

HD9XS Series
Medium-Voltage AC Drive
User Guide

Data code 19012767A00

Preface

Introduction

This product adopts high-performance vector control technology and a cascaded power unit structure, with the maximum output voltage up to 11 kV, featuring excellent control performance and reliability. It aims to fulfill the energy-saving and process speed regulation needs of large- to medium-sized fans and pumps in industries including electric power, metallurgy, mines, construction materials, petrochemical, and municipal projects.

This guide describes the product functions, features, and applications, including the selection, installation, parameter setting, commissioning, maintenance, and inspection. Read through this manual before use. The equipment integrators shall forward this manual to end users for reference.

If you have any problem concerning the functions or performance that is not described in this guide, contact the agent or the technical support to ensure correct use.

- **Unpacking inspection:**
  If you find any problem with the product, or the product is not consistent with your order or damaged during transportation, contact us or the agent immediately.

Inspection Point	Check Method
Check whether the drive ordered is complete.	Check whether all of the items listed in the supply list are delivered.
Check whether the items delivered are consistent with the order?	Check the nameplate of the drive to verify that the equipment model and specifications match the ordering requirements.
Check whether the product is damaged.	Check whether the product is damaged during transportation. Check the cabinet, doors, and side plates for damage and deformation.
Check whether the drive suffers from moisture.	Check whether the drive suffers from raindrops during transportation. Intrusion of raindrops can result in component short circuit or even equipment damage.
Check whether components inside the cabinet are complete.	Open the cabinet door to check the conditions inside the cabinet. Check for loose control cables, signs of water intrusion, and missing or damaged components.

Note

The supply list covers the equipment components, spare parts, and engineering drawings.

CAUTION

- If the device is damaged during transportation, register the damage items when unloading. The register must be signed by representative of the transportation company. Then submit a written report including the damage degree and estimated loss to the transportation company.
- Submit a written report on the non-obvious loss within the time contracted or notify the transportation company by fax or phone.
- Remain the damaged device in place for the transportation company to check or for legal authority to perform necessary inspection. The loss is estimated by the transportation company.

- **Terms and abbreviations**

Name	Description	Name	Description
d-q axis	Rotational coordinate system with synchronous rotation speed	DI	Digital input
Syn-transfer	Synchronous switchover	DO	Digital output
PWM	Pulse width modulation	EMC	Electromagnetic compatibility
I/O	Input/Output	HMI	HMI
AI	Analog input	PID	Closed loop: Proportional-integral-derivative
AO	Analog output	-	-

Change History

Date	Version	Description
July 2025	A00	Initial release.

Warranty

If your product becomes defective under normal use conditions, we will offer guaranteed repair services within the warranty period. A maintenance fee will be charged out of the warranty period.

Even in the warranty period, a maintenance fee will be charged for repair of the following damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage

- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (such as natural disaster, earthquake, and lightning strike)

The maintenance fee will be charged according to our latest Price List if not otherwise agreed upon.

For details, see the Product Warranty Card.

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Safety Precautions

Safety Disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the user guide, especially the safety instructions. Failure to observe the safety instructions may result in equipment damage, personal injuries, or even death.
- "DANGER", "WARNING", and "CAUTION" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- We shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions



indicates that failure to comply with the notice will result in severe personal injuries or even death.



indicates that failure to comply with the notice may result in severe personal injuries or even death.



indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Safety Precautions

- Some drawings in the guide shows the product without covers or protective guards to display more details. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- Product illustrations in this guide are for reference only. Actual products may vary.
- Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as anti-smashing shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

Unpacking
 • Do not install the product when you find that the product and its accessories have any damage or corrosion or they have been used. • Do not install the product when there is water inside the product or any of its parts is missing or damaged. • Do not install the product when the product name is inconsistent with that in the packing list.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the product layer by layer. Do not strike the package violently. • Check the surfaces of the equipment and accessories for any damage, rust, and scratches. • Check the equipment, accessories, and materials in the package against the packing list.

Storage and Handling



- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in personal injuries or equipment damage.
- Before hoisting the equipment, ensure that components, such as the front cover and terminal blocks, are secured firmly with screws. Loosely-connected components may fall off and result in personal injury or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in personal injuries or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storage and transportation in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Store the product for no more than 3 months. For longer storage periods, implement stricter protective measures and conduct necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

Installation



- Installation must be carried out by technicians who have received relevant training on electrical equipment and have sufficient electrical expertise. Non-professionals are not allowed to operate the equipment.



- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in electric shocks.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or fire.
- Do not modify the product.
- Do not fiddle with the bolts used to fix parts and components or the bolts marked in red.
- When installing the product in a cabinet or final assembly, make sure that the enclosure of the cabinet or final assembly provides adequate fire prevention, electrical protection, and mechanical protection conforming to relevant IEC standards and local laws and regulations.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the product on an incombustible object, such as metal, and do not touch or attach the product to combustibles. Failure to comply may result in fire accident.



- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects, such as metal chippings, oil, and water, from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply will result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply may result in electric shocks.



- Do not connect the input power supply to the output end of the equipment. Failure to comply may result in equipment damage or even a fire.
- When connecting a drive to a motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in a fire.
- After wiring is done, check that all cables are connected properly and no screws, washers, or exposed cables are left inside the equipment. Failure to comply may result in electric shocks or equipment damage.



- During wiring, follow proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap. Failure to comply can result in damage to the equipment or internal product circuits.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply can result in equipment malfunction.

Power-on



- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or fire accident.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.



- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in physical injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in physical injuries or even death.

Operation



- The equipment must be operated only by professionals. Failure to comply may result in death or personal injury.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply may result in electric shocks.



- Do not touch the equipment enclosure, fan, or resistor with bare hands. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment while power is on. Failure to comply will result in electric shocks.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- When a permanent magnet motor is used, do not touch the motor terminals immediately after power-off because the motor terminals can generate induced voltage during rotation even after the equipment power supply is off. Failure to comply may result in electric shocks.



- Carry out daily and periodic inspection and maintenance on the equipment according to maintenance requirements and retain a maintenance record.

Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in death, personal injury or equipment damage.
- When the equipment is faulty or damaged, require professionals to perform troubleshooting and repair by following repair instructions and keep a repair record.
- Replace quick-wear parts of the equipment in according with the replacement instructions.
- Do not perform operations on damaged equipment. Failure to comply may result in death, personal injuries, or severe equipment damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal
WARNING • Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death. • Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety Label

To ensure safe operations, comply with safety signs on the device and do not damage or remove the safety labels. See the following table for descriptions of the safety labels.

Safety Label	Description
	• Make sure that the Y-connection points are securely connected before locking the cabinet door. • Make sure the door is locked before MV switch-on. • Do not open the cabinet door while the AC drive is in operation. • Do not open the door for maintenance until MV has been cut off for a period of time. The MV disconnection time varies with models with different power ratings, which is subject to the safety label on the equipment.

1 Product Information

1.1 Model and Nameplate

HD 9X S - J 100 / 2500 - D N
① ② ③ ④ ⑤ ⑥ ⑦ ⑧

①	**Product category** HD: Medium-voltage drive product line	④	**Input voltage class** A: 1 kV B: 2.3 kV C: 3 kV D: 3.3 kV E: 4.2 kV F: 6 kV G: 6.6 kV H: 7.2 kV J: 10 kV K: 11 kV L: 13.8 kV	⑤	**Output voltage** 030: 3 kV 033: 3.3 kV 042: 4.16 kV 060: 6 kV 066: 6.6 kV 100: 10 kV 110: 11 kV
②	**Product series** 90: General-purpose fan/ pump/compressor 92: Process 93: Permanent magnet motor			⑥	**Rated capacity of AC drive** 2500: 2500 kVA
③	**Generation** Blank: First generation S: Second generation			⑦	**Energy regeneration** R: With energy feedback D: Without energy feedback
				⑧	**Cell bypass setting** B: With bypass configuration N: Without bypass configuration (default)

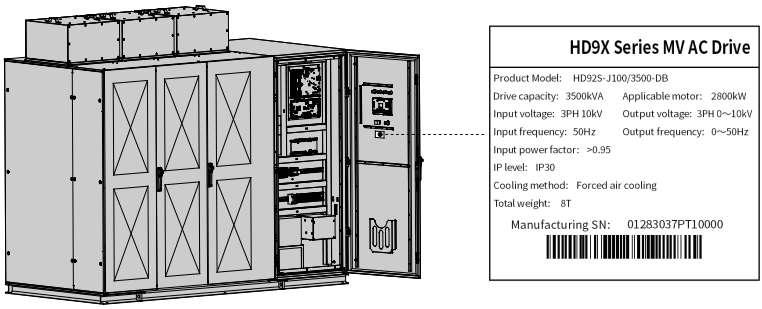


Figure 1-1 Nameplate description

1.2 Operation Principle and System Components

1.2.1 System Operation Principle

- The medium-voltage drive is voltage-sourced, with power units connected in series. Power units are divided into three groups.
- The medium voltage power of the power grid outputs multiple low-voltage power supplies with phase difference through the phase-shifting transformer. These power supplies are used as the power source of power units. After rectification of the power units, the single-phase PWM drive unit outputs AC with output voltage and frequency adjustable. Each group of power units are cascaded in series to form a multi-step PWM voltage output, providing the power supply needed by MV motors.
- The MV drive uses multi-pulse rectification technology to reduce harmonics on the input side, reduce harmonic contamination on the power grid side, thus improving the power factor on the power grid side. The output is in multi-level form and the waveform is close to the sine wave, greatly reducing motor torque pulse.
- Control signals of the master control part and unit control part are transmitted through optical fibers to prevent electromagnetic interference and ensure transmission reliability.

The AC drive connection topology is shown in the following figure.

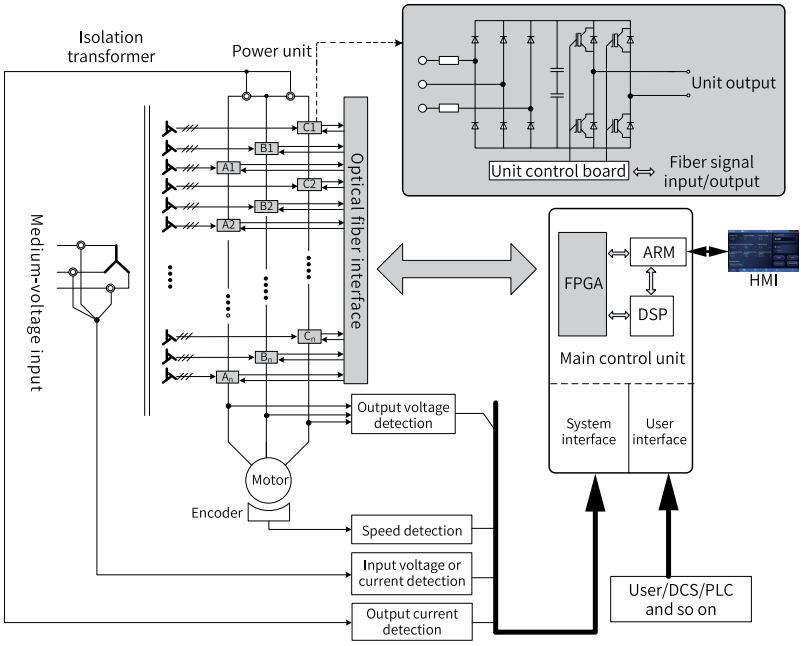


Figure 1-2 AC drive topology

1.2.2 System Components

The medium voltage drive consists of a transformer cabinet, power unit cabinet, and a control cabinet. In addition, you can add an optional one-to-one manual, one-to-one automatic, one-to-two manual, and one-to-two automatic bypass cabinet, a transformer cabinet, a power unit cabinet, a control cabinet, an input/output cabinet/wiring cavity, a manual bypass cabinet, an automatic bypass cabinet, an automatic bypass cabinet with disconnector, a pre-charge cabinet, or an output filter cabinet.

There are ten types in general, as shown in the following figure:

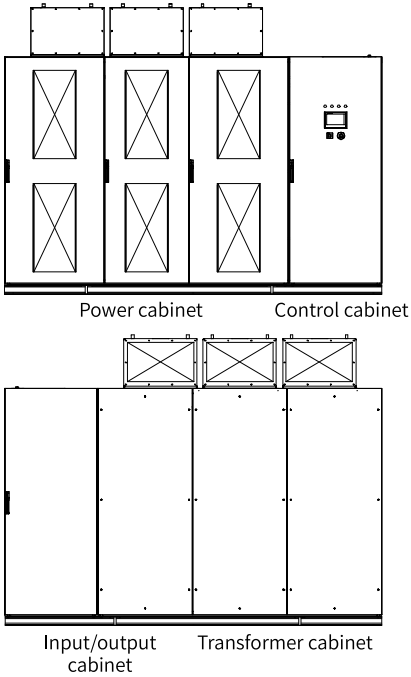


Figure 1-3 System components (models of 11kV-2500 kVA and below)

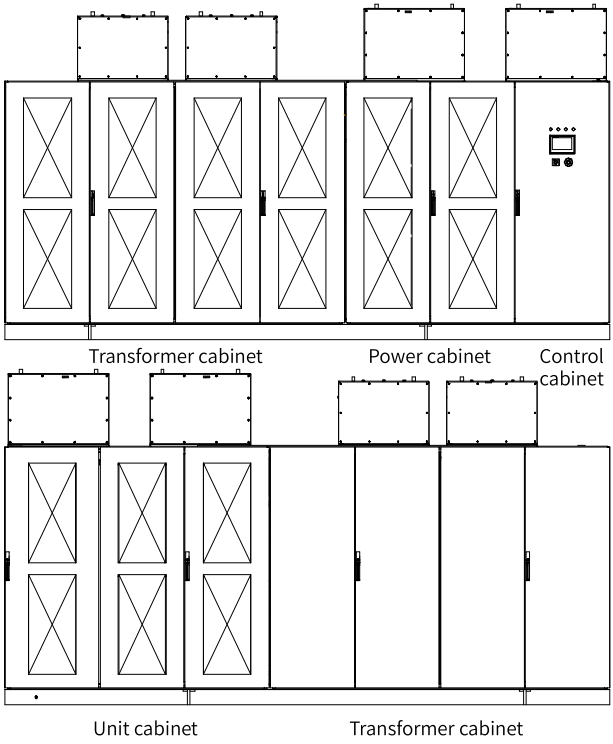


Figure 1-4 System components (models of 11 kV-2800 kVA to 4500 kVA)

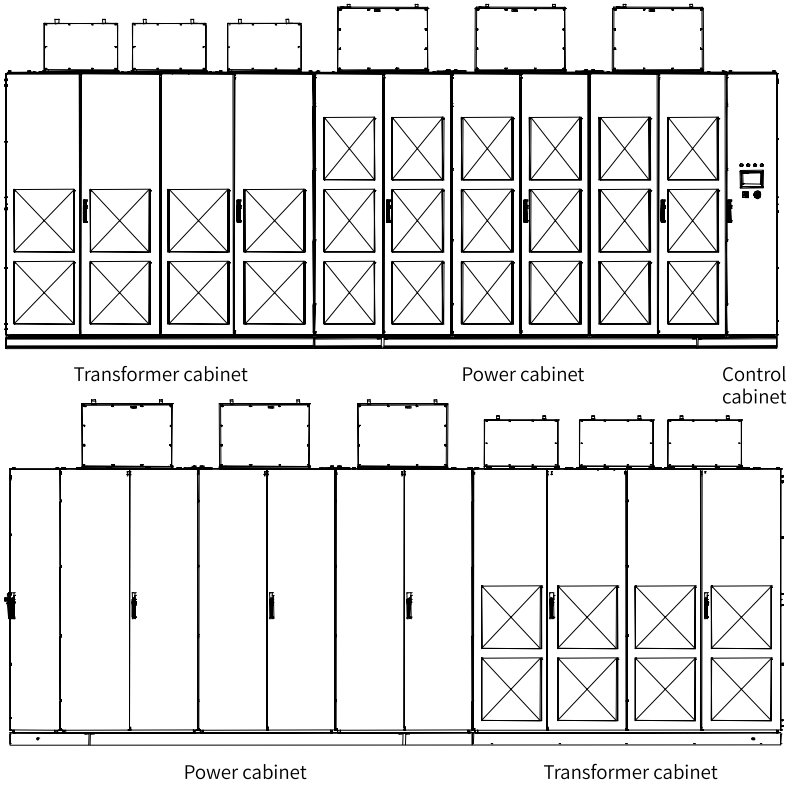


Figure 1-5 System components (models of 11 kV-5000 kVA to 7000 kVA)

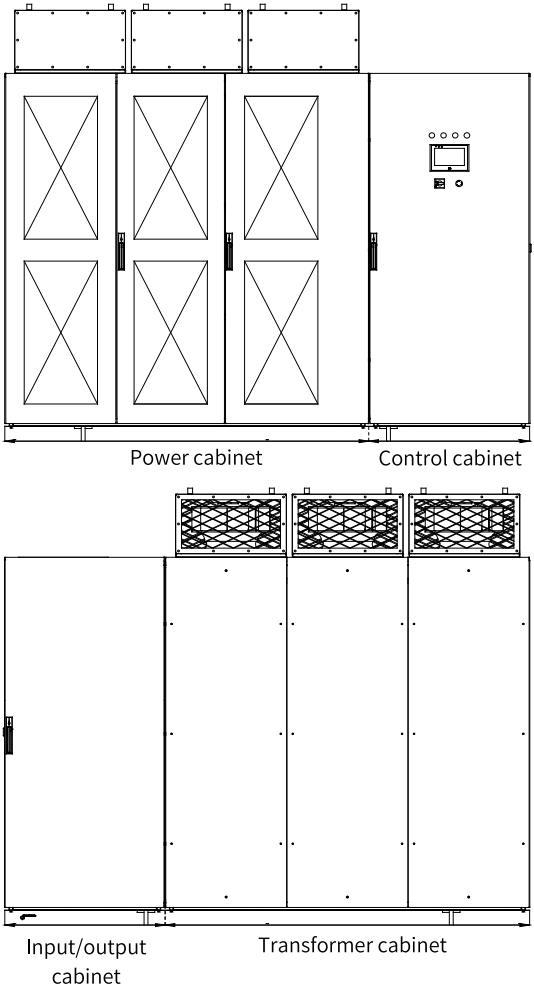


Figure 1-6 System components (models of 10 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

Note

Input and output cabinets for models of 10 kV-2500 kVA and lower specifications (manual bypass cabinet, auto bypass cabinet, and output isolation cabinet are optional).

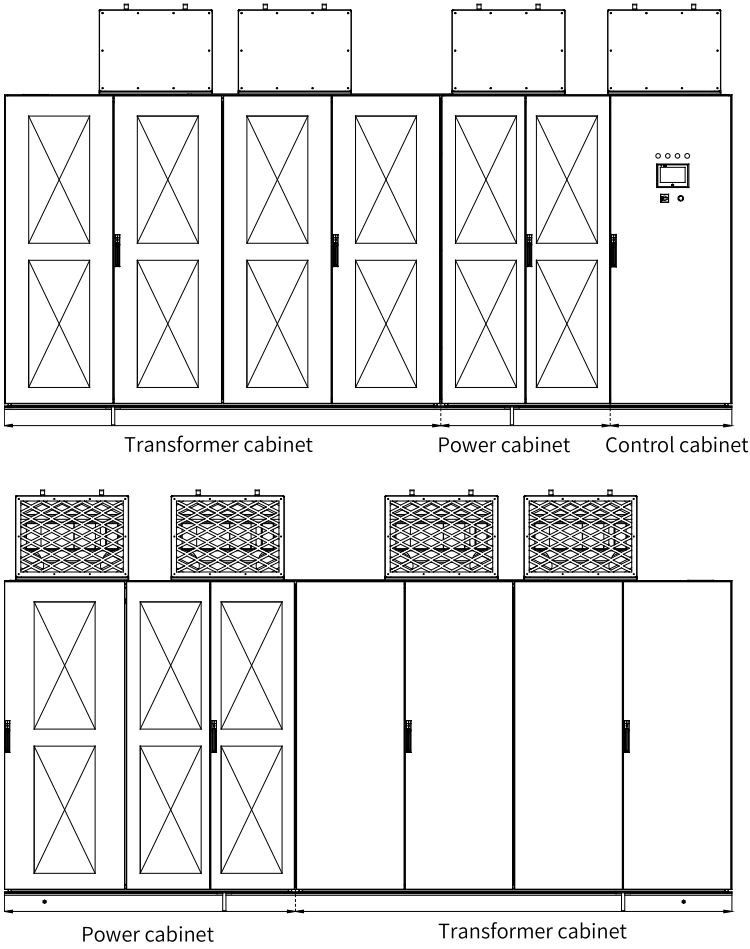


Figure 1-7 System components (models of 10 kV-2800 kVA to 4500 kVA, and 6.6 kV-1800 kVA to 3000 kVA)

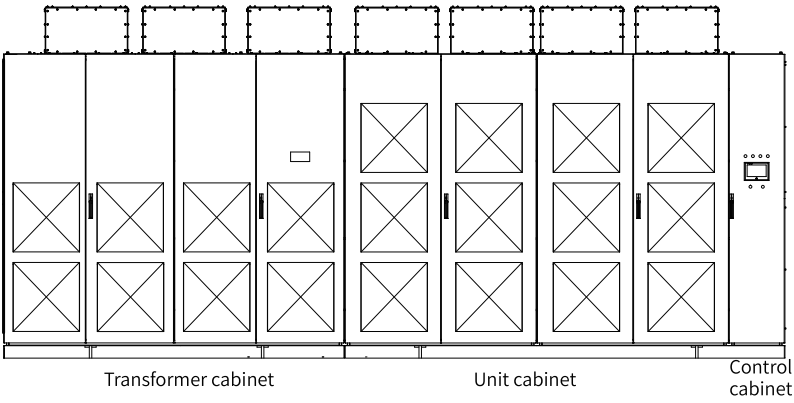


Figure 1-8 System components (models of 10 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

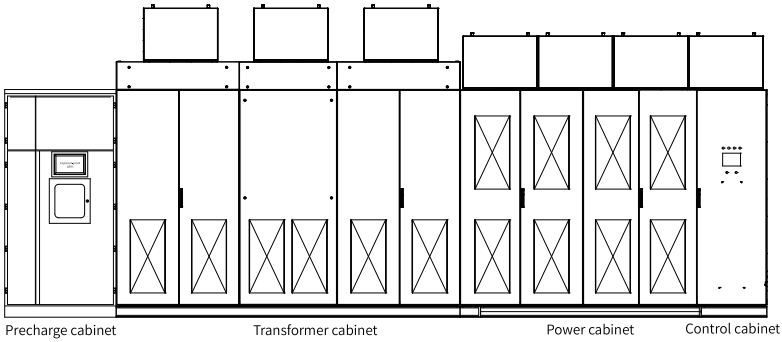


Figure 1-9 System components (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

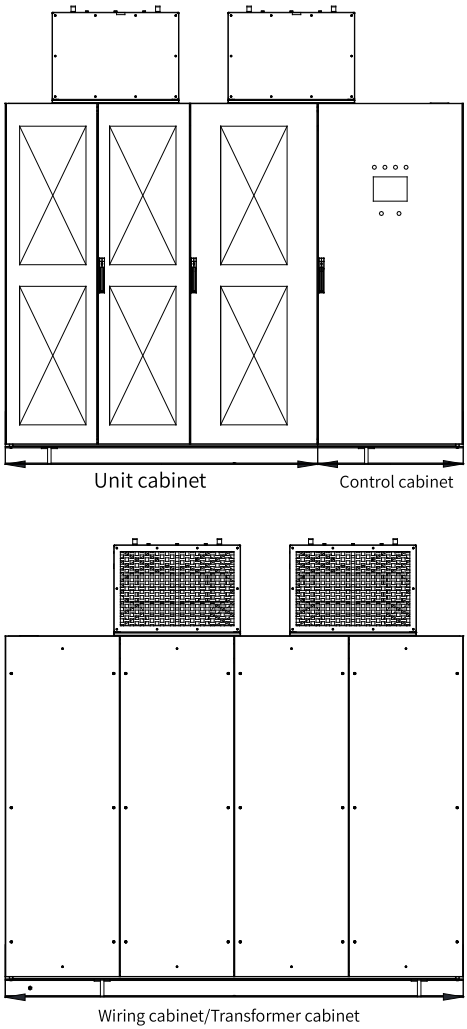


Figure 1-10 System components (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

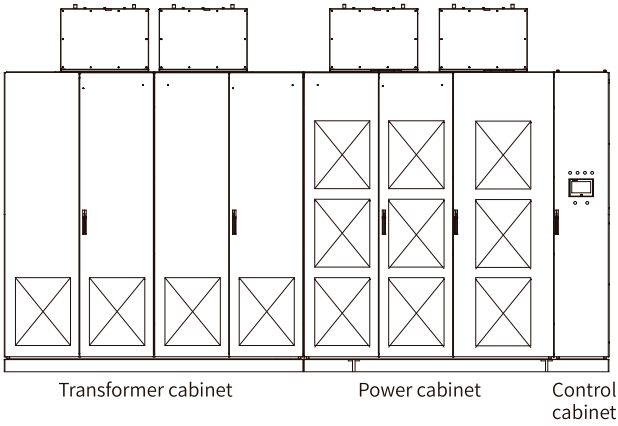


Figure 1-11 System components (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

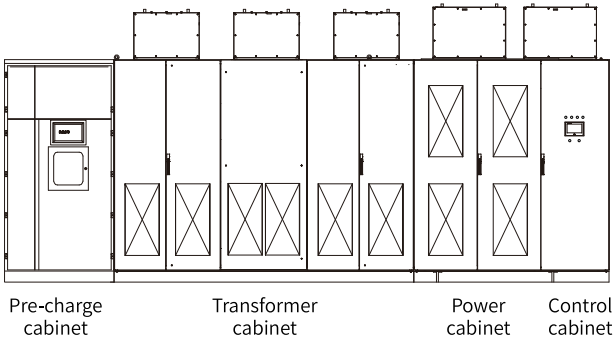


Figure 1-12 System components (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

1. **Transformer cabinet**

   The main equipment in the cabinet is the phase shifting transformer. The phase shift transformer uses a dry structure. The phase shifting transformer base is connected to the cabinet base through bolts. The cabinet top is equipped with a centrifugal fan used to cool down transformers and power units. The primary side of the phase shift transformer is connected to three-phase medium-voltage power (passing through the medium-voltage incoming cabinet or mains power bypass cabinet), and the multi-channel output on the secondary side are respectively connected to the input terminals of the power unit in the unit cabinet.

2. **Unit cabinet**

The cabinet consists of 9, 12, 15, 18, 24, or 27 power units (3, 4, 5, 6, 8, or 9 power units in series per phase) to achieve output voltage of 3 kV (3.3 kV), 4.16 kV, 6 kV, 6.6 kV, 10 kV, and 11 kV, respectively. Each power unit is equipped with a pair of communication fibers for communication with the master control system.

3. **Control cabinet**
   The control cabinet mainly includes the main control module, low voltage power distribution and interface components.

   The main functions of the main control module are system control and status collection. Low voltage power distribution and interface components are used to provide low voltage power supply interface for users, system fan control, and user signal interface.

   Door indication areas include the touch screen (HMI), indicators, REM/LOC switch, and emergency stop buttons.

4. **Input/output cabinet/wiring cavity**
   The input/output cabinet or wiring cavity is used as the wiring space for the drive input/output power cables.

5. **Manual bypass cabinet**
   The manual bypass cabinet is used to provide mains operation circuit of the motor when the drive is faulty. This is to ensure the motor can starts at mains frequency when the drive is faulty to ensure production continuity. After inspection on the drive is done, switch the motor to variable frequency operation state. The manual bypass cabinet has three disconnectors (QS1, QS2-a, QS2-b) that can be switched by operators manually. The following shows a manual bypass cabinet.

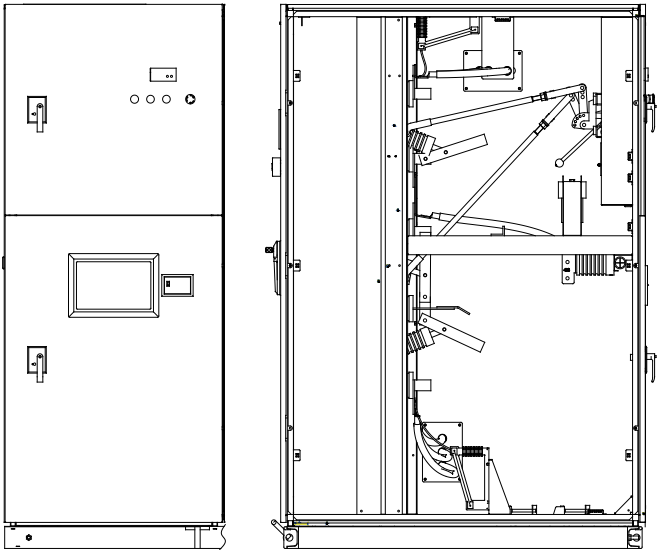


Figure 1-13 Internal manual bypass cabinet drawing (models of 10 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

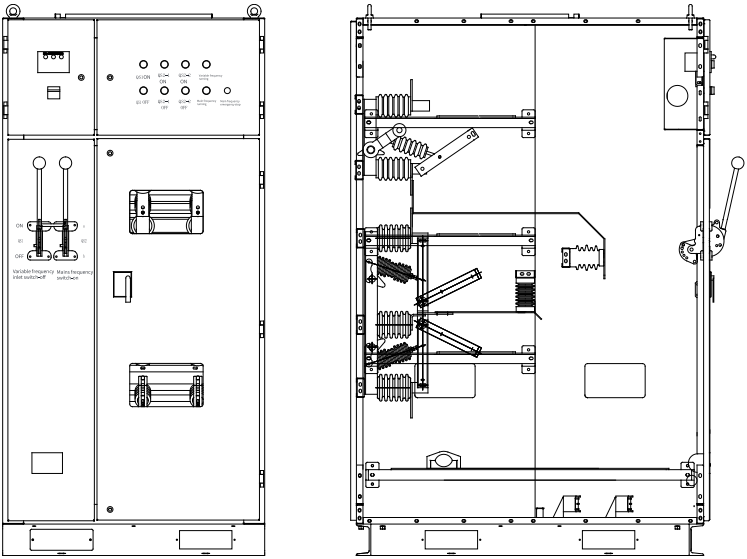


Figure 1-14 External manual bypass cabinet drawing (models of 10 kV-2800 kVA and above, 6.6 kV-1800 kVA and above, and 6 kV-2800 kVA and below)

The main circuit diagram is as follows: disconnector (QS1, QS2-a, QS2-b), user MV switch (QF).

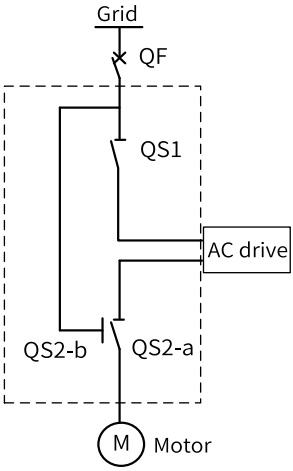


Figure 1-15 Main circuit diagram of manual bypass cabinet

6. **Automatic bypass cabinet**

The automatic bypass cabinet is used to provide mains frequency operation circuit of the motor when the drive is faulty. This is to ensure the motor can start at mains frequency when the drive is faulty to ensure production continuity. After inspection on the drive is done, switch the motor to variable frequency operation state. There are three vacuum contactors (KM1, KM2, KM3) or vacuum circuit breakers (QF1, QF2, QF3) in the automatic bypass cabinet. The automatic switching process is achieved through electrical control circuit. The following shows an automatic bypass cabinet.

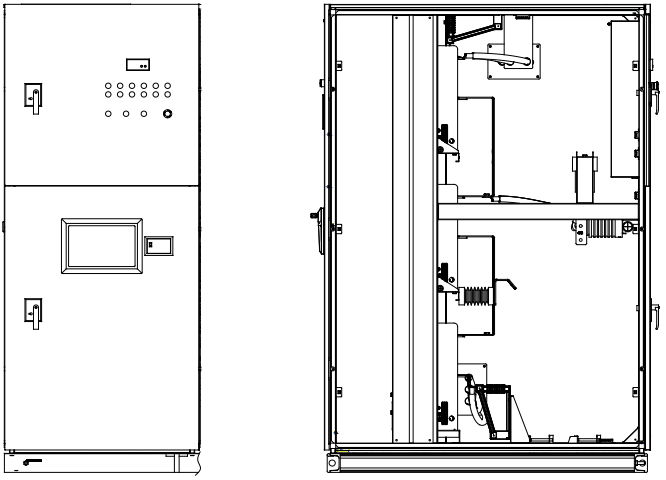


Figure 1-16 Automatic bypass cabinet drawing (models of 10 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

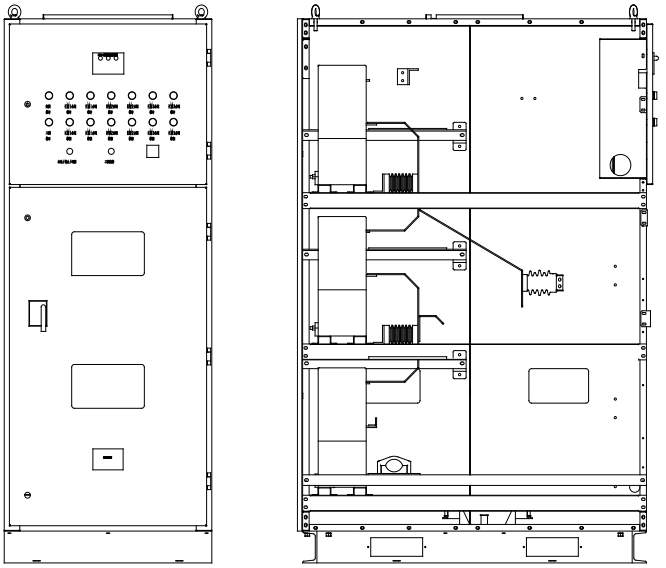


Figure 1-17 Automatic bypass cabinet drawing (models of 10 kV-2800 kVA and above, 6.6 kV-1800 kVA and above, and 6 kV-2800 kVA and below)

The main circuit diagram is as follows (taking the contactor as example): Vacuum contactors (KM1, KM2, KM3), user MV switch (QF).

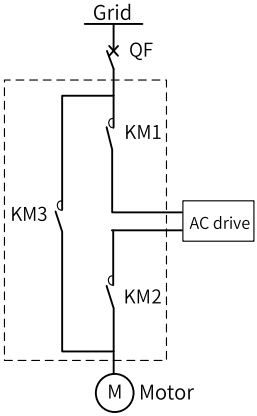


Figure 1-18 Main circuit diagram of automatic bypass cabinet

7. **Automatic bypass cabinet with disconnector**

There are three vacuum contactors (KM1, KM2, KM3), three vacuum circuit breakers (QF1, QF2, QF3), and two disconnectors (QS1, QS2) in the automatic bypass cabinet. The automatic switching process is achieved through electrical control circuit. The following shows an automatic bypass cabinet with isolation disconnector.

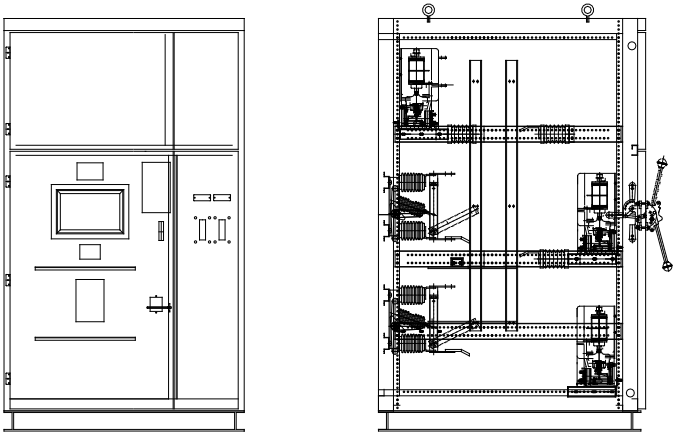


Figure 1-19 Automatic bypass cabinet with disconnector drawing (models of 10 kV-2800 kVA and above, 6.6 kV-1800 kVA and above, and 6 kV-2800 kVA and below)

The main circuit diagram is as follows (taking the contactor as example): Vacuum contactors (KM1, KM2, KM3), user MV switch (QF).

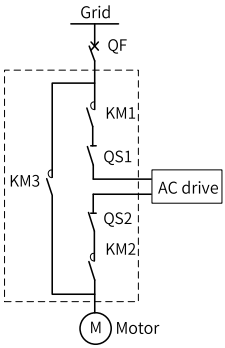


Figure 1-20 Main circuit diagram of automatic bypass cabinet with isolation disconnector

8. **Primary pre-charge cabinet**

   The primary pre-charge cabinet has one electrically-held vacuum contactor and one mechanically-held vacuum contactor or vacuum circuit breaker, along with three-phase pre-charge resistors (R1, R2, R3). The AC drive pre-charging process is achieved through an electrical control circuit. The following shows a primary pre-charge cabinet.

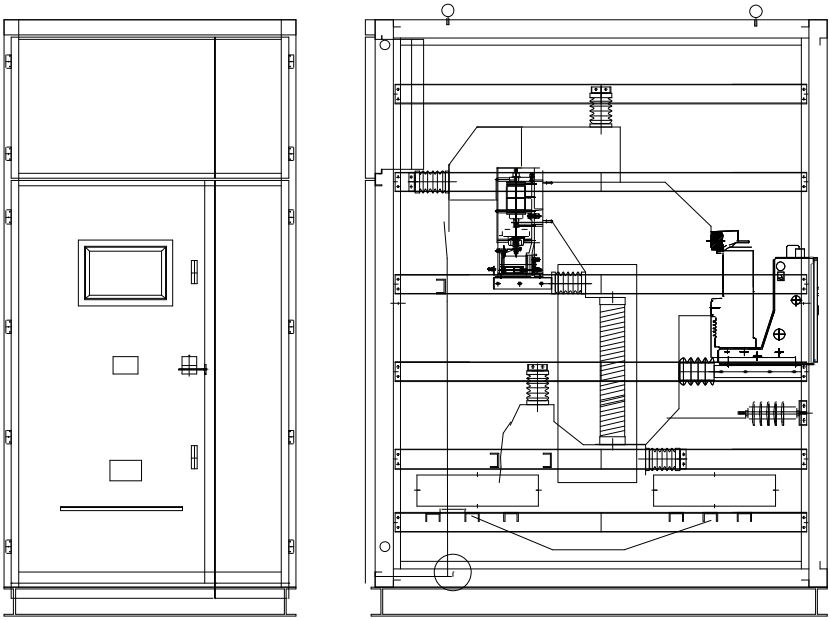


Figure 1-21 Primary pre-charge cabinet drawing (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

The main circuit diagram is as follows: Vacuum contactor (KM1), vacuum circuit breaker (QF4), three-phase pre-charge resistors (R1, R2, R3), and user MV switch (QF).

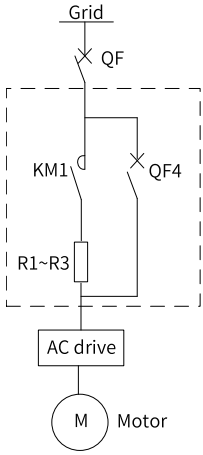


Figure 1-22 Main circuit diagram of primary pre-charge cabinet

Note

- When the output current of the drive is above 404 A, add a pre-charge cabinet to suppress the exciting inrush on the phase-shifting transformer upon power-on. It reduces the impact on your power grid and minimizes damage to the capacitors in each phase power unit of the AC drive during the power-on instant.
- Scheme: Connect current limiting resistors with corresponding resistances in series with the three phases of the primary side of the phase-shifting transformer. Install matching vacuum contactors in the series resistor circuit and add a bypass vacuum contactor (or circuit breaker). When pre-charging starts, close the vacuum contactor in the series resistor circuit. At this time, the current-limiting resistor is connected to the main circuit, limiting the exciting inrush during power-on of the phase-shifting transformer. After the pre-charging process ends, the bypass vacuum contactor (or circuit breaker) automatically closes. This bypasses the current-limiting resistor in the main circuit. Then, open the vacuum contactor in the series resistor circuit. This completes the entire AC drive power-on process.
- For other information regarding the pre-charge cabinet, contact us.

9. **Output filter cabinet**

The output filter cabinet is generally used for long-cable-drive and high-frequency motor applications. The cabinet contains one reactor primarily used to suppress higher-order harmonics output from the AC drive. The reactor operates on a continuous duty system and is equipped with cooling fans. The following figure shows an output filter cabinet.

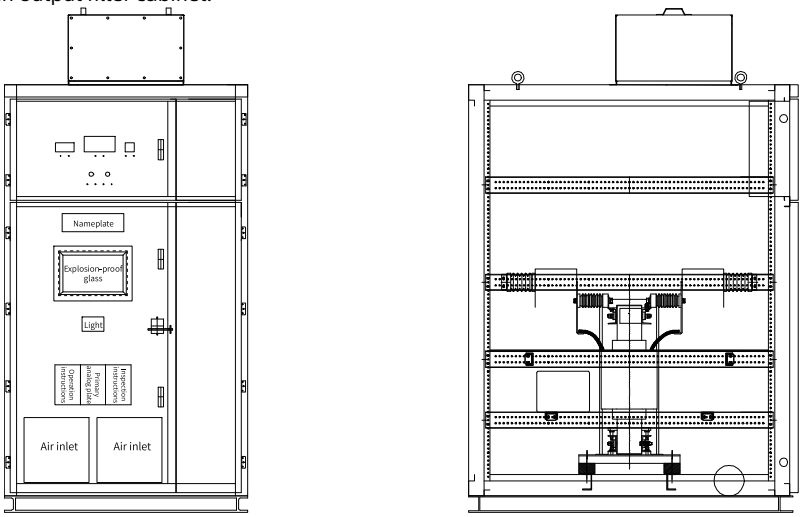


Figure 1-23 Output filter cabinet drawing

The main circuit diagram is as follows: Output filter (L) and user MV switch (QF).

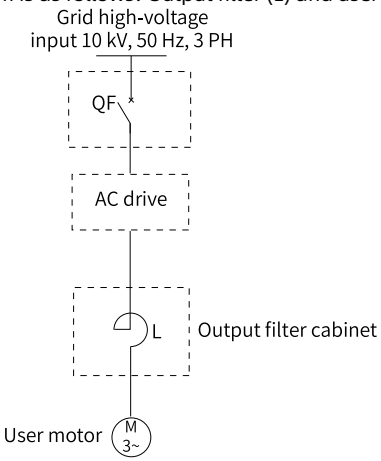


Figure 1-24 Main circuit of output filter cabinet

1.3 Technical Data

Item	Voltage	3 kV to 11 kV
Input	Rated input voltage	Three-phase 50 Hz/60 Hz, 3 kV to 11 kV[1]
	Voltage fluctuation	Full-current running at U_N ±10%; long-term running at -35% to -10% by applying derating
	Frequency range	50 Hz/60 Hz±5%
	Input voltage of power units	690 V
	Input power factor	≥ 0.95 (with load more than 20%)
	Input current harmonics	≤ 5%, compliant with the IEEE519-2014 and GBT14549-93 standards
Output	Output voltage range	0 kV to U_N
	Output voltage of power units	690 V
	Output frequency range	0 Hz to 50 Hz/60 Hz; max. 120 Hz; above 120 Hz as customized product
	Speed regulation ratio	40:1 (universal vector); 100:1 (SVC); 200:1 (FVC)
	Rotational speed accuracy	±0.5% (SVC); ±0.2% (FVC)
Acceleration and deceleration time		0.1s to 6500s; > 6500s customizable
Start/Stop control		Local or remote
Control system		ARM, DSP, FPGA, and HMI
Panel display		HMI, Support for English and Russian

Item	Voltage	3 kV to 11 kV
Overload capacity		120% of rated current, 1 minute (≥ 462 A, 110% of rated current, 1 minute)
Efficiency		≥ 96%
Power unit protection		Overvoltage, undervoltage, input phase loss, overcurrent, overtemperature, and communication
System protection		Motor overload, output overload, output short circuit, output grounding, input overcurrent, input overvoltage, input imbalance, input grounding, cooling fan fault alarm, door switch interlock protection, transformer overheat alarm, transformer overheat trip, and transformer secondary short circuit protection
Mean time between failures (MTBF)		50,000 hours
Communication interface		Modbus-RTU, Modbus-TCP/IP, CANlink, PROFIBUS-DP, Profinet
Digital input		7 inputs, relay dry contact
Digital output		8 outputs, relay dry contact
Analog input		4 inputs, 4 mA to 20 mA or 0 V to 10 V
Analog output		5 outputs, 4 mA to 20 mA or 0 V to 10 V
Service environment		Indoor
Ambient temperature		-10°C to +40°C; derating at 40°C to 50°C; preheating before startup below -10°C
Ambient humidity		5% to 95%, without condensation
Altitude		≤ 1000 m; derating at more than 1000 m. Specify the altitude when ordering
Total noise of equipment		80 dB to 90 dB
Cooling		Forced air cooling
IP rating		IP30, options IP31/IP41/IP42[1]
Cable entry and exit method		Lower cable entry and exit, or customized configuration
Control power supply		380 V±10% AC[1], three-phase and four-wire[2]
Supported encoder types		MD38PGMD

[1]: The default frequency of the control power supply is 50 Hz. If 60 Hz is required, customization is needed.

[2]: If you have any other requirements, please consult the manufacturer.

1.4 System Specifications and Dimensions

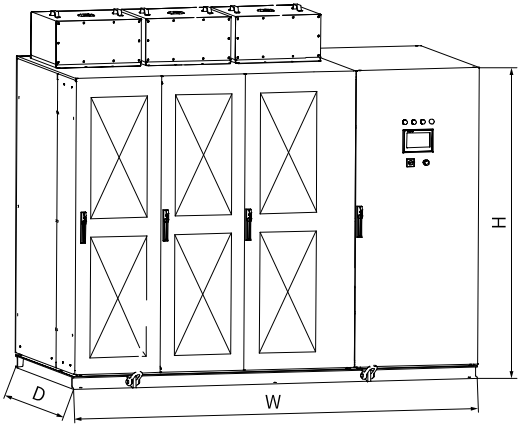


Figure 1-25 System appearance and dimensions (models of 11 kV-2500 kVA and below)

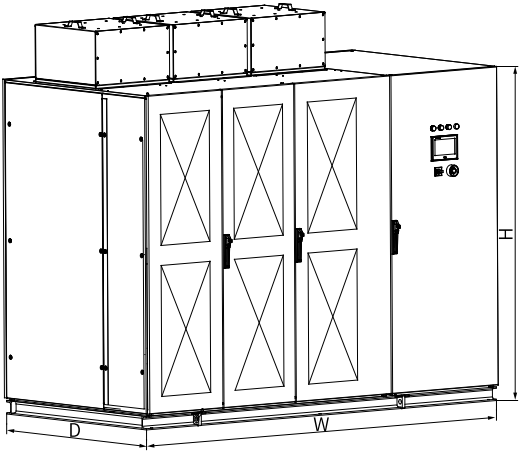


Figure 1-26 System appearance and dimensions (models of 10 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

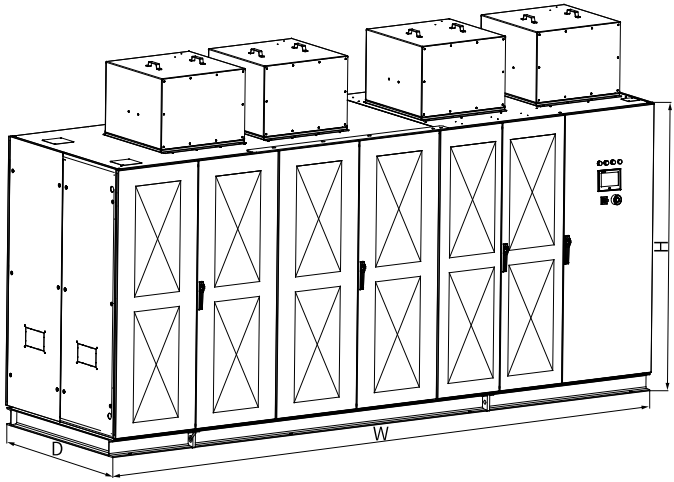


Figure 1-27 System appearance and dimensions (models of 10 kV/11 kV-2800 kVA to 4500 kVA, and 6.6 kV-1800 kVA to 3000 kVA)

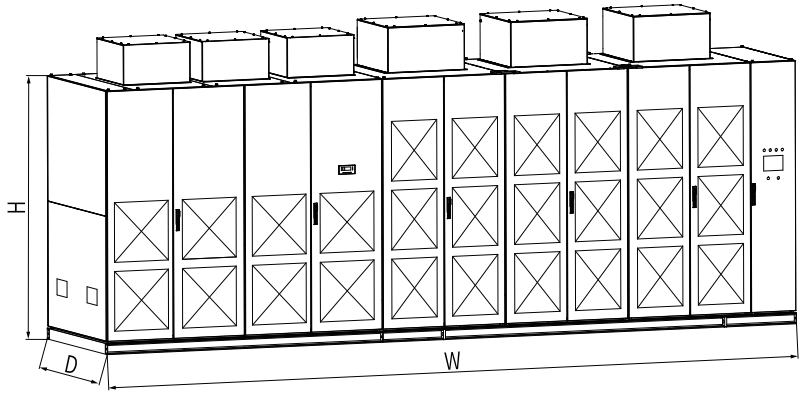


Figure 1-28 System appearance and dimensions (models of 10 kV/11 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

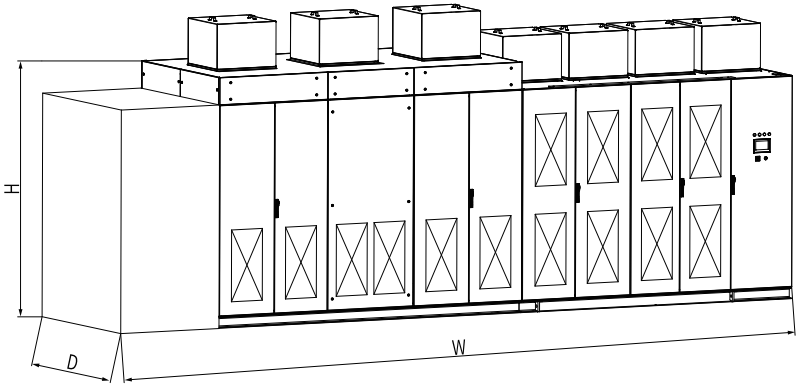


Figure 1-29 System appearance and dimensions (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

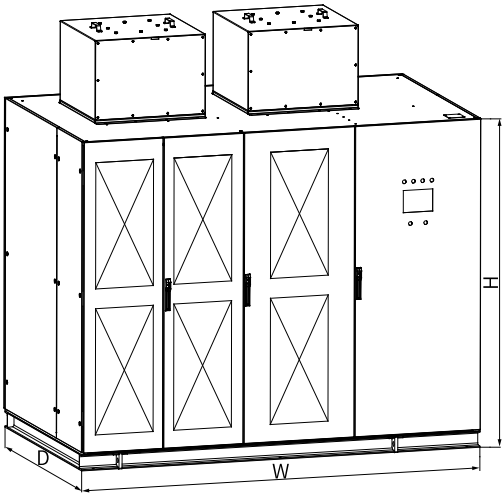


Figure 1-30 System appearance and dimensions (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

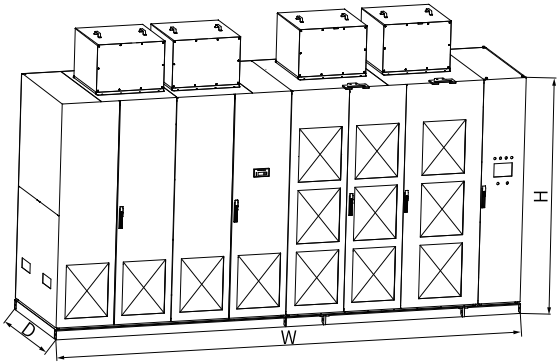


Figure 1-31 System appearance and dimensions (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

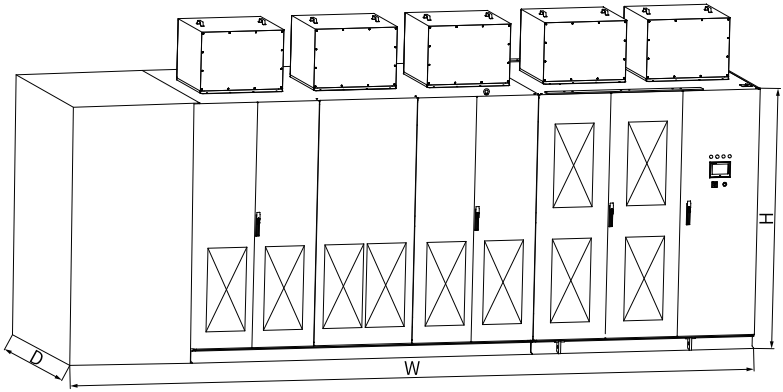


Figure 1-32 System appearance and dimensions (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

Note

Models of 6 kV-4500 kVA to 6300 kVA have four fans, and models of 6 kV-7000 kVA to 8000 kVA have five fans.

System dimensions shown in the following table are for reference only. The actual dimensions may vary. For details, contact the sales staff.

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
Voltage Class: 3 kV		
315	250	2000 x 1225 x 1908 (height of 2285 mm with fans)
355	280	2000 x 1225 x 1908 (height of 2385 mm with fans)
400	315	2300 x 1475 x 2008 (height of 2480 mm with fans)
450	355	2300 x 1475 x 2008 (height of 2480 mm with fans)
500	400	2300 x 1475 x 2008 (height of 2480 mm with fans)
560	450	2300 x 1475 x 2008 (height of 2480 mm with fans)
630	500	2300 x 1475 x 2008 (height of 2480 mm with fans)
710	560	2300 x 1475 x 2008 (height of 2480 mm with fans)
800	630	2300 x 1475 x 2008 (height of 2480 mm with fans)
900	710	2600 x 1525 x 2050 (height of 2600 mm with fans)
1000	800	2600 x 1525 x 2050 (height of 2600 mm with fans)
1120	900	2600 x 1525 x 2050 (height of 2600 mm with fans)
1250	1000	2600 x 1525 x 2050 (height of 2600 mm with fans)
1400	1120	4950 x 1300 x 2455 (height of 3007 mm with fans)
1600	1250	4950 x 1300 x 2455 (height of 3007 mm with fans)
1800	1400	4950 x 1300 x 2455 (height of 3007 mm with fans)
2000	1600	4950 x 1300 x 2455 (height of 3007 mm with fans)
2250	1800	6650 x 1900 x 2450 (height of 3061 mm with fans)
2500	2000	6650 x 1900 x 2450 (height of 3061 mm with fans)
2800	2250	6650 x 1900 x 2450 (height of 3061 mm with fans)
3150	2500	6650 x 1900 x 2450 (height of 3061 mm with fans)
3550	2800	6650 x 1900 x 2450 (height of 3061 mm with fans)
4000	3150	6650 x 1900 x 2450 (height of 3061 mm with fans)
Voltage Class: 3.3 kV		
315	250	2000 x 1225 x 1908 (height of 2285 mm with fans)
355	280	2000 x 1225 x 1908 (height of 2385 mm with fans)
400	315	2000 x 1225 x 1908 (height of 2385 mm with fans)
450	355	2300 x 1475 x 2008 (height of 2480 mm with fans)
500	400	2300 x 1475 x 2008 (height of 2480 mm with fans)
560	450	2300 x 1475 x 2008 (height of 2480 mm with fans)
630	500	2300 x 1475 x 2008 (height of 2480 mm with fans)
710	560	2300 x 1475 x 2008 (height of 2480 mm with fans)
800	630	2300 x 1475 x 2008 (height of 2480 mm with fans)
900	710	2600 x 1525 x 2050 (height of 2600 mm with fans)
1000	800	2600 x 1525 x 2050 (height of 2600 mm with fans)

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
1120	900	2600 x 1525 x 2050 (height of 2600 mm with fans)
1250	1000	2600 x 1525 x 2050 (height of 2600 mm with fans)
1400	1120	2600 x 1525 x 2050 (height of 2600 mm with fans)
1600	1250	4950 x 1300 x 2455 (height of 3007 mm with fans)
1800	1400	4950 x 1300 x 2455 (height of 3007 mm with fans)
2000	1600	4950 x 1300 x 2455 (height of 3007 mm with fans)
2250	1800	4950 x 1300 x 2455 (height of 3007 mm with fans)
2500	2000	6650 x 1900 x 2450 (height of 3061 mm with fans)
2800	2240	6650 x 1900 x 2450 (height of 3061 mm with fans)
3150	2500	6650 x 1900 x 2450 (height of 3061 mm with fans)
3550	2800	6650 x 1900 x 2450 (height of 3061 mm with fans)
4000	3150	6650 x 1900 x 2450 (height of 3061 mm with fans)
4500	3550	6650 x 1900 x 2450 (height of 3061 mm with fans)
Voltage Class: 4.16 kV		
315	250	2000 x 1225 x 1908 (height of 2285 mm with fans)
355	280	2000 x 1225 x 1908 (height of 2285 mm with fans)
400	315	2000 x 1225 x 1908 (height of 2285 mm with fans)
450	355	2000 x 1225 x 1908 (height of 2385 mm with fans)
500	400	2000 x 1225 x 1908 (height of 2385 mm with fans)
560	450	2300 x 1475 x 2008 (height of 2480 mm with fans)
630	500	2300 x 1475 x 2008 (height of 2480 mm with fans)
710	560	2300 x 1475 x 2008 (height of 2480 mm with fans)
800	630	2300 x 1475 x 2008 (height of 2480 mm with fans)
900	710	2300 x 1475 x 2008 (height of 2480 mm with fans)
1000	800	2300 x 1475 x 2008 (height of 2480 mm with fans)
1120	900	2600 x 1525 x 2050 (height of 2600 mm with fans)
1250	1000	2600 x 1525 x 2050 (height of 2600 mm with fans)
1400	1120	2600 x 1525 x 2050 (height of 2600 mm with fans)
1600	1250	2600 x 1525 x 2050 (height of 2600 mm with fans)
1800	1400	2600 x 1525 x 2050 (height of 2600 mm with fans)
2000	1600	4950 x 1300 x 2455 (height of 3007 mm with fans)
2250	1800	4950 x 1300 x 2455 (height of 3007 mm with fans)
2500	2000	4950 x 1300 x 2455 (height of 3007 mm with fans)
2800	2240	4950 x 1300 x 2455 (height of 3007 mm with fans)
3150	2500	6650 x 1900 x 2450 (height of 3061 mm with fans)
3550	2800	6650 x 1900 x 2450 (height of 3061 mm with fans)

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
4000	3150	6650 x 1900 x 2450 (height of 3061 mm with fans)
4500	3550	6650 x 1900 x 2450 (height of 3061 mm with fans)
5000	4000	6650 x 1900 x 2450 (height of 3061 mm with fans)
5600	4500	6650 x 1900 x 2450 (height of 3061 mm with fans)
Voltage Class: 6 kV		
315	250	2000 x 1225 x 1908 (height of 2285 mm with fans)
355	280	2000 x 1225 x 1908 (height of 2285 mm with fans)
400	315	2000 x 1225 x 1908 (height of 2285 mm with fans)
450	355	2000 x 1225 x 1908 (height of 2285 mm with fans)
500	400	2000 x 1225 x 1908 (height of 2285 mm with fans)
560	450	2000 x 1225 x 1908 (height of 2285 mm with fans)
630	500	2000 x 1225 x 1908 (height of 2285 mm with fans)
710	560	2000 x 1225 x 1908 (height of 2385 mm with fans)
800	630	2300 x 1475 x 2008 (height of 2480 mm with fans)
900	710	2300 x 1475 x 2008 (height of 2480 mm with fans)
1000	800	2300 x 1475 x 2008 (height of 2480 mm with fans)
1120	900	2300 x 1475 x 2008 (height of 2480 mm with fans)
1250	1000	2300 x 1475 x 2008 (height of 2480 mm with fans)
1400	1120	2300 x 1475 x 2008 (height of 2480 mm with fans)
1600	1250	2300 x 1475 x 2008 (height of 2480 mm with fans)
1800	1400	2600 x 1525 x 2050 (height of 2600 mm with fans)
2000	1600	2600 x 1525 x 2050 (height of 2600 mm with fans)
2250	1800	2600 x 1525 x 2050 (height of 2600 mm with fans)
2500	2000	2600 x 1525 x 2050 (height of 2600 mm with fans)
2800	2240	2600 x 1525 x 2050 (height of 2600 mm with fans)
3150	2500	4950 x 1300 x 2455 (height of 3007 mm with fans)
3550	2800	4950 x 1300 x 2455 (height of 3007 mm with fans)
4000	3150	4950 x 1300 x 2455 (height of 3007 mm with fans)
4500	3550	6650 x 1900 x 2450 (height of 3061 mm with fans)
5000	4000	6650 x 1900 x 2450 (height of 3061 mm with fans)
5600	4500	6650 x 1900 x 2450 (height of 3061 mm with fans)
6300	5000	6650 x 1900 x 2450 (height of 3061 mm with fans)
7000	5600	6650 x 1900 x 2450 (height of 3061 mm with fans)
8000	6300	6650 x 1900 x 2450 (height of 3061 mm with fans)
Voltage Class: 6.6 kV		
315	250	2700 x 1325 x 2008 (height of 2386 mm with fans)

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
355	280	2700 x 1325 x 2008 (height of 2386 mm with fans)
400	315	2700 x 1325 x 2008 (height of 2386 mm with fans)
450	355	2700 x 1325 x 2008 (height of 2386 mm with fans)
500	400	2700 x 1325 x 2008 (height of 2482 mm with fans)
560	450	2700 x 1325 x 2008 (height of 2482 mm with fans)
630	500	2700 x 1325 x 2008 (height of 2482 mm with fans)
710	560	2700 x 1325 x 2008 (height of 2482 mm with fans)
800	630	2700 x 1325 x 2008 (height of 2482 mm with fans)
900	710	3050 x 1575 x 2108 (height of 2582 mm with fans)
1000	800	3050 x 1575 x 2108 (height of 2582 mm with fans)
1120	900	3050 x 1575 x 2108 (height of 2582 mm with fans)
1250	1000	3050 x 1575 x 2108 (height of 2582 mm with fans)
1400	1120	3050 x 1575 x 2108 (height of 2582 mm with fans)
1600	1250	3050 x 1575 x 2108 (height of 2582 mm with fans)
1800	1400	4500 x 1325 x 2050 (height of 2525 mm with fans)
2000	1600	4500 x 1325 x 2050 (height of 2525 mm with fans)
2250	1800	4500 x 1325 x 2050 (height of 2600 mm with fans)
2500	2000	4500 x 1325 x 2050 (height of 2600 mm with fans)
2800	2240	4500 x 1325 x 2050 (height of 2600 mm with fans)
3000	2500	4500 x 1325 x 2050 (height of 2600 mm with fans)
3500	2800	6295 x 1500 x 2455 (height of 2930 mm with fans)
4000	3150	6295 x 1500 x 2455 (height of 2930 mm with fans)
4500	3550	8200 x 1900 x 2750 (height of 3300 mm with fans)
5000	4000	8200 x 1900 x 2750 (height of 3300 mm with fans)
5600	4500	8200 x 1900 x 2750 (height of 3300 mm with fans)
6300	5000	8200 x 1900 x 2750 (height of 3300 mm with fans)
7000	5600	8200 x 1900 x 2750 (height of 3300 mm with fans)
8000	6300	8200 x 1900 x 2750 (height of 3300 mm with fans)
9000	7100	8200 x 1900 x 2750 (height of 3300 mm with fans)
Voltage Class: 10 kV		
315	250	2700 x 1325 x 2008 (height of 2386 mm with fans)
355	280	2700 x 1325 x 2008 (height of 2386 mm with fans)
400	315	2700 x 1325 x 2008 (height of 2386 mm with fans)
450	355	2700 x 1325 x 2008 (height of 2386 mm with fans)
500	400	2700 x 1325 x 2008 (height of 2386 mm with fans)
560	450	2700 x 1325 x 2008 (height of 2386 mm with fans)

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
630	500	2700 x 1325 x 2008 (height of 2386 mm with fans)
710	560	2700 x 1325 x 2008 (height of 2386 mm with fans)
800	630	2700 x 1325 x 2008 (height of 2386 mm with fans)
900	710	2700 x 1325 x 2008 (height of 2482 mm with fans)
1000	800	2700 x 1325 x 2008 (height of 2482 mm with fans)
1120	900	2700 x 1325 x 2008 (height of 2482 mm with fans)
1250	1000	2700 x 1325 x 2008 (height of 2482 mm with fans)
1400	1120	3050 x 1575 x 2108 (height of 2582 mm with fans)
1600	1250	3050 x 1575 x 2108 (height of 2582 mm with fans)
1800	1400	3050 x 1575 x 2108 (height of 2582 mm with fans)
2000	1600	3050 x 1575 x 2108 (height of 2582 mm with fans)
2250	1800	3050 x 1575 x 2108 (height of 2582 mm with fans)
2500	2000	3050 x 1575 x 2108 (height of 2582 mm with fans)
2800	2240	4500 x 1325 x 2050 (height of 2525 mm with fans)
3000	2400	4500 x 1325 x 2050 (height of 2525 mm with fans)
3150	2500	4500 x 1325 x 2050 (height of 2525 mm with fans)
3500	2800	4500 x 1325 x 2050 (height of 2600 mm with fans)
3750	3000	4500 x 1325 x 2050 (height of 2600 mm with fans)
4000	3150	4500 x 1325 x 2050 (height of 2600 mm with fans)
4500	3550	4500 x 1325 x 2050 (height of 2600 mm with fans)
5000	4000	6295 x 1500 x 2455 (height of 2930 mm with fans)
5600	4500	6295 x 1500 x 2455 (height of 2930 mm with fans)
6300	5000	6295 x 1500 x 2455 (height of 2930 mm with fans)
7000	5600	6295 x 1500 x 2455 (height of 2930 mm with fans)
8000	6300	8200 x 1900 x 2750 (height of 3300 mm with fans)
9000	7100	8200 x 1900 x 2750 (height of 3300 mm with fans)
10000	8000	8200 x 1900 x 2750 (height of 3300 mm with fans)
11250	9000	8200 x 1900 x 2750 (height of 3300 mm with fans)
12500	10000	8200 x 1900 x 2750 (height of 3300 mm with fans)
13750	11000	8200 x 1900 x 2750 (height of 3300 mm with fans)
Voltage Class: 11 kV		
315	250	2951 x 1375 x 2008 (height of 2386 mm with fans)
355	280	2951 x 1375 x 2008 (height of 2386 mm with fans)
400	315	2951 x 1375 x 2008 (height of 2386 mm with fans)
450	355	2951 x 1375 x 2008 (height of 2386 mm with fans)
500	400	2951 x 1375 x 2008 (height of 2386 mm with fans)

Output Capacity (kVA)	Applicable Motor Power (kW)	Outline Dimensions (W x D x H) (mm)
560	450	2951 x 1375 x 2008 (height of 2386 mm with fans)
630	500	2951 x 1375 x 2008 (height of 2386 mm with fans)
710	560	2951 x 1375 x 2008 (height of 2386 mm with fans)
800	630	2951 x 1375 x 2008 (height of 2386 mm with fans)
900	710	2951 x 1375 x 2008 (height of 2481 mm with fans)
1000	800	2951 x 1375 x 2008 (height of 2481 mm with fans)
1120	900	2951 x 1375 x 2008 (height of 2481 mm with fans)
1250	1000	2951 x 1375 x 2008 (height of 2481 mm with fans)
1400	1120	3350 x 1575 x 2108 (height of 2582 mm with fans)
1600	1250	3350 x 1575 x 2108 (height of 2582 mm with fans)
1800	1400	3350 x 1575 x 2108 (height of 2582 mm with fans)
2000	1600	3350 x 1575 x 2108 (height of 2582 mm with fans)
2250	1800	3350 x 1575 x 2108 (height of 2582 mm with fans)
2500	2000	3350 x 1575 x 2108 (height of 2582 mm with fans)
2800	2240	4800 x 1325 x 2050 (height of 2600 mm with fans)
3000	2400	4800 x 1325 x 2050 (height of 2600 mm with fans)
3150	2500	4800 x 1325 x 2050 (height of 2600 mm with fans)
3500	2800	4800 x 1325 x 2050 (height of 2600 mm with fans)
3750	3000	4800 x 1325 x 2050 (height of 2660 mm with fans)
4000	3150	4800 x 1325 x 2050 (height of 2660 mm with fans)
4500	3550	4800 x 1325 x 2050 (height of 2660 mm with fans)
5000	4000	6870 x 1500 x 2455 (height of 3066 mm with fans)
5600	4500	6870 x 1500 x 2455 (height of 3066 mm with fans)
6300	5000	6870 x 1500 x 2455 (height of 3066 mm with fans)
7000	5600	6870 x 1500 x 2455 (height of 3066 mm with fans)
8000	6300	8200 x 1900 x 2750 (height of 3300 mm with fans)
9000	7100	8200 x 1900 x 2750 (height of 3300 mm with fans)
10000	8000	8200 x 1900 x 2750 (height of 3300 mm with fans)
11250	9000	8200 x 1900 x 2750 (height of 3300 mm with fans)
12500	10000	8200 x 1900 x 2750 (height of 3300 mm with fans)
13750	11000	8200 x 1900 x 2750 (height of 3300 mm with fans)

Note

- Models of 10 kV-4500 kVA, 6 kV-2800 kVA, and lower specifications do not have front or rear door plates with a thickness of 25 mm.
- The specific dimensions in this table are for reference only and the actual dimensions are subject to the order.

