Goodrive390L Series Lift-Dedicated VFD

User Manual

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Overview

Thank you for choosing Goodrive390L series lift-dedicated variable-frequency drive (VFD).

GD390L lift-dedicated VFD is widely used in passenger and freight lifts in various residential buildings, office buildings, shopping malls, and other areas. The product adopts the new generation of variable frequency vector control technology and integrates features such as STO and electronic star shorting. The following features are available:

- ✧ High-performance vector VFD, designed with separate MCU and DSP, that can drive both asynchronous motors (AMs) and synchronous motors (SMs), supporting open and closed loop
- ✧ Flexible motor autotuning modes with static and dynamic autotuning functions of motor parameter
- ✧ Advanced starting torque compensation technology without a weighing sensor
- ✧ High precision S-curve algorithm to improve the comfort of lift acceleration, deceleration, and stopping
- ✧ Supporting AC220V, DC 48V emergency power supply, with flexible emergency rescue operation plans
- ✧ Optional built-in C2 filter to help the product meet European C2 standards and get European energy efficiency certification
- ✧ With built-in STO function (SIL3 compliant) and synchronous motor electronic star shorting function as a standard configuration
- ✧ Supporting configuring IoT device to achieve remote OTA technology
- ✧ Supporting CANopen protocol and optional logic board to facilitate secondary development
- ✧ Diverse modular accessories, including various types of PG cards, LCD/LED built-in keypad, and optional external LED keypad
- ✧ Redundant safety design to prevent the lift from punching the top or hitting the bottom during the upward and downward running
- ✧ Dual chip control for braking and running, controlling the contactor and braking according to the operation logic of the lift to enhance the safety performance of the lift

This manual mainly describes the methods of mechanical installation, electrical installation, operation methods, commissioning, maintenance and troubleshooting of the VFD. Read the manual carefully before installing and using the VFD.

Readers

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

Change history

Due to product version upgrade or other reasons, this document will be updated from time to time without notice.

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

Contents

1 Safety precautions

1.1 Safety declaration

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the VFD. Otherwise, equipment damage or physical injury or death may be caused.

We shall not be liable or responsible for any equipment damage or physical injury or death caused due to failure to follow the safety precautions.

1.2 Safety level definition

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

Warning symbols	Name	Description
	Electric shock	Severe personal injury or even death can result if related requirements are not followed.
	Waiting time	Severe personal injury or even death can result if related requirements are not followed. As high voltage still presents in the bus capacitor after power off, wait for at least 5 minutes (depending on the warning symbols on the machine) after power off to prevent electric shock.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.
	Electrostatic discharge	The devices or internal components may be damaged if related requirements are not followed.
	Hot sides	You may get burnt if related requirements are not followed.
Note	Note	Slight personal injury or equipment damage can result if related requirements are not followed.

1.3 Personnel requirements

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

1.4 Safety guidelines

<table>
<tr><th colspan="2">General principles</th></tr>
<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. Before performing these operations, ensure all the input power supplies have been disconnected, 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>Model</th><th>Minimum waiting time</th></tr>
<tr><td>1PH 230V 2.2kW</td><td>5 minutes</td></tr>
<tr><td>3PH 230V 2.2kW–18kW</td><td>5 minutes</td></tr>
<tr><td>3PH 400V 4kW–37kW</td><td>5 minutes</td></tr>
</table>
</td></tr>
<tr><td>  </td><td>

Do not modify the VFD unless authorized; otherwise fire, electric shock or other injury may result.
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.
Prevent the screws, cables and other conductive parts from falling into the VFD.

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

The base may become hot when the VFD 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>

<table>
<tr><th colspan="2">Delivery</th></tr>
<tr><td>  </td><td>

Select appropriate tools for VFD delivery to avoid damage to the VFD, and take protective measures like wearing safety shoes and working uniforms to avoid physical injury or death.
Protect the VFD against physical shock or vibration.
Do not carry the VFD only by its front cover as the cover may fall off.

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

<table>
<tr><th colspan="2">Installation</th></tr>
<tr><td>  </td><td>

Do not install the VFD on inflammables. In addition, prevent the VFD from contacting or adhering to inflammables.
Do not install the damaged or incomplete VFD.

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

Installation	
	• Do not contact the VFD with damp objects or body parts. Otherwise, electric shock may result.
	• The installation site must be away from children and other public places. For details, see section 3.2.1 Installation environment and site. • Connect the optional braking parts (such as braking resistors, braking units or feedback units) according to the wiring diagrams. • As VFD leakage current caused 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). The minimum size of the protective earth conductor should comply with local safety regulations for high protection earth conductor current equipment. • L1/R, L2/S, and L3/T are the power input terminals, while U, V, and W are the output motor-connection terminals. Connect the input power cables and motor cables properly; otherwise, the VFD may be damaged. • When the VFD is installed in a confined space (such as cabinet), it is necessary to provide protective devices (such as fireproof housing, electrical protective housing, mechanical protective housing, etc.) that meet the IP rating, and the IP rating shall comply with the relevant IEC standards and local regulations.

Commissioning	
	• The VFD cannot act as an emergency brake for the motor; it is a must to install a mechanical braking device. • Do not switch on or switch off the input power supplies of the VFD frequently. • If the VFD has been stored without use for a long time, perform capacitor reforming (for details, see section 9.3 Reforming), inspection and pilot run for the VFD before the reuse.

Run	
	• Close the VFD front cover before running; otherwise, electric shock may occur. • High voltage presents inside the VFD during running. Do not carry out any operation on the VFD during running except for keypad setup. The control

Run	
	terminals of the product form extra-low voltage (ELV) circuits. Therefore, you need to prevent the control terminals from connecting to accessible terminals of other devices. ● During driving a synchronous motor, besides above-mentioned items, the following work must be done: ✓ All input power supplies have been disconnected, including the main power and control power. ✓ The synchronous motor has been stopped, and the voltage on output end of the VFD is lower than 36V. ✓ After the synchronous motor has stopped, wait for at least the time designated on the VFD, and ensure the voltage between (+) and (-) is lower than 36V. ✓ During operation, it is a must to ensure the synchronous motor 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 synchronous motor and the VFD.

Maintenance	
	● Do not perform VFD maintenance or component replacement when the power is on. Otherwise, electric shock may result. ● Only trained and qualified professionals are allowed to perform maintenance, inspection, and component replacement for the VFD. ● Keep the VFD and its parts and components away from combustible materials and ensure they have no combustible materials adhered.
	● During maintenance and component replacement, take proper anti-static measures on the VFD and its internal parts.
	● Do not carry out insulation voltage-endurance test on the VFD, or measure the control circuits of the VFD with a megohmmeter.
Note	● Use proper torque to tighten screws.

Disposal	
	● The VFD contains heavy metals. Dispose of a scrap VFD as industrial waste.

2 Product overview

2.1 Product nameplate and model

Each VFD is affixed with a nameplate containing the basic product information and, depending on the actual certification, certification marks such as the CE mark.

2.2 Product specifications

Item		Specifications
Input	Input voltage (V)	AC 3PH 380V (-15%)–440V (+10%); Rated voltage: 400V AC 3PH 220V (-15%)–240V (+10%); Rated voltage: 230V AC 1PH 220V (-15%)–240V (+10%); Rated voltage: 230V
	Input current (A)	For details, see section 2.3 Product ratings.
	Input frequency (Hz)	50Hz or 60Hz; Allowed range: 47–63Hz, with a maximum change rate of 20%/s
	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 100kA when the VFD runs at the maximum rated voltage.

Item		Specifications
Output	Output voltage (V)	0–Input voltage (V)
	Output current (A)	For details, see section 2.3 Product ratings.
	Output power (kW)	For details, see section 2.3 Product ratings.
	Output frequency (Hz)	0–200Hz
Control performance	Control mode	Sensorless vector control (SVC) mode, and feedback vector control (FVC) mode
	Motor type	Asynchronous motor (AM) and permanent magnetic synchronous motor (SM)
	Speed ratio	For AMs: 1:200 (SVC) For SMs: 1:20 (SVC); 1:1000 (FVC)
	Speed control accuracy	±0.5% (SVC); ±0.05% (FVC)
	Speed fluctuation	±0.3% (SVC)
	Torque response	<20Ms (SVC); <10ms (FVC)
	Torque control accuracy	10% (SVC); 5% (FVC)
	Starting torque	For AMs: 0.3Hz/150% (SVC) For SMs: 2.5Hz/150% (SVC); 0Hz/200% (FVC)
	Overload capacity	150% of the rated current for 60s; 200% of the rated current for 10s
Optional parts and functions	Dynamic braking	Already built in the entire series
	EMC filter	The C3 filter circuit has been built in the VFD as a standard part. C2 filters are optional parts and can be built into the VFD.
	SM star shorting function	Supports the electronic star shorting function
	OTA software upgrade	External IoT 4G module (not standard part) to achieve software upgrade through cloud
	Operator (keypad)	The VFD supports LED and LCD film keypads, and supports optional external LED keypad.
	Running time protection	A protection date can be set to issue a warning and disable the VFD when the time is reached (this function is only supported when the local film LCD keypad is configured).
Peripheral interface	Terminal analog input resolution	No more than 20mV
	Terminal digital input resolution	No more than 2ms
	Analog input	Two inputs. AI1/AI2: 0–10V or 0–20mA

Item		Specifications
	Digital input	Ten regular inputs. Max. frequency: 1KHz; internal impedance 3.3kΩ
	Digital output	One Y terminal open collector output
	Relay output	Three programmable relay outputs. RO1A: NO; RO1B: NC; RO1C: common; Two groups of NO output: RO2A, RO2C; RO3A, RO3C NO; Contact capacity: 3A/AC250V, 1A/DC30V
	Communication interface	One CANopen and one RS485
	STO input	Two redundant inputs, SIL3 level
	PT100 input	One output. Resolution rate: 1°C; range: -20°C – +150°C; detection accuracy: ±3°C
	Encoder input	Supports 5V/12V incremental encoder (Select power supply through the jumper. Default: 12V)
	PG card expansion	Supports incremental, sin/cos, Endat, and SSI PG cards
Environment requirements and certificatio	Mounting method	Wall mounting
	Cooling method	Forced air cooling
	Temperature of running environment	-10°C – +50°C. Derating is required when the ambient temperature exceeds 40°C.
	Storage temperature	-30–+60°C
	Ingress protection (IP) rating	IP20
	Pollution degree	PD2
	Applicable grid type	TN or TT type
	Protective class	Class I
	Certification	CE (with STO)

2.3 Product ratings

Model	Voltage class	Output power (kW)	Input current (A)	Output current (A)
GD390L-2R2G-S2	Single phase 230V	2.2	24	10
GD390L-2R2G-2	3PH 230V	2.2	12	10
GD390L-004G-2		4	21	18.5
GD390L-5R5G-2		5.5	30	27
GD390L-7R5G-2		7.5	38	34
GD390L-011G-2		11	52	48
GD390L-015G-2		15	65	60
GD390L-018G-2		18.5	78	75

Model	Voltage class	Output power (kW)	Input current (A)	Output current (A)
GD390L-004G-4	3PH 400V	4	14	10
GD390L-5R5G-4		5.5	19	14
GD390L-7R5G-4		7.5	24	18.5
GD390L-011G-4		11	32	27
GD390L-015G-4		15	40	34
GD390L-018G-4		18.5	47	40
GD390L-022G-4		22	54	48
GD390L-030G-4		30	70	60
GD390L-037G-4		37	80	75

2.4 Product dimensions and weight

Product model	Outline dimensions WxHxD (mm)	Package outline dimensions WxHxD (mm)	Net weight (kg)	Gross weight (kg)
GD390L-2R2G-S2	200×347×190	450×275×280	3.6	4.5
GD390L-2R2G-2	200×347×190	450×275×280	3.4	4.3
GD390L-004G-2	200×347×190	450×275×280	3.5	4.4
GD390L-5R5G-2	200×347×197.5	450×275×280	4.5	5.4
GD390L-7R5G-2	200×347×197.5	450×275×280	4.6	5.5
GD390L-004G-4	200×347×190	450×275×280	3.5	4.4
GD390L-004G-4-C2	200×347×190	450×275×280	3.8	4.7
GD390L-5R5G-4	200×347×190	450×275×280	3.5	4.4
GD390L-5R5G-4-C2	200×347×190	450×275×280	3.8	4.7
GD390L-7R5G-4	200×347×190	450×275×280	3.6	4.5
GD390L-7R5G-4-C2	200×347×190	450×275×280	3.9	4.8
GD390L-011G-4	200×347×197.5	450×275×280	4.5	5.4
GD390L-011G-4-C2	200×347×197.5	450×275×280	4.8	5.7
GD390L-015G-4	200×347×197.5	450×275×280	4.6	5.5
GD390L-015G-4-C2	200×347×197.5	450×275×280	4.9	5.8

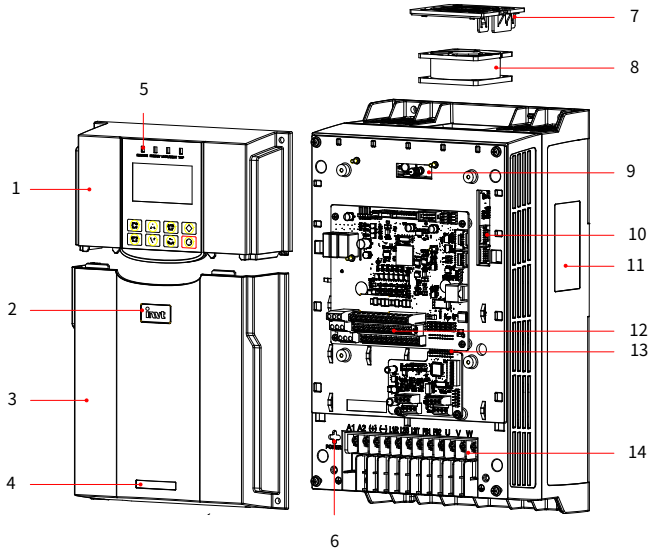
2.5 Product heat dissipation

Product model	Entire machine full load power dissipation (W)	Entire machine standby power dissipation (W)	Heat dissipation (BTU/hr)	Air rate (m^3/h)	Air rate (CFM) (ft^3/min)
GD390L-2R2G-S2	146	12	498	52.7	31

Product model	Entire machine full load power dissipation (W)	Entire machine standby power dissipation (W)	Heat dissipation (BTU/hr)	Air rate (m^3/h)	Air rate (CFM) (ft^3/min)
GD390L-2R2G-2	105	14	358	52.7	31
GD390L-004G-2	231	16	788	52.7	31
GD390L-5R5G-2	322	18	1099	57.8	34
GD390L-7R5G-2	406	18	1386	57.8	34
GD390L-004G-4	161	18	549	52.7	31
GD390L-5R5G-4	205	19	700	52.7	31
GD390L-7R5G-4	306	20	1044	52.7	31
GD390L-011G-4	408	19	1392	57.8	34
GD390L-015G-4	456	20	1556	57.8	34

2.6 Structure diagram

Figure 2-1 Product component diagram for 3PH 380V 15kW and lower



No.	Component	Description
1	Upper cover	Used to protect internal components.
2	Logo	Displays the brand logo.
3	Lower cover	Used to protect internal components.
4	Product label	See section 2.1 Product nameplate and model

No.	Component	Description
5	Local keypad	See chapter 5 Keypad
6	Power supply indicator	Indicates whether the VFD is powered on
7	Fan cover plate	See section 9.2.1 Cooling fan
8	Cooling fan	See section 9.2.1 Cooling fan
9	Interface between the drive board and MCU board	Used to connect the drive board and the MCU board
10	Interface between the MCU board and DSP board	Used to connect the MCU board and the DSP board
11	Nameplate	See section 2.1 Product nameplate and model
12	Control circuit terminals	See section 4.3.2 Control terminal diagram
13	PG card interface	Used to install the PG expansion card
14	Main circuit terminals	See section 4.2.5 Main circuit terminal

2.7 System configuration

When using the VFD to drive a motor to form a control system, various electrical devices need to be installed on the input and output sides of the VFD to ensure stable system running.

Figure 2-2 System composition

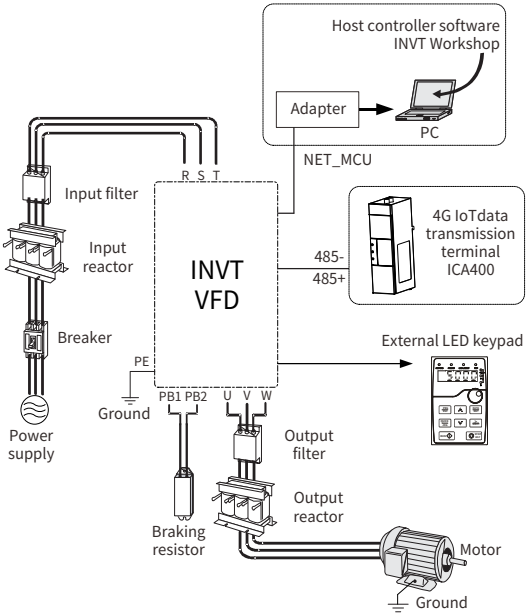


Table 2-1 System configuration

Component		Position value	Description
	Breaker	Between the power supply and the VFD input side	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	On the VFD input side	(Optional) Accessories used to improve the power factor on the input side of the VFD, and thus restrict high-order harmonic currents.
	Output reactor	Between the VFD output side and the motor, and installed near the VFD.	(Optional) Accessory used to lengthen the valid transmission distance of the VFD, which effectively restricts the transient high voltage generated during the switch-on and switch-off of the IGBT module of the VFD.
	Input filter	On the VFD input side	(Optional) 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. (Optional) Output filter: Accessory used to restrict interference generated in the wiring area on the output side of the VFD. All 380V VFD models can meet the conductive emission requirements (10 meters) of IEC/EN 61800-3 C3 electrical drive systems. Optional built-in C2 filters can be used to meet the conductive emission requirements (10 meters) of IEC/EN 61800-3 C2 electrical drive systems. **Note:** For the assembly of motors, motor cables and filters, observe the technical requirements specified in the appendix of the manual.
	Output filter	Try to install the output filter near the output terminal side of the VFD.	

Component		Position value	Description
	Braking resistor	Between the VFD main circuit terminals (+) and PB	Accessories used to consume the regenerative energy of the motor to reduce the DEC time. Braking components are external components.
	Host controller software	Installed in the host controller which controls the VFD	INVT Workshop software is used to configure and monitor the VFD. Its main functions include: ● Monitor multiple VFDs ● Set and monitor function code parameters, and upload and download parameters in batch ● View the modified function codes, compare the default values, follow function codes, and search function coeds ● View and follow state parameters ● View the real-time faults and historical faults ● Display function codes in configuration mode ● Control the start/stop and forward/reverse running of the device ● View oscilloscope curve, save and playback waveform data, operate the waveform by cursor, and simulate waveform data. You can visit our official website at www.invt.com to download the software for free.

For details about optional part model selection, see Appendix E Peripheral accessories.

3 Mechanical installation

3.1 Unpacking inspection

After receiving the product, perform the following steps to ensure the product use safety.

- **Check the package**

Before unpacking, check whether the product package is intact–whether the package is damaged, dampened, soaked, or deformed. After unpacking, check whether the interior surface of the packing box is abnormal, for example, in wet condition.

- **Check the machine and parts**

After unpacking, check whether the equipment enclosure is damaged or cracked, whether the parts (including the VFD and manual) inside the packing box are complete, and whether the nameplate and label on the product body are consistent with the model ordered.

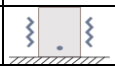
3.2 Preparing

Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter. Read the following installation preparation carefully before installation to ensure smooth installation and avoid personal injury or equipment damage.

Warning	
	• Carry out operations according to instructions presented in section 1.4 Safety guidelines. Ensure the VFD power has been disconnected before installation. If the VFD has been powered on, disconnect the VFD and wait for at least the time designated 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.

3.2.1 Installation environment and site

■ **Environment requirements**

Environment	Requirement	
Temperature		● -10–+50°C ● Do not use the VFD when the ambient temperature exceeds 50°C. When the ambient temperature exceeds 40°C, derate 1% for every increase of 1°C. ● The temperature does not change rapidly. ● When the VFD is installed in a closed space, such as control cabinet, use a cooling fan or air conditioner for temperature adjustment if necessary. ● 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)		● The relative humidity (RH) of the air is less than 90%, and there is no condensation. ● The max. RH cannot exceed 60% in the environment where there are corrosive gases.
Altitude		● Lower than 1000 meters ● When the altitude exceeds 1000m, derate by 1% for every increase of 100m. ● When the altitude exceeds 3000m, consult our local dealer or office for details.
Vibration		Max. vibration ACC: 5.8m/s^2 (0.6g)

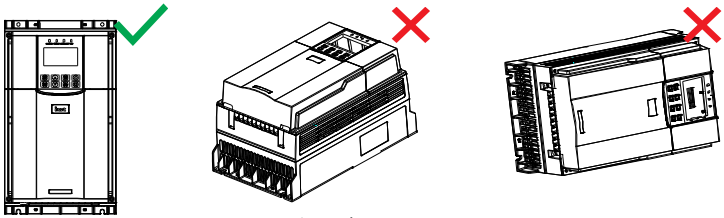
■ **Site requirement**

Site	Requirement	
Indoor		Without electromagnetic radiation sources and direct sunlight. **Note:** The VFD must be installed in a clean and well-ventilated environment based on the housing IP rating.
		Without foreign objects such as oil mist, metal powder, conductive dust, and water.
		Without radioactive, corrosive, hazard, and combustible and explosive substances. **Note:** Do not install the VFD onto combustible objects.
		With low salt content

3.2.2 Installation direction

The VFD can be installed on the wall or in a cabinet. Vertical installation is a must. Do not install the VFD in other directions such as horizontal, transverse or upside-down.

Figure 3-1 Mounting direction



Vertical installation

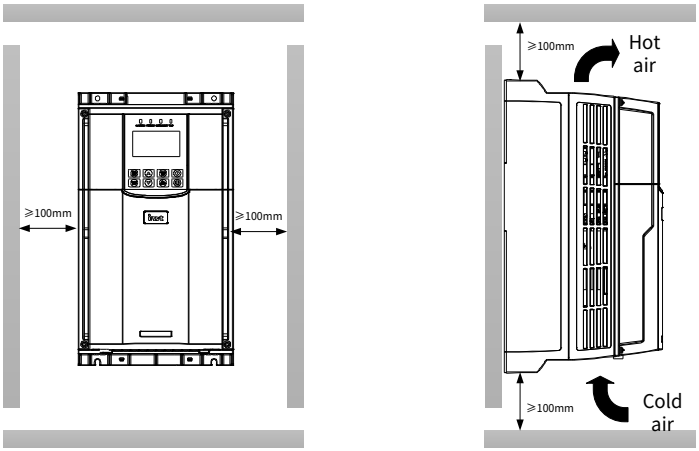
Horizontal installation

Transverse installation

3.2.3 Installation space

3.2.3.1 Single VFD

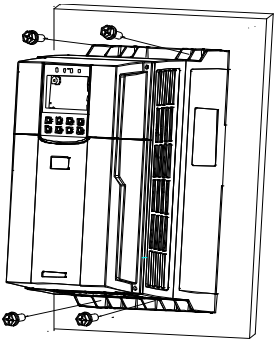
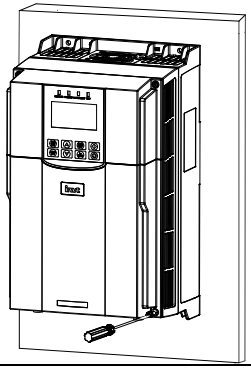
Figure 3-2 Installation space diagram of single VFD



3.3 Mounting method

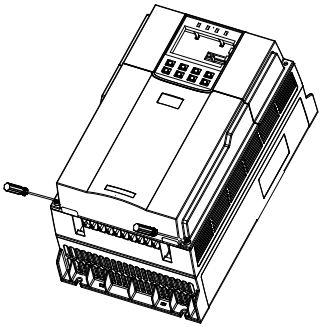
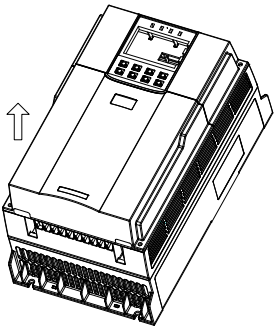
3.3.1 Wall mounting

The mounting procedures are as follows:

Step 1 Mark the installation hole positions. Mount the screws onto the designated positions. For details about the installation hole positions, see Appendix D Dimension drawings. 	Step 2 Fix the VFD on the wall or mounting plate, and tighten the screws on the wall or mounting plate. 

3.4 Remove the lower cover

Remove the lower cover of the VFD to perform the wiring of main circuit and control circuit. The removal steps are as follows.

Step 1 Remove two screws of the lower cover. 	Step 2 Gently lift the lower cover and remove it. 

4 Electrical installation

4.1 Insulation inspection

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. If you need to perform insulation resistance test on the VFD, please contact us.

Note: Remove the cable connection terminals from the VFD, then perform the insulation resistance test on the input and output power cables.

- **Input power cable**

Check the insulation conditions of the input power cable of a VFD according to the local regulations before connecting it.

- **Motor cable**

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. 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: If the motor inside is damp, the insulation resistance is reduced. If you suspect the inside of motor is moist, dry and re-measure the motor.

4.2 Cable selection and routing

4.2.1 Cable selection

- **Power cable**

Power cables mainly include input power cables and motor cables. To meet the EMC requirements stipulated in the CE standards, it is recommended to use symmetrical shielded cables as motor cables and input power cables. For details, see section E.1.1 Power cable.

Note: If the electrical conductivity of the motor cable shield layer does not meet the requirements, a separate PE conductor must be used.

■ **Control cable**

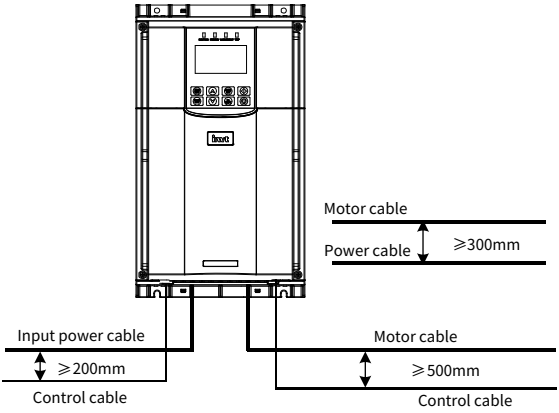
Control cables mainly include analog signal control cables and digital signal control cables. Analog signal control cables use twisted double shielded cables with a separate shielded twisted pair for each signal and different ground wires for different analog signals. For digital signal control cables, a double-shielded cable is preferred, but single-shielded or unshielded twisted pairs can also be used. For details, see section E.1.2 Control cable.

4.2.2 Cable arrangement

Motor cables must be arranged away from other cables. The dU/dt of the VFD output may increase electromagnetic interference on other cables. The motor cables of several VFDs can be arranged in parallel. It is recommended that you arrange the motor cables, input power cables, and control cables separately in different trays.

If a control cable and power cable must cross each other, ensure that the angle between them is 90°. The cable trays must be connected properly and well grounded. The cable trays must be connected properly and well grounded. Cable routing and routing distance are shown in Figure 4-1.

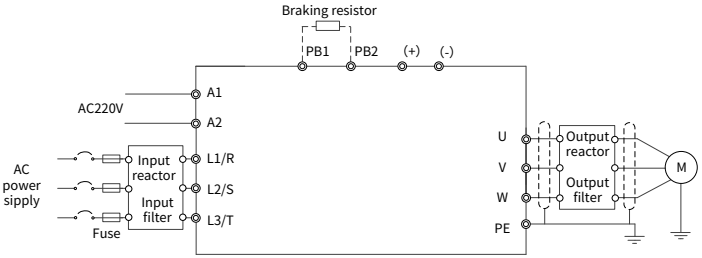
Figure 4-1 Cable routing distance



4.2.3 Standard wiring

4.2.4 Main circuit wiring diagrams

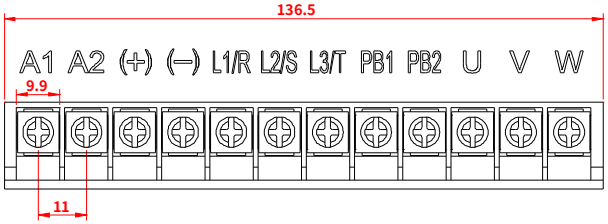
Figure 4-2 Main circuit wiring diagram



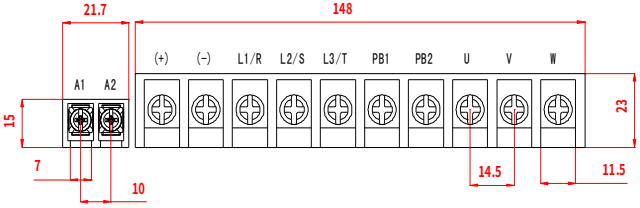
Note: The fuse, braking reactor, input reactor, input filter, output reactor, and output filter are optional parts. For details, see Appendix E Peripheral accessories.

4.2.5 Main circuit terminal

Main circuit terminal diagram for 380V 4–15kW VFD models



Main circuit terminal diagram for models using frame A



Main circuit terminal diagram for models using frame B

Table 4-1 Main circuit terminals

Terminal symbol	Terminal name	Function description
L1/R, L2/S, L3/T	Main circuit power input	3PH AC input terminals, connecting to the grid (Connect any two of L1, L2, L3 terminals for single phase AC 220V models.)
PB1, PB2	Braking resistor terminals	To connect the external braking resistor
(+), (-)	DC bus terminal	To connect the DC48V emergency power supply (an additional external battery protection adapter board is required)
U, V, W	VFD outputs	3PH AC output terminals, connected to the motor usually
A1, A2	220V control power inputs	When the emergency power supply is DC48V, A1 and A2 need to be connected to AC220V power supply
PE	Grounding terminal for safe protection	Grounding terminal for safe protection; each machine must carry two PE terminals and proper grounding is required

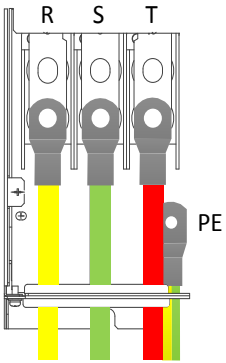
Note:

- It is not recommended to 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.
- Route the motor cable, input power cable and control cable separately.

4.2.6 Wiring procedure

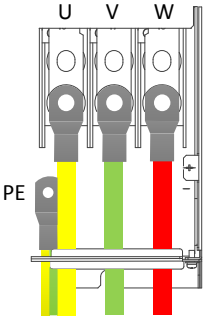
Step 1 Connect the grounding line of the cable to the grounding terminal (PE) of the VFD, and connect the 3PH input cable to R, S and T terminals and tighten up.

Figure 4-3 Wiring diagram of input power cables



Step 2 Connect the ground wire of the motor cable to the PE terminal of the VFD, connect the motor 3PH cable to the U, V and W terminals, and tighten up.

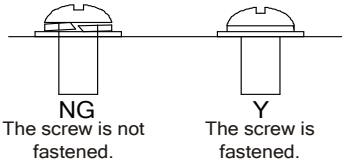
Figure 4-4 Wiring diagram of motor cables



Step 3 Connect optional parts such as the braking resistor that carries cables to designated positions. For details, see section 4.2.4 Main circuit wiring diagrams.

Step 4 Fasten all the cables outside the VFD mechanically if allowed.

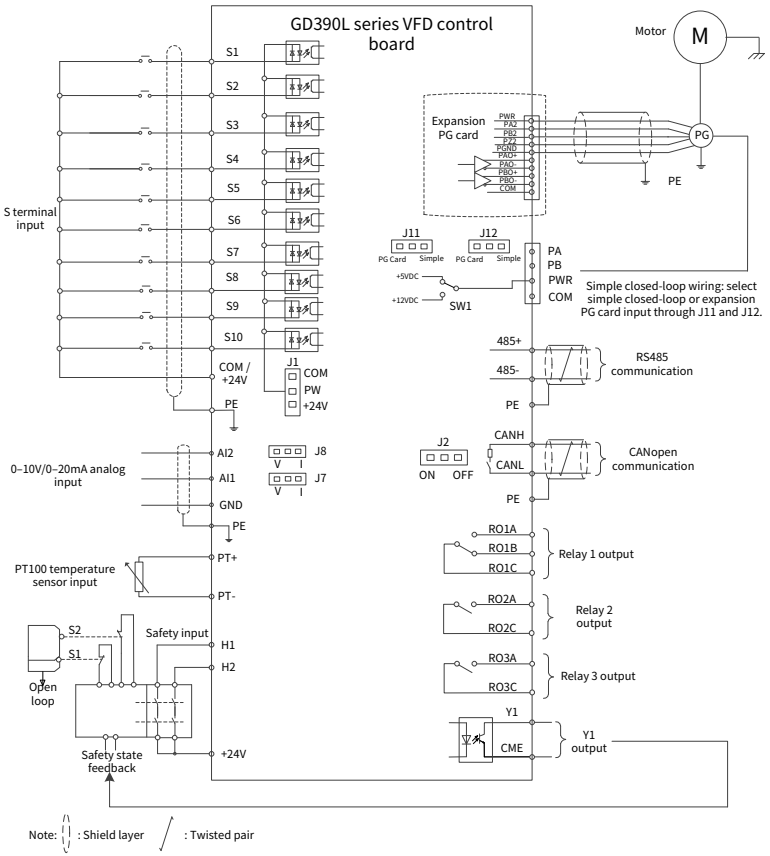
Figure 4-5 Screw installation diagram



4.3 Control circuit wiring

4.3.1 Control circuit wiring diagram

Figure 4-6 Control circuit wiring for 4–15kW (inclusive) models



Note: For the wiring of PG card, see Appendix A Expansion card.

