slot 1	The communication card in the expansion card slot 1 failed to be identified normally. The peripheral interference is too large.	Check whether the expansion card in card slot 1 is contacted well; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
E-F2	Identification fault occurred to the expansion card slot 2	The communication card in the expansion card slot 2 failed to be identified normally. The peripheral interference is too large.	Check whether the expansion card in card slot 2 is contacted well; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
E-CP	Expansion card detection abnormation	The type of the expansion card is wrong; The peripheral interference is too large.	Check whether the expansion card is good; Check the communication mode selection; Check the surrounding environment, and eliminate interference effects.
END	Running time reached	The actual running time is longer than the set time.	Ask the supplier to adjust the preset running time.

9.5.2 Inverter faults and solutions

When a fault occurred to the inverter unit, handle the fault as follows:

1. Check whether keypad display is improper. If yes, contact INVT or its local office.

2. If the keypad works properly, check the function codes in P07 group to check the fault record parameters to determine the real state when the fault occurred.

3. Check the following table to see whether the exception state exists by solution.

4. Rule out the fault or ask for help from professionals.

5. After confirming the fault is removed, perform fault reset, and start running.

Inverter fault code	Fault type	Possible cause	Solution
OUt1	Inverter unit U-phase protection	ACC is too fast; IGBT module is damaged; Misacts caused by interference; Drive wires are poorly connected; To-ground short circuit occurs.	Increase ACC time; Replace the power unit; Check drive wires; Check whether there is strong interference surrounding the peripheral device.
OUt2	Inverter unit V-phase protection		
OUt3	Inverter unit W-phase protection		
OV1	Over-voltage during ACC	Exception occurred to input voltage; Large energy feedback; Lack of braking units; Dynamic brake is not enabled.	Check the input power; Check whether load DEC time is too short; or the motor starts during rotating; Install dynamic brake components; Check the setup of related function codes.
OV2	Over-voltage during DEC		
OV3	Over-voltage during constant speed running		
OC1	Over-current during ACC	ACC is too fast; Grid voltage is too low; Inverter power is too small; Load transient or exception occurred; To-ground short circuit or output phase loss occurred; Strong external interference sources; Overvoltage stall protection is not enabled.	Increase ACC /DEC time; Check the input power; Select the inverter with larger power; Check if the load is short circuited (to-ground short circuit or line-to-line short circuit) or the rotation is not smooth; Check the output wiring; Check if there is strong interference; Check the setup of related function codes.
OC2	Over-current during DEC		
OC3	Over-current during constant speed running		
UV	Bus undervoltage fault	Grid voltage is too low; Overvoltage stall protection is not enabled.	Check the grid input power; Check the setup of related function codes.
OL1	Motor overload	Grid voltage is too low; Rated current of the motor is set improperly; Motor stall or load jumps violently.	Check the grid voltage; Reset the rated current of the motor; Check the load and adjust torque boost.

Inverter fault code	Fault type	Possible cause	Solution
OL2	Inverter overload	ACC is too fast; The motor in rotating is restarted; Grid voltage is too low; Load is too large; Power is too small.	Increase ACC time; Avoid restart after stop; Check grid voltage; Select the inverter with larger power; Select proper motor.
SECAN	Master/slave synchronous CAN fault	In master station mode, the communication network has two or more slaves of the same station; In the master station mode, the number of slaves detected by the master station is inconsistent with that set by the master station.	Check whether the slave stations in the communication network are set repeatedly; Check whether the wiring of each slave station and master station in the communication network is normal.
SPO	Phase loss on output side	Phase loss occurred to U, V, W output (or the three phases of motor is asymmetrical).	Check the output wiring; Check the motor and cable.
OH2	Overheat of inverter module	Air duct is blocked or fan is damaged; Ambient temperature is too high; Long-time overload running.	Ventilate the air duct or replace the fan; Lower the ambient temperature.
EF	External fault	SI external fault input terminal acts.	Check external device input.
CE	RS485 communication fault	Incorrect baud rate. Communication line fault. Incorrect communication address.	Set a proper baud rate. Check the communication interface cable. Set the communication address correctly. Replace or change the wiring to enhance the anti-interference capacity.
ItE	Current detection fault	Poor contact of the connector of control board; Hall component is damaged; Exception occurred to amplification circuit.	Check the connector and re-plug; Replace the hall component; Replace the main control board.
tE	Motor autotuning fault	Motor capacity does not match with the inverter capacity, this fault may occur easily if the difference between them is exceeds five power classes; Motor parameter is set improperly;	Change the inverter model, or adopt V/F mode for control; Set proper motor type and nameplate parameters; Empty the motor load and carry out autotuning again; Check the motor wiring and parameter setup;

Inverter fault code	Fault type	Possible cause	Solution
		The parameters gained from autotuning deviate sharply from the standard parameters; Autotuning timeout.	Check whether the upper limit frequency is larger than 2/3 of the rated frequency.
EEP	EEPROM fault	R/W error occurred to the control parameters; EEPROM is damaged.	Press STOP/RST to reset; Replace the main control board.
PIDE	PID feedback offline fault	PID feedback offline; PID feedback source disappears.	Check PID feedback signal wires; Check PID feedback source.
S-Err	Master/slave synchronous CAN slave fault	In the master station mode, the master station detects that a fault occurred to the slave.	Check the fault occurred to CAN slave station in the communication network.
END	Running time is up	The actual running time of the inverter is larger than the set running time	Ask help from the supplier, and adjust the set running time
OL3	Electronic overload fault	The inverter releases overload pre-alarm based on the set value	Check the load and overload pre-alarm threshold
PCE	Keypad communication fault	Keypad cable connected improperly or disconnected Keypad cable too long, causing strong interference Keypad or mainboard communication circuit error	Check the keypad cable to determine whether a fault occurs. Check for and remove the external interference source. Replace the hardware and seek maintenance services.
UPE	Parameter upload error	Keypad cable connected improperly or disconnected Keypad cable too long, causing strong interference Keypad or mainboard communication circuit error	Check for and remove the external interference source. Replace the hardware and seek maintenance services. Replace the hardware and seek maintenance services.
DNE	Parameter download error	Keypad cable connected improperly or disconnected Keypad cable too long, causing strong interference Keypad data storage error	Check for and remove the external interference source. Replace the hardware and seek maintenance services. Re-back up the data on the keypad.
E-DP	PROFIBUS communication fault.	Incorrect baud rate. Communication line fault. Incorrect communication address.	Set a proper baud rate. Check the communication interface cable. Set the communication address correctly. Replace or change the wiring to enhance the anti-interference capacity.

Inverter fault code	Fault type	Possible cause	Solution
E-NET	Ethernet communication fault	Communication line fault. Incorrect communication address. Communication suffers from strong interference.	Check the communication interface cable. Set the communication address correctly. Replace or change the wiring to enhance the anti-interference capacity.
E-CAN	CANopen communication fault	Incorrect baud rate. Communication line fault. Incorrect communication address.	Set a proper baud rate. Check the communication interface cable. Set the communication address correctly. Replace or change the wiring to enhance the anti-interference capacity.
ETH1	To-ground short circuit fault 1	Inverter output is short connected to the ground; Current detection circuit is faulty; Actual motor power setup deviates sharply from the inverter power.	Check whether the motor wiring is proper; Replace the hall component; Replace the main control board; Reset the motor parameters properly.
ETH2	To-ground short circuit fault 2	Inverter output is short connected to the ground; Current detection circuit is faulty; Actual motor power setup deviates sharply from the inverter power.	Check whether the motor wiring is proper; Replace the hall component; Replace the main control board; Reset the motor parameters properly.
dEu	Speed deviation fault	Load is too heavy, or stall occurred.	Check the load to ensure it is proper, and increase the detection time; Check whether the control parameters are set properly.
STo	Maladjustment fault	Control parameters of the synchronous motor is set improperly; The parameter gained from autotuning is inaccurate; The inverter is not connected to the motor.	Check the load to ensure it is proper, Check whether the control parameters are set correctly; Increase the maladjustment detection time.
LL	Electronic underload fault	The inverter performs the underload pre-alarm based on the set value	Check the load and overload pre-alarm threshold
ENC1O	Encoder offline fault	Encoder line sequence is wrong, or signal wires are poorly connected.	Check the encoder wiring.

Inverter fault code	Fault type	Possible cause	Solution
ENC1D	Encoder reversal fault	The encoder speed signal is contrary to the motor running direction.	Reset encoder direction.
ENC1Z	Encoder Z pulse offline fault	Z signal wires are disconnected.	Check the wiring of Z signal
OT	Motor over-temperature fault	Motor over-temperature input terminal is valid; The temperature detection resistance is abnormal. Long-time overload running or exception occurred.	Check the wiring of the motor over-temperature input terminal (terminal function 57); Check whether the temperature sensor is proper; Check the motor, and perform maintenance on the motor.
E-OT2	Overtemperature fault (24V PG card)	The temperature detected by EC-PG707-24 exceeds the threshold.	Check for external overtemperature. Check and maintain related devices.
E-OT3	Overtemperature fault (IO card)	The temperature detected by EC-IO702 exceeds the threshold.	Check for external overtemperature. Check and maintain related devices.
E-OT4	Overtemperature fault (AI/AO detection)	The temperature detected by AI/AO exceeds the threshold.	Check for external overtemperature. Check and maintain related devices.
STO	Safe torque off	Safe torque off function is enabled by external forces	/
STL1	Exception occurred to safe circuit of channel H1	The wiring of STO is improper; Fault occurred to external switch of STO; Hardware fault occurred to safety circuit of channel H1	Check whether terminal wiring of STO is proper and firm enough; Check whether the external switch of STO can work properly; Replace the control board.
STL2	Exception occurred to safe circuit of channel H2	The wiring of STO is improper; Fault occurred to external switch of STO; Hardware fault occurred to safety circuit of channel H2.	Check whether terminal wiring of STO is proper and firm enough; Check whether the external switch of STO can work properly; Replace the control board.
STL3	Exception occurred to channel H1 and channel H2	Hardware fault occurred to STO circuit.	Replace the control board.
CrCE	Safety code FLASH CRC check fault	Control board is faulty.	Replace the control board.

Inverter fault code	Fault type	Possible cause	Solution
P-E1	Programmable card customized fault 1	Faults defined by the PLC expansion card	View the PLC expansion card application program; Figure out the cause of the fault.
P-E2	Programmable card customized fault 2		
P-E3	Programmable card customized fault 3		
P-E4	Programmable card customized fault 4		
P-E5	Programmable card customized fault 5		
P-E6	Programmable card customized fault 6		
P-E7	Programmable card customized fault 7		
P-E8	Programmable card customized fault 8		
P-E9	Programmable card customized fault 9		
P-E10	Programmable card customized fault 10		
E-Err	Repetitive expansion card type	The two inserted expansion cards are of the same type	You should not insert two cards with the same type; check the type of expansion card, and remove one card after power-off.
ENCUV	Encoder UVW loss fault	No electric level variation occurred to UVW signal	Check the wiring of UVW; Encoder is damaged.
F1-Er	Failed to identify the expansion card in card slot 1	There is data transmission in interfaces of card slot 1, however, it cannot read the card type.	Confirm whether the expansion card inserted can be supported; Stabilize the expansion card interfaces after power-off, and confirm whether a fault still occurs at next power-on; Check whether the insertion port is damaged, if yes, replace the insertion port after power-off.
F2-Er	Failed to identify the expansion card in card slot 2	There is data transmission in interfaces of card slot 2, however, it cannot read the card type.	Confirm whether the expansion card inserted can be supported; Stabilize the expansion card interfaces after power-off, and confirm whether a fault still occurs at next power-on; Check whether the insertion port is damaged, if yes, replace the insertion port after power-off.

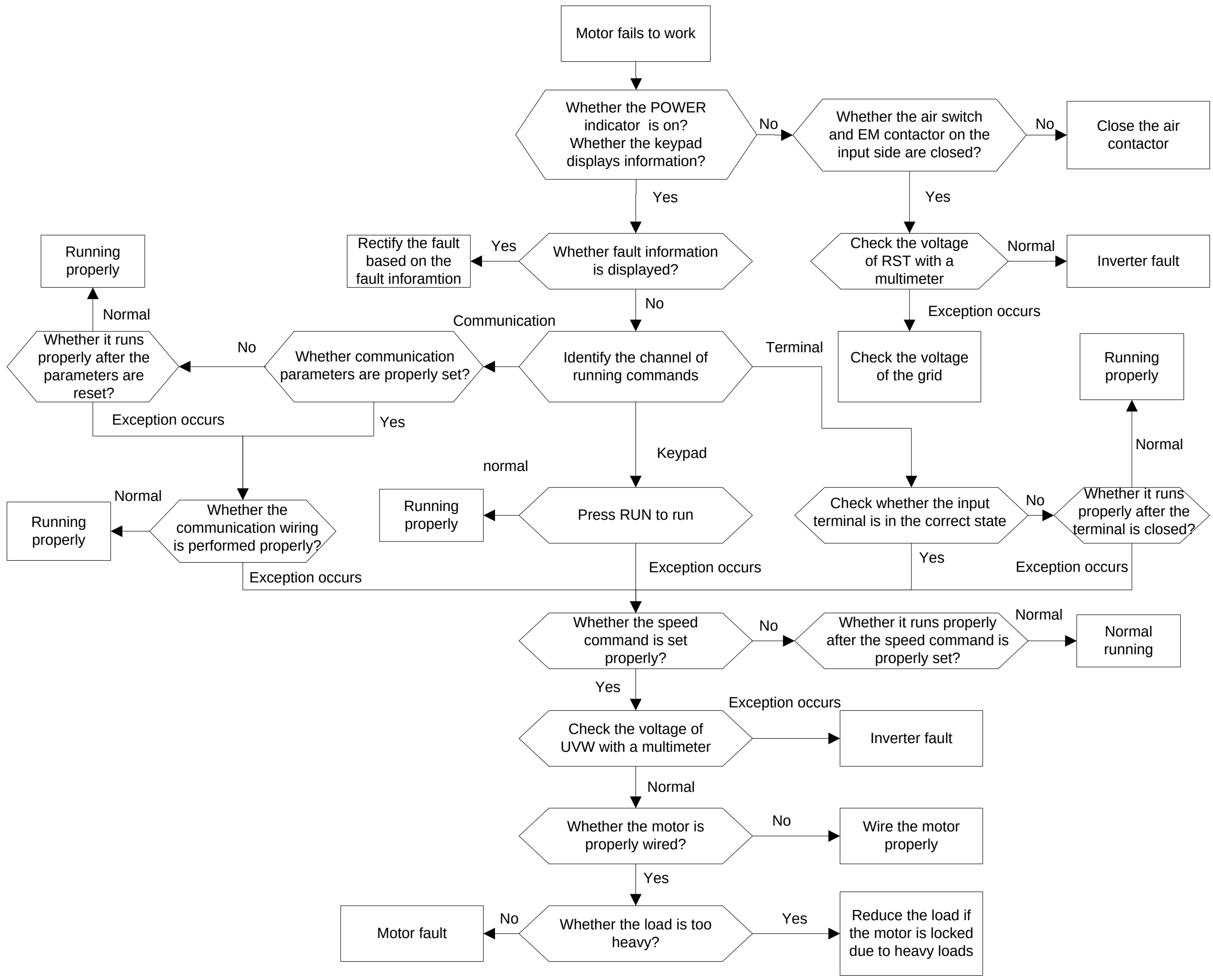
Inverter fault code	Fault type	Possible cause	Solution
C1-Er	Communication timeout occurred to the expansion card in card slot 1	There is no data transmission in interfaces of card slot 1	Confirm whether the expansion card inserted can be supported; Stabilize the expansion card interfaces after power-off, and confirm whether a fault still occurs at next power-on; Check whether the insertion port is damaged, if yes, replace the insertion port after power-off.
C2-Er	Communication timeout occurred to the expansion card in card slot 2	There is no data transmission in interfaces of card slot 2	Confirm whether the expansion card inserted can be supported; Stabilize the expansion card interfaces after power-off, and confirm whether a fault still occurs at next power-on; Check whether the insertion port is damaged, if yes, replace the insertion port after power-off.

9.5.3 Other status

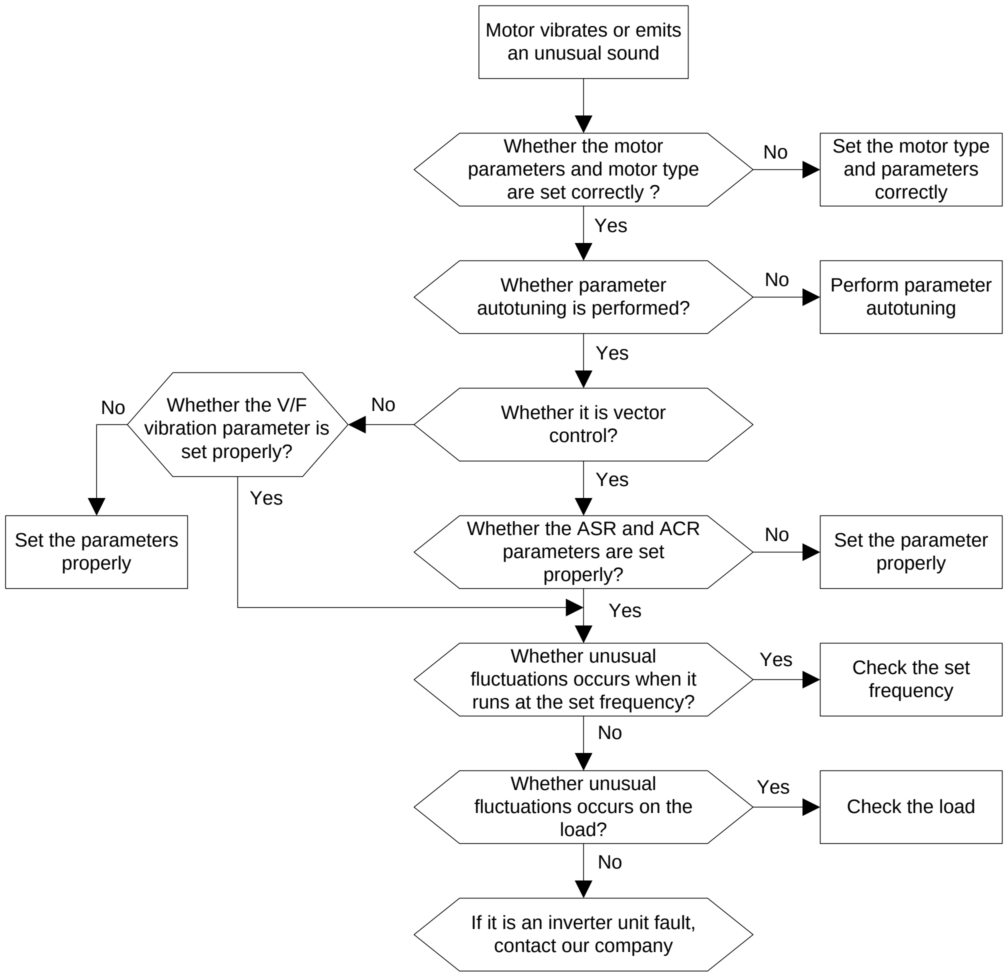
Displayed code	Status type	Possible cause	Solution
PoFF	System power failure	The system is powered off or the bus voltage is too low.	Check the grid conditions.

