Yolico

YD1000 MV Frequency Drive
User Manual

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Wuxi Yolico Electric Co., Ltd

About this manual

This manual is applicable to the YD1000 series general high-voltage inverter produced by Wuxi Yolico Electric Co., Ltd.

Technical support

If you encounter any problems when using YD1000 series universal high voltage inverter, please contact our company.

Table of Contents

CATALOGUE

Chapter 1 Safety Information and Precautions....01

1.1 Oerview....01
1.2 Manual Engagement....01
1.3 Safety precautions....01
1.4 Safe Operation....02

Chapter 2 Product Introduction....04

2.1 Product Information....04
2.2 Product Features:....05
2.3 Technical Parameters....07
2.4 Selection Instructions....08
2.5 Applications....09
2.6 Enforce the standard....10

Chapter 3 Hardware Configuration....11

3.1 Principle....11
3.1.1 Topology....11
3.1.2 Main circuit....12
3.2 Control System....14
3.2.1 Controller Configuration....14
3.2.2 Controller interface description....15
3.2.3 Interface Board....17
3.3 Power unit....24
3.3.1 Electrical principle....24
3.3.2 Unit structure....26
3.4 Cabinet configuration....27
3.4.1 Transformer cabinet....27
3.4.2 Control/Unit Cabinets....30
3.4.3 Pre-charging box....31
3.4.4 Starter cabinet (optional)....32
3.4.5 Switchgear (optional)....33
3.5 Cable selection....35
3.5.1 Selection of power cables....35
3.5.2 Control, signal and communication cable selection....35

Chapter 4 Human-Machine Interface........36

4.1 Introduction to Touch Screens........36
4.2 Touch screen operation and display instructions........36
4.2.1 Monitoring Interface........36
4.2.2 Trend Curves........37
4.2.3 Parameter Settings........38
4.2.4 Fault Logging........39
4.2.5 Unit Status........40

Chapter 5 Parameter Description........41

5.1 Inverter and motor parameters........41
5.2 Functional Parameters........48

Chapter 6 Functional Applications........54

6.1 Synchronous switching........54
6.2 Rotational speed start........54
6.3 Instantaneous power failure function........54
6.4 High voltage power loss treatment........55
6.5 System bypass function (optional)........56
6.6 Master-slave control........56
6.7 Motor overload protection function........56
6.8 Inverter stall prevention function........57
6.9 Mechanical bypass and neutral point drift........58
6.9.1 Mechanical bypass........58
6.9.2 Neutral point drift........58
6.10 Asynchronous machine open-loop vector........59

Chapter 7 Transportation, Storage and Installation........71

7.1 Transportation and storage requirements........71
7.2 Inspection........71
7.3 Lifting and unloading........71
7.4 Install in place........72

Chapter 8 Fault Handling and Maintenance....65

8.1 Minor Faults and Alarms....65
8.2 Heavy Failures and Alarms....65
8.3 Handling of Frequently Asked Questions....65
8.3.1 Inverter trip analysis....66
8.3.2 List of minor fault information....67
8.3.3 List of Critical Fault Information....68
8.4 Replacement of power units....72
8.5 Maintenance....72
8.5.1 Daily Patrols....72
8.5.2 Scheduled Maintenance....73
8.5.3 Maintenance of standby inverters and unit modules....73

Chapter 9 Instructions for the use of dry-type transformers....74

9.1 Instructions for installation and use of H-class dry-type transformer....74
9.2 Instructions for use of LD-B10-10 series dry-type transformer temperature controller....80

Chapter 10 Modbus Communication Protocol....89

Chapter 1

Safety Information and Precautions

1.1 Overview

First , thank you for choosing the YD general high-voltage inverter produced by Wuxi Yolico Electric Co., Ltd.!
YD general high-voltage inverter is a kind of high-voltage electrical equipment, which has been fully considered in the design of personal safety, but like other high-voltage equipment, there is dangerous voltage in the cabinet, which may lead to personal injury or equipment property damage if used improperly.
In order to prevent personal injury or damage to equipment property to you and others, please read this manual carefully before use! In order to use YD general-purpose high-voltage inverter safely, please pay special attention to the "Instructions" and "Precautions" marked on this manual.
In strict accordance with the guidance of this manual for the installation, commissioning, operation and maintenance of YD general high-voltage inverter, personnel and equipment are safe.

1.2 Manual Conventions

In this manual, safety matters are divided into the following two categories:

Danger: A situation that may result in serious injury or even death due to the danger caused by not following the required operation.

CAUTION: Moderate or minor injuries may result, as well as damage to the device, due to hazards caused by not operating as required.

Please read this chapter carefully when installing, debugging and repairing this system, and be sure to operate in accordance with the safety precautions required by the content of this chapter. In the event of any injury or loss caused by illegal operation, the company shall not be responsible for any injury.

1.3 Safety Precautions

We will provide technical training to the on-site personnel involved in the operation and maintenance of the equipment, so that everyone involved can learn the content of this manual in depth. In addition, on-site personnel must also strictly abide by the relevant power industry rules and regulations in addition to the safety knowledge introduced in this manual.

Wuxi Yolico Electric Co., Ltd. will not assume any responsibility for equipment damage, casualties caused by ignoring the above contents.

1.4 Safe Operation

1.4.1 Arrival inspection

Dangerous!

- When you find that the control system is flooded, missing or damaged when you open the box, please do not install it!
- When the packing list does not match the name of the actual product, please do not install it!
- When moving and hoisting equipment, it is necessary to ensure that the lifting equipment has sufficient strength, otherwise there is a risk of damaging the equipment!
- Please do not use the inverter with missing parts or damage, otherwise there is a risk of injury!

1.4.2 Installation

CAUTION!

- Install on flame-retardant objects such as metal, away from combustibles. Failure to do so may cause a fire.
- During the installation process, do not touch the components in the inverter cabinet with your hands, otherwise there is a risk of static damage.
- Do not twist the fixing bolts of the equipment components at will, otherwise there is a risk of damaging the equipment.
- Do not let the drilling residues, wire heads or screws fall into the inverter during operation, otherwise it will cause damage to the equipment.
- When you need to install or remove the circuit board, you must wear anti-static gloves and avoid touching the electronic components.

1.4.3 Wiring

Dangerous!

- The guidance of this manual must be followed and the construction must be carried out by professional electrical engineering personnel, otherwise there will be unexpected dangers!
- Wiring operations must be carried out under the guidance of our company's professionals and in accordance with relevant electrical safety operation standards!
- Make sure all power supplies are disconnected before wiring, otherwise there may be a risk of electric shock or fire!
- Grounding terminal PE should be reliably grounded, otherwise the inverter shell is in danger of being electrified!
- Never connect the input power supply to the output terminal (U, V, W) of the inverter. Pay attention to the markings of the terminal blocks!
- The input and output cables should meet the insulation and capacity requirements of relevant national or industry standards!
- The encoder must use shielded wire, and the shielding layer must ensure reliable grounding at one end!

Dangerous!

- Before powering on, further confirm whether the power supply voltage level is consistent with the rated voltage of the inverter, and whether the main circuit terminal is firm!
- After the inverter wiring is completed and the cabinet door is closed, it can be energized, and it is strictly forbidden to open the cabinet door in the live state, otherwise there is a risk of electric shock!

● When the self-start related function is enabled, safety isolation measures should be taken for the machinery and equipment, otherwise it may cause personal injury!
● After the inverter is connected to the power supply, even if it is in a shutdown state, the terminal of the inverter is still live and cannot be touched, otherwise it may cause the danger of electric shock!
● It is forbidden to disconnect the power supply of the fan in the operating state of the inverter, otherwise it will cause overheating and damage to the system equipment!
● For the water-cooled inverter, the cooling water should be turned off immediately after stopping operation to prevent condensation from damaging the inverter, and it is strictly forbidden to put cooling water in the shutdown state of the inverter speed control device!
● After confirming that the running command is cut off, the fault and alarm signal can be reset, otherwise it may cause personal injury!

CAUTION!

● Do not turn on or off the power supply to start and stop the inverter, otherwise it may cause damage to the inverter.
● Do not change the menu parameters of the manufacturer's function group at will, most of the factory-set parameters of the inverter can meet the operating requirements, as long as some necessary parameters are set, arbitrarily modifying the parameters may lead to damage to the mechanical equipment.
● When used on the lifting equipment, please configure the mechanical brake device at the same time.
● In the case of power frequency and frequency conversion switching, the two contactors controlling power frequency and frequency conversion switching should be interlocked.

1.4.5 Maintenance and inspection

Dangerous!

● In the energized state, do not touch any part of the inverter cabinet, otherwise there is a risk of electric shock.
● Do not maintain and maintain the inverter with electricity, and if you want to open and close the cabinet door, please be sure to turn off the power.
● Wait for at least 10 minutes after power failure or confirm that the power indicator of the unit is extinguished before maintenance and inspection can be carried out to prevent the residual voltage of the electrolytic capacitor in the main circuit from causing injury.
● Appoint qualified electrical engineers for maintenance, inspection, or replacement of parts.

1.4.6 Others

Dangerous!

● It is forbidden to modify the inverter by yourself, otherwise there is a risk of personal injury.

CAUTION!

● Waste components and parts should be disposed of as industrial waste.

Chapter 2 Product Introduction

2.1 Product Information

2.1.1 Product nameplate

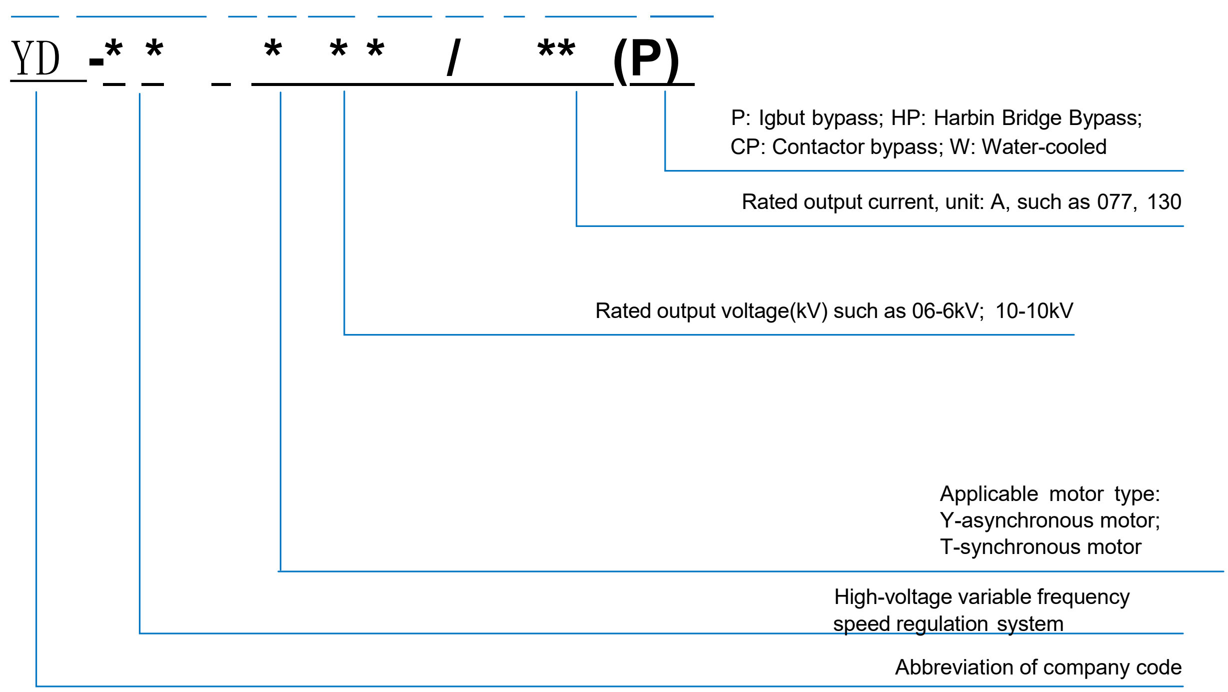
YD High Voltage Inverter System

Model：CT-HIVT		Adaptation Motor：	kW
Rated Capacity：	KVA	Rate Output Voltage：	VAC
Rate Input Voltage：	VAC	Rate Output Voltage：	A
Rate Input Frequency：	Hz	Output Frequency Range：	Hz
Rated Input Power Factor：	≥0.96	Cooling Method	Air
Weight：	kG	Ingress protection	IP31
Product number：		Date of manufacture	Y M

Wuxi Yolico Electric Co.,LTD

Figure 2.1 Product nameplate information

2.1.2 Naming conventions



2.2 Product Features

The general high-voltage inverter is independently developed and produced by Wuxi Yolico Electric Co., Ltd. This series of products is suitable for speed regulation and drive of high-voltage 3-phase AC motors, and has the following functions and characteristics:

● Motor control strategy

Asynchronous machine general, asynchronous machine vector, asynchronous machine open-loop vector, synchronous machine general, synchronous machine vector, synchronous machine open-loop vector, etc

● Magnetic flux closed-loop vector control technology

Based on the mathematical model of the motor, the magnetic flux of the motor is controlled in a closed-loop manner

● Unit bypass technology

Bypass methods are optional, including mechanical bypass and electronic bypass

● Neutral point drift technology

When a power unit fails, only the faulty unit is bypassed, and the neutral point of the output voltage is adjusted to improve the voltage output capability

● Output voltage self-adjustment function

When the input voltage fluctuates (-10%~+5%), the inverter has the rated voltage output capacity

● Torque lifting function

Increase the load carrying capacity of the motor during start-up and low-frequency operation

● Speed start function

When the motor is rotating, the inverter starts smoothly with the motor to reduce the impact on the power grid

● Instantaneous power failure function

When the power grid is instantaneously de-energized, the inverter runs continuously and stably

● High-voltage power loss self-start function

After the grid power supply is switched or the power grid is restored for a short period of time, the inverter will automatically restart

● Synchronous switching function (optional synchronous switching cabinet)

Realize the non-disturbance switching between power frequency operation and frequency conversion operation of the motor, and reduce the impact on electrical equipment and power grid

● Master-slave control function

The inverter operates in tandem or multi-machine

● Process PID control function

● Superior communication function

The power input of YD universal high-voltage inverter conforms to IEEE STD 519-2014 and GB/T 14549-1993 standards, and there is no need to install a separate input filter, which saves the cost of harmonic control for users, and the system power factor is high, and there is no need for power factor compensation device, which can effectively reduce reactive power input and reduce input capacity.

After the inverter input is converted to the secondary side through a phase-shifting transformer and phase-shifted, a multi-pulse diode is used to rectify the power unit to provide isolated power to the power unit, eliminating most of the harmonic currents caused by a single power unit (see Figure 2.2).

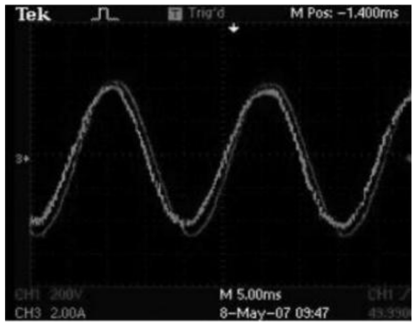


Figure 2.2 30-pulse input waveform (CH1 voltage, CH3 current)

The output harmonic content is low, and the sine wave is almost perfect (see Fig. 2.3, Fig. 2.4). Compared with other forms of high-voltage high-capacity inverters, it has the following advantages:

- There is no need to add an output filter
- Direct drive of high-voltage AC motor
- Insulate the main circuit motor and cable from the damage of DV/DT stress
- Low pulsating torque, prolonging the service life of motors and mechanical equipment
- Within the allowable range of cable voltage drop, there is no limit to the length of the motor cable

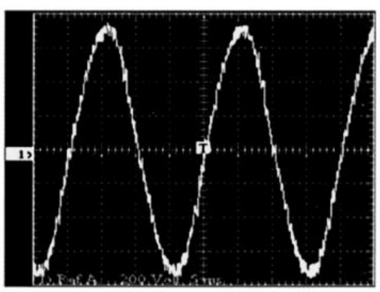


Figure 2.3 Output line voltage waveform

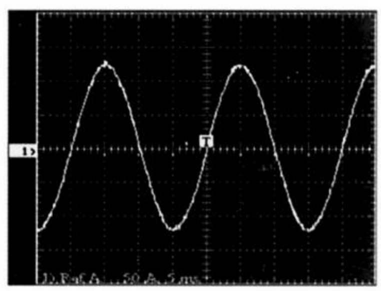


Figure 2.4 Output current waveform

2.3 Technical Parameters

YD high-voltage inverter has 6kV and 10kV voltage level standard products, and other voltage level products can also be customized according to user requirements.

Item	Parameters
Rated capacity of the inverter	400~25000kVA※
Rated Voltage	2.3kV~11kV(-20%~+5%)※(Out of range, special instructions required)
Rated frequency	50Hz/60Hz(-10%~+10%)※
Control the power supply	380VAC， 30kVA
Rated input power factor	≥0.96
Machine efficiency	＞96%
Output frequency range	0~80Hz※
Speed accuracy	±0.5% (open-loop vector) ±0.1% (closed-loop vector)
Overcurrent protection	150% (can be customized according to user requirements)
Overload capacity	120% load, 120s
Torque limiting	10%~150%
Analog input	3xCH 4~20mA/Excitation feedback 4~20mA (can be customized)
Analog output	4 channels 4~20mA
Communication	Isolated RS485 interface, ModBus RTU (optional: Profibus DP, Industrial Ethernet protocol)
Acc/Dec time	5 seconds ~ 6000 seconds (load dependent)
Switching input and output	14 input and 22 output (output 8 channels can be defined)
Operating ambient temperature	-5~+45℃※
Storage/transport temperature	-25~+55℃※
Cooling method	Forced Air Cooling (AF) / Water Cooling (WF) / Feng Shui Cooling (AFWF)
Ambient humidity	<95%，No condensation※
Installation altitude	≤1000m，Above 1000 m above sea level, the derating is 1% for each additional 100 m
Dust	Non-conductive and non-corrosive， <6.5mg/dm^3 ※u
Ingress protection	IP30※
Cabinet color	RAL 7035(Or customized according to the color code provided by the user)

Table 2-1: Technical parameters of YD general-purpose high-voltage inverter

※ Out of scope, please consult Wuxi Yolico Electric Co., Ltd

※ Dimensions of the equipment are subject to change without notice, and the specific dimensions are subject to the technical agreement.

2.4 Selection Instructions

YD general high-voltage inverter needs to be selected according to the motor type, load characteristics, and the rated voltage and rated current of the motor. For special loads, special motors and special use environments, the selection of YD general high-voltage inverter should also follow the following suggestions:

1. For compressors, vibrators and other load conditions with large torque fluctuations, the actual process and working conditions should be understood, and the rated current of the selected HIVT general high-voltage inverter must be greater than the maximum current required for power frequency operation.

2. For submersible pumps, submersible pumps and other load conditions, the rated current of the selected HIVT general high-voltage inverter is greater than the rated current of the motor.

3. For load conditions such as hydraulic pumps, the selection of YD general high-pressure inverter should be enlarged by one gear accordingly.

4. In some special applications such as high temperature and high altitude (more than 1000m above sea level), the HIVT general high-voltage inverter needs to be used with reduced capacity, and the selection should be enlarged accordingly.

2.5 Applications

YD general high-voltage inverter has been widely used in various industries, providing users with a complete high-voltage (asynchronous, synchronous) AC motor soft start, speed regulation and intelligent control scheme, won the praise of users. Typical applications in various industries are as follows:

Generate electricity

Powder exhaust fan booster fan blower induced draft fan condensate pump mortar pump Pumped storage pumps circulating water pumps boiler feed pumps compressors

Petrifaction

Pressurized fan induced draft fan pipeline transfer pump water injection pump feed pump submersible pump Oil transfer pump brine pump circulating water pump compressor

Mine

Cyclones dust removal fans main ventilators axial fans descaling pumps belt conveyors slurry pumps clean water pumps feed pumps mixing pumps drainage pumps medium pumps kiln drives mud pumps

Metallurgy

Induced draft fan supply fan secondary dust removal fan compression fan blast furnace blower blast furnace dust removal fan converter dust removal fan electric furnace dust removal fan sulfur dioxide fan slag flushing pump feed water pump water supply pump phosphorus removal pump mud pump descaling pump kneading machine oxygen compressor gas compressor

Cement

Kiln induced draft fan kiln gas supply fan separator fan kiln head fan high temperature fan cement mill fan dust removal fan circulating fan grate cooling fan kiln tail fan raw meal mill fan pressure supply fan raw meal mill rotary kiln drive coal mill

Municipal

Aeration fan induced draft fan blower pressurized pump hot water circulation pump reclaimed water pump Sewage pumps water purification pumps lifting pumps water supply pumps

Light

Gas blowers pressurized pumps cleaning pumps axial flow pumps soft water pumps water delivery pumps compressors beaters pulverizers

Other

Wind pump test bench motor test bench wind tunnel test device variable frequency power supply test bench

2.6 Implementation Standards

Standard number	Standard name
GB 156-2017	Standard voltage
GB/T 1980-2005	Standard frequency
GB/T 3797-2016	Electrical control equipment
GB/T 4208-2017/ IEC 60529:2013	Enclosure Rating (IP Code)
GB4588.1-1996	Single-sided and double-sided printed boards without metallized holes are sub-specified
GB4588.2-1996	There are metallized holes on single and double-sided printed boards
GB/T 12668.2-2002	Speed Regulating Electric Drive Systems Part 2: General Requirements Specification of ratings for low-voltage AC speed regulating electric drive systems
GB 12668.3-2012/ IEC 61800-3:1996	Speed-regulated electric drive systems Part 3: Electromagnetic compatibility requirements and their specific test methods
GB/T 12668.4-2006/ IEC 61800-4:2002	Speed Regulating Electric Drive System Part 4: General Requirements Specification of the rated value of AC speed regulating electric drive system with an AC voltage of more than 1 kV but not more than 35 kV
GB 12668.501-2013/ IEC 61800-5-1：2007	Speed-regulating electric drivetrain Part 5-1: Safety requirements Electrical, thermal, and energy
GB 12668.502-2013/ IEC 61800-5-2：2007	Speed-regulating electric drivetrains Part 5-2: Safety requirements Functions
GB/T 14549-1993	Power quality Utility grid harmonics
GB/T 10228-2015	Technical parameters and requirements of dry-type power transformers
DL/T 994-2006	High-pressure inverter for fan and water pump of thermal power plant
GB/T 1094.3-2017	Power Transformers Part 3: Insulation Levels, Insulation Tests and Outer Insulation Air Gaps
GB/T 16935.1-2008/ IEC 60664-1:2007	Insulation Coordination of Equipment in Low-Voltage Systems Part 1: Principles, Requirements and Tests
GB 5226.3-2005/IEC 60204-11：2000	Machinery Safety Mechanical and electrical equipment Part 11: Technical conditions for high-voltage equipment with a voltage higher than 1000 Va.c. or 1500 Vd.c. but not exceeding 36 kV
GB/T 4025-2010/ IEC 60073-2002	Basic and Safety Rules for Human-Machine Interface Marking Coding Rules for Indicators and Operating Devices
GB/T 30843.1-2014	General frequency conversion speed regulation equipment above 1kV and not more than 35kV Part 1: Technical conditions
GB/T 30843.2-2014	General frequency conversion speed regulation equipment above 1kV and not exceeding 35kV Part 2: Test methods
GB/T 12668.701-2012	Speed Regulating Electric Drive Systems Part 701: General Interfaces and Usage Specifications for Electric Drive Systems Interface Definitions
GB/T 12668.8-2017	Speed control electric drive system Part 8: Voltage specification for power supply interfaces

Chapter 3

Hardware configuration

3.1 Principle

YD general-purpose high-voltage inverter is generally composed of a transformer, a power unit and a control system.

3.1.1 Topology

The inverter topology is shown in Figure 3.1

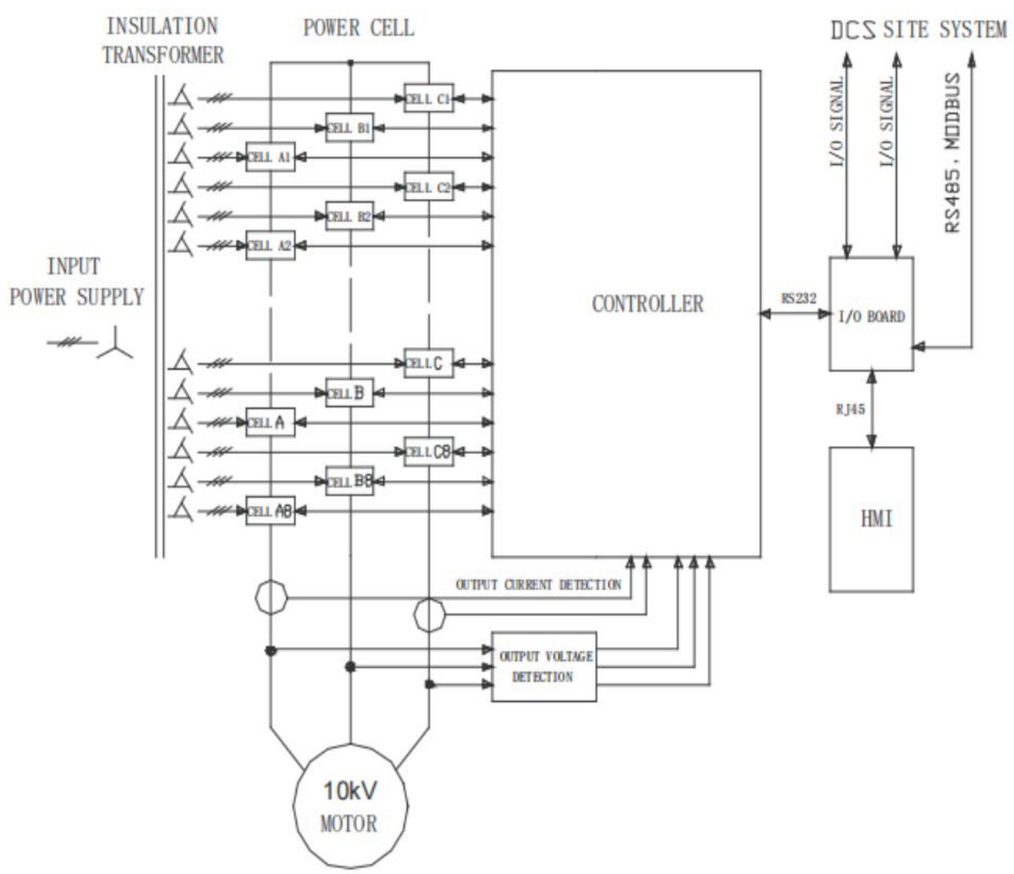


Figure 3.1 Inverter system diagram (10KV as an example)

3.1.2 Main circuit

The main circuit diagram of the inverter is shown in Figure 3.2

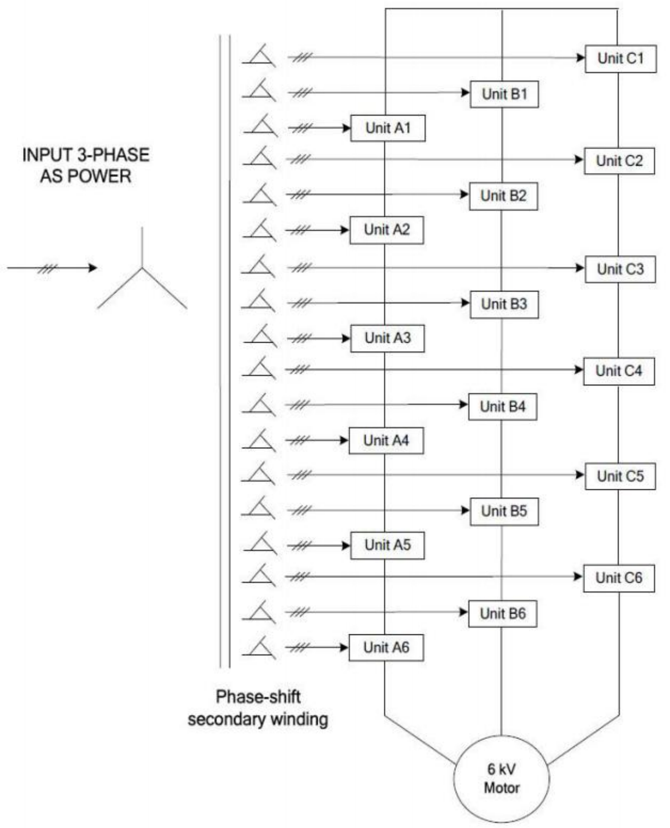


Figure 3.2 Main circuit diagram of inverter (6kV as an example)

The isolation transformer is a three-phase dry-type rectifier transformer, which is forced to be air-cooled; The primary side is Y-connected, which is directly connected to the high-voltage incoming line; The secondary windings are connected in a triangle and provide an isolated three-phase power input for each power unit, the number of which is determined by the voltage level and structure of the inverter. In order to suppress the harmonic content on the input side to the greatest extent, the secondary windings of the same phase are shifted by the extended triangle connection, and the phase difference between the windings is calculated by the following formula:

$$\text{Phase-shifting angle}=\frac{60°}{\text{Number of cell progressions}}$$

The output of the inverter is obtained by connecting multiple low-voltage power units with three-phase input and single-phase output in series. For example, five power units with a rated voltage of 690

Inverter Voltage level	Tandem/phase Number of units	Rated voltage/unit (V)	Output phase voltage (V)	Output line voltage (V)	Number of levels per phase
6kV	5	690	3450	6000	11
6kV	6	580	3480	6000	13
10kV	8	720	5760	10000	17
10kV	9	640	5760	10000	19

Table 3-1 Power unit configuration of YD general-purpose high-voltage inverter

The three-phase output Y connection obtains the high-voltage power supply required to drive the motor, and the number of power units of the 6kV product is 15 or 18, as shown in Figure 3.3. The number of power units for a 10kV product is 24 or 27, as shown in Figure 3.4.

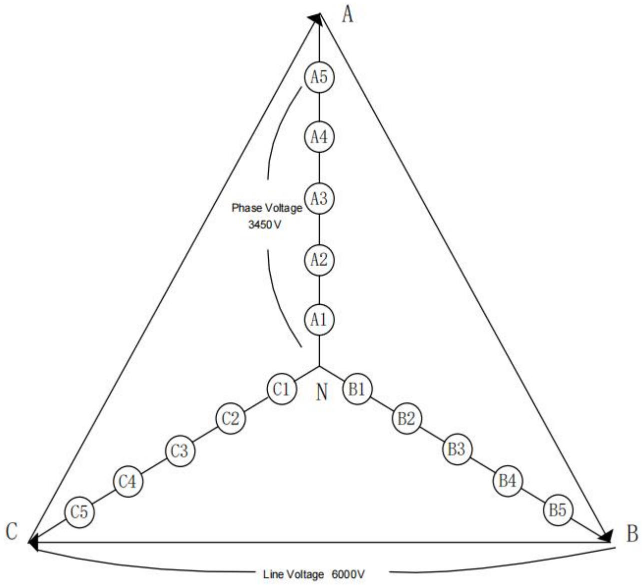


Figure 3.3 Overlay of 6kV inverter unit voltage

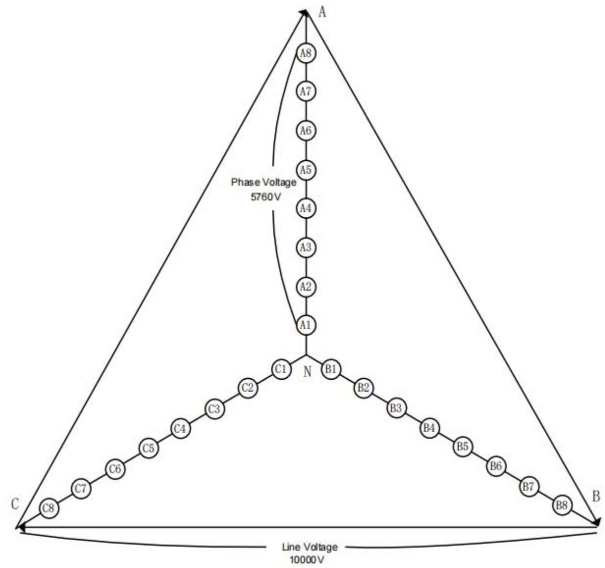


Figure 3.4 Overlay of 10kV inverter unit voltage

Taking a 6kV inverter with 5 power units in series as an example, there are 11 levels (-5~0~+5). While increasing the level, the voltage value of each level decreases, which reduces the damage of DV/DT to the motor insulation and weakens the harmonic content of the output voltage. The voltage waveform output by each power unit, and the phase voltage waveform output by the unit in series are shown in the figure below.

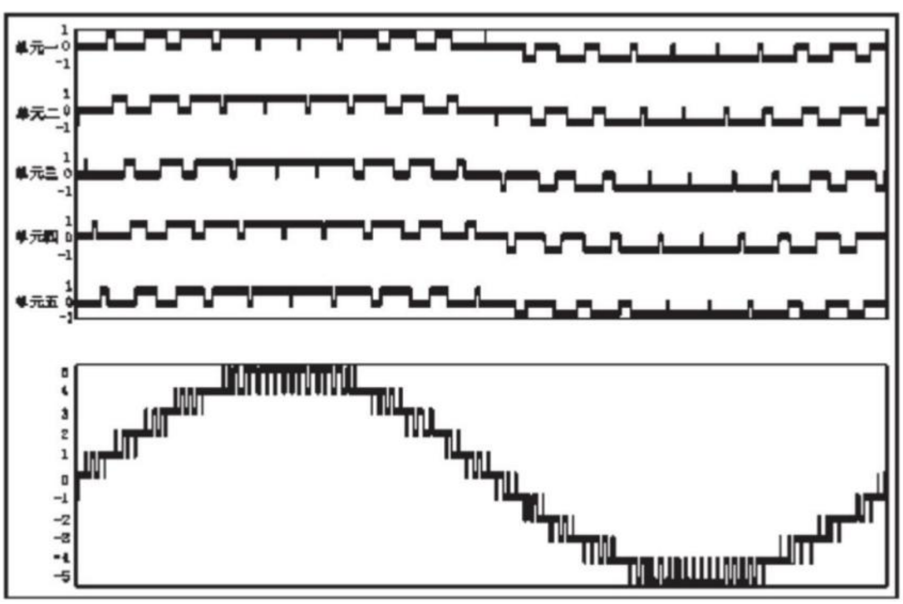


Figure 3.5 Waveform of output phase voltage of 6kV inverter

The control system consists of a controller, an interface board and a touch screen.

3.2.1 Controller Composition

The controller is mainly composed of a main control board, an optical fiber board, a power board, and a signal board, as shown in Figure 3.6.

(1) Main control board

The main control board consists of the following two parts:

DSP subsystem: complete functions such as motor control algorithm, unit fault diagnosis, real-time protection and communication with interface board; FPGA subsystem: real-time communication with DSP, communication with the unit, carrier phase-shifting PWM output and other logic functions.

(2) Fiber optic board

The optical fiber board is the communication bridge between the controller and the power unit, each controller is equipped with 3 optical fiber boards, and each optical fiber board controls all the units of a certain phase in the three-phase unit of the inverter. The optical fiber board periodically sends pulse-width modulation (PWM) signals and work instructions to the unit, and the power unit receives its trigger instructions and status signals through the optical fiber, and sends fault code signals to the optical fiber board when it fails.

(3) Power strip

In addition to generating power for the controller, the power strip also has an I/O interface and speed sampling functions:

- ● Generate +5V, ±15V power supply for power supply to the main control board, optical fiber board and signal board;
- ● Transmission of digital signals inside the inverter control system;
- ● For the closed-loop vector control model, the motor speed information fed back by the encoder is collected.

