W505 SERIES

SENSORLESS VECTOR CONTROL CONTROLLER

SIMPLE MANUAL

GUANGZHOU BEDFORD ELECTRIC EQUIPMENT CO.,LTD.

V1.0.1

CONTENTS

1 SAFETY PRECAUTIONS

Please read this manual carefully before installation, operation, maintenance or inspection.

In this manual, the safety precautions were sorted to “WARNING” or “CAUTION”. It reminds that safety precautions when handling, transporting, inspecting, and installing this product.

DANGER——Indicates a potentially hazardous situation which, if not, will result in death or serious injury.

WARNING——Indicates failure to comply with the requirements may result in personal injury or equipment damage.

CAUTION——Indicates steps taken to ensure proper operation

Qualified professionals: Refers to the personnel who operate this equipment must have professional electrical training and safety knowledge training and pass the examination, and have been familiar with the installation and commissioning, operation and maintenance procedures and requirements of this equipment, and can deal with various emergencies.

1.1 Safety Precautions

Use Stage	Safety Level	Caution Items
Before Installation	 DANGER	◆Do not install the equipment if you find water seepage, component missing or damage upon unpacking. ◆Do not install the equipment if the packing list is not conformed to the product you received.
	 WARNING	◆Handle the equipment with care during transportation to prevent the damage to the equipment. ◆Do not use the equipment with damaged or missing component. Failure to comply with result in personal injury. ◆Do not touch the components with your hands. Failure to comply with result in static electricity damage.
During Installation	 DANGER	◆Install the equipment on incombustible objects such as metal and keep it away from combustible materials. Failure to comply may result in a fire. ◆Do not loosen the fixed screws of the components, especially the screws with red mark.
	 WARNING	◆Do not drop wire end or screws into the controller. Failure to comply with result in damage to the controller. ◆Install the controller in places free of vibration and direct sunlight. ◆Arrange the installation position properly when two controllers are laid in the same cabinet to ensure the cooling effect.
At Wiring	 DANGER	◆Wiring must be performed only by qualified personnel under instructions described in this manual. Failure to comply may result in unexpected accidents. ◆A circuit breaker must be used to isolate the power supply and the controller. Failure to comply may result in a fire. ◆Ensure that the power supply is cut off before wiring. Failure to comply may result in electric shock. ◆Tie the controller to ground properly by standard. Failure to comply may result in electric shock.
	 WARNING	◆Never connect the power cables to the output terminals (U, V, W) of the controller. Pay attention to the marks of the wiring terminals and ensure correct wiring. Failure to comply will result in damage to the controller. ◆Never connect the braking resistor between the DC bus terminals (+) and (-). Failure to comply may result in a fire. ◆Use wire sizes recommended in the manual. Failure to comply may result in accidents.

Before Power-on	 DANGER	◆Check that the following requirements are met: –The voltage class of the power supply is consistent with the rated voltage class of the controller. –The input terminals (R, S, T) and output terminals (U, V, W) are properly connected. –No short-circuit exists in the peripheral circuit. –The wiring is secured. Failure to comply will result in damage to the controller. ◆Do not perform the voltage resistance test on any part of the controller because such test has been done in the factory. Failure to comply will result in accidents.
	 WARNING	◆Cover the controller properly before power-on to prevent electric shock. ◆All peripheral devices must be connected properly under the instructions described in this manual. Failure to comply will result in accidents.
After Power-on	 DANGER	◆Please do not open the controller's cover after power-on. Failure to comply may result in electric shock. ◆Do not touch any I/O terminal of the controller. Failure to comply may result in electric shock.
	 WARNING	◆Do not touch the rotating part of the motor during the motor auto-tuning or running. Failure to comply will result in accidents. ◆Do not change the default settings of the controller. Failure to comply will result in damage to the controller.
During Operation	 DANGER	◆Signal detection must be performed only by qualified personnel during operation. Failure to comply will result in personal injury or damage to the controller. ◆Do not touch the fan or the discharging resistor to check the temperature. Failure to comply will result in personal burnt.
	 WARNING	◆Avoid objects falling into the controller when it is running. Failure to comply will result in damage to the controller. ◆Do not start/stop the controller by turning the contactor ON/OFF. Failure to comply will result in damage to the controller.
During Maintenance	 DANGER	◆Repair or maintenance of the controller may be performed only by qualified personnel. Failure to comply will result in personal injury or damage to the controller. ◆Do not repair or maintain the controller at power-on. Failure to comply will result in electric shock. ◆Repair or maintain the controller only ten minutes after the controller is powered off. This allows for the residual voltage in the capacitor to discharge to a safe value. Failure to comply will result in personal injury. ◆Ensure that the controller is disconnected from all power supplies before starting repair or maintenance on the controller. ◆All the pluggable components must be plugged or removed only after power-off. ◆Set and check the parameters again after the controller is Replaced.
	 WARNING	◆The rotating motor generally feeds back power to the controller. As a result, the controller is still charged even if the motor stops, and the power supply is cut off. Thus, ensure that the controller is disconnect from the motor before starting repair or maintenance on the controller.

2 INTRODUCTION

2.1 Technology Features

● Input & Output

◆Input Voltage Range: 220V/380V ±15%

◆Input Frequency Range: 47Hz~63Hz

◆Output Voltage Range: 0V~rated input voltage

◆Output Frequency Range: 0Hz~600Hz

● Peripheral Interface Characteristics

◆Programmable Digital Input: Provide 6 digital input terminals

◆Programmable Analog Input: AI1, AI2: 0V~10V voltage input or 4mA~20mA current input.

◆Relay Output: Provide 2 relay output terminals

◆Analog Output: Provide 2 analog output terminal, AO1 supports 0mA~20mA current output or 0V~10V voltage output, AO2 supports 0mA~20mA current output

● Technical Performance Characteristics

◆Control Mode: Sensorless Vector Control (SVC), V/F Control, Torque Control.

◆Overload Capacity: G Type Mode: 60s with 150% of rated current, 3s with 180% of rated current150%; P Type Mode: 60s with 120% of rated current, 3s with 135% of rated current120%

◆Starting Torque: G Type Mode: 0.5Hz/150% (SVC); P Type Mode: 0.5Hz/100%

◆Speed Regulation Ratio: 1:100 (SVC)

◆Speed Control Accuracy: ±0.5% maximum speed (SVC)

◆Carrier Frequency: 0.5kHz~16.0kHz

● Functional Features

◆Reference Frequency Source: Digital setting, analog setting, serial communication setting, multi-speed setting, simple PLC setting, PID setting, etc., can realize the combination of setting and mode switching.

◆Built-in PID Control Function

◆Simple PLC Multi-step Speed Control Function: Can realize up to 16 section speed control

◆Traverse Control Function

◆Non-Stop when power is instantaneously cut off

◆Speed trace Function: Start the running motor smoothly

◆ Key: User defined shortcut key can be realized.

◆Automatic Voltage Regulation (AVR) Function: Automatically keep the output voltage stable when input voltage fluctuating

◆Various Fault Protection Function: Over current, over voltage, under voltage, over heat, phase failure, over load etc.

2.2 Description of Name Plate

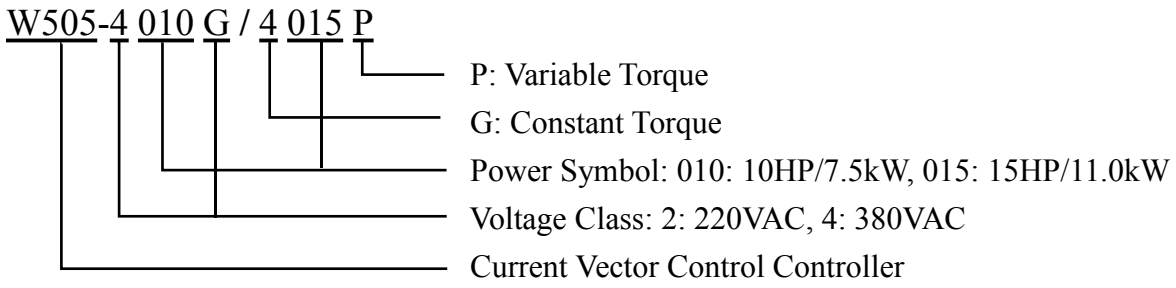


Figure 2.2.1 Nameplate of controller

2.3 Selection Guide

Model No.	Rated Input Voltage (V)	Rated Output Power (kW)	Rated Input Current (A)	Rated Output Current (A)	Motor Power (kW)
W505-2001	1AC: 220V -15%~+15%	0.75	7.1	4.5	0.75
W505-2002		1.5	11.1	7.0	1.5
W505-2003		2.2	15.8	10.0	2.2
W505-2001	3AC: 220V -15%~+15%	0.75	7.1	4.5	0.75
W505-2002		1.5	11.1	7.0	1.5
W505-2003		2.2	15.8	10.0	2.2
W505-2004		3.0	18.1	13.0	3.0
W505-2005		3.7	23.0	17.0	3.7
W505-2007		5.5	32.0	25.0	5.5
W505-2010		7.5	40.0	32.0	7.5
W505-2015		11.0	56.0	45.0	11.0
W505-2020		15.0	70.0	60.0	15.0
W505-2025		18.5	80.0	75.0	18.5
W505-2030		22.0	97.0	91.0	22.0
W505-2040		30.0	125.0	112.0	30.0
W505-2050		37.0	155.0	150.0	37.0
W505-2060		45.0	178.0	176.0	45.0
W505-2075		55.0	210.0	210.0	55.0
W505-4001	3AC: 380V -15%~+15%	0.75	3.4	2.1	0.75
W505-4002		1.5	5.0	3.8	1.5
W505-4003		2.2	5.8	5.1	2.2
W505-4005G/4007P		4.0/5.5	13.5/19.5	9.5/14.0	4.0/5.5
W505-4007G/4010P		5.5/7.5	19.5/25.0	14.0/18.5	5.5/7.5
W505-4010G/4015P		7.5/11.0	25.0/32.0	18.5/25.0	7.5/11.0
W505-4015G/4020P		11.0/15.0	32.0/40.0	25.0/32.0	11.0/15.0
W505-4020G/4025P		15.0/18.5	40.0/47.0	32.0/38.0	15.0/18.5
W505-4025G/4030P		18.5/22.0	47.0/51.0	38.0/45.0	18.5/22.0
W505-4030G/4040P		22.0/30.0	51.0/70.0	45.0/60.0	22.0/30.0
W505-4040G/4050P		30.0/37.0	70.0/80.0	60.0/75.0	30.0/37.0
W505-4050G/4060P		37.0/45.0	80.0/98.0	75.0/92.0	37.0/45.0
W505-4060G/4075P		45.0/55.0	98.0/128.0	92.0/115.0	45.0/55.0
W505-4075G/4100P		55.0/75.0	128.0/139.0	115.0/152.0	55.0/75.0
W505-4100G/4120P		75.0/90.0	139.0/168.0	152.0/180.0	75.0/90.0
W505-4120G/4150P		90.0/110.0	168.0/201.0	180.0/215.0	90.0/110.0
W505-4150G/4180P		110.0/132.0	201.0/265.0	215.0/260.0	110.0/132.0
W505-4180G/4215P		132.0/160.0	265.0/310.0	260.0/305.0	132.0/160.0
W505-4215G/4250P		160.0/185.0	310.0/345.0	305.0/340.0	160.0/185.0
W505-4250G/4270P		185.0/200.0	345.0/385.0	340.0/380.0	185.0/200.0
W505-4270G/4300P		200.0/220.0	385.0/430.0	380.0/426.0	200.0/220.0