9.6 Analysis on common faults

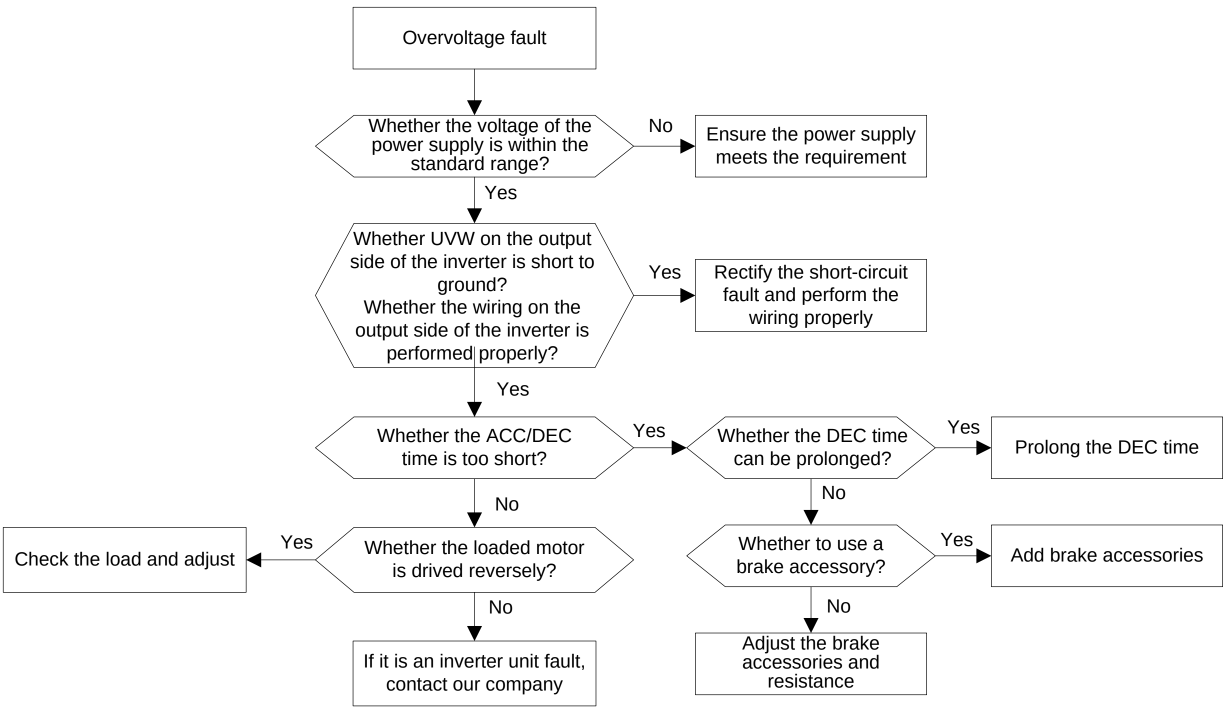
9.6.1 Motor fails to work



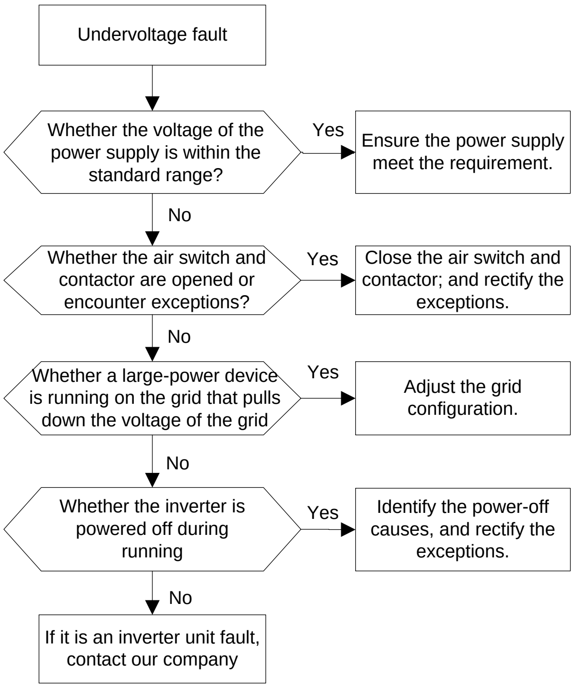
9.6.2 Motor vibrates



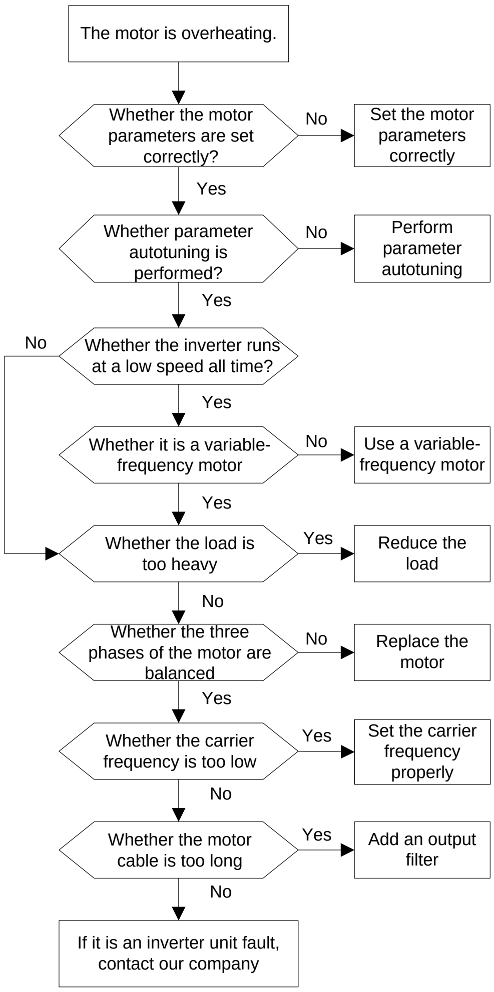
9.6.3 Overvoltage



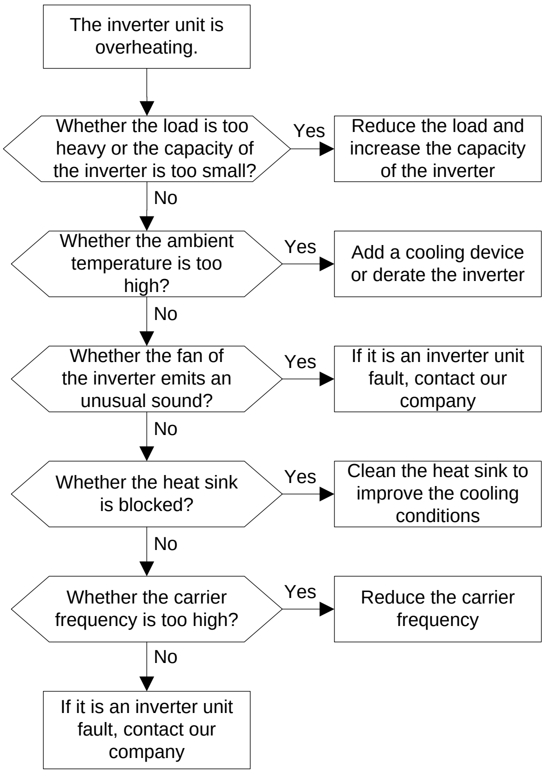
9.6.4 Undervoltage



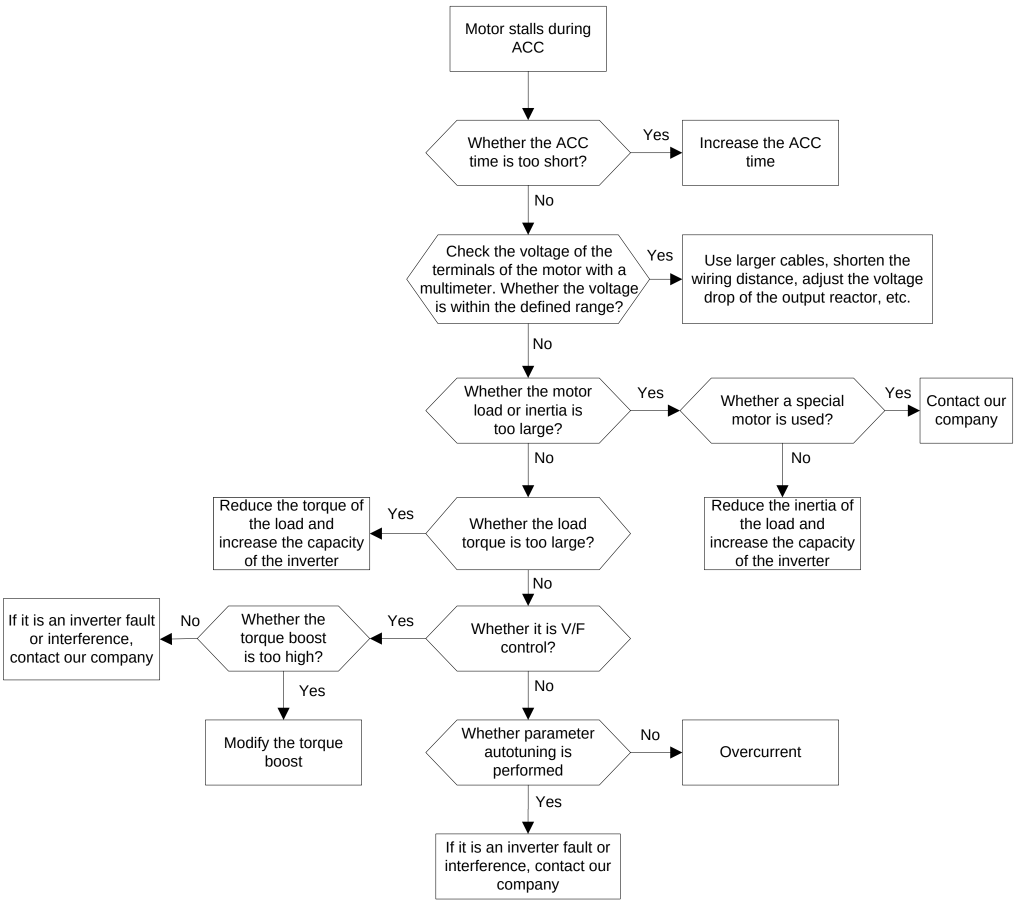
9.6.5 Motor overheating



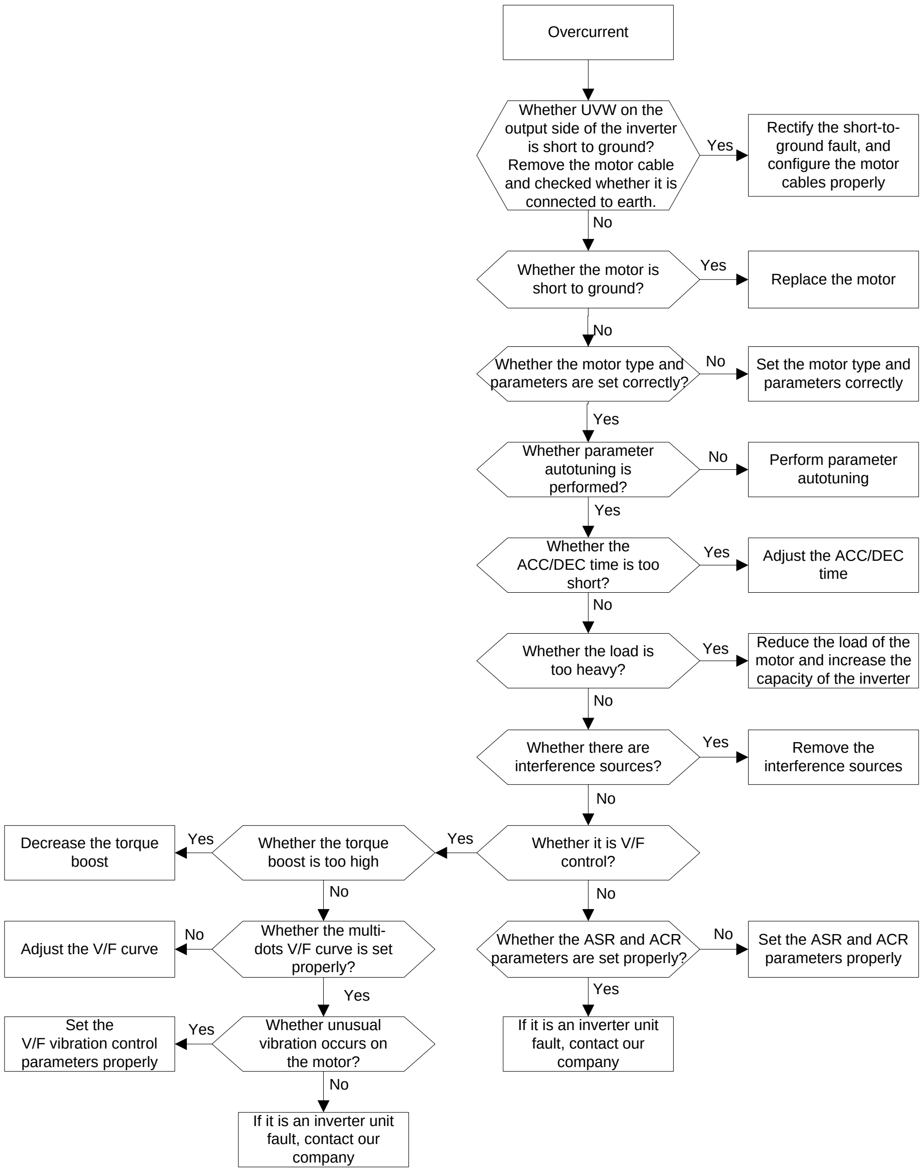
9.6.6 Inverter unit overheating



9.6.7 Motor stalls during ACC



9.6.8 Overcurrent



9.7 Countermeasures on common interference

9.7.1 Interference on meter switches and sensors

Interference phenomenon

Pressure, temperature, displacement, and other signals of a sensor are collected and displayed by a human-machine interaction device. The values are incorrectly displayed as follows after the power unit is started:

1. The upper or lower limit is wrongly displayed, for example, 999 or -999.

2. The display of values jumps (usually occurring on pressure transmitters).

3. The display of values is stable, but there is a large deviation, for example, the temperature is dozens of degrees higher than the common temperature (usually occurring on thermocouples).

4. A signal collected by a sensor is not displayed but functions as a drive system running feedback signal. For example, the inverter unit is expected to decelerate when the upper pressure limit of the compressor is reached, but in actual running, it starts to decelerate before the upper pressure limit is reached.

5. After the inverter unit is started, the display of all kinds of meters (such as frequency meter and current meter) that are connected to the inverter unit AO terminal is severely affected, displaying the values incorrectly.

6. Proximity switches are used in the system. After the inverter unit is started, the indicator of a proximity switch flickers, and the output level flips.

Solution:

1. Check and ensure that the feedback cable of the sensor is 20 cm or farther away from the motor cable.

2. Check and ensure that the ground wire of the motor is connected to the PE terminal of the power unit (if the ground wire of the motor has been connected to the ground block, you need to use a multimeter to measure and ensure that the resistance between the ground block and PE terminal is lower than 1.5 Ω).

3. Try to add a safety capacitor of 0.1 μF to the signal end of the feedback signal terminal of the sensor.

4. Try to add a safety capacitor of 0.1 μF to the power end of the sensor meter (pay attention to the voltage of the power supply and the voltage endurance of the capacitor).

5. For interference on meters connected to the VFD AO terminal, if AO uses current signals of 0 to 20 mA, add a capacitor of 0.47 μF between the AO and GND terminals; and if AO uses voltage signals of 0 to 10 V, add a capacitor of 0.1 μF between the AO and GND terminals.

Note:

- When a decoupling capacitor is required, add it to the terminal of the device connected to the sensor. For example, if a thermocouple is to transmit signals of 0 to 20 mA to a temperature meter, the capacitor needs to be added on the terminal of the temperature meter.; if an electronic ruler is to transmit signals of 0 to 30 V to a PLC signal terminal, the capacitor needs to be added on the terminal of the PLC.
- If a large number of meters or sensors are disturbed, it is recommended that you configure an external C2 filter on the inverter unit input power end. For details, see section E.7.2 Filter model selection.

9.7.2 Interference on RS485/CANopen communication

The interference described in this section on RS485/CANopen communication mainly includes communication delay, out of synchronization, occasional power-off, or complete power-off that occurs after the VFD is started.

If the communication cannot be implemented properly, regardless of whether the VFD is running, the exception is not necessarily caused by interference. You can find out the causes as follows:

1. Check whether the RS485/CANopen communication bus is disconnected or in poor contact.

2. Check whether the two lines of the RS485/CANopen communication are connected reversely.

3. Check whether the communication protocol (such as the baud rate, data bits, and check bit) of the VFD is consistent with that of the upper computer.

4. If you are sure that communication exceptions are caused by interference, you can resolve the problem through the following measures:

(1) Arrange the communication cables and motor cables in different cable trays.

(2) In multi-VFD application scenarios, adopt the chrysanthemum connection mode to connect the communication cables between power units, which can improve the anti-interference capability.

(3) In multi-VFD application scenarios, check and ensure that the driving capacity of the master is sufficient.

(4) In the connection of multiple VFDs, you need to configure one 120 Ω terminal resistor on each end.

Solution

1. Check and ensure that the ground wire of the motor is connected to the PE terminal of the power unit (if the ground wire of the motor has been connected to the ground block, you need to use a multimeter to measure and ensure that the resistance between the ground block and PE terminal is lower than 1.5 Ω).

2. Do not connect the power unit and motor to the same ground terminal as the upper computer (PLC, HMI, and touch screen). It is recommended that you connect the power unit and motor to the power ground, and connect the upper computer separately to a ground stud.

3. Try to short the signal reference ground terminal (CGND) of the power unit with that of the upper computer controller to ensure that ground potential of the communication chip on the control board of the power unit is consistent with that of the communication chip of the upper computer.

4. Try to short CGDN of the power unit to its ground terminal (PE).

5. Try to add a safety capacitor of 0.1 μF on the power terminal of the upper computer (PLC, HMI, and touch screen). During this process, pay attention to the voltage of the power supply and the voltage endurance capability of the capacitor. Alternatively, you can use a magnet ring (Fe-based nanocrystalline magnet rings are recommended). Put the power L/N line or +/- line of the upper computer through the magnet ring in the same direction and wind 8 coils around the magnet ring.

9.7.3 Failure to stop and indicator shimmering due to motor cable coupling

Interference phenomenon

1. Failure to stop

In a power unit system where an S terminal is used to control the start and stop, the motor cable and control cable are arranged in the same cable tray. After the system is started properly, the S terminal cannot be used to stop the inverter.

2. Indicator shimmering

After the power unit is started, the relay indicator, power distribution box indicator, PLC indicator, and indication buzzer shimmer, blink, or emit unusual sounds unexpectedly.

Solution

1. Check and ensure that the exception signal cable is arranged 20 cm or farther away from the motor cable.

2. Add a safety capacitor of 0.1 μF between the digital input terminal (S) and the COM terminal.

3. Connect the digital input terminal (S) that controls the start and stop to other idle digital input terminals in parallel. For example, if S1 is used to control the start and stop and S4 is idle, you can try to short connect S1 to S4 in parallel.

Note: If the controller (such as PLC) in the system controls more than 5 power units at the same time through digital input terminals (S), this scheme is not applicable.

9.7.4 Leakage current and interference on RCD

Inverters output high-frequency PWM voltage to drive motors. In this process, the distributed capacitance between the internal IGBT of an inverter and the heat sink and that between the stator and rotor of a motor may inevitably cause the inverter to generate high-frequency leakage current to the ground. A residual current operated protective device (RCD) is used to detect the power-frequency leakage current when a grounding fault occurs on a circuit. The application of an inverter may cause misoperation of a RCD.

1. Rules for selecting RCDs

(1) Inverter systems are special. In these systems, it is required that the rated residual current of common RCDs at all levels is larger than 200 mA, and the inverters are grounded reliably.

(2) For RCDs, the time limit of an action needs to be longer than that of a next action, and the time difference between two actions need to be longer than 20 ms. For example, 1 s, 0.5 s, and 0.2 s.

(3) For circuits in multi-drive systems, electromagnetic RCDs are recommended. Electromagnetic RCDs have strong anti-interference capability, and thus can prevent the impact of high-frequency leakage current.

Electronic RCD	Electromagnetic RCD
Low cost, high sensitivity, small in volume, susceptible to voltage fluctuation of the grid and ambient temperature, and weak anti-interference capability	Requiring highly sensitive, accurate, and stable zero-phase sequence current transformer, using permalloy high-permeability materials, complex process, high cost, not susceptible to voltage fluctuation of the power supply and ambient temperature, strong anti- interference capability

2. Solution to RCD misoperation (handling the VFD)

(1) Try to modify the modulation mode to "3PH modulation and 2PH modulation" (P08.40=00).

(2) Try to reduce the carrier frequency to 1.5 kHz (P00.14=1.5).

(3) Try to remove the screw for grounding jumper of the rectifier unit safety capacitor.

3. Solution to RCD misoperation (handling the system power distribution)

(1) Check and ensure that the power cable is not soaking in water.

(2) Check and ensure that the cables are not damaged or spliced.

(3) Check and ensure that no secondary grounding is performed on the neutral wire.

(4) Check and ensure that the main power cable terminal is in good contact with the air switch or contactor (all screws are tightened).

(5) Check 1PH powered devices, and ensure that no earth lines are used as neutral wires by these devices.

(6) Do not use shielded cables as VFD power cables and motor cables.

9.7.5 Live device chassis

After the VFD is started, there is sensible voltage on the chassis, and you may feel an electric shock when touching the chassis. The chassis, however, is not live (or the voltage is far lower than the human safety voltage) when the VFD is powered on but not running.

Solution

1. If there is power distribution grounding or ground stud on the site, ground the cabinet chassis of the VFD through the power ground or stud.

2. If there is no grounding on the site, you need to connect the motor chassis to the ground terminal PE of the VFD, and ensure that the screw for grounding jumper of the rectifier unit safety capacitor has been removed.

10 Maintenance

10.1 What this chapter contains

This chapter describes how to carry out preventive maintenance on the VFD.

10.2 Periodical inspection

Little maintenance is required when the VFD is installed in an environment that meets requirements. The following table describes the routine maintenance periods recommended by INVT.

<table>
<tr><th colspan="2">Check scope</th><th>Item</th><th>Method</th><th>Criterion</th></tr>
<tr><td colspan="2" rowspan="2">Ambient environment</td><td>Check the temperature, and humidity, and whether there is vibration, dust, gas, oil spray, and water droplets in the environment.</td><td>Visual inspection, and use instruments for measurement.</td><td>The requirements stated in this manual are met.</td></tr>
<tr><td>Check whether there are foreign matters, such as tools, or dangerous substances placed nearby.</td><td>Visual inspection</td><td>There are no tools or dangerous substances placed nearby.</td></tr>
<tr><td colspan="2">Voltage</td><td>Check the voltage of the main circuit and control circuit.</td><td>Use multimeters or other instruments for measurement.</td><td>The requirements stated in this manual are met.</td></tr>
<tr><td colspan="2" rowspan="2">Keypad</td><td>Check the display of information.</td><td>Visual inspection</td><td>The characters are displayed properly.</td></tr>
<tr><td>Check whether characters are not completely displayed.</td><td>Visual inspection</td><td>The requirements stated in this manual are met.</td></tr>
<tr><td rowspan="5">Main circuit</td><td rowspan="3">Common</td><td>Check whether the bolts loose or come off.</td><td>Screw them up.</td><td>No exception occurs.</td></tr>
<tr><td>Check whether the machine is deformed, cracked, or damaged, or their color changes due to overheating and aging.</td><td>Visual inspection</td><td>No exception occurs.</td></tr>
<tr><td>Check whether there are stains and dust attached.</td><td>Visual inspection</td><td>No exception occurs.
Note:
Discoloration of copper bars does not mean that they cannot work properly.</td></tr>
<tr><td rowspan="2">Conductor and wire</td><td>Check whether conductors are deformed or color change for overheat.</td><td>Visual inspection</td><td>No exception occurs.</td></tr>
<tr><td>Check whether the wire sheaths are cracked or their color changes.</td><td>Visual inspection</td><td>No exception occurs.</td></tr>
</table>

Check scope		Item	Method	Criterion
	Terminal block	Check whether there is damage.	Visual inspection	No exception occurs.
	Filter capacitor	Check whether there is electrolyte leakage, discoloration, cracks, and chassis expansion.	Visual inspection	No exception occurs.
		Check whether the safety valves are released.	Determine the service life based on the maintenance information, or measure them through electrostatic capacity.	No exception occurs.
		Check whether the electrostatic capacity is measured as required.	Use instruments to measure the capacity.	Electrostatic capacity ≥ initial value x 0.85
	Resistor	Check whether there is displacement caused due to overheat.	Olfactory and visual inspection	No exception occurs.
		Check whether the resistors are disconnected.	Visual inspection, or remove one end of the connection cable and use a multimeter for measurement.	Resistance range: ±10% (of the standard resistance)
	Transformer and reactor	Check whether there is unusual vibration sounds or smells.	Auditory, olfactory, and visual inspection	No exception occurs.
	Electromagnetic contactor and relay	Check whether there are vibration sounds in the workshop.	Auditory inspection	No exception occurs.
		Check whether the contacts are in good contact.	Visual inspection	No exception occurs.
Control circuit	Control PCB and connector	Check whether the screws and connectors loose.	Screw them up.	No exception occurs.
		Check whether there is unusual smell or discoloration.	Olfactory and visual inspection	No exception occurs.
		Check whether there are cracks, damage, deformation, or rust.	Visual inspection	No exception occurs.
		Check whether there is electrolyte leakage or deformation.	Visual inspection, and determine the service life based on the maintenance information.	No exception occurs.

