Operation Manual

Goodrive5000 Series
Medium Voltage Variable Frequency Speed Control System

SHENZHEN INVT ELECTRIC CO., LTD.

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Preface

Thank you for purchasing the medium voltage variable frequency speed control system of our company.

Goodrive5000 series medium voltage variable frequency speed control systems are the multilevel medium voltage electrical devices manufactured by our company, and are applicable to 3-phase high voltage synchronous and asynchronous motors. To ensure proper usage, please read and comprehend the contents stated in this manual before use. Improper usage will result in abnormal running or the reduction of the service life.

This user manual is only applicable to Goodrive5000 series medium voltage variable frequency speed control systems of our company.

Please keep this manual with the variable frequency speed control system under safe custody for use whenever it is necessary.

Chapter 1 Precautions

1.1 Safety notes

This chapter contains the safety precautions you must follow.

Warning symbols

	Danger: Serious physical injury or even death may occur if not follow the relative requirements
	Warning: Physical injury or damage to the devices may occur if not follow the relative requirements

Safety precautions and warning symbols are marked on the cabinets and power units.

 High voltage	Do not open the doors after power on, and wait for 15 minutes after all power supplies are disconnected.
 Electrical danger	Only qualified technicians are allowed to operate the inverters.
 Warning	There are more than two power supplies for the equipment. To avoid electric shock, all power supplies must be disconnected before maintenance.

Disconnect the main breaker before maintenance and ensure the DC circuit has been discharged (all LEDs of each unit off). Grounding connection and other measures are also required.

About usage

Warning

- ✧ Before installation, wiring, operation and maintenance inspection, read the manual carefully for proper use. Ensure to be familiar with the machinery situation and all relevant safety precautions.

Danger

- ✧ The series medium voltage variable frequency speed control systems are only applicable to 3-phase high voltage synchronous and asynchronous motors, and cannot be put into other applications; otherwise, danger may occur.
- ✧ Under the circumstances of application where the fault of this product may cause accidents or loss, corresponding safety measures must be provided for emergencies.
- ✧ Do not touch after power on; otherwise, electric shock may occur.

About delivery

Warning

- ✧ When moving, transporting and placing the equipment, keep it level and flat.
- ✧ When lifting the equipment, ensure the force is enough and the process is gentle.

- ✧ Don't leave foreign objects such as wire ends, paper, metal debris and tools in the variable frequency speed control system.

About installation

Danger

- ✧ Configure the grounding lines strictly in accordance with the national standards and the technical requirements as required by the manual.
- ✧ The wiring operation must be carried out by professional electrical technicians.
- ✧ The operation can only be carried out under the circumstance of confirming that both control circuit and main circuit have no voltage input.
- ✧ The I/O cables must be connected properly according to the instructions; otherwise, the equipment may be damaged.
- ✧ Confirm that input power supply complies with the requirement of product technical specifications.
- ✧ The variable frequency speed control system shall be installed on fire-retardant materials, such as metal support.
- ✧ Do not place flammable objects including drawings and manual in or near the cabinet of the variable frequency speed control system.
- ✧ Do not put into installation or operation when the system components are damaged.

About wiring

Danger

- ✧ The power side of the variable frequency speed control system shall be fitted with high voltage circuit breaker for circuit protection.
- ✧ It is required to connect the grounding lines reliably.
- ✧ The wiring must be implemented under the guidance of the professionals of our company according to the relevant electrical safety standards.
- ✧ It is required to carry out wiring after the main body of the equipment is installed in place.
- ✧ It is required to confirm that the phase number of the input power and the rated input voltage are consistent with the ratings of the system.
- ✧ The output terminals (U, V and W) must not be connected to AC power supply.
- ✧ The I/O cables shall meet the requirements of insulation and capacity in national or industrial standards.

About operation

Danger

- ✧ Only after the electrical cabinet doors are all closed can the system be connected to power supply. After the power supply is connected, the doors cannot be opened.
- ✧ Do not use wet hands to operate the switch.

- ✧ When trip and reboot occurs, the peripheral system shall guarantee personal and equipment safety.
- ✧ When the variable frequency speed control system is connected to power supply, even in stop state, the terminal may still be charged, please do not touch.
- ✧ The start-stop of the variable frequency speed control system cannot be controlled by connecting or disconnecting the main circuit.
- ✧ Control cabinet and other cabinets use optical fiber isolation technology without high voltage, but it is required to operate by trained and authorized personnel.
- ✧ Do not disconnect the power supply of the fan during operation; otherwise, it will cause overheating and damage the equipment.
- ✧ Confirm that there is good ventilation indoors where the system is installed, maintain the ambient temperature at -5~+40°C.
- ✧ The operation of transformer cabinet, power unit cabinet or bypass cabinet must comply with high-voltage operation procedures.
- ✧ The transformer cabinet, power unit cabinet and bypass cabinet are dangerous zones in high voltage, so do not open the cabinet door to operate after power on (the system has the lock device).
- ✧ It is required to install protective guards (with the symbol of high voltage) for some necessary places and do not move them when the system is running.

About maintenance and replacement

Danger

- ✧ Maintenance repair and replacement must be carried out by qualified personnel in accordance with relevant operation procedures.
- ✧ In case of voltage and high temperature, do not touch any part inside the cabinet.
- ✧ It is required to check whether the grounding resistor meets the requirements of operation and national standards usually. If not, it may be dangerous.

About disposal

Warning

- ✧ Deal with the scrapping parts and components as industrial effluent.

Chapter 2 Product overview

2.1 Product introduction

As the second generation of medium voltage variable frequency speed control system manufactured by Shenzhen INVT Electric CO. LTD., Goodrive5000 product adopts advanced high performance vector control mode and simultaneously it is compatible with vectorization V/F control. The product features high-quality input, high power factor and excellent power output, and it also has the advantages of high control precision, quick dynamic torque response and large low-frequency output torque.

2.1.1 High-quality input

Goodrive5000 series medium voltage variable frequency speed control systems are designed in compliance with the strictest requirements of IEEE 519 1992 voltage and current harmonic distortion standards. By secondary winding phase shifting of isolation transformer, the input side adopts multi-pulse diode rectifier input (30 pulses for 6kV, 48 pulses for 10kV) to provide isolated power supply for the power units, eliminating most of harmonic current caused by a single power unit.

As shown in Fig2.1, when Goodrive5000 series medium voltage variable frequency speed control systems are under 30 pulses rated load supply impedance, the total current harmonic distortion and corresponding voltage distortion are below 2.00%.

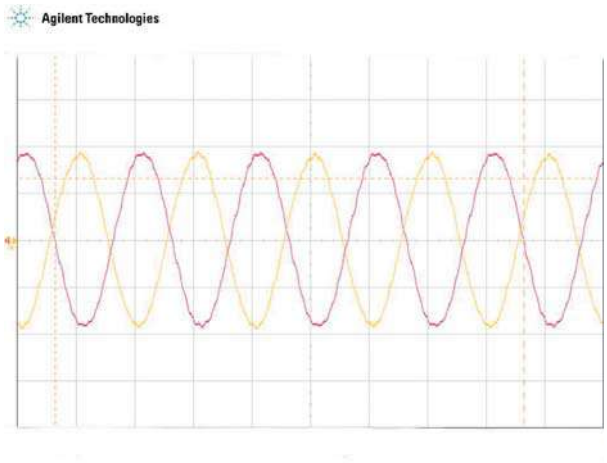


Fig 2.1 30 pulses input voltage and current waveform (100:1)

2.1.2 High power factor

Due to high-quality input, Goodrive5000 medium voltage variable frequency speed control systems acquire excellent sine-wave input current (see Fig2.1), and thus, without using external power factor to compensate capacitance, the power factor will exceed 0.97 in the whole range of speed control. However, low power factor usually generates rectangular wave current, which will cause harmonic and other relevant resonance problems. Meanwhile, the distribution cabinets, circuit breakers and transformers will not cause overload because of reactive power.

2.1.3 Excellent power output

The systems adopt the technology of multi-unit series PWM wave superposition, greatly reducing output harmonic and outputting excellent sine waves (see Fig2.2 and 2.3) without the necessity of

output filter equipment, which means the systems will generate little distortion and low motor noise, and the motor will not need to derate. Actually, the excellent systems eliminate the harmonic caused by motor heat as well as eliminate the torque ripple (even in the condition of low speed range), reducing the stress of the device, and minimizing the stress between common-mode voltage and dv/dt to protect the main circuit motor and cable insulation from damage. Within derating range, the motor cable has no length limit.

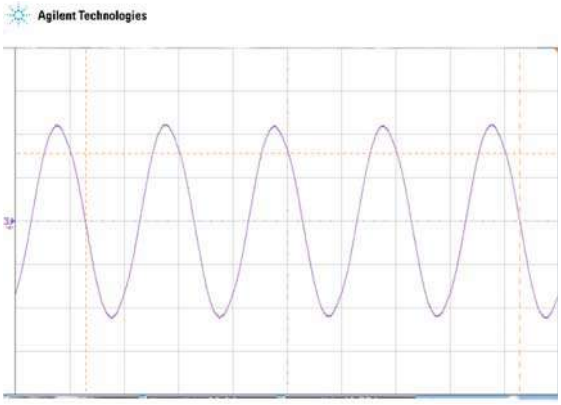


Fig 2.2 Output current waveform

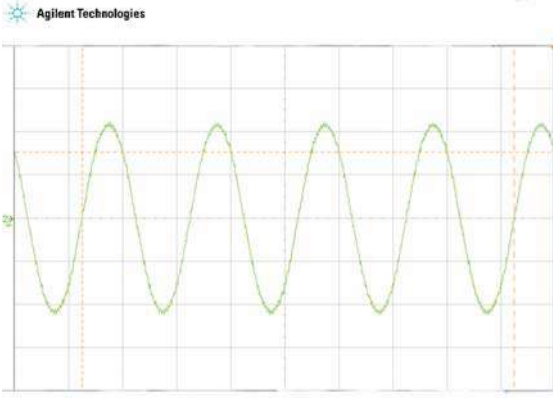


Fig 2.3 Output voltage waveform

2.2 Product features

Goodrive5000 series medium voltage variable frequency speed control systems, the new generation of high voltage (SM/AM) three-phase AC speed control device manufactured by our company, have following features:

- High performance vector control technology (SM/AM) of high precision and quick dynamic torque response
- Built-in PID regulator: Close loop running
- Compatible with vectorization V/F control, that is optimize V/F control and make the dynamic response approach the vector control level; gain better torque feature by low frequency automatic torque boost
- Excellent low frequency compensation: By the advanced algorithm of dead area compensation and low frequency oscillation suppression, low frequency output performance will be better under vector and V/F control modes
- No stop after instantaneous power off and main circuit power off (1-5s) ensures the device is not affected by sudden power off
- Optimized overvoltage speed loss: Bus voltage close loop facilitates quick deceleration without overvoltage alarm
- Master-slave control: Multi-motor control of the belt conveyor
- Power consumption statistics of variable frequency
- V/F separation (suitable for power industry)
- One-drive-more control of bypass cabinet
- Braking energy balance: By software optimization on braking energy distribution, balance the braking energy on each power unit and lower overvoltage point
- AVR function for output voltage (Automatic Voltage Regulation): Control the output voltage accurately and improve the control performance of the motor
- Strong voltage adaptability, with a wide range of input voltage, applicable at home and abroad
- All-around rotating speed tracking makes the motor restart in rotating to guarantee continuity
- Synchronous switching (optional): Smoothly switch between the grid and variable frequency,

decreasing impact on the grid and motor

- Multiple communication methods: MODBUS-RTU, PROFIBUS-DP (optional), Ethernet UDP (optional)
- Modularized design, convenient and simple maintenance
- The ventilating window mounted externally is convenient for dedusting and maintenance
- LCD display in Chinese, touch buttons on the panel
- Double-loop redundancy of control power, cascading fault protection

Besides, the systems also have:

- Realtime parameters monitoring, realtime data recording, alarm and fault protection, fault find and waveform displaying
- Overload and overcurrent protection
- Phase loss protection
- Overvoltage, undervoltage, overtemperature and overspeed protection
- Optical fiber isolating communication with high reliability

2.3 Technical parameters

See technical parameters of Goodrive5000 series medium voltage variable frequency speed control systems in Table 2-1:

Table 2-1 Technical parameters

Item		3kV	3.3kV	4.16kV	6kV	6.6kV	10kV	11kV
Input	Rated input voltage	AC 3PH 3kV	AC 3PH 3.3kV	AC 3PH 4.16kV	AC 3PH 6kV	AC 3PH 6.6kV	AC 3PH 10kV	AC 3PH 11kV
	Voltage fluctuation range	-15%~+10%						
	Input frequency	50/60Hz; ±5%						
	Input power factor	≥ 0.97 (full load)						
	System efficiency	≥ 96% (full load)						
	Input current harmonic	≤ 4%				≤ 2%		
Output	Output voltage	0~3kV	0~3.3kV	0~4.16kV	0~6kV	0~6.6kV	0~10kV	0~11kV
	Output current	0~539 A	0~551A	0~555A	0~539A	0~551A	0~577A	0~525A
	Output capacity	0~2800 kVA	0~3150kVA	0~4000kVA	0~5600kVA	0~6300kVA	0~10000 kVA	0~10000 kVA
	Output power	0~2240 kW	0~2500kW	0~3150kW	0~4500kW	0~5000kW	0~8000kW	0~8000kW
	Output frequency	0~120Hz						
	Output	≤ 4%				≤ 2%		

Item		3kV	3.3kV	4.16kV	6kV	6.6kV	10kV	11kV
	current harmonic							
Control performance	Control mode	V/F control, open loop vector control, close loop vector control						
	Control system	DSP, FPGA, ARM						
	HMI	10 inch touch screen						
	Speed ratio	1:50 (V/F) ; 1:100 (open loop vector), 1:200 (close loop vector)						
	Speed control precision	±1% the maximum speed (V/F) ; ±0.4% the maximum speed (open loop vector), ±0.2% the maximum speed (close loop vector)						
	Torque response time	< 200ms (open loop vector), < 100ms (close loop vector)						
	Overload protection	120%: 120s, 150%: 5s, 200% protect immediately						
	ACC/DEC time	0-3600s, customized						
	Feedback control mode	Synchronous rectification control technology (4-quadrant)						
	Feedback capability	100%, the maximum feedback power is the same as the maximum output power (4-quadrant)						
Signal I/O	Digital input	8 digital inputs						
	Digital output	8 digital outputs						
	Analog input	3 channels: AI1, AI2: 0~10V/0~20mA; AI3: -10V~10V						
	Analog output	4 channels: AO1, AO2, AO3, AO4: 0~10V/0~20mA						
	High-speed pulse input	1 input, range: 0~50kHz						
	High-speed pulse output	1 output, range: 0~50kHz						
Communication method		Modbus (RS485 interface), Profibus, Ethernet						
Protection function	System	Overcurrent, overvoltage, undervoltage, motor overload, inverter overload, phase loss						
		Overheating, temperature controller fault, communication fault, access fault						
	Unit	Communication fault, undervoltage, overvoltage, power supply overheating, input phase loss, VCE fault, bypass failure, hardware overcurrent						
Others	Installation manner	Cabinet mounting						
	IP grade	IP30						
	Noise degree	≤75dB						
	Feed in and	Bottom in and bottom out; other methods are optional						

Item		3kV	3.3kV	4.16kV	6kV	6.6kV	10kV	11kV
	out method							
	Cooling	Forced-air cooling						
	Control source	AC 380V±10%						
	MTBF	50000h						
	Temperature	-5°C~+40°C, derate 1.5% for every additional 1°C if the temperature is above 40°C and the maximum temperature is 50°C; run with no load if the temperature reaches 60°C						
	Altitude	Below 1000m; derate 1% for every additional 100m if the sea level is above 1000m						
	Storage	Keep away from dust, direct sunlight, flammable or corrosive gas, oil, steam and vibration						
	Vibration	0.59g						

2.4 Models and selection guide

When selecting the models, refer to the rated voltage, current and power of the motors to make sure the system capacity is not smaller than the motor capacity.

2.4.1 Type designation key

The product model definitions of Goodrive5000 series products are shown as Fig 2.4.

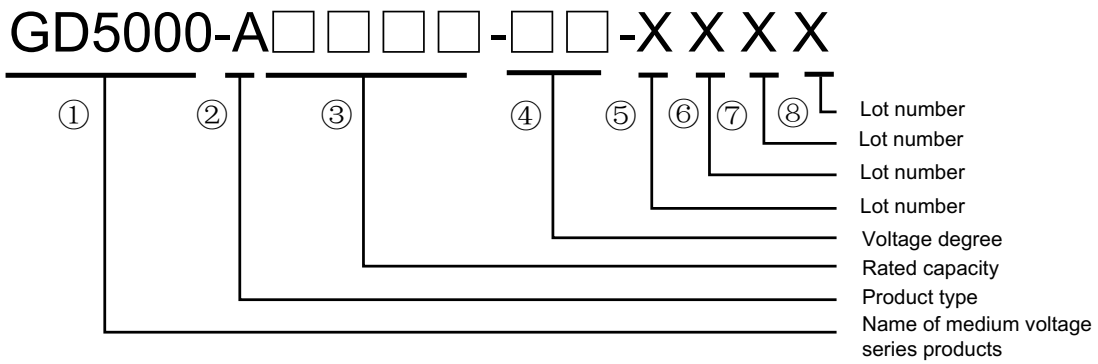


Fig 2.4 Product model definitions of Goodrive5000 series products

Table 2-2 Instruction of product model definitions

Label	Definition	Instruction
①	Name of medium voltage series products	GD5000: series medium voltage variable frequency speed control systems
②	Product type	A: asynchronous vector product (AM) B: synchronous vector product (SM)
③	Rated capacity	0500: 500kVA 10000: 10000kVA
④	Voltage degree	03: voltage degree 3kV 3.3: voltage degree 3.3kV 4.16: voltage degree 4.16kV 06: voltage degree 6kV 6.6: voltage degree 6.6kV

Label	Definition	Instruction
		10: voltage degree 10kV 11: voltage degree 11kV
⑤	Lot number	1) S: front maintenance 2) D: dual-side maintenance 3) L: integrated machine
⑥	Lot number	1) R: energy feedback system 2) If no, default
⑦	Lot number	1) C: bypass system with unit contactor 2) If no, default
⑧	Lot number	1) Important non-standard product 2) P: belt conveyor 3) Lot number special for other industries decided by product line 4) If no, default

2.4.2 Name plate

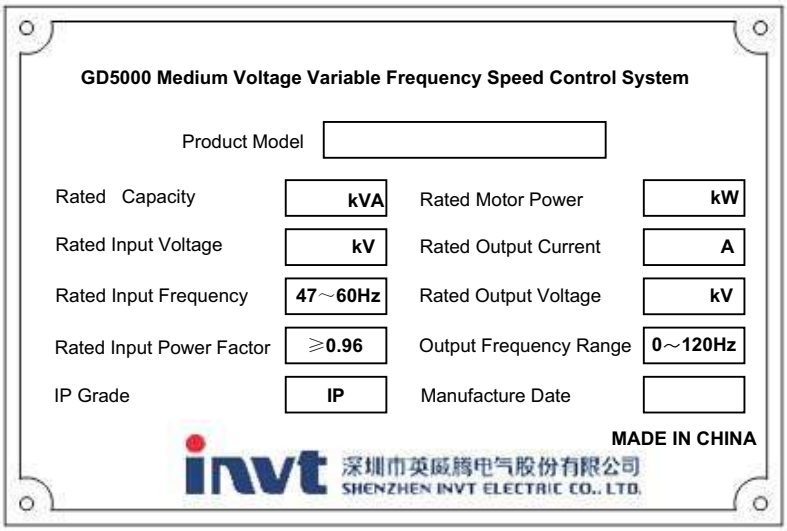


Fig 2.5 Name plate of Goodrive5000 series products

2.4.3 Product specifications and dimensions

Table 2-3 Parameters of Goodrive5000 series products (3kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0280-03	220	54	3200X1200X2720	2416
GD5000-A0315-03	250	61	3200X1200X2720	2466
GD5000-A0355-03	280	68	3200X1200X2720	2506
GD5000-A0400-03	315	77	3800X1200X2720	2731
GD5000-A0450-03	355	87	3800X1200X2720	2881
GD5000-A0500-03	400	96	3800X1200X2720	2961
GD5000-A0560-03	450	108	4000X1200X2720	3149
GD5000-A0630-03	500	121	4000X1200X2720	3299

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0710-03	560	137	4000X1200X2720	3349
GD5000-A0800-03	630	154	4000X1200X2720	3549
GD5000-A0900-03	710	173	4000X1200X2720	3790
GD5000-A1000-03	800	192	4000X1200X2720	3890
GD5000-A1120-03	900	216	4000X1200X2720	4030
GD5000-A1250-03	1000	241	4000X1200X2720	4380
GD5000-A1400-03	1120	269	5000X1500X2820	5560
GD5000-A1600-03	1250	308	5000X1500X2820	5810
GD5000-A1800-03	1400	346	5400X1500X2820	6710
GD5000-A2000-03	1600	385	5400X1500)X2820	7010
GD5000-A2240-03	1800	431	5800X1500X2820	7760
GD5000-A2500-03	2000	481	5800X1500X2820	8160
GD5000-A2800-03	2240	539	5800X1500X2820	8860

Table 2-4 Parameters of Goodrive5000 series products (3.3kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0280-3.3	220	49	3200X1200X2660	2283
GD5000-A0315-3.3	250	55	3200X1200X2720	2416
GD5000-A0355-3.3	280	62	3200X1200X2720	2466
GD5000-A0400-3.3	315	70	3200X1200X2720	2506
GD5000-A0450-3.3	355	79	3800X1200X2720	2731
GD5000-A0500-3.3	400	87	3800X1200X2720	2881
GD5000-A0560-3.3	450	98	3800X1200X2720	2961
GD5000-A0630-3.3	500	110	4000X1200X2720	3149
GD5000-A0710-3.3	560	124	4000X1200X2720	3299
GD5000-A0800-3.3	630	140	4000X1200X2720	3349
GD5000-A0900-3.3	710	157	4000X1200X2720	3549
GD5000-A1000-3.3	800	175	4000X1200X2720	3790
GD5000-A1120-3.3	900	196	4000X1200X2720	3890
GD5000-A1250-3.3	1000	219	4000X1200X2720	4030
GD5000-A1400-3.3	1120	245	4000X1200X2720	4380
GD5000-A1600-3.3	1250	280	5000X1500X2820	5560
GD5000-A1800-3.3	1400	315	5000X1500X2820	5810
GD5000-A2000-3.3	1600	350	5400X1500X2820	6710
GD5000-A2240-3.3	1800	392	5400X1500X2820	7010
GD5000-A2500-3.3	2000	437	5800X1500X2820	7760
GD5000-A2800-3.3	2240	490	5800X1500X2820	8160
GD5000-A3150-3.3	2500	551	5800X1500X2820	8860

Table 2-5 Parameters of Goodrive5000 series products (4.16kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0315-4.16	250	44	3600X1200X2720	3405
GD5000-A0355-4.16	280	49	3600X1200X2720	3455
GD5000-A0400-4.16	315	56	3600X1200X2720	3638
GD5000-A0450-4.16	355	62	3600X1200X2720	3718
GD5000-A0500-4.16	400	69	3600X1200X2720	3798
GD5000-A0560-4.16	450	78	4200X1200X2720	4053
GD5000-A0630-4.16	500	87	4200X1200X2720	4353
GD5000-A0710-4.16	560	99	4200X1200X2720	4483
GD5000-A0800-4.16	630	111	4600X1200X2720	4743
GD5000-A0900-4.16	710	125	4600X1200X2720	5093
GD5000-A1000-4.16	800	139	4600X1200X2720	5243
GD5000-A1120-4.16	900	155	4600X1200X2720	5593
GD5000-A1250-4.16	1000	173	4600X1200X2720	5975
GD5000-A1400-4.16	1120	194	4600X1200X2720	6425
GD5000-A1600-4.16	1250	222	4600X1200X2720	6865
GD5000-A1800-4.16	1400	250	4600X1200X2720	7515
GD5000-A2000-4.16	1600	278	5000X1500X2820	8910
GD5000-A2240-4.16	1800	311	5000X1500X2820	9410
GD5000-A2500-4.16	2000	347	5400X1500X2820	10860
GD5000-A2800-4.16	2240	389	5400X1500X2820	11510
GD5000-A3150-4.16	2500	437	5800X1500X2820	13210
GD5000-A3550-4.16	2800	493	5800X1500X2820	14110
GD5000-A4000-4.16	3150	555	5800X1500X2820	15010

Table 2-6 Parameters of Goodrive5000 series products (6kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0400-06	315	38	2600X1500X2720	2643
GD5000-A0500-06	400	48	2600X1500X2720	2808
GD5000-A0560-06	450	54	2600X1500X2720	2885
GD5000-A0630-06	500	61	2600X1500X2720	2962
GD5000-A0710-06	560	68	2600X1500X2720	3177
GD5000-A0800-06	630	77	2600X1500X2720	3221
GD5000-A0900-06	710	87	2600X1500X2720	3342
GD5000-A1000-06	800	96	2600X1500X2720	3452
GD5000-A0400-06	315	38	3800X1200X2660	2965
GD5000-A0500-06	400	48	3800X1200X2660	3035
GD5000-A0560-06	450	54	3800X1200X2660	3170
GD5000-A0630-06	500	61	3800X1200X2660	3320
GD5000-A0710-06	560	68	3800X1200X2660	3370
GD5000-A0800-06	630	77	4400X1200X2660	3635

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0900-06	710	87	4400X1200X2660	3785
GD5000-A1000-06	800	96	4400X1200X2660	3885
GD5000-A1120-06	900	108	4800X1200X2720	4268
GD5000-A1250-06	1000	120	4800X1200X2660	4408
GD5000-A1400-06	1120	135	4800X1200X2660	4758
GD5000-A1600-06	1250	154	4800X1200X2660	5058
GD5000-A1800-06	1400	173	4800X1200X2720	5610
GD5000-A2000-06	1600	192	4800X1200X2720	5810
GD5000-A2240-06	1800	216	4800X1200X2720	6060
GD5000-A2500-06	2000	241	4800X1200X2720	6560
GD5000-A2800-06	2240	269	5800X1500X2820	7550
GD5000-A3150-06	2500	303	5800X1500X2820	8350
GD5000-A3550-06	2800	342	6400X1500X2820	9750
GD5000-A4000-06	3150	385	6800X1500X2820	10000
GD5000-A4500-06	3550	433	7400X1500X2820	11600
GD5000-A5000-06	4000	481	7400X1500X2820	12000
GD5000-A5600-06	4500	539	7600X1500X2820	13180