2.4 Parts Description

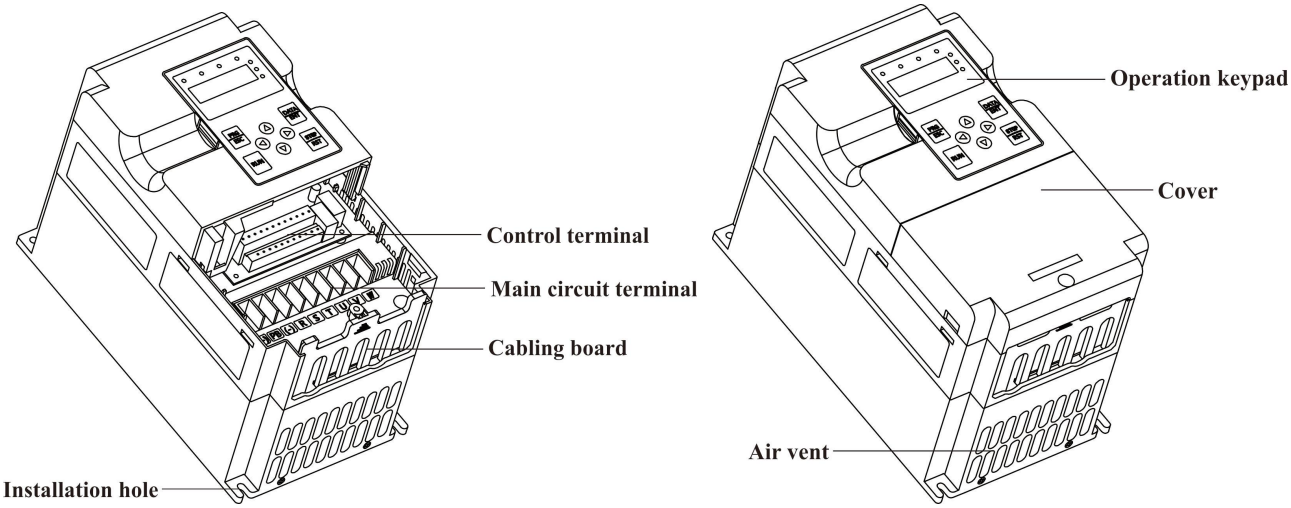


Figure 2.4.1 Parts of controllers (220V: 22.0kW and below, 380V: 37.0kW and below)

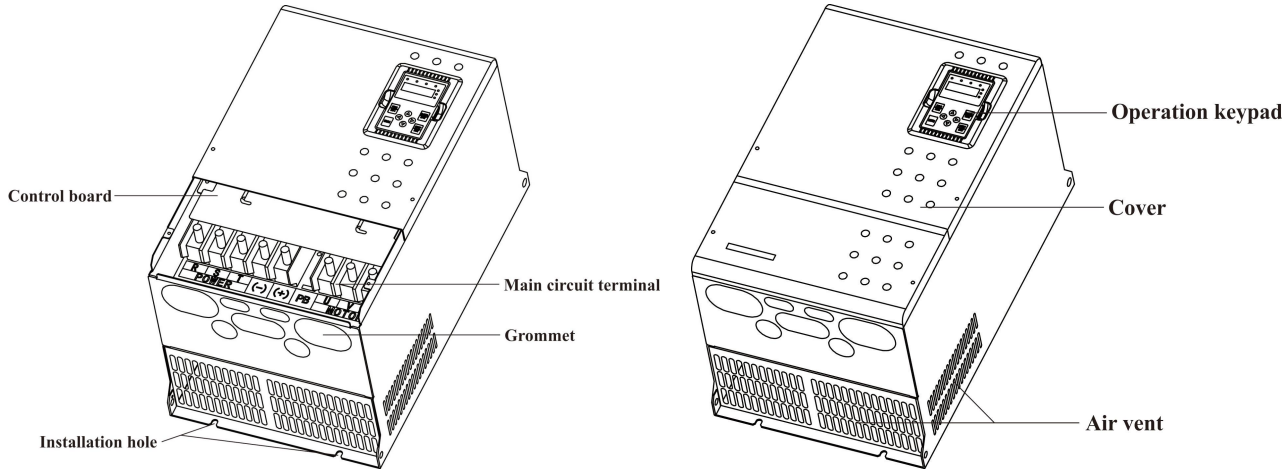


Figure 2.4.2 Parts of controllers (220V: 30.0kW and above, 380V: 45.0kW and above)

2.5 External Dimension

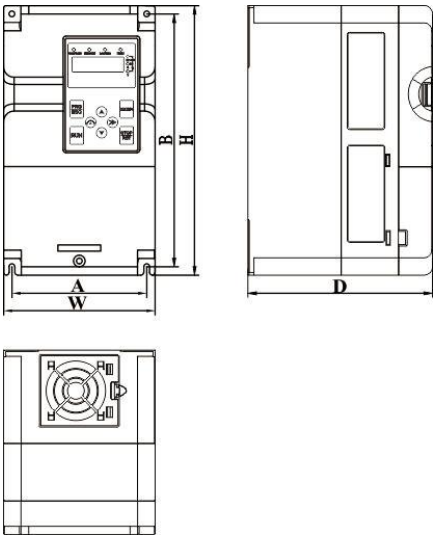


Figure 2.5.1 220V: 0.75kW~22.0kW, 380V: 0.75kW~37.0kW

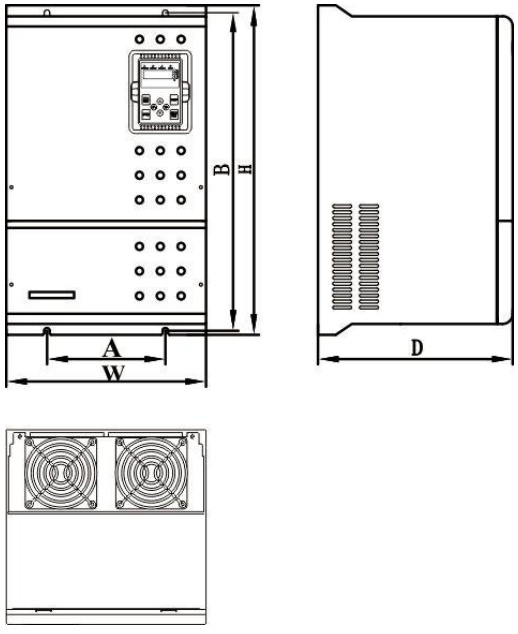


Figure 2.5.2 220V: 30.0kW~55.0kW, 380V: 45.0kW~200.0kW

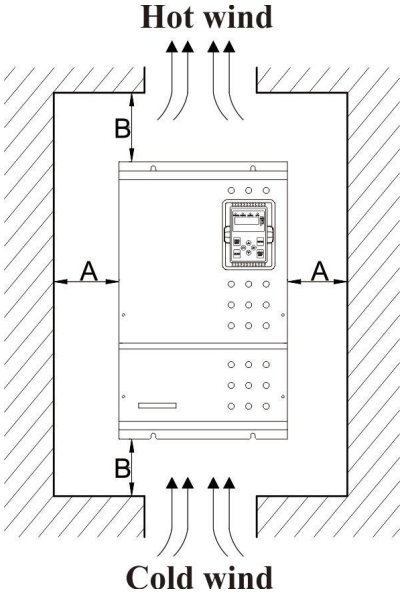
Power(kW)	Installation Dimension		External Dimension			Installation Hole (mm)
	A (mm)	B (mm)	H (mm)	W (mm)	D (mm)	
220V: 0.75kW~2.2kW	114	174	186	126	163.8	5
380V: 0.75kW~2.2kW						
220V: 3.0kW~3.7kW	114	174	186	126	185	5
380V: 4.0kW~5.5kW						
220V: 5.5kW	129	242	258	145	176.5	5.5
380V: 7.5kW						
220V: 7.5kW	146	301	313	161	210	6
380V: 11.0kW~15.0kW						
220V: 11.0kW~15.0kW	185	330	342	200	200.5	6
380V: 18.5kW~22.0kW						
220V: 18.5kW~22.0kW	233	381	400	251	213	6
380V: 30.0kW~37.0kW						
220V: 30.0kW~55.0kW	199	534	554	336	327.5	9
380V: 45.0kW~110.0kW						
380V: 132.0kW~200.0kW	360	848	870	503	362	11

3 INSTALLATION

3.1 Environmental Requirement

Item	Requirements
Environment temperature	-10℃~40℃, controller will be derated at 4% on every 1℃ if ambient temperature exceeds 40℃, the maximum temperature is less than 50℃.
Humidity	Less than 95% RH, without dewfall.
Altitude	Controller can output the rated power when installed with altitude of lower than 1000m. if exceeds 1000m, controller will be derated at 1% on every 100m.
Vibration	Less than 5.8m/Ss^2 (0.6g)
Mounting location	Keep away from the electromagnetic radiation source.
	Do not install the controller at the wringing or dewfall place.
	Keep away from air pollution such as dusty, corrosive gas.
Storage	Do not store the controller in the environment with direct sunlight, vapor, oil fog and vibration.

3.2 Installation Space



Model (KW)	Dimension	
220V: 0.75kW~7.5kW	A≥50mm	B≥100mm
380V: 0.75kW~15.0kW		
220V: 11.0kW~15.0kW	A≥50mm	B≥200mm
380V: 18.5kW~22.0kW		
220V: 15.0kW~22.0kW	A≥50mm	B≥200mm
380V: 22.0kW~37.0kW		
220V: 22.0kW~55.0k	A≥50mm	B≥300mm
380V: 37.0kW~200.0kW		

Installed vertically upward

Figure 3.2.1 Safe space

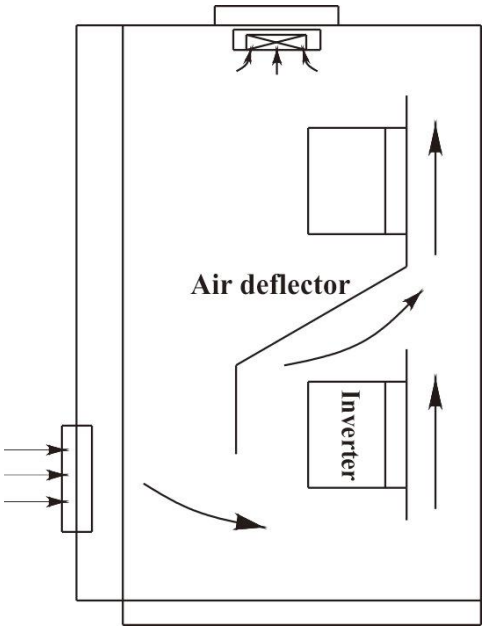


Figure 3.2.2 Installation of multiple controllers

Notice: Add the air deflector when apply the up-down installation.