2 Installation and Wiring

Install the medium-voltage drive to different positions based on different projects. See the foundation drawing provided for plant layout and construction.

2.1 Preparations Before Installation

2.1.1 Installation Environment Requirements

- The application environment must meet the requirements in the following table.

Table 2–1 Application environment requirements

Item	Description	
Ambient temperature	Pre-heating may be needed for temperatures below 0°C within -10°C to +40°C. Derating is needed for temperatures above 40°C. The daily average temperature must be within 5°C to 35°C.	
Relative humidity	5% RH to 95% RH, without condensation	
Height	< 1000 m (Derating is required for altitudes above 1000 m.) (Contact us for altitudes higher than 1000 m).	
Air pressure	86 kPa to 106 kPa	
Air quality	The dust in the electrical room must be equal to atmospheric dust and cannot contain ferrous power or organic silicon particles.	
Corrosion factors	**Corrosive Gas**	**Concentration**
	Hydrogen sulfide (H_2S)	≤ 0.001 PPM
	Sulfur dioxide (SO_2)	≤ 0.05 PPM
	Chlorine (Cl_2)	≤ 0.1 PPM
	Ammonia (NH_3)	≤ 0.1 PPM
	Nitrogen oxide (NO_x)	≤ 0.02 PPM
	Trioxygen (O_3)	≤ 0.002 PPM
	Hydrogen chloride (HCl)	≤ 0.1mg/m^3

Note

The preceding table lists the standard specifications. For details, see the Technical Protocol.

Note

- Never use silicon series paraffin for floor of the electrical room. Failure to comply will have bad impact on electrical contacts.
- After connecting external cables (grounding cables, main circuit cables, and control cables) into the cabinet, seal the cable entry holes with putty. Otherwise, small animals such as rats may gain access to the cabinets and this may cause serious damage to the device.

- The storage environment must meet the requirements in the following table.

Table 2–2 Storage environmental condition

Item	Specifications	
Storage temperature	-20°C to +50°C, air temperature change less than 1°C/min	No freezing or condensation should occur due to sharp change in temperature.
Relative humidity	5% to 95%	
Storage environment	Free from direct sunlight, dust, corrosive gases, inflammable gases, oil mist, vapor and water drop	

Note

- Improper storage can affect the service life of the AC drive and may even cause improper operation of the drive.
- For details about the environment conditions for storage, see IEC 60721-3-1: 2018 class 1K22 and IEC 60721-3-3: 2019 class 3K22 and 3S7 (solid particles).

General requirements

- Never directly place the drive on the floor but place it on a pallet.
- Add appropriate amount of desiccant in environments with excessive moisture.
- Use polyethylene sheet or aluminum foil as protective package to avoid water seepage.
- Regular inspection: Throughout the storage period, check the storage condition and packaging condition of the equipment monthly, pay particular attention to mechanical damage and damage caused by humidity, temperature or fire. If the packing is damaged or you find any damage to the equipment, check the damage condition immediately. After the damaged equipment is repaired, store it as described above.
- **Storage of spare parts**
  Pay attention to the following items to prevent spare parts of the equipment from being damaged.

CAUTION

- The spare parts must be stored in the position free from vibration and shock and be protected against moisture, frost, temperature change, dust and gravel.
- The spare parts must be stored in their original packing in a dry and insect-proof room. The storage place must be free of corrosive gases.
- Relative humidity: 5% to 95%. If you find the maximum allowed humidity has been exceeded, protect the spare parts by taking proper measures such as reducing temperature, heating, and dehumidifying.
- The spare parts must be stored in environments with a temperature range of -20°C to +50°C.
- The PCBs must be stored in antistatic bags that prevent desiccant leakage and free from corrosive gases or gases containing salt, soda, or other impurities. Do not freeze the PCBs.
- Long-term storage will degrade the capacitor that is built in the power unit. Then, the power unit must be energized once every six months.

2.1.2 Installation Clearance Requirements

See the engineering drawings provided by the manufacturer for cabinet dimensions and baseplate mounting drawings. All cabinets must be installed according to drawings. Reserve sufficient clearance in the surroundings to leave enough space for smooth air flow, free door opening/closing, and maintenance. Provide a passageway for entering the installation foundation and reserve sufficient space for the auxiliary equipment to transport the equipment.

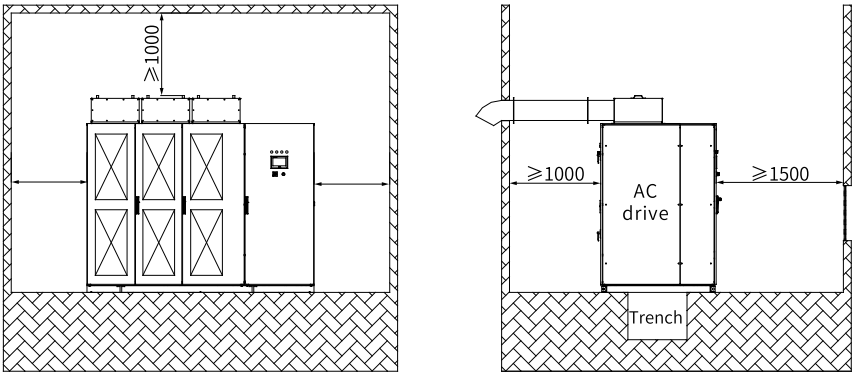


Figure 2-1 Installation clearance of models of 10 kV/11 kV-7000 kVA, 6.6 kV-4000 KVA, 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, and 3 kV-1250 kVA and below (unit: mm)

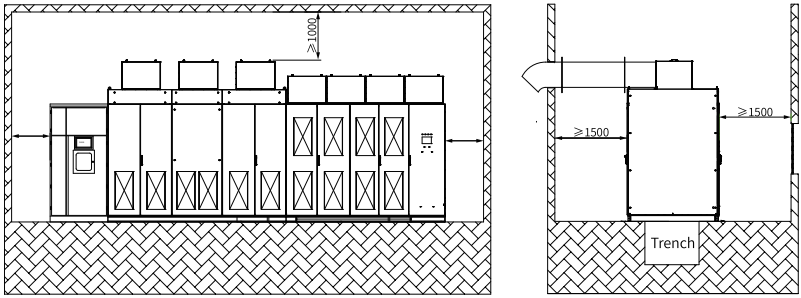


Figure 2-2 Installation clearance of models of 10 kV/11 kV-8000 kVA, 6.6 kV-4500 KVA, 6 kV-3150 kVA, 4.16 kV-2000 kVA, 3.3 kV-1600 kVA, and 3 kV-1250 kVA and above (unit: mm)

Note

- Install all cabinets on the U-steel base solidly and tie them to workshop ground reliably.
- The protective armor of medium-voltage inlet and outlet cables, which must be grounded and fixed to the cabinet reliably, must have sufficient mechanical strength and away from the ground based on the grounding insulation distance specified in all medium-voltage technical specifications.
- Reserve sufficient space at both the left and right sides of the cabinet for walking around.

2.1.3 Instructions for Heat Dissipation

This product is a large-scale electronic device with strict environmental requirements. The following describes the three heat dissipation solutions for AC drives. ① Install an air conditioner. ② Install an air duct. ③ Use the air-to-water cooling method.

These three solutions apply to different applications. The following describes these solutions in details.

Installing an air conditioner

Refrigerating capacity of air conditioner

Place the drive in an enclosed room and install an air conditioner in the room. The air conditioner dissipates the heat produced by the drive to the outside. The heat produced by the drive must be estimated according to actual operating condition. The maximum thermal design power is 4% of the rated power of the drive.

Calculate the refrigerating capacity needed based on the usable area of the room (0.15 kW generally). The total refrigerating capacity of the machine room is the sum of the thermal design power of the drive and the refrigerating capacity needed.

$$Q_{\text{total room heat}} = \{ Q_{\text{drive heat}} \} + \{ Q_{\text{space leakage heat}} \}$$
$$= (W_{\text{AC drive capacity}} \times 4\%) + (S_{\text{room area}} \times 0.15)$$

Selection of air conditioner

- Based on HP

$$X_{\text{horse power}} = Q_{\substack{\text{Refrigerating} \\ \text{capacity}}} \div 2.5$$

- Based on model
  Generally, 1P represents a refrigerating capacity of 2500 W (model 25). 1.5P represents a refrigerating capacity of 3500 W (model 35). For other models, you can estimate the HP needed based on the refrigerating capacity. For example, the model 50 is 2P.

$$\bigtriangledown_{\text{Model}} = Q_{\text{Refrigerating capacity}} \div 100$$

- Based on power consumption of the air conditioner

$$W_{\text{power}} = Q_{\text{Refrigerating capacity}} \div \eta_{\text{Energy efficiency ratio}}$$
$$\approx X_{\text{Horse power}} \times 735 \text{ (unit: watt)}$$

- Precautions for selecting the air conditioner
  - When the indoor and outdoor ambient temperatures exceed the rated cooling capacity conditions of the air conditioner, appropriately upgrade the air conditioner power.
  - The hot air discharged from the AC drive must be effectively cooled by the air conditioner. If site conditions prevent this, the air conditioner power must be upgraded.
  - When the power is greater than the power of the installed air conditioner, a significant temperature difference between the inside and outside of the machine room can easily cause condensation on the frequency converter. In this case, anti-condensation measures should be taken.

Advantage of an air conditioner

The air conditioner can help keep the environment clean as no direct air exchange exists, which can prolong the service life of the drive and reduce the maintenance rate.

Installing an air duct

Design of an air duct

Generally, the air duct is installed above the cabinet to dissipate the heat generated by the drive to the outside. The air inlet of the drive is refilled with cold air continuously to cool the system down.

The following two air duct installation methods are available.

- Air duct and fan cover connection

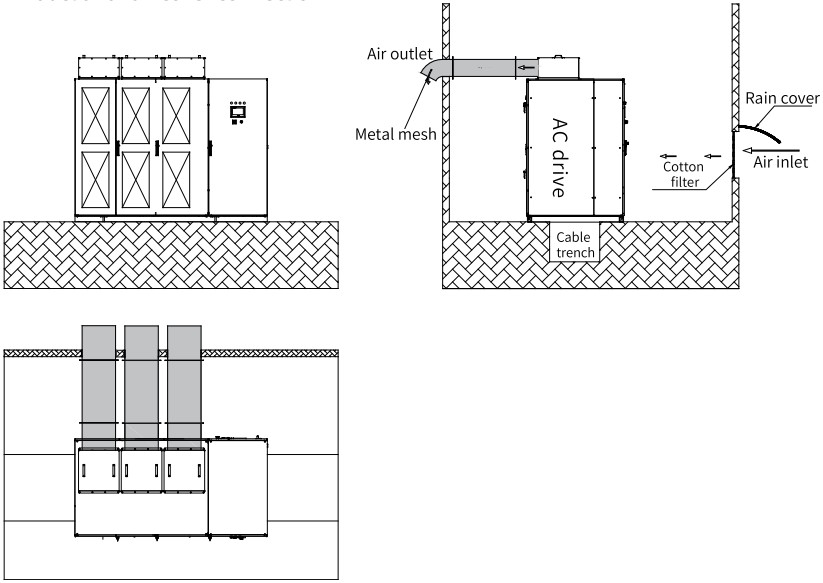


Figure 2-3 Air duct diagram (models of 10 kV/11 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

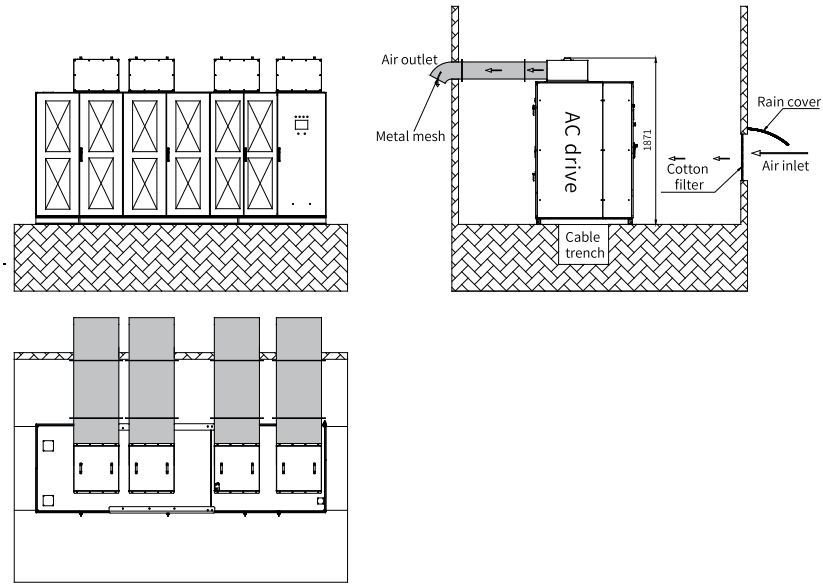


Figure 2-4 Air duct diagram (models of 10 kV/11 kV-2800 kVA to 4500kVA, and 6.6 kV-1800 kVA to 3000 kVA)

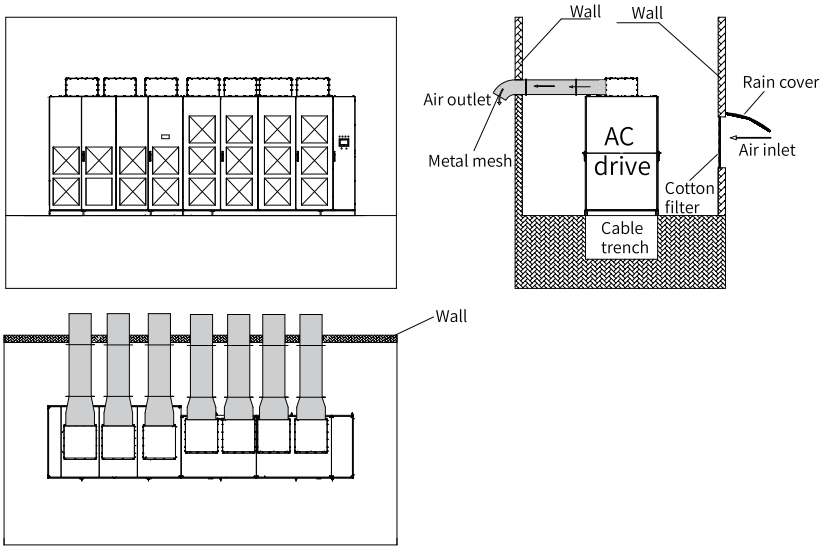


Figure 2-5 Air duct diagram (models of 10 kV/11 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

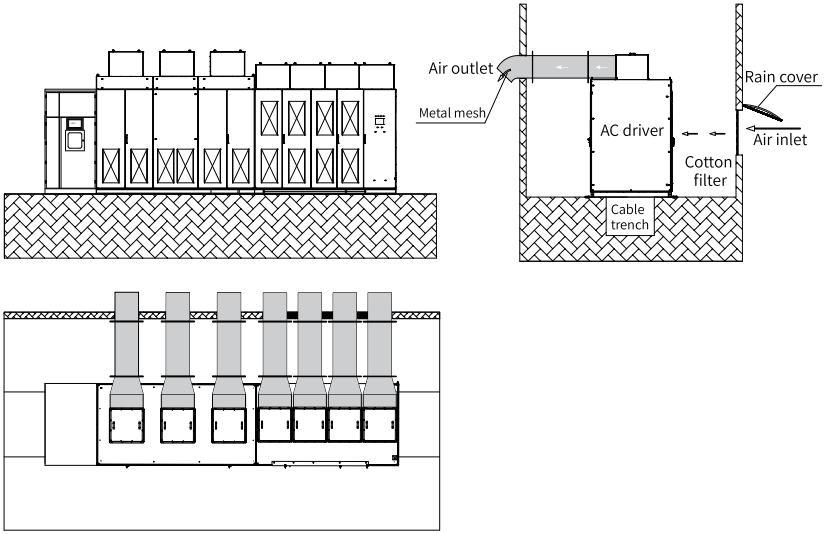


Figure 2-6 Air duct diagram (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

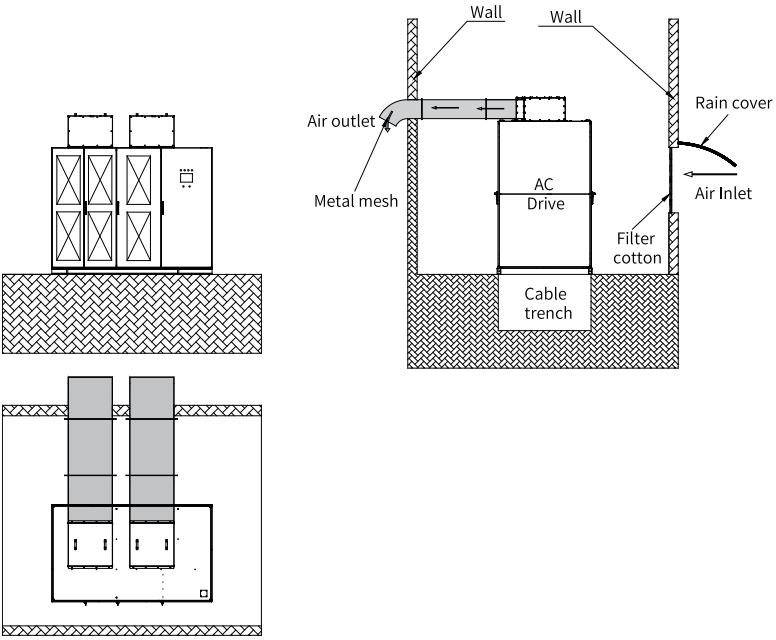


Figure 2-7 Air duct diagram (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

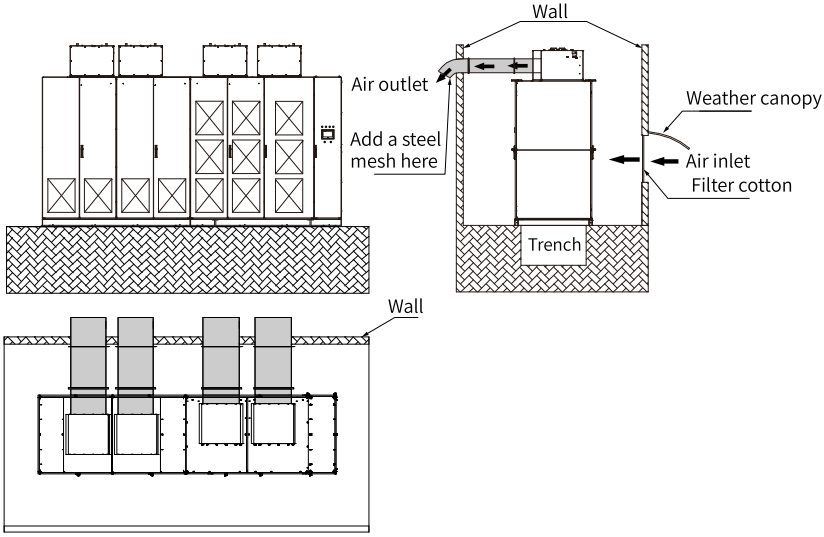


Figure 2-8 Air duct diagram (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

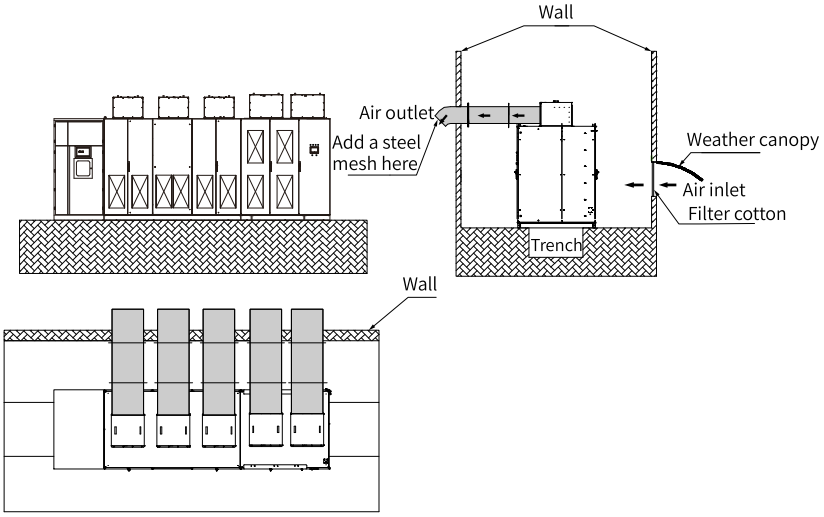


Figure 2-9 Air duct diagram (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

- Integrated air duct

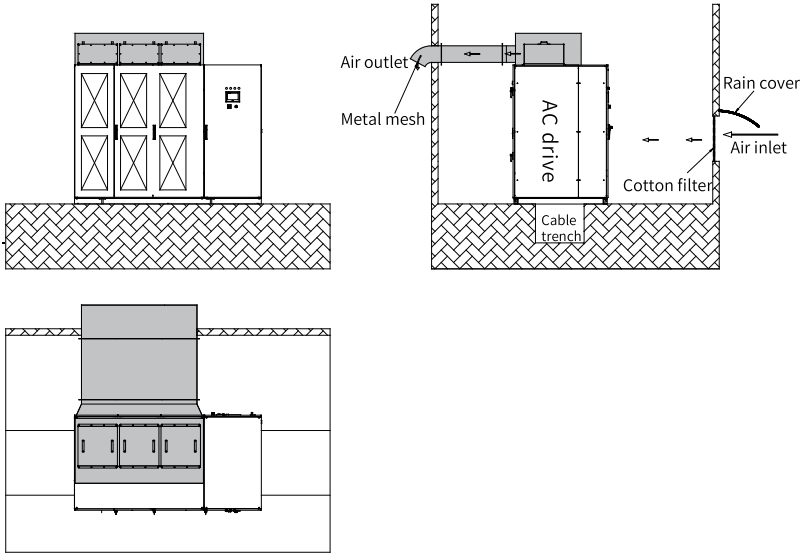


Figure 2-10 Air duct diagram (models of 10 kV/11 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

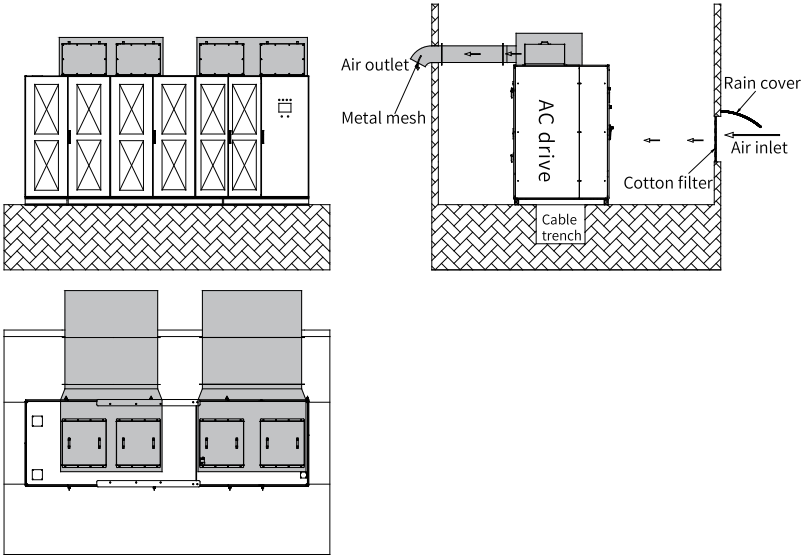


Figure 2-11 Air duct diagram (models of 10 kV/11 kV-2800 kVA to 4500kVA, and 6.6 kV-1800 kVA to 3000 kVA)

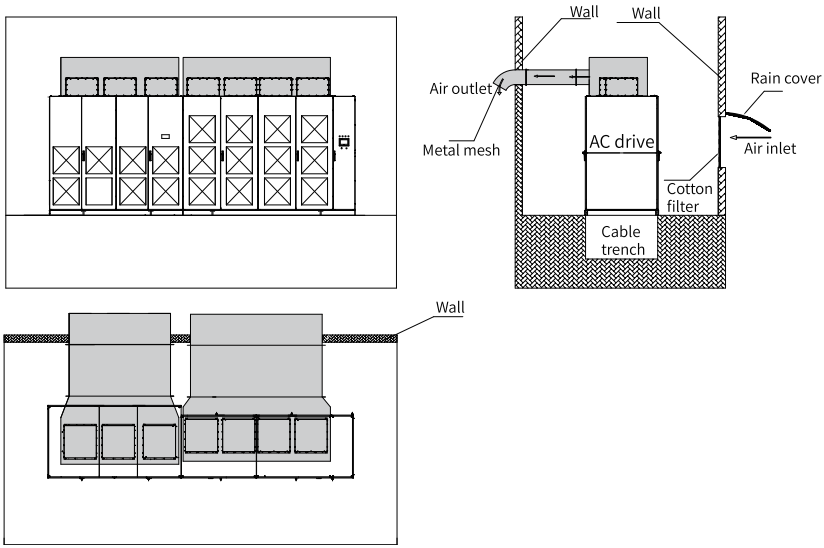


Figure 2-12 Air duct diagram (models of 10 kV/11 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

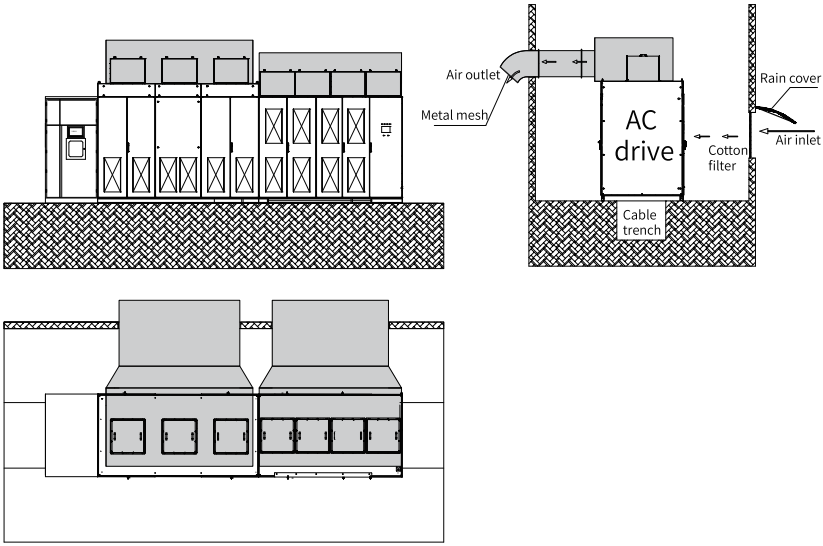


Figure 2-13 Air duct diagram (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

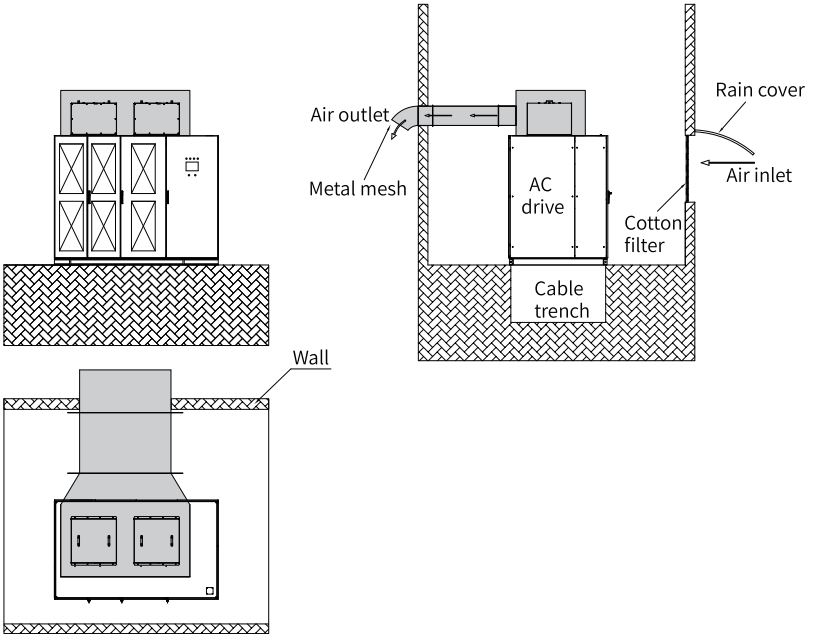


Figure 2-14 Air duct diagram (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

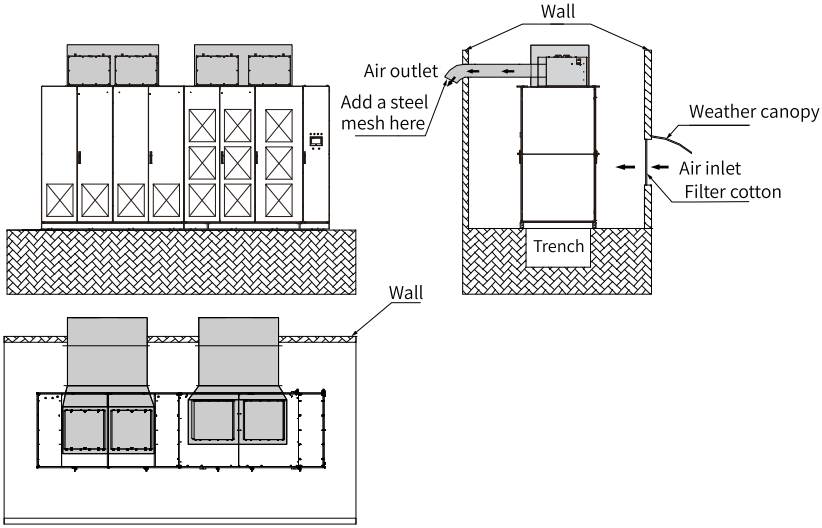


Figure 2-15 Air duct diagram (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

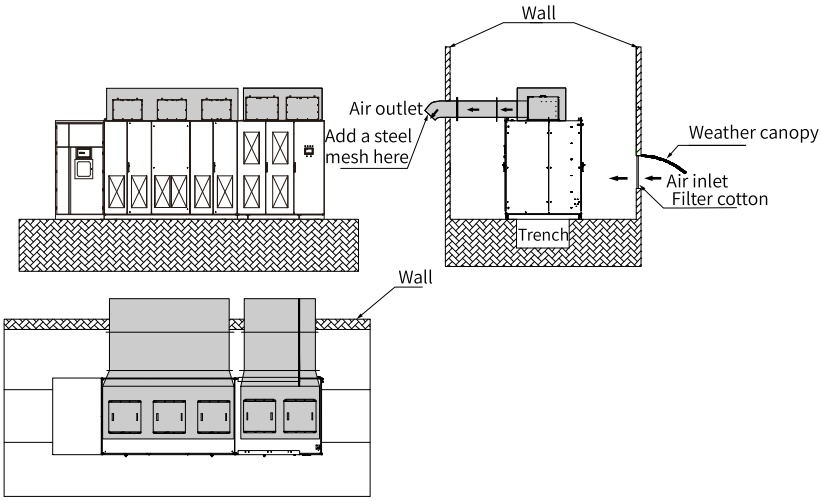


Figure 2-16 Air duct diagram (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

Advantage of an air duct:

The air duct features low cost, high reliability, and good heat dissipation performance. It is applicable to occasions requiring high cleanness.

Note

- If the cooling fan on the top of the cabinet is far away from the air outlet (longer than 10 m without turning in the air duct), install an auxiliary exhaust fan at the air outlet. If the air duct needs a turning for the convenience of construction, you may install a fan to force the air in.
- If the air duct is designed improperly, rainwater may flow backward on rainy days, which can result in short circuit in the drive. The whole ventilation pipe must have a certain inclination angle. Cut a hole at the downside of the pipe for ventilation to avoid rainwater from flowing backward, and add an air filter to the hole to prevent intrusion of small animals.
- Ensure that the air duct is made according to related air duct design drawing delivered together with the equipment.

Note

The air inlet dimensions of the product shall be determined by the specific project drawings.

The product does not provide an air duct by default. The air duct shown in the figures of this section is optional.

Air-to-water cooling solution

Air-to-water cooling principle

The hot air of the drive is directly exchanged by the air-cooling unit through the air duct, and the heat emitted by the drive is carried away by the cooling water, and the cool air is discharged directly into the room.

The cold water temperature in the air cooling unit is lower than 33°C, which allows the ambient temperature in the drive room to fall below 40°C, ensuring a good operating environment of the drive. The cooling water is completely separated from the circulating wind, and the water pipeline is clearly separated from the medium-voltage equipment outside the drive room to ensure that the medium-voltage equipment room is not subject to safety threats and accidents such as waterproofing and insulation damage. Meanwhile, the drive uses the circulating air inside the closed room to cool the device, which generates minimum amount of dust and requires little maintenance, thus reducing adverse impact on the power unit cabinet and control cabinet. The diagram of an air-to-water cooling system structure is as follows.

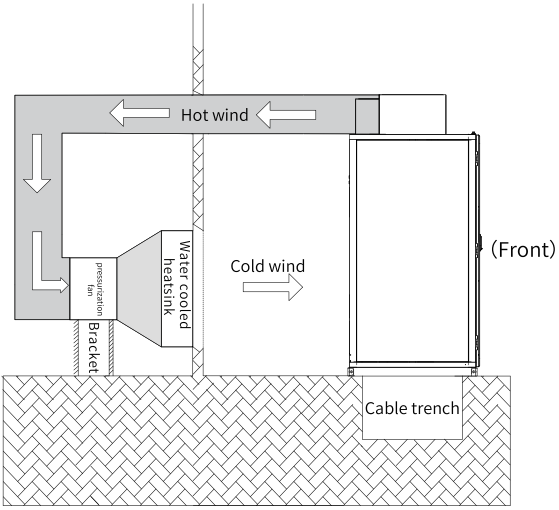


Figure 2-17 Air-to-water cooling diagram of the system

Air-to-water cooling condition

The application site should meet the following conditions.

- The temperature of industrial cooling water on site does not exceed 33°C. The inlet water pressure is between 0.25 MPa and 0.55 MPa, and the return water pressure drop does not exceed 0.1 MPa.
- The necessary amount of cooling water is available. The amount of circulating cooling water needed by the water cooling system is as follows:
  Thermal design power (kW): Cooling water flow (m^3/h) = 4:1 (single set of air-to-water cooling system)
- The drive needs to be placed in an independent closed room with a thermal insulation of more than 10 cm in thickness or in such a room that has been treated with thermal insulation measures, with net height of the room not higher than 3.5 m.
- Meanwhile, a place for construction and installation must also be available in the front/rear of the room in the width direction. The depth of this place cannot be lower than 2.0 m and the width must be equal to the room.
- As the power supply capacity required by the drive room is 6 kW, two 380 VAC/3PH power supplies are needed on site.
- The cooling water cannot contain suspension deposition and the pH value of the cooling water must be higher than or equal to 7.2.

Selection and configuration principles

Take the 800 kVA AC drive as an example:

Based on the rated power of 800 kVA and operating efficiency of 96%, the maximum thermal design power of the drive is 800 x 4% = 32 kW. As the system allows the hot air exhausted from the drive to exchange heat through the air-to-water cooling unit and then vented back into the room, the efficiency of the air circulation is greatly improved. The air circulation efficiency is close to 99%. Considering the heat generated under extreme operating conditions, high water temperature, system exchange efficiency and other factors, the design margin of the air-to-water cooling unit is usually 115% to 120%. The heat exchange power of the air-to-water cooling unit cannot be lower than 37 kW/set. The cooling power of the air-to-water cooling unit used is 40kW.

The formula for calculating the total cooling air volume of an individual drive is as follows: Air volume of a fan x Number of fans. The fan on top of the drive cabinet and the fan configured by the air cooling system adopt the hot standby structure. The system is cooled by indoor closed recirculation, with the ambient temperature kept below 40°C. When the air-to-water cooling unit fails or the outdoor ambient temperature is low, the air vent of the drive and the air inlet of the air-to-water cooling unit can be isolated, allowing the hot air of the drive to be directly discharged to the outside. Keep the temperature of the drive room lower than 40°C through cooling the external environment. This is to further reduce the operating cost of the drive.

The cooling water flow on site can be estimated according to the following basis: 3 m^3// h to 4 m^3/h cooling water flow per every 10kW of cooling power.

2.1.4 Foundation and Cable Design

The drive must be installed onto a flat concrete foundation with pre-installed U-steel for AC drive installation within any 2 mm of the installation support surface and a surface unevenness lower than 4 mm. The foundation must be able to bear the weight of the drive and made of incombustible materials with a smooth and moisture-proof surface. The cable ducts must also be made of incombustible materials which are moisture-proof and dust-proof. Take protective measures on the cable ducts to prevent intrusion of animals. Carry out construction work according to the foundation map provided.

During foundation design, take the following factors into consideration: Inspection space in front of/behind the drive and position of heat dissipation ducts. Wiring and routing directions of power supply cables, motor cables, and system control cables. It is recommended to design the cable trench or cable ducts below the drive. The MV cables, power cables, and signal cables must be routed through different routes. The wiring diagram and requirements are as follows. For detailed installation dimensions, see the engineer drawings delivered together with the drive.

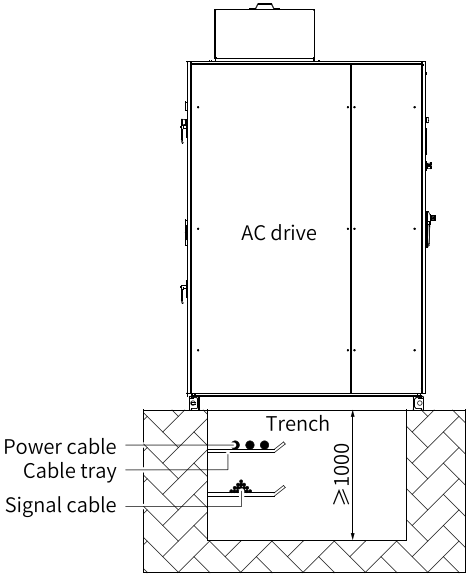


Figure 2-18 Foundation layout (unit: mm)

CAUTION

- Strictly separate medium-voltage cables from low-voltage cables.
- The cable trench must use non-flammable materials and be smooth. Damp-proof, dust-proof and rat-proof measures are required.

- Power cables
  - Route the main power supply cables and motor cables according to local standards and instructions from cable manufacturers.
  - To achieve the optimal EMC performance, steel-armored three-phase cables with each phase individually shielded are recommended. If single-phase cables are used, the cables of three different phases must be grouped together.
  - If the cross-sectional area of the cable shield is lower than 50% of the sectional area of one phase, lay an additional grounding cable along the power cable to avoid over-temperature of the cable shield. For more information, check local regulations.
  - Reserve adequate space between two cable brackets, ladders, or trays inside the cable trench so that it is convenient to lay cables and fix/connect connectors, and to replace or add a cable and its connector when multiple cables are laid on the same bracket, ladder, or tray.
  - The distance between cable brackets, ladders, or trays must be longer than 300 mm. The minimum clear distance from the bottom bracket to the trench bottom must be longer than 100 mm.
  - Cables are fixed by cable brackets. For horizontal cabling, if the outer diameter of power cables and control cables is lower than or equal to 50 mm, set a support every 0.6 m. If the outer diameter of power cables is larger than 50 mm, set a support every 1.0 m. The single-core cables that form a regular triangle must be tied up every 1.0 m. For vertical cabling, set a support every 1.0 m to 1.5 m.
  - The power and control cables must be installed on the brackets on both sides of the trench with vertical spacing greater than 300 mm. If conditions are not met, the power cable must be positioned on the bracket above the control cable.
- Grounding cable
  The grounding cable must be routed based on local standards.
- Control cable
  Control cables cannot be routed in parallel with power cables. If this is unavoidable, a minimum distance of 300 mm (12 in.) must be maintained between the control cable and the main circuit cable. Control cables and power cables must be cross-wired at 90 degrees.

Note

MV cables must be terminated with connectors according to the cable manufacturer's requirements. Power connectors must be made by authorized personnel.

2.2 Mechanical Installation

2.2.1 Packaging

Products are delivered in wooden crates or simple packages based on the transportation distance and agreement. We will guarantee the safety of the products during transportation. For special requirements, contact us.

- Definition
  Wooden crate packaging: Products are packed into a wooden crate.

  Simple packaging: The bottom of the products is supported by a pallet. The other sides of the products are packed by plastic film that prevents water/dust intrusion.

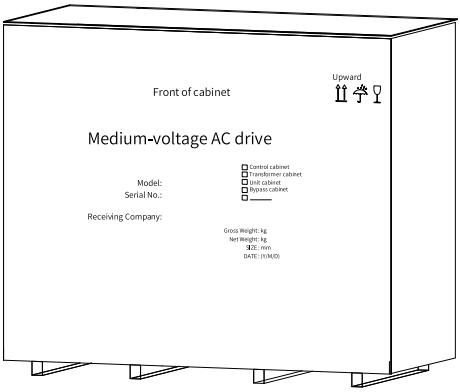


Figure 2-19 Wooden crate packaging

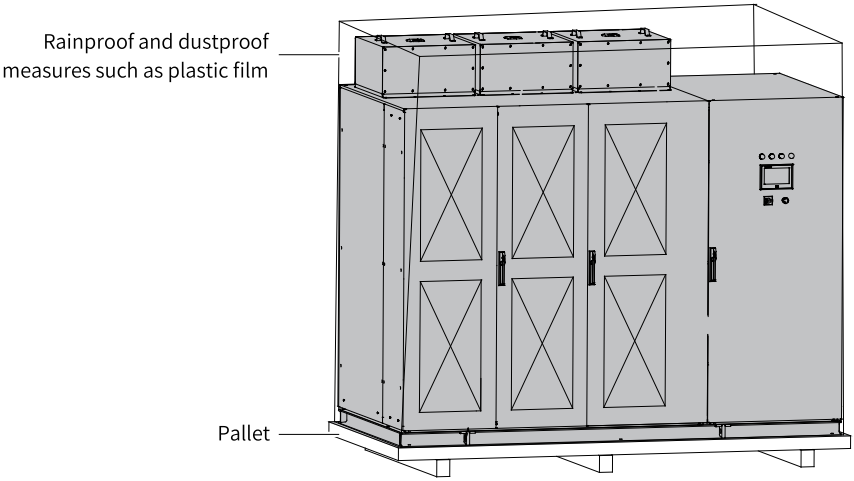


Figure 2-20 Simple packaging

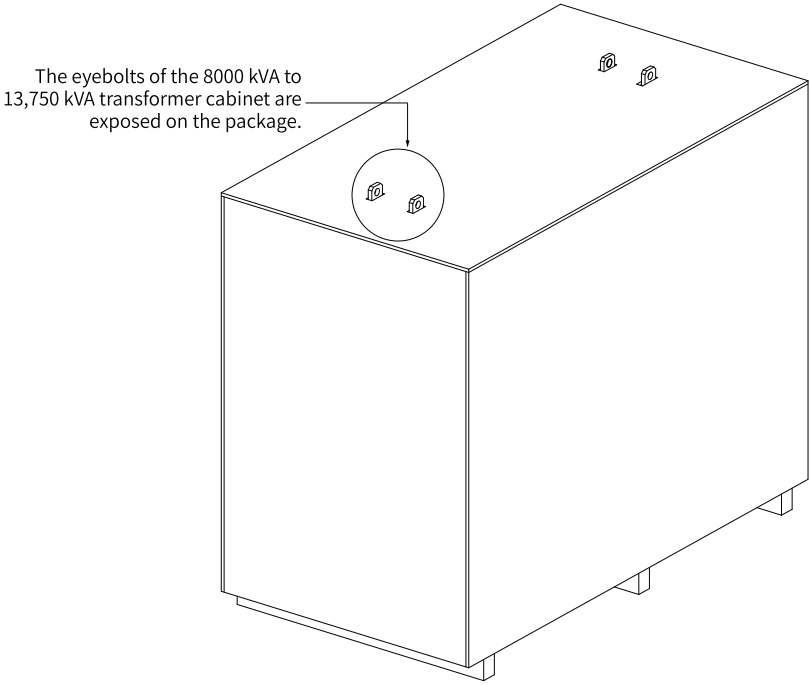


Figure 2-21 Packaging of 8000 kVA to 13,750 kVA transformer

Note

- Models of 10 kV-5000 kVA and above are transported without fans, except the 10 kV-8000 kVA to 13750 kVA power cabinets.
- The eyebolts of the 10 kV-8000 kVA to 13750 kVA transformer cabinet are exposed on the package to facilitate pick and place, regardless of whether the cabinet is naked or packed in the wooden crate.
- The distance between the device and the wooden crate cannot be shorter than 20 mm.

2.2.2 Handling

The MV AC drive can be handled by a crane or rollers.

- Crane
  The drive carries eyebolts on the base. When lifting the drive with a crane, install the four shackles to the four eyebolts on the drive base and pass the lifting rope (steel rope inhibited) through the shackles. Then lift the drive with the crane.



Four lifting slings of equal length must be used for hoisting the AC drive. Ensure the height from the hook to the top of the AC drive is greater than 1.5 m. Move slowly after hoisting. Continuously monitor the status of the AC drive in real time. Failure to comply may result in damage to the AC drive.

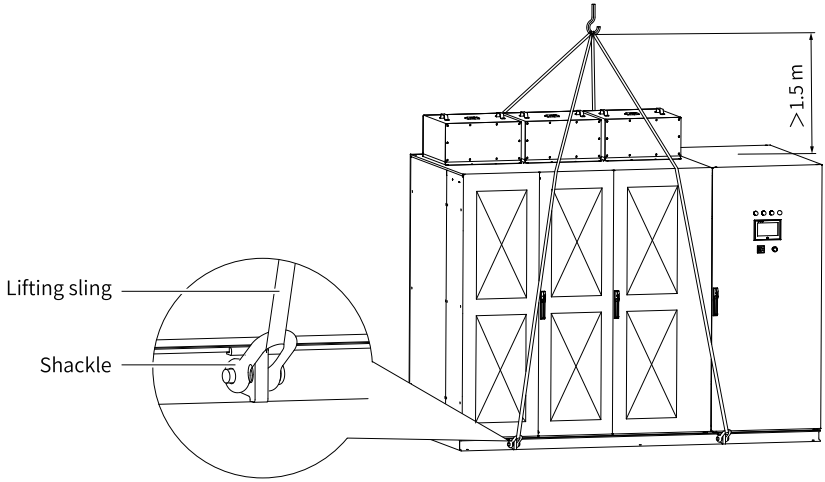


Figure 2-22 Handling with a crane

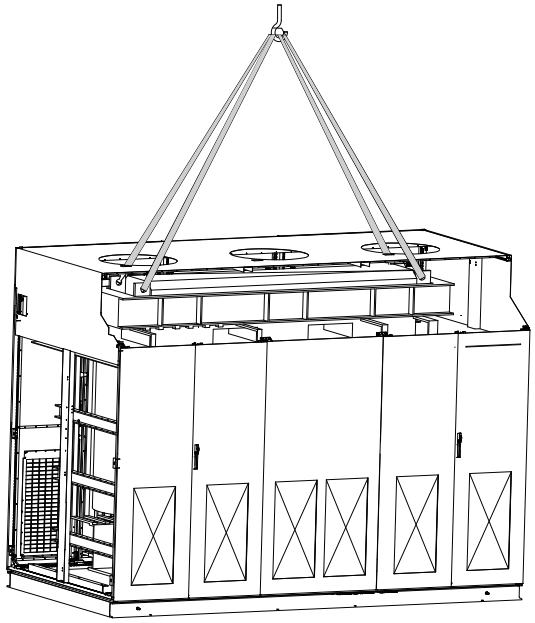


Figure 2-23 Handling the 10 kV/5000 kVA to 13,750 kVA transformer cabinet (unpacked) with a crane

Note

When lifting the transformer cabinet, the sling shall be threaded through the holes of fan guard on the top of the cabinet. But the sling should be kept a distance from the top board of the cabinet. Remember to close the cabinet door.

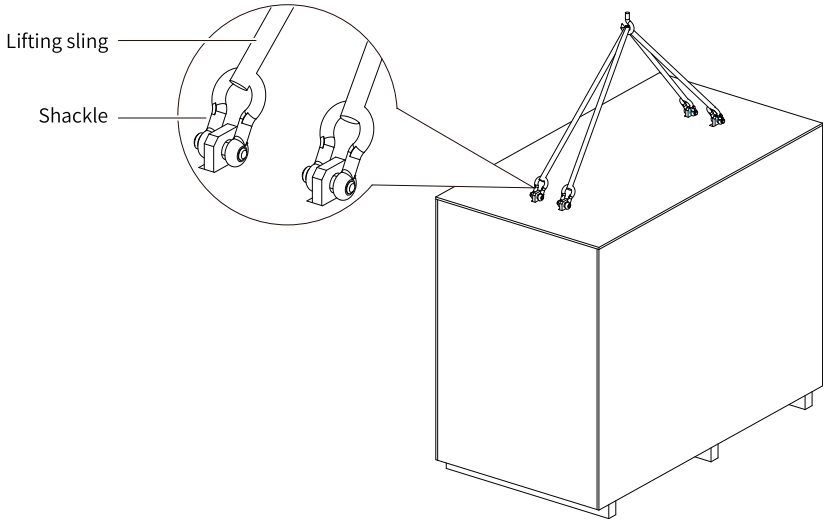


Figure 2-24 Handling the 10 kV/8000 kVA to 13,750 kVA transformer cabinet (packed) with a crane

Note

When lifting the transformer cabinet, you need to install shackles on the top of the cabinet. (The same lifting approach is applied in plastic wrapping and wooden wrapping.)

- Roller (recommended)
  When carrying the rollers, first lay the rollers side by side on the floor, then place the cabinet on the rollers, and move the rollers cyclically, as shown in the following figure.

CAUTION

Ensure that the roller diameter is no more than 30 mm and the interval between two adjacent rollers are no more than 300 mm; otherwise, the AC drive base may be deformed.

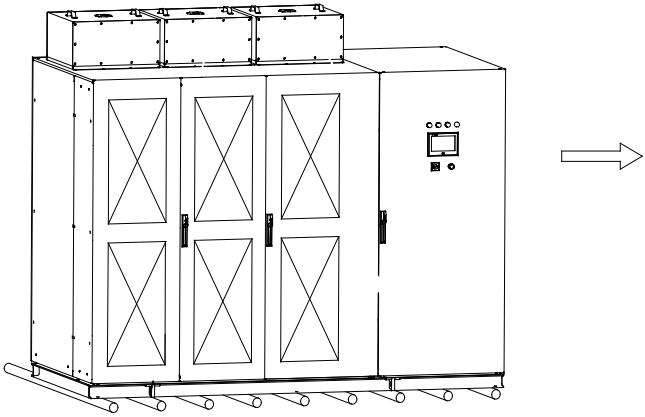


Figure 2-25 Handling with rollers

2.2.3 Unpacking

Check whether the spare parts are intact once receiving the MV AC drive. If any spare part is damaged, contact us immediately. Damage caused by external force or environment is not covered by warranty.

1. Pre-unpacking inspection

No.	Item	Checked
1	Inspect whether the package is intact and whether there are serious mechanical damage, collision marks, dust, water stains, fungus, deformation, and rust.	
2	Check that the product serial number matches the order.	
3	Check that the number of items in the package matches the packing list.	

Note

If the device is damaged during transportation, take photos of the damaged parts and fill in the transportation damage report. Then submit the photos and report to us or the carrier.

2. Unpacking a wooden crate

Step	Item
1	Place the product in an empty and flat production hall and prepare iron crowbars and other tools.
2	Pry out the wooden crate along the gap in the crate. Remove the cover, side plates, end plates, and pallet. During unpacking, put the crowbar into the crate as short as possible so as to prevent damaging the equipment. Exercise caution during the whole process to prevent personal injuries caused by iron nails.
3	When removing the packing materials such as plastic film, do not use sharp tools to avoid scratching the AC drive.
4	Unscrew the bolts that join the AC drive and the pallet.

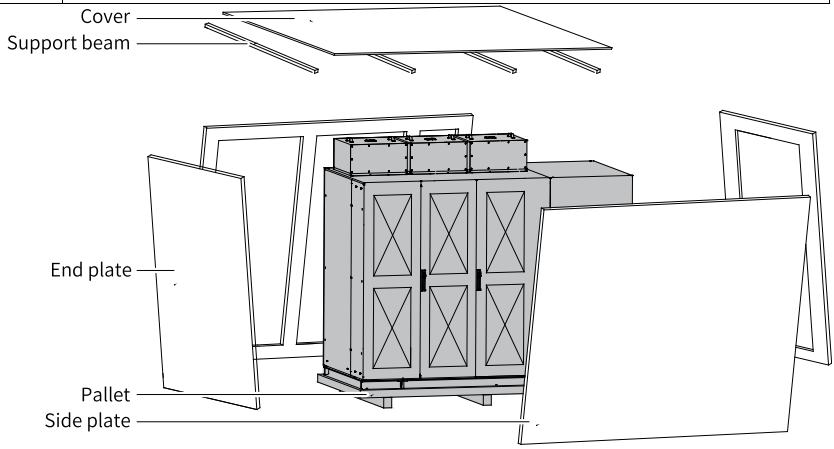


Figure 2-26 Unpacking the wooden crate

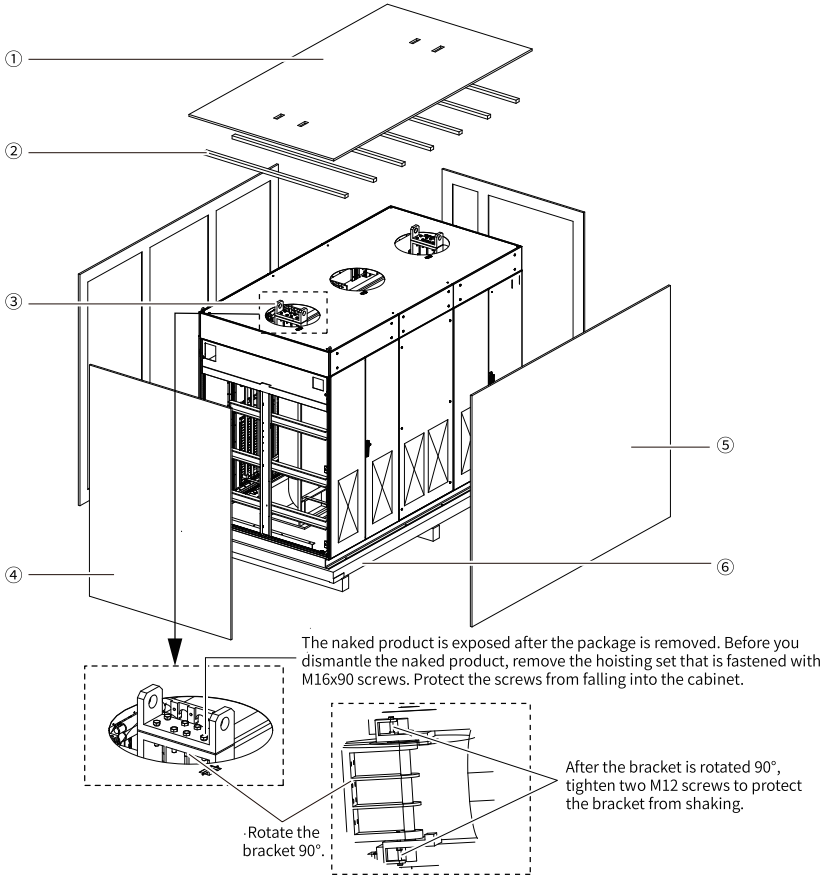


Figure 2-27 Unpacking a transformer cabinet (models of 10 kV/8000 kVA to 13,750 kVA)

No.	Component	No.	Component
①	Cover	④	End plate
②	Support beam	⑤	Side plate
③	Hoisting set of the cabinet	⑥	Wooden pallet

Note

- When unpacking the AC drive, first remove the cover plate and wooden support beam, then remove the side plate and end plate, and finally remove the pallet.
- Read the unpacking illustration before unpacking the 10 kV transformer cabinet with a capacity of 8000 kVA to 13750 kVA.
- The distance between the device and the wooden crate cannot be shorter than 20 mm.

3. Unpacking a simple package

Step	Item
1	Place the product in an empty and flat production hall and remove the packing materials such as plastic film. Do not use sharp tools to avoid scratching the AC drive.
2	Unscrew the bolts that join the AC drive and the pallet.

4. Inspection after unpacking

Check the condition of the drive immediately after unpacking and note the following items.

No.	Item	Checked
1	Open the rear door plate of the drive unit and check the internal condition.	
2	Check the condition of the related equipment (such as the transformer) according to the corresponding user guide.	
3	Check that spare parts are intact and complete. If any spare parts are missing, contact us or the carrier immediately.	

No.	Precautions	Checked
1	Check whether the door and side plates are deformed or peeled off.	
2	Check whether control cables are connected properly.	
3	Check whether unassembled spare parts are complete.	
4	Check whether the bolts are in place.	
5	Check whether there are damaged parts.	
6	Check the dust-proof layer.	
7	Check whether there is water stain.	
8	Check whether there is damage caused by insects and ants.	

2.2.4 Installation and Fixation

The following installation instructions apply to general installation conditions in industrial environment. For use in special environments, contact us first. Installation procedure:

1. Before performing mechanical installation, make sure that are all environment requirements described in preceding sections are satisfied.
2. Check the base level with a gradienter. The unevenness within 2 m around the mounting surface must be lower than or equal to 4 mm. Flatten the uneven floor before installation.
3. Open all the cabinet doors and check whether the drive and accessories are intact. If any part is damaged or missing, contact technical support or the carrier immediately. Open the cabinet door in the way, as shown in the following figures.