4.3.2 Control terminal diagram

Figure 4-7 GD390L MCU board terminal arrangement

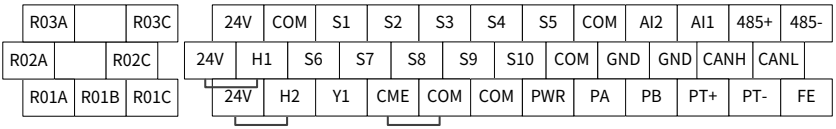


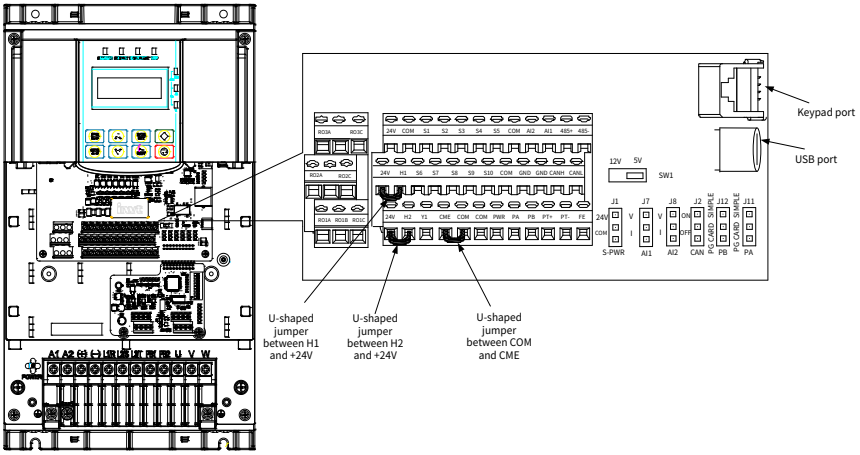
Table 4-2 GD390L control circuit terminals

Terminal name	Specifications
+24V	Used to externally provide 24V±10% power supply. Max. output current: 200mA
COM	Reference ground of +24V
S1–S10	Regular digital input terminal 1. Internal impedance: 3.3kΩ 2. 12–30V voltage input is acceptable. 3. Bi-direction input terminal, supporting NPN and PNP (switching through the jumper J1) 4. Max. input frequency: 1kHz 5. All of them are programmable digital input terminals. Users can set the terminal function by function code.
Y1, CME	Open collector output 1. Switch capacity: 50mA/30V 2. Output frequency range: 0–1kHz
RO1 RO2 RO3	Three programmable relay outputs. One group of NC and NO output: RO1A: NO; RO1B: NC; RO1C: common Two groups of NO output: RO2A, RO2C; RO3A, RO3C Contact capacity: 3A/AC250V, 1A/DC30V
AI1, AI2	1. Input range: 0–10V or 0–20mA, set through the jumper J7 and J8 2. Input impedance: 20kΩ for voltage input or 500Ω for current input 3. Resolution: 5mV when 10V corresponds to 50Hz. 4. Error: ±1% at 25°C
PT+, PT-	PT100 interface 1. Resolution: 1°C 2. Range: -20°C–150°C 3. Detection precision: ±3°C
PA, PB	Simplified closed loop encoder signal interface 1. Applicable to 5V/12V push-pull, OC encoders 2. Response frequency: 100kHz

Terminal name	Specifications
PWR	Encoder power interface. The common terminal is COM which can be set to 5V or 12V through SW1.
CANH, CANL	CANopen communication interface. The terminal matching resistor can be connected through the jumper J2.
485+, 485-	RS485 communication interface
H1, H2	STO function input terminal 1. Connected to external NC contacts. When the contacts open, STO acts and VFD output stops. 2. H1 and H2 are redundant inputs. They are short connected to +24V by default. Remove the jumper before using STO function. 3. Use the shielded cable with a length shorter than 25m.

4.3.3 Input/output signal connection diagram

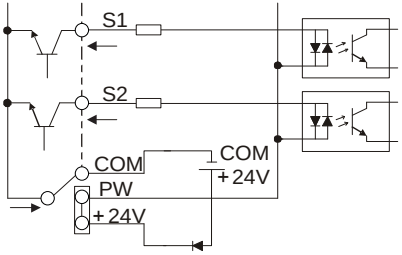
Figure 4-8 Input signal connection diagram



Use the jumper J1 to set the NPN /PNP mode for S terminal inputs. NPN internal mode is adopted by default.

If the input signal comes from the NPN transistor, set the jumper J1 between +24V and PW based on the power used according to Figure 4-9.

Figure 4-9 NPN mode



If the input signal comes from the PNP transistor, set the jumper J1 between +24V and COM based on the power used according to Figure 4-10.

Figure 4-10 PNP mode

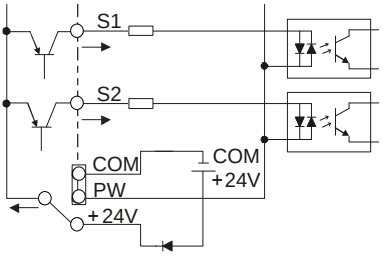
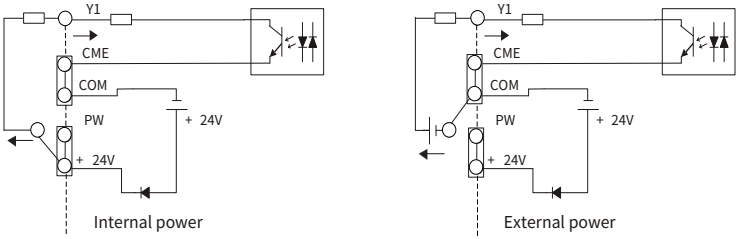


Figure 4-11 Y1 terminal output wiring diagram



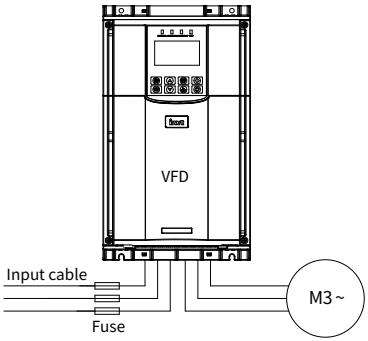
4.4 Power distribution protection

	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.

- **Power cable and VFD protection**

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. The wiring diagram is shown in Figure 4-12.

Figure 4-12 Fuse configuration



Note: Select the fuse according to section E.2 Breaker and electromagnetic contactor.

- **Motor and motor cable short-circuit protection**

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

Note: 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.

- **Motor thermal overload protection**

Once overload is detected, the power supply 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.

- **Bypass connection protection**

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.

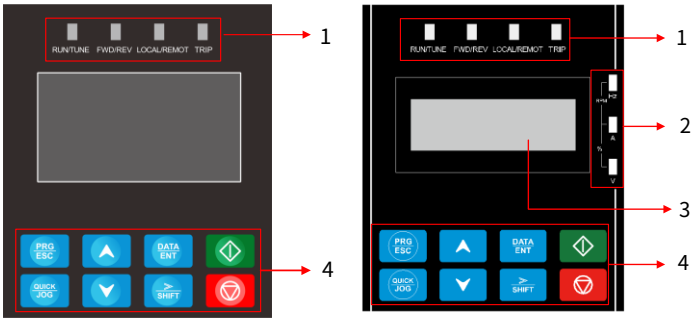
If VFD status needs to be switched frequently, you can use the switch which carries mechanical interlock or a contactor to ensure motor terminals are not connected to input power cables and VFD output ends simultaneously.

5 Keypad instruction

5.1 Keypad introduction

The keypad is provided to control the lift-dedicated VFD, read status data and adjust parameters.

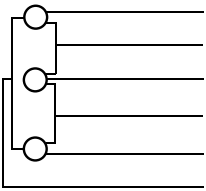
Figure 5-1 Keypad



LCD keypad LED keypad

Note: Some models of the product carries a LCD keypad, which supports multiple languages, parameter copying function, and four-row high-definition display. The other models carry a LED keypad.

No.	Name	Description	
1	Status indicator	RUN/TUNE	VFD running status indicator. LED off: The VFD is stopped. LED blinking: The VFD is autotuning parameters. LED on: The VFD is running.
		FWD/REV	Forward or reverse running indicator LED off: The VFD is running forward. LED on: The VFD is running reversely.
		LOCAL/REMOT	Indicates whether the VFD is controlled through the keypad, terminals, or communication. Off: The VFD is controlled through the keypad. Blinking: The VFD is controlled through terminals. On: The VFD is controlled through remote communication.

<table>
<tr><th>No.</th><th>Name</th><th colspan="4">Description</th></tr>
<tr><td></td><td></td><td colspan="2">TRIP</td><td colspan="2">Fault indicator
LED on: in fault state
LED off: in normal state
LED blinking: in pre-alarm state</td></tr>
<tr><td rowspan="7">2</td><td rowspan="7">Unit indicator</td><td colspan="4">Unit displayed currently</td></tr>
<tr><td colspan="2" rowspan="6">  </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>m/s</td><td>Linear speed unit</td></tr>
<tr><td>3</td><td>Digital display zone</td><td colspan="4">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></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>3</td><td>4</td><td>4</td><td>5</td><td>5</td></tr>
<tr><td>6</td><td>6</td><td>7</td><td>7</td><td>8</td><td>8</td></tr>
<tr><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></tr>
<tr><td>F</td><td>F</td><td>H</td><td>H</td><td>I</td><td>I</td></tr>
<tr><td>L</td><td>L</td><td>n</td><td>N</td><td>n</td><td>n</td></tr>
<tr><td>o</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></tr>
<tr><td>v</td><td>v</td><td></td><td></td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Keys</td><td>PRG ESC</td><td>Programming key</td><td colspan="2">Press it to enter or exit level-1 menus or delete a parameter.</td></tr>
<tr><td>DATA ENT</td><td>Confirmation key</td><td colspan="2">Press it to enter menus in cascading mode or confirm the setting of a parameter.</td></tr>
<tr><td></td><td>Up key</td><td colspan="2">Press it to increase data or move upward.</td></tr>
<tr><td></td><td>Down key</td><td colspan="2">Press it to decrease data or move downward.</td></tr>
<tr><td>SHIFT</td><td>Right-shifting key</td><td colspan="2">Press it to select display parameters rightward in the interface for the product in stopped or running state or to select digits to change during parameter setting.</td></tr>
</table>

No.	Name	Description		
			Run key	Press it to run the VFD when using the keypad for control.
			Stop/ Reset key	Press it to stop the product that is running. The function of this key is restricted by P07.04. In fault alarm state, this key can be used for reset in any control modes.
			Jogging key	Press it to jog the product when using the keypad for control.

5.2 Keypad display

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

5.2.1 Displaying stopped-state parameters

When the VFD is in stopped state, the keypad displays stopped-state parameters. See Figure 5-2 and Figure 5-3.

In the stopped state, various kinds of parameters can be displayed. You can determine which parameters are displayed in stopped state by setting function code P07.07. For details, See the description of P07.07.

In stopped state, there are 6 parameters that can be selected for display, including set speed, bus voltage, input terminal status, output terminal status, AI1 value, and AI2 value. You can determine which parameters are displayed by setting the binary bits of P07.07. You can press >>/SHIFT on the LED keypad to display next parameter, or press  on the LCD keypad to turn the page.

5.2.2 Displaying running-state parameters

After receiving a valid running command, the VFD enters the running state, and the keypad displays running-state parameters, with the RUN/TUNE indicator on. The on/off state of the FWD/REV indicator is determined by the actual running direction. See Figure 5-2 and Figure 5-3.

In running state, there are 15 parameters that can be selected for display, including running frequency, set speed, set frequency, bus voltage, output voltage, output current, running speed, output power, output torque, input terminal status, output terminal status, AI1 value, AI2 value, ramp frequency reference, linear speed, and frequency upper limit. You can determine which parameters are displayed by setting the binary bits of

P07.05 and P07.06. You can press >>/SHIFT on the LED keypad to display next parameter, or press on the LCD keypad to turn the page.

5.2.3 Displaying fault information

The VFD enters fault alarm display state once fault signal is detected, and the keypad screen displays fault code and fault name with TRIP indicator on the keypad turning on. You can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

If the fault persists, the fault code and fault name is continuously displayed.

In the stopped/running-state parameter display interface in the fault state, you can press 》/SHIFT to go to the fault display interface and view the present fault type.

5.2.4 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.

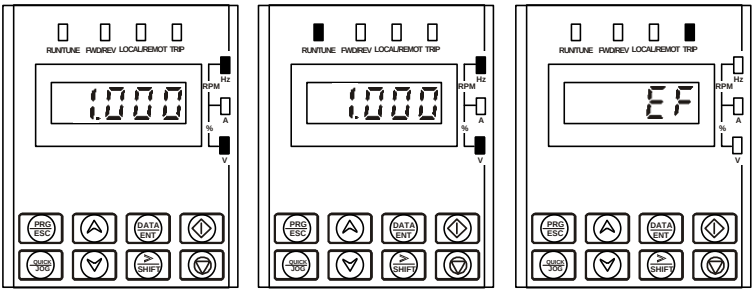
Figure 5-2 Status display (LCD keypad)

Parameter displayed in the stopped state

Parameter displayed in the running state

Faulty state displayed

Figure 5-3 Status display (LED keypad)



Parameter displayed in the stopped state

Parameter displayed in the running state

Faulty state displayed

5.3 Operation procedure

You can operate the VFD by using the keypad. For details about function code descriptions, see the Appendix F Function parameter list.

5.3.1 System settings of LCD keypad

In the status display interface, you can press DATA/ENT to go to the system settings interface, where you can set the language and backlight time.

5.3.2 How to modify VFD function codes

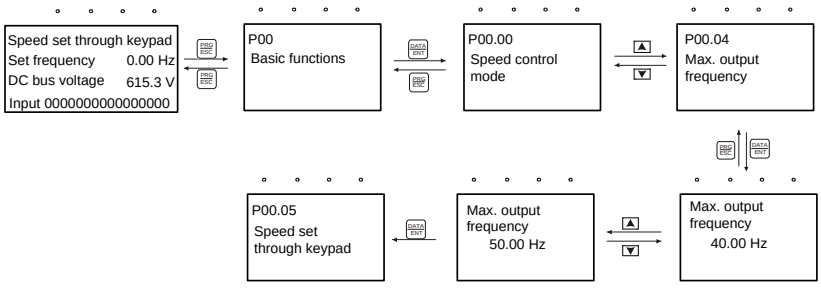
The VFD provides three levels of menus, including:

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

Note: 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.

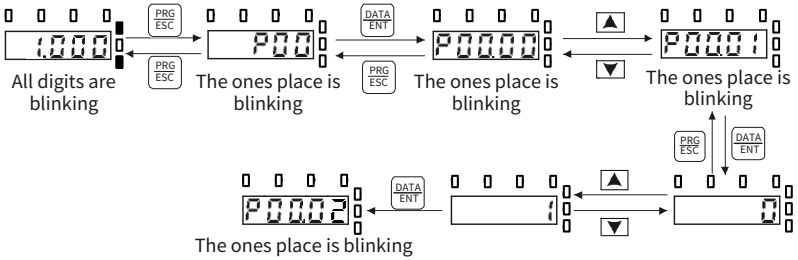
Example: Change the value of P00.04 from 40.00 to 50.00.

Figure 5-4 Modifying a parameter (LCD)



Note: When setting the value, you can press SHIFT to shift the blinking place, and press ▼+▲ to modify the value.

Figure 5-5 Modifying a parameter (LED)



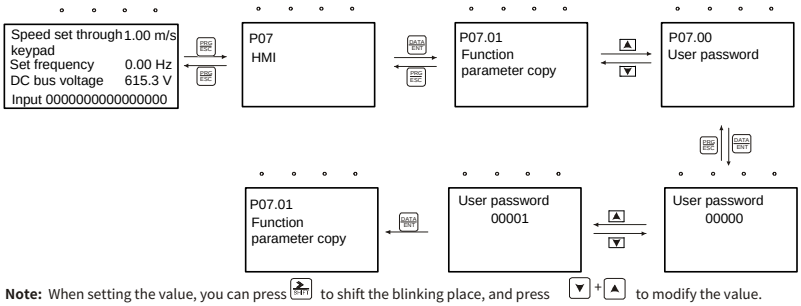
Note: When setting the value, you can press SHIFT to shift the blinking place, and press ▼ + ▲ to modify the value.

5.3.3 How to set the VFD user password

The VFD provides the user password protection function. When you set P07.00 to a non-zero value, the value is the user password. If password protection is enabled, "00000" 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.

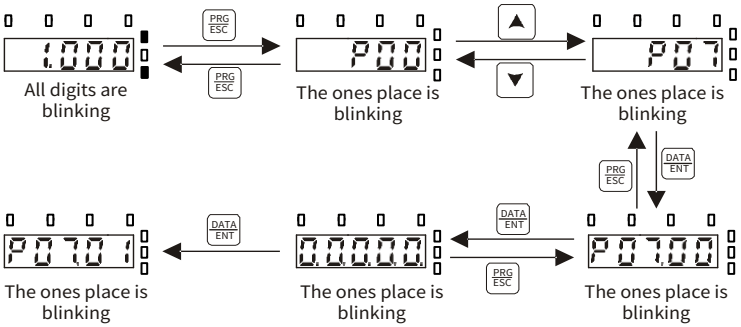
To disable the password protection function, you need only to set P07.00 to 0.

Figure 5-6 Setting a password (LCD)



Note: When setting the value, you can press SHIFT to shift the blinking place, and press ▼ + ▲ to modify the value.

Figure 5-7 Setting a password (LED)



Note: When setting the value, you can press SHIFT to shift the blinking place, and press ▼ + ▲ to modify the value.

5.3.4 How to view the function parameters

The VFD provides group P17 for status viewing. You can enter group P17 for viewing.

Figure 5-8 Viewing a parameter (LCD)

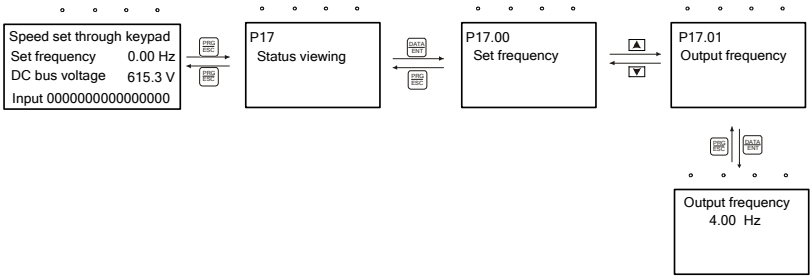
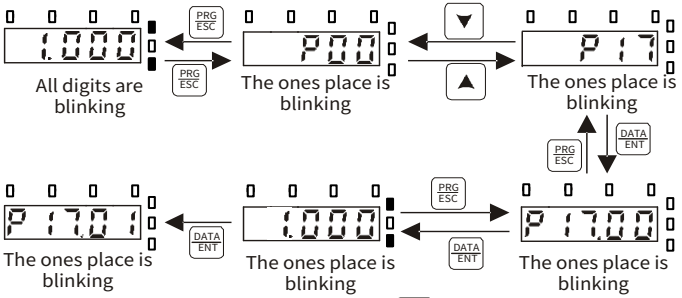


Figure 5-9 Viewing a parameter (LED)



Note: When setting the value, you can press SHIFT to shift the blinking place, and press ▼ + ▲ to modify the value.

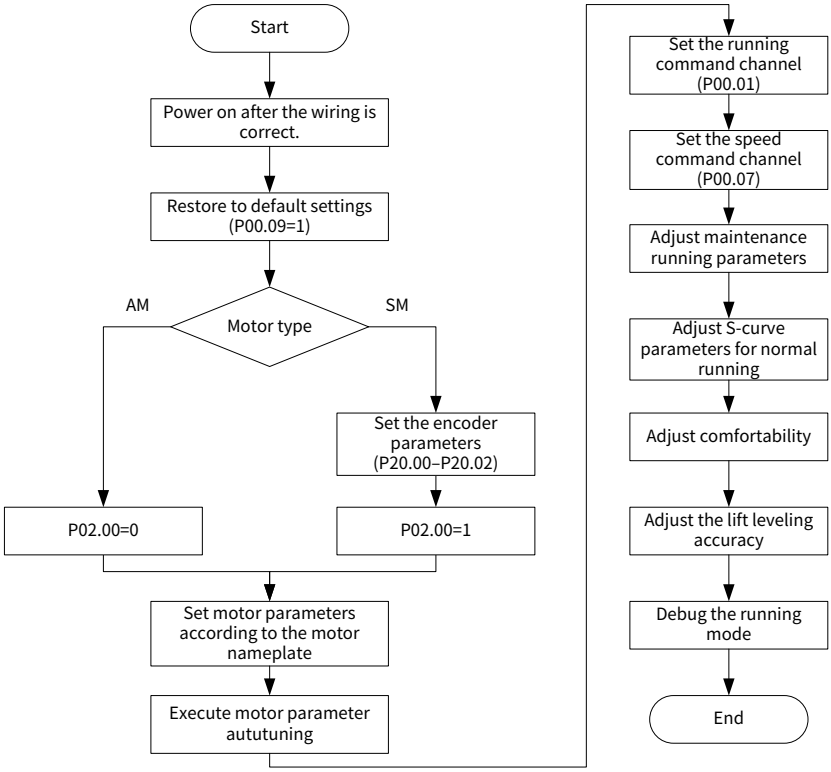
6 Commissioning guidelines

6.1 What this chapter contains

This chapter introduces the commissioning guidelines for GD390L lift-dedicated VFD.

The commissioning process is as follows.

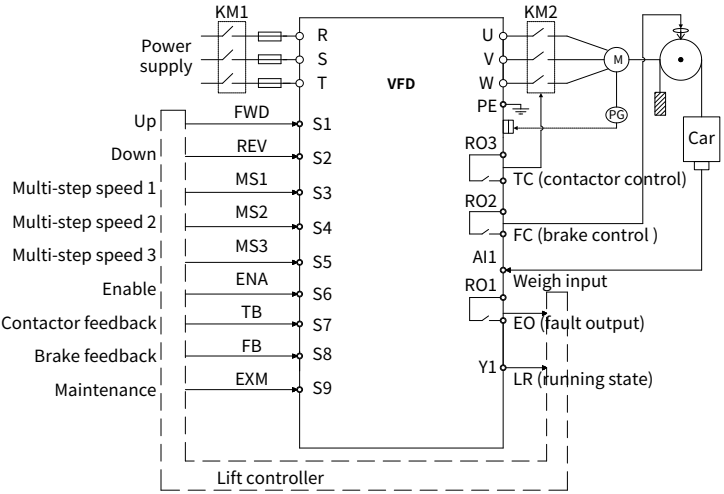
Figure 6-1 Commissioning procedure



6.2 Wiring between the lift controller and VFD

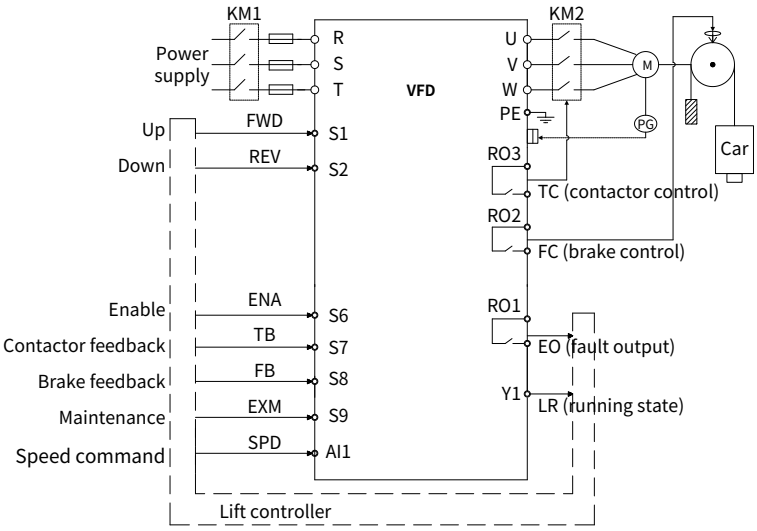
6.2.1 Wiring for the multi-step speed running mode

Figure 6-2 Typical wiring for the multi-step speed running mode



6.2.2 Wiring for the analog speed running mode

Figure 6-3 Wiring for the analog speed running mode



6.3 Basic parameter settings

After correct wiring, set application parameters as required. Pay high attention to the parameters related to peripheral electrical wiring, such as operation mode, control mode, programmable input/output setting, and feedback selection. Perform commissioning only after these parameters are correctly set. The table below lists the basic parameters.

Function code	Name	Recommended value	Remarks
P00.00	Speed control mode	0 or 3	0: Open-loop control for asynchronous motors 3: Closed-loop control for synchronous motors
P00.01	Channel of running commands	1	Terminal
P00.03	Max. output frequency	50.00Hz	-
P00.06	Rated speed of the lift	Based on lift speed	-
P00.07	Speed command selection	6	Multi-step speed running
P02.00	Motor type	Based on the motor.	-
P02.01	Rated power of AM	Traction machine nameplate	-
P02.02	Rated frequency of AM	Traction machine nameplate	-
P02.03	Rated speed of AM	Traction machine nameplate	-
P02.04	Rated voltage of AM	Traction machine nameplate	-
P02.05	Rated current of AM	Traction machine nameplate	-
P02.15	Rated power of SM	Traction machine nameplate	-
P02.16	Rated frequency of SM	Traction machine nameplate	-
P02.17	Number of pole pairs of SM	Traction machine nameplate	-
P02.18	Rated voltage of SM	Traction machine nameplate	-
P02.19	Rated current of SM	Traction machine nameplate	-
P20.00	Encoder type selection	0	-
P20.01	Encoder pulse number	Based on the encoder parameters	-
P20.02	Encoder direction	000 or 101	-
P05.01	S1 terminal	1	Up (FWD)
P05.02	S2 terminal	2	Down (REV)
P05.03	S3 terminal	8	Multi-step speed 1
P05.04	S4 terminal	9	Multi-step speed 2

Function code	Name	Recommended value	Remarks
P05.05	S5 terminal	10	Multi-step speed 3
P05.06	S6 terminal	19	Enable
P05.07	S7 terminal	17	Contactor feedback
P05.08	S8 terminal	18	Brake feedback
P05.09	S9 terminal	3	Inspection
P06.01	Y1 output	1	Running status output
P06.03	RO1 relay output	4	Fault output
P06.04	RO2 relay output	7	Brake output
P06.05	RO3 relay output	8	Contactor output

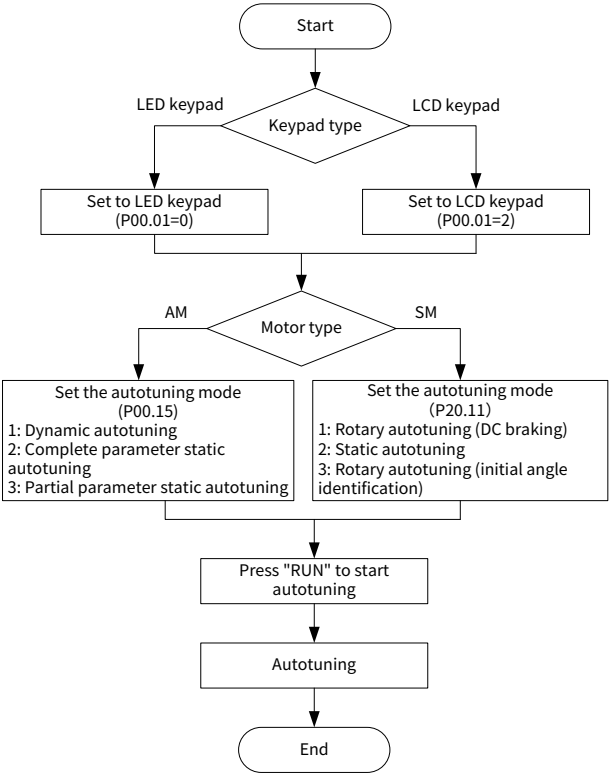
6.4 Commissioning running

After basic parameters are correctly set, commission running, including adjusting motor parameter autotuning, maintenance running, S curve for normal running, comfortability at startup or stop, and lift leveling accuracy.

6.4.1 Motor parameter autotuning

The control performance of the VFD largely depends on the accuracy of motor parameters. You need to carry out the motor parameter autotuning before first running. Set the VFD to use the keypad control mode (set P00.01=2 for LCD keypad and P00.01=0 for LED keypad), and execute parameter autotuning by using the method described in P00.15. The following figure shows the motor parameter autotuning procedures.

Figure 6-4 Motor parameter autotuning



Note:

- Set the motor parameters properly before the motor parameter autotuning is conducted.
- Note the difference in synchronous and asynchronous motor parameter autotuning processes.
- For autotuning on synchronous motor with load, it is required to handle the closing & opening timing of the output contactor and tractor brake.

6.4.2 Adjusting maintenance running parameters

Maintenance running can be used to check whether the lift system is running properly.

During maintenance, check whether the actual running direction of the lift is the consistent with the direction in the command. If not, swap any two cables of U, V, and W

or set P00.13=1.

Note: For SMs, swapping the motor cables requires the motor parameter autotuning (pole angle) again. It is recommended to set P00.13 to change the running direction of the lift.

6.4.3 Adjusting the S curve for normal running

Before normal running, check that the control logic is correct and wiring is correct. After these are confirmed to be correct, adjust the S curve. For details, see the descriptions of P10.38–P10.45.

Function code	Name	Setting range and default value
P01.01	Starting speed of direct start	0.000–P00.06 [0.000m/s]
P01.03	Hold time of starting frequency	0.0–50.0 [0.0s]
P01.15	Stop inflection speed	0.000–P00.06 [0.000m/s]
P10.38	S-curve ACC start segment duration	0.1–360.0 [2.0s]
P10.39	S-curve ACC end segment duration	0.1–360.0 [2.0s]
P10.40	ACC time	0.1–360.0 [2.0s]
P10.41	S-curve DEC start segment duration	0.1–360.0 [2.0s]
P10.42	S-curve DEC end segment duration	0.1–360.0 [2.0s]
P10.43	DEC time	0.1–360.0 [2.0s]
P10.44	S-curve start segment duration during stop	0.1–360.0 [2.0s]
P10.45	S-curve end segment duration during stop	0.1–360.0 [2.0s]
P10.53	DEC time for creeping to stop	0.1–360.0 [2.0s]

P10.38–P10.45 determine the shape of S curve. The S-curve quality directly impacts the comfortability of the lift at startup or stop. The S-cure parameters are listed in the above table. The following figure describes the relationship between these parameters and S-curve.

Figure 6-5 S-curve running

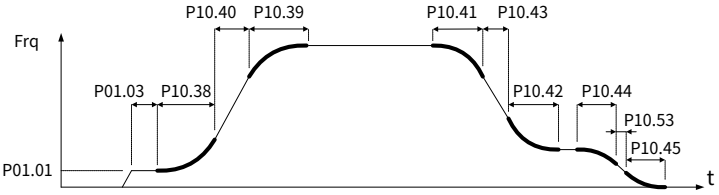
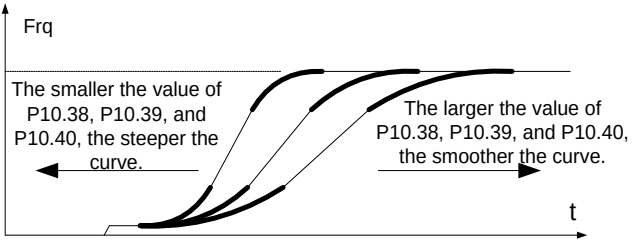


Figure 6-6 S-curve parameter adjustment



The above figure describes the S-curve parameter adjustment during the acceleration segment, in which the S curve changes sharply when the time parameter decreases while the S curve changes slightly when the time parameter increases. The S-curve parameter adjustment principle during the DEC segment and stop segment are similar to that during the ACC segment.

P01.03 indicates the initial speed during VFD startup. During VFD running, if the set speed is less than the starting speed of startup, the VFD output speed is 0. Only when the set speed is greater than or equal to the starting speed, the VFD starts at the starting speed and runs according to the S curve. Setting a proper starting speed can reduce startup impact by overcoming the static friction during startup.

P01.03 indicates the duration that the VFD run at the starting speed at startup.

Note: P10.38–P10.45 are the key S-curve parameters, impacting passenger comfortability during ACC, DEC, and stop.

6.4.4 Adjusting comfortability during startup or stop

Startup comfortability can be adjusted by setting the following function codes: P01.01, P01.03, P10.38, P10.39, P10.40, P03.00, P03.01, and P96.18. If the analog weighing equipment is used, startup pre-torque compensation must be adjusted. For details, see the descriptions of the function codes.

Stop comfortability can be adjusted by setting the following function codes: P10.44, P10.45, P10.53, P03.00, P03.01, and P96.17.

6.4.5 Adjusting lift leveling accuracy

When the leveling error of each floor is different, adjust the position of the leveling board for each floor to ensure that the leveling error of each floor is the same. When the leveling error of each floor is the same, adjust the lift creeping speed (set by multiple speeds) and P10.44, P10.45, and P10.53.

6.5 Lift running mode

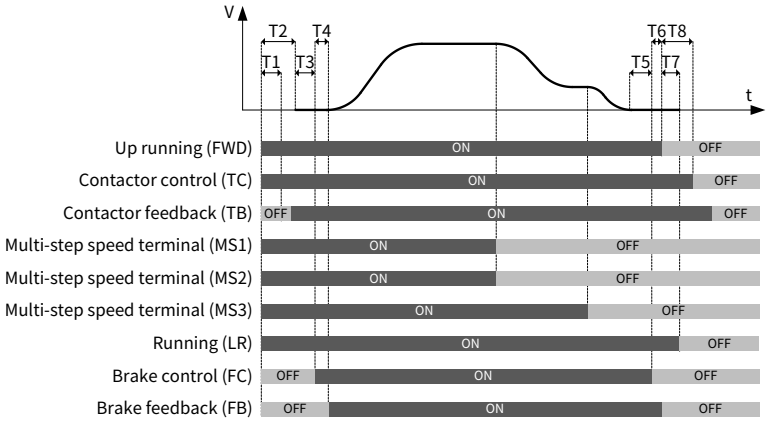
There are two running modes for the VFD: multi-step speed mode and analog speed mode. The multi-step speed mode is mainly used.