3.3 Disassembly

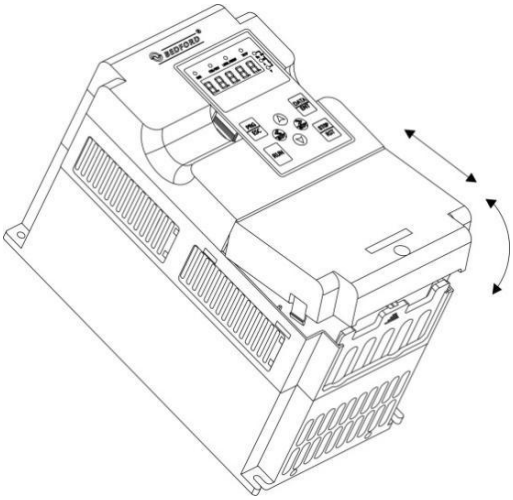


Figure 3.3.1 Dimension of plastic keypad

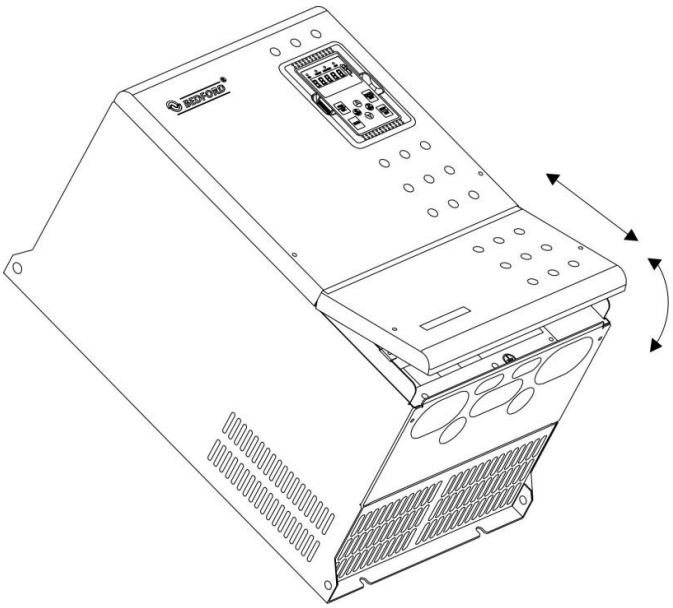


Figure 3.3.2 Dimension of metal plate cover

4 WIRING

- Wiring must be performed by the person certified in electrical work.
- Forbid testing the insulation of cable that connects the controller with high-voltage insulation testing devices.
- Cannot install the controller until discharged completely after the power supply is switched off for 10 minutes.
- Be sure to ground the ground terminal.
  (200V class: Ground resistance should be 100 Ω or less, 400V class: Ground resistance should be 10 Ω or less).
  Otherwise, it might cause electric shock or fire.
- Connect input terminals (R,S,T) and output terminals (U,V,W) correctly. Otherwise, it will cause damage the inside part of controller.
- Do not wire and operate the controller with wet hands. Otherwise, there is a risk of electric shock.

● Check to be sure that the voltage of the main AC power supply satisfies the rated voltage of the Controller. ● Connect power supply cables and motor cables tightly.

4.1 Connection of Peripheral Devices

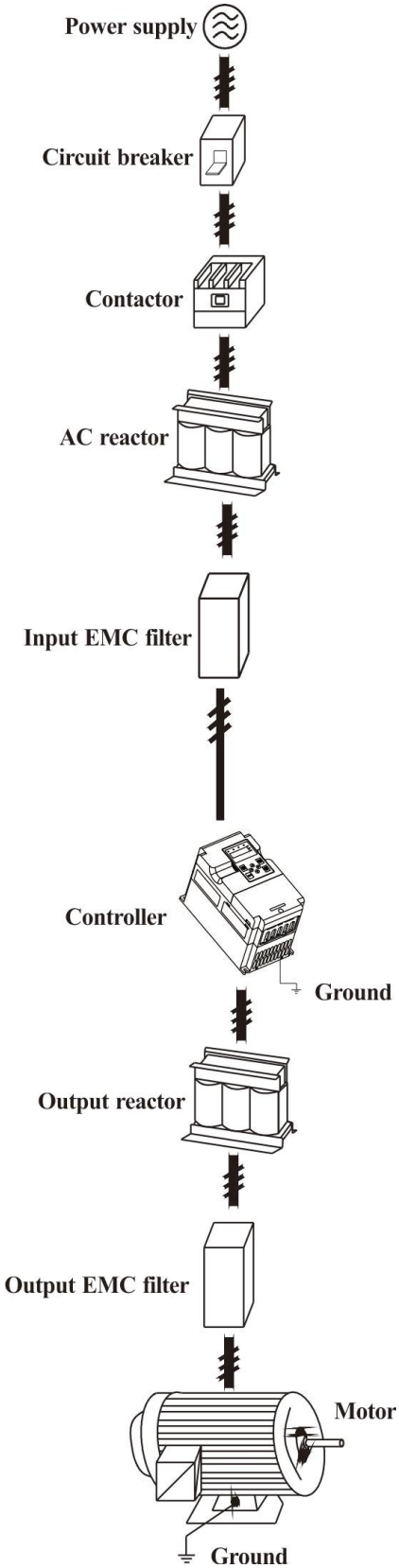


Figure 4.1.1 Connection of peripheral devices

4.1.1 Wiring at Input Side of Main Circuit

4.1.1.1 Circuit breaker

It is necessary to connect a circuit breaker (MCCB) which is compatible with the capacity of controller between 3ph AC power supply and power input terminals (R, S, T). The capacity of breaker is 1.5~2 times to the rated current of controller. For details, see <Specifications of Breaker, Cable, and Contactor>.

4.1.1.2 Contactor

In order to cut off the input power effectively when something is wrong in the system, contactor should be installed at the input side to control the on/off of the main circuit power supply.

4.1.1.3 AC reactor

In order to prevent the rectifier damage resulted from the large current, AC reactor should be installed at the input side. It can also prevent rectifier from sudden variation of power voltage or harmonic generated by phase-control load.

4.1.1.4 Input EMC filter

The surrounding device may be disturbed by the cables when the controller is working. EMC filter can minimize the interference. Just like the following figure.

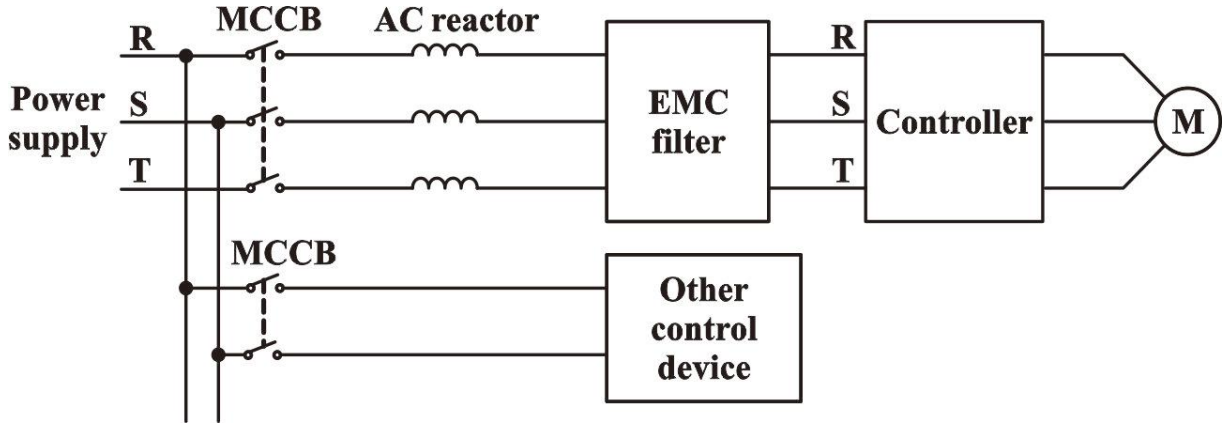


Figure 4.1.2 Wiring at input side of main circuit

4.1.2 Wiring at Motor Side of Main Circuit

1. Output Reactor

When the distance between controller and motor is more than 50m, controller may be tripped by over-current protection frequently because of the large leakage current resulted from the parasitic capacitance with ground. And the same time to avoid the damage of motor insulation, the output reactor should be installed.

2. Output EMC filter

EMC filter should be installed to minimize the leak current caused by the cable and minimize the radio noise caused by the cables between the controller and cable. Just see the following figure.

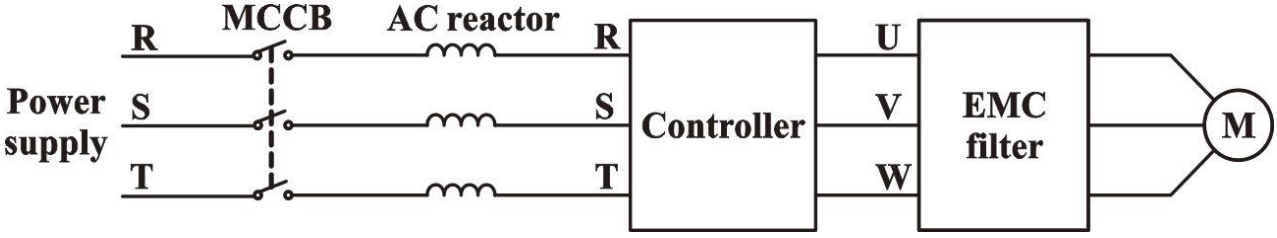


Figure 4.1.3 Wiring at motor side of main circuit

4.1.3 Wiring of Regenerative Unit

Regenerative unit is used for putting the electricity generated by braking of motor to the grid. Compared with traditional 3 phase inverse parallel bridge type rectifier unit, regenerative unit uses IGBT so that the total harmonic distortion (THD) is less than 4%. Regenerative unit is widely used for centrifugal and hoisting equipment.