(4) Signal board

The signal board collects the input/output voltage and current signals of the inverter, converts the collected signals into analog-to-digital and sends them to the main control board.

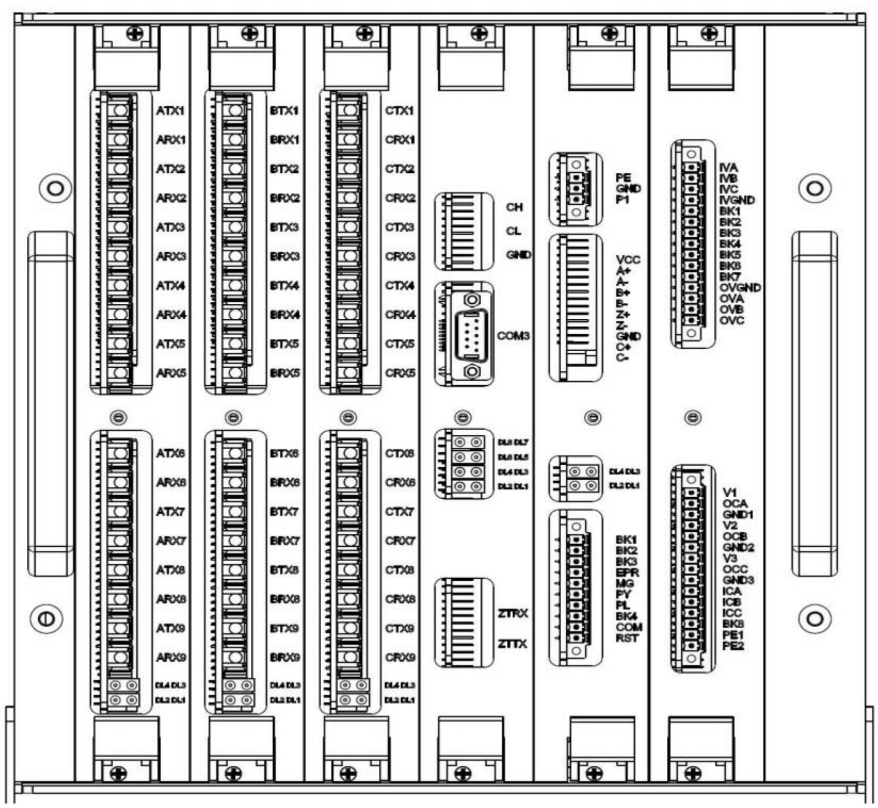


Figure 3.6 Schematic diagram of the controller panel

3.2.2 Controller interface description

3.2.2.1 Optical fiber board interface description

name	illustrate
A1/B1/C1	Fiber optic communication interface for power units at the first level
A2/B2/C2	Fiber optic communication interface for power units at the second level
A3/B3/C3	Fiber optic communication interface for power units at the third stage
A4/B4/C4	Fiber optic communication interface for power units at the 4th level
A5/B5/C5	Fiber optic communication interface for power units at the 5th level
A6/B6/C6	Fiber optic communication interface for power units at the 6th level
A7/B7/C7	Fiber optic communication interface for power units at the 7th level
A8/B8/C8	Fiber optic communication interface for power units at the 8th level
A9/B9/C9	Fiber optic communication interface for power units at the 9th level
LED	Status indication

3.2.2.2 Interface description of the main control board

name	illustrate
CH	CAN communication interface
CL	
GND	
485A	485 communication interface （COM3）
485B	
LED	Status indication
ZTRX	Fiber optic communication interface
ZTTX	

3.2.2.3 Power board interface

Item	Name	illustrate
1	PE	Shielded
2	GND	24V power ground
3	P1	24V power supply
1	VCC	Encoder power supply: +5V or +24V output, 200mA
2	A+	Encoder Signal A+ (RS422 Differential Signal)
3	A -	Encoder Signal A-
4	B+	Encoder Signal B+ (RS422 Differential Signal)
5	B -	Encoder Signal B-
6	Z+	Encoder Signal Z+ (RS422 Differential Signal)
7	Z -	Encoder Signal Z-
8	GND	Encoder power ground
9	C+	Clock signal + output (RS422 differential signal)
10	C-	Clock Signal - Output
	LED	Status indication

pins	name	illustrate
1 2	BACKOUT1 BACKOUT2	Standby output 1, normally open dry contact Alternate output 2
4 5 6	EPR MPG PY	High voltage ready output, normally open dry contact, effective disconnection Outputs a common point Controller-ready output, normally open dry contact, closed effectively
7 8 9 10	PENL BACK4 COM PRST	The interface board is ready for input, and the closure is valid Alternate inputs common of inputs Controller reset input, closure is active

3.2.2.4 Signal board interface description

item	name	illustrate
1 2 3 4	IVA IVB IVC IVGND	A phase input voltage detection signal, B phase input voltage detection signal, C phase input voltage detection signal, input voltage detection signal, common terminal
5~ 11	UNITA UNITG	Unit Voltage Sampling+ Unit Voltage Sampling-
12 13 14 15	OVGND OVA OVB OVC	The output voltage detection signal is on the common side U-phase output voltage detection V-phase output voltage detection W phase output voltage detection
1 2 3	V1 OCA GND1	Hall sensor forward power supply, U-phase output of current sampling, Hall sensor negative power supply
4 5 6	V2 OCB GND2	Hall sensor forward power supply, V-phase output of current sampling, Hall sensor negative power supply
7 8 9	V3 OCC GND3	Hall sensor forward power supply, W-phase output of current sampling, Hall sensor negative power supply
10 11 12	ICA ICB ICC	Phase A input current sampling Input current commons C-phase input current sampling
14 15	PE PE	Shielded ground Shielded ground

3.2.3 Interface Board

3.2.3.1 Introduction

The logic control device of the interface board is Siemens S7-200 SMART PLC, which is equipped with Siemens' dedicated high-speed processor chip, and the basic instruction execution time can reach 0.15us. Combined with the inverter control requirements, 24DI, 16DO, 4AI, 4AO are selected, which not only ensures sufficient interfaces but also ensures fast operation and processing.

The S7-200 SMART CPU module is equipped with Ethernet interface as standard, supporting Siemens S7 protocol, TCP/IP protocol, effectively supporting a variety of terminal connections, and the CPU module integrates one RS485 interface, which can communicate with third-party devices, and adds CM01 signal board to achieve RS232/RS485 free communication.

This machine integrates a Micro SD card slot, which can use the common Micro SD card on the market to realize program updates and PLC firmware upgrades, which greatly facilitates the service support of customer engineers to end users, and also saves the inconvenience of returning to the factory due to PLC firmware upgrades.

The interface board is used for the logic processing of the inverter's internal switching signals, field given and feedback signals, and status signals, and also has the ability to handle four analog inputs and four analog outputs, as shown in Figure 3.7.

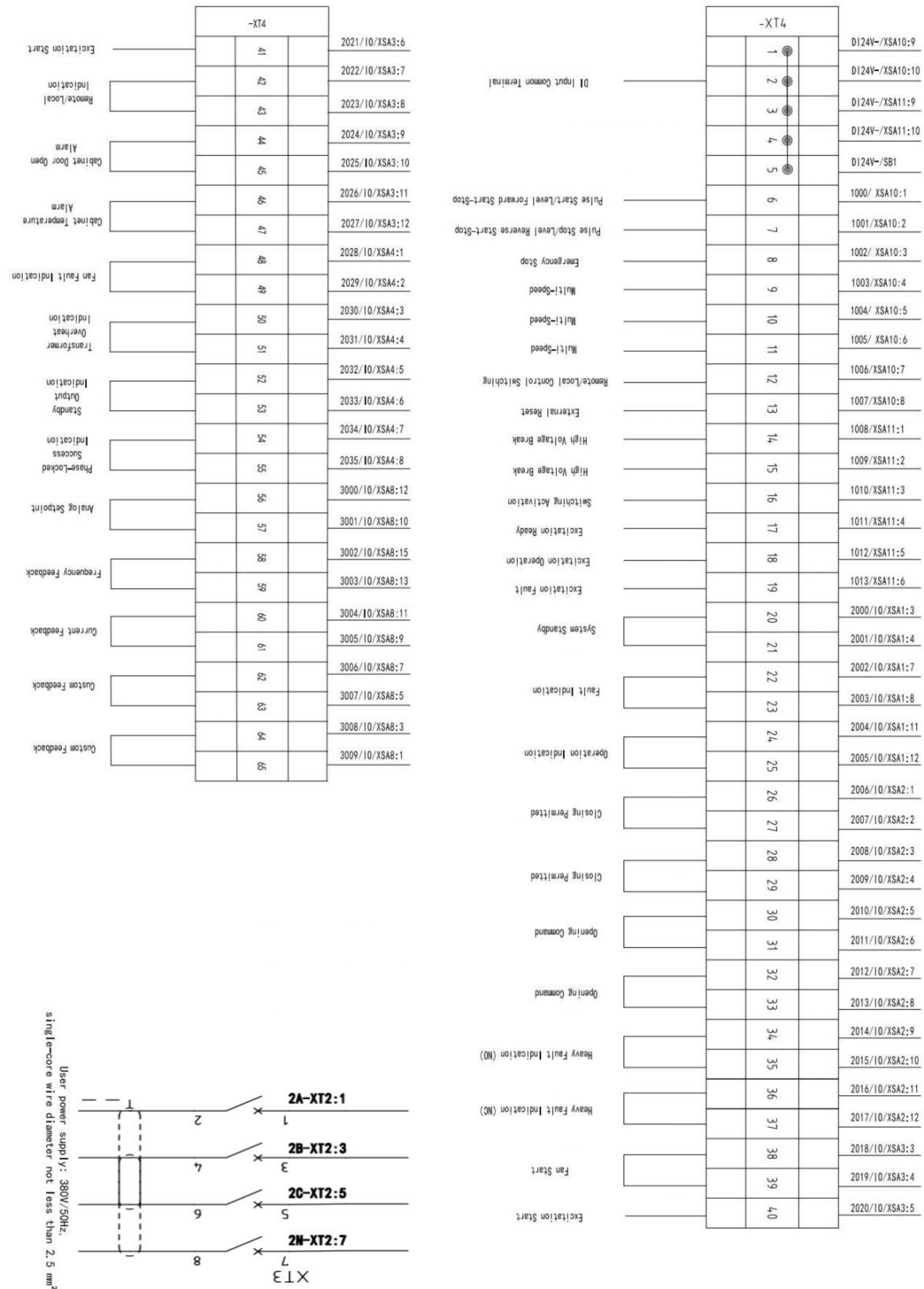


Figure 3.7 Schematic diagram of the I/O interface board

3.2.3.2 Upper terminal strip interface signal

The interface signal of the upper terminal strip is mainly composed of the external remote input signal group, the signal in the inverter cabinet and the excitation feedback signal. The input power supply 24V+2 is powered by an external switching power supply module, and then 24V+ is generated by the DC/DC module to supply power to the remote signal part of the circuit, and the remote signal is isolated from the PLC by a relay.

The block diagram is shown in the figure below:

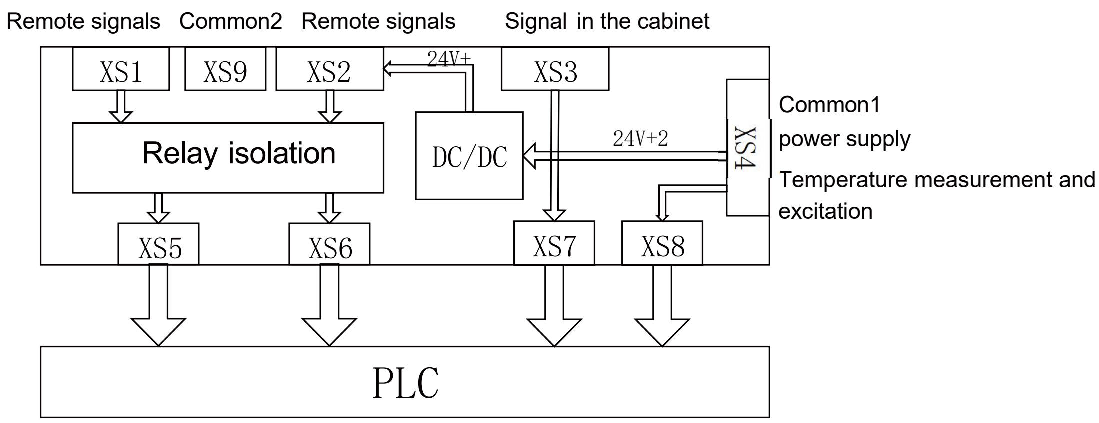


Figure 3.8 Block diagram of the board on the interface

The upper terminal is connected to the remote control and on-site switching input signals, of which there is a total of 1 analog input, which is 4~20mA current input, and the load impedance is required to be less than 500Ω; The remote control supports two kinds of signals, level and pulse, which can be set through the touch screen function item "remote start and stop mode"; The switching activation signal terminal is only connected when using the synchronous switching function, see the "Synchronous Switching Cabinet User Manual" for details.

Note!

The switching input is required to be a passive node, and when multiple switching quantities are wired at the same place, the 24V+ can be used in the way of sharing a common line. The remote reset signal of the interface board has the same function as the cabinet door reset button: in the state of no heavy fault of the inverter, only the touch screen is reset, and no other impact will be on the system (for example, the reset in the running state will not cause shutdown); When the inverter has a serious failure and the fault is eliminated, the control system is reset to restore the inverter to its normal state.

The terminal strip on the interface board is defined as follows:

Ter. num	PIN	Name	state	type	illustrate
XS1T	1 10	Level forward start/ pulse start	Close/ Open	DI/Level or pulse	The touch screen function item "Control mode" is set to remote control, and the corresponding two input modes are set according to the touch screen function item "Remote start and stop mode": Level Forward start/stop: Forward start when close, stop when open (level mode) Pulse start: close and open (pulse width greater than 500ms), Starting (pulse method)
	1 9	Level reverse start/ pulse stop	Close/ Open	DI/Level or pulse	The touch screen function item "Control mode" is set to remote control, and the corresponding two input modes are set according to the touch screen function item "Remote start and stop mode": Level Reversal start-stop: Reverse start when close, stop when open (level mode, inverter reversal is set to allow) Pulse Stop: close and open (pulse width greater than 500ms), stopping (pulse method)
	1 8	Emergency stop	Open valid	DI/N.C. Level	After open, the output is blocked, and the motor stops freely
	1 7	Speed1	Close valid	DI/N.O. Level	The touch screen function item "Operation Mode" is open-loop operation, "Given Mode" is effective when the switch is given, and the given frequency after closure corresponds to the touch screen parameter items "Switch Given 1", "Switch Given 2" and "Switch Given 3" respectively
	1 6	Speed2	Close valid		
	1 5	Speed3	Close valid		
	1 4	Remote control Enable	Close valid	DI/N.O. Level	The touch screen function item "Remote Control Mode" is set to Allow, and the inverter control mode is remote control after closing
	1 3	External reset	Close valid	DI/N.O. pulse	Reset the control system in the event of a major failure after closing, or reset the touchscreen during operation (equivalent to the door reset button)
XS2T	1 10	High voltage Breaking	Close valid	DI/N.O. pulse	Closes the high-voltage input power supply (equivalent to the high-voltage disconnect button for the cabinet door)
	1 9	High voltage Breaking	Close valid	DI/N.O. pulse	Closes the high-voltage input power supply (equivalent to the high-voltage disconnect button for the cabinet door)
	1 8	Switching activated	Close valid	DI/N.O. pulse	The touch screen function item "Frequency Conversion Switching" is set to Allow, and the output frequency of the inverter is increased to the grid frequency and locked in phase after closing
	1 7	Excitation Ready	Close valid	DI/N.O. pulse	The contact is closed and excitation ready (for synchronizers)
	1 6	Excitation Run	Close valid	DI/N.O. pulse	The contact is closed and excitation running (for synchronizers)
	1 5	Excitation Fault	Close valid	DI/N.O. pulse	The contact closure excitation fault (for the synchronizer)
XS4T	1 2	Excitation Feedback	4～20mA	AI/Current	The excitation current is fed back to the interface board, and the inverter adjusts accordingly
	4	Cabinet Temperature	4～20mA	AI/Current	The temperature signal is fed back to the interface board

3.2.3.3 Terminal strip interface signal under the interface board

The lower terminal is connected to the status output signal, the interlocking signal of the inverter inlet switch, the analog input and output and the communication signal. Digital signal XS11T: 1~XS13T: 8 nodes have a capacity of 250VAC/8A (or 250VDC/8A), and some are 250VAC/16A (or 250VDC/16A). When the demand is exceeded, please add an intermediate relay to expand the capacity. The analog input signal line must be shielded, the input impedance ≥ 250Ω, and the maximum input current is 30mA (the maximum input voltage is 15V); The phase-locked success signal terminal is only connected when using the synchronous switching function, see the "Synchronous Casting and Cutting Cabinet User Manual" for details.

Note!

The closing allow and opening signals are interlocked with the upper level switch of the inverter (circuit breaker in the power cabinet, or the incoming vacuum contactor/circuit breaker of the inverter in the automatic bypass cabinet):

The closing is allowed to be the normally open point, which should be connected in series to the closing circuit of the upper level switch as the closing condition, but does not participate in the operation of the upper level switch. When the point is closed, the upper switch is allowed to close and power on the inverter; Otherwise, the upper level switch is not allowed to close and power on.

The opening signal is normally closed, and should be connected in parallel to the opening circuit of the higher-level switch. When a serious fault occurs during the operation of the inverter, the point is closed, and the upper switch is automatically disconnected to protect the inverter.

The digital quantities of the terminal row under the interface board are defined as follows:

Ter. num	PIN	Name	state	type	capacity	illustrate
XS11T	1 2	High Voltage Indication 1	Close valid	DO/N.O.	8A/250VAC	High voltage ready closure
	3 4	High Voltage Indication 2	Close valid	DO/N.O.	8A/250VAC	
	5 6	Fault Indication 1	Close valid	DO/N.O.	8A/250VAC	Flashing for light faults (1 second cycle: 0.5s on/0.5s off),
	7 8	Fault Indication 2	Close valid	DO/N.O.	8A/250VAC	Heavy faults always on
	9 10	Running signal 1	Close valid	DO/N.O.	8A/250VAC	The inverter runs closed
XS12T	1 2	Running signal 2	Close valid	DO/N.O.	8A/250VAC	
	3 4	Closing allowed 1	Close valid	DO/N.O.	8A/250VAC	The touch screen function item "Control State" is in the normal state, and the inverter is closed when there is no heavy fault output
	5 6	Closing allowed 2	Close valid	DO/N.O.	8A/250VAC	
	7 8	Opening signal 1	Close valid	DO/N.C.	8A/250VAC	The "control state" of the touch screen function item is the debugging state, and the inverter is closed when there is no heavy fault output
	9 10	Opening signal 2	Close valid	DO/N.C.	8A/250VAC	
XS13T	1 2	Heavy fault output	Close valid	DO/N.O.	8A/250VAC	Heavy fault close
	3 4	Heavy fault output	Open valid	DO/N.C.	8A/250VAC	Heavy fault open
	5 6	Top blower start 1	Close valid	DO/N.O.	8A/250VAC	The top fan closes when it is time to start
	7 8	Top blower start 2	Close valid	DO/N.O.	8A/250VAC	
	9 10	Excitation start	Close valid	DO/N.O.	16A/250VAC	Closes when excitation needs to be activated
XS14T	1 2	Remote control Indication	Close valid	DO/N.O.	16A/250VAC	The inverter is closed when the control mode is remotely controlled
	3 4	Cabinet door Alarm	Close valid	DO/N.O.	16A/250VAC	The cabinet door closes when opened
	5 6	Unit overheating Alarm	Close valid	DO/N.O.	16A/250VAC	The unit cabinet closes when it is overheated
	7 8	Fan fault Alarm	Close valid	DO/N.O.	16A/250VAC	Closes when the fan fails
	9 10	Transformer overtemperature Alarm	Close valid	DO/N.O.	16A/250VAC	The transformer closes when it is overheated
XS15T	1 2	Alternate output	Close valid	DO/N.O.	16A/250VAC	Alternate contacts
	3 4	Phase-locked succeed	Close valid	DO/N.O.	16A/250VAC	When switching synchronously, the deviation between the output voltage and the grid voltage is closed within the allowable range of phase locking (the maximum phase deviation is ±5°, and the maximum amplitude deviation is ±2%)

The power, communication, and analog quantities of the terminal strip under the interface board are defined as follows:

Ter. num	PIN	Name	state	type	illustrate
XS17T	1 2 3	DCS Communications		RS485	Modbus communication interface between the inverter and the host computer (1 is +, 2 is -) Note: If the position of the XS17 terminal is changed after the interface board is upgraded, (2 is -, 3 is +) is the same as the signal of the terminal XS23
XS18T	1 2	Analog given	4~20mA	AI Current or Voltage	Adjust the touch screen parameters "minimum given current" and "maximum given current" to adjust the correspondence, with an accuracy of 1.5%. • 4~20mA corresponds to 0Hz~maximum frequency
	3 4	Analog feedback	4~20mA	AI Current or Voltage	Adjust the touch screen parameters "minimum given current" and "maximum given current" to adjust the correspondence, with an accuracy of 1.5%. • 4~20mA for 0~100%
	5 6	Output frequency	4~20mA	AO Current	Maximum load 500Ω, 10-bit A/D sampling, 0.1% resolution, 1.0% accuracy • 4~20mA corresponds to 0Hz~maximum frequency
	7 8	Output current	4~20mA	AO Current	Maximum load 500Ω, 10-bit A/D sampling, 0.1% resolution, 1.0% accuracy • 4~20mA corresponds to 0A~150% rated current of inverter
	9 10	Custom analog Output 1	4~20mA	AO Current	Maximum load 500Ω, 10-bit A/D sampling, 0.1% resolution, 1.0% accuracy According to the touch screen function parameter "Analog Output 1", the corresponding 3 types of outputs are set: • 4~20mA for 0Hz ~ maximum frequency (set to output frequency) • 4~20mA corresponds to 0A~150% of the rated current of the inverter (set to output current) • 4~20mA for 0~100°C (set to unit temperature) • 4~20mA for 0~1 (set to output power factor) • 4~20mA corresponds to 150% of 0~rated output power (set to output power) • 4~20mA corresponds to 0~excitation cabinet rated current (set to excitation given current)
	11 12	Custom analog Output 2	4~20mA	AO Current	Maximum load 500Ω, 10-bit A/D sampling, 0.1% resolution, 1.0% accuracy According to the touch screen function parameter "Analog Output 2", the corresponding 3 types of outputs are set: • 4~20mA for 0Hz ~ maximum frequency (set to output frequency) • 4~20mA corresponds to 0A~150% of the rated current of the inverter (set to output current) • 4~20mA for 0~100°C (set to unit temperature) • 4~20mA for 0~1 (set to output power factor) • 4~20mA corresponds to 150% of 0~rated output power (set to output power) • 4~20mA corresponds to 0~excitation cabinet rated current (set to excitation given current)

3.3 Power Units

3.3.1 Electrical Principles

The electrical topology of the power unit is shown in Figure 3.9: the input side R, S, and T are connected to the secondary windings of the transformer, and the DC bus is supplied with power through three-phase full-bridge rectification, and the output side is the H-bridge inverter circuit. The power unit receives the trigger signal through the optical fiber, controls the conduction and shutdown of the IGBT (Q1~Q4), and outputs the single-phase pulse width modulation waveform. Each unit has three output states: when Q1 and Q4 are turned on, the output voltage of the unit is DC bus voltage; When Q2 and Q3 are turned on, the output voltage of the unit is negative DC bus voltage; When "Q1 and Q3" or "Q2 and Q4" are turned on, the unit output voltage is zero.

If a unit fails and cannot continue to work, the unit will block the output of Q1~Q4, and turn on the bypass IGBT or bypass contactor K, and send out a bypass alarm to ensure the continuous operation of the inverter.

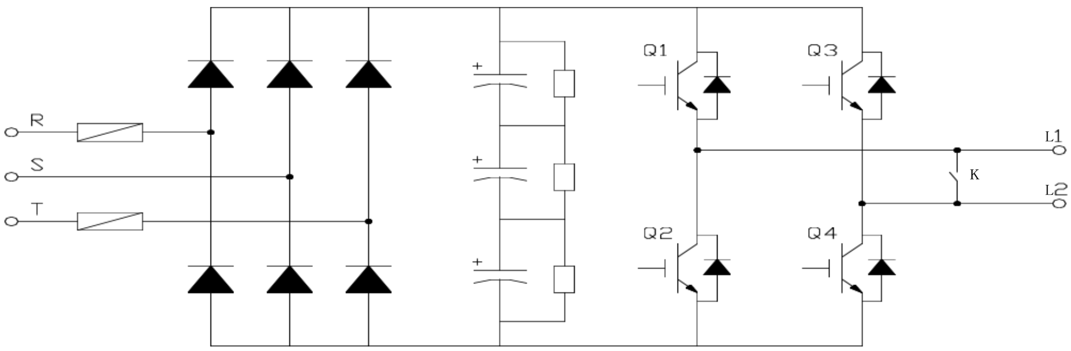


Figure 3.9 Power unit topology

The power unit consists of a unit control board and a unit driver board: the unit control board communicates with the controller through optical fiber, as shown in Figure 3.10, and the unit driver board is mainly used to drive IGBTs, as shown in Figure 3.11. Since the optical fiber is the only connection between the unit and the main control system, the unit and the main control system are completely electrically isolated.

The unit control board receives the signal from the controller through optical fiber (XS4), and is used to control the inverter IGBT and bypass IGBT or bypass contactor after receiving the decoder decoder; The unit control board has a variety of unit fault detection circuits (such as: overheating detection, phase loss detection, DC bus overvoltage detection, optical fiber fault detection, drive fault detection, contactor fault detection), and the fault signal is coded by the fault coding logic circuit and sent back to the controller by the optical fiber (XS3) to achieve fault protection and fault memory.

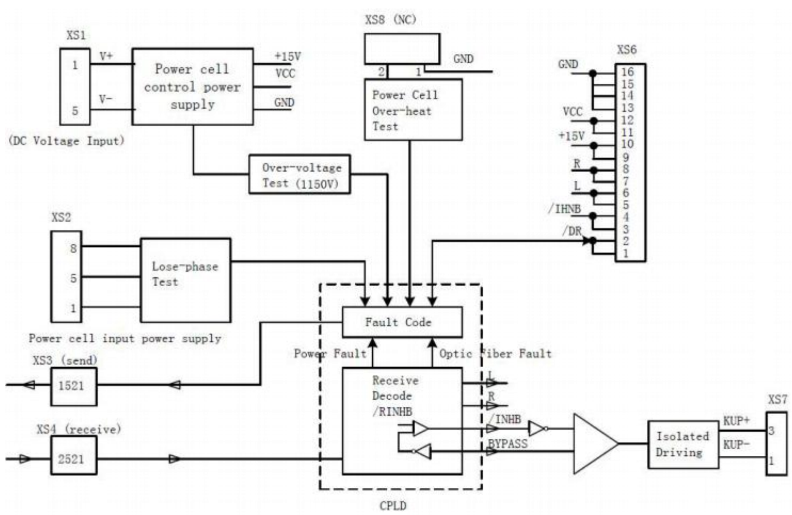


Figure 3.10 Schematic diagram of the unit control board

The power supply of the unit control board takes the DC bus (through XS1) in the autonomous loop, and obtains the required control power supply after isolation and conversion of the switching power supply. When the high-voltage power supply is disconnected, the unit control power does not disappear immediately (the power indicator on the unit control board does not go off until a few minutes elapse).

The unit driver board generates the driving signals of 4 IGBTs and feeds back the IGBT faults to the unit control board. The unit driver board is connected to the control board terminal XS6 through terminal XS5, and the specific signal is defined as follows:

- "L" controls two IGBTs (Q1, Q2) on the left arm, "R" controls two IGBTs (Q3, Q4) on the right arm, and the drive signals of "Q1, Q2" and "Q3, Q4" are interlocked.
- "/INHB" is the IGBT inhibition signal, and "/DR" is the fault signal of the IGBT, which is fed back to the unit control board for unit protection.
- The power supply of the unit driver board comes from the unit control board. The "+15V" power supply is isolated into 4 power supplies, which are used to drive 4 IGBTs.

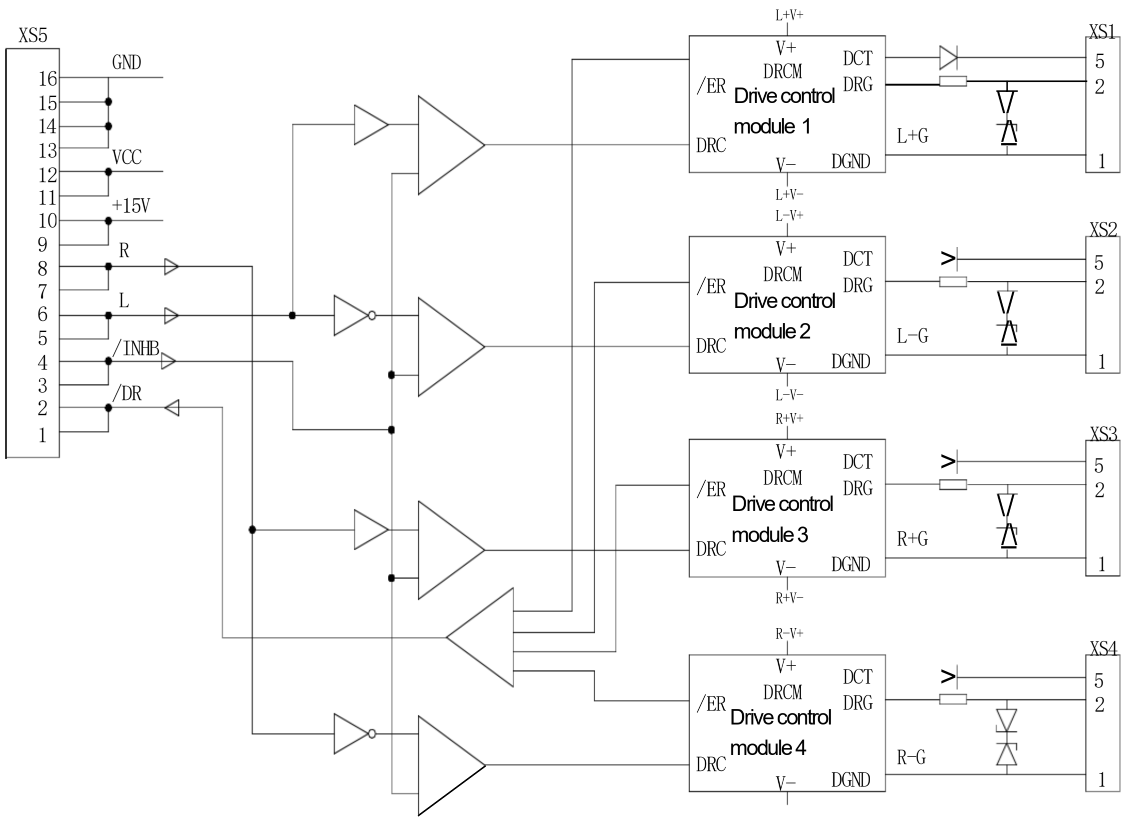


Figure 3.11 Schematic diagram of the unit driver board

3.3.2 Unit structure

The power unit (referred to as the unit) is installed in the unit cabinet and is fixed on the mounting rail by screws, and the appearance of the power unit is generally shown in Figure 3.12. The units in the cabinet have exactly the same electrical and mechanical parameters and are interchangeable. The three-phase input of the unit is connected to the secondary winding of the phase-shifting transformer, and the inlet side is equipped with fast melting.

Once the set screws, input cables, output busbars, and fiber optic connectors of the unit and rails have been removed, the unit is completely separated from the unit cabinet and can be removed from the rails. The steps for unit installation are reversed from disassembly.

After the power failure of the inverter, there is still a dangerous voltage in the unit. Therefore, be sure to wait for the unit indicator light to turn off before operating the unit.

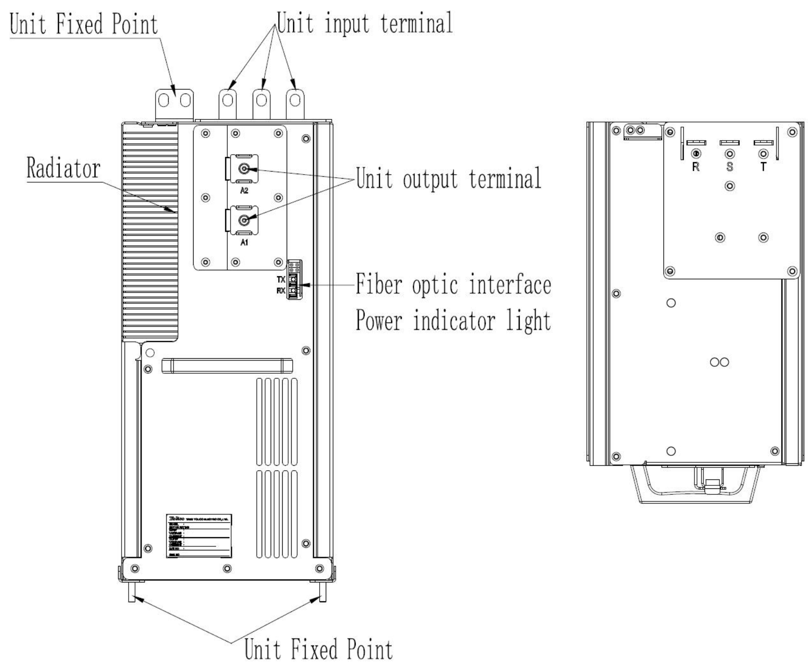


Figure 3.12 Outline diagram of the power unit

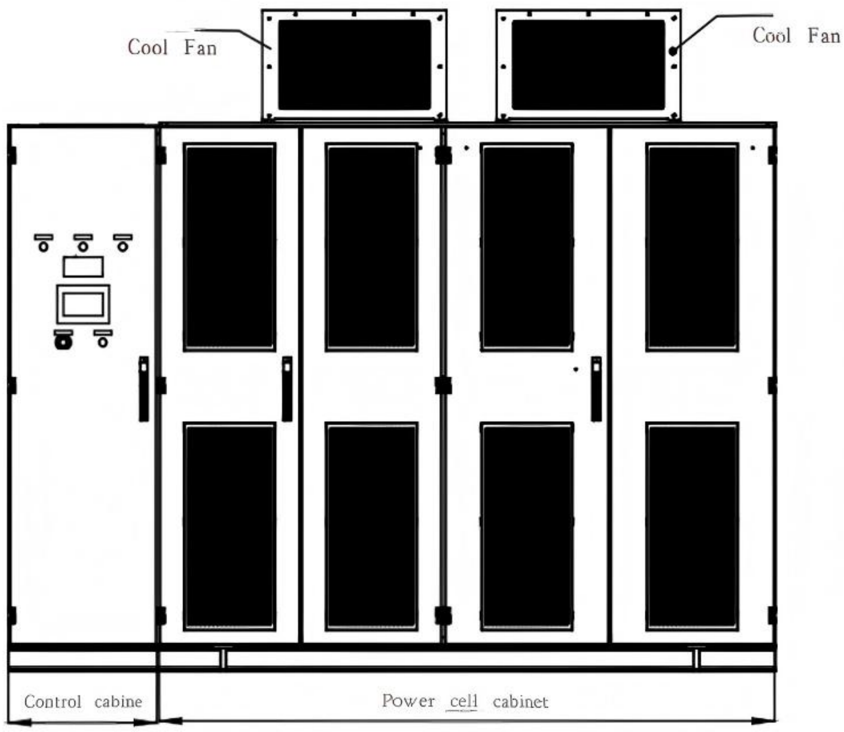
The meaning of the power unit model is shown in the figure below. For example, if the model number of the power unit is "RST700/050", the rated output voltage of the unit is 700V and the rated output current is 50A.