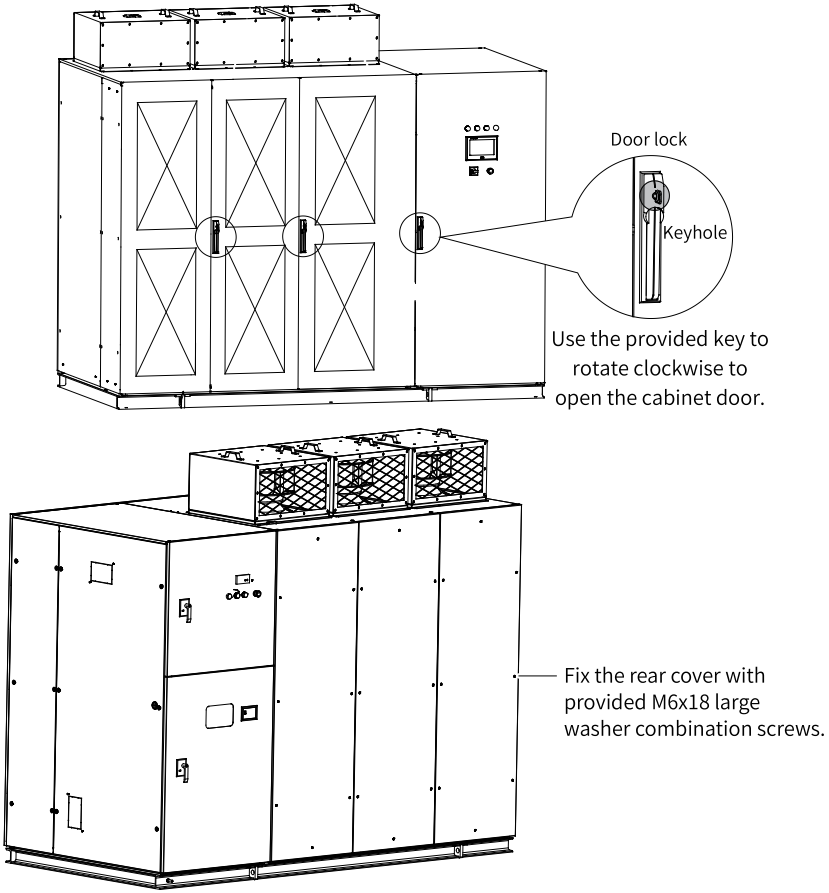


Figure 2-28 Opening the front door/rear cover of the cabinet (models of 10 kV/11 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

Note

Only the front cabinet door of models of 10 kV/11 kV-2500 kVA and 6.6 kV-1600 kVA and lower specifications has door locks. The rear cover is fixed with screws.

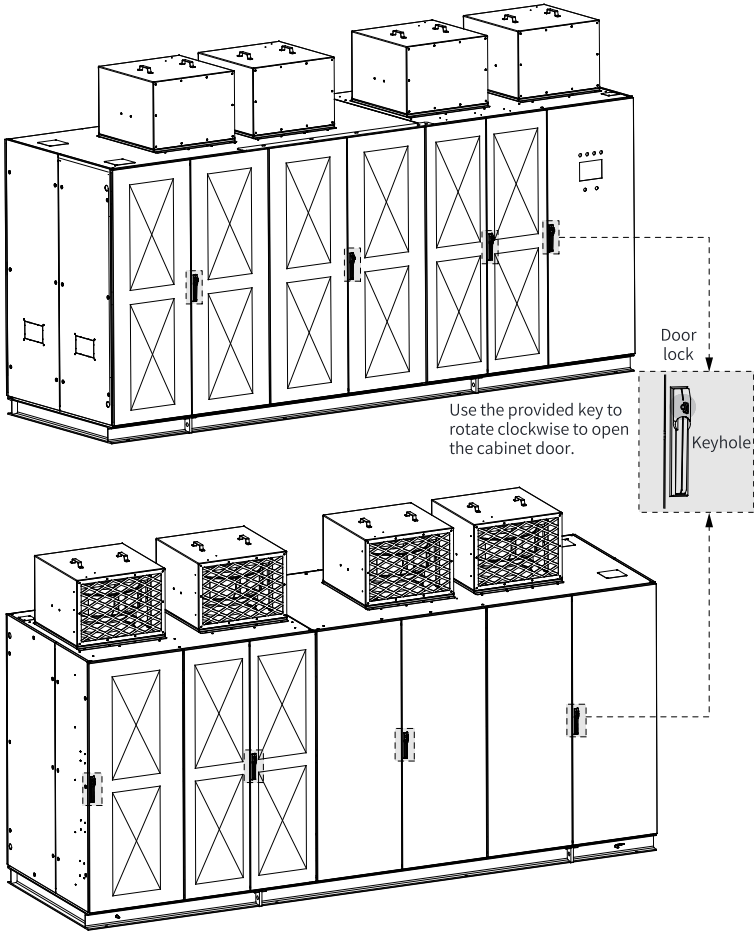


Figure 2-29 Opening the front door/rear cover of the cabinet (models of 10 kV/11 kV-2800 kVA, 6.6 kV-1800 kVA, and above)

Note

Both front and rear cabinet doors of models of 10 kV/11 kV-2800 kVA and 6.6 kV-1800 kVA and higher specifications have door locks.

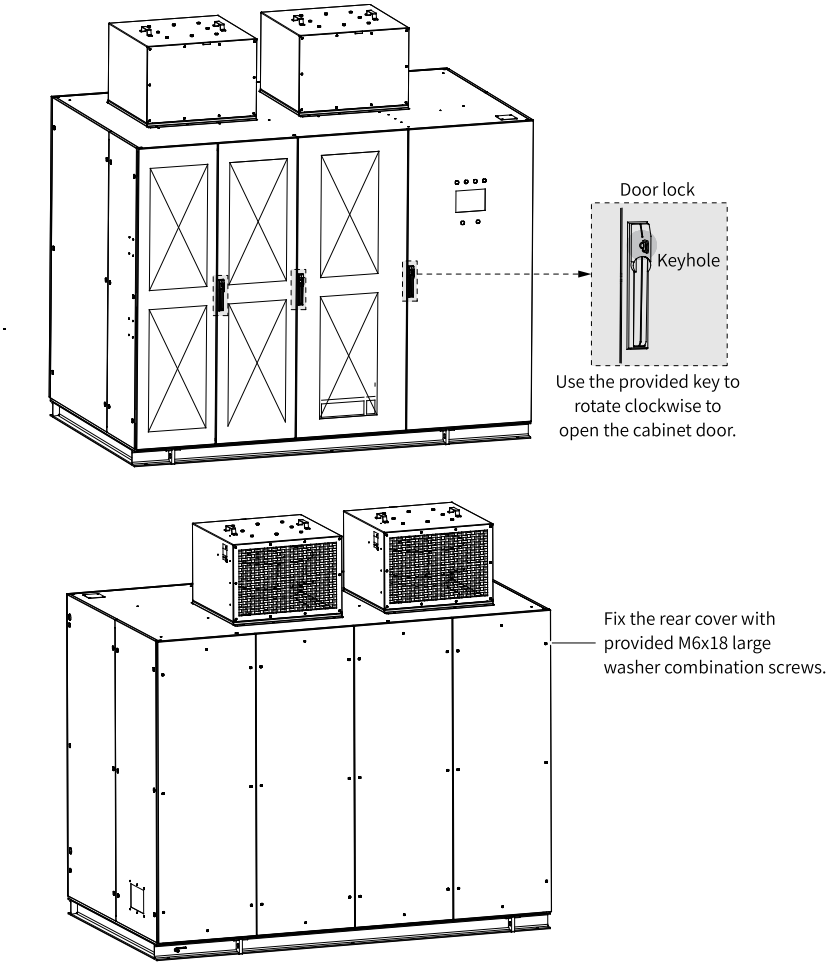


Figure 2-30 Opening the front door/rear cover of the cabinet (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

Note

Only the front cabinet door of models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and lower specifications has door locks. The rear cover is fixed with screws.

4. Check whether cabinet doors can be opened and closed completely. If not, adjust the cabinet. Check the limit lock on the doors. Except the master control cabinet door, all

the other front and rear doors cannot be opened after power-on. If the door is opened without authorization, the system reports a fault and triggers MV tripping.

5. After the cabinet is installed, the base of the cabinet is soldered to the foundation U-steel directly, as shown in the following figure. (For details about the foundation U-steel, see the engineering drawing delivered with the product.)

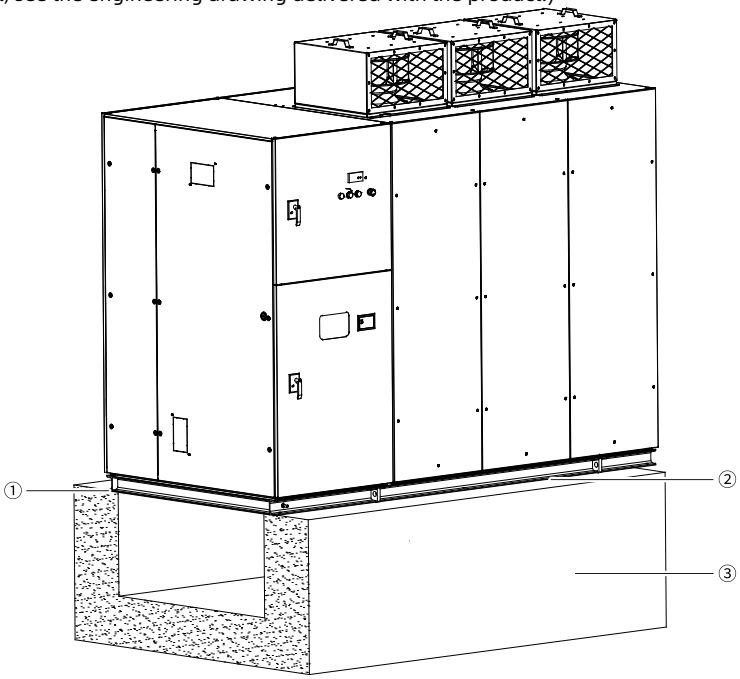


Figure 2-31 Soldering diagram

No.	Component
①	Solder point
②	Solder point
③	Foundation

CAUTION

Open the cabinet doors as described above. Otherwise, the equipment will be damaged.

2.3 Electrical Installation

2.3.1 Precautions for Electrical Installation

Note

- Ensure that the diameter and voltage resistance of inlet MV cables and control power cables meet the requirements. The input and output MV cables must pass the voltage resistance test.
- Ensure that the effective surge protection measure has been take on the MV switch on the input side.
- The armor of MV inlet cables and load cables must be grounded reliably, be fixed into cabinets reliably, have sufficient mechanical strength, and keep proper insulation distance as stipulated in all MV technical specifications.
- Route the input cables and output cables separately to avoid cable mixing and danger caused by insulation damage.
- Separate signal cables of the MV variable frequency power supply from strong power cables. Use shielded twisted-pair (STP) cables as analog signal cables and ensure that the shield is reliably grounded at one end.
- Always keep the MV variable frequency power cabinets to be tied to the workshop ground reliably to ensure personal safety.
- Set a special ground electrode in the control cabinet before electrical installation. The grounding resistance of the ground electrode cannot be greater than 2 Ω (4 Ω for others).
- Before measuring the insulation resistance of the transformer or performing the withstand voltage test, short-circuit all terminals on the secondary side of the transformer. Otherwise, units will be damaged. The test on the transformer must be agreed and supported by the manufacturer.

2.3.2 Positions of Outlet Holes on the Base

Note

Precautions on cable entry are as follows:

- Confirm the cable inlet hole positions of all cables.
- Make sure to strictly separate power cables from control cables.

The following figures show the positions of outlet holes on the base of different AC drive models.

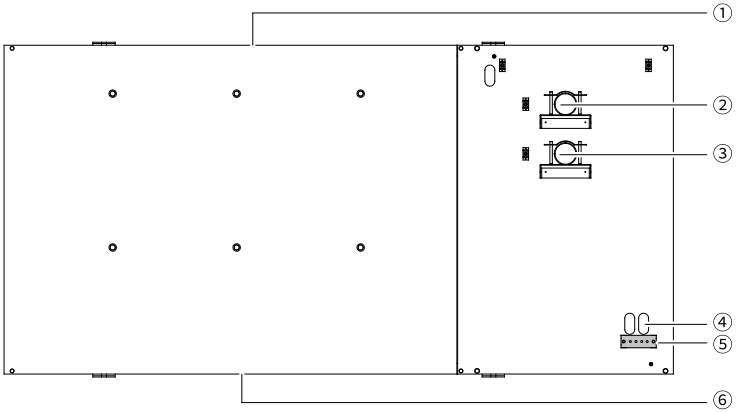


Figure 2-32 Positions of outlet holes on the base (models of 10 kV/11 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

No.	Component	No.	Component
①	Back of cabinet	④	Inlet/Outlet hole of control cables
②	Inlet/Outlet hole of MV cables	⑤	Main grounding copper busbar of control cabinet
③	Inlet/Outlet hole of MV cables	⑥	Front of cabinet

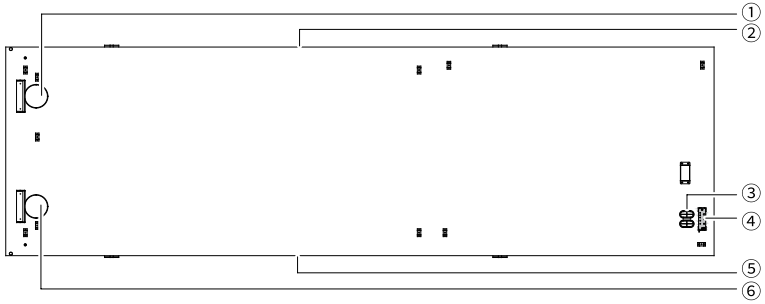


Figure 2-33 Positions of outlet holes on the base (models of 10 kV/11 kV-2800 kVA to 4500 kVA, and 6.6 kV-1800 kVA to 3000 kVA)

No.	Component	No.	Component
①	Inlet/Outlet hole of MV cables	④	Main grounding copper busbar of control cabinet
②	Back of cabinet	⑤	Front of cabinet
③	Inlet/Outlet hole of control cables	⑥	Inlet/Outlet hole of MV cables

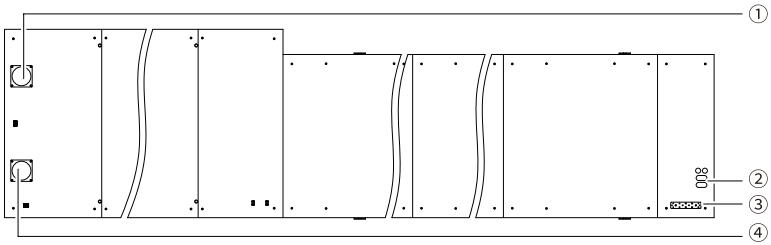


Figure 2-34 Positions of outlet holes on the base (models of 10 kV/11 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

No.	Component	No.	Component
①	Inlet/Outlet hole of MV cables	③	Main grounding copper busbar of control cabinet
②	Inlet/Outlet hole of control cables	④	Inlet/Outlet hole of MV cables

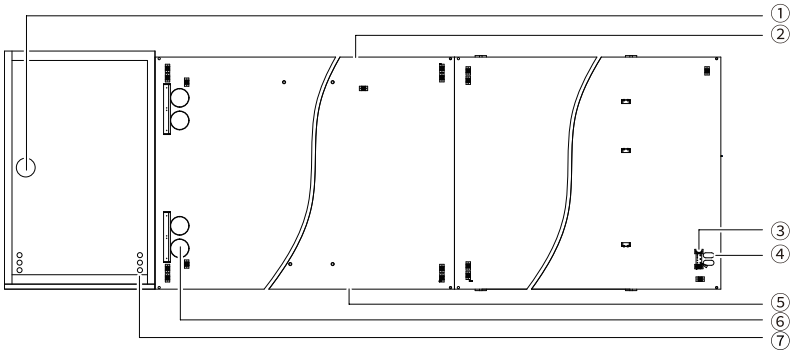


Figure 2-35 Positions of outlet holes on the base (models of 10 kV/11kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

No.	Component	No.	Component
①	Inlet/Outlet hole of MV cables for the pre-charge cabinet	⑤	Front of cabinet
②	Back of cabinet	⑥	Inlet/Outlet hole of MV cables for the AC drive
③	Inlet/Outlet hole of control cables	⑦	Inlet/Outlet hole of cables for the pre-charge cabinet
④	Main grounding copper busbar	-	-

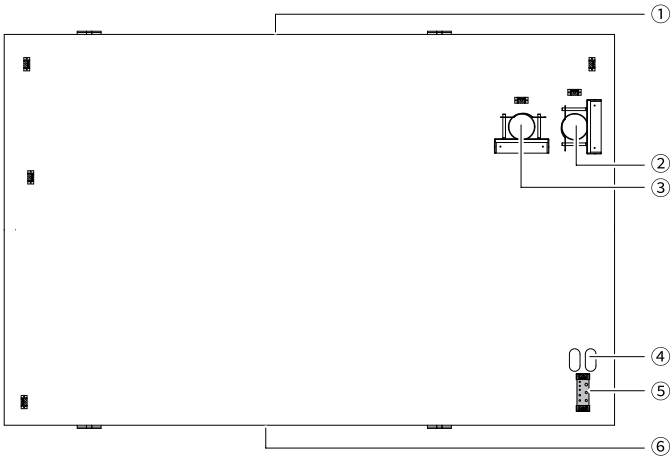


Figure 2-36 Positions of outlet holes on the base (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

No.	Component	No.	Component
①	Back of cabinet	④	Inlet/Outlet hole of control cables
②	Inlet/Outlet hole of MV cables	⑤	Main grounding copper busbar of control cabinet
③	Inlet/Outlet hole of MV cables	⑥	Front of cabinet

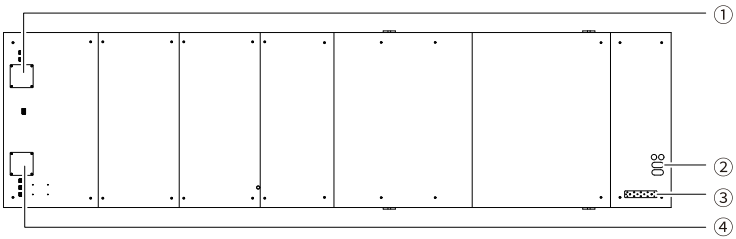


Figure 2-37 Positions of outlet holes on the base (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

No.	Component	No.	Component
①	Inlet/Outlet hole of MV cables	③	Main grounding copper busbar of control cabinet
②	Inlet/Outlet hole of control cables	④	Inlet/Outlet hole of MV cables

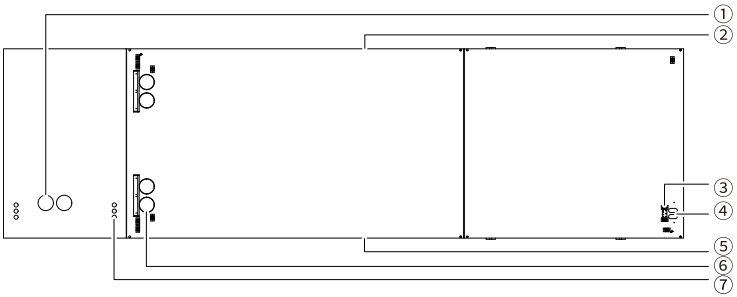


Figure 2-38 Positions of outlet holes on the base (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

No.	Component	No.	Component
①	Inlet/Outlet hole of MV cables for the pre-charge cabinet	⑤	Front of cabinet
②	Back of cabinet	⑥	Inlet/Outlet hole of MV cables for the AC drive
③	Inlet/Outlet hole of control cables	⑦	Inlet/Outlet hole of cables for the pre-charge cabinet
④	Main grounding copper busbar	-	-

2.3.3 System Grounding

Ensure that the grounding resistance is less than 4 Ω and use a copper bar of 25 mm x 4 mm for grounding. Install the copper bar in the cable trench under the foundation U-steel frame. Connect the main grounding point of the MV system to the copper bar tightly and then connect the copper bar to the base of all cabinets. Combine all signal cables into one grounding point and connect this point to the copper bar, as shown in the following figure.

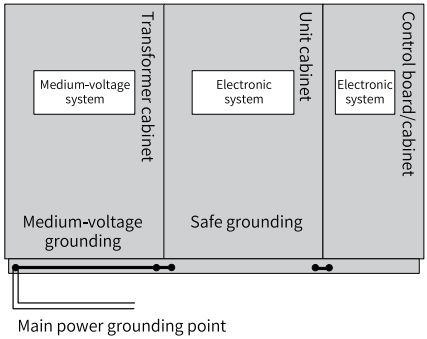


Figure 2-39 System grounding diagram

2.3.4 Connection of the Main Grounding Bolt

Note

The precautions on connecting the grounding bolt are as follows:

- Ensure that the measured resistance of the grounding cable is smaller than 4 Ω.
- Mark the grounding cable clearly.
- Ensure the MV AC power is de-energized.

Attach the user main grounding cable or copper busbar to the main grounding bolt of the AC drive as shown in the following figure, and use a wrench to tighten the screw with a tightening torque of 45 N·m.

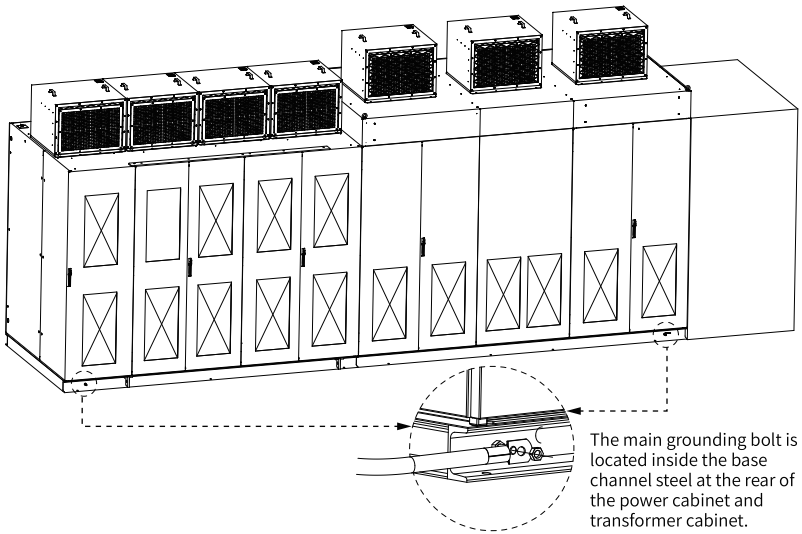


Figure 2-40 Wiring of the grounding bolt

2.3.5 Wiring of the Main Circuit

Note

- Never wire input terminals and output terminals wrongly. Failure to comply will result in severe damage to the MV AC drive.
- Make sure that the input power has been cut off before wiring. Failure to comply will result in an electric shock or a fire.
- Only allow authorized electrical engineer to perform wiring. Failure to comply will result in an electric shock or a fire.
- Ensure reliable grounding of cabinets. Failure to comply will result in an electric shock or a fire.
- Confirm that the emergency stop button is normal before power-on.
- Never touch output terminals directly, connect output terminals to the housing of the MV AC drive, or short output terminals. Failure to comply will result in an electric shock or a short circuit.

Connect the MV power cables and motor cables respectively to the input terminals and output terminals of the drive. A main circuit breaker is installed between the MV power cables and the drive. After receiving the signal that indicates MV switch-on is allowed, the breaker is allowed to be closed. The output terminals of the drive is connected to the

motor directly (or through the bypass cabinet). The input/output main circuit and the wiring flowchart are shown below.

- If a bypass cabinet is used, the main circuits are as wired according to the following figure.

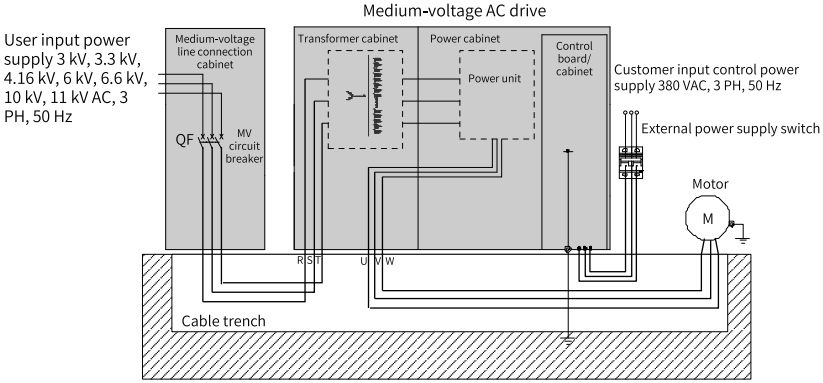


Figure 2-41 Main circuit wiring diagram (automatic bypass cabinet)

Note

If manual bypass cabinet is selected, only replace contactors KM1, KM2 and KM3 in the preceding figure with isolation switches QS1, QS2 and QS3. Prepare cables for connection in the preceding figure by yourself. For selection and making of these cables, refer to the engineering drawing that is delivered together with the AC drive.

- If the bypass cabinet is not used, the main circuits are as wired in the following figure.

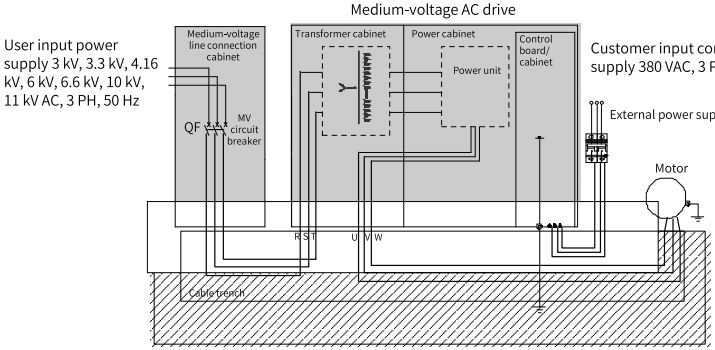


Figure 2-42 Main circuit wiring diagram (without bypass cabinet)

- The main circuit wiring diagram for a primary pre-charge cabinet is shown below:

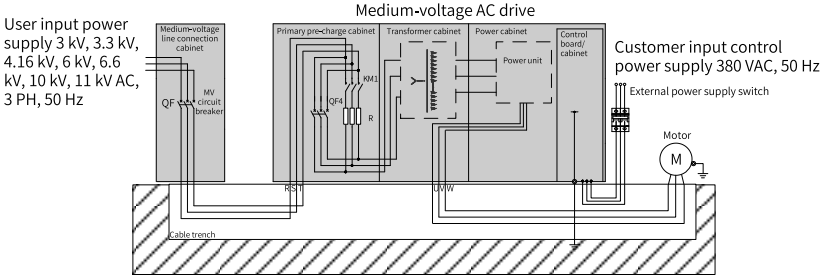


Figure 2-43 Main circuit connection diagram (primary pre-charge cabinet)

Note

Prepare the preceding cables beforehand. For details about selection and manufacturing of the cables, see the engineering drawings delivered with the AC drive.

2.3.6 Connection of the Cable Inlet/Outlet Terminals

Note

The precautions on connecting the MV inlet and outlet terminals are as follows:

- Check phases U, V, and W and mark them clearly.
- Confirm that the device is not energized.

As shown in the following figure, connect the three-phase cable to the corresponding three-phase copper busbar through the wiring holes. Tighten the bolts through a wrench with a tightening torque of 45 N·m.

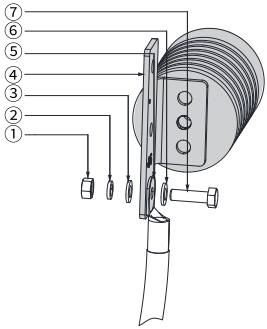


Figure 2-44 Wiring of cable inlet/outlet terminals

No.	Component
①	M10 nut
②	Spring washer
③	Flat washer
④	Copper busbar
⑤	O-type terminal
⑥	Flat washer
⑦	M10 hex bolt

2.3.7 Wiring of the Control Circuit

Components of the control circuit

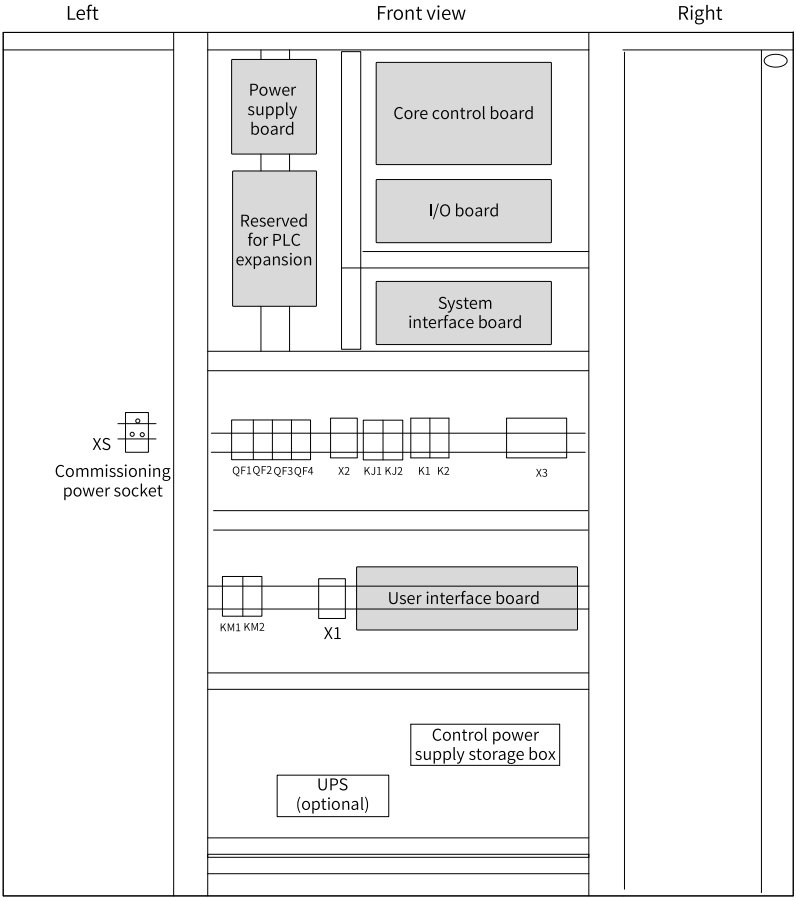


Figure 2-45 Layout of the control board components (models of 10 kV/11 kV-2500 kVA, 6.6 kV-1600 kVA, and below)

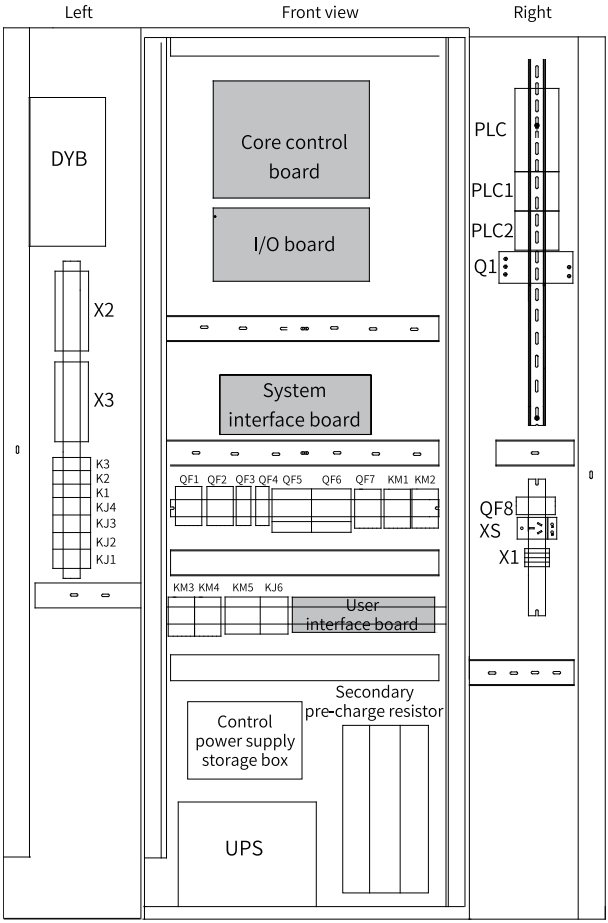


Figure 2-46 Layout of the control board components (models of 10 kV/11 kV-2800 kVA to 4500 kVA, and 6.6 kV-1800 kVA to 3000 kVA)

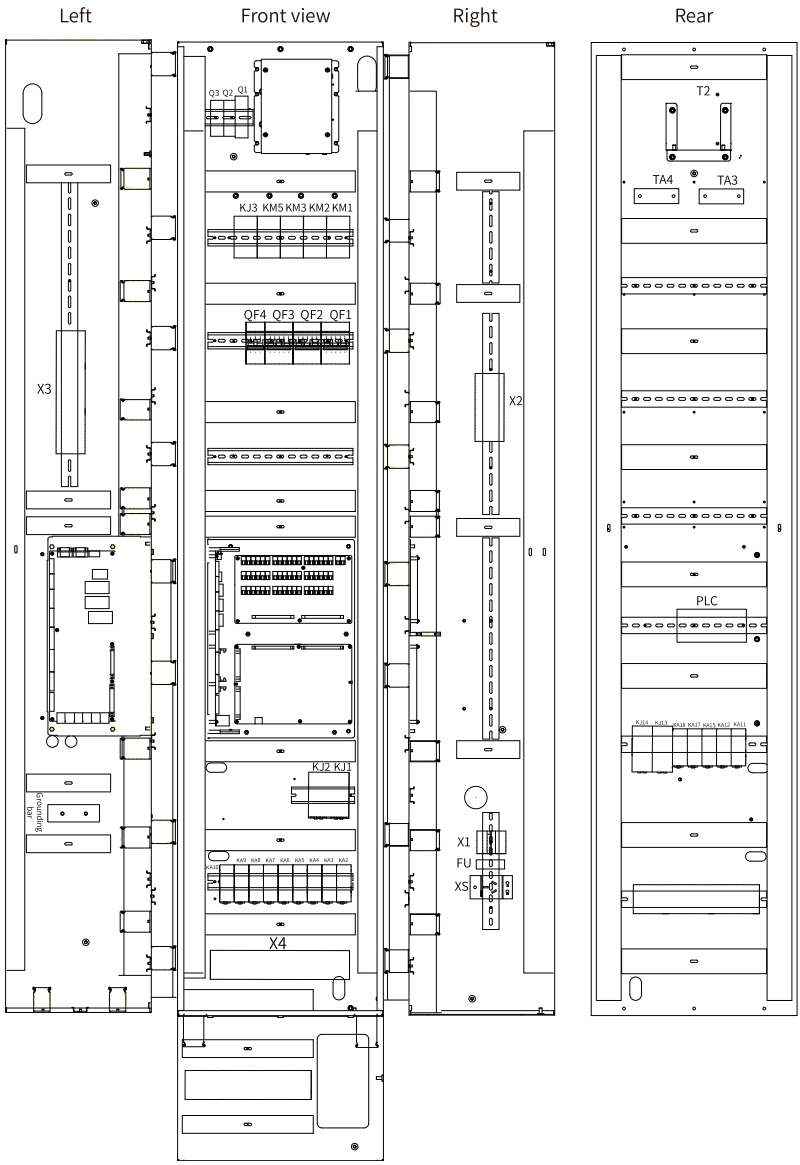


Figure 2-47 Layout of the control board components (models of 10 kV/11 kV-5000 kVA to 7000 kVA, and 6.6 kV-3500 kVA to 4000 kVA)

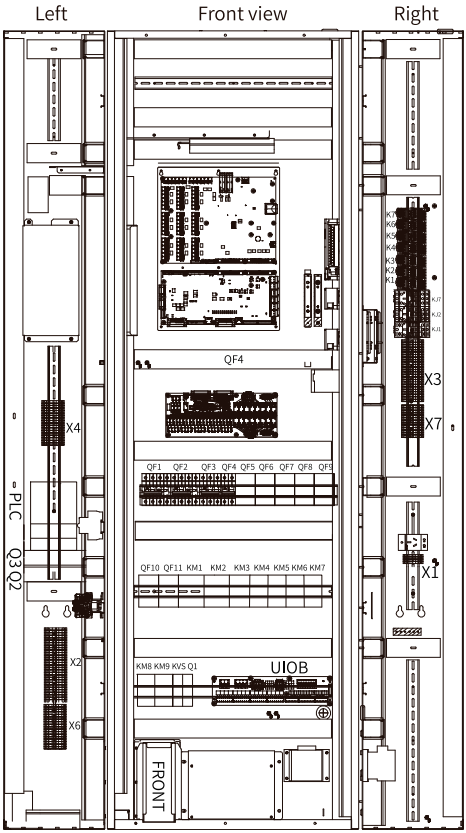


Figure 2-48 Layout of the control board components (models of 10 kV/11 kV-8000 kVA to 13750 kVA, and 6.6 kV-4500 kVA to 9000 kVA)

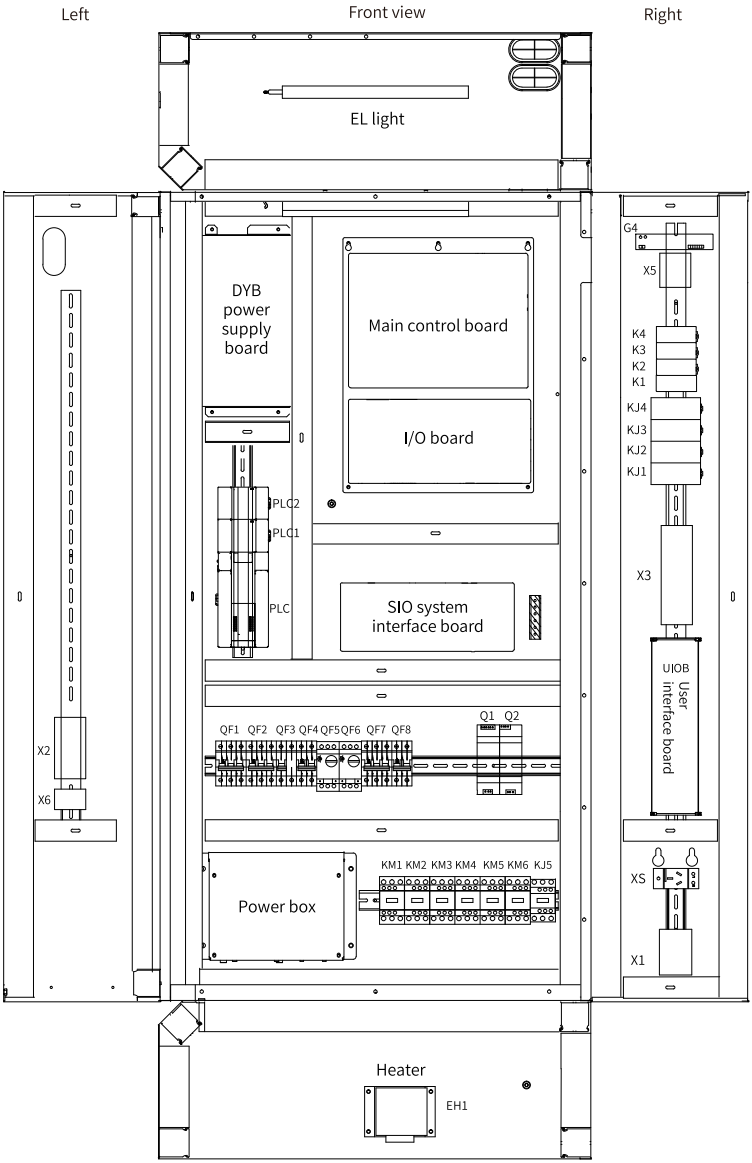


Figure 2-49 Layout of the control board components (models of 6 kV-2800 kVA, 4.16 kV-1800 kVA, 3.3 kV-1400 kVA, 3 kV-1250 kVA, and below)

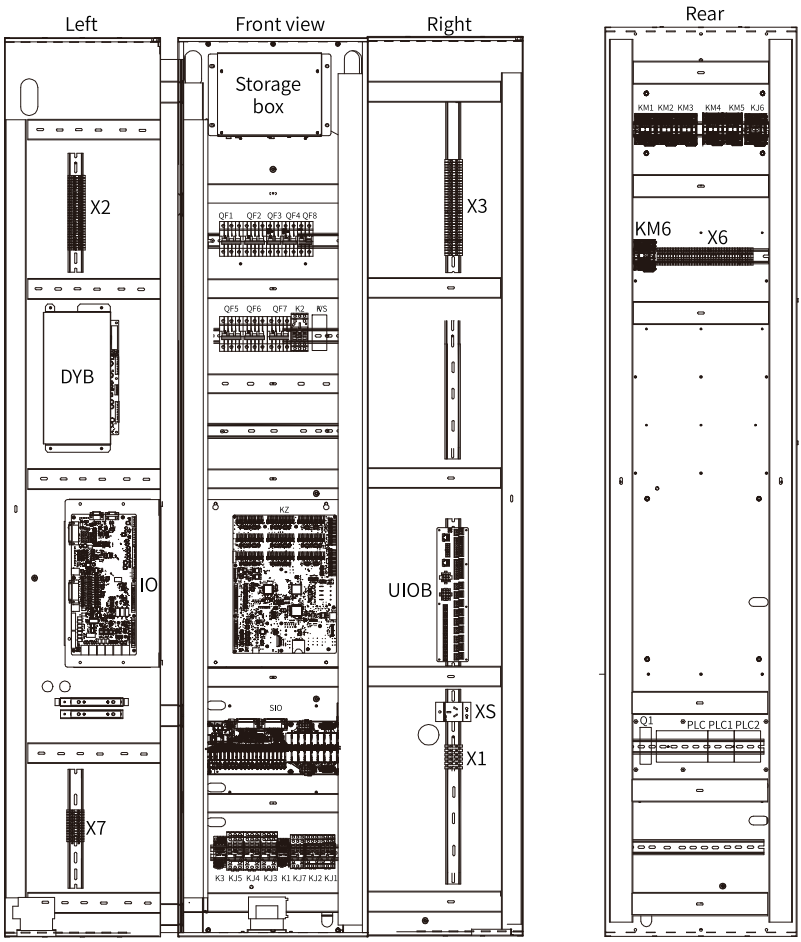


Figure 2-50 Layout of the control board components (models of 6 kV-3150 kVA to 4000 kVA, 4.16 kV-2000 kVA to 2800 kVA, 3.3 kV-1600 kVA to 2250 kVA, and 3 kV-1250 kVA to 2000 kVA)

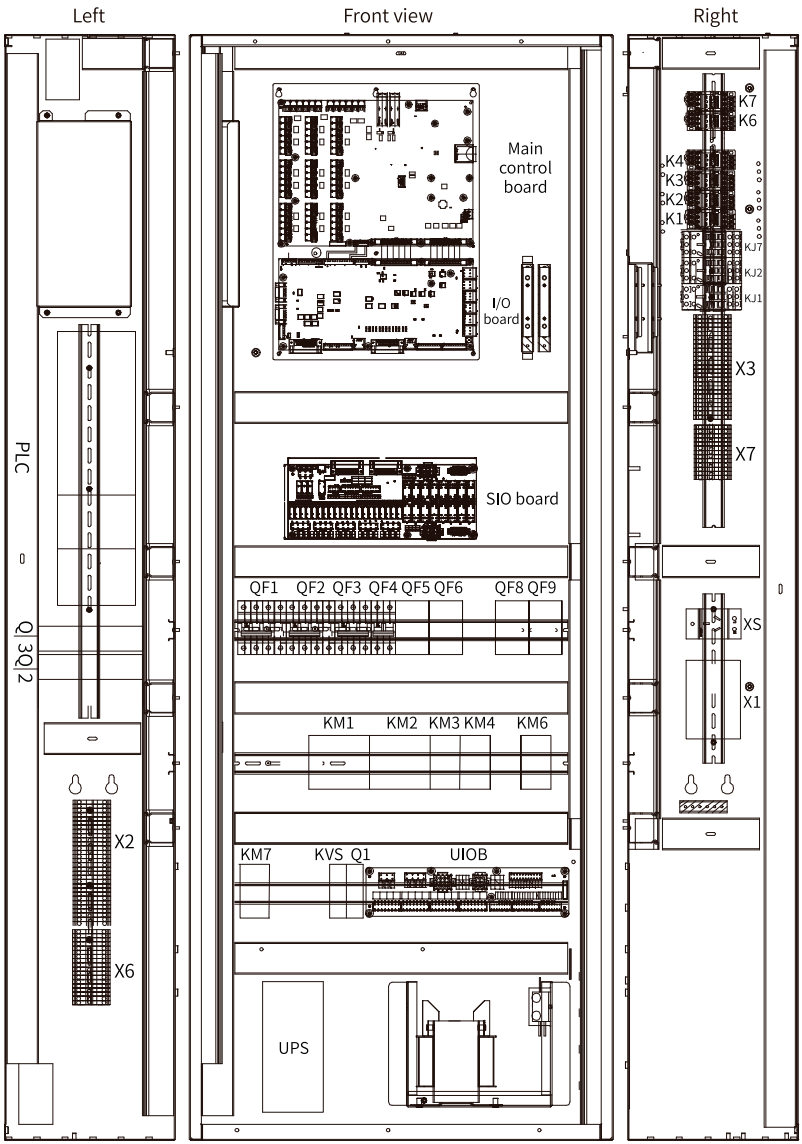


Figure 2-51 Layout of the control board components (models of 6 kV-4500 kVA to 8000 kVA, 4.16 kV-3150 kVA to 5600 kVA, 3.3 kV-2500 kVA to 4500 kVA, and 3 kV-2250 kVA to 4000 kVA)

Note

- The preceding figure takes the control panel as an example. The component layout in the control cabinet is similar to the layout of the control panel. Contact our company if you have any problem.
- The internal wiring is complete before delivery. You only need to perform wiring on the user terminal block and user interface board. For details, see the description of the user terminal block and user interface board at the end of this section.
- The control circuit is composed of the main control unit, power board, and air switch.

Table 2–3 Functions of control board components

Name	Function
Core control board	Used to implement the logic functions of the system, human-machine interaction, bus communication, motor control algorithm, real-time protection, unit diagnostics, phase shifting PWM output, unit communication, real-time data interaction with DSP/ARM, and system clock.
I/O interface board	The I/O interface board is used to provide all power supplies required by the control hardware system, including power supplies required for core control board and optical fiber board. It can also be used to implement adjustment of input/output current/voltage signals and provide interfaces for other boards, extension cards, HMI, DI/DO, and AI/AO to achieve human-machine interaction, communication, and I/O extension functions and interconnection with system interface board.
System interface board	The system interface board is used for interconnection with I/O board and act as the intermediary between interaction of the system logic function and main control system. It implements integration and modularity of system logic functions. It is integrated with intermediate relay, DI/DO interface and HMI power supply.

Description of control circuit

Port	Function
DO1	MV tripping
DO2	MV switch-on enable
DO3	Main power supply indication
DO4	Ready
DO5	AC drive running
DO6	AC drive stopped
DO7	Fault
DO8	Alarm
DO9	HMI reset

Port	Function
DO10	Bypass cabinet 1 KM2/KM3 unlock signal (optional)
DO11	Bypass cabinet 2 KM5/KM6 unlock signal (optional)
DO12	Motor 1 switched to mains frequency automatically (optional)
DO13	Bypass cabinet 1 outlet contactor switch-off (optional)
DO14	Bypass cabinet 1 outlet contactor switch-on (optional)
DO15	Bypass cabinet 1 mains frequency contactor switch-off (optional)
DO16	Bypass cabinet 1 inlet contactor switch-off (optional)
DO17	Bypass cabinet 1 inlet contactor switch-on (optional)
DO18	Bypass cabinet 2 inlet contactor switch-on (optional)
DO19	Bypass cabinet 2 inlet contactor switch-off (optional)
DO20	Bypass cabinet 2 outlet contactor switch-on (optional)
DO21	Bypass cabinet 2 outlet contactor switch-off (optional)
DO22	Motor 2 switched to mains frequency automatically (optional)
DO23	Bypass cabinet 2 mains frequency contactor switch-off (optional)
DO24	Cabinet top fan control
DO25	Undefined
DO26	Undefined
DO27	Mains frequency indication
DO28	Variable frequency indication
DO29	Undefined
DO30	Undefined
DO31	Undefined
DO32	Undefined
DO33	Undefined
DO34	Undefined

Note

For specific I/O definition, see the electrical drawings attached with this model.

Name (by Electrical Sign)	Function
QF1	User inlet switch
QF2	Transformer auxiliary winding switch
QF3	Lighting and 220 V socket power supply switch in the control cabinet
QF4	Control power switch

Name (by Electrical Sign)	Function
QF5	Fan power switch 1
QF6	Fan power switch 2
QFn	Fan power switch n

Wiring of I/O interface board

The I/O interface board provides 26 digital inputs (DIs), 34 digital outputs (DOs), 4 analog inputs (AIs) and 5 analog outputs (AOs). The DIs, DOs, AIs and AOs can be extended as needed.

- DI

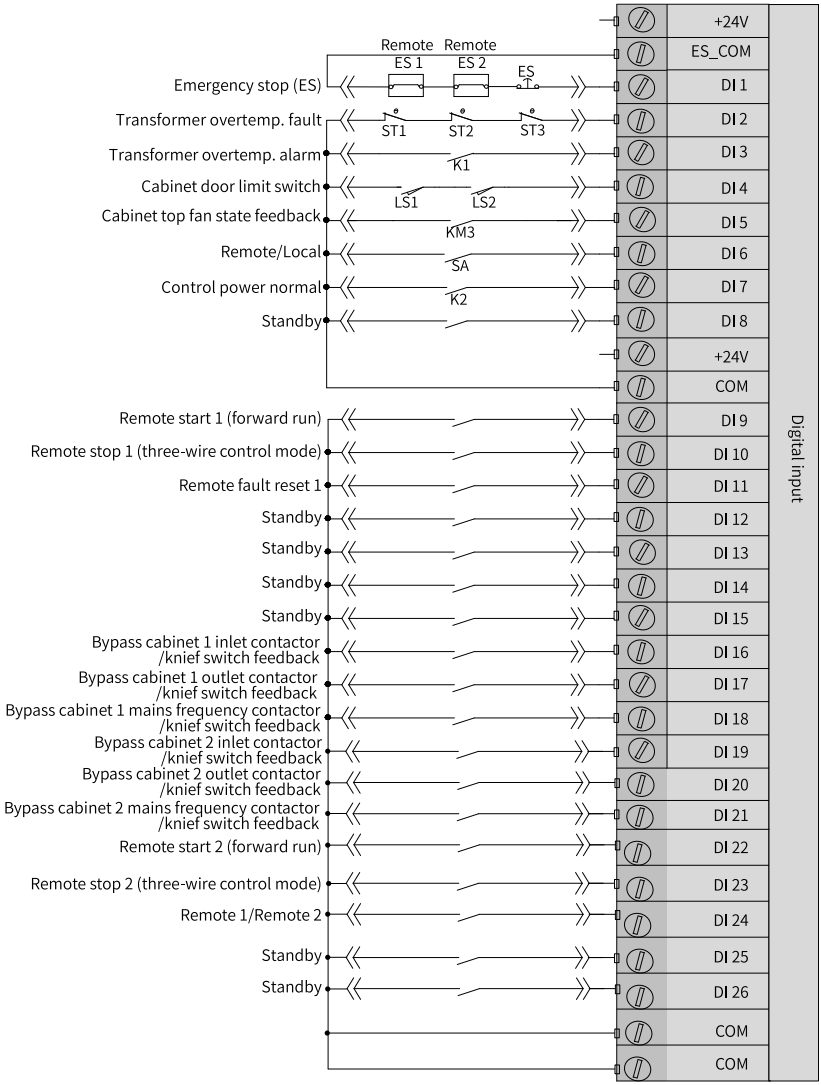


Figure 2-52 Wiring of the DIs

Note

The above figure shows the DI definition of one MV AC drive system with two automatic bypass cabinets. For specific DI definition, refer to the electrical drawings delivered together with the AC drive.

- DO

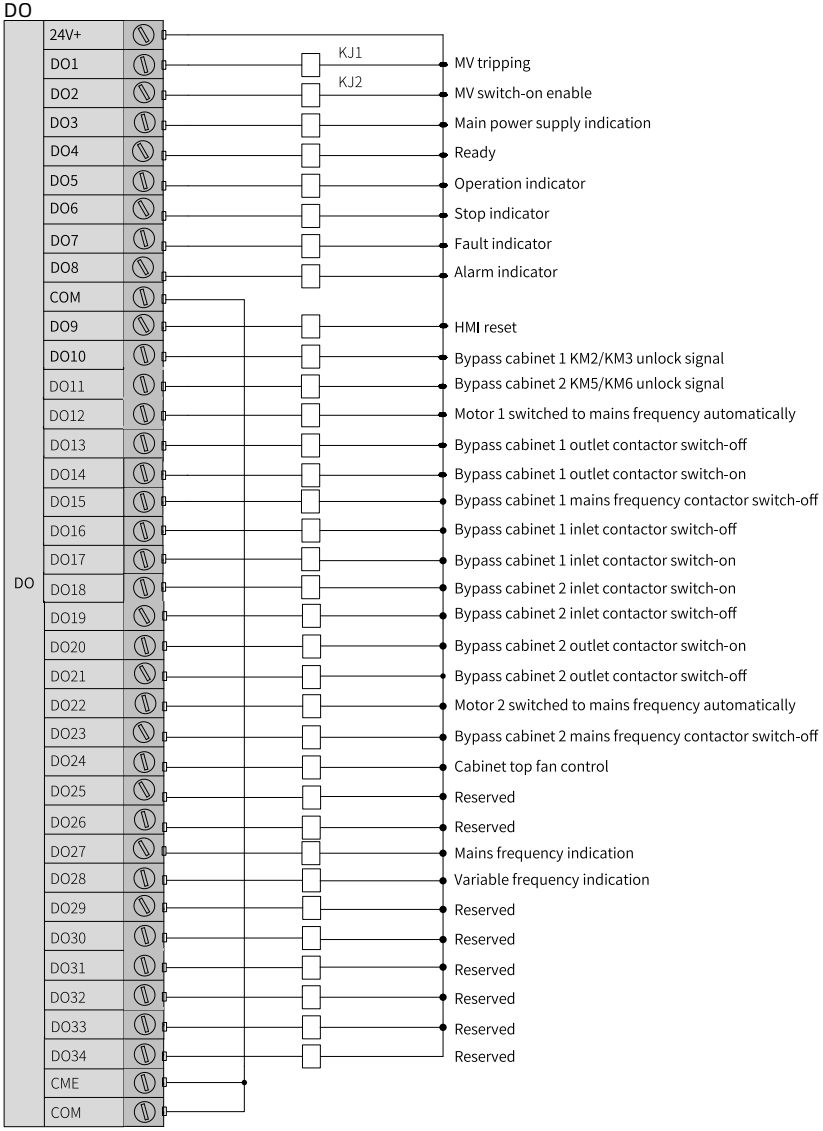


Figure 2-53 Wiring of the DOs

- Communication interface

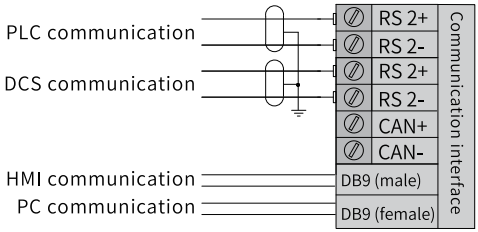


Figure 2-54 Wiring of communication terminal

Note

If a PRUFIBUS-DP communication card is configured, see relevant communication instructions in *"12.1 Overview" on page 277*.

- AI and AO

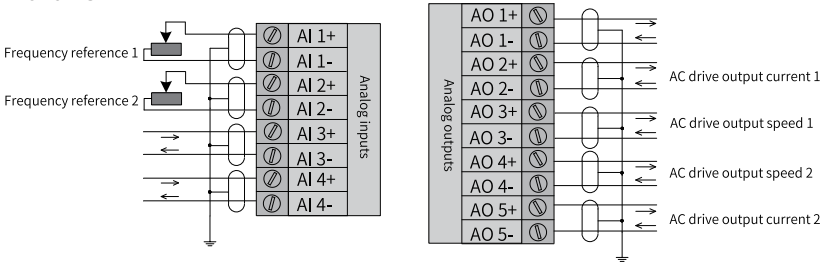


Figure 2-55 Wiring of AI/AO terminals

- Encoder interface

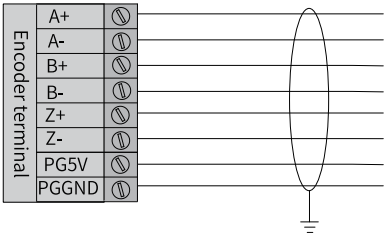


Figure 2-56 Wiring of encoder interfaces

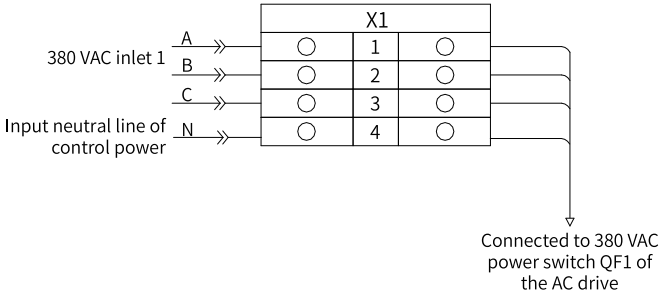
Note

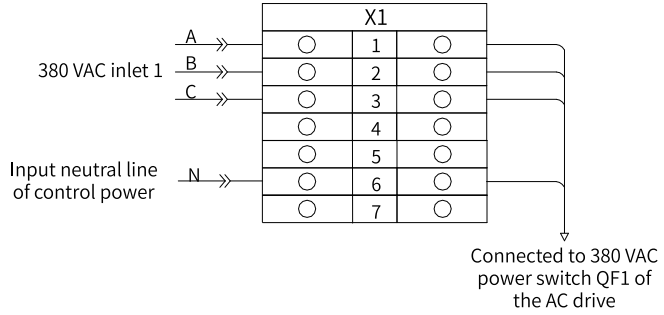
For details about the encoder, see *" Appendix E: Instructions for Use of the General-Purpose Encoder Expansion Card" on page 310*.

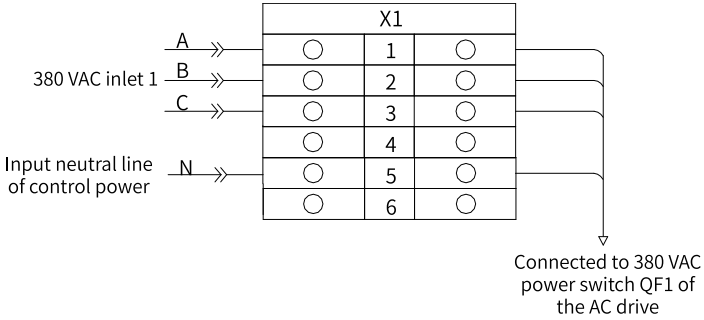
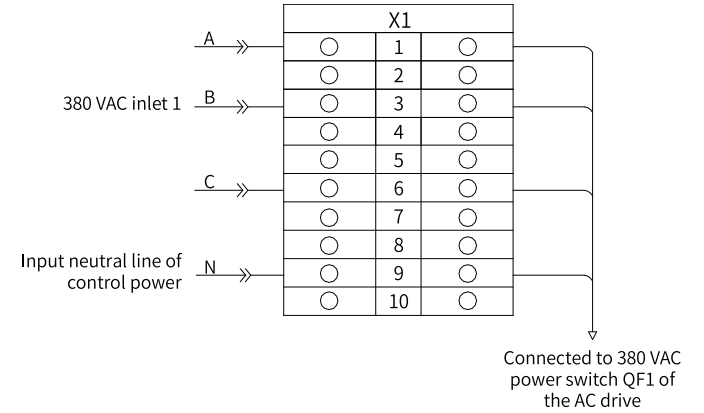
Wiring of user terminal block

Terminals needed are integrated into terminal block X1. You can perform wiring based on the following wiring diagram.

Type	Signal Name	User Wiring	User Signal Terminal Block
User power supply terminal	Terminal block for models of 10 kV/4500 kVA and below		
User power supply terminal	Terminal block for models of 10 kV/5000 kVA to 7000 kVA		





<table>
<tr><th>Type</th><th>Signal Name</th><th>User Wiring</th><th>User Signal Terminal Block</th></tr>
<tr><td>User power supply terminal</td><td colspan="3">Terminal block for models of 10 kV/8000 kVA to 13,750 kVA

</td></tr>
<tr><td>User power supply terminal</td><td colspan="3">Terminal block for models of 6 kV/2800 kVA and below

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

Terminals on the user interface board are named as follows:

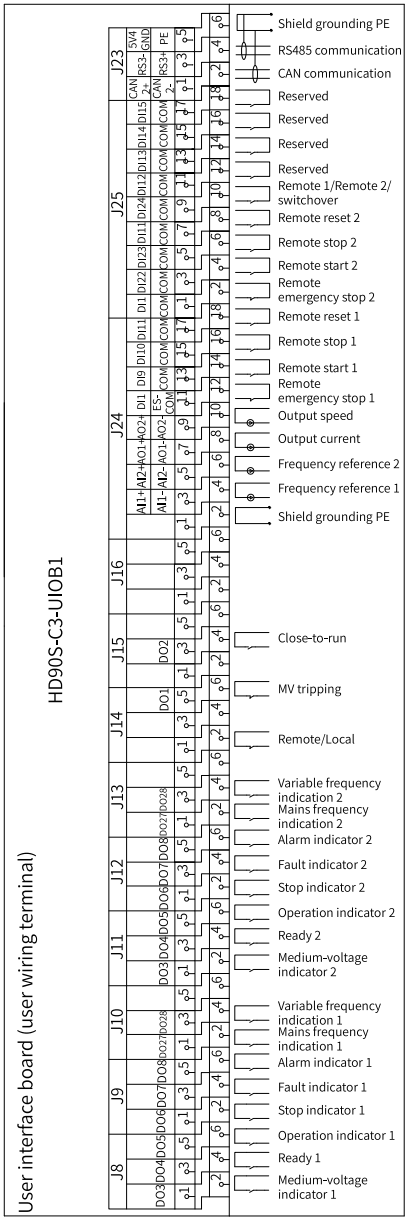


Figure 2-57 User interface board

2.3.8 Peripheral Wiring on the User Side

The peripheral wiring on the user side takes the AC drive with 1000 kVA capacity as an example. For details, see *"Figure 2-59 " on page 107* . The drawing delivered with the drive model prevails.

2.3.9 Typical System Wiring Diagram

For details about the typical system wiring diagram, see *"Figure 2-59 " on page 107* . As shown in the figure, all signals are connected to corresponding terminals. Select the signals for connection according to the actual application.