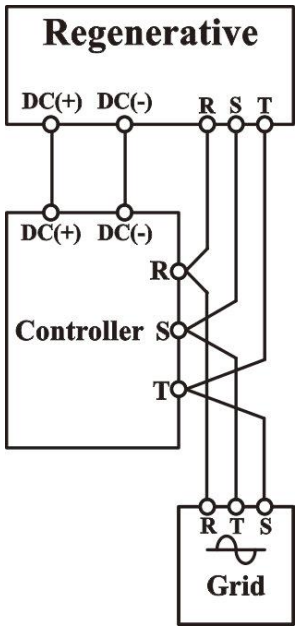


Figure 4.1.4 Wiring of regenerative unit

4.1.4 Wiring of Common DC bus

Common DC bus method is widely used in the paper industry and chemical fiber industry which need multi-motor to coordinate. In these applications, some motors are in driving status while some others are in regenerative braking (generating electricity) status. The regenerated energy is automatically balanced through the common DC bus, which means it can supply to motors in driving status. Therefore, the power consumption of whole system will be less compared with the traditional method (one controller drives one motor).

When two motors are running at the same time (i.e. winding application), one is in driving status and the other is in regenerative status. In this case the DC buses of these two controllers can be connected in parallel so that the regenerated energy can be supplied to motors in driving status whenever it needs. Detailed wiring is shown in the following figure:

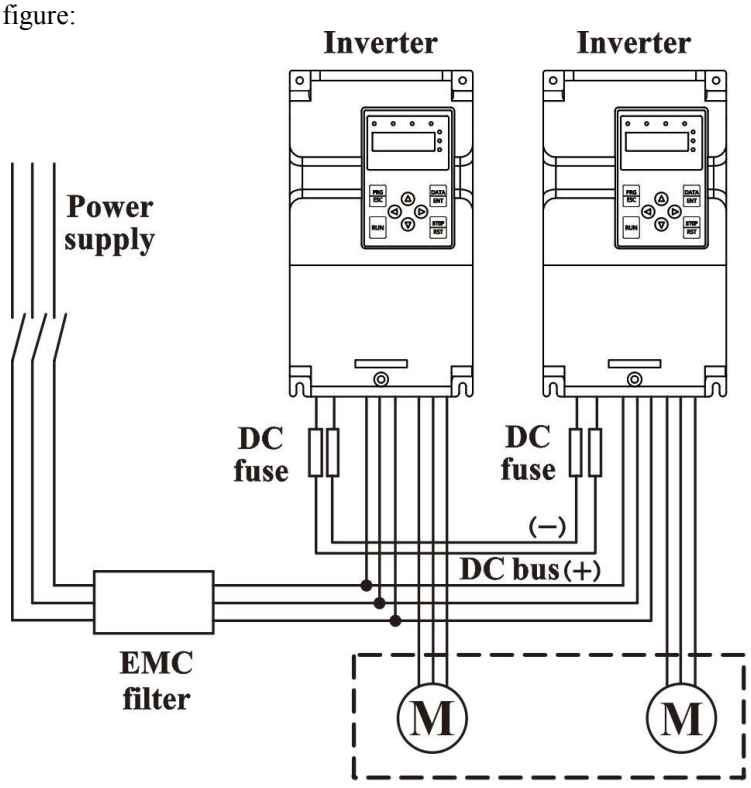


Figure 4.1.5 Wiring of common DC bus

Notice: Two controllers must be the same model when connected with Common DC bus method. Be sure they are powered on at the same time.

4.1.5 Ground Wiring

In order to ensure safety and prevent electrical shock and fire, ⏚ must be grounded with ground resistance. The ground wire should be big and short, and it is better to use copper wire (>3.5mm^2). When multiple controllers need to be grounded, do not loop the ground wire.

4.2 Terminal Configuration Terminal

4.2.1 Main Circuit Terminals (220V AC)

(+)	PB	(-)	R/L	S/N	T	U	V	W

Figure 4.2.1 Main circuit terminals (0.75kW~2.2kW)

(+)	PB	(-)	R	S	T	U	V	W

Figure 4.2.2 Main circuit terminals (3.0kW~15.0kW)

(-)	(+)	PB	R	S	T	U	V	W

Figure 4.2.3 Main circuit terminals (18.5kW ~22.0kW)

R	S	T	(-)	(+)	PB	U	V	W
POWER						MOTOR		

Figure 4.2.4 Main circuit terminals (30.0kW ~55.0kW)

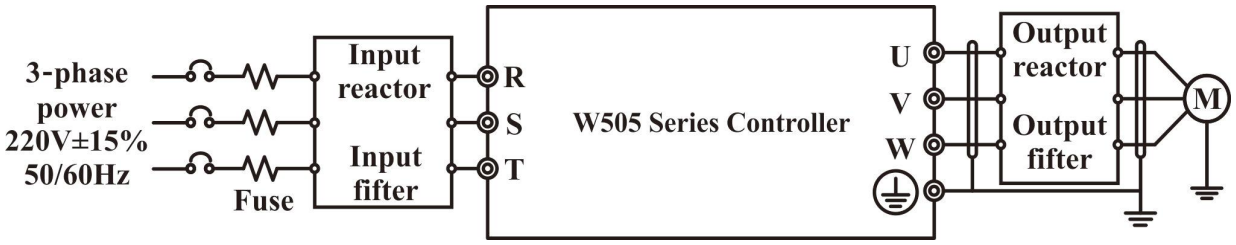


Figure 4.2.5 Wiring diagram of main circuit (220V)

4.2.2 Main Circuit Terminals (380V AC)

(+)	PB	(-)	R/L	S/N	T	U	V	W

Figure 4.2.6 Main circuit terminals (0.75kW~2.2kW)

(+)	PB	(-)	R	S	T	U	V	W

Figure 4.2.7 Main circuit terminals (4.0kW~22.0kW)

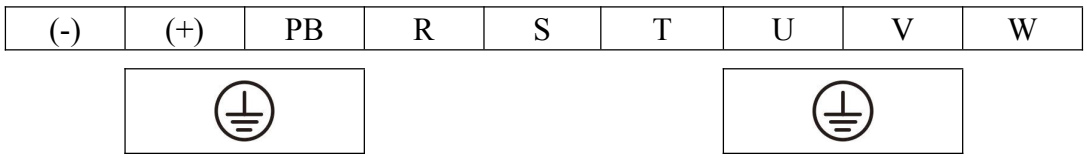


Figure 4.2.8 Main circuit terminals (30.0kW ~37.0kW)

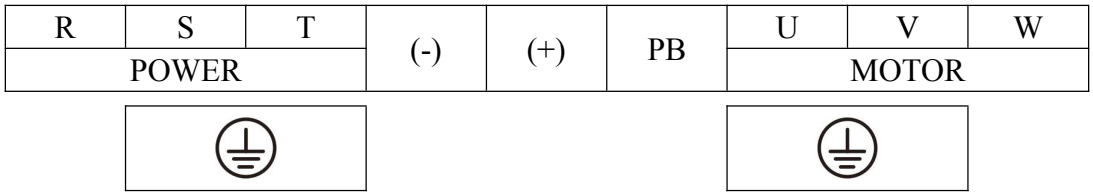


Figure 4.2.9 Main circuit terminals (45.0kW ~110.0kW)

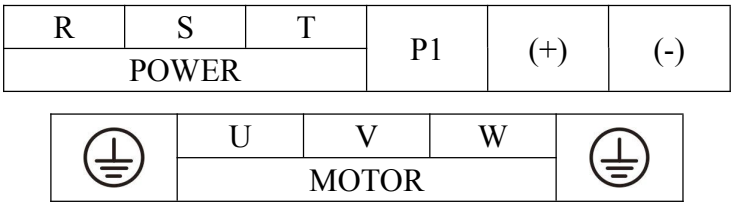


Figure 4.2.10 Main circuit terminals (132.0kW ~200.0kW)

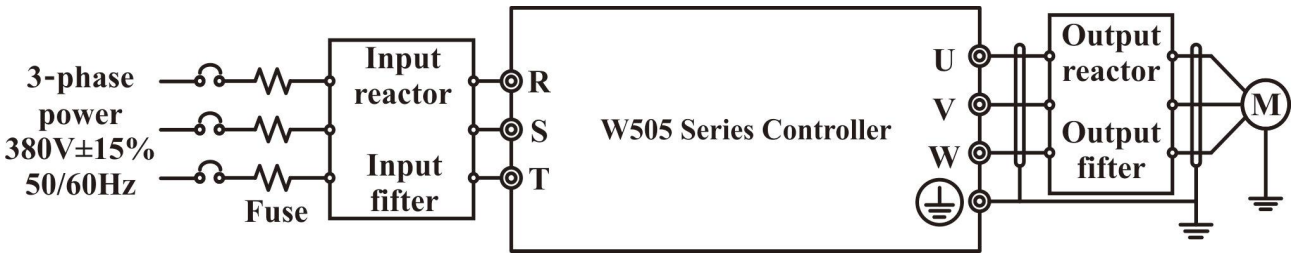


Figure 4.2.11 Wiring diagram of main circuit

Function description of main circuit terminals: Main circuit terminal functions are summarized according to the terminal to the terminal symbols in the following table. Wire the terminal correctly for the desired purposes.

Terminal Symbol	Function Description
L, N	Terminals of single-phase AC input
R, S, T	Terminals of 3 phase AC input
(+), (-)	Terminals of DC bus
U, V, W	Terminals of 3 phase AC output
⏚	Terminals of ground