3.4 Cabinet configuration

The inverter is mainly composed of the following parts:

- Transformer cabinet
- Control/Unit Cabinets
- Starter cabinet (high power configuration)
- Switchgear and other options (optional)

The typical arrangement of the inverter cabinet is shown in the figure below, including a transformer cabinet, a unit cabinet and a control cabinet. When the capacity of the inverter is small, the transformer and the unit are placed in the same cabinet; When the inverter capacity is large, the system arrangement may contain multiple cabinets.



3.4.1 Transformer cabinets

The transformer cabinet contains a phase-shifting transformer (referred to as transformer) and its auxiliary components. A typical assembly in the cabinet is shown in Figure 3.15 and includes:

- Transformer cabinet
- Transformer bottom fan (configuration on demand)
- Current transformer
- Cabinet top cooling fan
- Phase-shifting transformer
- Transformer temperature controller
- Transformer cabinet fan control and protection circuit

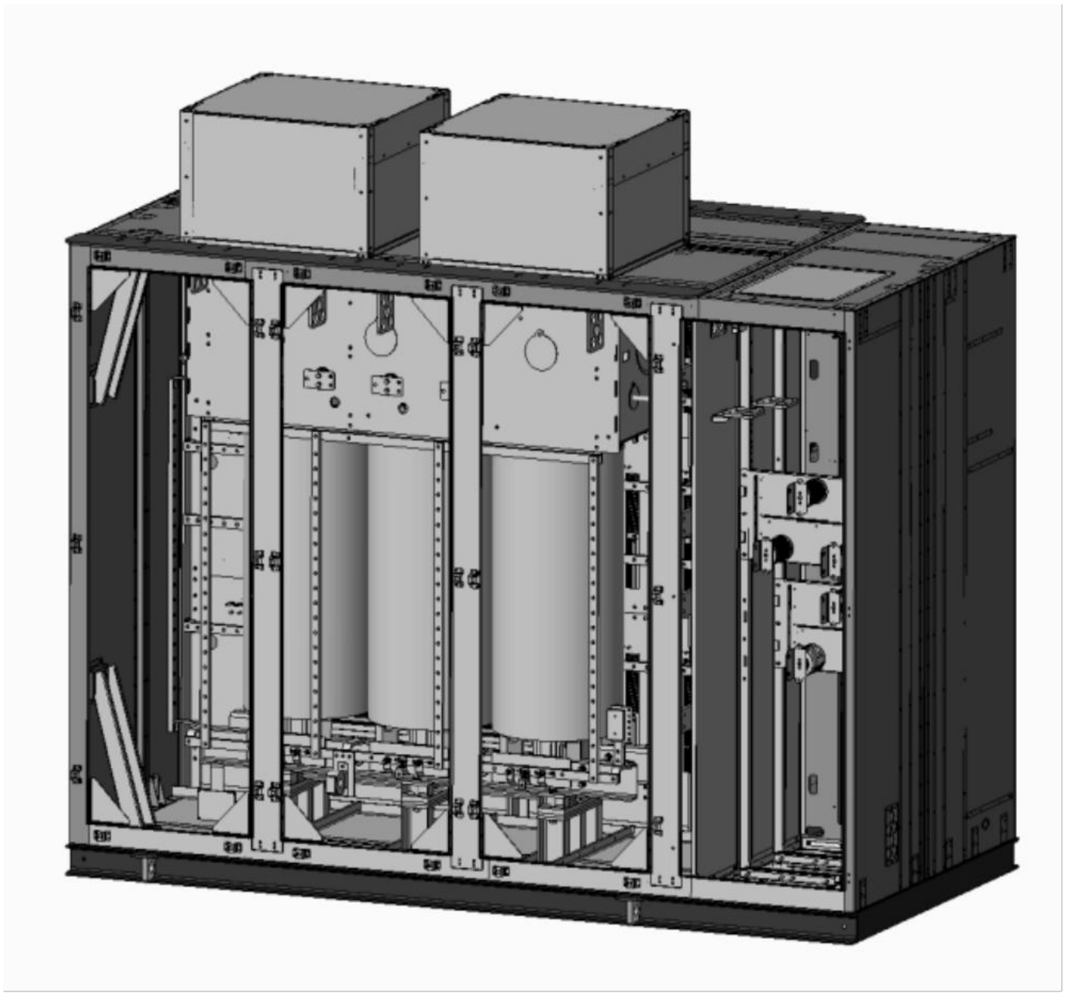


Figure 3.15 Typical transformer cabinet assembly drawing

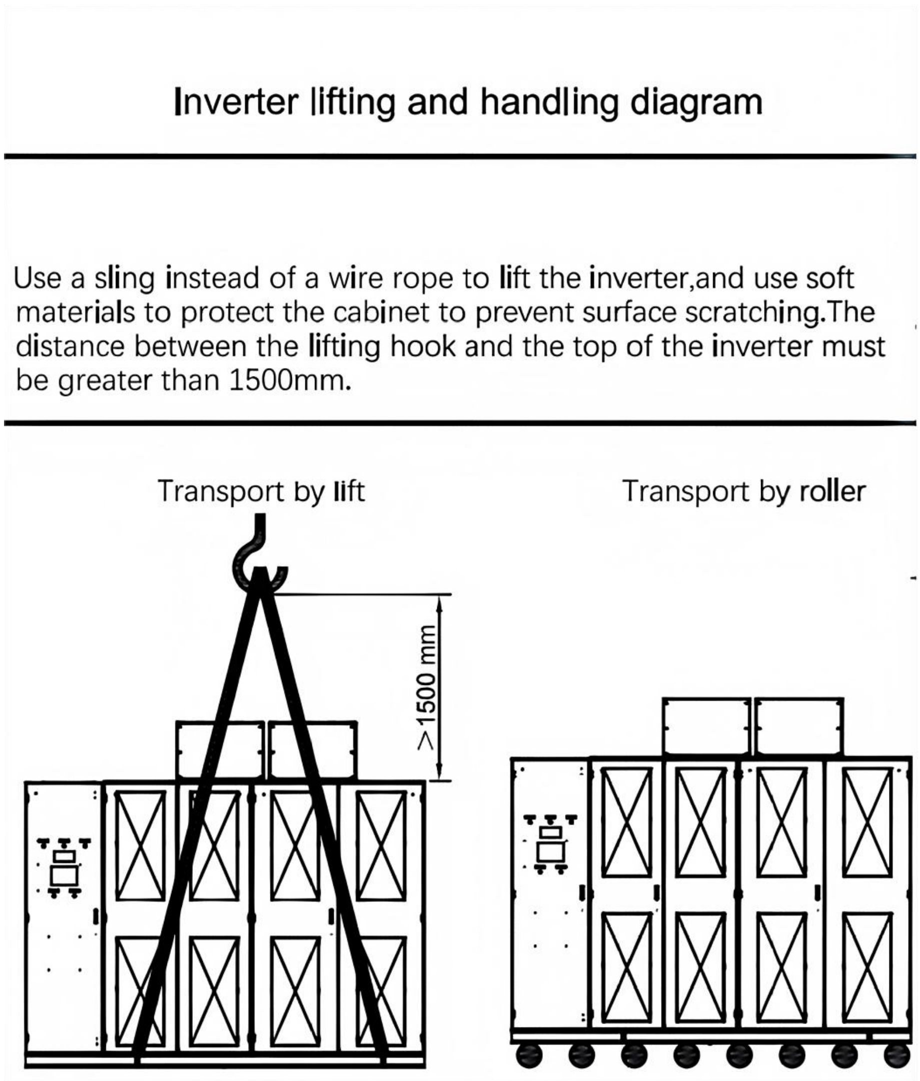


Figure 3.17 Sub-side structure diagram of transformer

The main body of the cabinet is a phase-shifting transformer, which provides an isolated low-voltage power supply to the power unit. Based on heat dissipation considerations, centrifugal fans are installed at the top of the cabinet, and 6 cooling fans can be equipped at the bottom of the transformer, one on the front and one on the back of each winding. The temperature controller is installed on the cabinet door, which has the functions of temperature alarm, overheating protection and bottom fan control; The inside of the cabinet door is equipped with a travel switch to monitor the status of the cabinet door.

The transformer and base are connected with screws for easy transportation and installation. When hoisting as a whole, it is necessary to use the transformer hoisting hole for hoisting, as shown in Figure 3.16/3.17. Please note: The cabinet lifting ring is only used for lifting the transformer cabinet, not for the overall lifting of the transformer.

The 3-phase input of the inverter enters the transformer cabinet from the bottom (through the trench) or the side (through the ground) and is connected to the upper part of the transformer.

3.4.2 Control/unit cabinets

The control/unit cabinet (referred to as the unit cabinet) contains the control system, the power unit and its auxiliary components. A typical unit cabinet layout is shown in the figure below, and the cabinet mainly contains the following components:

- Controllers
- Power unit
- Unit voltage detection board
- Output voltage detection board
- Centrifugal cooling fan
- Interface board
- Power unit resistance board
- Control transformer components
- Primary wiring room
- Dehumidifier (optional.)
- Touch screen
- Detection accessories
- Output current Hall element
- Secondary wiring room
- UPS (optional)

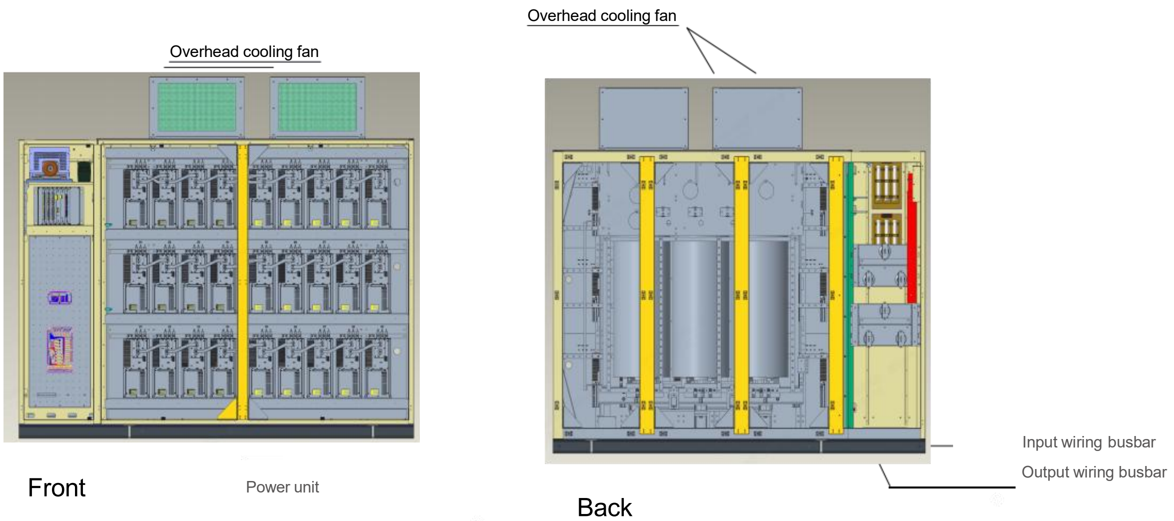


Figure 3.18 Typical unit cabinet layout

- 6kV series

The power units in the 6kV unit cabinet are divided into three groups from top to bottom, which are phase A, phase B and phase C. Taking 5 series elements per phase as an example, each phase unit is arranged from right to left, for example, phase A units are A1, A2, A3, A4, and A5 from right to left. The lower end of the unit is a 3-phase input power supply, which is connected to the output of the secondary side of the transformer through a fast fuse, and the upper end of the unit is a single-phase output, and each group of 5 units is connected into a phase by a copper bar. The left bridge arm of the three-phase first-stage unit is short-circuited to form a Y neutral point, and the output of the fifth-stage unit is connected to the inverter output.

The power unit is fixedly connected to the guide rail in the cabinet by two M8 screws. The rear of the unit cabinet is a ventilation duct, and the cold air flows through the filter layer of the front cabinet door through the unit radiator, bringing the heat generated in the power unit to the rear ventilation duct and being discharged by the centrifugal fan on the top of the cabinet.

A filter layer is installed on the outside of the cabinet door to block dust from entering the unit. The inside of the cabinet door is equipped with a travel switch for the door interlock alarm. The control system is installed on the right side behind the cabinet, and the controller and interface board are in order from top to bottom. The power switch and user terminal blocks are arranged on the right side of the back, and the output terminals of the inverter are arranged in the left baffle on the back of the transformer cabinet.

- 10kV series

Taking the single-phase 8-level unit series as an example, the units are arranged in front， The first stages of each phase unit are located on the front of the cabinet, such as phase A arranged from right to left, A1, A2, A3, A8 respectively. On the right side of the front is the control room, which is equipped with controllers, power supplies, switches, etc, respectively. The left bridge arm of the three-phase first-stage unit is short-circuited to form a Y neutral point, and the output of the eighth-stage unit is connected to the inverter output. The structural configuration is the same as that of the 6kV series.

Front　　　　　　Back

Figure 3.20 Cabinet layout of 10kV unit

3.4.3 Pre-charging case

When the capacity of the power unit of the inverter is too large (the rated current of the power unit is greater than 250A), a pre-charging box is configured. The pre-charge case has two modes of operation: pre-charge and unit detection.

Pre-charge mode: Used for pre-charging the capacitor of the power unit. By switching the number of current-limiting resistors in the series charging circuit, the power unit can be charged in three stages. After 3.5 seconds after the completion of charging, a closing permission signal (for 4.5 seconds) is issued, allowing the upper high-voltage switchgear to close.

Unit detection mode: used for unit self-detection. The charging process is the same as the pre-charge mode, with the only difference being that the third level of charging continues until the user presses the high-voltage disconnect button to stop. The pre-charging box is installed inside the inverter, and the power, value and number of resistors match the specifications of the inverter. The pre-charge primary circuit is shown in Figure 3.21:

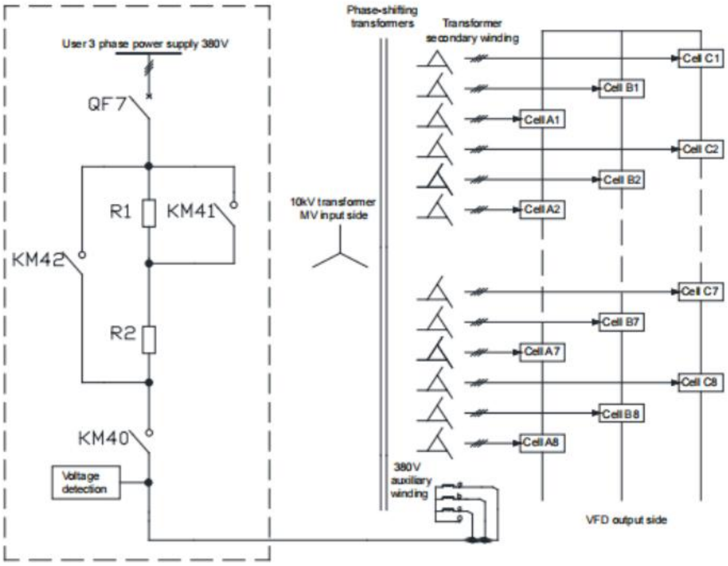


Figure 3.21 Primary circuit of the pre-charging box

The pre-charged input side is connected to the user's 380V power supply, and the output side is connected to the auxiliary winding of the phase-shifting transformer. The output voltage of the pre-charging cabinet changes with the number of pre-charging resistor switching, and the secondary winding of the transformer will induce the corresponding voltage to charge the DC capacitor of the power unit.

Note: To run the inverter, the output chamber motor cable must be removed.

3.4.4 Starter cabinet (optional)

Due to the excitation inrush current of the phase-shifting transformer, a large inrush current will occur when the large-capacity inverter is powered on. The start-up cabinet can be configured to suppress the power-on impulse current, and the principle of the start-up cabinet is shown in the figure below. The width of the starting cabinet is 1.2 meters, which is installed on the left side of the inverter, and the power, resistance value and quantity of the resistor match the specifications of the inverter.

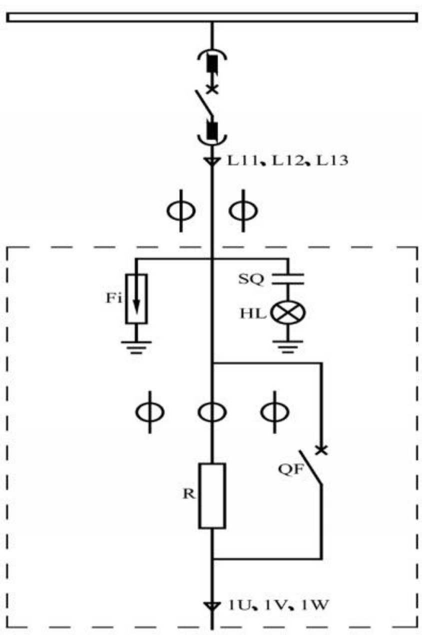


Figure 3.22 Diagram of the startup cabinet at one time

3.4.5 Switchgear (optional)

In practical applications, it is often necessary to use switchgear and frequency converter together. The switch cabinet is divided into a bypass cabinet and a switching cabinet.

(1) Bypass cabinet

The bypass cabinet can switch the motor to the power frequency grid operation when the inverter fails, so as to ensure the continuous production of the system. The bypass cabinet is divided into manual bypass cabinet and automatic bypass cabinet: the manual bypass cabinet is 0.8 meters wide and is equipped with a time converter and the power supply cabinet is interlocked, and the automatic bypass cabinet is 1 meter wide and configured with a time inverter and the incoming contactor KM1 interlock in the bypass cabinet.

When configuring the bypass cabinet, the primary cable (power inlet and motor outlet) on the user side usually enters from the bottom of the bypass cabinet, and the primary cable between the bypass cabinet and the inverter is arranged in the cabinet with a flexible wire.

When the system allows a short shutdown, a manual bypass cabinet can be configured, as shown in Figure 3.23. There are three knife switches in the manual bypass cabinet (of which QS1 and QS22 are electrically interlocked, and QS21 and QS22 are double-pole and double-throw disconnectors), which are manually switched by the operator.

When the system does not allow downtime, an automatic bypass cabinet can be configured, as shown in Figure 3.24. There are three vacuum contactors in the automatic bypass cabinet (in which KM1 and KM2 are interlocking, and KM2 and KM3 are interlocking), and the switching process is realized by automatic control of the electrical circuit. In order to facilitate the maintenance of the inverter, the automatic bypass cabinet is usually equipped with an isolated knife switch to isolate the inverter from the high-voltage power supply.

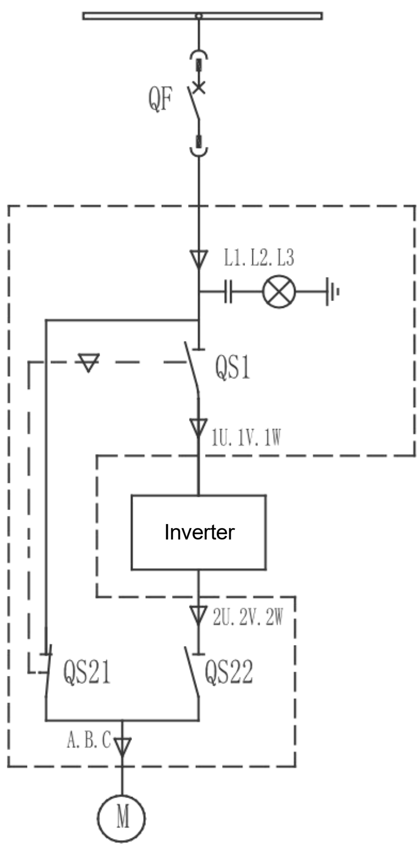


Figure 3.23 Manual bypass cabinet one-time diagram

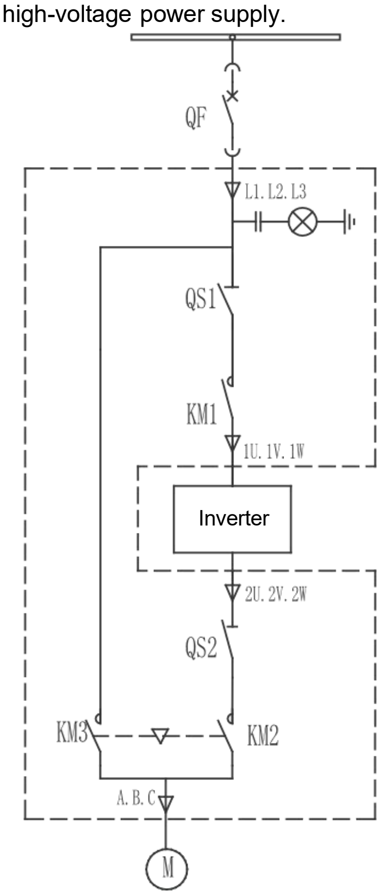


Figure 3.24 Automatic bypass cabinet one-time diagram

(2) Switching cabinets

The switching cabinet is suitable for the occasion where one inverter drags two motors. When the on-site motor is used and one standby or the working conditions of the two motors are similar, this scheme can be selected to improve the utilization rate of the inverter. Switching cabinets are divided into manual switching cabinets and automatic switching cabinets.

As shown in Figure 3.25, the principle of the manual switching cabinet is shown in Figure 3.25, QS1 and QS2 realize mechanical interlocking, and 1QF and QS1, 2QF and QS2 realize electrical interlocking; QS1 and QS2 are not mechanically interlocked in the automatic switching cabinet, and KM1 and KM2, KM1 and 1QF, KM2 and 2QF are electrically interlocked, as shown in Figure 3.26.

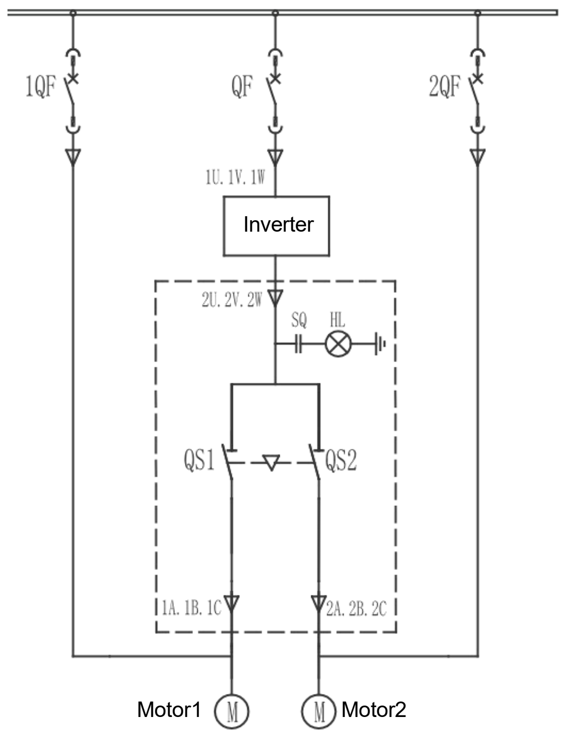


Figure 3.25 Manually switch cabinets once

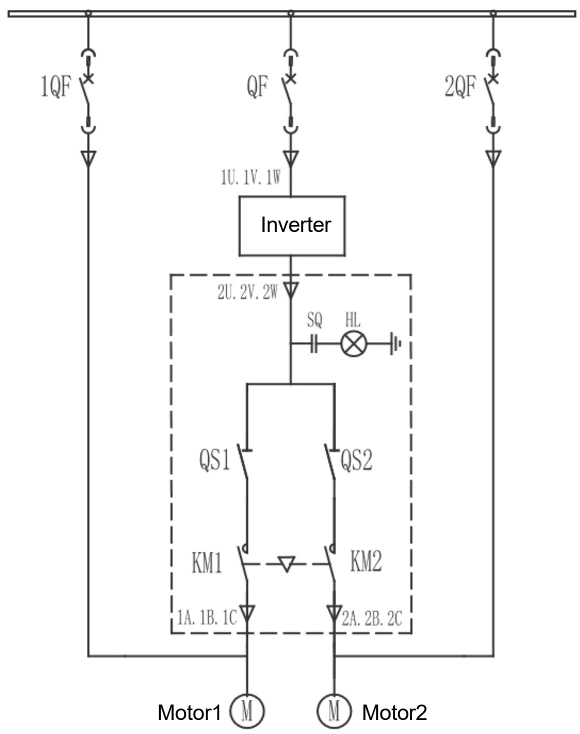


Figure 3.26 Automatic switching cabinet one-time diagram

NOTE

During the operation of the inverter, it is strictly forbidden to open the contactor at the outlet end of the inverter, so the automatic bypass cabinet and automatic switching cabinet are selected, and the normally closed contact of the inverter operation signal must be connected to the KM1 and KM2 opening circuit to avoid damage to the power unit caused by operation errors.

3.5 Selection of cables

3.5.1 Selection of power cables

The selection of power cables must be selected in strict accordance with the following requirements

- ● Cable current carrying capacity
- ● Cable manufacturer specifications
- ● Installation and laying method
- ● Voltage drop caused by cable length
- ● Power industry standards
- ● Comply with EMC specifications

Note!

● It is recommended to use shielded armored cables for the high-voltage cables between the inverter and the user's equipment (high-voltage power cabinets and motors) to prevent rodent infestation.

● If the total cross-sectional area of the cable shield is less than 50% of the cross-sectional area of the single-phase conductor, a ground wire needs to be added along the cable to prevent the overload of the shield caused by the potential difference of the factory grounding grid.

● The cross-section of the grounding cable must be greater than 16mm2.

3.5.2 Control, signal and communication cable selection

Recommended cross-sections and specifications for control, signal and communication cables:

● Analog input and output cables: integral shielded twisted pair wires with a cross-section of 1.5mm2~2.5mm2

● Digital input and output cables: integral shielded twisted pair wires are selected, with a cross-section of 0.5~1.5mm2

● Communication cable: choose professional communication cable required by relevant communication protocols, or integrally shielded twisted pair cable, with a cross-section of 0.5~1.5mm2

NOTE

● Signal cables used for communication, control, etc. should choose a single pair of twisted pair cables or multiple pairs of twisted pair cables with good quality.

● The signal cable and the power cable should be routed separately, and different cable trenches and bridges should be used. If this is not possible, the distance between the two types of cables should be greater than 30cm to avoid laying in parallel with each other.

● It is forbidden for the power cord to share a shielded cable with the signal cable.

● The signal cable should be laid near the corner and on the ground potential to improve the anti-interference performance.

● Wires that transmit different types of signals must be crossed and routed vertically.

● In order to place the interference potential between different components, a potential equalization cable parallel to the control cable should be laid to fix the connection to the ground

（The cable cross-section must be 16 mm2）。

● The shield should be grounded at one end on the inverter side; The distance between the shield and the terminal block should be as short as possible.

Chapter 4

Human-machine interface

4.1 Introduction to Touch Screens

The touch screen is installed on the front of the inverter cabinet door, and the user can set parameters, observe the status and read the data of the inverter through the touch screen.

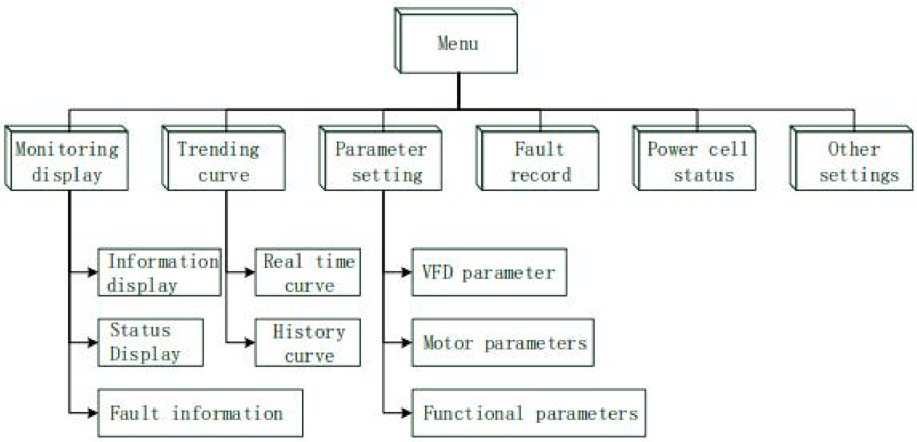
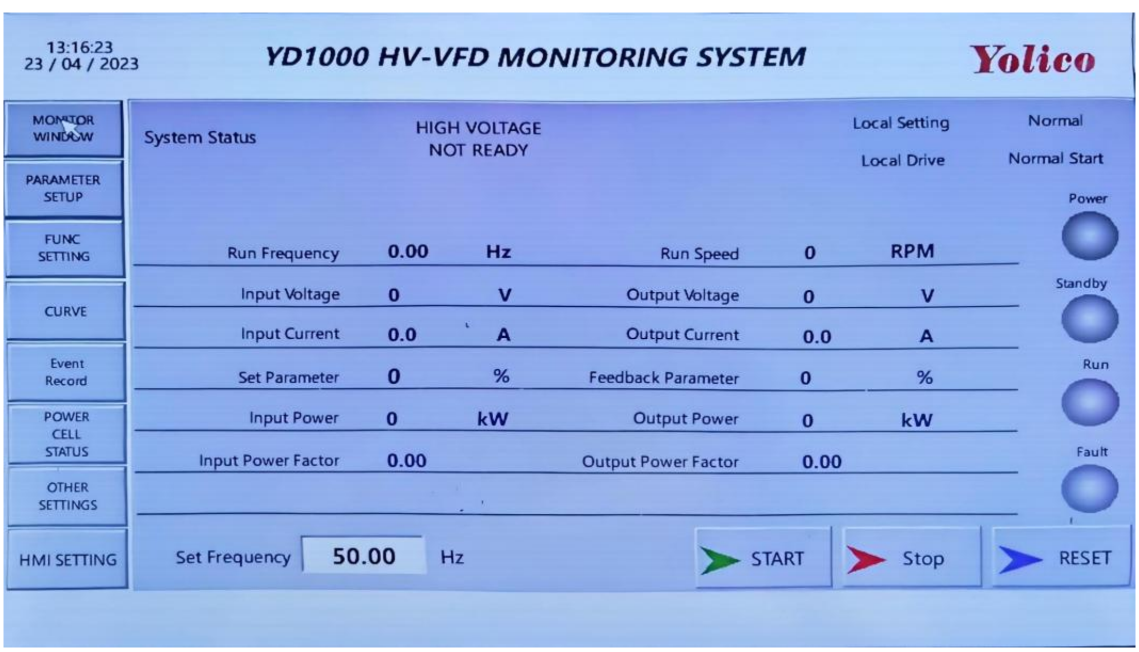


Figure 4.1 Block diagram of window menu

4.2 Touch screen operation and display instructions

4.2.1 Monitoring Interface

The default monitoring interface is the boot and can be divided into 4 areas: information display area, status indication area, fault information display area, and window menu selection area, as shown in the figure below.



The descriptions of each region are as follows:

region	illustrate
Information display area	The main display area includes the display of key parameters, the running status of the inverter and the start and stop control of the inverter
Status indication area	High Voltage: Lights up when the inverter is ready for high voltage (red) Standby: Lights up when the system is in standby (green) Operation: Illuminated when the inverter is running (green) Faults: Lights up (red) when major faults occur, flashes (red) when minor faults occur
fault information display area	the fault alarm information display area corresponds to the red alarm bar for heavy faults, and the yellow alarm bar corresponds to the alarm (light fault).
Window menu selection area	Click the menu button of each window to switch the content of the information display area

Table 4-1 Description of the monitoring page

4.2.2 Trend Curves

The trend curve is used to display the variable curve of the inverter, which is divided into real-time curve and historical curve, and all variables are standard unit values.

Real-time curve: real-time display of the inverter's operating frequency, output current and output voltage and other variables, the data is sampled at 100ms/time, and each screen can display a variable waveform of 300s, as shown in the fi ure below.

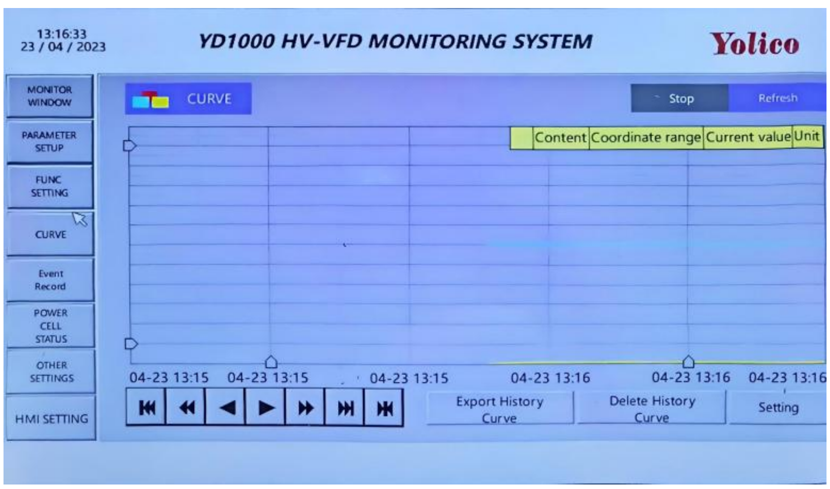
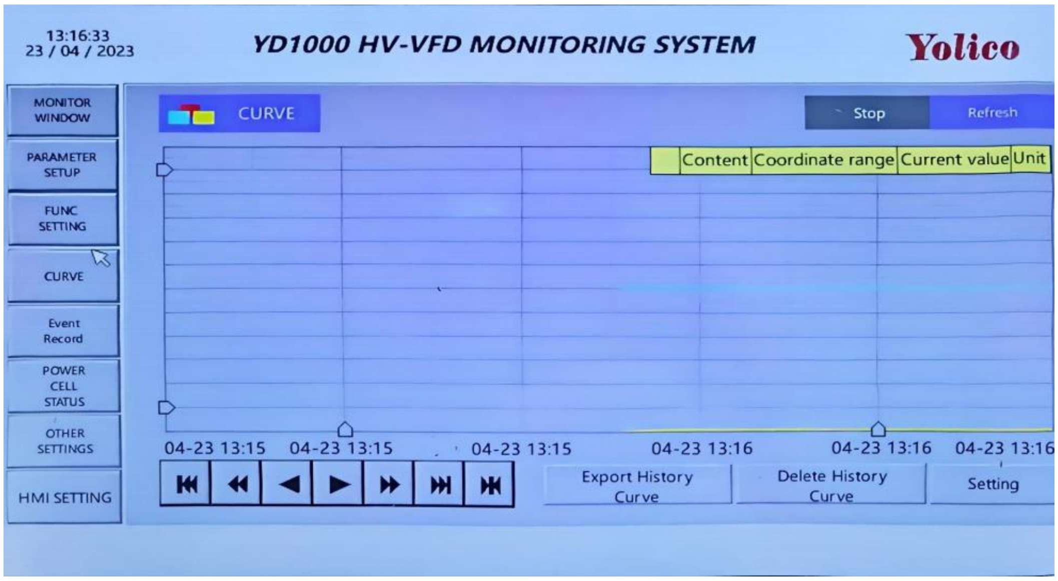


Figure 4.3 Real-time curve

Historical curve: display the variable curve of the inverter in the last 30 days, the excess part will be cyclically covered, the curve data acquisition period is 5s, and each screen can display the variable waveform of 300s, as shown in Figure 4.4. Users can save and delete historical curves through the "Export Historical Curves" and "Delete Historical Curves" buttons.

If you want to query the history of a certain time period, you can use the following two methods:

- Directly adjust the positioning of the arrow buttons;
- click“  ” , Set the positioning time for quick query.