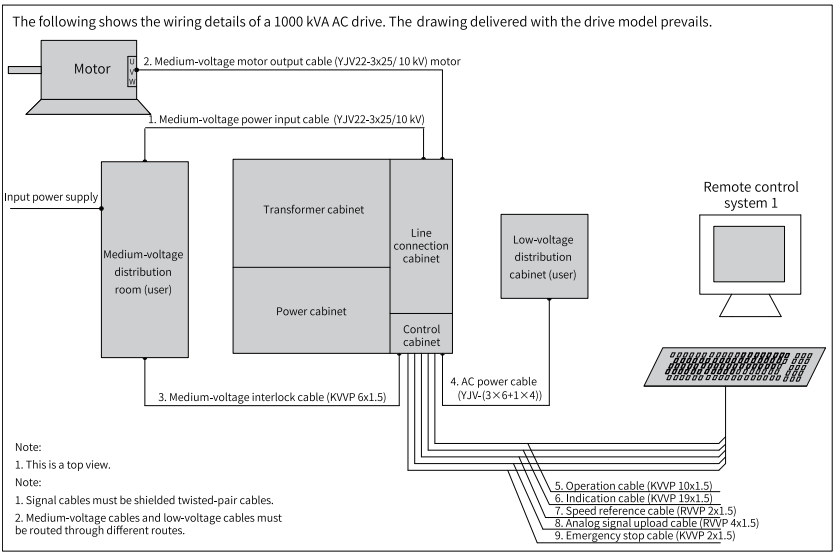


Figure 2-58 Peripheral wiring diagram

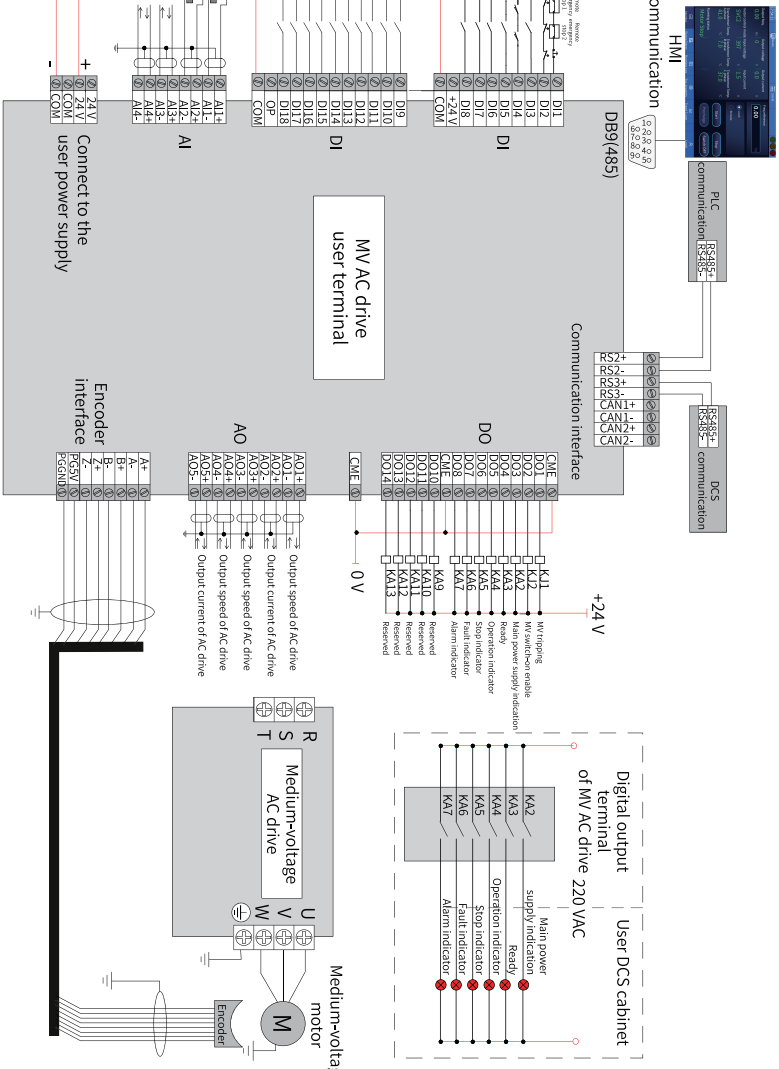

HMI communication
PLC communication
RS485+
RS485-
DCS communication
DB9(485)
Communication interface
RS2+
RS2-
RS3+
RS3-
CAN1+
CAN1-
CAN2+
CAN2-
+24 VDC
Emergency stop
Phase-shifting transformer over-temperature overlimit
Phase-shifting transformer over-temperature fault
Cabinet door travel switch
Cabinet top fan state feedback
Remote/Local
Control power supply normal
Reserved
DI
+24 VDC
Remote start 1 (forward running)
Remote stop 1 (three-wire motion control)
Fault reset
Reserved
Reserved
Reserved
Reserved
Reserved
KM1 (Bypass cabinet 1 inlet contactor/disconnector feedback)
KM2 (Bypass cabinet 1 inlet contactor/disconnector feedback)
KM3 (Bypass cabinet 1 inlet contactor/disconnector feedback)
DI
MV AC drive user terminal
DO
+24 V
0 V
MV tripping
MV switch-on enable
Main power supply indication
Ready
Operation indicator
Stop indicator
Fault indicator
Alarm indicator
Reserved
Reserved
Reserved
Reserved
Reserved
Frequency reference 1
Frequency reference 2
AI
Connect to the user power supply
24 V power supply
AO
Output speed of AC drive
Output current of AC drive
Output speed of AC drive
Output current of AC drive
Output speed of AC drive
Output current of AC drive
Encoder interface
Digital output terminal of MV AC drive 220 VAC
User DCS cabinet
Main power supply indication
Ready
Operation indicator
Stop indicator
Fault indicator
Alarm indicator
Medium-voltage AC drive
Medium-voltage motor
Encoder

Figure 2-59 System wiring diagram

Note

Prepare cables for connection in the preceding figure yourself. For selection of corresponding cables, see the Product Brochure.

3 System Commissioning

3.1 Commissioning Process

All steps for starting the MV AC drive from checking before power-on to MV motor test must be performed by engineers or trained professionals. The function test, performance commissioning, and parameter setting must be performed according to related regulations and the instructions in the manual.

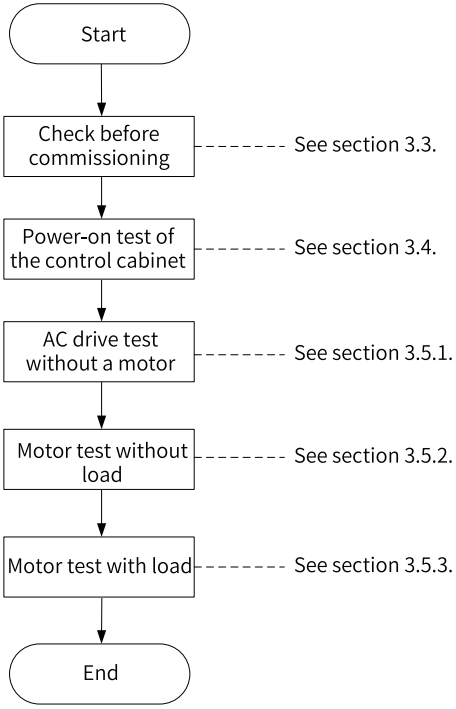


Figure 3-1 System commissioning flowchart

3.2 Commissioning Precautions

During commissioning, at least two electric technicians from the customer must be available for commissioning, who must:

- Be familiar with the MV electric device and related safety specifications.
- Be familiar with the load transmission process.
- Be authorized to operate the MV device (such as power circuit breaker and other MV switches).
- Be authorized to operate the transmission device.

CAUTION

Never cut off the control power after the MV power is energized. Otherwise, the cooling, monitoring, and control systems will stop working, which may cause serious faults or damage to the systems.

Note

- If the device is not installed or checked correctly, the test operations will probably cause severe personal injury or even death.
- Before performing test operations, be sure to cut off the power supply of the AC drive and obey the operation regulations such as using the correct interlock and warning signs.
- Even if the MV circuit breaker and control power switch are turned off, there still may be hazardous voltage in the AC drive cabinet (because of stored energy in the unit).

3.3 Check Before Commissioning

No.	Item	Checked
1	There is no unwanted matter inside the cabinet.	
2	All electric connections are fastened. The cabinet is intact without damage or serious painting-off. Otherwise, check whether the components, cables or other materials around the damaged part are intact.	
3	The conductors of cables at the joints and gaps are not exposed due to friction or improper transportation.	
4	The AC drive cabinet is tied to the workshop ground reliably to ensure personal safety.	
5	The cables of the AC drive connected to the grounding cable of the ground bar are intact and connected securely.	
6	The grounding cable that is separately transported with the cabinet must be connected again.	
7	The cabinet top fan is mounted solidly and can rotate freely without any abnormal friction noise.	
8	The power cable of the cabinet top fan is connected securely.	
9	The connecting wires between the phase-shifting transformer and the power units are connected correctly and securely.	

No.	Item	Checked
10	The optical fibers between the optical fiber board in the main control cabinet and all power units are connected correctly and securely.	
11	All strips of the I/O board are connected correctly and securely. The communication cable between the main control board and the optical fiber board is connected correctly.	
12	It is recommended that the analog signal cable provided by the customer be shielded cable and be deployed separately with the power cable to guarantee electromagnetic compatibility.	
13	All user wiring is correct and secure.	
14	The control power and main power are connected reliably according to related electrical codes.	
15	The power can be switched on only after the wiring of the MV AC drive is correctly connected and all cabinet doors are locked. The cabinet doors cannot be opened after power-on.	



Be sure that all cabinets are grounded reliably and power cables and power lines are connected correctly. Otherwise, it may result in personal injuries or equipment damage.

3.4 Power-On Test of Control Cabinet

Step	Test Item	Checked
1	Check whether wiring of the control power is correct and whether the voltage is within the range.	
2	Turn off the main power switch (QF1) of the control cabinet.	
3	Turn off the power switch for lighting lamps (QF3) and check whether the lighting lamps can be lighted.	
4	Turn off the control power switch (QF4) and check whether the control power supply is normal.	
5	Turn off the fan power switch (referring to the drawing), set auto fan running to inactive, and then enable the cabinet top fan. Check whether the fan is running smoothly in the correct direction.	
6	Check whether the HMI display is normal.	
7	After the HMI display is normal, the system attributes page is displayed. In the pop-up login dialog box, enter the account and password to log in.	

Step	Test Item	Checked
8	After the login is successful, the parameter settings page is displayed. Enter motor parameters and related control parameters correctly.	
9	Verify whether the logics of the MV cabinet interlock, emergency stop button, remote/local switch are correct, effective, and reliable.	
10	Go on with the MV power-on test.	

3.5 Medium-Voltage Power-On Test of Medium-Voltage AC Drive



Before applying MV power to the AC drive, be sure to test whether the MV breaker can be enabled and disabled properly at interlock with the AC drive.

3.5.1 Commissioning Procedure Without Motor



The input terminals R, S, T and output terminals U, V, W of the AC drive are respectively connected to the yellow, green, and red cables onsite to ensure consistent phase sequence.

Step	Test Item
1	Ensure that the system is in power-off state, and connect the input terminals R, S, T of the AC drive to the MV cabinet. Ensure that the output terminals U, V, W of the AC drive are disconnected from the motor and all cabinet doors are closed.
2	Apply the AC control power (by referring to *"3.4 Power-On Test of Control Cabinet" on page 111*). After the AC drive sends the MV switch-on permission signal, notify the operator that the MV power will be applied.
3	Apply the MV power according to the operation regulations. (For the first-time operation, all personnel must be 3 m away from the cabinet.) In the case of any abnormality, press the emergency stop button and notify the operator to switch off the MV power immediately.
4	Verify that MV tripping can be performed reliably at emergency stop.
5	Check whether the input voltage is normal after the MV power is applied.

Step	Test Item
6	Check whether the units and system report any alarm or fault and all states are normal.
7	Verify basic functions such as start, stop, acceleration, and deceleration.
8	Check whether the AC drive can report alarms and faults in time and perform correct actions.
9	After ensuring that all units are normal, verify the dual power switchover function.
10	After ensuring that all is normal, stop the AC drive and switch off the MV power.
11	Go on with the with-load motor test.



The medium-voltage AC drive must not be started or stopped in the same way as the medium-voltage power is applied or switched off.

3.5.2 No-load Motor Test Procedure

Step	Test Item	Checked
1	Ensure that the motor is disconnected from the load.	
2	After the control power and MV power are switched off, connect the motor cables to the output terminals U, V, W of the AC drive securely.	
3	Supply MV power to the AC drive and check that the AC drive passes the self-test.	
4	Ensure that all parameter settings are correct, auto-tune the motor, and set the frequency reference (5 Hz to 10 Hz) after auto-tuning is completed and no fault occurs.	
5	Start the AC drive. Check whether the motor runs properly in the correct direction (if a mains power bypass cabinet is used, check the mains frequency direction is reverse or forward), and check whether the motor is running normally.	
6	Gradually increase the frequency to 50 Hz and then reduce it to 5 Hz, and repeat this process multiple times to check for any motor error.	
7	After ensuring that all is normal, stop the AC drive, switch off the MV power, and go on with the with-load motor test.	

3.5.3 With-Load Motor Test Procedure

Step	Test Item	Checked
1	Connect the motor and the load. After all test items are completed, apply the control power and MV power.	
2	After the AC drive is ready, start it in the condition that the motor load is light. Increase the frequency and observe the AC drive voltage and current rise. Then, increase the load until the production process requirements are met.	
3	If an alarm or a fault is reported during startup or running, stop the AC drive immediately and perform troubleshooting according to the troubleshooting instructions.	
4	During the trial running, monitor the running onsite for 24 hours. Record the operating frequency, transformer temperature, input and output voltage, and input and output current of the AC drive.	
5	After 24-hour trial running is completed, the operators will be trained and the duty is transferred.	

Note

If the AC drive is not started normally, wait until the motor enters the stop state or wait at least 10 minutes and then start the drive again.

4 Operation Instructions

This chapter describes the operation procedure after the MV AC drive is installed and commissioned successfully. Observe the operation procedure strictly.

Note

- Only operators that have been trained and are authorized can operate the AC drive. All operations must be performed according to *" Safety Precautions" on page 9*.
- The MV AC drive may endanger the operators. The operators must be familiar with the following precautions before any operation. Otherwise, personal injury or property damage may occur.

4.1 Precautions Before Operation



- Ensure that the input voltage is within the allowable range.
- If the motor is started in the non-stop state, enable the flying start function.
- The power-on and power-off sequence must be as follows. Apply the control power and then MV power when you start the motor. After the motor stops completely, switch off the MV power and then control power.
- Operators must monitor the running load all the time, stops the system immediately if any abnormality occurs, and perform emergency stop if necessary.
- There is no abnormal electromagnetic interference around the AC drive installation location.
- Operators must have been trained, be familiar with the AC drive structure, and master the operation procedure, safety regulations, and precautions.
- Follow the MV operation regulations during maintenance, such as wearing insulation gloves, insulation shoes, and safety glasses.
- Always work with another person present.
- Install a security fence (marked with MV danger), and never move it away during operation and maintenance.
- Never put combustible materials (including the device drawings and user manual) near the AC drive.
- When processing or measuring AC drive components, prevent signal cables and control cables from shorting together or touching other terminals.
- Never run the AC drive with cabinet doors open, or never open any cabinet door during AC drive running. Failure to comply will result in personal injuries.
- Never remove or repair fans before the MV power is switched off.
- When handling the AC drive, lay it well in the transporting vehicle and ensure that the ground where the AC drive is unloaded to is flat.
- When maintaining or replacing the power unit, open the cabinet door at least 10 minutes after the MV power is switched off and ensure that the indicator of the power unit is OFF. (For details about the waiting time, see the mark on the cabinet door.) This is because there still may be hazardous MV power inside the AC drive a short time after the MV power is switched off.
- After the completion of the AC drive commissioning, its operating parameters have been set and finalized, and non-professionals are not allowed to modify them without authorization. Failure to comply may result in abnormal stop or device fault.

4.2 Buttons and Indicators on the Cabinet Door

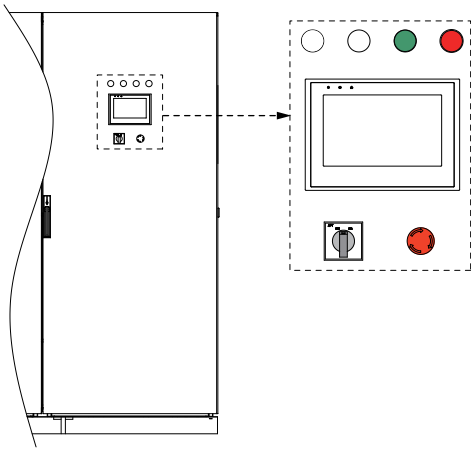


Figure 4-1 Diagram of the control cabinet panel

Table 4–1 Function of components

Symbol	Component	Function
	Emergency stop button	When an emergency fault occurs on the system, press this button to shut off all IGBTs. Then, the AC drive stops output and enables the MV breaker, reducing the loss to the minimum.
	Main power supply indicator	Indicates whether the MV input is normal. If it is normal, this indicator is ON.
	Control power indicator	Indicates whether the 380 VAC control power is normal. If it is normal, this indicator is ON.
	Operation indicator	Indicates whether the drive is in the operating state If yes, this indicator is ON.
	Fault indicator	Indicates whether the drive is in the fault state. If a fault occurs, this indicator is ON.
	Local/ Remote switch	This switch is used for switchover between local control and remote control.

Note

- If the emergency stop button has been pressed, reset the button by rotating it clockwise first, and then you can apply the MV power.
- When the auto bypass cabinet is connected to the mains frequency, the emergency stop button on the control cabinet is invalid. If the MV power needs to be switched off in this case, you can press the emergency stop button on the auto bypass cabinet to switch off the upstream MV power.

4.3 Control Mode Switchover

4.3.1 Local Control

When you turn the Local/Remote switch to "Local", you can directly start and stop the AC drive through the HMI. The target frequency is set via "Frequency reference" on the HMI.

4.3.2 Remote Control

When the Local/Remote switch is set to "Remote", both the frequency source and the command source can be set by parameters. Typically, the command source is digital terminals. The frequency source is AI terminals.

Note

Local/Remote switchover can be performed during operation of the AC drive, but the target frequency may change.

4.4 AC drive operation mode

The medium-voltage AC drive supports multiple running modes such as open-loop running, closed-loop running, decelerating to stop, and coasting to stop.

4.4.1 Open-Loop Running

In standby state, when the "Local/Remote" switch is turned to "Remote", if there is a remote start command, the AC drive starts based on the acceleration time of the system, and then runs at the frequency reference.

In standby state, when the "Local/Remote" switch is turned to "Local", the remote start command is invalid, and you can tap "Start" on the HMI to start the AC drive.

4.4.2 Normal Stop

When the "Local/Remote" switch is turned to "Remote", if there is a remote stop command, the MV AC drive stops according to the set stop mode.

When the "Local/Remote" switch is turned to "Local", the remote stop command is inactive, and you can tap the "Stop" button on the HMI to stop the drive.

4.4.3 Emergency Stop

The emergency stop button on the panel is active all the time. After receiving the emergency stop command, the system immediately stops output and coasts to stop; meanwhile, the MV power is switched off. The MV power switch-on is allowed only after the emergency stop button is reset.

4.5 Alarm and Fault Reset

When an alarm (such as transformer overtemperature) occurs on the system, the alarm is cleared automatically after the system is back to normal. When a fault occurs on the system, you can tap "Reset" to reset the fault.

4.6 AC Drive Operation Instructions

This device is directly connected to the medium-voltage power grid. Take the following safety precautions during operation:

- Wear insulated safety shoes before entering the MV system room to perform operations.
- Insulation mats must be laid around the device.
- Always work with another person present.

Note

- After the MV power is switched off, do not open the cabinet doors and perform maintenance immediately. This is because there still may be residual voltage on the DC bus of the power unit a short time after the MV power is switched off, which may cause electric shock. For the specific wait period, see the safety label on the cabinet.
- This device can only use power systems of voltage class specified in the technical protocol.

4.6.1 Power-On

Check the following items before initial power-on or after maintenance/inspection.

No.	Item	Checked
1	Confirm that screws of MV input and output terminals are in place.	
2	Confirm that cables for cabinets that are separately transported are connected properly and securely.	
3	Confirm that all control cables and signal cables are connected properly and securely.	
4	Confirm that the system grounding cables that are separately transported are connected to the workshop ground properly.	
5	Confirm that cables for connecting units in series and neutral point cables are connected properly and securely.	

Routine inspection before power-on:

No.	Item	Checked
1	Confirm that all PE cables are removed before power-on.	
2	Check whether the filter screen needs to be replaced.	
3	Check whether the faults of the drive have been handled properly.	
4	Close and lock the cabinet door.	

Procedure for powering on the drive:

No.	Steps	Checked
1	Power on the control cabinet.	
2	Check that all parameters related to the transmission system are set correctly. These parameters include those related to the frequency setting, operation control mode, and operation curves.	
3	Close all cabinet doors (excluding the control cabinet door, which can be left open).	
4	Switch on the upstream MV switch only after the MV switch-on allowed signal from the AC drive is activated.	
5	After the MV switch is turned on, check that the system state displayed on the HMI is "ready". Then, start the AC drive.	

Note

- Carefully confirm the correct setting of parameters that have special effect on startup to ensure safe and normal startup.
- If a cabinet door is not closed properly, the system will report a fault and does not output the switch-on permission signal.

4.6.2 Start

No.	Steps	Checked
1	Power on the system according to the power-on requirements.	
2	Check whether the system state displayed on the HMI is ready and whether the fault indicator on the control cabinet is OFF. If an alarm or a fault occurs, perform troubleshooting according to the alarm/fault information displayed on the HMI and rectify the fault according to *" Troubleshooting" on page 208*.	
3	Set the target frequency based on the specified frequency reference source.	
4	Send the start signal based on the set control mode.	

4.6.3 Stop

Perform the stop operation based on the set stop mode.

Note

When "Decelerate to stop" is selected, if the start signal is sent again before the output frequency is reduced to the stop frequency, the AC drive accelerates again to the set target frequency.

4.6.4 Coast to Stop

In this stop mode, the AC drive stops voltage output and the motor coasts to stop by decelerating gradually due to the load and friction.

Note

- Estimate whether the process allows the motor to coast to stop.
- When the motor coasts to stop, there is still residual voltage on the output cables due to remanence of the motor.

4.6.5 Power-Off

Except that the MV power is switched off directly in the case of critical faults, switch off the MV power only after the AC drive stops.

Step	Action	Checked
1	Notify all workers to prepare for power-off.	
2	Tap the stop button to stop the device.	
3	Disconnect the incoming cabinet breaker on the user side.	

Note

The DC voltage reduces to the safety value at least 10 minutes after the MV power is switched off (for details about the waiting time, see the mark on the cabinet door).

4.6.6 Troubleshooting

No.	Step	Checked
1	If the main control system is abnormal, press the emergency stop button on the control cabinet to switch off the MV power immediately.	
2	The fault levels are graded into minor (alarm), major, and critical. When an alarm occurs, the AC drive continues to run. When a major fault occurs, the AC drive determines whether to continue to run, decelerate to stop, or stop immediately based on the related setting. When a critical fault occurs, the AC drive immediately coasts to stop and disconnects the MV power input.	
3	Stop the AC drive.	
4	Power off the AC drive.	
5	Rectify the fault 10 minutes after power-off according to *" Troubleshooting" on page 208*.	



If the emergency stop button has been pressed, you need to knob the button clockwise to reset it after the fault is rectified.

4.6.7 Inspection

Note

After the MV power is switched off, wait at least 10 minutes and then you can open the cabinet doors and perform maintenance. This is because there still may be residual voltage on the DC bus of the power unit a short time after the MV power is switched off, which may cause electric shock.

- Inspection procedure of the drive

No.	Item	Checked
1	Power off the drive.	
2	Keep the emergency stop button held down and ensure that the upstream MV switch cabinet has a clear opening point and the grounding switch is grounded and hanged with a warning notice.	
3	Open the transformer cabinet door and connect the grounding cable on the input side of the transformer reliably.	
4	Inspect the transformer cabinet and power cabinet.	
5	After inspection is done, remove the safety grounding cables on input and output sides of the transformer.	
6	Resume the emergency stop button.	

- Precautions for system inspection

No.	Item	Checked
1	Before line inspection, turn off the circuit breaker, turn off the disconnector, and label a warning notice to prevent sudden power-on by others.	
2	Ensure that the AC drive is in the stop state and the MV charge indicator is OFF.	
3	After medium voltage and low voltage are cut off, perform electrical inspection before operation. For medium voltage inspection, use an electroscope of the corresponding voltage class and wear insulated safety articles.	
4	After verifying that the drive is de-energized, ground the three-phase inlet cables of the AC drive to ensure personal safety.	
5	Ground all parts of the drive which are liable to become energized. When inspecting a bus disconnector, an isolation switch, or a load switch in double-circuit systems, disconnect both bus disconnectors and ground the construction disconnector at both ends.	

No.	Item	Checked
6	When installing a grounding cable, make one end of the grounding cable grounded first, and then attach the other end. When removing a grounding cable, do vice versa. For either installation or removal, wear insulated safety articles.	
7	Attach the grounding cable in the place where electrical engineer can see it at any time and label a "Working" warning notice there.	

- Static electricity prevention
  PCB boards and some components inside the power unit are sensitive to static electricity. Eliminate the static electricity before touching or servicing these PCB boards and components, failure to comply can result in damage to the electronic components and cause equipment failure.

  These components can only be touched or serviced by professional technicians only. The following rules apply to elimination of static electricity:

  - Wear an ESD wrist strap.
  - Transport electrostatic sensitive devices in antistatic bags.
  - When handling a PCB, hold the board by its edges.
  - Never slide PCBs across any surface.
  - When returning any component to us for repairing, deliver it in antistatic bags.

5 Panel Operations

The HMI allows you to drive functions and view information. The HMI is a standard configuration. See the following diagram for function divisions.

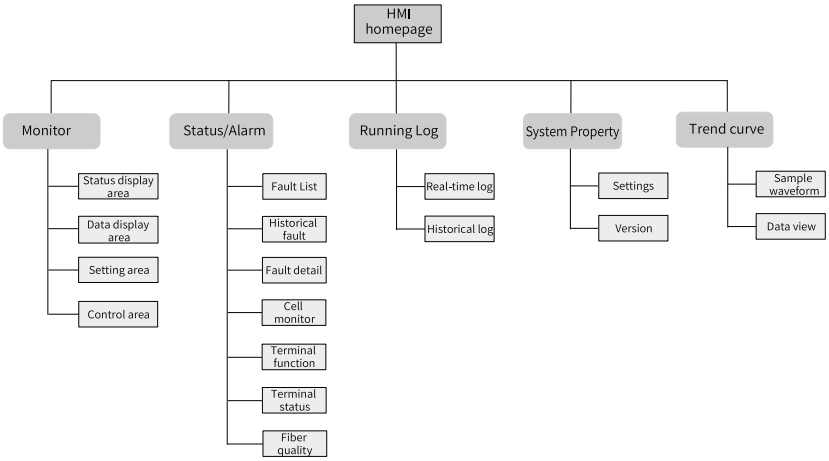


Figure 5-1 Block diagram of HMI functions

You can switch among the six functions by tapping the tabs. Once the operator selects a function, the background color of the corresponding button changes to dark blue. The current page is "Monitor", as shown in the following figure. The first page after power-on is the monitoring page.

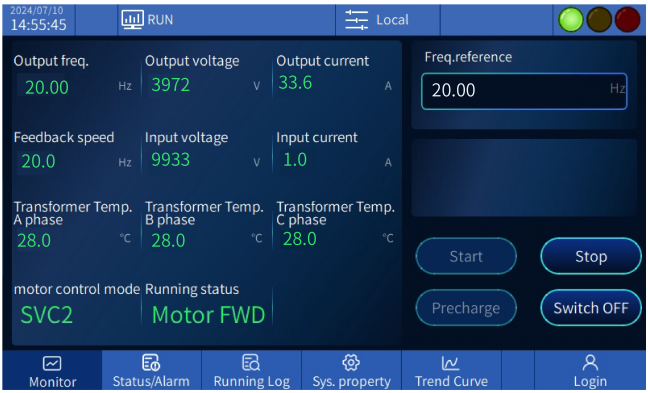


Figure 5-2 System main page - Monitor page

5.1 Monitor Page

The monitoring page is divided into four areas: status display, data display, and reference area, and control area.



Figure 5-3 Monitor page

See the following table for function descriptions:

Table 5–1 Functions of monitoring page area

No.	Area Name	Description
①	Status display area	Displays the local time, fault/alarm, system status, control mode, user permission and indicators.
②	Data display area	Displays common system parameters such as system output frequency, input/output voltage and current, motor control mode, and operating status.

No.	Area Name	Description
③	Reference area[1]	Sets the target frequency. "Frequency reference" is used to calculate the target frequency operation when the HMI is the frequency source. When the frequency source of the AC drive is not set by the HMI, the value in the frequency setting area is displayed as the frequency set by the current command source and cannot be modified by the HMI.
④	Control area	In the local control mode, the control zone can start/stop the MV drive. When the AC drive command source is remote or the AC drive is in the device dehumidification state, the start/stop button is disabled, not responding to user actions. • "Start": When the system is in the "Ready" state and the frequency reference is set, press the start button and confirm the operation. The AC drive will run according to the set mode. The HMI supports modification of the frequency reference online during AC drive running. The last frequency reference is regarded as the target running frequency. • "Stop": Click the stop button and confirm the operation. The AC drive will stop according to the set mode. • "Pre-charge": For models configured with the pre-charge function, you can press the "Pre-charge" button to apply medium voltage on the AC drive. After pre-charging is done, the button is disabled and does not respond to user actions. • "Switch-off": Click the switch-off button during pre-charging to stop pre-charging. After power-on is done, click the switch-off button to disconnect the medium voltage of the AC drive.

Note

[1]: This area supports customization of three user-defined parameters according to customer requirements. These parameters must be logged in to the user level.

When a fault or alarm occurs on the system, a fault or alarm information dialog box appears automatically and the backlight turns on. "System status" on the page becomes "System fault" or "System alarm", and the corresponding status indicator turns on. The floating window for faults is shown below.

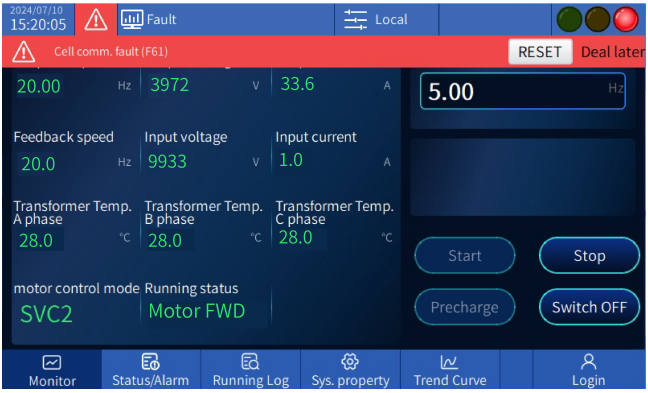


Figure 5-4 Floating window for fault

5.2 Status Alarms

5.2.1 Fault List

When the "Status/Alarm" function is enabled, the "Fault List" page is displayed by default. This page displays the fault records of the medium-voltage AC drive since the current power-on. The maximum number of faults supported is 300. The events in red indicate the faults to be handled. The events in black indicate the faults that have been rectified.

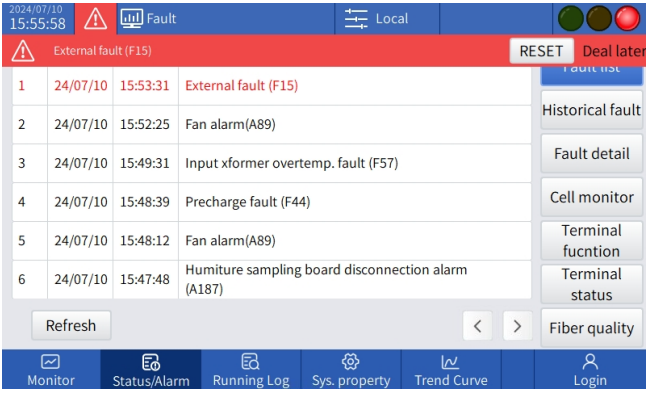


Figure 5-5 Fault list page

5.2.2 Fault Log

The historical fault information can be viewed through the "Historical fault" function. In the following figure, you can open the "Historical fault" page, select the start and end

date, and tap the "Find" button to view the alarm/fault within the selected date. Up to 300 records are available.

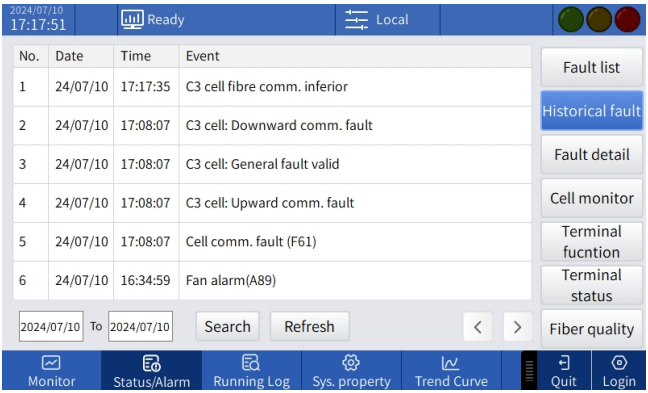


Figure 5-6 Fault log page

Tap the  button to page through the HMI. The HMI supports the cyclic storage of fault records for the last 90 days.

5.2.3 Fault Details

The "Fault detail" page displays the details of the latest fault, including fault codes, fault subcodes, and fault levels, as shown in the following figure.

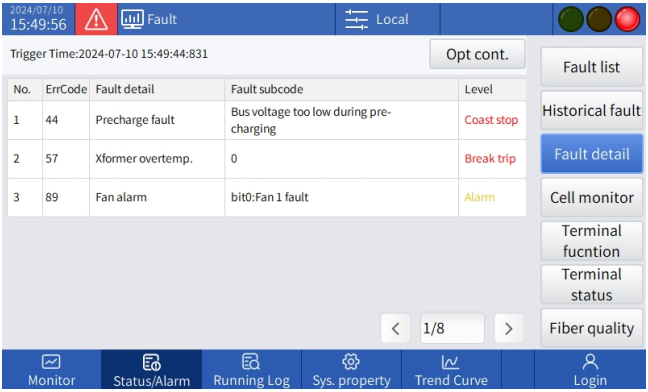


Figure 5-7 Fault detail page

Tap  to page through the latest 10 faults. Input is not supported in the text box in the lower right corner.

5.2.4 Unit Monitoring

The unit monitoring function is used to display the real-time state of all the units.



Figure 5-8 Unit monitoring page

- 

: The unit label is displayed in blue, indicating that the unit is normal.
- 

: The unit label is displayed in gray, indicating that the unit is in the bypass state.
- 

: The unit label is displayed in red, indicating that the unit is in the fault/alarm state.

Click the unit module to view the fault details, bus voltage, and temperature of the unit.

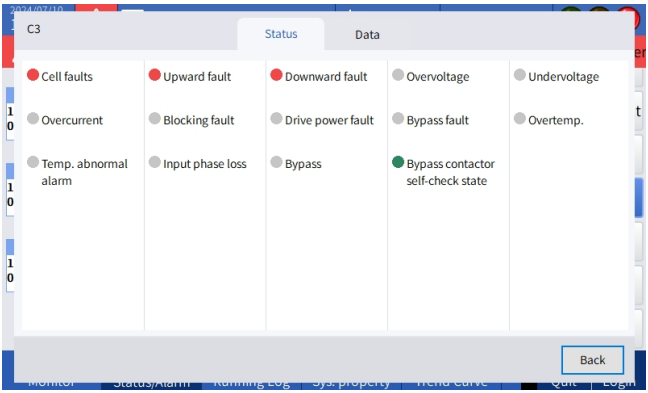


Figure 5-9 Viewing the unit state

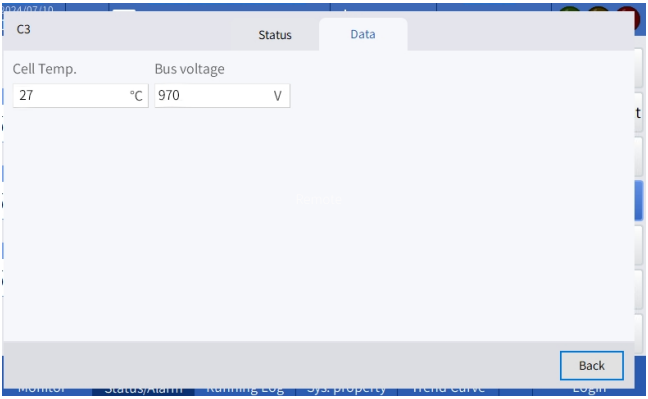


Figure 5-10 Viewing the unit data

5.2.5 Terminal Functions

The drive provides abundant DI/DO functions. "Terminal function" shows the status of all DI/DO functions of the system and the terminal matching relationship. When the function of a DI/DO terminal is active, the corresponding function name is displayed in green. When it is inactive, the corresponding function name is displayed in gray.

Only one DI physical terminal can be configured for a DI function. For DI/DO terminals assigned with functions, the corresponding terminal number is displayed after the function name. For DI/DO terminals not assigned with any function, the terminal number is not displayed after the function name.

As shown in the following figure, DI9 terminal is assigned with the forward running function, which is inactive currently. DI10 terminal is assigned with the three-wire motion control function, which is active currently. The reverse running function is not assigned to any terminal, so this function is inactive currently.

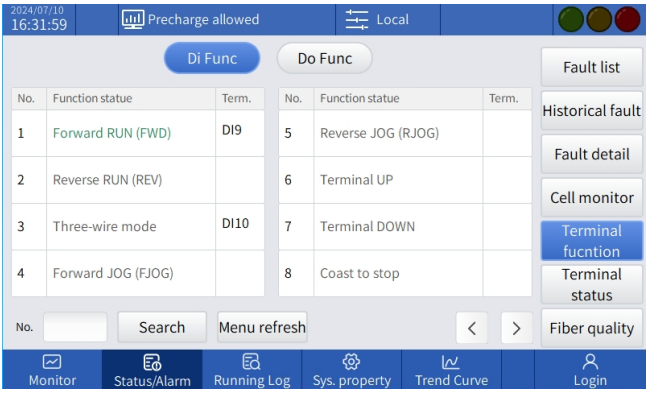


Figure 5-11 DI function page

Different DO terminals can be assigned with the same function. When a function is assigned to three or more DO terminals, the terminal number is displayed as "More" for this function. In this case, tap "More" to expand all the terminals assigned with this function. The DO function can be assigned to multiple physical DO terminals.

As shown in the following figure, DO5 and DO9 are configured as "AC drive running" and the current function is active. DO7 and other DO terminals are configured as "fault output", and the current function is inactive. Click "More" to view all terminal numbers assigned with the "Fault output" function. The "Frequency level detection FDT1 output" function is not assigned to any DO terminal and the current function is inactive.

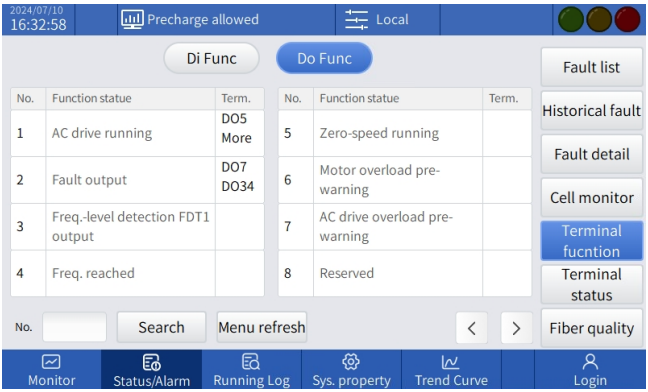


Figure 5-12 DO function page

5.2.6 Terminal Status

The drive provides abundant DI, DO, AI, and AO terminals. The terminal status function serves to update the digital/analog values, temperature, and communication interface status in real time, helping the commissioning staff to monitor current signals of the terminal. The DI/DO indicator is blue when the DI/DO terminal is active or gray when inactive.

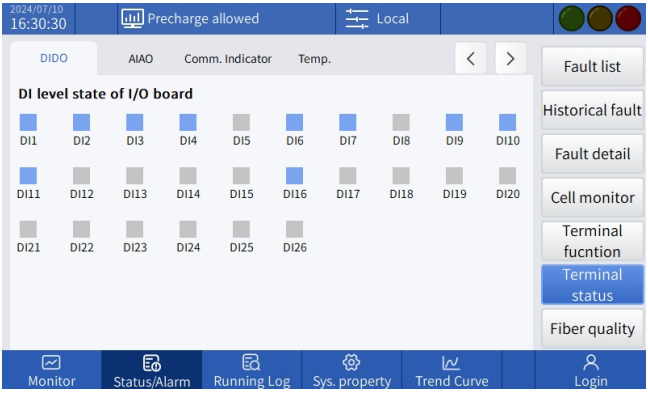


Figure 5-13 DI/DO terminal state

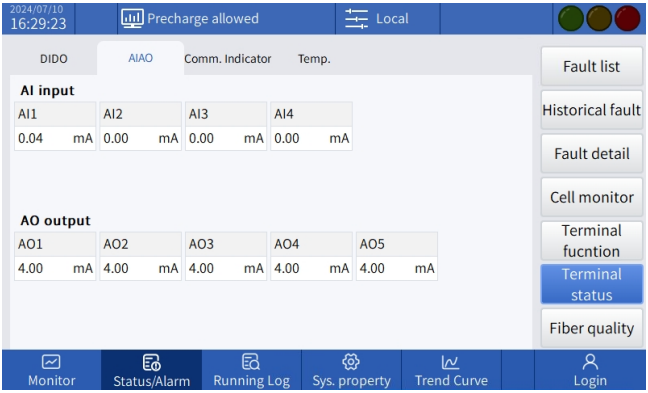


Figure 5-14 AI/AO terminal state

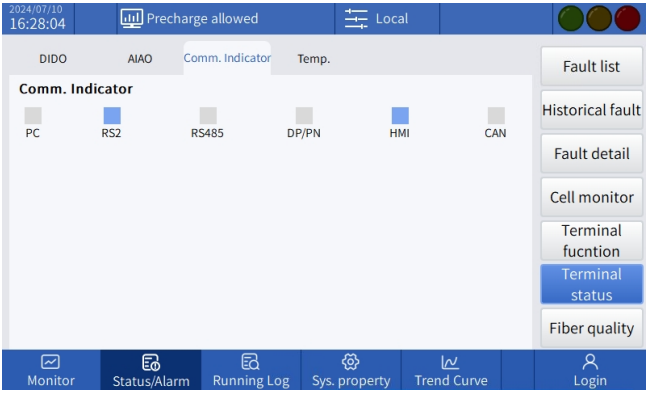


Figure 5-15 Communication indicator status

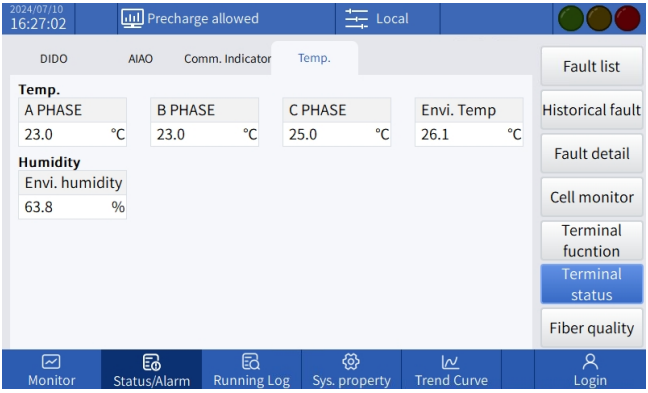


Figure 5-16 Temperature status

5.2.7 Quality of the Optical Fiber

The "Fiber quality" page displays the cumulative optical fiber error values of each unit after power-on, helping you determine whether the optical fiber needs to be replaced. This value is for reference only and will not result in any fault or alarm.

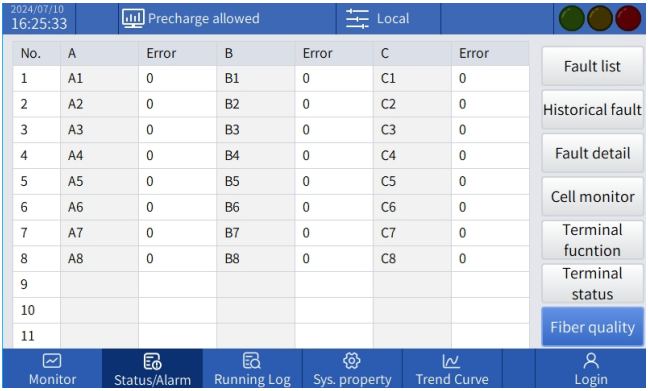


Figure 5-17 Fiber quality page

5.3 Running Log

The "Running log" function records system events and their occurrence time, including commands, important states, faults, and alarm. Open the "Running log" function. By default, the "Instant Log" page is displayed. This list displays the fault records of the drive since the current power-on. Up to 300 faults can be recorded.

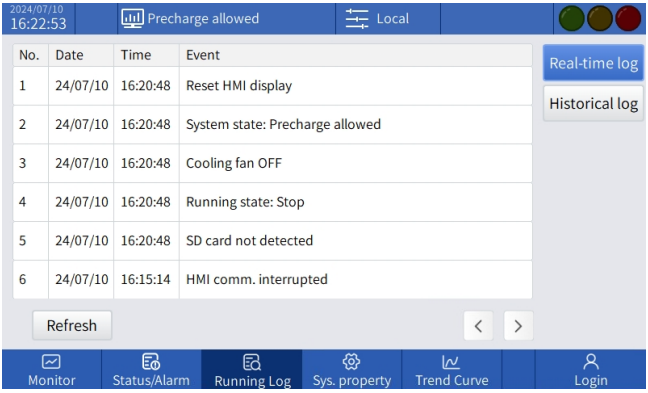


Figure 5-18 Instant log page

History events can be viewed on the "Historical log"page.

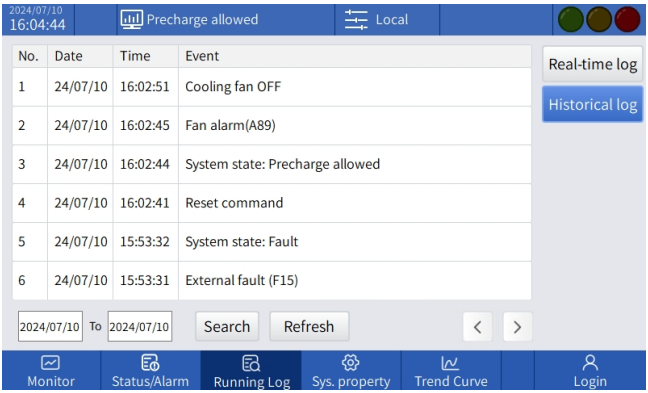


Figure 5-19 Historical log page

In the preceding figure, you can open the "Historical log" page, select the start and end dates, and tap the "Find" button to view the logs within the selected dates. Up to 300 records are available. Tap the < > button to page through the HMI. The HMI supports the cyclic storage of logs for the last 90 days.

5.4 System Properties

System properties can be used to switch the system language, buzzer switch, and view the version number, including the following two sub-functions.

Basic setting

- System language: Supports online language switchover (Simplified Chinese or English).

- Buzzer switch: Used to switch on/off the button buzzer.

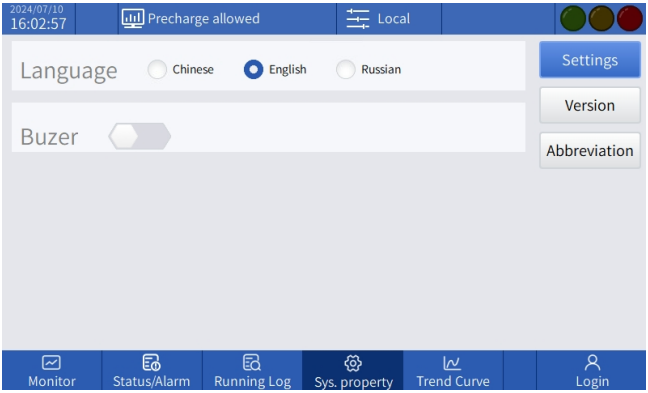


Figure 5-20 Basic setting page

Version

Used to view the current main control board, unit, and option version.

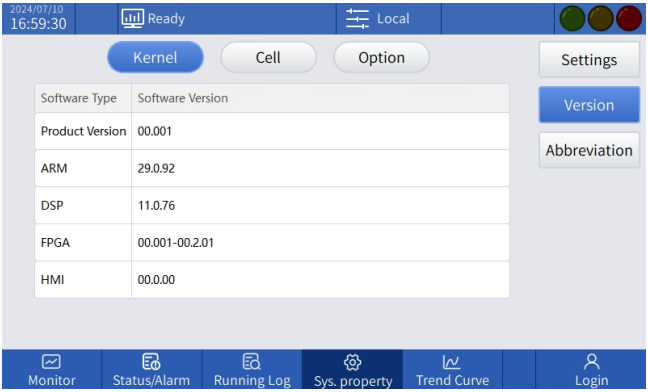


Figure 5-21 Main control board version page

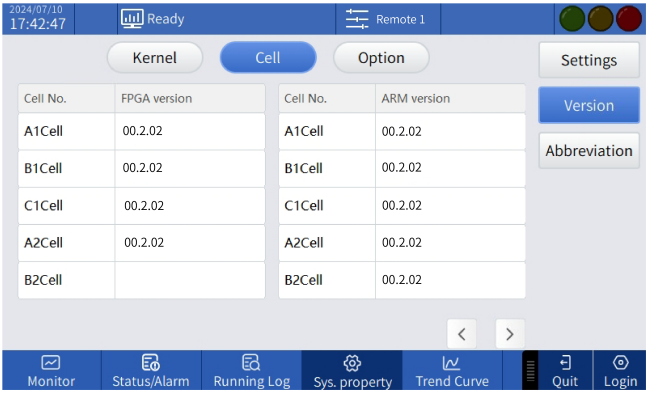


Figure 5-22 Unit version page

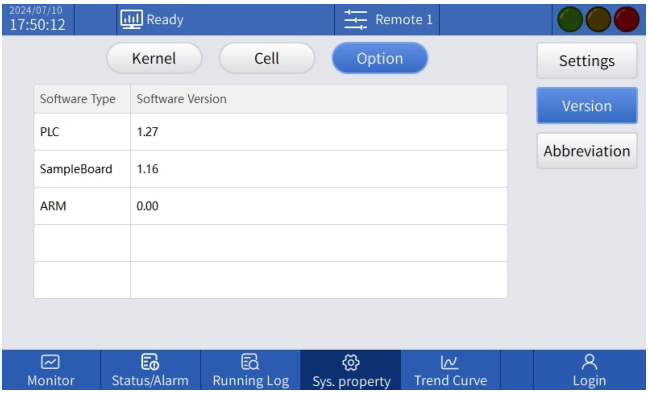


Figure 5-23 Option version page

5.5 Trend Curves

The trend curve function is used to dynamically view the process of system state change. It supports two data viewing modes: curve and table. This function helps check whether the system operates stably.

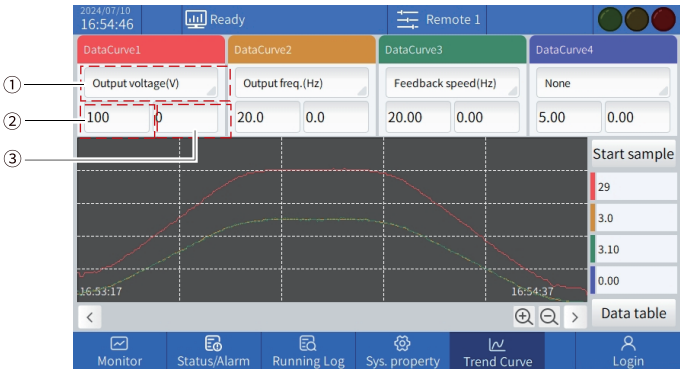


Figure 5-24 Trend curve page

There are four sync signal channels in the trend curve function, with a sampling cycle of 200 ms. The active sampling records of the latest 90 days can be saved and exported through SD card.

- Click on area ① to open the channel selection page and select the sampling object of the channel.
- Click area ② to set the upper limit of the vertical axis of the channel.
- Click area ③ to set the lower limit of the vertical axis of the channel.

The time axis supports scaling. The default value is 4 seconds per unit. The minimum value is 2 seconds per unit, and the maximum value is 32 seconds per unit. The accuracy and curve color of each channel are shown in the following table.

Channel Number	Precision	Curve Color
Channel 1	1	Red
Channel 2	0.1	Orange
Channel 3	0.01	Green
Channel 4	0.01	Purple

To view the data in the trend curve function, do as follows:

1. Select the channel signals to be viewed and set its upper limit and lower limit.
2. Tap "Start sample". The HMI immediately samples the corresponding signals and draws the waveform in real time.
3. Tap "Stop sample" to stop sampling of the corresponding signal. In the sampling stop state, you can view the sampling value of a moment on the right of the trend chart.

In the sampling stop state, you can tap "Data table" to view the sampling data of the latest 10 minutes in a table. You can also tap < or > to view the data on the previous or next page, as shown in the following figure.

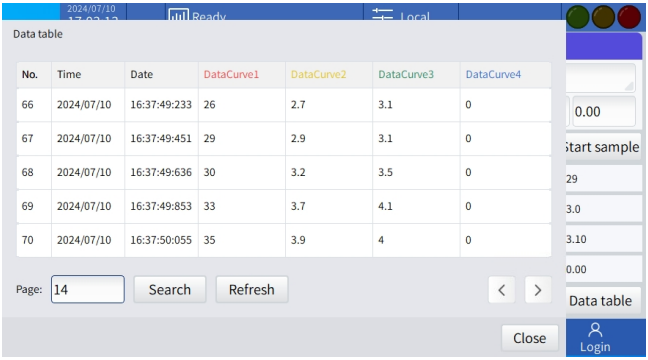


Figure 5-25 Viewing the data in table format

5.6 Login

The system account has four levels: User, agent, after-sales and R&D.

After the control cabinet is powered on, the HMI sets no account level by default. In this case, you can view information, start/stop the system, and set frequency references. With user account, you can manage customer-defined function parameters. With after-sales account, you can manage most of function parameters. With R&D account, you can manage all function parameters.

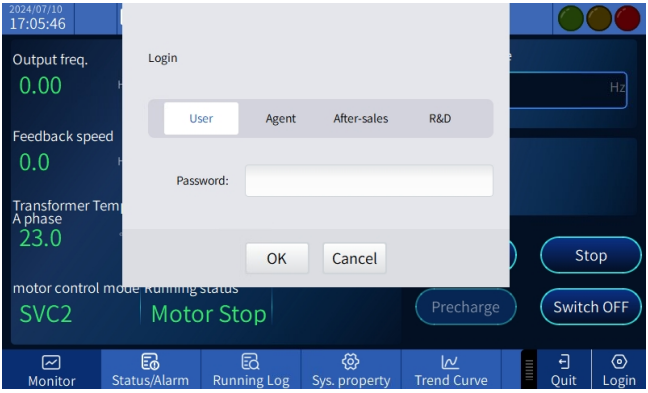


Figure 5-26 Login page

5.7 Precautions for HMI Operation

- All the operators must observe the operation instructions strictly.
- Power on the control power first. Power on the MV power only after MV switch-on is allowed.
- When using the HMI, tap it slightly with finger. Never knock it or strike it violently.

- Never allow irrelevant personnel to use the HMI so as to avoid mal-function.
- The SD card records important system parameters. Only the user of after-sales level or higher are allowed to insert and plug the SD card.
- Never open cabinet doors when the drive is running. Failure to comply can result in a danger or system stop due to a fault.

6 Drive Configuration

6.1 Drive Start/Stop Control

6.1.1 Start/Stop Signal Source

There are three start/stop command sources, namely, local, remote 1 and remote 2. The command source is selected through the Local/Remote switch on the control cabinet and the user's remote 1/remote 2 switch.

- **Local command source: HMI**
  The HMI exchanges data with the control system of the drive through communication. Turn the "Local/Remote" switch to "Local". Then you can control start/stop of the drive through the HMI.

- **Remote 1/Remote 2 command source: terminal control**
  This control mode is applicable to cases where the DIP switch or electromagnetic switch button is used to start or stop the application system or where the dry contact signal is used to start or stop the drive.

The drive provides multiple terminal control modes. The switch signal mode is set in F4-73. The input terminal of the start/stop signal is set in F4-08 to F4-17. For details, see the description of F4-73 and F4-08 to F4-17.

Example 1: To use the DIP switch as the start/stop switch, connect the forward run switch signal to DI9 and the reverse run switch signal to DI10, as shown below.

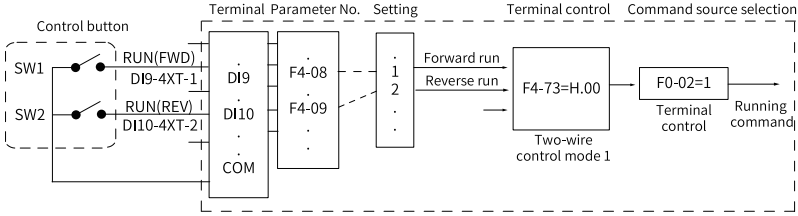


Figure 6-1 Terminal start and stop control method 1

In the preceding figure, when SW1 is ON, forward operation applies. When SW1 is OFF, the drive stops. When SW2 is ON, reverse operation applies. When SW2 is OFF, the drive stops. If SW1 and SW2 are ON or OFF simultaneously, the drive stops.

Note

The system prohibits reverse running by default. If reverse running is required in some applications, set F8-13 to 0.

Example 2: To use the electromagnetic switch button as the start/stop source, and assign the start signal to DI9, stop signal to DI10 and reverse rotation signal to DI11, perform the setting as shown in the following figure.

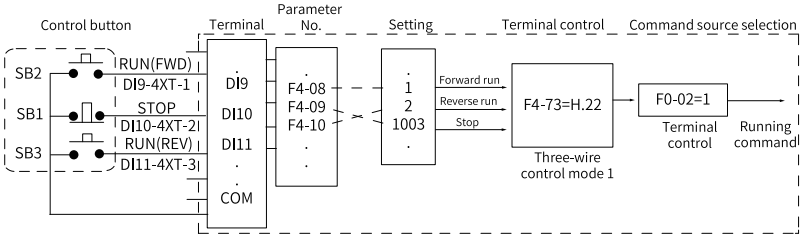


Figure 6-2 Terminal start and stop control method 2

In the preceding figure, once SB1 becomes OFF during normal operation, the drive stops immediately. When the SB1 is in the OFF state, the signals from SB2 and SB3 are activated once they become ON.

6.1.2 Start Mode

The AC drive supports four start modes, which are direct start, forward flying start, reverse flying start, and forward/reverse flying start, as defined by F6-00.

F6-00 = 0: Direct start (The following figure shows the frequency curve during direct start.)

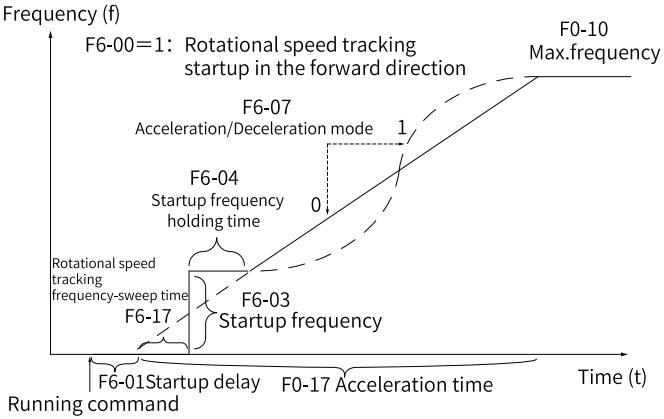


Figure 6-3 Direct start

F6-00 = 1/2/3: Flying start (The following shows the frequency curve during flying start)

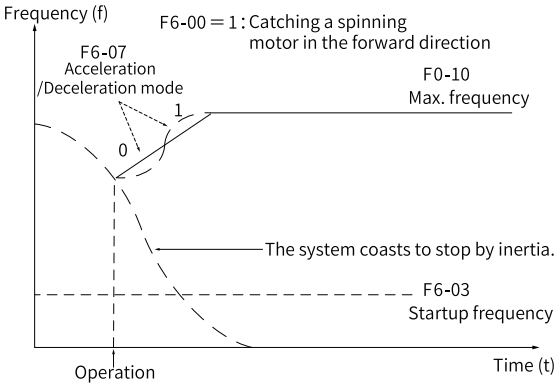


Figure 6-4 Flying start

6.1.3 Stop Mode

The AC drive supports two stop modes, decelerate-to-stop or coast-to-stop, as defined by F6-10.

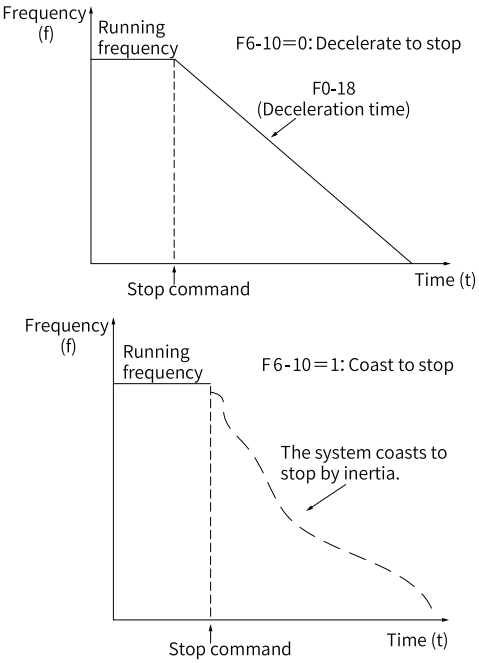


Figure 6-5 Curve for the stop mode

6.2 Operating Frequency Control

The drive provides 15 frequency reference sources.

6.2.1 Setting the Frequency Reference Source

There are 15 frequency sources, which are digital setting (UP/DOWN non-retentive), digital setting (UP/DOWN retentive), AI1, AI2, AI3, AI4, multi-reference, simple PLC, PID, PC setting, Modbus setting, PROFIBUS/PROFINET setting, HMI setting, and CAN setting. The frequency source can be defined by F0-03.

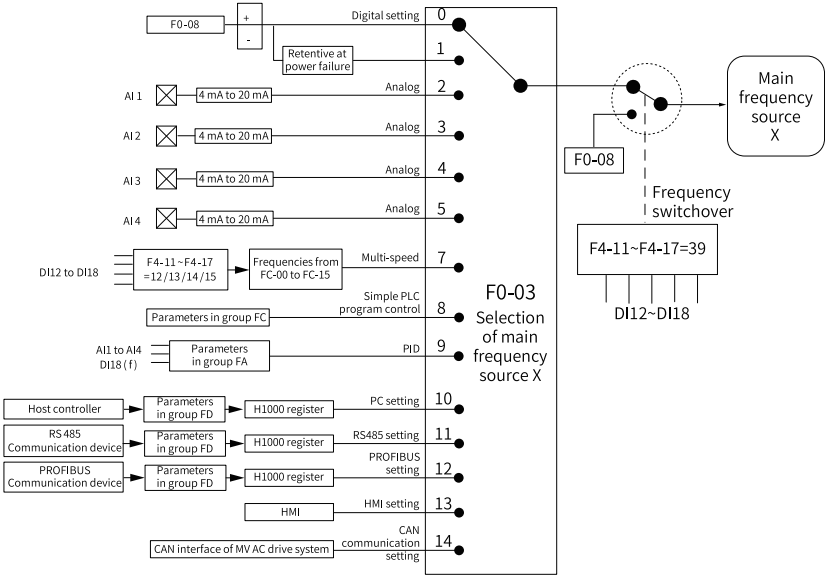


Figure 6-6 Frequency reference source selection

According to the preceding figure, the running frequency of the AC drive can be set by means of parameters, manual adjustment, analog input, multi-speed terminal, external feedback signal, internal PID regulator, or various communication modes.

The preceding figure shows parameters set by each frequency source. See parameter descriptions during setting.

6.2.2 Binding the Command Source to the Frequency Source

The remote command source 1 of the AC drive can be bound to its frequency source by setting F0-02 and F0-27. For example, if F0-27 is set to H0020 and F0-02 is set to 1, it indicates when the Local/Remote switch is set to "Remote", terminal control 1 applies and the frequency is defined by AI1. The setting of remote command source 2 is similar to the setting of remote command source 1.

6.2.3 Closed-Loop Frequency Control for Process Control

The MV AC drive has a built-in PID regulator. Together with the frequency sources, the PID regulator can implement automatic adjustment of process control, such as constant temperature, constant voltage, and tension control.

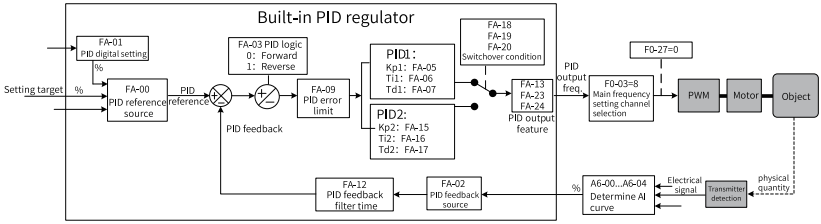


Figure 6-7 Frequency closed-loop selection for process control

When PID frequency closed-loop control is implemented, F0-03 must be set to 9 (PID). The PID-related parameters are set in group FA, as shown in the preceding figure.