4.2.3 Control Circuit Terminals

485-	485+	AI2	DI1	DI3	DI5	DI6	DI7	+24V	P/A	P/C	P/B	
AO1	AO2	AI1	+10V	DI2	DI4	GND	COM	FM	T/A	T/C	T/B	

Figure 4.2.12 Control circuit terminals

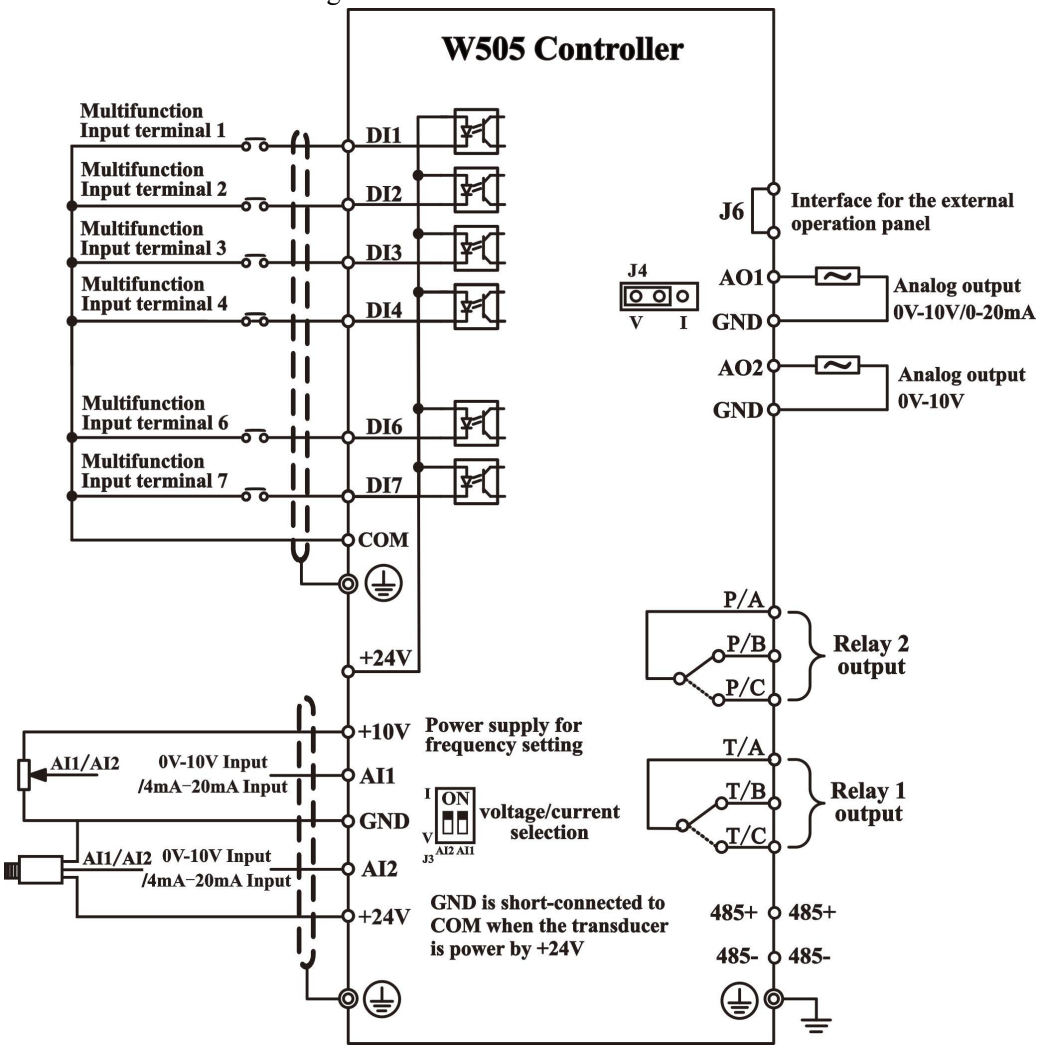


Figure4.2.13 Control circuit wiring diagram

Description of Wiring of Signal Input Terminals:

1) Wiring of AI Terminals:

Weak analog voltage signals are easy to suffer external interference, and therefore the shielded cable must be used, and the cable length must be less than 20m, as shown in Figure 4.2.14.

In applications where the analog signal suffers severe interference, install filter capacitor or ferrite magnetic core at the analog signal source, as shown in figure 4.2.15.

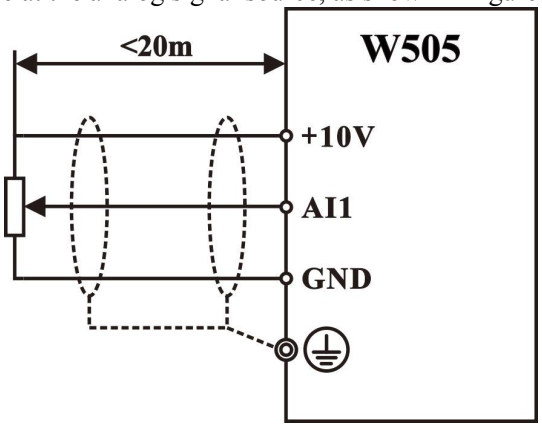


Figure 4.2.14 Wiring diagram of AI terminal

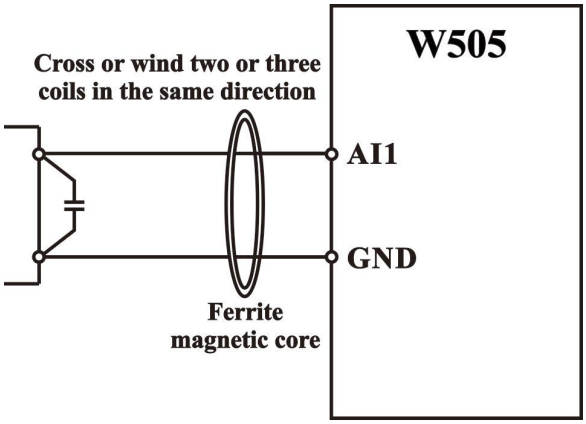


Figure 4.2.15 Processing wiring diagram of AI terminal

2) Wiring of DI Terminals:

Generally, select shielded cable no longer than 20m. When active driving is adopted, necessary filtering measures shall be taken to prevent the interference to the power supply. It is recommended to use the contact control mode. Input signal source: From the NPN transistor, using the internal power supply of the controller. As shown in figure 4.2.16.

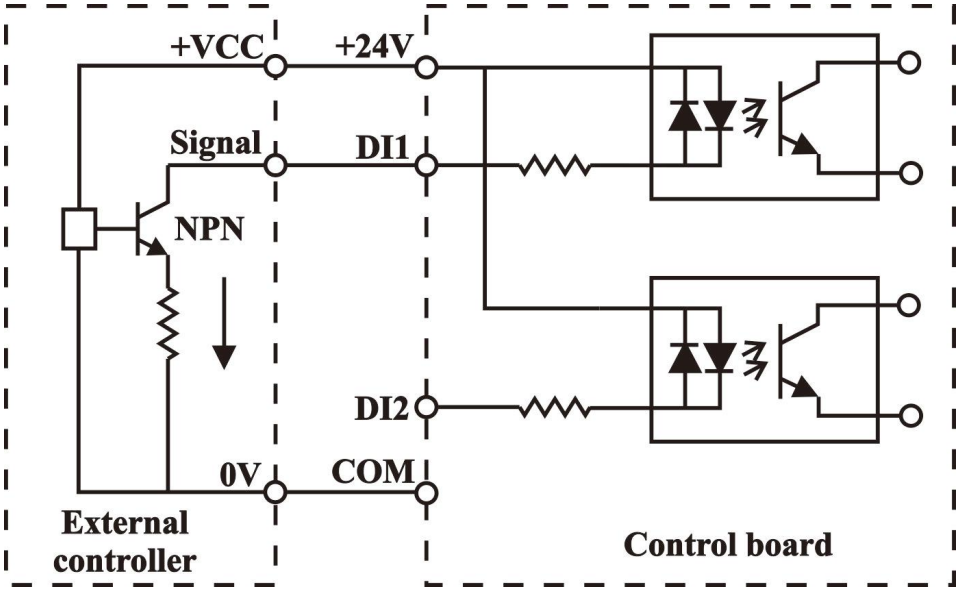


Figure 4.2.16 Internal power supply mode (NPN Mode)

Precautions:

●Use shielded or twisted-pair cables to connect control terminals.

●Connect the ground terminal (⏚) with shield wire.

●The cable connected to the control terminal should leave away from the main circuit and heavy current circuits (including power supply cable, motor cable, relay and contactor connecting cable) at least 20 cm and parallel wiring should be avoided. It is suggested to apply perpendicular wiring to prevent controller malfunction caused by external interference.

Description of Control Circuit Terminal

Type	Terminal Symbol	Function Description
Power Source	+10V-GND	Provide +10V power supply to external unit. Max. output current: 10 mA. Generally, it provides power supply to external potentiometer with resistance range of 1kΩ~5kΩ.
	+24V-COM	Provide +24V power supply to external unit. Max. output current: 200 mA. Generally, it provides power supply to DI/DO terminals and external sensors.
Analog Input	AI1-GND	Input range: 0V~10V/4mA~20mA, determined by the dipswitch J3 selection on the control board. Resistance input: 22kΩ (voltage input), 500Ω (current input)
	AI2-GND	
Digital Input	DI1-COM	ON-OFF signal input, optical coupling with +24V and COM Voltage range for level input: 9V~30V Resistance input: 2.4kΩ
	DI2-COM	
	DI3-COM	
	DI4-COM	
	DI6-COM	
	DI7-COM	
Analog Output	AO1-GND	Voltage or current output is decided by jumper J4. Output voltage range: 0V~10V Output current range: 0mA~20mA
	AO2-GND	Output current range: 0mA~20mA

Relay Output	T/A-T/B	Relay output, T/A-T/B, P/A-P/B NC terminal, T/A-T/C, P/A-P/C NO terminal Contact driving capacity: AC 250V/3A, DC 30V/1A
	T/A-T/C	
	P/A-P/B	
	P/A-P/C	
Commu-nication	485+	485 communication terminal, please use twisted-pair or shielding wire.
	485-	

Jumpers on Control Board

Jumper	Description
Dipswitch J3	Switch between (0V~10V) voltage input and (0mA~20mA) current input. Toggle switch turn to ON side as current type signal, otherwise, as voltage type signal.
Jumper J4	Switch between (0~10V) voltage output and (0~20mA) current output. V connected to GND means voltage output; I connect to GND means current output.

4.3 Installation Guideline to EMC Compliance

4.3.1 General Description of EMC

EMC is the abbreviation of electromagnetic compatibility, which means the device or system has the ability to work normally in the electromagnetic environment and will not generate any electromagnetic interference to other equipment.

EMC includes two subjects: electromagnetic interference and electromagnetic anti-jamming.

According to the transmission mode, Electromagnetic interference can be divided into two categories: conducted interference and radiated interference.

Conducted interference is the interference transmitted by conductor. Therefore, any conductors (such as wire, transmission line, inductor, capacitor and so on) are the transmission channels of the interference.

Radiated interference is the interference transmitted in electromagnetic wave, and the energy is inverse proportional to the square of distance.

Three necessary conditions or essentials of electromagnetic interference are: interference source, transmission channel and sensitive receiver. For customers, the solution of EMC problem is mainly in transmission channel because of the device attribute of disturbance source and receiver cannot be changed.

4.3.2 EMC Features of Controller

Like other electric or electronic devices, controller is not only an electromagnetic interference source but also an electromagnetic receiver. The operating principle of controller determines that it can produce certain electromagnetic interference noise. And the same time controller should be designed with certain anti-jamming ability to ensure the smooth working in certain electromagnetic environment. The following is its EMC features:

- Input current is non-sine wave. The input current includes large amount of high-harmonic waves that can cause electromagnetic interference, decrease the grid power factor and increase the line loss.
- Output voltage is high frequency PWM wave, which can increase the temperature rise and shorten the life of motor. And the leakage current will also increase, which can lead to the leakage protection device malfunction and generate strong electromagnetic interference to influence the reliability of other electric devices.
- As the electromagnetic receiver, too strong interference will damage the controller and influence the normal using of customers.
- In the system, EMS and EMI of controller coexist. Decrease the EMI of controller can increase its EMS ability.

4.3.3 EMC Installation Guideline

In order to ensure all electric devices in the same system to work smoothly, this section, based on EMC features of controller, introduces EMC installation process in several aspects of application (noise control, site wiring, grounding, leakage current and power supply filter). The good effective of EMC will depend on the good effective of all of these five aspects.