4.2.3 Parameter Settings

The configurable parameters are divided into three categories: inverter parameters, motor parameters and functional parameters, a total of 5 pages, and the parameter descriptions are detailed in Chapter 5. The first time you enter the "Parameter Settings", you need to log in to the user to authenticate, as shown in the following figure.

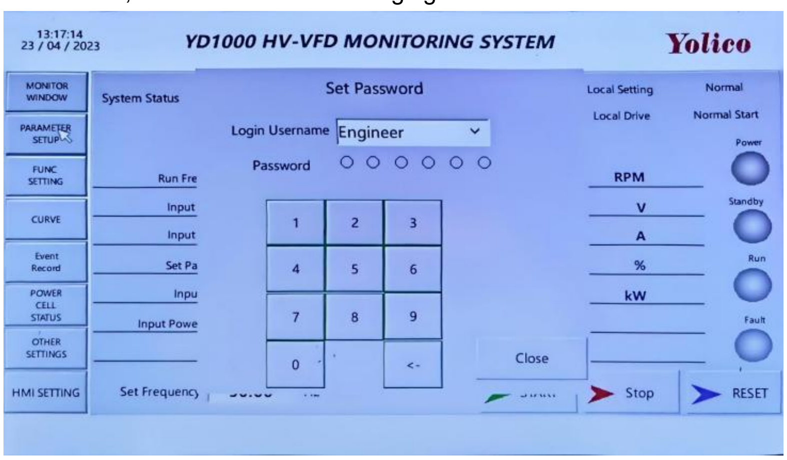


Figure 4.5 Parameter Settings Login Window

The default users of the system are 2: Engineer and Operator. The following table describes the user password and permissions.

Username	level	Password (6 digits)	Permissions
engineer	high	456789	All parameters
operator	low	123456 (Initial Password)	Some parameters

Table 4-2 User password permissions

note!

If there is no operation within 10 minutes of the user's login, the parameter settings will be automatically encrypted.

After the user logs in successfully, he or she can perform parameter setting operations, as shown in the following figure.

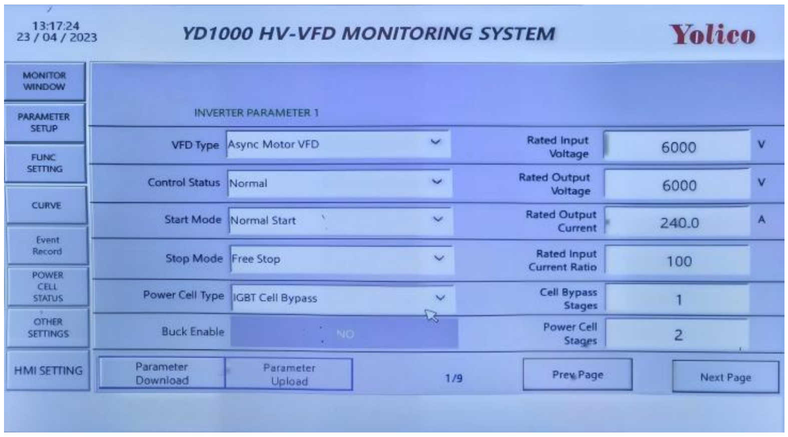


Figure 4.6 Parameter setting interface

There are three types of parameter settings: parameter upload, parameter download, and factory reset. The

Function buttons	illustrate
Factory reset	All parameters are factory reset
Parameter upload	Upload the parameter values from the controller to the PLC and transfer them to the touch screen
Parameter download	The parameter values of the touch screen are transferred to the PLC and downloaded to the controller

Table 4-3 Function buttons

4.2.4 Fault Logging

The fault logging interface records the fault information that occurs in the inverter.

Through the "Settings" button, you can quickly locate the historical fault information, as shown in the figure below.

The "Export Historical Data" and "Delete Historical Data" buttons allow you to save and delete historical data. When the fault record is overflowing, the excess will be cyclically overwritten.

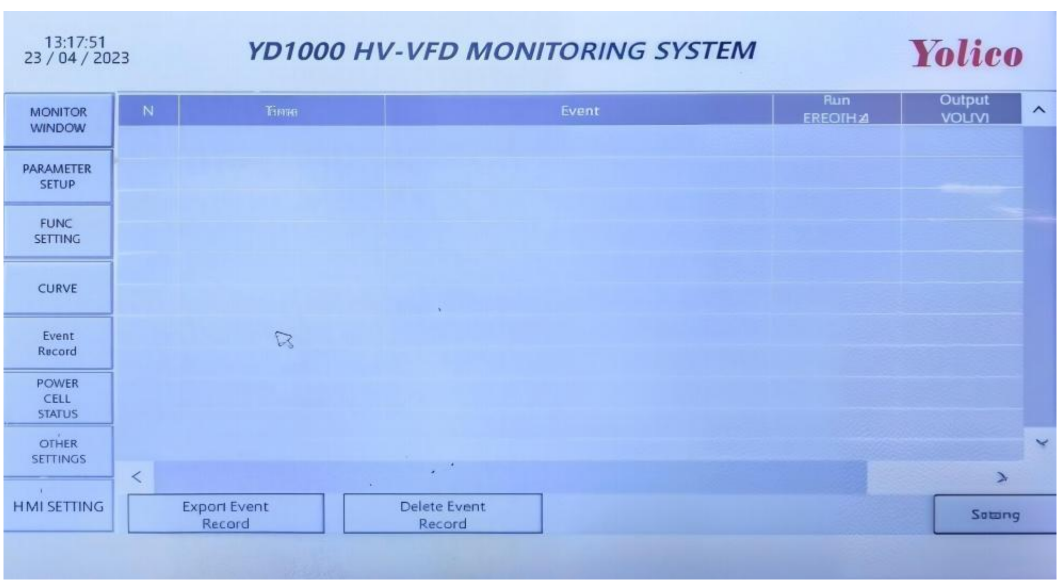


Figure 4.7 Fault Logging Interface

4.2.5 Unit Status

The cell status interface displays the real-time status of all units, as shown in the following figure.

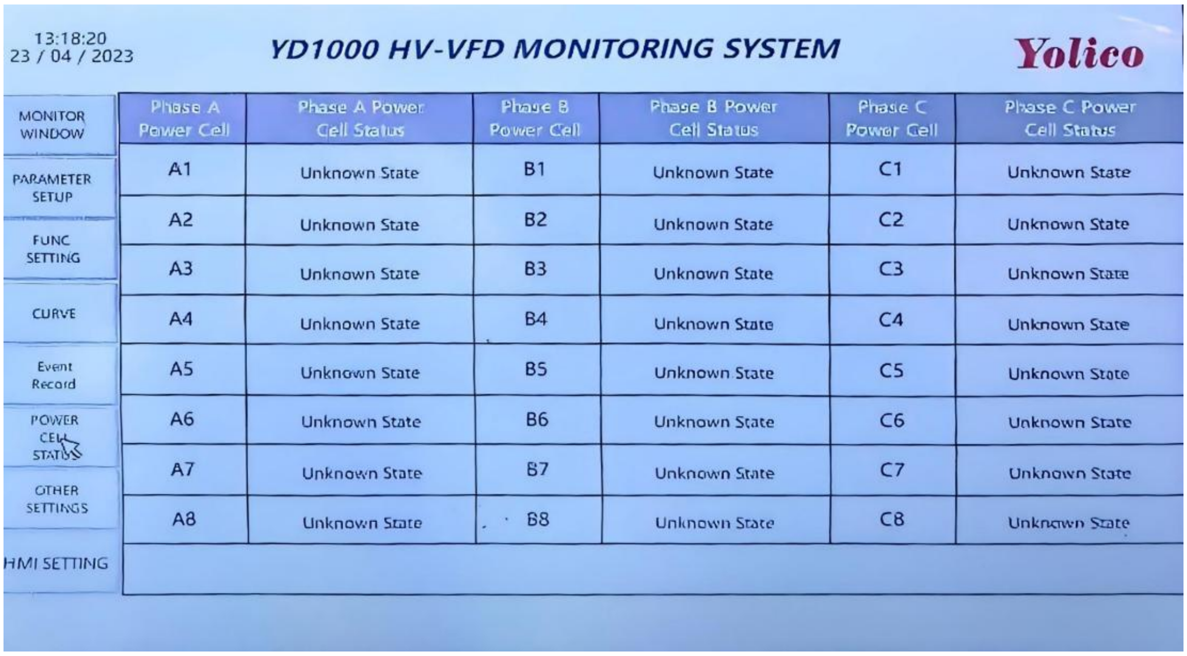


Figure 4.8 Cell status display interface

Chapter 5

Parameter description

5.1 Inverter and motor parameters

ID	description	unit	minimum	maximum	Default value
1	Startup frequency	Hz	0	5.0	0.2

The initial output frequency of the inverter, that is, the frequency at which the inverter starts to run after it is started; If the starting frequency is set too large, it may cause the inverter to overcurrent when starting; The starting frequency is not zero, which can ensure the output of motor torque when starting; In order for the magnetic flux to be fully established when the motor starts, the starting frequency needs to be maintained for a certain period of time.

General asynchronous machine: if the starting frequency is not zero, and the actual output current is greater than the no-load current of the motor, the step-down function will be turned on;

Open-loop vector of asynchronous machine: During normal start-up, the start-up frequency is used to establish the operating frequency of magnetic flux.

ID	description	unit	minimum	maximum	Default value
2	Maximum frequency	Hz	0	80.0	50.0
3	Minimum frequency	Hz	0	80.0	0

Maximum frequency: the highest frequency (absolute value) that the inverter is allowed to operate; If the inverter runs more than 10% of the maximum frequency and reaches 0.5 seconds, the inverter will report the "system overspeed" fault and shut down.

Minimum frequency: The lowest frequency (absolute) at which the inverter will operate continuously.

ID	description	unit	minimum	maximum	Default value
4	Rated output voltage	V	380	15000	6000
5	Rated output current	A	20	3000	77
35	Rated input voltage	V	380	15000	6000
36	Rated input voltage (proportional)		100	2000	200

The above parameters are set according to the identification on the nameplate of the inverter, or the factory setting of the inverter, and the user does not need to modify it.

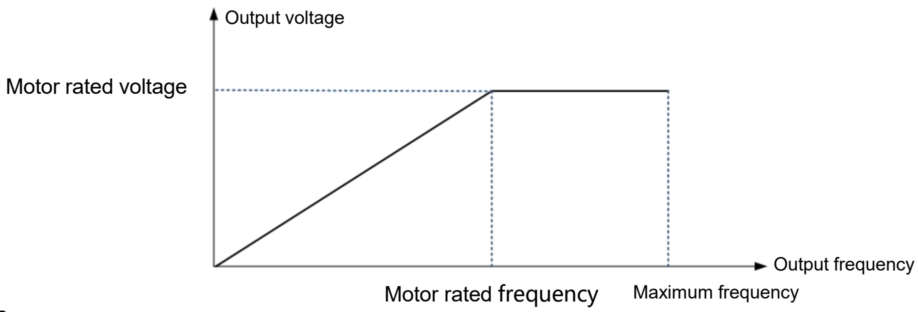
ID	description	unit	minimum	maximum	Default value
6	Motor current limiting coefficient	%	100	200	100

Set the current limit of the inverter output to avoid the inverter outputting too much current and damaging the motor.

100% corresponds to the rated current of the motor, for example, the rated current of the motor is 61A, and the current limiting coefficient of the motor is 100%, the maximum output current of the inverter is 61A; If the current limiting coefficient of the motor is equal to 120%, the maximum output current of the inverter is 73.2A.

ID	description	unit	minimum	maximum	Default value
7	Motor rated voltage	V	50	15000	6000
8	Motor rated current	A	1	1600	77
9	Motor rated frequency	Hz	5	80	50
10	Motor rated speed	rpm	10	3600	980
11	Motor rated power	kW	1	60000	1000

The above parameters are set according to the identification on the nameplate of the motor, and the relationship between the rated frequency of the motor and the rated voltage of the motor is shown in the following figure:



Note

If the rated voltage of the motor is set less than the nameplate of the motor, the inverter will operate with reduced capacity;
If the rated voltage of the motor is set greater than the motor nameplate, it will cause the motor to over-excite the operation, reduce the operating efficiency, and increase the temperature rise.

ID	description	unit	minimum	maximum	Default value
12	Motor moment of inertia	$Kg.m^2$	1	3000	30
14	Motor no-load of current	%	0	50	25
16	Motor stator resistance	%	0	25	0.1
17	Motor stator leakage inductance	%	0	50	16

If the above asynchronous motor parameters are provided by the manufacturer, the corresponding value is entered; If the manufacturer does not provide it, it can be identified by the parameters.

Open-loop vector of asynchronous machine: parameter identification 1 is the static identification of the motor, and the motor and the load do not need to be disconnected, and the stator resistance and stator leakage inductance of the motor are obtained; Parameter identification 2 is dynamic identification, which requires the inverter to be disconnected from the load, that is, equivalent to the no-load state, and obtains the moment of inertia of the motor and the no-load current of the motor; The stator resistance of the motor is the standard unit value, and the conversion relationship with the ohm value is as follows:

$$R_s\% = 100 \times \sqrt{3} \times R_s(\Omega) \times \frac{Motor\ rated\ current(A)}{Motor\ rated\ voltage(V)}\%$$

Asynchronous machine general: when the motor runs at no load or light load, the output power factor of the inverter is low, and in order to avoid the overvoltage protection of the inverter, step-down operation is usually adopted. When the starting frequency is non-zero and the actual output current is less than the no-load current of the motor, the inverter will automatically reduce the voltage output, and the minimum limit is 50% of the rated voltage of the motor.

ID	description	unit	minimum	maximum	Default value
15	Master-slave frequency difference	Hz	0	1.0	0.5
1-2	Master-slave settings		0	1	0
1-3	Master-slave mode		0	1	0

In the master-slave control case of the inverter, the master-slave frequency difference is used to balance the master-slave power output; The maximum allowable value of the master-slave frequency difference is 1.0 Hz for flexible connections, and is usually set to zero for rigid connections.

When the master-slave is set to 0-the master-slave is invalid, the inverter runs on a stand-alone machine; 1- When the master-slave is active, the inverter allows the master-slave linkage to operate.

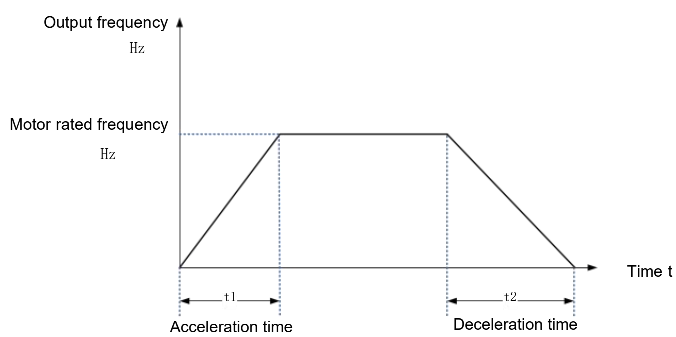
Through the master-slave mode parameters, a certain inverter can be arbitrarily set as the master, and other inverters are the slaves; If two inverters are set to operate in tandem, one inverter can be set as the master and the other inverter can be set as a slave; You cannot set both as a master or both as a slave.

ID	description	unit	minimum	maximum	Default value
19	Magnetic flux given	pu	0.1	1.0	0.96

Asynchronous machine open-loop vector: the motor flux is given, and the default value is 0.96

ID	description	unit	minimum	maximum	Default value
20	Acceleration time	sec	5	6000	30
21	Deceleration time	sec	5	6000	50

Acceleration time refers to the time required for the inverter to accelerate from zero speed to the rated frequency of the motor, see t1 in the figure;
Deceleration time refers to the time required for the inverter to decelerate from the rated frequency of the motor to the zero speed of the motor, see T2 in the figure.



Note!

The setting of on-site acceleration and deceleration time needs to consider the actual working conditions of the load, if the acceleration time is too short, it is easy to cause the inverter to overcurrent; If the deceleration time is too short, it is easy to cause the unit to overpressurize.

ID	description	unit	minimum	maximum	Default value
22	RPM scale factor		0.5	20	5
23	RPM integration time	sec	0.1	20	3.0

Vector control: The dynamic response characteristics of speed control can be improved by adjusting the speed scale coefficient and speed integration time of the speed loop. Increasing the speed scale coefficient and decreasing the speed integration time can speed up the dynamic response of the speed loop. However, too large a speed scale factor or too little speed integration time may cause system oscillation. The recommended adjustment method is as follows: if the default value cannot meet the requirements, fine-tune on the basis of the default value, and increase the proportion coefficient first to ensure that the system does not oscillate; Then, the integration time is reduced so that the system has both faster response characteristics and less overshoot.

Asynchronous machine general: asynchronous machine generally belongs to open-loop control, sometimes in individual low-frequency bands there is speed oscillation, at the same time produce motor current fluctuations, affecting the system operation in reliability, by adjusting the speed ratio system can effectively avoid oscillation. Note that the speed proportional factor is valid below 45Hz, and the three-phase output waveform of the motor must be observed when adjusting.

ID	description	unit	minimum	maximum	Default value
24	Magnetic flux proportionality factor		0.5	20	5
25	Flux integration time	s	0.1	20	2.0

For vector control, the dynamic response characteristics of flux control can be improved by adjusting the magnetic flux proportional coefficient and magnetic flux integration time of the magnetic flux loop. The adjustment method is similar to that of a tacho ring.

ID	description	unit	minimum	maximum	Default value
26	Current proportionality factor		0.1	20	0.6
27	Current integration time	ms	0.1	50	10

Vector control: The dynamic response characteristics of the current loop can be improved by adjusting the current proportionality coefficient and current integration time. When adjusting this value in actual use, it is necessary to carefully observe the output current waveform, and improper parameter setting will cause the output circuit waveform to be distorted.

VF control master-slave mode: The response characteristics of the master-slave power balance are adjusted by adjusting the current proportional coefficient and current integration time. Inappropriate parameters can easily cause the system to report an overcurrent fault.

ID	description	unit	minimum	maximum	Default value
28	Number of encoder pulses	p/r	512	65535	8192

When the encoder is used for vector control and encoder, it is important to note that the number of encoder pulses must correspond strictly to the actual encoder.

ID	description	unit	minimum	maximum	Default value
29	Frequency search current	pu	0.1	1.0	0.4

Open-loop vector of asynchronous machine: The starting mode is set to speed start, and the frequency search mode is set to "positive search", "negative search" or "two-way search", the parameter is the search current in the frequency search process, and the value is the percentage of the rated current relative to the motor.

ID	description	unit	minimum	maximum	Default value
30	Motor phase sequence 0: reverse, 1: forward		0	1	1

It is used for the vector of the synchronous machine and the encoder is installed, that is, the output phase sequence of the inverter is selected, UVW is the positive sequence, and UWV is the negative sequence. This parameter generally does not need to be set by the user, and is automatically identified by the rotor positioning process of the synchronous machine. Incorrect motor phase sequence setting will cause the inverter to fail to start properly.

ID	description	unit	minimum	maximum	Default value
31	Cut the phase-locked angle	degree	0.5	5	5

It is used for inverters with synchronous switching, and the performance of synchronous switching is adjusted by setting the switching lock-in angle.

The smaller the switching phase-locking angle, the smaller the difference between the grid electrical angle and the inverter output electrical angle after phase locking, and the more accurate the phase-locking, but the difficulty of locking is increasing, and the smaller the impulse current during switching.

The larger the switching phase-locking angle, the greater the difference between the grid electrical angle and the output electrical angle of the inverter after phase locking, but the worse the phase-locking accuracy, the easier the phase-locking, and the greater the impulse current during switching.

ID	description	unit	minimum	maximum	Default value
32	Inverter type 1: Asynchronous general 2: Asynchronous vector 3: Synchronous general 4: Synchronizer vector 5: Asynchronous open-loop vector 6: Synchronous open-loop vector		1	12	1

By setting the inverter type, you can change the control mode of the inverter.

For occasions with low load requirements or one master and multiple slaves, such as fans and pumps, asynchronous machine or synchronous machine is usually selected;

For occasions with high performance requirements, the open-loop vector control mode is usually selected; It is usually selected for high performance requirements and high requirements for low frequency performance

Vector control mode, i.e., closed-loop vector or encoder vector.

ID	description	unit	minimum	maximum	Default value
33	Instantaneous power outage time	ms	0	1000	0

When the inverter type is general asynchronous machine or asynchronous open-loop vector, the maximum time allowed for the inverter to maintain normal operation when the grid voltage drops briefly.

ID	description	unit	minimum	maximum	Default value
34	Number of cell progressions		2	9	5

The actual unit stage of the strain inverter is set at the factory, and generally does not need to be changed by the user.

Note!

This parameter must be accurate, otherwise it can have serious consequences

ID	description	unit	minimum	maximum	Default value
37	Dead time compensation	us	0	20	1

It is used to compensate for the dead zone loss of power devices, which is set at the factory and generally does not need to be changed by the user.

ID	description	unit	minimum	maximum	Default value
1-1	The type of load 0: Fan load 1: Pump load		0	1	0

When the speed starts, the time to establish excitation can be adjusted according to the load type, and the time for establishing excitation for fan load is greater than that of the pump load.

ID	description	unit	minimum	maximum	Default value
1-4	Number of bypasses in unit	PCS	0	1	0
3-3	Bypass type 0: No bypass 1: Mechanical bypass 2: IGBT bypass		0	4	0

The bypass type of the inverter is set according to the actual unit type, and the default is 0-no bypass; The inverter with bypass function is selected according to the actual unit type, that is, mechanical bypass or IGBT bypass, which is usually set at the factory and does not need to be changed by the user; Inverter with mechanical bypass function, inverter performs self-test on the contactor during the power-on process, and enters standby mode after passing the self-test; If the contactor fails, the inverter reports "contactor fault".

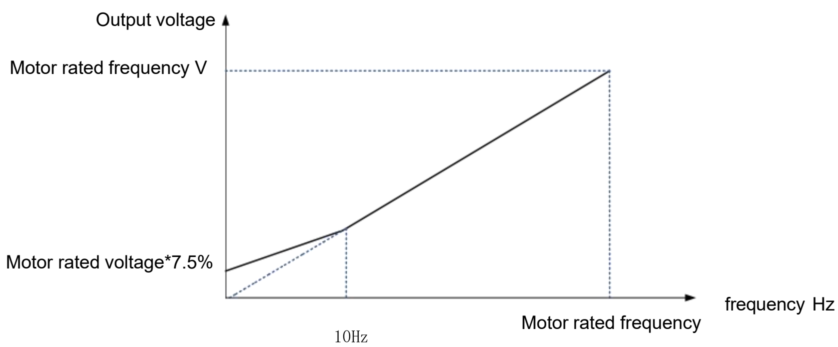
When the number of bypasses of the unit is set to 0, the inverter has no bypass function;

When set to 1, the unit bypass function is effective, if a unit fails hardware during operation, the inverter will automatically isolate the unit and keep the inverter bypass operation through the neutral point drift function; Due to the failure of a unit, the voltage output capacity of the inverter is reduced, in order to protect the inverter, the inverter is appropriately reduced.

ID	description	unit	minimum	maximum	Default value
1-5	Torque boost		0	15	0

The purpose of torque boost is to compensate for the voltage drop dissipated on the stator resistance of the motor during low-frequency operation to increase the output torque of the motor. For the operating conditions of large torque loads (such as compressors, slurry machines, belt conveyors, etc.), by setting this parameter, the problem of difficult start-up can be solved. The amplitude of torque lifting should be appropriately set according to the load situation, and if the lifting is too much, a large current impact will be generated during the start-up process.

General purpose of asynchronous machine: the torque increase below 10Hz is effective, every 1 unit is equal to (motor rated voltage * 0.5%), when the set torque is increased to 15, the corresponding VF curve is as follows:



Synchronous machine: the start-up process is DC directional, the current loop runs to 5Hz, and the operation is switched to VF mode. The current standard value of DC direction and current loop operation (starting current standard value) is set by torque lifting, and the starting current standard value is calculated as follows:

Starting current (PU) = torque boost value ×0.1× motor current limiting coefficient

For example, if the torque lift value = 10 and the current limiting coefficient of the motor = 100%, the starting current (pu) = 1.0, if the rated current of the motor = 61A, the starting current = 61A.

Torque lift value = 5, motor current limiting coefficient = 120%, then starting current (pu) = 0.6, if motor rated current = 61A, then starting current = 36.6A.

Note!

For the general type of synchronous machine, if the torque lift value is set too small, it is easy to cause switching failure when the motor cannot rotate.

ID	description	unit	minimum	maximum	Default value
1-6	Startup mode 0: Starts normally 1: Speed start 2: Parameter identification 1 3: Parameter identification 2		0	4	0

Normal start: The inverter starts to run from the starting frequency and accelerates to the target frequency according to the acceleration time curve; When the inverter type is universal synchronous machine, it will be output in high torque mode when starting, and then switch to VF mode after stable operation to 5Hz; The starting torque can be set according to the parameter-torque promotion, and each unit is equal to 10% of the current limiting coefficient of the motor, that is, 15 corresponds to 150% of the current limiting coefficient of the motor.

Speed start: The inverter starts in the rotating state of the motor, the inverter first tracks the speed of the motor, and then starts according to the frequency of the tracked motor, which can be started without current impact for the rotating motor. It is suitable for instantaneous power failure and re-start of loads with large inertia;

Parameter identification 1: The inverter type is the open-loop vector of the asynchronous machine, which is used for static parameter identification;
Parameter identification 2: The inverter type is the open-loop vector of the asynchronous machine, which is used for dynamic parameter identification.

ID	description	unit	minimum	maximum	Default value
1-7	Frequency search method 0: Residual pressure detection 1: Forward search 2: Negative search 3: Two-way search		0	3	0

When the speed is started, the inverter needs to track the speed of the motor first, and the default is 0-residual pressure detection;
Open-loop vector control of asynchronous machine: 0-residual pressure detection, 1-positive search, 2-negative search, and 3-two-way search can be selected.

ID	description	unit	minimum	maximum	Default value
1-8	Control status 0: Debug mode 1: Normal mode		0	1	0

Commissioning mode: the inverter has no high-voltage state, which is used for in-plant debugging;

Normal mode: high voltage state on the inverter, used in the actual field.

ID	description	unit	minimum	maximum	Default value
1-9	Downtime mode 0: Decelerates and stops 1: Free stop		0	1	0

Deceleration and stops: After receiving the shutdown order, the inverter decreases according to the deceleration time curve, and blocks the output and standby after decelerating to the lowest frequency; In order to avoid overvoltage fault during the deceleration process, the inverter automatically judges the unit voltage during the deceleration process, and if the unit voltage is too high, the inverter deceleration process is suspended, so the actual deceleration time may be greater than the set deceleration time;

Free stop: The inverter immediately blocks the output after receiving the shutdown command, and the motor stops by uncontrolled inertia.

ID	description	unit	minimum	maximum	Default value
2-1	Overexcitation frequency	Hz	1	30	20
2-2	Overexcitation gain	%	0	30	0

Deceleration and stop in the case of large inertia in the field, especially in the low frequency band, because the inverter is in power generation mode, the output power is close to zero, and it is easy to overvoltage failure. In order to solve the above problems, the motor is in an over-excitation state by adding the deceleration over-excitation function, which can inhibit the continuous rise of the bus voltage and avoid the overvoltage fault reported by the inverter. The larger the excitation gain, the more obvious the suppression effect, but too large can easily lead to too large output current, which needs to be weighed in the actual use process.

Overexcitation frequency: The frequency at which the overexcitation starts working, the default value is 20Hz.

5.2 Functional parameters

ID	name of the parameter	Set the range	default	It can be changed on run
1	Factory reset	0: Forbidden 1: 0 allowed	0	NO

This parameter is used to set whether to allow the factory default, and the "Factory Reset" button is valid when it is 1.

ID	name of the parameter	Set the range	default	It can be changed on run
2	Analog disconnection	0: Forbidden 1: 0 allowed	1	NO

Whether to allow a given frequency to maintain the original given value after a given disconnection, and whether the given mode is set to be valid when the given time is simulated;

Allowed: The given frequency will maintain the original given value after the disconnection occurs; If a reset operation is performed, the given frequency becomes the lowest frequency; Forbidden: The given frequency becomes the lowest frequency after a drop occurs.

ID	name of the parameter	Set the range	default	It can be changed on run
3	High voltage power loss	0: Forbidden 1: 0 allowed	0	NO

When a high-voltage power loss occurs, the parameter is set to Allow, and the inverter will report the high-voltage power loss;

If it is set to inhibit, the inverter will standby, the status will not report the fault, the high-voltage ready will be displayed, and the high-voltage power loss will be reported during operation (depending on the setting of the shielding delay time).

ID	name of the parameter	Set the range	default	It can be changed on run
4	Self-start when high voltage loses power	0: Forbidden 1: 0 allowed	0	NO

The high-voltage power loss time is within the power loss shield delay (less than or equal to), and the inverter is allowed/prohibited to automatically return to the operating state before the power loss; Before the power loss, the system status is running, the high-voltage power loss speed is prohibited, and the start mode is effective when the speed is started.

ID	name of the parameter	Set the range	default	It can be changed on run
5	inverter reversed	0: Forbidden 1: 0 allowed	0	NO

When the motor needs to be reversed, the touch screen function item "Inverter Reversal" needs to be set to allow. Depending on how the frequency is given, it is reversed
The operation steps are also different, and the process is shown in Figure 5.21:

● Locally given or given at a higher level: Operate the touch screen or host computer, set the frequency to a negative value, and the inverter can be reversed. If the control mode is set
Set to remote control, set the remote start-stop mode to the level mode, and control the start-stop through the interface board level positive start-stop signal.

● Analog given or switched given: set the control mode to remote control, set the remote start-stop mode to the level mode, and turn on and off through the interface board
Stop signal terminal, which controls the motor to reverse start and stop.

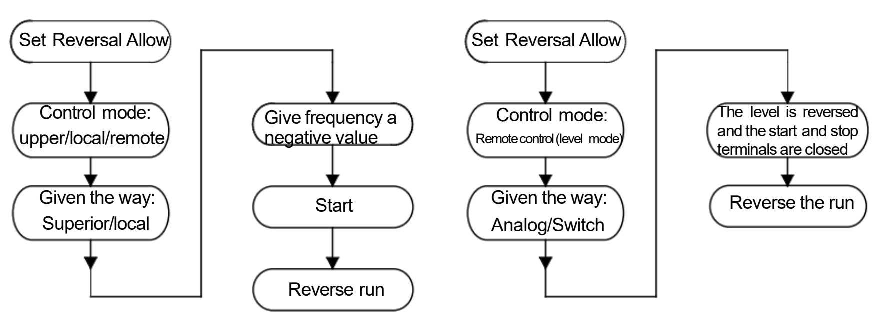


Figure 5.21 Reverse Running Flow Chart

ID	name of the parameter	Set the range	default	It can be changed on run
6	Power frequency switching direction	0: Switch up 1: Switch down	0	YES

Switch up: switch the motor from the variable frequency drive to the grid operation, and separate the motor from the inverter;

Switch down: switch the motor from the grid operation to the inverter drive, and separate the motor from the grid.

Note!

This function needs to be valid if the Variable Frequency Switching parameter is set to Allow.

ID	name of the parameter	Set the range	default	It can be changed on run
7	Remote start-stop mode	0: Pulse mode 1: Level mode	0	NO

When the remote start and stop trigger mode is set, the control mode is set to remote control.

Level mode: PLC-XS1T-1, 10 terminals are defined as level positive start and stop; XS1T-1 and 9 terminals are level reverse start and stop;

Pulse mode: PLC-XS1T-1, 10 terminals are defined as pulse start; The XS1T-1 and 9 terminals are stopped for pulses.

ID	name of the parameter	Set the range	default	It can be changed on run
8	Analog output 1	0: Output frequency 1: Output current 2: Unit cabinet temperature 3: Excitation current 4: Output power 5: Output power factor 6：Output Voltage	0	NO

Customize the setting of analog output signal content for PLC-XS18T-11 and M3 terminals.

ID	name of the parameter	Set the range	default	It can be changed on run
9	Analog output 2	0: Output frequency 1: Output current 2: Unit cabinet temperature 3: Excitation current 4: Output power 5: Output power factor 6：Output Voltage	1	NO

Customize the setting of analog output signal content for PLC-XS18T~12 and M4 terminals.

ID	name of the parameter	Set the range	default	It can be changed on run
10	Analog feedback drops	0: Forbidden 1: Allowed	1	NO

Whether to allow a given parameter to maintain the original given value after a given disconnection, and whether the given method is set to Simulate a given given value. Allow: The given parameter will maintain the original given value after the disconnection occurs;

Forbidden: The given parameter becomes 0 after a disconnection occurs.

ID	name of the parameter	Set the range	default	It can be changed on run
11	Remote control mode	0: Forbidden 1: Allowed	0	NO

Whether it is allowed to remotely set the control mode of the drive. If allowed, there are two control modes: local control (remote control of the interface board is enabled and disconnected) and remote control (remote control of the interface board is enabled and closed).

ID	name of the parameter	Set the range	default	It can be changed on run
12	Switch given selection	0: 3-stage speeds 1: 7-stage speeds	0	YES

When the inverter is given in a given mode as a switch, the switch is set to a given gear.

ID	name of the parameter	Set the range	default	It can be changed on run
13	Fan control	0: Stop 1: Start	0	YES

The setting selection of the start and stop of the built-in fan in the inverter.

ID	name of the parameter	Set the range	default	It can be changed on run
14	Power on for minor fault	0: Forbidden 1: Allowed	0	YES

When a slight fault occurs in the inverter, whether the inverter is allowed to operate normally with high voltage.

ID	name of the parameter	Set the range	default	It can be changed on run
15	Frequency conversion switching	0: Allowed 1: Forbidden	1	YES

Whether it is allowed to realize the "synchronous switching" function, that is, the mutual switching between the power frequency operation of the power grid and the frequency modulation operation of the frequency converter, see section 6.1 for details.

ID	name of the parameter	Set the range	default	It can be changed on run
16	Control mode	0: local control 1: Upper control 2: Remote control	0	YES

There are 3 control modes for the setting of the inverter start-stop control mode:

● Local control: control the start and stop of the inverter through the buttons on the monitoring interface of the touch screen.
● Remote control: Using the remote control signal, the inverter is controlled to start and stop through the remote level (or pulse) start and stop signal terminal of the interface board.
● Upper control: use the upper computer software to control the start and stop of the inverter through the upper computer communication.

ID	name of the parameter	Set the range	default	It can be changed on run
17	Given the way	0: Locally given 1: Analog given 2: Switch given 3: Superior given	0	YES

There are 4 given ways to give a frequency to an inverter:

● Locally given: The local given frequency of the touch screen function parameter interface is input into the given frequency through numerical values.

● Analog given: The frequency of the inverter is set by simulating a given signal through the interface board. The input current signal (4~20mA) can be adjusted by the touch screen parameters "Min Given Current" and "Max Given Current". Under open-loop control, the analog given signal corresponds to 0Hz~the highest frequency, and under closed-loop control, the analog given signal corresponds to 0% ~100%. The correspondence between a given value and frequency is shown in Figure 5.22.

● Switch given: set the given frequency of the inverter through the interface board 3 switching signals (switch given 1~3), which is only valid in open-loop operation (invalid in closed-loop operation). When no switch is closed, the given frequency is the lowest frequency; When the multi-gear switch is closed, the given frequency is the given of the highest gear, and the correspondence between the given value and the frequency is shown in Figure 5.23.

● Upper level given: set the given frequency (or given parameters) of the inverter through the upper computer communication.