Check scope		Item	Method	Criterion
Cooling system	Cooling fan	Check whether there are unusual sounds or vibration.	Auditory and visual inspection, and turn the fan blades with your hand.	The rotation is smooth.
		Check whether the bolts loose.	Screw them up.	No exception occurs.
		Check whether there is decoloration caused due to overheat.	Visual inspection, and determine the service life based on the maintenance information.	No exception occurs.
	Ventilation duct	Check whether there are foreign matters blocking or attached to the cooling fan, air inlets, or air outlets.	Visual inspection	No exception occurs.

For more details about maintenance, contact the local INVT office, or visit our website http://www.invt.com, and choose **Support** > **Services**.

10.3 Cooling fan

The service life of the cooling fan of the VFD is more than 25,000 hours. The actual service life of the cooling fan is related to the use of the VFD and the temperature in the ambient environment.

You can view the running duration of the VFD through P07.14 (Accumulated running time).

The increase of the bearing noise indicates a fan fault. If the VFD is applied in a key position, replace the fan once the fan starts to generate unusual noise. You can purchase spares of fans from INVT.

Cooling fan replacement:

⚠	Read chapter 1 Safety precautions carefully and follow the instructions to perform operations. Ignoring these safety precautions may lead to physical injury or death, or equipment damage.

1. Stop the VFD, disconnect the AC power supply, and wait for a time no shorter than the waiting time designated on the VFD.
2. Remove the fan coverplate.
3. Pull out the fan and remove the pluggable terminal of the fan cable.
4. Replace the fan.
5. Install the new fan inside the VFD, connect the pluggable terminal of the fan cable in the reverse order, put the fan into the corresponding position of the VFD, and fasten the fan coverplate. Ensure that the air direction of the fan is consistent with that of the VFD, as shown in Figure 10-2.
6. Power on the VFD.

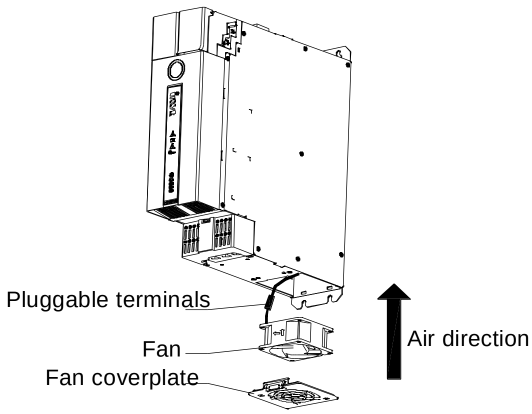


Figure 10-1 Fan maintenance for the 7.5kW inverter unit model or higher

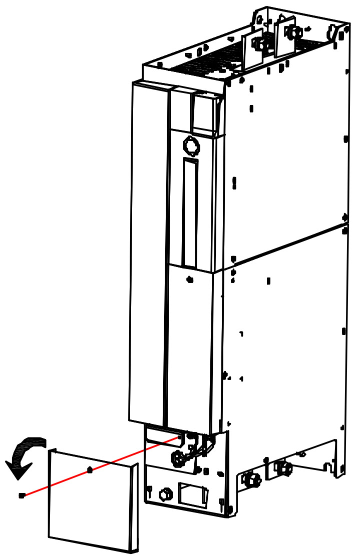
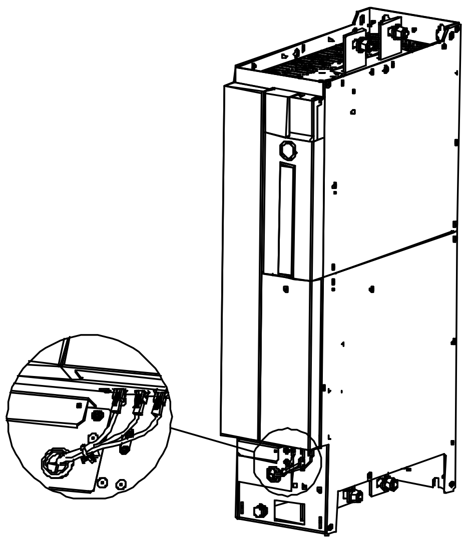
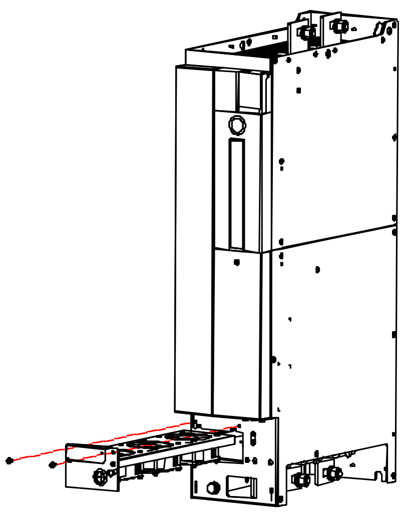
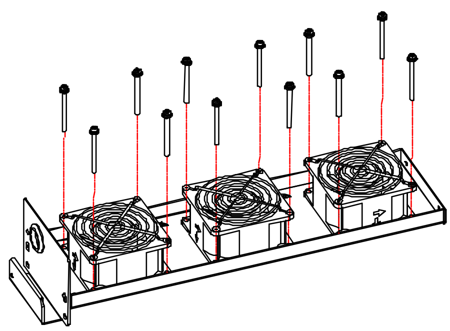
1. Remove the one fasten screw on the coverplate and remove it in the direction shown in the figure. 	2. Unplug the fan power cable connector. 
3. Remove the two fasten screws from the fan assembly and pull out the fan assembly. 	4. Remove the four fasten screws from each fan. 

Figure 10-2 Fan maintenance for the 355kW rectifier unit model

10.4 Capacitor reforming

If the VFD has been left unused for a long time, you need to follow the instructions to reform the DC bus capacitor before using it. The storage time is calculated from the date the VFD is delivered.

Storage time	Operation principle
Less than 1 year	No charging operation is required.
1 to 2 years	The VFD needs to be powered on for 1 hour before the first running command.
2 to 3 years	Use a voltage controlled power supply to charge the VFD: Charge the VFD at 25% of the rated voltage for 30 minutes, and then charge it at 50% of the rated voltage for 30 minutes, at 75% for another 30 minutes, and finally charge it at 100% of the rated voltage for 30 minutes.
More than 3 years	Use a voltage controlled power supply to charge the VFD: Charge the VFD at 25% of the rated voltage for 2 hours, and then charge it at 50% of the rated voltage for 2 hours, at 75% for another 2 hours, and finally charge it at 100% of the rated voltage for 2 hours.

The method for using a voltage controlled power supply to charge the VFD is described as follows:

The selection of a voltage controlled power supply depends on the power supply of the VFD. For VFDs with an incoming voltage of 1PH/3PH 230 V AC, you can use a 230 V AC/2 A voltage regulator. Both 1PH and 3PH VFDs can be charged with a 1PH voltage controlled power supply (connect L+ to R, and N to S or T). All the DC bus capacitors share one rectifier, and therefore they are all charged.

For VFDs of a high voltage class, ensure that the voltage requirement (for example, 380 V) is met during charging. Capacitor changing requires little current, and therefore you can use a small-capacity power supply (2 A is sufficient).

The method for using a resistor (incandescent lamp) to charge the drive is described as follows:

If you directly connect the drive device to a power supply to charge the DC bus capacitor, it needs to be charged for a minimum of 60 minutes. The charging operation must be performed at a normal indoor temperature without load, and you must connect a resistor in series mode in the 3PH circuit of the power supply.

For a 380 V drive device, use a resistor of 1 kΩ/100W. If the voltage of the power supply is no higher than 380 V, you can also use an incandescent lamp of 100W. If an incandescent lamp is used, it may go off or the light may become very weak.

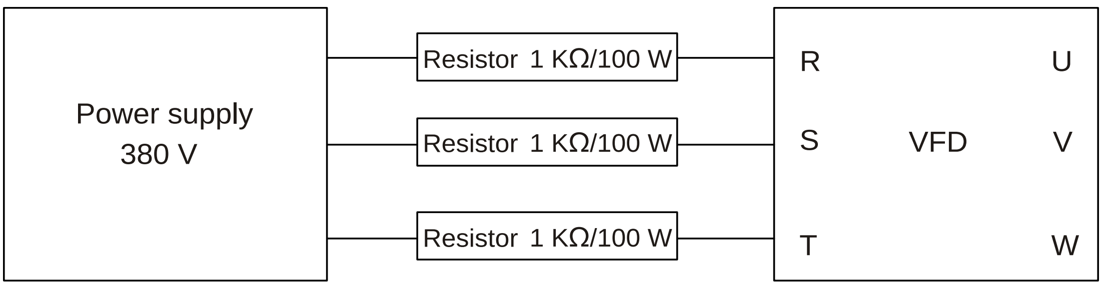


Figure 10-3 380V driving-device charging circuit exmaple

10.5 Electrolytic capacitor replacement

	Read chapter 1 Safety precautions carefully and follow the instructions to perform operations. Ignoring these safety precautions may lead to physical injury or death, or equipment damage.

The electrolytic capacitor of a VFD must be replaced if it has been used for more than 35,000 hours. For details about the replacement, contact the local INVT office.

10.6 Power cable

	Read chapter 1 Safety precautions carefully and follow the instructions to perform operations. Ignoring these safety precautions may lead to physical injury or death, or equipment damage.

1. Stop the VFD, disconnect the power supply, and wait for a time no shorter than the waiting time designated on the VFD.
2. Check the connection of the power cables. Ensure that they are firmly connected.
3. Power on the VFD.

Appendix A Expansion cards

A.1 Model definition

EC – PG 7 01 – 05

① ② ③ ④ ⑤

Field	Description	Naming example
①	Product category	EC: Expansion card
②	Card category	PG: PG card
③	Technical version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, 5, and 7 indicate the 1st, 2nd, 3rd and 4th generations of the technical version.
④	Distinguishing code	01: Incremental PG card + frequency-divided output
		02: Sine/Cosine PG card + pulse direction setting + frequency-divided output
		03: UVW PG interface + pulse direction setting + frequency-divided output
		04: Resolver PG interface + pulse direction setting + frequency-divided output
		05: Incremental PG card + pulse direction setting + frequency-divided output
		06: Absolute PG interface + pulse direction setting + frequency-divided output
		07: 24V simplified incremental PG card
⑤	Working power	00: Passive
		05: 5V
		12: 12-15V
		24: 24V

EC – PC 7 01 – 02

① ② ③ ④ ⑤

Field	Description	Naming example
①	Product category	EC: Expansion card
②	Card category	PC: Programmable card
③	Technical version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, 5, and 7 indicate the 1st, 2nd, 3rd and 4th generations of the technical version.
④	Distinguishing code	01: 6 points, 4 inputs and 2 outputs (relay outputs)
		02: Reserved
⑤	Special requirement	Reserved

EC – **TX** **7** **01**

① ② ③ ④

Symbol	Description	Naming example
①	Product category	EC: Expansion card
②	Card category	TX: Communication card
③	Technical version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, 5, and 7 indicate the 1st, 2nd, 3rd and 4th generations of the technical version.
④	Distinguishing code	01: /
		02: /
		03: PROFIBUS communication card
		04: Ethernet communication card
		05: CANopen communication card
		06: DeviceNet communication card
		07: BACnet communication card
		08: EtherCAT communication card
		09: PROFINET communication card
		10: RS485 communication card

EC – **IO** **7** **01** – **00**

① ② ③ ④ ⑤

Symbol	Description	Naming example
①	Product category	EC: Expansion card
②	Card category	IO: IO card
③	Technical version	Indicates the generation of a technical version by using odd numbers, for example, 1, 3, 5, and 7 indicate the 1st, 2nd, 3rd and 4th generations of the technical version.
④	Distinguishing code	01: Multiple-function I/O card
		02: Digital I/O card
		03: Analog I/O card
		04: Reserved 1
		05: Reserved 2
⑤	Special requirement	/

The following table describes expansion cards that the VFD supports. The expansion cards are optional and need to be purchased separately.

Name	Model	Specifications
Resolver PG card	EC-PG704-00	• Applicable to resolver encoders • Supporting frequency-divided output of resolver-simulated A, B, Z • Supporting pulse string reference input
Multi-function incremental PG card	EC-PG705-12	• Applicable to OC encoders of 5 V or 12 V • Applicable to push-pull encoders of 5 V or 12 V • Applicable to differential encoders of 5 V • Supporting the orthogonal input of A, B, and Z

Name	Model	Specifications
		• Supporting the frequency-divided output of A, B, and Z • Supporting pulse string setting
24V simplified incremental PG card	EC-PG707-24	• Applicable to 24V OC encoders • Applicable to 24V push-pull encoders • Applicable to 24V differential encoders • Supporting A, B, Z orthogonal input • Supporting PT100/PT1000/KTY84-130 temperature detection
Programmable card	EC-PC701-02	• Adopting the global mainstream development environment PLC, supporting multiple types of programming languages, such as the instruction language, ladder diagram, and sequential function chart • Supporting resumable commissioning and task period execution mode selection • Providing user program storage space of 128KB, and data storage space of 64KB • 4 digital inputs • 2 relay outputs (N.C. and N.O.)
PROFIBUS-DP communication card	EC-TX703	• Supporting the PROFIBUS-DP protocol
Ethernet communication card	EC-TX704	• Supporting Ethernet communication with INVT's internal protocol • Can be used in combination with INVT's upper computer monitoring software INVT Workshop
EtherCAT communication card	EC-TX708	• Supporting the EtherCAT protocol
PROFINET communication card	EC-TX709	• Supporting the PROFINET protocol
IO card	EC-IO702	• 2 digital inputs • 1 analog input • 1 analog output • 1 double-contact relay output • Supporting PT100/PT1000/KTY84-130/NTC temperature detection

A.2 Dimensions and installation methods

All expansion cards are of the same dimensions (119x70mm) and can be installed in the same way.

Comply with the following rules when installing or removing an expansion card:

- Ensure that no power is applied before installing the expansion card.
- The expansion card can be installed in any one of the SLOT1 and SLOT2 card slots.
- If interference occurs on the external wires after the expansion card is installed, change the installation card slot flexibly to facilitate the wiring. For example, the connector of the connection cable of the DP card is large, and you are recommended to install the card at SLOT2.

The following figure shows the installation diagram and the VFD with expansion cards installed.

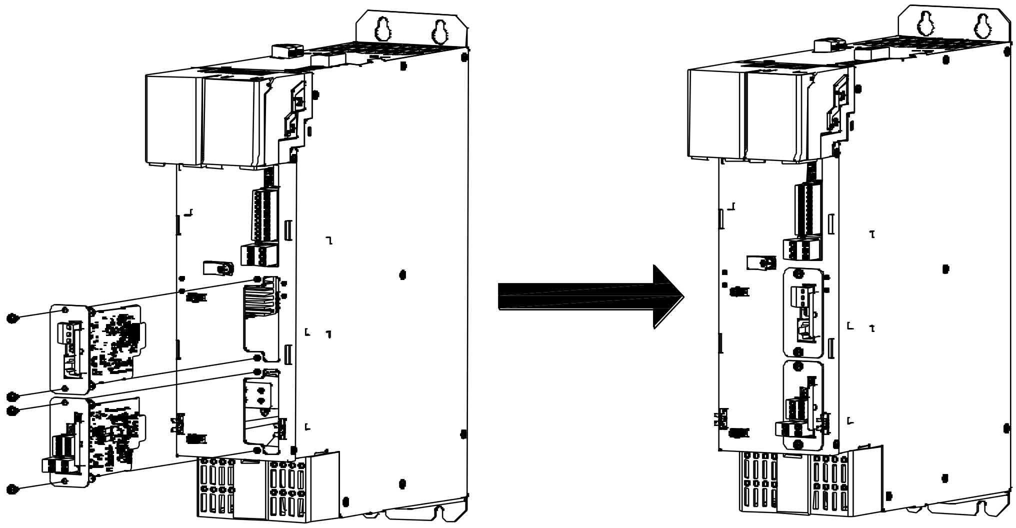


Figure A-1 VFD with expansion cards installed

Expansion card installation procedure:

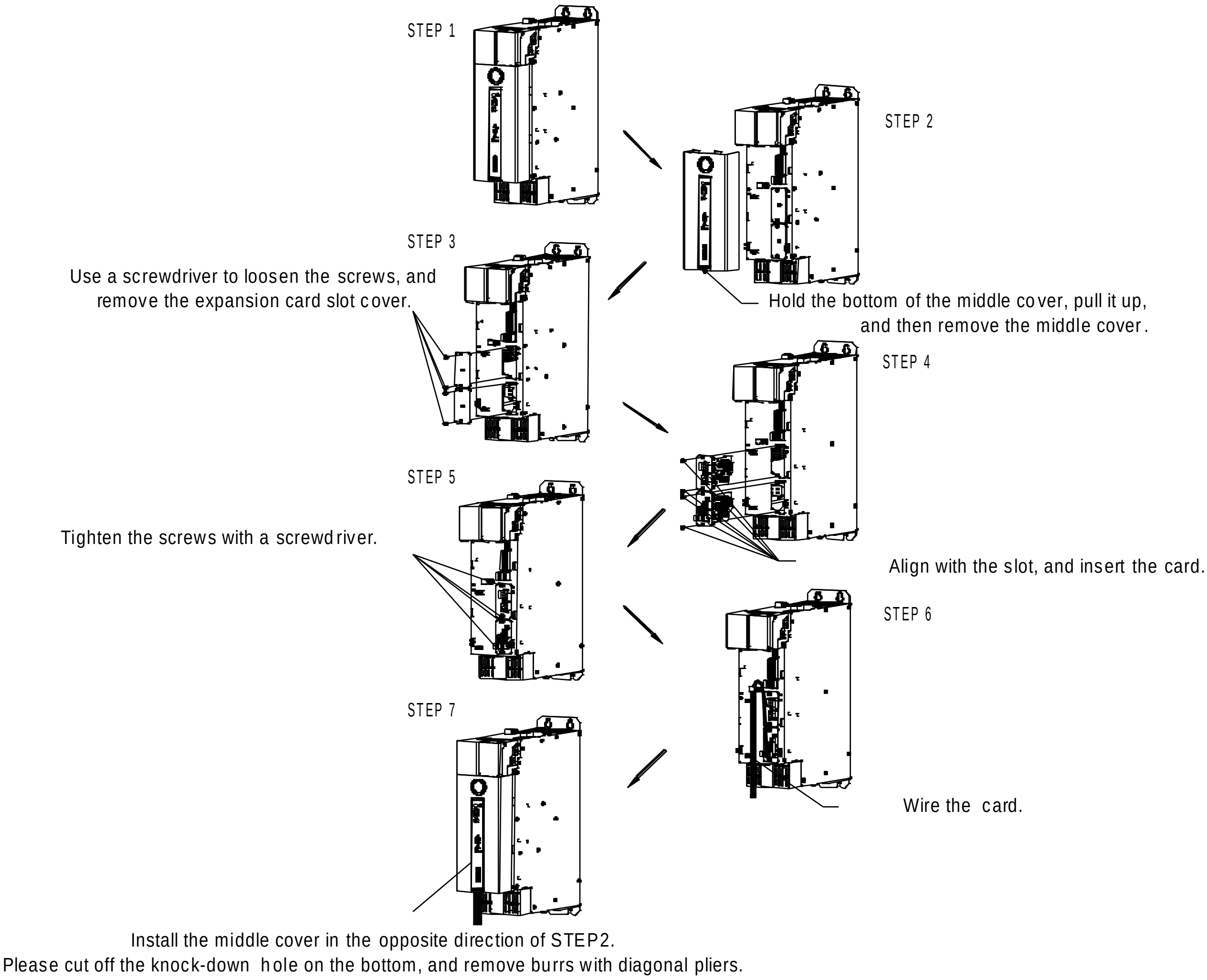


Figure A-2 Expansion card installation procedure

A.3 Wiring

1. Ground a shielded cable as follows:

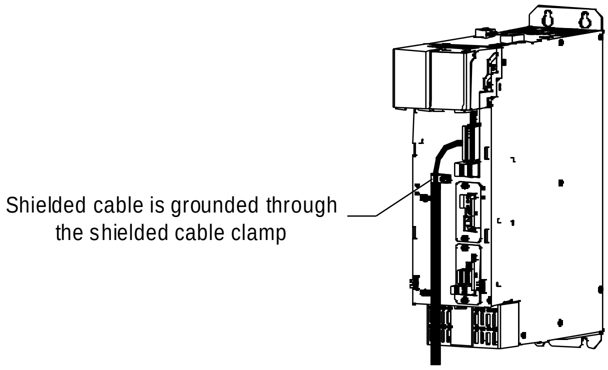


Figure A-3 Shielded cable grounding diagram

2. Wire an expansion card as follows.

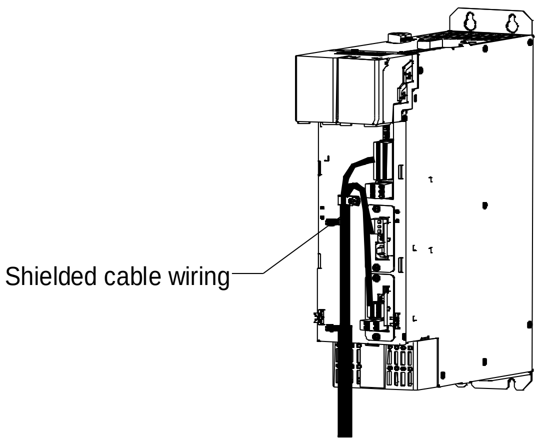
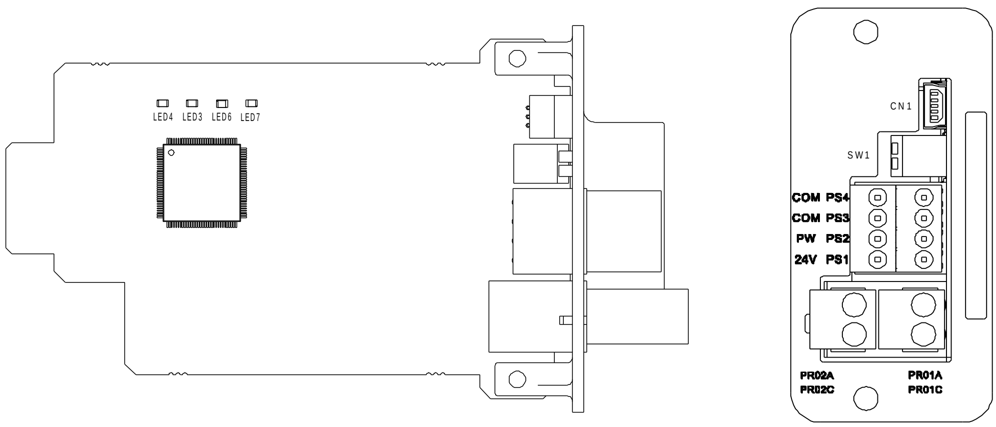


Figure A-4 Expansion card wiring diagram

A.4 Programmable card——EC-PC701-02



EC-PC701-02 has 4 digital inputs and 2 relay outputs, using spring cage terminals.