Table 2-7 Parameters of Goodrive5000 series products (6.6kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0400-6.6	315	35	4000X1200X2720	3026
GD5000-A0450-6.6	355	39	4000X1200X2720	3056
GD5000-A0500-6.6	400	44	4000X1200X2720	3096
GD5000-A0560-6.6	450	49	4000X1200X2720	3126
GD5000-A0630-6.6	500	55	4000X1200X2720	3402
GD5000-A0710-6.6	560	62	4000X1200X2720	3482
GD5000-A0800-6.6	630	70	4000X1200X2720	3552
GD5000-A0900-6.6	710	79	4600X1200X2720	3917
GD5000-A1000-6.6	800	87	4600X1200X2720	4017
GD5000-A1120-6.6	900	98	4600X1200X2720	4117
GD5000-A1250-6.6	1000	109	5000X1200X2660	4522
GD5000-A1400-6.6	1120	122	5000X1200X2660	4872
GD5000-A1600-6.6	1250	140	5000X1200X2660	5172
GD5000-A1800-6.6	1400	157	5000X1200X2660	5472
GD5000-A2000-6.6	1600	175	5000X1200X2720	5965
GD5000-A2240-6.6	1800	196	5000X1200X2720	6215
GD5000-A2500-6.6	2000	219	5000X1200X2720	6765
GD5000-A2800-6.6	2240	245	5000X1200X2720	7065
GD5000-A3150-6.6	2500	276	5800X1500X2820	8425
GD5000-A3550-6.6	2800	311	5800X1500X2820	8725
GD5000-A4000-6.6	3150	350	6800X1500X2820	9625

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A4500-6.6	3550	394	6800X1500X2820	10825
GD5000-A5000-6.6	4000	437	7400X1500X2820	12975
GD5000-A5600-6.6	4500	490	7600X1500X2820	13755
GD5000-A6300-6.6	5000	551	7600X1500X2820	14555

Table 2-8 Parameters of Goodrive5000 series products (10kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0500-10	400	29	2600X1500X2720	3194
GD5000-A0560-10	450	32	2600X1500X2720	3359
GD5000-A0710-10	560	41	2600X1500X2720	3513
GD5000-A0800-10	630	46	2600X1500X2720	3755
GD5000-A0900-10	710	52	2600X1500X2720	3876
GD5000-A1000-10	800	58	2600X1500X2720	4008
GD5000-A1120-10	900	65	2600X1500X2720	4283
GD5000-A1250-10	1000	72	2600X1500X2720	4360
GD5000-A1400-10	1120	81	2600X1500X2720	4525
GD5000-A1600-10	1250	92	2600X1500X2720	4723
GD5000-A1700-10	1400	98	2600X1500X2720	4855
GD5000-A0500-10	400	29	4600X1200X2660	3550
GD5000-A0560-10	450	32	4600X1200X2660	3550
GD5000-A0710-10	560	41	4800X1200X2660	3960
GD5000-A0800-10	630	46	4800X1200X2720	4070
GD5000-A0900-10	710	52	4800X1200X2720	4366
GD5000-A1000-10	800	58	4800X1200X2660	4426
GD5000-A1120-10	900	65	4800X1200X2660	4776
GD5000-A1250-10	1000	72	4800X1200X2660	4976
GD5000-A1400-10	1120	81	5200X1200X2720	5271
GD5000-A1600-10	1250	92	5200X1200X2720	5421
GD5000-A1700-10	1400	98	5200X1200X2720	5621
GD5000-A2000-10	1600	115	5800X1200X2720	6481
GD5000-A2240-10	1800	129	6200X1500X2720	6876
GD5000-A2500-10	2000	144	6200X1500X2720	7276
GD5000-A2800-10	2240	162	6200X1500X2720	7576
GD5000-A3150-10	2500	182	6200X1500X2720	8210
GD5000-A3550-10	2800	205	6200X1500X2720	9310
GD5000-A4000-10	3150	231	6200X1500X2720	10030
GD5000-A4500-10	3550	260	7000X1500X2820	10960
GD5000-A5000-10	4000	289	7000X1500X2820	11260
GD5000-A5600-10	4500	323	7200X1500X2820	11940
GD5000-A6300-10	5000	364	8000X1500X2820	14340
GD5000-A7100-10	5600	410	8800X1500X2820	15990

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A7500-10	6000	433	11200X1500X2820	19880
GD5000-A8000-10	6300	462	11200X1500X2820	21080
GD5000-A9000-10	7100	520	11200X1500X2820	22280
GD5000-A10000-10	8000	577	11200X1500X2820	23080

Table 2-9 Parameters of Goodrive5000 series products (11kV)

Model	Rated power (kW)	Rated output current (A)	Overall dimension W*D*H (mm)	Standard weight (kg)
GD5000-A0500-11	400	26	4800X1200X2720	3699
GD5000-A0560-11	450	29	4800X1200X2720	3749
GD5000-A0630-11	500	33	4800X1200X2720	3849
GD5000-A0710-11	560	37	5000X1200X2720	4129
GD5000-A0800-11	630	42	5000X1200X2720	4179
GD5000-A0900-11	710	47	5000X1200X2720	4279
GD5000-A1000-11	800	52	5000X1200X2660	4608
GD5000-A1120-11	900	59	5000X1200X2660	4918
GD5000-A1250-11	1000	66	5000X1200X2660	5118
GD5000-A1400-11	1120	73	5000X1200X2660	5368
GD5000-A1600-11	1250	84	5400X1200X2720	5503
GD5000-A1800-11	1400	94	5400X1200X2720	5843
GD5000-A2000-11	1600	105	6000X1200X2720	6376
GD5000-A2240-11	1800	118	6000X1200X2720	6826
GD5000-A2500-11	2000	131	6400X1200X2720	7421
GD5000-A2800-11	2240	147	6400X1200X2720	7671
GD5000-A3150-11	2500	165	6400X1200X2720	7871
GD5000-A3550-11	2800	186	6400X1200X2720	9395
GD5000-A4000-11	3150	210	6400X1200X2720	10295
GD5000-A4500-11	3550	236	6400X1200X2720	10595
GD5000-A5000-11	4000	262	7800X1500X2820	12005
GD5000-A5600-11	4500	294	8000X1500X2820	14385
GD5000-A6300-11	5000	331	9000X1500X2820	16885
GD5000-A7000-11	5600	367	9000X1500X2820	17585
GD5000-A8000-11	6300	420	12600X1500X2820	21765
GD5000-A9000-11	7100	472	12600X1500X2820	23265
GD5000-A10000-11	8000	525	12600X1500X2820	25665

Note:

1. The overall dimensions of medium voltage variable frequency speed control systems listed in the tables above are standard. They may differ from the actual dimensions required by users.

2. If the value exceeds the rated data, please contact with SHENZHEN INVT ELECTRIC CO., LTD.

3. The dimensions may be subject to the technical agreement without notice during improving.

2.4.4 External dimension

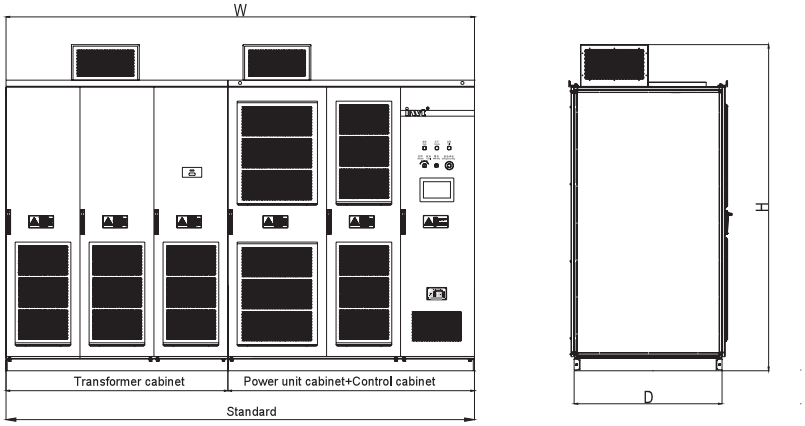


Fig 2.6 External dimension of Goodrive5000 series products

2.5 Product application

Widely used in various industries, Goodrive5000 series products provide perfect high voltage AC motor (AM/SM) soft-start, speed regulation, energy saving and smart control solutions. The detailed applications are as follows:

Steel/Metallurgy: air blowers, dusting blowers, ID (induced draft) fans, descaling pumps, mud pumps, feed pumps, slag washing pumps, phosphorus removal pumps, rolling mills, etc.

Cement/Building material: high temperature fans, furnace head fans, furnace end fans, dusting blowers, raw meal rolling machine, ore rolling machine, etc.

Thermal power/Hydropower/Garbage power: ID (induced draft) fans, FD (forced draught) fans, primary air fans, secondary air fans, air compressors, sweetening fans, feed pumps, condensate pumps, circulating pumps, ash pumps, etc.

Oil/Chemical industry/Natural gas: injection pumps, circulating pumps, oil pipe pumps, submersible pumps, electric submersible pumps, brine pumps, descaling pumps, mud pumps, compressors, etc.

Paper making/Pharmacy: beating pumps, cleaning pumps, etc.

Mining: belt conveyors, air exhausters, dusting blower, gas pumps, medium pumps, etc.

Municipal engineering: domestic water pumps, industrial water pumps, sewage pumps, clean water pumps, purifying pumps, etc.

Others: power station pumps, wind tunnel test fans, etc.

2.6 Design standards

Goodrive5000 series medium voltage variable frequency speed control systems are designed and manufactured according to latest national standards (GB or GB/T) and the standards of International Electricotechnical Commission (IEC), and International System of Units (SI). As the lowest technical specifications, the related technical parameters meet the requirements of GB or GB/T and IEC.

Part of the technical standards referenced by the design:

IEC 60071-1-2011	Insulation coordination Part 1: definitions , principles and rules
IEC 61800-5-1-2007	Adjustable speed electrical power drive systems-Part 5-1: Safety requirements-Electrical, thermal and energy
IEC 60529-2001	Degrees of protection provided by enclosure (IP code)
IEC 61000-4	EMC testing and measurement techniques (series standards)
IEC 61800-3-2004	Adjustable speed electrical power drive systems-Part 3: EMC requirements

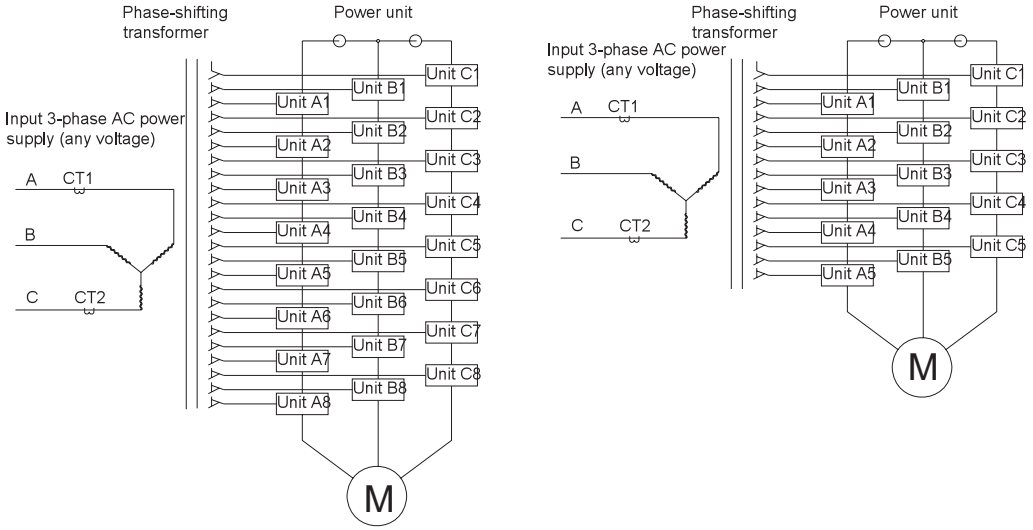
	and specific test methods
IEC 61800-4-2002	Adjustable speed electrical power drive systems-Part 4: General requirements-Rating specifications for AC power drive systems above 1000V AC not exceeding 35kV
IEC 60038-2009	IEC standard voltage
IEC 60196-2009	IEC standard frequency
IEC 60076-1-2000	Power transformers-Part 1: General
IEC 60068-2	Series standards of environmental testing
IEC 60204-11-2000	Safety of machinery-Electrical equipment of machines-Part 11: Requirements for HV equipment for voltages above 1000V AC or 1500V DC and not exceeding 36kV
IEEE 519-1992	Recommended practices and requirements for harmonic control in electrical power systems
GB/T 3859.1-1993	Basic requirements for semiconductor converters
GB/T 14549-1993	Power quality-Utility grid harmonics
GB 19212.1-2008	Safety of power transformers, power supplies, reactors and similar products-Part 1: General requirements and tests
GB 12668-1990	General specification for speed control assembly with semiconductor adjustable frequency for AC motor
DL-T 994-2006	Application of high voltage inverter to fan and pump in thermal power plant
JB 3975-1985	Basic standards for circular copper conductor connectors
JB 2438-78	Standards for general wiring ducts

Chapter 3 Product principle and composition

3.1 Product principle

Goodrive5000 series medium voltage variable frequency speed control systems adopt the technology of multi-unit series PWM wave superposition. By power units in series, the input voltage of the grid runs through phase-shifting transformer, becomes 3*N channels 3-phase 690V voltage (N: the number of power units in each phase), and then supplies power to each power unit. Each unit uses H-bridge whose PWM output is controlled by the main control system; connect the unit outputs of the same phase in series, connect the first unit of each phase in “Y”, and combine the last units of three phases into high voltage output. The system consists of the main circuit, power units and control system, as shown in Fig 3.1.

3.1.1 Main circuit



10kV 6kV

Fig 3.1 Topological diagram of Goodrive5000 series products

The isolation transformer is dry-type phase shifting transformer using forced air cooling, the original side is in “Y” connection directly connected to high voltage incoming line, and the secondary side winding is in prolonged delta connection with a certain phase difference.

Phase-shifting angle=60°/the number of power units in each phase

The secondary side winding supplies power to the power units and the phase difference is determined by the number of power units and the voltage degree of the variable frequency speed control system.

3.1.2 Power unit

The power units mainly consist of main circuit and control circuit. The main circuit includes protection, rectification, filtering, converting and bypass (optional).

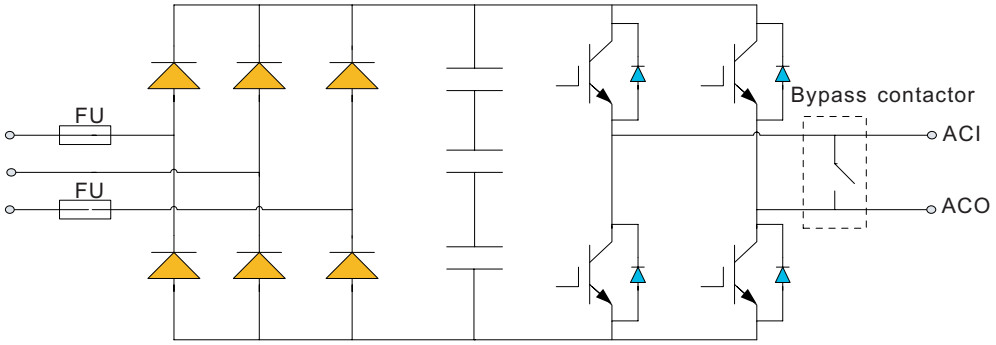


Fig 3.2 Schematic diagram of power units

The input terminals R/S/T are connected to 3-phase low voltage output of the secondary coil of the transformer, electrify DC bus after 3-phase full-bridge rectification, and then convert into AC output by H-bridge converting. The output terminal of power units in single phase is ACI/ACO.

The control circuit controls the power units by receiving the signals from the main control system, and simultaneously it monitors the power units by sending its own information including voltage, faults and states back to the main control system via optical fiber.

The power units have the function of unit bypasses, one is IGBT bypass and the other is contactor bypass (optional). When a unit has a fault, the unit will achieve automatic bypass to ensure the system continues working normally.

3.1.3 Control system

The main control system of Goodrive5000 series medium voltage variable frequency speed control systems adopts modular structure. Each single board of the main control system is connected to the main control board via connecting slots. In this way, each single board has clear functions for the convenience of signals distinguishing and maintenance.

With interfaces of multi-functional I/O terminals, all user I/O terminals are located in the user I/O board, including 16-channel digital input, 3-channel analog input, 1-channel high-speed pulse input, 4-channel analog output, 1-channel high-speed pulse output and 20-channel relay output.

3.1.4 Board jumper and selector switch

Voltage and current switch jumper on user I/O board:

The analog I/O signals can be current or voltage signals which are switched by jumper, J1 corresponding to AI1, J2 corresponding to AI2, J3 corresponding to AO1, J4 corresponding to AO2, J5 corresponding to AO3, J6 corresponding to AO4. According to instructions on I/O board, connect the mini jumper to select the corresponding voltage or current signal.

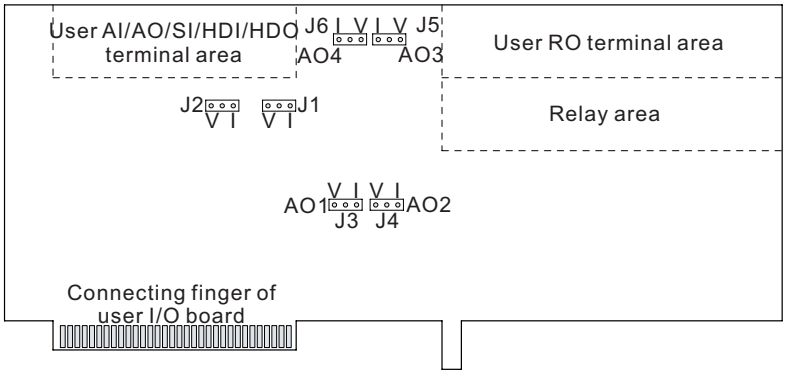


Fig 3.3 Switch jumper of analog voltage and current on the user I/O board

RS232/485 jumper:

Select RS232/485 interface to support MODBUS communication protocol.

Function of DIP switches on the main control board:

SW1, SW2, SW3 function and position

		ON	OFF
SW1	DIP switch 1	Configuration mode	Normal mode
	DIP switch 2	DSP flash loading mode	DSP serial programming mode enable
SW2	DIP switch 1	FPGA normal mode	FPGA flash loading mode
	DIP switch 2		
SW3	DIP switch 1	485 interface connected to termination resistor	Not connected to termination resistor
	DIP switch 2		

Configuration mode: Users can modify IP of the variable frequency speed control system. Refer to the configuration mode and P17.00~P17.08 parameters of HMI. The modify steps are: (1) switch the switch in configuration mode to ON; (2) power on the main control system, press and hold at the blank of log-in interface for 3 seconds, the additional menu options will pop up; (3) select configuration mode; after the interface of modify IP address pops up, modify the relevant information according to P17 group; (4) power off the main control cabinet and switch the switch in configuration mode to OFF (normal mode); (5) power on the main control cabinet and the modified IP address is valid.

Switch of the switch cabinet:

Goodrive5000 series products support one-drive-four switch cabinet control, that is to say, 4 switch cabinets are controlled by corresponding 4 control boards. The address codes are selected by the DIP switches on the boards.

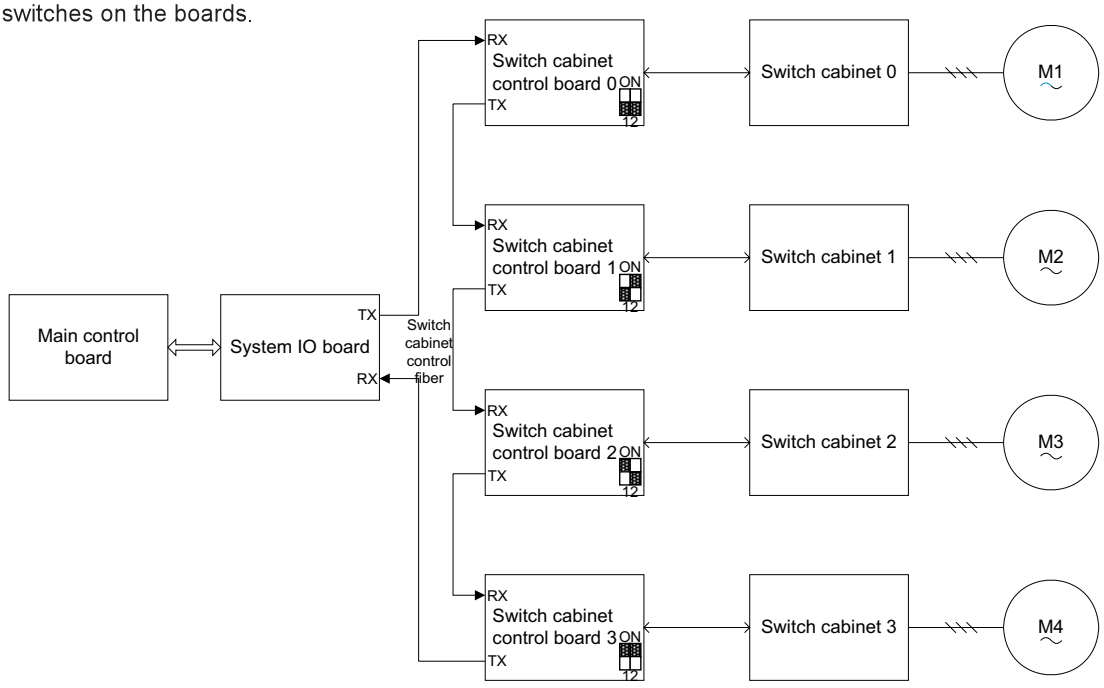


Fig 3.4 Configuration of switch cabinets

The DIP switch 1 and 2 on the control board can combine into 4 states corresponding to 4 addresses of switch cabinets. As shown in below table, the main control board will send command to the switch cabinet along with corresponding address, only when the address is the same as the command address, the switch cabinet will act.

Combination address		DIP 1	
		ON	OFF
DIP switch 2	ON	Switch cabinet 3	Switch cabinet 2
	OFF	Switch cabinet 1	Switch cabinet 0

The switches and jumpers in the control system shall be set well in factory. It is not recommended to modify; otherwise, damage may occur. If necessary, please read the instructions carefully before proper operating.

3.2 Product composition

Goodrive5000 series medium voltage speed control systems are mainly composed of the transformer cabinet, power unit cabinet, control cabinet, power units and HMI; in actual use, bypass cabinet (or switch cabinet) can be fitted as optional according to requirements of users.

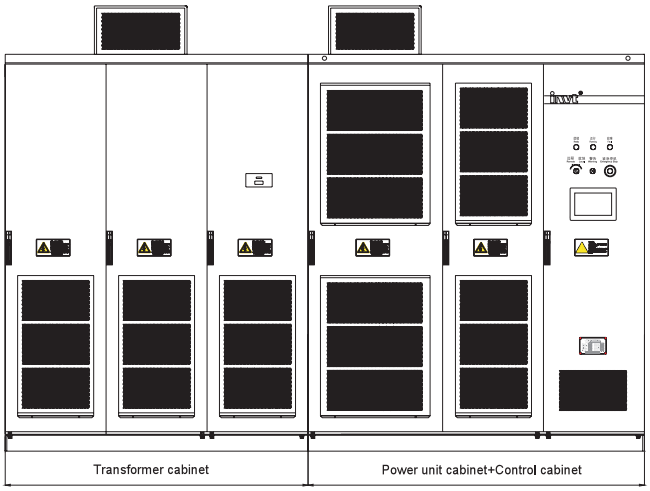


Fig 3.5 Appearance of Goodrive5000 series products

3.2.1 Transformer cabinet

The transformer cabinet is used to install phase shifting isolation transformer and accessories.

Fig 3.6 Layout in the transformer cabinet

The phase shifting isolation transformer installed in the transformer cabinet provides 3-phase power supply for power units to achieve high/low voltage shifting and isolation. The phase shifting transformer adopts dry-type structure, isolation degree at H and secondary side in prolonged delta connection, reducing harmonics at the grid side.

The temperature controller installed on the door of the cabinet monitors the temperature of each phase, and provides temperature protection and alarm. The default setting is: when the temperature of the phase shifting transformer exceeds 130°C, the system will alarm but not stop; when the temperature exceeds 150°C, the system will conduct temperature protection and stop. At the bottom of the transformer, special grounding copper bar is used for reliable high voltage grounding. The system shall be grounded together with the high voltage grounding during construction.

3.2.2 Power unit cabinet

The power unit cabinet is the converter of the system and the actuator for AC-DC-AC conversion. It is used to install power units and accessories.

Fig 3.7 Layout in the power unit cabinet

The power unit cabinet is used for placing power units; by the connection of high-voltage cable and secondary side winding of phase-shifting isolation transformer, the transformer can supply power to power units. The power units are placed in three lines in the cabinet, with the units of the same line in series connection forming A/B/C 3-phase. The last unit 3-phase close to the control cabinet is in “Y” connection. Being the output terminal of the system, the first unit 3-phase is in connection via the high-voltage cable and the copper bar of output terminals. By the connection of the optical fiber and main control system, the main control system realizes control and protection on power units.

3.2.3 Control cabinet

As the brain of the system, the control cabinet has the functions of command, control and self-protection. It is used to install the main control system, secondary control circuit system and UPS power supply, and so on.

Fig 3.8 Layout in the control cabinet

Goodrive5000 series variable frequency speed control systems use independent control cabinets which are isolated from the high-voltage section of transformer cabinet, power unit cabinet by optical fiber or isolation transformer and special grounding.

There are 3 power supplies for the control system: main power supply, backup power supply and UPS power supply. When the main supply fails, the system will switch into backup power supply automatically; when both the main and backup power supplies fail, UPS will supply power. When a power supply has a fault, the system will alarm. Therefore, the system can be used in bad power conditions.

3.2.4 Bypass cabinet (optional)

To meet the requirements of users, Goodrive5000 series medium voltage variable frequency speed control systems provide different combinations between standard manual bypass cabinet and automatic bypass cabinet.

The bypass cabinets are used to make the motor run at power frequency if the system has a fault, in order to guarantee continuity of the production and improve reliability of the system. According to production process, the dimension of the manual bypass cabinet and automatic bypass cabinet is 1000×1200×2690. It is recommended to install the bypass cabinets on the left of the transformer cabinet. Due to limited space, the arrangement is different from that recommended, which shall be stated in the technical agreement.

As shown in Fig 3.9, when the system stops for a short time, operators can switch variable frequency to power frequency by using the manual bypass cabinet.