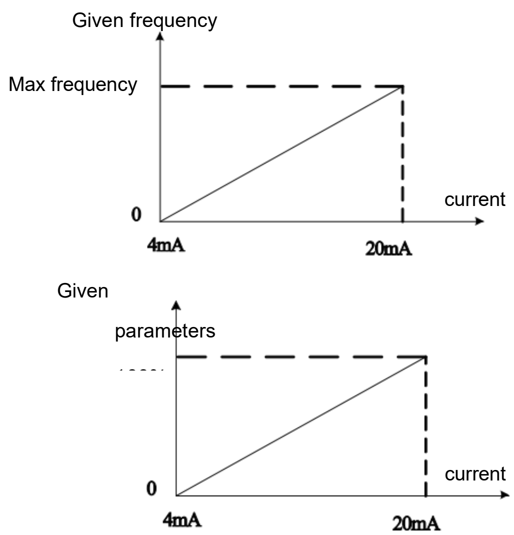


Figure 5.22 Simulating a given

Mode	Switch selection			Frequency given		
	SW3#	SW2#	SW1#	Freq3	Freq2	Freq1
3-stage speed	001			f1		
	010			f2		
	100			f3		
7-stage speed	001			f1		
	010			(2* f1+ f2)/3		
	011			(2* f2+ f1)/3		
	100			f2		
	101			(2* f2+ f3)/3		
	110			(2* f3+ f2)/3		
	111			f3		

Figure 5.23 Switch given

ID	name of the parameter	Set the range	default	It can be changed on run
18	Run method	0: Open-loop 1: Close-loop	0	YES

The inverter operates in two ways:

● Open-loop operation: The operating frequency of the inverter is directly given by the user.

● Close-loop operation: The operating frequency of the inverter is adjusted by the actual value of the controlled quantity (such as pressure and temperature) and the user-set value.

ID	name of the parameter	Set the range	default	It can be changed on run
19	Cooling method	0: Air cooled 1: Water cooled	0	YES

When the temperature of the inverter cabinet is too high, the setting of the heat dissipation mode of the inverter.

ID	name of the parameter	Set the range	default	It can be changed on run
20	Motor parameter group selection	0: Group 1 1: Group 2 3: Group 3 4: Group 4	0	NO

When the inverter drags more than one motor, the selection of motor parameters can only be up to four groups.

ID	name of the parameter	Set the range	default	It can be changed on run
21	Communication mode	0 : Modbus RTU 1: Profibus 2:Profinet 3:Modbus TCP	0	NO

When inverter communicates with upper level, you can choose 0: Modbus or 1: Profibus-DP communication.

Note!

The inverter can only be used as a slave station, and there is bus communication between the inverter and the field master station.

ID	name of the parameter	Set the range	default	It can be changed on run
22	Inverter Modbus address	1~247	31	NO

When the host computer communicates with the inverter on Modbus, the slave address assigned to the inverter must be consistent with the address set by the host computer.

ID	name	Set the range	default	changed on run
23	baud rate	0: 1200 1: 2400 2 : 4800 3: 9600 4 : 19200 5 : 38400	3	YES

When the inverter communicates with the Modbus upper level, the selection and setting of the Modbus communication baud rate is 9600 by default.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
24	Given frequency resolution	0.01~1.00	Hz	0.01	YES

The default value is 0.01Hz for a given frequency value.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
25	Jump frequency 1L	0.00~80.00	Hz	51.00	YES
26	Jump frequency 1U	0.00~80.00	Hz	51.00	YES
27	Jump frequency 2L	0.00~80.00	Hz	51.00	YES
28	Jump frequency 2U	0.00~80.00	Hz	51.00	YES

The jump frequency setting is the frequency jump range of the inverter that needs to be set to avoid the resonance points inherent in the mechanical system. There are two points in the jump frequency, except in the process of acceleration and deceleration, when the set frequency is in the jump frequency area, the system will automatically adjust the running frequency to the upper limit of the jump frequency. In order to determine the jump frequency region, two parameters need to be set for each jump frequency point, namely the upper frequency U and the lower frequency L. In the same jump area, the upper frequency value must be greater than the lower frequency value. If there are two jump frequency points, the setting of jump frequency 2 must be greater than jump frequency 1, as shown in Figure 5.24:

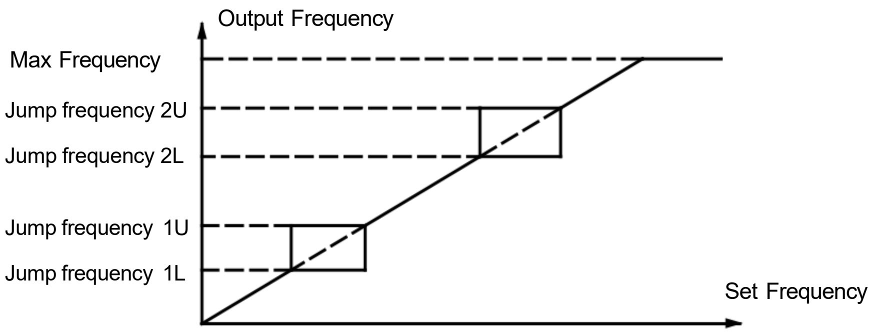


Figure 5.24 Jump frequency

ID	name of the parameter	Set the range	unit	default	It can be changed on run
29	Enter voltage coefficient	50~200		100	YES

Enter the correction factor for the voltage value. If the measured input voltage is less than the true value, the value should be adjusted to a larger value, and vice versa.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
30	Maximum given current	10.00~25.00	mA	20	YES
31	Minimum given current	0.00~8.00	mA	4	YES

The maximum value of a given current signal in the field at a given time of simulation corresponds to the highest frequency (or 100% of the amount given by closed-loop control); The minimum value of a given current signal in the field, corresponding to 0Hz (or 0% of a given amount for closed-loop control).

ID	name of the parameter	Set the range	unit	default	It can be changed on run
32	Switch given 1	0.00~80.00	Hz	10	YES
33	Switch given 2	0.00~80.00	Hz	20	YES
34	Switch given 3	0.00~80.00	Hz	30	YES

When the switch is given, speed 1, speed 2, speed 3 correspond to different given frequency values when closed.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
35	Loss of power shielding time	1~100	S	1	NO

When a high-voltage power loss occurs, the delay time of the shielded high-voltage power loss fault is set to 100s, which is equivalent to infinity (unlimited time)

ID	name of the parameter	Set the range	unit	default	It can be changed on run
36	Max. feedback current	10.00~25.00	mA	20	YES
37	Min. feedback current	0.00~8.00	mA	4	YES

In the case of analog feedback, the maximum value of the current signal fed back in the field corresponds to 100% of the feedback amount. The minimum value of the current signal fed back in the field, corresponding to 0% of the feedback amount.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
38	Close-loop proportional factor	0.5~20.00		10	NO
39	Close-loop integration time	0.01~20.00	Min	10.00	NO
40	Close-loop differential time	0.00~20.00	Min	10.00	NO

The operation mode is closed-loop operation, P controls the scale coefficient, I controls the integration time, and D controls the setting of the differential time.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
41	Timed dust removal time	15~3000	Day	0	YES

Ventilation filter cleaning is set as a reminder, and this parameter is valid.

ID	name of the parameter	Set the range	unit	default	It can be changed on run
42	Ventilator stop time		Min	0	YES

The amount of time that the ventilator is allowed to continue to operate to dissipate heat from the cabinet after the drive is stopped

ID	name of the parameter	Set the range	default	It can be changed on run
43	Cabinet door light and heavy fault selection	0： light 1： heavy	0	YES

When the cabinet door fails, the alarm type can be set to two types: light fault and heavy fault, light fault will not affect normal operation, heavy fault will lead to direct shutdown.

ID	name of the parameter	Set the range	default	It can be changed on run
44	Ventilation filter cleaning	0: Do not remind 1: Remind	0	YES

When there is too much dust on the ventilation filter, choose whether to set an alarm reminder for the cleaning of the ventilation filter.

Chapter 6

Functional applications

This chapter describes some of the more complex applications and features of YD's general-purpose high-voltage inverters.

6.1 Synchronous switching

Using synchronous switching technology, the inverter can be used to soft-start and control multiple motors. Synchronous switching is divided into two operations: frequency switching (up-cutting) and power-frequency switching (down-cutting).

Frequency switching refers to switching the motor from the inverter drive operation state to the grid operation state, and then separating the motor from the inverter. After the inverter obtains the switching instruction, the inverter detects the grid frequency on the input side and uses the frequency as the output speed command to achieve frequency matching. After the frequencies of the input and output are matched, the phase matching is performed by using the grid phase information measured by using the phase-locked loop on the input side and the output phase information measured by the phase-locked loop on the output side. When the output voltage frequency, amplitude and phase of the inverter are consistent with the power grid, the touch screen shows that the phase locking is successful, and the switching can be carried out. After successful switching, the output contactor of the inverter is disconnected, and the inverter stops freely. In order to adapt to the site under different working conditions, the switching phase-lock angle parameter is increased, ranging from 0.5° to 5°.

Power frequency switching refers to separating the motor in the operating state of the power grid from the power grid and then switching to the operating state of the variable frequency drive. When the motor is running at the power frequency, the inverter first runs no-load and tracks the power grid to the phase lock, and after the grid is connected, the motor is cut out of the power frequency and put into frequency conversion operation.

Note!

Before attempting synchronous switching, it is necessary to check whether the setting of system parameters is reasonable and meets the requirements, and commands or functions that may cause switching failure, such as speed curves, speed limits, given methods, etc., may change the output frequency of the inverter during synchronous switching, resulting in switching failure.

When using the synchronous switching function, it is necessary to equip the synchronous switching cabinet, reactor cabinet, and synchronous switching sampling plate, and the specific function application is detailed in the "Synchronous Switching Cabinet User Manual".

6.2 Speed start

When the motor is in rotation, the speed start function allows the inverter to measure the speed of the motor, and the inverter outputs a voltage of the same frequency as the rotation frequency of the motor, so that the inverter has the least impact on the motor when it starts.

When [Stop Mode] is set to free shutdown and [Start Mode] is set to speed start, the inverter has been detecting the speed of the motor before starting, and once the start command is received, the inverter will immediately output the frequency corresponding to the speed, and on this basis, the acceleration and deceleration will be carried out to reach the given frequency operation.

6.3 Instantaneous power failure function

In actual operation in the field, the power grid is often unstable. When the inverter detects a voltage drop in the grid, it slows down and operates, which is equivalent to charging the grid side. Within the [instantaneous power failure time], the inverter operates normally; If the power supply is not restored after the [instantaneous power outage time], see 6.4 for status switching.

6.4 High-voltage power loss treatment

When the voltage of the power grid drops beyond the [instantaneous power outage time], the state at this time is called high-voltage power loss. By setting the parameters [high-voltage power loss quick break], [high-voltage power loss self-start], and [power loss shielding delay], the user can choose whether the inverter will report a weight fault when a high-voltage power loss occurs; and whether the inverter runs automatically when resuming an incoming call.

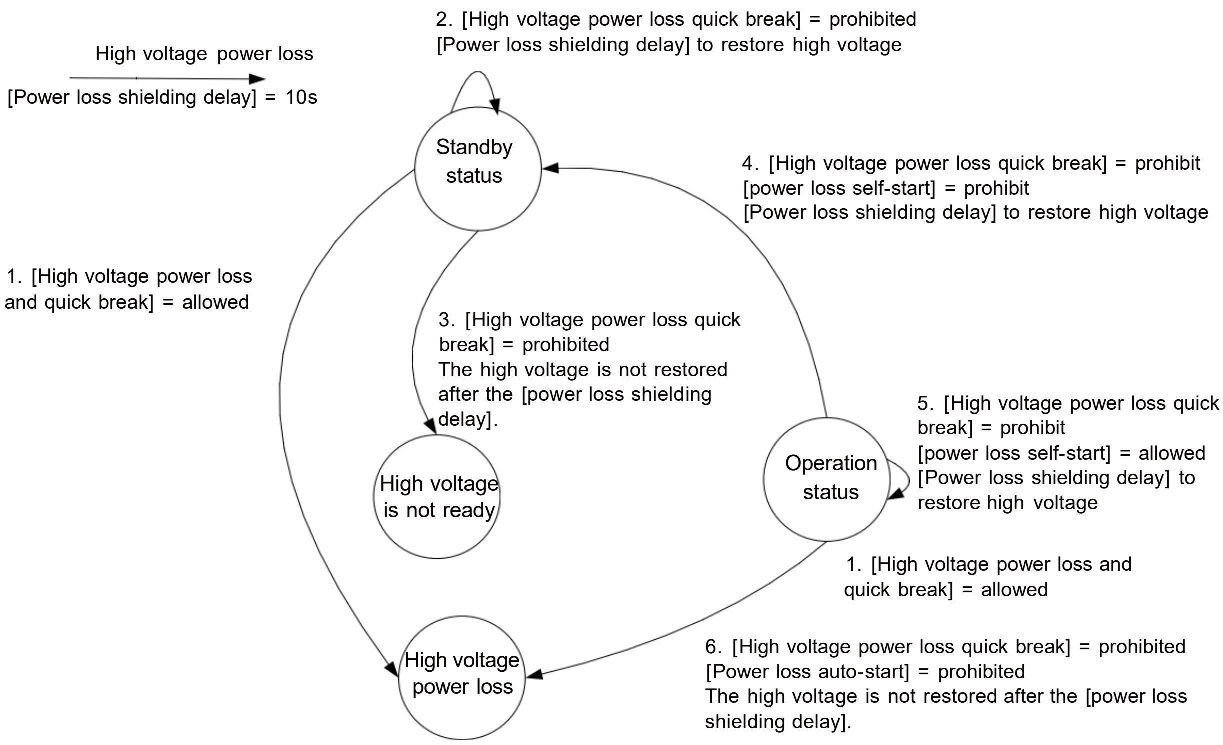


Figure 6.1 High-voltage power loss state machine

As shown in the figure above, the status of the inverter is set according to different parameters, as shown in the following table:

Item	State before high-voltage power loss	parameter	condition	results
1	Standby, running	[High voltage power loss and quick break] = allowed		High voltage power loss and heavy fault
2	Standby	[High voltage power loss and quick break] = forbid	Restore high pressure within 10 seconds	Standby
3	Standby	[High voltage power loss and quick break] = forbid	High pressure is not restored within 10 seconds	High voltage is not ready
4	Running	[High voltage power loss and quick break] = forbid [Power loss auto-start] = prohibited = forbid	Restore high pressure within 10 seconds	Standby
5	Running	[High voltage power loss and quick break] = forbid [Power loss auto-start] = prohibited = allowed	Restore high pressure within 10 seconds	Running
6	Running	[High voltage power loss and quick break] = forbid [Power loss auto-start] = prohibited = forbid	High pressure is not restored within 10 seconds	High voltage power loss and heavy fault

Table 6-1 Switching table of high-voltage power failure status

6.5 System bypass function (optional)

When the inverter fails and the normal operation of the motor cannot be guaranteed, and the on-site working conditions do not allow the shutdown to occur, the optional bypass cabinet can realize the system bypass function and put the motor into the power frequency power grid operation.

There are two types of bypass cabinets: manual and automatic. When the system can be stopped for a short time, a manual bypass cabinet is used to switch through the operator; When the system requirements do not allow shutdown, it is recommended to use automatic bypass cabinet when the working conditions allow, and the switching process is automatically realized. After the motor power frequency operation, the inverter can be isolated from the high-voltage power supply, which is convenient for the maintenance and repair of the inverter.

6.6 Master-Slave Control

Master-slave control is designed for multi-drive applications, where the system is driven by two or more high-voltage inverters, and the motor shafts are coupled together by couplings, chains, gears or conveyor belts. With the master-slave control function, the load can be evenly distributed between the individual motors.

When master-slave control is applied, the system parameters [Master-slave settings] should be set to active, [Master-slave mode] master should be set to master mode, and slave should be set to slave mode. The master and slave communicate through optical fiber. The master will transmit the operation, speed, torque and other information to the slave in real time, and the slave will respond to the data instructions transmitted by the master according to its own measured data.

6.7 Motor overload protection function

In order to prevent the motor from working in the overload overcurrent state for a long time and damaging the motor, the HIVT high-voltage inverter protects the motor according to the motor thermal overload model, and the specific motor overload inverse time protection expression is as follows:

$$\int_0^t \left[\left(\frac{I}{I_N}\right)^2 - 1 \right] dt \geq k$$

where I_N is the rated current of the motor, I is the instantaneous value of the motor current, t is the overcurrent protection time of the reverse time limit, and k is the setting value of the protection constant. From the expression, it can be seen that when the motor current exceeds the rated current, the inverse time protection function will be activated, and the larger the motor current, the shorter the protection action time. Anti-time protection

The schematic diagram of the protection is shown in the figure below:

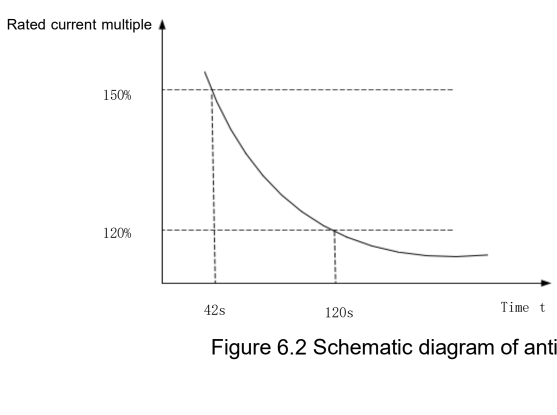


Figure 6.2 Schematic diagram of anti-time limit protection

The larger the motor overcurrent multiple, the larger the integration step size, and the shorter the continuous operation time of the inverter. For the sake of quantitative illustration, assuming that the output current of the inverter is constant at a certain overload multiple of the motor, the inverter will continue to run for a corresponding time until the corresponding fault is reported. Table 6-2 shows the motor overload multiplier and duration of the HIVT high-voltage inverter.

Overload multiple	Duration (seconds)
110%	251
120%	120
130%	76
140%	55
150%	42
200%	18

Table 6-2 Corresponding Table of Motor Overload Factor and Duration

6.8 Inverter stall prevention function

If the given acceleration or deceleration time of the inverter is too short, the output frequency of the inverter changes much more than the change in the speed of the motor, and the inverter will trip due to overcurrent or overvoltage, a phenomenon called stall. In order to prevent stalling and keep the motor running stably, it is necessary to detect the magnitude of the current and cell voltage for frequency control, and to suppress the acceleration and deceleration rate appropriately.

When a large current occurs in the process of acceleration and deceleration of the inverter, if the current exceeds the preset overcurrent adjustment point (that is, the maximum allowable value of the acceleration current), the output frequency of the inverter will not change, and the acceleration and deceleration will be suspended, and the acceleration and deceleration will continue after the current drops below the overcurrent recovery point. As shown in the figure below:

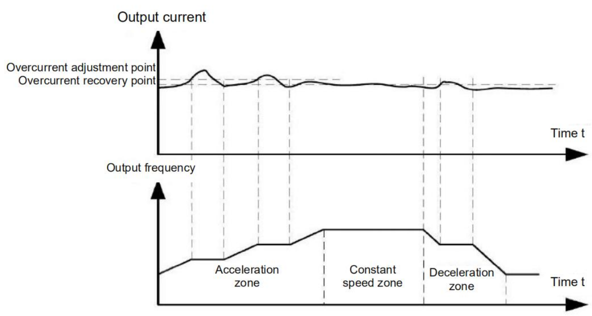


Figure 6.3 Schematic diagram of overcurrent regulation

When the inverter is running at a deceleration, if the load inertia is too large or the deceleration time is too short, it will cause the DC bus voltage to rise, which may lead to the overvoltage protection of the unit. In order to avoid this situation, the inverter will detect the unit bus voltage in real time, stop the deceleration process when it exceeds the unit overvoltage adjustment point, and continue to decelerate when the unit bus voltage is lower than the overvoltage adjustment point, as shown in the following figure:

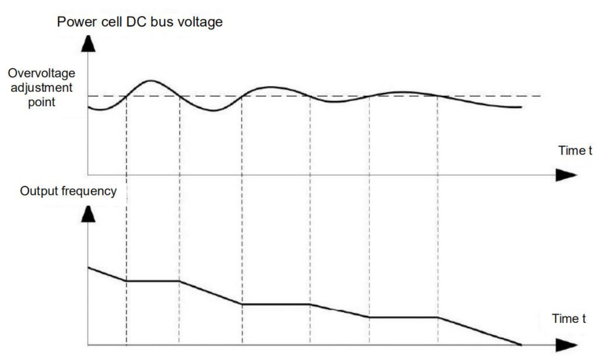


Figure 6.4 Schematic diagram of overvoltage regulation

6.9 Mechanical bypass and neutral drift

6.9.1 Mechanical bypass

Each phase unit of the high-voltage inverter is connected in series, and when one or several units of the inverter fails, in order not to cause complete shutdown at the customer's site, bypass operation is usually used to maintain on-site production.

The YD universal high-voltage inverter mechanical bypass unit realizes the bypass function by adding a contactor at the output end. When the inverter detects that a unit is faulty, it immediately blocks all IGBT outputs and simultaneously issues a bypass command to close the corresponding contactor, thereby separating the unit from the output circuit, and the inverter restarts and runs with derating.

Mechanical bypass can bypass virtually any fault type, including fiber optic faults, and is not limited to protecting the drive in the event of a failure of a power semiconductor device.

6.9.2 Neutral point drift

The bypass of the unit that will fail will not affect the current output capability of the inverter, but its voltage output capability will be reduced. In the traditional same-level bypass mode, when a certain unit fails, in order to maintain the three-phase output balance, one unit per phase is bypassed, so the voltage output capacity is greatly reduced.

YD general high-voltage inverter according to the neutral drift mode, when a unit fails, only the unit is bypassed, and the other units work normally, so that the voltage output capacity reaches the maximum.

Figure 6.5 is a schematic diagram of 5-stage high-voltage inverter without bypass, each phase is cascaded by 5 power units, at this time all units are normal, no fault occurs, so A, B, C three-phase voltage angle difference of 120° per phase. In the figure, taking phase A as an example, A1 refers to the first-level unit of phase A, A2 refers to the second-level unit of phase A, and so on.

When one unit of phase A of the inverter fails and is bypassed, only four units remain in normal operation, and the output voltage becomes unbalanced, as shown in Figure 6.6. At this time, the output phase voltage of phase A is significantly reduced, and the output line voltage is no longer balanced.

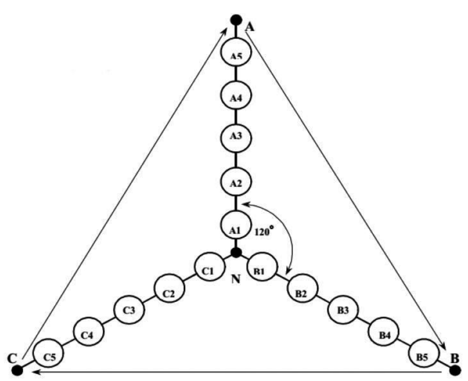


Figure 6.5 Schematic diagram of 5-stage inverter without bypass

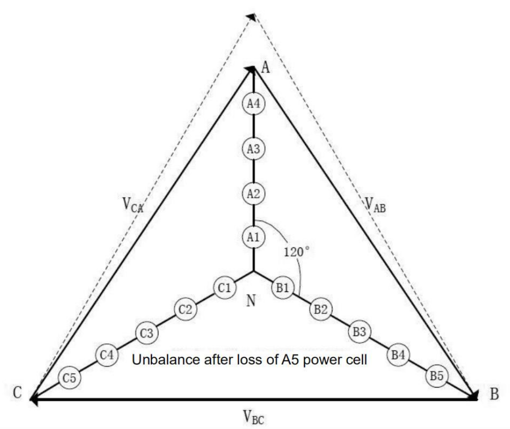


Figure 6.6 Schematic diagram of the bypass of unit A5

A neutral point drift algorithm is used, as shown in Figure 6.7. The premise of this method is that the neutral point of the unit is floating and is not connected to the neutral point of the motor, so that the neutral point of the output voltage of the inverter can deviate from the neutral point of the motor. We can change the balance of the output line voltage by adjusting the phase angle of the output phase voltage. Therefore, although the number of units working in each phase is different, and the output phase voltage is unbalanced, the balanced line voltage can be obtained, and the motor can operate normally. This method is equivalent to injecting an unbalanced zero-sequence component into the modulated waveform during PWM modulation. The 14 units shown in the diagram are still functional, providing an output voltage equivalent to 92.9% of the nominal output voltage. As can be seen in the diagram, the phase angle of the output phase voltage is appropriately adjusted, and the phase difference between phase A and phase B (phase C) is 126.4°, which is not the usual 120°, but it is the phase difference between this phase voltage that produces a balanced line voltage output.

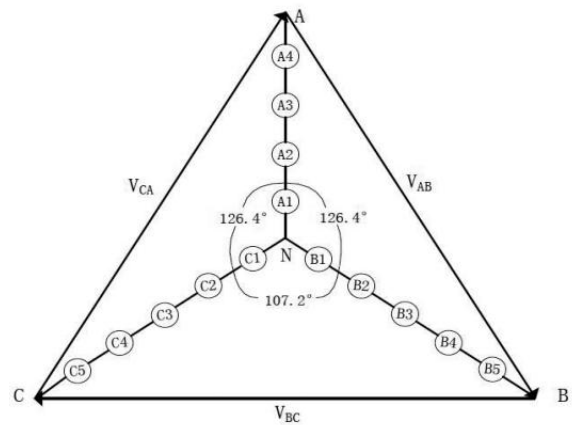


Figure 6.7 Schematic diagram of neutral point drift output

6.10 Asynchronous machine open-loop vector

The open-loop vector control of the asynchronous machine is suitable for most single asynchronous motor applications. In this way, the inverter estimates the slip, magnetic flux, synchronization angle and other parameters according to the motor model according to the measured voltage and current, and realizes the closed-loop control of magnetic flux and speed, which can provide performance close to that of coded vector control.

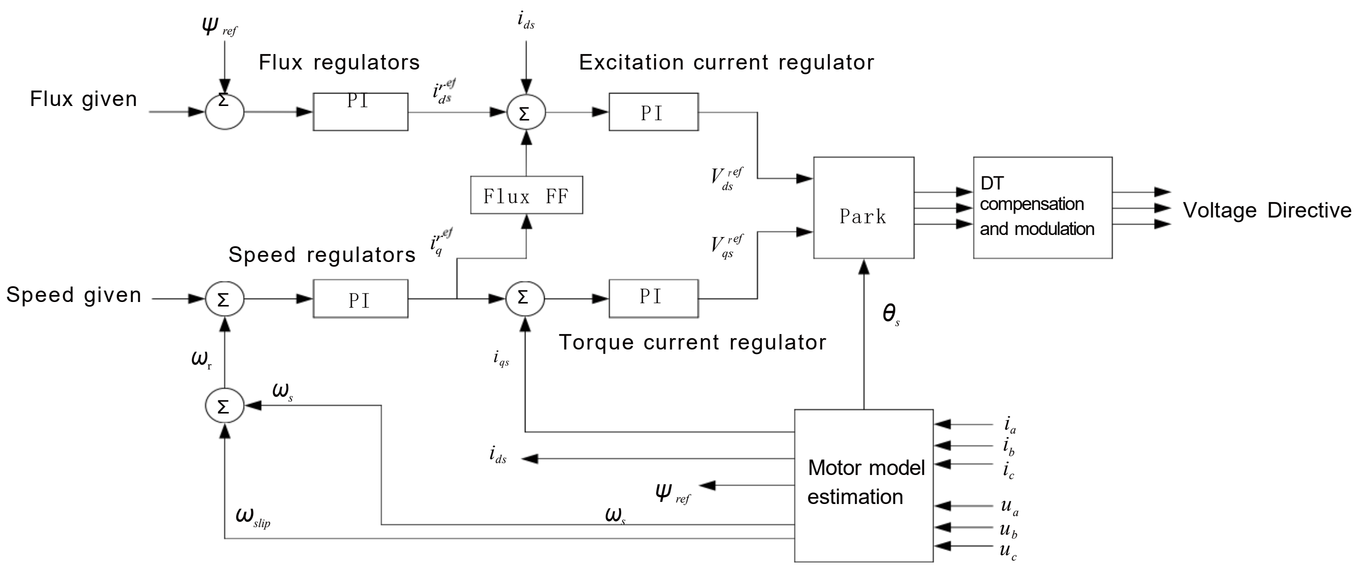


Figure 6.8 Open-loop vector control block diagram of an asynchronous machine

As shown in Figure 6.8, according to the measured stator voltage, UA, UB UC, and stator current

A b c i and i i are estimated according to the motor model, and the magnetic flux, synchronous speed sω, synchronous electrical angle sθ and slip ω are calculated.

The stator current a b c i i i , according to the synchronous electrical angle sθ coordinate transformation, the magnetic flux current ds i and the torque current qs i in the synchronous coordinate system are obtained.

The flux regulator adjusts the PI according to the given magnetic flux and the difference, and generates the excitation current given refds i, and the excitation current regulator adjusts the PI according to the difference between the given refds i and the flux current ds i, and generates the d-axis voltage output refds V.

The speed regulator adjusts the PI according to the difference between the given speed and the actual speed rω, and generates the torque current given refqs i, and the torque current regulator adjusts the PI according to the difference between the given refqs i and the torque current qs i, and generates the q-axis voltage output refqs V.

dq axis voltage output refds V, ref

qs V performs coordinate transformation and dead time compensation modulation according to the synchronization angle Sθ to obtain the voltage output command.

Chapter

Transportation, storage and installation

7.1 Transportation and Storage Requirements

YD general high-voltage inverter can be transported by cars, trains, ships and other means of transportation. In addition, the inverter should be stored in an indoor room with air circulation, a temperature of -25°C~55°C, and a maximum relative humidity of the air not exceeding 95%; During storage, it should be protected from direct sunlight to prevent flooding, rain and corrosion.

Note!

● YD general high-voltage inverter is strictly forbidden to be exposed to rain and sun during transportation, and it is strictly forbidden to vibrate, impact and invert violently.
●When choosing a means of transportation and a route, please consider whether there is a limit in the transportation process and the existence of factors such as height.
● The load-bearing capacity of automobiles and other means of transportation should be greater than the actual weight of YD general high-voltage inverter.

7.2 Inspection

The complete acceptance procedure of YD universal high-voltage inverter is as follows:

● Confirm whether the outer packaging of the inverter is in good condition;

● After unpacking, confirm whether the appearance of the inverter is damaged;

● Check the delivery list to confirm that the equipment is complete and the specifications and models are correct.

Note!

If the inverter is damaged or damaged, please refuse to sign for it, and immediately contact Beijing Shente Innovation Technology Co., Ltd. for confirmation!

7.3 Lifting

When the YD universal high-voltage inverter is unloaded and installed in place, it can be handled in the following three ways:

● Cranes

● Chain hoist

● Wheels

When using a crane or chain hoist, make sure that:

● The load bearing is within the allowable range of the crane or chain hoist;

● The wire rope must be long enough, and the strength of the rope must be able to support the weight of the equipment;

● It is forbidden for the wire rope to pass directly through the lifting hole, and the wire rope with a safety hook must be used.

The rollers are suitable for occasions where the space is small and there is no above-mentioned equipment: when using, the rollers are placed side by side on the floor and the cabinet is placed on it; With a crowbar, loop

Move the rollers and carry them in place.

Note!

● When using cranes, chain hoists, and rollers to transport, it is necessary to avoid damaging the surface of the cabinet; The sling must not touch the fan.

● When hoisting any cabinet, 4 lifting rings must be used at the same time.

● When hoisting the unit cabinet, in order to prevent the deformation of the cabinet, the angle between the lifting rope and the cabinet shall not be less than 60°.

● When hoisting the transformer cabinet, except for the packaging logo and the location of the drawing, the flat steel part of the transformer itself should be hoisted, and the transformer cabinet body should not be hoisted (see Figure 7.1). If there are multiple fans installed on the top of the transformer cabinet, the fans must also be removed when the transformer is hoisted, and they need to be restored as they are after hoisting.

● Be cautious when operating in the transformer cabinet, and it is strictly forbidden to touch the transformer coil with hard objects to prevent foreign objects from falling into the transformer. At the same time, when hoisting the transformer, the hoisting angle should consider the position of the cabinet top cover plate and the fan, and the fan or cover plate should not be deformed by force.

● The cabinet needs to be placed on a flat ground, and the metal shell of the inverter may be deformed, which will cause the door to be misaligned and unable to open and close normally.

● When the cabinet is hoisted and unloaded, it is strictly forbidden for personnel to stand under the lifting equipment; When the cabinet is tilted during the lifting process, it is strictly forbidden for manpower to try to correct it.

7.4 Installation, Positioning

In order to make YD's general high-voltage inverter operate stably and reliably for a long time, the following requirements are made for the inverter installation environment:

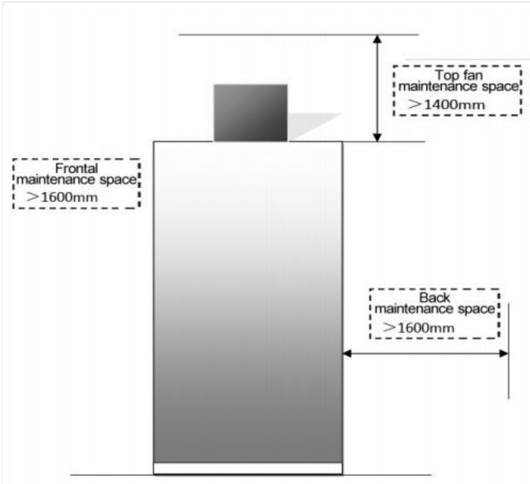
● The equipment should be installed in an indoor room free of corrosive gases, flammable gases, conductive dust, dripping water, salts, and oil fumes.

● The ambient temperature should be within the range of -5°C~45°C, if the environment exceeds the allowable value, a safe and reliable temperature regulating device should be installed.

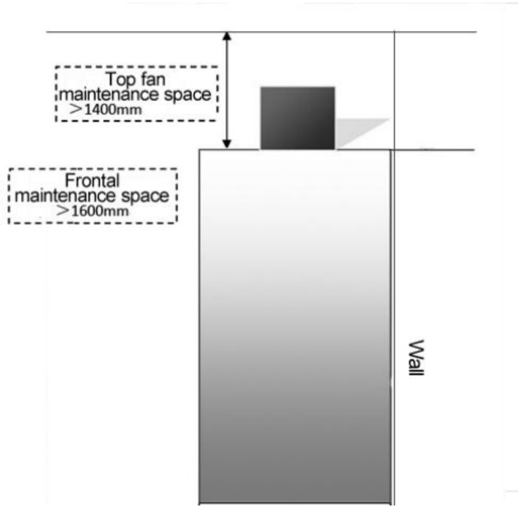
● The equipment site should be equipped with protective measures to prevent the invasion of small animals such as snakes and rats, and the equipment damage caused by the invasion of such animals should be strictly avoided.