6.2.4 Motor Rotating Direction

When the drive is ready, tap the start key on the HMI, and the drive drives the motor to run in the forward direction. If in this case, the direction of rotation is opposite to the direction required, disconnect the drive from the main power, exchange the wiring phases of any two of U/V/W cables. (Note: Wait for at least 10 minutes after power-off until the drive is discharged.)

6.3 Instructions for Use of DI Terminals

The control system provides 26 DI terminals numbered DI1 to DI26. The logic upon active DI signal is defined by the value selected for the terminal function. If the thousands of a DI terminal is set to 1, the terminal logic is 1 upon inactive DI signal. If the thousands of a DI terminal is set to 0, the terminal logic is 0 upon inactive DI signal.

For example, if the thousands of the setpoint is set to 1, the DI signal is active upon NO (normally open). If the setpoint is 1001, the drive drives the motor to run forwardly when the external terminal is inactive. If the setpoint is 1, the drive drives the motor to run forwardly when the external terminal is active.

You can set F4-66 (DI filter time) to improve the anti-interference level of the DI signal, but this will reduce the responsiveness of DI terminals.

Functions of preceding 26 DI terminals can be defined by F4-00 to F4-25. Assign DI functions based on the electrical drawings. For details, see descriptions for parameters.

6.4 Instructions for Use of DO Terminals

The control board carries 34 transistor-type DO terminals (DO1 to DO34).

You can define the functions of the DO terminals by setting F5-01 to F5-34. The DO terminals are used to output various working states of the AC drive and related signals of control requirements, helping you implement specific automation control.

Parameter	Output Specification
DO1 to DO34	Transistor driving capacity: 24 VDC, 50 mA

6.5 Instructions for Use of AI Terminals

The drive supports a total of four AI terminals, in which AI1 and AI2 are internally isolated.

Port	Input Signal Specification
AI1+ and AI1-	Receiving 4 mA to 20 mA current signals
AI2+ and AI2-	Receiving 4 mA to 20 mA current signals
AI3+ and AI3-	Receiving 4 mA to 20 mA current signals
AI4+ and AI4-	Receiving 4 mA to 20 mA current signals

As external voltage/current signal, AI is used for frequency source setting, torque setting, and PID setting or feedback.

The sampling value of the AI terminal can be read on the HMI. The AI3 terminal also supports voltage input.

6.6 Instructions for Use of AO Terminals

The drive supports a total of five AO terminals with output impedance of 0 Ω to 300 Ω, in which AO1 and AO2 are internally isolated.

Port	Output signal characteristics
AO1+ and AO1-	Output current signals of 4 mA to 20 mA
AO2+ and AO2-	Output current signals of 4 mA to 20 mA
AO3+ and AO3-	Output current signals of 4 mA to 20 mA
AO4+ and AO4-	Output current signals of 4 mA to 20 mA
AO5+ and AO5-	Output current signals of 4 mA to 20 mA

AO1 to AO5 can be used to indicate internal operating parameters, and the indicated parameter properties can be selected by parameters A6-52 to A6-56, where AO4 and AO5 ports also support voltage output.

The designated operating parameters can be corrected before output. The rectification feature is Y = kX + b, among which "X" indicates the operating parameters to be output.

- The k and b of AO1 are set by A6-62 and A6-61.
- The k and b of AO2 are set by A6-64 and A6-63.

- The k and b of AO3 are set by A6-66 and A6-65.
- The k and b of AO4 are set by A6-68 and A6-67.
- The k and b of AO5 are set by A6-69 and A6-70.

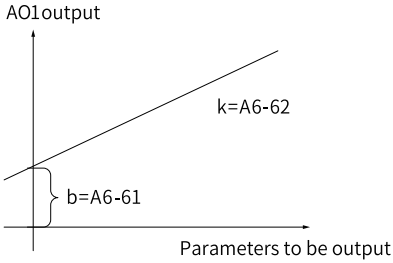


Figure 6-8 Correction characteristic curve of AO terminals

7 Parameter Description

7.1 Group F0: Basic Function Parameters

Parameter	Name	Value Range	Default
F0-01	Motor 1 control mode	0 to 2	2

Value Range	Meaning	Description
0	Sensorless vector control (SVC 1)	The SVC mode is a type of open-loop vector control applicable to high-performance control applications in which one AC drive can drive only one motor.
1	Feedback vector control (FVC)	In FVC mode, the motor must have an encoder, and the AC drive must have a PG card of the same type as the encoder. This control mode is applicable to scenarios requiring high precision speed or torque control. One AC drive can drive only one motor.
2	Voltage-type sensorless vector control (SVC2)	It also indicates open-loop vector control, and is applicable to applications without strict load requirements. Compared with SVC1, this control mode has lower control accuracy, and is less dependent on motor parameters. One AC drive can drive multiple motors.

Note

The three control modes supported by the MV AC drive are all vector control, and motor auto-tuning is required for the three control modes. The vector control mode can be best used only when the motor parameters are properly set. Better performance can be achieved by adjusting speed regulator parameters in group F2.

Parameter	Name	Value Range	Default
F0-02	Remote 1 command source selection	0 to 3	1

It is used to determine the input channel of the AC drive remote 1 control commands. The AC drive control commands include start, stop, forward run, reverse run, jog, variable-to-power frequency switchover (up transfer), power-to-variable frequency switchover (down transfer).

Value Range	Meaning	Description
0	Operating panel	Operation commands are given by pressing keys RUN and STOP/RES on the operating panel.
1	Terminal control 1	Commands are sent by multi-functional input terminals with functions such as FWD, REV, JOGF, JOGR, pre-charge, pre-charge switch-off, variable frequency to mains frequency (switch up), and mains frequency to variable frequency (switch down).
2	Modbus	Commands such as start, stop, pre-charge, and switchover are sent through Modbus communication. For details about word definition of these commands, see Appendix B.
3	PROFIBUS-DP/ PROFINET-IO	Commands such as start, stop, pre-charge, and switchover are sent through communication. When this command source is used, use the communication device that supports the PROFIBUS-DP/PROFINET-IO communication card. For details, see *"12.1 Overview" on page 277* and *"13.1 Overview" on page 282*.

Parameter	Name	Value Range	Default
F0-08	Preset frequency	0.00 to Maximum frequency (F0-10)	50.00 Hz

Note

If the frequency source is digital setting, the value of this parameter is the initial digital setting frequency of the AC drive.

Parameter	Name	Value Range	Default
F0-09	Running direction	0 to 1	0
When F0-09 is set to 0, the motor rotation direction is consistent with that defined by wiring. When F0-09 is set to 1, the motor rotation direction is reverse to that defined by wiring. It is used to change the motor rotation direction through parameter modification, which equals to adjusting any two of U, V, and W cables.			

Note

- The motor will resume rotating in the original direction after initialization. Do not use this function in applications where changing the rotating direction of the motor is prohibited after system commissioning is completed.
- For scenarios where synchronous switchover is required, do not change the motor rotation direction by modifying F0-09.

Parameter	Name	Value Range	Default
F0-10	Maximum frequency	50.00 Hz to 600.00 Hz	50.00 Hz
When the frequency source is AI or multi-reference, 100.0% of the input corresponds to the value of this parameter.			

Parameter	Name	Value Range	Default
F0-11	Frequency upper limit source	0 to 6	0

Value Range	Meaning
0	Determined by the setting of F0-12
1	AI1
2	AI2
3	AI3
5	Communication setting
6	AI4

It is used to set the source of the frequency upper limit, including digital setting (F0-12), AI setting, or communication setting.
If the frequency upper limit is set by means of AI1, AI2, AI3, AI4 or communication, the setting is similar to that of the main frequency source. For details, see the description of F0-03.
For example, to avoid runaway in torque control mode in winding application, you can set the frequency upper limit by means of analog input. When the AC drive reaches the upper limit, it will continue to run at this speed.

Parameter	Name	Value Range	Default
F0-12	Frequency upper limit	Frequency lower limit (F0-14) to Maximum frequency (F0-10)	50.00 Hz

Parameter	Name	Value Range	Default
F0-14	Frequency lower limit	0.00 Hz to Frequency upper limit (F0-12)	3.00 Hz
If the frequency reference is lower than the value of this parameter, the AC drive runs at the frequency lower limit by default.			

Parameter	Name	Value Range	Default
F0-17	Acceleration time 1	0.0s to 6500.0s	80.0s
F0-18	Deceleration time 1	0.0s to 6500.0s	100.0s

Acceleration time indicates the time required by the AC drive to accelerate from 0 Hz to the maximum frequency specified by F0-10, that is, t1 in the following figure.

Deceleration time indicates the time required by the AC drive to decelerate from the maximum frequency specified by F0-10 to 0 Hz, that is, t2 in the following figure.

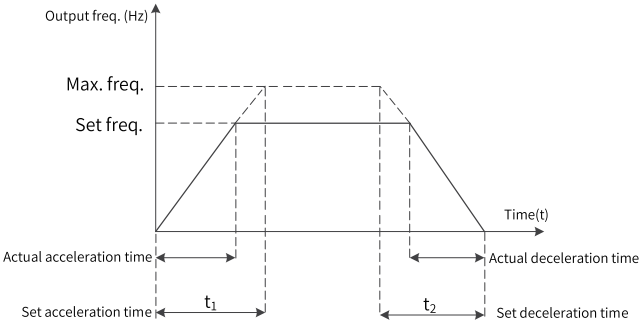


Figure 7-1 Acceleration/Deceleration time

Parameter	Name	Value Range	Default
F0-24	Motor selection	0 to 3	0

Value Range	Meaning
0	Motor 1
1	Motor 2
2	Motor 3
3	Motor 4

The HD9X can drive four motors at different time. You can set the motor nameplate parameters, independent motor auto-tuning, different control modes, and parameters related to running performance respectively for the four motors.
Motor parameter group 1 corresponds to parameter groups F1 and F2. Motor parameter group 2 corresponds to parameter groups A2. Motor parameter group 3 corresponds to parameter groups A3. Motor parameter group 4 corresponds to parameter groups A4.
You can select the current motor parameter group specified by F0-24 or through a DI assigned with the corresponding function. If the motor parameter group selected through F0-24 conflicts with that selected through DI, the one selected by DI applies.

Parameter	Name	Value Range	Default
F0-27	Binding frequency source of remote 1 command source	See the following table.	H.0020

Value Range	Meaning
Tens position	Binding frequency source selection for terminal I/O control 1 (0 to E, same as the ones position)
0	Not bound
1	Digital setting
2	AI1
3	AI2
4	AI3
5	AI4
8	Simple PLC
9	PID
b	Modbus setting
C	PROFIBUS-DP setting
d	HMI setting
Hundreds position	Binding frequency source selection for Modbus communication (0 to d, same as the tens position)
Thousands position	Binding frequency source selection for PROFIBUS-DP communication (0 to d, same as the tens position)

It is used to bind the four running command sources to the 15 frequency sources, facilitating synchronous switchover.
Different running command sources can be bound to the same frequency source. If a command source has a bound frequency source, only the corresponding bound frequency source takes effect when the command source is effective.

Parameter	Name	Value Range	Default
F0-29	Remote 2 command source selection	0 to 3	1

Value Range	Meaning
1	Terminal control 2
0 and 2 to 3	Same as the description of F0-02.

It is used to determine the input channel of the AC drive remote 2 control commands. For details, see the description of F0-02. You can select one communication protocol each time.
This parameter applies to the optional remote 2 command source that is selected. If the user changes the remote 2 command source, this parameter must be set correctly.

Parameter	Name	Value Range	Default
F0-30	Binding frequency source of remote 2 command source	0 to H.dddd	H.0030
This parameter is set in the same way as F0-27.			

7.2 Group F1: Motor 1 Parameters

Parameter	Name	Value Range	Default
F1-00	Motor type selection	0 to 3	0

Value Range	Meaning
0	Common asynchronous motor
1	Variable frequency asynchronous motor
2	Excited synchronous motor
3	Permanent magnet synchronous motor (PMSM)

Parameter	Name	Value Range	Default
F1-01	Rated motor power	1 kW to 65535 kW	Model dependent
F1-02	Rated motor voltage	1 V to 65535 V	Model dependent
F1-03	Rated motor current	0.1 A to 6553.5 A	Model dependent

Parameter	Name	Value Range	Default
F1-04	Rated motor frequency	0.01 Hz to maximum frequency	Model dependent
F1-05	Rated motor speed	1 RPM to 65535 RPM	Model dependent

Note

- Set these parameters according to the motor nameplate no matter whether sensorless vector control (SVC) or feedback vector control (FVC) is used.
- To achieve better SVC or FVC performance, you need to perform motor auto-tuning. The motor auto-tuning accuracy depends on the correct setting of motor nameplate parameters.

Parameter	Name	Value Range	Default
F1-27	Pulses per revolution	1 to 65535	1024

Note

- This parameter is used to set the pulses per revolution (PPR) of ABZ or UVW incremental encoder.
- In FVC mode, the motor cannot run properly if this parameter is set incorrectly.

Parameter	Name	Value Range	Default
F1-28	Encoder type	0 or 2	0

Value Range	Meaning
0	ABZ incremental encoder
2	Resolver

This parameter specifies the encoder type.

Parameter	Name	Value Range	Default
F1-30	A/B phase sequence of the ABZ incremental encoder	0 to 1	0

Value Range	Meaning
0	Forward
1	Reverse direction

This parameter is valid only for the ABZ incremental encoder and is used to set the A/B phase sequence of the ABZ incremental encoder.

Parameter	Name	Value Range	Default
F1-31	Installation position angle of the absolute encoder	0 to 359.9	0

Note

The installation position of absolute position encoder can be obtained automatically through auto-tuning, and can also be set by the manufacturer. If it is incorrect, the decrease of loading capacity may occur.

Parameter	Name	Value Range	Default
F1-34	Number of resolver pole pairs	1 to 65535	1

Note

For the setting of the number of resolver pole pairs, see the encoder guide or specifications.

Parameter	Name	Value Range	Default
F1-37	Auto-tuning selection	0 to 2	0

Value Range	Meaning	Description
0	No operation	Auto-tuning is prohibited.
1	Static auto-tuning for asynchronous motor	• It is applicable to scenarios where dynamic auto-tuning cannot be performed because the asynchronous motor cannot be disconnected from the load. • Before performing static auto-tuning, properly set the motor type and motor nameplate parameters F1-01 to F1-05 first. In the FVC mode, you also need to set the encoder PPR in F1-27. • Set this parameter to 1, and press "Start". Then, the AC drive starts static auto-tuning. During static motor auto-tuning, there is current in the motor, but the motor will not rotate or only rotate slightly.
2	Dynamic auto-tuning for asynchronous motor	• To perform this type of auto-tuning, ensure that the motor is disconnected from the load. • During the process of dynamic auto-tuning, the AC drive performs static auto-tuning first and then accelerates to 30% of the rated motor frequency within the acceleration time set in F0-17. The AC drive keeps running for a certain period and then decelerates to stop within the deceleration time set in F0-18. • Before performing dynamic auto-tuning, properly set the motor type and motor nameplate parameters F1-00 to F1-05. In addition, you also need to set the encoder type and encoder PPR in F1-27 and F1-28. • By dynamic auto-tuning, the AC drive obtains motor parameters F1-06, F1-08, and F1-10, A/B phase sequence of encoder in F1-30, and vector control current loop PI parameters F2-13 to F2-16. • Set this parameter to 2, and press "Start". Then, the AC drive starts dynamic auto-tuning.

Auto-tuning can also be performed by operations on the HMI. In local control mode, log in to the HMI with the after-sales password. Switch to the parameter setting interface and choose "Guide" > "Motor Pr". Set and download the motor parameters. (If the default motor parameters are correct, use the default values.) After the parameters are downloaded successfully, perform operations according to the instructions in the "Motor Auto-Tuning" section. When the system is ready, select static auto-tuning or dynamic auto-tuning. In the "Start" or "Stop" dialog box that is displayed, tap "OK". The motor auto-tuning starts.

7.3 Group F2: Vector Control Parameters of Motor 1

Parameter	Name	Value Range	Default
F2-00	Speed loop proportional gain 1	0.000 to 1.000	0.025
F2-01	Speed loop integral gain 1	0.000 to 65.535	0.05
F2-02	Switchover frequency 1	0.00 to F2-05	5
F2-03	Speed loop proportional gain 2	0.000 to 1.000	0.015
F2-04	Speed loop integral gain 2	0.000 to 65.535	0.025
F2-05	Switchover frequency 2	F2-02 to F0-10	10
F2-08	Speed loop Kf gain	0.01 to 1.00	1

Select speed loop PI parameters based on the operating frequency of the drive. If the operating frequency is lower than or equal to "Switchover frequency 1" (F2-02), the speed loop PI parameters are F2-00 and F2-01. If the running frequency is higher than F2-05 (Switchover frequency 2), PI parameters are F2-03 and F3-04. If the running frequency is between F2-02 and F2-05, PI parameters are obtained from linear switchover between two groups of PI parameters, as shown below.

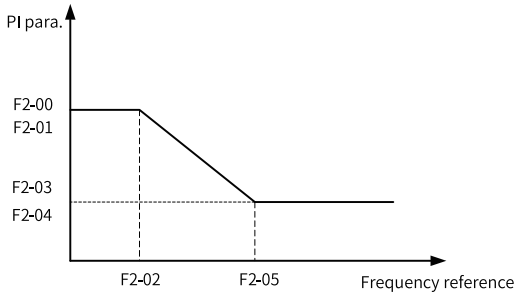


Figure 7-2 Relationship between running frequencies and PI parameters

The speed dynamic response characteristics in the vector control mode can be adjusted by setting the proportional gain and integral time of the speed regulator.

To achieve a faster system response, increase the proportional gain or reduce the integral time. Be aware that either a too big gain or a too short time may lead to system oscillation. We recommend that you adjust these parameters as follows:

If the default setting cannot meet the requirements, make proper adjustment. Increase the proportional gain first to ensure that the system does not oscillate, and then reduce the integral time to ensure that the system has quick response and small overshoot.

Note

Improper PI parameter setting may cause too large speed overshoot, and overvoltage fault may even occur when the overshoot drops.

<table>
<tr><th>Parameter</th><th>Name</th><th>Value Range</th><th>Default</th></tr>
<tr><td rowspan="2">F2-09</td><td>Torque upper limit source in speed control (driving)</td><td>0 to 8</td><td>0</td></tr>
<tr><td colspan="3"><table>
<tr><th>Value Range</th><th>Meaning</th></tr>
<tr><td>0</td><td>F2-10</td></tr>
<tr><td>1</td><td>AI1</td></tr>
<tr><td>2</td><td>AI2</td></tr>
<tr><td>3</td><td>AI3</td></tr>
<tr><td>5</td><td>Communication setting</td></tr>
<tr><td>6</td><td>MIN (AI1, AI2)</td></tr>
<tr><td>7</td><td>MAX (AI1, AI2)</td></tr>
<tr><td>8</td><td>AI4</td></tr>
</table></td></tr>
<tr><th>Parameter</th><th>Name</th><th>Value Range</th><th>Default</th></tr>
<tr><td>F2-10</td><td>Digital setting of torque upper limit in speed control (driving)</td><td>0.0% to 300.0%</td><td>120.0%</td></tr>
<tr><td>F2-12</td><td>Digital setting of torque upper limit in speed control (braking)</td><td>0.0% to 150.0%</td><td>1.0%</td></tr>
</table>

In the speed control mode, the maximum output torque of the drive is restricted by the torque upper limit source. F2-09 and F2-10 specify the torque upper limit during drive running, that is, when the motor is in running state. F2-12 specifies the torque upper limit during braking running, that is, when the motor generates power. When the value increases, the AC drive deceleration braking is improved, but a too large value may result in an AC drive power unit overvoltage fault.

When the torque upper limit source is analog or communication setting, 100% of the setting corresponds to the value of F2-10, and 100% of the value of F2-10 corresponds to the rated AC drive torque.

7.4 Group F4: Input Terminal Parameters

The AC drive provides 26 multi-functional DI terminals. If more input/output terminals are required, configure an optional PLC module.

Parameter	Name	Value Range	Default
F4-00	DI1 function selection	0 to 145	1031 (Emergency stop)
F4-01	DI2 function selection		1025 (Transformer over-temperature fault)
F4-02	DI3 function selection		1024 (Transformer over-temperature alarm)
F4-03	DI4 function selection		1026 (Cabinet door travel switch)
F4-04	DI5 function selection		27 (Cabinet top fan status feedback)
F4-05	DI6 function selection		1020 (Local/Remote switchover)
F4-06	DI7 function selection		33 (Control power supply normal)
F4-07	DI8 function selection		0
F4-08	DI9 function selection		1 (Forward running)
F4-09	DI10 function selection		1003 (Three-wire motion control)
F4-10	DI11 function selection		9 (Fault reset)
F4-11 to F4-20	DI12 function selection to DI21 function selection		0
F4-21	DI22 function selection		58 (Forward running 2)
F4-22	DI23 function selection		1060 (Three-wire motion control 2)
F4-23	DI24 function selection		28 (Remote 1/Remote 2 switchover)
F4-24	DI25 function selection		0
F4-25	DI26 function selection		145 (Fan power supply fault)
F4-42 to F4-57	DI43 function selection X00 to DI58 function selection X17		0

Note

- These parameters are used to set the functions of DIs, and the values of F4-00 to F4-06 and F4-05 to F4-06 must not be changed. The following table shows optional functions:
- For the thousand's digit of the value, 1 indicates NO valid and 0 indicates NC valid. Take the value 1001 as an example: when the DI with function 1 (Forward RUN) is OFF, the AC drive instructs forward running; when the DI with function 1 (Forward RUN) is ON, the AC drive instructs forward running.

Value Range	Meaning	Description
0	No function	Set reserved terminals to "no function" to avoid malfunction.
1	Forward running (FWD)	An external terminal is used to control forward or reverse running of the AC drive. It is applicable to terminal channel 1.
2	Reverse running (REV)	
3	Three-wire motion control	It is applicable to terminal channel 1. This terminal determines the three-wire control mode of the AC drive. For details, see the description of F4-73 (Terminal command mode).
9	Fault reset (RESET)	When a terminal is used for fault reset, it is used to reset the fault remotely.
11	External fault input	When this signal is sent to the AC drive, it reports fault F15.
12	Multi-reference terminal 1	The setting of 16 multi-references or 16 other references can be implemented through combinations of 16 states of these four terminals. For details, see "Multi-reference function description" next to this table.
13	Multi-reference terminal 2	
14	Multi-reference terminal 3	
15	Multi-reference terminal 4	
20	Local/Remote switchover	This terminal is used to perform switchover between local control and remote control (F0-02). When the terminal becomes ON, local control (HMI) is prohibited, and the AC drive is in remote control mode.
24	Transformer over-temperature alarm	When this terminal is ON, the temperature of phase-shifting transformer of the AC drive reaches the alarm threshold, and the AC drive reports alarm A87.
25	Transformer over-temperature fault	When this terminal is ON, the temperature of the phase-shifting transformer reaches the fault threshold, and the AC drive reports fault F57.

Value Range	Meaning	Description
26	Cabinet door travel switch	When this terminal is ON, the cabinet doors are not properly closed or the cabinet door travel switch is faulty, and the AC drive reports fault F58.
27	Cabinet top fan status feedback	After the AC drive is energized by medium-voltage (MV) power supply, the fan is not normally started and a fan fault or fan alarm is reported according to the system configuration.
28	Remote 1/Remote 2 switchover	This terminal is used to perform switchover between remote 1 command source (F0-02) and remote 2 command source (F0-29). When this terminal becomes ON, remote 1 command source is prohibited, and the AC drive is in remote 2 control mode.
31	Emergency stop	After you press the emergency stop button, the system stops and MV tripping occurs.
33	Control power supply normal	If this terminal becomes OFF, the AC drive reports fault F46 and stops.
41	Motor selection 1	There are four motor selection terminals. Motor parameters are switched based on the priority level of the terminal state. When this terminal is ON first, motor 1 parameters apply.
42	Motor selection 2	There are four motor selection terminals. Motor parameters are switched based on the priority level of the terminal state. When this terminal is ON first, motor 2 parameters apply.
44	User-defined fault 1	If these two terminals become ON, the AC drive reports faults F27 and F28 respectively.
45	User-defined fault 2	
58	Forward running 2 (FWD)	An external terminal is used to control forward or reverse running of the AC drive. It is applicable to terminal channel 2.
59	Reverse running 2 (REV)	
60	Three-wire motion control 2	It is applicable to terminal channel 2. This terminal determines the three-wire control mode of the AC drive. For details, see the description of F4-73 (Terminal command mode).

Description of multi-reference function

The four multi-reference terminals can provide 16 state combinations, corresponding to 16 reference values. The following table describes eight state combinations that are listed ahead.

K4	K3	K2	K1	Command	Parameter
OFF	OFF	OFF	OFF	Multi-reference 0	FC-00
OFF	OFF	OFF	ON	Multi-reference 1	FC-01
OFF	OFF	ON	OFF	Multi-reference 2	FC-02
OFF	OFF	ON	ON	Multi-reference 3	FC-03
OFF	ON	OFF	OFF	Multi-reference 4	FC-04
OFF	ON	OFF	ON	Multi-reference 5	FC-05
OFF	ON	ON	OFF	Multi-reference 6	FC-06
OFF	ON	ON	ON	Multi-reference 7	FC-07

Note

- If the frequency source is multi-reference, the value 100% of FC-00(Reference 0) to FC-15 (Reference 15) corresponds to the value of F0-10 (Max. frequency).
- Besides the multi-speed function, the multi-reference can be also used as the PID setting source, satisfying the requirement for switchover of different setting values.

Parameter	Name	Value Range	Default
F4-66	Filter time of DI1 to DI26	0.000s to 1.000s	0.030s

Note

It is used to set the software filter time of DI terminal status. If DI terminals are liable to interference, which may cause malfunction, increase the value of this parameter to enhance the anti-interference capability. Note that an excessively high filter time may slow down the DI response.

Parameter	Name	Value Range	Default
F4-73	Terminal command mode	See the following table.	H.22

Value Range	Meaning
Ones position	Mode of terminal I/O control 1
0	Two-wire mode 1
1	Two-wire mode 2
2	Three-wire mode 1
3	Three-wire mode 2
Tens position	Mode of terminal I/O control 2
0	Two-wire mode 1
1	Two-wire mode 2
2	Three-wire mode 1
3	Three-wire mode 2

Note

- This parameter defines the four different modes of controlling the AC drive running using external DI terminals.
- Here takes DI9, DI10 and DI11 as the external DI terminals to control the AC drive running. You can set the function of DI9, DI10 and DI11 by setting F4-08 (DI9 function selection), F4-09 (DI10 function selection) and F4-10 (DI11 function selection), respectively. For details, see the descriptions of F4-08 (DI9 function selection) to F4-17 (DI18 function selection).
- 0: Two-wire Control Mode 1. It is the most commonly used two-wire control mode. Allocate the DI9 with the forward run function and the DI10 with the reverse run function.

The following table describes parameter setting for remote 1 terminal I/O control 1.

Parameter	Name	Value Range	Description
F4-73	Terminal command mode	H.x0	Two-wire mode 1
F4-08	DI9 function selection	1	Forward running (FWD)
F4-09	DI10 function selection	2	Reverse running (REV)

K1	K2	Running command
1	0	Forward
0	1	Reverse
1	1	Stop
0	0	Stop

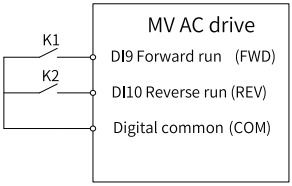


Figure 7-3 Two-wire mode 1

As shown in the preceding figure, when only K1 is ON, the AC drive instructs forward rotation. When only K2 is ON, the AC drive instructs reverse rotation. When K1 and K2 are ON or OFF simultaneously, the AC drive stops.

Value Range 1 indicates two-wire mode 2. In this mode, DI9 is used to enable operation and DI10 is used to define the operating direction.

The following table describes parameter setting for remote 1 terminal I/O control 1.

Parameter	Name	Value Range	Description
F4-73	Terminal command mode	H.x1	Two-wire mode 2
F4-08	DI9 function selection	1	Forward running (FWD)
F4-09	DI10 function selection	2	Reverse running (REV)

K1	K2	Running command
1	0	Forward
1	1	Reverse
0	0	Stop
0	1	Stop

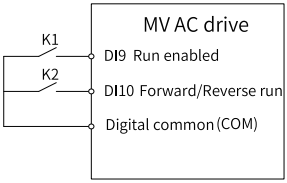


Figure 7-4 Two-wire mode 2

As shown in the preceding figure, if K1 is ON, the AC drive instructs forward rotation when K2 is OFF, and instructs reverse rotation when K2 is ON. If K1 is OFF, the AC drive stops.

Value Range 2 indicates three-wire mode 1. In this mode, DI10 is used to enable operation and DI9 and DI11 are used to define the operating direction.

The following table describes parameter setting for remote 1 terminal I/O control 1.

Parameter	Name	Value Range	Description
F4-73	Terminal command mode	H.x2	Three-wire mode 1
F4-08	DI9 function selection	1	Forward running (FWD)
F4-09	DI10 function selection	1003	Three-wire motion control
F4-10	DI11 function selection	2	Reverse running (REV)

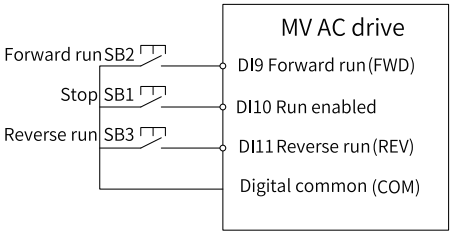


Figure 7-5 Three-wire mode 1

As shown in the preceding figure, if SB1 is OFF, the AC drive instructs forward rotation when SB2 is pressed to be ON and instructs reverse rotation when SB3 is pressed to be ON. The AC drive stops immediately after SB1 becomes ON. During normal startup and running, SB1 must remain OFF. Commands from SB2 or SB3 take effect immediately after SB2 or SB3 becomes ON. The AC drive running state is determined by the final actions on SB1, SB2 and SB3.

Value Range 3 indicates three-wire mode 2. In this mode, DI10 is assigned with the enable function, DI9 is used to send the operation command, and DI11 determines the direction.

The following table describes the parameters.

Parameter	Name	Value Range	Description
F4-73	Terminal command mode	3	Three-wire mode 2
F4-08	DI9 function selection	1	Operation command
F4-09	DI10 function selection	1003	Three-wire motion control
F4-10	DI11 function selection	2	Running direction

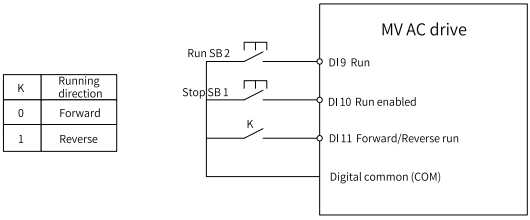


Figure 7-6 Three-wire mode 2

As shown in the preceding figure, if SB1 is OFF, the AC drive starts running when SB2 is pressed to be ON, instructs forward rotation when K is OFF, and instructs reverse rotation when K is ON. The AC drive stops immediately after SB1 becomes ON. During normal startup and running, SB1 must remain OFF. The command instructed by SB2 takes effect immediately after SB2 becomes ON.

7.5 Group F5: Output Terminal Parameters

The AC drive provides 34 multi-function DO terminals. If more DO terminals are required, configure an optional PLC extension module.

Parameter	Name	Value Range	Default
F5-01	DO1 function selection	See the following table.	1041 (MV tripping)
F5-02	DO2 function selection		40 (MV switch-on enable)
F5-03	DO3 function selection		44 (Main power supply indication)
F5-04	DO4 function selection		15 (Ready for RUN)
F5-05	DO5 function selection		1 (AC drive running)
F5-06	DO6 function selection		1001 (AC drive stopping)
F5-07	DO7 function selection		2 (Fault (stop upon fault))
F5-08	DO8 function selection		45 (Alarm)
F5-09	DO9 function selection		46 (HMI reset)
F5-24	DO24 function selection		62
F5-33	DO33 function selection		1
F5-34	DO34 function selection		2

The following table describes functions of the multi-function DO terminals.

Value Range	Function	Description
0	No output	The output terminal has no function.
1	AC drive running	The AC drive is operating and generates output frequency (can be zero). In this case, the ON signal is output.
2	Fault (stop upon fault)	When the AC drive stops due to a fault, the ON signal is output.
15	Ready for RUN	After the MV power is energized properly, system self-check is completed and the AC drive does not detect any fault. The AC drive is ready for running and outputs the ON signal.

Value Range	Function	Description
40	MV switch-on enable	After the control system is powered on, the ON signal is output when all the following conditions are met: 1. Emergency stop, emergency breaking, and grounding disconnector feedback are inactive. 2. The drive does not report F09 (Medium-voltage undervoltage on user side) or reports no fault. 3. The medium-voltage power-off time exceeds the allowable switch-on delay specified by F8-58. 4. Automatic decondensation is done. (The optional heater is turned off.) 5. When the manual bypass cabinet is configured, the inlet switch of bypass cabinet 1 is ON. 6. When the auto bypass cabinet is configured, the inlet contactor of bypass cabinet 2 remains OFF.
41	MV tripping	When any of the following conditions are met, the ON signal is output: 1. The emergency stop input, emergency breaking input, or grounding disconnector feedback is active. 2. A major fault occurs in the system. Note: If condition 2 is met and the mains power contactor of bypass cabinet 1 is in the switch-off state, the ON signal is output.
44	Main power supply indication	The ON signal is output when the input voltage reaches 1/16 of the rated input voltage of the drive.
45	Alarm	When any alarm exists in the system, the ON signal is output.

7.6 Group F6: Start/Stop Control Parameters

Parameter	Name	Value Range	Default
F6-00	Start mode	0 to 3	0

- In flying start, the AC drive detects the rotational speed of the motor in running state, and outputs the voltage corresponding to the motor frequency, minimizing impact of power supply on the motor. During flying start, the AC drive detects the motor magnetic flux and starts the motor at the current motor frequency.
- You can set the direction of flying start in this parameter. If the motor rotating direction is known, set this parameter to 1 or 2 according to the actual direction. If the motor rotating direction is unknown, set this parameter to 3. If you select "Direct start", the AC drive starts directly.

Value Range	Function	Description
0	Direct start	The AC drive starts to run at the startup frequency.
1	Forward flying start	The AC drive detects the motor rotational speed in the forward direction and then starts at the tracked motor frequency, implementing smooth startup without impacting the rotating motor.
2	Reverse flying start	The AC drive detects the motor rotational speed in the reverse direction and then starts at the tracked motor frequency, implementing smooth startup without impacting the rotating motor.
3	Forward/Reverse flying start	The AC drive detects the motor rotational speed in the forward direction first. If the detection fails, the AC drive performs detection in the reverse direction. Then, the AC drive starts at the tracked motor frequency, implementing smooth startup without impacting the rotating motor.

Parameter	Name	Value Range	Default
F6-01	Start delay	0.0s to 60.0s	0.0s
F6-03	Startup frequency	0.00 Hz to 10.00 Hz	1.00 Hz
F6-04	Startup frequency active time	0.0s to 100.0s	0.0s

A proper startup frequency is required to ensure a proper motor torque at start. In addition, to build excitation when the motor starts up, the startup frequency must be held for a certain period.

The startup frequency (F6-03) is not restricted by the frequency lower limit. When the frequency reference is lower than the startup frequency, the AC drive will not start but stay standby.

During switchover between forward rotation and reverse rotation, the startup frequency active time is disabled.

The startup frequency active time is not included in the acceleration time, but included in the running time of the simple PLC.

Example 1:

F0-03 = 0: The frequency source is digital setting.

F0-08 = 2.00 Hz: The digital setting frequency is 2.00 Hz.

F6-03 = 5.00 Hz: The startup frequency is 5.00 Hz.

F6-04 = 2.0s: The startup frequency active time is 2.0s.

In this example, the AC drive stays in the standby state and the output frequency is 0.00 Hz.

Example 2:

F0-03 = 0: The frequency source is digital setting.

F0-08 = 10.00 Hz: The digital setting frequency is 10.00 Hz.

F6-03 = 5.00 Hz: The startup frequency is 5.00 Hz.

F6-04 = 2.0s: The startup frequency active time is 2.0s.

In this example, the AC drive accelerates to 5.00 Hz, and then accelerates to the set frequency 10.00 Hz after 2.0s.

Parameter	Name	Value Range	Default
F6-07	Acceleration/ Deceleration mode	0 or 1	0

This parameter defines the frequency change mode during start and stop of the drive.

Value Range	Function	Description
0	Linear acceleration/ deceleration	The output frequency increases or decreases linearly. The HD9X/HD9XS provides four groups of acceleration/deceleration time. The acceleration/deceleration time can be selected through DI parameters F4-00 to F4-08.
1	Static S curve	The output frequency increases or decreases based on the S curve on the condition that target frequency is fixed. This mode is suitable for applications requiring smooth start or stop, such as elevators and conveyors.

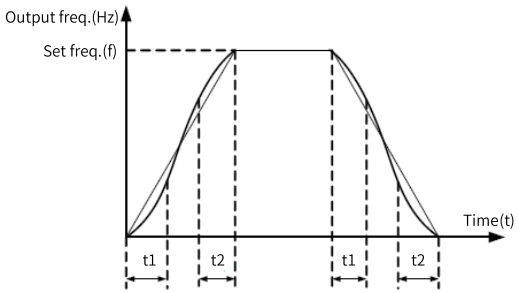


Figure 7-7 Static S curve

Parameter	Name	Value Range	Default
F6-10	Stop mode	0 or 1	1

Value Range	Function	Description
0	Decelerate to stop	After the stop command is active, the AC drive decreases the output frequency based on the deceleration time and stops only when the frequency decreases to zero.
1	Coast to stop	After the stop command becomes active, the drive stops output immediately and the motor coasts to stop based on the mechanical inertia.

7.7 Group F7: Time Parameters

Parameter	Name	Value Range	Default
F7-06	Accumulative power-on time	0 h to 65535 h	0 h

Note

This parameter displays the total power-on time of the AC drive. When the power-on time reaches the set power-on time F8-16, the multi-functional DO of the AC drive (24) outputs the ON signal.

Parameter	Name	Value Range	Default
F7-07	Accumulative running time	0 h to 65535 h	0 h

Note

It is used to display the total running time of the AC drive. After total running time reaches the value set in F8-17, multi-functional DO of the AC drive (12) outputs the ON signal.

Parameter	Name	Value Range	Default
F7-08	Accumulative power consumption	0 MWh to 9999 MWh	0 MWh

Note

This parameter displays the total power consumption of the AC drive in unit of MWh.

Parameter	Name	Value Range	Default
F7-23	Accumulative power consumption	0 GWh to 9999 GWh	0 GWh

Note

This parameter displays the total power consumption of the AC drive in unit of GWh.

7.8 Group F8: Auxiliary Function Parameters

Parameter	Name	Value Range	Default
F8-00	Jog frequency	0.00 Hz to maximum frequency	2.00 Hz
F8-01	Jog acceleration time	0.0s to 6500.0s	20.0s
F8-02	Jog deceleration time	0.0s to 6500.0s	20.0s

These parameters are used to define the set frequency and acceleration/deceleration time of the AC drive during jogging.

If jog is adopted, F6-00 must be fixed to 0 (Direct start) and F6-10 must be fixed to 0 (Decelerate to stop).

Parameter	Name	Value Range	Default
F8-03	Acceleration time 2	0.0s to 6500.0s	Model dependent
F8-04	Deceleration time 2	0.0s to 6500.0s	Model dependent
F8-05	Acceleration time 3	0.0s to 6500.0s	Model dependent
F8-06	Deceleration time 3	0.0s to 6500.0s	Model dependent
F8-07	Acceleration time 4	0.0s to 6500.0s	Model dependent
F8-08	Deceleration time 4	0.0s to 6500.0s	Model dependent

The HD9X provides four groups of acceleration/deceleration time, that is, the preceding three groups of acceleration/deceleration time and the group defined by F0-17 and F0-18.

Definitions of four groups of acceleration/deceleration time are completely the same. For details, see the descriptions of F0-17 and F0-18.

You can switch between the four groups of acceleration/deceleration time through different state combinations of DI terminals. For more details, see the section "Group F4: DI Terminals".

Parameter	Name	Value Range	Default
F8-09	Jump frequency 1	0.00 Hz to maximum frequency	0.00 Hz
F8-10	Jump frequency 2	0.00 Hz to maximum frequency	0.00 Hz
F8-11	Jump frequency band	0.00 Hz to maximum frequency	0.00 Hz
F8-68	Jump frequency 3	0.00 Hz to maximum frequency	0.00 Hz
F8-69	Jump frequency band 3	0.00 Hz to maximum frequency	0.00 Hz

If the reference frequency is within the jump frequency range, the actual operation frequency is the jump frequency close to the reference frequency. The drive can avoid the mechanical resonance point of the load through the jump frequency.

MV drives support jump frequency points. If the jump frequency band is set to 0, the jump frequency function is disabled.

The following figure shows the principle of the jump frequency and jump frequency band.

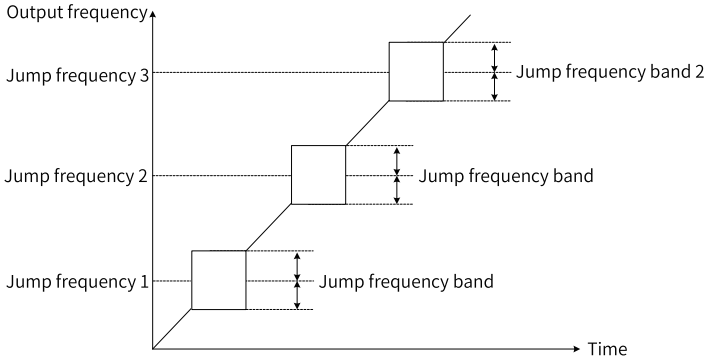


Figure 7-8 Jump frequency

Parameter	Name	Value Range	Default
F8-13	Reverse control enable	0 to 1	1

Value Range	Meaning
0	Reverse running allowed
1	Reverse running inhibited

This parameter specifies whether the AC drive allows reverse running. If reverse running is inhibited, set F8-13 to 1.

Parameter	Name	Value Range	Default
F8-18	Start protection selection	0 to 1	1

Value Range	Meaning
0	Disabled
1	Enabled

This parameter specifies whether to enable the safety protection function.

If this parameter is set to 1, the drive does not respond to the operation command that is activated the moment upon power-on (for example, an input terminal is ON before power-on). In this case, cancel the operation command and activate the operation command again.

In addition, the AC drive does not respond to the operation command activated upon fault reset of the drive. The safety protection function can be disabled only after the operation command is canceled.

In this way, the risk caused by motor responding to operation commands upon power-on or fault reset can be prevented.

Parameter	Name	Value Range	Default
F8-22	Jump frequency enable during acceleration/ deceleration	0: Disabled 1: Enabled	0

This parameter specifies whether the jump frequency is active during acceleration/ deceleration.

When the jump frequency is active and the operating frequency is within the jump frequency range, the actual operating frequency jumps over the set jump frequency threshold. The following figure shows the diagram when the jump frequency is active during acceleration/deceleration.

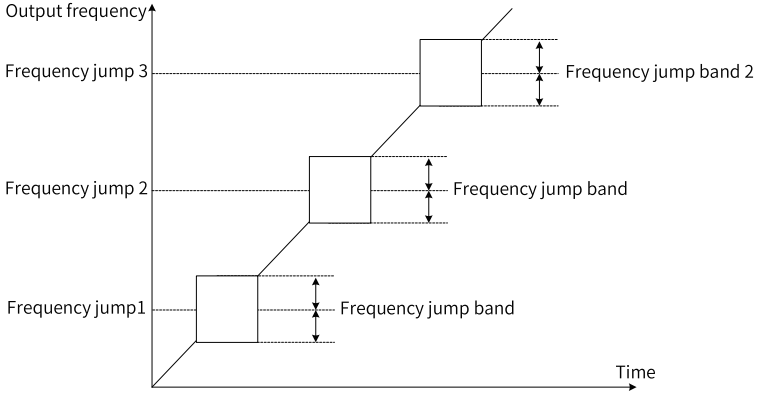


Figure 7-9 Jump frequency enable during acceleration/deceleration

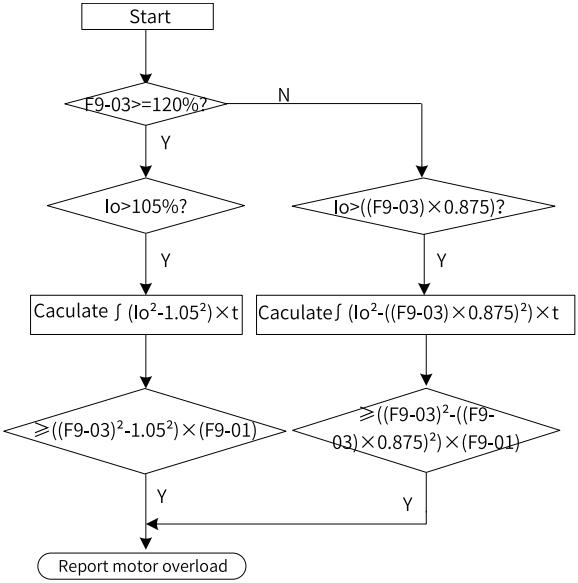
7.9 Group F9: Protection Parameters

Parameter	Name	Value Range	Default
F9-00	Motor overload software protection selection	0 to 1	1
F9-01	Motor overload time	0.01s to 600.00s	60.00s

F9-00 = 0: Motor overload protection is unavailable. The motor may be damaged by over-temperature.

F9-00 = 1: The drive determines whether the motor is overloaded according to the inverse time curve of motor overload protection.

Timing diagram of motor overload protection



Parameter	Name	Value Range	Default
F9-02	Motor overload pre-warning coefficient	50% to 100%	80%

This function is used to send a pre-warning signal to the control system through DO before motor overload protection applies. The motor overload pre-warning coefficient is used to determine how early the pre-warning signal is sent before the motor overload protection applies. The higher the value is, the later the pre-warning signal is sent.

Parameter	Name	Value Range	Default
F9-03	Software protection threshold for motor overload	10.0% to 220.0%	120.0%

This function is used for motor overload fault protection. The value 100.0% corresponds to the rated motor current. When motor current keeps higher than rated motor current x

motor overload protection threshold for the time defined by F9-01, a motor overload fault will be reported.

Parameter	Name	Value Range	Default
F9-03	Software protection threshold for motor overload	10.0% to 220.0%	120.0%

It is used to set the motor overvoltage protection threshold to avoid excessively high back EMF. The value 100.0% corresponds to the rated motor voltage.

Parameter	Name	Value Range	Default
F9-14	Input current imbalance threshold	0.0% to 100.0%	40.0%

If the negative sequence component of the input current exceeds the threshold specified by F9-14 and lasts for 500 ms, an input current imbalance fault is reported.

Parameter	Name	Value Range	Default
F9-15	Output current imbalance threshold	0.0% to 100.0%	40.0%

If the negative sequence component of the output current exceeds the threshold specified by F9-15 and lasts for 500 ms, an output current imbalance fault is reported.

Parameter	Name	Value Range	Default
F9-17	Input voltage imbalance threshold	0.0% to 100.0%	40.0%

Parameter	Name	Value Range	Default
F9-27	Output voltage imbalance threshold	0.0% to 100.0%	40.0%

When the negative sequence component of the output voltage keeps exceeding F9-27 for 500 ms, output voltage imbalance fault is reported. The output voltage imbalance is set to the alarm level by default, which can be set through the thousands of F9-48.

Parameter	Name	Value Range	Default
F9-30	AC drive overcurrent threshold setting	0.0% to 180.0% (The value 100.0% corresponds to the rated output current of the drive.)	150.0%

During running of the AC drive, if the instantaneous output current is greater than the rated output current of the AC drive multiplied by the value specified by F9-30, the AC drive reports an overcurrent fault.

Parameter	Name	Value Range	Default
F9-31	Maximum output current limit of the drive	0.0% to (Value specified by F9-30 – 20.0)% (The value 100.0% corresponds to the rated output current of the drive.)	120.0%

This parameter is used to set the maximum output current of the drive during operation.

The value of F9-31 is related to F9-30. When the value of F9-30 is lower than or equal to 20.0%, the range of F9-31 is 0.0% to 180.0%. When the value of F9-30 is higher than 20.0%, the range of F9-31 is 0.0% to (Value specified by F9-30 – 20.0)%. The value 100.0% corresponds to the rated output current of the drive.

Parameter	Name	Value Range	Default
F9-40	Locked-rotor frequency	5.0 Hz to 50.0 Hz	20.0 Hz
F9-41	Locked-rotor time	0 to 400	20s

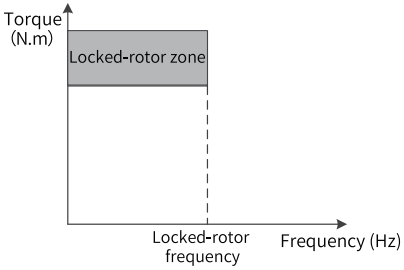


Figure 7-10 Locked-rotor area of the motor

The motor locked-rotor fault is active if all the following conditions are met:

1. The output frequency of the drive is lower than the locked-rotor frequency specified by F9-40.
2. The output torque of the drive reaches the torque limit. The output torque limit of the drive is specified by F9-31. Torque limit is a basic parameter of the drive and specifies the maximum output torque. Torque limit has an indirect impact on detection of the motor locked-rotor fault, but is not the required parameter of this fault.
3. Both of the conditions are met, and the fault lasts for longer than the locked-rotor time specified by F9-41.

If F9-41 is set to 0s, detection of the motor locked-rotor fault is disabled.

Parameter	Name	Value Range	Default
F9-67	Overspeed detection level	0.0% to 50.0% (maximum frequency)	20.0%
F9-68	Overspeed detection time	0.0s to 60.0s	5.0s

When the detected motor feedback frequency keeps exceeding the max. frequency for more than the value of F9-67 in a period longer than the time set in F9-68, the drive reports F43 and acts as defined.

When the overspeed detection time is set to 0.0s, overspeed fault detection is disabled.

Parameter	Name	Value Range	Default
F9-69	Detection level of excessive speed deviation	0.0% to 50.0% (maximum frequency)	20.0%
F9-70	Detection time of excessive speed deviation	0.0s to 60.0s	0.0s

When the drive is running, if the detected motor feedback speed and the frequency reference do not match and the situation lasts for a period longer than the detection time of excessive speed deviation specified by F9-70, the drive reports fault or alarm F42 (Excessive speed deviation) and applies a fault protection action.

7.10 Group FA: PID Parameters

PID control is a general process control method. By performing proportional, integral, and differential operations on the difference between the feedback signal and the target signal, it adjusts the AC drive output frequency and constitutes a feedback system to stabilize the controlled counter around the target value.

It is applied to process control such as flow control, pressure control, and temperature control. The following figure shows the PID control principle.

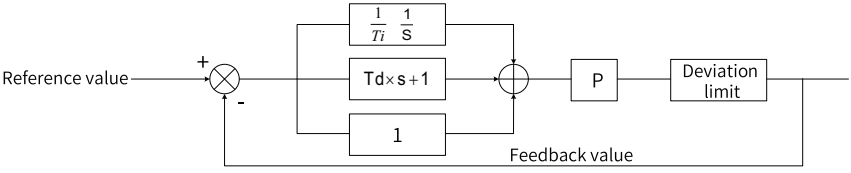


Figure 7-11 PID control principle

Parameter	Name	Value Range	Default
FA-00	PID reference source	0 to 7	0

Value Range	Meaning
0	Set by FA-01
1	AI1
2	AI2
3	AI3
5	Communication setting
6	Multi-reference setting
7	AI4

Parameter	Name	Value Range	Default
FA-01	PID digital reference	0.0% to 100.0%	50.0%

This parameter is used to select the target process PID reference source.

The target setpoint of PID is a relative value ranging from 0.0% to 100.0%. The PID feedback is also a relative value. The purpose of PID control is to make the PID setting and PID feedback equal.

Parameter	Name	Value Range	Default
FA-02	PID feedback source	0 to 9	0

Value Range	Meaning
0	AI1
1	AI2
2	AI3
3	AI1 to AI2
5	Communication setting
6	AI1+AI2
7	MAX (|AI1|, |AI2|)
8	MIN (|AI1|, |AI2|)
9	AI4

This parameter is used to select the feedback signal channel of process PID.

The PID feedback is also a relative value ranging from 0.0% to 100.0%.

Parameter	Name	Value Range	Default
FA-03	PID action direction	0 to 1	0
	Value Range	0	Positive
		1	Negative

This function is affected by the multi-function terminal function 35 "Inverted PID action".

Value Range	Meaning	Description
0	Positive	When the PID feedback value is lower than the PID reference, the output frequency of the AC drive increases. For example, the winding tension control requires forward PID action.
1	Negative	When the PID feedback value is lower than the PID reference, the output frequency of the AC drive decreases. For example, the winding tension control requires reverse PID action.

Parameter	Name	Value Range	Default
FA-04	PID reference and feedback range	0 to 65535	1000

This parameter is a non-dimensional unit. It is used for PID reference display (U0-15) and PID feedback display (U0-16).

The relative value 100.0% of PID reference/feedback corresponds to the value of FA-04. For example, if FA-04 is set to 2000 and PID reference is 100.0%, the PID reference display (U0-15) is 2000.

Parameter	Name	Value Range	Default
FA-05	Proportional gain Kp1	0.0 to 100.0	20
FA-06	Integral time Ti1	0.01s to 10.00s	2.00s
FA-07	Derivative time Td1	0.00s to 10.000s	0.000s

- Proportional gain Kp1:
  This parameter specifies the regulating intensity of the PID regulator. Higher Kp1 indicates greater regulating intensity. The value 100.0 indicates that when the deviation between PID feedback and PID setting is 100.0%, the adjustment amplitude of the PID regulator on the output frequency reference is the maximum frequency.
- Integral time Ti1:
  This parameter specifies the integral regulating intensity of the PID regulator. Shorter integral time indicates greater regulating intensity. When the deviation between PID

feedback and PID reference is 100.0%, the integral regulator performs continuous regulation within the set time, and the regulation amount reaches the maximum frequency.

- Derivative time Td1:
  This parameter specifies the regulating intensity of the PID regulator on the deviation change. Longer derivative time indicates greater regulating intensity. Derivative time indicates the time within which the feedback change reaches 100.0%. In this case, the regulation amount reaches the maximum frequency.

Parameter	Name	Value Range	Default
FA-08	PID reverse cut-off frequency limit	0.00 to maximum frequency	2.00 Hz

In some applications, only when the PID output frequency is a negative value (reverse running), PID setting and PID feedback can be equal. However, an excessively high reverse operating frequency is prohibited in some applications. FA-08 is used to specify the reverse operating frequency upper limit.

Note

- When balance conditions cannot be met even after the on-site PID is adjusted to the frequency lower limit and running below the frequency lower limit is not allowed, FA-08 must be set to 0.00 Hz.
- When the frequency source is main+auxiliary (PID), PID reverse cut-off frequency upper limit is not limited. That is, FA-08 is invalid.

Parameter	Name	Value Range	Default
FA-09	PID deviation limit	0.0% to 100.0%	0.0%

If the deviation between PID feedback and PID setting is lower than the value of FA-09, PID control stops. When the deviation between PID feedback and PID setting is small, the output frequency is stable.

Parameter	Name	Value Range	Default
FA-10	PID derivative limit	0.00% to 100.00%	0.10%

It is used to set the PID derivative output range. In PID control, the derivative operation may easily cause system oscillation. Therefore, the PID derivative regulation is restricted to a small range.

Parameter	Name	Value Range	Default
FA-11	PID reference change time	0.00s to 650.00s	0.00s

The PID reference change time indicates the time required for the PID reference to change from 0.0% to 100.0%.

The PID reference changes linearly according to the change time, reducing the impact caused by sudden reference change on the system.

Parameter	Name	Value Range	Default
FA-12	PID feedback filter time	0.00s to 60.00s	0.00s
FA-13	PID output filter time	0.00s to 60.00s	0.00s

FA-12 is used to filter the PID feedback, helping reduce the interference on the feedback. However, this slows the responsiveness of the process closed-loop system.

FA-13 is used to filter the PID output frequency, helping weaken sudden change of the AC drive output frequency. However, this slows the responsiveness of the process closed-loop system.

Parameter	Name	Value Range	Default
FA-15	Proportional gain Kp2	0.0 to 100.0	20
FA-16	Integral time Ti2	0.01s to 10.00s	2.00s
FA-17	Derivative time Td2	0.00 to 10.000	0.000s
FA-18	PID parameter switchover condition	0 to 2	0
	Value Range	0	No switching
		1	Switching by DI terminal
		2	Automatic switchover based on deviation
FA-19	PID parameter switchover deviation 1	0.0% to value of FA-20	20.0%
FA-20	PID parameter switchover deviation 2	Value of FA-19 to 100.0%	80.0%

In some applications, PID parameter switchover is required when one group of PID parameters cannot satisfy the requirements of the whole operating process.

These parameters are used for switchover between two groups of PID parameters. Regulator parameters FA-15 to FA-17 are set in the same way as FA-05 to FA-07.

The switchover can be implemented either through a DI or based on the PID deviation.

To enable switchover through a DI, assign the DI with function 43 (PID parameter switchover). If the DI is invalid, group 1 (FA-05 to FA-07) is selected. If the DI is valid, group 2 (FA-15 to FA-17) is selected.

If you select automatic switchover, when the absolute value of the deviation between the reference value and feedback is lower than the value of FA-19, group 1 is selected. When the absolute value of the deviation between the reference value and feedback is higher than the value of FA-20, group 2 is selected. When the deviation between PID feedback and PID reference is between the value of FA-19 and the value of FA-20, the PID parameters are the linear interpolated value of the two groups of parameter values, as shown in the following figure.

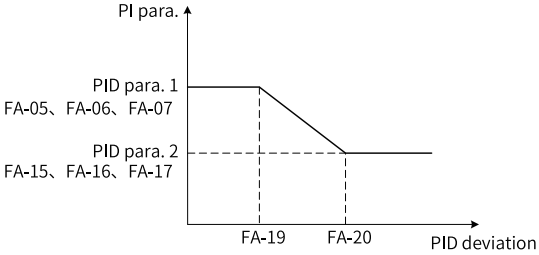


Figure 7-12 PID parameter switchover

Parameter	Name	Value Range	Default
FA-21	PID initial value	0.0% to 100.0%	0.0%
FA-22	PID initial value active time	0.00s to 650.00s	0.00s

When the AC drive starts, the PID starts the closed-loop regulation algorithm only after the PID output is fixed to the PID initial value (FA-21) and such status lasts for the time defined by FA-22. The following figure shows the PID initial value.

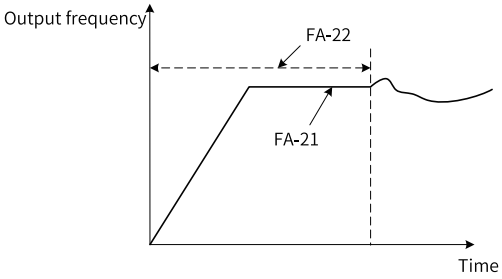


Figure 7-13 PID initial value

Parameter	Name	Value Range	Default
FA-23	Two-output deviation forward max.	0.00% to 100.00%	1.00%
FA-24	Two-output deviation reverse max.	0.00% to 100.00%	1.00%

This function is used to limit the difference between two PID outputs (2 ms every output) so as to suppress too fast PID output change and stabilize the running of the AC drive.

FA-23 and FA-24 specify the maximum output absolute value during forward running and reverse running, respectively.

Parameter	Name	Value Range	Default
FA-25	PID integral property	See the following table.	0

Value Range	Meaning
Ones position	Integral separation
0	Disabled
1	Enabled
Tens position	Whether to stop integral operation when the output reaches the limit
0	Continue integral operation
1	Stop integral operation

Integral separation:

If the integral separation is active, the PID integral operation stops when the DI assigned with function 22 is active. In this case, only proportional and derivative actions take effect.

If the integral separation is invalid, the integral separation remains invalid no matter whether the DI is valid.

Whether to stop integral operation when the output reaches the limit:

Determines whether to stop the integral operation when the PID operation output reaches the maximum or minimum value. If you select "Stop integral operation", the PID integral operation stops, which may help reduce the PID overshoot.

Parameter	Name	Value Range	Default
FA-26	Detection level of PID feedback loss	0.0%: No detection 0.1% to 100.0%	0.0%
FA-27	Detection time of PID feedback loss	0.0s to 20.0s	0.0s

These parameters are used to judge whether PID feedback is lost.

If the PID feedback remains smaller than the value of FA-26 and such status lasts for the time set in FA-27, the AC drive reports fault F31 and acts according to the selected fault protection action.

Parameter	Name	Value Range	Default
FA-28	PID operation at stop	0 to 1	0

Value Range	Meaning
0	Disabled
1	Enabled

It is used to determine whether to continue the PID operation when the AC drive stops. Generally, the PID operation needs to be stopped when the AC drive stops.

7.11 Group FC: Multi-Reference and Simple PLC

The multi-reference provided by the MV AC drive can be used to implement richer functions. Apart from the multi-speed function, it can also be used as the setting source for the simple PLC. Therefore, the multi-reference is a relative value.

The simple PLC function is different from the user programmable function. Simple PLC can only complete simple combination of multi-reference.

Parameter	Name	Value Range	Default
FC-00	Multi-reference 0	-100.0% to +100.0%	0.0%
FC-01	Multi-reference 1	-100.0% to +100.0%	0.0%
FC-02	Multi-reference 2	-100.0% to +100.0%	0.0%
FC-03	Multi-reference 3	-100.0% to +100.0%	0.0%
FC-04	Multi-reference 4	-100.0% to +100.0%	0.0%
FC-05	Multi-reference 5	-100.0% to +100.0%	0.0%
FC-06	Multi-reference 6	-100.0% to +100.0%	0.0%
FC-07	Multi-reference 7	-100.0% to +100.0%	0.0%
FC-08	Multi-reference 8	-100.0% to +100.0%	0.0%
FC-09	Multi-reference 9	-100.0% to +100.0%	0.0%
FC-10	Multi-reference 10	-100.0% to +100.0%	0.0 Hz
FC-11	Multi-reference 11	-100.0% to +100.0%	0.0%
FC-12	Multi-reference 12	-100.0% to +100.0%	0.0%
FC-13	Multi-reference 13	-100.0% to +100.0%	0.0%
FC-14	Multi-reference 14	-100.0% to +100.0%	0.0%
FC-15	Multi-reference 15	-100.0% to +100.0%	0.0%

Multi-reference can be used in multiple applications, such as acting as the frequency source or setting source of simple PLC.

The multi-reference is a relative value that ranges from –100.0% to +100.0%. When used as the frequency source, it is a percentage to the maximum frequency specified in F0-10. When used as the process PID setting source, it does not require value conversion.

Multi-reference can be switched based on different states of DIs. For details, see related descriptions for parameters in group F4.

Parameter	Name	Value Range	Default
FC-16	Simple PLC running mode	0 to 2	0

Value Range	Meaning
0	Stop after running for one cycle
1	Keep final values after running for one cycle
2	Repeat after running for one cycle

Simple PLC can be the frequency source or V/f separation voltage source.

The following figure describes the simple PLC used as the frequency source. When the simple PLC is used as the frequency source, the positive or negative values of FC-00 to FC-15 determine the running direction. If the parameter values are negative, the AC drive runs in the reverse direction.