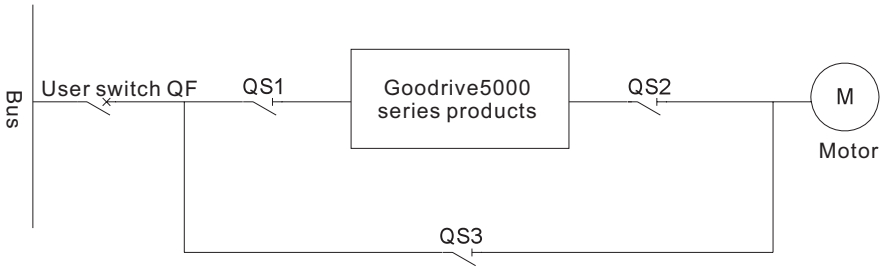


Fig 3.9 Diagram of the main circuit of manual bypass cabinet

When the system is not allowed to stop, the automatic bypass cabinet will switch automatically. The cabinet has three high-voltage vacuum contactors KM1, KM2 and KM3, among which KM2 and KM3 realize electric interlock to ensure the power frequency supply will not be directly sent to the output terminal of the variable frequency speed control system. The cabinet also has two isolation knife switches QS1 and QS2 to isolate the variable frequency speed control system from high-voltage power supply when the motor runs at power frequency, convenient for maintenance and inspection.

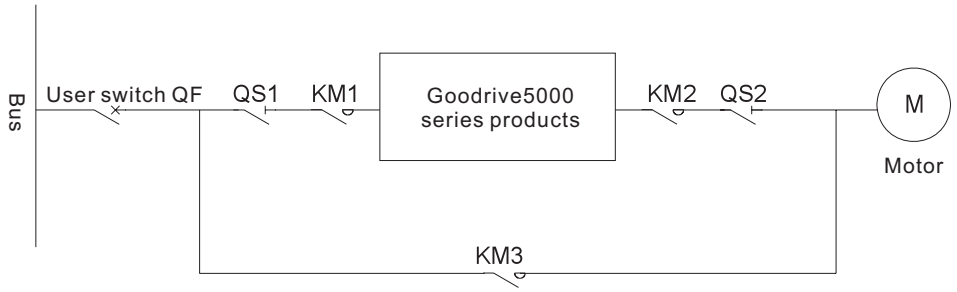


Fig 3.10 Diagram of the main circuit of automatic bypass cabinet

With bypass cabinets, users' power cables (power incoming cable and motor outgoing cable) usually feed in at the bottom or top of the cabinets; while the power cable, between the bypass cabinet and the variable frequency speed control system, adopts flexible wire and lays out in the cabinet.

3.2.5 Power unit

The power units, the converting part of the variable frequency speed control system, achieve high-low-high voltage shifting of the system by connection in series. The main control system controls H-bridge PWM output of each power unit, achieving perfect sine waves and control on motor rotation.

When installing the power units, put them on the brackets, next push the units inside till close to the air duct baffle, then fix them with screws, connect corresponding input cables and series copper bars, and finally plug corresponding optical fiber cables in.

When removing the power units, unplug the optical fiber cables, input cables and series copper bars, twist off the screws on the units, and finally remove the power units from the brackets.

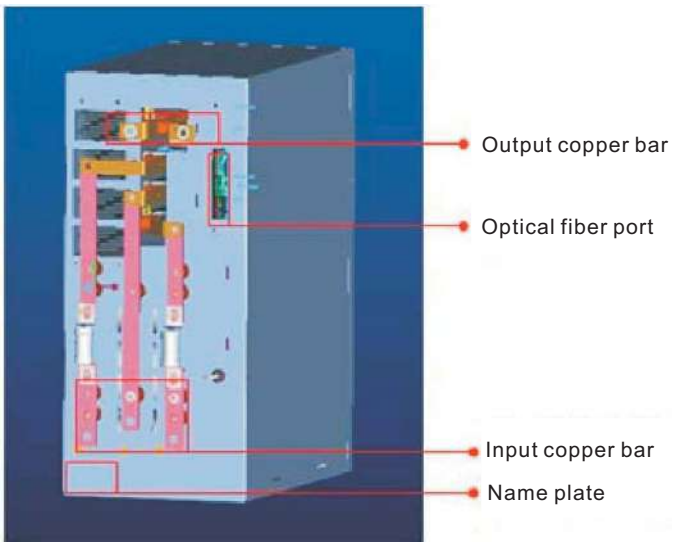


Fig 3.11 Appearance of the power unit

3.2.6 HMI

Goodrive5000 series medium voltage variable frequency speed control systems provide HMI with touch screen/indicator light/button/alarm apparatus installed on the door of the control cabinet.

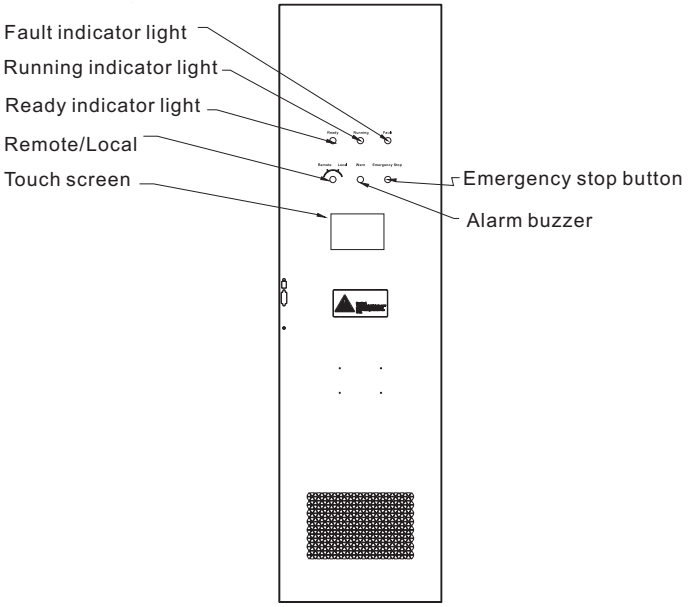


Fig 3.12 Layout of control cabinet door

Fault indicator light: means whether the system is in fault or alarm state, if so, the indicator light on;
Running indicator light: means whether the system is in running state, if so, the indicator light on;
Ready indicator light: means whether the system is in standby or ready state. If the system does not run and no fault is in detection after power on, the indicator light on;
Emergency stop button: if the main control board is damaged or cannot be controlled normally, users can push the emergency stop button; by the physical circuit disconnection, damage will be minimized.

Danger

- **Power on only after disconnecting high voltage by loosening the emergency stop button with rotation;**

- ✧ **When the switching cabinet under power frequency, the emergency stop button is invalid. Disconnect high voltage by directly powering off the higher level or sending the command of disconnecting high voltage to the system;**
- ✧ **When under manual switching, the emergency stop button can only control higher level high-voltage breaker or contactor. Connect the knife switch in series in the switching cabinet to high level control circuit.**

3.3 Setting and definition of touch screen

After the touch screen is power-on, the login interface will pop up for users to select username and input password. The main interface appears after login. Then users can operate on the interface by clicking the buttons.

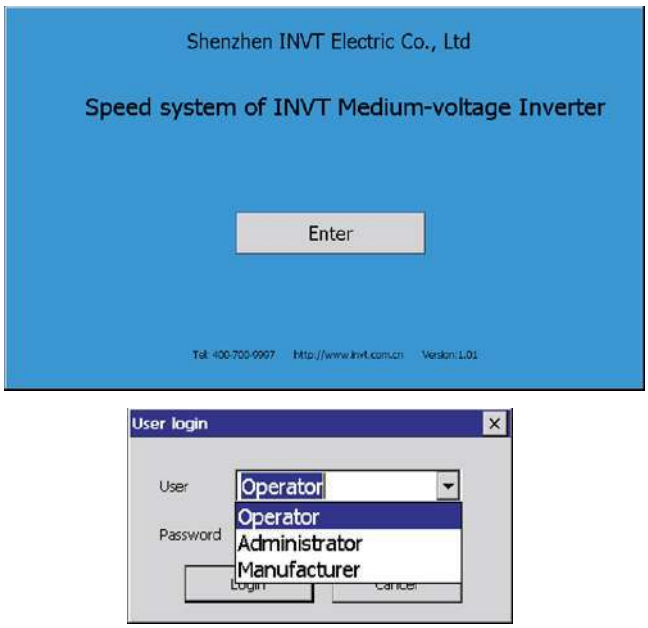


Fig 3.13 Login interface

Click the buttons on the main interface to enter into corresponding special interface called sub-interface. Because special interface appears after clicking corresponding buttons, the sub-interface has hierarchy. Therefore, the main interface is the first level interface, the sub-interface which appears after clicking the main interface is the second level interface, and so on.

Click the region for setting values and then enter into the interfaces for users to input values. The interfaces called general interfaces are not sub-interfaces.

3.3.1 Main interface

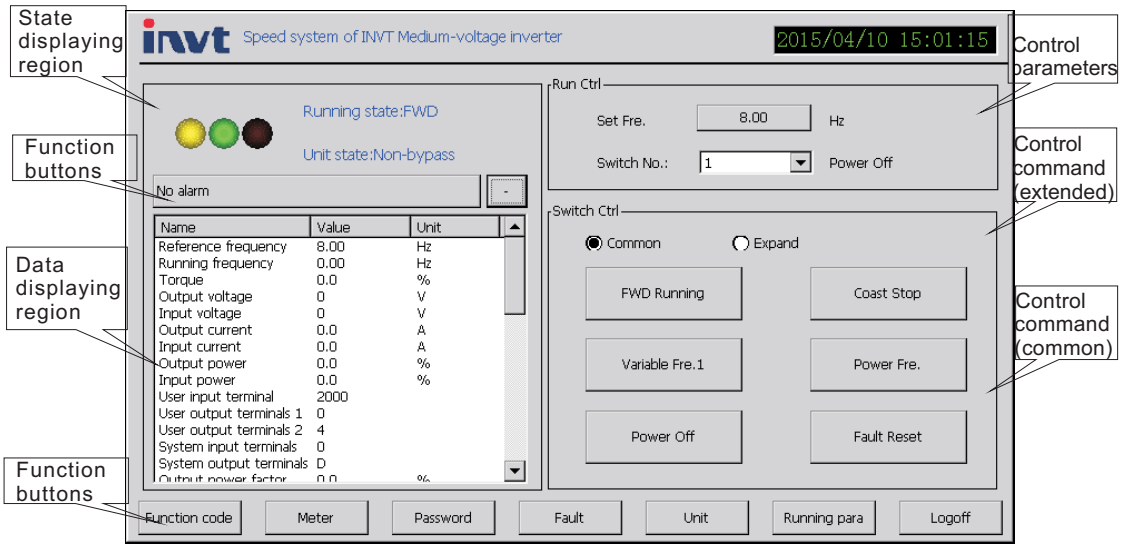


Fig 3.14 Main interface of the touch screen

The figure above is the main interface of the touch screen and it is divided into following regions:

No.	Region	Buttons	Instruction
1	State displaying	Running state	In forward running/reverse running/stand-by/fault/POFF state
		Unit state	Bypass/non-bypass
		Icon state	yellow on, in stand-by; green on, in running; red on, in fault; not connected to Internet
2	Data displaying	Set frequency	Set frequency of variable frequency speed control system
		Running frequency	Running frequency of variable frequency speed control system
		Rotating speed	Current rotating speed of the motor
		Output voltage	Output voltage of variable frequency speed control system
		Input voltage	Input voltage of variable frequency speed control system
		Output current	Output current of variable frequency speed control system
		Input current	Input current of variable frequency speed control system
		Output power	The percentage of motor rated power current output power accounts for
		Input power	The percentage of motor rated power current input power accounts for
		Torque	The percentage of system rated torque current output torque accounts for
		User input terminal	The binary digit 0/1 corresponding to open/close state of user input terminal
		User output terminal 1	The binary digit 0/1 corresponding to open/close state of user output terminal 1
		User output terminal 2	The binary digit 0/1 corresponding to open/close state of user output terminal 2
		System input terminal	The binary digit 0/1 corresponding to open/close state of system input terminal

No.	Region	Buttons	Instruction
		System output terminal	The binary digit 0/1 corresponding to open/close state of system output terminal
		Output power factor	Output power factor
		Input power factor	Input power factor
		Active component of input current	Active component of input current
		Reactive component of input current	Reactive component of input current
		Active component of output current	Active component of output current
		Reactive component of output current	Reactive component of output current
		U-phase bus voltage	U-phase DC bus voltage
		V-phase bus voltage	V-phase DC bus voltage
		W-phase bus voltage	W-phase DC bus voltage
		Temperature of the motor	Current temperature of the motor
		Corresponding value of AI1	Corresponding input voltage or current percentage of AI1
		Corresponding value of AI2	Corresponding input voltage or current percentage of AI2
		Corresponding value of AI3	Corresponding input voltage or current percentage of AI3
		Value of HDI	Frequency of multi-functional HDI
		Corresponding value of AO1	Corresponding output function percentage of AO1
		Corresponding value of AO2	Corresponding output function percentage of AO2
		Corresponding value of AO3	Corresponding output function percentage of AO3
		Corresponding value of AO4	Corresponding output function percentage of AO4
		Value of HDO	Frequency of multi-functional HDO
		PID reference	Percentage of PID reference
		PID feedback	Percentage of PID feedback
3	Control parameters	Set frequency	Set frequency of function code
		Switch cabinet No.	0~8

No.	Region	Buttons	Instruction
4	Control command (common)	Forward running	Under communication command channel, push the button to send forward running command to the system.
		Coast to stop	Under any command channel, push the button to send coast to stop command to the system.
		Variable frequency 1	One drives more and other motors are in variable frequency. When specified motor receives variable frequency 1, other motors in variable frequency will coast to stop and the motor will run in variable frequency.
		Power frequency	The motor runs in power frequency.
		Power off	Disconnect the input power of specified motor and other motors are not affected.
		Fault reset	Fault reset by manual
5	Control command (extended)	Reverse running	Under communication command channel, push the button to send reverse running command to the system.
		Decelerate to stop	If the running command channel is communication command channel and the system is in running state, push the button to send decelerate to stop command to the system.
		Power frequency into variable frequency 1	One drives more and other motors are in variable frequency. When specified motor receives power frequency into variable frequency 1, other motors in variable frequency will coast to stop and the motor will switch power frequency into variable frequency.
		Variable frequency into power frequency	The motor switches variable frequency running into power frequency bypass.
		Variable frequency 2	One drives more and other motors are in variable frequency. When specified motor receives variable frequency 2, other motors in variable frequency will run in power frequency and the motor in variable frequency.
		Power frequency into variable frequency 2	One drives more and other motors are in variable frequency. When specified motor receives power frequency into variable frequency 2, other motors will switch variable frequency into power frequency and the motor will switch power frequency into variable frequency.
6	Function buttons	Alarm information	Click the button and the second level interface of fault information will pop up.
		Function codes	Click the button and the second level interface of function groups will pop up.
		Virtual instrument	Click the button and the interface of instrument data will pop up.
		Change password	Change login password of variable frequency speed control system.
		Fault records	Click the button and the second level interface of fault information will pop up.
		Units	Click the button and the second level interface of unit information will pop up.

No.	Region	Buttons	Instruction
		Running parameters	Click the button and the second level interface of running parameters will pop up.
		User logout	Back to login interface

3.3.2 Login interface

After the control system powers on or users exit the main interface, the login interface will be displayed on the touch screen. There are three types of operators:

Operator: for who will not configure the system and only start or stop the variable frequency speed control system.

Administrator: for technical leaders who can configure and operate the system.

Manufacturer: only for who manufacture the system

Limited rights in different regions for different operators

Region	Operator	Administrator
State displaying	Allow view	Allow view
Data displaying	Allow view	Allow view
Start-stop control	Prohibit changing control channels	Allow operation
Frequency switching control	Allow operation	Allow operation
Function button	Prohibit viewing function codes	Allow operation

3.3.3 Second level interface

1) Each function button corresponds to a second level interface

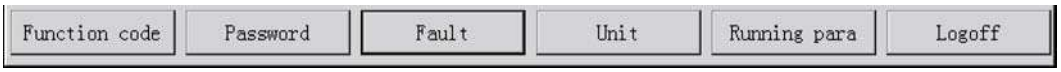


Fig 3.15 Function buttons

2) Introduction to the second level interface of function groups

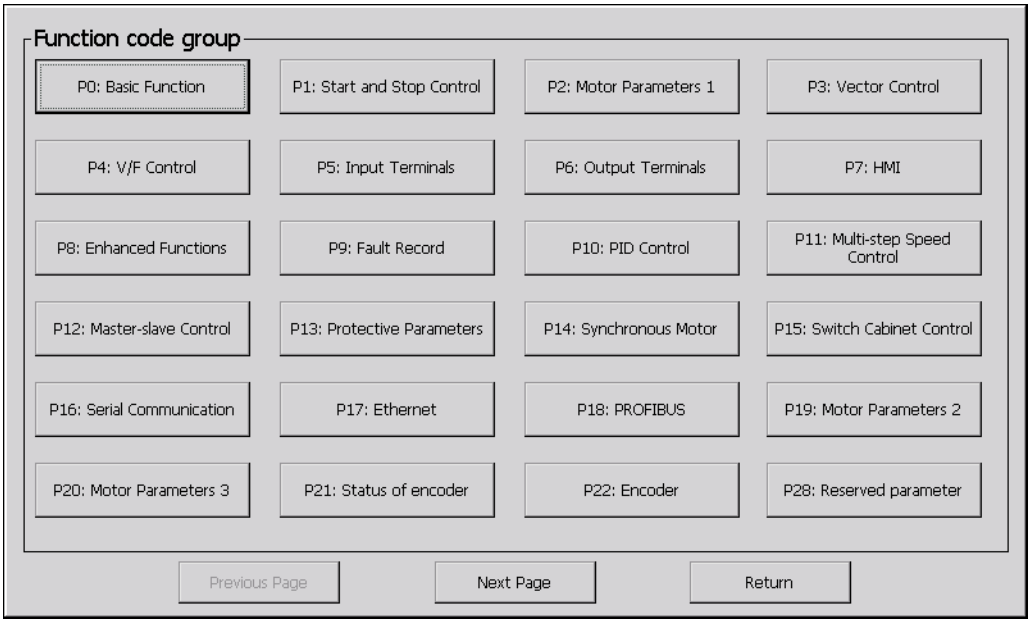


Fig 3.16 Second level interface of function groups

Setting is a necessity for above groups. Click the button of each group and the corresponding setting interface will pop up. Return to the top level by clicking back button.

3) Introduction to the second level interface of virtual instrument

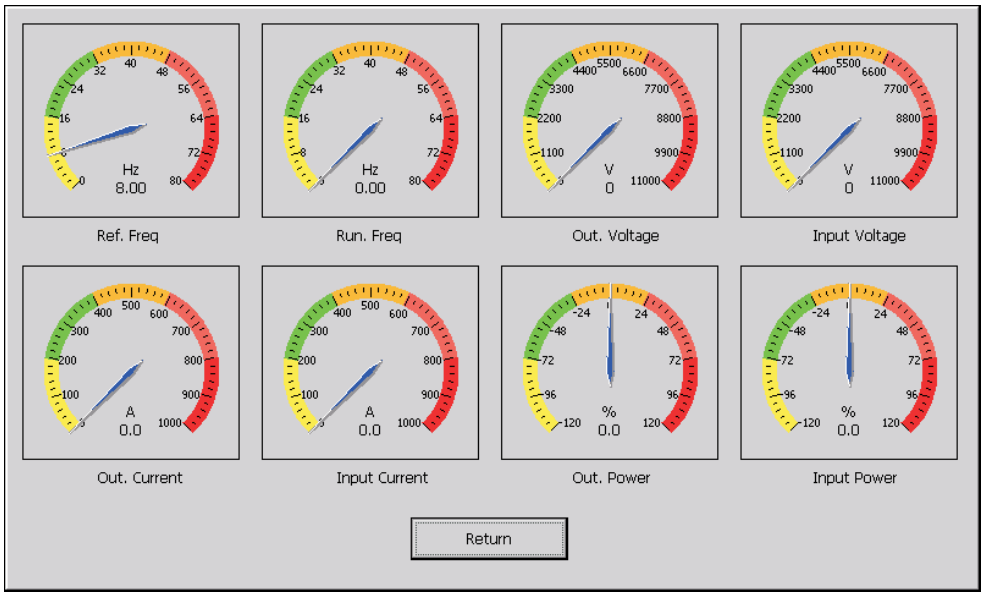


Fig 3.17 Second level interface of virtual instrument

The virtual instrument is used to display the variables in common use.

4) Introduction to the second level interface of change password

Fig 3.18 Second level interface of change password

5) Introduction to the second level interface of fault records

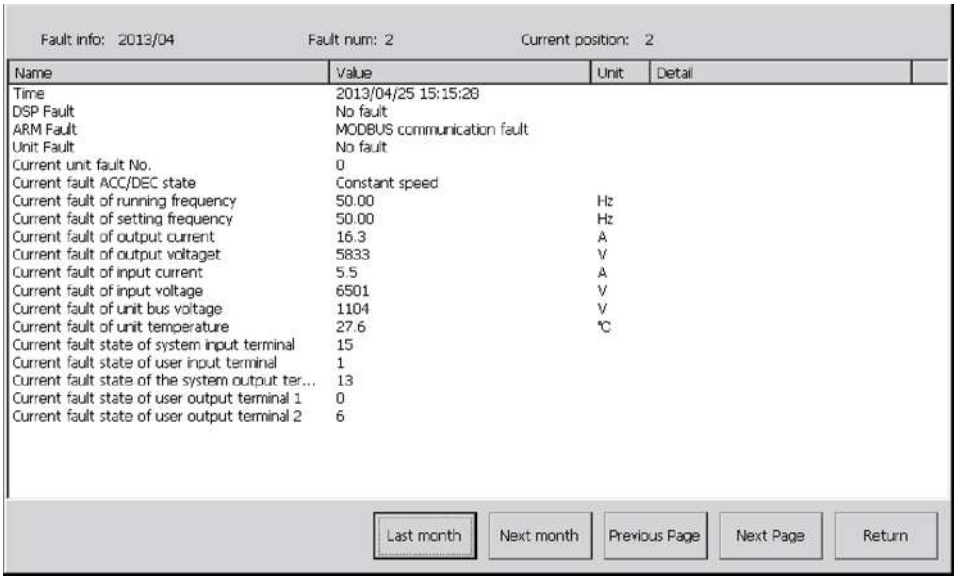


Fig 3.19 Second level interface of fault record

6) Introduction to the second level interface of units

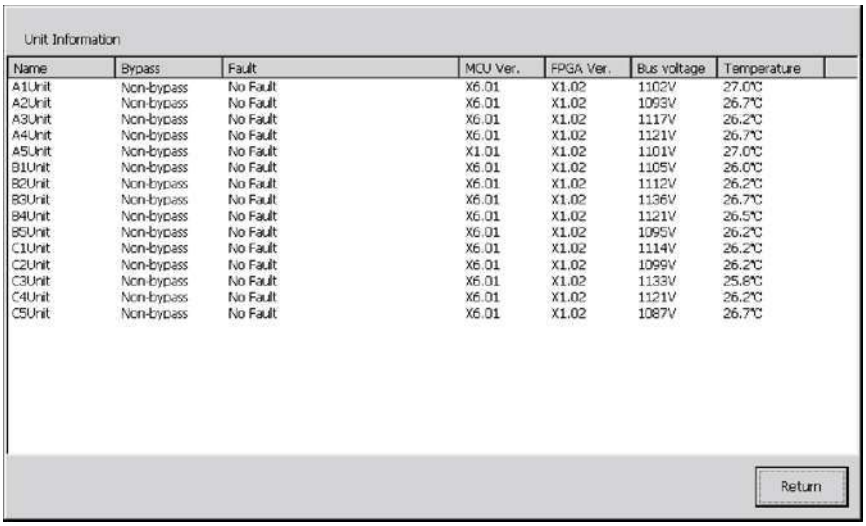


Fig 3.20 Second level interface of unit

7) Introduction to the second level interface of running parameters

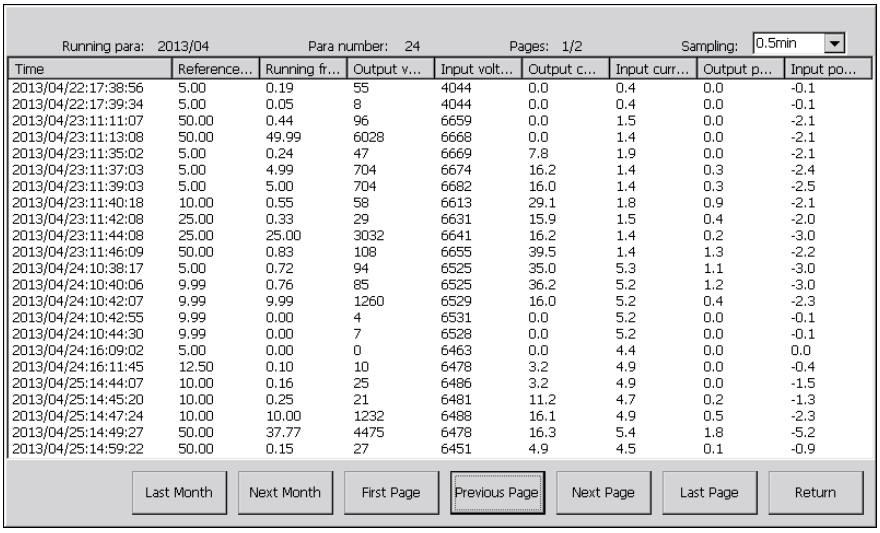


Fig 3.21 Second level interface of running parameters

The interface displays running records of the system and the period for the records can be modified.

3.3.4 Third level interface

1) Second level interface generating the third level

The second level interface of function groups can generate third level interface.

2) Introduction to the third level interface of function groups

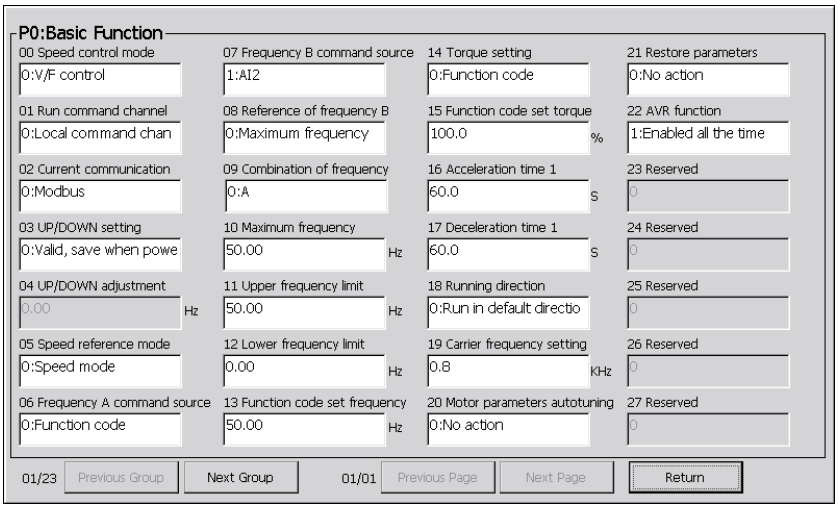


Fig 3.22 Third level interface for setting parameters

The interface displays the value and state of each function code which can be modified or set by users. The white edit box is modifiable while the grey box is read-only.