In order to ensure the smooth flow of the cooling air path (see Figure 7.3 and 7.4 for the cooling air path), as well as the convenience of operation and maintenance, a certain space must be left for the inverter during installation:

As shown in Figure 7.2:



Double-sided operating space



Single-sided operating space

Figure 7.2 Cabinet space

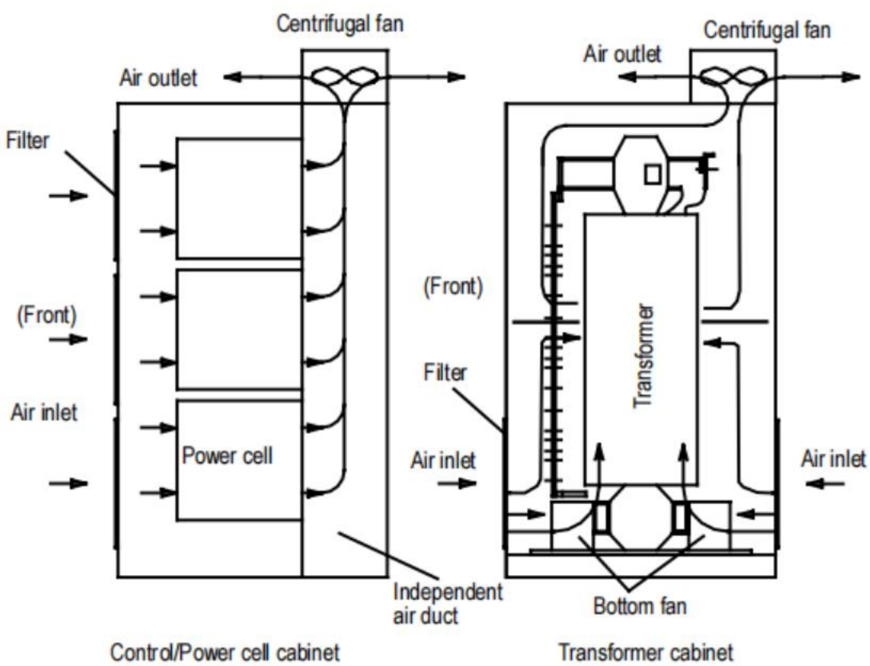


Figure 7.3 Diagram of 6kV general inverter cooling air path

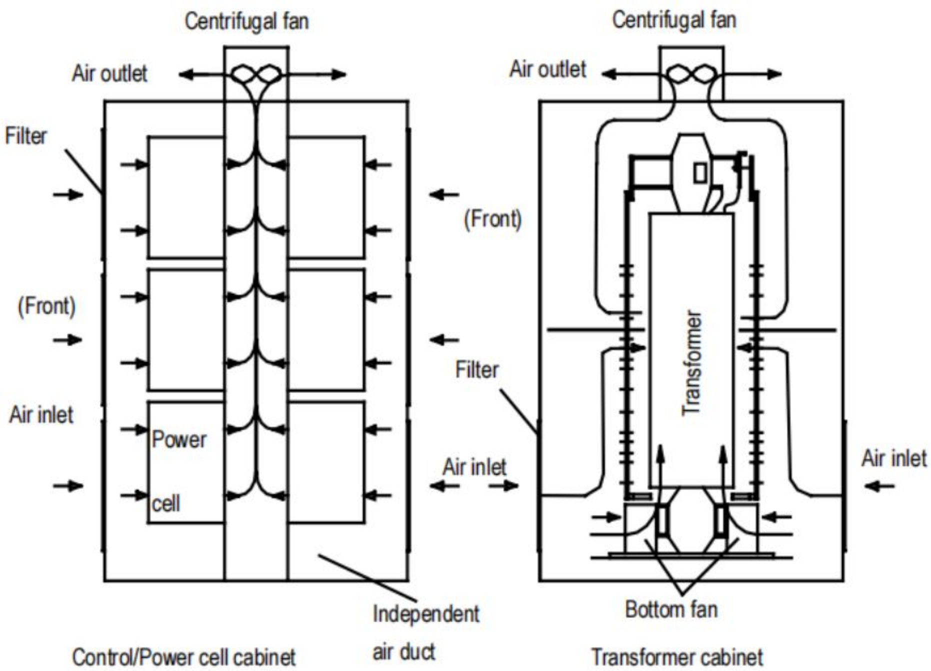


Figure 7.4 Diagram of 10kV general inverter cooling air path

For occasions with high ambient temperature or poor ventilation, it is necessary to add circulating fans or industrial air conditioners corresponding to the refrigeration capacity. In order to further reduce the ambient temperature of the inverter, the user can install a centralized ventilation duct to direct the hot air through the centrifugal fan to the outside. The centralized air duct outside the cabinet is directly connected with the cooling fan on the top of the cabinet, as shown in Figure 7.5.

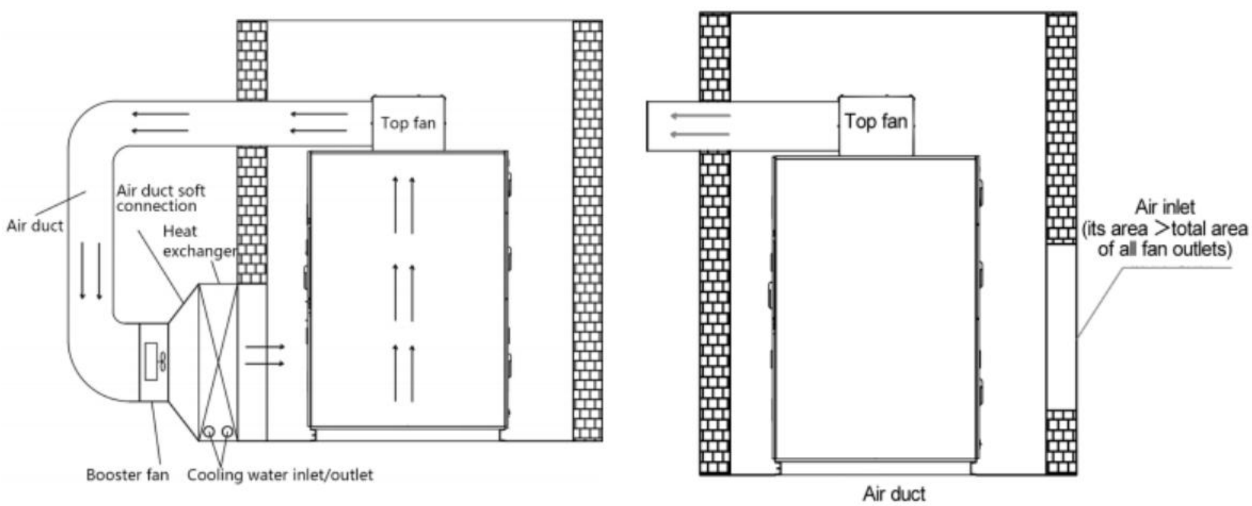


Figure 7.5 Air-water cooling diagram

For the safety and convenience of wiring, the inverter cabinet is recommended to be installed on the cable trench, as shown in Figure 7.6. The inverter base on the cable trench can usually choose 10# channel steel; When the power of the inverter is greater than or equal to 1600kW, 16# channel steel can be selected; For more than 4000kW, 18# I-beam can be selected. Once installed, the transformer cabinet and unit cabinet are neatly arranged from left to right from the front. After the cabinet is installed in place, all cabinets should be spot welded and fixed with the base channel steel, and the multi-core copper cable (above 35mm2) for the inverter should be reliably connected with the user's grounding point, and the grounding resistance should not be greater than 4Ω.

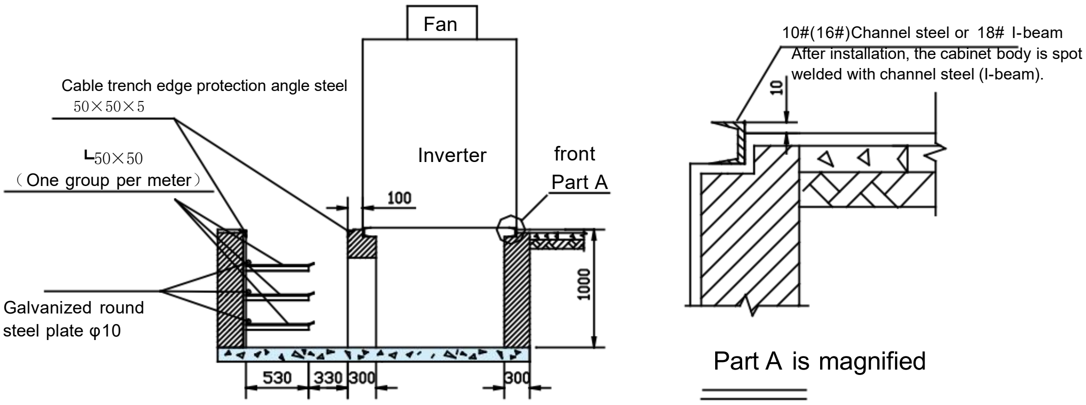


Figure 7.6 Cable trench

In the industrial site, some auxiliary switchgear may be selected according to the requirements of working conditions, such as a one-to-one bypass cabinet for switching between frequency conversion and power frequency, a one-to-two switching cabinet for switching between two motors for frequency conversion output, and a start-up cabinet for limiting the power-on current of a large-capacity inverter. When these auxiliary cabinets are selected, the specific installation location is carried out in accordance with the technical agreement.

Chapter 8
Troubleshooting and maintenance

YD high-voltage inverter has perfect fault monitoring and protection functions. Faults are divided into two categories: light faults and heavy faults, light faults: only an alarm is issued, and the system can be powered on, started and run normally; Critical fault: The system immediately cuts off the high-voltage power supply, saves the fault information, and latches the system status.

Before seeking service, users can conduct a self-check according to the fault name and the prompts in this section, analyze the cause of the fault, and find out the solution. When seeking service, contact the agent of the inverter you purchased or directly with Beijing Shente Innovation Technology Co., Ltd.

8.1 Light Faults and Alarms

When the fault is light, the system sends out an alarm signal (the system does not make memory processing for the light fault, only makes the fault indication), the fault indicator flashes, and the alarm is automatically canceled after the fault disappears. When there is a slight fault alarm during the operation of the inverter, the system will not stop; When there is a light fault before the high voltage on the inverter, it can be set by the light fault power-on option of the touch screen: when you select Allow, the power cabinet at the upper end of the inverter can be closed; When the ban is selected, the power cabinet at the upper end of the inverter is prohibited.

Light faults include:

- Minor fault of transformer cabinet door
- Fan failure alarm
- Fan failure
- The fan loses power
- Transformer overheating alarm
- Unit cabinet overheating alarm
- Unit cabinet door alarm
- Simulate a given dropout
- Unit bypass
- Motor overload
- The touch screen is not communicating
- The excitation difference is too large
- Water cooling failure
- Clean the ventilation filter
- Transformer heat exchanger leakage

8.2 Heavy Failures and Alarms

Heavy fault alarms are divided into system heavy faults and unit heavy faults. When the heavy fault alarm, the system sends out an alarm signal and fault indication, and at the same time gives a high-voltage breaking instruction (the high-voltage power supply of the inverter will be automatically disconnected). In addition, the fault indication and high-voltage breaking instruction are memorized - even if the fault disappears, the fault indication and high-voltage breaking instruction are still maintained. After troubleshooting and resetting the system, the drive returns to a high-voltage unready state.

If the following faults occur in the system, they will be handled as major faults

- External faults
- The transformer is overheated
- Motor overcurrent
- The cabinet temperature is overheated
- Unit failure
- Inverter overcurrent
- The output is unbalanced
- Input short-circuit to ground
- High-voltage power loss
- The interface board is faulty
- System over-speeding
- The main control board is faulty
- Wrong parameter settings
- The interface board is not ready
- The output is short-circuited to ground
- Contactor failure
- The controller is enabled to disconnect
- The transformer cabinet door is seriously faulty
- The unit cabinet door is seriously faulty
- The master version is incorrect
- Overvoltage fault
- Input imbalance
- Excitation failure
- High voltage is forbidden in the debugging state

8.3 Handling of Frequently Asked Questions

After the inverter fails, it is clearly displayed on the touch screen. Users can take corresponding measures according to the fault information displayed on the touch screen.

8.3.1 Inverter trip analysis
Please refer to Figure 8.1 to analyze the cause of the trip.

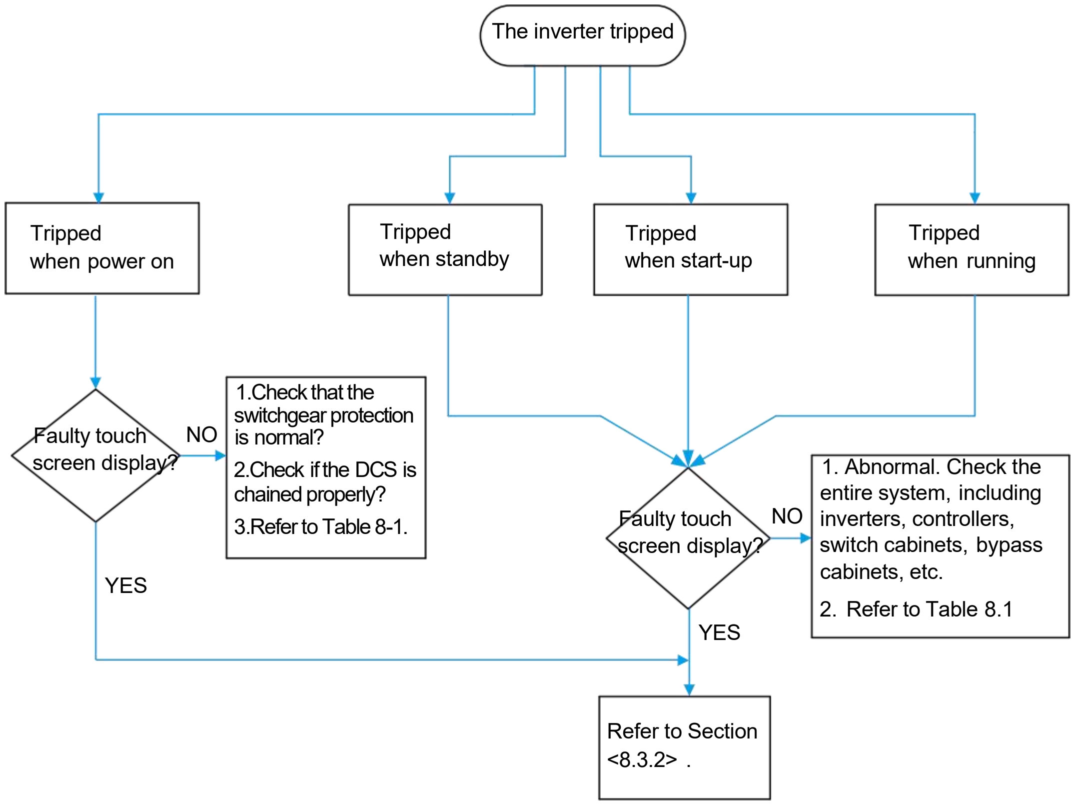


Figure 8.1 Flow chart of inverter trip detection

Item	Detection items		Check the points
1	Inverters and ancillary equipment	Switchgear	Whether the L1, L2, and L3 voltages of the primary incoming power supply of the switch cabinet are normal, and whether the circuit breaker is closed
		Bypass cabinets	Whether the live indicator indicates whether the high-voltage vacuum contactor is closed
		One line entry	Whether the wiring from the switch cabinet to the bypass cabinet is correct Whether the connection line from the bypass cabinet to the inverter is correct
		Interlocking wiring and control power supply	Check whether the power supply of the control loop of the bypass cabinet is normal Whether the closing allowable and high-voltage opening interlock wiring is correct
		Frequency converters	Whether the primary wiring from the transformer cabinet to the unit cabinet is correct and whether the parameters of the inverter are set correctly Whether the inverter status shows that the high voltage is not ready Whether the fault indicator is always on, and whether there is a signal output for multiple faults
2	Load equipment	Wiring at once	Whether the inverter-to-motor cable is connected correctly
		Motor	Whether the motor is stalled and whether the power frequency operation is normal
		load	Whether the fan is working properly
3	Documentation	Install the debugging files	Whether it is checked step by step

Table 8-1 Inverter detection before power-on

Table 8-1 Inverter detection before power-on

8.3.2 List of minor fault information

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
1	Transformer over-temperature alarm	100℃	1. The temperature protection value is set incorrectly 2. The resistance value of platinum thermal resistance is abnormal 3. The fans on the top and bottom of the cabinet are not running 4. The inverter runs overload for a long time 5. The ambient temperature is too high	1. Check whether the protection value of the temperature setting is correct 2. Check whether the platinum thermal resistance is damaged 3. Check whether the circuit breaker, contactor and thermal relay are working normally 4. Observe the transformer temperature after reducing the load 5. Control the ambient temperature and increase air conditioning and refrigeration
2	Unit cabinet over-temperature alarm	55℃	1. The unit cabinet fan is not running 2. The filter screen is blocked 3. The inverter runs overload for a long time 4. The ambient temperature is too high	1. Check whether the circuit breaker, contactor and thermal relay are working normally 2. Test whether it is adsorbed to the air inlet with A4 paper 3. Observe the touch screen temperature after reducing the load 4. Control the ambient temperature and increase air conditioning and refrigeration
3	Door interlock alarm		1. The travel switch and the top of the cabinet door are not compacted 2. The secondary line of the travel switch is broken 3. The relay of the IO port of the interface board is damaged	1. Check whether the travel switch is in good contact 2. Check whether the wiring of the secondary line is correct and the measurement of the secondary line is on/off 3. Seek technical support
4	Analog a given dropout		1. The analog signal line is broken 2. The current source is not supplied	1. Check whether the analog signal wiring is correct and whether there is any disconnection in the measurement 2. Check whether the current source is working normally
5	Analog feedback drops		1. The analog signal line is broken 2. The current source is not supplied	1. Check whether the analog signal wiring is correct and whether there is any disconnection in the measurement 2. Check whether the current source is working normally
6	Touch screen is not communicating		1. The communication network cable is disconnected 2. Poor contact 3. The touch screen port is damaged	1. Check whether the network cable is on or off 2. Check whether the network cable is plugged into place 3. Seek technical support
7	The fan loses power		1. The power circuit breaker, contactor and thermal relay of the fan are not closed 2. Fan thermal relay protection trips 3. The auxiliary contact of the fan is open	1. Check whether the circuit breaker, contactor and thermal relay are working normally 2. Whether the protection value of the thermal relay is set to be small, adjust the protection value 3. Seek technical support
8	The fan failure		1. The wiring of the fan fault point is wrong 2. The auxiliary contact inside the fan is disconnected	1. Check whether the signal line of the fan fault is correctly connected 2. Measure the opening and breaking of the auxiliary contact of the fan
9	Ventilation filter cleaning	remind	1. The alarm value of the ventilation filter is not appropriate 2. The dust filter is blocked	1. Check whether the alarm protection value of the ventilation filter is appropriate 2. Replace the dust filter
10	The motor is overloaded		1. The motor current reaches the protection value 2. Short acceleration time 3. Short deceleration time 4. The parameter setting is incorrect 5. Mechanical stall rotation of motor 6. The input power supply is too low 7. The inverter selection is small	1. Check whether the inverter is overloaded and reduce the output current of load observation 2. Extend the acceleration time 3. Extend the deceleration time 4. Check whether the rated current value of the motor is set correctly 5. Replace the motor or remove the mechanical fault 6. Check whether the voltage value of the bus network is within the allowable range 7. Select the matching inverter according to the load characteristics

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
11	The controller does not communicate		1. The communication cable is incorrectly connected 2. The power supply of the interface board is abnormal 3. The power supply of the controller is abnormal 4. The program version of the main control board does not match 5. The main control board is damaged	1. Check whether the internal wiring is correct 2. Whether the direction of the end of the communication line is firmly in contact with the wire 3. Measure whether the voltage of the power supply board is within the allowable range 4. Seek technical support 5. Seek technical support
12	Unit bypass		1. Fuse failure 2. IGBT failure 3. Optical fiber failure 4. Contactor failure 5. The unit is overheated and faulty 6. Excessive dust accumulation on the circuit board leads to false alarm faults of the unit module	1. Seek technical support 2. Seek technical support 3. Seek technical support 4. Seek technical support 5. Seek technical support 6. Clean the dust inside the circuit board and unit module
13	Water cooling failure		1. The temperature is too high 2. The conductivity is too high 3. The water level is low 4. Wrong wiring	1. Check whether the parameter settings are correct and whether the external circulating water is turned on 2. Check whether the conductivity value exceeds the set value and open the internal water for deionization process 3. Check whether the water level is too low 4. Check whether the secondary line is correct
14	The excitation difference is too large	≥10%	1. The parameter setting is incorrect 2. The deviation between the given current and the feedback current value of the excitation cabinet is more than 10%	1. Check whether the parameters of the excitation interface are set correctly 2. Check whether the current deviation value is within the allowable range
15	Leakage of transformer heat exchanger		1. Water leakage of heat exchanger	1. Seek technical support

8.3.3 List of duplicate fault information

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
1	Motor overcurrent	110%-150%	1. The parameter setting is incorrect 2. Motor or auxiliary machinery stalled 3. The input power supply is too low	1. Check current parameter of motor are set correctly 2. Replace motor or remove the mechanical fault 3. Check whether the voltage value of the bus network is within the allowable range
2	Inverter over-current	150%	1. Load mutation 2. The parameter setting is incorrect 3. The wiring of the main circuit is wrong 4. The control mode is the open-loop vector of the asynchronous machine and there is no parameter identification 5. The control mode is the wrong wiring of the vector encoder of the asynchronous machine 6. The control mode is the wrong wiring of the vector encoder of the synchronous machine 7. The main circuit connection line is virtually connected 8. The diode of the output voltage detection board is damaged 9. The output current oscillates 10. The motor insulation is damaged 11. The hall sensor is wired incorrectly 12. Short deceleration time 13. Short acceleration time 14. The unit works abnormally 15. Motor or auxiliary machinery stalled	1. Find the cause of load mutation and eliminate the fault 2. The current module of the signal board is consistent with the parameter setting 3. Check the wiring of the output loop is correct 4. Identify motor parameters in the correct order of parameter identification 5. Check whether the encoder signal line is connected correctly 6. Check whether the encoder signal cable is connected correctly 7. Check whether there is poor contact with the peripheral cables and bronze plates 8. Seek technical support 9. Adjust the speed ratio parameter to optimize the output current waveform 10. Measure whether the insulation of the connecting cable and motor winding is within the allowable range 11. Check whether the wiring of the Hall sensor is correct and whether the voltage of the Hall sensor is within the allowable range 12. Extend the deceleration time 13. Extend the acceleration time 14. Seek technical support 15. Replace the motor or remove the mechanical fault

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
2	Inverter over-current	150%	16. The starting frequency is set too high 17. The torque lift setting is too large 18. The power factor correction capacitor or surge absorption device on the output side is incorrectly wired 19. The inverter selection is small	16. Check whether the starting frequency setting is appropriate 17. Check whether the torque lift value is set appropriately 18. Check whether the wiring of the peripheral electrical equipment at the output end of the inverter is correct 19. Select the matching inverter according to the load characteristics
3	Fuse failure		1. The input power supply is out of phase 2. Abnormal power failure of the power grid 3. The incoming line of the unit module is not connected 4. The fuse of the unit module is damaged 5. The electrical distance between the secondary terminal of the transformer and the adjacent terminal is not up to standard 6. The grounding of the inverter cabinet is not up to standard 7. Excessive ash accumulation on the circuit board leads to false alarm fault of the unit module	1. Check whether the wiring of the superior power cabinet is correct 2. Detect the cause of abnormal power failure of the power grid and eliminate the source of fault 3. Check whether the three-phase inlet line of the unit module is connected correctly 4. Seek technical support 5. Check whether the electrical distance between the secondary terminal and the adjacent terminals of the transformer is within the allowable range 6. The grounding resistance of the inverter cabinet is not greater than 0.1Ω 7. Remove the dust inside the circuit board and unit
4	The IGBT driver is faulty		1. The unit voltage detection board is short-circuited 2. Load mutation 3. The output grounding wire of the inverter has not been removed 4. The motor insulation is damaged 5. Motor load stall 6. The electrical distance between the secondary terminal of the transformer and the adjacent terminal is not up to standard 7. The inverter cabinet is not grounded according to the requirements 8. Excessive ash accumulation on the circuit board leads to false alarm fault of the unit module	1. Check whether the voltage detection board and power resistance wiring of the unit are correct 2. Check the cause of the load mutation to eliminate the fault 3. Check whether the output wiring of the inverter is correct 4. Measure whether the motor insulation is within the allowable range 5. Replace the motor or remove the mechanical fault 6. Check the electrical terminal on the secondary side of the transformer and adjacent terminals Whether the distance is within the allowable range 7. The grounding resistance of the inverter cabinet is not greater than 0.1Ω 8. Remove the dust inside the circuit board and unit
5	The Unit is overheating	85℃	1. The fan on the top of the cabinet is not working 2. The filter screen is blocked 3. The unit overheat sensor is damaged 4. It is in an overload state for a long time 5. The ambient temperature is too high	1. Place A4 paper on the filter screen to see if it is adsorbed 2. Check whether the filter is blocked 3. Seek technical support 4. Check whether the motor load is overloaded, reduce the load and observe the operation 5. Control the ambient temperature and increase air conditioning and refrigeration
6	The Unit is overvoltage	1150-1190VDC	1. The deceleration time is too fast 2. The input power supply exceeds the rated value 3. The output current oscillates 4. The Hall sensor works abnormally 5. The reactive power of the motor is large 6. The output of the double-machine linkage load is unbalanced	1. Extend the deceleration time and adjust the over-excitation gain coefficient 2. Check whether the bus voltage is within the allowable range 3. Adjust the speed proportional coefficient 4. Check whether the Hall device is in good condition and whether the wiring is correct 5. Seek technical support 6. Seek technical support
7	Fiber failure		1. The control board of the unit module works abnormally 2. The optical fiber signal sending and receiving positions are connected incorrectly 3. There is dust inside the optical fiber connection base 4. Poor contact between the optical fiber core and the external plug 5. Optical fiber breakage 6. The optical fiber connector falls off 7. The inverter cabinet is not grounded according to the requirements 8. Excessive ash accumulation on the circuit board leads to false alarm fault of the unit module 9. The unit module is damaged 10. The optical fiber board is damaged	1. Seek technical support 2. Check whether the optical fiber connection is correct 3. Use a dust-free cloth to remove dust 4. Check whether the contact of the optical fiber plug is in place 5. Replace the entire optical fiber 6. Check whether the peripheral pressing parts of the optical fiber are firm 7. The grounding resistance of the inverter cabinet is not greater than 0.1Ω 8. Remove the dust inside the circuit board and unit 9. Seek technical support 10. Seek technical support

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
8	Inverter trips when it is powered on		Troubleshoot of the fault	1. The grounding wire of the main circuit has not been removed 2. The protection value of the superior power cabinet is too small 3. The transformer excitation surge current is too large
9	The output frequency oscillates at low speed during start-up		1. The output torque of the inverter is not enough 2. The output of the inverter is out of phase 3. The current limiting coefficient of the inverter is not set appropriately 4, the acceleration time parameter is not set appropriately 5, and the unit module works abnormally	1. Adjust the torque lifting parameters, and use the CAN background to monitor the output current and output voltage waveform 2. Check whether the wiring of the output end of the inverter is correct 3. Adjust the current limiting coefficient of the inverter, 4. Adjust the acceleration time parameters 5. Seek technical support
10	The output is unbalanced		1. The output voltage of a certain unit module is low 2. A unit outputs half a wave 3. The signal board version does not match	1. Seek technical support 2. Seek technical support 3. Seek technical support
11	The output is short-to-ground		1. The control mode is the output short circuit of the open-loop vector inverter of the asynchronous machine	1. Check whether the wiring of the output end of the inverter and the connection of the motor are correct
12	The input is unbalanced		1. The voltage of the bus network is unbalanced 2. The version of the signal board does not match the control system 3. The sampling resistance of the signal board is not matched	1. Check whether the input power supply is normal 2. Seek technical support 3. Seek technical support
13	Enter a short circuit to ground		1. The grounding wire at the input end of the transformer has not been removed 2. The insulation of the input cable is damaged 3. The lightning protection plate is abnormal	1. Check whether the wiring of the main circuit of the inverter is correct 2. Measure whether the insulation resistance of the input cable is within the allowable range 3. Check whether the lightning protection device is damaged
14	The upper switch cabinet tripped when the bypass cabinet was automatically bypassed		1. The delay and engagement time relay in the bypass cabinet is abnormal 2. The setting value of the power cabinet is too small	1. Seek technical support 2. Seek technical support
15	The cabinet temperature is overheated	60℃	1. The fan of the unit cabinet is not working 2. The filter screen is blocked 3. The inverter runs overload for a long time 4. The ambient temperature is too high 5. The temperature measuring plate is damaged	1. Check the circuit breaker, contactor and thermal relay are working normally 2. Use A4 paper to test whether it is adsorbed to the air inlet 3. Check inverter is overloaded or reduce the load to observe the temperature of the touch screen 4. Control the ambient temperature and increase air conditioning and refrigeration 5. Seek technical support
16	The transformer is overheating	130℃	1. The temperature protection setting is incorrect 2. The filter screen is blocked 3. The fans on the top and bottom of the cabinet are not working 4. The inverter runs overload for a long time 5. The ambient temperature is too high	1. Check the temperature protection value is set correctly 2. Use A4 paper to test whether it is adsorbed to the air inlet 3. Check the circuit breaker, contactor and thermal relay are working normally 4. Observe the transformer temperature after reducing the load 5. Control the ambient temperature and increase air conditioning and refrigeration
17	The parameter is incorrect		1. The control mode is the vector of the synchronous machine, and the parameter setting is wrong	1. Check the parameter settings are correct
18	Contactor failure		1. The power supply of the unit control board is abnormal 2. The contactor is damaged	1. Seek technical support 2. Seek technical support

Item	Fault name	Value	Troubleshoot of the fault	Troubleshooting countermeasures
19	High voltage is prohibited in the debugging state		1. The signal line of the XS3T-4 terminal of the interface board is broken 2. The power cabinet is not forced to close without interlocking	1. Check whether the wiring is broken or virtually connected 2. Check whether the interlock protection is working normally
20	system is over-speeding		1. The control mode is wrong setting of parameters of the asynchronous machine 2. The control mode is wrong setting of parameters of the synchronous machine	1. Seek technical support 2. Seek technical support
21	Excitation failure		1. The excitation cabinet is faulty 2. The signal line of the IO port of the interface board is short-circuited due to the excitation fault	1. Check there is a fault in the excitation cabinet 2. Check the wiring of the interface board is correct
22	External faults		1. The cabinet door high-voltage breaking button is closed 2. Remote high-voltage disconnect point closure 3. The input point of the interface board is short-circuited at the high voltage break 4. The internal relay of the interface board is damaged	1. Check the high-voltage breaking button is closed 2. Check the remote high-voltage disconnect button is closed 3. Check the port wiring of the input point of the interface board is correct 4. Seek technical support
23	High voltage power loss		1. The inverter is powered off at high voltage during operation 2. The delay parameter setting of power loss shielding is not appropriate 3. The signal board signal is abnormal	1. Check whether there is any abnormal situation in the on-site power grid 2. Check whether the parameter settings are correct 3. Seek technical support
24	controller en is disable		1. The wiring between the controller and the PLC interface board is disconnected	1. Check whether the wiring has poor contact and disconnection
25	The input power display value is incorrect		1. The input current conversion ratio parameter is set incorrectly 2. The KA1 relay is not closed 3. The input voltage and input current are incorrectly connected in phase sequence	1. Check whether the input current conversion ratio parameter is set correctly 2. Check whether the KA1 relay is working normally 3. Check whether the signal line of input voltage phase sequence and input current phase sequence is connected correctly
26	The MPU version is incorrect		1. The parameters have not been uploaded 2. The program version does not match	1. The fault is automatically cleared after the parameter is uploaded 2. Seek technical support

8.4 Replacement of power units

The model and size of the power unit module in the unit cabinet are exactly the same, and it is confirmed that the inverter cannot work normally due to the failure of a unit.

It can be replaced with a spare unit at the time the device is allowed to exit. When replacing, contact Beijing Shente Innovation Technology Co., Ltd. to repair the faulty unit module. The power unit module replacement is carried out in accordance with the following steps:

- Shut down, so that the inverter out of the running state;
- Cut off the high-voltage power supply, exit the high-voltage cabinet trolley (when there is a bypass cabinet, the inverter can be isolated by the isolation switch of the bypass cabinet), lock the local or remote high-voltage disconnect switch, and ground the high-voltage cabinet to the ground.
- Open the door of the unit cabinet and wait for the indicator light of all units to go out;
- Unplug the TX and RX optical fiber heads of the faulty unit;
- Remove the R, S, and T input power wiring of the faulty unit and the L1 and L2 output connection copper bars;
- Remove the fixing screws of the faulty unit and the track;
- Pull out the faulty unit along the track, and pay attention to handling it gently;
- Place the fiber optic seat plug on the new unit on the replaced unit;
- Install and wire the spare unit in the reverse order of the above disassembly;
- The system is powered on again and put into operation.

8.5 Maintenance

8.5.1 Daily Patrols

Item	Check the content	means of inspection	Judging criteria
Operating environment	Temperature	thermometer	-10~+40℃ Derating between 40~50oC, 1oC per liter, the rated output current is reduced by 1%
	humidity	hygrometer	5~95% non-condensing
	Dust, oil, water and drips	Visual	No traces of dirt, oil stains, or water leakage
	vibration	Dedicated tester	0.15mm,9-58Hz; 03m/s2,
	Special gas tester	nose, nose, visual	No peculiar smell and no abnormal smoke
Frequency converters	fever	Dedicated tester	The outlet temperature is normal
	sound	Dedicated tester, ear listening	No abnormal noise
	gas	Nose, nose, eye	No peculiar smell and no abnormal smoke
	appearance	Visual	The appearance is intact and there are no defects
	Cooling air ducts	Visual	No dirt, cotton wool, etc. blocking the air duct
	Input current	ammeter	Refer to the nameplate in noraml
	Input voltage	voltmeter	Refer to the nameplate in noraml
	Output current	ammeter	short-term overloads are allowed in rated range
	Output voltage	voltmeter	in the nominal range
Motor	fever	Special tester, nose sniff	There is no abnormality in fever and no burning odor
	sound	Ear to ear	The sound is non-anomalous
	vibration	Dedicated tester	There is no abnormality in vibration

8.5.2 Scheduled Maintenance

Please perform regular maintenance of the inverter every 3~6 months according to the following table according to the usage rate

project	Check the contents	means of inspection	Judging criteria
Inverter	Main circuit terminals	Screwdriver/sleeve	Screws are tightened, and Cable is not damaged
	PE terminals	Screwdriver/sleeve	Screws are tightened, and Cable is not damaged
	Control loop terminals	Screwdriver	Screws are tightened, and Cable is not damaged
	Internal cables, connectors	Screwdrivers, hands	Plug securely
	Mounting screws	Screwdriver/sleeve	Screw fastening
	Dust sweeping	vacuum cleaner	No dust, cotton wool, etc
	Internal foreign bodies	Visual	No foreign bodies
Motor	Insulation test	2500V megaohms	There is no abnormality in the table

Note!

● The regular maintenance interval is recommended to be cleaned once every 3~6 months, if there is a lot of dust, the filter should be cleaned regularly, and the replacement cycle can be shortened to once a week.

● It is recommended that within the first month of operation, all the incoming and outgoing cables of the transformer, the inlet and outgoing cables of the power unit, and the control cables should be tightened once, and then every 3~6 months, and the dust in the cabinet should be removed with a vacuum cleaner.

● Record the operation of the inverter (see Table 8-2), and when the fault trips, the fault situation should be recorded, the cause should be identified and eliminated before it can be powered on again.

Record time	Indoor temperature	Transformer temperature	Unit cabinet temperature	Frequency of operation	Output current	Output voltage	Fault logging and overview

Table 8-2 Fault Records

8.5.3 Maintenance of standby inverters and unit modules

● Make sure that the TX and RX fiber socket plugs of the standby unit are plugged in to prevent dust pollution.

● Regularly (generally 6 months) power on the standby unit module for operation.

● When the inverter is stored for a long time, it should be guaranteed that the power-on test should be carried out for 6 months, and the power-on time should not be less than 1 hour, and the voltage regulator should be used to slowly boost the voltage to the rated value when the power is on.