SW1 is the start/stop switch of the programmable card, CN1 is the program download interface, using a standard USB cable to connect to a computer.

COM	PS4
COM	PS3
PW	PS2
24V	PS1

PRO2A	PRO1A
PRO2C	PRO1C

EC-PC701-02 terminal functions:

Category	Terminal	Name	Description
Power supply	PW	External power	Used to provide input digital working power from the external to the internal Voltage range: 12–24V The terminals PW and 24V are shorted before delivery.
	24V	Internal power	User power provided by the card. Max. output current: 100mA
Digital input/output	PS1—COM	Digital input 1	Internal impedance: 4kΩ 12–30V voltage input is acceptable Bi-direction input terminal Max. input frequency: 1kHz
	PS2—COM	Digital input 2	
	PS3—COM	Digital input 3	
	PS4—COM	Digital input 4	
Relay output	PR01A	NO contact of relay 1	Contact capacity: 2A/AC250V, 1A/DC30V Cannot be used as high frequency digital output
	PR01C	Common contact of relay 1	
	PR02A	NO contact of relay 2	
	PR02C	Common contact of relay 2	

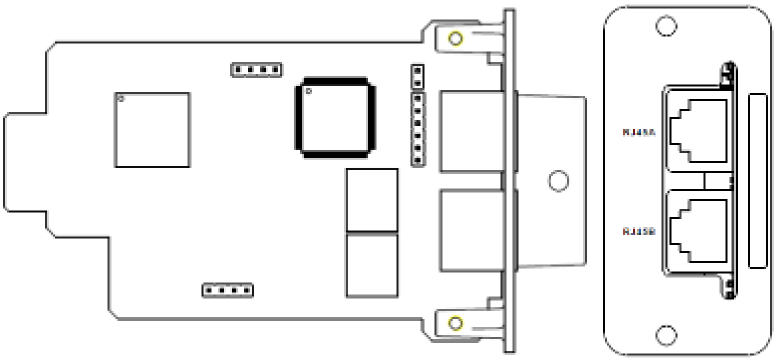
Indicator	Definition	Function
LED3	RUN status indicator (green)	On: PLC program is running Off: PLC program stops
LED4	PWR power indicator (green)	The indicator is on when the expansion card is powered on.
LED6	ERR fault indicator (red)	Blinks: an error occurs (the period is 1s, on for 0.5s, and off for the other 0.5s), and the error type can be queries through the upper computer Auto Station; Off: no fault.
LED7	COMM communication indicator (green)	On: the expansion card is establishing a connection with the control board. Blinks periodically (the period is 1s, on for 0.5s, and off for the other 0.5s): the expansion card is properly connected to the control board. Off: the expansion card is disconnected from the control board.

EC-PC701-02 can replace some micro PLC applications. It adopts the global mainstream development environment PLC, supporting the instruction language (IL), ladder diagram (LD), and sequential function chart (SFC). It provides a user program storage space of 16K steps and data storage space of 8K words, and supports saving data of 1K words at power failure, which facilitate customers' secondary development and meets the customization requirements.

For details about how to use the programmable card, see the VFD programmable card manual.

A.5 Communication cards

A.5.1 PROFINET communication card——EC-TX709



The terminal CN2 adopts standard RJ45 interfaces, which are in the dual design, and the two RJ45 interfaces are not distinguished from each other and can be interchangeably inserted.

Pin	Name	Description
1	TX+	Transmit Data+
2	TX-	Transmit Data-
3	RX+	Receive Data+
4	n/c	Not connected
5	n/c	Not connected
6	RX-	Receive Data-
7	n/c	Not connected
8	n/c	Not connected

The PROFINET communication card has 9 indicators, among which LED1 is the power indicator, LED2–5 are the communication status indicators of the communication card, and LED6–9 are the status indicators of the network port.

LED	Color	Status	Description
LED1	Green		3.3V power indicator
LED2 (Bus status indicator)	Red	On	No network connection
		Blinking	The connection to the network cable between the PROFINET controller is OK, but the communication is not established.
		Off	Communication with the PROFINET controller has been established.
LED3 (System fault indicator)	Green	On	PROFINET diagnosis exists.
		Off	No PROFINET diagnosis.
LED4 (Slave ready indicator)	Green	On	TPS-1 protocol stack has started.
		Blinking	TPS-1 waits for MCU initialization.
		Off	TPS-1 protocol stack does not start.
LED5 (Maintenance status indicator)	Green		Manufacturer-specific, depending on the characteristics of the device
LED6/7 (Network port status indicator)	Green	On	The PROFINET communication card and PC/PLC have been connected by using a network cable.
		Off	The connection between the PROFINET communication card and PC/PLC has not been established.

LED	Color	Status	Description
LED8/9 Indicator	Green	On	The PROFINET communication card and PC/PLC are communicating.
		Off	The PROFINET communication card and PC/PLC have no communication yet.

Electrical connection:

The PROFINET communication card adopts standard RJ45 interfaces, which can be used in a linear network topology and a star network topology. The linear network topology electrical connection diagram is shown as follows.

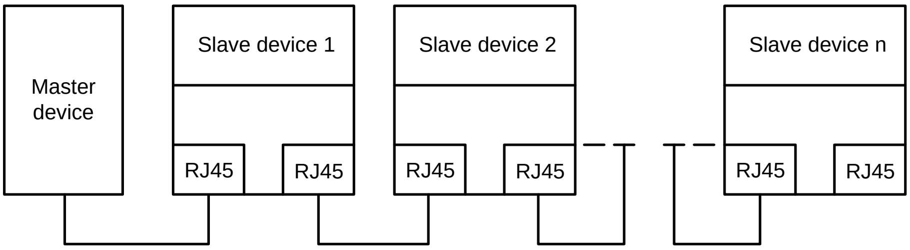


Figure A-5 Linear network topology electrical connection diagram

Note: For the star network topology, you need to prepare PROFINET switches.

The star network topology electrical connection diagram is shown as follows.

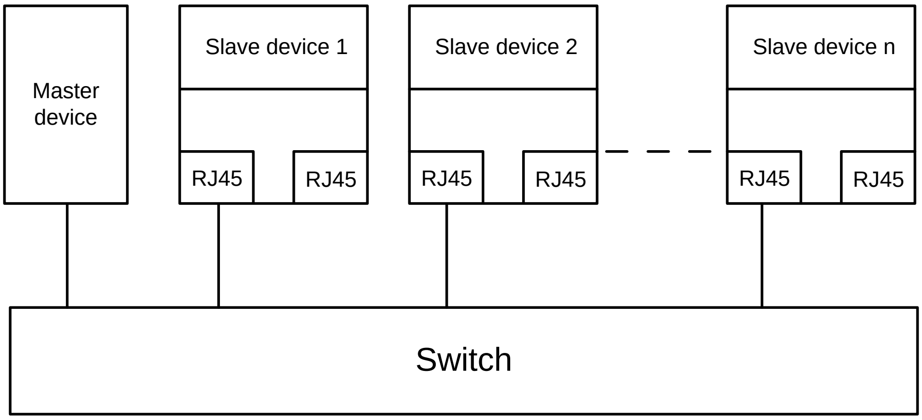
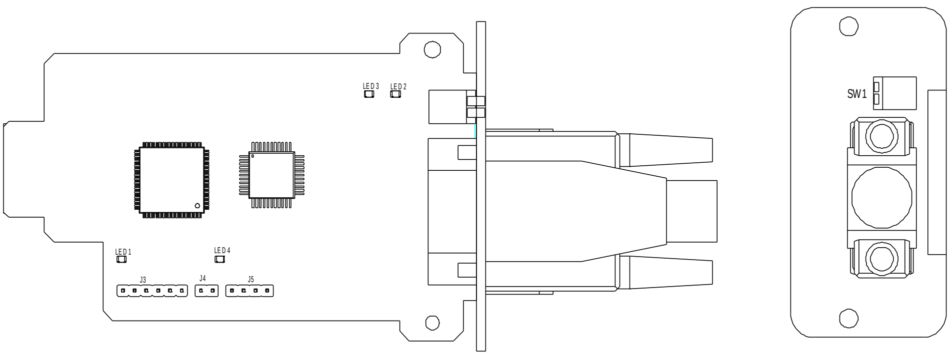
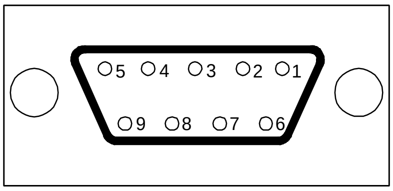


Figure A-6 Star network topology electrical connection diagram

A.5.2 PROFIBUS-DP communication card——EC-TX703



SW1 is the DIP switch for the terminal matching resistor, using 9-pin D-type connector, of which pins are arranged as follows.



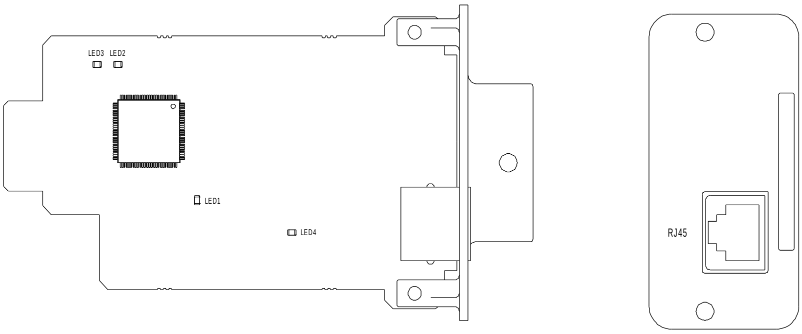
Connector pin		Description
1	-	Unused
2	-	Unused
3	B-Line	Data+ (twisted pair 1)
4	RTS	Request sending
5	GND_BUS	Isolation ground
6	+5V_BUS	Isolated power supply of 5 V DC
7	-	Unused
8	A-Line	Data- (twisted pair 2)
9	-	Unused
Housing	SHLD	PROFIBUS cable shielding line

+5V_BUS and GND_BUS are bus terminators. Some devices, such as the optical transceiver (RS485), may need to obtain power through these pins. Some devices use RTS to determine the sending and receiving directions. In normal applications, only A-Line, B-Line, and the shield layer need to be used.

Indicators:

Indicator	Definition	Function
LED1	Status indicator	This indicator is on when the expansion card is establishing a connection with the control board; it blinks periodically after the expansion card is properly connected to the control board (the period is 1s, on for 0.5s, and off for the other 0.5s); and it is off when the expansion card is disconnected from the control board.
LED2	Online indicator	This indicator is on when the communication card is online and data exchange can be performed. It is off when the communication card is not in the online state.
LED3	Offline/Fault indicator	This indicator is on when the communication card is offline and data exchange cannot be performed. It blinks when the communication card is not in the offline state. It blinks at the frequency of 1 Hz when a configuration error occurs: The length of the user parameter data set during the initialization of the communication card is different from that during the network configuration. It blinks at the frequency of 2 Hz when user parameter data is incorrect: The length or content of the user parameter data set during the initialization of the communication card is different from that during the network configuration. It blinks at the frequency of 4 Hz when an error occurs in the ASIC initialization of PROFIBUS communication. It is off when the diagnosis function is disabled.
LED4	Power indicator	This indicator is on after the control board feeds power to the communication card.

A.5.3 Ethernet communication card——EC–TX704

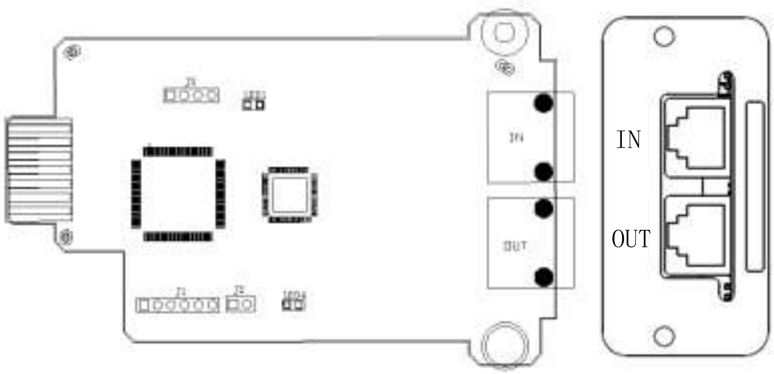


EC-TX704 uses standard RJ45 terminals.

Indicators:

Indicator	Definition	Function
LED1	Status indicator	This indicator is on when the expansion card is establishing a connection with the control board; it blinks periodically after the expansion card is properly connected to the control board (the period is 1s, on for 0.5s, and off for the other 0.5s); and it is off when the expansion card is disconnected from the control board.
LED2	LINK indicator (Green)	This indicator is on when the connection with the upper computer is normal; it is off when the expansion card is disconnected from the upper computer.
LED3	ACK indicator (Red)	This indicator is on when data is returned to the upper computer; it is off when there is no data returned.
LED4	Power indicator	This indicator is on after the control board feeds power to the communication card.

A.5.4 EtherCAT communication card——EC–TX708



Features:

(1) Supported functions

- Automatic network address setting

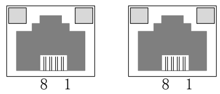
(2) Supported services

- PDO service
- Object dictionary defined by the manufacturer
- PKW reading data from and writing data to VFD function codes

Components:

(1) Communication port

EtherCAT communication card is externally connected. The following figure shows the communication card interfaces. IN (indicating input) and OUT (indicating output) are EtherCAT wiring network ports. The interfaces appears as follows:



The following table describes the interface pins.

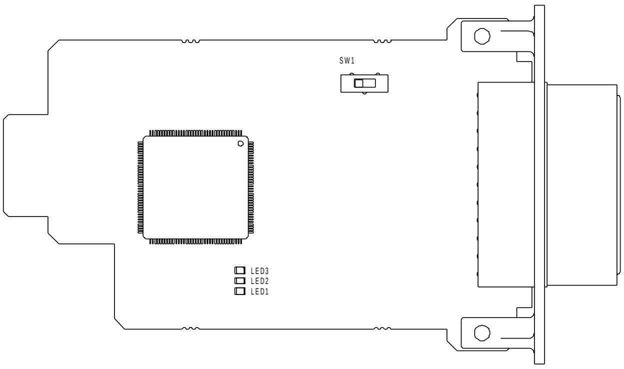
Pin	Name	Description
1	TX+	Transmit Data+
2	TX-	Transmit Data-
3	RX+	Receive Data+
4	NC	Not connected
5	NC	Not connected
6	RX-	Receive Data-
7	NC	Not connected
8	NC	Not connected

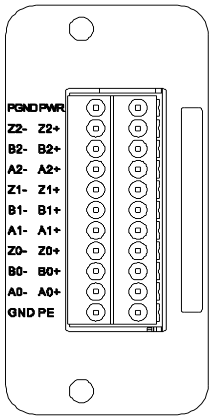
(2) There are 6 LED indicators on the EtherCAT communication card, of which LED1 and LED4 are on the PCB board and the other 4 indicators are distributed on the two interfaces. Description of LEDs:

Indicator	Status	Description
LED1	Blinking or On	Communication connection error
	Off	Communication connection is normal.
LED4	Off	Power supply is disconnected.
	ON	Power supply is connected.
IN network port (CN3) yellow LED	Off	EtherCAT state machine = Init
	On for 0.2s and Off for the other 0.2s	EtherCAT state machine = Pre-Op
	On for 0.2s and Off for the other 1s	EtherCAT state machine = Safe-Op
	ON	EtherCAT state machine = Op
IN network port (CN3) green LED	Blinking	Data communication available
	On or Off	No data communication
OUT network port (CN5) yellow LED (This indicator is available only if the unit is connected with the IN port of the next slave.)	Off	EtherCAT state machine = Init
	On for 0.2s and Off for the other 0.2s	EtherCAT state machine = Pre-Op
	On for 0.2s and Off for the other 1s	EtherCAT state machine = Safe-Op
	ON	EtherCAT state machine = Op
OUT network port (CN5) green LED	Blinking	Data communication available
	On or Off	No data communication

A.6 PG cards

A.6.1 Multifunction incremental PG card——EC-PG705-12





The DIP switch SW1 is used to set the voltage class (5 V or 12 V) of the power supply of the encoder. Select a power class before inserting the card into the slot.

Indicators:

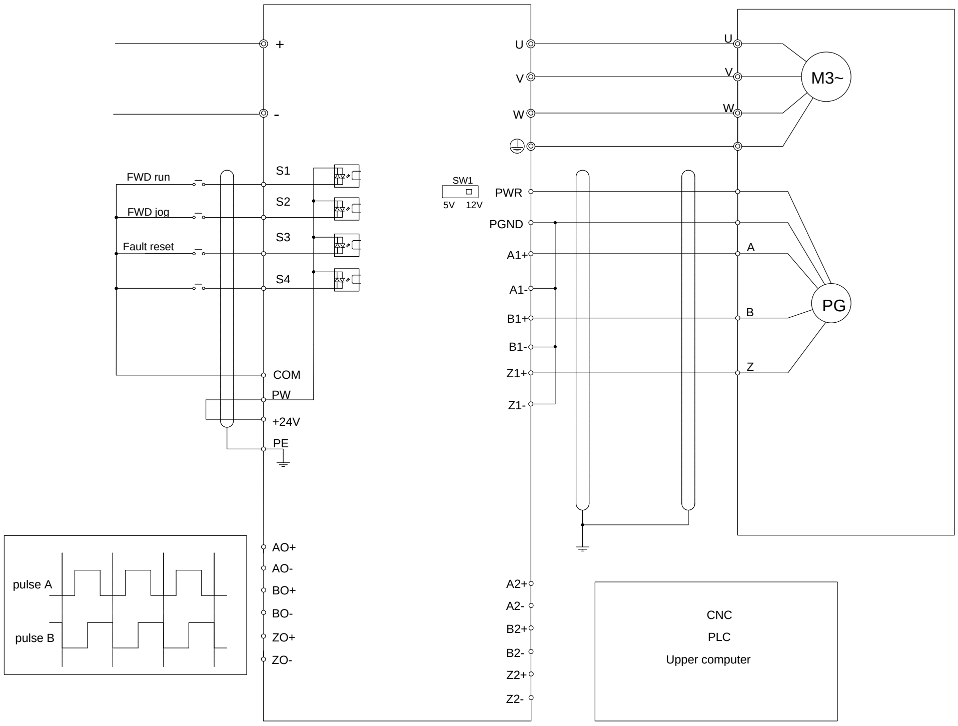
Indicator	Definition	Function
LED1	Status indicator	This indicator is on when the expansion card is establishing a connection with the control board; it blinks periodically after the expansion card is properly connected to the control board (the period is 1s, on for 0.5s, and off for the other 0.5s); and it is off when the expansion card is disconnected from the control board.
LED2	Disconnection indicator	This indicator is off when A1, B1, or Z1 of the encoder is disconnected; and it is on when the pulses are normal.
LED3	Power indicator	This indicator is on after the control board feeds power to the PG card.

EC-PG705-12 terminals:

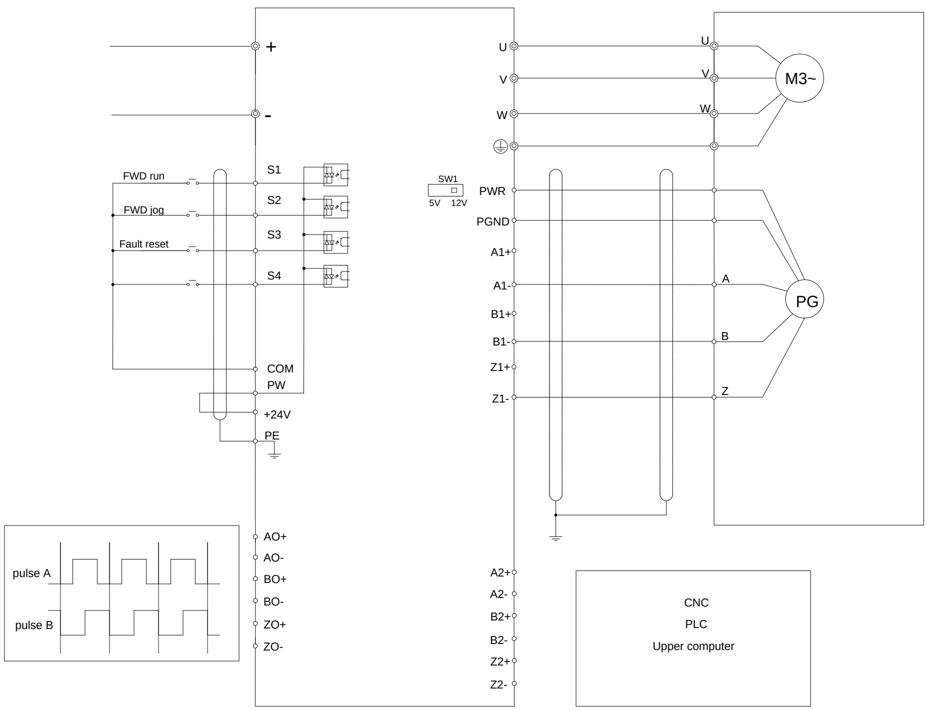
Signal	Port	Description
PWR	Encoder power	Voltage: 5V/12V ± 5% Max. output: 150 mA Select the voltage class through SW1 based on the voltage class of the used encoder.
PGND		
A1+	Encoder interface	● Supporting push-pull interfaces of 5V/12V ● Supporting open collector interfaces of 5V/12V ● Supporting differential interfaces of 5V ● Response frequency: 200 kHz
A1-		
B1+		
B1-		
Z1+		
Z1-		
A2+	Pulse setting	● Supporting the same signal types as the encoder signal types ● Response frequency: 200 kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		

Signal	Port	Description
AO+	Frequency-divided output	● Differential output of 5 V ● Supporting frequency division of 1–255, which can be set through P20.16 or P24.16
AO-		
BO+		
BO-		
ZO+		
ZO-		

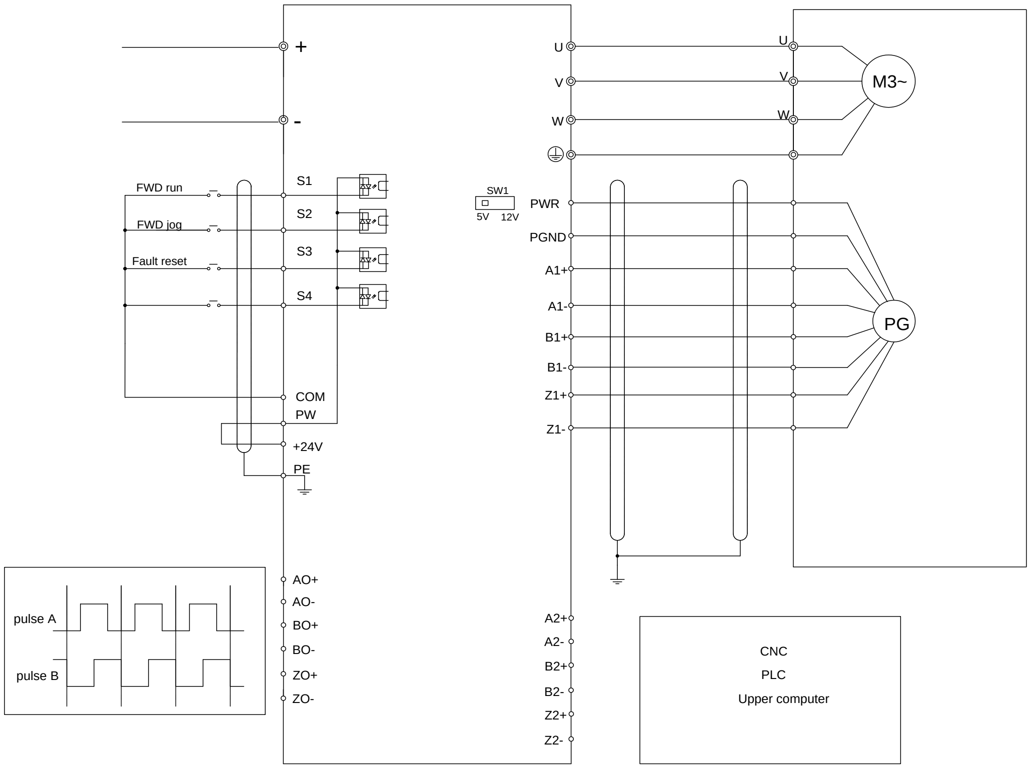
The following figure shows the external wiring when the expansion card is used in combination with an open collector encoder. A pull-up resistor is configured inside the PG card.