6.5.1 Multi-step speed mode (brake and contactor are controlled by the VFD)

In multi-step speed mode, the speed command can be selected by external multi-step terminals. See Figure 6-2 for the wiring diagram. Speed commands (MS1–MS3) are input by S terminals. Brake control (FC) and contactor control (TC) can be set as relay output. Brake feedback (FB) and contactor feedback (TB) are set as S terminal inputs.

The timing diagram for closed-loop running with an encoder is as follows (use the lift up running as an example).

Figure 6-7 Timing diagram for lift multi-step speed running in closed-loop mode



Timing sequence description for closed-loop running with encoder:

1. After receiving the upward running command FWD and speed commands MS1–MS3 from the controller, the VFD sends the contactor actuation command and outputs the running signal.
2. With the delay of T2 (P01.23), the VFD starts zero-speed output.
3. The VFD sends the brake release control signal with the delay of T3 (P96.18).
4. After the delay of T4, the VFD detects that the brake is completely released and then starts acceleration from the starting frequency to the given speed.
5. After the controller switches off the speed commands (MS1–MS3), the VFD decelerates to stop according to the S curve. If the speed reaches P96.29, the VFD

outputs the brake closing command with the delay of T5 (P96.17), requiring the controller to remove the running command.

6. After the delay of T6, the VFD receives the stop command from the controller. With the delay of T7 (P96.30), the VFD stops output and withdraws the running signal during running. With the delay of T8 (P96.23), the VFD disconnects the contactor and the running process ends.

Note: The preceding logic is applicable to contactor and brake signal control by the VFD. For brake and contactor control signal output, the running signal can be used for contactor control and then the auxiliary point of the contactor and control system are serially connected for brake control.

The following table lists the typical function codes for closed-loop multi-step speed running.

Function code	Name	Recommended value	Remarks
P00.00	Speed control mode	3	Feedback vector control
P00.01	Running commands	1	Terminal
P00.03	Max. output frequency	50.00Hz	Based on the motor parameters and requirements
P00.06	Rated speed of the lift	1.000m/s	Based on the requirements
P00.07	Speed command selection	6	Multi-step speed run
P01.15	Stop inflection speed	0.000m/s	Generally, the speed is consistent with the leveling speed. It is usually used to switch the stop curve. After the speed decreases to this point, the stop curves switches to the stop S curve.
P02.00	Motor type	Actual motor type	Based on the traction machine nameplate
P02.15	Rated power of SM	Traction machine nameplate	
P02.16	Rated frequency of SM	Traction machine nameplate	
P02.17	Number of pole pairs of SM	Traction machine nameplate	
P02.18	Rated voltage of SM	Traction machine nameplate	

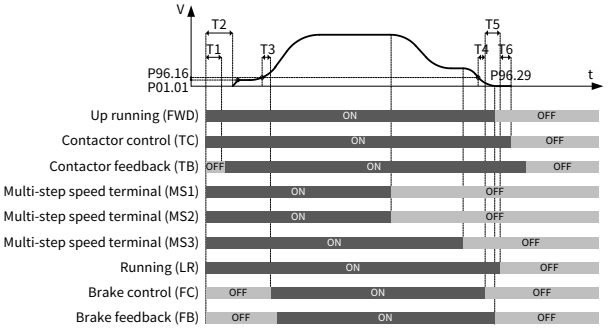
Function code	Name	Recommended value	Remarks
P02.19	Rated current of SM	Traction machine nameplate	
P03	Vector control group	Default value	Adjust according to the running effect
P05.01	Function of S1	1	Up running (FWD)
P05.02	Function of S2	2	Down running (REV)
P05.03	Function of S3	8	Multi-step speed terminal 1 (MS1)
P05.04	Function of S4	9	Multi-step speed terminal 2 (MS2)
P05.05	Function of S5	10	Multi-step speed terminal 3 (MS3)
P05.06	Function of S6	19	VFD enabling (ENA)
P05.07	Function of S7	17	Contactor feedback (TB)
P05.08	Function of S8	18	Brake feedback (FB)
P05.09	Function of S9	3	Maintenance (EXM)
P05.10	Function of S10	6	Fault reset (RET)
P06.01	Y1 output	1	Running feedback output (LR)
P06.03	RO1 relay output	4	Fault output (EO)
P06.04	RO2 relay output	7	Brake control (FC)
P06.05	RO3 relay output	8	Contactor control (TC)
P96.17	Brake closing delay	0.10s	
P96.18	Brake release delay	0.10s	
P96.19	Brake feedback detection time	2.0s	
P96.21	Contactor feedback detection time	2.0s	
P96.30	VFD stop delay	0.10s	
P10.00	Multi-step speed 0	(0) zero speed	Set based on user control requirements. The speed of step 0 is set to 0.000m/s.
P10.01	Multi-step speed 1	Leveling speed	
P10.02	Multi-step speed 2	Emergency speed	
P10.03	Multi-step speed 3	Normal low speed	
P10.04	Multi-step speed 4	Speed at maintenance	
P10.05	Multi-step speed 5	Reserved	
P10.06	Multi-step speed 6	Reserved	
P10.07	Multi-step speed 7	Normal high speed	

Function code	Name	Recommended value	Remarks
P10.38	S-curve ACC start segment duration	2.0s	Set the value according to the onsite commissioning.
P10.39	S-curve ACC end segment duration	2.0s	
P10.40	ACC time	2.0s	
P10.41	S-curve DEC start segment duration	2.0s	
P10.42	S-curve DEC end segment duration	2.0s	
P10.43	DEC time	2.0s	
P10.44	S-curve start segment duration during stop	2.0s	
P10.45	S-curve end segment duration during stop	2.0s	
P10.46	Running speed at maintenance	0.200m/s	
P10.47	ACC/DEC time at maintenance	4.0s	
P10.53	DEC time for creeping to stop	2.0s	
P20.00	Encoder type selection	Determined encoder type/pulse quantity	Based on the encoder used
P20.01	Encoder pulse number		
P20.02	Encoder direction	0	Modified according to the commissioning result

Note: In multi-step speed running mode, multi-step speed 0 must be set to zero speed.

The timing diagram for open-loop running without an encoder is as follows (use the lift upward running as an example).

Figure 6-8 Timing diagram for lift multi-step speed running in open-loop mode



1. After receiving the upward running command FWD and speed commands MS1–MS3 from the controller, the VFD sends the contactor actuation command and outputs the running signal.
2. With the delay of T2 (P01.13), the VFD accelerates to the start frequency P01.01.
3. After accelerating from the start frequency to the P96.16, the VFD sends the brake release control signal with the delay of T3 (P96.18).
4. After brake releasing, the VFD accelerates from the start speed to the given speed.
5. After the controller switches off the speed commands (MS1–MS3), the VFD decelerates to stop according to the S curve. If the speed reaches P96.29, the VFD outputs the brake closing command with the delay of T4 (P96.17), requiring the controller to remove the running command.
6. With the delay of T5 (P96.30) after the VFD receives the stop command from the controller, the VFD stops output and withdraws the running signal during running. With the delay of T6 (P96.23), the VFD disconnects the contactor and the running process ends.

The following table lists the typical function codes for open-loop multi-step speed running.

Function code	Name	Recommended value	Remarks
P00.00	Speed control mode	0	Sensorless vector control (SVC) mode 0
P00.01	Running commands	1	Terminal
P00.03	Max. output frequency	50.00Hz	Based on the motor parameters and requirements
P00.06	Rated speed of the lift	1.000m/s	Based on the requirements

Function code	Name	Recommended value	Remarks
P00.07	Speed command selection	6	Multi-step speed run
P01.00	Running mode of start	1	Start after DC braking
P01.01	Starting speed of direct start	0.000m/s	
P01.04	Braking current before start	80%	
P01.09	Starting frequency of DC braking for stop	0.2Hz	
P01.10	DC braking current for stop	80%	
P01.15	Stop inflection speed	0.000m/s	Generally, the speed is consistent with the leveling speed. It is usually used to switch the stop curve. After the speed decreases to this point, the stop curves switches to the stop S curve.
P02.00	Motor type	Actual motor type	Based on the traction machine nameplate
P02.01	Rated power of AM	Traction machine nameplate	
P02.02	Rated frequency of AM	Traction machine nameplate	
P02.03	Rated speed of AM	Traction machine nameplate	
P02.04	Rated voltage of AM	Traction machine nameplate	
P02.05	Rated current of AM	Traction machine nameplate	
P03 group	Vector control group	Default value	Adjust according to the running effect
P05.01	Function of S1	1	Up running (FWD)
P05.02	Function of S2	2	Down running (REV)
P05.03	Function of S3	8	Multi-step speed terminal 1 (MS1)
P05.04	Function of S4	9	Multi-step speed terminal 2 (MS2)
P05.05	Function of S5	10	Multi-step speed terminal 3 (MS3)
P05.06	Function of S6	19	VFD enabling (ENA)
P05.07	Function of S7	17	Contactor feedback (TB)

Function code	Name	Recommended value	Remarks
P05.08	Function of S8	18	Brake feedback (FB)
P05.09	Function of S9	3	Maintenance (EXM)
P05.10	Function of S10	6	Fault reset (RET)
P06.01	Y1 output	1	Running feedback output (LR)
P06.03	RO1 relay output	4	Fault output (EO)
P06.04	RO2 relay output	7	Brake control (FC)
P06.05	RO3 relay output	8	Contactor control (TC)
P96.16	AM open-loop start brake release frequency	0.0Hz	
P96.17	Brake closing delay	0.10s	
P96.18	Brake release delay	0.10s	
P96.19	Brake feedback detection time	2.0s	
P96.21	Contactor feedback detection time	2.0s	
P96.29	Stop braking frequency	0.40Hz	
P96.30	VFD stop delay	0.10s	
P10.00	Multi-step speed 0	(0) zero speed	Set based on user control requirements. The speed of step 0 is set to 0m/s.
P10.01	Multi-step speed 1	Leveling speed	
P10.02	Multi-step speed 2	Emergency speed	
P10.03	Multi-step speed 3	Normal low speed	
P10.04	Multi-step speed 4	Speed at maintenance	
P10.05	Multi-step speed 5	Reserved	
P10.06	Multi-step speed 6	Reserved	
P10.07	Multi-step speed 7	Normal high speed	
P10.38	S-curve ACC start segment duration	2.0s	Set the value according to the onsite commissioning.
P10.39	S-curve ACC end segment duration	2.0s	
P10.40	ACC time	2.0s	
P10.41	S-curve DEC start segment duration	2.0s	
P10.42	S-curve DEC end segment duration	2.0s	
P10.43	DEC time	2.0s	

Function code	Name	Recommended value	Remarks
P10.44	S-curve start segment duration during stop	2.0s	
P10.45	S-curve end segment duration during stop	2.0s	
P10.46	Running speed at maintenance	0.200m/s	
P10.47	ACC/DEC time at maintenance	4.0s	
P10.53	DEC time for creeping to stop	2.0s	

Note: The open-loop control is only available for AMs.

6.5.2 Analog speed tracking running mode

This running mode indicates that the speed command is provided by analog input, the VFD passively runs based on the analog signal as provided, the elevator running curve is determined by the analog change curve generated by the external controller, and the VFD is responsible for driving the motor to run. The analog tracking running input channel must be provided by AI1 (P00.07=1).

The running sequence in this mode is similar to that in the multi-step speed running mode. See Figure 6-7 for details.

Typical function codes for analog tracking speed mode (use the open-loop running mode as an example)

Function code	Name	Recommended value	Remarks
P00.00	Speed control mode	0	Sensorless vector control (SVC) mode 0
P00.01	Running commands	1	Terminal
P00.03	Max. output frequency	50.00Hz	Based on the motor parameters and requirements
P00.06	Rated speed of the lift	1.000m/s	Based on the requirements
P00.07	Speed command selection	1	AI1 (follow)
P01.00	Running mode of start	1	Start after DC braking
P01.01	Starting speed of direct start	0.000m/s	
P01.04	Braking current before start	80%	

Function code	Name	Recommended value	Remarks
P01.09	Starting frequency of DC braking for stop	0.2Hz	
P01.10	DC braking current for stop	80%	
P01.15	Stop inflection speed	0.000m/s	Generally, the speed is consistent with the leveling speed. It is usually used to switch the stop curve. After the speed decreases to this point, the stop curves switches to the stop S curve.
P02.00	Motor type	Actual motor type	Based on the traction machine nameplate
P02.01	Rated power of AM	Traction machine nameplate	
P02.02	Rated frequency of AM	Traction machine nameplate	
P02.03	Rated speed of AM	Traction machine nameplate	
P02.04	Rated voltage of AM	Traction machine nameplate	
P02.05	Rated current of AM	Traction machine nameplate	
Group P03	Vector control group	Default value	Adjust according to the running effect
P05.01	Function of S1	1	Up running (FWD)
P05.02	Function of S2	2	Down running (REV)
P05.03	Function of S3	8	Multi-step speed terminal 1 (MS1)
P05.04	Function of S4	9	Multi-step speed terminal 2 (MS2)
P05.05	Function of S5	10	Multi-step speed terminal 3 (MS3)
P05.06	Function of S6	19	VFD enabling (ENA)
P05.07	Function of S7	17	Contactor feedback (TB)
P05.08	Function of S8	18	Brake feedback (FB)
P05.09	Function of S9	3	Maintenance (EXM)
P05.10	Function of S10	6	Fault reset (RET)
P05.37	AI1 lower limit	0.00V	Adjust according to actual needs
P05.38	Corresponding setting of AI1 lower limit	0.0%	

Function code	Name	Recommended value	Remarks
P05.39	AI1 upper limit	10.00V	
P05.40	Corresponding setting of AI1 upper limit	100.00%	
P05.41	AI1 input filter time	0.030s	
P06.01	Y1 output	1	Running feedback output (LR)
P06.03	RO1 relay output	4	Fault output (EO)
P06.04	RO2 relay output	7	Brake control (FC)
P06.05	RO3 relay output	8	Contactor control (TC)
P96.16	AM open-loop start brake release frequency	0.0Hz	
P96.17	Brake closing delay	0.10s	
P96.18	Brake release delay	0.10s	
P96.19	Brake feedback detection time	2.0s	
P96.21	Contactor feedback detection time	2.0s	
P96.29	Stop braking frequency	0.40Hz	
P96.30	VFD stop delay	0.10s	

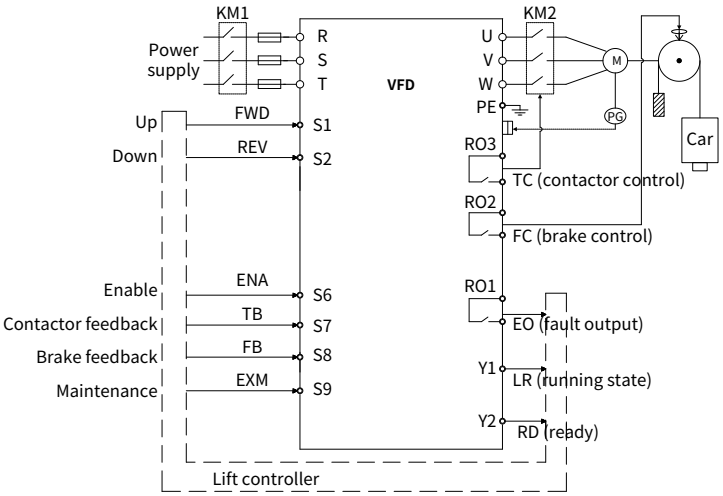
Note:

- During analog tracking running, the VFD internal S curve does not work, the S curve of lift running is generated by the external lift controller. Adjusting P05.41 or P05.50 impacts the sensitivity of analog input.
- Great analog change ratio will cause a sudden change in running frequency of the VFD, which may result in VFD overcurrent or overvoltage faults.

6.5.3 Maintenance running

Figure 6-9 shows the basic wiring for maintenance running.

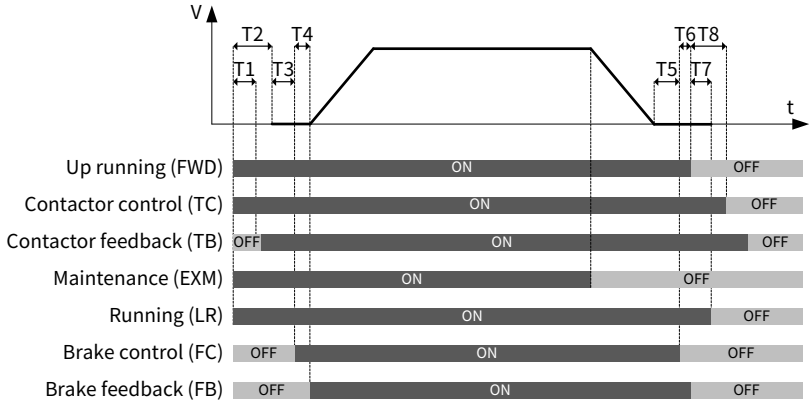
Figure 6-9 Wiring for maintenance running



The maintenance running is the same as the normal timing sequence. The maintenance ACC/DEC is linear. The maintenance speed is set by P10.46.

For detailed timing sequence description, see section 6.5.1 Multi-step speed mode (brake and contactor are controlled by the VFD).

Figure 6-10 Timing sequence of maintenance running

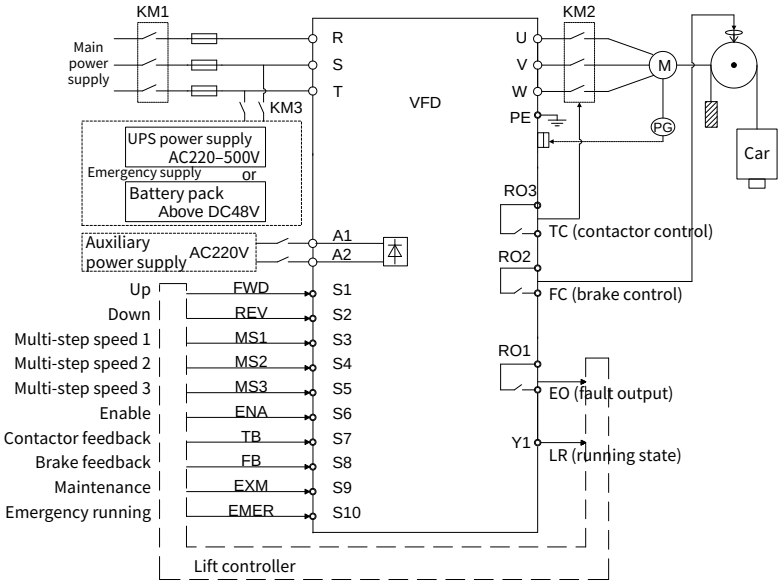


6.5.4 Emergency running

The emergency running based on the multi-step speed mode is shown in Figure 6-11. The

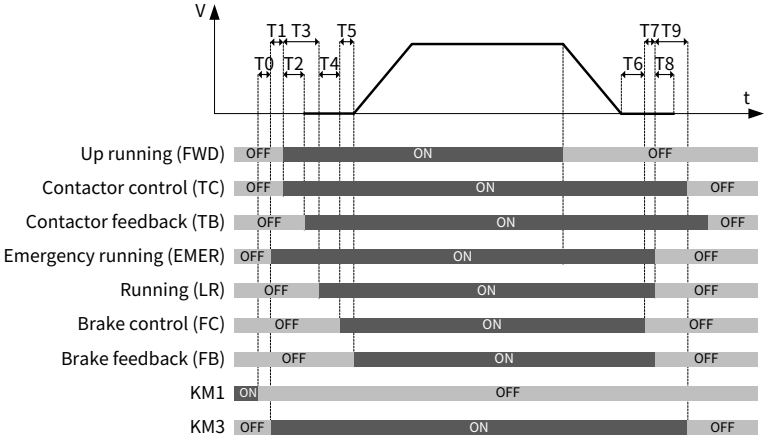
UPS is connected to any two phases of R, S, and T of the VFD to provide main power to the motor drive in case of main power RST power failure. The auxiliary control power is connected to A1 and A2 of the VFD to provide control power to the VFD in case of main power RST power failure. When the UPS is AC power supply of more than 220V or DC power supply of more than 250V, A1 and A2 can be not connected to the 220V auxiliary control power. After the controller sends the emergency running signal (EMER), the KM3 contactor is immediately connected externally to the VFD, allowing the auxiliary power to be connected to the VFD. After the EMER signal is removed and the VFD is stopped, disconenct the KM3 contactor, i.e. disconnect the auxiliary power from the VFD.

Figure 6-11 Wiring for emergency running



Timing diagram for emergency running is as follows.

Figure 6-12 Timing sequence of emergency running



The meanings of T0–T9 are as follows:

Symbol	Meaning
T0	Delay time from the main power is switched off to the switch of external emergency power is on.
T1	Delay time from the time when the VFD receives the running signal to the time when the VFD outputs contactor actuation command.
T2	Wait delay time from the time when the VFD outputs contactor actuation command to the time when the VFD receives the contactor feedback signal.
T3	Delay time from the time when the run command is sent to the time when the☒ run signal is output
T4	Delay time from the time when the run signal is output to the time when the brake open signal is sent.
T5	Interval from the brake open command sending time to the feedback time of brake open.
T6	Brake closing delay from the time when the VFD reaches the braking frequency to the time when the brake closing command is sent. (P96.17)
T7	Wait delay time from the time when the VFD outputs the brake close command to the time when the VFD receives the stop command from the external controller.
T8	Delay time from the time when the VFD receives the stop command to the time when the VFD stops output.
T9	Contactor switch-off delay from the VFD stops to the time when the contactor is disconnected. (P96.23)

1. When the main power is off, the controller cuts off the main power relay (KM1), after T0, the emergency command (EMER) outputs. After receiving the emergency command, the VFD close the internal relays K3–K6 immediately. After T1, the VFD receives the running command (FWD/REW) from the controller, and outputs contactor actuation control command.
2. Then after T2, the VFD detects the contactor actuation command signal, and then the VFD starts to run at zero speed, at the same time outputs running signal (Y1). After T4, the VFD outputs brake release signal.
3. After T5, the VFD detecs brake feedback signal, after affirming the brake is released completely, the VFD accelerates with emergency acceleration time (P10.50) to reach to emergency running speed (10.49), and then runs at a constant speed.
4. When the lift runs to the leveling floor, the controller will cut off emergency command (EMER), and the VFD begins to decelerate to stop with emergency deceleration time (P10.50), when the VFD decelerates to P96.29, after T6, the VFD outputs brake close command, and requires the controller to cut off running command.
5. After T7, the VFD receives the stop command, and then after the delay time of T8 and T9, the VFD stops, and outputs contactor releasing command and lift stop signal (Y1). By now, one operation cycle ends.

7 Communication protocol

This chapter describes the communication protocol of the VFD.

7.1 Modbus protocol

The VFD provides RS485 communication interfaces and adopts the master-slave communication based on the international standard Modbus communication protocol. You can implement centralized control (setting commands for controlling the VFD, modifying the running frequency and related function code parameters, and monitoring the working state and fault information of the VFD) through PC/PLC, upper control computer, or other devices to meet specific application requirements.

Modbus is a communication protocol for use with electronic controllers. By using this protocol, a controller can communicate with other devices through transmission lines. It is a general industrial standard. With this standard, control devices produced by different manufacturers can be connected to form an industrial network and be monitored in a centralized way.

The Modbus protocol provides two transmission modes, namely American Standard Code for Information Interchange (ASCII) and remote terminal units (RTU). On one Modbus network, all the device transmission modes, baud rates, data bits, check bits, end bits, and other basic parameters must be set consistently.

A Modbus network is a control network with one master and multiple slaves, that is, on one Modbus network, there is only one device serving as the master, and other devices are the slaves. The master can communicate with any single slave or with all slaves. For separate access commands, a slave needs to return a response. For broadcasted information, slaves do not need to return responses.

7.1.1 Application of Modbus

The VFD uses the Modbus RTU mode and communicates through RS485 interfaces.

7.1.1.1 RS485

RS485 interfaces work in half-duplex mode and transmit data signals in the differential transmission way, which is also referred to as balanced transmission. An RS485 interface uses a twisted pair, where one wire is defined as A (+), and the other B (-). Generally, if the positive electrical level between the transmission drives A and B ranges from +2V to +6V, the logic is "1"; and if it ranges from -2V to -6V, the logic is "0".

On the VFD terminal block, the 485+ terminal corresponds to A, and 485- corresponds to B.

The communication baud rate (P14.00) indicates the number of bits sent in a second, and the unit is bit/s (bps). A higher baud rate indicates faster transmission and poorer anti-interference capability. When a twisted pair of 0.56mm (24AWG) is used, the maximum transmission distance varies according to the baud rate, as described in the following table.

Baud rate	Max. transmission distance	Baud rate	Max. transmission distance
2400bps	1800m	9600bps	800m
4800bps	1200m	19200bps	600m

In long-distance RS485 communication, it is recommended that you use shielded cables, and use the shielding layer as the ground wire.

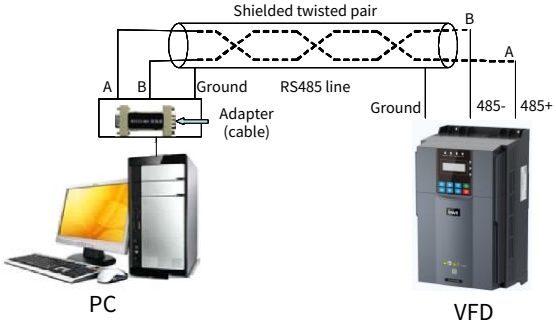
When there are fewer devices and the transmission distance is short, the whole network works well without terminal load resistors. The performance, however, degrades as the distance increases. Therefore, it is recommended that you use a 120Ω terminal resistor when the transmission distance is long.

7.1.1.1.1 Application to one VFD

Figure 7-1 is the Modbus wiring diagram of one VFD and a PC. Generally, PCs do not provide RS485 interfaces, and therefore you need to convert an RS232 interface or USB port of a PC to an RS485 interface. Connect end A of the RS485 communication cable to the 485+ port on the terminal block of the VFD, and connect end B to the 485- port. It is recommended that you use shielded twisted pairs. When an RS232-RS485 adapter is used, the cable used to connect the RS232 interface of the PC and the adapter cannot be longer than 15m. Use a short cable when possible. It is recommended that you insert the adapter directly into the PC. Similarly, when a USB-RS485 converter is used, use a short cable when possible.

After wiring, select the correct port (such as COM1 to connect the RS232-RS485 converter) on the upper computer, and set the basic parameters such as baud rate and data bit check consistent with those of the VFD.

Figure 7-1 Wiring of one RS485 VFD application



7.1.1.1.2 Application to multiple VFDs

In pratical application to multiple VFDs, chrysanthemum connection and star connection are commonly used.

According to the requirements of the RS485 industrial bus standards, all the devices need to be connected in chrysanthemum mode with one 120 Ω terminal resistor at the first and last ends, as shown in Figure 7-2. Figure 7-3 shows the simplified wiring diagram. Figure 7-4 shows the actual application.

Figure 7-2 Onsite chrysanthemum connection

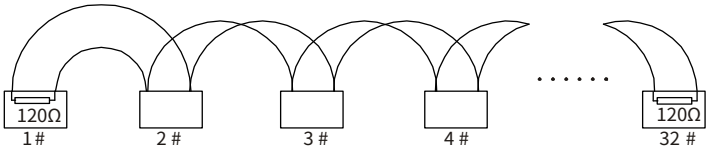


Figure 7-3 Simplified chrysanthemum connection

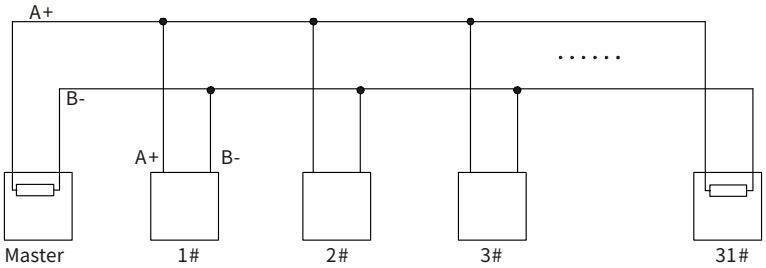


Figure 7-4 Practical chrysanthemum connection application

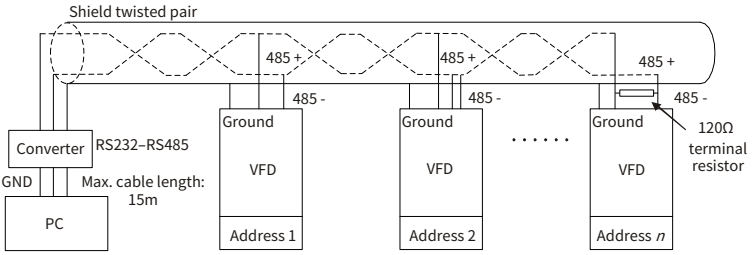
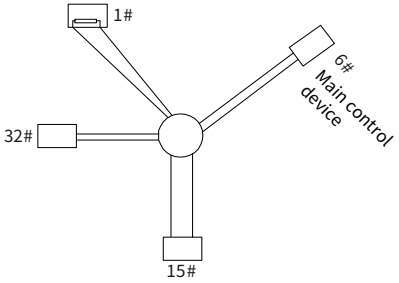


Figure 7-5 shows the start connection diagram. When this connection mode is adopted, each of the two devices that are farthest away from each other on the line must be configured with a terminal resistor (in this figure, the two devices are devices 1# and 15#).

Figure 7-5 Star connection



Use shielded cables, if possible, in multi-device connection. The baud rates, data bit check settings, and other basic parameters of all the devices on the RS485 line must be set consistently, and addresses cannot be repeated.

7.1.1.2 RTU mode

7.1.1.2.1 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 transmit more data with the same baud rate.

Code system

- 1 start bit
- 7 or 8 data bits; the minimum valid bit is transmitted 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 end bit (with check performed), 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	Check bit	Stop bit

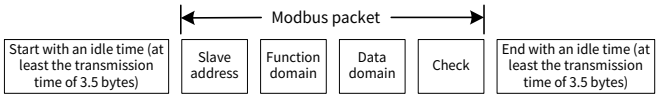
10-bit character frame (Bits 1 to 7 are data bits)

Start bit	BIT1	BIT2	BIT3	BIT4	BIT5	BIT6	BIT7	Check bit	Stop bit

In a character frame, only the data bits carry information. The start bit, check bit, and end 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, the transmission of a new frame always starts from an idle time (the transmission time 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 transmitted in the following sequence: slave address, operation command code, data, and CRC check character. Each byte sent in each domain includes 2 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 transmission time 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 transmitted 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 (decimal system) (0 is 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 LSB	Detection value: CRC verification value (16 bits)
CRC CHK MSB	
END (frame tail)	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

7.1.1.2.2 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 an incorrect response. The incorrect 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 incorrect.

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 sent 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.

Cyclic redundancy check (CRC)

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, stop, 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 least significant bit (LSB) to the most significant bit (MSB), and 0 is placed in the MSB. Then, LSB is detected. If LSB is 1, the XOR operation is performed on the current value in the register and the preset value. If LSB is 0, no operation is performed. This process is repeated for 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.

7.1.2 RTU command codes and communication data

7.1.2.1 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 presented using the hexadecimal system (a number followed by "H" indicates a hexadecimal value). One hexadecimal value occupies one byte.

The 03H command is used to read information including the parameters and running status of the VFD.

For example, to read two contiguous data content pieces from 0004H from the VFD with the address of 01H (that is, to read content from data addresses 0004H and 0005H), the frame structure is as follows:

RTU master command (from the master to the VFD)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR (address)	01H
CMD (command code)	03H
Start address MSB	00H
Start address LSB	04H
Data count MSB	00H
Data count LSB	02H
CRC LSB	85H

CRC MSB	CAH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

The value in START and END is "T1-T2-T3-T4 (transmission time of 3.5 bytes)", indicating that the RS485 needs to stay idle for at least the transmission time of 3.5 bytes. An idle time is required to distinguish on message from another to ensure that the two messages are not regarded as one.

"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" means reading data from the address and it occupies two bytes with the MSB on the left and LSB 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 LSB on the left, and MSB on the right.

RTU slave response (from the VFD to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	03H
Number of bytes	04H
MSB of data in 0004H	13H
LSB of data in 0004H	88H
MSB of data in 0005H	00H
LSB of data in 0005H	00H
CRC LSB	7EH
CRC MSB	9DH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

The definition of the response information is described as follows:

"ADDR" is "01H", indicating that the command 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 LSB", that is, "MSB of data in 0004H", "LSB of data in 0004H", "MSB of data in 0005H", and "LSB of data in 0005H".

A piece of data contains two bytes, with the MSB on the left and LSB 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 LSB on the left, and MSB on the right.

7.1.2.2 Command code 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, if the master writes 5000 (1388H) to 0004H of the VFD whose address is 02H, the frame structure is as follows.

RTU master command (from the master to the VFD)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
MSB of data writing address	00H
LSB of data writing address	04H
MSB of data content	13H
LSB of data content	88H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU slave response (from the VFD to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
MSB of data writing address	00H
LSB of data writing address	04H
MSB of data content	13H
LSB of data content	88H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

Note: The sections 7.1.2.1 and 7.1.2.2 mainly describe the command formats. For the detailed application, see the examples in section 7.1.2.8.

7.1.2.3 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 format is described as follows.

RTU master command:

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code MSB	00H
Sub-function code LSB	00H
MSB of data content	12H
LSB of data content	ABH
CRC CHK LSB	ADH
CRC CHK MSB	14H
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU slave response:

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code MSB	00H
Sub-function code LSB	00H
MSB of data content	12H
LSB of data content	ABH
CRC CHK LSB	ADH
CRC CHK MSB	14H
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

7.1.2.4 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 quantity", 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 structure is as follows.