3) Click the edit box and then the third level sub-interface will pop up.

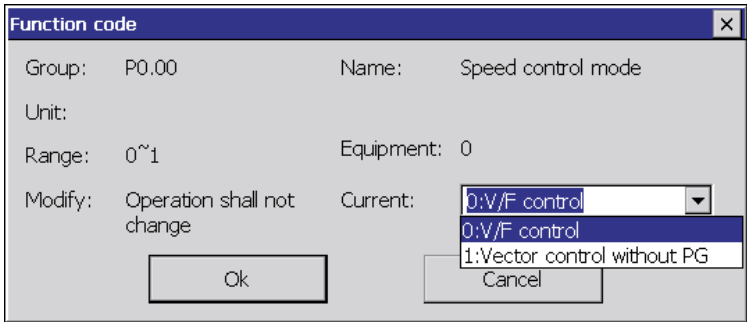


Fig 3.23 Interface for modifying the edit box

3.3.5 Other interfaces

1) Soft keyboard

Fig 3.24 Soft keyboard

The software input of touch screen depends on the soft keyboard. After users click the keyboard, above interface will pop up.

2) Additional options on login interface

Note: On login interface, press and hold the touch board for seconds and additional options will pop up.

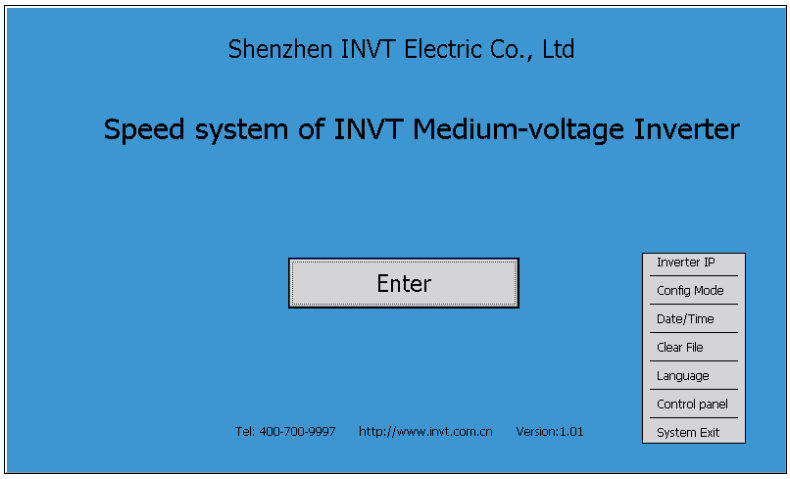


Fig 3.25 Additional options on login interface

1) Inverter IP

Click the option to display the inverter IP which can be changed via soft keyboard by users.

2) Configuration mode

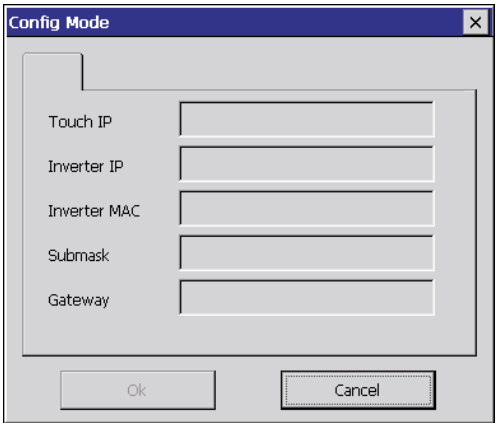


Fig 3.26 Interface of configuration mode

Refer to 3.1.4.

3) Date/Time

Users can change current date and time of variable frequency speed control system.

4) Clear file

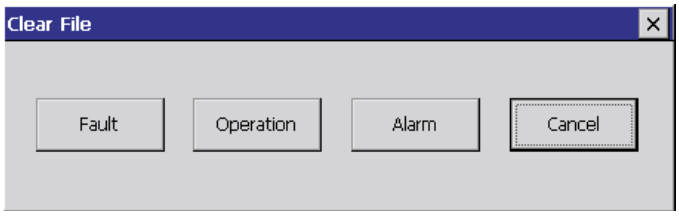


Fig 3.27 Interface of clear file

5) Language

Users can select the language as required. After selection, restart the touch screen. The system will change the language into the set one.

6) Control panel

Click the button and enter into the control panel of Win CE control system.

7) System exit

Click the button and return to the desktop of Win CE control system.

Chapter 4 Wiring and terminals

4.1 Wiring of main circuit

As shown in Fig 4.1, due to interlocking between the switch cabinet and the variable frequency speed control system, the closing of QF of the switch cabinet will be invalid when the system in fault state, QF will open automatically when the system in fault state after closing.

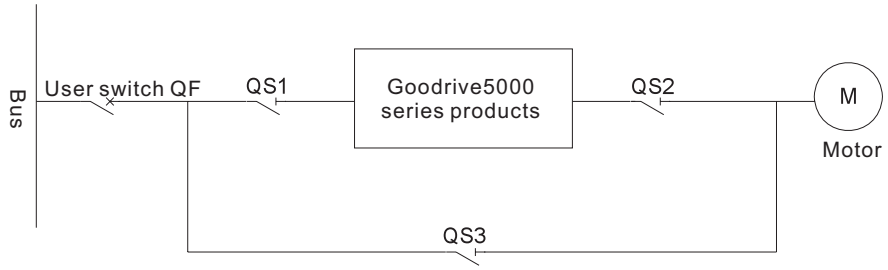


Fig 4.1 Wiring diagram of main circuit

When there is no bypass cabinet, the wiring of main circuit feeds in R, S, T terminals and feeds out U, V, W terminals in transformer cabinet. The copper bar at the bottom of the transformer cabinet will be connected to the grounding of transformer, unit cabinet and control cabinet, and user grounding grid after the system is installed. The terminals of control circuit in control cabinet shall be grounded independently.

When there is bypass cabinet, I/O terminals in the switching cabinet are top in or bottom out. The copper bar at the bottom of the bypass cabinet will be connected to the grounding of transformer, unit cabinet and control cabinet, and user grounding grid after the system is installed. The terminals of control circuit in control cabinet shall be grounded independently.

Warning	✧ Do not exchange the wiring of I/O terminals; otherwise, the system and other devices may be damaged.

1. Standard requirements of power distribution

Before the power is connected to Goodrive5000 series variable frequency speed control system, it needs to pass through the main circuit breaker which is allowed to close only after receiving the switching signal from the system.

The power of main circuit breaker is directly connected to the input terminals of switch cabinets in no need of passing through the input reactor.

The output of the system is connected to the motor by the output terminals of switch cabinets.

Danger	✧ Collect I/O terminals properly; otherwise, the system may be damaged.

2. Wiring of switch cabinets

Terminals		Name	Instruction
Input	R	Power input of main circuit, the 1st phase sequence	Connect to 3-phase AC power, the 1st phase sequence
	S	Power input of main circuit, the 2nd	Connect to 3-phase AC power, the 2nd

		phase sequence	phase sequence
	T	Power input of main circuit, the 3rd phase sequence	Connect to 3-phase AC power, the 3rd phase sequence
Output	U	Output of medium voltage variable frequency speed control system, the 1st phase sequence	Connect to 3-phase AC motor, the 1st phase sequence
	V	Output of medium voltage variable frequency speed control system, the 2nd phase sequence	Connect to 3-phase AC motor, the 2nd phase sequence
	W	Output of medium voltage variable frequency speed control system, the 3rd phase sequence	Connect to 3-phase AC motor, the 3rd phase sequence

Note: Phase sequence of U, V and W terminals may be different from that of R, S and T. When power frequency bypass is a necessity, make sure input phase sequence is consistent with output phase sequence; otherwise, the system cannot work properly.

3. Requirements of devices and cables

◆ Main circuit breaker

The main circuit breaker can be vacuum or air isolation circuit breaker which will meet not only the requirements of voltage and current of power supply, but also the requirements of primary side voltage and current of phase shifting transformer. Furthermore, it shall be capable of bearing current surge caused by switching on the transformer, and it will not trip after fault current caused by secondary side short circuit in 100ms.

◆ Input cables

There are no special requirements for the cables from the circuit breaker to the primary side of transformer. The rated voltage of the cables shall keep consistent with the voltage of the primary side circuit. The rated current shall satisfy the transformer and the set value for protection. On basis of the maximum ambient temperature, set the decreased capacity of the cables according to the cooling factors and local electrical regulations.

◆ Output cables

There are no special requirements for the cables from Goodrive5000 series medium voltage variable frequency speed control system to the motor. It is recommended that the length to be no longer than 1 kilometer, the case that the field cable length is longer than 1 kilometer shall be proposed in the order.

The rated voltage of the cables shall keep consistent with the motor model, and the rated current of the cables shall comply with the motor model as well as allowable overload current for motor protection. The decreased capacity of the cables shall refer to the maximum ambient temperature, cooling factors, and other factors required by national electrical standards.

4. Layout of high voltage cables

The layout of main power supply and motor cables must comply with national standards. Please refer to the instructions and suggestions of the manufacturer.

- It is recommended to use 3-phase armoring steel cables shielded individually. If single phase cable is used, 3-phase cables shall be combined with each other to ensure EMC.
- According to requirements of the manufacturer, install collectors at the cable terminations.
- Corresponding ground wire shall be grounded in compliance with national electrical standards.

5. Grounding

Ensure the ground wire with less than 4Ω ground resistance, use wires between the cabinet and door of the system, channel in base among cabinets, copper conductor cable with no less than 50mm^2 sectional area for the ground connection between the whole-set equipment and the grid. To guarantee equipment and personal safety, check the grounding before using.

Danger

- ✧ Before cabling, please confirm that the input power supply has been cut off. There is the risk of electric shock and fire.
- ✧ Electric engineering professionals are allowed to perform the cabling. There is the risk of electric shock and fire.
- ✧ Be sure to make reliable grounding of the cabinet bodies. There is the risk of electric shock and fire.
- ✧ Please check whether the AC main circuit power supply is consistent with the rated voltage of the variable frequency speed control system; otherwise, there will be risk of injury and fire hazard.
- ✧ Please use the screwdriver of designated torque to tighten the terminals; otherwise, there will be the risk of fire.
- ✧ Do not connect the input power supply to the output terminals U, V and W; otherwise, internal damage may occur to the variable frequency speed control system.

Danger

- ✧ All connectors must receive insulation treatment to ensure good insulation. The connecting positions must be kept clean and meet the requirement of corresponding cleanliness.
- ✧ Medium voltage electrical insulation distance must meet the requirements of electrical safety distance in order to avoid short circuit.

4.2 Wiring of control circuit

Recommended cross section and specification of control, signal and communication cables:

◆Analog I/O cables: Whole shielded twisted pair, cross section 0.5~1.5 mm^2;

◆Digital I/O cables: Whole shielded twisted pair, cross section 0.5~1.5 mm^2;

◆Communication cables: Select specialized communication according to relevant requirements, or whole shielded twisted pair, cross section 0.5~1.5 mm^2;

4.2.1 General introduction to user terminals

Goodrive5000 series medium voltage variable frequency speed control systems provide standard 16-channel digital inputs, 20-channel relay outputs, 3-channel analog inputs, 4-channel analog outputs, 1-channel HDI and 1-channel HDO. All user terminals are programmable and they can be set by function codes. Simultaneously, the control terminals can be extended as required.

All user terminals are connected to the terminal blocks, so pay attention to connecting from the terminal blocks before using. The wiring of control circuit for users shall be conducted in the control cabinet.

4.2.2 User terminals and functions

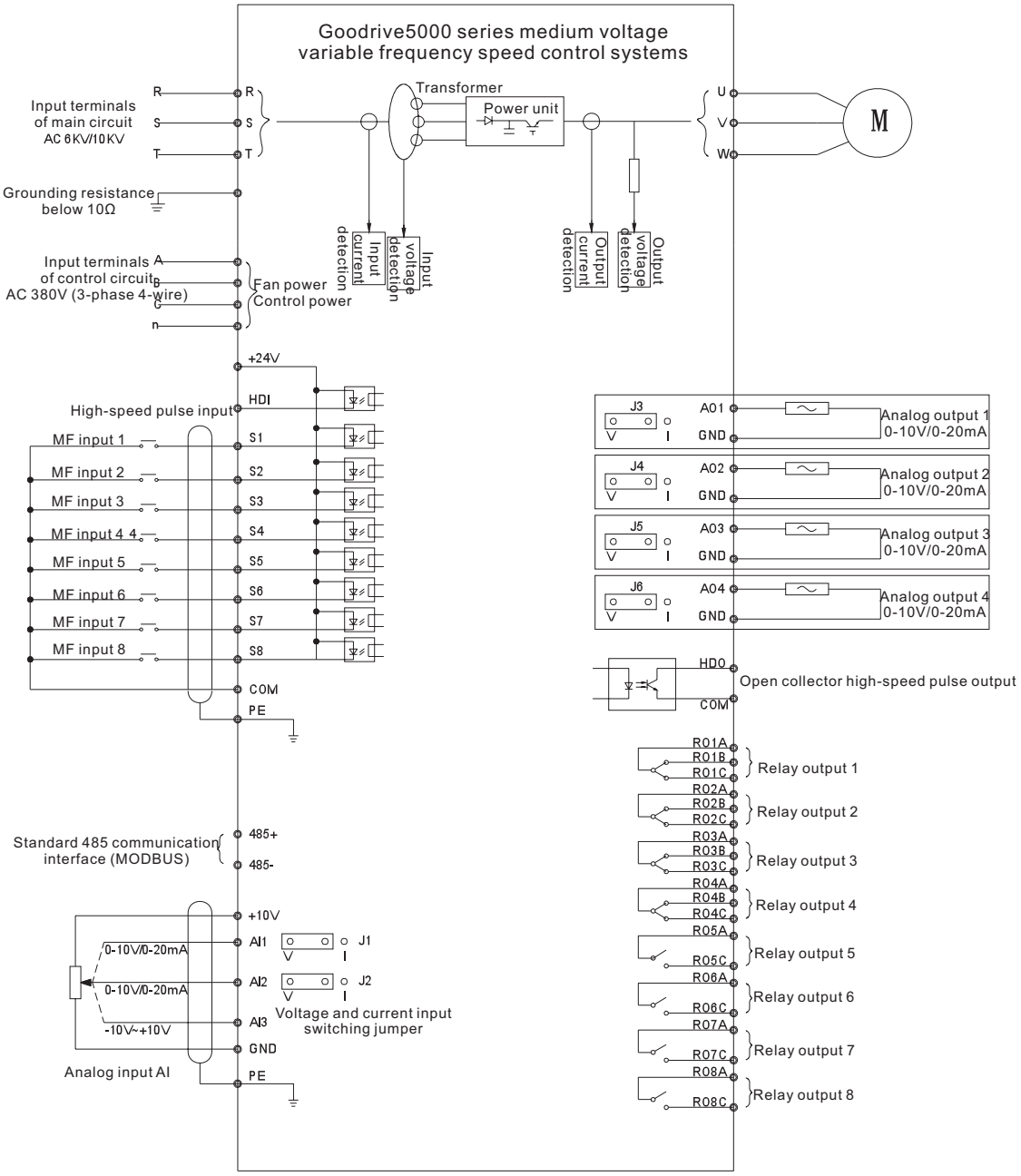


Fig 4.2 Wiring diagram of user terminals

Classification	Terminal	Terminal function	Technical specifications
Digital input	S1	Multi-functional input 1	1. Forming the optical coupler isolation input with COM 2. The input voltage can only be 24V provided by the system 3. The suspension of terminals will be regarded as disconnected 4. Input impedance: 3.3kΩ
	S2	Multi-functional input 2	
	S3	Multi-functional input 3	
	S4	Multi-functional input 4	
	S5	Multi-functional input 5	
	S6	Multi-functional input 6	
	S7	Multi-functional input 7	
	S8	Multi-functional input 8	
High-speed pulse input	HDI	High-speed pulse input terminal	1. Forming the optical coupler isolation input with COM

Classification	Terminal	Terminal function	Technical specifications
			2. The input voltage can only be the 24V provided by the system 3. The suspension of terminals will be regarded as disconnected 4. Input impedance: 1.1kΩ
24V power supply	+24V	+24V power supply provided by the system, for the digital input and high-speed pulse input	
	COM	+24V power supply grounding	
10V power supply	+10V	+10V power supply provided by the system, for the analog input	
	GND	+10V power supply grounding	
Analog input	AI1	Analog input terminal1	1. Forming a loop connection with GND 2. It is recommended to use the +10V provided by the system as the input voltage. 3. For voltage input, voltage range 0~+10V; for current input, current range 0~20mA, 20mA current corresponding to +10V 4. Input impedance: 20kΩ (voltage) /250Ω (current)
	AI2	Analog input terminal 2	
	AI3	Analog input terminal 3	1. Forming a loop connection with GND 2. It is recommended to use the +10V provided by the system as the input voltage. 3. For voltage input, voltage range -10V ~+10V 4. Input impedance: 20kΩ (voltage)
Analog output	AO1	Analog output terminal 1	1. Outputting the voltage and current corresponding to the GND terminals. 2. Output voltage range 0~+10V, output current range 0~20mA 3. While voltage output, allowable output impedance ≥5kΩ; while current output, allowable output impedance 100~5000Ω
	AO2	Analog output terminal 2	
	AO3	Analog output terminal 3	
	AO4	Analog output terminal 4	
Relay output	RO01	Relay output terminal 1	1. Each relay has normally open/closed output. 2. Current withstand capacity: 3A
	RO02	Relay output terminal 2	
	RO03	Relay output terminal 3	
	RO04	Relay output terminal 4	

Classification	Terminal	Terminal function	Technical specifications
	RO05	Relay output terminal 5	
	RO06	Relay output terminal 6	
	RO07	Relay output terminal 7	
	RO08	Relay output terminal 8	
High-speed pulse output	HDO	Programmable high-speed pulse output terminal	1. Optical coupler isolation 2. Maximum output frequency: 50.000kHz

Note:

1. Do not route the analog cables and input power cables in parallel;

2. Do not use the same line for the signal cables and input power cables.

Danger

✧ Installation of large current positions: to enable the variable frequency speed control system to meet the technical properties, pay close attention to large current installation (All I/O terminals with more than 10A current flow shall be considered large current terminals). The key points are:

- ◆ Terminals shall use the materials with excellent conductive property, such as oxygen-free copper terminals, silver-plating or tin-plating fasteners and other connecting materials.
- ◆ All terminals shall be carefully cleaned with ethanol before connecting.
- ◆ Connections of all connectors shall be very reliable, the fasteners shall be tightened with wrenches, the important connectors shall be wrenched tight reliably with torque wrenches to ensure the contact resistance is less than 2mΩ.
- ◆ The fasteners of all large current connecting positions shall include spring washers which will be pressed flat after fastening.
- ◆ The current density of large current wires shall be appropriate to avoid heating and thus influence the device.

Chapter 5 Detailed function description

P00 Group Basic function

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.00	Control mode selection	0: V/F control 1: Sensorless vector control 0 2: Sensorless vector control 1 3: Vector control	0~3	0

Select speed control mode of the variable frequency speed control system.

0: V/F control

V/F is applicable to cases where speed control precision is not required high for general load, such as fans, pumps and synchronous motors, and where a variable frequency speed control system drives multi-motors.

1: Sensorless vector control 0

Sensorless vector control 0 also called open loop vector supports asynchronous motors and applies to the cases requiring high performance without pulse encoders, low-frequency large-torque and high speed control precision. One variable frequency speed control system drives only one motor such as conveyors and large-power drive equipment.

2: Sensorless vector control 1

Sensorless vector control 1 only supports synchronous motors and the inverter should carry out high precision adjustment on output current by close loop control algorithm to make torque and speed output more stable and accurate.

3: Vector control

Vector control supports asynchronous motors, uses encoders as speed detection sensor for higher precision and wider range, and applies to the cases requiring high rotating speed control precision and low-frequency large-torque.

Note: Precise motor parameters are the necessity for vector control with high performance. Therefore, input the name plate parameters of the motor correctly before running and finish motor parameters autotuning. Adjusting P3 vector control group can optimize vector control performance.

Note: At present, only V/F control mode is available for synchronous motors.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.01	Run command channel	0: Local command channel 1: Terminal command channel 2: Communication command channel 3: Master command channel	0~3	0

When the function code is invalid to the terminal R_N of the control cabinet, it is used to select the command channel of the system in remote-local state; when the function code is valid to the terminal R_N, it has nothing to do with P0.01 in local state and the operation is only controlled by the touch screen.

The control commands include: start, stop, forward running, reverse running, jogging, and fault reset and so on.

0: Local command channel

Some functions are available by setting the function codes.

1: Terminal command channel

The control commands including forward running, reverse running, forward jogging, reverse jogging, stop, and fault reset are controlled by multifunctional input terminals. Please refer to detailed settings in P5.

2: Communication command channel

The run command is controlled by P0.02 to select communication methods. Please refer to communication methods in Appendix.

3: Master command channel

The channel is mainly used to set the run command of the slave under master-slave control. If the function code is set to 3, the slave is controlled by the start/stop command of the master.

Note: The touch screen of the system applies Ethernet channel.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.02	Current communication command channel	0: MODBUS 1: Profibus 2: Ethernet	0~2	0

When P0.01=2, the function code is used to select the communication method of frequency setting command channel.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.03	UP/DOWN setting	0: Valid, save when power off 1: Valid, do not save when power off 2: Invalid 3: Valid during running, clear at stop	0~3	0
P0.04	UP/DOWN adjustment	-120.00~120.00Hz	-120.00~120.00	0.00Hz

The function code of UP/DOWN setting (frequency setting increasing/decreasing) can modify the set frequency of the system, adjust any frequency setting except multi-step speed setting and achieve fine adjustment on the set frequency of the system. Actual set frequency of the system=set frequency of channels + adjusted frequency, as shown in Fig5.1.

0: Valid, save UP/DOWN value when power off

Users can adjust the reference frequency by UP/DOWN. The value of UP/DOWN can be saved when power off.

1: Valid, do not save UP/DOWN value when power off

Users can adjust the reference frequency by UP/DOWN, but the value of UP/DOWN will not be saved when power off.

2: Invalid

Users can not adjust the reference frequency by UP/DOWN. The value of UP/DOWN will be cleared.

3: Valid during running, clear at stop

Users can adjust the reference frequency by UP/DOWN during running. When the system stops, the value of UP/DOWN will be cleared

Note: When the parameters of the system restore to default values, the value of UP/DOWN will be cleared automatically.

After the UP/DOWN setting is valid, P0.03 will display the UP/DOWN adjusted value with the range of -120.00~120.00Hz.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.05	Speed reference mode	0: Speed mode 1: Torque mode 2: Slave speed mode 3: Slave torque mode	0~3	0

0: Speed mode. The system will output frequency at the set speed command and the motor will automatically adjust the output torque to keep the speed. But the output torque is limited by P3.12. If the load torque is above the upper limit, the output torque of the system is limited and the motor speed will change.

1: Torque mode. The system will output torque at the set torque command and the output frequency is limited by the upper and lower limit. When the set torque is above the load torque, the output frequency will increase to the upper limit and when the set torque is below the load torque, the output frequency will decrease to the lower limit. If the output frequency of the system is limited, the output torque is different from the set torque.

2~3: Slave speed and torque mode. The two modes have no difference and they are mainly used in the master-slave mode.

Note: During decelerating to stop, the system will switch from torque control mode to speed control mode.

Note: When P12.29=3 (slave) and P0.01=3, the local is the slave.

Note: The torque control mode and speed control mode can also be switched via MF terminals. The torque control mode is only for vector control.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.06	Frequency A command source	0: Function code 1: AI1 2: AI2 3. AI3 4: HDI 5: Multi-step speed 6: PID control 7: MODBUS setting 8: Profibus setting	0~8	0

Goodrive5000 series variable frequency speed control systems have two command sources A and B, A command source is the general channel, B command source is the assistant channel. The combination of P0.06 and P0.07 determines the value of frequency setting. Refer to P0.09 for the way of combination.

0: Function code, frequency A setting is the value of P0.13.

1~3: AI setting, AI1, AI2 and AI3 are programmable analog input terminals. Refer to P5 group for the functions. Whether AI1 and AI2 are current or voltage inputs can be selected by the jumpers.

4: HDI, set frequency=maximum output frequency (P0.10) * percentage. The percentage is determined by input HDI frequency. Refer to P5 group for the function.

5: Multi-step speed, the system runs at multi-step speed and P11.00 will select multi-step speed. P11.00=0, the multi-step speed terminal in P5 will select current step; P11.00=1, P11.18~P11.33 is the current step and P11.01~P11.16 is current frequency (multi-step n frequency=maximum frequency

P0.10 * speed n percentage)

6: PID control, the result of built-in PID module adjustment is the set frequency of the system. See PID source, setting, feedback and parameters in P10.

7: MODBUS setting, set the frequency of frequency A source

8: Profibus setting, set the frequency of frequency A source

Note: The fieldbus card of the system is optional.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.07	Frequency B command source	0: AI1 1: AI2 2: AI3 3: HDI	0~3	0
P0.08	Reference of frequency B	0: Maximum frequency 1: Frequency A command	0~1	0

P0.07 and P0.08 determine the value of B frequency setting. B frequency=Reference of frequency B (P0.08)* Frequency B command source (P0.07).

If P0.07=0, P0.08=0, AI1 input percentage is 50%, max frequency setting is 50Hz, then B frequency= 50Hz×50%=25Hz; P0.07=0, P0.08=1, AI1 input percentage is 50%, frequency A command source is 40Hz, then B frequency=40Hz×50%=20Hz.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.09	Combination of frequency source	0: A 1: B 2: A+B 3: Max(A, B)	0~3	0

P0.09 is used to set the combination of frequency source, and it can be also switched by P5 group, as shown in Fig5.1.