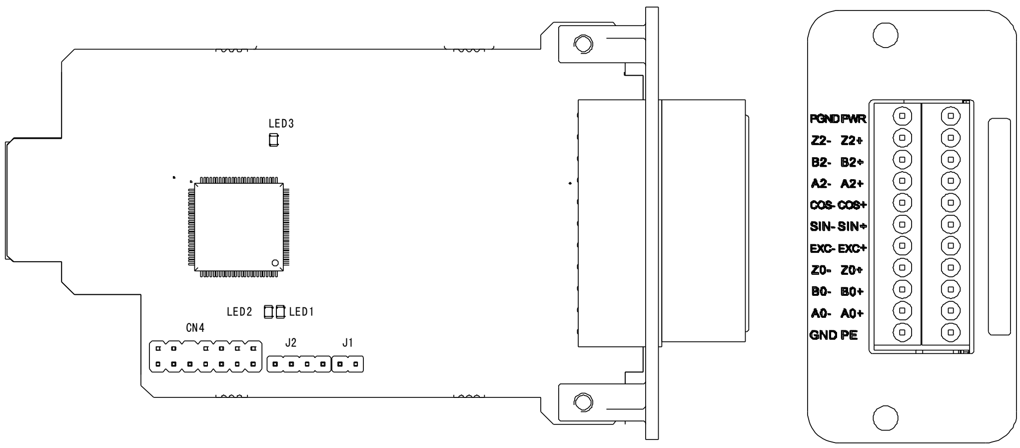
The following figure shows the external wiring when the expansion card is used in combination with a push-pull encoder.



The following figure shows the external wiring when the expansion card is used in combination with a differential encoder.



A.6.2 Resolver PG card——EC-PG704-00



Indicators:

Indicator	Definition	Function
LED1	Status indicator	This indicator is on when the expansion card is establishing a connection with the control board; it blinks periodically after the expansion card is properly connected to the control board (the period is 1s, on for 0.5s, and off for the other 0.5s); and it is off when the expansion card is disconnected from the control board.
LED2	Disconnection indicator	This indicator is off when the encoder is disconnected; it is on when the encoder signals are normal; and it blinks when the encoder signals are not stable.

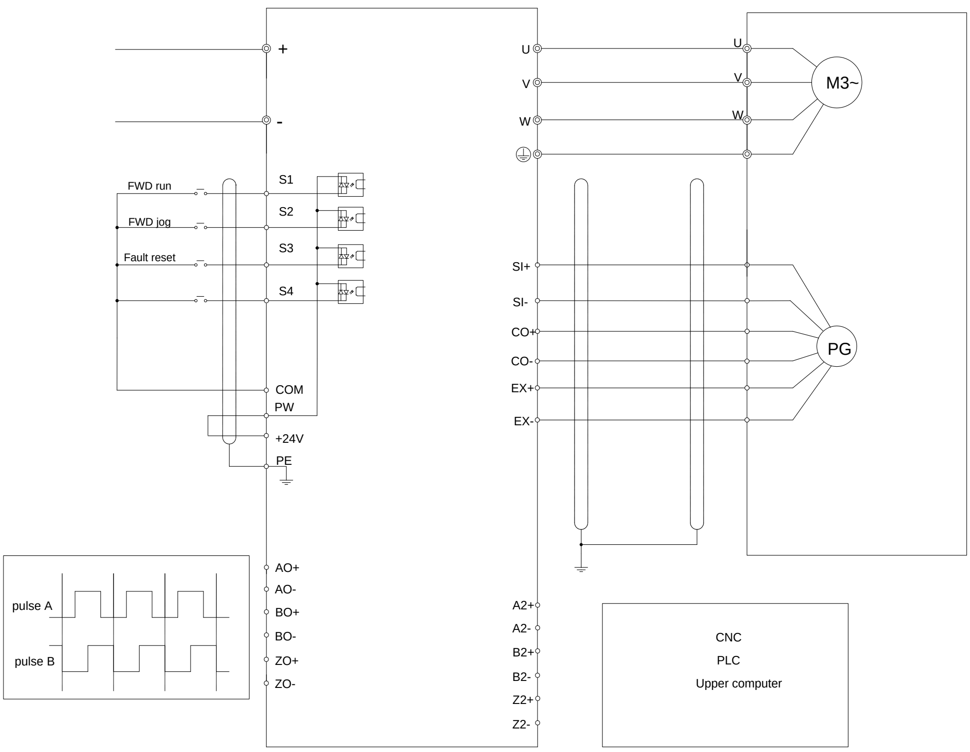
Indicator	Definition	Function
LED3	Power indicator	This indicator is on after the control board feeds power to the PG card.

EC-PG704-00 can be used in combination with a resolver of excitation voltage 7 Vrms. It is user-friendly, adopting spring cage terminals.

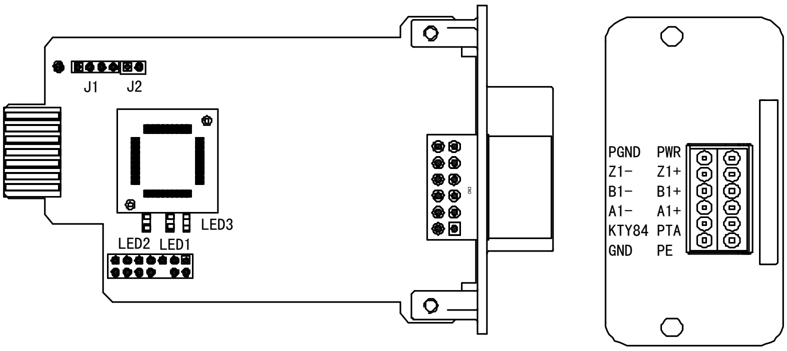
EC-PG704-00 terminals:

Signal	Port	Description
SI+	Encoder signal input	Recommended resolver transformation ratio: 0.5
SI-		
CO+		
CO-		
EX+	Encoder excitation signal	✧ Factory setting of excitation: 10 kHz ✧ Supporting resolvers with an excitation voltage of 7 Vrms
EX-		
A2+	Pulse setting	✧ Differential input of 5 V ✧ Response frequency: 200 kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		
AO+	Frequency-divided output	✧ Differential output of 5 V ✧ Frequency-divided output of resolver simulated A1, B1, and Z1, which is equal to an incremental PG card of 1024 pps. ✧ Supporting frequency division of 2^N, which can be set through P20.16 or P24.16 ✧ Max. output frequency: 200 kHz
AO-		
BO+		
BO-		
ZO+		
ZO-		

The following figure shows the external wiring when EC-PG704-00 is used.



A.6.3 24V simplified incremental PG card——EC-PG707-24



Indicators

Indicator	Definition	Function
LED1	Disconnection indicator	This indicator is off when A1 and B1 of the encoder are disconnected; it is on when the encoder pulses are normal.
LED2	Power indicator	This indicator is on after the control board feeds power to the expansion card.
LED3	Status indicator	This indicator is on when the expansion card is establishing a connection with the control board; it blinks periodically after the expansion card is properly connected to the control board (the period is 1s, on for 0.5s, and off for the other 0.5s); and it is off when the expansion card is disconnected from the control board.

EC-PG707-24 terminals:

Signal	Port	Description
PWR	Encoder power supply	Voltage: 24 V ± 5% Max. output current: 150 mA
PGND		
A1+	Encoder interface	• Supporting 24 V push-pull interfaces • Supporting 24 V open collector interfaces • Supporting 24V differential interfaces • Frequency response: 200 kHz
A1-		
B1+		
B1-		
Z1+		
Z1-		
KTY84	KTY84 temperature sensor interface	Supporting the KTY84-130 temperature sensor; measurable temperature range: -20°C–175°C; error: ±5°C
PTA	PT100/PT1000 temperature sensor interfac	Supporting the PT100/ PT1000 temperature sensor; measurable temperature range: -20°C–175°C; error:±5°C
GND	GND terminal	Temperature sensor reference ground
PE	Grounding terminal	Shield ground

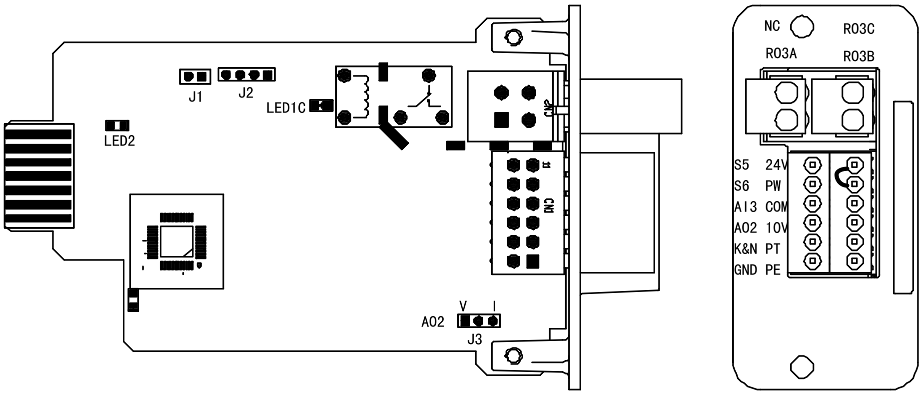
Note:

- The 24V simplified incremental PG card simultaneously supports connecting to one type of temperature sensor, which can be selected through P28.12.
- It is not recommended the connection cable length of the PT100 temperature sensor be longer than 3 m.
- When the temperature detection sensor and the electricity line are routed in parallel, you are recommended to use shield layers to prevent interference.

- For details about the wiring with the encoder interfaces (push-pull, open collector, and differential), see the description for EC-PG705-12.

A.7 IO cards

A.7.1 IO card——EC-IO702



EC-IO702 terminals:

Category	Terminal	Description
Digital IO	PW	• Used to provide input digital working power from the external to the internal • Voltage range: 12–24V • PW and +24V have been short connected before delivery.
	24V	User power supply provided by the VFD. Max. output current: 200mA
	COM	24V reference ground
	S5	• Internal resistance: 3.3kΩ • Acceptable input of 12–30V voltage • Bi-direction input terminal, supporting both NPN and PNP • Max. input frequency: 1kHz
	S6	
Analog IO	10V	Locally provided +10V power supply
	GND	Reference ground of the 10V power supply
	AI3	• Input range: 0(2)–10V/0(4)–20mA • P25.40 specifies whether to use voltage or current input. • Input impedance: 20kΩ for voltage input or 250Ω for current input • Resolution: 5mV when 10V corresponds to 50Hz • Error: ±0.5% when input exceeds 5V or 10mA
	AO2	• Output range: 0(2)–10V/0(4)–20mA • J3 is used to select voltage or input output. • Error: ±0.5% when output exceeds 5V or 10mA at 25°C
Relay Output	RO3A	• RO3 output; RO3A: NO; RO3B: NC; RO3C: common • Contact capacity: 3A/AC250V, 1A/DC30V
	RO3B	
	RO3C	
Temperature detection circuit	K&N	• Supporting KTY84-130/PT100/PT1000/NTC temperature sensors • KTY84-130/NTC are connected through the K&N interface, while PT100/PT1000 are connected through the PT interface. Only one type of temperature sensor can be simulatenously connected, which can be selected through P28.16. • Temperature measuring range: -20°C–175°C • NTC supports the 5K/10K types, and the B value range is 0–6000. • Temperature measuring error: ±5°C
	PT	
	GND	Temperature sensor reference ground

Category	Terminal	Description
Grounding terminal	PE	Grounding terminal
Reserved	NC	Reserved

Note:

- It is not recommended the connection cable length of the PT100 temperature sensor be longer than 3 m.
- When the temperature detection sensor and the electricity line are routed in parallel, you are recommended to use shield layers to prevent interference.
- IO-EC702 is applicable only to the inverter unit currently .

Appendix B Object dictionary

Index (hexadecimal)	Subindex	Description	Access permission	Data type	Default value
1000	0	Device type	RO	Unsigned32	0x0000 0000
1001	0	Error register	RO	Unsigned8	/
1003	**Error code register**				
	0	Number of subindexes	RW	/	/
	1	Error code	RO	Unsigned32	/
1005	0	COB-ID SYNC	RW	Unsigned32	/
1006	0	Communication cycle period	RW	Unsigned32	/
1007	0	Length of synchronous window	RW	Unsigned32	/
1008	0	Manufacturer-defined device name	CONST	String	INVT CANopen
1009	0	Manufacturer-defined hardware version	CONST	String	V1.00
100A	0	Manufacturer-defined software version	CONST	String	V1.00
100C	0	Protection time	RW	Unsigned16	0
100D	0	Life cycle factor	RW	Unsigned16	0
1016	**Consumer heartbeat time**				
	0	Number of subindexes	RO	Unsigned8	/
	1	Consumer heartbeat time	RW	Unsigned32	/
1017	0	Producer heartbeat time	RW	Unsigned16	0
1018	**Identifier objects**				
	0	Number of subindexes	RO	Unsigned8	4
	1	Supplier ID	RO	Unsigned32	0x0000 0000
	2	Product code	RO	Unsigned32	0x0000 0000
	3	Revision No.	RO	Unsigned32	0x0000 0000
	4	Sequence No.	RO	Unsigned32	0x0000 0000
1200	**Server SDO**				
	0	Number of subindexes	RO	Unsigned8	/
	1	COB-ID Client -> server (Rx)	RO	Unsigned32	600H+Node ID
	2	COB-ID Server -> client (Tx)	RO	Unsigned32	580H+Node ID
1280	**Client SDO**				
	0	Number of subindexes	RO	Unsigned8	/

Index (hexadecimal)	Subindex	Description	Access permission	Data type	Default value
	1	COB-ID Client -> server (Rx)	RO	Unsigned32	/
	2	COB-ID Server -> client (Tx)	RO	Unsigned32	/
	3	Node ID of server SDO	RO	Unsigned8	/
1400	**PDO1 Rx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	/
	3	/	/	Unsigned16	/
	4	/	/	Unsigned8	/
	5	Event timer	RW	Unsigned16	/
1401	**PDO2 Rx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	/
	3	/	/	Unsigned16	/
	4	/	/	Unsigned8	/
	5	Event timer	RW	Unsigned16	/
1402	**PDO3 Rx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	/
	3	/	/	Unsigned16	/
	4	/	/	Unsigned8	/
	5	Event timer	RW	Unsigned16	/
1403	**PDO4 Rx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	/
	3	/	/	Unsigned16	/
	4	/	/	Unsigned8	/
	5	Event timer	RW	Unsigned16	/
1600	**PDO1 Rx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	3

Index (hexadecimal)	Subindex	Description	Access permission	Data type	Default value
	1	First mapped object	RW	Unsigned32	0x21000010
	2	Second mapped object	RW	Unsigned32	0x21000110
	3	Third mapped object	RW	Unsigned32	0x21000210
1601	**PDO2 Rx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x21010010
	2	Second mapped object	RW	Unsigned32	0x21000310
	3	Third mapped object	RW	Unsigned32	0x21000410
	4	Fourth mapped object	RW	Unsigned32	0x21000510
1602	**PDO3 Rx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x21000610
	2	Second mapped object	RW	Unsigned32	0x21000710
	3	Third mapped object	RW	Unsigned32	0x21000810
	4	Fourth mapped object	RW	Unsigned32	0x21000910
1603	**PDO4 Rx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x21000a10
	2	Second mapped object	RW	Unsigned32	0x21000b10
	3	Third mapped object	RW	Unsigned32	0x21000c10
	4	Fourth mapped object	RW	Unsigned32	0x21000d10
1800	**PDO1 Tx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	255
	3	Disabled time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	/
	5	Event timer	RW	Unsigned16	0

Index (hexadecimal)	Subindex	Description	Access permission	Data type	Default value
1801	**PDO2 Tx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	254
	3	Disabled time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	/
	5	Event timer	RW	Unsigned16	0
1802	**PDO3 Tx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	254
	3	Disabled time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	/
	5	Event timer	RW	Unsigned16	0
1803	**PDO4 Tx communication parameters**				
	0	Supported Max. number of subindexes	RO	Unsigned8	/
	1	COB-ID used by PDO	RW	Unsigned32	/
	2	Transmission type	RW	Unsigned8	254
	3	Disabled time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	/
	5	Event timer	RW	Unsigned16	0
1A00	**PDO1 Tx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	3
	1	First mapped object	RW	Unsigned32	0x20000010
	2	Second mapped object	RW	Unsigned32	0x20000110
	3	Third mapped object	RW	Unsigned32	0x20000210
1A01	**PDO2 Tx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x20010010
	2	Second mapped object	RW	Unsigned32	0x20000310
	3	Third mapped object	RW	Unsigned32	0x20000410
	4	Fourth mapped object	RW	Unsigned32	0x20000510

Index (hexadecimal)	Subindex	Description	Access permission	Data type	Default value
1A02	**PDO3 Tx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x20000610
	2	Second mapped object	RW	Unsigned32	0x20000710
	3	Third mapped object	RW	Unsigned32	0x20000810
	4	Fourth mapped object	RW	Unsigned32	0x20000910
1A03	**PDO4 Tx mapping parameters**				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapped object	RW	Unsigned32	0x20000a10
	2	Second mapped object	RW	Unsigned32	0x20000b10
	3	Third mapped object	RW	Unsigned32	0x20000c10
	4	Fourth mapped object	RW	Unsigned32	0x20000d10

Appendix C Technical data

C.1 What this chapter contains

This chapter describes the technical data of the VFD and its compliance to CE and other quality certification systems.

C.2 Derated application

C.2.1 Capacity

Choose a VFD model based on the rated current and power of the motor. To endure the rated power of the motor, the rated output current of the VFD must be larger or equal to the rated current of the motor. The rated power of the VFD must be higher or equal to that of the motor.

Note:

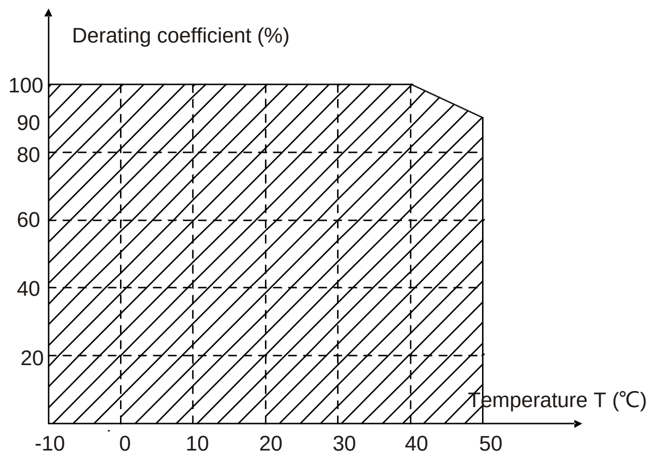
- The maximum allowable shaft power of the motor is limited to 1.5 times the rated power of the motor. If the limit is exceeded, the VFD automatically restricts the torque and current of the motor. This function effectively protects the input shaft against overload.
- The rated capacity is the capacity at the ambient temperature of 40°C.
- You need to check and ensure that the power flowing through the common DC connection in the common DC system does not exceed the rated power of the motor.

C.2.2 Derating

If the ambient temperatue on the site where the inverter is installed exceeds 40°C, the altitude exceeds 1000 m, or the switching frequency is changed from 4 kHz to 8, 12, or 15 kHz, the VFD needs to be derated.

C.2.2.1 Derating due to temperature

When the temperature ranges from +40°C to +50°C, the rated output current is derated by 1% for each increased 1°C. For the actual derating, see the following figure.



Note: It is not recommended to use the VFD at an environment with the temperature higher than 50°C. If you do, you shall be held accountable for the consequences caused.

C.2.2.2 Derating due to altitude

When the altitude of the site where the VFD is installed is lower than 1000 m, the VFD can run at the rated power. When the altitude exceeds 1000m, derate 1% for every additional 100m. When the installation site altitude exceeds 3000m, consult the local INVT dealer or office.

C.2.2.3 Derating due to carrier frequency

The VFD models in different power classes are different in carrier frequency. The VFD rated power is defined based on the carrier frequency set in factory. If the carrier frequency exceeds the factory setting, the power of the VFD is derated by 10% for each increased 1 kHz.