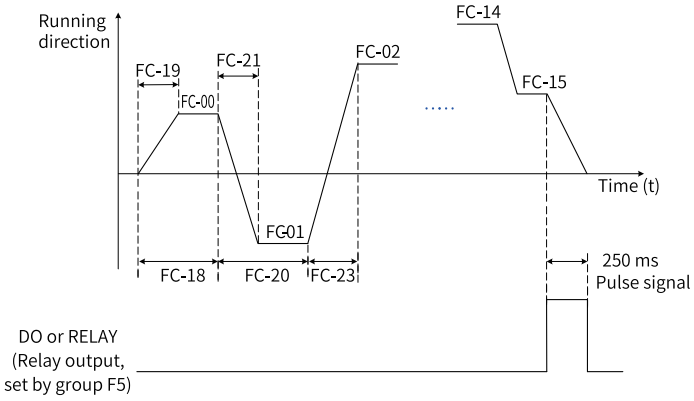


Figure 7-14 Simple PLC

When used as the frequency source, the PLC supports the following three running modes. When used as the V/f separation voltage source, the modes are not supported. Specifically:

0: Stop after running for one cycle

The drive stops after running for one cycle and will not start until receiving a run command.

1: Keep final values after running for one cycle

The AC drive keeps the final operating frequency and direction after running for one cycle.

2: Repeat after running for one cycle

The AC drive automatically starts another cycle after running for one cycle and will not stop until receiving the stop command.

Parameter	Name	Value Range	Default
FC-17	Simple PLC retentive selection	See the following table.	0

Value Range	Meaning
Ones position	Retention selection upon power failure
0	Non-retentive upon power failure
1	Retentive at power failure
Tens position	Retentive upon stop selection
0	Non-retentive upon stop
1	Retentive upon stop

PLC retentive upon power failure indicates that the AC drive memorizes the PLC running phase and operating frequency before power failure and will continue to run from the memorized values after it is powered on again. If "Non-retentive upon power failure" is selected, the AC drive restarts the PLC process after it is powered on again.

PLC retentive upon stop indicates that the AC drive memorizes the PLC running phase and operating frequency upon stop and will continue to run from the memorized values after it operates again. If "Non-retentive upon stop" is selected, the AC drive restarts the PLC process every time it starts.

Parameter	Name	Value Range	Default
FC-18	Simple PLC section 0 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-19	Acceleration/ deceleration time of simple PLC section 0	0 to 3	0
FC-20	Simple PLC section 1 running time	0s (h) to 6500.0s (h)	0.0s (h)

Parameter	Name	Value Range	Default
FC-21	Acceleration/ deceleration time of simple PLC section 1	0 to 3	0
FC-22	Simple PLC section 2 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-23	Acceleration/ deceleration time of simple PLC section 2	0 to 3	0
FC-24	Simple PLC section 3 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-25	Acceleration/ deceleration time of simple PLC section 3	0 to 3	0
FC-26	Simple PLC section 4 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-27	Acceleration/ deceleration time of simple PLC section 4	0 to 3	0
FC-28	Simple PLC section 5 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-29	Acceleration/ deceleration time of simple PLC section 5	0 to 3	0
FC-30	Simple PLC section 6 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-31	Acceleration/ deceleration time of simple PLC section 6	0 to 3	0
FC-32	Simple PLC section 7 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-33	Acceleration/ deceleration time of simple PLC section 7	0 to 3	0
FC-34	Simple PLC section 8 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-35	Acceleration/ deceleration time of simple PLC section 8	0 to 3	0
FC-36	Simple PLC section 9 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-37	Acceleration/ deceleration time of simple PLC section 9	0 to 3	0

Parameter	Name	Value Range	Default
FC-38	Simple PLC section 10 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-39	Acceleration/ deceleration time of simple PLC section 10	0 to 3	0
FC-40	Simple PLC section 11 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-41	Acceleration/ deceleration time of simple PLC section 11	0 to 3	0
FC-42	Simple PLC section 12 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-43	Acceleration/ deceleration time of simple PLC section 12	0 to 3	0
FC-44	Simple PLC section 13 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-45	Acceleration/ deceleration time of simple PLC section 13	0 to 3	0
FC-46	Simple PLC section 14 running time	0s (h) to 6500.0s (h)	0.0s (h)
FC-47	Acceleration/ deceleration time of simple PLC section 14	0 to 3	0
FC-48	Simple PLC section 15 running time	0s (h) to 6500.05s (h)	0.0s (h)
FC-49	Acceleration/ deceleration time of simple PLC section 15	0 to 3	0
FC-50	Simple PLC running time unit	0: s (second) 1: h (hour)	0

Parameter	Name	Value Range	Default
FC-51	Source of multi-reference 0	0 to 7	0

Value Range	Meaning
0	Value specified by FC-00
1	AI1
2	AI2
3	AI3
5	PID
6	Preset frequency (F0-08), which can be modified by the UP and DOWN keys
7	AI4

This parameter specifies the source of multi-reference 0.

You can perform convenient switchover between the reference sources. When multi-reference or simple PLC is used as the frequency source, the switchover between two frequency sources can be achieved easily.

7.12 Group FD: Communication Parameters

This group includes the system interface parameters for external communication.

Parameter	Name	Value Range	Default
FD-00	Baud rate	See the following table.	H.5065

Value Range	Value Range and Meaning
Ones: Modbus baud rate	1: 600 bps
	2: 1200 bps
	3: 2400 bps
	4: 4800 bps
	5: 9600 bps
	6: 19200 bps
	7: 38400 bps
	8: 57600 bps
	9: 115200 bps
Tens: RS2 baud rate	1: 600 bps
	2: 1200 bps
	3: 2400 bps
	4: 4800 bps
	5: 9600 bps
	6: 19200 bps
	7: 38400 bps
	8: 57600 bps
	9: 115200 bps
Hundreds: Reserved	Reserved
Thousands: CANlink baud rate	0: 20
	1: 50
	0.152777778
	0.211805556
	0.340277778
	0.555555556
	6: 1 M

This parameter is used to set the data transmission rate between the host computer and the AC drive. Note that the baud rate of the host computer must be the same as that of the AC drive. Otherwise, communication shall fail. A larger baud rate indicates faster communication speed.

Parameter	Name	Value Range	Default
FD-01	RS3 data format	0 to 3	0

Value Range	Meaning
0	No check (8-N-2)
1	Even parity check (8-E-1)
2	Odd parity check (8-O-1)
3	8-N-1

Parameter	Name	Value Range	Default
FD-06	RS2 data format	0 to 3	0

Value Range	Meaning
0	No check (8-N-2)
1	Even parity check (8-E-1)
2	Odd parity check (8-O-1)
3	8-N-1

This parameter is used to set the data format between the host computer and the AC drive. The setting on the host computer must be the same as that on the AC drive; otherwise, communication shall fail.

Parameter	Name	Value Range	Default
FD-02	RS3 local address	1 to 247 (0 is the broadcast address.)	1
FD-07	RS2 local address	1 to 247 (0 is the broadcast address.)	1

When the local address is set to 0 (that is, the broadcast address), the AC drive can only receive and execute broadcast commands of the host computer, but will not respond to the host computer.

This address is unique (except the broadcast address), which is the basis for point-to-point communication between the host computer and the AC drive.

Parameter	Name	Value Range	Default
FD-03	RS3 response delay	0 ms to 20 ms	2
FD-09	RS2 response delay	0 ms to 20 ms	2

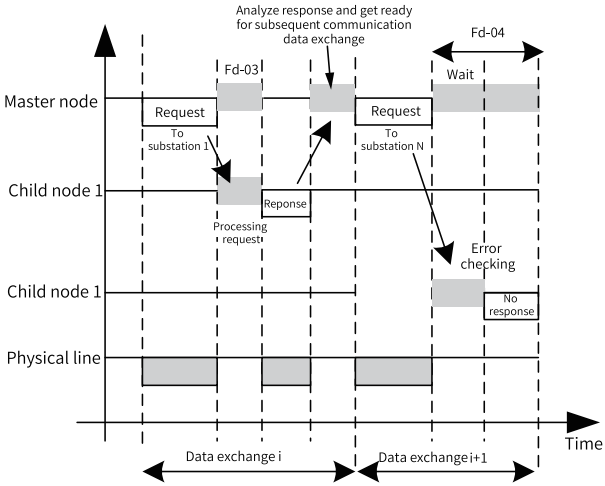


Figure 7-15 Master/slave commutation timing diagram in difference situations

This parameter is used to set the delay from the time when AC drive receives the frame matching the local address to the time when the AC drive starts returning a response frame. If the response delay is shorter than the system processing time, the system processing time shall prevail. If the response delay is longer than the system processing time, the system sends data to the host computer only after the response delay is up.

Parameter	Name	Value Range	Default
FD-04	RS3-Modbus communication timeout time	0.0 (inactive), 0.1s to 60.0s	0
FD-10	RS2-Modbus communication timeout time	-	0

When this parameter is set to 0.0s, the system does not detect communication timeout.

If this parameter is set to a non-zero value, when the AC drive does not receive the communication signal within the time set in this parameter, it will report the communication timeout fault (F16). Generally, set it to 0.0s. This parameter can be set to monitor communication status in a system with continuous communication.

Parameter	Name	Value Range	Default
FD-05	Data transmission format	See the following table.	1

Value Range	Meaning
Ones position	Ones: RS3-interface protocol selection
0	0: Non-standard Modbus protocol
1	1: Standard Modbus protocol
Tens position	Tens: RS2-interface protocol selection
0	0: Non-standard Modbus protocol for expansion I/O
1	1: Standard Modbus protocol for expansion I/O
2	2: Standard Modbus protocol

When the ones position is set to 1, the standard Modbus protocol is used; when the ones position is set to 0, the slave returns one more byte than in the standard Modbus protocol at the read command. For details, see "Appendix A: Modbus Communication Protocol".

Parameter	Name	Value Range	Default
FD-08	PROFIBUS communication timeout time	0.0 (inactive), 0.1s to 60.0s	0

When this parameter is set to 0.0s, the system does not detect communication timeout.

When it is set to an effective value, if time interval between this communication and next communication exceeds the value of this parameter, the system will report the DP communication fault (F52) and the fault level is selected in (F9-48). Generally, set it to 0.0s. This parameter can be set to monitor communication status in a system with continuous communication.

7.13 Group A6: Analog Parameters

Parameter	Name	Value Range	Default
A6-00	Minimum input of AI curve 1	0.00 mA to A6-02	4.00 mA
A6-01	Percentage corresponding to minimum input of AI curve 1	-100.00% to +100.0%	0.0%
A6-02	Maximum input of AI curve 1	A6-00 to 20.00 mA	20.00 mA

Parameter	Name	Value Range	Default
A6-03	Percentage corresponding to maximum input of AI curve 1	-100.00% to +100.0%	100.0%
A6-04	AI1 filter time	0.00s to 10.00s	0.10s
A6-05	Minimum input of AI curve 2	0.00 mA to A6-07	4.00 mA
A6-06	Percentage corresponding to minimum input of AI curve 2	-100.00% to +100.0%	0.0%
A6-07	Maximum input of AI curve 2	A6-00 to 20.00 mA	20.00 mA
A6-08	Percentage corresponding to maximum input of AI curve 2	-100.00% to +100.0%	100.0%
A6-09	AI2 filter time	0.00s to 10.00s	0.10s
A6-10	Minimum input of AI curve 3	0.00 mA to A6-12	4.00 mA
A6-11	Percentage corresponding to minimum input of AI curve 3	-100.00% to +100.0%	-100.0%
A6-12	Maximum input of AI curve 3	A6-10 to 20.00 mA	20.00 mA
A6-13	Percentage corresponding to maximum input of AI curve 3	-100.00% to +100.0%	100.0%

These parameters are used to define the relationship between the analog input voltage and the corresponding setting.

When the analog input current exceeds the maximum value (for example, A6-02), the maximum value is used. When the analog input current is less than the minimum value (for example, A6-00), the minimum value or 0.0% is used. If A6-11 is used, -100.0% is used.

The parameter AI filter time is used to set the software filter time of AI. If the analog input may be easily disturbed on site, increase the filter time to stabilize the detected analog value. Note that an excessively high AI filter time can slow down the responsiveness of analog detection. Set this parameter properly based on actual conditions.

In different applications, 100.0% of analog setting corresponds to different nominal values. For details, see the descriptions of different applications. The following figure shows a typical AI setting example

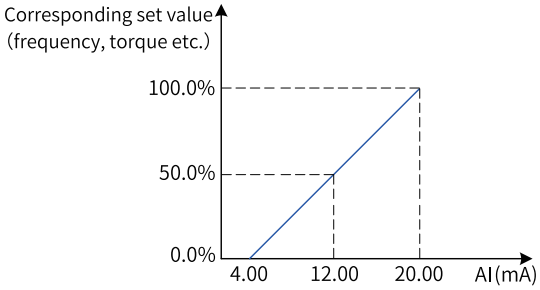


Figure 7-16 Relationship between analog input and corresponding setting

Parameter	Name	Value Range	Default
A6-14	Minimum input of AI curve 4	0.00 mA to A6-16	4.00 mA
A6-15	Percentage corresponding to minimum input of AI curve 4	-100.00% to +100.0%	0.0%
A6-16	Inflection 1 input of AI curve 4	A6-14 to A6-18	8.80 mA
A6-17	Percentage corresponding to inflection 1 input of AI curve 4	-100.00% to +100.0%	30.0%
A6-18	Inflection 2 input of AI curve 4	A6-16 to A6-20	13.60 mA
A6-19	Percentage corresponding to inflection 2 input of AI curve 4	-100.00% to +100.0%	60.0%
A6-20	Maximum input of AI curve 4	A6-18 to 20.0 mA	20.00 mA
A6-21	Percentage corresponding to maximum input of AI curve 4	-100.00% to +100.0%	100.0%
A6-22	Minimum input of AI curve 5	0.00 mA to A6-24	4.00 mA
A6-23	Percentage corresponding to minimum input of AI curve 5	-100.00% to +100.0%	-100.0%
A6-24	Inflection 1 input of AI curve 5	A6-22 to A6-26	9.60 mA

Parameter	Name	Value Range	Default
A6-25	Percentage corresponding to inflection 1 input of AI curve 5	-100.00% to +100.0%	-30.0%
A6-26	Inflection 2 input of AI curve 5	A6-24 to A6-28	14.40 mA
A6-27	Percentage corresponding to inflection 2 input of AI curve 5	-100.00% to +100.0%	30.0%
A6-28	Maximum input of AI curve 5	A6-26 to 20.00 mA	20.00 mA
A6-29	Percentage corresponding to maximum input of AI curve 5	-100.00% to +100.0%	100.0%

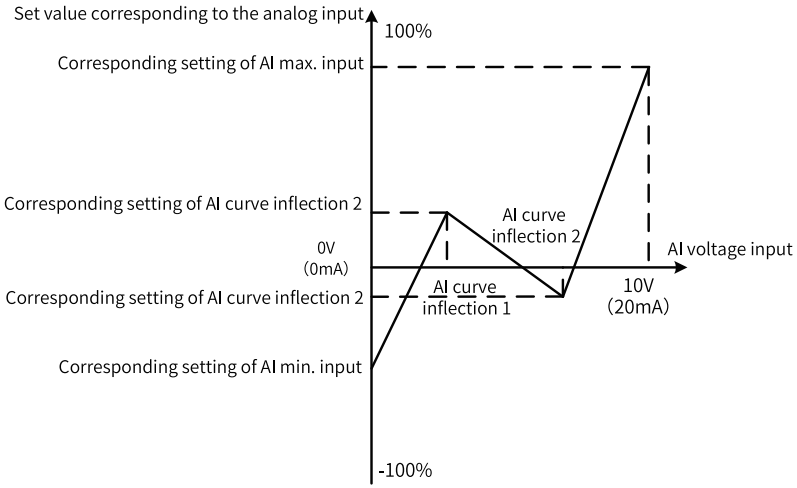


Figure 7-17 Percentage corresponding to AI - AI input voltage curve

In addition to the linear correspondence, AI curves 4 and 5 simultaneously provide inflection points 1 and 2. Using this function allows for more flexible setting of values corresponding to AI inputs. Note that the minimum AI input voltage (current), inflection point 1 voltage (current), inflection point 2 voltage (current), and maximum voltage (current) must increase in sequence.

Parameter	Name	Value Range	Default
A6-30	AI1 skip point	Default	0
	Value Range	-100.0% to +100.0%	
A6-31	AI1 skip amplitude	Default	0.5
	Value Range	0.0% to 100.0%	
A6-32	AI2 skip point	Default	0
	Value Range	-100.0% to +100.0%	
A6-33	AI2 skip amplitude	Default	0.5
	Value Range	0.0% to 100.0%	
A6-34	AI3 skip point	Default	0
	Value Range	-100.0% to +100.0%	
A6-35	AI3 skip amplitude	Default	0.5
	Value Range	0.0% to 100.0%	
A6-36	AI4 skip point	Default	0
	Value Range	-100.0% to +100.0%	
A6-37	AI4 skip amplitude	Default	0.5
	Value Range	0.0% to 100.0%	

AI1 to AI4 of HD9XS all support the setpoint jump function. The jump function fixes percentage corresponding to the AI to the jump point when this percentage jumps around the jump range.

For example, AI1 input voltage jumps around 5.00 V and the jump range is 4.90–5.10 V. AI1 minimum input 10.00 V corresponds to 100.0%. The detected AI1 input corresponding setting varies between 49.0% and 51.0%. If you set AI1 skip point to 50.0% and AI1 skip amplitude to 1.0%, then the obtained AI1 input corresponding setting is fixed to 50.0%, eliminating the fluctuation effect.

Parameter	Name	Value Range			Default
A6-48	AI curve selection 1	Ones: AI1 curve selection	1	Curve 1	1
			2	Curve 2	
			3	Curve 3	
			4	Curve 4	
			5	Curve 5	
		Tens: AI2 curve selection	1	Curve 1	1
			2	Curve 2	
			3	Curve 3	
			4	Curve 4	
			5	Curve 5	
		Hundreds: AI3 curve selection	1	Curve 1	1
			2	Curve 2	
			3	Curve 3	
			4	Curve 4	
			5	Curve 5	
		Thousands: AI4 curve selection	1	Curve 1	1
			2	Curve 2	
			3	Curve 3	
			4	Curve 4	
			5	Curve 5	

Set A9-14 to select AI1 to AI4 input curve modes. The specific curve modes 1 to 5 can be viewed in A6-01 to A6-29.

Parameter	Name	Value Range	Default
A6-50	Setting for AI less than minimum input	See the following table.	0

Value Range		Meaning
Ones: Corresponding value of AI1 minimum input	0	Corresponding percentage of minimum input
	1	0.0%
Tens: Corresponding value of AI2 minimum input	0	Corresponding percentage of minimum input
	1	0.0%
Hundreds: Corresponding value of AI3 minimum input	0	Corresponding percentage of minimum input
	1	0.0%
Thousands: Corresponding value of AI4 minimum input	0	Corresponding percentage of minimum input
	1	0.0%

Set A6-50 to select function at small AI input. 0 indicates the value is fixed to the minimum value and 1 indicates the value is fixed to 0.0%.

Parameter	Name	Default
A6-52	AO1 function selection	0
A6-53	AO2 function selection	2
A6-54	AO3 function selection	0
A6-55	AO4 function selection	0
A6-56	AO5 function selection	2

The output range of AO1 to AO5 is 4–20 mA.

The relationship between analog output ranges and corresponding functions is listed in the following table.

Value Range	Function	Range (Corresponding to Pulse or Analog Output Range 0.0%–100.0%)
0	Running frequency	0 to maximum output frequency
1	Target frequency	0 to maximum output frequency
2	Output current	0 to 2 times the rated motor current
3	Output torque	0 to 2 times the rated motor torque
4	Output power	0 to 2 times the rated motor power
5	Output voltage	0 to 1.5 times the rated voltage of the drive
7	AI1	4.00 mA to 20.00 mA
8	AI2	4.00 mA to 20.00 mA
9	AI3	4.00 mA to 20.00 mA
10	AI4	4.00 mA to 20.00 mA
12	Communication setting	0.0% to 100.0%
13	Motor speed	0 to rotational speed corresponding to maximum output frequency
16	Exciting current	0 to 2 times the rated motor current
17	Input voltage	0 to 1.5 times the rated input voltage of the drive
18	Input current	0 to 2 times the rated input current of the drive

Parameter	Name	Value Range	Default
A6-61	AO1 zero offset coefficient	–100.0% to +100.0%	20.0%
A6-62	AO1 gain	–10.00 to +10.00	0.8
A6-63	AO2 zero offset coefficient	–100.0% to +100.0%	20.00%
A6-64	AO2 gain	–10.00 to +10.00	0.8
A6-65	AO3 zero offset coefficient	–100.0% to +100.0%	20.0%

Parameter	Name	Value Range	Default
A6-66	AO3 gain	-10.00 to +10.00	0.8
A6-67	AO4 zero offset coefficient	-100.0% to +100.0%	20.00%
A6-68	AO4 gain	-10.00 to +10.00	0.8
A6-69	AO5 zero offset coefficient	-100.0% to +100.0%	20.0%
A6-70	AO5 gain	-10.00 to +10.00	0.8

These parameters are used to correct the offset of the analog output zero drift and the output amplitude. They can also be used to define the required AO curve.

On the AO curve, if b indicates the zero offset, k indicates the gain, and X indicates the standard output, the actual output Y is as follows:

Y = kX + b

The zero offset coefficient 100% of AO1 to AO5 corresponds to 20 mA. The standard output refers to the value corresponding to the analog output of 0–20 mA with no zero offset or gain adjustment.

Parameter	Name	Value Range				Default
A6-79	AI/AO type selection	Ones position	BIT0: AI3 type selection	0	Current input	0
				1	Voltage input	
		Tens position	BIT0: AO4 type selection	0	Current output	0
				1	Voltage output	
			BIT1: AO5 type selection	0	Current output	
				1	Voltage output	
		Hundreds position	BIT0: AI5 type selection	0	Current output	0
				1	Voltage output	
			BIT1: AI6 type selection	0	Current output	
				1	Voltage output	
		Thousands position	BIT0: AO6 type selection	0	Current output	0
				1	Voltage output	
			BIT1: AO7 type selection	0	Current output	
				1	Voltage output	
			BIT2: AO8 type selection	0	Current output	
				1	Voltage output	
			BIT3: AO9 type selection	0	Current output	
				1	Voltage output	

You can set A6-79 to select the type of each AI and AO. For example, when the hundreds position of A6-79 is set to 3, AI5 and AI6 are set to voltage output. When this position is set to 2, BIT1 is 1 but BIT0 is 0, which means that AI5 is set to current output and AI6 is set to voltage output.

After parameter setting, adjust the positions of jumpers on the I/O interface board as follows: Select AI3 voltage/current input at J6, AO4 voltage/current output at J8, and AO5 voltage/current output at J5.

Parameter	Name	Value Range	Default
A6-87	AI3 filter time	0.00s to 10.00s	0.10s
A6-88	AI4 filter time	0.00s to 10.00s	0.10s
A6-89	PLC AI filter time	1 beat to 250 beats	1 beat

The parameter filter time is used to set the software filter time of AI. If the analog input may be easily disturbed on site, increase the filter time to stabilize the detected analog value. Note that an excessively high AI filter time can slow down the responsiveness of analog detection. Set this parameter properly based on actual conditions.

Parameter	Name	Value Range				Default
A6-90	AI wire break age selection	Ones: AI1 wire breakage selection	BIT0: Reserved	-		2
			BIT1: Signal retention upon AI1 wire breakage	0	Non-retentive	
				1	Retentive	
		Tens: AI2 wire breakage selection	BIT0: Reserved	-		2
			BIT1: Signal retention upon AI2 wire breakage	0	Non-retentive	
				1	Retentive	
		Hundreds: AI3 wire breakage selection	BIT0: Reserved	-		2
			BIT1: Signal retention upon AI3 wire breakage	0	Non-retentive	
				1	Retentive	
		Thousands: AI4 wire breakage selection	BIT0: Reserved	-		2
			BIT1: Signal retention upon AI4 wire breakage	0	Non-retentive	
				1	Retentive	

Use A6-90 to set the effect upon wire breakage of AI1 to AI4. When a position is set to 2, the wire breakage retention function is enabled. If the value decrease of an AI exceeds the threshold, the AI is disconnected. If the wire breakage retention function is enabled, the conversion value of the AI is retained at the data before wire breakage.

7.14 Group A9: Unit Parameters

Parameter	Name	Value Range	Default
A9-00	Bypass enable	Ones position For details, see the following table.	0x0

Value Range	Meaning	Description
0	Disabled	-
1	Manual bypass	For models with a unit bypass contactor, set A9-04 and A9-05 to perform bypass for the specified unit.
2	Auto bypass	For models with a unit bypass contactor, automatically calculate the bypass command and bypass the unit according to the settings of A9-13 and A9-14 when the unit fails.
A	Manual bypass	For models without a unit bypass contactor, short the unit outputs T1 and T2 after MV power is cut off, and use HMI parameters to specify a bypassed unit to which the flow is switched to bypass the faulty unit.

Note

Operate the manual bypass unit (if any) as follows:

1. De-energize the entire medium-voltage system. Wait for more than 20 minutes. Ensure the unit voltage is completely discharged.
2. Disconnect the R/S/T input cables of the unit. Protect and secure the disconnected cables. Prevent the disconnected cables from coming into contact with other units or cabinets.
3. Short-circuit the T1/T2 output terminals of the unit with jumpers.
4. Set the manual bypass unit parameters on the HMI.

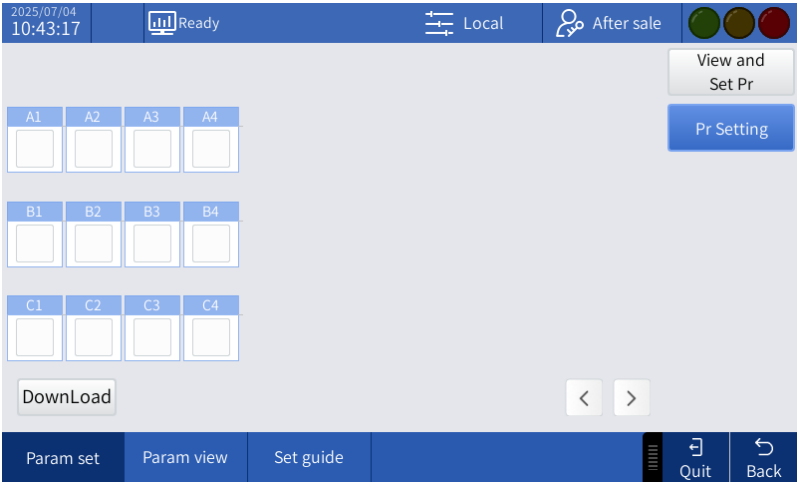


Figure 7-18 Page for manually bypassing the faulty unit

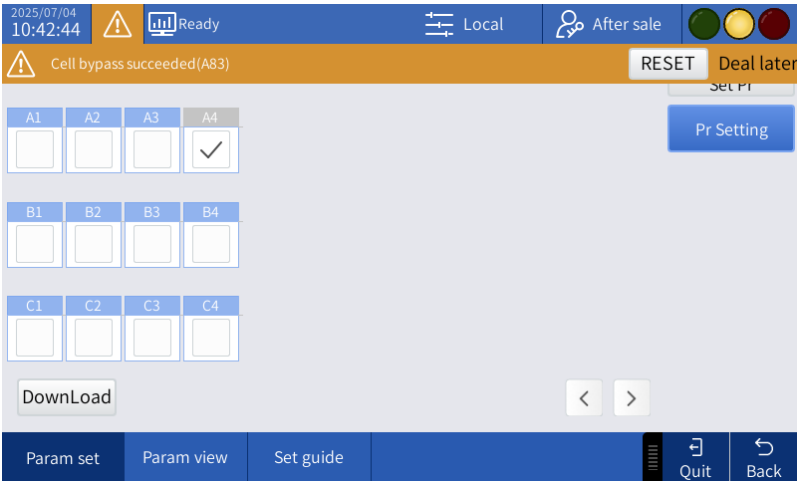


Figure 7-19 Selecting the unit to be bypassed

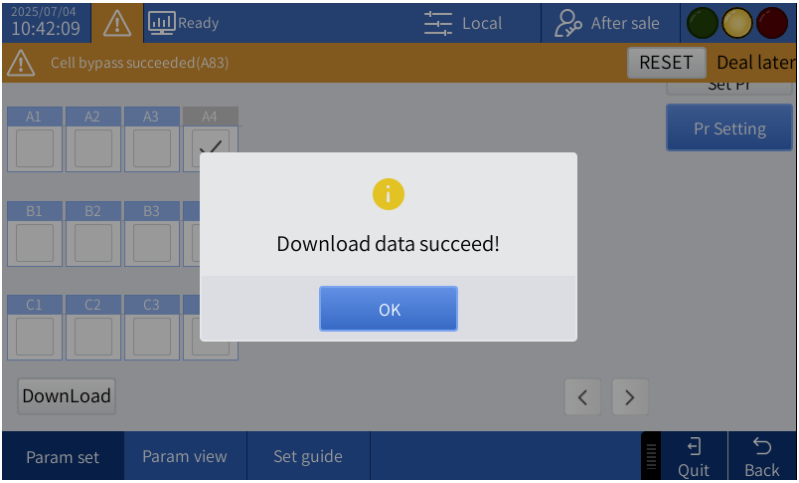


Figure 7-20 Unit manual bypass parameter download succeeded

On the "Parameter Settings" tab page, select "Parameter Settings", click the paging down button in the upper-right corner to access the unit bypass page, as shown in *"Figure 7-18 Page for manually bypassing the faulty unit" on page 206*. Click the button in the lower-right corner of the target unit field, and select the unit, as shown in *"Figure 7-19 Selecting the unit to be bypassed" on page 206*. Click the yellow button to download the bypass parameters. After download is completed, the download success is prompted, as shown in *"Figure 7-20 Unit manual bypass parameter download succeeded" on page 207*.

8 Troubleshooting

The MV AC drive provides rich alarm and fault functions. When a fault occurs on the AC drive, the system indicates the fault information clearly and performs protections according to the fault/alarm grade, such as stopping, bypassing the faulty power unit, or even cutting off the MV inputs.

The faults are indicated, and fault causes and solutions are displayed on the touch screen. This helps you quickly locate the fault and take countermeasures. If you need to seek technical support, contact us.

The system records all the faults. The system performs protection and stops output once a fault occurs. If the fault disappears itself, the fault indicator becomes OFF but the fault information is recorded. The AC drive can be re-started only after the fault is rectified and the system is reset by pressing the "Reset" button. When a critical fault occurs, the MV power switches off automatically. If the MV power does not switch off due to other reasons, press the "Emergency Stop" button on the control cabinet.

8.1 System Alarms

Alarm Code	Description	Cause	Solution
A05	Input overvoltage alarm	The input voltage is too high.	Adjust the input voltage to the normal range.
A11	Motor overload	1. Motor protection parameters are set improperly. 2. The load is too heavy or locked-rotor occurs on the motor. 3. The motor is faulty. 4. Three-phase output voltage sampling is abnormal. 5. The control hardware is faulty.	1. Set the motor overload parameters (F9-01 to F9-03) correctly. 2. Reduce the load and check the motor and mechanical conditions. 3. Check whether the motor and three-phase winding insulation are normal. 4. If three-phase output voltage sampling is abnormal, locked-rotor may occur on the motor and the output current reaches the upper limit. Check whether the three-phase output voltage sampling board and three-phase output voltage sampling circuit are normal. 5. Replace the I/O board or the MCB.
A15	External alarm	External fault signals are input through the multi-function DI.	Reset the AC drive.
A16	Communication alarm	1. The RS485 or CAN interface of the customer is abnormal. 2. The communication cable is damaged. 3. Communication parameters in the FD group are set incorrectly.	1. Check whether the RS485 or CAN interface of the customer is working properly. 2. Check the communication cable. 3. Set the communication parameters correctly.

Alarm Code	Description	Cause	Solution
A20	Encoder alarm	1. The parameters in the F1 group are set incorrectly. 2. The encoder and the PG card are incorrectly connected. 3. The PG card is faulty. 4. The 24 V or 15 V switched-mode power supply is abnormal. 5. The encoder is faulty. 6. The MCB is faulty.	1. Set the parameters in the F1 group correctly. 2. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 3. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 4. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 5. Replace the encoder. 6. Replace the I/O board or the MCB.

Alarm Code	Description	Cause	Solution
A23	Output insulation drop alarm	1. The three-phase output voltage sampling board is faulty. 2. The three-phase output voltage sampling circuit is abnormal. 3. The grounding insulation of the motor three-phase winding is abnormal. 4. The output grounding insulation of the AC drive is abnormal. 5. The control hardware is faulty.	1. Check whether the resistance and phase sequence of the three-phase output voltage sampling board are correct and whether U/V/W three-phase output power cables of the AC drive are connected properly. 2. Check whether the three-phase output voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Disconnect the AC drive from the motor and rectify the three-phase winding insulation fault of the motor. 4. Disconnect the AC drive from the motor and use a multimeter to measure the U/V/W three-phase output impedance to earth of the AC drive. In normal cases, the impedance must be 1 MΩ or higher. 5. Replace the I/O board or the MCB.
A27	User-defined alarm 1 alarm	1. The signal of user-defined fault 1 that is input through the multi-function DI terminal is active. 2. The I/O board is faulty.	1. Reset the AC drive. 2. Replace the other DI terminal or the I/O board.
A28	User-defined alarm 2 alarm	1. The signal of user-defined fault 2 that is input through the multi-function DI terminal is active. 2. The I/O board is faulty.	1. Reset the AC drive. 2. Replace the other DI terminal or the I/O board.

Alarm Code	Description	Cause	Solution
A31	PID feedback loss during operation	The PID feedback is smaller than that set by FA-26 and lasts for the time set by FA-27.	Check the PID feedback signal or set FA-26 or FA-27 properly.
A42	Excessive speed deviation	1. The encoder parameters are set incorrectly. 2. Motor auto-tuning is not performed. 3. The excessive speed deviation detection time is set incorrectly. 4. The encoder and the PG card are incorrectly connected. 5. The PG card is faulty. 6. The 24 V or 15 V switched-mode power supply is abnormal. 7. The MCB is faulty. 8. The encoder is faulty.	1. Set encoder parameters in the F1 group properly. 2. Perform motor auto-tuning before running the motor. 3. Set the F9-70 parameter based on actual conditions. 4. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 5. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 6. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 7. Replace the I/O board or the MCB. 8. Replace the encoder.

Alarm Code	Description	Cause	Solution
A43	Motor overspeed	1. The encoder parameters are set incorrectly. 2. Motor auto-tuning is not performed. 3. The overspeed detection parameters are set improperly. 4. The encoder and the PG card are incorrectly connected. 5. The PG card is faulty. 6. The 24 V or 15 V switched-mode power supply is abnormal. 7. The MCB is faulty. 8. The encoder is faulty.	1. Set encoder parameters in the F1 group properly. 2. Perform motor auto-tuning before running the motor. 3. Set F9-67 and F9-68 based on actual conditions. 4. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 5. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 6. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 7. Replace the I/O board or the MCB. 8. Replace the encoder.
A45	Motor overheat alarm	The value of the motor over-temperature pre-warning threshold (F9-58) is not 0, and the temperature of any of the channels CH1 to CH4 collected by the PLC is higher than the setpoint. F9-90 is set to Enabled, indicating temperature detection for PLC channels.	1. Set F9-90 to Disabled to disable temperature detection for PLC channels as needed. 2. Check whether the motor is locked or over-loaded. If so, reduce the load.
A46	Control system voltage supply alarm	1. The 24 V control power supply is abnormal. 2. The control power supply detection circuit is abnormal. 3. The DI terminal of the I/O board is abnormal. 4. The control hardware is faulty.	1. Check whether the control system provides 24 V power supply. 2. Check the control power supply detection circuit. 3. Use another DI terminal or replace the I/O board. 4. Replace the I/O board or the MCB.

Alarm Code	Description	Cause	Solution
A52	DP communication alarm	1. Communication between the DP/PN card and the PLC master is interrupted. 2. The slave number of the DP/PN card is out of range. 3. Communication between the DP/PN card and the PLC master timed out.	1. Check whether the DP card and the PLC master are properly and reliably connected. 2. Modify the slave number of the DP card to the allowed range. 3. Adjust the PROFIBUS timeout time (FD-08).
A80	Unit over-temperature alarm	1. The ambient temperature or unit temperature is too high. 2. The unit is not well ventilated. 3. The filter screen is blocked. 4. The fan on top of the cabinet is faulty. 5. The unit control board is faulty.	1. Reduce the ambient temperature. 2. Replace the unit or contact technical support. 3. Clean the dust filter. 4. Check whether the cooling fan is running in reverse direction and whether the fan on the top of the cabinet is faulty. 5. Replace the faulty unit control board.
A82	Analog wire breakage alarm	1. The reference value of AI1 to AI4 is excessively low or disconnection occurs on AI1 to AI4. 2. The AI terminal specified by A6-90 does not match the one used. 3. An AI terminal is faulty. 4. The I/O board is faulty.	1. Check and confirm that the AI terminals are connected properly. 2. Confirm that the AI terminal specified by A6-90 matches the one used. 3. Replace the other AI terminal or the I/O board. 4. Replace the I/O board.

Alarm Code	Description	Cause	Solution
A83	Unit bypass alarm	1. A unit bypass exists. 2. The unit bypass board feedback state is incorrect. 3. The unit control board is faulty. 4. The unit bypass board is faulty.	1. View the records to check why the unit is bypassed. Replace the faulty unit. 2. Connect to the MV power supply again, perform unit self-test, and check whether the HMI unit bypass board is working properly. 3. Replace the faulty unit control board. 4. Replace the unit bypass board.
A85	Transformer pre-overload	1. The load is too heavy or locked-rotor occurs on the motor. 2. The input transformer is faulty. 3. The power rating of the AC drive is too low.	1. Reduce the load and check the motor and mechanical conditions. 2. Contact technical support. 3. Select a drive of higher power rating.
A86	Motor pre-overload	1. Motor protection parameters are set improperly. 2. The load is too heavy or locked-rotor occurs on the motor. 3. The motor is faulty. 4. Three-phase output voltage sampling is abnormal. 5. The control hardware is faulty.	1. Set F9-01 to F9-03 properly. 2. Reduce the load and check the motor and mechanical conditions. 3. Check whether the motor and three-phase winding insulation are normal. 4. If three-phase output voltage sampling is abnormal, locked-rotor may occur on the motor and the output current reaches the upper limit. Check whether the three-phase output voltage sampling board and three-phase output voltage sampling circuit are normal. 5. Replace the control hardware. Contact technical support.

Alarm Code	Description	Cause	Solution
A87	Input transformer overheat alarm	1. The ambient temperature is too high (higher than the setpoint of FF-26). 2. The filter screen is blocked. 3. The gap of the transformer weather board becomes larger. 4. The cooling fan on the cabinet top works improperly. 5. The humiture board is faulty. 6. The control hardware is faulty.	1. Check and record the ambient temperature properly. 2. Clean the dust filter. 3. Check whether the gap of the transformer weather board is too large. 4. Check whether the cooling fan is running in reverse direction and whether the fan on the top of the cabinet is faulty. 5. Check whether the humiture board operates properly. 6. Replace the I/O board or the MCB. Contact technical support.
A89	Fan alarm	1. The DO output configuration does not match the electric interface when the fan runs automatically. 2. The thermal relay is faulty. 3. The fan is faulty. 4. The DI circuit of the I/O board is abnormal. 5. The control hardware is faulty.	1. Check whether the DO configuration is consistent during auto fan running. 2. Check the auto-tuning setting of the thermal relay and whether the thermal relay is working properly. 3. Replace the cooling fan on top of the cabinet. 4. Use another DI terminal or replace the I/O board. 5. Replace the I/O board or the MCB.
A123	Locked-rotor alarm	1. The load is too heavy or locked-rotor occurs on the motor. 2. The motor power is not large enough, and the power rating of the drive is low. 3. F9-40 and F9-41 are set improperly.	1. Perform motor auto-tuning before running the motor in vector control mode. 2. Reduce the load and check the motor and mechanical conditions. 3. Restore locked-rotor parameters to factory settings.

Alarm Code	Description	Cause	Solution
A182	Unit bypass contactor fault	1. The unit bypass board feedback state is incorrect. 2. The unit bypass board is faulty.	1. Connect to the MV power supply again, perform unit self-test, and check whether the HMI unit bypass board is working properly. 2. Replace the faulty unit control board.
A185	Unit bad communication	1. The optical fiber of the unit is damaged. 2. The power supply of the optical fiber communication link is disturbed.	1. Replace the optical fiber. 2. Contact technical support.
A186	Input voltage drop alarm	After the power dip ride-through function is enabled, the drive's input voltage drops out of expectation after power-on but the voltage is still within the range specified in Table 6-1.	Check whether the power grid error is caused by startup or operation of large device.

8.2 System Faults

Fault Code	Description	Cause	Solution
F02	Overcurrent during acceleration	1. The output current sampling circuit is abnormal. 2. The output Hall is abnormal. 3. Motor parameters in the F1 group are incorrectly configured. Vector control is adopted and motor auto-tuning is not performed. 4. The setpoint of F9-30 (AC drive overcurrent point) is too low. 5. The MCB is faulty. 6. A rotating motor is being started. 7. A sudden load is applied during acceleration. 8. The power rating of the AC drive is too low. 9. T1 and T2 on the unit output side are connected inversely.	1. Check whether the output current sampling circuit is connected correctly and whether open circuit or loose connection occurs. Check whether the output Hall is installed reversely. 2. Check whether ±15 V and M signals of the output Hall are connected correctly. Replace the output Hall. 3. Set the motor parameters in the F1 group correctly. Perform motor auto-tuning before operation. 4. Properly increase the value of F9-30. 5. Replace the MCB and reset the AC drive parameters. 6. Enable the flying start function or wait for the motor to stop completely before starting the motor. 7. Cancel the sudden load applied during acceleration. 8. Select a drive of higher power rating. 9. Check the serial-connection line and central line on the unit output side.

Fault Code	Description	Cause	Solution
F03	Overcurrent during deceleration	1. The output current sampling circuit is abnormal. 2. The output Hall is abnormal. 3. Motor parameters in the F1 group are incorrectly configured. Vector control is adopted and motor auto-tuning is not performed. 4. The setpoint of F9-30 (AC drive overcurrent point) is too low. 5. The MCB is faulty. 6. A rotating motor is being started. 7. A sudden load is applied during acceleration. 8. The power rating of the AC drive is too low. 9. T1 and T2 on the unit output side are connected inversely.	1. Check whether the output current sampling circuit is connected correctly and whether open circuit or loose connection occurs. Check whether the output Hall is installed reversely. 2. Check whether ±15 V and M signals of the output Hall are connected correctly. Replace the output Hall. 3. Set the motor parameters in the F1 group correctly. Perform motor auto-tuning before operation. 4. Properly increase the value of F9-30. 5. Replace the MCB and reset the AC drive parameters. 6. Enable the flying start function or wait for the motor to stop completely before starting the motor. 7. Cancel the sudden load applied during acceleration. 8. Select a drive of higher power rating. 9. Check the serial-connection line and central line on the unit output side.

Fault Code	Description	Cause	Solution
F04	Overcurrent during operation at constant speed	1. The output current sampling circuit is abnormal. 2. The output Hall is abnormal. 3. Motor parameters in the F1 group are incorrectly configured. Vector control is adopted and motor auto-tuning is not performed. 4. The setpoint of F9-30 (AC drive overcurrent point) is too low. 5. The MCB is faulty. 6. A rotating motor is being started. 7. A sudden load is applied during acceleration. 8. The power rating of the AC drive is too low. 9. T1 and T2 on the unit output side are connected inversely.	1. Check whether the output current sampling circuit is connected correctly and whether open circuit or loose connection occurs. Check whether the output Hall is installed reversely. 2. Check whether ±15 V and M signals of the output Hall are connected correctly. Replace the output Hall. 3. Set the motor parameters in the F1 group correctly. Perform motor auto-tuning before operation. 4. Properly increase the value of F9-30. 5. Replace the MCB and reset the AC drive parameters. 6. Enable the flying start function or wait for the motor to stop completely before starting the motor. 7. Cancel the sudden load applied during acceleration. 8. Select a drive of higher power rating. 9. Check the serial-connection line and central line on the unit output side.

Fault Code	Description	Cause	Solution
F09	User medium-voltage power undervoltage	1. The running AC drive is not connected to medium-voltage power supply. 2. The three-phase input voltage sampling board is faulty. 3. The input voltage sampling circuit of the AC drive is abnormal. 4. The input voltage of the AC drive is not within the specified range. 5. The control hardware is faulty.	1. Stop the AC drive operation, connect to medium-voltage power supply after confirming that the AC drive operates normally, and wait for the unit to complete self test. 2. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 3. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 4. Adjust the input voltage to the normal range. 5. Replace the I/O board or the MCB.
F10	AC drive overload	1. The load is too heavy or locked-rotor occurs on the motor. 2. The input transformer is faulty. 3. The power rating of the AC drive is too low.	1. Reduce the load and check the motor and mechanical conditions. 2. Contact technical support. 3. Select a drive of higher power rating.

Fault Code	Description	Cause	Solution
F11	Motor overload	1. Motor protection parameters are set improperly. 2. The load is too heavy or locked-rotor occurs on the motor. 3. The motor is faulty. 4. Three-phase output voltage sampling is abnormal. 5. The control hardware is faulty.	1. Set the motor overload parameters (F9-01 to F9-03) correctly. 2. Reduce the load and check the motor and mechanical conditions. 3. Check whether the motor and three-phase winding insulation are normal. 4. If three-phase output voltage sampling is abnormal, locked-rotor may occur on the motor and the output current reaches the upper limit. Check whether the three-phase output voltage sampling board and three-phase output voltage sampling circuit are normal. 5. Replace the I/O board or the MCB.
F12	Input phase loss	1. The three-phase power input is abnormal. 2. The three-phase input voltage sampling board is faulty. 3. The input voltage sampling circuit of the AC drive is abnormal. 4. The control hardware is faulty.	1. Check and eliminate faults in peripheral circuits. 2. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 3. Rectify the fault of the three-phase input voltage sampling circuit. 4. Replace the I/O board or the MCB. Contact technical support.

Fault Code	Description	Cause	Solution
F13	Output phase loss	1. The cable from the AC drive to the motor is abnormal. 2. The output is not connected to the motor.	1. Remove the fault that occurs in periphery parts. 2. Connect the output to the motor load.
F15	External fault	External fault signals are input through the multi-function DI.	Eliminate the external fault signal input through the DI.
F16	Communication fault	1. The RS485 or CAN interface of the customer is abnormal. 2. The communication cable is damaged. 3. Communication parameters in the FD group are set incorrectly.	1. Check whether the RS485 or CAN interface of the customer is working properly. 2. Check the communication cable. 3. Set the communication parameters correctly.

Fault Code	Description	Cause	Solution
F19	Motor auto-tuning fault	1. Three-phase output current sampling is abnormal. 2. The output Hall is abnormal. 3. Three-phase output voltage sampling is abnormal. 4. The three-phase output voltage sampling board is faulty. 5. The output is not connected to the motor. 6. The motor is driven by an external force. 7. Parameters in the F1 group are not set based on the motor nameplate. 8. The control hardware is faulty.	1. Check whether the output current sampling circuit is connected correctly and whether open circuit or loose connection occurs. 2. Check whether ±15 V and M signals of the output Hall are connected correctly. Replace the output Hall. 3. Check whether the three-phase output voltage sampling circuit is connected correctly without open circuit or loose connection. Check whether U/V/W power cables of the AC drive are connected properly. 4. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 5. Connect the output to the motor. 6. Cancel the external force. 7. Set the motor parameters in the F1 group correctly. 8. Replace the I/O board or the MCB.

Fault Code	Description	Cause	Solution
F20	Encoder fault	1. The parameters in the F1 group are set incorrectly. 2. The encoder and the PG card are incorrectly connected. 3. The PG card is faulty. 4. The 24 V or 15 V switched-mode power supply is abnormal. 5. The encoder is faulty. 6. The MCB is faulty.	1. Set the parameters in the F1 group correctly. 2. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 3. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 4. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 5. Replace the encoder. 6. Replace the I/O board or the MCB.
F21	Parameter read-write error	The EEPROM chip is damaged.	Replace the MCB.
F27	User-defined fault 1	1. The signal of user-defined fault 1 that is input through the multi-function DI terminal is active. 2. The I/O board is faulty.	1. Reset the AC drive. 2. Replace the other DI terminal or the I/O board.
F28	User-defined fault 2	1. The signal of user-defined fault 2 that is input through the multi-function DI terminal is active. 2. The I/O board is faulty.	1. Reset the AC drive. 2. Replace the other DI terminal or the I/O board.
F31	PID feedback loss during operation	The PID feedback is lower than the value of FA-26.	Check the PID feedback signal or set FA-26 properly.

Fault Code	Description	Cause	Solution
F32	Input impedance too low	1. The three-phase input voltage sampling board is faulty. 2. The three-phase input voltage sampling circuit is abnormal. 3. The input grounding insulation of the AC drive is abnormal. 4. The control hardware is faulty. 5. The input transformer is faulty.	1. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 2. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Disconnect the AC drive from the grid and use a multimeter to measure the R/S/T three-phase input impedance to earth of the AC drive. In normal cases, the impedance must be 1 MΩ or higher. 4. Replace the I/O board or the MCB. 5. Contact technical support.
F33	AC drive contactor fault	1. The output circuit of the AC drive contactor is abnormal. 2. The feedback loop of the AC drive contactor is abnormal. 3. The AC drive contactor is damaged.	1. Check the output terminal configuration of the AC drive contactor and whether output wiring is correct and intact without damage. 2. Check the feedback configuration of the AC drive contactor and whether feedback wiring is correct and intact without damage. 3. Replace the AC drive contactor.

Fault Code	Description	Cause	Solution
F34	Input transformer overload	1. The load is too heavy or locked-rotor occurs on the motor. 2. The power rating of the AC drive is too low. 3. The control hardware is faulty. 4. The input transformer is faulty.	1. Reduce the load and check the motor and mechanical conditions. 2. Select a drive of higher power rating. 3. Replace the I/O board or the MCB. 4. Contact technical support.
F35	Transformer no-load current error	1. The transformer is faulty. 2. The input current detection circuit is abnormal.	1. Contact technical support. 2. Contact technical support.
F36	Input current asymmetry fault	1. The input current detection circuit is abnormal. 2. The instrument transformer for input current sampling is faulty. 3. The input transformer has an exception on the input side. 4. The control hardware is faulty.	1. Check whether the input current detection circuit is connected correctly and whether open circuit or loose connection occurs. 2. Check whether the two-level current transformer is correctly installed and rectify the fault. 3. Contact technical support. 4. Replace the I/O board or the MCB.

Fault Code	Description	Cause	Solution
F37	Input voltage out of limit	1. The AC drive is not connected to the correct medium-voltage grid. 2. The three-phase input voltage sampling board is faulty. 3. The three-phase input voltage sampling circuit is abnormal. 4. The control hardware is faulty.	1. Check whether the AC drive is connected to the correct medium-voltage grid. 2. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 3. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 4. Replace the I/O board or the MCB.
F38	Output current asymmetry	1. The wiring between the AC drive and the motor is loose. 2. The output current sampling circuit of the AC drive is abnormal. 3. The control hardware is faulty. 4. The parameters in the F1 group are incorrectly set.	1. Check the wiring and tighten the screws. 2. Check the output current sampling circuit. 3. Replace the I/O board or the MCB. 4. Set the motor parameters in the F1 group correctly.
F39	PLC communication error	1. The PLC is not powered on. 2. The PLC is not running. 3. The communication circuit between the PLC and the control board is abnormal.	1. Check the PLC power. 2. Check whether the PLC is in the RUN state. 3. Check the communication circuit wiring of the PLC.

Fault Code	Description	Cause	Solution
F41	Motor switchover fault during operation	1. Motor switchover occurs during operation. 2. A motor selection terminal is configured, but the run command is delivered before an effective motor is selected. 3. The motor selection terminal is incorrectly wired. 4. The control hardware is faulty.	1. Do not switch the motor during operation. 2. Deliver the start command after the corresponding motor selection terminal becomes active. 3. Confirm the motor selection terminal configuration or the wiring circuit. 4. Cancel the motor selection terminal configuration and select an effective motor by using the parameter number.
F42	Excessive speed deviation	1. The encoder parameters are set incorrectly. 2. Motor auto-tuning is not performed. 3. The excessive speed deviation detection parameter is set incorrectly. 4. The encoder and the PG card are incorrectly connected. 5. The PG card is faulty. 6. The 24 V or 15 V switched-mode power supply is abnormal. 7. The MCB is faulty. 8. The encoder is faulty.	1. Set encoder parameters in the F1 group properly. 2. Perform motor auto-tuning before running the motor. 3. Set the F9-69 parameter based on actual conditions. 4. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 5. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 6. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 7. Replace the I/O board or the MCB. 8. Replace the encoder.

Fault Code	Description	Cause	Solution
F43	Motor overspeed	1. The encoder parameters are set incorrectly. 2. Motor auto-tuning is not performed. 3. The excessive speed deviation detection parameter is set incorrectly. 4. The encoder and the PG card are incorrectly connected. 5. The PG card is faulty. 6. The 24 V or 15 V switched-mode power supply is abnormal. 7. The MCB is faulty. 8. The encoder is faulty.	1. Set encoder parameters in the F1 group properly. 2. Perform motor auto-tuning before running the motor. 3. Set F9-67 and F9-68 based on actual conditions. 4. Connect the cable to the PG card properly. Check whether open circuit or loose connection occurs. 5. Check whether the flat cable of MF38PG5 PG card is in good contact and wired properly. 6. Check whether the 24 V and 15 V switched-mode power supplies are normal. Replace the I/O board. 7. Replace the I/O board or the MCB. 8. Replace the encoder.

Fault Code	Description	Cause	Solution
F44	Pre-charge fault	1. The pre-charge contactor is not closed. 2. The upstream input voltage is not large enough. 3. The pre-charge control circuit is abnormal. 4. The pre-charge controller is faulty. 5. The bus voltage of any unit cannot be charged. 6. The self test cannot be completed due to a unit communication or hardware exception. 7. No input current is available during pre-charging. 8. The control hardware is faulty.	1. Check whether the pre-charge contactor can be normally closed. 2. Confirm the upstream input voltage. 3. Check whether the pre-charge control circuit is correctly connected without open circuit or loose connection. 4. Check whether the pre-charge controller operates properly. 5. Check whether input terminals of the unit are wired properly. 6. Replace the unit optical fiber and unit control board, and pre-charge the unit. 7. Change A9-29 to a smaller value. 8. Replace the I/O board or the MCB.
F45	Motor over-temperature	1. The external value of DI function 134 (Motor over-temperature feedback) is active. 2. The value of the motor over-temperature pre-warning threshold (F9-57) is not 0, and the temperature of any of the channels CH1 to CH4 collected by the PLC is higher than the setpoint. 3. Temperature detection enabling (F9-90) is not set as required.	1. Check whether disconnection occurs for the external setpoint of the DI. 2. Check whether the motor is locked or over-loaded. If so, reduce the load. 3. Cancel motor over-temperature detection for the channels that do not need this function.

Fault Code	Description	Cause	Solution
F46	Control system power supply fault	1. The 24 V control power supply is abnormal. 2. The control power supply detection circuit is abnormal. 3. The DI terminal of the I/O board is abnormal. 4. The control hardware is faulty.	1. Check whether the control system provides 24 V power supply. 2. Check the control power supply detection circuit. 3. Use another DI terminal or replace the I/O board. 4. Replace the I/O board or the MCB.
F51	Pole position detection failure	Contact technical support.	Contact technical support.
F52	DP card communication fault	1. Communication between the DP/PN card and the PLC master is interrupted. 2. The slave number of the DP/PN card is out of range. 3. Communication between the DP/PN card and the MCB timed out.	1. Check whether the DP card and the PLC master are properly and reliably connected. 2. Modify the slave number of the DP card to the allowed range. 3. Adjust the PROFIBUS timeout time (FD-08).
F54	Excitation cabinet fault	1. Terminal function 57 (Excitation cabinet fault feedback) is active. 2. The excitation command output of the excitation cabinet is inconsistent with the excitation status feedback.	1. Check the input signal of the terminal for short circuit or disconnection. 2. Check whether the excitation cabinet is faulty. If so, reset the excitation cabinet. 3. Check the signal of the excitation command for disconnection and whether the excitation cabinet starts or stops according to the command. 4. Check the feedback signal line of the excitation cabinet for disconnection.

Fault Code	Description	Cause	Solution
F55	Output overvoltage	1. The power rating of the motor does not match that of the AC drive. 2. The motor parameters in the F1 group are incorrectly set.	1. Select another AC drive or motor. 2. Check whether motor parameters in the F1 group are set correctly.
F57	Input transformer over-temperature	1. The ambient temperature is too high (higher than the setpoint of FF-25). 2. The filter screen is blocked. 3. The gap of the transformer weather board becomes larger. 4. The cooling fan on the cabinet top works improperly. 5. The over-temperature fault detection circuit signal of the AC drive is abnormal. 6. The humiture board is faulty. 7. The control hardware is faulty.	1. Check and record the ambient temperature properly. 2. Clean the dust filter. 3. Check whether the gap of the transformer weather board is too large. 4. Check whether the cooling fan is running in reverse direction and whether the fan on the top of the cabinet is faulty. 5. Check whether the over-temperature fault detection circuit of the AC drive is disconnected, connected loosely, or connected incorrectly. 6. Check whether the humiture board operates properly. 7. Replace the I/O board or the MCB. Contact technical support.

Fault Code	Description	Cause	Solution
F58	Cabinet door travel switch fault	1. The cabinet door is closed improperly. 2. The cabinet door travel switch is faulty. 3. The fault detection circuit of the cabinet door travel switch is abnormal. 4. The DI circuit of the I/O board is abnormal. 5. The control hardware is faulty.	1. Check the closed state of all cabinet doors. 2. Check the cabinet door travel switch and its contact. 3. Check whether the fault detection circuit of the cabinet door travel switch is disconnected, connected loosely, or connected incorrectly. 4. Use another DI terminal or replace the I/O board. 5. Replace the I/O board or the MCB.
F59	Fan fault	1. The DO output configuration does not match the electric interface when the fan runs automatically. 2. The fan is faulty. 3. Permissible number of fan faults (F9-76) is set incorrectly. 4. The DI circuit of the I/O board is abnormal. 5. The control hardware is faulty.	1. Check whether the DO configuration is consistent during auto running. 2. Replace the cooling fan on top of the cabinet. 3. Set the F9-76 parameter based on actual conditions. 4. Use another DI terminal or replace the I/O board. 5. Replace the I/O board or the MCB.
F119	Parameter setting error	Cabinet top fan feedback is not specified.	Set the cabinet top fan feedback DI correctly.

Fault Code	Description	Cause	Solution
F120	Input voltage unbalance	1. The three-phase input voltage sampling board is faulty. 2. The three-phase input voltage sampling circuit is abnormal. 3. The control hardware is faulty. 4. The grid input voltage is abnormal.	1. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 2. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Replace the I/O board or the MCB. 4. Check whether the grid voltage on the user input end is normal.
F121	Output voltage unbalance	1. The three-phase output voltage sampling board is faulty. 2. The three-phase output voltage sampling circuit is abnormal. 3. The control hardware is faulty.	1. Check whether the resistance and phase sequence of the three-phase output voltage sampling board are correct and whether U/V/W three-phase output power cables of the AC drive are connected properly. 2. Check whether the three-phase output voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Replace the I/O board or the MCB.

Fault Code	Description	Cause	Solution
F122	Motor excitation fault	1. The three-phase output voltage sampling board is faulty. 2. The three-phase output voltage sampling circuit is abnormal. 3. The runaway current reference (F6-16) is too large. 4. The control hardware is faulty.	1. Check whether the resistance and phase sequence of the three-phase output voltage sampling board are correct and whether U/V/W three-phase output power cables of the AC drive are connected properly. 2. Check whether the three-phase output voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Check whether the value of F6-16 meets the site requirements. Generally, the value is smaller than the no-load current (F1-10). 4. Replace the I/O board or the MCB.
F157	Fan power supply fault	The fan power supply is abnormal.	Contact technical support.

Fault Code	Description	Cause	Solution
F160	Input voltage abnormal	1. The three-phase input voltage sampling board is faulty. 2. The three-phase input voltage sampling circuit is abnormal. 3. The control hardware is faulty. 4. The grid input voltage is abnormal. 5. The circuit breaker feedback is abnormal. 6. Pre-charge resistor error	1. Check whether the three-phase input voltage sampling board, resistance of the sampling board, and phase sequence are correct and whether R/S/T three-phase power cables of the AC drive are connected properly. 2. Check whether the three-phase input voltage sampling circuit is connected correctly without open circuit or loose connection. 3. Replace the I/O board or the MCB. 4. Check whether the grid voltage on the user input end is normal. 5. Check whether input signals of the circuit breaker and I/O board are normal. 6. Check whether the resistance of the pre-charge cabinet is normal.
F169	Invalid start command	The start command is triggered before the system is ready.	Start the AC drive when the system is ready.

8.3 Unit Faults

Fault Code	Description	Cause	Solution
F60	Unit fault	Contact technical support.	Contact technical support.
F61	Unit communication failure	1. The 5 V power cable of the optical fiber board is not connected. 2. The optical fiber splice is dirty. 3. The optical fiber connector is loose. 4. The optical fiber is damaged. 5. The optical fiber of the unit is not connected. 6. The unit control board is faulty.	1. Connect the 5 V power cable of the optical fiber board properly. 2. Clean the optical fiber splice. 3. Re-connect the transceiving connector of the optical fiber. 4. Replace the optical fiber. 5. Replace the unit control board. 6. Replace the MCB.
F62	Unit blocking fault	1. The power device is faulty. 2. The unit control board is faulty.	1. Replace the unit with a unit of the same power rating. 2. Replace the unit control board.
F63	Unit overcurrent fault	1. The power device is faulty. 2. The unit control board is faulty.	1. Replace the unit with a unit of the same power rating. 2. Replace the unit control board.
F64	Unit input phase loss	1. The input terminals of the unit are wired improperly. 2. The input transformer is faulty. 3. The unit fuse is blown. 4. The unit control board is faulty.	1. Check whether input terminals of the unit are wired properly. 2. Contact technical support. 3. Replace the fuse and rule out potential problems that may lead to a blown fuse. 4. Replace the faulty unit control board.

Fault Code	Description	Cause	Solution
F66	Unit overvoltage fault	1. The power grid voltage is excessively high. 2. F2-12 (Upper limit of braking torque output) is set to an excessively high value. 3. Output phase loss occurs. 4. The input terminals of the faulty unit are wired improperly. 5. The load inertia is high but the deceleration time is set to an excessively low value. 6. The unit control board is faulty. 7. Output current oscillation occurs.	1. Reduce the input voltage and adjust the input transformer contact to +5%. 2. Decrease the value of F2-12 to ensure normal voltage output at 50 Hz. 3. Check whether the wiring between the drive and motor is proper. 4. Check whether input terminals of the unit are wired properly. 5. Set the deceleration time to a larger value. 6. Replace the unit control board. 7. Contact technical support.
F68	Unit over-temperature fault	1. The temperature of the unit is too high. 2. The unit is not well ventilated. 3. The filter screen is blocked. 4. The fan on top of the cabinet is faulty. 5. The unit control board is faulty.	1. Reduce the ambient temperature. 2. Replace the unit or contact technical support. 3. Clean the dust filter. 4. Check whether the cooling fan is running in reverse direction and whether the fan on the top of the cabinet is faulty. 5. Replace the unit control board.
F69	Unit undervoltage fault	1. The grid input voltage is too low. 2. The input transformer is faulty. 3. The unit control board is faulty.	1. Check the grid voltage. Adjust the voltage of the input transformer contact to -5%. 2. Contact technical support. 3. Replace the faulty unit control board or contact technical support.