P0.09=0: current frequency is frequency A command;

P0.09=1: current frequency is frequency B command;

P0.09=2: current frequency is frequency A command+B command;

P0.09=3: current frequency is the maximum value between frequency A and B command;

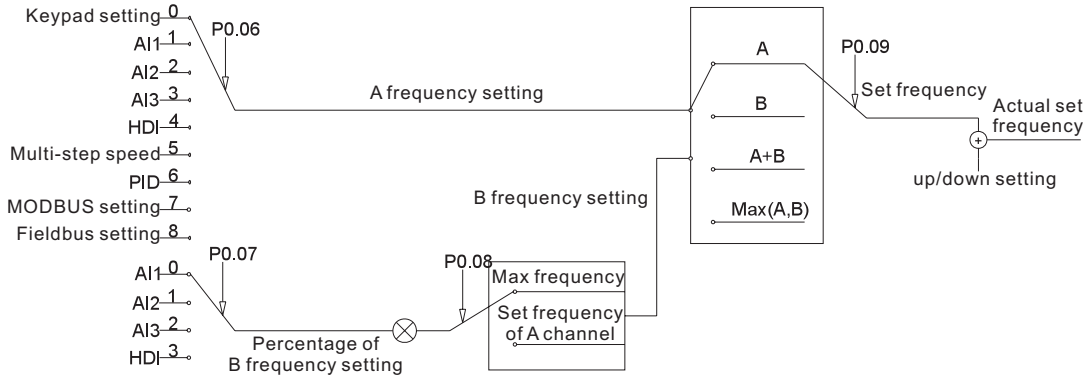


Fig 5.1 Combination of frequency source

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.10	Maximum	P0.11~120.00Hz	P0.11~120.00	50.00Hz

	frequency			

Set the maximum frequency of the system.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.11	Upper frequency limit	P0.12~P0.10 (Max. frequency)	P0.12~P0.10	50.00Hz
P0.12	Lower frequency limit	0.00Hz~P0.11 (upper frequency limit)	0.00~P0.11	0.00Hz

P0.11 and 0.12 are used to set upper and lower frequency limit of the variable frequency speed control system. Pay attention to distinguish upper limit of running frequency from maximum frequency, the former for actual maximum frequency and the latter for set maximum frequency.

Restrictions on the relationship between frequencies: Maximum frequency ≥ upper frequency ≥ set frequency ≥ lower frequency.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.13	Function code set frequency	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	50.00Hz

P0.06=0, the function code is the initial value of frequency setting.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.14	Torque setting	0: Function code 1: AI1 2: AI2 3: AI3 4: HDI 5: Multi-step speed 6: MODBUS setting 7: Profibus setting	0~7	0

In the vector control mode, P0.05=1, torque reference channel can be selected by P0.14. If the torque is set as negative, the torque output direction is reverse to the set running direction.

Note: The set running direction is determined by the reference direction and P0.18.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.15	Function code set torque	-100.0%~100.0%	-100.0~100.0%	100.0%

P0.14=0, P0.15 is used to set the set torque of the system, among which 100.0% corresponds to the rated output current.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.16	Acceleration time 1	0.1~3600.0s	0.1~3600.0	Depend on model
P0.17	Deceleration time 1	0.1~3600.0s	0.1~3600.0	Depend on model

Acceleration time is the time of accelerating from 0Hz to maximum frequency (P0.10). Deceleration time is the time of decelerating from maximum frequency (P0.10) to 0Hz.

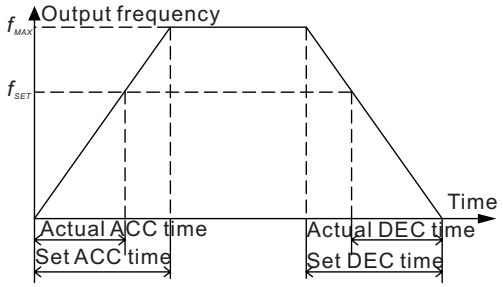


Fig 5.2 Acceleration and deceleration time

When the set frequency (f_{SET}) equals to the maximum frequency (f_{MAX}), the actual acceleration and deceleration time will be in accordance with the set time.

When the set frequency is less than the maximum frequency, the actual acceleration and deceleration time will be less than the set time.

Actual acceleration and deceleration time = set time * (set frequency ÷ maximum frequency)

Goodrive5000 has 4 groups of acceleration and deceleration time.

1st: P0.15, P0.16;

2nd: P8.00, P8.01;

3rd: P8.02, P8.03;

4th: P8.04, P8.05.

The acceleration and deceleration time can be selected by combination of multifunctional ON-OFF input terminals. The default is the first group.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.18	Running direction	0: Run in default direction 1: Run in opposite direction 2: Forbid reverse running	0~2	0

0: Run in default direction, the motor runs in accordance with the actual direction.

1: Run in opposite direction, the motor runs in opposite direction, which is equivalent to changing the direction of motor by changing any two-phase sequence.

Note: After initialization of parameters, the direction of the motor will restore to the original state. Be cautious to use when the motor direction is forbidden to change after commissioning.

2: Forbid reverse running, applicable when reverse running is forbidden, such as in situations which need to switch between power frequency and variable frequency. During forbidding reverse running, the system will enter into standby after receiving reverse running command.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.19	Carrier frequency setting	0.5~2.0kHz	0.5~2.0	0.8kHz

The factory setting is optimal in most cases, so modification of this parameter is not recommended. If the carrier frequency exceeds the factory setting, the system must be derated.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.20	Motor parameters autotuning	0: No action 1: Autotuning	0~1	0

In vector control, to obtain more accurate motor parameters, choose to perform parameters autotuning based on applications.

0: No action, do not perform parameters autotuing

1: Autotuning, release load and then carry out overall parameters autotuing

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.21	Restore parameters	0: No action 1: Restore factory setting 2: Clear fault records 3: Clear ammeter records	0~3	0

The function code can restore the parameters to default values, clear all fault records and ammeter records of the system.

Note: After P0.21 function operation is completed, this function code will restore to 0 automatically. The parameters of P2 group will not restore.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.22	AVR function	0: Disabled 1: Enabled all the time 2: Disabled during deceleration	0~2	1

Note: When AVR (Auto Voltage Regulation) function is disabled, the output voltage of the system will change along with the input voltage; when the function is enabled, the output voltage will keep stable in a certain range; when deceleration time is too long to meet field requirements, cancel AVR function to shorten the time.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P0.23	Reserved	0~65536	0~65536	0
P0.24	Reserved	0~65536	0~65536	0
P0.25	Reserved	0~65536	0~65536	0
P0.26	Reserved	0~65536	0~65536	0
P0.27	Reserved	0~65536	0~65536	0

P01 Group Start and stop control

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.00	Braking mode	0: DC braking 1: Dual-frequency braking (reserved)	0~1	0

The function code is used to set braking modes.

0: DC braking

When the output frequency of the system reaches the starting frequency of DC braking, DC current will run through the stator winding, and the braking torque will generate because the rotor cuts the static magnetic field.

1: Dual-frequency braking (reserved)

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.01	Start mode	0: Start directly	0~2	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		1: Start after DC braking 2: Start after rotating speed tracking		

0: Start directly: Start the motor from the starting frequency.

1: Start after DC braking: The system outputs DC current firstly and then starts the motor at the starting frequency. Please refer to description of P1.04 and P1.05. It is suitable for the motor which have small inertia load and may reverse rotate when start.

2: Start after rotating speed tracking: The system detects the rotation speed and direction of motor, then start running from current speed. This can realize smooth start of rotating motor.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.02	Starting frequency	0.00~10.00Hz	0.00~10.00	0.10Hz
P1.03	Hold time of starting frequency	0.0~50.0s	0.0~50.0	0.0s

The system will start from the starting frequency (P1.02), and then accelerate to the reference frequency on basis of the set acceleration time after hold time of starting frequency (P1.03). The starting frequency could not be limited by the lower frequency.

Increasing the starting torque will avoid the motor cannot start up at 0 frequency.

Note:

1. When the reference frequency is less than starting frequency, the system will have no output.

2. Starting frequency shall not be larger than upper frequency limit; otherwise, the system will have no output to respond to commands. When starting frequency is higher than DC braking frequency, the system will stop and DC braking is invalid; when running frequency is less than starting frequency, the system will coast to stop.

3. No output: during PID hibernation and forbidding reverse running, reference frequency less than starting frequency and lower frequency limit, the system has no frequency and voltage output. When the system satisfies the conditions for restore, it will output.

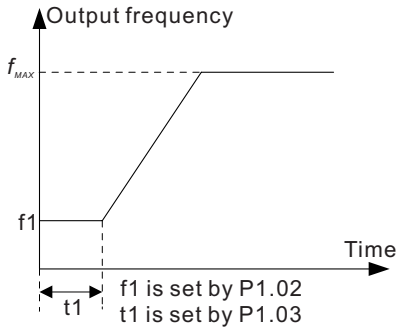


Fig 5.3 Direct start

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.04	DC braking current before start	0.0~120.0% (rated current of the system)	0.0~120.0	0.0%
P1.05	DC braking time	0.0~50.0s	0.0~50.0	0.0s

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	before start			

P1.04: Before start, the value of DC braking current is the percentage of rated current of the variable frequency speed control system.

P1.05: It is duration of DC braking before start. DC braking is invalid when P1.05 is set to be 0.

Note: 1. Only on condition that both P1.04 and P1.05 are non-zero is DC braking current before start valid.

2. The bigger the DC braking current, the greater the braking torque. However, the motor will also produce great heat, so set the function code properly according to actual conditions.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.06	ACC/DEC mode	0: Linear type 1: S curve	0~1	0

0: Linear type, output speed increases or decreases as a straight line, acceleration=maximum frequency ÷ ACC (DEC) time

1: S curve, output speed changes as S curve. S curve is applicable when smooth start and stop are required, such as hoisters and belt conveyors.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.07	S curve starting-segment proportion	1.0~40.0% (ACC/DEC time)	1.0~40.0	30.0%
P1.08	S curve ending-segment proportion	1.0~40.0% (ACC/DEC time)	1.0~40.0	30.0%

S curve can directly influence whether the system starts and stops at load smoothly. The parameters of S curve are ACC and DEC parameters, as shown in Fig 5.4. In the figure, t1 (t1=t*P1.07) is the DEC/ACC time defined by P1.07, the rate of output frequency variation increases progressively; t2 (t2=t*P1.08) is the DEC/ACC time defined by P1.08, the rate of output frequency variation decreases progressively. During t1 and t2, the rate of output frequency variation is constant. The shape of S curve is determined by ACC/DEC frequency range, ACC/DEC time, starting-segment time and ending-segment time.

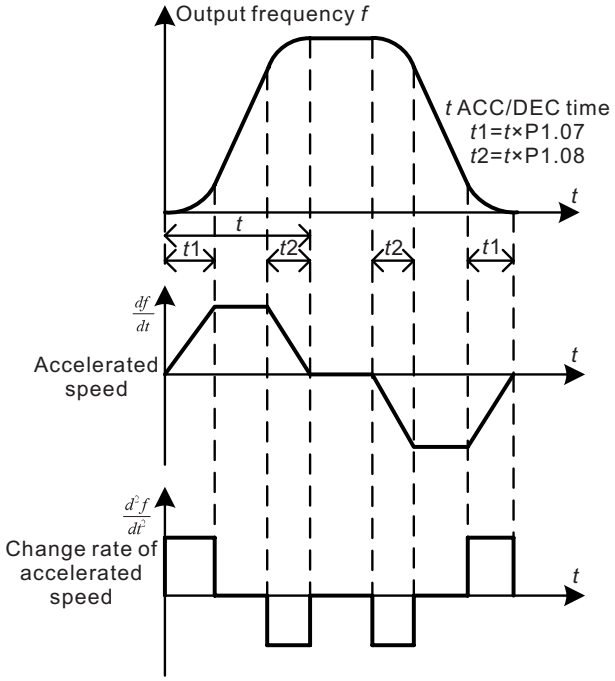


Fig 5.4 ACC/DEC of S curve

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.09	Stop mode	0:Decelerate to stop 1:Coast to stop	0~1	0

0: Decelerate to stop

When the stop command becomes valid, the system decreases the output frequency according to defined DEC curve. If there is no DC braking at stop, the system will coast to stop when running frequency reaches starting frequency; otherwise, it will coast to stop after DC braking.

1: Coast to stop

When the stop command becomes valid, the system will block output immediately and the motor will coast to stop by mechanical inertia.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.10	Starting frequency of stop braking	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	0.00Hz
P1.11	Waiting time before stop braking	0.0~50.0s	0.0~50.0	0.0s
P1.12	Stop DC braking current	0.0~120.0% (rated current of the system)	0.0~120.0	0.0%
P1.13	Stop DC braking time	0.0~50.0s	0.0~50.0	0.0s

Starting frequency of stop braking: During deceleration, start the DC braking when running frequency reaches the starting frequency. If the value of stop braking starting frequency is 0 or lower than starting frequency (P1.02), DC braking is invalid; the variable frequency speed control system will coast to stop when running frequency reaches starting frequency.

Waiting time before DC braking: The system will block output before reaching starting frequency of stop

braking during DEC and the DC braking will start after the waiting time, which prevents over-current fault caused by DC braking at high speed.

Stop DC braking current: The added DC braking current. The bigger the DC braking current, the greater the braking torque.

Stop DC braking time: The time for DC braking

Note: Only on condition that both P1.12 and P1.13 are non-zero is stop DC braking valid.

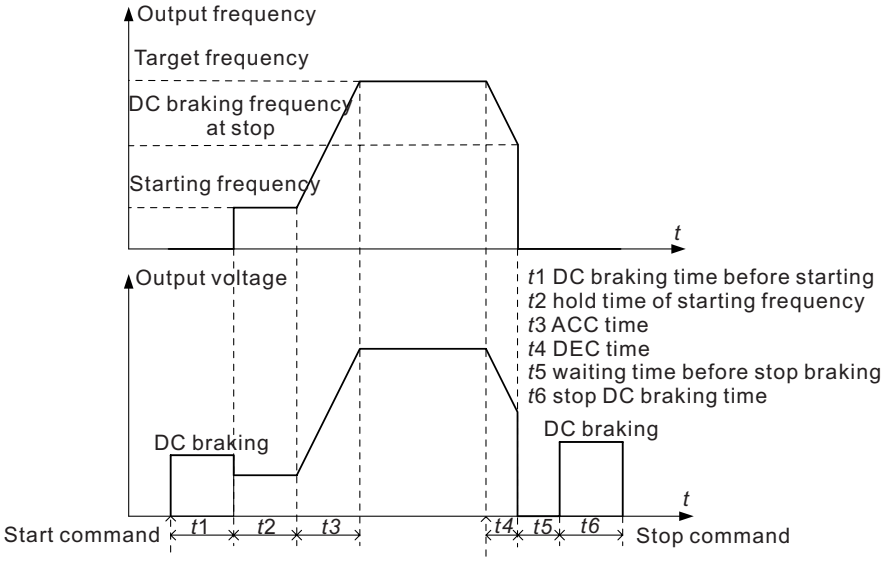


Fig 5.5 Stop DC braking

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.14	Torque of dual-frequency braking	0.0%~50.0%	0.0~50.0	30.0%
P1.15	Enabling voltage of dual-frequency braking	1000~1500V	1000~1500	1130V
P1.16	Dual-frequency frequency of dual-frequency braking	200.0~500.0Hz	200.0~500.0	300.0Hz
P1.17	Reserved	0~65536	0~65536	0
P1.18	Dual-frequency voltage limit of dual-frequency braking	50.0%~100.0%	50.0~100.0	80.0%
P1.19	Proportional coefficient of dual-frequency braking	0~65536	0~65536	5
P1.20	Integral coefficient of dual-frequency	0~65536	0~65536	2

	braking			
P1.21	Adjusting multiple of dual-frequency braking	0~65536	0~65536	2
P1.22	Reserved	0~65536	0~65536	0
P1.23	Reserved	0~65536	0~65536	0

When the dual-frequency braking is valid and the bus voltage exceeds P1.15, the inverter starts outputting dual-frequency frequency to reduce bus voltage. At the time, dual-frequency voltage amplitude output should not exceed P1.18 (relative to motor rated voltage) and dual-frequency frequency output is P1.16. In vector mode, when P1.14 is large, dual-frequency braking deceleration will be faster; in V/F mode, the function code is invalid.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.24	Dead time of FWD/REV	0.0~3600.0s	0.0~3600.0	1.0s

Set the hold time at zero frequency in the transition between forward and reverse running. It is shown as following figure:

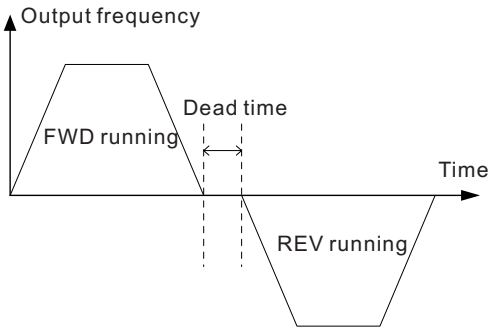


Fig 5.6 FWD/REV dead time

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.25	Action when running frequency is less than lower frequency limit (valid when lower frequency limit > 0)	0: Run at the lower frequency limit 1: Stop 2: Stand-by	0~2	0

This function code determines the running state of the variable frequency speed control system.

0: Run at the lower frequency limit. The reference frequency is equal to lower frequency limit;

1: Stop. The system will coast to stop when it decelerates to lower frequency limit;

2: Stand-by. The system will stand by when the reference frequency is less than lower frequency limit (refer to Note 3 in P1.03). When the reference frequency is higher than or equal to lower frequency limit again, the system will start to run automatically.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.26	Restart after power off	0: Disabled 1: Enabled	0~1	0
P1.27	Instantaneous power off time	0.00~5.00s	0.00~5.00	1.00s
P1.28	Delay time for restart	0.0~3600.0s (valid when P1.26=1)	0.0~3600.0	1.0s

Note: If the main circuit of the system powers off, the steps for processing are as follows:

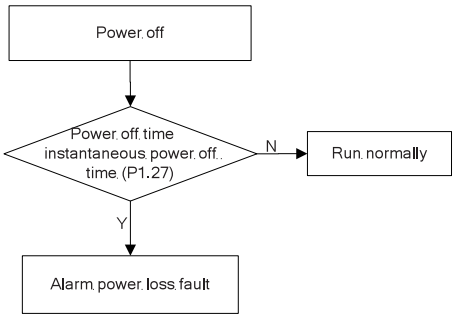


Fig 5.7 Processing after power off

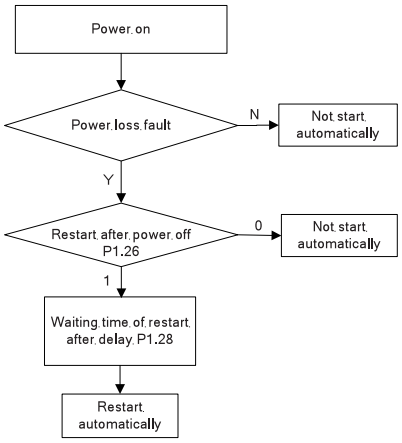


Fig 5.8 Restart after power off

P1.26 is the action when the system powers off and on again during running.

0: Disabled: The system will not automatically restart when power on again.

1: Enabled: When the system is running, after power off and power on again, the system will automatically restart after delay time for restart (P1.28) (If the system is terminal control, must ensure that the running terminals are still in closed state), otherwise the system will not automatically restart.

Note: This function may cause serious consequences, please use it with cautions.

P1.27 is the instantaneous power off time. If the power off time is no more than the set time, the system can work normally and it will not alarm power off.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.29	High voltage switching action at stop	0: Cut off high voltage supply 1: Not cut off high voltage supply	0~1	0

P1.29 decides whether to cut off high voltage at stop.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.30	Waiting time of switching on	0.0~3600.0s	0.0~3600.0s	10.0s

P1.30 refers to the waiting time from responding to power frequency into variable frequency properly to sending out switching on signals. It is used to protect the units from impact caused by a short time in switching on twice continuously.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.31	Waiting time of running readiness	0.0~3600.0s	0.0~3600.0s	10.0s

The waiting time of running readiness is the time from finishing charging of the bus to sending signals of running readiness to upgrade DCS after vacuum contactor high voltage switching on.

The time is used to make sure DC bus charging completely so as to reduce voltage surge of the grid.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P1.32	Reserved	0~65536	0~65536	0
P1.33	Reserved	0~65536	0~65536	0
P1.34	Reserved	0~65536	0~65536	0
P1.35	Command source of coast to stop	0: No 1: UDP 2: Internal command 3: Terminal 4: Modbus 5: Profibus	0~5	0
P1.36	Command source of decelerate to stop	0: No 1: UDP 2: Terminal 3: Modbus 4: Profibus	0~4	0

P1.35 and P1.36 are used to check the current command source of coast to stop and decelerate to stop and cleared in next start.

P02 Group Motor parameters 1

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P2.00	Motor 1 type	0: Asynchronous motor 1: Synchronous motor	0~1	0

Note: The motor parameters are particularly important in motor protection and the voltage output, so be sure to set the parameters in accordance with the set parameters. When P2.00 is asynchronous motors, the parameters of synchronous motors are unmodifiable; when P2.00 is synchronous motors, the parameters of asynchronous motors are unmodifiable.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P2.01	Rated power of	4~50000kW	4~50000	Depend

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	asynchronous motor 1			on model
P2.02	Rated frequency of asynchronous motor 1	0.01Hz~P0.10 (Max. frequency)	0.01~P0.10	50.00Hz
P2.03	Rated speed of asynchronous motor 1	1~36000rpm	1~36000	Depend on model
P2.04	Rated voltage of asynchronous motor 1	0~20000V	0~20000	Depend on model
P2.05	Rated current of asynchronous motor 1	0.1~1000.0A	0.1~1000.0	Depend on model

In order to achieve control performance, the system needs to match with the motor at power. If the bias is too big, the control performance of the system will decrease distinctly.

Note: Resetting motor rated power (P2.01) can initialize P2.06~P2.10 automatically.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P2.06	Stator resistance of asynchronous motor 1	0.001~65.535Ω	0.001~65.535	Depend on model
P2.07	Rotor resistance of asynchronous motor 1	0.001~65.535Ω	0.001~65.535	Depend on model
P2.08	Inductance of asynchronous motor 1	0.1~6553.5mH	0.1~6553.5	Depend on model
P2.09	Mutual inductance of asynchronous motor 1	0.1~6553.5mH	0.1~6553.5	Depend on model
P2.10	Non-load current of asynchronous motor 1	0.01~655.35A	0.01~655.35	Depend on model

The parameters from P2.06~P2.10 have a great impact on control performance in vector control. During initialization, the system will confirm a group of initial parameters. After motor autotuning, the parameters will be updated and saved automatically and users should not modify them. Be sure not to change P2.06~P2.10 in V/F control.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P2.11	Rated power of synchronous motor	4~50000kW	4~50000	Depend on

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	1			model
P2.12	Rated frequency of synchronous motor 1	0.01Hz~P0.10 (Max. frequency)	0.01~P0.10	50.00Hz
P2.13	Rated speed of synchronous motor 1	0~36000rpm	0~36000	1500rpm
P2.14	Number of pole pairs for synchronous motor 1	1~50	1~50	2
P2.15	Rated voltage of synchronous motor 1	0~20000V	0~20000	Depend on model
P2.16	Rated current of synchronous motor 1	0.1~1000.0A	0.1~1000.0	Depend on model

Note: The motor parameters are particularly important in motor protection and the voltage output, so be sure to set the parameters in accordance with the set parameters.

In order to achieve control performance, the system needs to match with the motor at power. If the bias is too big, the control performance of the system will decrease distinctly.

Note: Resetting motor rated power (P2.11) can initialize P2.17~P2.20 automatically.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P2.17	Stator resistance of synchronous motor 1	0.001~65.535Ω	0.001~65.535	Depend on model
P2.18	Direct axis inductance of synchronous motor 1	0.1~6553.5mH	0.1~6553.5	Depend on model
P2.19	Quadrature axis inductance of synchronous motor 1	0.1~6553.5mH	0.1~6553.5	Depend on model
P2.20	Back emf constant of synchronous motor 1	0~20000V/1000rpm	0~20000	15000 V/1000rpm

The parameters from P2.17~P2.20 are reserved in V/F control.

P03 Group Vector control

Only in V/F control are the parameters of P03 valid. (P0.00＝1)

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P3.00	Speed loop proportional gain 1	0~100	0~100	25
P3.01	Speed loop integral time 1	0.01~10.00s	0.01~10.00	1.00s
P3.02	Low switching frequency	0.00Hz~P3.05	0.00~P3.05	5.00Hz
P3.03	Speed loop proportional gain 2	0~100	0~100	30
P3.04	Speed loop integral time 2	0.01~10.00s	0.01~10.00	1.00s
P3.05	High switching frequency	P3.02~P0.10 (Max. frequency)	P3.02~P0.10	10.00Hz

Under P3.02, PI is P3.00 and P3.01. Above P3.05, PI is P3.03 and P3.04. Between P3.02 and P3.05, PI changes according to the 2 groups of parameters:

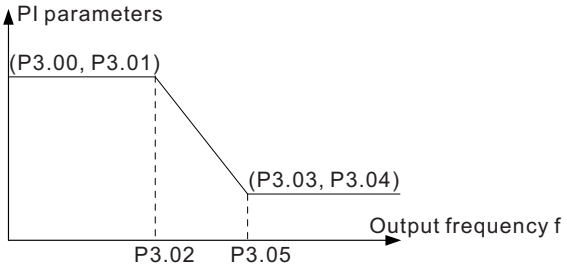


Fig 5.9 PI parameters

Dynamic response of speed loop in vector control is adjustable by setting the proportional coefficient and integral time in speed regulator. Either increasing proportional gain or decreasing integral time can accelerate dynamic response, but too large proportional gain or too low integral time will cause oscillation easily and speed offset may occur.

PI parameters have a close relationship with the inertia of the system. Adjust them on basis of different loads to meet all requirements.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P3.06	Current loop proportional gain P	0~65535	0~65535	500
P3.07	Current loop integral time I	0~65535	0~65535	500

Above two function codes are parameters of current loop PI. They directly influence dynamic response speed and control precision. Generally, it is unnecessary for users to modify default values.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P3.08	Speed loop filter time	0.000~1.000s	0.000~1.000	0.000s

The function code is the filter time of speed detection for suppressing interference from encoders. If the interference is great, set the time appropriately.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P3.09	VC slip compensation factor	50.0%~200.0%	50.0~200.0	100.0%

The slip compensation factor is used to adjust the slip frequency in vector control and improve speed control precision. Adjusting the parameter appropriately can suppress speed offset.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P3.10	Reserved	0~65535	0~65535	0
P3.11	Reserved	0~65535	0~65535	0
P3.12	Upper torque limit	0.0~200.0% (rated current of the system)	0.0~200.0%	150.0%

P3.12 is used to set the upper torque limit, 100% corresponding to rated output current of the system.

Note: The larger P3.12, the better the speed tracking performance. But too large upper torque limit will easily cause overcurrent.

Note: P3.12 is valid in the speed control mode. In the torque mode, actual output torque=set torque percentage*P3.12.

P04 Group V/F control

Only in V/F control are the parameters of P04 valid. (P0.00＝0)

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.00	V/F curve	0: Straight line V/F curve 1: Multi-dots V/F curve 2:1.3th power low torque V/F curve 3:1.7th power low torque V/F curve 4:2.0th power low torque V/F curve 5: Customized (V/F separation)	0~5	0

0: Straight line V/F curve. It is applicable for constant torque load.

1: Multi-dots V/F curve. It can be defined by setting P4.05~P4.10.

2~4: Multi-power V/F curve. It is applicable for variable torque load, such as fans, pumps and so on. Please refer to following figure.

5: Customized (V/F separation)

Note: The V_b corresponds to motor rated voltage; f_b corresponds to motor rated frequency in the figure below.