C.3 Grid specifications

Grid voltage	AC 3PH 380V (-15%)–440V (+10%)
Short-circuit capacity	According to the definition in IEC 61439-1, the maximum allowable short-circuit current at the incoming end is 100 kA. Therefore, the VFD is applicable to scenarios where the transmitted current in the circuit is no larger than 100 kA when the VFD runs at the maximum rated voltage.
Frequency	50/60 Hz±5%, with a maximum change rate of 20%/s

C.4 Motor connection data

Motor type	Asynchronous induction motor or permanent-magnet synchronous motor
Voltage	0–U1 (motor rated voltage), 3PH symmetrical, Umax (VFD rated voltage) at the field-weakening point
Short-circuit protection	The motor output short-circuit protection meets the requirements of IEC 61800-5-1.
Frequency	0–400 Hz
Frequency resolution	0.01 Hz
Current	See section 3.6 Product ratings.
Power limit	1.5 times of the rated power of the motor
Field-weakening point	10–400 Hz
Carrier frequency	4, 8, 12, or 15 kHz

C.4.1 EMC compatibility and motor cable length

The following table describes the maximum motor cable lengths that meet the requirements of the EU EMC directive (2014/30/EU).

All models (with external EMC filters)	Maximum motor cable length (m)
Environment category II (C3)	30

You can learn the maximum length of the motor cable through the running parameters of the VFD. To understand the accurate maximum cable length for using an external EMC filter, contact the local INVT office.

For details about the environment categories, see section C.6 EMC regulations.

C.5 Application standards

The following table describes the standards that VFDs comply with.

EN/ISO 13849-1	Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design
IEC/EN 60204-1	Safety of machinery—Electrical equipment of machines. Part 1: General requirements
IEC/EN 62061	Safety of machinery—Safety-related functional safety of electrical, electronic, and programmable electronic control systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems—Part 3:EMC requirements and specific test methods
IEC/EN 61800-5-1	Adjustable speed electrical power drive systems—Part 5-1: Safety requirements—Electrical, thermal and energy
IEC/EN 61800-5-2	Adjustable speed electrical power drive systems—Part 5-2: Safety requirements—Function

C.5.1 CE marking

The CE marking on the VFD nameplate indicates that the VFD is CE-compliant, meeting the regulations of the European low-voltage directive (2014/35/EU) and EMC directive (2014/30/EU).

C.5.2 EMC compliance declaration

European union (EU) stipulates that the electric and electrical devices sold in Europe cannot generate electromagnetic disturbance that exceeds the limits stipulated in related standards, and can work properly in environments with certain electromagnetic interference. The EMC product standard (EN 61800-3) describes the EMC standards and specific test methods for adjustable speed electrical power drive systems. Our products have been compliant with these EMC regulations.

C.6 EMC regulations

The EMC product standard (EN 61800-3) describes the EMC requirements on VFDs.

Application environment categories:

First environment: Civilian environments, including application scenarios where VFDs are directly connected to the civil power supply low-voltage grids without intermediate transformers

Second environment: All environments except those in Category I.

VFD categories:

C1: Rated voltage lower than 1000 V, applied to environments of Category I.

C2: Rated voltage lower than 1000 V, non-plug, socket, or mobile devices; power drive systems that must be installed and operated by specialized personnel when applied to environments of Category I

Note: The EMC standard IEC/EN 61800-3 no longer restricts the power distribution of VFDs, but it specifies their use, installation, and commissioning. Specialized personnel or organizations must have the necessary skills (including the EMC-related knowledge) for installing and/or performing commissioning on the electrical drive systems.

C3: Rated voltage lower than 1000 V, applied to environments of Category II. They cannot be applied to environments of Category I.

C4: Rated voltage higher than 1000 V, or rated current higher or equal to 400 A, applied to complex systems in environments of Category II.

C.6.1 VFD category C2

The induction disturbance limit meets the following stipulations:

1. Select an optional EMC filter according to Appendix E Optional peripheral accessories and install it following the description in the EMC filter manual.
2. Select the motor and control cables according to the description in the manual.
3. Install the VFD according to the description in the manual.
4. For the maximum length of the motor cable, see section EMC compatibility and motor cable length.

	Currently in environments in China, the VFD may generate radio interference, you need to take measures to reduce the interference.

C.6.2 VFD category C3

The anti-interference performance of the VFD meets the requirements of the second environment in the IEC/EN 61800-3 standard.

The induction disturbance limit meets the following stipulations:

1. Select an optional EMC filter according to Appendix E Optional peripheral accessories and install it following the description in the EMC filter manual.
2. Select the motor and control cables according to the description in the manual.
3. Install the VFD according to the description in the manual.
4. For the maximum length of the motor cable, see section EMC compatibility and motor cable length.

	VFDs of category C3 cannot be applied to civilian low-voltage common grids. When applied to such grids, the VFDs may generate radio frequency electromagnetic interference.

Appendix D Dimension drawings

D.1 What this chapter contains

This chapter provides the VFD dimension drawings, which uses millimeter (mm) as the unit.

D.2 VFD structure

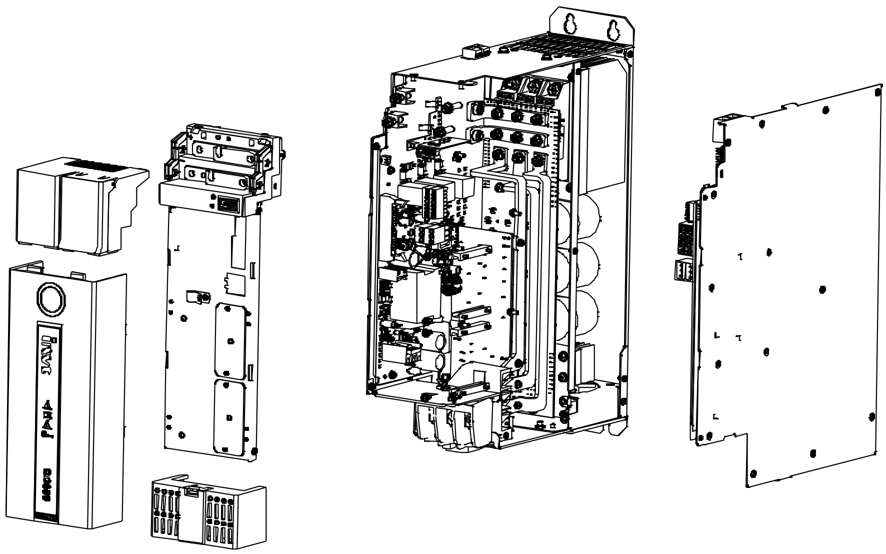


Figure D-1 Structure diagram of the 45kW rectifier unit

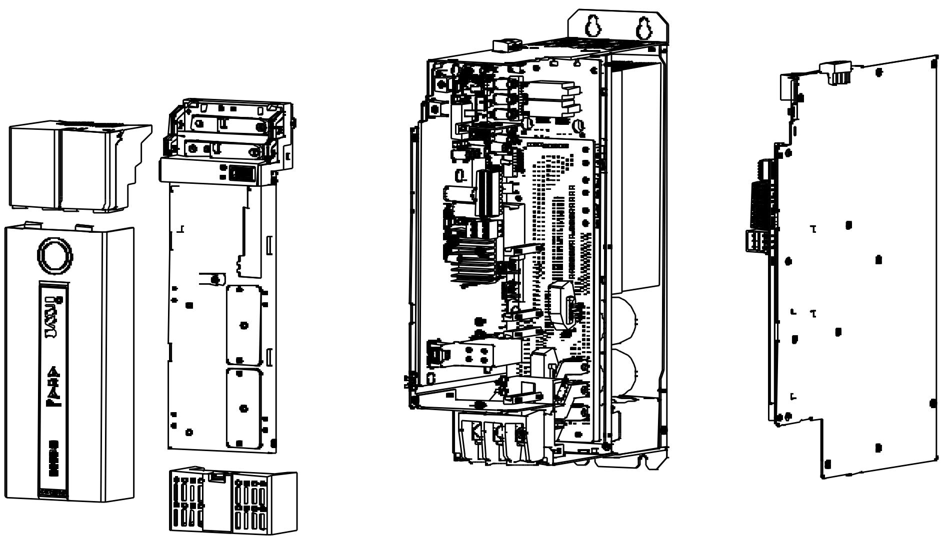


Figure D-2 Structure diagram of the 37kW inverter unit

D.3 Installation dimensions

D.3.1 Wall mounting dimensions (for rectifier unit)

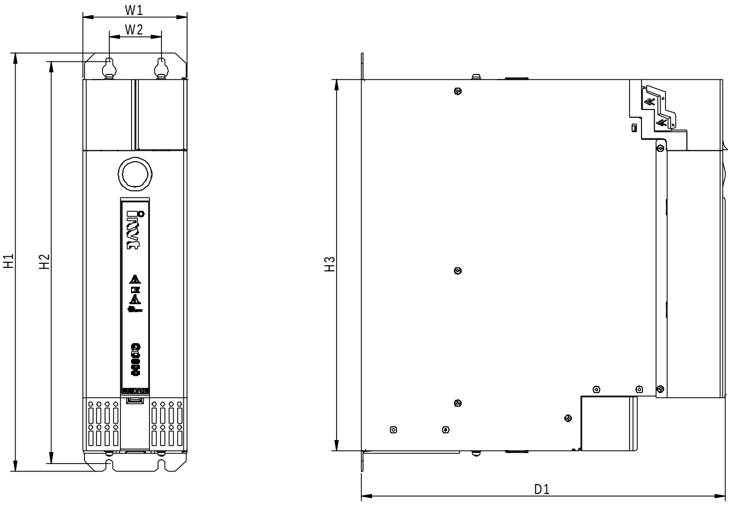


Figure D-3 Wall-mounting drawing for the 380V 45kW rectifier unit

Table D-1 Wall-mounting dimensions for the 380V 45kW rectifier unit

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-71-045-4-B	400	355	100	350	384	50	-	Ø7	9

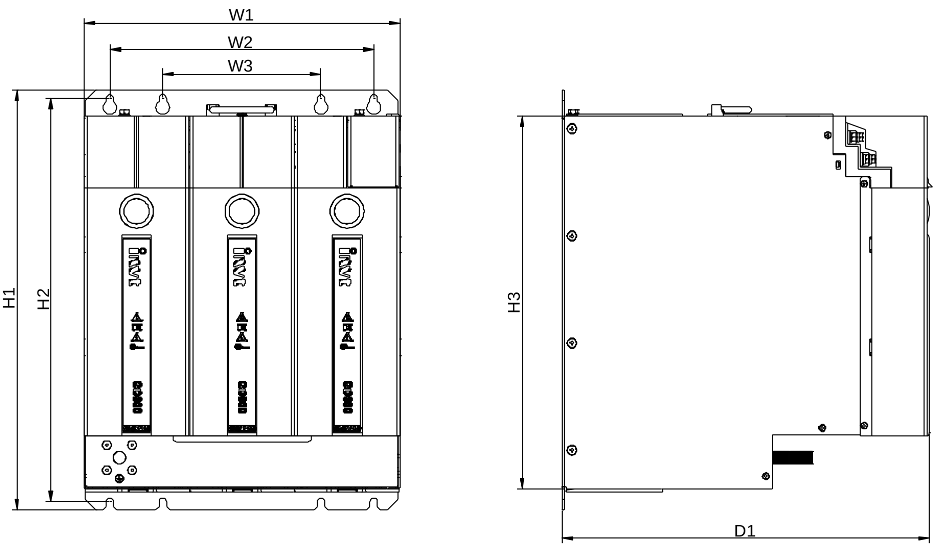


Figure D-4 Wall-mounting drawing for the 380V 160kW rectifier unit

Table D-2 Wall-mounting dimensions for the 380V 160kW rectifier unit

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-71-160-4	400	355	300	350	384	250	150	Ø7	28

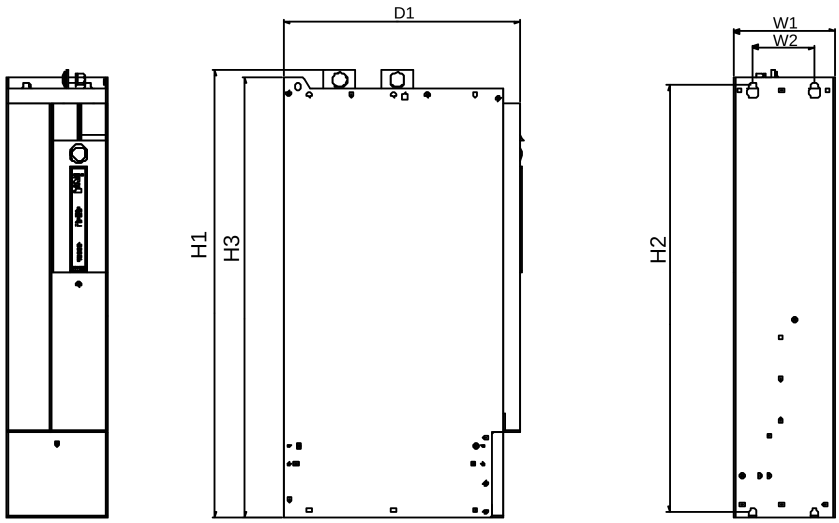


Figure D-5 Wall-mounting drawing for the 380V 355kW rectifier unit

Table D-3 Wall-mounting dimensions for the 380V 355kW rectifier unit

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-71-355-4	805	790	180	423	767.5	110	-	Ø11	42.6

D.3.2 Wall mounting dimensions (for inverter unit)

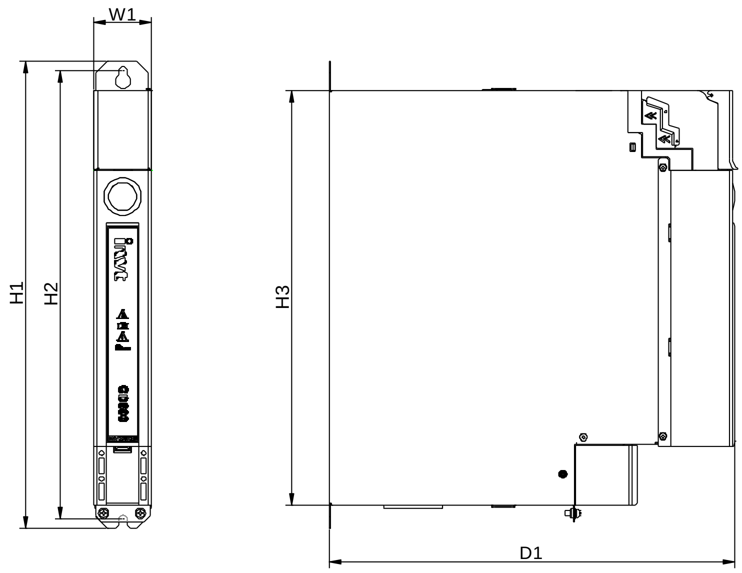


Figure D-6 Wall-mounting drawing for the 380V 1.5–7.5kW inverter units

Table D-4 Wall-mounting dimensions for the 380V 1.5–7.5kW inverter units

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-51-1R5-4	400	355	50	350	384	-	-	Ø7	4
GD600-51-2R2-4	400	355	50	350	384	-	-	Ø7	4
GD600-51-004-4	400	355	50	350	384	-	-	Ø7	4
GD600-51-5R5-4	400	355	50	350	384	-	-	Ø7	4
GD600-51-7R5-4	400	355	50	350	384	-	-	Ø7	4

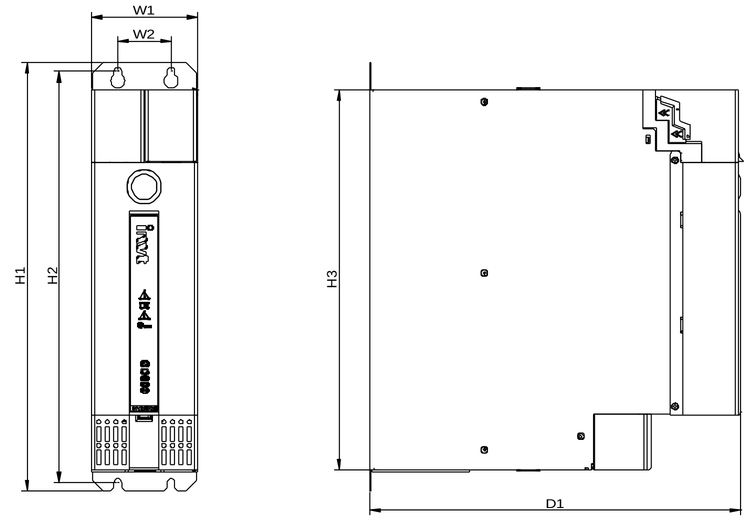


Figure D-7 Wall-mounting drawing for the 380V 11–37kW inverter units

Table D-5 Wall-mounting dimensions for the 380V 11–37kW inverter units

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-51-011-4	400	355	100	350	384	50	-	Ø7	9
GD600-51-015-4	400	355	100	350	384	50	-	Ø7	9
GD600-51-018-4	400	355	100	350	384	50	-	Ø7	9
GD600-51-022-4	400	355	100	350	384	50	-	Ø7	9
GD600-51-030-4	400	355	100	350	384	50	-	Ø7	9
GD600-51-037-4	400	355	100	350	384	50	-	Ø7	9

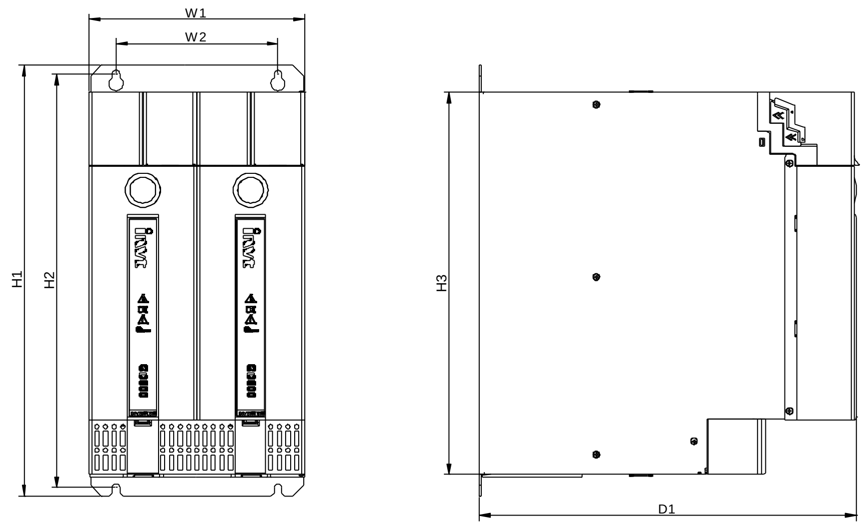


Figure D-8 Wall-mounting drawing for the 380V 45–75kW inverter units

Table D-6 Wall-mounting dimensions for the 380V 45–75kW inverter units

Model	Dimensions (mm)							Installation hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
GD600-51-045-4	400	355	200	350	384	150	-	Ø7	18
GD600-51-055-4	400	355	200	350	384	150	-	Ø7	18
GD600-51-075-4	400	355	200	350	384	150	-	Ø7	18

D.3.3 Flange installation dimensions (rectifier and inverter units in parallel)

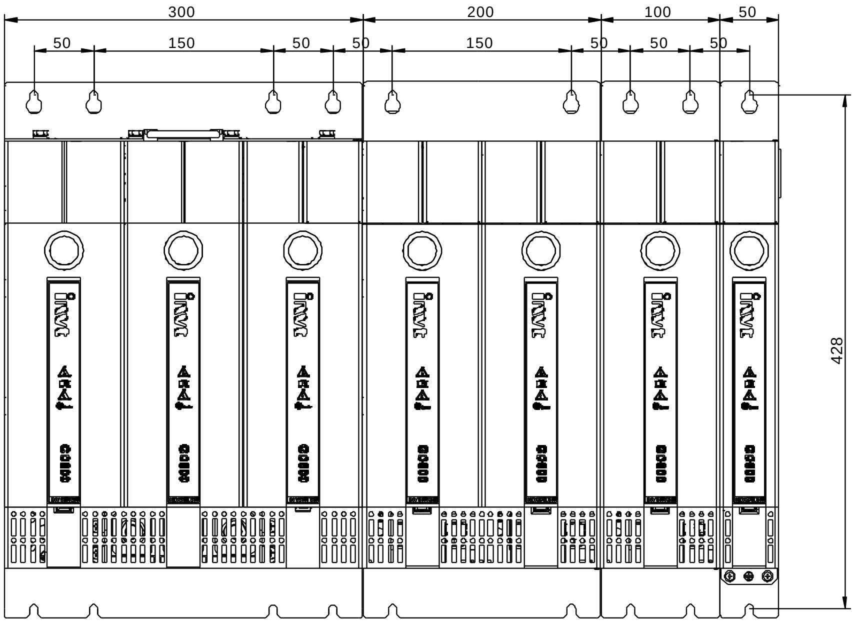


Figure D-9 Flange installation drawing for the 380V rectifier and inverter units

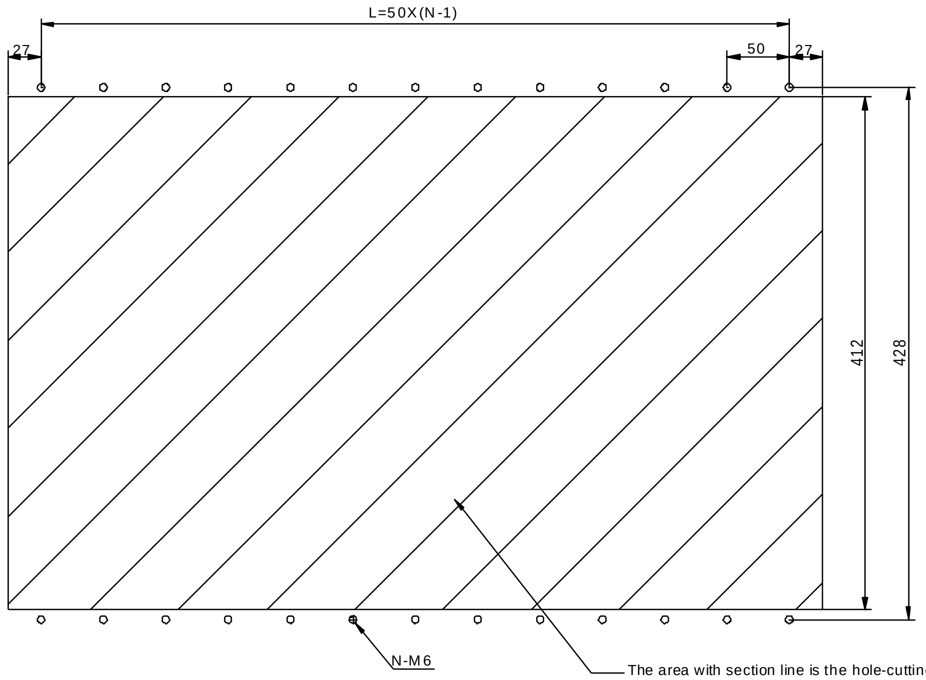


Figure D-10 Cut-out drawing in the flange installation for the 380V rectifier and inverter units

Appendix E Optional peripheral accessories

E.1 What this chapter contains

This chapter describes how to select optional accessories of the VFD.