RTU master command (from the master to the VFD)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	10H
MSB of data writing address	00H
LSB of data writing address	04H
Data count MSB	00H
Data count LSB	02H
Number of bytes	04H
MSB of data to be written to 0004H	13H
LSB of data to be written to 0004H	88H
MSB of data to be written to 0005H	00H
LSB of data to be written to 0005H	32H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU slave response (from the VFD to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	10H
MSB of data writing address	00H
LSB of data writing address	04H
Data count MSB	00H
Data count LSB	02H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

7.1.2.5 Data address definition

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

7.1.2.5.1 Function code address format rules

The address of a function code consists of two bytes, with the MSB on the left and LSB on the right. The high-order byte ranges from 00 to ffH, and the low-order byte also ranges from 00 to ffH. The MSB is the hexadecimal form of the group number before the dot mark, and LSB is that of the number behind the dot mark. Take P05.06 as an example: The group number is 05, that is, the MSB of the parameter address is the hexadecimal form of 05; and the number behind the dot mark is 06, that is, the LSB is the hexadecimal form of 05. Therefore, the function code address is 0506H in the hexadecimal form. For P10.01, the parameter address is 0A01H.

Function code	Name	Description	Setting range	Default	Modify
P10.00	Multi-step speed 0	Multi-step speed 0	0.000–P00.06(m/s)	0.000	○
P10.01	Multi-step speed 1	Multi-step speed 1	0.000–P00.06(m/s)	0.000	○

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.

7.1.2.5.2 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 the VFD, and monitoring the running status of the VFD. The following table lists other function parameters.

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Run forward	R/W
		0002H: Run reversely	
		0003H: Jog forward	
		0004H: Jog reversely	
		0005H: Stop	

Function	Address	Data description	R/W
		0006H: Coast to stop	
		0007H: Fault reset	
		0008H: Jogging 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	Upper limit setting of forward running frequency (0–Fmax; unit: 0.01 Hz)	R/W
	2006H	Upper limit setting of reverse running frequency (0–Fmax; unit: 0.01Hz)	R/W
	2007H	Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W
	2008H	Braking torque upper limit (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W
	2009H	Special CW 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 data =0: Keep electricity consumption data Bit4: =1 Enable pre-excitation =0: Disable pre-excitation Bit5: =1 Enable DC braking =0: Disable DC braking	R/W
	200AH	Virtual input terminal command (0x000–0x3FF) Corresponding to the local S10/S9/S8/S7/S6/S5/S4/S3/S2/S1	R/W
	200BH	Virtual output terminal command (range: 0x00–0x0F) (corresponding to local RO3/RO2/RO1/Y1)	R/W
	200CH	Voltage setting (used when V/F separation is implemented)	R/W

Function	Address	Data description		R/W
		(0–1000, in which 1000 corresponds to 100.0% of the motor rated voltage)		
	200DH	AO setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)		R/W
	200EH	AO setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)		R/W
VFD status word 1	2100H	0001H: Forward running		R
		0002H: Reverse running		
		0003H: Stopped		
		0004H: VFD in fault		
		0005H: POFF		
		0006H: Pre-exciting		
VFD status word 2	2101H	Bit0: =0: Not ready to run =1: Ready to run Bit1–2=00: Motor 1 =01: Motor 2 Bit3: =0: AM =1: SM Bit4: = 0: No pre-alarm upon overload =1: overload pre-alarm Bit5–Bit6=00: Keypad-based control =01: Terminal-based control =10: Communication-based control Bit 7: Reserved Bit8=0: Speed control =1: Torque control Bit9=0: Non position control =1: Position control Bit10–Bit11: =0: Vector 0 =1: Vector 1 =2: Closed-loop vector = 3: Space voltage vector		R
VFD fault code	2102H	See the description of fault types.		R
VFD identification code	2103H	GD390L-----0x2701		R
Running frequency	3000H	0–Fmax (Unit: 0.01Hz)	Compatible with CHF100A and CHV100 communication addresses	R
Set frequency	3001H	0–Fmax (Unit: 0.01Hz)		R
Bus voltage	3002H	0.0–2000.0V (Unit: 0.1V)		R
Output voltage	3003H	0–1200V (Unit: 1V)		R
Output current	3004H	0.0–3000.0A (Unit: 0.1A)		R
Rotational speed	3005H	0–65535 (Unit: 1rpm)		R
Output power	3006H	-300.0–300.0% (Unit: 0.1%)		R
Output torque	3007H	-250.0–250.0% (Unit: 0.1%)		R

Function	Address	Data description	R/W
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 IO status	300AH	0x00–0x3F Corresponding to the local S10/S9/S8/S7/S6/S5/S4/S3/S2/S1	R
Output IO status	300BH	0x00–0x0F (corresponding to local RO3/RO2/RO1/Y1)	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 HDIA high-speed pulse	3010H	0.00–50.00kHz (Unit: 0.01Hz)	R
Read input of HDIB high-speed pulse	3011H		R
Read the actual step of multi-step speed	3012H	0–15	R
External length value	3013H	0–65535	R
External counting value	3014H	0–65535	R
Torque setting	3015H	-300.0–300.0% (Unit: 0.1%)	R
VFD identification code	3016H		R
Fault code	5000H		R

The Read/Write (R/W) characteristics indicate whether a function parameter 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 parameter can only be read, and W indicates that a function parameter can only be written.

Note: Some parameters in the preceding table are valid only after they are enabled. For example, for the running or stop operation, you must set "Channel of running commands" (P00.01) to "Communication", and set "Communication channel of running commands" (P00.02) to "Modbus".

7.1.2.6 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, multiply 50.12 by 100 to obtain an integer 5012, and then 50.12 can be represented as 1394H in the hexadecimal form (5012 in the decimal 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 decimal places in the value specified in "Setting range" or "Default". If there are n decimal places in the value, the fieldbus scale m is the nth-power of 10. Take the following table as an example, m is the value of 10 to the power of n.

7.1.2.7 Error message response

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

Error message responses are sent from the VFD to the master. The following table lists 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 host controller is not allowed. In particular, the combination of the register address and the number of the to-be-sent bytes 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 setting is invalid in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Incorrect password	The password entered in the password verification address is different from that set in P07.00.
06H	Data frame error	The data frame sent from the host controller is incorrect in the length, or in the RTU format, the value of the CRC check bit is

Code	Name	Definition
		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 host controller is a read-only parameter.
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the host controller cannot be modified during the running of the VFD.
09H	Password protection	If the host controller does not provide the correct password to unlock the system to perform a read or write operation, the error of "system being locked" is reported.

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

For example, if the master sends a request message to a slave for reading a group of function code address data, the following code is generated:

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

In a normal response, the slave returns the same function code. In an exception response, the slave returns the following code:

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 is to send the request message again or modify the command based on the fault information.

For example, to set the "Channel of running commands" (P00.01, the parameter address is 0000H) to 03 for the VFD whose address is 01H, the command is as follows:

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

However, the "Running command channel" ranges from 0 to 2. The value 3 is out of 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 highest-order bit "1" of the write command 06H) indicates that it is an exception response to the write command (06H). The error code is 04H, which indicates "Operation failure".

7.1.2.8 Read/Write operation examples

For the formats of the read and write commands, see section section 7.1.2.1 and 7.1.2.2.

7.1.2.8.1 Example of reading command 03H

Example 1: Read SW 1 of the VFD whose address is 01H. According to the table of other Modbus function addresses in section 7.1.2.5.2 Addresses of other Modbus functions, 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 present 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	Most recent 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 STo fault.

7.1.2.8.2 Example of writing command 06H

Example 1: Set the VFD whose address is 03H to run forward. According to the table of address description of other function codes in section 7.1.2.5.2 Addresses of other Modbus functions, the parameter address of "communication-based control command" is 2000H and forward running is 0001.

The command sent from 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 (same as the command transmitted from the master) is returned:

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

Example 2: Set the max. output frequency to 100Hz for the VFD with the address of 03H.

Function code	Name	Description	Setting range	Default	Modify
P00.03	Max. output frequency	P00.04–200.00H	P00.04–200.00Hz	50.00Hz	◎

According to the number of decimal places, 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 (same as the command transmitted from the master) is returned:

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.

7.1.2.8.3 Example of continuous writing 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 address description of other function codes in section 7.1.2.5.2 Addresses of other Modbus functions, the parameter address of "communication-based control command" is 2000H and forward running is 0001. The address of "Communication-set frequency" is 2001H and 10Hz corresponds to 03E8H.

In the actual operation, set P00.01 to 2 and P00.07 to 8.

The command sent 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 "Acceleration time" of the VFD whose address is 01H to 10s, and "Deceleration time" to 20s.

Function code	Name	Description	Default	Modify
P00.11	ACC time 1	P00.11 and P00.12 setting range: 0.0–3600.0s	Model depended	○
P00.12	DEC time 1		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 sent 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:

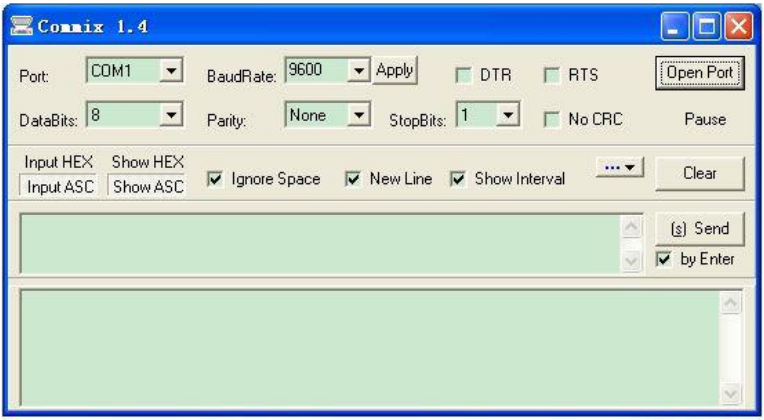
01	10	00 0B	00 02	30 0A
VFD address	Continuous write command	Parameter address	Parameter quantity	CRC

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.

7.1.2.8.4 Example of Modbus communication commissioning

A PC is used as the host, an RS232-RS485 converter is used for signal conversion, and the PC serial port used by the converter is COM1 (an RS232 port). The host controller 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** ☑ ModbusRTU, select **CRC16 (MODBU SRTU)**, 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:

- Set the address (P14.00) of the VFD to 03.
- Set "Channel of running commands" (P00.01) to "Communication", and set

"Communication channel of running commands" (P00.02) to the Modbus channel.

- Click **Send**. If the line configuration and settings are correct, a response transmitted from the VFD is received.

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

7.1.3 Common communication faults

Common communication faults include the following:

- No response is returned.
- The VFD returns an exception response.

Possible causes of no response include the following:

1. The serial port is set incorrectly. For example, the adapter uses the serial port COM1, but COM2 is selected for the communication.
2. The settings of the baud rates, data bits, end bits, and check bits are inconsistent with those set on the VFD.
3. The positive pole (+) and negative pole (-) of the RS485 bus are connected reversely.
4. The resistor connected to 485 terminals on the terminal block of the VFD is set incorrectly.

7.2 CANopen communication protocol

7.2.1 Electrical connection

1. Supported functions
   - Supports the CAN2.0A protocol
   - Supports the CANopen DS301
2. Supported CANopen services
   - PDO: 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 a VFD, and the PDO2, PDO3 and 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 node protection (NMT Node Guarding).
- Supports heartbeat packets (Heartbeat Producer).
- 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 disabled time.
- Supports event timers.
- Supports manufacturer-defined object dictionary. You can use SDOs to control and obtain the actual parameter values of a VFD in real time.

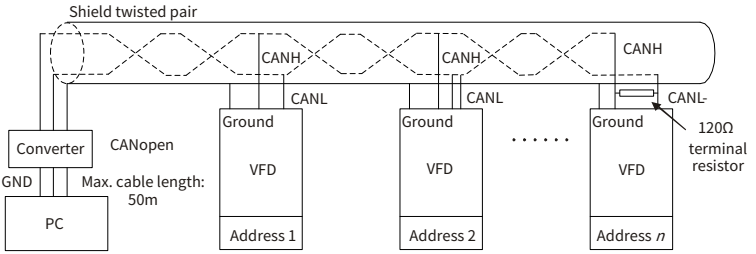
3. Non-supported CANopen services
   - Saves object dictionary parameters at power outage
   - Time stamp service
4. Supported CANopen addresses and baud rates

Table 7-1 Supported addresses and baud rates

Item	Supported specification
Address	1–127 (decimal)
Baud rate	20k bps (bit/s)
	50k bps (bit/s)
	100k bps (bit/s)
	125k bps (bit/s)
	250k bps (bit/s)
	500k bps (bit/s)
	800k bps (bit/s)
	1000k bps (bit/s)

Use shielding wires as the bus cable, if possible. It is recommended to connect the shield cable to the PE terminal of the VFD when using it. When the last VFD is used as a terminal slave, it is required to turn on the terminal resistor switch. See Figure 7-6.

Figure 7-6 Electrical wiring diagram

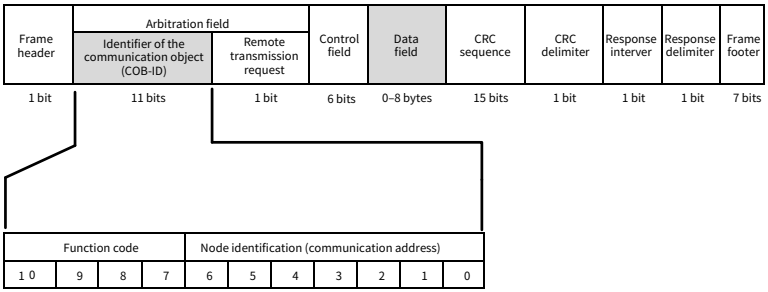


7.2.2 Communication

7.2.2.1 Packet format

CAN2.0A packets are used to transmit data between the master station and bus nodes through data frames.

Figure 7-7 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

Communication object	Function code (binary)	COB-ID (hexadecimal)
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.

7.2.2.2 CANopen state transition

The start sequence defined in the CANopen communication protocol is supported. The following figure shows the NMT state transition diagram.

Figure 7-8 NMT state diagram

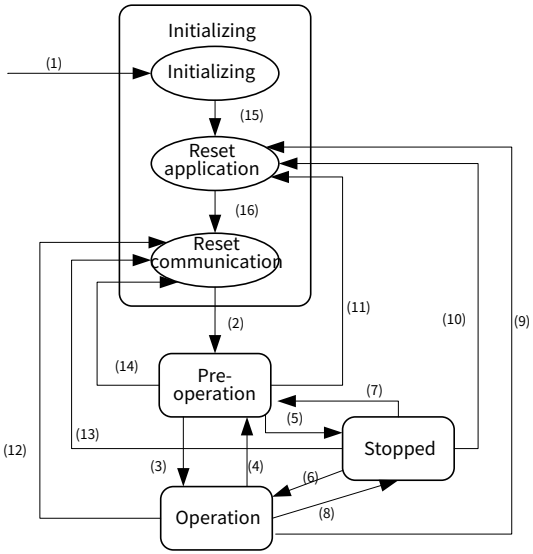


Table 7-2 NMT state transition

State transition	Required triggering event
(1)	Automatic initialization after power-on
(2)	Automatic change after initialization
(3), (6)	Command of the NMT master station for starting a remote node
(4), (7)	Command of the NMT master station for entering the pre-operation state

State transition	Required triggering event
(5), (8)	Command of the NMT master station for entering the stopped state
(9), (10), (11)	Command of the NMT master station for resetting a remote node
(12), (13), (14)	Command of the NMT master station for resetting a remote node communication parameter

Different services are supported in different states, as described in Table 7-3.

Table 7-3 Services supported in various NMT states

Service	Pre-operation state	Operation state	Stopped state
PDOs	No	Yes	No
SDOs	Yes	Yes	No
SYNC packets	Yes	Yes	No
Emergency packets	Yes	Yes	No
Network management	Yes	Yes	No
Error control	Yes	Yes	Yes

7.2.2.3 Management service command (NMT)

This function is used by the master station to control the NMT states of slave station nodes. After powering on, this VFD is forced to enter the operating state.

- **Command**

Master station -> slave station

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

- **Description**

The command COB-ID is fixed to 0x00. If Node-ID is set to 0, the command is broadcasted to all CANopen slave stations, and each slave station must execute the NMT command. Table 7-4 describes the function of each CS.

Table 7-4 Function of each CS

NMT CS	NMT service (control action)
0x01	Starts a slave station device.
0x02	Stops a slave station device.
0x80	Enables a slave station to enter the pre-operation state.
0x81	Resets a slave station.
0x82	Resets communication of a node.

- **Example**

For example, the command to enable the VFD, 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 VFD nodes on the CANopen network is described as follows.

COB-ID	Byte0	Byte1
0x000	0x01	0x00

7.2.2.4 Node protection (NMT Node Guarding)

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

- **Command**

Request: Master station (remote frame) –> slave station

COB-ID	No data
0x700 + Node-ID	

Response: Slave station -> master station

COB-ID	Byte0 (state value)
0x700 + Node-ID	Bit 7: Triggering bit; Bits 0 to 6: State

- **Description**

The most significant bit (MSB) bit 7 of Byte0 (state 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 station transmits a response frame to distinguish frames. Bits 0 to 6 indicate the state of the slave station. Table 7-5 describes the state values and their corresponding state.

Table 7-5 State values and their corresponding states

State value (Byte0: Bits 0–6)	State
0x00	Initializing
0x04	Stopped
0x05	Operation
0x7F	Pre-operational

- **Example**

For example, the command for the master station to detect the state of slave station 3.

Master station (remote frame) -> slave station

COB-ID	No data
0x703	-

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

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

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

7.2.2.5 Heartbeat packet (Heartbeat Producer)

In some cases, the master station requires that a slave station automatically transmits a frame of heartbeat packets at an interval, so that it can learn the state of the slave station in real time. The interval parameter (data length: 16 bits; unit: ms) is defined in the object dictionary 0x1017. If the interval is set to 0, the slave station does not transmit heartbeat packets. For the GD390L VFD, the interval is set to 1000ms by default.

- **Command**

Slave station -> master station

COB-ID	Byte0
0x700 + Node-ID	State 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 7-5 describes the state values.

- **Example**

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

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: Node protection and heartbeat packets cannot be used simultaneously.

7.2.2.6 Start packet (NMT Boot-up)

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

- **Command**

Slave station -> master station

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

- **Example**

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

COB-ID	Byte0
0x703	0x00

7.2.2.7 Synchronous packet object (SYNC)

Generally, SYNC signals are transmitted by the CANopen master station cyclically. A SYNC signal does not contain any data and is used mainly to request PDO Tx of a slave station 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 station -> slave station

COB-ID	No data
0x80	-

7.2.2.8 Emergency packet object (EMCY)

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

- **Command**

Slave station -> master station

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x80 +	Emergency error code		Error	VFD error code				
Node-ID	LSB	MSB	register	bit7-0	bit15-8	bit23-16	bit31-24	bit39-32

- **Description**

An emergency error code is two bytes. Byte0 is the least significant byte (LSB), and Byte1

is the most significant byte (MSB). A VFD error code is five bytes. Byte3 is the LSB, and Byte7 is the MSB.

An emergency error code indicates the type of the current error, as described in Table 7-6. 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 7-7 describes the indication of the bits of the error register. For VFD error codes, see section 8.2.1 Faults and solutions.

Table 7-6 Definition of emergency error code

Emergency error code (hex)	Code function description
00xx	Error reset or no error
10xx	Generic Error
20xx	Current
21xx	Current, device input side
22xx	Current, inside the device
23xx	Current, device input 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 exceed

Emergency error code (hex)	Code function description
90xx	External error
F0xx	Additional functions
FFxx	Device specific

Table 7-7 Definition of emergency register bits

Error register bit	Error 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 "Overvoltage during constant speed running (E9)" fault occurs on the slave VFD whose node ID is 3, and the fault type is 9 (that is, the VFD error code is 9), the following emergency packet is transmitted.

COB-ID	Emergency error code		Error register	VFD error code				
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x83	0x00	0x20	0x02	0x09	0x00	0x00	0x00	0x00

As you can see in the command, the emergency error code is 0x2000. The error register is 0x02, that is, the second bit is "1", indicating a voltage error. The device error code is 0x0000000009. According to the faults and solutions table, and you can find that the error code 9 indicates the "Overvoltage during constant speed running (E9)".

After the fault is reset, the VFD transmits the following emergency packet to notify the master station that the slave station 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

7.2.2.9 Service data object (SDO)

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

- **Command**

Request: master station -> slave station

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x600+NodeID	Request code	Object index		Sub-index	Response data			
		LSB	MSB		bit7-0	bit15-8	bit23-16	bit31-24

Response: Slave station -> master station

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x580+NodeID	Response code	Object index		Sub-index	Response data			
		LSB	MSB		bit7-0	bit15-8	bit23-16	bit31-24

- **Description**

An object index is two bytes. Byte1 is the LSB, and Byte2 is the MSB. For information about the indexes and subindexes, see the object dictionary. 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 7-8.

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 7-9.

Table 7-8 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	bit7-0	bit15-8	bit23-16	bit31-24
	0x2B	Writes 2-byte data	bit7-0	bit15-8	-	-
	0x2F	Writes 1-byte data	bit7-0	-	-	-
Read	0x40	Reads data	-	-	-	-

Table 7-9 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	bit7-0	bit15-8	bit23-16	bit31-24
	0x4B	Reads 2-byte data	bit7-0	bit15-8	-	-
	0x4F	Reads 1-byte data	bit7-0	-	-	-
Write	0x60	Writing succeeds	-	-	-	-
Read/write	0x80	Reading/writing fails	Interruption error code			
			bit7-0	bit15-8	bit23-16	bit31-24

Note: The symbol "-" in Table 7-8 and Table 7-9 indicates that the byte is reserved and provides no function.

Table 7-10 describes the interruption error codes.

Table 7-10 Interruption error code

Interruption code	Code function 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
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 state of the device
0800 0023	Error occurs dynamically on the object dictionary or object dictionary cannot be found

- **Example**

For example, slave station 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 station transmits the following write operation command.

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

After receiving the command transmitted by the master station, the slave station 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 station transmits the following read operation command.

COB-ID	Request code	Object index		Sub-index	Requested 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 station, the slave station transmits the following command response if the current disabled time of PDO2 Tx is 1000 ms.

COB-ID	Respons e 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 station 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	Requested 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 station 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".

7.2.3 Process data object (PDO)

The VFD 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 by the master station to a slave station, that is, it is a master station command. PDO Tx is a PDO command transmitted by a slave station to the master station.

The CW, 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. For more information, see the next chapter.

7.2.3.1 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. Both the disabled time and event timer units are milliseconds.

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≤n≤240), a slave station 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 station transmits PDO Tx commands periodically. For example, if the event timer of PDO2 Tx is set to 200, the slave station transmits a PDO2 Tx command at the interval of 200 ms. When the value of the event timer is zero, the slave station 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 50 ms, 50 ms is used as the disabled time.

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

Table 7-11 Triggering modes supported

Trigger mode	Transmission type (decimal)	Event triggering	PDO1 TX	PDO2 TX	PDO3 TX	PDO4 TX
Synchronous	1–240	-	Non-supported	Supported	Supported	Supported
Asynchronization	254	Event timer	Non-supported	Supported	Supported	Supported
		Disabled time	Non-supported	Supported	Supported	Supported
	255	Event timer=0	Supported	Supported	Supported	Supported
		Event timer	Non-supported	Supported	Supported	Supported

Table 7-12 Default PDO Tx settings for the VFD

	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.

7.2.3.2 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 station.

7.2.3.2.1 PDO1 Rx

- **Command**

Request: master station -> slave station

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

- **Description**

A request code is two bytes. Byte0 is the LSB, and Byte1 is the MSB. The manufacturer defines the index 0x2100 and subindex 0x00 for the request codes. Table 7-13 describes the functions of the request codes.

Table 7-13 Request code

Request code	Function
0	No task.
1	Reading a parameter value
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 LSB, and Byte3 is the MSB. It indicates the address of the parameter to be read or modified.

Parameter address representation rules: The MSB is the hexadecimal form of the number before the dot mark, and LSB is that of the number behind the dot mark. Take P11.05 as an example, the number before the dot mark is 11, that is, the MSB of the parameter address is 0×0B; and the number behind the dot mark is 05, that is, the LSB is 0×01. Therefore, the function code address is 0×0B05.

Table 7-14 VFD parameter addresses

Function code	Name	Description	Setting range	Default	Modify
P11.05	Current limit selection	0x00–0x11 Ones place: Current limit action 0: Invalid 1: Always valid Tens place: Hardware current limit overload alarm 0: Valid 1: Invalid	0x00–0x11	0x00	◎

A piece of requested data is two bytes. Byte4 is the LSB, and Byte5 is the MSB. 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 VFD reports an emergency packet.

7.2.3.2.2 PDO1Tx

- **Command**

Response: Slave station -> master station

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x180+ NODEID	Response code		Error code		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 LSB, and Byte1 is the MSB. Table 7-15 describes the functions of the response codes.

Table 7-15 Response code

Response code	Function
0	No response
1	Reading or writing succeeds
3	A reading or writing error occurs. Table 7-16 describes the error codes.

A piece of response data is four bytes. Byte4 is the LSB, and Byte7 is the MSB. 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. Byte2 is the LSB, and Byte3 is the MSB. Error codes are valid only when the response code is 3. An error code indicates the reason why it fails to respond to PDO2 Rx. Table 7-16 describes the definitions of the error codes.

Table 7-16 Error code

Code	Name	Definition
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 station 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 station 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 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.

Code	Name	Definition
		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 setting is invalid in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Incorrect password	The password entered in the password verification address is different from that set by the user.
06H	Data frame error	The data frame sent from the host controller is incorrect in the length, 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 station is a read-only parameter.
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the master station cannot be modified during the running of the VFD.
09H	Password protection	If the master station does not provide the correct password to unlock the system to perform a read or write operation, the error of "system being locked" is reported.

- **Example of PDO1**

The VFD slave station address is 3. Assume that you want to set the function code P15.13 of the VFD to 1.

Command analysis: The parameter address of P15.13 is 0×0F0D. According to the protocol, the request code of PDO2 Rx is 0×02, the parameter address is 0x0F0D, and the requested data is 0x01, and therefore PDO1 Rx transmitted by the master station is as follows.

COB-ID	Request code		Parameter address		Requested data	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
0x203	0x02	0x00	0x0D	0x0F	0x01	0x00

If the VFD parameter is successfully modified, the following PDO2Tx command is returned.

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

7.2.3.3 PDO2 Rx

PDO2 Rx is used to modify CWs and real-time process data (setting 1, setting 2, and

setting 3) of a VFD. A CW is used to control the start and stop of a VFD, and settings are used to control the real-time running values of the VFD, such as set frequency.

- **Command**

Master station -> slave station

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

- **Description**

A CW is two bytes. Byte0 is the LSB, and Byte1 is the MSB. Table 7-17 describes the definitions of VFD CWs.

Table 7-17 VFD CWs

Bit	Name	Value	Description
0–7	Communication-based control command	1	FWD run
		2	REV run
		3	Jog forward
		4	Jog reverse
		5	Stop
		6	Coast to stop (emergency stop)
		7	Fault reset
		8	Jog stop
8	WIRTE ENABLE	1	Enable writing (mainly PKW1–PKW4)
9–10	Motor group setting	00	MOTOR GROUP 1 SELECTION (Select motor 1)
		01	MOTOR GROUP 2 SELECTION (Select motor 2)
11	Control mode switchover selection	1	Enable the switchover between torque control/ speed control
		0	No switchover
12	ELECTRIC CONSUMPTION CLEAR	1	Enabling the function for resetting power consumption to zero
		0	Disabling the function for resetting power consumption to zero
13	PRE-EXCIATION (Pre-exciting)	1	Enable pre-exciting
		0	Disable pre-exciting
14	DC BRAKE (DC braking)	1	Enabling DC braking
		0	Disabling DC braking

Bit	Name	Value	Description
15	HEARTBEAT REF (Heartbeat reference)	1	Enable heartbeat
		0	Disable heartbeat

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 communication. For details, see the VFD operation manual. 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 VFD slave station address is 3. you want to control the running of the VFD through CANopen communication, and you want to set the running frequency to 50Hz 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, P00.06=9) first. In this example, use Setting 2 to set the running frequency (P15.03=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 PDO1 Rx command transmitted by the master station is as follows.

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

7.2.3.4 PDO2 Tx

PDO2 Tx is a command transmitted by a VFD to the master station. 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 state 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 station -> master station

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

- **Description**

A SW is two bytes. Byte0 is the LSB, and Byte1 is the MSB. Table 7-18 describes the definitions of VFD SWs.

Table 7-18 VFD SWs

Bit	Name	Value	Description
0–7	Running status	1	Running forward
		2	Running reversely
		3	Stopped
		4	In fault
		5	VFD POFF state
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–10	Motor group feedback	0	Feedback of motor 1
		1	Feedback of motor 2
11	Motor type feedback	1	Synchronous motor (SM)
		0	Asynchronous motor (AM)
12	Overload pre-alarm feedback	1	Overload pre-alarm
		0	No overload pre-alarm
13–14	RUN/STOP MODE (Running mode selection)	0	Keypad-based control
		1	Terminal-based control
		2	Communication-based control
		3	Reserved
15	HEARTBEAT FEEDBACK (Heartbeat feedback)	1	Heartbeat feedback
		0	No heartbeat feedback

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 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 VFD slave station 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 (P15.13=1), returned value 2 to the output voltage of the VFD (P15.14=4), and returned value 3 to invalid (P15.15=0) first.

The VFD is running 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 380 V, returned value 2 is 0x017C.

The PDO1 Tx command transmitted by the VFD is as follows.

COB-ID	Status word		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

7.2.3.5 PDO3 Rx and PDO4 Rx

- **PDO3 Rx command**

Master station -> slave station

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 station -> slave station

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.

7.2.3.6 PDO3 Tx and PDO4 Tx

PDO3 Tx and PDO4 Tx are used by the VFD to transmit real-time process data to the master station, 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 station -> master station

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 station -> master station

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	

- **Description**

The application methods for PDO3 Tx and PDO4 Tx are the same as that for PDO2 Tx.

7.2.4 Monitoring process data through SDO commands

The VFD can use SDOs as well as PDOs to monitor the process data of a VFD. You can select a monitoring mode as required. 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 section 7.2.3 Process data object (PDO). See section 7.2.2.9 Service data object (SDO) for usage instructions. Do not try to use SDOs to read and write VFD parameters.

Table 7-19 and Table 7-20 describe the manufacturer-defined object dictionary.

Table 7-19 Objects with the control function in the manufacturer-defined object dictionary

Index (hexadecimal)	Subindex (hexadecimal)	Function	Access permission	Data length	Description
2100	0	Request code (do not use it)	RW	2 bytes	-
	1	Parameter address (do not use it)	RW	2 bytes	-
	2	Requested data (do not use it)	RW	2 bytes	-
	3	Setting 1	RW	2 bytes	Received PZD2
	4	Setting 2	RW	2 bytes	Received PZD3
	5	Setting 3	RW	2 bytes	Received PZD4
	6	Setting 4	RW	2 bytes	Received PZD5
	7	Setting 5	RW	2 bytes	Received PZD6
	8	Setting 6	RW	2 bytes	Received PZD7
	9	Setting 7	RW	2 bytes	Received PZD8
	A	Setting 8	RW	2 bytes	Received PZD9

Index (hexadecimal)	Subindex (hexadecimal)	Function	Access permission	Data length	Description
	B	Setting 9	RW	2 bytes	Received PZD10
	C	Setting 10	RW	2 bytes	Received PZD11
	D	Setting 11	RW	2 bytes	Received PZD12
	E	Reserved	RW	2 bytes	-
	F	Reserved	RW	2 bytes	-
2101	0	Control word	RW	2 bytes	-

Table 7-20 Objects with the monitoring function in the manufacturer-defined object dictionary

Index (hexadecimal)	Subindex (hexadecimal)	Function	Access permission	Data length	Description
2000	0	Response code (do not use it)	RO	2 bytes	-
	1	Error code (do not use it)	RO	2 bytes	-
	2	Response data (do not use it)	RO	2 bytes	-
	3	Returned value 1	RO	2 bytes	Sent PZD2
	4	Returned value 2	RO	2 bytes	Sent PZD3
	5	Returned value 3	RO	2 bytes	Sent PZD4
	6	Returned value 4	RO	2 bytes	Sent PZD5
	7	Returned value 5	RO	2 bytes	Sent PZD6
	8	Returned value 6	RO	2 bytes	Sent PZD7
	9	Returned value 7	RO	2 bytes	Sent PZD8
	A	Returned value 8	RO	2 bytes	Sent PZD9
	B	Returned value 9	RO	2 bytes	Sent PZD10
	C	Returned value 10	RO	2 bytes	Sent PZD11
	D	Returned value 11	RO	2 bytes	Sent PZD12
	E	Reserved	RO	2 bytes	-
	F	Reserved	RO	2 bytes	-
2001	0	Status word	RO	2 bytes	-

- **Example**

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

COB-ID	Request code	Object index		Sub-index	Requested 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 station 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 station transmits the following SDO command.

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

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

COB-ID	Request code	Object index		Sub-index	Requested 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 station.

COB-ID	Request code	Object index		Sub-index	Requested 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 station 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 station transmits the following SDO command.

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

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

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

7.2.5 Baud rate and communication address setting

7.2.5.1 Baud rate setting

After setting the CANopen baud rate and communication address, you need to restart the VFD to enable the settings to take effect.

The CANopen baud rate is set through the corresponding VFD function parameter. Table 7-21 describes the values of the function parameter and their corresponding baud rates.

Table 7-21 Baud rate setting

Function parameter value	Baud rate (bit/s)
7	20k bps
6	50k bps
5	100k bps
4	125k bps
3	250k bps
2	500k bps
1	800k bps
0	1000k bps

7.2.5.2 Communication address setting

The CANopen communication address is set through the function parameter P15.01.