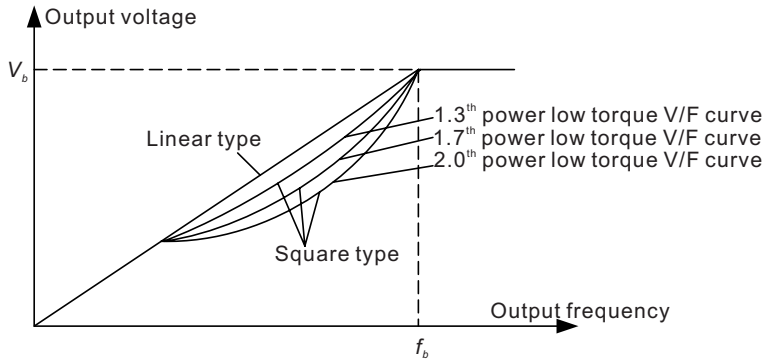


Fig 5.10 V/F curves

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.01	Torque boost	0.0%: (automatic) 0.1%~10.0%	0.0~10.0	0.5%
P4.02	Torque boost cut-off	0.0%~50.0% (relative to motor rated frequency)	0.0~50.0	20.0%

To compensate the torque performance at low frequency, boost compensation is the necessity to output voltage.

When P4.01 is non-zero, the system is manual torque boost. The V/F curve after boost is shown as follows (less than P4.02, the value of torque boost is determined by P4.01 and current frequency.). Torque boost can improve the low-frequency torque V/F performance.

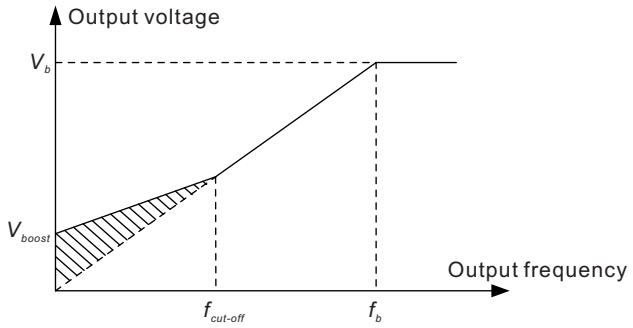


Fig 5.11 Manual torque boost

Set the value of torque boost according to loads. The heavier the load, the larger the value needs to be set. But too large torque boost will cause over excitation and overheat of the motor or the inverter would be tripped by over-current.

Note: When torque boost=0.0%, the system is automatic torque boost and it is valid in the whole frequency range.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.03	V/F slip compensation	0.0~200.0%	0.0~200.0	0.0%

The parameter can compensate motor speed changes which results in the variation of loads to improve the mechanical rigidity of the motor. The value is set to motor rated slip, which can be calculated as below:

P4.03= (fb-n*p/60)/ fb*100%

Among which fb is motor rated frequency (P2.02), n is motor rated speed (P2.03), and p is pole pairs.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.04	Energy saving operation	0: Energy saving invalid 1: Energy saving valid	0~1	0

Energy saving operation: When the motor is running with light load or without load, output voltage will be reduced appropriately to save energy.

Note: The function has a particular effect to fans, pumps etc.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.05	V/F frequency 1	0.00Hz~P4.07	0.00~P4.07	0.00Hz
P4.06	V/F voltage 1	0.0%~P4.08	0.0~P4.08	0.0%
P4.07	V/F frequency 2	P4.05~P4.09	P4.05~P4.09	0.00Hz
P4.08	V/F voltage 2	P4.06~ P4.10	P4.06~P4.10	0.0%
P4.09	V/F frequency 3	P4.07~P2.02 (motor rated frequency)	P4.07~P2.02	0.00Hz
P4.10	V/F voltage 3	P4.08~100.0% (motor rated voltage)	P4.08~100.0	0.0%

P4.05~P4.10 are used to set the user-defined V/F curve. The value needs to be set according to the load characteristic of the motor.

Note: V1 < V2 < V3, f1 < f2 < f3. The voltage corresponding to low frequency shall not be set too high; otherwise, it may cause motor overheat or burnout, or the system overcurrent protection.

Note: Set (P4.09, P4.10) at first, then (P4.07, P4.08), and finally (P4.05, P4.06)

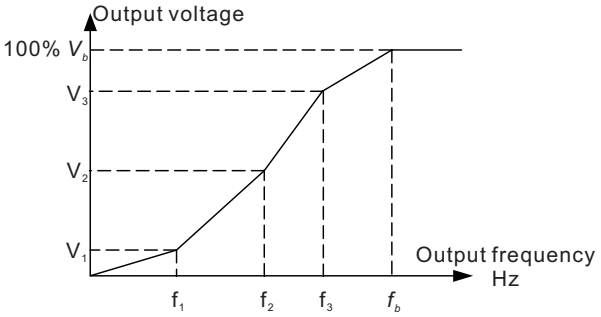


Fig 5.12 V/F curve setting

Note: V/F voltage is relative to the percentage of motor rated voltage (P2.04).

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.11	PWM mode	0: PWM 1 1: PWM 2	0~1	0

P4.11 is used to select the mode of modulating waves.

0: SPWM 1, sine waves with triple-harmonics

1: SPWM 2, standard sine waves

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.12	Voltage setting channel	0: Keypad 1: AI1 2: AI2 3: AI3 4: HDI1	0~8	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		5: Multi-step speed 6: PID 7: MODBUS communication 8: PROFIBUS communication		

When V/F curve separates (P4.00=5), select the voltage setting channel.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.13	Voltage setting by keypad	0.0%~100.0% (motor rated voltage)	0.0~100.0	20.0%

When P4.12=0, the voltage is set by keypad (touch screen).

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.14	Voltage increasing time	0.0s~3600.0s	0.0~3600.0	100.0s
P4.15	Voltage decreasing time	0.0s~3600.0s	0.0~3600.0	100.0s

Voltage increasing time refers to the time the system needs to accelerate from 0V to motor rated voltage while voltage decreasing time refers to the time the system needs to decelerate from motor rated voltage to 0V.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P4.16	Minimum output voltage	0.0%~P4.17	0.0~P4.17	5.0%
P4.17	Maximum output voltage	P4.16~100.0%	P4.16~100.0	100.0%

The function codes are used to set the upper and lower voltage limit.

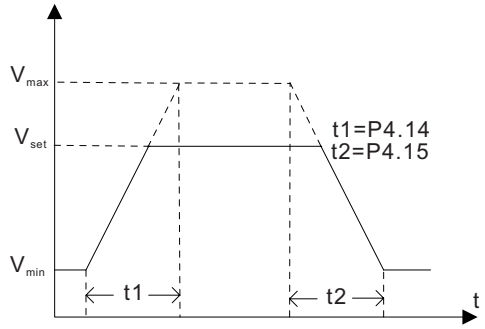


Fig 5.13 Setting diagram of upper and lower voltage limit

P05 Group Input terminals

Goodrive5000 series variable frequency speed control systems provide 16 MF digital input terminals, 3 AI terminals and 1 HDI terminal for users.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.00	S1 terminal	0: Invalid	0~63	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	function	1: Forward running 2: Reverse running 3: 3-wire control 4: Forward jogging 5: Reverse jogging 6: Coast to stop (emergency stop) 7: Fault reset 8: External fault NO input 9: External fault NC input 10: Frequency increase (UP) 11: Frequency decrease (DOWN) 12: Clear UP/DOWN 13: Clear UP/DOWN (temporary) 14: ACC/DEC time selection 1 15: ACC/DEC time selection 2 16: Multi-step speed terminal 1 17: Multi-step speed terminal 2 18: Multi-step speed terminal 3 19: Multi-step speed terminal 4 20: Multi-step speed pause 21: Switch between A and B 22: Switch between (A+B) and A 23: Switch between (A+B) and B 24: Variable frequency running (pulse signal ↑) 25: Power frequency running (pulse signal ↑) 26: Switching from variable frequency to power frequency (pulse signal ↑) 27: Switching from power frequency to variable frequency (pulse signal ↑) 28: High voltage breaking input (pulse signal) 29: PID pause 30: Reserved 31: Reserved 32: Switch cabinet address 0 33: Switch cabinet address 1 34: Switch cabinet address 2 35: Running command switching to the local 36: Running command switching to terminals 37: Running command switching to		
P5.01	S2 terminal function		0~63	0
P5.02	S3 terminal function		0~63	0
P5.03	S4 terminal function		0~63	0
P5.04	S5 terminal function		0~63	0
P5.05	S6 terminal function		0~63	0
P5.06	S7 terminal function		0~63	0
P5.07	S8 terminal function		0~63	0
P5.08	S9 terminal function		0~63	0
P5.09	S10 terminal function		0~63	0
P5.10	S11 terminal function		0~63	0
P5.11	S12 terminal function		0~63	0
P5.12	S13 terminal function		0~63	0
P5.13	S14 terminal function		0~63	0
P5.14	S15 terminal function		0~63	0
P5.15	S16 terminal function		0~63	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		communication 38: Reserved 39: Reserved 40: Torque control disabled 41: Master-slave control enabled (reserved) 42: Master-slave speed synchronous counter reset terminal (reserved) 43: ACC/DEC disabled 44: Vacuum contactor KM2 feedback 45: Commissioning signal input 46: Reserved 47: Reserved 48: QF1M1 feedback 49: QF1M2 feedback 50: QF1M3 feedback 51: QF1M4 feedback 52: QF1M5 feedback 53: QF1M6 feedback 54: QF1M7 feedback 55: QF1M8 feedback 56: QF2M1 feedback 57: QF2M2 feedback 58: QF2M3 feedback 59: QF2M4 feedback 60: QF2M5 feedback 61: QF2M6 feedback 62: QF2M7 feedback 63: QF2M8 feedback		

The parameters are used to set the functions of MF input terminals.

0: Invalid

1: Forward running (FWD)

2: Reverse running (REV)

3: 3-wire control

1~3 are valid when running command channel is set to terminals. Please refer to description of P5.18.

4: Forward jogging

5: Reverse jogging

The terminals are used to select the states of jogging. Please refer to description of P8.06~P8.08.

6: Coast to stop (emergency stop)

When the command takes effect, the system will block output immediately. For large inertia loads and without limit to stop time, it is advised to apply the method. It has the same meaning as P1.09. If the terminal command is not cancelled, the system cannot start.

7: Fault reset

It is used for long distance fault reset. If the terminal acts, the system will perform fault reset. The function

is pulse triggering, a pulse rising time for reset once.

8: External fault NO input

9: External fault NC input

Above two functions are for receiving external faults. If the external alarms fault, the system will generate external fault signals and act according to P9.02. As for external fault NO input, the terminal on indicates no fault while the terminal off indicates external faults. External fault NC input is opposite.

10: Frequency increase (UP)

11: Frequency decrease (DOWN)

12: Clear UP/DOWN

13: Clear UP/DOWN (temporary)

Above four are used to adjust the frequency by external terminals. (Refer to description of P0.02 and P0.03) Up is frequency increase and DOWN is frequency decrease. (Refer to description of P5.19 and P5.20)

Clear UP/DOWN: The terminal is used to clear the value of setting by UP / DOWN.

Clear UP/DOWN (temporary): The terminal is used to clear the value of setting by UP/DOWN temporarily when it is valid. The frequency value goes back to normal when the terminal is invalid

14, 15: ACC/DEC time selection 1 and 2

Four groups of ACC/DEC time can be selected by the combination of these two terminals.

Terminal 2	Terminal 1	ACC/DEC time selection	Corresponding parameters
OFF	OFF	ACC/DEC time 1	P0.16, P0.17
OFF	ON	ACC/DEC time 2	P8.00, P8.01
ON	OFF	ACC/DEC time 3	P8.02, P8.03
ON	ON	ACC/DEC time 4	P8.04, P8.05

16~19: Multi-step speed terminal 1~4

16-step speed can be set by the combination of these four terminals. See detailed instructions of multi-step speed parameters in P0 and P11.

Note: Multi-step speed 1 is low bit, and multi-step speed 4 is high bit.

Multi-step speed terminal 4	Multi-step speed terminal 3	Multi-step speed terminal 2	Multi-step speed terminal 1
BIT3	BIT2	BIT1	BIT0

20: Multi-step speed pause

Once the terminal is enabled, whatever multi-step speed terminals or analog terminals change, the set frequency keeps in current step.

21: Switch between A and B

22: Switch between (A+B) and A

23: Switch between (A+B) and B

Switching the channel of frequency can be realized by three terminals.

When the system frequency is given by A-channel and the terminal 21 acts, the channel of frequency setting will switch to B-channel; after the terminal 21 returns, the channel of frequency setting will switch to A-channel. The terminals 22 and 23 are invalid.

When the system frequency is given by B-channel and the terminal 21 acts, the channel of frequency setting will switch to A-channel; after the terminal 21 returns, the channel of frequency setting will switch to B-channel.

The functions of terminals 22 and 23 are similar to the function of 21.

24: Variable frequency running

The system changes from switch off state to variable frequency state by pulse signal of the terminal, that is to say, KM1, KM2, KM3 and KM4 off at first, then KM1, KM2 and KM3 on (KM4 still off). If system is under other states, the terminals are invalid.

25: Power frequency running

The system changes from switch off state to power frequency state by pulse signal of the terminal, that is to say, KM1, KM2, KM3 and KM4 off at first, then KM4 on. If system is under other states, the terminals are invalid.

26: Switching from variable frequency to power frequency

The system switches from variable frequency to power frequency by pulse signal of the terminal, that is to say, KM1, KM2, KM3 on and KM4 off at first, then KM4 on and KM1, KM2 and KM3 off. If system is under other states, the terminals are invalid.

27: Switching from power frequency to variable frequency

The system switches from power frequency to variable frequency by pulse signal of the terminal, that is to say, KM1, KM2, KM3 off and KM4 on at first, then KM4 off and KM1, KM2 and KM3 on. If system is under other states, the terminals are invalid.

Note: 24~27 are valid only for the system with isolated automatic switch cabinet. If no, they are invalid.

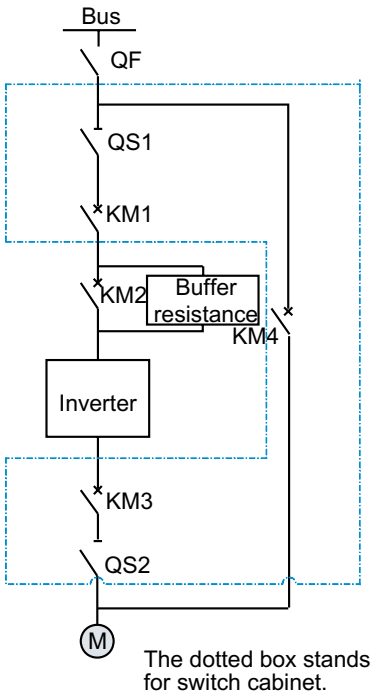


Fig 5.14 Switch cabinet

28: High voltage breaking input (pulse signal)

If the terminal is valid, the system will automatically cut off the power.

29: PID pause

PID invalid, the system will keep the current output frequency.

30~31: Reserved

32: Switch cabinet address 0

33: Switch cabinet address 1

34: Switch cabinet address 2

Take the combinations of 0 and 1 of 3 switch cabinet addresses (000~111, 8 combinations in total) as the number of 1~8 switch cabinets.

35: Running command switching to the local

If the terminal is valid, the running command channel of the system will be forced to switch into UDP.

36: Running command switching to terminals

If the terminal is valid, the running command channel will be forced to switch into terminals.

37: Running command switching to communication

If the terminal is valid, the running command channel will be forced to switch into communication command channel specified in P0.22.

Note: Above channel switching is valid only when the remote-local switch is at remote.

38~39: Reserved

40: Torque control disabled

The control mode will switch from torque control to speed control if the terminal is valid. In actual application, the terminal can be used to switch between speed control and torque control.

41: Master-slave control enabled (reserved)

42: Master-slave speed synchronous counter reset terminal (reserved)

43: ACC/DEC disabled

The system will not be affected by external frequency source if the function is valid.

44: Vacuum contactor KM2 feedback

The system will be installed with buffer cabinet if the function is valid.

Note: If the system is installed with buffer cabinet, confirm which MF input terminal the buffer cabinet feedback is connected to according to on-site wiring and set corresponding terminal to 44; otherwise, buffer resistance may emit heat or even burn out after working too long.

45: Commissioning signal input

46~47: Reserved

48: QF1M1 feedback

49: QF1M2 feedback

50: QF1M3 feedback

51: QF1M4 feedback

52: QF1M5 feedback

53: QF1M6 feedback

54: QF1M7 feedback

55: QF1M8 feedback

56: QF2M1 feedback

57: QF2M2 feedback

58: QF2M3 feedback

59: QF2M4 feedback

60: QF2M5 feedback

61: QF2M6 feedback

62: QF2M7 feedback

63: QF2M8 feedback

48 and 56 are vacuum breaker feedback of QF1M1 at variable frequency side and QF2M1 at power frequency side of switch cabinet 1 (main switch cabinet). When P15.01=1, variable frequency and power frequency share the power. As long as either QF1M1 or QF2M1 feedback switches on, the common vacuum breaker will switch off. As long as both QF1M1 and QF2M1 feedback switch off, the common vacuum breaker will switch off. When P15.01=0, variable frequency and power frequency do not share the power. QF1M1 and QF2M1 feedback indicates the states of vacuum breakers respectively, high electrical level standing for switching on and low electrical level for switching off.

49~55: QF1M2~ QF1M8 feedback

States of vacuum breaker feedback at variable frequency sides of switch cabinets 2~8

57~63: QF2M2~ QF2M8 feedback

States of vacuum breaker feedback at power frequency sides of switch cabinets 2~8

Note: If the system is installed with vacuum breakers, set vacuum contactor feedback to corresponding vacuum breaker feedback according to on-site wiring.

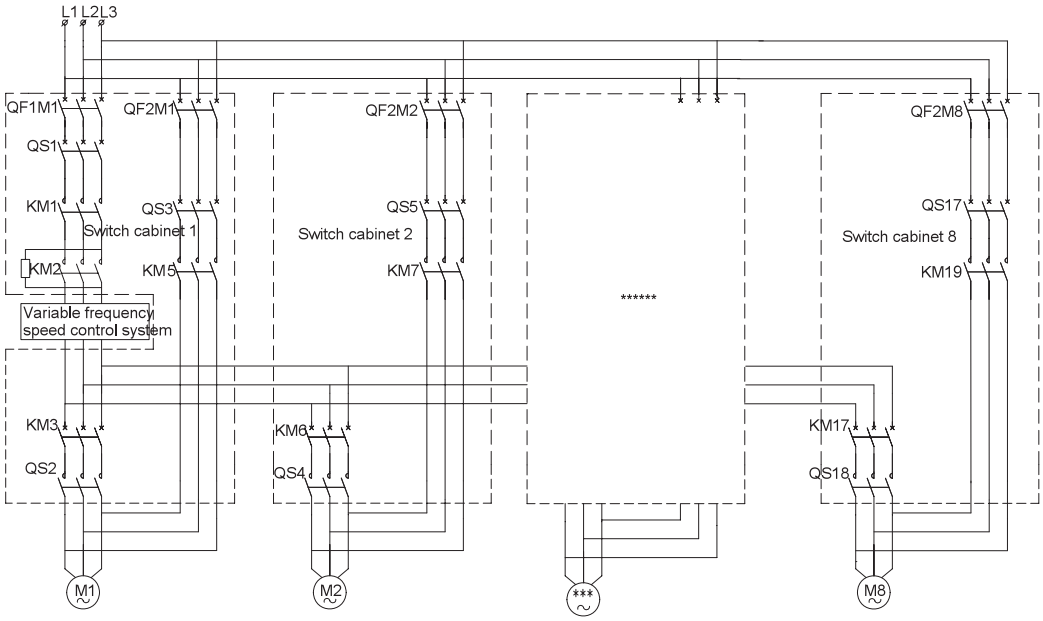


Fig 5.15 One-drive-more control

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.16	Polarity of input terminal	0x0000~0xFFFF	0000~FFFF	0000

The function code is used to set polarity of ON/OFF input terminals, each terminal takes up one bit, 0: NO contact, 1: NC contact.

S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1
BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.17	Filter time of digital signal	1~500	1~500	20

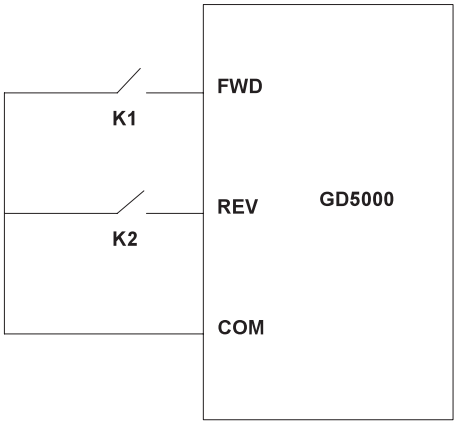
The function code is used to set filter time of S1~S16 terminals sampling. In the case of strong interference, increasing the parameter can prevent incorrect operation.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.18	Terminal control run mode	0: Two-wire control mode 1 1: Two-wire control mode 2 2: Three-wire control mode 1 3: Three-wire control mode 2	0~3	0

This parameter defines four different control modes that control the system through external terminals.

0: Two-wire control mode 1

Enabling and direction are combined together. This is the most frequently used two-wire mode. Whether the motor is forward or reverse running is determined by FWD and REV terminal commands.

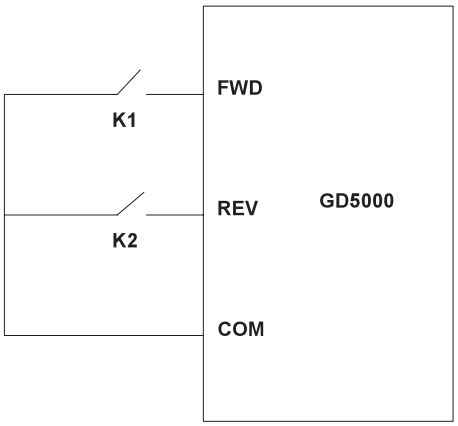


K1	K2	Running command
OFF	OFF	Stop
OFF	ON	REV running
ON	OFF	FWD running
ON	ON	Stop

Fig 5.16 Two-wire control (enabling and direction combined)

1: Two-wire control mode 2

Enabling is separated from direction. START/STOP command is determined by FWD terminal. Direction is determined by REV terminal.

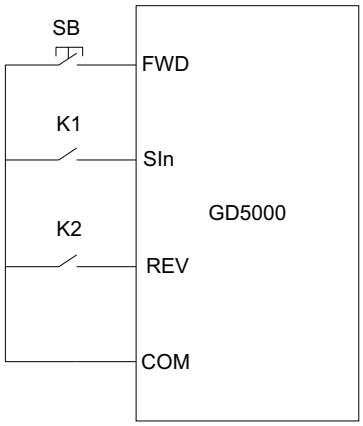


K1	K2	Running command
OFF	OFF	Stop
OFF	ON	Stop
ON	OFF	FWD running
ON	ON	REV running

Fig 5.17 Two-wire control (enabling and direction separated)

2: Three-wire control mode 1

SIn (In=1-16) =3 (three-wire control enabled), when SIn switches on, the running command will be generated by FWD (terminal rising edge valid) and the direction will be controlled by REV (REV off indicates forward running; REV on indicates reverse running.). When SIn switches off, the system will stop.



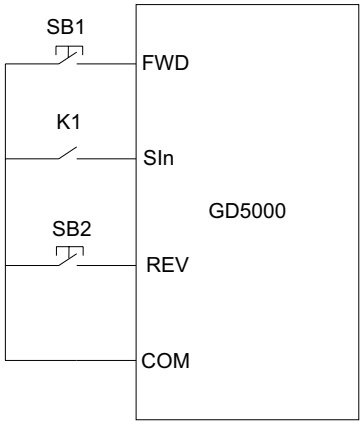
K1	K2	SB	Running command
ON	OFF	Action	FWD running
	ON		REV running
OFF	OFF		Stop
	ON		

Fig 5.18 Three-wire control mode 1

K1: Enabling switch SB1: Run button K2: REV/FWD running switch

3: Three-wire control mode 2

SIn (In=1-16) =3 (three-wire control enabled), when SIn switches on, the running command will be generated by FWD or REV and the direction will be controlled by both of them. When SIn switches off, FWD and REV are invalid. FWD and REV (both rising edges valid) refer to inputs of forward and reverse running commands respectively.



K1	SB1	SB2	Running command
ON	Action	No action	FWD running
	No action	Action	REV running
OFF			Stop

Fig 5.19 Three-wire control mode 2

SB1: Forward running button K1: Enabling switch SB2: Reverse running button

Note: The system will not respond to the running commands given before two-wire control is ready. Only after readiness of two-wire control will the system respond to re-given running commands.

Note: During 2-wire control mode, when the FWD/REV terminal is valid, the stop command generated by other sources cannot make the system stop, the system will not run after the stop command disappears even if FWD/REV terminal is still valid. In order to make the inverter run again, you must retrigger FWD/REV.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.19	UP setting change rate	0.01~50.00Hz/s	0.01~50.00	0.50Hz/s
P5.20	DOWN setting change rate	0.01~50.00Hz/s	0.01~50.00	0.50Hz/s

When UP/DOWN terminal functions are used to adjust set frequency, P5.19 and P5.20 are for setting

UP/DOWN setting change rate.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.21	AI1 lower limit	0.00V~ P5.23	0.00~P5.23	0.00V
P5.22	AI1 lower limit corresponding setting	-100.0%~ P5.24	-100.0~P5.24	0.0%
P5.23	AI1 upper limit	P5.21~10.00V	P5.21~10.00	10.00V
P5.24	AI1 upper limit corresponding setting	P5.22~100.0%	P5.22~100.0	100.0%
P5.25	AI1 input filter time	0.00s~10.00s	0.00~10.00	2.00s

The parameters determine the relationship between AI1 input voltage or current and the corresponding setting value. When the analog input voltage or current exceeds the range between lower limit and upper limit, it will be regarded as the upper limit or lower limit.

If the signal of analog input is current signal, 0mA~20mA current corresponds to 0V~5V voltage.

For different applications, the corresponding value of 100.0% analog setting is different. For details, please refer to description of each application.

The following figure is about the relationship between AI1/AI2 and corresponding setting.