E.2 External wiring

The following figure shows the external wiring of the VFD.

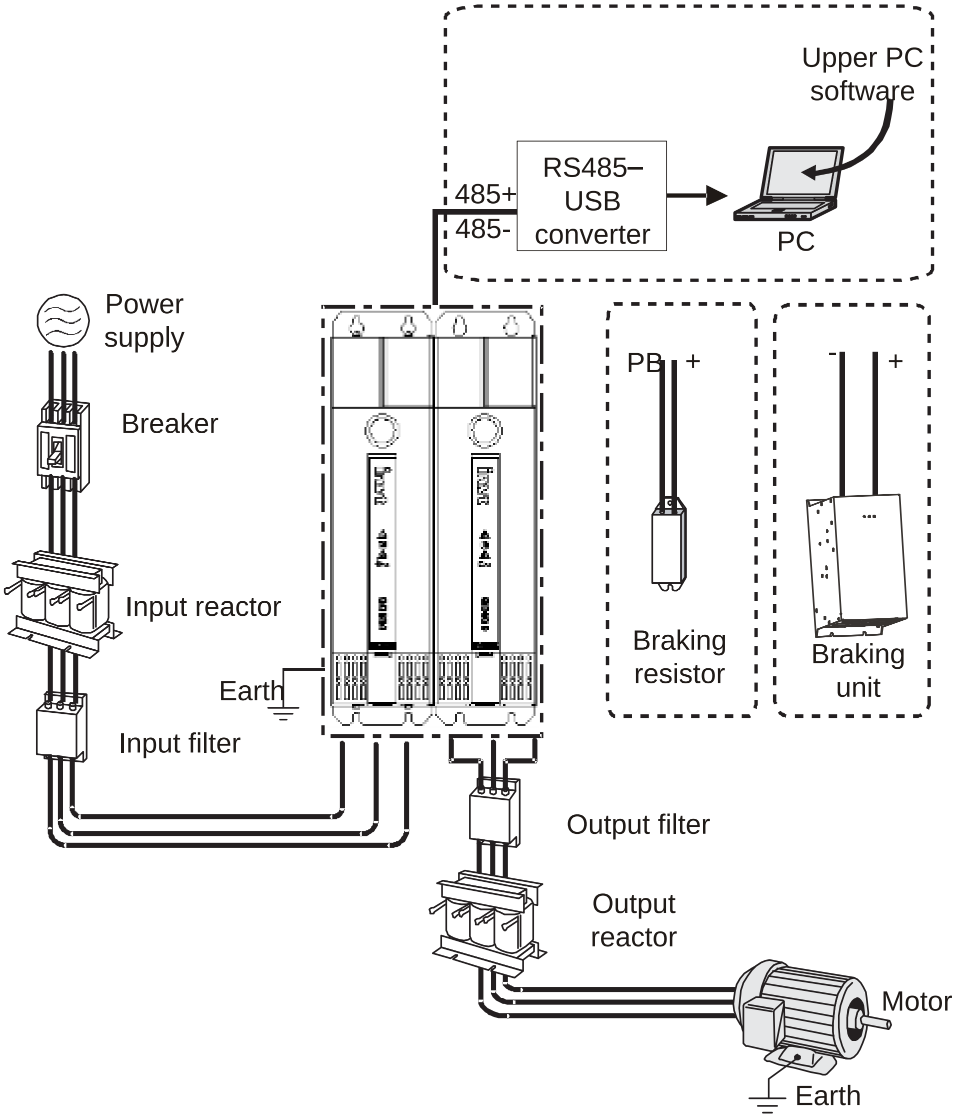
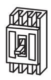
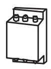
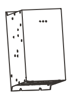
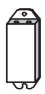
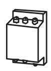


Figure E-1 External wiring of the VFD

Note:

- The built-in braking unit is a standard configuration part for the 45kW rectifier unit.
- The braking units adopt INVT's DBU series standard braking units. For details, see the DBU operation manual.

Image	Name	Description
	Cable	Accessory for signal transmission.
	Breaker	Device for electric shock prevention and protection against short-to-ground that may cause current leakage and fire. Select residual-current circuit breakers (RCCBs) that are applicable to VFDs and can restrict high-order harmonics, and of which the rated sensitive current for one VFD is larger than 30 mA.
	Input reactor	Accessories used to improve the power factor on the input side of the VFD, and thus restrict high-order harmonic currents.
	Input filter	Accessory that restricts the electromagnetic interference generated by the VFD and transmitted to the public grid through the power cable. Try to install the input filter near the input terminal side of the VFD.
 or 	Braking unit or braking resistor	Accessories used to consume the regenerative energy of the motor to reduce the DEC time. Rectifier units of 45 kW need only to be configured with braking resistors, other rectifier units also need to be configured with braking units.
	Output filter	Accessory used to restrict interference generated in the wiring area on the output side of the VFD. Try to install the output filter near the output terminal side of the VFD.
	Output reactor	Accessory used to lengthen the valid transmission distance of the inverter, which effectively restrict the transient high voltage generated during the switch-on and switch-off of the IGBT module of the inverter.

E.3 Power supply

Refer to the installation guidelines.

	Ensure that the voltage class of the VFD is consistent with that of the grid.

E.4 Cable

E.4.1 Power cable

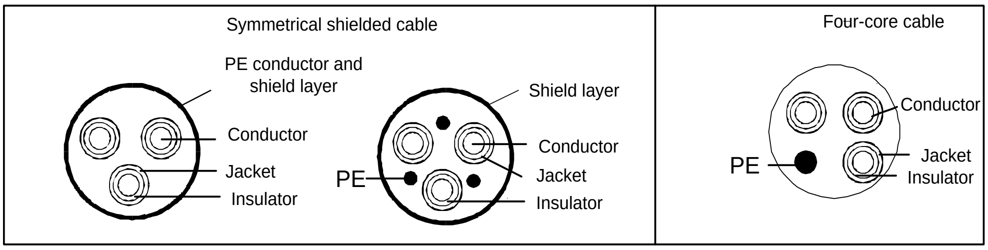
The sizes of the input power cables and motor cables must meet the local regulation.

- The input power cables and motor cables must be able to carry the corresponding load currents.
- The maximum temperature margin of the motor cables in continuous operation cannot be lower than 70°C.

- The conductivity of the PE grounding conductor is the same as that of the phase conductor, that is, the cross-sectional areas are the same.
- For details about the EMC requirements, see Appendix C Technical data.

To meet the EMC requirements stipulated in the CE standards, you must use symmetrical shielded cables as motor cables (as shown in the following figure).

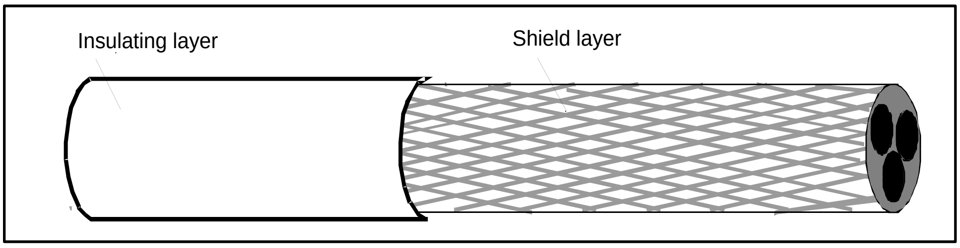
Four-core cables can be used as input cables, but symmetrical shielded cables are recommended. Compared with four-core cables, symmetrical shielded cables can reduce electromagnetic radiation as well as the current and loss of the motor cables.



Note: If the conductivity of the shield layer of the motor cables cannot meet the requirements, separate PE conductors must be used.

To protect the conductors, the cross-sectional area of the shielded cables must be the same as that of the phase conductors if the cable and conductor are made of materials of the same type. This reduces grounding resistance, and thus improves impedance continuity.

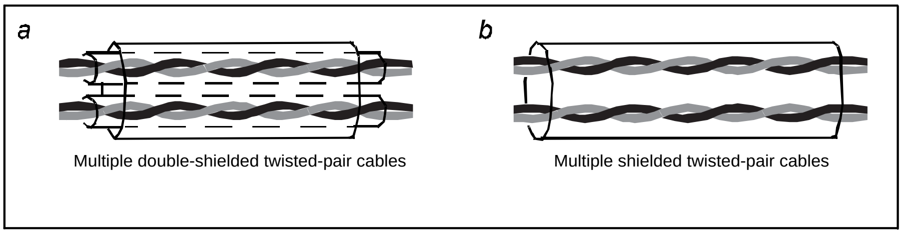
To effectively restrict the emission and conduction of radio frequency (RF) interference, the conductivity of the shielded cable must at least be 1/10 of the conductivity of the phase conductor. This requirement can be well met by a copper or aluminum shield layer. The following figure shows the minimum requirement on motor cables of a VFD. The cable must consist of a layer of spiral-shaped copper strips. The denser the shield layer is, the more effectively the electromagnetic interference is restricted.



Cross-section of the cable

E.4.2 Control cable

All analog control cables and cables used for frequency input must be shielded cables. Analog signal cables need to be double-shielded twisted-pair cables (as shown in figure a). Use one separate shielded twisted pair for each signal. Do not use the same ground wire for different analog signals.



Power cable arrangement

For low-voltage digital signals, double-shielded cables are recommended, but shielded or unshielded twisted pairs (as shown in figure b) also can be used. For frequency signals, however, only shielded cables can be used.

Relay cables need to be those with metal braided shield layers.

Keypads need to be connected by using network cables. In complicated electromagnetic environments, shielded network cables are recommended.

Note: Analog signals and digital signals cannot use the same cables, and their cables must be arranged separately.

Do not perform any voltage endurance or insulation resistance tests, such as high-voltage insulation tests or using a megameter to measure the insulation resistance, on the VFD or its components. Insulation and voltage endurance tests have been performed between the main circuit and chassis of each VFD before delivery. In addition, voltage limiting circuits that can automatically cut off the test voltage are configured inside the VFDs.

Note: Check the insulation conditions of the input power cable of a VFD according to the local regulations before connecting it.

Rectifier unit model	Recommended cable size (mm^2)		Connectable cable size (mm^2)			Terminal screw	Fastening torque (Nm)
	RST	PE	RST	PB, (+)	PE		
GD600-71-045-4-B	35	16	35-70	35-70	16-35	M6	2.5
GD600-71-160-4	240	120	95-300	95-300	120-240	Nuts are used for terminals. You are recommended to use a wrench or sleeve.	
GD600-71-355-4	95*4P	95*4P	95*4P -150*4P	95*4P -150*4P	95*2P -150*2P		

Inverter unit model	Recommended cable size (mm^2)		Connectable cable size (mm^2)		Terminal screw	Fastening torque (Nm)
	UVW	PE	UVW	PE		
GD600-51-1R5-4	2.5	2.5	2.5-6	2.5-6	M5	2.3
GD600-51-2R2-4	2.5	2.5	2.5-6	2.5-6	M5	2.3
GD600-51-004-4	2.5	2.5	2.5-6	2.5-6	M5	2.3
GD600-51-5R5-4	2.5	2.5	2.5-6	2.5-6	M5	2.3
GD600-51-7R5-4	4	4	2.5-6	2.5-6	M5	2.3
GD600-51-011-4	6	6	4-10	4-10	M6	2.5
GD600-51-015-4	6	6	4-10	4-10	M6	2.5
GD600-51-018-4	10	10	10-16	10-16	M6	2.5
GD600-51-022-4	16	16	10-16	10-16	M6	2.5
GD600-51-030-4	25	16	25-50	16-25	M6	2.5
GD600-51-037-4	25	16	25-50	16-25	M6	2.5
GD600-51-045-4	35	16	35-70	16-35	M8	10
GD600-51-055-4	50	25	35-70	16-35	M8	10
GD600-51-075-4	70	35	35-70	16-35	M8	10

Note: Cables of the sizes recommended for the main circuit can be used in scenarios where the ambient temperature is lower than 40°C, the wiring distance is shorter than 100 m, and the current is the rated current.

E.4.3 Cable arrangement

Motor cables must be arranged away from other cables. The motor cables of several inverters can be arranged in parallel. It is recommended that you arrange the motor cables, input power cables, and control cables separately in different trays. The output dU/dt of the inverters may increase electromagnetic interference on other cables. Do not arrange other cables and the motor cables in parallel.

If a control cable and power cable must cross each other, ensure that the angle between them is 90 degrees.

The cable trays must be connected properly and well grounded. Aluminum trays can implement local equipotential.

The following figure shows the cable arrangement.

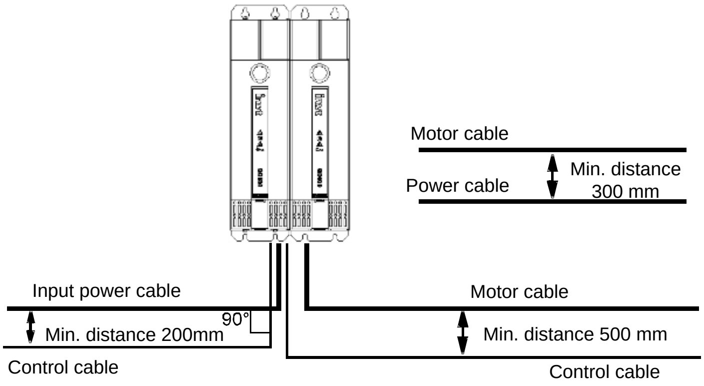


Figure E-2 Cable routing distance

E.4.4 Insulation inspection

Check the motor and the insulation conditions of the motor cable before running the motor.

1. Ensure that the motor cable is connected to the motor, and then remove the motor cable from the U, V, and W output terminals of the VFD.

2. Use a megohmmeter of 500V DC to measure the insulation resistance between each phase conductor and the protection grounding conductor. For details about the insulation resistance of the motor, see the description provided by the manufacturer.

Note: The insulation resistance is reduced if it is damp inside the motor. If it may be damp, you need to dry the motor and then measure the insulation resistance again.

E.5 Breaker and electromagnetic contactor

You need to add a fuse to prevent overload.

You need to configure a manually manipulated molded case circuit breaker (MCCB) between the AC power supply and VFD. The breaker must be locked in the open state to facilitate installation and inspection. The capacity of the breaker needs to be 1.5 to 2 times the VFD rated input current.

	According to the working principle and structure of breakers, if the manufacturer's regulation is not followed, hot ionized gases may escape from the breaker enclosure when a short-circuit occurs. To ensure safe use, exercise extra caution when installing and placing the breaker. Follow the manufacturer's instructions.

To ensure safety, you can configure an electromagnetic contactor on the input side to control the switch-on and switch-off of the main circuit power, so that the input power supply of the VFD can be effectively cut off when a system fault occurs.

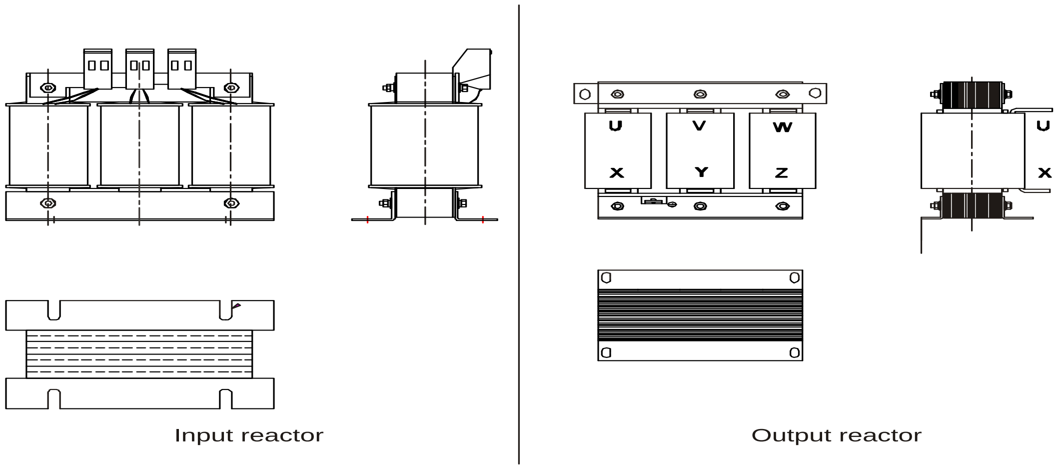
Rectifier unit model	Fuse (A)	Braker (A)	Contactor rated current (A)
GD600-71-045-4-B	270	200	135
GD600-71-160-4	870	630	450
GD600-71-355-4	1860	1280	960

Note: The accessory specifications described in the preceding table are ideal values. You can select accessories based on the actual market conditions, but try not to use those with lower values.

E.6 Reactor

When the voltage of the grid is high, the transient large current that flows into the input power circuit may damage rectifier components. You need to configure an AC reactor on the input side, which can also improve the current adjustment coefficient on the input side.

When the distance between the VFD and motor is longer than 50 m, the parasitic capacitance between the long cable and ground may cause large leakage current, and overcurrent protection of the VFD may be frequently triggered. To prevent this from happening and avoid damage to the motor insulator, compensation must be made by adding an output reactor. When a VFD is used to drive multiple motors, take the total length of the motor cables (that is, sum of the lengths of the motor cables) into account. When the total length is longer than 50 m, an output reactor must be added on the output side of the VFD. If the distance between the VFD and motor is 50 m to 100 m, select the reactor according to the following table. If the distance is longer than 100 m, contact INVT's technical support technicians.



Rectifier unit model	Input reactor
GD600-71-045-4-B	ACL2-045-4
GD600-71-160-4	ACL2-160-4
GD600-71-355-4	ACL2-350-4

Inverter unit model	Output reactor
GD600-51-1R5-4	OCL2-1R5-4
GD600-51-2R2-4	OCL2-2R2-4
GD600-51-004-4	OCL2-004-4
GD600-51-5R5-4	OCL2-5R5-4
GD600-51-7R5-4	OCL2-7R5-4
GD600-51-011-4	OCL2-011-4

Inverter unit model	Output reactor
GD600-51-015-4	OCL2-015-4
GD600-51-018-4	OCL2-018-4
GD600-51-022-4	OCL2-022-4
GD600-51-030-4	OCL2-037-4
GD600-51-037-4	OCL2-037-4
GD600-51-045-4	OCL2-045-4
GD600-51-055-4	OCL2-055-4
GD600-51-075-4	OCL2-075-4

Note:

- The rated input voltage drop of input reactors is 2%±15%.
- The rated output voltage drop of output reactors is 1%±15%.
- The preceding table describes external accessories. You need to specify the ones you choose when purchasing accessories.

E.7 Filter

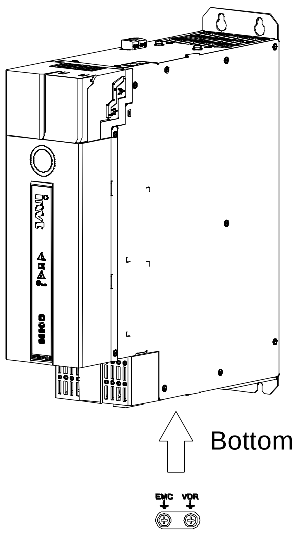
EMC screws are connected in factory for the rectifier unit products, all of which meet the requirements of level C3.

Note:

Disconnect EMC screw in the following situations:

1. The EMC filter is applicable to the neutral-grounded grid system. If it is used for the IT grid system (that is, non-neutral grounded grid system), disconnect EMC screws (M3: tightening torque 5–6 kgf.cm).

2. If leakage protection occurs during configuration of a residual-current circuit breaker, disconnect EMC screws (M3: tightening torque 5–6 kgf.cm).



Note: Do not connect C3 filters in IT power systems.

Interference filters on the input side can reduce the VFD interference on the surrounding devices.

Noise filters on the output side can decrease the radio noise caused by the cables between VFDs and motors and the leakage current of conducting wires.

INVT provides some of the filters for you to choose.

E.7.1 Filter model description

FLT – P 04 045 L – B

① ② ③ ④ ⑤ ⑥

Field	Description
①	FLT: VFD filter series
②	Filter type P: Power input filter L: Output filter
③	Voltage class 04: AC 3PH 380V (-15%)–440V (+10%) 06: AC 3PH 520V (-15%)–690V (+10%)
④	3-digit code indicating the rated current. For example, 015 indicates 15 A.
⑤	Filter performance L: General H: High-performance
⑥	Filter application environment A: First environment (IEC61800-3), category C1 (EN 61800-3) B: First environment (IEC61800-3), category C2 (EN 61800-3) C: Second environment (IEC61800-3), category C3 (EN 61800-3)

E.7.2 Filter model selection

Rectifier unit model	Input filter
GD600-71-045-4-B	FLT-P04100L-B
GD600-71-160-4	FLT-P04400L-B
GD600-71-355-4	FLT-P04800L-B

Inverter unit model	Output reactor
GD600-51-1R5-4	FLT-L04006L-B
GD600-51-2R2-4	
GD600-51-004-4	FLT-L04016L-B
GD600-51-5R5-4	
GD600-51-7R5-4	FLT-L04032L-B
GD600-51-011-4	
GD600-51-015-4	FLT-L04045L-B
GD600-51-018-4	
GD600-51-022-4	FLT-L04065L-B
GD600-51-030-4	
GD600-51-037-4	FLT-L04100L-B
GD600-51-045-4	
GD600-51-055-4	FLT-L04150L-B
GD600-51-075-4	

Note:

- The input EMI meets the C2 requirements after an input filter is configured.
- The accessories in the preceding tables are external. You need to specify the ones you choose when purchasing accessories.

E.8 Braking system

E.8.1 Braking component selection

When the VFD driving a high-inertia load decelerates or needs to decelerate abruptly, the motor runs in the power generation state and transmits the load-carrying energy to the DC circuit of the VFD, causing the bus voltage of the VFD to rise. If the bus voltage exceeds a specific value, the VFD reports an overvoltage fault. To prevent this from happening, you need to configure braking components.

- The design, installation, commissioning, and operation of the device must be performed by trained and qualified professionals.
- Follow all the "Warning" instructions during the operation. Otherwise, major physical injuries or property loss may be caused.
- Only qualified electricians are allowed to perform the wiring. Otherwise, damage to the VFD or braking components may be caused.
- Read the braking resistor or unit instructions carefully before connecting them to the VFD.
- Connect braking resistors only to the terminals PB and (+), and braking units only to the terminals (+) and (-). Do not connect them to other terminals. Otherwise, damage to the braking circuit and VFD and fire may be caused.