7.2.5.3 Function codes related to transmitted and received PZD

Table 7-22 Received PZD

Function code	Word	Value range	Default value
P15.02	Received PZD2	0–31 0: Invalid 1: Set frequency (0–P00.06, unit: 0.00Hz) 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–P00.06, unit: 0.00Hz) 6: Setting of the upper limit of reverse running frequency (0–P00.06, unit: 0.00Hz)	0
P15.03	Received PZD3		0
P15.04	Received PZD4		0
P15.05	Received PZD5		0
P15.06	Received PZD6		0
P15.07	Received PZD7		0
P15.08	Received		0

Function code	Word	Value range	Default value
	PZD8	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 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: Reserved 13: Reserved 14: MSB of position reference (signed)(reserved) 15: Low-order bit of position reference (unsigned)(reserved) 16: MSB of position feedback (signed)(reserved) 17: LSB of position feedback (unsigned)(reserved) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)(reserved) 19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59) 20–31: Reserved	
P15.09	Received PZD9		0
P15.10	Received PZD10		0
P15.11	Received PZD11		0
P15.12	Received PZD12		0

Table 7-23 Sent PZD

Function code	Word	Value range	Default value
P15.13	Sent PZD2	0–31 0: Invalid 1: Running frequency (×1000, 0.00Hz) 2: Set frequency (×1000, 0.00Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotation speed of running (×1, RPM) 9: Linear speed of running (×1, m/s) 10: Ramp reference frequency (×1000, 0.00Hz) 11: Fault code 12: AI1 input (×100, V) 13: AI2 input (×100, V)	0
P15.14	Sent PZD3		0
P15.15	Sent PZD4		0
P15.16	Sent PZD5		0
P15.17	Sent PZD6		0
P15.18	Sent PZD7		0
P15.19	Sent PZD8		0
P15.20	Sent PZD9		0
P15.21	Sent PZD10		0
P15.22	Sent PZD11		0
P15.23	Sent PZD12		0

Function code	Word	Value range	Default value
		14: Reserved 15: Reserved 16: Terminal input status 17: Terminal output status 18: PID reference (×100, %)(reserved) 19: PID feedback (×100, %)(reserved) 20: Motor rated torque (reserved) 21: MSB of position reference (signed)(reserved) 22: Low-order bit of position reference (unsigned)(reserved) 23: MSB of position feedback (signed)(reserved) 24: LSB of position feedback (unsigned)(reserved) 25: Status word (reserved) 26: HDIB frequency value (×100, kHz) (reserved) 27: MSB of PG card pulse feedback count (reserved) 28: LSB of PG card pulse feedback count (reserved) 29: MSB of PG card pulse reference count (reserved) 30: LSB of PG card pulse reference count (reserved) 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70)	

7.2.6 Common communication faults

Common communication faults include the following:

- No response is returned.
- The VFD returns an exception response.

Possible causes of no response include the following:

1. CANH and CANL are connected reversely.
2. The baud rate setting is inconsistent with that set on the VFD.
3. Terminal resistor is unmatched.

7.2.7 Object dictionary

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
1000	0	Device type	RO	Unsigned32	0x0000 0000
1001	0	Error register	RO	Unsigned8	

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
1003	**Error 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 hardware version	CONST	String	V1.00
100A	0	Manufacturer 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	
	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**				

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
	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
	1	First mapped object	RW	Unsigned32	0x21000010
	2	Second mapped object	RW	Unsigned32	0x21000110

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
	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
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

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
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
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

Index (hex)	Sub-index	Description	Access permission	Data type	Default value
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

8 Troubleshooting

8.1 Fault indication and reset

When the TRIP indicator is on, the VFD is in abnormal state, with the keypad showing the fault code. For details about fault causes and solutions, see section 8.2.1 Faults and solutions. If the fault cause cannot be located, contact our local office for technical support. There are three methods to reset VFD faults:

Method 1 Press the  key on the keypad.

Method 2 Set the corresponding parameter in P05.01– P05.06 to 6.

Method 3 Cut off the VFD power supply.

8.2 Faults and solutions

When a fault occurred, handle the fault as follows:

Step 1 Check whether keypad display is improper. If yes, contact the local INVT office.

Step 2 If no, check function group P07 to view the fault record parameters and understand the actual condition.

Step 3 See the following table for a detailed solution and check for exceptions.

Step 4 Rectify the fault or ask for help.

Step 5 Ensure the fault has been rectified, perform fault reset, and run the VFD again.

8.2.1 Faults and solutions

Fault code	Fault type	Possible cause	Solution
E1	Inverter unit U-phase protection	• ACC is too fast. • IGBT module is damaged. • Misoperation caused by interference. • Drive wires 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.
E2	Inverter unit V-phase protection		
E3	Inverter unit W-phase protection		
E4	Overcurrent during acceleration	• ACC/DEC is too fast. • Grid voltage too low. • VFD power too small.	• Increase ACC/DEC time. • Check the input power. • Select a VFD with larger
E5	Overcurrent during		

Fault code	Fault type	Possible cause	Solution
	deceleration	• Load transient or exception occurred. • To-ground short circuit or output phase loss occurred. • Strong external interference sources existed. • The overvoltage stall protection is not enabled.	power. • Check whether 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 whether there is strong interference. • Check the related function code settings. • Check whether phase loss occurred on output side.
E6	Overcurrent during constant speed running		
E7	Overvoltage during acceleration	• Abnormal input voltage. • Large energy feedback. • Lack of braking units.	• Check the input power. • Check whether load DEC time is too short or the motor starts during rotating.
E8	Overvoltage during deceleration		
E9	Overvoltage during constant speed running		
E10	Bus undervoltage fault	• Grid voltage is too low. • The overvoltage stall protection is not enabled.	• Check the grid input power supply. • Check the setting of related function codes.
E11	Motor overload	• Grid voltage is too low. • Motor rated current set incorrectly. • The motor stall occurs or the load transient is too large.	• Check the grid voltage. • Reset the rated current of the motor. • Check the load and adjust the torque boost quantity.
E12	VFD overload	• ACC is too fast. • The motor in rotating is restarted. • Grid voltage is too low. • Load too heavy. • Power is too small.	• Increase ACC time. • Avoid restart after stop. • Check the grid voltage. • Select the VFD with larger power. • Select a proper motor.
E13	Phase loss on input	Phase loss or violent	• Check the input power.

Fault code	Fault type	Possible cause	Solution
	side	fluctuation occurred on input R, S, T.	• Check the installation wiring.
E14	Phase loss on output side	Phase loss output occurs to U, V, W (or the three phases of the load are seriously asymmetrical).	• Check the output wiring. • Check the motor and cables.
E15	Rectifier module overheating	• Air duct is blocked or fan is damaged. • Ambient temperature too high. • Long-time overload running.	• Ventilate the air duct or replace the fan. • Lower the ambient temperature.
E16	Inverter module overheat		
E17	External fault	SI external faulty input terminal action.	Check external device input.
E18	RS485 communication fault	• Improper baud rate. • Communication line fault. • Incorrect communication address. • Communication suffers from strong interference.	• Set proper baud rate. • Check the communication port wiring. • Set the proper communication address. • Change or replace the wire or improve the anti-interference capability.
E19	Current detection fault	• Poor contact of the connector of control board. • The Hall component is damaged. • Exception occurred to amplification circuit.	• Check the connector and re-plug. • Replace the hall component. • Replace the main control board.
E20	Motor autotuning fault	• The motor capacity does not match the VFD capacity. • Motor parameter is set improperly. • Autotuned parameter settings deviate sharply from the standard ones.	• Change the VFD model. • Set proper motor type and nameplate parameters. Empty the motor load and carry out autotuning again. • Check motor wiring and parameter settings. • Ensure that the frequency

Fault code	Fault type	Possible cause	Solution
		• Autotuning timeout.	upper limit is greater than 2/3 of the rated frequency.
E21	EEPROM operation fault	• Error in reading or writing control parameters. • EEPROM is damaged.	• Press STOP/RST to reset. • Replace the main control board.
E23	Braking unit fault	• Fault occurred to the braking 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.
E24	Running time reached	The actual running time of the VFD is longer than the internal set running time.	Ask for the supplier and adjust the set running time.
E25	Electronic overload fault	The VFD reports overload pre-alarm according to the setting.	Check the load and the overload pre-alarm points.
E26	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.
E27	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.
E28	Parameter download error	• Keypad cable connected improperly or disconnected.	• Check for and remove the external interference source. • Replace the hardware and

Fault code	Fault type	Possible cause	Solution
		• Keypad cable too long, causing strong interference. • Data storage error occurred to the keypad.	seek maintenance services. • Re-back up the data on the keypad.
E31	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 lines and remove the build-out resistor. • Set the same baud rate. • Check the surrounding environment, and eliminate interference effects.
E32	To-ground short-circuit fault 1	• The output of the VFD is short circuited to the ground. • There is a fault in the current detection circuit.	• Check whether the motor wiring is normal. • Replace the hall component. • Replace the main control board.
E33	To-ground short-circuit fault 2	• The output of the VFD is short circuited to the ground. • There is a fault in the current detection circuit.	• Check whether the motor wiring is normal. • Replace the hall component. • Replace the main control board.
E34	Speed deviation fault	• The load is too heavy or stalled. • Output phase loss occurred in SM.	• Check the load to ensure it is proper, and increase the detection time. • Check whether the control parameters are set properly. • Check the output cable. • Check the motor supply and cables.
E35	Mal-adjustment fault	• SM control parameters are set incorrectly. • Autotuned parameters are not accurate. • The VFD is not connected to the motor.	• Check the load and ensure the load is normal. • Check whether control parameters are set correctly. • Increase the mal-adjustment detection time.
E36	Electronic	The VFD reports underload	Check the load and the

Fault code	Fault type	Possible cause	Solution
	underload fault	pre-alarm according to the setting.	underload pre-alarm points.
E37	Encoder disconnection fault	● Incorrect encoder wiring, causes the failure to get the encoder signal. ● Incorrect encoder parameter settings.	● Check the wiring. ● Check encoder parameter settings.
E38	Encoder reversal fault	Incorrect encoder signal direction.	Change the encoder direction through P20.02, or check that the wiring sequence of encoder AB signal is correct.
E39	Encoder Z pulse offline fault	The Z-pulse signal cable is not connected.	Check the Z-pulse signal cable.
E40	Safe torque off	STO function operates normally.	
E41	Exception occurred to safe circuit of channel H1	Channel H1 malfunction or internal hardware circuit malfunction.	Replace the STO switch. If the malfunction persists, contact the manufacturer.
E42	Exception occurred to safe circuit of channel H2	Channel H2 malfunction or internal hardware circuit malfunction.	Replace the STO switch. If the malfunction persists, contact the manufacturer.
E43	Channel H1 and H2 exceptions	Channel H1 and channel H2 malfunction or internal hardware circuit malfunction.	Replace the STO switch. If the malfunction persists, contact the manufacturer.
E44	Safety code FLASH CRC check fault	STO safety code FLASH CRC check error.	Contact the manufacturer.
E59	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 overtemperature input terminal. ● Check whether the temperature sensor is proper. ● Check the motor, and perform maintenance on the motor.
E82	PT100	● The PT100 sensor obtains	● Calibrate the sensor through

Fault code	Fault type	Possible cause	Solution
	overtemperature	inaccurate temperature or it is calibrated inaccurately. ● Device or ambient temperature is too high.	parameter settings. ● Lower the device or ambient temperature.
E92	AI1 disconnection	● Input voltage of AI1 is too low. ● AI1 wiring is disconnected.	● Connect a 5V or 10mA power source to check if the input is normal. ● Check the wiring or replace the cables.
E93	AI2 disconnection	● Input voltage of AI2 is too low. ● AI2 wiring is disconnected.	● Connect a 5V or 10mA power source to check if the input is normal. ● Check the wiring or replace the cables.
E96	No upgrade bootloader	The upgrade bootload is missing.	Contact the manufacturer.
E580	Brake fault	● Brake signal and control signal are inconsistent. ● Feedback terminal signal is interfered.	● Check whether the brake is in good condition. ● Check feedback terminal signal.
E581	Contactor fault	● Contactor feedback signal and control signal are inconsistent. ● Feedback terminal signal is interfered.	● Check whether the contactor is in good condition. ● Check feedback terminal signal.
E582	No enabling signal	Enabling signal is missing during operation.	Check the enabling signal timing and connection.
E583	Braking pipe overcurrent fault	Braking pipe resistance is unmatched. Braking pipe fault.	Check the resistance of braking pipe.
E584	AM output without current	The AM is not connected to the motor cable or phase loss occurs.	Check the motor wiring.
E585	No absolute position signal	● The sine-cosine or absolute-value encoder position signal is lost. ● The encoder is interfered.	● Check whether the encoder is in good condition. ● Check whether the VFD and encoder are grounded.
E586	Electronic star shorting fault	● Electronic star shorting feedback fault.	● Check whether there is a hardware fault with the star

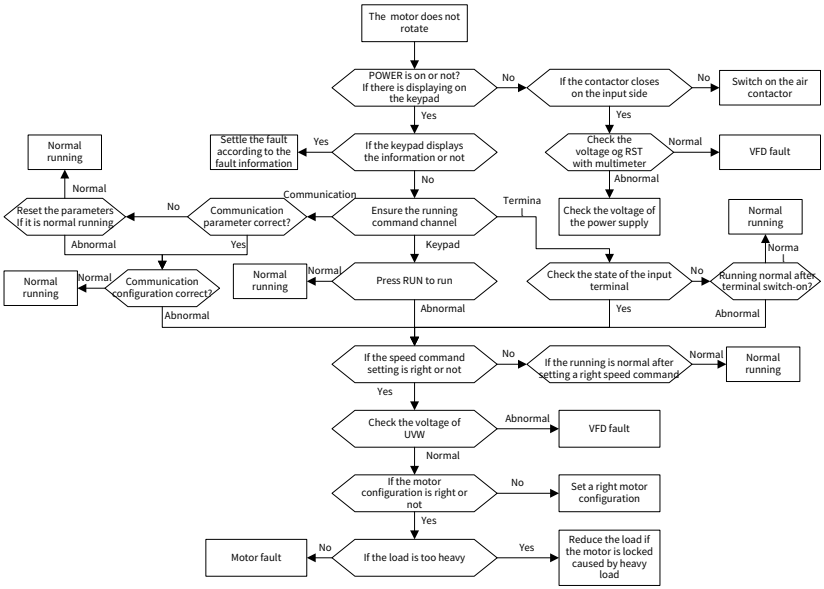
Fault code	Fault type	Possible cause	Solution
		• Overspeed or over current during star shorting.	shorting. • Check whether the current and speed are normal during star shorting.
E587	Dual-CPU communication fault 1	DSP communication is disconnected in dual CPU structure.	Check the DSP communication wiring.
E588	Dual-CPU communication fault 2	MCU communication is disconnected in dual CPU structure.	Check the MCU communication wiring.
E589	Dual-CPU communication fault 3	Communication disconnected in dual CPU structure.	Check the communication wiring of dual CPU structure.

8.2.2 Other status

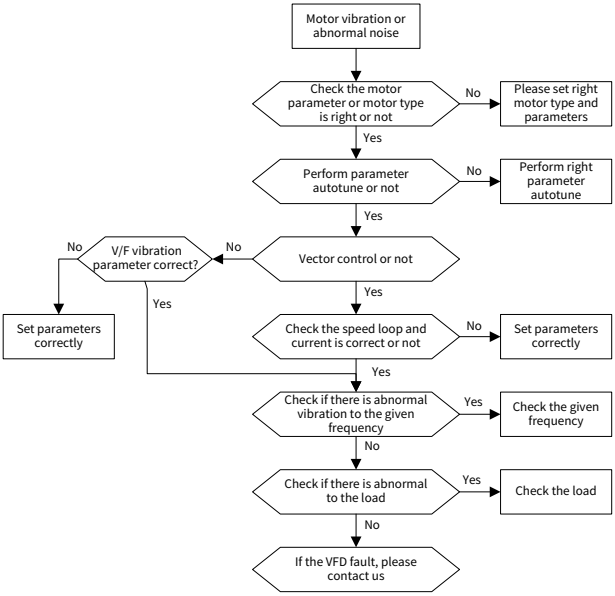
Displayed code	Status type	Possible cause	Solution
PoFF	System power failure	The system is powered off or the bus voltage is too low.	Check the grid conditions.
-	Communication between the keypad and main control board failed	The keypad is not properly connected.	Check the installation environment of the keypad.

8.3 Analysis on common faults

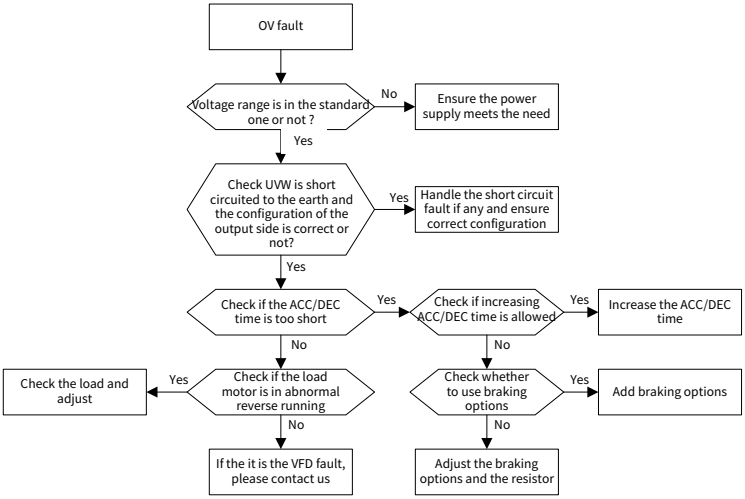
8.3.1 Motor fails to work



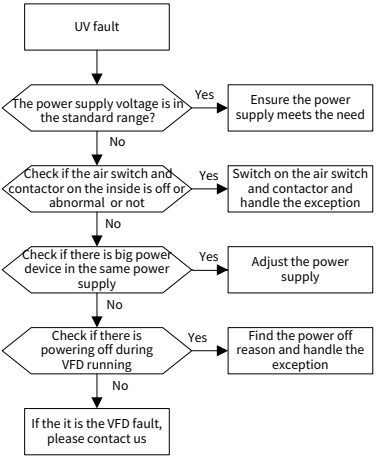
8.3.2 Motor vibrates



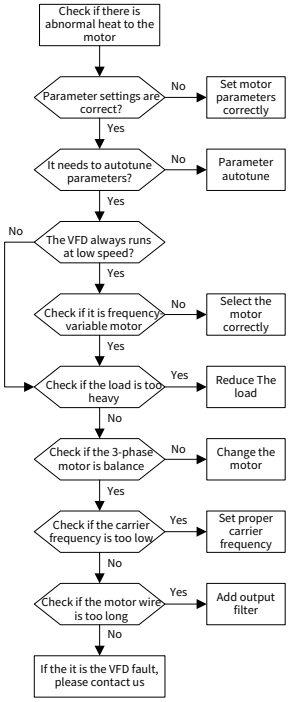
8.3.3 Overvoltage



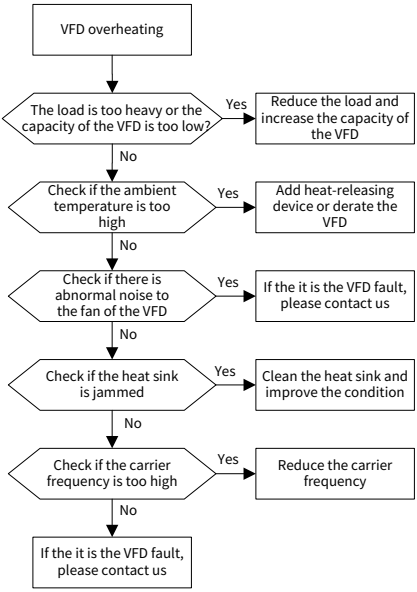
8.3.4 Undervoltage



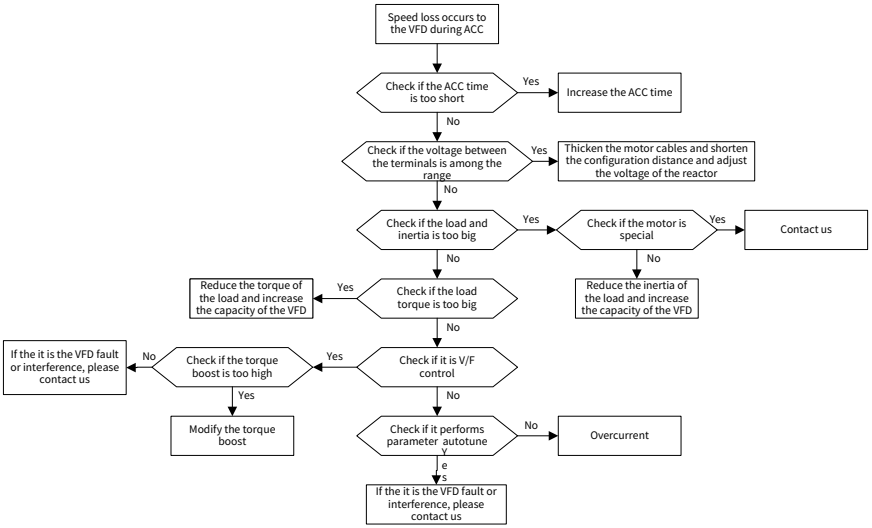
8.3.5 Motor overheating



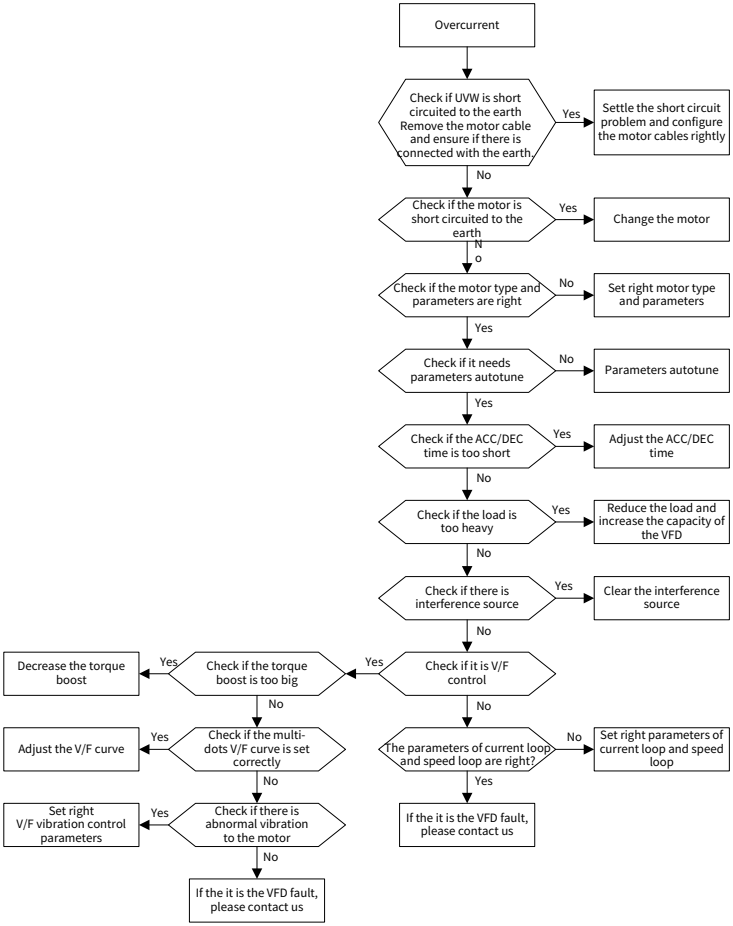
8.3.6 VFD overheating



8.3.7 Motor stalls during ACC



8.3.8 Overcurrent



9 Inspection and maintenance

9.1 Daily inspection and regular maintenance

The VFD internal components will become aging due to the influence of environmental temperature, humidity, dust, vibration and other factors, which causes the potential failure or shortens the service life. Therefore, to extend the VFD service life and prevent safety hazards, daily inspection and regular maintenance are required.

Check item	Content	Method
Daily inspection: Recommended on each day.		
Ambient environment	Whether the ambient temperature, humidity, vibration, dust, gas, and oil are too great, and whether there is condensation or water droplets inside and outside the machine	Visual inspection, and use instruments for measurement.
	Whether there are foreign matters, such as tools, or dangerous substances placed nearby	Visual inspection
Power supply voltage	Whether the voltage between the main circuit and control circuit is normal	Multimeter or voltage meter
Keypad	Whether display is clear	Visual inspection
	Whether some characters or fields are displayed incompletely	Visual inspection
Fan	Whether it runs normally	Visual inspection
Load	Whether the motor is overloaded or overheating, or it sounds abnormally.	Visual inspection
Regular maintenance: Recommended on a quarterly basis, especially in harsh environments such as with dust, oil, or corrosive gases. Before regular maintenance, cut off the power and wait at least 15 min.		
Machine	Whether the bolts become loose or come off	Visual inspection
	Whether the machine is deformed, cracked, or damaged, or the color changes due to overheating and aging	Visual inspection
	Whether much dirt or dust is attached	Visual inspection
	Whether there is abnormal sound or vibration, odor, discoloration (transformer, reactor and fan)	Auditory, olfactory, and visual inspection
Motor	Whether the installation is secure, motor insulation is normal, and the fan runs properly	Instrument or visual inspection
Cable	Whether there is discoloration, deformation, or damage	Visual inspection
	Whether the cable connectors or bolts become loose	Visual inspection

Check item	Content	Method
Connection terminal	Whether there is overheating or damage	Visual inspection
Electrolytic capacitor	Whether there is electrolyte leakage, discoloration, cracks, and housing expansion	Visual inspection
	Whether the safety valve is exposed outside	Visual inspection
External braking resistor	Whether there is displacement caused due to overheating	Olfactory and visual inspection
	Whether aging, skin breakage, or wire damage occurs to the resistor cable	Visual inspection, or measuring with a multimeter after removing one cable end
Contactor and relay	Whether there is vibration sound during running	Auditory inspection
	Check whether the contacts are in good contact.	Visual inspection
Control PCB and connector	Whether the screws and connectors become loose	Screw them up.
	Whether there is unusual smell or discoloration	Olfactory and visual inspection
	Whether there is corrosion or rust stains	Visual inspection
Ventilation duct	Whether there are foreign matters blocking or attached to the cooling fan, air inlets, or air outlets	Visual inspection

For more details about maintenance, contact the local INVT office, or visit our website www.invt.com, and choose **Support** > **Services**.

9.2 Replacement of wearing parts

The wearing parts of VFD mainly include the cooling fan and electrolytic capacitor, of which the service life is closely related to the running environment and maintenance condition. In normal use at the ambient temperature of 40°C, the general life time is as follows:

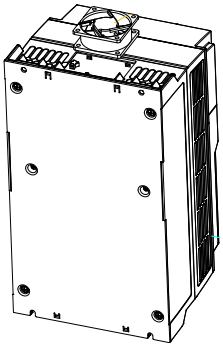
Part	Service life
Fan	⩾ 5 years
Electrolytic capacitor	⩾ 5 years

9.2.1 Cooling fan

■ **Possible damage cause**

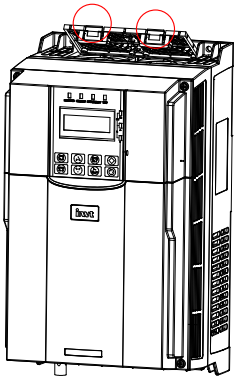
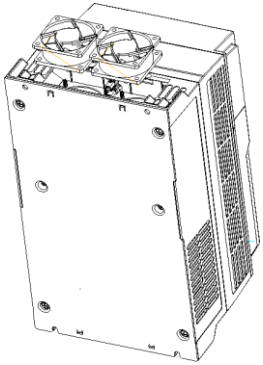
Bearing wear, blade aging, water, oil, dust and other environmental factors may cause circuit board damage.

■ **Cooling fan replacement procedure**

Disassembling and installing a fan (4–7.5kW)	
Step 1 Press the snap of the fan cover gently to remove the fan cover.	Step 2 Lift the fan upward, and remove the fan connection terminal.
	
Step 3 Install a new fan in the VFD in the reverse steps. Assemble the VFD. Ensure the air direction of the fan is consistent with that of the VFD (blowing upwards).	

Note:

- Before disassembling or installing the VFD, stop the VFD, cut off the power, and wait at least 5 minutes.
- Different VFD models may be slightly different in the fan quantity and position. The fan disassembly and assembly methods are similar.

Disassembling and installing a fan (11–15kW)	
Step 1 Press the snap of the fan cover gently to remove the fan cover.	Step 2 Lift the fan upward, and remove the fan connection terminal.
	
Step 3 Install a new fan in the VFD in the reverse steps. Assemble the VFD. Ensure the air direction of the fan is consistent with that of the VFD (blowing upwards).	

9.2.2 Electrolytic capacitor

■ **Possible damage cause**

The possible causes include high input power harmonics, high ambient temperature, frequent load jumps, and electrolyte aging.

■ **Filter capacitor replacement**

It is recommended that a professional be asked for the replacement because the filter capacitor involves VFD internal components.

9.3 Reforming

If the VFD has been left unused for a long time, you need to follow the instructions to reform the DC bus electrolytic capacitor before using it. The storage time is calculated from the date the VFD is delivered. For detailed operation, contact us.

Storage time	Operation principle
Less than 1 year	No charging operation is required.
1 to 2 years	Before the first run, apply the voltage of one class lower than the VFD voltage class to the VFD for 1 hour.
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

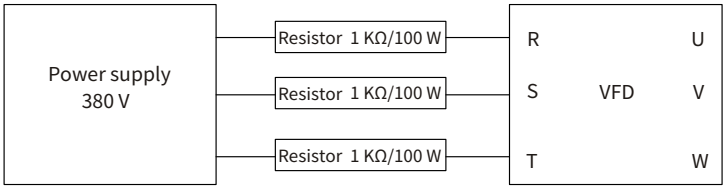
use a small-capacity power supply (2 A is sufficient).

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 380V 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 9-1 380V drive device charging circuit example



Appendix A Expansion card

The VFD can be equipped with various expansion cards to extend its application functions, supporting the installation of one expansion card.

A.1 Model description

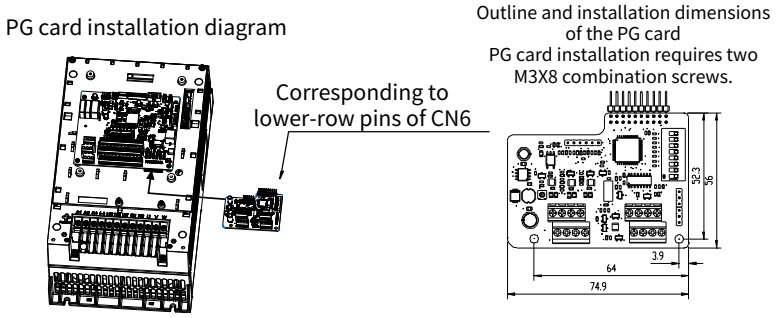
EC-PG 1 01 – 05 B-T
① ② ③ ④ ⑤ ⑥ ⑦

Table A-1 Model description

No.	Description	Naming example
①	Product category	EC: Expansion card
②	Board card category	PG: PG card
③	Technology 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 encoder PG card 02: Sin/Cos encoder PG card 06: Absolute encoder PG card
⑤	Working power	00: Passive 05: 5V 12: 12–15V 24: 24V
⑥	Version	Empty: Version A B: Version B
⑦	Subdivision type	S: SSI absolute encoder T: European-type connection terminal

A.2 Dimensions and installation of the PG card

Figure A-1 Dimensions and installation of the GD390L series PG card



A.3 Incremental encoder PG card

A.3.1 Technical specifications

Table A-2 Technical specifications

Model	EC-PG101-05	EC-PG101-12	EC-PG101-24
Output power supply	Adjustable voltage range: 4.75–7V Default setting: 5V/±5% Max. output current: 300mA	Supporting the voltage output of 11.75–16V. Default: 12V±5%. Max. output current: 350mA	Voltage output: 24 V ± 5%☒ Max. output current: 300mA
Input signal	Supporting the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz	Supporting the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz	Supporting the A, B, and Z signal inputs of differential, open collector, and push-pull encoders. Response speed: 0–100kHz
Output signal	Output frequency: 0–80kHz Output mode: Differential output, push-pull output, open collector output, and frequency-divided output Range: 1–256 Output impedance: 70Ω	Output frequency: 0–80kHz Output mode: Differential output, push-pull output, open collector output, and frequency-divided output Range: 1–256 Output impedance: 70Ω	Output frequency: 0–80kHz Output mode: Differential output, push-pull output, open collector output, and frequency-divided output Range: 1–256 Output impedance: 70Ω

When the asynchronous motor uses the FVC mode, a PG card is a must. The asynchronization PG card functions include processing circuits for two quadrature encoder signals, receiving signals of differential, open collector, and push-pull encoders, and encoder power supply output (+12V). Frequency-divided output can be performed for the input encoder signals. The output quantity includes two channels of quadrature open collector signals. You can choose according to your actual use.

A.3.2 Terminal interfaces and switches

The incremental encoder PG card has two 2*4P user wiring terminals. See the following figure.

Figure A-2 Wiring terminals

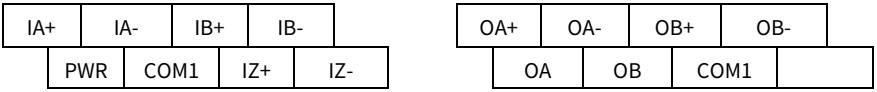


Table A-3 Terminal description

Symbol	Function description
PWR	Encoder power
COM1	
IA+	Encoder signal input terminal
IA-	
IB+	
IB-	
IZ+	
IZ-	
OA+	5V differential crossover signal output terminal
OA-	
OB+	
OB-	
OA	Push-pull or open collector frequency-divided signal output terminal (The output form is selected through jumpers J1 and J2.)
OB	
COM1	

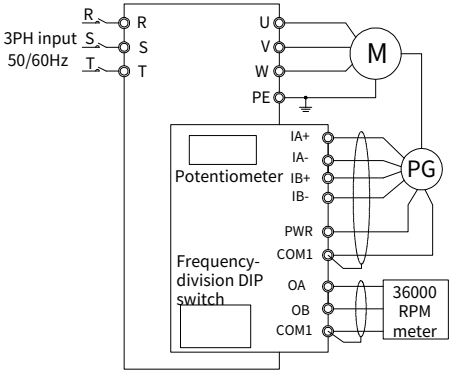
The frequency division coefficient of the incremental encoder PG card is determined by the dip switch on the card. The dip switch have 8 bits, and the frequency division coefficient is determined by adding 1 to the binary number that the dip switch represents. The place labeled with "1" is the low binary bit, and the one labeled with "8" is the high binary bit. When the dip switch is turned to ON, the bit is valid, indicating "1"; otherwise, the bit indicates "0". See the following table for frequency division coefficients.