Chapter 9

Dry-type transformer instructions for use

9.1 Instructions for installation and use of H-class dry-type transformers

Overview:

The content of this instruction includes installation and use instructions and maintenance.

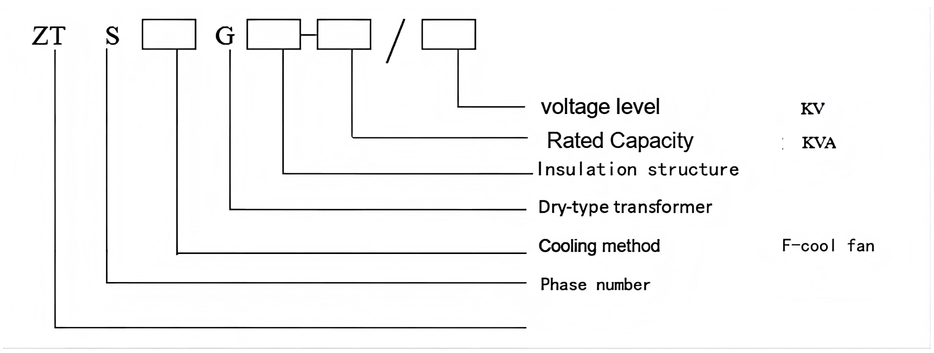
Before installing, commissioning and using the equipment, be sure to read the complete instruction manual.

9.1.1 Uses

At present, the company produces two series of H-class dry-type rectifier transformers for frequency conversion speed regulation: ZTSFG series of dry-type rectifier transformers for domestic inverters and ZPSG series of dry-type rectifier transformers for foreign inverters, all of which are non-encapsulated structures, the heat resistance level of insulating materials is H class, and the coil turn insulation is made of NOMEX paper, and the voltage level is 20kV and below, which are widely used in frequency conversion speed regulation devices for water plants, power plants, metallurgy and petrochemicals.

9.1.2 Model Description

9.1.2.1. Dry-type rectifier transformer for domestic inverter is generally expressed as follows:

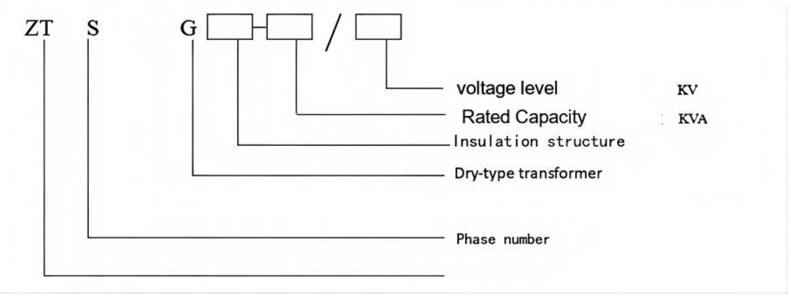


Example: a. ZTSGN-500/6: 500KVA/6KV H-class three-phase dry-type frequency conversion speed regulation rectifier transformer,

b.ZTSFGN-1000/10: 1000KVA/10KV H-class three-phase air-cooled dry-type rectifier transformer for frequency conversion speed regulation, H-class insulation with NOMEX

Paper insulates the turns of the coil.

9.1.2.2. Dry-type rectifier transformer for foreign inverter is generally expressed as follows:



Example: ZPSG-1000/10: 1000KVA/10KV H-class three-phase air-cooled dry frequency conversion speed regulation rectifier transformer, our company's H-class insulation is insulated with NOMEX paper as the turn of the coil.

9.1.3 Conditions of Normal Use

● The altitude does not exceed 1000 meters;

● Ambient temperature:

- maximum temperature +40 ° C
- Maximum average daily temperature +30°C
- Maximum average annual temperature +20°C
- Minimum temperature -5°C (for indoor transformers)

● The ambient air does not contain harmful gases or dust that corrode and destroy the insulation, and the transformer shall not be soaked by water, rain and snow during use;

● The power supply voltage waveform is approximately similar to the sine wave, and the power supply voltage connected to the multi-phase transformer should be approximately symmetrical;

● The protective shell with shutters is more than 1 meter away from the object to ensure good ventilation;

9.1.4 Transportation and Storage

● The H-class dry-type rectifier transformer for frequency conversion speed regulation should have rainproof and moisture-proof measures during transportation, and the factory information should be properly packaged to prevent moisture;

● H-class dry-type frequency conversion speed regulation rectifier transformer should not have serious shock and vibration during loading, unloading and transportation;

● After the H-class dry-type rectifier transformer for frequency conversion speed regulation arrives at the site, the appearance inspection should be carried out in time to check whether there is mechanical damage, whether the accessories are complete, and whether it leaves the factory

Whether the information is protected from moisture, rain and moisture protection is in good condition.

● After the H-class dry-type rectifier transformer for frequency conversion speed regulation arrives at the site, it should be installed in place in time, and if it cannot be installed in time, it should be stored and kept indoors

Take effective measures to prevent rain and moisture.

9.1.5 General Inspection Before Installation

● After the H-class dry-type rectifier transformer for frequency conversion speed regulation is transported and stored for a long distance, the user must conduct a comprehensive visual inspection. Inspect and remove all parts of the transformer

Whether there are foreign objects in the air duct between the core and the coil, and whether all fasteners are loose. After the inspection, the dust is cleaned with dry compressed air, and the fasteners are loose

Need to be tightened.

● Core inspection

- The core should be free of deformation, and the insulation between the yoke and the clamp should be good;
- The iron core should not be grounded at multiple points;

If necessary, the clamp and the iron yoke grounding piece can be further opened, and the insulation resistance of the iron core to the ground should be measured with a 2500V megohmmeter ≥5MΩ, and the core screw and the iron

The insulation resistance between the core and the clamp should be ≥ 100MΩ;

● Winding inspection

- The winding insulation layer should be intact, without damage, dislocation and deformation;
- Each winding should be arranged neatly and the gap should be even;
- The upper and lower yoke cushion blocks of the winding should be tightened, and the fastening nut should be locked;

● The insulation and wrapping of the lead wire is firm, and there is no damage, displacement, breakage and twisting; The lead wire is fixed firmly, and its fixing bracket should be tightened, and the lead wire is insulated

The seat should be intact;

● The connection between the non-excitation voltage regulating terminal board or each tap of the device and the coil should be correct and tightened, and the contact position or rotating contact should stay in each position correctly

and is consistent with the position indicated by the sign or indicator;

● Class H dry-type frequency conversion speed regulation rectifier transformer should be used to measure the insulation resistance of the coil to the ground using a 2500V megohmmeter when it is not wired with the outside, and if it is lower than the minimum allowable insulation resistance value listed in the following table, corresponding drying measures can be taken with reference to the appendix for drying treatment.

Coil voltage level (kV)		0.4			3.0			6.0			10			20		
Factory test	Test conditions	Room temperature 10-40°C, humidity <85%														
	Insulation Resistance (MΩ)	≥50			≥100			≥200			≥300			≥500		
Field trials	Humidity (%)	≤85														
	Temperature (°C)	5	15	25	5	15	25	5	15	25	5	15	25	5	15	25
	Insulation Resistance (MΩ)	11.5	7.5	5.0	45	30	20	68	45	30	90	60	40	225	75	50

9.1.6 H-class dry-type frequency conversion speed regulation rectifier transformer and accessories installation

9.1.6.1 The transformer is installed smoothly and the base foot bolts are tightened; If there are rollers, their wheel base should be matched with the track gauge, and they should be fixed with a braking device after being in place.

9.1.6.2 Installation of the fan: Install the fan according to the requirements of the operating manual of the cooling fan, and distinguish between the side blowing fan and the top blowing fan. Fans are generally installed in transformers

On the underside of the presser body, (sometimes a fan is installed on the top of the cover to pump hot air through and out), it should be pressed by a side blowing fan or a top blowing fan

The best location map is installed, and the air flow is divided into core heat dissipation air duct, low-voltage coil air duct, high and low voltage coil air duct and high-voltage coil air duct according to the rotation direction of the fan. pick up

The input power supply voltage and phase number should be consistent with the rated voltage and phase number of the fan. Fans on the same transformer are connected in parallel to the thermostat. Larger capacity fans

An intermediate relay should be installed. After the initial installation of the fan, it should be energized and put into trial operation to check whether the wiring is correct, whether the steering is consistent with the mark of the fan, and whether the air flow is corresponding

The heat dissipation airway, whether the three phases are uniform. The insulation resistance of the fan shall not be less than 0.5MΩ. In order to prevent foreign objects from falling into the fan impeller during installation, our company is out

There is protective paper in front of the factory, please uncover the protective paper before the equipment is installed and commissioned.

9.1.6.3 Thermostat installation: (Note: When the transformer is running, the temperature control power supply must be ensured to be normal, otherwise the transformer may burn out!))

Install and debug in strict accordance with the instruction manual of the thermostat. The H class adopts three heat shrinkable sleeves with an inner diameter of Φ11 and is fixed at the upper end of the airway of the high and low pressure coils

Division. The sensing cable is installed in the wiring epoxy tube of the upper clamp, and three platinum thermal resistance PT100s are inserted into the tube respectively, and the three-phase insertion depth is the same (the insertion depth is based on

Before installation and operation, it is necessary to confirm that the temperature measuring probe needs to be inserted into the temperature control tube file; The external wiring of the thermostat needs to correspond to the wiring identification of the back cover:

Control fan start and stop, over-temperature alarm, over-temperature tripping, fault alarm, after the wiring is completed, it is necessary to power on to check the corresponding contact, whether the action is correct.

9.1.6.4 The wiring of the thermostat and the cooling fan shall be carried out in accordance with the requirements of the installation standard of low-voltage electrical installations.

9.1.6.5 Grounding: The transformer and its housing, fan and temperature controller must be reliably grounded. Requires a ground resistance of ≤ 2Ω.

9.1.6.6 It is recommended to send power from the primary side for no-load operation of the transformer, and it is not recommended to send power from the 380V winding on the secondary side, which may cause overheating damage to the 380V winding.

9.1.7 Acceptance test and trial operation of H-class dry-type rectifier transformer for frequency conversion speed regulation

9.1.7.1 Acceptance test items and their standards; Click on the table:

	Pilot project	Scope of application		Quality characteristics requirements and permissible deviations						remark
1	DC resistance of the windings	Capacity (kVA)		Imbalance rate						
				phase			line			
		Distribution ≤ 2500 power transformer ≥ 630		≤4% ≤2% Midpoint lead)			≤2% ≤2% (Midpoint not lead)			
		Rectifier and converter transformers		There are no regulations, only the measured values of the factory are provided						
2	Coupling group designators	All transformers		Conform to the nameplate						
3	The core is grounded	All transformers		must be only one point of grounding						10-40°C humidity ≤ 85%
	Iron core insulation resistance	All transformers		2500V megohmmeter lasts for 1 min, and there should be no flashover and breakdown						
4	Insulation resistance	Disconnect the external wiring		kV	1	3	6	10	20	25℃ humidity ≤85%
				MΩ/2500V	5	20	30	40	50	
					R2=R1×1.5 (t1-t2) /10					
5	Transformer ratio	Distribution transformer power transformer		Rated tap ≤±0.5% or ≤ measured impedance ±10%						
		Rectifier converter transformers	DC voltage <250V	By technical agreement						By technical agreement
			DC voltage 250V	Rated tap ≤±1%						
6	Check the voltage regulation switching device and experiments	No excitation voltage regulating transformer	Terminal block type	The gear is in accordance with the nameplate and the connection is reliable						
			Tap-changers	The rotation is flexible, and the gear position is consistent with the indication sign						
7	AC withstand voltage (disconnect external wiring, unplug temperature probe)	Distribution transformer, power transformer		Voltage level kV	≤1	3	6	10	15	No breakdown or flashover
				Withstand voltage kV/1min	2.6	8.5	17	24	32	
8	Check phase	All transformers		The primary side is in phase with the grid						
				The secondary side is consistent with the user's design requirements						

9.1.7.2 Inspection prior to commissioning

A comprehensive inspection should be carried out to confirm whether the transformer meets the following 8 trial operation conditions:

- The body and cooling device, all accessories should be fully installed and free of defects;
- There shall be no metallic or non-metallic foreign matter left on the transformer body;
- The tap position should meet the voltage and operation requirements of the on-site power grid, and the nuts of each tap should be tightened and fastened with lock nuts;
- The phase and wiring group of the transformer should meet the operation requirements, and the wiring sequence and phase sequence identification should be in accordance with the requirements;
- The connection of the grounding lead and its grounding grid should meet the design requirements and be grounded reliably;
- the indication of the temperature measuring device is correct and the setting value meets the requirements (see clause 9.1.8.3);

- The fan is connected correctly (see clause 9.1.6.2) and the test operation is normal;

- The transformer handover test items are all qualified, the protection setting value meets the regulations, and the operation and linkage test are correct.

9.1.7.3 The size of the inrush current of the transformer under the no-load rated voltage depends on the phase of the line voltage and the state of the residual flux of the core when the transformer is put into the transformer, which can reach 10-12 times of the rated current value, and its value is attenuated after a few cycles to a few seconds, so the inrush current does not have much harm to the transformer, but if the corresponding measures are not taken, it may cause the transformer to overcurrent or differential and other protection malfunctions, so it should be noted that the phase excitation surge should be paid attention to when the transformer is operated Disconnect the secondary side wiring and perform 5 impact closures at the rated voltage, not less than 10 min after the first power supply, and every 5 min thereafter. The transformer should be abnormal, and the excitation inrush current should not cause the malfunction of the protection device;

9.1.7.4 After the rectifier transformer for H-class dry-type frequency conversion speed regulation passes the five times of impact closing, the no-load operation for 30 min without abnormality can be gradually loaded until the rated load, and the continuous operation is 24 hours. If there is no abnormality, the trial run will end here; The transformer equipment can be put into formal operation after handover and acceptance in accordance with relevant regulations.

9.1.8 The operation of H-class dry-type rectifier transformer for frequency conversion speed regulation and the problems that should be paid attention to in operation

9.1.8.1 The operation of Class H dry-type rectifier transformer for frequency conversion speed regulation shall be in accordance with DL/T572-2010 "Power Transformer Operation Regulations" and GB/

T17211-1998 "Load Guidelines for Dry-type Power Transformers";

9.1.8.2 Excitation inrush current when no-load closing

The peak flow IP should be converted to the effective value of the phase-excited inrush current

$$I\Phi = \frac{0.6}{J_2} ip(A)。$$

9.1.8.3 According to the temperature level of the insulating material, the temperature rise limit of the winding of class B, F and H is as follows:

Temperature rating	Class B	Class F	Class H
maximum permissible temperature of the insulating material is oC	130	155	180
Winding temperature rise limit	80	100	125

Under normal conditions of use, the coil temperature rise of the transformer should not exceed the limit value in the table (resistance method). Since the PT thermal resistance of the dry variable temperature controller is inserted into the protective tube of the upper part of the airway, and the temperature shown is the temperature of the airway, generally it is about 30 °C less than the actual temperature of the coil, the user should alarm and trip according to the specific environmental conditions and operation specifications, and select the appropriate setting value, which can also refer to the following table:

Temperature °C (airway temperature)	Over-temperature alarm °C	Over-temperature tripping °C
Class H	110	130

9.1.8.4 During the operation of the transformer, it should be monitored and inspected frequently

- Monitor the sound and temperature of the transformer when it is running;

- Monitor and check the appearance of coils, cores and sealing wires for damage and discoloration; dust accumulation and dirtiness;

- Monitor whether the air-cooling device, tap-changer and temperature measuring device are in normal condition;

- Be sure to prevent water droplets from dripping on the transformer, and should prevent the direct ray circle of sunlight; The operation duty record of the transformer should be made.

- The operation duty record of the transformer should be made.

9.1.9 Regular maintenance of H-class dry-type rectifier transformer for frequency conversion speed regulation

9.1.9.1 For regular maintenance, please refer to DL/T 596-2005 "Preventive Test Regulations for Power Equipment";

9.1.9.2 H-class dry-type frequency conversion speed regulation rectifier transformer according to the on-site operating environment (the site operating conditions are harsh, should be maintained once every six months, normal loop

environmental operating conditions shall not exceed one year) shall be in the power outage for the maintenance of the following corresponding items:

- Inspect all fasteners of coils, cores, sealing wires, tap terminals and various parts of the coil, deformation, discoloration, loosening, overheating and corrosion

erosion; If there is an abnormality, the cause should be identified and necessary measures should be taken;

- Turn on the top fan and use dry compressed air to remove the dust on the transformer and the box, and pull it out of the box, or wipe it with a cotton dry cloth

use volatile detergents;

- Remove dust from the external and internal impellers of the fan and check for replenishment or replacement of bearing grease;

- Unloaded or on-load tap-changers can be inspected and maintained according to the provisions of their operating instructions;

9.1.9.3 Each inspection and maintenance of the transformer must be tested for each insulation resistance, and the value of the tested insulation resistance shall not be lower than that described in this instruction manual

According to the provisions of Article 5.6, when the insulation resistance value meets the requirements, the H-class dry-type rectifier transformer for frequency conversion speed regulation can have the conditions for re-operation;

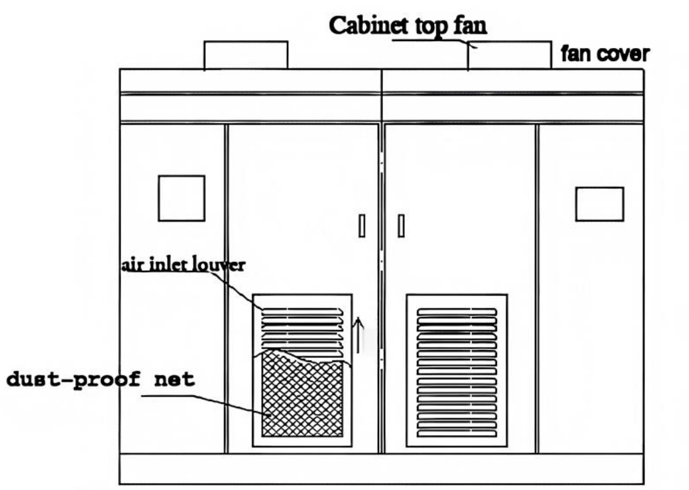
9.1.9.4 There is a dust net in the air inlet shutter of the transformer, and the dust net should be checked regularly according to the operating environment of the equipment (A3 paper or newspaper should be used at the air inlet each time

The paper is placed on the air inlet shutter, if the paper can be strongly adsorbed on the shutter air inlet, it is qualified, if it can not be adsorbed or the adsorption is weak, it means the dust net

There is a blockage) and clean, and the cleaned dust filter should be installed after drying; Every time you check the air inlet, you should also check the air outlet of the cabinet top fan to prevent it

The air outlet is blocked, and the hot air in the cabinet cannot be circulated, resulting in the transformer being unable to dissipate heat.

The shutter removal is shown in the figure below:



Instructions:

1, Lift the shutter as shown in the diagram to remove it;

2, Then, simply move the dustproof net upwards to remove it;

3, According to transformers with different parameters, there are 1-3 roof fans (please refer to the packing list);

9.1.10 Appendix

H-class dry-type dry-type frequency conversion speed regulation rectifier transformer is dried after moisture.

9.1.10.1 Selection of drying method: According to the moisture condition of transformer insulation and site conditions, infrared lamp, oven, hot air, short circuit and other methods can be used

For drying, the specific use method can be referred to as follows:

- Infrared lamp drying method: high-power infrared lamp is used around and on top of the transformer;
- Oven drying method: suitable for small capacity H-class dry frequency conversion speed regulation rectifier transformer, it is hoisted into the oven, the temperature of the oven is controlled ≤ 100 °C, and the oven temperature is controlled

The inside of the oven is dried for 3~4 hours, the oven is exhausted for 10 minutes every 50 minutes, and the insulation resistance is measured after the drying is completed and the transformer is naturally cooled;

- Hot air drying method: according to the size of the H-class dry frequency conversion speed regulation rectifier transformer, the drying room is built with a wall plate, and the inner surface of the wall plate is covered with asbestos board or its impregnation

over the fireproof solution of the canvas linen or asbestos cloth. The transformer is hoisted into it, and the distance between it and the periphery is not less than 200mm, and it can be heated by an electric furnace or a steam serpentine tube

The volume of hot air passing through the drying chamber is 1.5× the volume of the drying chamber is m3/min, and the hot air not exceeding 100 °C blows upwards from the bottom of the body, and the moisture is released from the upper vent.

- Low-voltage winding short-circuit heating method: low-voltage winding short-circuit, the generator set or transfer voltage regulator is used to supply power to the high-voltage winding from zero to maintain the high-voltage winding

The current is equal to the rated current until drying;

9.1.10.2 Temperature control in drying: When drying, platinum resistance thermometers must be installed in each part of the transformer for monitoring. Pay attention to the heating even

Homogeneous, the heating rate is 10-15 °C/h. The windings, in particular, should not exceed the maximum permissible temperature of their insulation class. Class B insulated transformer, its airway temperature

It should not exceed 80 °C, and H class should not exceed 100 °C. Measure the temperature of each part of the high and low coil every 1 hour;

9.1.10.3 Judgment of drying end: After the drying of the transformer is completed, the transformer is naturally cooled to room temperature and then the insulation resistance test is carried out every 1 hour

When the insulation resistance is measured, and there is no obvious difference in the insulation resistance value for 3 consecutive measurements, the insulation resistance value in accordance with the factory test report is qualified;

9.1.10.4 When drying the transformer, fire safety measures should be taken in advance to prevent the heating system from failing or overheating the winding and burning the transformer;

9.1.10.5 The body of the transformer after drying shall be inspected, all electrical connection bolts and fastening parts shall not be loose, and the insulating surface shall not be overheated

Often.

9.2 LD-B10-10 Series Dry-type Transformer Temperature Controller Instructions

9.2.1 General

LD-B10-10 series dry-type transformer temperature controller (referred to as thermostat) is an intelligent controller specially designed for the safe operation of dry-type transformer. The temperature

The controller adopts single-chip microcomputer technology, and uses three platinum thermal resistors embedded in the three-phase winding of the dry-type transformer to detect and display the temperature rise of the transformer winding

The start-stop cooling fan forces air cooling on the winding, and can control the over-temperature alarm and over-temperature trip output to ensure that the transformer runs in a safe state.

9.2.2 Technical Indicators

● Measuring range: -30.0°C~240.0°C

● Measurement accuracy:

- Accuracy class 1 (0.5 for thermostat, B for sensor);

- Resolution: 0.1°C

● Conditions of use:

- Ambient temperature -20°C~+55°C

- Relative humidity < 95% (25°C)

- Supply voltage AC220V (+10%, -15%)

- Power Frequency: 50Hz or 60Hz (±2Hz)

- Thermostat power consumption: ≤8W
- Executive standard:

- Production standard: JB/T7631-2005
- Certifications: ISO9001: 2008 International Quality Management System Certification
- Passed the test: IEC61000-4:2002 International Standard
- GB/T17626-2008 "Electromagnetic Compatibility Test and Measurement Technology" standard

- Relay contact output: fan contact capacity: 10A/250VAC

- Control output capacity: 5A/250VAC; 5A/30VDC (resistive)

- The lead wire of Pt100 sensor adopts three-wire system, and its probe size is Φ3mm×30mm or Φ4mm×40mm
- Thermostat size: 80mm×160mm×100mm (height×width×depth)

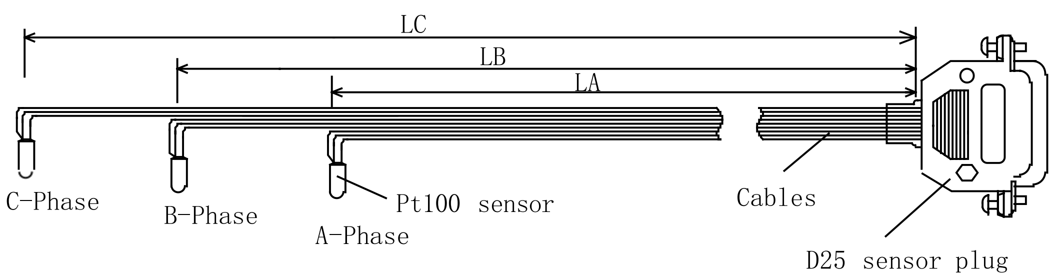
- Insert cut-out size: 76+1mm×152+1mm (H×W)

9.2.3 Classification of functions and models

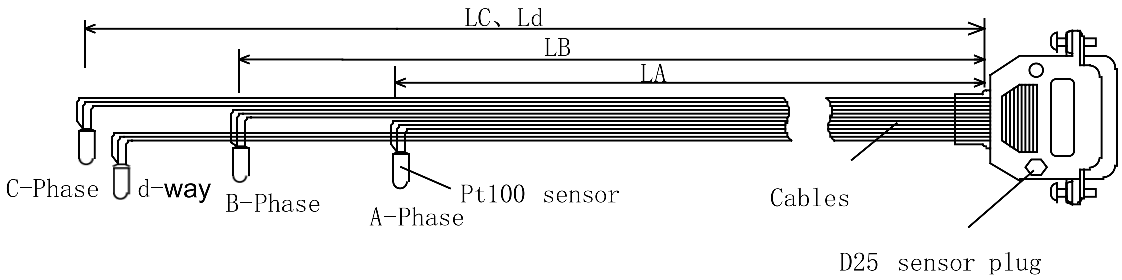
Model	Function
LD-B10-10D (Normal type)	3-phase circuit measurement; Three-phase circuit display/maximum value display and two functions can be switched between each other; Input open circuit and fault self-test display and output; Automatic start and stop output of cooling fan; Over-temperature alarm display and output; Over-temperature trip display and output; The fan manually and automatically controls two status displays, outputs and mutual switching; Digital compensation of the display value of each channel; "Black Box" function; Fan timing start and stop control function; Output status detection.
LD-B10-10E	Same as LD-B10-10D type, add three independent 4~20mA analog current outputs.
LD-B10-10F	Same as LD-B10-10D, RS-485/232 serial communication function is added.
LD-B10-10G	Same as LD-B10-10D, add a computer room ambient temperature measurement and control.
LD-B10-10I	Same as LD-B10-10D, add a transformer core temperature measurement and alarm.
LD-B10-10*P	Same as LD-B10-10*, the fan control output is changed to active output.

9.2.4 Sensing cable assembly

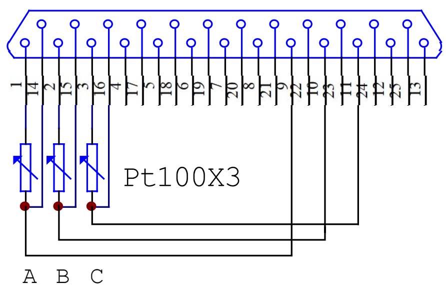
9.2.4.1 D25 sensor cable (3-wire)



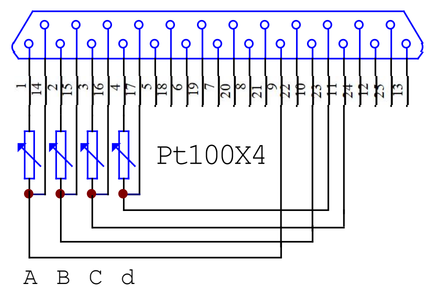
Schematic diagram of D/E/F type 3-way cable connection



Schematic diagram of G/I type four-way cable connection



Schematic diagram of the internal diagram of the 3-way plug type D/E/F



Schematic diagram of the inside of the G/I 4-way plug

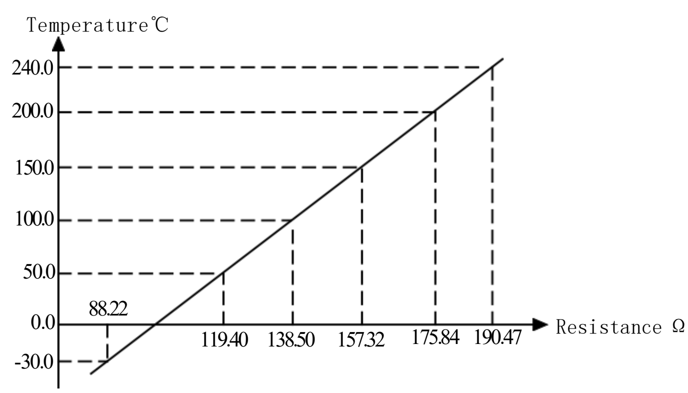
9.2.4.2 Sensors

● Pt100 platinum resistance is a kind of thermal resistance with good linearity in the range of -30.0°C~240.0°C, which conforms to GB/T8622-97 "Industrial Platinum Resistance Technology".

Conditions and Grading Table" Level B Requirements.

● Dimensions: Φ3mm×30mm or Φ4mm×40mm

● Corresponding curve of resistance and temperature of Pt100 platinum resistance:



9.2.5 Display & Buttons

9.2.5.1 Display of the working status of the thermostat (taking the conventional D-type thermostat as an example)

● After the thermostat is powered on, it will first enter the "Power-on Self-Test" state, and the panel will be displayed as follows:

PV LEAd

SV -b10

After 6 seconds, the thermostat automatically turns to normal working state. If the input wiring is correct, the thermostat measurement loop itself is not faulty, and the PV and SV are displayed separately

Quantities and measurement winding phase sequences. If the thermostat is required to self-test, you can press the reset button.

● If the thermostat measuring loop is wired incorrectly, the PV flashes -Er- and the fault relay J5 is closed.

● If the thermostat measuring circuit is open, the PV flashes –OP- and the fault relay J5 is closed.

● If the input signal is outside the thermostat measurement range:

When the upper limit is exceeded, the PV flashes -OH-, and the fault relay J5 is closed.

When the lower limit is exceeded, the PV flashes –OL- , and the fault relay J5 is closed.

● Fan operation: the green indicator light is on, and the fan control relay J3 is closed.

● Over-temperature alarm: the yellow indicator light is on, and the over-temperature alarm relay J2 is closed.

● Over-temperature tripping: PV flashes to display the temperature value, and the over-temperature tripping relay J1 is closed.

● SV display value meaning:

SV	Thermostat working status	Remarks
PH X	3-phase circuit display status, temperature of 3-phase winding is lower than alarm	X, X' are phases A, b, C, (d circuit) X: Refers to the phase sequence being measured X': refers to the overtemperature phase sequence
X′ X	The X' phase in the three-phase winding is overheated.	
HH X	temperature of 3-phase winding is normal, and fan is in the manual starting state.	
HX′ X	The fan is in the manual start state, and the X' phase is over-temperature.	
UU X	The thermostat displays the status at the maximum value.	
HU X	The thermostat shows status at the maximum value , and the fan is in the manual start-up state.	

9.2.5.2 Key Functions

Key	Function
SET	In the normal working state, press the button, the temperature control will be transferred to the parameter setting state, and the key will be pressed to enter the next step during the setting process.
▵	In the setting state, press the key once, the displayed parameter value will increase by 1, and hold the key to quickly increase the number. Under normal working conditions, press this button to switch the fan to be in manual control or automatic control state.
▿	In the setting state, press the key once, the displayed parameter value will be reduced by 1, and the key can be quickly subtracted by holding the key. Under normal working conditions, press this button to switch the thermostat to be in the maximum value display or the patrol display of each phase.

Note: During the key operation, if you do not press any key, the thermostat will automatically return to normal working state after about 100 seconds, and the setting will be invalid.

9.2.6 Parameter Settings

9.2.6.1 "Black Box" Function

Enter the operation state of this function, and you can check the temperature value of each phase winding at the moment before the power failure.

step	show / key	PV	SV	illustrate	note
1	SET	-Cd-	1000		
2	△or▽	-Cd-	1002	Enter black box operation password	
3	SET	xxx.x	EE A	Temperature value of phase A winding at power off	Press the "SET" key to go back Normal working condition. Note: This step is only available for Type G/I
4	△	xxx.x	EE b	Temperature value of phase B winding at power off	
5	△	xxx.x	EE C	Temperature value of phase C winding at power off	
6	△	xxx.x	EE d	Temperature value of phase A winding at power off	
7	SET	The thermostat exits the black box function operation state and returns to the normal working state.			

9.2.6.2 Cooling fan excitation (fan timing start and stop) function

step	show / key	PV	SV	illustrate	note
1	SET	-Cd-	1000		
2	△or▽	-Cd-	1003	Enter the password for the timed start and stop of the fan	password should be correctly
3	SET	-00-	xxx	Set the start-stop interval of the front fan	
4	△or▽	-00-	xxx	Set the start-stop interval of the back fan	
5	SET	The thermostat exits the fan timing start and stop function and returns to normal working state.			

Note: The time interval unit is hours, and the setting range is 0~150. The automatic running time of the fan has been set by the software to 2 minutes each time, which cannot be modified by the user.

For example, if it is set to 0, it means that the fan does not have a timed start and stop function; If it is set to 24, the fan will automatically start and stop every 24 hours, and the user can choose according to the actual situation

to set the interval.

9.2.6.3 Parameter setting steps (the parameters shown in the table are reference values, and the specific setting values are subject to the factory label of the product)

- The operation process of LD-B10-10D/E/F thermostat:

step	show / key	PV	SV	illustrate	note	
1	SET	-Cd-	1000			
2	△or▽	-Cd-	1005	Enter the parameter setting password 1005	password should be correctly	
3	SET	-Ob-	90.0	The target starting temperature of the fan is set at 90.0oC.	Set the range -30.0～240.0	All △ ▽ or parameter keys can be modified
4	SET	-dF-	10.0	The fan start-up differential value set at the factory is 10.0°C.	Set the range 0.0～15.0	
5	SET	-AH-	150.0	Default value is 150.0°C for over-temperature tripping temperature and 0.3°C for backtime.	Set the range -30.0～240.0	
6	SET	-AL-	130.0	The default value of the over-temperature alarm temperature is 130.0°C, and the back-difference value is 0.3°C.	Set the range -30.0～240.0	
7	SET	After confirming the modified parameter value, the thermostat exits the parameter setting state and returns to the normal working state.				

Note: If Ob=90.0 dF=10.0, that is, the fan starting temperature > 90.0+10.0=100.0°C and the fan turning off temperature < 90.0-10.0=80.0°C

- The operation process of LD-B10-10G thermostat:

step	show / key	PV	SV	illustrate	note	
⋮	Connect 10.2.6.3 LD-B10-10D/E/F thermostat operation process steps 1~6					
7	SET	-ObJ	35.0	Set the target value of the fan in the computer room to 35.0°C at the factory.	Set the range -30.0 ~ 240.0	All ▵ ▿ or parameter keys can be modified
8	SET	-dFJ	2.5	Set the starting return value of the fan in the computer room to 2.5°C at the factory.	Set the range 0.0 ~ 15.0	
9	SET	-AHJ	70.0	The over-temperature tripping temperature value of the computer room is set to 70°C and the return difference value is 0.3°C.	Set the range -30.0 ~ 240.0	
10	SET	After confirming the modified parameter value, the thermostat exits the parameter setting state and returns to the normal working state.				

Note:
(1) If ObJ=35.0 dFJ=2.5, the starting temperature of the fan in the computer room > 35.0+2.5=37.5°C and the temperature of the fan in the computer room < 35.0-2.5=32.5°C
(2) The over-temperature tripping of the computer room and the over-temperature tripping of the winding share the same contact, please carefully change the temperature value of the equipment room tripping (AHJ).

- The operation process of LD-B10-10| thermostat:

step	show / key	PV	SV	illustrate	note	
⋮	Connect 10.2.6.3 LD-B10-10D/E/F thermostat operation process steps 1~6					
7	SET	-ALJ	130.0	The default core over temperature alarm temperature value is 130.0°C, and the return difference value is 0.3°C.	Set the range -30.0 ~ 240.0	▵ ▿ keys can be modified
8	SET	After confirming the modified parameter value, the thermostat exits the parameter setting state and returns to the normal working state.				