Connect the braking components to the VFD according to the wiring diagram. If the wiring is not properly performed, damage to the VFD or other devices may be caused.

E.8.2 Braking unit

The 45kW rectifier unit model is equipped with the built-in braking unit, and other rectifier unit models can be configured only with external braking units. Select braking resistors according to the specific requirements (such as the braking torque and braking usage) on site.

VFD model	Braking unit model	Resistance applicable for 100% braking torque (Ω)	Braking resistor dissipation power (kW)			Min. allowed braking resistance (Ω)
			10% braking usage	50% braking usage	80% braking usage	
GD600-71-045-4-B	Built-in braking unit	10	7	34	54	6.4
GD600-71-160-4	DBU100H-320-4	3.1	24	120	192	2.2
GD600-71-355-4	DBU100H-320-4×2	3.2*2	24*2	118*2	189*2	2.2*2

Note:

- Select braking resistors according to the resistance and power data provided by our company.
- The braking resistor may increase the braking torque of the VFD. The preceding table describes the resistance and power for 100% braking torque, 10% braking usage, 50% braking usage, and 80% braking usage. You can select the braking system based on the actual operation conditions.
- When using an external braking unit, set the brake voltage class of the braking unit properly by referring to the manual of the dynamic braking unit. If the voltage class is set incorrectly, the VFD may not run properly.

Do not use braking resistors whose resistance is lower than the specified minimum resistance. The VFD does not provide protection against overcurrent caused by resistors with low resistance.

	In scenarios where braking is frequently implemented, that is, the braking usage is greater than 10%, you need to select a braking resistor with higher power as required by the operation conditions according to the preceding table.

E.8.3 Braking resistor cable selection

Braking resistor cables should be shielded cables.

E.8.4 Braking component installation

All resistors need to be installed in places with good cooling conditions.

	The materials near the braking resistor or braking unit must be non-flammable since the surface temperature of the resistor is high and air flowing from the resistor is of hundreds of degrees Celsius. Prevent any materials from coming into contact with the resistor.

Braking resistor installation

	• The 45kW rectifier unit model needs to be configured only with external braking resistors. • PB and (+) are the terminals for connecting braking resistors.

Braking unit installation

	• All rectifier unit models except the 45kW model need to be configured with external braking units. • (+) and (-)are the terminals for connecting braking units. • The connection cable length between the (+) and (-) terminals of the VFD and those of a braking unit must be shorter than 5 m, and the connection cable length between the BR1 and BR2 terminals of a braking unit and the terminals of a braking resistor must be shorter than 10 m.

E.9 Other optional accessories

E.9.1 List of other optional accessories

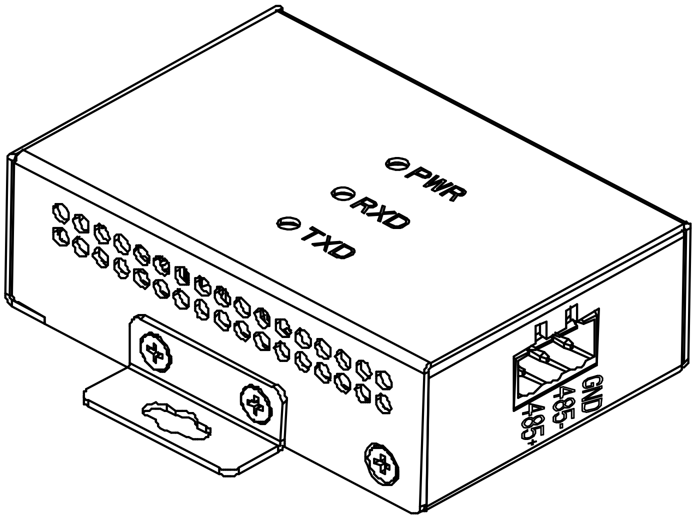
No.	Name	Specifications	Applicable model
1	External DC connection terminal	DSTB100-YW	Current-carrying capability: 100A; applicable to 1.5–7.5kW inverter unit models
2		BSTB200-YW	Current-carrying capability: 200A; applicable to 45/160kW rectifier unit models and 11–75kW inverter unit models
3	External LCD keypad	SOP-600	Applicable to all rectifier and inverter unit models
4	USB-RS485 communication module	EC-TM485-USB	Used to connect the rectifier unit to the upper computer
5	Shield bracket	GD600-SH1	50mm-wide shield bracket, applicable to 1.5–7.5kW inverter unit models
6		GD600-SH2	100mm-wide shield bracket, applicable to 11–37kW inverter unit models

No.	Name	Specifications	Applicable model
7	Flange-type installation bracket	GD600-FLAN1	50mm-wide shield bracket, applicable to 1.5-7.5kW inverter unit models
8		GD600-FLAN2	100mm-wide shield bracket, applicable to 11–37kW inverter unit models and 45kW rectifier unit model
9		GD600-FLAN3	200mm-wide shield bracket, applicable to 45–75kW inverter unit models
10		GD600-FLAN4	300mm-wide shield bracket, applicable to 160kW rectifier unit model
11	Air deflector	GD600-AD1	50mm-wide air deflector, applicable to 1.5–7.5kW inverter unit models
12		GD600-AD2	100mm-wide air deflector, applicable to 11–37kW inverter unit models and 45kW rectifier unit model
13		GD600-AD3	200mm-wide air deflector, applicable to 45–75kW inverter unit models
14		GD600-AD4	300mm-wide air deflector, applicable to the 160kW rectifier unit model
15	Buffer unit	BUB600-7R5-4	50mm buffer unit for the 1.5-7.5kW inverter units
16		BUB600-037-4	100mm buffer unit for the 11-37kW inverter units
17		BUB600-075-4	200mm buffer unit for the 45-75kW inverter units

E.9.2 LCD keypad

The LCD keypad (model: SOP-600) is the commissioning assistant for the VFD. The keypad allows you to perform flexible interactive operations through the friendly and simple visual interface. It features efficient data processing, real-time monitoring and alarming, fast editing and debugging, customized configuration, large-capacity data storage, and user-friendly U-disk software (keyboard software) update function. For details, see the multifunction LCD keypad manual.

E.9.3 USB-RS485 communication module



The USB-RS485 communication module (model: EC-TM485-USB) is used to connect the Workshop on the upper computer to the A interface (RJ45) of the VFD. This module has been configured with the RS485 and type-B interfaces and with adapter cables (for type B-USB and RJ45-RS485).

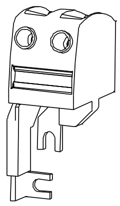
E.9.4 Bus terminals

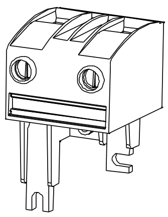
The 100A bus terminal is applicable to the 1.5–7.5kW inverter units (50mm wide), with one terminal for one unit.

The 200A bus terminal is applicable to the 11–75kW inverter units and the 45kW and 160kW rectifier units. Only one terminal can be installed for the 45kW rectifier unit and 11–37kW inverter units. Two terminals can be installed for the 45–75kW inverter units. Three terminals can be installed for the 160kW rectifier unit.

No.	Terminal	Terminal specifications	Cable specifications
1	100A bus terminal	DSTB100-YW	16AWG-2AWG
2	200A bus terminal	BSTB200-YW	6AWG-150mm²

The bus terminal drawing is as follows.

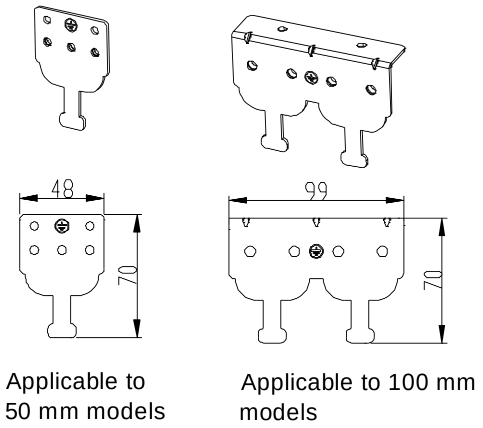

100 A bus terminal


200 A bus terminal

E.9.5 Shield bracket

You are recommended to use the cable with a shield layer as the inverter unit output cable. You can use a shield bracket to fix the shield layer (selecting different shield brackets according to width dimensions).

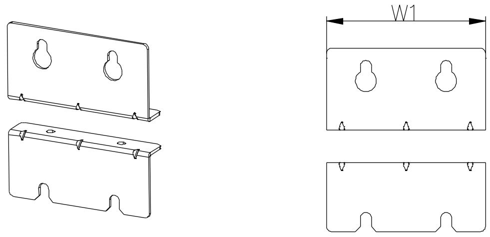
The shield bracket structure is as follows.



E.9.6 Flange installation braket

Cooling air ducts can be installed on both rectifier units (except the 350kW model) and inverter units through the flange installation method, and different models support different flange installation brackets.

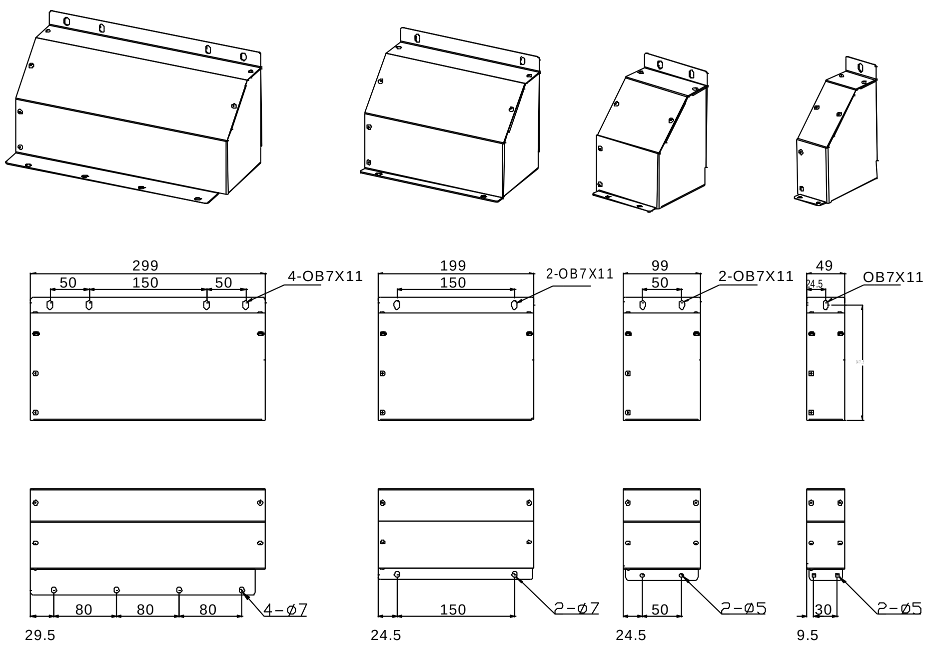
The flange installation bracket structure is as follows.



E.9.7 Air deflector

The rectifier and inverter units are vertically installed inside the cabinet (wall-mounting) after being connected in parallel manner. In order to make the heat dissipation of an upper unit free from being affected by a lower unit air duct, you are recommended to install an air deflector at the outlet of the lower unit.

The air deflector structure is as follows.



E.9.8 Buffer unit

BUB600 is a DC power-up buffer device for Goodrive600 series inverter units. It is connected between the rectifier unit and the inverter unit. By connecting the BUB600 with the DC circuit breakers in series, you can replace an inverter unit without powering off the rectifier unit (the bus voltage remains normal),and the inverter unit can be independently powered up and down.

Dimensions

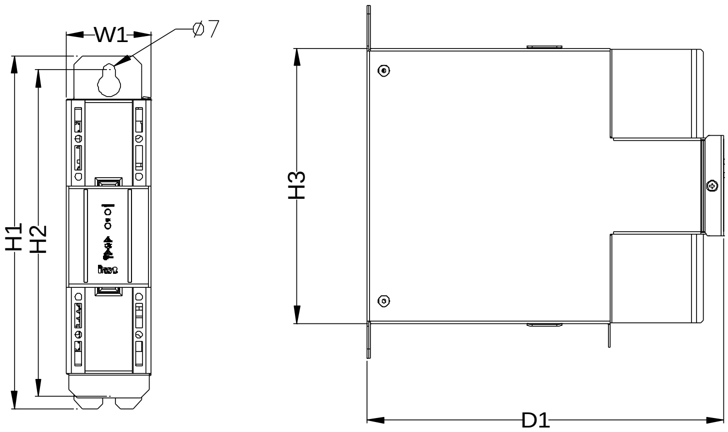


Figure E-1 Wall-mounting drawing for BUB600-7R5-4

Table E-1 Wall-mounting dimensions of BUB600-7R5-4

Model	Diemnsions (mm)				Installation hole position (mm)			Hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
BUB600-7R5-4	205	160	50	207	190	-	-	Ø7	1.3

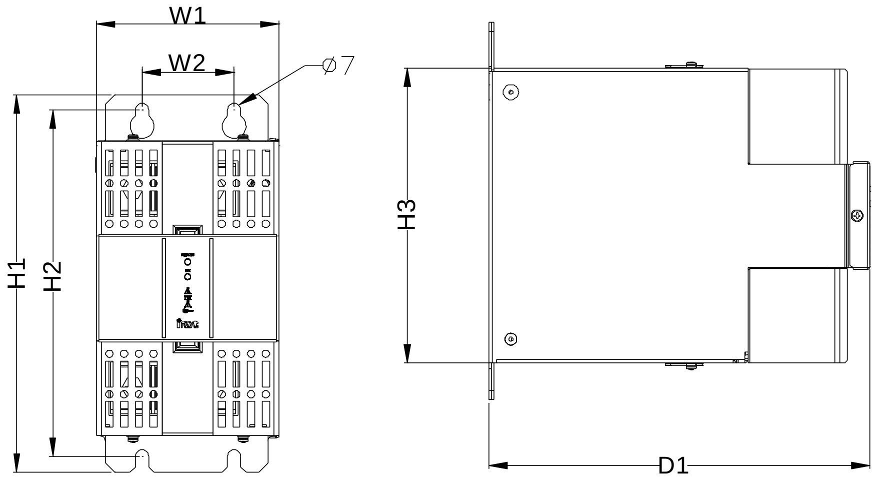


Figure E-2 Wall-mounting drawing for BUB600-037-4/ BUB600-075-4

Table E-2 Wall-mounting dimensions of BUB600-037-4/ BUB600-075-4

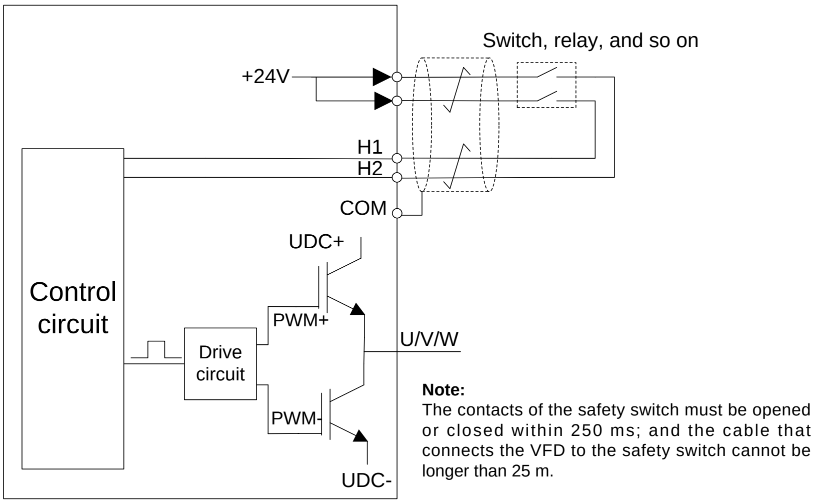
Model	Diemnsions (mm)				Installation hole position (mm)			Hole diameter (mm)	Weight (kg)
	H1	H3	W1	D1	H2	W2	W3		
BUB600-037-4	205	160	100	207	190	50	-	Ø7	2.3

For details about how to use the buffer unit, see the BUB600 series buffer unit mannual.

Appendix F STO function description

Reference standards: IEC 61508-1, IEC 61508-2, IEC 61508-3, IEC 61508-4, IEC 62061, ISO 13849-1, and IEC 61800-5-2

You can enable the safe torque off (STO) function to prevent unexpected startups when the main power supply of the drive is not switched off. The STO function switches off the drive output by turning off the drive signals to prevent unexpected startups of the motor (see the following figure). After the STO function is enabled, you can perform some-time operations (such as non-electrical cleaning in the lathe industry) and maintain the non-electrical components of the device without switching off the drive.



F.1 STO function logic table

The following table describes the input states and corresponding faults of the STO function.

STO input state	Corresponding fault
H1 and H2 opened simultaneously	The STO function is triggered, and the drive stops running. Fault code: 40: Safe torque off (STO)
H1 and H2 closed simultaneously	The STOP function is not triggered, and the drive runs properly.
One of H and H2 opened, and the other closed	The STL1, STL2, or STL3 fault occurs. Fault code: 41: Channel H1 exception (STL1) 42: Channel H2 exception (STL2) 43: Channel H1 and H2 exceptions (STL3)

F.2 STO channel delay description

The following table describes the trigger and indication delay of the STO channels.

STO mode	STO trigger delay[1] and indication delay[2]
STO fault: STL1	Trigger delay < 10 ms Indication delay < 280 ms
STO fault: STL2	Trigger delay < 10 ms Indication delay < 280 ms
STO fault: STL3	Trigger delay < 10 ms Indication delay < 280 ms
STO fault: STO	Trigger delay < 10 ms Indication delay < 100 ms

1. STO trigger delay: Time interval between trigger the STO function and switching off the drive output
2. STO indication delay: Time interval between trigger the STO function and STO output state indication

F.3 STO function installation checklist

Before installing the STO, check the items described in the following table to ensure that the STO function can be properly used.

	Item
☐	Ensure that the drive can be run or stopped randomly during commissioning.
☐	Stop the drive (if it is running), disconnect the input power supply, and isolate the drive from the power cable through the switch.
☐	Check the STO circuit connection according to the circuit diagram.
☐	Check whether the shielding layer of the STO input cable is connected to the +24 V reference ground COM.
☐	Connect the power supply.
☐	Test the STO function as follows after the motor stops running: ● If the drive is running, send a stop command to it and wait until the shaft of the motor stops rotating. ● Activate the STO circuit and send a start command to the drive. Ensure that the motor does not start. ● Deactivate the STO circuit.
☐	Restart the drive, and check whether the motor is running properly.
☐	Test the STO function as follows when the motor is running: ● Start the drive. Ensure that the motor is running properly. ● Activate the STO circuit. ● The drive reports an STO fault (for details, see section 9.5.2 Inverter faults and solutions). Ensure that the motor coasts to stop rotating. ● Deactivate the STO circuit.
☐	Restart the drive, and check whether the motor is running properly.

Appendix G Further information

G.1 Product and service queries

Should you have any queries about the product, contact the local INVT office. Provide the model and serial number of the product you query about. You can visit www.invt.com to find a list of INVT offices.

G.2 Feedback on INVT VFD manuals

Your comments on our manuals are welcome. Visit www.invt.com, directly contact online service personnel or choose **Contact Us** to obtain contact information.

G.3 Documents on the Internet

You can find manuals and other product documents in the PDF format on the Internet. Visit www.invt.com and choose **Support** > **Download**.

Appendix H Ordering guidelines

You can quickly find product models and order products by 10-digit order number.

Product category	Order number	Model	Remarks
Power unit	11020–00141	GD600-71-045-4-B	45kW rectifier unit
	11020–00154	GD600-71-160-4	160kW rectifier unit
	11020–00160	GD600-71-355-4	355kW rectifier unit
	11020–00145	GD600-51-1R5-4	1.5kW inverter unit
	11020–00144	GD600-51-2R2-4	2.2kW inverter unit
	11020–00143	GD600-51-004-4	4kW inverter unit
	11020–00142	GD600-51-5R5-4	5.5kW inverter unit
	11020–00136	GD600-51-7R5-4	7.5kW inverter unit
	11020–00146	GD600-51-011-4	11kW inverter unit
	11020–00147	GD600-51-015-4	15kW inverter unit
	11020–00140	GD600-51-018-4	18.5kW inverter unit
	11020–00139	GD600-51-022-4	22kW inverter unit
	11020–00138	GD600-51-030-4	30kW inverter unit
	11020–00137	GD600-51-037-4	37kW inverter unit
	11020–00155	GD600-51-045-4	45kW inverter unit
	11020–00157	GD600-51-055-4	55kW inverter unit
	11020–00156	GD600-51-075-4	75kW inverter unit
Expansion card	11060-00263	EC-PC701-02	Programmable card
	11023–00099	EC-TX709	PROFINET communication card
	11023–00111	EC-TX703	PROFIBUS-DP communication card
	11023–00097	EC-TX704	Ethernet communication card
	11023–00127	EC-TX708	EtherCAT communication card
	11023–00096	EC-PG705-12	Multifunction incremental PG card
	11023–00110	EC-PG704-00	Resolver PG card
	11023–00122	EC-PG707-24	24Vsimplified incremental PG card
	11023–00123	EC-IO702	IO card
Structural part	61001–01444	GD600-SH1	50mm-wide shield bracket
	61001–01446	GD600-SH2	100mm-wide shield bracket
	62001–01985	GD600-FLAN1	50mm-wide flange mounting kit
	62001–01910	GD600-FLAN2	100mm-wide flange mounting kit
	62001–02021	GD600-FLAN3	200mm-wide flange mounting kit
	62001–02092	GD600-FLAN4	300mm-wide flange mounting kit
	60005–00128	GD600-AD1	50mm-wide air deflector
	60005–00127	GD600-AD2	100mm-wide air deflector
	60005–00133	GD600-AD3	200mm-wide air deflector
	60005–00134	GD600-AD4	300mm-wide air deflector
	19005-00354	DSTB100-YW	100A DC bus terminals
	19005-00355	BSTB200-YW	200A DC bus terminals
Network cable	37005–00020	/	1m, non-shield, common
	37005–00017	/	1.5m, non-shield, common
	37005–00021	/	2m, non-shield, common
Other	11022–00135	SOP-600	LCD keypad
	11023–00116	EC-TM485-USB	USB-RS485 communication module

Service line:86-755-23535967 E-mail:overseas@invt.com.cn Website:www.invt.com

The products are owned by **Shenzhen INVT Electric Co.,Ltd.**

Two companies are commissioned to manufacture: (For product code, refer to the 2nd/3rd place of S/N on the name plate.)

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