Fault Code	Description	Cause	Solution
F70	Unit bypass fault	1. The bypass contactor is faulty. 2. The control board on the bypass contactor is connected improperly. 3. The bypass board is faulty. 4. The unit control board is faulty.	1. Replace the bypass contactor. 2. Re-plug the control cable on the bypass contactor. 3. Replace the bypass plate. 4. Replace the faulty unit control board or contact technical support.
F71	Drive power fault	Contact technical support.	Contact technical support.

8.4 Replacing Damaged Power Units

All power units are the same and do not have highly matching requirements on power devices. If a power unit is damaged, the technician of the user can replace it

by performing the following steps.

1. Stop the AC drive by remote control or press the emergency stop button.
2. Cut off the MV power and wait for 15 minutes until all indicators of the power units become OFF.
3. Remove the optical fiber connector of the damaged power unit.
4. Remove the connected cables and the tightening screws of the damaged power unit.
5. Pull the damaged power unit out along the track. Handle it with care.
6. Mount a new power unit, perform wiring.
7. Power on the system again.
8. Contact us to repair the damaged power unit.

9 Maintenance

This chapter describes precautions for equipment maintenance.

Note

- Do not touch the wiring terminals of the drive within ten minutes after the medium voltage is cut off as residual voltage may still exist in the terminals.
- Perform maintenance only after the main circuit power supply is turned off and the power unit is fully discharged (power indicator of the power unit turned off).



- Never touch the circuit board directly with fingers because electrostatic induction may damage the integrated circuit of the circuit board.
- Never change wiring or remove cables connecting to the terminals at power-on. Failure to comply may result in electric shock.

9.1 Precautions for Maintenance

- Before line inspection, turn off the circuit breaker, pull down the knife switch, and label a warning notice to prevent sudden power-on by others.
- Ensure that the AC drive is in the stop state and the MV charge indicator is OFF.
- After medium voltage and low voltage are cut off, perform electrical inspection before operation. For medium voltage inspection, use an electroscope of the corresponding voltage class and wear insulated safety articles.
- After verifying that the drive is de-energized, ground the input three phases of the drive to ensure safety.
- Ground all devices which are liable to become energized. When inspecting a bus disconnector, an isolator, or a load break in a two-way supply unit, pull down both bus disconnectors and ground the construction knife switches at both ends.
- When installing a grounding cable, make one end of the grounding cable grounded first, and then attach the other end. When removing a grounding cable, do vice versa. For either installation or removal, wear insulated safety articles.
- Attach the grounding cable in the place where electrical engineer can see it at any time and label a "Working" warning notice there.
- Perform inspection only after verifying that the residual DC voltage is lower than 20 V.

9.2 Precautions for Operation

- The drive is a hazardous equipment. All the operators must strictly observe the operation instructions.
- Power on the control circuit first. Power on the MV circuit only after MV switch-on is allowed.
- When using the HMI, tap it slightly with finger. Never knock it or strike it violently.
- Never allow irrelevant personnel to operate the HMI so as to avoid mal-function.
- Never open the cabinet door when the AC is operating. Otherwise, the system will report a fault and enable the MV breaker, which may lead to personal injury.

9.3 Daily Inspection

The influence of the ambient temperature, humidity, smoke and aging of internal components of the AC drive may cause potential faults. Therefore, daily inspection must be performed on the AC drive during storage and use. Check for exceptions such as over-temperature, discoloration, unusual smell, and unusual vibration. Record the input/output parameters of the AC drive regularly.

Table 9–1 Daily checklist for the drive

Target	Item	Method	Criterion	Solution
Ambient environment	• Dust, greasy dirt, and water drops • Ambient temperature, humidity, vibration • Unwanted objects and hazardous objects around the drive	Visual inspection	Ambient temperature: -10℃ to +40℃ Humidity: 95% RH and below	Improve the on-site conditions.
Phase-shifting trans former	• Blockage in the heat dissipation channel Tightness of the outlet connectors and the burnt sign • Unusual temperature rise • Cleanness of the transformer	Visual inspection	No exception	Find out the cause and clean the dirt.
HMI	Definition of display	Visual inspection	No exception	Adjust the contrast and brightness.
Frame structure	• Unusual vibration or noise • Tightness of fasteners such as screws • Deformation or damage • Dust and dirt	Hearing Visual inspection	No exception	Find the cause.
Lead wire	• Discoloration or deformation caused by over-temperature • Damage or discoloration of insulation layer	Visual inspection	No exception	Find the over-temperature cause.

Target	Item	Method	Criterion	Solution
Terminal	Damage	Visual inspection	No exception	Replace the damaged terminal.
Filter capacitor	• Liquid leakage, discoloring, cracking and housing expansion • Electrostatic capacitance	Visual inspection Capacitance measurement with a multimeter	No exception Electrostatic capacitance ≥ Initial value x 0.85	Replace the capacitor.
Resistor	• Cable break • Insulator crack	Visual inspection Measurement with a multimeter	Resistance: ±10% of the allowable range	Replace the resistor.
Transformer	Abnormal vibration and peculiar smell	Visual inspection Hearing Smelling	No exception	Find the cause.
PCB	• Loose connection between screw and connector • Unusual smell or discoloration • Cracking, damage, deformation, or corrosion • Capacitor leakage or deformation	Visual inspection	No exception	Tighten the screws or repair the PCB.
Cooling fan	Unusual vibration or noise	Visual inspection Hearing	No exception	Replace the fan.
Air filter	Blockage or unwanted objects attached to the air filter	Visual inspection Hearing	No exception	Clear unwanted objects.

9.4 Regular Maintenance

The drive is highly reliable and maintenance-free. We still suggest the user to perform maintenance regularly.

- Clean the dust filters on cabinet doors regularly to ensure good heat dissipation effect.

- The operator on duty or maintenance engineer must inspect and check the transformer periodically. Record the temperature of the transformer windings, and ensure that this temperature in normal operating condition does not exceed 80°C.
- Once the transformer is in operation, clean it every year.
- Check and tighten all wiring screws every six months.
- The withstand voltage test on the MV AC drive has been done before delivery. Never perform such test to avoid damage to the drive. However, you can check the insulation condition of the system regularly.
- Power off the system regularly and open the cabinet doors to perform inspection based on the routine maintenance checklist. For details, see *"Table 9-1 Daily checklist for the drive" on page 242*.

- Measures for drives idled (powered off) for more than 90 days
  If the drive has not been commissioned for a long time, or the drive has been shut down (MV disconnected) for longer than 90 days due to various reasons, store the drive based on specified requirements. If the drive has been in the power-off state for more than six months, contact us to help perform recovery commissioning. During initial commissioning by us, the drive needs to be tested with a voltage regulation device provided by users.

- Storage of spare parts
  Environmental requirements: Environmental conditions must meet the requirements in *"2.1.1 Installation Environment Requirements" on page 48*.

  Routine maintenance: The power unit contains a large number of capacitors, which may deteriorate their electrical properties if they are not energized for a long time. It is recommended to power on the power unit for at least one hour every six months as maintenance. As the power unit carries high power, it is recommended to use pre-charging mode of voltage regulator upon power-on, and connect the output phases A, B, and C to the input phases R, S, and T of the power unit. Adjust the output voltage to 450 V to 690 V and observe the power unit state.

- Service life of electronic components
  To ensure normal operation of the drive, it is necessary to perform regular maintenance based on the service life of internal components of the drive. The service life is related to the operating environment and condition. The general service life of the internal components is listed in the following table.

Table 9-2 Replacement interval of components

Device Name	Standard Replacement Interval
Cabinet top fan	3 to 5 years
Capacitance	5 to 8 years
Fuse	10 years

- Replacement of the filter screen

The drive adopts the forced-air cooling mode, which causes dust accumulation around the filter screen during long-term operation. To ensure normal operation of the drive, clean the filter screen at least every ten days, or replace the filter screen if necessary. In environments with excessive dust, shorten the cleaning interval.

The following figure shows how to clean or replace the filter screen.

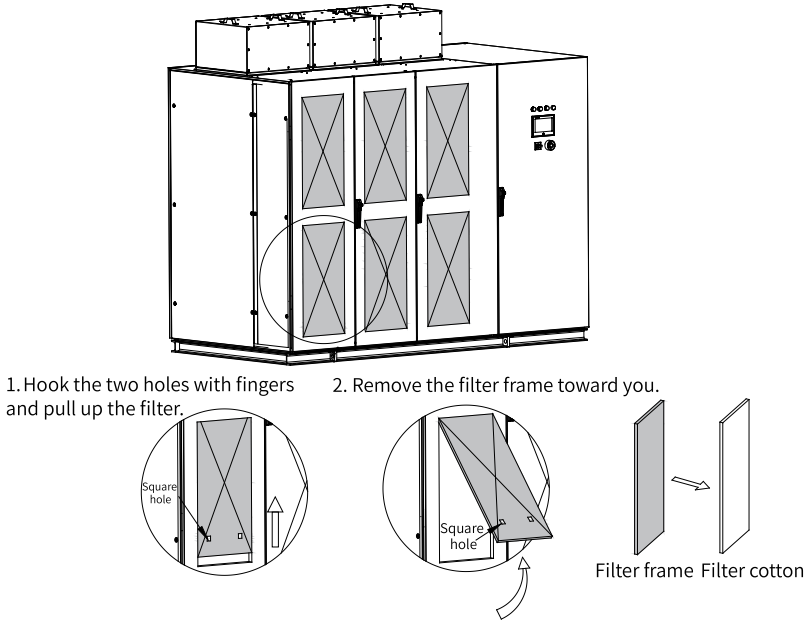


Figure 9-1 Removing the filter screen

1. After removing the filter as shown in the preceding figure, it is recommended to use a vacuum cleaner to remove the dust on the filter screen. If the dust cannot be removed, replace the filter screen.
2. Install the filter screen.
3. Clean or replace the filter screens on other cabinet doors in the same way.

9.5 Precautions for Disposal

When disposing of retired AC drives and components, pay attention to the following items:

- Capacitor: The capacitors inside the AC drive may be exploded during burning.
- The circuit board, plastic, rubber, and epoxy board on the AC drives may generate toxic or harmful gas during burning.
- Treat them as ordinary industrial waste.

10 Appendix A: Parameter List

Special symbols in the following table:

☆: Modifiable during stop or running

★: Modifiable only during stop

●: Read-only

10.1 List of Monitoring Parameters

10.1.1 Group U0: Basic Monitoring Parameters

Parameter	Name	Minimum Unit
U0-00	Operation frequency (Hz)	0.01 Hz
U0-01	Frequency reference (Hz)	0.01 Hz
U0-02	Input current (A)	0.1 A
U0-03	Output voltage (V)	1 V
U0-04	Output current (A)	0.1 A
U0-05	Output power (kW)	1 kW
U0-06	Output torque (%)	0.1%
U0-07	Input voltage (V)	1 V
U0-08	Input frequency (Hz)	0.1 Hz
U0-09	AI3 current (mA)	0.01 mA
U0-10	AI4 current (mA)	0.01 mA
U0-11	AI5 sampling	0.01 mA
U0-12	AI6 sampling	0.01 mA
U0-13	System state	1
U0-15	PID reference	1
U0-16	PID feedback	1
U0-17	PLC stage	1
U0-19	Feedback speed (Hz)	0.1 Hz
U0-23	Torque current	1
U0-24	Input power (kW)	1 kW
U0-25	Reactive power	1 kW
U0-28	Communication reference (%)	0.01%
U0-29	Encoder feedback speed (Hz)	0.01 Hz
U0-34	Control mode	1
U0-35	Target torque (%)	0.1%
U0-49	Input point level status	1

Parameter	Name	Minimum Unit
U0-50	Input point level status	1
U0-51	Output point level status	1
U0-52	Output point level status	1
U0-53	AO4 output	0.01 mA
U0-54	AO5 output	0.01 mA
U0-55	AO6 output	0.01 mA
U0-56	AO7 output	0.01 mA
U0-58	AO8 output	0.01 mA
U0-59	AO9 output	0.01 mA
U0-61	AI1 current (mA)	0.01 mA
U0-62	AI2 current (mA)	0.01 mA
U0-63	Input point level status	1
U0-64	Output point level status 2	1
U0-65	Output point level status	1
U0-66	AO1 output	0.01 mA
U0-67	AO2 output	0.01 mA
U0-68	AO3 output	0.01 mA
U0-71	Maximum unit temperature	1°C
U0-72	Minimum unit temperature	1°C
U0-75	Ambient humidity in cabinet	0.1%
U0-76	Ambient temperature in cabinet	0.1°C
U0-81	PLC 4PT sampling temperature CH1	0.1°C
U0-82	PLC 4PT sampling temperature CH2	0.1°C
U0-83	PLC 4PT sampling temperature CH3	0.1°C
U0-84	PLC 4PT sampling temperature CH4	0.1°C
U0-86	Phase-shifting transformer phase A temperature	0.1°C
U0-87	Phase-shifting transformer phase B temperature	0.1°C
U0-88	Phase-shifting transformer phase C temperature	0.1°C
U0-90	Low-order bits of accumulative power consumption	1 MWh

Parameter	Name	Minimum Unit
U0-91	High-order bits of accumulative power consumption	1 GWh
U0-92	Exciting current	0.1

10.1.2Group U1: Product Parameters

Parameter	Name	Minimum Unit
U1-00	Software version	0.001
U1-01	Software version 1 (ARM)	00.0.01
U1-02	Software version 2 (DSP)	00.0.01
U1-03	Software version 3 (FPGA)	00.0.01
U1-04	Software version 4 (PLC)	00.0.01
U1-05	Software version 5 (HMI)	00.0.01
U1-06	A1CPLD version	1
U1-07	B1CPLD version	1
U1-08	C1CPLD version	1
U1-09	A2CPLD version	1
U1-10	B2CPLD version	1
U1-11	C2CPLD version	1
U1-12	A3CPLD version	1
U1-13	B3CPLD version	1
U1-14	C3CPLD version	1
U1-15	A4CPLD version	1
U1-16	B4CPLD version	1
U1-17	C4CPLD version	1
U1-18	A5CPLD version	1
U1-19	B5CPLD version	1
U1-20	C5CPLD version	1
U1-21	A6CPLD version	1
U1-22	B6CPLD version	1
U1-23	C6CPLD version	1
U1-24	A7CPLD version	1
U1-25	B7CPLD version	1
U1-26	C7CPLD version	1
U1-27	A8CPLD version	1
U1-28	B8CPLD version	1
U1-29	C8CPLD version	1
U1-40	DP card type	0.01
U1-41	DP card software version	0.01

Parameter	Name	Minimum Unit
U1-42	FPGA product version	0.001
U1-43	Temperature and humidity sampling board version	0.01

10.1.3Group U2: Unit Status

Parameter	Name	Minimum Unit
U2-30	A1 temperature	1°C
U2-31	B1 temperature	1°C
U2-32	C1 temperature	1°C
U2-33	A2 temperature	1°C
U2-34	B2 temperature	1°C
U2-35	C2 temperature	1°C
U2-36	A3 temperature	1°C
U2-37	B3 temperature	1°C
U2-38	C3 temperature	1°C
U2-39	A4 temperature	1°C
U2-40	B4 temperature	1°C
U2-41	C4 temperature	1°C
U2-42	A5 temperature	1°C
U2-43	B5 temperature	1°C
U2-44	C5 temperature	1°C
U2-45	A6 temperature	1°C
U2-46	B6 temperature	1°C
U2-47	C6 temperature	1°C
U2-48	A7 temperature	1°C
U2-49	B7 temperature	1°C
U2-50	C7 temperature	1°C
U2-51	A8 temperature	1°C
U2-52	B8 temperature	1°C
U2-53	C8 temperature	1°C
U2-54	A9 temperature	1
U2-55	B9 temperature	1
U2-56	C9 temperature	1
U2-57	A10 temperature	1
U2-58	B10 temperature	1
U2-59	C10 temperature	1
U2-62	A1 bus voltage	1 V
U2-63	B1 bus voltage	1 V

Parameter	Name	Minimum Unit
U2-64	C1 bus voltage	1 V
U2-65	A2 bus voltage	1 V
U2-66	B2 bus voltage	1 V
U2-67	C2 bus voltage	1 V
U2-68	A3 bus voltage	1 V
U2-69	B3 bus voltage	1 V
U2-70	C3 bus voltage	1 V
U2-71	A4 bus voltage	1 V
U2-72	B4 bus voltage	1 V
U2-73	C4 bus voltage	1 V
U2-74	A5 bus voltage	1 V
U2-75	B5 bus voltage	1 V
U2-76	C5 bus voltage	1 V
U2-77	A6 bus voltage	1 V
U2-78	B6 bus voltage	1 V
U2-79	C6 bus voltage	1 V
U2-80	A7 bus voltage	1 V
U2-81	B7 bus voltage	1 V
U2-82	C7 bus voltage	1 V
U2-83	A8 bus voltage	1 V
U2-84	B8 bus voltage	1 V
U2-85	C8 bus voltage	1 V
U2-86	A9 bus voltage	1 V
U2-87	B9 bus voltage	1 V
U2-88	C9 bus voltage	1 V
U2-89	A10 bus voltage	1 V
U2-90	B10 bus voltage	1 V
U2-91	C10 bus voltage	1 V

10.1.4Group U3: Communication Shortcut Data

Parameter	Name	Minimum Unit
U3-00	Fault and alarm integration data	1
U3-14	Fault subcode	1
U3-18	Active motor No.	1

10.2 List of Basic Function Parameters

10.2.1Group F0: Basic Function Parameters

Parameter	Name	Value Range	Default	Change
F0-01	Motor 1 control mode	0: Sensorless vector control (SVC1) 1: Feedback vector control (FVC) 2: Voltage-type sensorless vector control (SVC2)	2	★
F0-02	Remote 1 command source selection	0: Operating panel 1: Terminal control 1 2: Modbus setting 3: PROFIBUS-DP setting	1	☆
F0-03	Main frequency source X selection	0: Digital setting (the initial value is the preset frequency (F0-08) and can be changed by pressing UP/ DOWN; non-retentive at power failure) 1: Digital setting (the initial value is the preset frequency (F0-08) and can be changed by pressing UP/ DOWN; retentive at power failure) 2: AI1 3: AI2 4: AI3 5: AI4 7: Multi-reference 8: Simple PLC 9: PID 11: Modbus setting 12: PROFIBUS-DP setting 13: HMI setting	0	★
F0-08	Preset frequency	0.00 Hz to maximum frequency (F0-10)	50.00 Hz	☆
F0-09	Running direction	0: Run in the same direction 1: Run in the opposite direction	0	☆
F0-10	Maximum frequency	50.00 Hz to 120.00 Hz	50.00 Hz	★
F0-12	Frequency upper limit	Frequency lower limit (F0-14) to Maximum frequency (F0-10)	50.00 Hz	☆
F0-14	Frequency lower limit	0.00 Hz to Frequency upper limit (F0-12)	3.00 Hz	☆
F0-17	Acceleration time 1	0.0s to 6500.0s	80.0s	☆

Parameter	Name	Value Range	Default	Change
F0-18	Deceleration time 1	0.0s to 6500.0s	100.0s	☆
F0-24	Motor selection	0: Motor 1 1: Motor 2 2: Motor 3 3: Motor 4	0	☆
F0-27	Binding frequency source of remote 1 command source	0: Not bound 1: Frequency set through digital setting 2: AI1 3: AI2 4: AI3 5: AI4 7: Multi-speed 8: Simple PLC 9: PID A: PC setting b: Modbus setting C: PROFIBUS-DP setting Tens: Binding frequency source selection through terminal command 1 Hundreds: Modbus binding frequency source selection Thousands: Binding frequency source selection for PROFIBUS-DP communication	H.0020	☆
F0-29	Remote 2 command source selection	1: Terminal control 2 0 and 2 to 3. Same as F0-02	1	☆
F0-30	Binding frequency source of remote 2 command source	Tens: Binding frequency source selection through terminal command 2 Others: Same as F0-27	H.0030	☆

10.2.2Group F1: Motor 1 Parameters

Parameter	Name	Value Range	Default	Change
F1-00	Motor type selection	0: Common asynchronous motor 1: Reserved 2: Excited synchronous motor 3: Permanent magnet synchronous motor	0	★
F1-01	Rated motor power	1 kW to 65535 kW	Model dependent	★
F1-02	Rated motor voltage	1 V to 65535 V	Model dependent	★
F1-03	Rated motor current	0.1 A to 6553.5 A	Model dependent	★
F1-04	Rated motor frequency	0.01 Hz to maximum frequency	Model dependent	★
F1-05	Rated motor speed	1 RPM to 65535 RPM	Model dependent	☆
F1-27	Pulses per revolution	1 to 65535	1024	★
F1-30	A/B phase sequence of the ABZ incremental encoder	0: Forward 1: Reverse	0	★
F1-37	Auto-tuning selection	0: No operation 1: Static auto-tuning 2: Complete auto-tuning	0	★

10.2.3Group F2: Vector Control Parameters of Motor 1

Parameter	Name	Value Range	Default	Change
F2-00	Speed loop proportional gain 1	0.000 to 1.000	0.025	☆
F2-01	Speed loop integral gain 1	0.000 to 65.535	0.05	☆
F2-02	Switchover frequency 1	0.00 to F2-05	5	☆

Parameter	Name	Value Range	Default	Change
F2-03	Speed loop proportional gain 2	0.000 to 1.000	0.015	☆
F2-04	Speed loop integral gain 2	0.000 to 65.535	0.025	☆
F2-05	Switchover frequency 2	F2-02 to F0-10	10	☆
F2-08	Speed loop Kf gain	0.01 to 1.00	1	☆
F2-09	Torque upper limit source in speed control (driving)	0: F2-10 1: AI1 2: AI2 3: AI3 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: Full range of options 1 to 8 of AI4 corresponding to the value of F2-10	0	☆
F2-10	Digital setting of torque upper limit in speed control (driving)	0.0% to 300.0%	120.0%	☆
F2-12	Digital setting of torque upper limit in speed control (braking)	0.0% to 150.0%	0.30%	☆

10.2.4Group F4: Input Parameters

Parameter	Name	Value Range	Default	Change
F4-00	DI1 function selection	0: No function 1: Forward running (FWD) 2: Reverse running (REV) 3: Three-wire motion control 9: Fault reset (RESET) 11: External fault input 12-15: Multi-reference terminals 1-4 20: Local/Remote switchover 24: Transformer over-temperature alarm 25: Transformer over-temperature fault 26: Cabinet door travel switch 27: Cabinet top fan status feedback 28: Remote 1/Remote 2 switchover 31: Emergency stop 33: Control power supply normal 41: Motor selection 1 42: Motor selection 2 44: User-defined fault 1 45: User-defined fault 2 58: Forward running 2 (FWD) 59: Reverse running 2 (REV) 60: Three-wire motion control 2	1031	●
F4-01	DI2 function selection		1025	●
F4-02	DI3 function selection		1024	●
F4-03	DI4 function selection		1026	●
F4-04	DI5 function selection		27	●
F4-05	DI6 function selection		1020	●
F4-06	DI7 function selection		33	●
F4-07	DI8 function selection		0	★
F4-08	DI9 function selection		1	★
F4-09	DI10 function selection		1003	★
F4-10	DI11 function selection		9	★
F4-11	DI12 function selection		28	★
F4-12	DI13 function selection		58	★
F4-13	DI14 function selection		1060	★
F4-14	DI15 function selection		0	★
F4-15	DI16 function selection		0	★
F4-16	DI17 function selection		0	★
F4-17	DI18 function selection		0	★
F4-18	DI19 function selection		0	★
F4-19	DI20 function selection		0	★
F4-20	DI21 function selection		0	★
F4-21	DI22 function selection		0	★
F4-22	DI23 function selection		0	★
F4-23	DI24 function selection		0	★

Parameter	Name	Value Range	Default	Change
F4-66	DI filter time	0.000s to 1.000s	0.030s	☆
F4-73	Terminal command mode	Ones: Mode of terminal command channel 1 0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2 Tens: Mode of terminal command channel 2, same as above	H.22	★

10.2.5Group F5: Output Parameters

Param.	Name	Value Range	Default	Change
F5-01	DO1 function	0: No output 1: AC drive running 2: Fault (stop upon fault) 15: Ready for RUN 40: MV switch-on enable 41: MV tripping 44: Main power supply indication 45: Alarm 62: Automatic fan operation	1041	★
F5-02	DO2 function		40	★
F5-03	DO3 function		44	★
F5-04	DO4 function		15	★
F5-05	DO5 function		1	★
F5-06	DO6 function		1001	★
F5-07	DO7 function		2	★
F5-08	DO8 function		45	★
F5-09	DO9 function		46	★
F5-10	DO10 function		0	★
F5-11	DO11 function		0	★
F5-12	DO12 function		0	★
F5-13	DO13 function		0	★
F5-14	DO14 function		0	★
F5-15	DO15 function		0	★
F5-16	DO16 function		0	★
F5-17	DO17 function		0	★
F5-18	DO18 function		0	★
F5-19	DO19 function		0	★
F5-20	DO20 function		0	★
F5-21	DO21 function	0: No output 1: AC drive running 2: Fault (stop upon fault) 15: Ready for run 40: MV switch-on enable 41: MV tripping 44: Main power supply indication 45: Alarm 62: Automatic fan operation	0	★
F5-22	DO22 function		0	★
F5-23	DO23 function		0	★
F5-24	DO24 function		62	★
F5-25	DO25 function		0	★
F5-26	DO26 function		0	★
F5-27	DO27 function		0	★
F5-28	DO28 function		0	★
F5-28	DO29 function		0	★
F5-30	DO30 function		0	★
F5-31	DO31 function		0	★
F5-32	DO32 function		0	★
F5-33	DO33 function		0	★
F5-34	DO34 function		0	★

10.2.6Group F6: Start/Stop Parameters

Parameter	Name	Value Range	Default	Change
F6-00	Start mode	0: Direct start 1: Forward flying start 2: Reverse flying start 3: Forward/Reverse flying start	0	☆
F6-01	Start delay	0.0s to 60.0s	0.0s	☆
F6-07	Acceleration/ Deceleration mode	0: Linear acceleration/deceleration 1: Static S curve	0	★
F6-10	Stop mode	0: Decelerate to stop 1: Coast to stop	1	☆

10.2.7Group F7: Time and Display Parameters

Parameter	Name	Value Range	Default	Change
F7-06	Accumulative power-on time	0 h to 65535 h	-	●
F7-07	Accumulative running time	0 h to 65535 h	-	●
F7-08	Accumulative power consumption (MWh)	0 to 9999	-	●
F7-23	Accumulative power consumption (GWh)		-	●

10.2.8Group F8: Auxiliary Function Parameters

Parameter	Name	Value Range	Default	Change
F8-00	Jog frequency	0.00 Hz to maximum frequency	5	☆
F8-01	Jog acceleration time	0.0s to 6500.0s	80	☆
F8-02	Jog deceleration time	0.0s to 6500.0s	100	☆
F8-03	Acceleration time 2	0.0s to 6500.0s	80	☆

Parameter	Name	Value Range	Default	Change
F8-04	Deceleration time 2	0.0s to 6500.0s	100	☆
F8-05	Acceleration time 3	0.0s to 6500.0s	80	☆
F8-06	Deceleration time 3	0.0s to 6500.0s	100	☆
F8-07	Acceleration time 4	0.0s to 6500.0s	80	☆
F8-08	Deceleration time 4	0.0s to 6500.0s	100	☆
F8-09	Jump frequency 1	0.00 Hz to maximum frequency	0.00 Hz	☆
F8-10	Jump frequency 2	0.00 Hz to maximum frequency	0.00 Hz	☆
F8-11	Jump frequency band	0.00 Hz to maximum frequency	0.00 Hz	☆
F8-13	Reverse control enable	0: Enabled 1: Disabled	1	☆
F8-18	Start protection selection	0 to 1	1	☆
F8-22	Jump frequency enable during acceleration/ deceleration	0 to 1	0	☆
F8-68	Jump frequency 3	0.00 Hz to maximum frequency	0	☆
F8-69	Jump frequency band 3	0.00 Hz to maximum frequency	0	☆

10.2.9Group F9: Protection Parameters

Parameter	Name	Value Range	Default	Change
F9-00	Motor overload software protection selection	0: Disabled 1: Direct inverse time lag 2: Constant 3: Attenuate inverse time lag	1	☆
F9-01	Motor overload time	0.01s to 600.00s	60.00s	☆
F9-02	Motor overload pre-warning coefficient	50% to 100%	80%	☆
F9-03	Software protection threshold for motor overload	10.0% to 220.0%	120.0%	☆

Parameter	Name	Value Range	Default	Change
F9-06	Output overvoltage protection threshold	0.0% to 200.0%	125.0%	☆
F9-27	Output voltage unbalance threshold	0.0: Disable 0.1% to 100.0%	40.0%	☆
F9-30	AC drive overcurrent threshold setting	0.0% to 180.0% (The value 100.0% corresponds to the rated output current of the drive.)	150.0%	☆
F9-31	Maximum output current limit of the drive	0.0% to (Value specified by F9-30 – 20.0)% (The value 100.0% corresponds to the rated output current of the drive.)	120.0%	☆
F9-40	Locked-rotor frequency	5.0 Hz to 50.0 Hz	10.0 Hz	☆
F9-41	Locked-rotor time	0s to 400s	20s	☆
F9-67	Overspeed detection level	0.0% to 50.0% (maximum frequency)	20.0%	☆
F9-68	Overspeed detection time	0.0s to 60.0s	5.0%	☆
F9-69	Detection level of excessive speed deviation	0.0% to 50.0% (maximum frequency)	20.0%	☆
F9-70	Detection time of excessive speed deviation	0.0s to 60.0s	0s	☆

10.2.10Group FA: PID Parameters

Parameter	Name	Value Range	Default	Change
FA-00	PID reference source	0: Set by FA-01 (PID digital setting) 1: AI1 2: AI2 3: AI3 5: Communication setting 6: Multi-reference setting 7: AI4	0	☆
FA-01	PID digital reference	0.0% to 100.0%	50.0%	☆

Parameter	Name	Value Range	Default	Change
FA-02	PID feedback source	0: AI1 1: AI2 2: AI3 3: AI1-AI2 5: Communication setting 6: AI1 + AI2 7: Max. (|AI1|, |AI2|) 8: Min. (|AI1|, |AI2|) 9: AI4	0	☆
FA-03	PID action direction	0 to 1	0	☆
FA-04	PID reference and feedback range	0 to 65535	1000	☆
FA-05	Proportional gain Kp1	0.0 to 100.0	20	☆
FA-06	Integral time Ti1	0.01s to 10.00s	2.00s	☆
FA-07	Derivative time Td1	0.000s to 10.000s	0.000s	☆
FA-08	PID reverse cut-off frequency	0.00 to maximum frequency	2	☆
FA-09	PID deviation limit	0.0% to 100.0%	0	☆
FA-10	PID derivative limit	0.00% to 100.00%	0.1	☆
FA-11	PID reference change time	0.00s to 650.00s	0	☆
FA-12	PID feedback filter time	0.00s to 60.00s	0	☆
FA-13	PID output filter time	0.00s to 60.00s	0	☆
FA-15	Proportional gain P2	0.0 to 100.0	20	☆
FA-16	Integral time I2	0.01s to 10.00s	2	☆
FA-17	Differential time D2	0.000s to 10.000s	0	☆
FA-18	PID parameter switchover condition	0 to 2	0	☆
FA-19	PID parameter switchover deviation 1	0.0% to value of FA-20	20	☆
FA-20	PID parameter switchover deviation 2	Value of FA-19 to 100.0%	80	☆
FA-21	PID initial value	0.0% to 100.0%	0	☆

Parameter	Name	Value Range	Default	Change
FA-22	PID initial value active time	0.00s to 650.00s	0	☆
FA-23	Two-output deviation forward max.	0.0% to 100.0%	1	☆
FA-24	Two-output deviation reverse max.	0.0% to 100.0%	1	☆
FA-25	PID integral property	0 to 11	0	☆
FA-26	Detection level of PID feedback loss	0.0%: No detection 0.0% to 100.0%	0	☆
FA-27	Detection time of PID feedback loss	0.0s to 20.0s	1	☆
FA-28	PID operation at stop	0 to 1	0	☆

10.2.11 Group FC: Multi-Speed and Simple PLC

Parameter	Name	Value Range	Default	Change
FC-00	Multi-reference 0	-100.0% to +100.0%	0.0%	☆
FC-01	Multi-reference 1	-100.0% to +100.0%	0.0%	☆
FC-02	Multi-reference 2	-100.0% to +100.0%	0.0%	☆
FC-03	Multi-reference 3	-100.0% to +100.0%	0.0%	☆
FC-04	Multi-reference 4	-100.0% to +100.0%	0.0%	☆
FC-05	Multi-reference 5	-100.0% to +100.0%	0.0%	☆
FC-06	Multi-reference 6	-100.0% to +100.0%	0.0%	☆
FC-07	Multi-reference 7	-100.0% to +100.0%	0.0%	☆
FC-08	Multi-reference 8	-100.0% to +100.0%	0	☆
FC-09	Multi-reference 9	-100.0% to +100.0%	0	☆
FC-10	Multi-reference 10	-100.0% to +100.0%	0	☆
FC-11	Multi-reference 11	-100.0% to +100.0%	0	☆
FC-12	Multi-reference 12	-100.0% to +100.0%	0	☆
FC-13	Multi-reference 13	-100.0% to +100.0%	0	☆
FC-14	Multi-reference 14	-100.0% to +100.0%	0	☆
FC-15	Multi-reference 15	-100.0% to +100.0%	0	☆

Parameter	Name	Value Range	Default	Change
FC-16	Simple PLC running mode	0 to 2	0	☆
FC-17	Simple PLC retentive selection	0 to 11	0	☆
FC-18	Running time of PLC reference 0	0.0s (h) to 6553.5s (h)	0	☆
FC-19	Acceleration/ Deceleration time of PLC reference 0	0 to 3	0	☆
FC-20	Running time of PLC reference 1	0.0s (h) to 6553.5s (h)	0	☆
FC-21	Acceleration/ Deceleration time of PLC reference 1	0 to 3	0	☆
FC-22	Running time of PLC reference 2	0.0s (h) to 6553.5s (h)	0	☆
FC-23	Acceleration/ Deceleration time of PLC reference 2	0 to 3	0	☆
FC-24	Running time of PLC reference 3	0.0s (h) to 6553.5s (h)	0	☆
FC-25	Acceleration/ Deceleration time of PLC reference 3	0 to 3	0	☆
FC-26	Running time of PLC reference 4	0.0s (h) to 6553.5s (h)	0	☆
FC-27	Acceleration/ Deceleration time of PLC reference 4	0 to 3	0	☆
FC-28	Running time of PLC reference 5	0.0s (h) to 6553.5s (h)	0	☆
FC-29	Acceleration/ Deceleration time of PLC reference 5	0 to 3	0	☆
FC-30	Running time of PLC reference 6	0.0s (h) to 6553.5s (h)	0	☆
FC-31	Acceleration/ Deceleration time of PLC reference 6	0 to 3	0	☆
FC-32	Running time of PLC reference 7	0.0s (h) to 6553.5s (h)	0	☆
FC-33	Acceleration/ Deceleration time of PLC reference 7	0 to 3	0	☆

Parameter	Name	Value Range	Default	Change
FC-34	Running time of PLC reference 8	0.0s (h) to 6553.5s (h)	0	☆
FC-35	Acceleration/ Deceleration time of PLC reference 8	0 to 3	0	☆
FC-36	Running time of PLC reference 9	0.0s (h) to 6553.5s (h)	0	☆
FC-37	Acceleration/ Deceleration time of PLC reference 9	0 to 3	0	☆
FC-38	Running time of PLC reference 10	0.0s (h) to 6553.5s (h)	0	☆
FC-39	Acceleration/ Deceleration time of PLC reference 10	0 to 3	0	☆
FC-40	Running time of PLC reference 11	0.0s (h) to 6553.5s (h)	0	☆
FC-41	Acceleration/ Deceleration time of PLC reference 11	0 to 3	0	☆
FC-42	Running time of PLC reference 12	0.0s (h) to 6553.5s (h)	0	☆
FC-43	Acceleration/ Deceleration time of PLC reference 12	0 to 3	0	☆
FC-44	Running time of PLC reference 13	0.0s (h) to 6553.5s (h)	0	☆
FC-45	Acceleration/ Deceleration time of PLC reference 13	0 to 3	0	☆
FC-46	Running time of PLC reference 14	0.0s (h) to 6553.5s (h)	0	☆
FC-47	Acceleration/ Deceleration time of PLC reference 14	0 to 3	0	☆
FC-48	Running time of PLC reference 15	0.0s (h) to 6553.5s (h)	0	☆
FC-49	Acceleration/ Deceleration time of PLC reference 15	0 to 3	0	☆

Parameter	Name	Value Range	Default	Change
FC-50	PLC running time unit	0 to 1	0	☆
FC-51	Source of multi-reference 0	0 to 7	0	☆

10.2.12Group FD: Communication Parameters

Parameter	Name	Value Range	Default	Change
FD-00	Baud rate	H.0001 to 6099	H.5005	☆
FD-01	Modbus data format	0 to 3	0	☆
FD-02	Local address	1 to 247 (0 is the broadcast address.)	1	☆
FD-03	Response delay	0 ms to 20 ms	2	☆
FD-04	Modbus communication timeout time	0.0 (inactive), 0.1s to 60.0s	0	☆
FD-05	Data transmission format	0 to 11	1	☆
FD-08	PROFIBUS communication timeout time	0.0 (inactive), 0.1s to 30.0s	0	☆
FD-09	RS2 response delay	0 ms to 20 ms	2	☆
FD-10	RS2-Modbus communication timeout time	0s to 30.0s	0.0s	☆

10.2.13Group A6: Analog Parameters

Parameter	Name	Value Range	Default	Change
A6-00	Minimum input of AI curve 1	0.00 mA to A6-02	4.00 mA	☆
A6-01	Percentage corresponding to minimum input of AI curve 1	-100.0% to +100.0%	0.0%	☆
A6-02	Maximum input of AI curve 1	A6-00 to 20.00 mA	20.00 mA	☆

Parameter	Name	Value Range	Default	Change
A6-03	Percentage corresponding to maximum input of AI curve 1	-100.0% to +100.0%	100.0%	☆
A6-04	AI1 filter time	0.00s to 10.00s	0.10s	☆
A6-09	AI2 filter time	0.00s to 10.00s	0.10s	☆
A6-10	Minimum input of AI curve 3	0.00 mA to A6-12	4.00 mA	☆
A6-11	Percentage corresponding to minimum input of AI curve 3	-100.0% to +100.0%	-100.0%	☆
A6-12	Maximum input of AI curve 3	A6-10 to 20.00 mA	20.00 mA	☆
A6-13	Percentage corresponding to maximum input of AI curve 3	-100.0% to +100.0%	100.0%	☆
A6-14	Minimum input of AI curve 4	0.00 mA to A6-16	4	☆
A6-15	Percentage corresponding to minimum input of AI curve 4	-100.0% to +100.0%	0	☆
A6-16	Inflection 1 input of AI curve 4	A6-14 to A6-18	8.8	☆
A6-17	Percentage corresponding to curve 4 inflection point 1 input	-100.0% to +100.0%	30	☆
A6-18	Inflection 2 input of AI curve 4	A6-16 to A6-20	13.6	☆
A6-19	Percentage corresponding to curve 4 inflection point 2 input	-100.0% to +100.0%	60	☆
A6-20	Maximum input of AI curve 4	A6-18 to 20.00 mA	20	☆
A6-21	Percentage corresponding to maximum input of AI curve 4	-100.0% to +100.0%	100	☆
A6-22	Minimum input of AI curve 5	0.00 mA to A6-24	4.00 mA	☆

Parameter	Name	Value Range	Default	Change
A6-23	Percentage corresponding to minimum input of AI curve 5	-100.0% to +100.0%	-100.0%	☆
A6-24	Inflection 1 input of AI curve 5	A6-22 to A6-26	9.60 mA	☆
A6-25	Percentage corresponding to curve 5 inflection point 1 input	-100.0% to +100.0%	-30.0%	☆
A6-26	Inflection 2 input of AI curve 5	A6-24 to A6-28	14.40 mA	☆
A6-27	Percentage corresponding to curve 5 inflection point 2 input	-100.0% to +100.0%	30.0%	☆
A6-28	Maximum input of AI curve 5	A6-26 to 20.00 mA	20.00 mA	☆
A6-29	Percentage corresponding to maximum input of AI curve 5	-100.0% to +100.0%	100.0%	☆
A6-30	AI1 (DSP)-set skip point	-100.0% to +100.0%	0	☆
A6-31	AI1 (DSP)-set skip range	0.0% to 100.0%	0.5	☆
A6-32	AI2 (DSP)-set skip point	-100.0% to +100.0%	0	☆
A6-33	AI2 (DSP)-set skip range	0.0% to 100.0%	0.5	☆
A6-34	AI3 (ARM)-set skip point	-100.0% to +100.0%	0.0%	☆
A6-35	AI3 (ARM)-set skip range	0.0% to 100.0%	0.5%	☆
A6-36	AI4 (ARM)-set skip point	-100.0% to +100.0%	0.0%	☆
A6-37	AI4 (ARM)-set skip range	0.0% to 100.0%	0.5%	☆
A6-48	AI curve selection 1	1111 to 5555	1111	☆
A6-50	Setting for AI less than minimum input	0 to 1111	0	☆

Parameter	Name	Value Range	Default	Change
A6-52	AO1 selection	0: Running frequency 1: Target frequency 2: Output current 3: Output torque 4: Output power 5: Output voltage 7: AI1 8: AI2 9: AI3 10: AI4 12: Communication setting 13: Motor speed 16: Exciting current 17: Input voltage 18: Input current	0	☆
A6-53	AO2 selection		2	☆
A6-54	AO3 selection		0	☆
A6-55	AO4 selection		0	☆
A6-56	AO5 selection		2	☆
A6-57	AO6 (PLC) selection		0	☆
A6-58	AO7 (PLC) selection		0	☆
A6-59	AO8 (PLC) selection		0	☆
A6-60	AO9 (PLC) selection		0	☆
A6-61	AO1 zero offset coefficient	-100.0% to +100.0%	20.0%	☆
A6-62	AO1 gain	-10.00 to +10.00	0.8	☆
A6-63	AO2 zero offset coefficient	-100.0% to +100.0%	20.0%	☆
A6-64	AO2 gain	-10.00 to +10.00	0.8	☆
A6-65	AO3 zero offset coefficient	-100.0% to +100.0%	20.0%	☆
A6-66	AO3 gain	-10.00 to +10.00	0.8	☆
A6-67	AO4 zero offset coefficient	-100.0% to +100.0%	20.0%	☆
A6-68	AO4 gain	-10.00 to +10.00	0.8	☆
A6-69	AO5 zero offset coefficient	-100.0% to +100.0%	20.0%	☆
A6-70	AO5 gain	-10.00 to +10.00	0.8	☆
A6-71	AO6 zero offset coefficient	-100.0% to +100.0%	0	☆
A6-72	AO6 gain	-10.00 to +10.00	1	☆
A6-73	AO7 zero offset coefficient	-100.0% to +100.0%	0	☆
A6-74	AO7 gain	-10.00 to +10.00	1	☆
A6-75	AO8 zero offset coefficient	-100.0% to +100.0%	0	☆
A6-76	AO8 gain	-10.00 to +10.00	1	☆
A6-77	AO9 zero offset coefficient	-100.0% to +100.0%	0	☆
A6-78	AO9 gain	-10.00 to +10.00	1	☆
A6-79	AI/AO type selection	0x0 to 0xFF31	0x0	☆

Parameter	Name	Value Range	Default	Change
A6-87	AI3 filter time	0.00s to 10.00s	0.1	☆
A6-88	AI4 filter time	0.00s to 10.00s	0.1	☆
A6-89	PLC AI filter time	1 beat to 250 beats	1	☆
A6-90	AI wire breakage selection	0 to 0x3333	0x2222	☆

10.2.14Group A9: Unit Parameters

Parameter	Name	Value Range	Default	Change
A9-00	Bypass enable	0x0 to 0x1A	0x0	☆

11 Appendix B: Modbus Communication Protocol

The MV AC drive provides RS485 communication interface and supports the Modbus-RTU communication protocol. You can carry out integrated control through the RS485 terminal and set operation commands, modify or read parameters, and read operating status and fault information of the AC drive through this protocol.

11.1 Protocol

This protocol defines the content and format of transmitted messages during serial communication, The format includes master polling and master coding method, and the content includes parameters for the action, transmission data, and error check. The slave uses the same structure in response, including action confirmation, data returning, and error check. If an error occurs when the slave receives a message, or the slave cannot complete the action required by the master, the slave returns a fault message as a response to the master.

Application

The AC drive connects as a communication slave to a "single-master multi-slave" PC/PLC control network equipped with the RS485 bus.

Bus structure

- Hardware interface
  I/O interface board hardware RS3+, RS3-terminal

Note

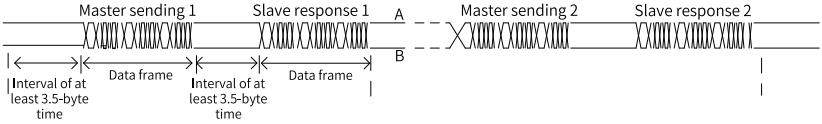
To prevent external interference on the communication, it is recommended to use the twisted pair as communication cables and lay them parallel.

- Topology
  The system consists of a single master and multiple slaves. Each device in the network has a unique address. Usually one device (usually PC, PLC or HMI) acts as the master to initiate communication and reads or writes parameters of the slave. Other devices act as communication slaves to respond to the query or communication operations generated by the master. Only one device is allowed to transmit data at a time and other device receives data only.

  The set range of the slave address is 1 to 247. A slave address must be unique in the network.

- Communication transmission mode
  The network adopts the asynchronous serial communication in half-duplex mode. During asynchronous serial communication, data is sent frame by frame in the form of packets. According to the Modbus-RTU protocol, an interval that is longer than the

transmission time of 3.5 bytes on the communication data line marks the start of a new communication frame.

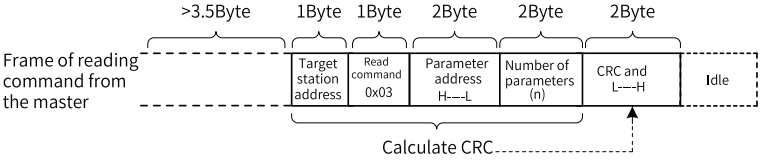


The communication protocol used by the drive is the Modbus-RTU slave communication protocol, which allows the drive to provide data to respond to "query/command" from the master or execute the action according to "query/command" from the master.

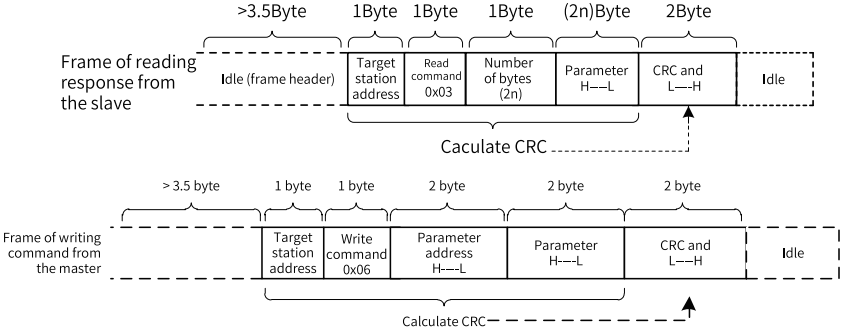
The master here refers to a PC, an industrial control device, or a PLC. The slave being accessed needs to feed back a response frame upon "query/command" from the master.

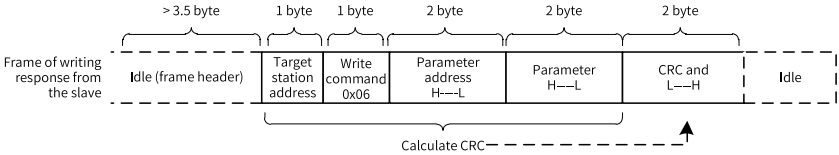
11.2 Communication Data Structure

The communication data format of Modbus protocol is shown below. The drive supports reading and writing of word-type parameters only. The reading command is 0x03 and writing command is 0x06. The drive does not support reading and writing of bytes or bits.

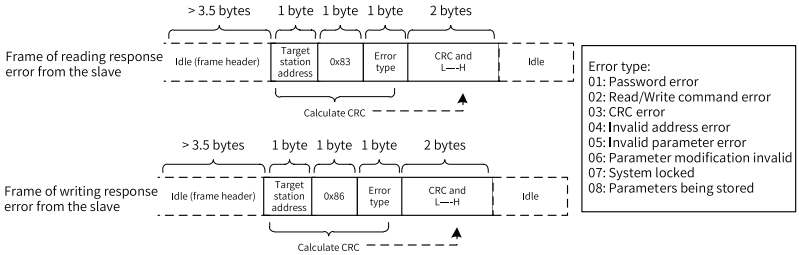


In theory, the RS485 terminal can read n consecutive parameters (n ≤ 100) at a time. Note that these parameters must be in the same parameter group. Otherwise, a response error can occur.





If a slave detects a communication frame error or reading/writing failure caused by other reasons, it returns an error frame.



- Data frame field of commands 0x03 and 0x06

Byte	Meaning
Frame header (START)	Idle time longer than the transmission time of 3.5 characters
Slave address (ADR)	Communication address: 1 to 247
Command code (CMD)	03: Read slave parameters; 06: Write slave parameters
Parameter address (H)	Internal parameter address of the AC drive, in hexadecimal format; parameter type or non-parameter type (such as the running state and running command). For details, see the address definition. During transmission, low-order bytes follow high-order bytes.
Parameter address (L)	
Number of parameters (H)	Number of parameters read in this frame. 1 indicates that one parameter is read. During transmission, low-order bytes follow high-order bytes. This field is unavailable because this protocol allows only one parameter to be modified at a time.
Number of parameters (L)	
Data (H)	Response data or data to be written. During transmission, low-order bytes follow high-order bytes.
Data (L)	
CRC CHK low-order bits	Check value: CRC16 check value. During transmission, high-order bytes follow low-order bytes. For details about the calculation method, see the description of CRC in this section.
CRC CHK high-order bits	
END	Transmission time of 3.5 characters

- CRC mode
  The cyclical redundancy check (CRC) adopts the RTU frame format. A Modbus message includes a CRC-based error-check field, which checks content of the entire message. The CRC field is two bytes, containing a 16-bit binary value. The CRC field is calculated by the transmitting device, and then added to the message. The receiving device recalculates CRC of received messages that is compared with the value in the received CRC domain. If the two CRC values are inconsistent, a transmission error occurs.

  The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the consecutive 8-bit byte in the message and the value in the register. Only the 8-bit data in each character is valid for the CRC. The start bit, stop bit and the parity bit do not apply to the CRC.

  During CRC, each eight-bit character is XORed with the content in the register. The result is shifted to the least significant bit (LSB), and the most significant bit (MSB) is filled with 0. The LSB is extracted and examined. If the LSB is 1, the register then performs XOR with a preset value. If the LSB is 0, no XOR is performed. This process is repeated until eight shifts have been performed. After the last (eighth) time, the next 8-bit byte is in XOR with the register's current value, and the process repeats for eight more shifts as described above. The final value of the register, after all the bytes of the message have been applied, is the CRC value.

  When CRC is added in a message, high-order bytes follow low-order bytes.

  The following is a simple CRC function.

```
unsigned int crc_chk_value(unsigned char *data_value, unsigned char length)
{
        unsigned int crc_value = 0xFFFF;
        int i;

        while(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);
}
```

Note

Never modify the parameters that are only for the factory use or for monitoring.

11.3 Parameter Address Designation Rules

The RS485 terminal can control the AC drive, monitor and modify the parameters through these communication protocols. The communication data can be divided into parameter data and non-parameter data. The latter includes the operating commands, operating status, operating parameters, and alarms.

Parameter data

Parameter data are critical for the drive. The following table describes the parameter data.

Parameter Data	Group F	F0, F1, F2, F4, F5, F6, F8, F9, FA, FC, and FD
	Group A	A6

For details about the parameter data, see related descriptions in *"10.1.1 Group U0: Basic Monitoring Parameters" on page 246*. When reading parameter data through communication, the parameter data communication address is defined as follows:

For parameter data in groups F and A, the eight high bits of the communication address represent the parameter group number, and the eight low bits represent the parameter number in the parameter group.

Example:

The communication address of F0-27 is F01BH, in which F0H represents the parameter group number F0 and 1BH represents the parameter number 27 in hexadecimal data format.

The communication address of Fd-05 is FD05, in which FDH represents parameters in group FD and 05H represents the hexadecimal data format of the parameter number 5 in the group.

Non-parameter data

Non-parameter Data	Status Data (Read-Only)	Monitoring parameters in group U0, drive fault description, drive operating status, and user-changed parameters
	Control Parameter (Write-Only)	Control command, communication reference, and frequency reference

Status parameters

- Group U (monitoring parameters):
  For details about the monitoring data of group U, see related descriptions in *"10.1.1 Group U0: Basic Monitoring Parameters" on page 246*. The addresses are defined as follows:

  For group U0, the high 8 bits of the communication address is 70H, and the low 8 bits indicate the parameter number in the group. For example, the communication address of U0-23 is 7017H.

- Drive operating status (read-only):
  When the drive operating status is read through communication, the communication address is fixed to 3000H. The RS485 terminal can get the present operating status of the drive through reading this address data.

State Word Address	State Word Function
3000H	0001: Forward running
	0002: Reverse running
	0003: Stop

- Drive fault description (read-only):
  Fault description of the AC drive is read through communication from a fixed communication address (8000H). The host controller obtains the current fault code of the AC drive by reading data in address 8000H.

AC Drive Fault Address	AC Drive Fault Information
8000H	Range: 0 to 199

Control parameters

- Frequency reference:
  The frequency reference value is mainly used to set the target frequency when the frequency source of the drive is communication setting. The communication address is 1000H. When the RS485 terminal sets the value of the communication address, its data range is -30000 to +30000.

Parameter Address	Description
1000H	Frequency reference (decimal): -30000 to +30000

- Communication reference:
  Parameters that can be set through communication include the torque upper limit, PID reference source, and PID feedback source. The communication address is 1002H. When the RS485 terminal sets the value of the communication address, its data range is -30000 to +30000.

Parameter Address	Description
1002H	Communications reference (decimal) -30000 to +30000

- Control command (write-only):
  When the control mode is performed through remote 485 terminal: The RS485 terminal can control the start/stop of the drive through this communication address. The control command is defined as follows:

Command Word Address	Command Definition
2000H	0001: Forward running
	0002: Reverse running
	0005: Coast to stop
	0006: Stop according to the stop mode
	0007: Fault reset
	0008: Pre-charge
	0010: Pre-charge switch-off
	0013: Switch-up
	0014: Switch-down

12 Appendix C: Instructions for Use of the PROFIBUS-DP Card

12.1 Overview

The PROFIBUS-DP card is designed to be used with MV AC drives, making the drive a slave of the fieldbus to be controlled by the fieldbus master.

The use of the PROFIBUS fieldbus in the system saves costs on the hardware, installation, and engineering, making the system more flexible.

12.2 Layout and Terminals

CAUTION

- The PROFIBUS-DP card is designed to be embedded in the MV AC drive. Before installation, cut off the MV power and control power of the AC drive and wait for about 10 minutes until all the unit indicators of the AC drive become OFF.
- Then, insert the PROFIBUS-DP card into the AC drive and fasten the screws to protect the signal socket between boards from damage caused by external signal cable tension.

The following figure shows the hardware layout of the PROFIBUS-DP card.

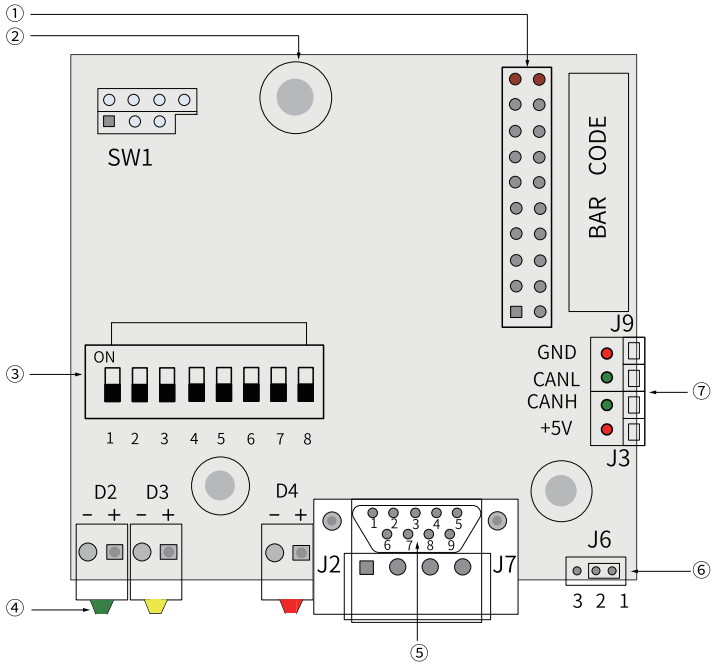


Figure 12-1 Hardware layout of PROFIBUS-DP card

No.	Component	Description
①	Pin header	Used to connect the drive.
②	Fixing screw hole	Secure this card with M3×8 screws.
③	Slave address for PROFIBUS-DP communication	-
④	Indicator	D2: AC drive connection indicator D3: Master connection indicator D4: Power indicator
⑤	PROFIBUS communication terminal	-
⑥	CANlink termination resistor setting (J6)	Pins 1 and 2 shorted: resistor connected Pins 2 and 3 shorted: resistor disconnected
⑦	CANlink communication terminal	-

- DIP switch

<table>
<tr><th>Bit No.</th><th>Function</th><th colspan="2">Description</th></tr>
<tr><td rowspan="5">1 to 8</td><td rowspan="5">Slave address for PROFIBUS-DP communication</td><td colspan="2">Addresses of stations 0 to 124 can be set by the 8-bit binary DIP switch. Example:</td></tr>
<tr><td>Address</td><td>Switch Setting</td></tr>
<tr><td>0</td><td>0000 0000</td></tr>
<tr><td>7</td><td>0000 0111</td></tr>
<tr><td>20</td><td>0001 0100</td></tr>
<tr><td>124</td><td>0111 1100</td></tr>
</table>

- Interface description
  - Description of standard 9-pin PROFIBUS interface

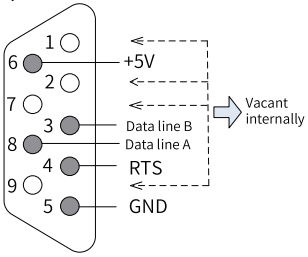


Figure 12-2 Standard 9-pin PROFIBUS interface

  - Control terminal functions

Table 12–1 Control terminal functions

Category	Terminal Symbol	Terminal Name	Description
PROFIBUS communication terminal (J2)	1, 2, 7, and 9	NC	Unconnected internally
	3	Data cable B	Positive terminal of data cable
	4	RTS	Request transmit signal
	5	GND	Ground terminal of isolated 5 V power supply
	6	+5V	Isolated 5 V power supply
	8	Data cable A	Negative terminal of data cable
CANlink communication terminal (J3 and J9)	+5V	Power supply	Isolated 5 V power supply
	CANH	Positive CAN input	Positive terminal of data cable
	CANL	Negative CAN input	Negative terminal of data cable
	GND	Power ground	Ground terminal of isolated 5 V power supply

Category	Terminal Symbol	Terminal Name	Description
Programming	SW1	Programming	Interface for commissioning in production environment. This terminal is not intended for users.
Jumper	J6	CANlink termination resistor selection	Pins 1 and 2 shorted: resistor connected Pins 2 and 3 shorted: resistor disconnected
Indicator[1]	D4 (red)	Power indicator	Steady ON: The AC drive is powered on. OFF: The AC drive is not energized or the PROFIBUS-DP card is not installed properly.
	D3 (yellow)	Indicator of communication between the PROFIBUS-DP card and the master	Solid ON: Communication between the DP card and the master is normal. Solid OFF: Communication between the DP card and the master is not established. Check the connection of PROFIBUS cables and the setting of the station number. Flashing: The master does not run or a fault occurs during communication between the DP card and the PROFIBUS master.
	D2 (green)	Indicator of communication between the PROFIBUS-DP card and the AC drive	Steady ON: Communication between the PROFIBUS-DP card and the AC drive is normal. Solid OFF: Communication between the PROFIBUS-DP card and the drive fails (check the baud rate setting). Flashing: Interference exists on communication between the DP card and the AC drive or the expansion card address is beyond the range of 1 to 125.

Note

[1]: The indicator color does not match the indicator SN in some products. The indicator SN shall prevail and is D2, D3, and D4 from left to right, as shown in *"Figure 12-1 " on page 278* .

- Connection with PROFIBUS

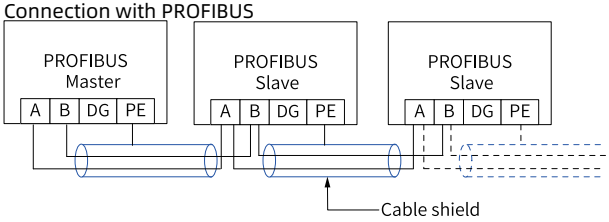


Figure 12-3 Connection with PROFIBUS

For PROFIBUS connection, PROFIBUS-DP only provides one type of DB9. The DB9 is a standard Siemens DB9 socket, in which the PE level for the system must be grounded reliably. If the baud rate is high, you need to strictly follow the Siemens DB9 wiring requirements.

The baud rate varies with the wire length, as listed in the following table.

Table 12–2 Relationship between the bus length and the baud rate

Baud Rate (kbps)	Maximum Length of Wire A (m)	Maximum Length of Wire B (m)
9.6	1200	1200
19.2	1200	1200
187.5	600	600
500	200	200
1500	100	70
3000	100	Not supported
6000	100	
12000	100	

13 Appendix D: PROFINET IO Use Instructions

13.1 Overview

The MD500-PN1 card is a PROFINET fieldbus adapter card complying with PROFINET Ethernet standards.

It is designed to be used with HD9X series drives to improve the communication efficiency and allow easy networking of drives, enabling the drive to act as a slave of the fieldbus master.

The software version of the MD500-PN1 card must be 1.00 or later. After the card is installed and powered on, you can query the card model and software version on the HD9X based on the parameter numbers U1-40 and U1-41, respectively. The matching GSDML file is named GSDML-V2.31-inovance-md500-20180705.xml.

This user guide is applicable only to HD9X series drives. If you need to use the MD500-PN1 card with other drives, consult the technical support center for applicability and related technical data.

Read through this guide before use.

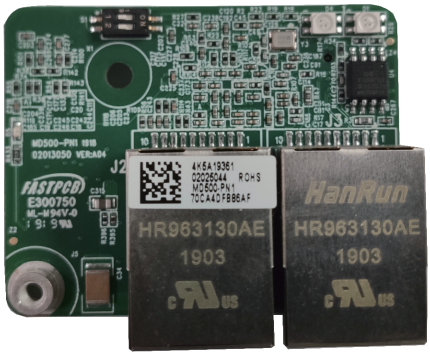


Figure 13-1 MD500-PN1 card appearance

13.2 Installation and Setup

13.2.1 Installing MD500-PN1

The MD500-PN1 card is designed to be embedded into the HD9X series AC drives. Before installation, turn off the AC drive control power supply and wait for the MCB indicator to become OFF. Then, insert the MD500-PN1 card into the AC drive and fasten the screws to protect the signal socket between boards from damage caused by external signal cable tension. The following figure shows the MD500-PN1 card installation.