Table A-4 Frequency division coefficients

Decimal	Binary	Frequency division coefficient
0	00000000	1
1	00000001	2
2	00000010	3
…	…	…
m	…	m+1
255	11111111	256

A.3.3 Wiring

Figure A-3 Wiring diagram of the incremental PG card



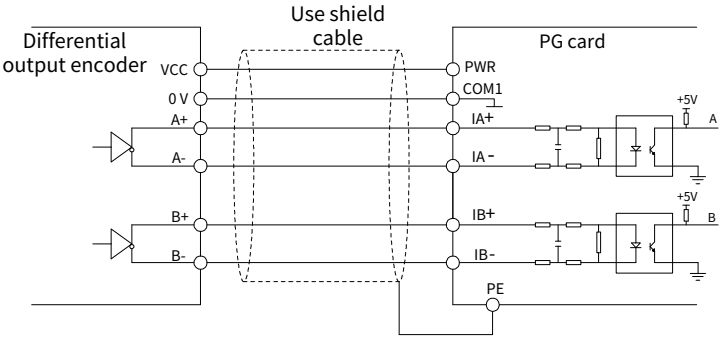
Note:

- A PG card signal line and a power line must be routed separately and disallow parallel routing.
- To avoid interference from encoder signals, use a shielded cable for the PG card signal line;
- The shield layer of the encoder shield cable should be connected to the earth (such as the PE of VFD), and it must be connected to earth only at one end to avoid signal interference;
- If the PG card uses frequency-divided output when connecting to an external power supply, the voltage should be less than 24V; otherwise the PG card will be damaged;

A.3.4 Application connection

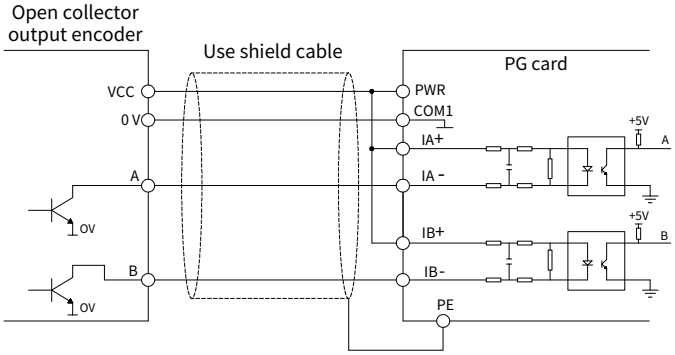
1. Differential output encoder connection

Figure A-4 Wiring diagram of differential output encoder



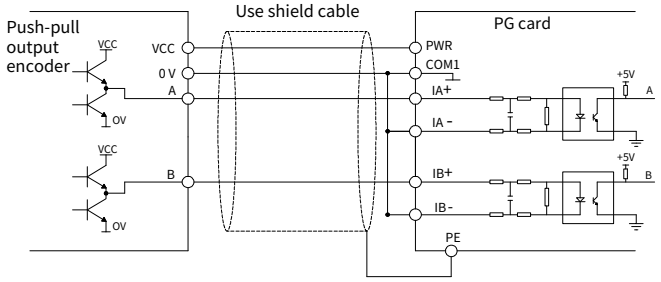
2. Open collector output encoder connection

Figure A-5 Wiring diagram of open collector output encoder



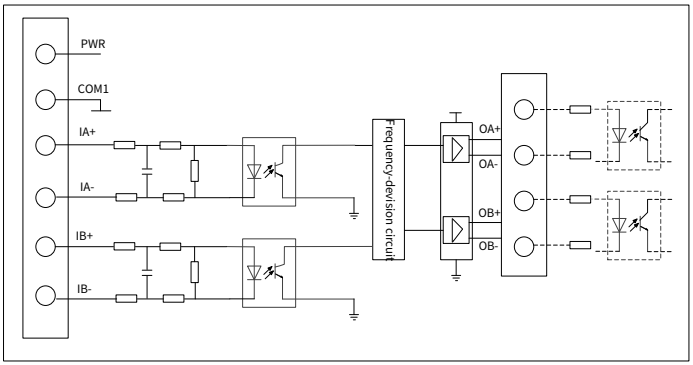
3. Push-pull output encoder connection

Figure A-6 Wiring diagram of push-pull output encoder



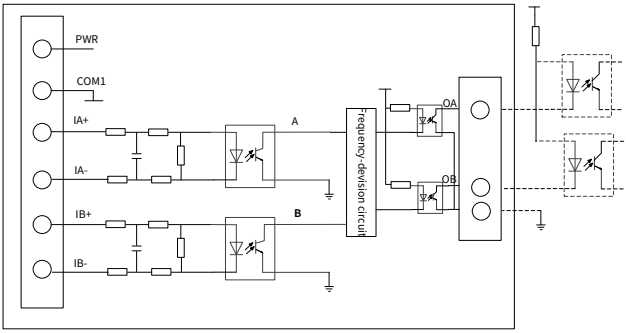
4. PG card frequency-divided differential output connection

Figure A-7 Wiring diagram of PG card frequency-divided differential output



5. PG card frequency-divided open collector output connection

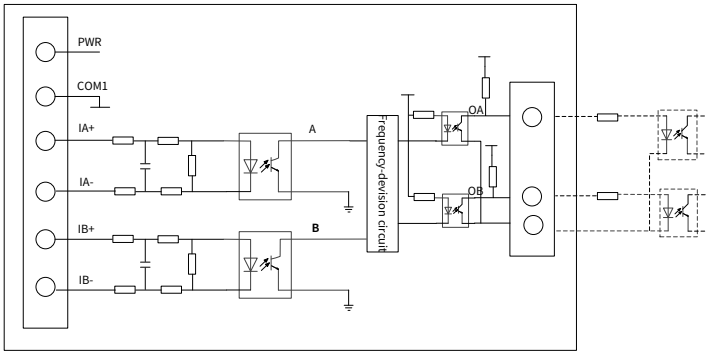
Figure A-8 Wiring diagram of PG card frequency-divided open collector output



Note: During open collector output, PWR at J1 and that at J2 are short connected to COA and COB.

6. PG card frequency-divided push-pull output connection

Figure A-9 Wiring diagram of PG card frequency-divided push-pull output



Note:

- Note: During push-pull output, PWR at J1 and that at J2 are short connected to HOA and HOB.
- Incremental encoder PG cards are mainly used to closed-loop vector control on asynchronous motors.

A.4 Sin/Cos encoder PG card

A.4.1 Technical specifications

See Table A-5 for the specifications of the Sin/Cos encoder PG card.

Table A-5 Technical parameters

NAME	EC-PG102-05-T
Frequency division coefficient	1 (Without a frequency-division switch)
Output power supply	Adjustable voltage range: 4.75–7V Default setting: 5V±5% Max. output current: 300mA
Output signal	Output form: Two quadrature frequency division differential outputs, and one open collector output Open collector output impedance: 70Ω

You can choose the output voltage value according to the actual application. When the

encoder signal is transmitted at a long distance, you can adjust the output power supply voltage by potentiometer (the regulation method is the same as incremental encoder card) to increase the wiring distance.

A.4.2 Terminal interfaces and switches

The Sin/Cos encoder PG card has one 2*6P and one 2*4P user terminals, as shown in Figure A-10.

Figure A-10 Ports and terminals of PG card

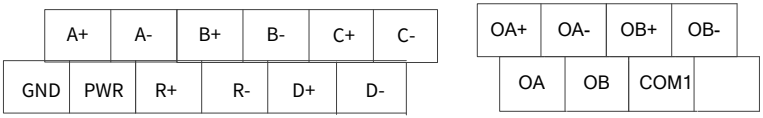


Table A-6 Terminal description

Symbol	Function description
PWR	Encoder power
GND	
A+	Encoder signal input terminal
A-	
B+	
B-	
C+	
C-	
D+	
D-	
R+	
R-	
OA+	5V differential crossover signal output terminal
OA-	
OB+	
OB-	
OA	Open collector frequency-divided signal output terminal
OB	
COM1	

Note:

- The PG card does not internally connect the PE to the earth, and you can connect the PE to the earth during use.

- The Sin/Cos encoder PG card have the similar output signal wiring method as the incremental encoder PG card, but they do not support push-pull output.

A.5 Absolute encoder PG card

A.5.1 Technical specifications

Absolute encoders (mainly applicable to ECN1313, ECN413 encoders) have the following parameters.

Table A-7 Technical parameters

Model	EC-PG106-05-T (EnDat)	EC-PG106-05-S (SSI)
Frequency division coefficient	1 (Without a frequency-division switch)	1 (Without a frequency-division switch)
Input signal	Supports two differential A and B (sine signal, 1Vpp) inputs with the response speed of 0–50kHz;☒ Supports the transmission of absolute position value signal, fault and other information in Endat protocol.	Supports two differential A and B (sine signal, 1Vpp) inputs with the response speed of 0–50kHz;☒ Supports the transmission of absolute position value signal, fault and other information in SSI protocol.
Output power supply	Default setting: 5V/±5% Max. output current: 300mA	Default setting: 5V/±5% Max. output current: 300mA
Output signal	Output form: Two quadrature frequency division differential outputs (LVDS electrical level), and one open collector output Open collector output impedance: 70Ω	Output form: Two quadrature frequency division differential outputs(LVDS electrical level), and one open collector output Open collector output impedance: 70Ω

A.5.2 Terminal interfaces and switches

The absolute encoder PG card has one 2*5P and one 2*4P user terminals, as shown in Figure A-11.

Figure A-11 Ports and terminals of PG card

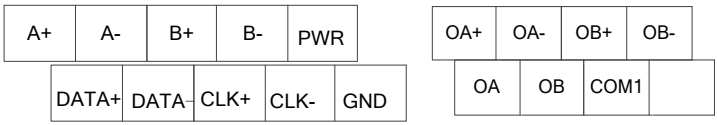


Table A-8 Terminal description

Symbol	Function description
PWR	Encoder power
GND	
DATA+	Encoder signal input terminal
DATA-	
CLK+	
CLK-	
A+	
A-	
B+	
B-	
OA+	5V differential crossover signal output terminal
OA-	
OB+	
OB-	
OA	Open collector frequency-divided signal output terminal
OB	
COM1	

Note:

- The PG card does not internally connect the PE to the earth, and you need to connect PE to the earth during use.
- The absolute encoder PG card have the similar output signal wiring method as the incremental encoder PG card, but they do not support push-pull output.

Appendix B Derating

If the ambient temperature at the VFD installation site exceeds 40°C, the VFD installation site altitude exceeds 1000m, a cover with heat dissipation vents is used, or the carrier frequency is higher than the recommended (see P00.14), the VFD needs to be derated.

B.1 Derating due to temperature

When the temperature is higher than +40°C, the rated output current is derated by 1% for each increased 1°C.

Note: It is not recommended to use the VFD at an environment with the temperature higher than 50°C. If you do, we shall not hold accountable for the consequences caused.

B.2 Derating due to altitude

When the VFD installation site altitude is lower than 1000m, the VFD can run at the rated power. When the altitude exceeds 1000m, derate by 1% for every increase of 100m. When the altitude exceeds 3000m, consult our local dealer or office for details.

B.3 Derating due to carrier frequency

The carrier frequency of the VFD varies with power class. The VFD rated power is defined based on the carrier frequency factory setting. If the carrier frequency exceeds the factory setting, the VFD power is derated by 20% for each increased 1 kHz.

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 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 100kA when the VFD runs at the maximum rated voltage.
Frequency	50/60Hz±5%, with a maximum change rate of 20%/s

C.3 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 VFD short-circuit protection meets the requirements of IEC 61800-5-1.
Frequency	0–200Hz
Frequency resolution	0.01Hz
Current	For details, see section 2.3 Product ratings.
Power limit	1.5 times of the motor rated power
Carrier frequency	4, 6, or 8kHz

C.3.1 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	Maximum motor cable length (m)
Environment category I (C2)	10
Environment category II (C3)	10

Note:

- 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 environment categories C3 and C2, see section C.5 EMC regulations.
- For description about the C2, C3 models, see section 2.1 Product nameplate and model.

C.4 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
EN12015	Electromagnetic compatibility. Product family standard for lifts, escalators and moving walks. Emission
EN12016	Electromagnetic compatibility. Product family standard for lifts, escalators and moving walks. Immunity
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
GB/T 30844.1	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 1: Technical conditions
GB/T 30844.2	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 2: Test methods
GB/T 30844.3	General-purpose variable-frequency adjustable-speed equipment of 1 kV and lower—Part 3: Safety requirements

C.4.1 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.4.2 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, EN12015, EN12016) describes the EMC standards and specific test methods for such system products. Our products have been compliant with these EMC regulations.

C.5 EMC regulations

The EMC product standard (EN 61800-3) describes the EMC requirements on VFDs.

Application environment categories:

First environment: Civilian environment, including application scenarios where VFDs are directly connected to the civil power supply low-voltage grids without intermediate transformers.

Second environment: All locations outside a residential area.

VFD categories:

Category C1: VFD of rated voltage lower than 1000V, applied to the first environment.

C2: Rated voltage lower than 1000V, 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 product may generate radio interference in some environments, and you need to take measures to reduce the interference.

Category C3: VFD of rated voltage lower than 1000V, applied to the second environment. They cannot be applied to the first environment.

Note: VFDs of category C3 cannot be applied to civilian low-voltage public grids. When applied to such grids, the VFD may generate radio frequency electromagnetic interference.

Category C4: VFD of rated voltage higher than 1000V, or rated current higher or equal to 400A, applied to complex systems in the second environment.

Note: The EMC standard IEC/EN 61800-3 no longer restricts the power distribution of the VFD, but defines the use, installation, and commissioning of the VFD. 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.

Appendix D Dimension drawings

D.1 VFD overall dimensions

Figure D-1 Mounting dimensions diagram for 2.2–15kW VFD models

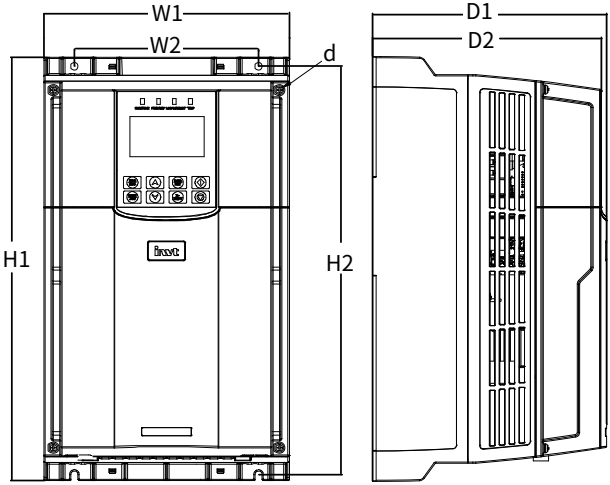


Table D-1 Dimensions and mounting hole size of 2.2–15kW VFD models

VFD model	Outline dimensions (mm)				Installation dimensions (mm)		Mounting hole diameter d (mm)
	W1	H1	D1	D2	W2	H2	
GD390L-2R2G-2	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-2R2G-S2	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-004G-2	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-004G-4	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-5R5G-4	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-7R5G-4	200.0	347.0	190.0	185.4	150.0	334.5	Ø6
GD390L-5R5G-2	200.0	347.0	197.5	192.9	150.0	334.5	Ø6
GD390L-7R5G-2	200.0	347.0	197.5	192.9	150.0	334.5	Ø6
GD390L-011G-4	200.0	347.0	197.5	192.9	150.0	334.5	Ø6
GD390L-015G-4	200.0	347.0	197.5	192.9	150.0	334.5	Ø6

Appendix E Peripheral accessories

E.1 Cable

E.1.1 Power cable

Power cables mainly include input power cables and motor cables. The sizes of the cables must comply with local regulations.

VFD model	Recommended cable size (mm^2)		Terminal screw	Fastening torque (Nm)
	R, S, T, U, V, W PB1, PB2, (+), (-)	PE		
GD390L-2R2G-S2	2.5	2.5	M4	1.2~1.5
GD390L-2R2G-2	2.5	2.5	M4	1.2~1.5
GD390L-004G-2	2.5	2.5	M4	1.2~1.5
GD390L-5R5G-2	4	4	M5	2~2.5
GD390L-7R5G-2	6	6	M5	2~2.5
GD390L-011G-2	10	10	M5	2~2.5
GD390L-015G-2	16	16	M6	4~6
GD390L-018G-2	25	16	M6	4~6
GD390L-004G-4	2.5	2.5	M4	1.2~1.5
GD390L-5R5G-4	2.5	2.5	M4	1.2~1.5
GD390L-7R5G-4	2.5	2.5	M4	1.2~1.5
GD390L-011G-4	4	4	M5	2~2.5
GD390L-015G-4	6	6	M5	2~2.5
GD390L-018G-4	10	10	M5	2~2.5
GD390L-022G-4	10	10	M5	2~2.5
GD390L-030G-4	16	16	M6	4~6
GD390L-037G-4	25	16	M6	4~6

Note:

- The cables 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 100m, and the current is the rated current.
- The terminals PB1 and PB2 are used to connect to the braking resistor.
- If a control cable and power cable must cross each other, ensure that the angle between them is 90 degrees.
- The insulation resistance is reduced if it is damp inside the motor. If you suspect the inside of motor is moist, dry and re-measure the motor.

- If the electrical conductivity of the motor cable shield layer does not meet the requirements, a separate PE conductor must be used.

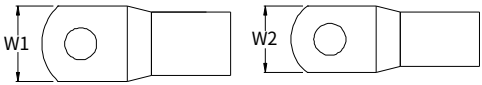
■ **Crimp terminal selection**

The cross-sectional area of the cable needs to be increased for some reasons, for example, excessive long cables or cable laying. When the width of the copper tube terminal exceeds the allowable width of the VFD terminal, the narrow head terminals can be used.

GTNR terminal reference brand: Suzhou Yuanli

SC, SG terminal reference brands: Richeng

The series name of the crimp terminal varies from manufacturers.



GTNR series, SC series SG narrow-head series

VFD power range	GTNR series, SC series	SG narrow-head series
37kW and lower	✓	-

E.1.2 Control cable

Control cables mainly include analog signal control cables and digital signal control cables. All analog signal control cables and cables used for frequency input must be shielded cables.

Note:

- Analog signals and digital signals cannot share a same cable, and their cables must be routed separately.
- A relay cable needs to carry the metal braided shield layer.
- Keypads need to be connected by using network cables. In complicated electromagnetic environments, shielded network cables are recommended.

E.2 Breaker and electromagnetic contactor

The circuit breaker is mainly used to prevent electric shock accidents and short circuits to the ground that may cause leakage current fire. The electromagnetic contactor is mainly used to control the main circuit power on and off, which can effectively cut off the input power of the VFD in case of system failure to ensure safety.

VFD model	Fuse (A)	Circuit breaker (A)	Contactor rated current (A)
GD390L-2R2G-S2	50	40	32
GD390L-2R2G-2	25	25	18
GD390L-004G-2	50	40	38
GD390L-5R5G-2	60	60	50
GD390L-7R5G-2	70	65	55
GD390L-011G-2	100	90	80
GD390L-015G-2	125	125	95
GD390L-018G-2	150	140	115
GD390L-004G-4	25	25	18
GD390L-5R5G-4	35	32	25
GD390L-7R5G-4	50	40	38
GD390L-011G-4	60	60	50
GD390L-015G-4	70	65	55
GD390L-018G-4	90	80	65
GD390L-022G-4	100	90	80
GD390L-030G-4	125	125	95
GD390L-037G-4	150	140	115

E.3 Optional parts

Reactors, filters, braking components, and mounting brackets are external accessories and need to be specifically specified when purchasing.

E.3.1 Reactor

A reactor is used to improve the power factor on the input side of the VFD, and thus restrict high-order harmonic currents.

Due to parasitic capacitance between the long cable and ground, the leakage current is large and the 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. If the total distance between the VFD and the motor is longer than 50m, select the reactor according to the following table. If the distance is longer than 150m, please contact our technical support.

VFD model	Input reactor	Output reactor
GD390L-2R2G-S2	-	-
GD390L-2R2G-2	ACL2-004-4	OCL2-004-4
GD390L-004G-2	ACL2-7R5-4	OCL2-7R5-4
GD390L-5R5G-2	ACL2-011-4	OCL2-011-4

VFD model	Input reactor	Output reactor
GD390L-7R5G-2	ACL2-015-4	OCL2-015-4
GD390L-011G-2	ACL2-022-4	OCL2-022-4
GD390L-015G-2	ACL2-030-4	OCL2-030-4
GD390L-018G-2	ACL2-037-4	OCL2-037-4
GD390L-004G-4	ACL2-004-4	OCL2-004-4
GD390L-5R5G-4	ACL2-5R5G-4	OCL2-5R5G-4
GD390L-7R5G-4	ACL2-7R5-4	OCL2-7R5-4
GD390L-011G-4	ACL2-011-4	OCL2-011-4
GD390L-015G-4	ACL2-015-4	OCL2-015-4
GD390L-018G-4	ACL2-018-4	OCL2-018-4
GD390L-022G-4	ACL2-022-4	OCL2-022-4
GD390L-030G-4	ACL2-030-4	OCL2-030-4
GD390L-037G-4	ACL2-037-4	OCL2-037-4

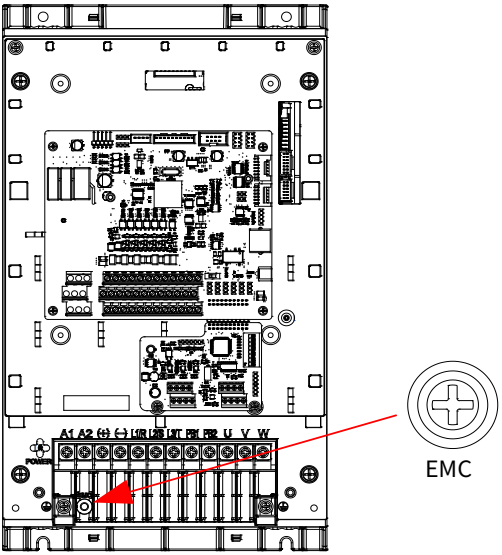
Note: The rated input voltage drop of input reactors is 2%. The rated output voltage drop of output reactors is 1%.

E.3.2 Filter

A filter is used to prevent the surrounding interference and prevent the interference from the VFD during running. GD390L series product includes models with built-in C2 filters and models with C3 filters (see section 2.1 Product nameplate and model for descriptions on C2, C3 models). The "EMC" screw has been installed in the factory to meet the requirements of the corresponding class of IEC 61800-3 (the length requirements of motor cables are detailed in the section C.3.1 EMC compatibility and motor cable length).

Remove the "EMC" screw in the following situations:

- 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), remove the "EMC" screw.
- If leakage protection occurs during configuration of a residual-current circuit breaker, remove the "EMC" screw.



E.3.3 Braking component

The braking component includes braking resistors and braking units, which can be used to dissipate the regenerative energy generated by the motor, greatly improving braking and deceleration capabilities. 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.

VFD model	Braking unit model	Resistance applicable for 100% braking torque (Ω)	Braking resistor dissipation power (kW)			Min. allowed braking resistance (Ω)
			(20% braking usage)	(30% braking usage)	(50% braking usage)	
GD390L-2R2G-S2	Built-in braking unit	65	0.7	1	1.7	44
GD390L-2R2G-2		65	0.7	1	1.7	44
GD390L-004G-2		36	1.2	1.8	3	26
GD390L-5R5G-2		26	1.7	2.5	4.1	18
GD390L-7R5G-2		19	2.3	3.4	5.6	14
GD390L-011G-2		13	3.3	5	8.3	10

VFD model	Braking unit model	Resistance applicable for 100% braking torque (Ω)	Braking resistor dissipation power (kW)			Min. allowed braking resistance (Ω)
			(20% braking usage)	(30% braking usage)	(50% braking usage)	
GD390L-015G-2		10	4.5	6.8	11	9
GD390L-018G-2		8	5.6	8.3	14	8
GD390L-004G-4		122	1.2	1.8	3	80
GD390L-5R5G-4		89	1.7	2.5	4.1	60
GD390L-7R5G-4		65	2.3	3.4	5.6	47
GD390L-011G-4		44	3.3	5	8.3	31
GD390L-015G-4		32	4.5	6.8	11	23
GD390L-018G-4		27	5.6	8.3	14	19
GD390L-022G-4		22	6.6	10	17	17
GD390L-030G-4		17	9	13.5	23	15
GD390L-037G-4		13	11	16.7	28	12

Note:

- Select braking resistors according to the resistance and power data provided by INVT.
- The braking resistor may increase the braking torque of the VFD. The preceding table describes the resistance and power for 100% braking torque, 20% braking usage, 30% braking usage, and 50% braking usage. You can select the braking system based on the actual operation conditions.

Appendix F Function parameter list

The function parameters of the VFD are divided into groups by function. 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 VFD supplies the password protection function. For detail settings, see P07.00. The parameters adopt the decimal system (DEC) and hexadecimal system (0–F). If the hexadecimal system is adopted, all bits are mutually independent on data during parameter editing. The symbols in the table are described as follows:

"○" indicates that the value of the parameter can be modified when the VFD is in stopped or running state.

"◎" indicates that the value of the parameter cannot be modified when the VFD is in running state.

"●" indicates that the value of the parameter is detected and recorded, and cannot be modified. (When "Restore factory settings" is performed, the actual detected parameter values or recorded values will not be restored.)

Group P00—Basic functions

Function code	Name	Description	Default	Modify
P00.00	Speed control mode	Specifies a speed control mode. Setting range: 0–3 0: Sensorless vector control (SVC) mode 0 1: SVC 1 2: Space voltage vector control mode 3: Feedback vector control (FVC) mode **Note:** Before using a vector control mode, enable the VFD to perform motor parameter autotuning first.	2	◎
P00.01	Channel of running commands	Specifies a channel of running commands. Setting range: 0–2 0: Keypad	1	◎

Function code	Name	Description	Default	Modify
		1: Terminal 2: Communication (LCD keypad, CANopen)		
P00.02	Communication mode of running commands	The function code is used to select a communication mode of running commands. Setting range: 0–6 0: Modbus/Modbus TCP communication 1: CANopen 2–6: Reserved	0	◎
P00.03	Max. output frequency	Specifies the max. output frequency of the VFD, which is the basis of the frequency setting and the acceleration (ACC) and deceleration (DEC) speed. Setting range: Max (P00.04, 10.00)–200.00Hz	50.00Hz	◎
P00.04	Upper limit of running frequency	Specifies the upper limit of the VFD output frequency, which should be smaller than or equal to the max. output frequency. If 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	Specifies the lower limit of the VFD output frequency. If the set frequency is lower than the lower limit of the running frequency, the lower limit of the running frequency is used for running. Setting range: 0.00Hz–P00.04 (Upper limit of running frequency) **Note:** Max. output frequency ⩾	0.00Hz	◎

Function code	Name	Description	Default	Modify
		Upper limit of frequency ⩾ Lower limit of frequency		
P00.06	Rated speed of the lift	0.100–4.000m/s	1.000m/s	
P00.07	Speed command channel selection	Specifies the frequency command source. Setting range: 0–15 0: Keypad digital 1: AI1 (follow) 2: AI2 (follow) 3–5: Reserved 6: Multi-step speed running 7–8: Reserved 9: CANopen communication 10–15: Reserved	6	◎
P00.08–P00.09	Reserved	-	-	-
P00.10	Speed set through keypad	Specifies the VFD speed set by keypad. Setting range: 0.00m/s–P00.06 (Rated lift speed)	1.000m/s	○
P00.11–P00.12	Reserved	-	-	-
P00.13	Running direction	Specifies the running direction. Setting range: 0–2 0: Run in default direction 1: Run in reverse direction 2: Disable reverse running	0	◎
P00.14	Carrier frequency setting	Specifies the carrier frequency. A high carrier frequency will have an ideal current waveform, few current harmonics, and small motor noise, but it will increase the switch loss, increase VFD temperature, and impact the output capacity. At the same time, the VFD current leakage and electrical magnetic interference will increase. On the contrary, an	Model depended (8.0kHz)	○

Function code	Name	Description	Default	Modify
		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 VFD is delivered. In general, you do not need to modify it. Setting range: 1.0–15.0 kHz **Note:** When the frequency used exceeds the default carrier frequency, the VFD needs to derate by 10% for each increased of 1kHz.		
P00.15	Motor parameter autotuning	Specifies the motor autotuning function. Setting range: 0x000–0x134 Ones place: Motor basic parameter autotuning 0: No operation 1: Dynamic autotuning 2: Complete parameter static autotuning 3: Partial parameter static autotuning 4: Deadzone compensation autotuning Tens place: Initial pole angle autotuning 0: No operation 1: Rotary autotuning 2: Static autotuning 3: Rotary autotuning 2 Hundreds place: Reserved	0x000	◎
P00.16	AVR function selection	The function code is used to set the VFD automatic voltage regulation (AVR) function, which can eliminate the impact of the bus voltage fluctuation on the VFD output	1	○

Function code	Name	Description	Default	Modify
		voltage. Setting range: 0–1 0: Invalid 1: Valid during the whole process		
P00.17	Reserved	-	-	-
P00.18	Function parameter restore	Specifies the function parameter restoration. Setting range: 0–6 0: No operation 1: Restore to default values (excluding motor parameters) 2: Clear fault records 3–6: Reserved **Note:** Restoring to default values will delete the user password. After the selected operation is performed, the function code is automatically restored to 0.	0	◎

Group P01—Start and stop control

Function code	Name	Description	Default	Modify
P01.00	Running mode of start	Specifies the start mode. Setting range: 0–2 0: Direct start 1: Start after DC braking 2–4: Reserved	0	◎
P01.01	Starting speed of direct start	Specifies the initial speed during VFD start. Setting range: 0.00–P00.06 (rated lift speed)	0.000m/s	◎
P01.02	ACC time of start	Specifies the acceleration time of startup. Setting range: 0.000–0.100s	0.010s	◎
P01.03	Hold time of starting frequency	Specifies the hold time of starting frequency.	0.0s	◎

Function code	Name	Description	Default	Modify
		Setting range: 0.0–50.0s		
P01.04	Braking current before start	Specifies the DC braking current before startup. Setting range: 0.0–100.0%	0.0%	◎
P01.05	Braking time before start	Specifies the DC braking time before startup. Setting range: 0.00–50.00s	0.00s	◎
P01.06	ACC/DEC mode	Specifies the speed changing mode 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.	1	◎
P01.07	Reserved	-	-	-
P01.08	Stop mode	Specifies the stop mode. Setting range: 0–1 0: Decelerate to stop. After the stop command becomes valid, the VFD decelerates to decrease the output frequency during the set time. When the frequency decreases to zero, the VFD stops. 1: Coast to stop. After a stop command takes effect, the VFD ceases the output immediately, and the load coasts to stop according to mechanical inertia.	0	○
P01.09	Starting frequency of DC braking for stop	Specifies the starting frequency of DC braking for stop. Setting range: 0.00Hz–P00.03 (Max. output frequency)	0.00Hz	○
P01.10	Reserved	-	-	-
P01.11	DC braking current for stop	Specifies the DC braking current for stop, that is, the DC braking energy. Setting range: 0.0–100.0% (of the rated VFD output current)	0.0%	○

Function code	Name	Description	Default	Modify
P01.12	DC braking time for stop	Specifies the duration of DC braking. Setting range: 0.00–50.00s **Note:** If the value is 0, DC braking is invalid, and the VFD decelerates to stop within the specified time.	0.00s	○
P01.13–P01.14	Reserved	-	-	-
P01.15	Stop inflection speed	Specifies the stop speed. Setting range: 0.00–P00.06 (rated lift speed)	0.000m/s	◎
P01.16–P01.17	Reserved	-	-	-
P01.18	Terminal-based running command protection at power-on	Specifies whether the terminal running command is valid at power-on. Setting range: 0–1 0: The terminal running command is invalid at power-on. 1: The terminal running command is valid at power-on.	0	○
P01.19–P01.22	Reserved	-	-	-
P01.23	Start delay	Setting range: 0.0–600.0s	0.0s	○
P01.24–P01.43	Reserved	-	-	-

Group P02—Parameters of motor 1

Function code	Name	Description	Default	Modify
P02.00	Type of motor 1	Setting range: 0–1 0: Asynchronous motor (AM) 1: Synchronous motor (SM)	0	◎
P02.01	Rated power of AM 1	Setting range: 0.1–3000.0kW	Model depended	◎
P02.02	Rated frequency of AM 1	Setting range: 0.01Hz–P00.03 (Max. output frequency)	50.00Hz	◎

Function code	Name	Description	Default	Modify
P02.03	Rated speed of AM 1	Setting range: 1–60000rpm	Model depended	◎
P02.04	Rated voltage of AM 1	Setting range: 0–1200V	Model depended	◎
P02.05	Rated current of AM 1	Setting range: 0.8–6000.0A	Model depended	◎
P02.06	Stator resistance of AM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.07	Rotor resistance of AM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.08	Leakage inductance of AM 1	Setting range: 0.1–6553.5mH	Model depended	○
P02.09	Mutual inductance of AM 1	Setting range: 0.1–6553.5mH	Model depended	○
P02.10	No-load current of AM 1	Setting range: 0.1–6553.5A	Model depended	○
P02.11–P02.14	Reserved	-	-	-
P02.15	Rated power of SM 1	Setting range: 0.1–3000.0kW	Model depended	◎
P02.16	Rated frequency of SM 1	Setting range: 0.01Hz–P00.03 (Max. output frequency)	50.00Hz	◎
P02.17	Number of pole pairs of SM 1	Setting range: 1–128	2	◎
P02.18	Rated voltage of SM 1	Setting range: 0–1200V	Model depended	◎
P02.19	Rated current of SM 1	Setting range: 0.8–6000.0A	Model depended	◎
P02.20	Stator resistance of SM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.21	Direct-axis inductance of SM 1	Setting range: 0.01–655.35mH	Model depended	○
P02.22	Quadrature-axis inductance of SM 1	Setting range: 0.01–655.35mH	Model depended	○
P02.23	Counter-emf constant of SM 1	Setting range: 0–10000	300	○
P02.24–P02.25	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P02.26	Motor overload protection selection	Setting range: 0–2 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	Specifies the motor overload protection coefficient. A small motor overload protection coefficient indicates a great overload multiplication (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%–150.0%	100.0%	○
P02.28–P02.32	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P02.33	Pulley diameter	100–2000mm	500mm	◎
P02.34	DEC ratio	0.50–50.00	1.00	◎
P02.35	Speed ratio	0–65535	1000	○
P02.36–P02.38	Reserved	-	-	-