9.2.6.4 Steps for setting the digital compensation value of the thermostat

step	show / key	PV	SV	illustrate	note
1	SET	-Cd-	1000		
2	▵ or ▿	-Cd-	1008	Enter the password for setting the value compensation	The password should be entered correctly
3	SET	Phase A temperature value	A 0.0	Enter the setting state of phase A compensation value, and the original phase A compensation value is 0.0°C	The compensation value can be set as positive compensation or negative compensation, and the setting range is 0.0°C~ ±19.9°C. Note: Only the G/I type has a d circuit.
4	▵ or ▿	Displayed after phase A compensation	A 1.5	Set phase A compensation to 1.5°C	
5	Follow steps 3 and 4 to set the compensation values for phases B and C and path d				
6	SET	After confirming the set compensation value, the thermostat exits the compensation value setting state and returns to the normal working state.			

Note: When you press the SET button to switch to another phase, you need to wait and make adjustments.

9.2.6.5 Output Status Detection Procedure

The temperature change can be measured by digital setting, and the output status of the thermostat and the corresponding contacts can be detected.

step	show / key	PV	SV	illustrate	note
1	SET	-Cd-	1000		
2	△or▽	-Cd-	1012	input/output function detects password	password should correct
3	SET	-30.0	EE A	starting temperature is -30.0oC	
4	△	100.1	EE A	Exceeding the fan starting temperature	fan is output and light on
5	△	130.4	EE A	Exceeding over-temperature alarm temperature	alarm is output and light on
6	△	240.1	EE A	Out of the measurement range	fault is output and light on
7	▽	240.0	EE A	Into of the measurement range	fault is disconnect and light off
8	▽	129.6	EE A	Below the over-temperature alarm temperature	alarm is disconnect and light off
9	▽	79.9	EE A	Below the fan stop temperature	fan is disconnect and light off
10	SET	The thermostat exits the output function detection state and returns to the normal working state.			

Note:
(1) In order to avoid mis-tripping of transformer, the software does not support simulated over-temperature tripping function!
(2) The G/I thermostat does not have an analog fault output function.
(3) The actual operating temperature point is subject to the internal parameters of temperature control (1005 function setting).

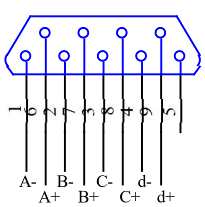
9.2.7 DC4~20mA current output type (E type)

9.2.7.1 Features

On the basis of the general-purpose function, the output of independent 3 channels (4 channels) 4~20mA current signal with a linear correspondence with the detected temperature value can be directly output

It is connected to a remote A/D card to form a distributed monitoring system (DCS).

9.2.7.2 Schematic diagram of current output socket



A+, A- correspond to the current output of the temperature of the transformer's phase A coil

B+, B- correspond to the current output of the transformer's B-phase coil temperature

C+, C- correspond to the current output of the C-phase coil temperature of the transformer

D+ and D- correspond to the current output terminal of the D channel temperature

Inside the thermostat, A+, B+, C+, and d+ are connected, that is, the common cathode, if the user's acquisition system contradicts it, please say it before ordering

Bright. We usually provide 3 phase winding temperature and current output, if the user needs to add D channel temperature current output, please explain before ordering.

9.2.7.3 Technical requirements for current output

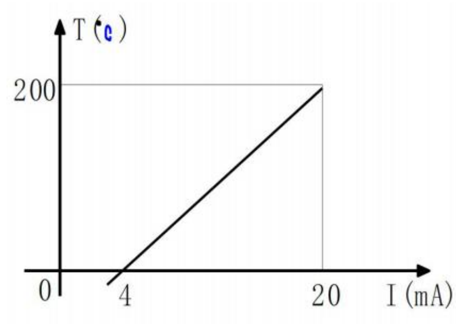
● Maximum load resistance R≤500Ω;

output accuracy; ±1%

● The corresponding curve and relationship between the temperature measured by the thermostat and the output current:

The relationship between temperature and current is I=(16T/200)+4

Wherein: T is the temperature value of a phase coil (°C) I is the current value corresponding to the temperature of the phase (mA)



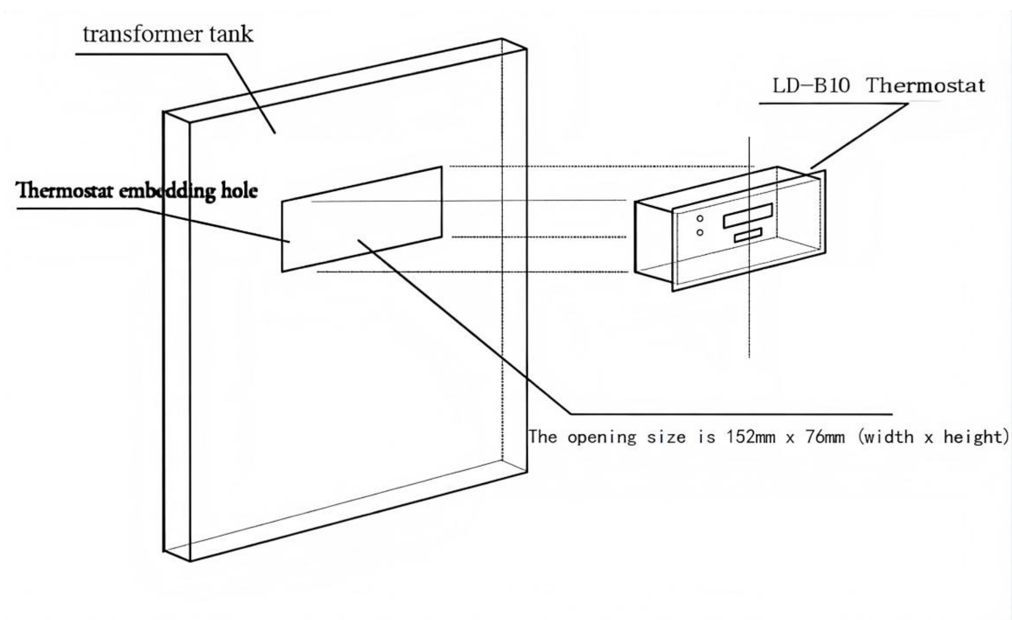
Output conversion

If the user's acquisition system requires receiving analog voltage signals, it can directly connect the high-precision 250Ω resistor at the existing current output terminal to obtain a voltage signal of 1~5V and access the load resistor R≥20KΩ.

9.2.8 RS485 communication type (F type)

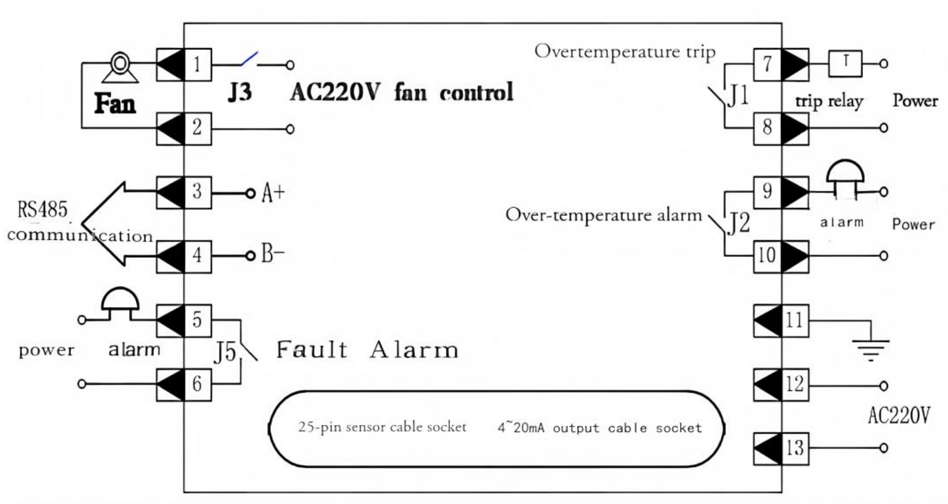
Please refer to the Statement of Communication Protocol (attached).

9.2.9 Thermostat installation diagram (in mm)

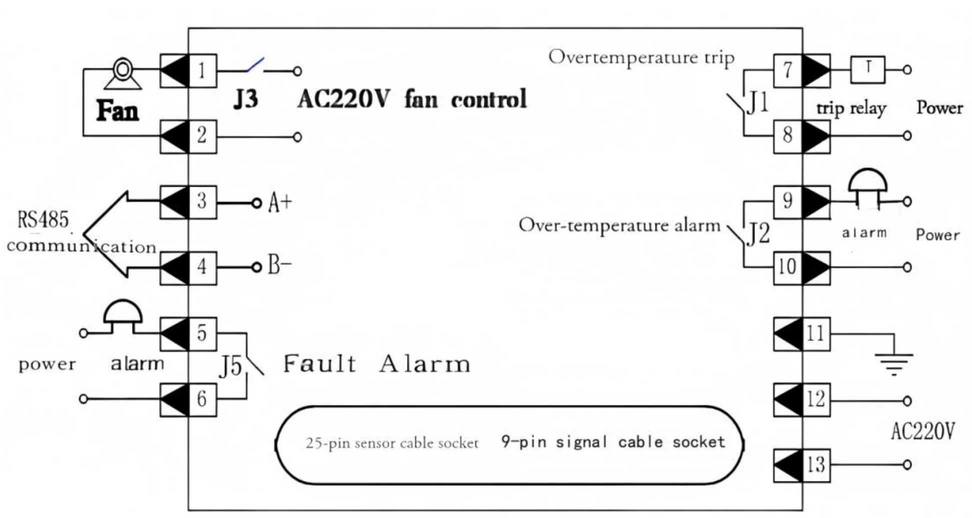


9.2.10 Wiring diagram

9.2.10.1 LD-B10-10DP/EP/FP rear cover terminal wiring diagram
(Note: 10DP does not have 9-core signal cable socket)



9.2.10.2 LD-B10-10EFP Back Cover Terminal Wiring Diagram



Chapter 10

Modbus communication protocol

10.1 Basic Principles

YD high-voltage inverter provides RS485 communication interface and supports Modbus communication protocol. Through this protocol interface, the user can use the host computer to read or change the parameters of the frequency converter and check the working status and fault information of the frequency converter, etc., and use the host computer to send the start and stop commands of the frequency converter, control the start and stop of the frequency converter, etc., and realize the centralized control of the industrial site.

Topology: Single-master multi-slave system, slave address is unique, slave address range is 1~247, 0 is broadcast communication address. The master refers to a personal computer or programmable logic controller (PLC), etc., and the slave refers to an inverter. The master can communicate with one slave individually and publish broadcast information to all slaves.

Interface: RS485 hardware interface.
Transmission mode: asynchronous serial half-duplex transmission mode, the master and slave can only send data by one and receive data by the other at the same time.

Data and frame format: the inverter adopts RTU mode, and the data bit is -8; Parity - No checksum; Stop bit -1; Baud rates are available in 2400, 4800, 9600, 19200, 38400bps. RTU data frames, using CRC checks, start with a pause interval of at least 3.5 character times per frame, and after the last transmitted character (CRC check data), a pause of at least 3.5 character times represents the end of the message. If there is a time interval of more than 1.5 characters before the end of the transmission of the entire frame, the receiving device considers the packet frame incomplete and discards the packet frame.

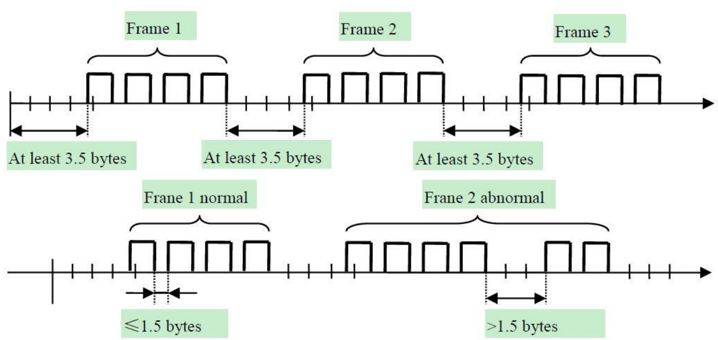


Figure 11.1 Data and frame format

Standard structure of RTU frames:

Name	illustrate
START	T1-T2-T3-T4 (3.5 bytes of transfer time)
ADDR	Address: 0~247 (decimal) (0 is the broadcast address)
CMD Function	03H: read slave parameters; 06H: send slave command; 10H: writes slave parameters
Data Format DATA (N-1) ... DATA (0)	2*N bytes of data, this part is the main content of communication, and it is also the core of data exchange in communication.
CRC L	DETECTION VALUE: CRC CHECK VALUE (16BIT)
CRC H	
END	T1-T2-T3-T4 (3.5 bytes transfer time)

10.2 Packet Structure

Item	name	Number of bytes	range	note
1	Address	1	1～247	Slave address
2	Function code	1	0x03、0x06、0x10	03H、06H、10H
3	datas	2*N	0x00～0xFF	The core content of data exchange
4	CRC	2	0x00～0xFF	CRC check sum
Totals		≤256		

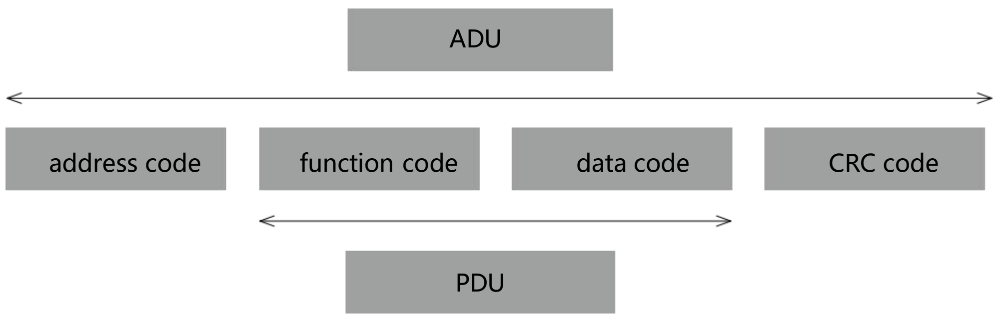


Figure 11.2 Packet structure

10.3 Function Code Definitions

function code	name	illustrate
03H	Read	Reading data from slave registers (parameter setpoints)
06H	Write one	Write a register value to the slave
10H	Write multiple	Write multiple register values to the slave

10.4 Common Function Codes and Answers

10.4.1 Function code 0x03 to read multiple registers host request packets

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x03
Starting address high byte	1	0x00～0xFF
Starting address low byte	1	0x00～0xFF
Number of registers high byte	1	N registers
Number of registers low byte	1	
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

The slave answers the packet

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x03
Number of registers	1	2*N byte
Data of starting address high byte	1	Data of First register
Data of starting address low byte	1	
...	...	...
Data of N Reg address high byte	1	Data of N register
Data of N Reg address low byte	1	
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

*N = Number of registers

Error response

Data content	Number of bytes	illustrate
Function codes	1	0x83
Error codes	1	01 or 02 or 03 or 04

Error code description:

01 The function code is incorrect

02 Start address or (start address + number of registers) error

03 The number of registers is incorrect

04 Read multiple registers error

10.4.2 Function code 0x06, write a single register host request packet

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x06
Address of REG high byte	1	0x00～0xFF
Address of REG low byte	1	0x00～0xFF
Data of REG high byte	1	0x00～0xFF
Data of REG low byte	1	0x00～0xFF
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

The slave answers the packet

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x06
Address of REG high byte	1	0x00～0xFF
Address of REG low byte	1	0x00～0xFF
Data of REG high byte	1	0x00～0xFF
Data of REG low byte	1	0x00～0xFF
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

Error response

Data content	Number of bytes	illustrate
Function codes	1	0x86
Error codes	1	01or 02 or 03 or 04

Error code description:

01The function code is incorrect

02 The register address is incorrect

03 The register value is incorrect

04 Write a single register error

10.4.3 Function code 0x10, write multiple registers from

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x10
First address of REG high byte	1	0x00～0xFF
First address of REG low byte	1	0x00～0xFF
Numbers of REG high byte	1	0x00
Numbers of REG low byte	1	0x01～0x7B（1～123）
Numbers of bytes	1	2×N
Data of First REG high byte	1	0x00～0xFF
Data of First REG low byte	1	0x00～0xFF
...		
Data of N REG high byte	1	0x00～0xFF
Data of N REG low byte	1	0x00～0xFF
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

*N = Number of registers

The slave answers the packet

Data content	Number of bytes	illustrate
Slave address	1	1～247
Function codes	1	0x06
First address of REG high byte	1	0x00～0x81
First address of REG low byte	1	0x00～0xFF
Numbers of REG high byte	1	0x00
Numbers of REG low byte	1	0x01～0x7B（1～123）
CRC low byte	1	Cyclic redundancy code check
CRC high byte	1	

Error response

Data content	Number of bytes	illustrate
Function codes	1	0x90
Error codes	1	01or 02 or 03 or 04

Error code description:

01The function code is incorrect

02 Start address or (start address + number of registers) error

03 The number of registers or bytes is incorrect

04 Write multiple registers error

10.5 CRC Verification (16-bit)

CRC: Cyclic Redundancy Check (CHeck) CRC calculation steps:

(1) XOR polynomial U = 0xA001

(2) Initial value of CRC register V = 0xFFFF

(3) V and the first byte (B0, which is the address code) XOR coexist in V, V = V XOR B0

(4) V shifted one place to the right

(5a) If the outgoing bit is 1, then V = V XOR U, return to step 6

(5b) If the outgoing bit is 0, return to step 6

(6) Repeat steps 4 or 5 to complete 8 shifts

(7) V and the next byte (B1, function code) XOR coexist in V, V = V XOR B1

(8) Repeat steps 4-7 until all bytes in the packet are xor and shifted 8 times.

(9) Register V is the CRC check code, which is attached to the end of the packet, with the low byte in front and the high byte in the back.

10.6 Address Code Definition and Assignment

In order to facilitate the user to control and manage the inverter, all the parameters and operating status variables of the inverter are open to the user, and through the upper control system, the user can view all the parameters and operating status of the inverter. Users can send different function codes and address code messages through the host computer to control the operation of the inverter, obtain the status information of the inverter and set the relevant functional parameters of the inverter.

The address range of Modbus communication packets is 00H~79H.

The address range of 27H~3DH is the functional parameter, and the user can change its parameters, but some functional parameters cannot be changed when the inverter is in the running state; The address range 3EH~63H is the system parameter, the user can change the parameters when the inverter is in standby, and cannot be changed when the inverter is in the running state; To change the parameters, also pay attention to the set range of the parameters.

Inverter control parameter address code assignment table

ID	name	attribute	Register address	PLC address	illustrate
1	Given frequency	R\W	0H	40001	Lowest frequency ~ highest frequency
2	Given parameters	R\W	1H	40002	0-100%
3	Start-stop control	R\W	2H	40003	Start: 00FF; Stop: 0F00

Inverter status address code

<table>
<tr><th>ID</th><th>name</th><th>attribute</th><th>Register address</th><th>PLC address</th><th colspan="5">Parameter description</th></tr>
<tr><td>4</td><td>Feedback</td><td>R</td><td>3H</td><td>40004</td><td colspan="5">0.01%</td></tr>
<tr><td>5</td><td>Operate Frequency</td><td>R</td><td>4H</td><td>40005</td><td colspan="5">0.01Hz</td></tr>
<tr><td>6</td><td>Input voltage</td><td>R</td><td>5H</td><td>40006</td><td colspan="5">1V</td></tr>
<tr><td>7</td><td>Input current</td><td>R</td><td>6H</td><td>40007</td><td colspan="5">0.1A</td></tr>
<tr><td>8</td><td>Input power</td><td>R</td><td>7H</td><td>40008</td><td colspan="5">1kW</td></tr>
<tr><td>9</td><td>Input power factor</td><td>R</td><td>8H</td><td>40009</td><td colspan="5">0.01</td></tr>
<tr><td>10</td><td>Output voltage</td><td>R</td><td>9H</td><td>40010</td><td colspan="5">1V</td></tr>
<tr><td>11</td><td>Output current</td><td>R</td><td>AH</td><td>40011</td><td colspan="5">0.1A</td></tr>
<tr><td>12</td><td>Output power</td><td>R</td><td>BH</td><td>40012</td><td colspan="5">1kW</td></tr>
<tr><td>13</td><td>Output power factor</td><td>R</td><td>CH</td><td>40013</td><td colspan="5">0.01</td></tr>
<tr><td>14</td><td>Motor speed</td><td>R</td><td>DH</td><td>40014</td><td colspan="5">1RPM</td></tr>
<tr><td>15</td><td>Cabinet temperature</td><td>R</td><td>EH</td><td>40015</td><td colspan="5">0.1℃</td></tr>
<tr><td rowspan="10">16</td><td rowspan="10">Inverter status</td><td rowspan="10">R</td><td rowspan="10">FH</td><td rowspan="10">40016</td><td>High bytes</td><td>Run status</td><td colspan="3">High bytes
Operational status
0: The master is initialized
1: The master is ready
2: PLC ready
4: The system is in standby
5: Inverter operation
6: Excitation state
7: Rotating load
8: Shutdown status
10: Fault status
11: Synchronous switching: Switch(Cut) up
12: Synchronous switching: Switch(Cut) down
13: Parameter identification</td></tr>
<tr><td rowspan="9">Low bytes</td><td rowspan="9">System status</td><td>Bit</td><td>0</td><td>1</td></tr>
<tr><td>7</td><td>MPU is fault</td><td>MPU is normal</td></tr>
<tr><td>6</td><td>Lock-in successful</td><td>Lock-in failed</td></tr>
<tr><td>5</td><td>parameter set correct</td><td>parameter set incorrect</td></tr>
<tr><td>4</td><td>interface board ready</td><td>interface board not ready</td></tr>
<tr><td>3</td><td>normal</td><td>system overspeed</td></tr>
<tr><td>2</td><td>normal</td><td>inverter overcurrent</td></tr>
<tr><td>1</td><td>normal</td><td>unit is re-faulted</td></tr>
<tr><td>0</td><td>normal</td><td>High voltage not ready</td></tr>
<tr><td rowspan="17">17</td><td rowspan="17">Heavy fault</td><td rowspan="17">R</td><td rowspan="17">10H</td><td rowspan="17">40017</td><td colspan="2">Bit</td><td>0</td><td colspan="2">1</td></tr>
<tr><td colspan="2">15</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">14</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">13</td><td></td><td colspan="2">Transformer cabinet door faulty</td></tr>
<tr><td colspan="2">12</td><td></td><td colspan="2">Unit door fault</td></tr>
<tr><td colspan="2">11</td><td></td><td colspan="2">The controller can't make</td></tr>
<tr><td colspan="2">10</td><td></td><td colspan="2">High voltage on the debug state</td></tr>
<tr><td colspan="2">9</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">8</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">7</td><td></td><td colspan="2">Unit failure</td></tr>
<tr><td colspan="2">6</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">5</td><td></td><td colspan="2">High voltage power loss</td></tr>
<tr><td colspan="2">4</td><td></td><td colspan="2">The upper limit of motor is over-current</td></tr>
<tr><td colspan="2">3</td><td></td><td colspan="2">inverter is overcurrent</td></tr>
<tr><td colspan="2">2</td><td></td><td colspan="2">unit is overcurrent</td></tr>
<tr><td colspan="2">1</td><td></td><td colspan="2">Transformer overcurrent</td></tr>
<tr><td colspan="2">0</td><td></td><td colspan="2">External faults</td></tr>
</table>

ID	name	attribute	Register address	PLC address	Parameter description			
18	Status Monitoring	R	11H	40018	Bit	0	1	
					15			
					14			
					13			
					12			
					11			
					10		Water cooling failure	
					9		controller does not communicate	
					8		Unit bypass	
					7		Analog feedback drops	
					6		Analog setting drops	
					5		motor is overloaded	
					4		transformer cabinet door opens	
					3		Unit cabinet doors open	
					2		Unit cabinet over-heated	
					1		Transformer over-temperature	
					0		Fan failure	
19	The duration of this run	R	12H	40019	Low bytes: min; High bytes: hours			
20		R	13H	40020	DAY			
21	Cumulative run time	R	14H	40021	Low bytes: min; High bytes: hours			
22		R	15H	40022	DAY			
23	Controller version	R	16H	40023				
24	Interface component version	R	17H	40024				
25	A1B1	R	18H	40025	BYTE	NAME	Mechanical bypass	IGBT bypass
26	C1A2	R	19H	40026	H-BYTE	A1,C1,B2,A3,C3,B4,A5, C5,B6, A7,C7,B8,A8,C9	0: Normal 1: Fuse failure 2: Overheating 3: IGBT failure 4: Fuse failure 5: Fiber uplink 6: Bus overvoltage 7: Fiber downlink	0: Normal 1: Fuse failure 2: Overheating 3: IGBT failure 4: Power failure 5: Under-voltage 6: Over-voltage 7: Fiber faulty
27	B2C2	R	1AH	40027				
28	A3B3	R	1BH	40028				
29	C3A4	R	1CH	40029				
30	B4C4	R	1DH	40030				
31	A5B5	R	1EH	40031				
32	C5A6	R	1FH	40032	L-BYTE	B1,A2,C2,B3, A4,C4,B5,A6, C6,B7,A8,C8,B9		
33	B6C6	R	20H	40033				
34	A7B7	R	21H	40034				
35	C7A8	R	22H	40035				
36	B8C8	R	23H	40036				
37	A8B9	R	24H	40037				
38	C9	R	25H	40038				

Inverter command parameter address code assignment table

ID	name	attribute	Register address	PLC address	Parameter description		
39	Parameter control group	R/W	26H	40039	Bit	0	1
					15		
					14		
					13		
					12		
					11		
					10		
					9		
					8		Upload failed
					7		Download failed
					6		Upload successful
					5		Download successful
					4		Parameter Upload (Pulse Signal)
					3		Parameter Download (Pulse signal)
					2		Factory reset
					1	Factory reset is prohibited	Factory reset allowed
					0	Parameter setting is disabled	Parameter settings allowed

Function parameter address code assignment table

ID	name	attribute	Register address	PLC address	Parameter description			
40	Parameter combination 1	R/W	27H	40040	Bit	name	0	1
					15	Comm. mode	Modbus	Profibus-DP
					14	Door failure selection	Light failures	Heavy failures
					13	Filter cleaning reminder	No reminders	remind
					12	Cooling method	Air-cooled	Water
					11	Frequency switch	forbid	allow
					10	Power on for light faults	forbid	allow
					9	Fan control	Stop	Start
					8	switche given selection	3-stage	7-stage
					7	Remote control mode	forbid	allow
					6	Analog feedback drops	forbid	allow
					5	Remote start-stop mode	pulse	level
					4	Inverter reversal	forbid	allow
					3	Self-start when high voltage	forbid	allow
					2	High-voltage power loss and quick break	forbid	allow
					1	Analog set break	forbid	allow
					0	control mode	Open-loop	Closed-loop
41	Parameter combination 2	R/W	28H	40041	Byte	name	Byte parsing	
					HByte	Given the way	0: Locally given 1: Analog given 2: Switch given 3: Superior given	
					LByte	control mode	0: Local control 1: Superior control 2: Remote control	
42	Analog output	R/W	29H	40042	Byte	name	Byte parsing	
					HByte	Analog output 1	0: Operating Frequency 1: Output current 2: Unit cabinet temperature 3: Excitation current 4: Output power 5: Power factor 6: Output voltage	
					LByte	Analog output 2		

ID	name	attribute	Register address	PLC address	Parameter description		
					byte	name	Byte parsing
43	Modbus paremeter	R/W	2AH	40043	HByte	Modbus addr	1-31
					LByte	Modbus baud rate	0：1200 1：2400 2：4800 3：9600 4：19200 5：38400
44	Jump frequency 1L	R/W	2BH	40044	0~80.00Hz		
45	Jump frequency 1U	R/W	2CH	40045	0~80.00Hz		
46	Jump frequency 2L	R/W	2DH	40046	0~80.00Hz		
47	Jump frequency 2U	R/W	2EH	40047	0~80.00Hz		
48	input voltage coefficient	R/W	2FH	40048	50-200		
49	Switch given 1	R/W	30H	40049	0~80.00Hz		
50	Switch given 2	R/W	31H	40050	0~80.00Hz		
51	Switch given 3	R/W	32H	40051	0~80.00Hz		
52	Loss of power shielding delay	R/W	33H	40052	1.0~100.0s		
53	Min. given current	R/W	34H	40053	0~8.00mA		
54	Max. given current	R/W	35H	40054	10.00~25.00mA		
55	Min. feedback current	R/W	36H	40055	0~8.00mA		
56	Max. feedback current	R/W	37H	40056	10.00~25.00mA		
57	Closed-loop P. factor	R/W	38H	40057	0~50.00		
58	Closed-loop I. time	R/W	39H	40058	0.01~20.00min		
59	Closed-loop d. time	R/W	3AH	40059	0~20.00min		
60	Given freq. resolution	R/W	3BH	40060	0.01-1.00Hz		
61	Timed dust removal time	R/W	3CH	40061	15~30000 day		
62	Ventilator stop time	R/W	3DH	40062	0~30min		
63	Motor para. group selection	R/W	4EH	40079	0: Group 1 1: Group 2 2: Group 3 3: Group 4		

System parameter address code assignment table

ID	name	attribute	Register address	PLC address	Parameter description			
64	Startup frequency	R/W	3EH	40063	0~5.00Hz			
65	Max. frequency	R/W	3FH	40064	0~80.00Hz			
66	Min. frequency	R/W	40H	40065	0~80.00Hz			
67	Motor current limit coefficient	R/W	41H	40066	10%-200%			
68	Parameter combination 3	R/W	42H	40067	byte	name	Byte parsing	
					HByte	unit pass series	0-1	
						unit series	2~9	
69	Parameter combination 4	R/W	43H	40068	byte	name	note	
					HByte	DT comp	0-20	
					LByte	Torque boost	0-15	
70	Acceleration. time	R/W	44H	40069	5.0s~6000.0s			
71	Deceleration. time	R/W	45H	40070	5.0s~6000.0s			
72	Instantaneous power outage time	R/W	46H	40071	0~1000ms			
73	Parameter combination 5	R/W	47H	40072	Bit	name	0	1
					15			
					14			
					13			
					12			

ID	name	attribute	Register address	PLC address	Parameter description			
					Bit	name	0	1
73	Parameter combination 5	R/W	47H	40072	11			
					10			
					9			
					8			
					7			
					6			
					5			
					4	Control status	Debug status	Normal state
					3	Stop mode	Dec.to stop	Free to stop
					2	Master-slave mode	Master mode	Slave mode
					1	Master-slave set	Invalid	Effective
					0			
74	Parameter combination 6	R/W	48H	40073	byte	name	Byte parsing	
					HByte	Inverter type	1. Asyn. 2. Asyn. vector 3. Sync. 4. Sync. vectors 5. Asyn. open-loop vectors 6. Sync. open-loop vectors 7. DC Brushless 8. Permanent magnet sync.	
					LByte	Startup mode	0: Normal Start 1: Speed start 2: Parameter identification 1 3: Parameter identification 2	
75	Rated input voltage of the inverter	R/W	49H	40074	380~15000V			
76	Rated output voltage of the inverter	R/W	4AH	40075	380~15000V			
77	Rated output current of the inverter	R/W	4BH	40076	31.0~1600.0A			
78	Proportion of rated input current of the inverter	R/W	4CH	40077	100-2000			
79	Cut phase-locked angle	R/W	4DH	40078	0.5-5°			
80	Motor rated voltage	R/W	4FH	40080	380~15000V			
81	Motor rated current	R/W	50H	40081	0.1~1600.0A			
82	Motor rated frequency	R/W	51H	40082	5.00~80.00H			
83	Motor rated speed	R/W	52H	40083	0~3600RPM			
84	Motor rated power	R/W	53H	40084	1~60000kW			
85	Motor rated inertia	R/W	54H	40085	0.1-300kg.m²			
86	Motor No-load current	R/W	55H	40086	1~1600.0A			
87	Motor stator resistance	R/W	56H	40087	0.001~10.000Ω			
88	Motor stator leakage	R/W	57H	40088	0.1~1000.0mH			
89	Function word 2	R/W	58H	40089	Bit	name	0	1
					B15			speed loop auto-calculated
					B14			current loop auto-calculated
					B13			flux loop auto-calculated
					B12			VF slip compensation
					B11~B4	Spare		
					B3~B0	Excitation time	1~16s	

ID	name	attribute	Register address	PLC address	Parameter description			
90	Magnetic flux	R/W	59H	40090	0.1~1.0pu			
91	RPM scale factor	R/W	5AH	40091	0.5~20.00			
92	RPM integration time	R/W	5BH	40092	0.1~20.00s			
93	Flux proportial. factor	R/W	5CH	40093	0.5~20.00			
94	Flux integratial time	R/W	5DH	40094	0.1~20.00s			
95	Current proportial factor	R/W	5EH	40095	0.1~15.00			
96	Current integratial time	R/W	5FH	40096	0.15~30.00ms			
97	Num of encoder pulses	R/W	60H	40097	0: 512 1: 1024 2: 2048 3: 4096 4: 19200 5: 16384 6: 65535			
98	Freq. search current	R/W	61H	40098	0.1~1.0pu			
99	Motor phase sequence	R/W	62H	40099	0: Reverse 1: Forward			
100	Function word 3	R/W	63H	40100	Bit	name	0	1
					B15~B13	VF Curve	0: linear VF curve 1: 1.2 power curve 2: 1.5 power curve 3: 1.7 power curve 4: 2 power curve 5: VF separation curve	
					B12~B8	Over-excitation frequency	1~30	
					B7~B3	Over-excitation gain	1~30	
					B2~B0	Bypass type	0: No bypass 1: Mechanical bypass 2: IGBT bypass	

Excitation parameter address code assignment table

ID	name	attribute	Register address	PLC address	Parameter description			
101	Parameter combination 7	R/W	64H	40101	Bit	name	0	1
					15			
					14			
					13			
					12			
					11			
					10			
					9			
					8	Excitation fault status	No faults	Fault
					7	Excitation oper. status	Stop	Run
					6	Excitation ready status	Not ready	Ready
					5	Excitation Start/stop	Stop	Start
					4	Excitation feedback	Yes	No
					3	Power/Conver switch	Forbid	Allow
					2	Working mode	Manual adjust	Closed-loop adjust
					1	Excitation mode	Asynchronous	Synchronous
					0	Excitation control	Forbid	Allow

ID	name	attribute	Register address	PLC address	Parameter description
102	Set power factor	R/W	65H	40102	0.5-0.98
103	Automatically adjusts switching frequency	R/W	66H	40103	25.00-50.00Hz
104	Asynchronous pitch frequency	R/W	67H	40104	0-50.00Hz
105	Motor rated excitation	R/W	68H	40105	0.1~1600.0A
106	Excitation min.current	R/W	69H	40106	0-20.00mA
107	Excitation max.current	R/W	6AH	40107	0-20.00mA
108	Excitation minimum feedback current	R/W	6BH	40108	0-20.00mA
109	Excitation maximum feedback current	R/W	6CH	40109	0-20.00mA
110	Excitation cabinet current	R/W	6DH	40110	0~1600.0A
111	Given excitation current	R/W	6EH	40111	0~1600.0A
112	Feedback excitation current	R	6FH	40112	0.1A
113	Output excitation current	R	71H	40113	0.1A
114	Excitation closed-loop proportionality factor	R/W	70H	40114	0~20.00
115	Excitation closed-loop differential time	R/W	72H	40115	0~30.00min
116	Excitation closed-loop integration time R	R/W	73H	40116	0.1~20.00min