4.3.3.1 Noise control

All the connections to the control terminals must use shielded wire. And the shield layer of the wire must ground near the wire entrance of controller. The ground mode is 360-degree annular connection formed by cable

clips. It is strictly prohibitive to connect the twisted shielding layer to the ground of controller, which greatly decreases or loses the shielding effect.

Connect controller and motor with the shielded wire or the separated cable tray. One side of shield layer of shielded wire or metal cover of separated cable tray should connect to ground, and the other side should connect to the motor cover. Installing an EMC filter can reduce the electromagnetic noise greatly.

4.3.3.2 Site wiring

Power supply wiring: the power should be separated supplied from electrical transformer. Normally it is 5 core wires, three of which are fire wires, one of which is the neutral wire, and one of which is the ground wire. It is strictly prohibitive to use the same line to be both the neutral wire and the ground wire.

Device categorization: there are different electric devices contained in one control cabinet, such as controller, filter, PLC and instrument etc., which have different ability of emitting and withstanding electromagnetic noise. Therefore, it needs to categorize these devices into strong noise device and noise sensitive device. The same kinds of device should be placed in the same area, and the distance between devices of different category should be more than 20cm.

Wire Arrangement inside the control cabinet: there are signal wire (light current) and power cable (strong current) in one cabinet. For the controller, the power cables are categorized into input cable and output cable. Signal wires can be easily disturbed by power cables to make the equipment malfunction. Therefore, when wirings, signal cables and power cables should be arranged in different area. It is strictly prohibitive to arrange them in parallel or interlacement at a close distance (less than 20cm) or tie them together. If the signal wires have to cross the power cables, they should be arranged in 90 angles. Power input and output cables should not either be arranged in interlacement or tied together, especially when installed the EMC filter. Otherwise the distributed capacitance of its input and output power cable can be coupling each other to make the EMC filter out of function.

4.3.3.3 Ground

Controller must be ground safely when in operation. Grounding enjoys priority in all EMC methods because it does not only ensure the safety of equipment and persons, but also is the simplest, most effective and lowest cost solution for EMC problems.

Grounding has three categories: special pole grounding, common pole grounding and series-wound grounding. Different control system should use special pole grounding, and different devices in the same control system should use common pole grounding, and different devices connected by same power cable should use series-wound grounding.

4.3.3.4 Leakage current

Leakage current includes line-to-line leakage current and over-ground leakage current. Its value depends on distributed capacitance and carrier frequency of controller. The over-ground leakage current, which is the current passing through the common ground wire, can not only flow into controller system but also other devices. It also can make leakage current circuit breaker, relay or other devices malfunction. The value of line-to-line leakage current, which means the leakage current passing through distributed capacitors of input output wire, depends on the carrier frequency of controller, the length and section areas of motor cables. The higher carrier frequency of controller, the longer of the motor cable and/or the bigger cable section area, the larger leakage current will occur.

Countermeasure:

Decreasing the carrier frequency can effectively decrease the leakage current. In the case of motor cable is relatively long (longer than 50m), it is necessary to install AC reactor or sinusoidal wave filter at the output side, and when it is even longer, it is necessary to install one reactor at every certain distance.

4.3.3.5 EMC filter

EMC filter has a great effect of electromagnetic decoupling, so it is preferred for customer to install it.

For controller, noise filter has following categories:

- Noise filter installed at the input side of controller;
- Install noise isolation for other equipment by means of isolation transformer or power filter.

5 OPERATION

5.1 Keypad Description

5.1.1 Keypad schematic diagram

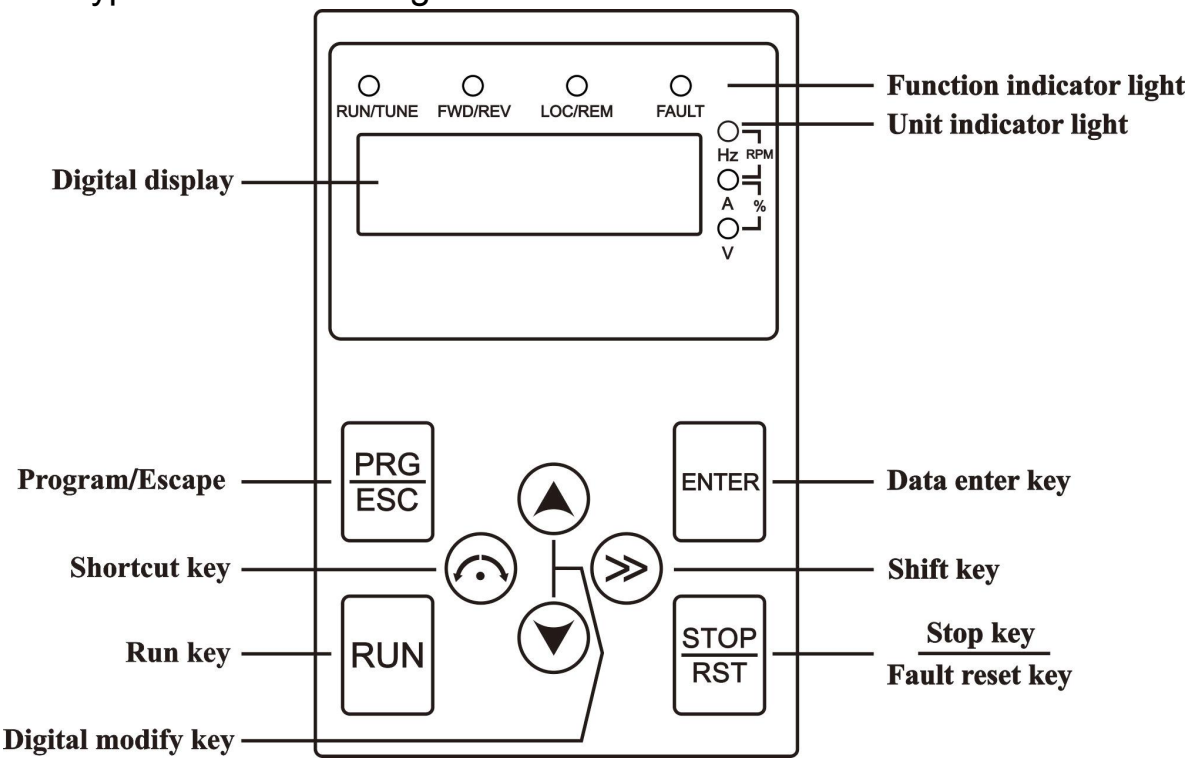


Figure 5.1.1 Keypad schematic diagram

5.1.2 Key function description

Button Symbol	Name	Function Description
PRG ESC	Programming Key	Entry or exit of first-level menu.
ENTER	Enter Key	Enter the menu interfaces level by level, and confirm the parameter setting.
▲	UP Increment Key	Progressively increase data or function codes.
▼	DOWN Decrement Key	Progressive decrease data or function codes.
≫	Shift Key	Select the displayed parameters in turn in the stop or running state and select the digit to be modified when modifying parameters.
RUN	Run Key	Start to run the controller in keypad control mode.
STOP RST	STOP/RESET Key	Stop the controller when it is in the running state and perform the reset operation when it is in the fault state. The functions of this key are restricted in F7.04.
	Shortcut Multifunction Key	Determined by Function Code F7.01: 0: Jog 1: FDW/REV switching 2: Cleat UP/DOWN setting

5.1.3 Indicator light description

1) Function Indicator Light Description

Indicator Light Name	Indicator Light Description
RUN/TUNE	Extinguished: Stop status; Light on: Operation status; Flickering: Parameter auto-tuning status.
FWD/REV	Extinguished: Forward operation; Light on: Reverse operation.
LOC/REM	Extinguished: Keypad control; Flickering: Terminal control; Light on: Communication control.
FAULT	Extinguished: Normal operation status; Flickering: Overload pre-warning status.

2) Unit Indicator Light Description

Symbol	Description
Hz	Frequency unit
A	Current unit
V	Voltage unit
RPM	Rotation speed unit
%	Percentage

3) Digital Display

Digital Display: Have 5-digit LED, which can display all kinds of monitoring data and alarm codes such as reference frequency, output frequency and so on.

5.2 Operation Process

5.2.1 Parameter Setting

Three levels of menu are:

1. Function code group (first-level);
2. Function code (second-level);
3. Function code value (third-level).

Remarks: Press both the PRG/ESC and the ENTER can return to the second-class menu from the third-class menu. The difference is: pressing ENTER will save the set parameters into the control panel, and then return to the second-class menu with shifting to the next function code automatically; while pressing PRG/ESC will directly return to the second-class menu without saving the parameters, and keep staying at the current function code.

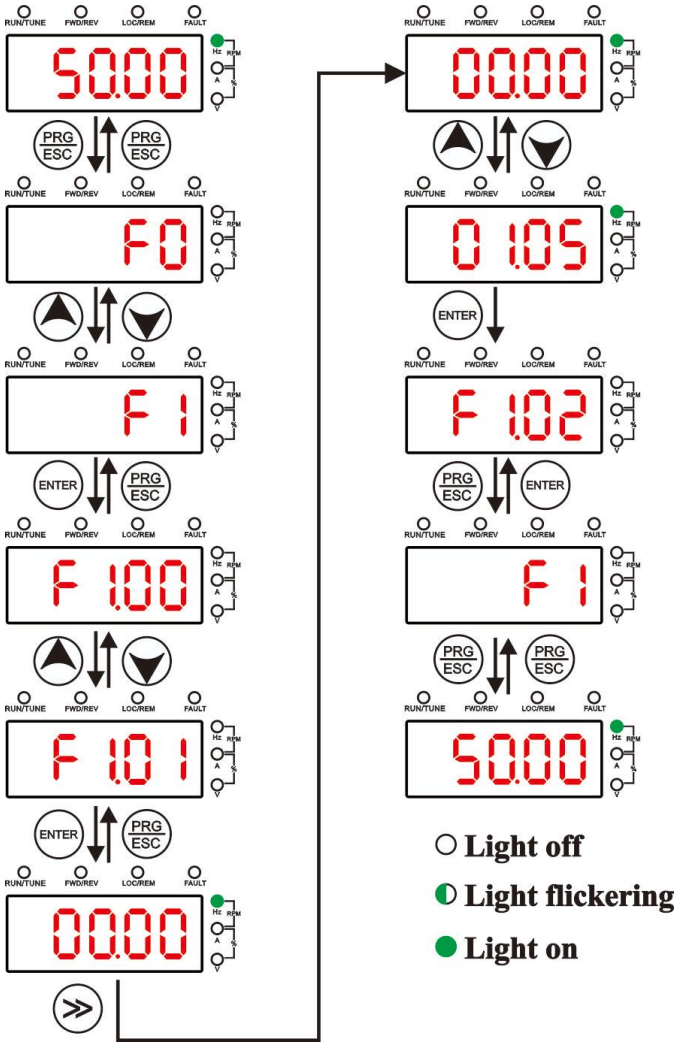


Figure 5.2.1 Flow chart of parameter setting

Under the third-class menu, if the parameter has no flickering bit, it means the function code cannot be modified. The possible reasons could be:

1) This function code is not modifiable parameter, such as actual detected parameter, operation records and so on;

2) This function code is not modifiable in running status, but modifiable in stop status.