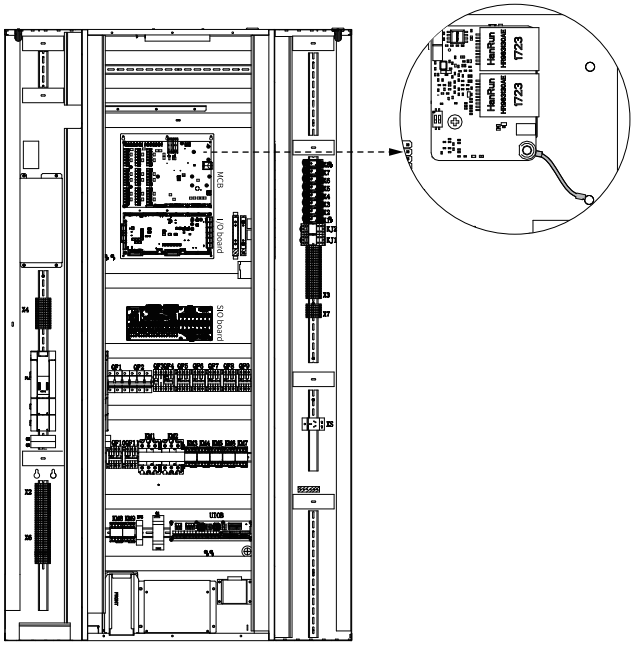


Figure 13-2 MD500-PN1 card installation

After installing the MD500-PN1 card to the AC drive, connect the grounding terminals of the MD500-PN1 card and the AC drive properly.

13.2.2Hardware Layout

The following figure shows the hardware layout of the MD500-PN1 card. The pin header J1 on the back of the MD500-PN1 card is used to connect the AC drive. The MD500-PN1 card provides two network ports J2 and J3 for communication with the PROFINET card (PLC). For details about the hardware, see the following table.

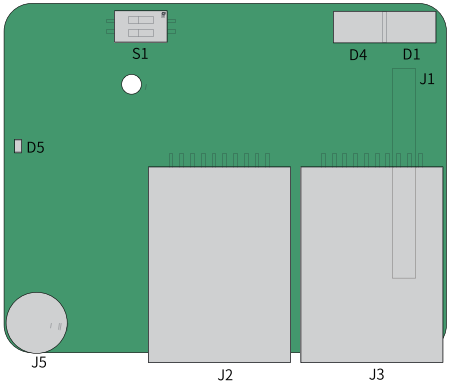


Figure 13-3 Hardware description of MD500-PN1

Table 13–1 Hardware description of MD500-PN1

Identifier	Hardware Name	Description
J1	Pin header	It connects to the AC drive.
J2	Network port	It is used by the PN card to communicate with that of the PROFINET card (PLC), with direction insensitive.
J3		
J5	EMC ground terminal	It connects to the EMC ground terminal of the AC drive.
D5	Power indicator	It is used to indicate the status of the power supply. On: Normal OFF: Abnormal. Check whether the card is installed properly.
D1	Status indicator of communication with PLC (PLCLINK)	For details, see *"Table 13-2 " on page 285*
D4	Status indicator of communication with AC drive (DSPLINK)	
S1	2-position DIP switch	It is used for upgrade only by the manufacturer.

Table 13–2 Indicators of the MD500-PN1 card

Indicator		Status Description	Action
DSPLINK	Steady green	Normal	None
	Steady yellow	MAC address abnormal	Replace the PN card.
	Blinking yellow	AC drive faulty	Clear the AC drive fault.
	Steady red	Abnormal communication with the AC drive	Check whether the drive supports the PN card.
PLCLINK	Steady green	Communication normal	None
	Blinking green	Master not found	Check whether a device name is assigned to the slave. Check whether the corresponding PLC is connected.
	Steady yellow	Configuration error	Check whether the GSD is correct.
	Steady red	Communication with the master interrupted	Check the wiring.

13.2.3Interface Description

The MD500-PN card is connected to the PROFINET master by using the standard Ethernet RJ45 socket. Its pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables.

Table 13–3 PROFINET communication terminals

Terminal Symbol	Terminal Name	Description
P1	Port 1	Direction-insensitive terminals that can be connected to the PLC end
P2	Port 2	

Note

After the MD500-PN1 card is installed, P1 is on the left and P2 is on the right when you face the RJ45 interface. It is recommended to use Cat 5e shielded twisted pair cables to ensure stable operation.

13.3 Communication Configuration

13.3.1 Configuration for Communication Between PN Card and HD9XS AC Drive

After the MD500-PN1 card is installed to the HD9XS drive, the written PZD1 is mapped as the drive command word, the written PZD2 is mapped as the target frequency, the read PZD1 is mapped as the drive operating state, and the read PZD2 is mapped as the drive operating frequency by default. For details about parameters related to communication monitoring, see *" Appendix A: Parameter List" on page 246*.

13.3.2 Configuration for Communication Between PN Card and PROFINET Master

After enabling the communication between the PN card and HD9XS series AC drive, connect the PROFINET master correctly to enable the communication between PN card and PROFINET master to achieve networking of AC drives.

- PROFINET topology
  The PROFINET protocol supports a variety of topologies, including bus-, star-, and tree-type topologies. Diversified networking modes can be implemented by using switches.

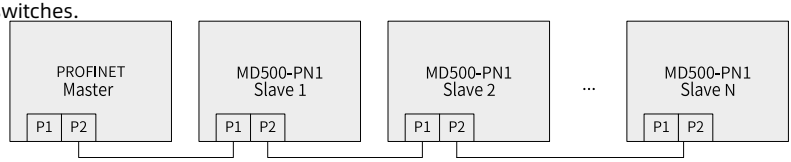


Figure 13-4 Bus topology

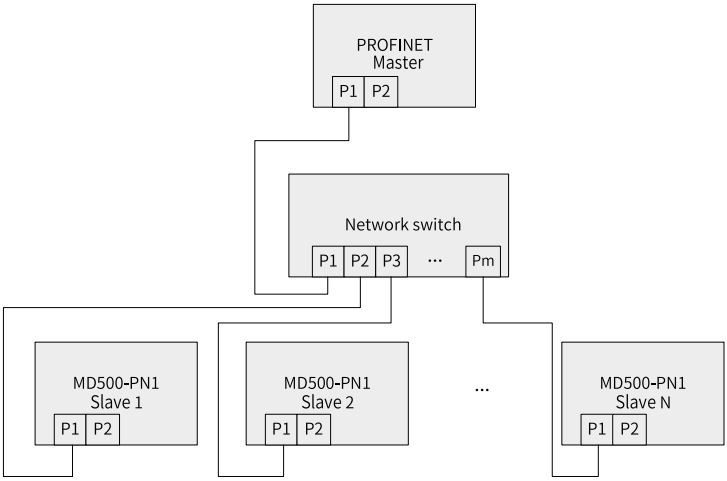


Figure 13-5 Star topology

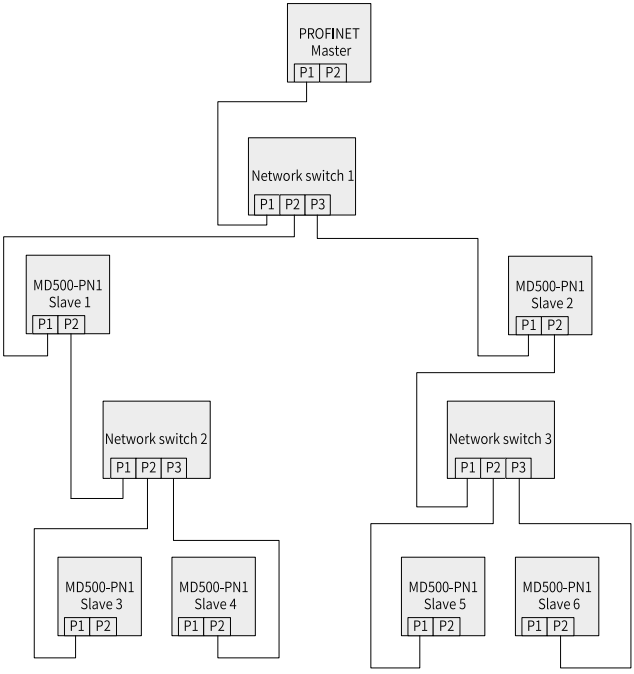


Figure 13-6 Tree topology

- PROFINET communication protocol

Data transmission format

The MD500-PN1 card transmits data using PZD formats with different lengths as required. You can set the PZD functions during configuration.

The following table lists the functions supported by each data format.

Data Type	Data Length	Supported Function
Standard telegram 6	PZD-12/12	Setting of AC drive command and frequency Cyclic writing of 10 functional parameters Reading of AC drive status and operating frequency Cyclic reading of 10 function parameters

- PZD data

  The PZD area enables the master to modify or read AC drive data in real time and exchange data with the AC drive cyclically. The data communication addresses are directly configured by the AC drive. The PZD area is used to:

  - Set the AC drive control command or frequency reference in real time.
  - Read the AC drive status or operation frequency in real time.
  - Exchange function parameter data and monitoring parameter data between the AC drive and the PROFINET master in real time.

  PZD is used for the following cyclic data exchange between the master and the AC drive.

PZD Data Sent by Master		
AC Drive Command	AC Drive Frequency Reference	Real-time Modification of AC Drive Function Parameters
PZD1	PZD2	PZD3 to PZD12
PZD Data in AC Drive Response		
AC Drive Command	AC Drive Operation Frequency	AC Drive Parameters Read in Real Time
PZD1	PZD2	PZD3 to PZD12

- Master request

PZD Sent by Master	
PZD1	**AC drive command word (command source set to communication)**
	01: Forward running 02: Reverse running 03: Forward jog 04: Reverse jog 05: Coast to stop 06: Stop according to the stop mode specified by F6-10 07: Fault reset 08: Pre-charge 10: Pre-charge switch-off 13: Switch-up 14: Switch-down
PZD2	**AC drive target frequency (frequency source set to communication)** The frequency reference ranges from -100.00% to +100.00%. When the specified target frequency is beyond the range, the AC drive does not respond to the frequency reference.
PZD3 to PZD12	**Modifying the function parameter values (groups F, A, B, and C) in real time, not writing to EEPROM** FE-02 to FE-11 correspond to PZD3 to PZD12. For the configuration, see PZD data configuration.

- AC drive response

PZD Data in AC Drive Response	
PZD1	AC drive operating status AC drive running states are determined by the following bits: Bit 0: 0: AC drive stopped; 1: AC drive running Bit 1: 0: Forward running; 1: Reverse running Bit 2: 0: No fault; 1: AC drive fault Bit 3: 0: Frequency reference not reached; 1: Frequency reference reached Bit 8: 0: No alarm; 1: Drive alarm
PZD2	AC drive operating frequency (unit: 0.01 Hz) The current AC drive operating frequency is indicated by 16-bit signed data in the response.
PZD3 to PZD12	Reading function parameter values (groups F, A, B, and C) and monitoring parameter values (group U) in real time FE-22 to FE-31 correspond to PZD3 to PZD12. For the configuration, see PZD data configuration.

- Parameter address description

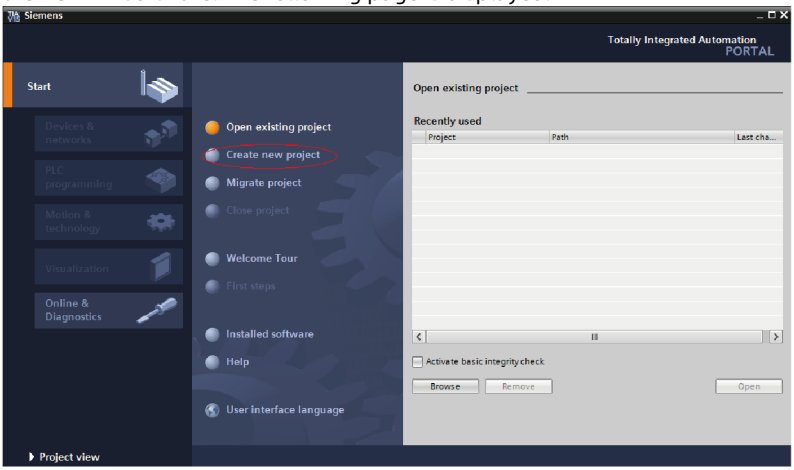
  For parameters in groups F, A, B, and C, the high-order 8 bits of the communication address indicate the group number and the low-order 8 bits indicate the parameter

number in the group. For example, the communication address of FD-05 is FD05H, in which FDH represents the group FD and 05H represents the fifth (in hexadecimal data format) parameter in the group.

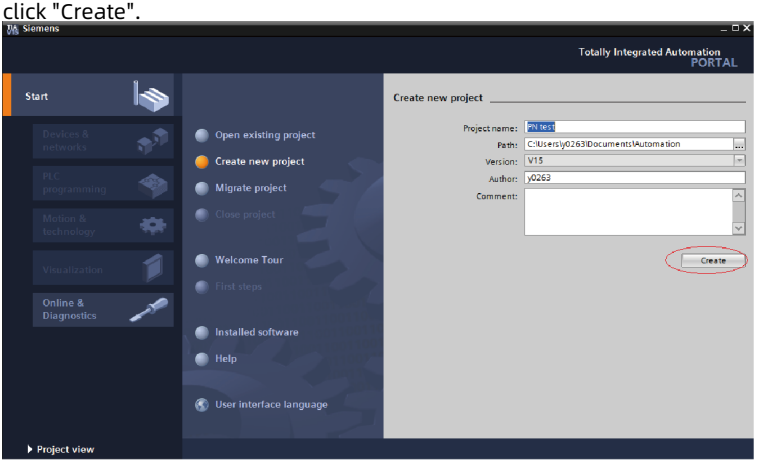
For parameters in group U, the high-order 8 bits in the communication address is 70H, and the low-order 8 bits indicate the parameter number in the group. For example, the communication address of U0-23 is 7017H.

- Configuring slaves on the S7-300 master
  Before using the PROFINET master, you need to configure a GSDML file of the slave to add the corresponding slave device to the system of the master. If the file exists, skip step 2. You can obtain the GSDML file from the agent or the manufacturer. To configure the slave, do as follows:

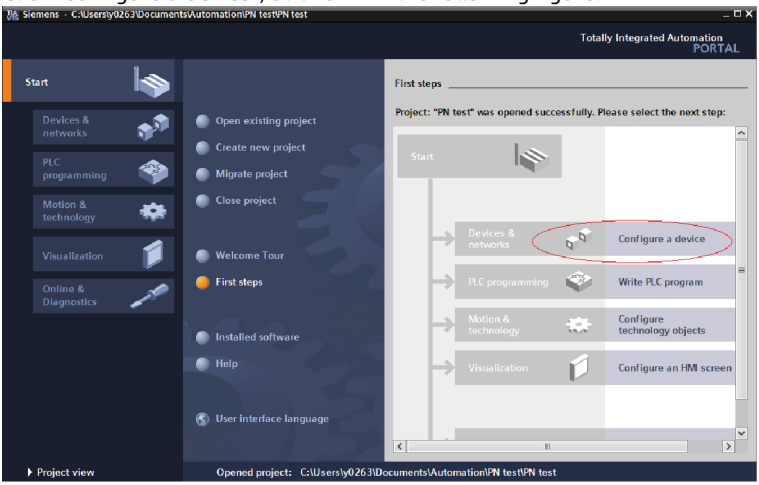
  1. Create a project in PORTAL and add S7-300 master in the project. Double-click the PORTAL software. The following page is displayed.



Click "Create new project", enter a project name and storage path, and click "Create".

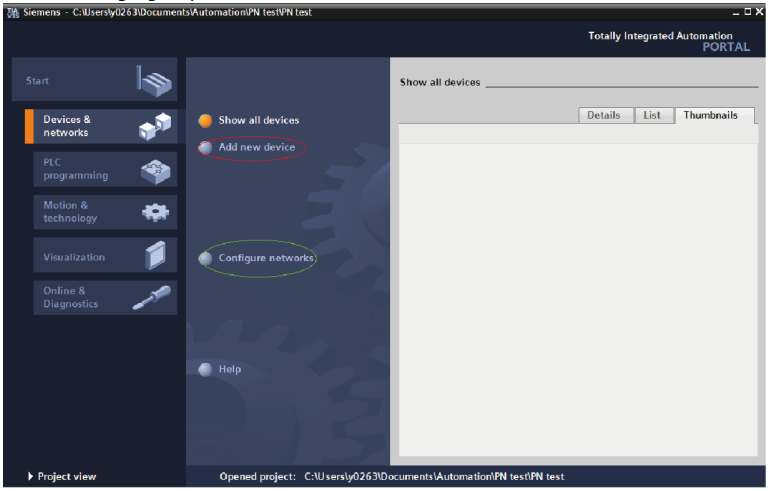


Click "Configure a device", as shown in the following figure.

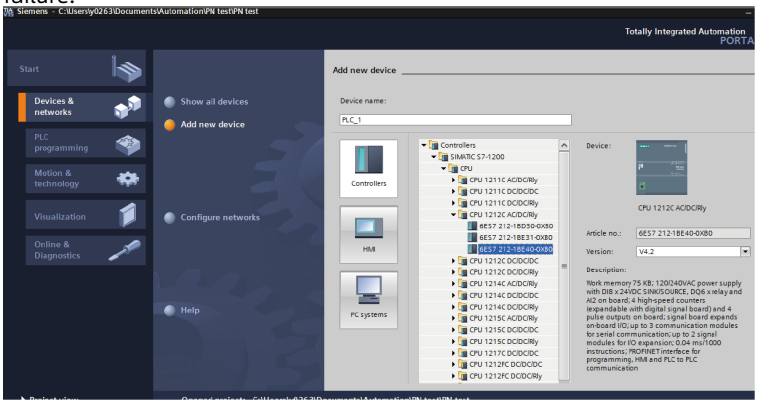


- For a new project, click "Add new device" (marked with a red circle in the following figure).

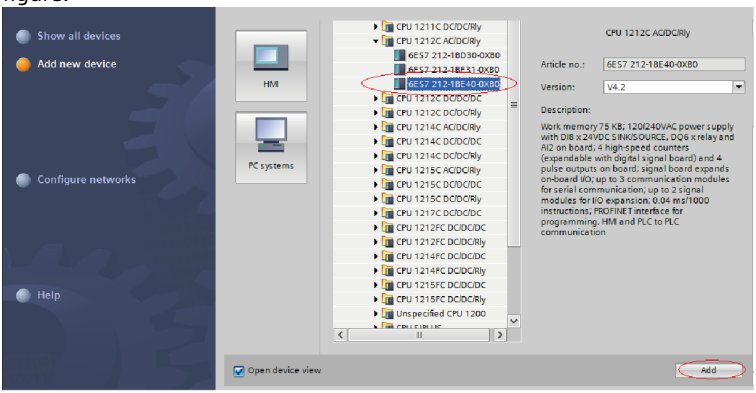
- For an existing project, click "Configure networks" (marked with a green circle in the following figure).



Select a PLC on the displayed page. Set the article number and firmware version of the PLC correctly. Incorrect settings will result in download failure.

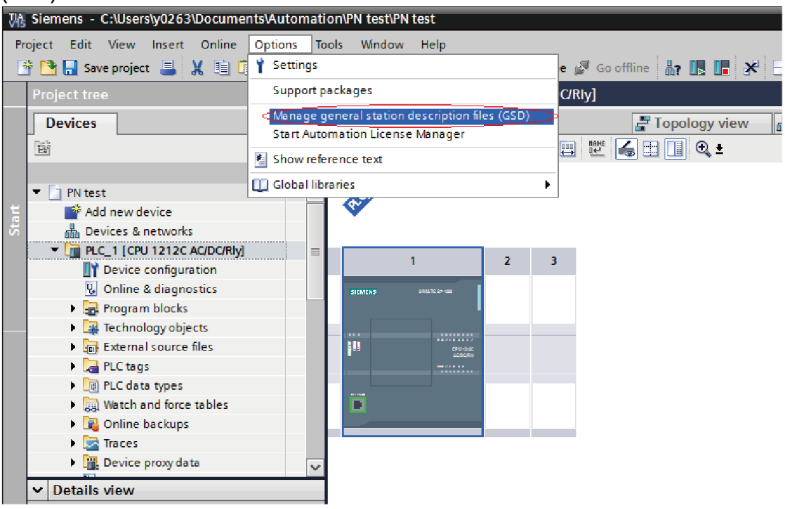


Click "Add" or double-click the selected master as shown in the following figure.

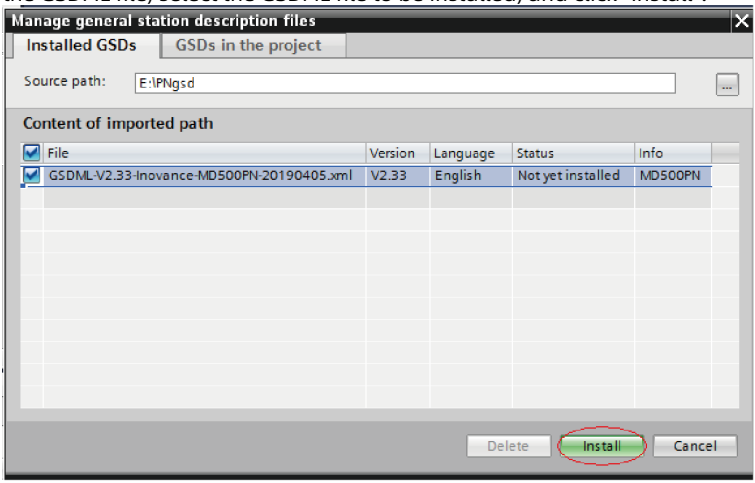


The master is added.

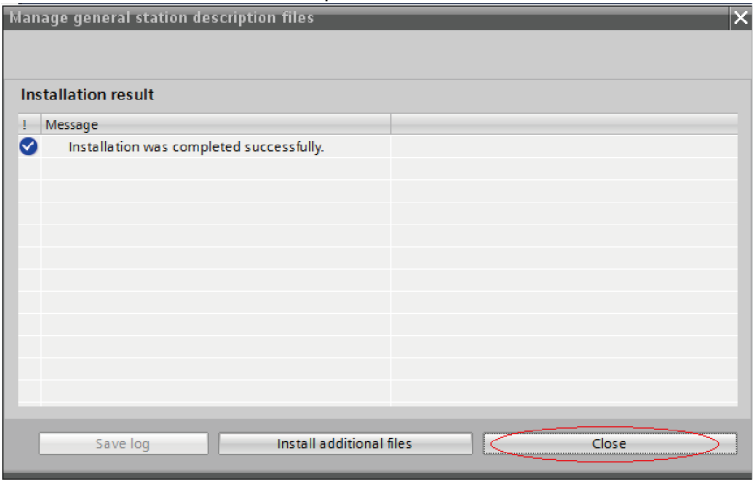
2. Install the GSDML file. (Skip this step if the GSDML file has been installed.) Specifically, choose "Options" > "Mange general station description files (GSD)".



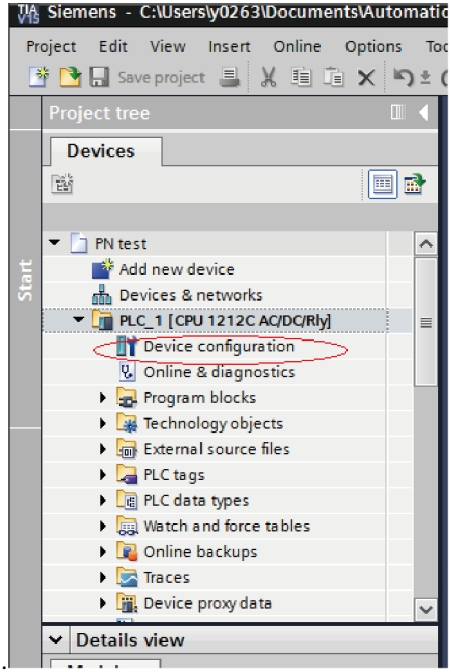
Select a path (which must not contain any Chinese character) for storing the GSDML file, select the GSDML file to be installed, and click "Install".



Wait until the installation is completed, and click "Close".

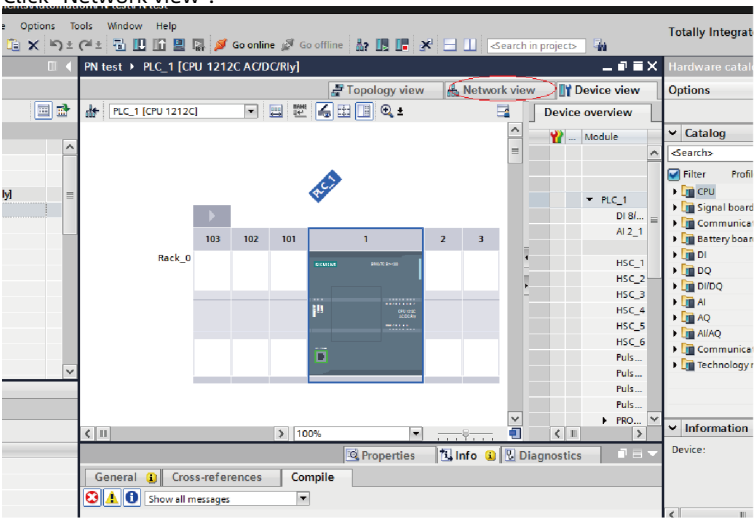


3. Configure a slave.

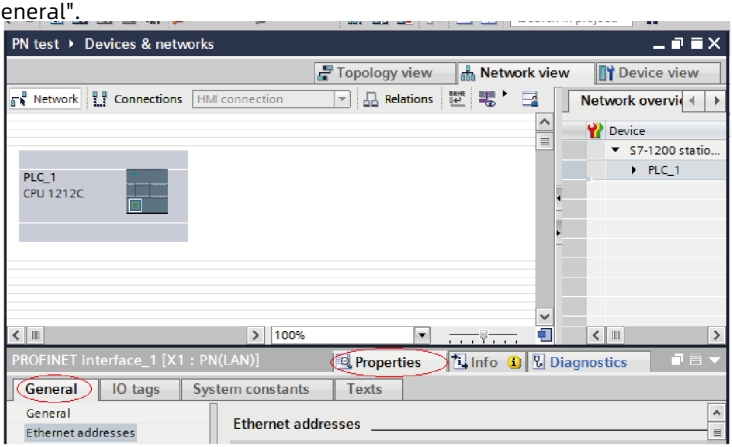


Click "Device configuration".

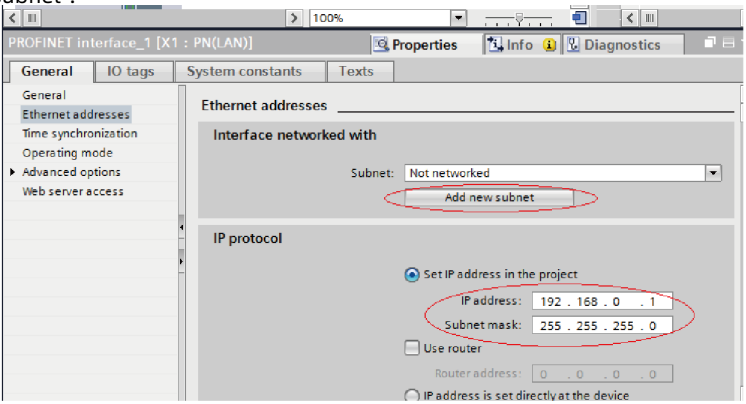
Click "Network view".



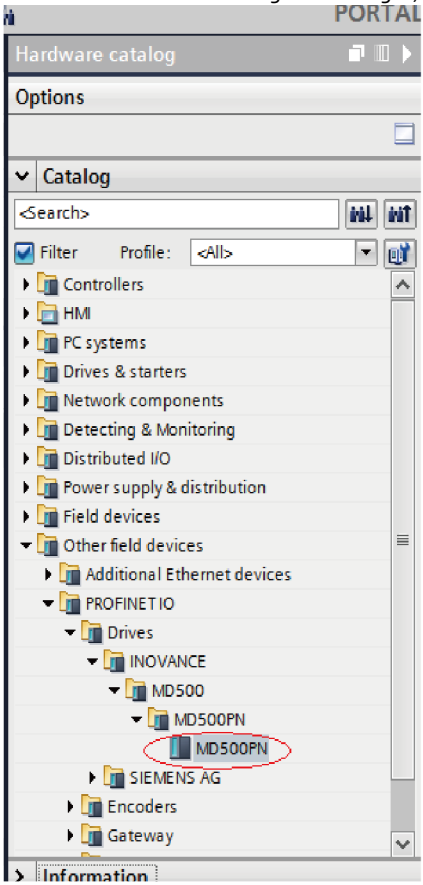
Select the Ethernet interface of the PLC, and choose "Properties" > "General".



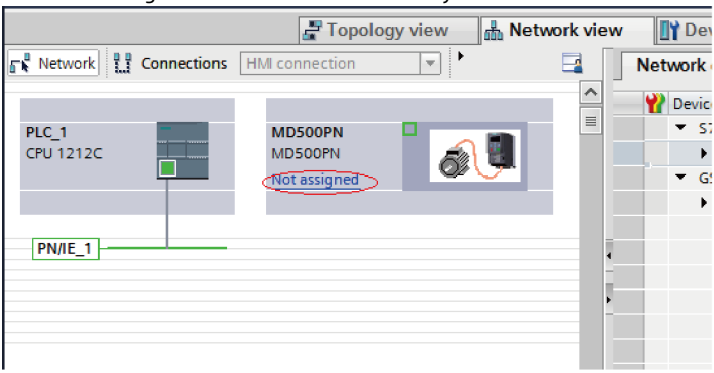
Set the IP address and subnet mask of the PLC master, and click "Add new subnet".



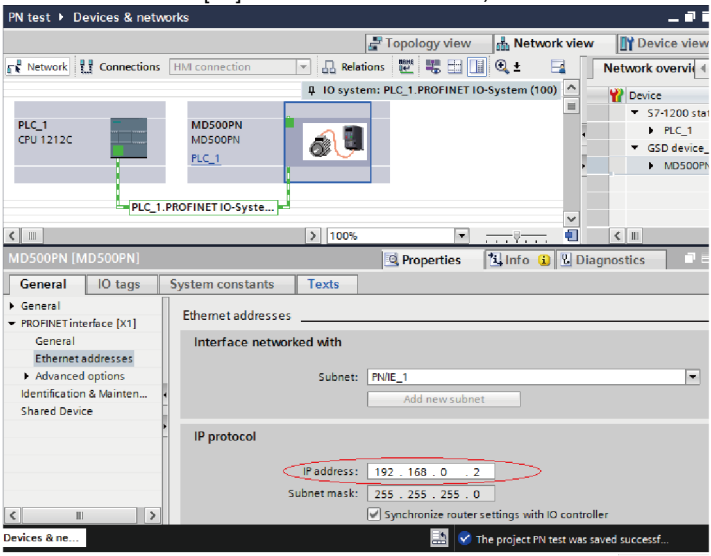
Locate MD500 under "Hardware catalog" on the right, and double-click MD500PN.



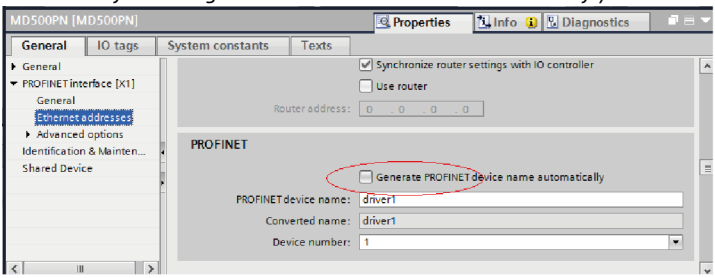
Click "Not assigned" and select the master system for the slave.



Select the slave station, and choose "Properties" > "General". Then choose "PROFINET interface [X1]" > "Ethernet addresses", and set the IP address.

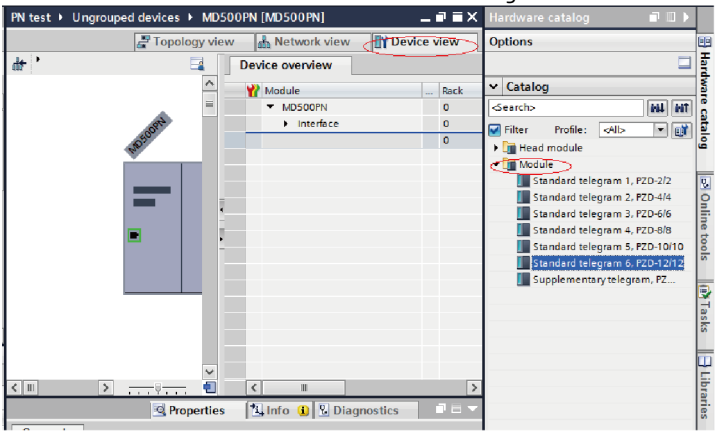


Scroll down the screen to the "PROFINET" section. Deselect "Generate PROFINET device name automatically" and enter a name in the "PROFINET device name" field. (Alternatively, you can keep the option selected to allow the system to generate a device name automatically.)



4. Configure data properties of the slave.

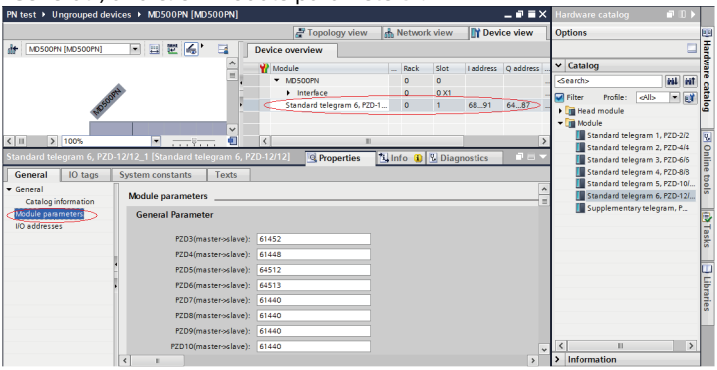
Select the slave and switch to the "Device view". In the "Catalog", navigate to "Module" and double-click the desired data length for the slave.



5. Configure PZD.

The fixed configuration of PZD1 and PZD2 cannot be modified by users. PZD3 to PZD12 are intended for customized periodic data exchange. They can be set in the hardware configuration.

After completing step 4, select the message format. Choose "Properties" > "General", and click "Module parameters".



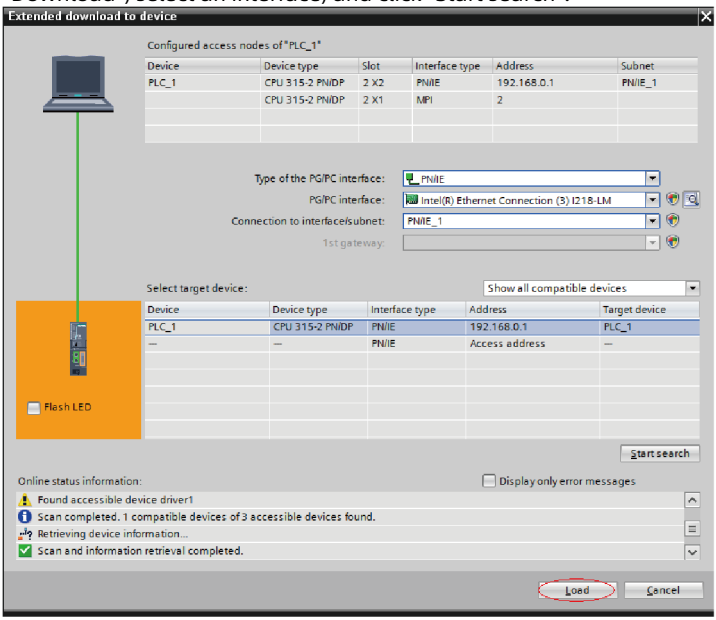
PZDx(master->slave) indicates the address of the slave used by the master to write data to the slave, and PZDx(slave->master) indicates the address of the slave used by the master to read data from the slave. PZD3 to PZD12 (determined by the selected message type) are displayed in decimal and can be modified. For example, to set PZD3(master->slaver) to F0-12, enter 61452.

By default, all PZDs of the MD500-PN1 are set to F0-00 (61440 in decimal). For unused PZDs, modification is not required and default values can be retained. PZD mapping must be set independently for each slave as required. If mapping relationships of various slaves are the same, you can select one configured slave, press Ctrl+C, select the PROFINET bus in the configuration, press Ctrl+V, and modify the device name and IP address.

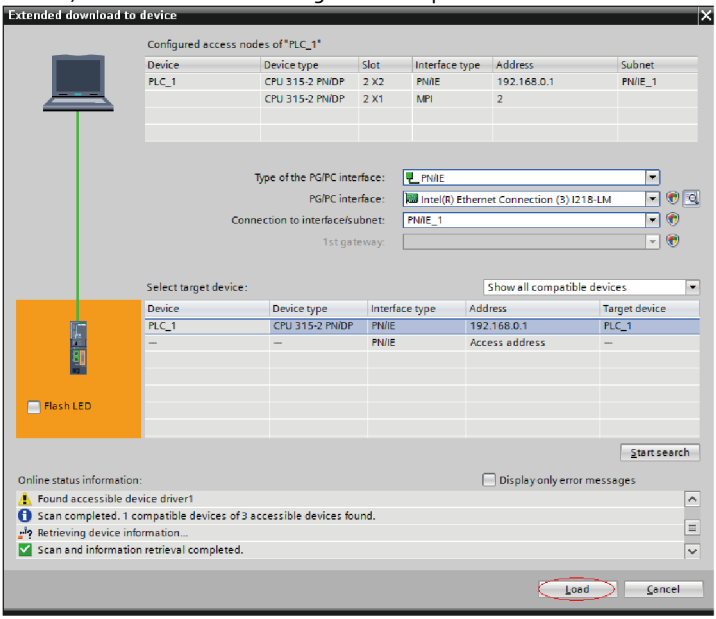
Switch to "Network view". To add more stations, repeat the preceding steps. If the configuration is the same, select and copy a configured slave and modify the IP address and device name. (Note that the device name must be unique.)

6. Download the configuration.

Save the network configuration. Set the IP address of the PC to be in the same network segment as the PLC. (Avoid IP address conflicts with the slaves in the configuration. Alternatively, you can allow automatic IP address allocation for the PC.) Then, compile the configuration, click "Download", select an interface, and click "Start search".

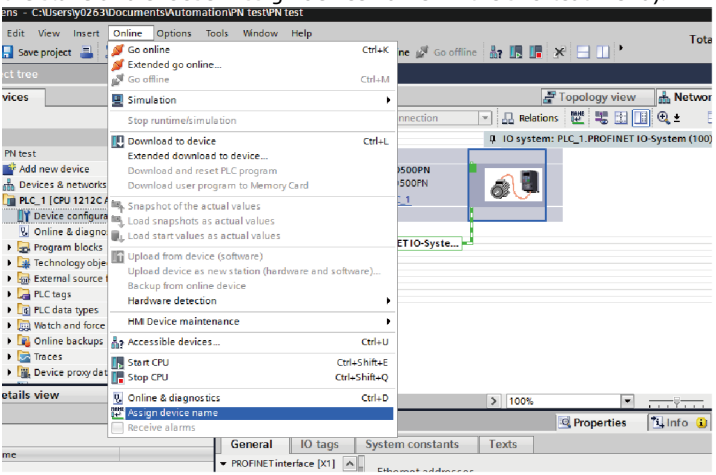


Select the device corresponding to the PLC from the search results, click "Load", and wait for the loading to be completed.

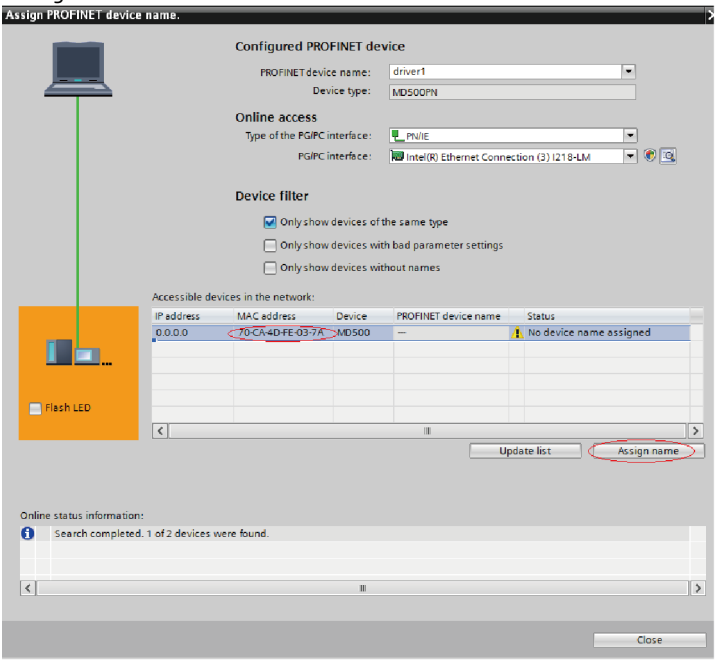


7. Assign a device name.

After the loading, you need to assign device names for slaves not named. Select a slave, and choose "Online" > "Assign device name" (or right-click the slave and choose "Assign device name" in the shortcut menu).

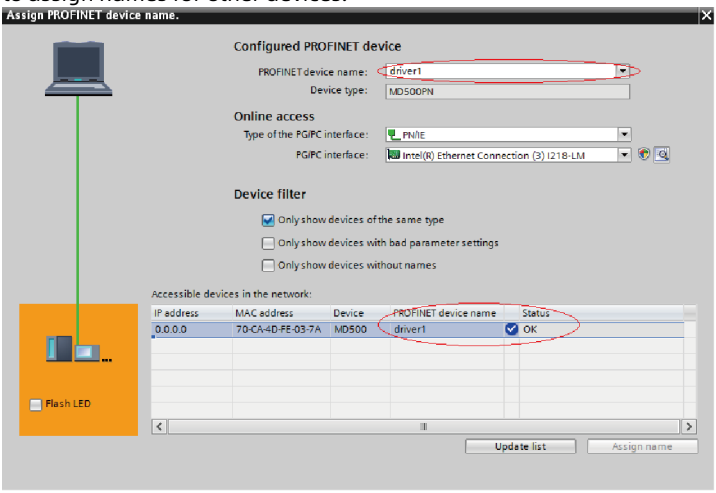


Devices of the same type will be displayed on the popped-out page. Select the slave to be assigned with the device name. The MAC address for each slave is unique. When multiple devices of the same type exist in a network, differentiate such devices with their MAC addresses. The MAC address of the MD500PN card is on the product enclosure. Then, click "Assign name".



If information similar to the following figure is displayed, the device name is assigned successfully. The displayed "PROFINET device name" must be consistent with the name under "Configured PROFINET device" shown in the preceding figure. After assigning the device name, close the interface or select another device from the "PROFINET device name" drop-down list

to assign names for other devices.

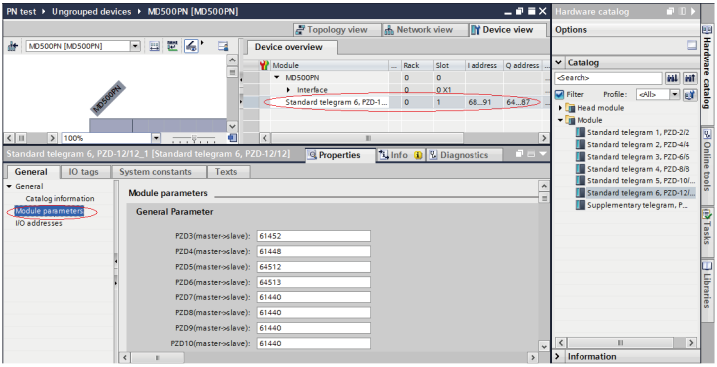


The slave will save the assigned name, and the master identifies each slave based on the device name. (The MAC address is not intuitive in use. The process of assigning the device name is actually binding the device name with the MAC address.)

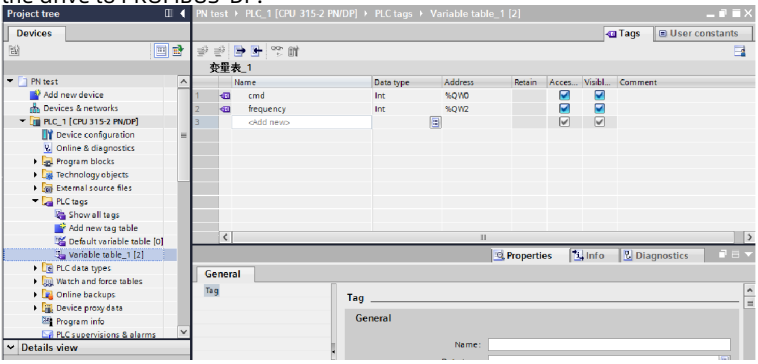
Note

- Each device name can be assigned to only one slave station on the network.
- After you modify a device name in the configuration, it is necessary to re-assign the name (for any exception, see *"13.4 Rectifying Device Fault" on page 306*).
- After you modify an IP address, you only need to load the modified configuration to the PLC for the modification to take effect. Name re-assignment is not required.
- After the preceding steps, the PROFINET slave is configured. You can compile programs in the PLC to control the AC drive.
- Reading and writing operations on PROFINET slaves through the PLC are similar to those on PROFIBUS-DP slaves through the PLC.

8. Example for start/stop of HD90S

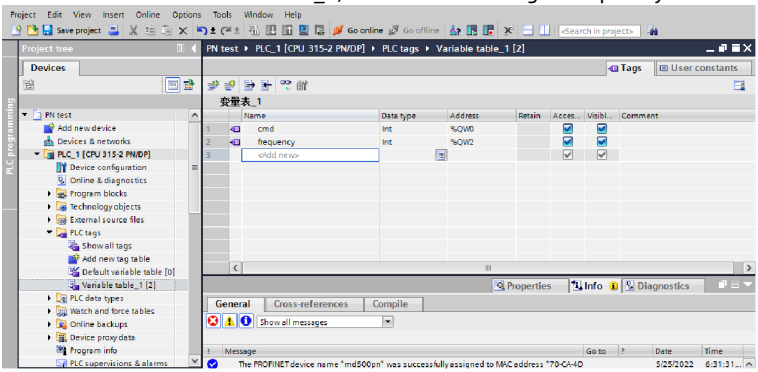


Open the "Network view" page, and select the slave. Open the slave device view and change the I address and Q address in the standard telegram. (I address is the address used by the drive to transmit data to the PLC, and Q address is the address used by the PLC to transmit data to the drive.) The I address and Q address must be changed to 0 to 23, corresponding to PZD1 to PZD12 respectively. The control command PZD1 is QW0, and the target frequency reference PZD2 is QW2. After setting the I address and Q address, set the command source and frequency source of the drive to PROFIBUS-DP.

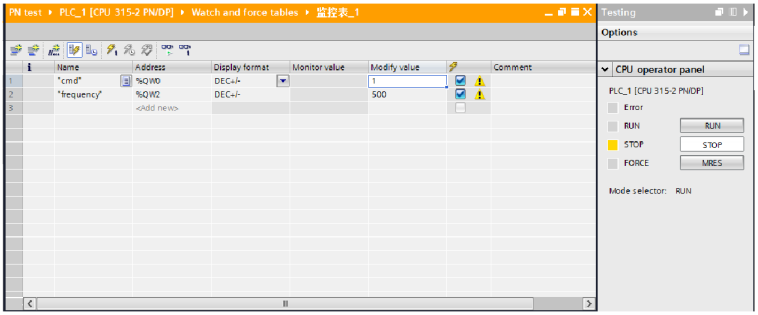


Open the PLC variable in the project tree on the left side of the page, and add a new variable table, which appears below it. Then, add a control

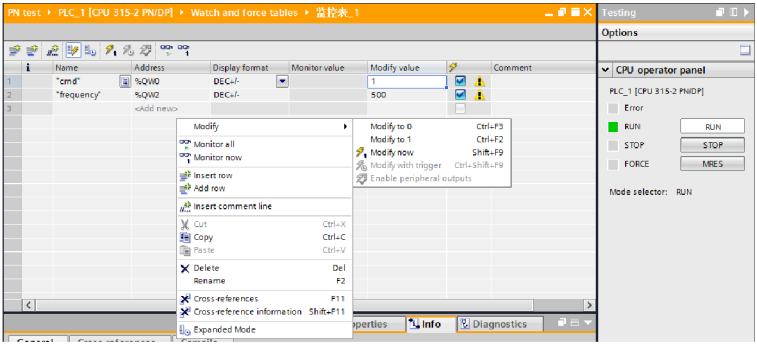
command to the variable table_1, which sets the target frequency.



Once the PLC variable is set, compile it, load it to the device, and go online.



Click the monitoring and force table in the project tree. Click "Add new monitoring table", and the monitoring table_1 will appear below it. Add several defined PLC variables in the monitoring table_1 and assign each of them with a value. When "cmd" is set to 1, forward running applies. When "frequency" is set to 500, the target frequency is 5 Hz. Then, click "RUN" on the CPU operating panel on the right side of the page, right-click the monitor page, click "Modify", and then click "Modify Now". At this time, the HD9x drive runs at 5 Hz. Change "cmd" to 5, right-click "Modify", and then click "Modify Now". At this time, the drive stops immediately.



13.4 Rectifying Device Fault

The MD500-PN1 card can be replaced directly when a slave node is faulty (only the MD500-PN1 card is faulty) without performing device configuration again.

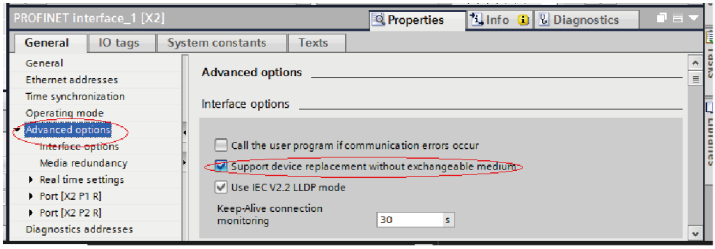
Prerequisites for directly replacing the MD500-PN1 card are as follows:

- The new card and the old card to be replaced are both MD500-PN1 cards.
- The new MD500-PN1 card has not been assigned with a device name before.
- The topology has been configured during PLC network configurations.
- The "Support device replacement without exchangeable medium" option is selected during PLC configuration.

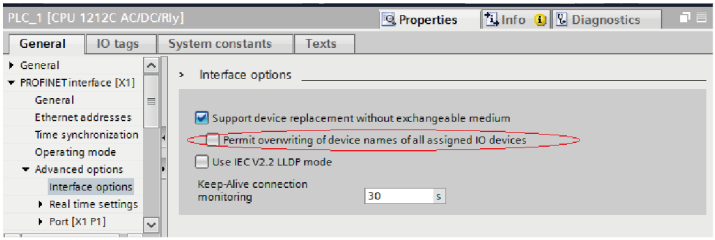
To replace the MD500-PN1 card directly, you need to perform corresponding settings during configuration. Settings in STEP7 Micro/WIN and TIA Portal are different.

Selecting the "Support device replacement without exchangeable medium" option and setting the topology in TIA Portal

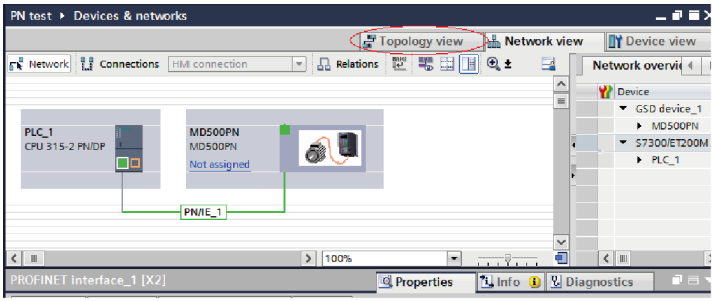
On the hardware configuration page of TIA Portal, select the PROFINET interface of the master. Choose "Properties" > "General" > "Advanced options" > "Interface options", and select "Support device replacement without exchangeable medium", as shown in the following figure.



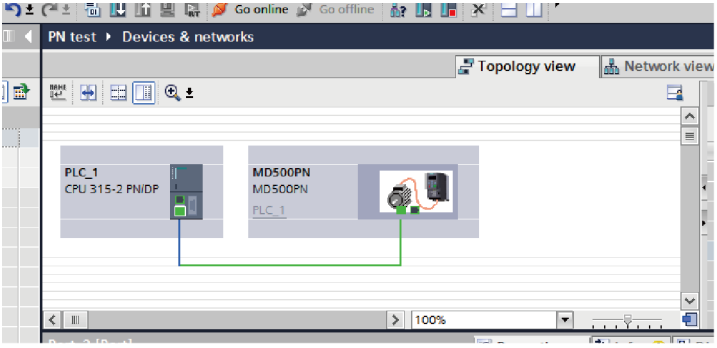
For the S7-1200 or S7-1500 PLC, a sub-option "Permit overwriting of device names of all assigned IO devices" is available. If this sub-option is selected, the second prerequisite for direct replacement can be ignored.



Then, switch to the "Topology view", as shown in the following figure.



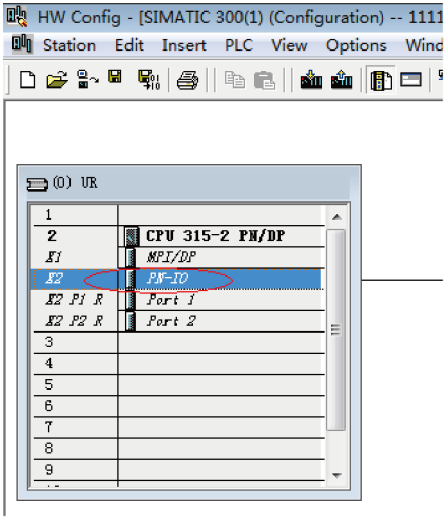
In the topology view, click and drag an interface to the interface of another device which is directly connected with the first interface, and release the mouse button. Note that the preceding connection must be consistent with the actual network connection of devices. For example, if P1 of the PLC is connected to P2 of slave 1, and P1 of slave 1 is connected to another slave, the connections must be consistent in the topology. An incorrect topology will cause a function failure after replacement and even communication errors. After the MD500-PN1 card is installed, P1 is on the left and P2 is on the right when you face the RJ45 interface.



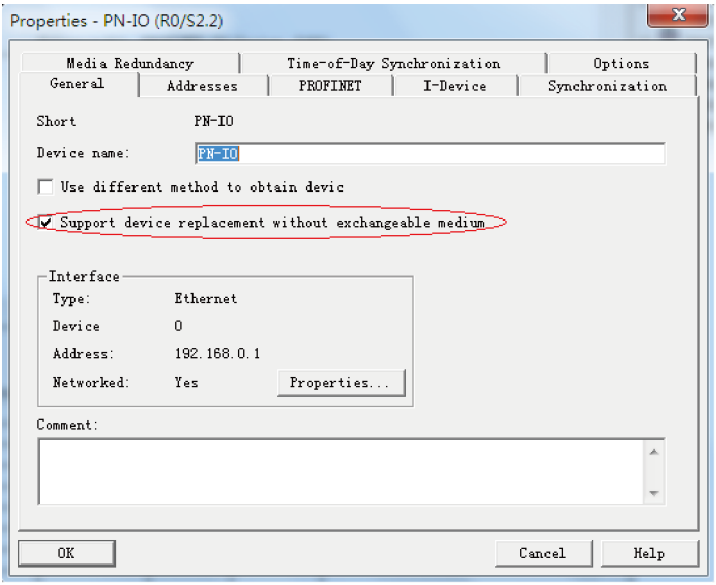
Set the topology. Then, compile the configuration and load it to the PLC.

Selecting the "Support device replacement without exchangeable medium" option and setting the topology in STEP7 Micro/WIN

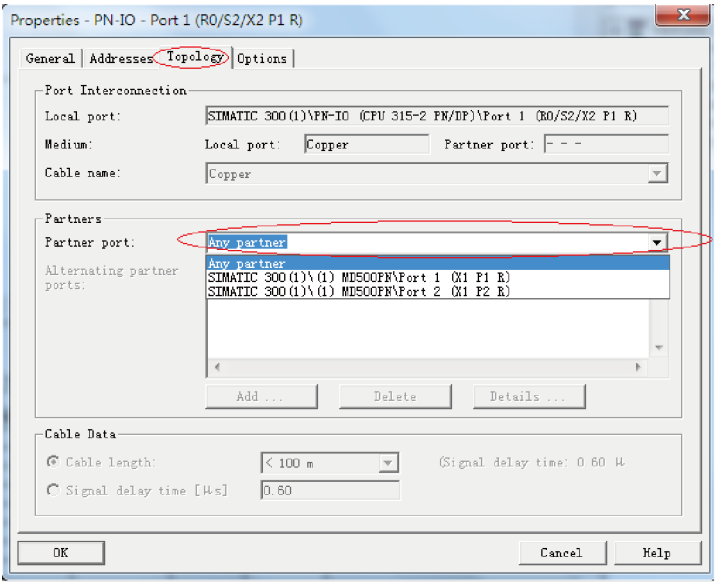
On the hardware configuration page, double-click "PN-IO", as shown in the following figure.



Select the option marked below, and click "OK".



According to the actual network connection, double-click "Port 1" or "Port 2" of the PLC and switch to "Topology". Then select the slave port connected to the PLC and click "OK". ("Any Partner" is selected by default, which must be changed to the port that is actually connected.)



Click the corresponding port of the slave to set the topology with the same method. After setting all connected ports, compile the configuration and load it to the PLC.

After completing the preceding configuration, perform the following operations when any slave device needs to be replaced: (1) Disconnect the device from the network. (2) Install a new device to which no device name is assigned before at the same position. (For S7-1200 or S7-1500, if "Permit overwriting of device names of all assigned IO devices" has been selected, a device that has been assigned with a name can be used.) (3) Connect the new device to the network using the original wiring mode. (**Note**: The network cable connection must be consistent with the original connection and the connection in the topology.) (4) Power on the slave device. The PLC assigns a device name to the newly connected device automatically.

14 Appendix E: Instructions for Use of the General-Purpose Encoder Expansion Card

(Applicable to all models)

Overview

The drive support multiple general-purpose encoder extension cards (PG card) as options. The extension card is essential for closed-loop vector control. Select the corresponding PG card based on the encoder output type. The models are as follows:

Option	Description	Remarks
MD38PGMD	The card supports differential input, collector input, and push-pull input, as well as differential output and collector output.	Terminal wiring

Appearance

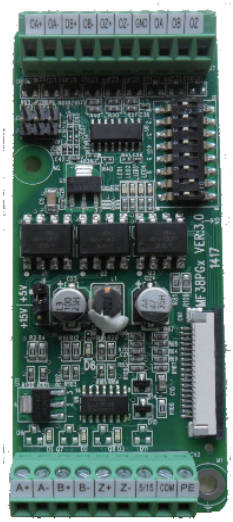


Figure 14-1 MD38PGMD card appearance

CAUTION

- Install/Remove the PG card after the AC drive is switched off completely.
- Connect the PG card to the J21 on the main control board by using the 18-pin FFC.

Specifications of encoder extension cards and signal assignment of the terminal block are as follows.

Table 14–1 Specifications and terminal signal assignment

Encoder power supply	5 V/200 mA, 15 V/100 mA	
Max. input frequency	Differential: 500 kHz; collector: 100 kHz	
Encoder interface type	Differential, collector, and push-pull	
Frequency division range	0 to 63	
Frequency division interface type	Differential and collector	
Cable specifications	26AWG to 16AWG	
Terminal clearance	3.5 mm	
Terminal screw	Slotted	
Terminal type	Slanted terminal block	
Pin definition of encoder signal input terminal CN2		
Pin Number	**Terminal Name**	**Description**
1	A+	Encoder output signal A (positive)
2	A–	Encoder output signal A (negative)
3	B+	Encoder output signal B (positive)
4	B–	Encoder output signal B (negative)
5	Z+	Encoder output signal Z (positive)
6	Z–	Encoder output signal Z (negative)
7	5 V/15 V	5 V/15 V encoder power supply
8	COM	Encoder power ground
9	PE	Shield connection terminal
Pin assignment of the J7 frequency-division output signal terminal		
Pin Number	**Terminal Name**	**Description**
1	OA+	Differential frequency division output signal A (positive)
2	OA–	Differential frequency division output signal A (negative)
3	OB+	Differential frequency division output signal B (positive)
4	OB–	Differential frequency division output signal B (negative)
5	OZ+	Differential frequency division output signal Z (positive)
6	OZ–	Differential frequency division output signal Z (negative)
7	GND	Frequency-division output reference ground
8	OA	Collector frequency division output signal A
9	OB	Collector frequency division output signal B
10	OZ	Collector frequency division output signal Z

The DIP switch S1 has two main functions: setting a frequency-division coefficient and selecting a filtering function. The code is 1 when the DIP switch is ON. Otherwise, the code is 0. See the following table.

Frequency-Division Coefficient	DIP Switch								
	Pins for Frequency-Division Coefficient Settings						Pins for Filtering Function Selection		Filtering Function
	1	2	3	4	5	6	7	8	
No output	0	0	0	0	0	0	0	0	Non-adaptive filtering
Frequency-division output 1	1	0	0	0	0	0			
Frequency-division output 2	0	1	0	0	0	0	1	0	Adaptive filtering
Frequency-division output 3	1	1	0	0	0	0			
-	-	-	-	-	-	-	0	1	Fixed interlock
-	-	-	-	-	-	-			
-	-	-	-	-	-	-	1	1	Automatic interlock
Frequency-division output 63	1	1	1	1	1	1			

- Non-adaptive filtering: The PG card filter coefficient is fixed and small. This mode is suitable for applications with little to no interference or high-speed requirements.
- Adaptive filtering: The filter coefficient of the PG card is automatically adjusted. Therefore, the PG card features strong anti-interference abilities, especially when the feedback speed of the encoder is lower than 100 kHz. This mode applies to scenarios with strong interference. This is the default mode at delivery.
- Fixed interlock: When the PG card is set to this mode, it has all functions when set to adaptive filtering. In addition, in this mode, the PG card also features edge jitter elimination of the encoder feedback signal. This mode applies to scenarios where edge jitter exists in the encoder feedback signal.
- Automatic interlock: When the PG card is set to this mode, it has all functions when set to fixed interlock. In addition, the PG card can switch between the adaptive filtering mode and the fixed interlock mode. This can meet requirements of zero-speed running and non-zero-speed running, and prevent useful signals from being cleared as edge jitter during zero speed running in the fixed interlock mode.

15 Appendix F: Drive-Related Design Standards

The design and manufacturing of medium drives adopts the latest version of GB or GB/T standards in China and international Electrotechnical Commission standards (IEC) and international unit system (SI). As the minimum design technical indicators, some technical parameters comply with GB or GB/T standards in China and international Electrotechnical Commission standards (IEC).

Standards:

Standard No.	Name
IEC 61800-3	Adjustable speed electrical power drive systems: EMC
GB12668.3	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
IEC 61800-4	Adjustable speed electrical power drive systems: General requirements
IEC 61800-5-1:+A1	Adjustable speed electrical power drive systems: Safety requirement
GB/T 12668.501	Adjustable speed electrical power drive systems: Safety requirement
IEC 60204-1	Safety of machinery - Electrical equipment of machines General requirements
IEC 60204-11	Safety of machinery - Electrical equipment of machines Requirements for HV equipment
IEEE 519	Recommended procedures and requirements for harmonic control of power systems
GBT14549	Standards for quality of electric energy supply and harmonics in public supply network
GB 10233	Basic testing method for low-voltage switch cabinet and control gear assemblies
GB 1094.1	Power Transformers - Part 1: General
GB 1094.2	Power Transformer - Part 2: Temperature rise
GB 1094.3	Power Transformer - Part 3: Insulation levels, dielectric tests and external clearances in air
GB 1094.5	Power Transformer - Part 5: Ability to withstand short circuit
GB 4208	Degree of protection of enclosure (IP code)

Standard No.	Name
IEC 60721-3-1, class: 1K22	Classification of groups of environmental parameters and their severities - Part 1: storage
IEC 60721-3-2, class: 2K13, 2C2 (chemical gases), and 2S6 (solid particles) *	Classification of groups of environmental parameters and their severities - Part 2: storage
IEC 60721-3-3, class: 3K22 and 3S7 (solid particles).	Environmental Conditions Existing in the Application of Electric and Electronic Products - Part 3: Stationary Use at Weather-Protected Locations

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