Group P03—Vector control of motor

Function code	Name	Description	Default	Modify
P03.00	Speed-loop proportional gain 1	Setting range: 0.0–200.0 **Note:** Applicable only to vector control mode.	20.0	○
P03.01	Speed-loop integral time 1	Setting range: 0.000–10.000s **Note:** Applicable only to vector control mode.	0.200s	○
P03.02	Low-point frequency for switching	Setting range: 0.00Hz–P03.05 **Note:** Applicable only to vector control mode.	5.00Hz	○
P03.03	Speed-loop proportional gain 2	Setting range: 0.0–200.0 **Note:** Applicable only to vector control mode.	20.0	○
P03.04	Speed-loop integral time 2	Setting range: 0.000–10.000s **Note:** Applicable only to vector control mode.	0.200s	○
P03.05	High-point frequency for switching	Setting range: P03.02–P00.03 (Max. output frequency) **Note:** It is applicable only to vector control mode.	10.00 Hz	○
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%	○

Function code	Name	Description	Default	Modify
P03.08	Power-generation 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%	○
P03.09	Current loop bandwidth KP	Setting range: 0–2000Hz **Note:** ● The function code impacts the dynamic response speed and control accuracy of the system. ● Applicable to SVC mode 0 (P00.00=0), SVC mode 1 (P00.00=1), and FVC mode (P00.00=3).	200Hz	○
P03.10	Current loop bandwidth KI		200Hz	○
P03.11–P03.20	Reserved	-	-	-
P03.20	Electromotive, braking torque upper limit set through keypad	The function code is used to set the torque limit. Setting range: 0.0–300.0% (of the motor rated current)	220.0%	○
P03.21	Emergency running torque upper limit	Specifies the torque limit during emergency running. Setting range: 0.0–200.0% (of the motor rated current)	150.0%	○
P03.22–P03.23	Reserved	-	-	-
P03.24	Max. voltage limit	Specifies the max. VFD output voltage, 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–P03.46	Reserved	-	-	-
P03.47	DC bus voltage delay compensation	0–60000	0	○

Function code	Name	Description	Default	Modify
P03.48–P03.66	Reserved	-	-	-

Group P04—V/F control

Function code	Name	Description	Default	Modify
P04.00	Motor V/F curve setting	Specifies the V/F curve of motor 1 to meet the needs of different loads. Setting range: 0–5 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 to the torque loads such as fans and water pumps. You can adjust according to the characteristics of the loads to achieve best performance. 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.	0	◎
P04.01	Torque boost of motor	Setting range: 0.0% (automatic Torque boost); 0.1% –10.0%	0.0%	○
P04.02	Torque boost cut-off of motor	Setting range: 0.0%–50.0%	20.0%	○
P04.03	Motor V/F frequency point 1	When P04.00 = 1 (multi-dot V/F curve), you can set the V/F curve	0.00Hz	○

Function code	Name	Description	Default	Modify
		through P04.03–P04.08. Setting range: 0.00Hz–P04.05 **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.		
P04.04	Motor V/F voltage point 1	Setting range: 0.0%–110.0% (of the rated voltage of motor 1) **Note:** Refer to the description for P04.03.	0.0%	○
P04.05	Motor V/F frequency point 2	Setting range: P04.03–P04.07 **Note:** Refer to the description for P04.03.	0.00Hz	○
P04.06	Motor V/F voltage point 2	Setting range: 0.0%–110.0% (of the rated voltage of motor 1) **Note:** Refer to the description for P04.03.	0.0%	○
P04.07	Motor V/F frequency point 3	Setting range: P04.05–P02.02 (Rated frequency of AM 1) or P04.05– P02.16 (Rated frequency of SM 1) **Note:** Refer to the description for P04.03.	0.00Hz	○
P04.08	Motor V/F voltage point 3	Setting range: 0.0%–110.0% (of the rated voltage of motor 1) **Note:** Refer to the description for P04.03.	0.0%	○
P04.09	Motor V/F slip compensation gain	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. Setting range: 0.0–200.0%	100.0%	○
P04.10	Low-frequency oscillation control factor of motor	In space voltage vector control mode, the motor, especially the large-power motor, may experience	10	○

Function code	Name	Description	Default	Modify
		current oscillation at certain frequencies, which may cause unstable motor running, or even VFD overcurrent. You can adjust the two function codes properly to eliminate such phenomenon. Setting range: 0–100		
P04.11	High-frequency oscillation control factor of motor	Setting range: 0–100	10	○
P04.12	Oscillation control threshold of motor	Setting range: 0.00Hz–P00.03 (Max. output frequency)	30.00Hz	○
P04.13–P04.25	Reserved	-	-	-
P04.26	Energy-saving run	Setting range: 0–1 0: Disable 1: Automatic energy-saving run	0	◎
P04.27	Reserved	-	-	-
P04.28	Voltage set through keypad	The function code is used to set the voltage value when the keypad is selected as the voltage setting channel. Setting range: 0.0%–100.0%	100.0%	○
P04.29	Voltage increase time	Voltage increase time means the time needed for the VFD to accelerate from min. output voltage to the max. output frequency. Setting range: 0.0–3600.0s	5.0s	○
P04.30	Voltage decrease time	Voltage decrease time means the time needed for the VFD to decelerate from the max. output frequency to min. output voltage. Setting range: 0.0–3600.0s	5.0s	○
P04.31	Max. output voltage	The function code is used to set the upper limit of output voltage. Setting range: P04.32–100.0% (of the motor rated voltage)	100.0%	◎

Function code	Name	Description	Default	Modify
P04.32	Min. output voltage	Specifies the lower limit of output voltage. Setting range: 0.0%–P04.31	0.0%	◎
P04.33	Weakening coefficient in constant power zone	1.00–1.30	1.00	○
P04.34	Pull-in current 1 in SM V/F control	The function code is valid when the SM V/F control mode is enabled. It 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%	○
P04.35	Pull-in current 2 in SM V/F control	The function code is valid when the SM VF control mode is enabled. It is used to set the reactive current of the motor when the output frequency is higher 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 pull-in current switching in SM V/F control	When the SM V/F control mode is enabled, the function code 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 V/F control mode is enabled, the function code is used to set the proportional coefficient of reactive current closed-loop control. Setting range: 0–500	50	○
P04.38	Reactive current closed-loop integral time in SM V/F control	When the SM V/F control mode is enabled, the function code is used to set the integral coefficient of reactive current closed-loop control. Setting range: 0–300	30	○

Function code	Name	Description	Default	Modify
P04.39	Reserved	-	-	-
P04.40	Enabling IF mode for AM 1	Setting range: 0–1 0: Invalid 1: Enable	0	○
P04.41	Current setting in IF mode for AM	The function code is used to set the output current when IF control is adopted for AM 1. 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	The function code is used to set the proportional coefficient of the output current closed-loop control when IF control is adopted for AM 1. Setting range: 0–5000	350	○
P04.43	Integral coefficient in IF mode for AM	The function code is used to set the integral coefficient of the output current closed-loop control when IF control is adopted for AM 1. Setting range: 0–5000	150	○
P04.44	Starting frequency point for switching off IF mode for AM 1	Setting range: 0.00Hz–P04.50	10.00Hz	○
P04.45–P04.49	Reserved	-	-	-
P04.50	End frequency point for switching off IMVF mode for motor	Setting range: P04.44–P00.03 (Max. output frequency)	25.00	○
P04.51–P04.56	Reserved	-	-	-
P04.57	AM VF energy-saving mode selection	Setting range: 0–2 0: Max. efficiency 1: Optimal power factor 2: Max. torque current ratio	0	○
P04.58	AM VF energy-saving optimization coefficient	Setting range: 25.0–400.0%	100.0%	○
P04.59–P04.63	Reserved	-	-	-

Group P05—Input terminals

Function code	Name	Description	Default	Modify
P05.00	Reserved	-	-	-
P05.01	Function of S1	Setting range: 0–40 0: No function 1: Up running (FWD) 2: Down running (REV) 3: Running in inspection (EXM) 4: Emergency operation (EMER) 5: Coast to stop (FSTP) 6: Fault reset (RET) 7: External fault (EF) 8: Multi-step speed terminal 1 (MS1) 9: Multi-step speed terminal 2 (MS2) 10: Multi-step speed terminal 3 (MS3) 11: Up forced DEC 1 (UFS1) 12: Up forced DEC 2 (UFS2) 13: Up forced DEC 3 (UFS3) 14: Down forced DEC 1 (DFS1) 15: Down forced DEC 2 (DFS2) 16: Down forced DEC 3 (DFS3) 17: Contactor feedback signal (TB) 18: Brake feedback signal (FB) 19: VFD enabling (ENA) 20: Forced decelerate to stop 21: Emergency mode 22: Motor overheating 23: Main power supply input disconnected (for India) 24: UPS input disconnected by main control (for India) 25: Base lockout 26–40: Reserved	1	◎
P05.02	Function of S2		2	◎
P05.03	Function of S3		8	◎
P05.04	Function of S4		9	◎
P05.05	Function of S5		10	◎
P05.06	Function of S6		0	◎
P05.07	Function of S7		0	◎
P05.08	Function of S8		0	◎
P05.09	Function of S9		0	◎
P05.10	Function of S10		0	◎
P05.11	Reserved	-	-	-
P05.12	Reserved	-	-	-
P05.13	Input terminal polarity	The function code is used to set the polarity of the input terminal.	0x000	○

Function code	Name	Description	Default	Modify
		When a bit is 0, the input terminal is positive. when a bit is 1, the input terminal is negative. Setting range: 0x000–0x3FF Bit0: S1 Bit1: S2 Bit2: S3 Bit3: S4 Bit4: S5 Bit5: S6 Bit6: S7 Bit7: S8 Bit8: S9 Bit9: S10		
P05.14	Digital input filter time	Specifies the filter time of S1–S10 terminal sampling. In strong interference cases, increase the value to avoid maloperation. Setting range: 0.000–1.000s	0.010s	○
P05.15–P05.16	Reserved	-	-	-
P05.17	S1 switch-on delay	Used to specify the delay time corresponding to the electrical level change when a programmable input terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P05.18	S1 switch-off delay		0.000s	○
P05.19	S2 switch-on delay		0.000s	○
P05.20	S2 switch-off delay		0.000s	○
P05.21	S3 switch-on delay		0.000s	○
P05.22	S3 switch-off delay		0.000s	○
P05.23	S4 switch-on delay		0.000s	○
P05.24	S4 switch-off delay		0.000s	○
P05.25	S5 switch-on delay		0.000s	○
P05.26	S5 switch-off delay		0.000s	○
P05.27	S6 switch-on delay		0.000s	○
P05.28	S6 switch-off delay		0.000s	○
P05.29	S7 switch-on delay		0.000s	○
P05.30	S7 switch-off delay		0.000s	○
P05.31	S8 switch-on delay		0.000s	○

Function code	Name	Description	Default	Modify
P05.32	S8 switch-off delay		0.000s	○
P05.33	S9 switch-on delay		0.000s	○
P05.34	S9 switch-off delay		0.000s	○
P05.35	S10 switch-on delay		0.000s	○
P05.36	S10 switch-off delay		0.000s	○
P05.37	AI1 lower limit	Setting range: 0.00V–P05.39	0.00V	○
P05.38	Corresponding setting of AI1 lower limit	Setting range: 0.0%–300.0%	0.0%	○
P05.39	AI1 upper limit	Setting range: P05.37–10.00V	10.00V	○
P05.40	Corresponding setting of AI1 upper limit	Setting range: 0.0%–300.0%	100.0%	○
P05.41	AI1 input filter time	Setting range: 0.000s–10.000s	0.030s	○
P05.42	AI2 lower limit	Setting range: 0.00V–P05.44	0.00V	○
P05.43	Corresponding setting of AI2 lower limit	Setting range: 0.0%–300.0%	0.0%	○
P05.44	AI2 middle value 1	Setting range: P05.42–P05.46	0.00V	○
P05.45	Corresponding setting of AI2 middle value 1	Setting range: 0.0%–300.0%	0.0%	○
P05.46	AI2 middle value 2	Setting range: P05.44–P05.48	0.00V	○
P05.47	Corresponding setting of AI2 middle value 2	Setting range: 0.0%–300.0%	0.0%	○
P05.48	AI2 upper limit	Setting range: P05.46–10.00V	10.00V	○
P05.49	Corresponding setting of AI2 upper limit	Setting range: 0.0%–300.0%	100.0%	○
P05.50	AI2 input filter time	Setting range: 0.000s–10.000s	0.030s	○
P05.51	AI1 input signal type	Setting range: 0–1 0: Voltage 1: Current **Note:** You can set the AI1 input signal type through the corresponding function code.	0	◎
P05.52	Threshold voltage of motor OH protection analog signal	Setting range: 0.0–10.0V	0.0	○
P05.53–P05.56	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P05.57	AI2 input signal type	Setting range: 0–1 0: Voltage 1: Current **Note:** You can set the AI2 input signal type through the corresponding function code.	0	◎
P05.58–P05.60	Reserved	-	-	-

Group P06—Output terminals

Function code	Name	Description	Default	Modify
P06.00	Reserved	-	-	-
P06.01	Y1 output selection	Setting range: 0–30 0: No output 1: Lift in operation 2: Up operation 3: Down running 4: Fault output 5: Running at zero speed 6: Ready to run 7: Brake control 8: Contactor control 9: Any frequency reached 10: Frequency level detection FDT1 output 11: Frequency level detection FDT2 output 12: Reserved 13: Light-load direction detection completed 14: Down as the light-load direction detection result 15: Up as the light-load direction detection result 16: Running 1 (excluding current	1	○
P06.02	Reserved		-	-
P06.03	RO1 output selection		0	○
P06.04	RO2 output selection		7	
P06.05	RO3 output selection		8	○

Function code	Name	Description	Default	Modify
		withdrawal) 17: STO action 18: SPI fault output 19: UPS control signal output (India) 20: Sealed-star output 21: Waiting after autonomous rescue leveling (reserved) 22–30: Reserved		
P06.06	Output terminal polarity selection	Specifies the output terminal polarity. Setting range: 0x00–0x0F bit0: Y1 bit1: RO1 bit2: RO2 bit3: RO3	0x00	○
P06.07	Y1 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.08	Y1 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.09–P06.10	Reserved	-	-	-
P06.11	RO1 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.12	RO1 switch-off delay	Specifies the delay time corresponding to the electrical level	0.000s	○

Function code	Name	Description	Default	Modify
		change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s		
P06.13	RO2 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.14	RO2 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.15	RO3 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.16	RO3 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.17–P06.39	Reserved	-	-	-

Group P07—HMI

Function code	Name	Description	Default	Modify
P07.00	User password	By default, the user password is not enabled (the default value is 0).	0	○

Function code	Name	Description	Default	Modify
		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 setting takes effect, you need to enter the password to view or edit parameters. 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. Setting range: 0–65535		
P07.01	Parameter copy	Setting range: 0–4 0: No operation 1: Upload parameters to the keypad 2: Download all parameters (including motor parameters) 3: Download non-motor parameters 4: Download motor parameters	0	◎
P07.02–P07.03	Reserved	-	-	-
P07.04	Stop function validity of STOP/RST	Specifies the validness range of the STOP/RST stop function. For fault reset, STOP/RST is valid in any conditions.	0	○

Function code	Name	Description	Default	Modify
		Setting range: 0–3 0: Valid for keypad control only 1: Valid both for keypad and terminal control 2: Valid both for keypad and communication control 3: Valid for all control modes		
P07.05	Selection 1 of parameters displayed in running state	Setting range: 0x0000–0xFFFF BIT0: Running speed (m/s on) Bit1: Set speed (m/s blinking) Bit2: Bus voltage (V on) BIT3: Output voltage (V on) BIT4: Output current (A on) BIT5: Running speed (rpm on) Bit 6: Output power (% on) Bit 7: Output torque (% on) Bit 8: Reserved Bit 9: Reserved BIT10: Input terminal status Bit11: Output terminal status Bit 12: Reserved Bit 13: Reserved Bit14: Reserved Bit 15: Reserved	0x0FFF	○
P07.06	Selection 2 of parameters displayed in running state	Setting range: 0x0000–0xFFFF Bit 0: AI1 (V on) Bit 1: AI2 (V on) Bit 2: Reserved Bit 3: Reserved Bit 4: Reserved Bit5: Reserved Bit6: Ramp reference speed (m/s on) Bit 7: Linear speed Bit 8: Reserved Bit9: Upper limit frequency (Hz on)	0x0000	○
P07.07	Selection of parameters displayed in stopped	Setting range: 0x0000–0xFFFF Bit0: Set speed (m/s on, blinking	0x00FF	○

Function code	Name	Description	Default	Modify
	state	slowly) Bit 1: Bus voltage (V on) Bit2: Input terminal state BIT3: Output terminal state Bit 4: Reserved Bit5: Reserved Bit6: Reserved Bit7: AI1 (V on) Bit8: AI2 (V on) Bit 9: Reserved Bit 10: Reserved Bit 11: Reserved Bit 12: Reserved Bit 13: Reserved Bit14: Reserved		
P07.08	Frequency display coefficient	Setting range: 0.01–10.00 Display frequency = Running frequency * P07.08	1.00	○
P07.09	Rotational speed display coefficient	Setting range: 0.1–999.9% Mechanical rotation speed = 120 × (Displayed running frequency) × P07.09/(Number of motor pole pairs)	100.0%	○
P07.10	Linear speed display coefficient	Setting range: 0.1–999.9% Linear speed = (Mechanical rotation speed) × P07.10	1.0%	○
P07.11	Rectifier bridge temperature	Setting range: -20.0–120.0°C	0.0°C	●
P07.12	Inverter module temperature	Setting range: -20.0–120.0°C	0.0°C	●
P07.13	Software version of MCU board	Setting range: 1.00–655.35	Version depended	●
P07.14	Software version of DSP board	Setting range: 1.00–655.35	Version depended	●
P07.15	VFD electricity consumption MSB	The function code is used to display the electricity consumption of the VFD. VFD electricity consumption = P07.15	0kWh	●

Function code	Name	Description	Default	Modify
		× 1000 + P07.16 Setting range: 0–65535kWh (*1000)		
P07.16	VFD electricity consumption LSB	The function code is used to display the electricity consumption of the VFD. VFD electricity consumption = P07.15 × 1000 + P07.16 Setting range: 0.0–999.9kWh	0.0kWh	●
P07.17	VFD model	Setting range: 0x0000–0xFFF1 bit0–bit3: G type or P type 0x0: G type 0x1: P type bit4–bit11: Chip type and manufacturer 0x00: DSP(TI) 0x01–0x20: Reserved 0x21: MCU(ST) 0x22–0xFF: Reserved bit12–bit15: VFD series 0x0: GD390L 0x1–0xF: Reserved **Note:** bit4–bit8 indicate the chip manufacturer (such as TI, ST), while bit9–bit11 indicate the chip type (such as DSP, MCU).	0x0000	●
P07.18	VFD rated power	Setting range: 0.4–3000.0kW	Model depended	●
P07.19	VFD rated voltage	Setting range: 50–1200V	Model depended	●
P07.20	VFD rated current	Setting range: 0.1–6000.0A	Model depended	●
P07.21	Factory bar code 1	Setting range: 0x0000–0xFFFF	Model depended	●
P07.22	Factory bar code 2	Setting range: 0x0000–0xFFFF	Model depended	●
P07.23	Factory bar code 3	Setting range: 0x0000–0xFFFF	Model depended	●

Function code	Name	Description	Default	Modify
P07.24	Factory bar code 4	Setting range: 0x0000–0xFFFF	Model depended	●
P07.25	Factory bar code 5	Setting range: 0x0000–0xFFFF	Model depended	●
P07.26	Factory bar code 6	Setting range: 0x0000–0xFFFF	Model depended	●
P07.27	Type of present fault	Setting range: 0–65535 0: No fault 1: Inverter unit U-phase protection (E1) 2: Inverter unit V-phase protection (E2) 3: Inverter unit W-phase protection (E3) 4: Overcurrent during acceleration (E4) 5: Overcurrent during deceleration (E5) 6: Overcurrent during constant speed running (E6) 7: Overvoltage during acceleration (E7) 8: Overvoltage during deceleration (E8) 9: Overvoltage during constant speed running (E9) 10: Bus undervoltage fault (E10) 11: Motor overload (E11) 12: VFD overload (E12) 13: Phase loss on input side (E13) 14: Phase loss on output side (E14) 15: Rectifier module overheat (E15) 16: Inverter module overheat (E16) 17: External fault (E17) 18: Modbus/Modbus TCP communication fault (E18) 19: Current detection fault (E19)	0	●
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
		20: Motor autotuning fault (E20) 21: EEPROM operation error (E21) 22: Reserved 23: Braking unit fault (E23) 24: Running time reached (E24) 25: Reserved 26: Keypad communication error (E26) 27: Parameter upload error (E27) 28: Parameter download error (E28) 29: Reserved 30: Reserved 31: CANopen communication fault (E31) 32: To-ground short-circuit fault 1 (E32) 33: To-ground short-circuit fault 2 (E33) 34: Speed deviation fault (E34) 35: Mal-adjustment fault (E35) 36: Reserved 37: Encoder disconnection fault (E37) 38: Encoder reversal fault (E38) 39: Encoder Z-pulse disconnection fault (E39) 40: Safe torque off (E40) 41: Channel 1 safety circuit exception (E41) 42: Channel 2 safety circuit exception (E42) 43: Exception to both channels 1 and 2 (E43) 44: Safety code FLASH CRC fault (E44) 45–58: Reserved 59–69: Reserved 82: Expansion card PT100		

Function code	Name	Description	Default	Modify
		overtemperature (E82) 83: Reserved 95: Reserved 96: No upgrade bootload (E96) 92: AI1 disconnection (E92) 93: AI2 disconnection (E93) 94: Reserved 580: Brake failure (E580) 581: Contactor failure (E581) 582: No enabling signal (E582) 583: Braking overcurrent (E583) 584: Output without current (E584) 585: No absolute position signal fault (E585) 586: Electronic star shorting fault (E586) 587: Dual-CPU communication fault 1 (E587) 588: Dual-CPU communication fault 2 (E588) 589: Dual-CPU communication fault 3 (E589)		
P07.33	Running speed at present fault	Setting range: 0.00Hz–P00.06	0.000m/s	●
P07.34	Ramp reference speed at present fault	Setting range: 0.00Hz–P00.03	0.000m/s	●
P07.35	Output current at present fault	Setting range: 0–1200V	0V	●
P07.36	Output current at present fault	Setting range: 0.0–6300.0A	0.0A	●
P07.37	Output braking current at present fault	Setting range: 0.0–6300.0A	0.0A	●
P07.38	Bus voltage at present fault	Setting range: 0.0–2000.0V	0.0V	●
P07.39	Max. temperature at present fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.40	Input terminal status at	Setting range: 0x0000–0xFFFF	0x0000	●

Function code	Name	Description	Default	Modify
	present fault			
P07.41	Output terminal status at present fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.42	Running frequency at last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.43	Ramp reference frequency at last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.44	Output voltage at last fault	Setting range: 0–1200V	0V	●
P07.45	Output current at last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.46	Output braking current at last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.47	Bus voltage at last fault	Setting range: 0.0–2000.0V	0.0V	●
P07.48	Temperature at last fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.49	Input terminal state at last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.50	Output terminal state at last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.51	Running frequency at 2nd-last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.52	Ramp reference frequency at 2nd-last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.53	Output voltage at 2nd-last fault	Setting range: 0–1200V	0V	●
P07.54	Output current at 2nd-last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.55	Output braking current at 2nd-last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.56	Bus voltage at 2nd-last fault	Setting range: 0.0–2000.0V	0.0V	●
P07.57	Temperature at 2nd-last fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.58	Input terminal state at 2nd-last fault	Setting range: 0x0000–0xFFFF	0x0000	●

Function code	Name	Description	Default	Modify
P07.59	Output terminal state at 2nd-last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.60	Present time: year	Setting range: 2000–3000	2020	
P07.61	Present time: month	Setting range: 1–12	1	○
P07.62	Present time: date	Setting range: 1–31	1	○
P07.63	Present time: hour	Setting range: 0–23	0	○
P07.64–P07.71	Reserved	-	-	-
P07.72	Local accumulative running time	Setting range: 0–65535h	0h	●

Group P08—Enhanced functions

Function code	Name	Description	Default	Modify
P08.00–P08.27	Reserved	-	-	-
P08.28	Auto fault reset count	Specifies the number of automatic fault reset times when the VFD uses automatic fault reset. When the number of continuous reset times exceeds the value, the VFD reports a fault and stops. After VFD starts, If no fault occurred within 600s after the VFD starts, the number of automatic fault reset times is cleared. Setting range: 0–10	0	○
P08.29	Auto fault reset interval	Specifies the time interval from when a fault occurred to when automatic fault reset takes effect. Setting range: 0.1–3600.0s	1.0s	○
P08.30–P08.31	Reserved	-	-	-
P08.32	FDT1 electrical level detection value	Used to view the FDT1 electrical level detection value. When the output frequency exceeds the	0.000m/s	○

Function code	Name	Description	Default	Modify
		corresponding speed of FDT electrical level, the multifunction digital output terminal continuously outputs the signal of "Speed level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the speed corresponding to (FDT electrical level—FDT lagging detection value). Setting range: 0.00Hz–P00.06 (rated lift speed)		
P08.33	FDT1 lagging detection value	Used to view the FDT1 lagging detection value. When the output frequency exceeds the corresponding speed of FDT electrical level, the multifunction digital output terminal continuously outputs the signal of "Speed level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the speed corresponding to (FDT electrical level—FDT lagging detection value). Setting range of: 0.0–100.0% (FDT1 electrical level)	5.0%	○
P08.34	FDT2 electrical level detection value	Used to view the FDT2 electrical level detection value. When the output frequency exceeds the corresponding speed of FDT electrical level, the multifunction digital output terminal continuously outputs the signal of "Speed level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the speed corresponding to (FDT	0.000m/s	○

Function code	Name	Description	Default	Modify
		electrical level—FDT lagging detection value). Setting range: 0.00Hz–P00.06 (rated lift speed)		
P08.35	FDT2 lagging detection value	Used to view the FDT2 lagging detection value. When the output frequency exceeds the corresponding speed of FDT electrical level, the multifunction digital output terminal continuously outputs the signal of "Speed level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the speed corresponding to (FDT electrical level—FDT lagging detection value). Setting range of: 0.0–100.0% (FDT2 electrical level)	5.0%	○
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	-	-	-
P08.38	Dynamic braking threshold voltage	The function code is used to set the starting bus voltage of dynamic braking. Adjust this value properly to achieve effective braking for the load. The default value varies depending on the voltage class. Setting range: 200.0–2000.0V	For 230V: 380.0V For 400V: 700.0V	○
P08.39	Reserved	-	-	-
P08.40	PWM selection	Setting range: 0x0000–0x1221 Ones place: PWM mode selection	0x1121	◎

Function code	Name	Description	Default	Modify
		0: Switch from SVPWM to DPWM overmodulation 1: SPWM overmodulation throughout the entire process 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 (only for vector control) 2: Compensation method 3 (only for vector control) Thousands place: SVPWM mode selection 0: SVPWM using three-order harmonic injection method 1: Traditional SPWM		
P08.41–P08.47	Reserved	-	-	-
P08.48	Initial electricity consumption MSB	Specifies the initial electricity consumption. Initial electricity consumption = P08.48 × 1000 + P08.49 Setting range: 0–59999kWh (k)	0kWh	○
P08.49	Initial electricity consumption LSB	The function code is used to set the initial electricity consumption. Initial electricity consumption = P08.48 × 1000 + P08.49 Setting range: 0.0–999.9kWh	0.0kWh	○
P08.50–P08.51	Reserved	-	-	-
P08.52	STO fault reset selection	Setting range: 0–1	0	○

Function code	Name	Description	Default	Modify
		0: Re-power on to reset STO fault 1: Manually reset STO fault		
P08.53–P08.54	Reserved	-	-	-
P08.55	Enabling auto carrier frequency reduction	Setting range: 0–1 0: Disable 1: Enable **Note:** Automatic carrier frequency reduction indicates that the VFD automatically reduces the carrier frequency when detecting the heat sink temperature exceeds the rated temperature. When the temperature decreases to a specified value, the carrier frequency restores to the setting. This function can reduce the VFD overheat alarm reporting chances.	0	○
P08.56	Min. carrier frequency	Setting range: 0.0–15.0kHz	Model depended	●
P08.57	Temperature point of auto carrier frequency reduction	Setting range: 40.0–85.0°C	70.0°C	○
P08.58	Interval of carrier frequency reduction	Setting range: 0–30min	10min	○
P08.59	AI1 disconnection detection threshold	Setting range: 0–100%	0	○
P08.60	AI2 disconnection detection threshold	Setting range: 0–100%	0	○
P08.61	Reserved	-	-	-
P08.62	Output current filter time	Setting range: 0.000–10.000s	0.000s	○
P08.63–P08.86	Reserved	-	-	-

Group P09—PID control (Reserved)

Group P10—Speed curve settings

Function code	Name	Description	Default	Modify
P10.00	Multi-step speed 0	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.01	Multi-step speed 1	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.02	Multi-step speed 2	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.03	Multi-step speed 3	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.04	Multi-step speed 4	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.05	Multi-step speed 5	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.06	Multi-step speed 6	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.07	Multi-step speed 7	Setting range: 0.000–P00.06(m/s)	0.000	○
P10.08–P10.37	Reserved	-	-	-
P10.38	S-curve ACC start segment duration	Setting range: 0.1–360.0s	2.0s	◎
P10.39	S-curve ACC end segment duration	Setting range: 0.1–360.0s	2.0s	◎
P10.40	ACC time	Setting range: 0.1–360.0s	2.0s	◎
P10.41	S-curve DEC start segment duration	Setting range: 0.1–360.0s	2.0s	◎
P10.42	S-curve DEC end segment duration	Setting range: 0.1–360.0s	2.0s	◎
P10.43	DEC time	Setting range: 0.1–360.0s	2.0s	◎
P10.44	S-curve start segment duration during stop	Setting range: 0.1–360.0s	2.0s	◎
P10.45	S-curve end segment duration during stop	Setting range: 0.1–360.0s	2.0s	◎
P10.46	Running speed at maintenance	Setting range: 0.000–P00.06m/s	0.200m/s	◎
P10.47	ACC/DEC time at maintenance	Setting range: 0.1–360.0s	4.0s	◎
P10.48	Forced DEC time	Setting range: 0.1–360.0s	0.0s	◎
P10.49	Emergency running	Setting range: 0.001m/s–P00.06	0.100m/s	◎

Function code	Name	Description	Default	Modify
	speed			
P10.50	Emergency ACC/DEC time	Setting range: 0.1–360.0s	20.0s	◎
P10.51–P10.52	Reserved	-	-	-
P10.53	DEC time for creeping to stop	Setting range: 0.1–360.0s	2.0s	◎
P10.54	Speed threshold for light-load detection in open-loop control	Setting range: 5.00–20.00Hz	5.00Hz	○
P10.55–P10.58	Reserved	-	-	-

Group P11—Protection parameters

Function code	Name	Description	Default	Modify
P11.00	Protection against phase loss	Setting range: 0x000–0x111 Ones place: 0: Disable software input phase loss protection. 1: Enable software input phase loss protection. Tens place: 0: Output phase loss protection disabled 1: Enable protection against output phase loss. Hundreds place: 0: Output phase loss detection not enabled before startup 1: Output phase loss detection enabled before startup	0x010	○
P11.01–P11.04	Reserved	-	-	-

Function code	Name	Description	Default	Modify
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. To prevent the VFD trip due to overcurrent during acceleration, take the current limit measures. Setting range: 0x00–0x11 Ones place: Current limit action 0: Invalid 1: Always valid Tens place: Hardware current limit overload alarm 0: Valid 1: Invalid	0x00	◎
P11.06	Automatic current limit threshold	Setting range: 50.0–200.0% (of the rated VFD output current)	For the G type: 160.0% For the P type: 120.0%	◎
P11.07	Frequency decrease ratio in current limiting	Setting range: 0.00–50.00Hz/s	10.00 Hz/s	◎
P11.08	Reserved	-	-	-
P11.09	Overload pre-alarm detection threshold	If the VFD 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. Setting range: P11.11–200% (relative value determined by the ones place of P11.08)	Type G: 150% For the P type: 120%	○
P11.10	Overload pre-alarm detection time	Setting range: 0.1–3600.0s	1.0s	○
P11.11–P11.12	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P11.13	Fault output terminal action upon fault occurring	Specifies the action of fault output terminals at undervoltage and fault reset. Setting range: 0x00–0x11 Ones place: 0: Act at undervoltage 1: Do not act upon an undervoltage fault Tens place: 0: Act during automatic reset 1: Do not act during the automatic reset period	0x00	○
P11.14	Speed deviation detection value	Specifies the speed deviation detection value. Setting range: 0.0–50.0%	10.0%	○
P11.15	Speed deviation detection time	Specifies the speed deviation detection time. If the speed deviation detection time is smaller than the set value, the VFD continues running. Setting range: 0.0–10.0s **Note:** Speed deviation protection is invalid when P11.15 is set to 0.0.	2.0s	○
P11.16–P11.29	Reserved	-	-	-
P11.30	Emergency running undervoltage point	Setting range: 0.0–1000.0V	30.0V	◎
P11.55–P11.71	Reserved	-	-	-

Group P12—Parameters of motor 2 (Reserved)