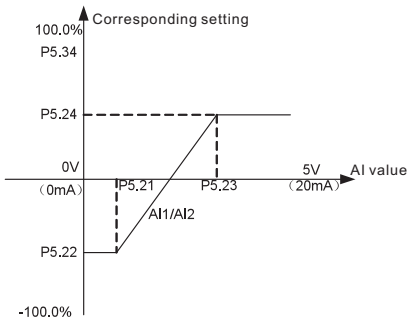


Fig 5.20 Relationship between AI1/AI2 and corresponding setting

AI1 input filter time: Adjust the analog input sensitivity. Increasing the value appropriately can enhance anti-interference capability but will weaken the sensitivity.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.26	AI2 lower limit	0.00V~ P5.28	0.00~ P5.28	0.00V
P5.27	AI2 lower limit corresponding setting	-100.0%~ P5.29	-100.0~ P5.29	0.0%
P5.28	AI2 upper limit	P5.26~10.00V	P5.26~10.00	10.00V
P5.29	AI2 upper limit corresponding setting	P5.27~100.0%	P5.27~100.0	100.0%
P5.30	AI2 input filter time	0.00s~10.00s	0.00~10.00	2.00s
P5.31	AI3 lower limit	-10.00V~ P5.33	-10.00~P5.33	0.00V
P5.32	AI3 lower limit	-100.0%~ P5.34	-100.0~P5.34	0.0%

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	corresponding setting			
P5.33	AI3 upper limit	P5.31~10.00V	P5.31~10.00	10.00V
P5.34	AI3 upper limit corresponding setting	P5.32~100.0%	P5.32~100.0	100.0%
P5.35	AI3 input filter time	0.00s~10.00s	0.00~10.00	2.00s

The setting of AI2 and AI3 is the same as that of AI1.

Note: AI2 supports 0~10V voltage or 0~20mA current input (the same as AI1) and AI3 only supports voltage input in the range of -10V~10V.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P5.36	HDI lower limit	0.000 kHz~P5.38	0.000~P5.38	0.000kHz
P5.37	HDI lower limit corresponding setting	-100.0%~P5.39	-100.0~P5.39	0.0%
P5.38	HDI upper limit	P5.36~50.000kHz	P5.36~50.000	50.000kHz
P5.39	HDI upper limit corresponding setting	P5.38~100.0%	P5.38~100.0	100.0%
P5.40	HDI input filter time	0.00s~10.00s	0.00~10.00	0.10s

The function codes define the corresponding relationships between the pulse frequency at high-speed pulse input port and the corresponding input value. The description of P5.21~P5.25 is similar to AI1.

P06 Group Output terminals

Goodrive5000 series variable frequency speed control systems are fitted with 20 MF relay output terminals (RO1~RO20), 1 HDO terminal (only as high-speed pulse output) and 4 MF analog output terminals (AO1~AO4) as standard.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.00	RO1 output	0: No output 1: In running 2: Fault output 3: FDT output 4: Frequency arrival 5: Zero speed running 6: Variable frequency state 7: Power frequency state 8: Running time arrival 9: Upper frequency limit arrival 10: Lower frequency limit arrival 11: Ready for running (run request)	0~70	0
P6.01	RO2 output		0~70	0
P6.02	RO3 output		0~70	0
P6.03	RO4 output		0~70	0
P6.04	RO5 output		0~70	0
P6.05	RO6 output		0~70	0
P6.06	RO7 output		0~70	0
P6.07	RO8 output		0~70	0
P6.08	RO9 output		0~70	0
P6.09	RO10 output		0~70	0
P6.10	RO11 output		0~70	0
P6.11	RO12 output		0~70	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.12	RO13 output	12: Alarm output	0~70	0
P6.13	RO14 output	13: Permission of QF1M1 switching on	0~70	0
P6.14	RO15 output	14: Permission of QF1M2 switching on	0~70	0
P6.15	RO16 output	15: Permission of QF1M3 switching on	0~70	0
P6.16	RO17 output	16: Permission of QF1M4 switching on	0~70	0
P6.17	RO18 output	17: Permission of QF1M5 switching on	0~70	0
P6.18	RO19 output	18: Permission of QF1M6 switching on	0~70	0
P6.19	RO20 output	19: Permission of QF1M7 switching on 20: Permission of QF1M8 switching on 21: Permission of QF2M1 switching on 22: Permission of QF2M2 switching on 23: Permission of QF2M3 switching on 24: Permission of QF2M4 switching on 25: Permission of QF2M5 switching on 26: Permission of QF2M6 switching on 27: Permission of QF2M7 switching on 28: Permission of QF2M8 switching on 29: Permission of QF1M1 switching off 30: Permission of QF1M2 switching off 31: Permission of QF1M3 switching off 32: Permission of QF1M4 switching off 33: Permission of QF1M5 switching off 34: Permission of QF1M6 switching off 35: Permission of QF1M7 switching off 36: Permission of QF1M8 switching off 37: Permission of QF2M1 switching off 38: Permission of QF2M2 switching off 39: Permission of QF2M3 switching off 40: Permission of QF2M4 switching off 41: Permission of QF2M5 switching off 42: Permission of QF2M6 switching off 43: Permission of QF2M7 switching off 44: Permission of QF2M8 switching off 45: Variable frequency state of switch cabinet 1 46: Power frequency state of switch cabinet 1 47: Variable frequency state of switch cabinet 2 48: Power frequency state of switch cabinet 2 49: Variable frequency state of switch cabinet 3 50: Power frequency state of switch	0~70	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		cabinet 3 51: Variable frequency state of switch cabinet 4 52: Power frequency state of switch cabinet 4 53: Variable frequency state of switch cabinet 5 54: Power frequency state of switch cabinet 5 55: Variable frequency state of switch cabinet 6 56: Power frequency state of switch cabinet 6 57: Variable frequency state of switch cabinet 7 58: Power frequency state of switch cabinet 7 59: Variable frequency state of switch cabinet 8 60: Power frequency state of switch cabinet 8 (Both power frequency and variable frequency valid at the same time indicates fault.) 61: Unit bypass state 62: Remote-local state 63: Vacuum contactor control 64: Vacuum contactor power control 65: Low-voltage commissioning vacuum contactor KM1 control 66: Low-voltage commissioning vacuum contactor KM2 control 67~70: Reserved, no output		

0: No output

1: In running: When the system is running, ON signal will be output.

2: Fault output: When any fault occurs to the system, ON signal will be output.

3: FDT output: Please refer to P8.15~P8.16.

4: Frequency arrival: Please refer to P8.17.

5: Zero speed running: When the system is running and the output frequency is zero, ON signal will be output.

6: Variable frequency state: When the system is running at variable frequency, ON signal will be output.

7: Power frequency state: When the system is running at power frequency, ON signal will be output.

8: Running time arrival: When cumulative running time reaches the set time in P7.11, ON signal will be output.

9: Upper frequency limit arrival: When the running frequency reaches upper frequency limit, ON signal will be output.

10: Lower frequency limit arrival: When the running frequency reaches lower frequency limit, ON signal will be output.

11: Ready for running (run request): When the power supply of main circuit and control circuit is established, and the system is capable to run without protective function action, ON signal will be output.

12: Alarm output: When the system alarms (not to cause fault abnormality), ON signal will be output.

13: Permission of QF1M1 switching on

14: Permission of QF1M2 switching on

15: Permission of QF1M3 switching on

16: Permission of QF1M4 switching on

17: Permission of QF1M5 switching on

18: Permission of QF1M6 switching on

19: Permission of QF1M7 switching on

20: Permission of QF1M8 switching on

21: Permission of QF2M1 switching on

22: Permission of QF2M2 switching on

23: Permission of QF2M3 switching on

24: Permission of QF2M4 switching on

25: Permission of QF2M5 switching on

26: Permission of QF2M6 switching on

27: Permission of QF2M7 switching on

28: Permission of QF2M8 switching on

13~28: After the system receives variable frequency signals, it needs to pass self-testing and waiting time of switching on (P1.30), and then send signals to up level (operation platform or switch). The up level will switch on up switch after the receiving the signal.

29: Permission of QF1M1 switching off

30: Permission of QF1M2 switching off

31: Permission of QF1M3 switching off

32: Permission of QF1M4 switching off

33: Permission of QF1M5 switching off

34: Permission of QF1M6 switching off

35: Permission of QF1M7 switching off

36: Permission of QF1M8 switching off

37: Permission of QF2M1 switching off

38: Permission of QF2M2 switching off

39: Permission of QF2M3 switching off

40: Permission of QF2M4 switching off

41: Permission of QF2M5 switching off

42: Permission of QF2M6 switching off

43: Permission of QF2M7 switching off

44: Permission of QF2M8 switching off

29~44: When the system needs to switch off up switch, it is necessary to send signals to up level (operation platform or vacuum breaker) which will have to switch off up switch to protect the system.

45: Variable frequency state of switch cabinet 1

46: Power frequency state of switch cabinet 1

47: Variable frequency state of switch cabinet 2
48: Power frequency state of switch cabinet 2
49: Variable frequency state of switch cabinet 3
50: Power frequency state of switch cabinet 3
51: Variable frequency state of switch cabinet 4
52: Power frequency state of switch cabinet 4
53: Variable frequency state of switch cabinet 5
54: Power frequency state of switch cabinet 5
55: Variable frequency state of switch cabinet 6
56: Power frequency state of switch cabinet 6
57: Variable frequency state of switch cabinet 7
58: Power frequency state of switch cabinet 7
59: Variable frequency state of switch cabinet 8
60: Power frequency state of switch cabinet 8
(Both power frequency and variable frequency valid at the same time indicate fault.)
45~60: The states of switch cabinets 1~8
ON signals will be output when the switch cabinets correspond to the motors in variable frequency state or power frequency state.
61: Unit bypass state: When the system has unit bypass, ON signal will be output.
62: Remote-local state: When the switch is at the local state, the system can only control through the local command channel and output ON signal; and at the remote state, the system can control through terminals, MODBUS and Profibus and output OFF signal.
63: Vacuum contactor control
When the system powers on at variable frequency, the vacuum contactor control of buffer cabinet will output ON signal after unit bus voltage beyond undervoltage point. The contactor switches on to disconnect buffer resistance and the signal remains ON. When the system powers off, the vacuum contactor control will output OFF signal. The contactor switches off to connect buffer resistance and the signal remains OFF.
64: Vacuum contactor power control
When the vacuum contactor control of buffer cabinet switches on or off, ON signal will be output for just 2 seconds to supply power.
Note:

1. **If the system is installed with buffer cabinet, functions of MF terminals in P5 must be buffer cabinet vacuum contactor feedback.**
2. **The vacuum contactor control terminals shall be connected properly according to the electrical drawings of the factory. Output terminals (buffer cabinet vacuum contactor control and buffer cabinet vacuum contactor power control) have been set by the factory, so there is no need for users to set them.**

65: Low-voltage commissioning vacuum contactor KM1 control
66: Low-voltage commissioning vacuum contactor KM2 control
65, 66: Mainly used for low-voltage power on commissioning of the factory
67~70: Reserved
Note: ON signals refer to the signals of the contactor NO contact on and the contactor NC contact off.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.20	HDO output	0: Running frequency (100%: Max. frequency) 1: Set frequency (100%: Max. frequency) 2: Inverter current RMS (100%: 2 times of system rated current) 3: Motor current RMS (100%: twice of motor rated current) 4: Output voltage (100%: 1.2 times of system rated voltage) 5: Output power (100%: twice of motor rated power) 6: Output torque (100%: twice of motor rated torque) 7: AI1 voltage 8: AI2 voltage 9: AI3 voltage (100%: 10V)	0~9	0
P6.21	AO1 output		0~9	0
P6.22	AO2 output		0~9	0
P6.23	AO3 output		0~9	0
P6.24	AO4 output		0~9	0

AO1, AO2, AO3 and AO4 provide 0~10V voltage output or 0~20mA current output which can be selected by the jumpers J3 (AO1), J4 (AO2), J5 (AO3) and J6 (AO4) on the I/O board. The range of HDO open collector high-speed pulse output is 0~50.000 kHz.

The corresponding ranges are shown in the following table:

Setting value	Function	Range
0	Running frequency	100%: Max. frequency
1	Set frequency	100%: Max. frequency
2	Inverter current RMS	100%: 2 times of system rated current
3	Motor current RMS	100%: twice of motor rated current
4	Output voltage	100%: 1.2 times of system rated voltage
5	Output power	100%: twice of motor rated power
6	Output torque	100%: twice of motor rated torque
7	AI1 voltage	100%: 10V
8	AI2 voltage	100%: 10V
9	AI3 voltage	100%: 10V

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.25	HDO lower limit	0.00%~ P6.27	0.00~ P6.27	0.00%
P6.26	HDO lower limit corresponding output	0.000kHz~ P6.28	0.000~ P6.28	0.000kHz
P6.27	HDO upper limit	P6.25~100.00%	P6.25~100.00	100.00%
P6.28	HDO upper limit corresponding output	P6.26~50.000kHz	P6.26~50.000	50.000kHz

Above function codes define the relationship between high-speed pulse output frequency and the corresponding output value. When the output value exceeds the range between lower limit and upper limit, it will be calculated as the upper limit or lower limit.

For different applications, the corresponding value of 100.0% high speed pulse output is different. For details, please refer to description of each application.

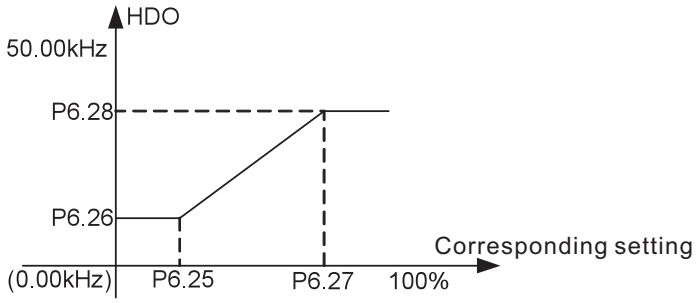


Fig 5.21 Relationship between HDO and corresponding setting

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.29	AO1 lower limit	0.00%~P6.31	0.00~P6.31	0.0%
P6.30	AO1 lower limit corresponding output	0.00V~P6.32	0.00~P6.32	0.00V
P6.31	AO1 upper limit	P6.29~100.0%	P6.29~100.0	100.0%
P6.32	AO1 upper limit corresponding output	P6.30~10.00V	P6.30~10.00	10.00V
P6.33	AO2 lower limit	0.00%~P6.35	0.00~P6.35	0.0%
P6.34	AO2 lower limit corresponding output	0.00V~P6.36	0.00~P6.36	0.00V
P6.35	AO2 upper limit	P6.33~100.0%	P6.33~100.0	100.0%
P6.36	AO2 upper limit corresponding output	P6.34~10.00V	P6.34~10.00	10.00V
P6.37	AO3 lower limit	0.00%~P6.39	0.00~P6.39	0.0%
P6.38	AO3 lower limit corresponding output	0.00V~P6.40	0.00~P6.40	0.00V
P6.39	AO3 upper limit	P6.37~100.0%	P6.37~100.0	100.0%
P6.40	AO3 upper limit corresponding output	P6.38~10.00V	P6.38~10.00	10.00V
P6.41	AO4 lower limit	0.00%~P6.43	0.00~P6.43	0.0%
P6.42	AO4 lower limit corresponding output	0.00V~P6.44	0.00~P6.44	0.00V

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P6.43	AO4 upper limit	P6.41~100.0%	P6.41~100.0	100.0%
P6.44	AO4	P6.43~10.00V	P6.43~10.00	10.00V

The functions are similar to HDO terminals. The analog output is shown as follows.

Note: When current output is selected for AO1, AO2, AO3 and AO4, 1mA corresponds to 0.5V.

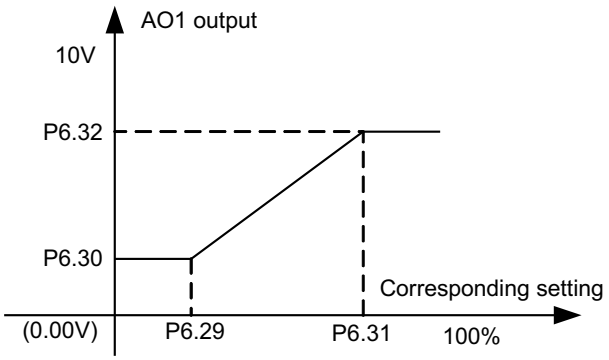


Fig 5.22 Relationship between AO and corresponding setting

P07 Group HMI

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.00	Reserved	0~65536	0~65536	0
P7.01	Reserved	0~65536	0~65536	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.02	FPGA software version	0~655.35	0~655.35	Factory setting
P7.03	DSP software version	0~655.35	0~655.35	Factory setting
P7.04	ARM software version	0~655.35	0~655.35	Factory setting

The software versions are read-only and unmodifiable.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.05	Valid control mode	0: V/F control 1: Sensorless vector control 0 2: Sensorless vector control 1 3: Vector control	0~3	Factory setting

According to the purchasing needs of customers, set the authority before leaving the factory. 0 means only V/F control, 1 means both V/F control and sensorless vector control 0 are available, 2 means the first three control modes are available and 3 means all control modes are available.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.06	Max. available	1~12	1~12	Factory

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	unit			setting

Each phase of the system supports 12 units in series at most.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.07	Motor type	0: Asynchronous motor 1: Synchronous motor 2: Asynchronous and synchronous motors	0~2	Factory setting

0: Asynchronous motor only

1: Synchronous motor only

2: Both asynchronous and synchronous motors are available

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.08	I/O extension card	0: Not support 1: Support	0~1	Factory setting
P7.09	Profibus card	0: Not support 1: Support	0~1	Factory setting

The system supports 20 relay outputs as the standard part. That is to say, the factory setting supports extension. It is necessary to set P7.08=1 when using extension function.

0: Not support I/O extension card: The extension of 12 relay outputs cannot be available.

1: Support I/O extension card: When equipped with PG card, the option must be 1, if not, invalid.

The system supports Profibus as the optional part. The Profibus card supports PROFIBUS protocol. It is necessary to set P7.09=1 when applying Profibus card.

0: Not support Profibus

1: Support Profibus

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.10	Max. switch cabinet	0~8	0~8	Factory setting

The function code is applicable to one-drive-more control, 8 switch cabinets at most.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.11	Local accumulative running time	0~65535h	0~65535	0

The function code is used to record the accumulative running time of the system by hours. It is read-only and unmodifiable.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P7.12	Local running time	0~65535min	0~65535	0

The function code is used to set the current running time of the system by minutes. If the running time arrives, users can operate after the system outputs the signal of running time arrival.

P08 Group Enhanced functions

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.00	ACC time 2	0.1~3600.0s	0.1~3600.0	Depend on model
P8.01	DEC time 2	0.1~3600.0s	0.1~3600.0	Depend on model
P8.02	ACC time 3	0.1~3600.0s	0.1~3600.0	Depend on model
P8.03	DEC time 3	0.1~3600.0s	0.1~3600.0	Depend on model
P8.04	ACC time 4	0.1~3600.0s	0.1~3600.0	Depend on model
P8.05	DEC time 4	0.1~3600.0s	0.1~3600.0	Depend on model

The function codes P8.00~P8.05 can be switched by of MF input terminal combinations (see the description of P5). The definitions of different ACC/DEC time are the same, as described in P0.16 and P0.17.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.06	Jogging frequency	0.00 Hz~P0.10 (Max. frequency)	0.00~P0.10	5.00Hz
P8.07	Jogging ACC time	0.1~3600.0s	0.1~3600.0	Depend on model
P8.08	Jogging DEC time	0.1~3600.0s	0.1~3600.0	Depend on model

Jogging start/stop mode: Direct start and decelerate to stop

Jogging ACC time is the time the system needs to accelerate from 0Hz to the maximum frequency (P0.10).

Jogging DEC time is the time the system needs to decelerate from the maximum frequency (P0.10) to 0Hz.

Note: Jogging enjoys the top priority. Under torque mode, if the jogging command is valid, it is necessary to switch into speed mode to respond to the command.

Note: When the jogging command is valid, run in linear ACC/DEC according to jogging ACC/DEC time; otherwise, switch into common ACC/DEC curve.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.09	Jumping frequency 1	0.00 Hz~P0.10 (Max. frequency)	0.00~P0.10	0.00Hz
P8.10	Jumping frequency range 1	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	0.00Hz
P8.11	Jumping frequency 2	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	0.00Hz
P8.12	Jumping frequency range 2	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	0.00Hz

Setting the jumping frequency can keep the system from the mechanical resonance point. The system can set two jumping frequency points. But this function will be unavailable if both of the jumping points are set to 0.

Note: The jumping frequency limits the set frequency. For example, f_0 =initial set frequency, f_j =jumping frequency, Δ_f =jumping range, f =actual set frequency

If $(f_j - \Delta_f/2) \le f_0 < f_j$, thus $f = f_j - \Delta_f/2$;

If $f_j \le f_0 \le (f_j + \Delta_f/2)$, thus $f = f_j + \Delta_f/2$

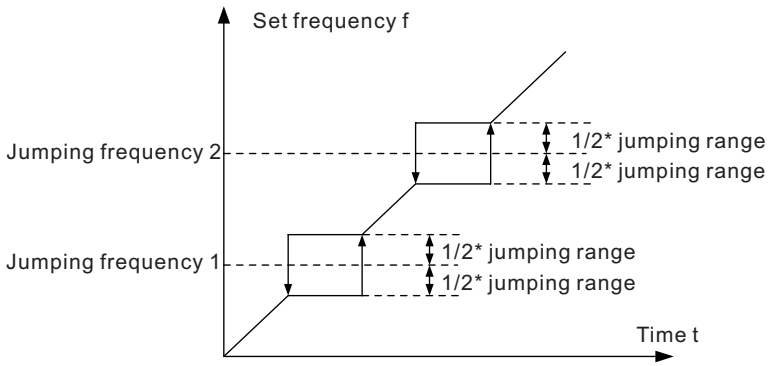


Fig 5.23 Jumping frequency

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.13	Automatic fault reset times	0~3	0~3	0
P8.14	Interval of automatic fault reset	0.1~100.0s	0.1~100.0	1.0s

Automatic fault reset times: Users can set automatic fault reset times when the function code is selected. The system will automatically reset and start rotating speed tracking when minor faults occur to it. If the continuous reset times exceed this set value, the system will stop and need repairing.

Interval of automatic fault reset: Select the interval from fault occurrence to its auto-reset.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.15	FDT electrical level detection value	0.00Hz~P0.10 (Max. frequency)	0.00~P0.10	50.00Hz
P8.16	FDT retention detection value	0.0~100.0% (FDT electrical level)	0.0~100.0	5.0%

When the output frequency exceeds the corresponding frequency FDT electrical level, output the signal until the output frequency decreases to a value lower than the corresponding frequency (FDT retention detection value). Below is the diagram:

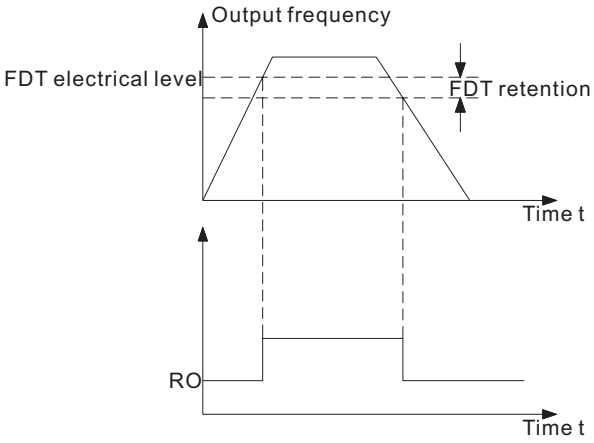


Fig 5.24 FDT electrical level

Note: FDT retention detection value is the percentage corresponding to FDT electrical level.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.17	Frequency arrival detection range	0.0~100.0% (Max. frequency)	0.0~100.0	0.0%

When the output frequency is among the below or above range of the set frequency, the pulse signal will be output. See the diagram below for detailed information:

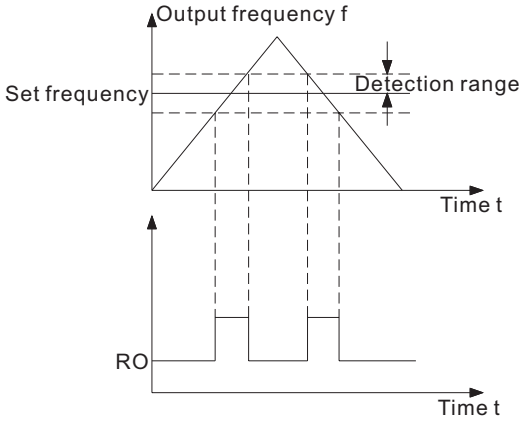


Fig 5.25 Frequency arrival detection range

Note: Frequency arrival detection range is the percentage corresponding to the maximum frequency (P0.10).

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.18	Overmodulation	0: Invalid 1: Valid	0~1	0

Under the conditions of low voltage (below 85% of rated voltage) or heavy loads for a long time, the system can improve utilization of bus voltage and thus raise output voltage by overmodulation.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.19	Running mode of cooling fan	0: Rated running mode 1: The fan keeps running after powering on	0~1	0

0: Rated running mode: The cooling fan keeps running when the system in running state. When the

system stops after 30s, the fan will stop.

1: The fan keeps running after powering on

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.20	Alarm reset interval	0.0s (invalid) 0.1~3600.0s	0.0~3600.0	0.0

Note: Alarm means when the system works abnormally, if users do not pay attention, the abnormity will cause faults. Users can choose whether it is necessary for the system to alarm and set alarm reset interval via the function code.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.21	Frequency reference offline threshold	0.0~100.0%	0.0~100.0	0.0
P8.22	Frequency reference offline time	0.0~360.0s	0.0~360.0	0.0s

100% of frequency reference offline threshold corresponding to upper frequency limit (P0.11), when the system detects the set frequency less than or equal to the set frequency threshold, it will start timing. If the timing exceeds offline time, the system will alarm frequency reference offline fault.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.23	Frequency change rate of dropping control	0.00~10.00Hz	0.00~10.00	0.00Hz

When several variable frequency speed control systems drive one load, due to different speeds, unbalanced load distribution will make the system at the highest speed bear heavy load. The dropping control is featuring speed changing along with loads and balanced distribution. Adjust the parameter from the smallest one to the largest one. The relationship between load and output frequency is shown as follows:

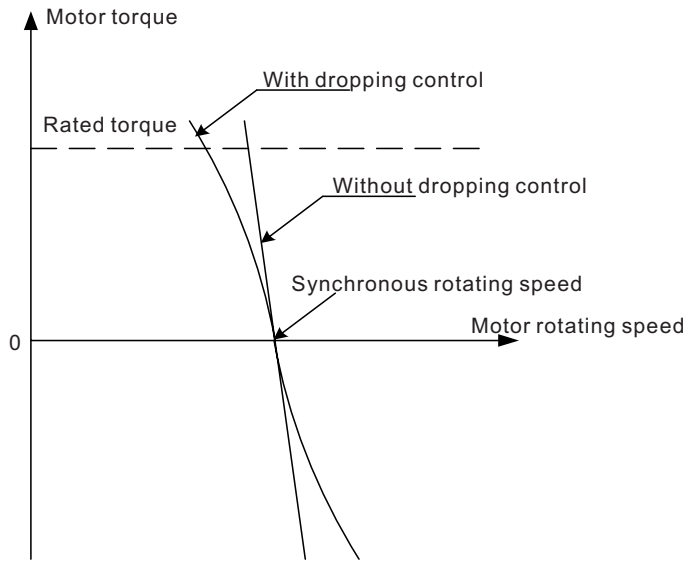


Fig 5.26 Dropping control

The parameter is used to adjust the frequency change rate of dropping control for the system.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.24	Ambient overtemperature threshold	0~100.0%	0.0~100.0	100.0

When ambient temperature exceeds P8.24, the system will alarm overtemperature, 0.0% and 100% corresponds to -100°C and 200°C respectively, corresponding value of ambient overtemperature threshold = P8.24*300-100.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P8.25	Motor temperature zero-calibration factor	-100.00%~100.00%	-100.00~100.00	0.00
P8.26	Motor temperature proportional calibration factor	0~200.00%	0~200.00	100.00
P8.27	Motor temperature sensor selection	0: Not installed 1: Installed	0~1	0

When P8.27=1, correct the temperature by P8.25 and P8.26.