5.2.2 Stand-by

At stop or running status, parameters of multi-status can be displayed. Whether or not to display this parameter can be chosen through Function Code F7.03 (Running status display selection) and F7.05 (Stop status display selection) according to binary bits, the detailed description of each bit please refer the function code description of F7.03, F7.04 and F7.07.

In stop status, there are 12 parameters which can be chosen to display or not. Whether or not to display can be decided by setting the corresponding binary bit of F7.05. Press the >> to scroll through the parameters in right order.

In running status, there are 25 parameters which can be chosen to display or not. Whether or not to display can be decided by setting the corresponding binary bit of F7.04. Press the >> to scroll through the parameters in right order.

5.2.3 Password Setting

W505 series controller offers user's password protection function. When F7.00 is set to be nonzero, it will be the user's password, and after exiting function code edit mode, it will become effective. If pressing the PRG/ESC again to try to access the function code edit mode, "0.0.0.0.0." will be displayed, and the operator must input correct user's password, otherwise will be unable to access it.

If it is necessary to cancel the password protection function, just set F7.00 to be zero.

5.2.4 Keypad Shortcut Key Setting

Keypad could be defined by the parameter of F7.01, which is used for the switchover of the command channel or the switchover of the rotation direction of the controller. For the details, pleases see the descriptions of F7.01.

5.3 Running State

5.3.1 Power-on initialization

Firstly, the system initializes during the controller power-on, and LED displays “505”. After the initialization is completed, the controller is on stand-by status.

5.3.2 Fault reset

If the controller has fault, it will prompt the related fault information. User can use STOP/RST or according terminals determined by F5 Group to reset the fault. After fault reset, the controller is at stand-by state. If user does not reset the controller when it is at fault state, the controller will be at operation protection state, and cannot run.

5.3.3 Run Command Source

The controller start/stop command have 3 sources, respectively is operation panel, terminals and communication, which is defined by the parameter of F0.01.

Function Code	Name	Description	Setting Range	Factory Setting
F0.01	Run command source	0: Keypad (“LOC/REM” LED lights off) 1: Terminal (“LOC/REM” LED flickering) 2: Communication (“LOC/REM” LED lights on)	0~2	0

1. Operation panel control can be reached through the operation panel and F0.01 is set to 0.

Press RUN key, the controller start working (“RUN” LED lights on); Press STOP/RST key, the controller stops working (“RUN” LED lights off).

2. Terminal control can be reached through the means of multifunctional input terminals with functions such as FWD, REV etc. And F0.01 is set to 1.

W505 series controller provides a variety of terminal control modes. The control operation mode is determined by function code F5.08, and the input ports of start-stop control signals are determined by function codes F5.00~F5.06. For specific setting method, please refer to F5.08, F5.00~F5.06 and other function codes for detailed explanation.

For example, it is required to use the toggle switch as the start-stop switch of the controller and connect the forward running switch signal to the DI1 port and the reverse running switch signal to the DI3 port. The method setting as shown in the following figure: The controller will stop when K1, K2 command switch is closed or disconnected at the same time; The controller will runs forward, when K1 command switch is closed and K2 command switch is disconnected; The controller will runs in reverse, when K1 command switch is disconnected and K2 command switch is closed.

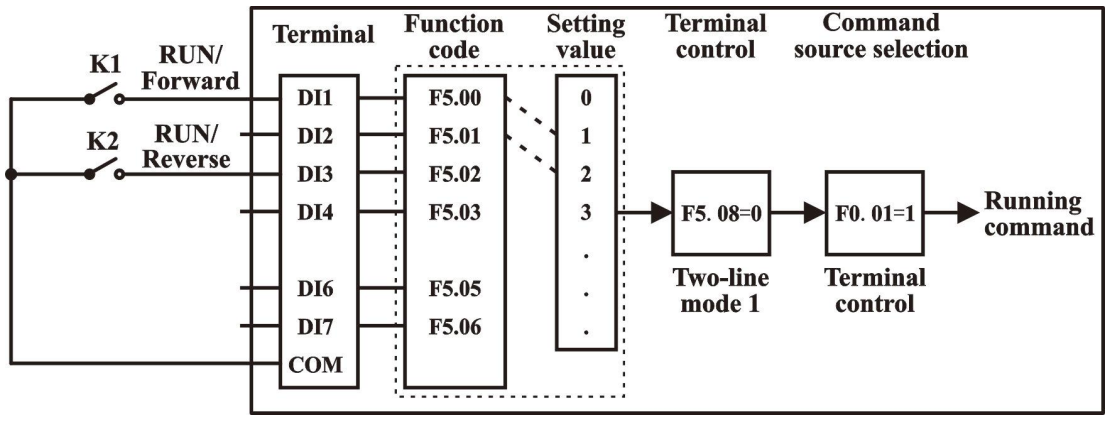


Figure 5.3.1 Terminal star-stop control mode

3. Communication start-stop control is through communication operation to set function code F0.01=2. The related function code of communication setting as shown in the following figure: When FC.04 is set to a non-zero value, the function of automatic controller stop upon communication timeout is enabled. This prevents uncontrollable controller running due to faults of the communication cable or the host computer.

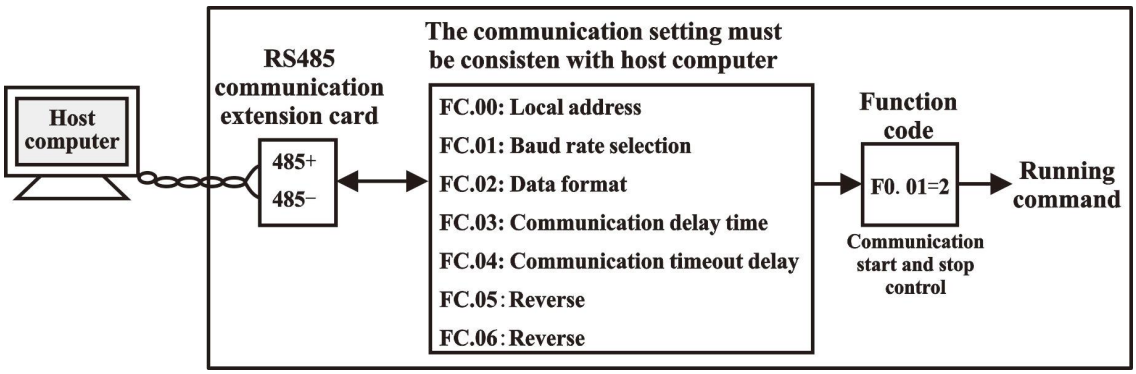


Figure 5.3.2 Terminal star-stop control mode

The communication port of the controller is built with the Modbus slave station protocol, and the communication is implemented only when the host computer supports the Modbus master station protocol. The specific definition of communication protocol, please refers to the detailed description of communication protocol.

5.3.4 Start Mode

The controller supports three start modes, namely, direct start, rotational speed tracking restart, and pre-excited start, selected by function code F1.00.

F1.00=0 Direct start. It is applicable to most small inertia loads, whose DC braking before start is applicable to drive of load such as elevator and crane. Starting frequency of direct start is applicable to drive with burst start equipment under start torque, such as cement mixer.

F1.00=1 Rotational speed tracking restart. it is applicable to large-inertia load. If the load motor sill run with inertia when the controller starts, use rotational speed tracking restart that can prevent start over-current.

F1.00=2 Pre-excited start. The controller performs preexcitation before starting, which can improve quick response of the asynchronous motor and meet the requirements of short acceleration time.

5.3.5 Stop Mode

The controller supports two stop modes, decelerate to stop and coast to stop, set in F1.05.

F1.05=0 Decelerate to stop. After stop command effective implemented, the controller will reduce the output frequency according to the deceleration time and stop after the frequency is 0.

F1.05=1 Coast to stop. After stop command effective implemented, the controller will immediately stop output and load coast to stop under mechanical inertia.

5.4 Motor Parameter Auto-tuning

If “Sensorless Vector Control” mode is chosen (F0.00=0/2), motor nameplate parameters must be input correctly as the auto-tuning is based on it. The performance of vector control depends on the parameters of motor strongly. To achieve excellent performance, firstly must obtain the parameter of motor exactly.

The procedure of motor parameter auto-tuning is specified as follows:

Firstly, choose the keypad command channel as the operation command channel (F0.01=0).

And then input following parameters according to the actual motor parameters:

F2.01: motor rated power; F2.02: motor rated frequency; F2.03: motor rated speed; F2.04: motor rated voltage; F2.05: motor rated current.

If the motor can be completely disconnected from load, thus set F0.15 to 2 (Asynchronous motor complete auto-tuning) and press ENTER to confirm. The keypad displays “TUNE”, and press RUN, the controller will drive the motor to accelerate/decelerate and run in the forward/reverse direction, and the “RUN” indicator is flashing. When the preceding display information disappears and the operation panel returns to the normal parameter display status, it indicates that the auto-tuning is complete. The controller will automatically calculate the following motor parameters:

F2.06: motor stator resistance; F2.07: motor rotor resistance; F2.08: motor stator and rotor inductance; F2.09: motor stator and rotor mutual inductance; F2.10: motor current without load;

If the motor cannot be completely disconnected from the load, set F0.15 to 1 (Asynchronous motor static tuning) and press ENTER to confirm, and then press RUN on the operation panel to start the motor auto-tuning operation. After asynchronous motor static tuning, the controller will get three parameters F2.06~F2.08. Mutual inductance and no-load current of motor cannot be measured, the user needs to set the corresponding function code based on experience.