Group P13—SM control

Function code	Name	Description	Default	Modify
P13.00	SM injected-current	Specifies the reduction rate of the	80.0%	○

Function code	Name	Description	Default	Modify
	decrease ratio	input reactive current. When the active current of the synchronous motor increases to some extent, the input reactive current can be reduced to improve the power factor of the motor. Setting range: 0.0%–100.0% (of the the motor rated current)		
P13.01	Detection mode of initial pole	Setting range: 0–2 0: No detection 1: High-frequency superposition 2: Pulse superposition	2	◎
P13.02	Pull-in current 1	Specifies the pole position orientation current. It 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: -100.0%–100.0% (of the motor rated current)	30.0%	○
P13.03	Pull-in current 2	Used to set the pole position orientation current. It is valid within the upper limit of pull-in current switch-over frequency threshold. You do not need to change the value in most cases. Setting range: -100.0%–100.0% (of the motor rated current)	10.0%	○
P13.04	Switch-over frequency of pull-in current	Setting range: 0.0–200.0% **Note:** The value is relative to the motor rated frequency.	20.0%	○
P13.05	Reserved	-	-	-
P13.06	High-frequency superposition voltage	Specifies the pulse current threshold when the initial magnetic pole position is detected in the pulse mode. The value is a percentage in	80.0%	◎

Function code	Name	Description	Default	Modify
		relative to the rated current of the motor. Setting range: 0.0–300% (of the motor rated voltage)		
P13.07	Control parameter 0	0.0–400.0	0.0	○
P13.08	Vector control optimization mode	Setting range: 0x0000–0xFFFF Bit0: Enable back-emf self-adapter (applicable to PM-SVC1 mode only) Bit1: Enable SM flux weakening optimization (used with P03.22 to adjust the compensation) Bit2: Enable current loop parameter optimization Bite3: Enable SM back-emf identification optimization Bit4: Enable SM MTPA Bit5: Reserved Bit6: Online autotuning of stator resistance Bit7: Initial position identification optimization bit8–15: Reserved	0x0000	○
P13.09	Reserved	-	-	-
P13.10	Initial compensation angle of SM	Setting range: 0.0–359.9	0.0	○
P13.11	Mal-adjustment 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: 0.0–10.0s	0.5s	○
P13.12	Reserved	-	-	-
P13.13	High-frequency pull-in current	Setting range: 0–300.0% (of the rated VFD output current)	20.0%	◎
P13.14	SVC speed feedback bandwidth	10.0–200.0 rad/s	62.5 rad/s	◎

Function code	Name	Description	Default	Modify
P13.15	SM back-emf adaptive bandwidth	Setting range: 1–100Hz	1 Hz	○
P13.16–P13.21	Reserved	-	-	-

Group P14—Serial 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 slave address cannot be set to 0.	1	○
P14.01	Communication baud rate setting	The function code is used to set the data transmission speed between the host controller and the VFD. Setting range: 0–7 0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps 7: 115200bps **Note:** The baud rate set on the VFD must be consistent with that on the host controller. Otherwise, the	4	○

Function code	Name	Description	Default	Modify
		communication fails. A greater baud rate indicates faster communication.		
P14.02	Data bit check setting	Setting range: 0–5 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 **Note:** The data format set on the VFD must be consistent with that on the host controller. Otherwise, the communication fails.	1	○
P14.03	Communication response delay	Setting range: 0–200ms	5ms	○
P14.04	RS485 communication timeout time	Setting range: 0.0 (invalid)–60.0s	0.0s	○
P14.05	Transmission error processing	Setting range: 0–3 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	Modbus communication processing action selection	Setting range: 0x000–0x111 Ones place: 0: Respond to write operations 1: Not respond to write operations Tens place: 0: Communication password protection is invalid. 1: Communication password protection is valid.	0x000	○

Function code	Name	Description	Default	Modify
		Hundreds place: (valid for RS485 communication only) 0: User-defined addresses specified by P14.07 and P14.08 are invalid. 1: User-defined addresses specified by P14.07 and P14.08 are valid.		
P14.07	User-defined running command address	Setting range: 0x0000–0xFFFF	0x2000	○
P14.08–P14.09	Reserved	-	-	-
P14.10	Enabling 485 upgrade program	Setting range: 0–2 0: Disable 1: Enable OTA upgrade of MCU 2: Enable USB upgrade of MCU **Note:** The OTA upgrade of DSP does not require software enablement, and hardware enablement can be achieved by burning the adapter cable. DSP currently does not support USB upgrade.	0	◎
P14.11	Reserved	-	-	-
P14.12	MCU bootload software version	Setting range: 0.00–655.35	0.00	●
P14.13	DSP bootload software version	Setting range: 0.00–655.35	0.00	●
P14.14	Display of no upgrade bootload fault	Setting range: 0–1 0: Display 1: Do not display	0	○
P14.15	Program upgrade result	Setting range: 0–5 0: Not upgraded 1–2: Reserved 3: Upgraded successfully 4–5: Reserved **Note:** When upgrading, set P14.15 to 0 before setting P14.10. After successful upgrade, P14.15 is automatically set to 3.	0	◎

Function code	Name	Description	Default	Modify
P14.16–P14.47	Reserved	-	-	-
P14.48	Channel selection for mapping between PZDs and function codes	Setting range: 0x00–0x11 Ones place: Channel for mapping function codes to PZDs 0: Reserved 1: Group P15 Tens place: Save function at power off 0: Disable 1: Enable	0x11	○
P14.49	PZD2 receives mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.50	Mapped function code of received PZD3	Setting range: 0x0000–0xFFFF	0x0000	○
P14.51	Mapped function code of received PZD4	Setting range: 0x0000–0xFFFF	0x0000	○
P14.52	Mapped function code of received PZD5	Setting range: 0x0000–0xFFFF	0x0000	○
P14.53	Mapped function code of received PZD6	Setting range: 0x0000–0xFFFF	0x0000	○
P14.54	Mapped function code of received PZD7	Setting range: 0x0000–0xFFFF	0x0000	○
P14.55	Mapped function code of received PZD8	Setting range: 0x0000–0xFFFF	0x0000	○
P14.56	Mapped function code of received PZD9	Setting range: 0x0000–0xFFFF	0x0000	○
P14.57	Mapped function code of received PZD10	Setting range: 0x0000–0xFFFF	0x0000	○
P14.58	Mapped function code of received PZD11	Setting range: 0x0000–0xFFFF	0x0000	○
P14.59	Mapped function code of received PZD12	Setting range: 0x0000–0xFFFF	0x0000	○
P14.60	PZD2 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.61	Mapped function code of sent PZD3	Setting range: 0x0000–0xFFFF	0x0000	○

Function code	Name	Description	Default	Modify
P14.62	PZD4 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.63	PZD5 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.64	PZD6 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.65	PZD7 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.66	PZD8 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.67	PZD9 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.68	PZD10 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.69	PZD11 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○
P14.70	PZD12 sends mapping function code	Setting range: 0x0000–0xFFFF	0x0000	○

Group P15—Communication expansion card 1 functions

Function code	Name	Description	Default	Modify
P15.00	Reserved	-	-	-
P15.01	Module address	Setting range: 0–127	2	◎
P15.02	Received PZD2	Setting range: 0–31 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	0	○
P15.03	Received PZD3		0	○
P15.04	Received PZD4		0	○
P15.05	Received PZD5		0	○
P15.06	Received PZD6		0	○
P15.07	Received PZD7		0	○
P15.08	Received PZD8		0	○
P15.09	Received PZD9		0	○
P15.10	Received PZD10		0	○
P15.11	Received PZD11		0	○
P15.12	Received PZD12		0	○

Function code	Name	Description	Default	Modify
		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, corresponding to S10/S9/S8/S7/S6/S5/S4/S3/S2/S1) 10: Virtual output terminal command (range: 0x00–0x0F, corresponding to RO3/RO2/RO1/Y1) 11: Voltage setting (special for V/F separation) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12–18: Reserved 19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59) 20–31: Reserved		
P15.13	Sent PZD2	Setting range: 0–31 0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (*10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotation speed of running (×1,	0	○
P15.14	Sent PZD3		0	○
P15.15	Sent PZD4		0	○
P15.16	Sent PZD5		0	○
P15.17	Sent PZD6		0	○
P15.18	Sent PZD7		0	○
P15.19	Sent PZD8		0	○
P15.20	Sent PZD9		0	○
P15.21	Sent PZD10		0	○
P15.22	Sent PZD11		0	○

Function code	Name	Description	Default	Modify
P15.23	Sent PZD12	rpm) 9: Linear speed of running (×1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (×100, V) 13: AI2 input (×100, V) 14: Reserved 15: Reserved 16: Terminal input status 17: Terminal output status 18–30: Reserved 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70)	0	○
P15.24–P15.25	Reserved	-	-	-
P15.26	CANopen communication timeout period	Setting range: 0.0 (invalid)–60.0s	5.0s	○
P15.27	CANopen communication baud rate	Setting range: 0–7 0: 1000kbps 1: 800kbps 2: 500kbps 3: 250kbps 4: 125kbps 5: 100kbps 6: 50kbps 7: 20kbps	3	◎
P15.28–P15.30	Reserved	-	-	-
P15.31	Communication control word expression format	Setting range: 0–1 0: Decimal format 1: Binary format	0	◎
P15.32–P15.69	Reserved	-	-	-

Group P16—Communication expansion card 2 functions

Function code	Name	Description	Default	Modify
P16.00–P16.01	Reserved	-	-	-
P16.02	Ethernet monitoring card IP address 1	Setting range: 0–255	192	◎
P16.03	Ethernet monitoring card IP address 2	Setting range: 0–255	168	◎
P16.04	Ethernet monitoring card IP address 3	Setting range: 0–255	28	◎
P16.05	Ethernet monitoring card IP address 4	Setting range: 0–255	11	◎
P16.06	Ethernet monitoring card subnet mask 1	Setting range: 0–255	255	◎
P16.07	Ethernet monitoring card subnet mask 2	Setting range: 0–255	255	◎
P16.08	Ethernet monitoring card subnet mask 3	Setting range: 0–255	255	◎
P16.09	Ethernet monitoring card subnet mask 4	Setting range: 0–255	0	◎
P16.10	Ethernet monitoring card gateway 1	Setting range: 0–255	192	◎
P16.11	Ethernet monitoring card gateway 2	Setting range: 0–255	168	◎
P16.12	Ethernet monitoring card gateway 3	Setting range: 0–255	28	◎
P16.13	Ethernet monitoring card gateway 4	Setting range: 0–255	11	◎
P16.14	Ethernet card monitoring variable address 1	Setting range: 0x0000–0xFFFF	0x0000	○
P16.15	Ethernet card monitoring variable address 2	Setting range: 0x0000–0xFFFF	0x0000	○
P16.16	Ethernet card monitoring variable address 3	Setting range: 0x0000–0xFFFF	0x0000	○

Function code	Name	Description	Default	Modify
P16.17	Ethernet card monitoring variable address 4	Setting range: 0x0000–0xFFFF	0x0000	○
P16.18–P16.84	Reserved	-	-	-

Group P17—Status viewing

Function code	Name	Description	Default	Modify
P17.00	Set speed	Displays the present set speed of the VFD. Setting range: 0.000m/s–P00.06 (rated lift speed)	0.000m/s	●
P17.01	Output speed	Displays the present output speed of the VFD. Setting range: 0.000m/s–P00.06 (rated lift speed)	0.000m/s	●
P17.02	Ramp reference speed	Displays the present ramp reference speed of the VFD. Setting range: 0.000m/s–P00.06 (rated lift speed)	0.000m/s	●
P17.03	Output voltage	Displays the present output voltage of the VFD. Setting range: 0–1200V	0V	●
P17.04	Output current	Displays the valid value of present output current of the VFD. Setting range: 0.0–5000.0A	0.0A	●
P17.05	Motor rotation speed	The function code is used to display the present motor speed. Setting range: 0–65535rpm	0rpm	●
P17.06	Torque current	The function code is used to display the present torque current of the VFD. Setting range: -3000.0–3000.0A	0.0A	●
P17.07	Exciting current	The function code is used to display	0.0A	●

Function code	Name	Description	Default	Modify
		the present exciting current of the VFD. Setting range: -3000.0–3000.0A		
P17.08	Motor power	The function code is used to display the present motor power. 100% corresponds to the rated motor power. Setting Range: -300.0–300.0% (of the rated motor power)	0.0%	●
P17.09	Motor output torque	Displays the present output torque of the VFD. 100% corresponds to the motor rated torque. Setting range: -250.0–250.0%	0.0%	●
P17.10	Estimated motor frequency	Used to indicate the estimated motor rotor frequency under the open-loop vector condition. Setting range: 0.00–P00.03	0.00Hz	●
P17.11	DC bus voltage	Displays the present DC bus voltage of the VFD. Setting range: 0.0–2000.0V	0.0V	●
P17.12	Digital input terminal state	Displays the present digital input terminal state of the VFD. Setting range: 0x000–0x3FF bit0: S1 bit1: S2 bit2: S3 bit3: S4 bit4: S5 bit5: S6 bit6: S7 bit7: S8 bit8: S9 bit9: S10	0x000	●
P17.13	Digital output terminal state	Displays the present digital output terminal state of the VFD. Setting range: 0x00–0x0F bit0: Y1	0x00	●

Function code	Name	Description	Default	Modify
		bit1: RO1 bit2: RO2 bit3: RO3		
P17.14	Reserved	-	-	-
P17.15	Torque reference value	Indicates the percentage of the rated torque of the present motor, displaying the torque reference. Setting range: -300.0%–300.0% (of the motor rated current)	0.0%	●
P17.16	Linear speed	0–65535	0	●
P17.17–P17.18	Reserved	-	-	-
P17.19	AI1 input voltage	Displays the AI1 input signal. Setting range: 0.00–10.00V	0.00V	●
P17.20	AI2 input voltage	Displays the AI2 input signal. Setting range: -10.00V–10.00V	0.00V	●
P17.21–P17.25	Reserved	-	-	-
P17.26	Duration of this run	Displays the duration of this run of the VFD. Setting range: 0–65535min	0min	●
P17.27	Present step of simple PLC	The function code is used to display the present step of the simple PLC function. Setting range: 0–15	0	●
P17.28	Motor ASR controller output	Displays the ASR controller output value as a percentage relative to the rated motor torque under the vector control mode. Setting 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. Setting range: 0.0–360.0	0.0	●
P17.30	Phase compensation of SM	Displays the phase compensation of SM. Setting range: -180.0–180.0	0.0	●

Function code	Name	Description	Default	Modify
P17.31–P17.35	Reserved	-	-	-
P17.36	Output torque	The function code is used to display 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. Setting range: -3000.0Nm–3000.0Nm	0.0Nm	●
P17.37–P17.38	Reserved	-	-	-
P17.39	Function code in parameter download error	Setting range: 0.00–99.99	0.00	●
P17.40	Motor control mode	Setting range: 0x000–0x123 Ones place: Control mode 0: Vector 0 1: Vector 1 2: VF 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	0x000	●
P17.41	Electromotive torque upper limit	Setting range: 0.0%–300.0% (of the motor rated current)	0.0%	●
P17.42	Braking torque upper limit	Setting range: 0.0%–300.0% (of the motor rated current)	0.0%	●
P17.43–P17.46	Reserved	-	-	-
P17.47	Motor pole pairs	Setting range: 0–65535	0	●

Function code	Name	Description	Default	Modify
P17.48	VFD overload count value	Setting range: 0–65535	0	●
P17.49–P17.57	Reserved	-	-	-
P17.58	Actual carrier frequency	Setting range: 0.000–15.000kHz	0.000kHz	●
P17.59	SM signal-noise ratio	Setting range: 0.0–1000.0	0.0	●
P17.60	Counter-emf of SM	Setting range: 0–1200(V)	0V	●
P17.61	Braking pipe average current	Setting range: 0.0–P02.19(A)	Model depended	●
P17.62–P17.63	Reserved	-	-	-

Group P18—Status viewing in closed-loop control

Function code	Name	Description	Default	Modify
P18.00	Actual frequency of encoder	The function code is used to indicate the actual-measured encoder frequency. The value of forward running is positive; the value of reverse running is negative. Setting range: -999.9–3276.7Hz	0.0Hz	●
P18.01	Encoder position count value	The function code is used to indicate the encoder count value, quadruple frequency. Setting range: 0–65535	0	●
P18.02	Encoder Z pulse count value	The function code is used to indicate the count value of the encoder Z pulse. Setting range: 0–65535	0	●
P18.03–P18.10	Reserved	-	-	-
P18.11	Encoder Z pulse direction	The function code is used to indicate the Z pulse direction. When the spindle stops accurately, there may be a couple of pulses' error between the position of forward and	0	●

Function code	Name	Description	Default	Modify
		reverse orientation, which can be eliminated by adjusting Z pulse direction of P20.02 or exchanging phase AB of encoder. Setting range: 0–1 0: Forward 1: Reverse		
P18.12	Encoder Z pulse angle	Reserved. Setting range: 0.00–359.99	0.00	●
P18.13	Encoder Z pulse error times	Reserved. Setting range: 0–65535	0	●
P18.14–P18.34	Reserved	-	-	-
P18.35	CPU load rate	Setting range: 0.0–100.0%	0.0	●
P18.36–P18.44	Reserved	-	-	-

Group P19—Expansion card status viewing (reserved)

Group P20—Encoders

Function code	Name	Description	Default	Modify
P20.00	Encoder type display	Setting range: 0–6 0: Incremental encoder 1: Reserved 2: Sin/Cos encoder 3: EnDat absolute encoder 4: SSI absolute encoder 5–6: Reserved	0	◎
P20.01	Encoder pulse number	The function code is used to indicate the number of pulses generated when the encoder revolves for one circle. Setting range: 0–16000	1024	◎
P20.02	Encoder direction	Setting range: 0x000–0x111 Ones place: AB direction	0x000	◎

Function code	Name	Description	Default	Modify
		0: Forward 1: Reverse Tens place: Reserved Hundreds place: Reserved		
P20.03	Encoder disconnection fault detection time	Setting range: 0.0–10.0s	2.0s	○
P20.04	Encoder reversal fault detection time	Setting range: 0.0–100.0s	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	Setting range: 0x0000–0xFFFF Bit0: Enable Z pulse calibration Bit1: Enable encoder angle calibration Bit2: Enable SVC speed measurement Bit3: Reserved Bit4: Reserved Bit5: Reserved 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 Bit11: Update initial angle	0x2003	○

Function code	Name	Description	Default	Modify
		Bit12: Clear the Z pulse arrival signal after stop Bit13: Enable encoder direction identification Bit14: Detect Z pulse after one rotation Bit15: Reserved		
P20.08	Enabling pulse Z disconnection detection	Setting range: 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	Initial pole angle autotuning	Setting range: 0–3 0: No operation 1: Rotary autotuning (DC braking) 2: Static autotuning 3: Rotary autotuning (initial angle identification)	0	◎
P20.12	Speed measurement optimization selection	Setting range: 0–1 0: No optimization 1: Optimization mode 1	1	◎
P20.13–P20.14	Reserved	-	-	-
P20.15	Speed measurement mode	Setting range: 0–1 0: Reserved 1: By PG card and simple terminal	1	◎

Function code	Name	Description	Default	Modify
P20.16–P20.20	Reserved	-	-	-
P20.21	Enabling SM angle compensation	Setting range: 0–1	1	○
P20.22	Reserved	-	-	-
P20.23	Angle compensation coefficient	-200.0–200.0(%)	100.0	○
P20.24–P20.39	Reserved	-	-	-

Group P21—Position control (reserved)

Group P22—Spindle positioning (reserved)

Group P23—Vector control of motor 2 (reserved)

Group P24—Encoder of motor 2 (reserved)

Group P25—Expansion I/O card input (reserved)

Group P26—Expansion I/O card output (reserved)

Group P27—Programmable expansion card functions (reserved)

Group P28—Master/slave control (reserved)

Group P90—Deadzone compensation identification 1

Function code	Name	Description	Default	Modify
P90.00	Max. current	Setting range: 0–4096	0	○
P90.01	Deadzone compensation current step number	Setting range: 0–64	0	○
P90.02–P90.69	Reserved	-	-	-

Group P91—Deadzone compensation identification 2

Function code	Name	Description	Default	Modify
P91.00	IGBT conduction voltage drop 0	Setting range: 0–500	0	○
P91.01	IGBT conduction voltage drop 1	Setting range: 0–500	0	○
P91.02–P91.69	Reserved	-	-	-

Group P92—Running time reached function (reserved)

Function code	Name	Description	Default	Modify
P92.00	Dynamic password	Setting range: 0–65535	0	○
P92.01	Running time reached function	Setting range: 0–3 0: Disable 1: Number of times 2: Time 3: RTC	0	○
P92.02	Factory running count setting	Setting range: 0–65535	0	○
P92.03	Factory running time setting	Setting range: 0–65535h	0h	○
P92.04	Factory running deadline setting: year	Setting range: 2000–3000	2020	○
P92.05	Factory running deadline setting: month	Setting range: 1–12	1	○
P92.06	Factory running deadline setting: day	Setting range: 1–31	1	○
P92.07	Factory running deadline setting: hour	Setting range: 0–23	0	○
P92.08	DSP UID	Setting range: 0–65535	0	○
P92.09	DSP ID binding	Setting range: 0–1	0	◎
P92.10–P92.12	Reserved	-	-	-

Group P93—Simple direct docking function (reserved)

Group P94—Demonstration type direct docking function (reserved)

Group P95—Communication type direct docking function (reserved)

Group P96—Lift enhanced function

Function code	Name	Description	Default	Modify
P96.00	Non-weighing compensation enabling	Setting range: 0–1 0: Disable 1: Enable	0	◎
P96.01	Load compensation time	Setting range: 0.000–5.000s	0.400s	◎
P96.02	Load compensation reducing time	Setting range: 0.000–5.000s	0.100s	◎
P96.03	Load compensation ASR gain	Setting range: 0.0–100.0	25.0	○
P96.04	Load compensation ASR integral time	Setting range: 0.001–1.000s	0.160s	○
P96.05	Load compensation current coefficient KP gain	Setting range: 0.0–200.0%	50.0%	○
P96.06–P96.08	Reserved	-	-	-
P96.09	Current loop filter coefficient	Setting range: 0x0000–0xFFFF Bit0–2: Current command filter times (compensation completion stage) Bit3–5: Current command filter times (compensation stage) Bit6: Speed measurement switchover 0: Subdivision 1: Observer Bit7–8: Current sampling filter times Bit14: Enable temperature carrier frequency reduction 0: Enable 1: Cancel Bit9–13: Reserved	0x0000	○

Function code	Name	Description	Default	Modify
P96.10–P96.11	Reserved	-	-	-
P96.12	Analog weighing input	Setting range: 0–1 0: None 1: AI1	0	◎
P96.13	Pre-torque offset	Setting range: 0.0–100.0%	45.0%	○
P96.14	Drive-side gain	Setting range: 0.000–7.000	2.000	○
P96.15	Braking-side gain	Setting range: 0.000–7.000	2.000	○
P96.16	AM open-loop start brake release frequency	Setting range: 0.00–5.00Hz	0.00Hz	○
P96.17	Brake closing delay	Setting range: 0.00–5.00s	0.10s	◎
P96.18	Brake release delay	Setting range: 0.00–5.00s	0.10s	◎
P96.19	Brake feedback detection time	Setting range: 0.0–5.0s	2.0s	◎
P96.20	Brake fault action selection	Setting range: 0–1 0: Report a fault and stop 1: Stop without reporting a fault	0	◎
P96.21	Contactor feedback detection time	Setting range: 0.0–5.0s	2.0s	◎
P96.22	Contactor fault action selection	Setting range: 0–1 0: Report a fault and stop 1: Stop without reporting a fault	0	◎
P96.23	Contactor switch-off delay	Setting range: 0.00–10.00s	0.50s	◎
P96.24–P96.28	Reserved	-	-	-
P96.29	Stop braking frequency	Setting range: 0.00–5.00Hz	0.40Hz	○
P96.30	Stop delay	Setting range: 0.00–5.00s	0.10s	◎
P96.31	Current withdrawal time after stop	Setting range: 0.00–5.00s	0.00s	◎
P96.32	Enable light load direction search	Setting range: 0–2 0: Disable 1: Enable auto running 2: Enable to only provide running direction	1	◎
P96.33	Light-load direction detection time	Setting range: 0.000–5.000s	2.000s	◎

Function code	Name	Description	Default	Modify
P96.34	Reserved	-	-	-
P96.35	Enable electronic star shorting	Setting range: 0–1 0: Disable 1: Enable	1	○
P96.36–P96.40	Reserved	-	-	-

Group P97—Temperature detection calibration

Function code	Name	Description	Default	Modify
P97.00	PT100 detected temperature	Setting range: -20.0–150.0°C	0.0°C	●
P97.01	PT100 digital volumn	Setting range: 0–4095	0	●
P97.02	Reserved	-	-	-
P97.03	PT100 temperature detection enabling	Setting range: 0–1 0: Disable 1: Enable	0	○
P97.04	PT100 detected OH protection threshold	Setting range: 0.0–150.0°C	120.0°C	○
P97.05	PT100 overtemperature pre-alarm point	Setting range: 0.0–150.0°C	100.0°C	○
P97.06	Upper limit of PT100 calibration temperature	Setting range: 50.0–150.0°C	130.0°C	○
P97.07	Lower limit of PT100 calibration temperature	Setting range: -20.0–50.0°C	10.0°C	○
P97.08	Upper limit of PT100 calibration digital quantity	Setting range: 0–4095	3356	○
P97.09	Lower limit of PT100 calibration digital quantity	Setting range: 0–4095	1394	○
P97.10	Enabling PT100 disconnection detection	Setting range: 0–1 0: Disable 1: Enable	0	○
P97.11	PT100 calibration	Setting range: 0–2 0: Invalid or calibration complete	0	○

Function code	Name	Description	Default	Modify
		1: Calibrate PT100 temperature lower limit 2: Calibrate PT100 temperature upper limit		
P97.12–P97.20	Reserved	-	-	-

Group P98—AIAO calibration function

Function code	Name	Description	Default	Modify
P98.00	Calibration parameter group password	Setting range: 0–65535	*****	○
P98.01	AD sampling value of AI1 voltage input	Setting range: 0–4095	0	●
P98.02	AI1 reference voltage 1	Setting range: -0.50–4.00V	0.00V	○
P98.03	AD sampling value corresponding to AI1 reference voltage 1	Setting range: 0–4095	0	○
P98.04	AI1 reference voltage 2	Setting range: 6.00–10.50V	10.00V	○
P98.05	AD sampling value corresponding to AI1 reference voltage 2	Setting range: 0–4095	3972	○
P98.06	AD sampling value of AI1 current input	Setting range: 0–4095	0	●
P98.07	AI1 reference current 1	Setting range: -1.00–8.00mA	0.00mA	○
P98.08	AD sampling value corresponding to AI1 reference current 1	Setting range: 0–4095	0	○
P98.09	AI1 reference current 2	Setting range: 12.00–21.00mA	20.00mA	○
P98.10	AD sampling value corresponding to AI1 reference current 2	Setting range: 0–4095	3903	○
P98.11	Sampling value of AI2 voltage input	Setting range: 0–4095	0	●
P98.12	AI2 reference voltage 1	Setting range: -0.50–4.00V	0.00V	○
P98.13	AD sampling value	Setting range: 0–4095	136	○

Function code	Name	Description	Default	Modify
	corresponding to AI2 reference voltage 1			
P98.14	AI2 reference voltage 2	Setting range: 6.00–10.50V	10.00V	○
P98.15	AD sampling value corresponding to AI2 reference voltage 2	Setting range: 0–4095	3958	○
P98.16	AD sampling value of AI2 current input	Setting range: 0–4095	0	●
P98.17	AI2 reference current 1	Setting range: -1.00–8.00mA	0.00mA	○
P98.18	AD sampling value corresponding to AI2 reference current 1	Setting range: 0–4095	0	○
P98.19	AI2 reference current 2	Setting range: 12.00–21.00mA	20.00mA	○
P98.20	AD sampling value corresponding to AI2 reference current 2	Setting range: 0–4095	3903	○
P98.21–P98.22	Reserved	-	-	-
P98.23	Phase U current calibration	Setting range: 90.0–110.0%	100.0%	◎
P98.24	Phase W current calibration	Setting range: 90.0–110.0%	100.0%	◎
P98.25–P98.48	Reserved	-	-	-

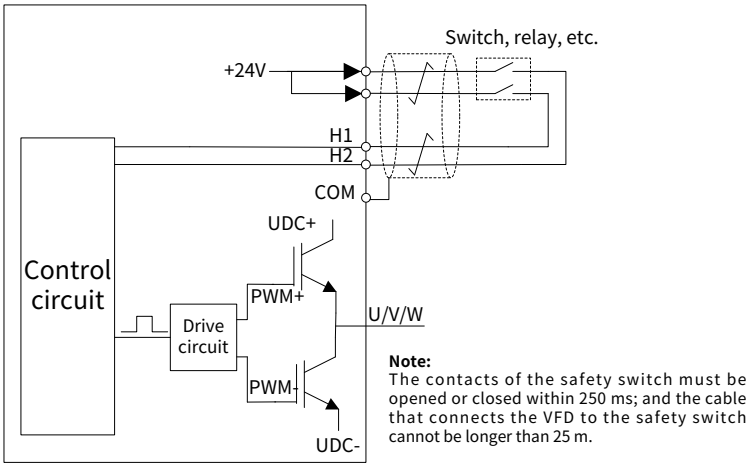
Appendix G STO function codes

This product is equipped with STO function as standard with the safety input ports +24V, H1, and H2. The port +24V is short connected to H1, H2 in the factory.

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.

Figure G-1 Principle diagram of STO function



G.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: STO fault (E40)

STO input state	Corresponding fault
H1 and H2 closed simultaneously	The STOP function is not triggered, and the drive runs properly.
One of H1 and H2 opened, and the other closed	The STL1, STL2, or STL3 fault occurs. Fault code: 41: Channel H1 exception (E41) 42: Channel H2 exception (E42) 43: Channel H1 and H2 exceptions (E43)

G.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: E41	Trigger delay < 10ms Indication delay < 280ms
STO fault: E42	Trigger delay < 10ms Indication delay < 280ms
STO fault: E43	Trigger delay < 10ms Indication delay < 280ms
STO fault: E40	Trigger delay < 10ms Indication delay < 100ms

[1]: STO trigger delay: time interval between trigger the STO switching off the drive output

[2]: STO indication delay: time interval between trigger the STO function and STO output state indication

G.3 STO function parameter

Function code	Name	Description	Default	Modify
P08.52	STO fault reset selection	Setting range: 0–1 0: Re-power on to reset STO fault 1: Manually reset STO fault	0	○

G.4 STO fault

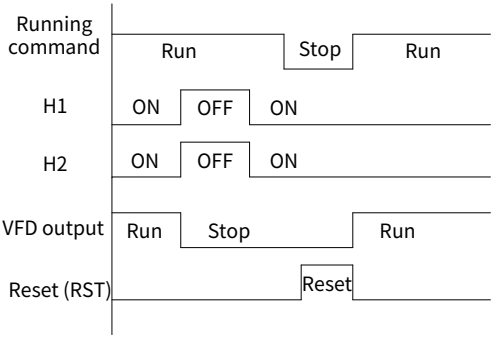
Fault code	Fault type	Possible cause	Solution
E40	Safe torque off	STO function operates normally.	

Fault code	Fault type	Possible cause	Solution
E41	H1 is abnormal.	Channel H1 malfunction or internal hardware circuit malfunction.	Replace the STO switch. If the malfunction persists, contact the manufacturer.
E42	H2 is abnormal.	Channel H2 malfunction or internal hardware circuit malfunction.	
E43	Channel H1 and H2 exceptions	Channel H1 and channel H2 malfunction or internal hardware circuit malfunction.	
E44	Safety code FLASH CRC check fault	STO safety code FLASH CRC check error.	Contact the manufacturer.

G.4.1 E40 alarm

As shown in Figure G-2, when H1 and H2 go off (the safety function is required), the drive enters the safe operation mode and stops output. After troubleshooting, when P08.52=1, manual reset is allowed. Otherwise repower-on is needed for reset.

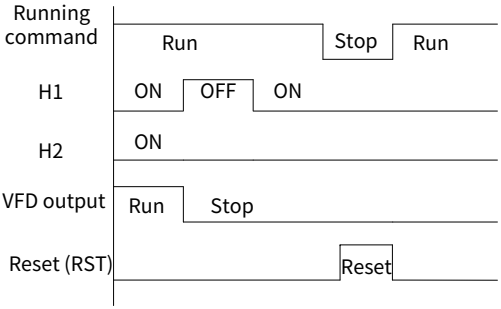
Figure G-2 Logic diagram of manual reset allowed upon fault E40



G.4.2 E41 fault

As shown in Figure G-3, when exceptions occur on the hardware line of safety circuit 1 (that is, exceptions occur on the running of H1) but H2 signals are normal, the drive enters the safe operation mode and stops output regardless of the running command. The drive is locked due to the E41 alarm, and does not execute the running command again even it receives a reset command and the external running command is reset.

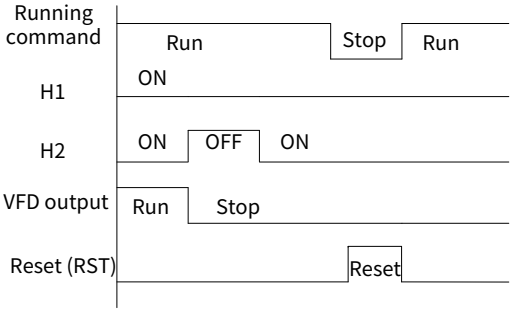
Figure G-3 Logic diagram of safety circuit 1 exception



G.4.3 E42 fault

As shown in Figure G-4, when exceptions occur on the hardware line of safety circuit 2 (that is, exceptions occur on the running of H2) but H1 signals are normal, the drive enters the safe operation mode and stops output regardless of the running command. The drive is locked due to the E42 alarm, and does not execute the running command again even it receives a reset command and the external running command is reset.

Figure G-4 Logic diagram of safety circuit 2 exception



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