P09 Group Fault record

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.00	DSP fault action 1	0xEABA~0xFFFF Two bits stand for a fault. 00: No solution 01: Alarm 10: Fault, stop but not cut off high voltage power 11: Serious fault, stop and cut off high voltage power	0xEABA~0xFFFF	0xEABA
P9.01	DSP fault action 2	0x3EAA~0xFFFF	0x3EAA~0xFFFF	0xBEAA
P9.02	ARM fault action 1	0x830A~0xFFFF	0x830A~0xFFFF	0xABAE
P9.03	ARM fault action 2	0xB28A~0xFFFF	0xB28A~0xFFFF	0xBAAA
P9.04	ARM fault action 3	0xAA00~0xFFFF	0xAA00~0xFFFF	0xAAAA
P9.05	ARM fault action 4	0x009A~0xFFFF	0x000A~0xFFFF	0x009A
P9.06	Unit fault action 1	0x2AEA~0xFFFF	0x2AEA~0xFFFF	0xAAEA
P9.07	Unit fault action 2	0xAE8~0xFFFF	0xAE8~0xFFFF	0x0AEA

The fault action includes 4 types: no solution; alarm; fault, stop but not cut off high voltage power; serious fault, stop and cut off high voltage power.

00: No solution

01: Alarm

10: Fault, stop but not cut off high voltage power, can carry out fault auto reset

11: Serious fault, stop and cut off high voltage power, cannot carry out fault auto reset

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.08	Previous 2 DSP fault type	Each bit stands for 1 fault type. 0: No fault 1: Fault bit0: Software overcurrent bit1: Hardware overcurrent bit2: Grid overvoltage bit3: Grid undervoltage bit4: Motor overload bit5: Inverter overload bit6: Output phase loss bit7: Current detection fault bit8: Motor autotuning fault bit9: Encoder offline fault bit10: Encoder REV fault bit11: Input phase loss bit12: Handshake fault bit13: Input overcurrent bit14: Transmission board fault	0~FFFF	0

P9.08 includes 15 DSP fault types, each bit stands for 1 fault type, bitn=1 means some fault occur, bitn=0 means the fault does not occur. P9.09 and P9.10 includes 28 ARM fault types, P9.11 includes 14 fault types.

For example, the relationship between fault word and fault type:

If there is DSP hardware overcurrent in P9.08, bit1=1 (P9.08). If P9.00 is set to 0XEABA, bit3~bit2 =10 (P9.00). The system will stop but not cut off high voltage because of the fault.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.09	Previous 2 ARM fault 1	Each bit stands for 1 fault type. 0: No fault 1: Fault bit0: Transformer temperature controller fault bit1: Transformer overheat bit2: External fault bit3: MODBUS communication fault bit4: Buffer cabinet fault bit5: PID feedback disconnection fault bit6: Access fault bit7: Synchronous switching timeout bit8: Reserved bit9: Factory time arrival	0~FFFF	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		bit10: The motor temperature is too high bit11: Switch cabinet uplink communication fault bit12: Switch cabinet downlink communication fault bit13: QF feedback fault bit14: DSP and ARM handshake fault bit15: Power off in operation		

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.10	Previous 2 ARM fault 2	bit16: PROFIBUS communication fault bit17: Frequency reference disconnection bit18: Switch cabinet 1 action fault bit19: Switch cabinet 2 action fault bit20: Switch cabinet 3 action fault bit21: Switch cabinet 4 action fault bit22: Switch cabinet 5 action fault bit23: Switch cabinet 6 action fault bit24: Switch cabinet 7 action fault bit25: Switch cabinet 8 action fault bit26: Fan overheat bit27: Master-slave optical fiber communication fault	0~FFFF	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.11	Previous 2 unit fault type	Each bit stands for 1 fault type. 0: No fault 1: Fault bit0: Unit fiber uplink communication fault bit1: Unit fiber downlink communication fault bit2: Unit not ready bit3: Unit overvoltage bit4: Unit undervoltage bit5: Unit power fault bit6: Unit overheat bit7: Unit input phase loss protection bit8: Unit input power off protection bit9: Up bridge VCE fault	0~FFFF	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
		bit10: Down bridge VCE fault bit11: Hardware overvoltage bit12: The unit does not match bit13: Unit bypass failure		

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.12	Previous 2 fault No.	If the number is 0, there is no unit fault. If it is not 0, then A1~A12: 1~12 B1~B12: 13~24 C1~C12: 14~36	0~36	0

Display the previous 2 fault number. 1~12 stand for the unit fault of A phase A1~A12; 13~24 stand for the unit fault of B phase B1~B12; 25~36 stands for the unit fault of C phase C1~C12.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.13	ACC/DEC state at previous 2 fault	0:Constant speed 1: ACC 2: DEC	0~2	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.14	Running frequency at previous 2 fault	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz
P9.15	Set frequency at previous 2 fault	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz
P9.16	Output current at previous 2 fault	0.0~6553.5A	0.0~6553.5	0.0A
P9.17	Output voltage at previous 2 fault	0~65535V	0~65535	0V
P9.18	Input current at previous 2 fault	0.0~6553.5A	0.0~6553.5	0.0A
P9.19	Input voltaga at previous 2 fault	0~65535V	0~65535	0V
P9.20	Bus voltage at previous 2 fault	0~65535V	0~65535	0V
P9.21	Unit temperature at previous 2 fault	0.0~6553.5°C	0.0~6553.5	0.0°C

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.22	System input terminal state at	0~65535	0~65535	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	previous 2 fault			
P9.23	User input terminal state at previous 2 fault	0~65535	0~65535	0

The input terminals at previous 2 fault are decimal to display the states of all digital input terminals. If the input terminal is ON, then the corresponding bit is 1; if it is OFF, the corresponding bit is 0.

BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8
S16	S15	S14	S13	S12	S11	S10	S9
BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
S8	S7	S6	S5	S4	S3	S2	S1

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.24	System output terminal state at previous 2 fault	0~65535	0~65535	0
P9.25	User output terminal state at previous 2 fault 1	0~65535	0~65535	0
P9.26	User output terminal state at previous 2 fault 2	0~65535	0~65535	0

The output terminals at previous 2 fault are decimal to display the states of all digital output terminals. If the output terminal is ON, then the corresponding bit is 1; if it is OFF, the corresponding bit is 0.

BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
RO8	RO7	RO6	RO5	RO4	RO3	RO2	RO1

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.27	Previous DSP fault type	Same as P9.08		0
P9.28	Previous ARM fault 1	Same as P9.09		0
P9.29	Previous ARM fault 2	Same as P9.10		0
P9.30	Previous unit fault	Same as P9.11		0
P9.31	Previous fault No.	Same as P9.12		0
P9.32	ACC/DEC state at previous fault	0:Constant speed 1: ACC 2: DEC	0~2	0
P9.33	Running frequency	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	at previous fault			
P9.34	Set frequency at previous fault	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz
P9.35	Output current at previous fault	0.0~6553.5A	0.0~6553.5	0.0A
P9.36	Output voltage at previous fault	0~65535V	0~65535	0V
P9.37	Input current at previous fault	0.0~6553.5A	0.0~6553.5	0.0A
P9.38	Input voltage at previous fault	0~65535V	0~65535	0V
P9.39	Bus voltage at previous fault	0~65535V	0~65535	0V
P9.40	Unit temperature at previous fault	0.0~6553.5°C	0.0~6553.5	0.0°C
P9.41	System input terminal state at previous fault	0~65535	0~65535	0
P9.42	User input terminal state at previous fault	0~65535	0~65535	0
P9.43	System output terminal state at previous fault	0~65535	0~65535	0
P9.44	User output terminal state at previous fault 1	0~65535	0~65535	0
P9.45	User output terminal state at previous fault 2	0~65535	0~65535	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.46	Current DSP fault	Same as P9.08		0
P9.47	Current ARM fault 1	Same as P9.09		0
P9.48	Current ARM fault 2	Same as P9.10		0
P9.49	Current unit fault	Same as P9.11		0
P9.50	Current fault No.	Same as P9.12		0
P9.51	ACC/DEC state at current fault	0:Constant speed 1: ACC 2: DEC	0~2	0
P9.52	Running frequency at current fault	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P9.53	Set frequency at current fault	0.00Hz~P0.10	0.00Hz~P0.10	0.00Hz
P9.54	Output current at current fault	0.0~6553.5A	0~6553.5	0.0A
P9.55	Output voltage at current fault	0~65535V	0~65535	0V
P9.56	Input current at current fault	0.0~6553.5A	0.0~6553.5	0.0A
P9.57	Input voltage at current fault	0~65535V	0~65535	0V
P9.58	Bus voltage at current fault	0~65535V	0~65535	0V
P9.59	Unit temperature at current fault	0.0~6553.5°C	0~6553.5	0.0°C
P9.60	System input terminal state at current fault	0~65535	0~65535	0
P9.61	User input terminal state at current fault	0~65535	0~65535	0
P9.62	System output terminal state at current fault	0~65535	0~65535	0
P9.63	User output terminal state at current fault 1	0~65535	0~65535	0
P9.64	User output terminal state at current fault 2	0~65535	0~65535	0
P9.65	Reserved	0~65535	0~65535	0

P10 Group PID control

PID control is a common method used in process control, such as flow, pressure and temperature control. The principle will firstly detect the bias between preset value and feedback value, then calculate output frequency of the system according to proportional gain, integral and differential time. Please refer to following figure:

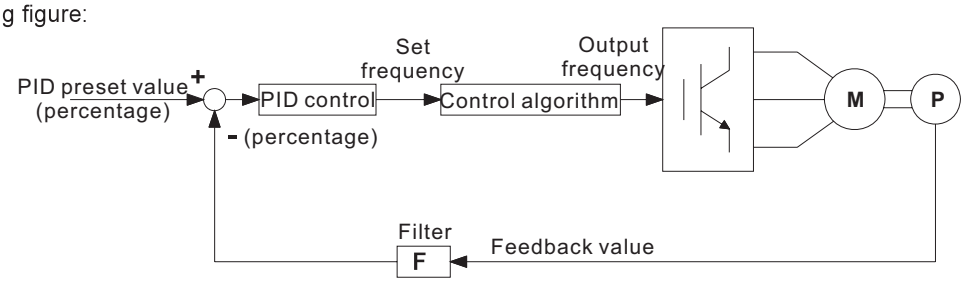


Fig 5.27 PID control

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.00	PID preset source	0: Function code (P10.01) 1: AI1 2: AI2 3: AI3 4: AI1+AI2 5: AI2+AI3 6: AI3+AI1 7: HDI 8: Multi-step 9: MODBUS 10: PROFIBUS	0~10	0

When the frequency source selects PID, that is, P0.06=6, the group function decides the target volume channels of this PID parameter. Reference target of the process PID is a relative value, 100% of preset value corresponds to 100% of feedback value. The system operates in relative value (0~100%), by default, 100% of the values of PID reference and feedback correspond to 10V.

Note: After setting the parameters in P11, multi-step reference can be achieved by current step selection via terminals.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.01	Local preset PID	0.0%~100.0%	0.0~100.0	0.0%

P10.00=0, set the function code. The value of this parameter is the system feedback value.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.02	PID feedback source	0: AI1 1: AI2 2: AI3 3: AI1+AI2 4: AI2+AI3 5: AI3+AI1 6: HDI 7: MODBUS 8: PROFIBUS	0~8	0

Please select the PID feedback channel through this parameter.

Note: Preset channel and feedback channel shall not be the same; otherwise, PID cannot be effectively controlled.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.03	PID output characteristic	0: Positive 1: Negative	0~1	0

0: Positive. When the feedback value is greater than the preset value, output frequency has to decrease to get the actual value reach the preset value.

1: Negative. When the feedback value is greater than the preset value, output frequency has to increase to get the actual value reach the preset value.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.04	Proportional gain (Kp)	0.00~100.00	0.00~100.00	1.00
P10.05	Integral time (Ti)	0.01~10.00s	0.01~10.00	0. 50s
P10.06	Differential time (Td)	0.00~10.00s	0.00~10.00	0.00s

Proportional gain (P): When the feedback and preset have offset, the adjustment is proportional to the offset. The offset is constant, so is the adjustment. Proportional gain can respond to feedback changes but only proportional gain cannot achieve floating control. The larger the proportional gain, the higher the adjusting speed. Too large P may cause oscillation. Set the integral time quite long and differential time to zero, make the system run through proportional gain, change the preset value and check the offset of the feedback and the preset. If the offset is in the direction of the preset variation, continue to increase proportional gain; otherwise, decrease it. Repeat the operation till the offset is much smaller.

Integral time (I): When the feedback and preset have offset, the adjustment is accumulated continuously. If the offset remains, increase the adjustment till no offset. Integral controller can effectively eliminate offset, the smaller the integral time, the stronger the effect. However, too strong integral effect may cause repeated over adjustment and even oscillation. Adjust the integral time from large to small gradually and check the effect till the speed of the system becomes stable.

Differential time (D): When the feedback and preset have offset, the adjustment is proportional to the offset. The adjustment is only related to the direction and size of offset variation and it has nothing to do with offset. When the feedback signal changes, differential time is used to perform adjustment based on variations and thus suppress feedback signal change, the larger the differential time, the stronger the effect. Please use differential controller with cautions, because the adjustment can easily enlarge system interference, especially interference with frequent change.

PID parameters setting

(1) Proportional gain Kp setting

Ti=0 and Td=0, set input to 60%~70% of the maximum value allowed by the system, increase Kp from 0 gradually till system oscillation appears; decrease Kp till the oscillation disappears, record Kp at this time. The set proportional gain is 60%~70% of current proportional gain. Proportional gain setting finishes.

(2) Integral time Ti setting

After above setting, set Td to 0, proportional gain to the value in first step and integral time Ti to a larger value, then decrease Ti till system oscillation appears, increase Ti till the oscillation disappears, and finally record Ti at this time. The set integral coefficient is 150%~180% of current integral coefficient. Integral time setting finishes.

(3) Differential time Td setting

Generally, Td=0, if differential effect necessary, the setting is the same as Kp and Ti setting, 30% of critical oscillation.

(4) Adjustment

After all settings, the system runs with load. Adjust the values under different conditions to achieve satisfying control effects. As for experienced engineers, they can skip over above three steps and adjust PID factors directly.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.07	Sampling cycle (T)	0.01~100.00s	0.01~100.00	0.10s
P10.08	PID control deviation limit	0.0~100.0% (reference source)	0.0~100.0	0.0%

The sampling cycle means the sampling cycle of the feedback. The controller calculates once in each sampling cycle. The longer the sampling cycle is, the slower the response will be.

The output of PID system is relative to the maximum deviation of the close loop reference. As shown in the diagram below, PID controller stops adjusting in the range of deviation limit and works out the range of deviation limit. Set the function code properly to adjust the accuracy and stability of PID system.

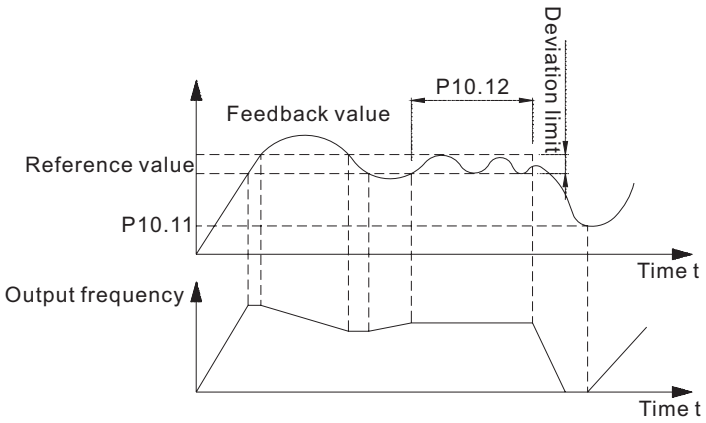


Fig 5.28 The relationship between PID deviation limit and system output frequency

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.09	Feedback offline detection value	0.0~100.0% (reference source)	0.0~100.0%	0.0%
P10.10	Feedback offline detection time	0.0~3600.0s (reference source)	0.0~3600.0	1.0s

The feedback offline detection value is corresponding value of PID feedback 100%. The system will be detecting PID feedback when PID reference is valid. When feedback value is less than or equal to feedback offline detection value, the system begins timing for detection. If the detection time exceeds feedback offline detection time, the system will alarm PID feedback offline.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P10.11	PID dormancy wake up value	0.0~100.0% (reference source)	0.0~100.0%	0.0
P10.12	PID dormancy delay time	0.0~360.0s	0.0~360.0	1.0s

PID dormancy awakening value: If the system is in dormancy, PID feedback higher than dormancy value (negative) or lower than dormancy value (positive), PID will be waked up. Then system output frequency increases from 0 until PID feedback reaches PID preset again.

PID dormancy delay time: If the time is not 0, PID dormancy will be valid. After PID feedback reaches PID preset and work steadily, the system will keep current output frequency for PID dormancy delay time, then reduce frequency to 0 and enter dormancy state until PID is waked up again.

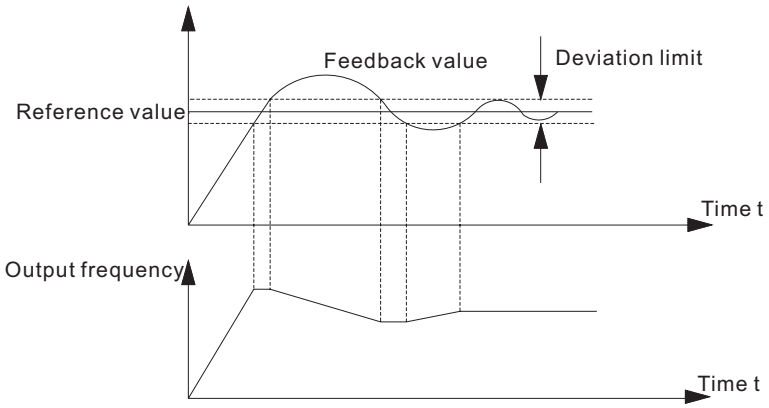


Fig 5.29 PID dormancy and PID dormancy wake up

As shown above, after the system starts running, output frequency increases, so does PID feedback. When the feedback reaches preset value within bias limit, the system remains current state for PID dormancy delay time P10.12, and then the frequency reduces to 0. Because of system inertia, PID feedback reduces slowly. When feedback value reaches the wake up value P10.11, the system will be waked up from dormancy, and then frequency increases, so does PID feedback.

P11 Group Multi-step speed control

In non-jogging mode, multi-step speed control has the highest priority. If the speed step is not 0, that is to say, the frequency setting or PID setting source is other modes, the system will run at multi-step speed mode.

Note: Only when the frequency setting or PID setting source is multi-step speed mode is step 0 valid.

When PID setting source is multi-step speed, the setting of multi-step speed is the percentage of PID reference rather than frequency.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P11.00	Multi-step speed reference	0: Terminal 1: Analog	0~1	0

0: Terminal: Refer to the description of P5

1: Analog: Refer to the description of P11.17

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P11.01	Multi-step speed 0	-100.0~100.0%	-100.0~100.0	0.0%
P11.02	Multi-step speed 1	-100.0~100.0%	-100.0~100.0	0.0%
P11.03	Multi-step speed 2	-100.0~100.0%	-100.0~100.0	0.0%
P11.04	Multi-step speed 3	-100.0~100.0%	-100.0~100.0	0.0%
P11.05	Multi-step speed 4	-100.0~100.0%	-100.0~100.0	0.0%
P11.06	Multi-step speed 5	-100.0~100.0%	-100.0~100.0	0.0%
P11.07	Multi-step speed 6	-100.0~100.0%	-100.0~100.0	0.0%
P11.08	Multi-step speed 7	-100.0~100.0%	-100.0~100.0	0.0%
P11.09	Multi-step speed 8	-100.0~100.0%	-100.0~100.0	0.0%
P11.10	Multi-step speed 9	-100.0~100.0%	-100.0~100.0	0.0%
P11.11	Multi-step speed 10	-100.0~100.0%	-100.0~100.0	0.0%

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P11.12	Multi-step speed 11	-100.0~100.0%	-100.0~100.0	0.0%
P11.13	Multi-step speed 12	-100.0~100.0%	-100.0~100.0	0.0%
P11.14	Multi-step speed 13	-100.0~100.0%	-100.0~100.0	0.0%
P11.15	Multi-step speed 14	-100.0~100.0%	-100.0~100.0	0.0%
P11.16	Multi-step speed 15	-100.0~100.0%	-100.0~100.0	0.0%

P11.01~ P11.16 are used to set the value of each step speed.

If the frequency setting source is multi-step speed, 100.0% corresponds to the maximum frequency P0.10. The sign of multi-step speed determines the running direction. Negative means reverse running. Multi-step speed range can be set continuously within -fmax~fmax. Goodrive5000 series variable frequency speed control systems can set 16-step speed.

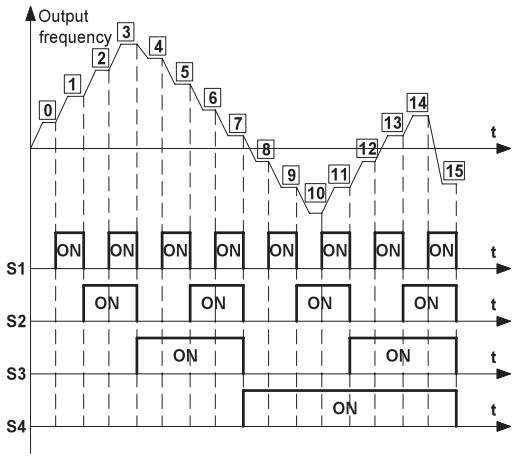


Fig 5.30 Multi-step speed operation

As for terminals mode, the step speed can be set by the combination of input terminals.

Set S1~S4 to multi-step speed input terminals. The following table shows the relationship between the terminals and steps.

S1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
S2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
S3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
S4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
Step	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

As for analog mode (P11.17), select analog input source at first and then set the step speed (P11.18~P11.33).

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P11.17	Analog input source	0: AI1 1: AI2 2: AI3	0~2	0

When P11.00=1, P11.17 is used to set the analog input source, AI1~AI3.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P11.18	Corresponding	-100.0~100.0%	-100.0~100.0	0.0%

Function code	Name	Detailed instruction of parameters	Setting range	Default value
	analog of step 0			
P11.19	Corresponding analog of step 1	-100.0~100.0%	-100.0~100.0	0.0%
P11.20	Corresponding analog of step 2	-100.0~100.0%	-100.0~100.0	0.0%
P11.21	Corresponding analog of step 3	-100.0~100.0%	-100.0~100.0	0.0%
P11.22	Corresponding analog of step 4	-100.0~100.0%	-100.0~100.0	0.0%
P11.23	Corresponding analog of step 5	-100.0~100.0%	-100.0~100.0	0.0%
P11.24	Corresponding analog of step 6	-100.0~100.0%	-100.0~100.0	0.0%
P11.25	Corresponding analog of step7	-100.0~100.0%	-100.0~100.0	0.0%
P11.26	Corresponding analog of step 8	-100.0~100.0%	-100.0~100.0	0.0%
P11.27	Corresponding analog of step 9	-100.0~100.0%	-100.0~100.0	0.0%
P11.28	Corresponding analog of step 10	-100.0~100.0%	-100.0~100.0	0.0%
P11.29	Corresponding analog of step 11	-100.0~100.0%	-100.0~100.0	0.0%
P11.30	Corresponding analog of step 12	-100.0~100.0%	-100.0~100.0	0.0%
P11.31	Corresponding analog of step 13	-100.0~100.0%	-100.0~100.0	0.0%
P11.32	Corresponding analog of step 14	-100.0~100.0%	-100.0~100.0	0.0%
P11.33	Corresponding analog of step 15	-100.0~100.0%	-100.0~100.0	0.0%

P11.18~P11.33 are used to set corresponding steps of analog. Take AIn for example, P11.29<AIn≤P11.30, corresponding step 12, corresponding frequency P11.13*P0.10.

During step setting by analog, the step will be 15 if not satisfying the conditions of 0~14 step.

P12 Group Master-slave control

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.00	Master-slave mode selection	0: Power-balancing mode 1: Speed synchronous mode (reserved)	0~1	0

Power-balancing mode is the main mode of master-slave control that the motors are connected to work together in way of gearboxes, guide rails or shafts coupling and the powers among the motors are

distributed properly to reach corresponding control precision. The slaves are controlled by master communication.

Speed synchronous mode is used for multiple drives in synchronous running. It requires the system shall have pulse encoder feedback and communication connection.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.01	Master output signal source	0: Master output torque signal 1: Master output current signal 2: Master output PG signal (reserved)	0~2	0

The signals sent by the master to the slave are command signals, master running frequency signals and P12.01.

0: Master output torque signal: The master will send output torque to the slave.

1: Master output current signal: The master will send output current to the slave.

2: Master output PG signal: The function is reserved.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.02	Filter time of slave reference signal	0.00s~655.35s	0.00~655.35	0.00s

The function code is used to set the filter time of slave reference signal to eliminate influence caused by interference.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.03	PID adjustment amplitude limit	0.0~100.0%	0~100	100.0%

-P12.03≤PID output≤P12.03, when PID output is smaller than -P12.03, PID output=-P12.03; when PID output is larger than P12.03, PID output=P12.03.

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.04	PID mode	0: Proportion plus integration as synchronous coefficient 1: Proportion plus integration as error correction	0~1	0

Function code	Name	Detailed instruction of parameters	Setting range	Default value
P12.05	Slave reference frequency source gain	0.01~100.00	0.01~100.00	1.00
P12.06	Slave reference signal source gain	0.01~100.00	0.01~100.00	1.00

In master-slave control, the product of slave reference frequency source (reference signal 1) and P12.05 are internal operational frequency data. It is more convenient to adjust master and slave speed relationship flexibly.

As the same, in master-slave control, the product of slave reference signal source (reference signal 2) and P12.06 are internal operational signal data. It is more convenient to adjust master and slave speed