5.5 Quick Testing

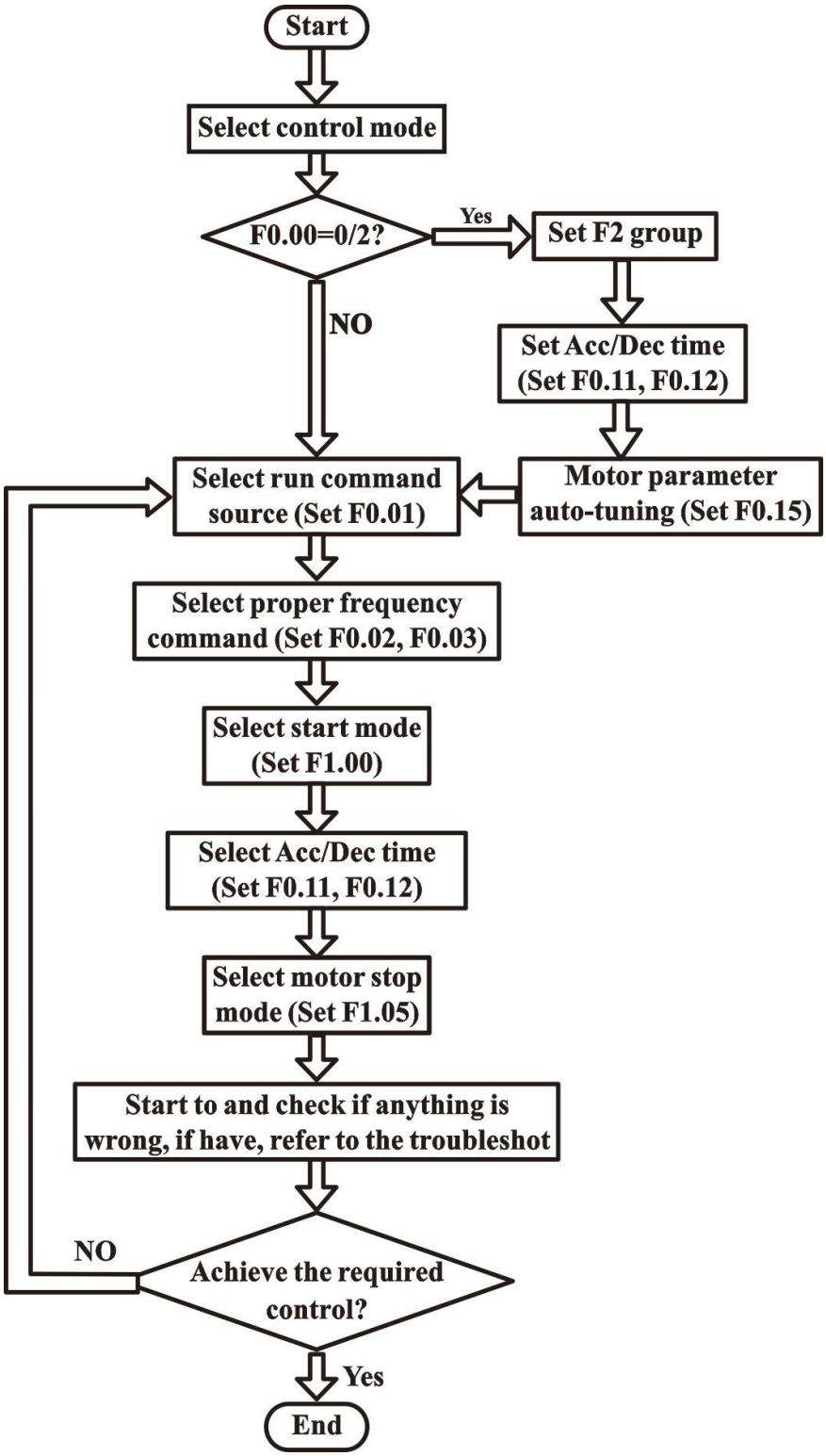


Figure 5.5.1 Quick testing

6 MAINTENANCE and TROUBLESHOOTING

6.1 Faults and Solutions

Fault Code	Fault Type	Possible Causes	Solutions
OUT (1)	Controller Unit Fault	1.The output circuit is grounded or short circuited; 2.The connecting cable of motor is too long; 3.The IGBT overheats; 4.The internal connections become loose; 5.The main control board is faulty; 6.The drive board is faulty; 7.The IGBT is faulty.	●Eliminate the external faults; ●Install a reactor or an output filter; ●Check the air filter and the cooling fan; ●Connect all cables properly; ●Contact the agent; ●Contact the agent; ●Contact the agent.
OC1 (2)	Over-current During Acceleration	1.The output circuit is grounded or short circuited; 2.Motor auto-tuning is not performed; 3.The acceleration time is too short 4.Manual torque boost or V/F curve is not appropriate; 5.The voltage is too low; 6.The start-up operation is performed on the rotating motor; 7.A sudden load is added during acceleration; 8.The model is of too small power class.	●Eliminate the external faults; ●Perform the motor auto-tuning; ●Increase the acceleration time; ●Adjust the manual torque or V/F curve; ●Adjust the voltage to normal range; ●Select rotational speed tracking restart or start the motor after it stops; ●Remove the added load; ●Select a model of higher power class.
OC2 (3)	Over-current During Deceleration	1.The output circuit is grounded or short circuited; 2.Motor auto-tuning is not performed; 3.The deceleration time is too short 4.The voltage is too low; 5.A sudden load is added during deceleration; 6.The braking unit and braking resistor are not installed.	●Eliminate the external faults; ●Perform the motor auto-tuning; ●Increase the deceleration time; ●Adjust the voltage to normal range; ●Remove the added load; ●Install the braking unit and braking resistor.
OC3 (4)	Over-current at Constant Speed	1.The output circuit is grounded or short circuited; 2.Motor auto-tuning is not performed; 3.The voltage is too low; 4.A sudden load is added during operation; 5.The model is of too small power class.	●Eliminate the external faults; ●Perform the motor auto-tuning; ●Adjust the voltage to normal range; ●Remove the added load; ●Select a model of higher power class.
OV1 (5)	Over-voltage During Acceleration	1.The input voltage is too high; 2.An external force drives the motor during acceleration; 3.The acceleration time is too short; 4.The braking unit and braking resistor are not installed.	●Adjust the voltage to normal range; ●Cancel the external force or install the braking resistor; ●Increase the acceleration time; ●Install the braking unit and braking resistor.
OV2 (6)	Over-voltage During Deceleration	1.The input voltage is too high; 2.An external force drives the motor during deceleration; 3.The deceleration time is too short; 4.The braking unit and braking resistor are not installed.	●Adjust the voltage to normal range; ●Cancel the external force or install the braking resistor; ●Increase the deceleration time; ●Install the braking unit and braking resistor.

Fault Code	Fault Type	Possible Causes	Solutions
OV3 (7)	Over-voltage at Constant Speed	1.The input voltage is too high; 2.An external force drives the motor during operation.	●Adjust the voltage to normal range; ●Cancel the external force or install the braking resistor.
CPE (8)	Control Power Supply Fault	1.The input voltage is not within the allowable range.	●Adjust the voltage to the allowable range.
UV (9)	Under-voltage	1.Instantaneous power failure occurs on the input power supply; 2.The controller's input voltage is not within the allowable range; 3.The DC bus voltage is abnormal; 4.The rectifier bridge and buffer resistor are faulty; 5.The drive board is faulty; 6.The main control board is faulty.	●Reset the fault; ●Adjust the voltage to normal range; ●Contact the agent; ●Contact the agent; ●Contact the agent.
OL2 (10)	Controller Overload	1.The load is heavy or locked rotor occurs on the motor; 2.The model is of too small power class.	●Reduce the load and check the motor and the mechanical condition; ●Select a model of higher power class.
OL1 (11)	Motor Overload	1.Fb.01 is set improperly; 2.The load is too heavy or locked rotor occurs on the motor; 3.The model is of too small power class.	●Set Fb.01 correctly; ●Reduce the load and check the motor and the mechanical condition; ●Select a model of higher power class.
SPI (12)	Power Input Phase Fault	1.The three-phase input power is abnormal; 2.The drive board is faulty; 3.The main control board is faulty.	●Eliminate the external faults; ●Contact the agent; ●Contact the agent.
SPO (13)	Power Output Phase Fault	1.The cable connecting controller and motor is faulty; 2.The controller's three -phase outputs are unbalanced when the motor is running; 3.The drive board is faulty; 4.The IGBT is faulty.	●Eliminate the external faults; ●Check whether the motor three-phase winding is normal; ●Contact the agent; ●Contact the agent.
OH2 (14)	IGBT Overheat	1.The ambient temperature is too high; 2.The air filter is blocked; 3.The fan is damaged; 4.The thermistor of the IGBT is damaged; 5.The controller IGBT is damaged.	●Lower the ambient temperature; ●Clean the air filter; ●Replace the damaged fan; ●Replace the damaged the thermistor; ● Replace the controller IGBT.
EF (15)	External Equipment Fault	1.External fault signal is input via DI.	●Check the external equipment input; ●Reset the operation.
CE (16)	Communication Fault	1.The host computer is in abnormal state; 2.The communication cable is faulty; 3.The communication parameters are set improperly.	●Check the cabling of the host computer; ●Check the communication cabling; ●Set the communication parameters properly; ●Press STOP/RST key to reset and contact the agent.
CF (17)	Contactor Fault	1.The drive board and power supply are faulty; 2.The contactor is faulty.	●Replace the drive board or power supply board; ●Replace the contactor.

Fault Code	Fault Type	Possible Causes	Solutions
ITE (18)	Current Detection Fault	1.The cabling of the main control board is in bad contact; 2.Auxiliary power supply is damaged; 3.The HALL device is damaged; 4.Amplication circuit is abnormal.	●Check the connector and plug the cable again; ●Contact the agent; ●Contact the agent; ●Contact the agent.
TE (19)	Motor Auto-tuning Fault	1.The motor capacity and the controller power class are not matched; 2.The motor parameters are set according to the nameplate; 3.The deviation between the auto-tuning parameter and the nameplate parameter is too big; 4.The motor auto-tuning times out.	●Replace the controller model according to motor capacity; ●Set the parameters according to the nameplate properly; ●Make the motor non-loaded and identify the nameplate again; ●Check the cable connecting the motor and the controller.
EEP (21)	EEPROM Read-write Fault	1.Read-write fault of control parameter occurs; 2.EEPROM chip is damaged.	●Press STOP/RST key to reset and contact the agent; ●Contact the agent.
IHE (22)	The Controller Hardware Fault	1.Over-voltage exits; 2.Over-current exits.	●Handle based on over-voltage; ●Handle based on over-current.
SCF (23)	Shot Circuit to Ground	1.The motor is short circuit to the ground.	●Replace the cable or motor.
LFE (30)	Load Becoming 0 Fault	1.The running current of controller is too small.	●Check whether the load becomes 0.
PIDE (31)	PID Feedback Lost During Running	1.PID feedback cable is disconnected; 2.PID feedback source is disappeared/	●Check PID feedback cable; ●Check PID feedback source.
CLE (40)	Pulse-by-pulse Current Limit Fault	1.The load is too heavy or locked rotor occurs on the motor; 2.The model is of too small power class.	●Reduce the load and check the motor and mechanical condition; ●Select a model of higher power class.
SPE (41)	Motor Switchover Fault During Running	1.Change the selection of the motor during the running of the controller.	●Perform motor switch over after the controller stops.
ADL (42)	Too Large Speed Deviation	1.Locked rotor occurs on the motor; 2.The cable between the controller's output terminals UVW and the motor is abnormal.	●Check whether the motor mechanical is abnormal, the motor auto-tuning is performed and parameter of F3.07 is too small; ●Check the cable connecting the controller and motor.
OSE (43)	Motor Over-speed	1.The motor auto-tuning is not performed.	●Perform the motor auto-tuning.

6.2 Common Faults and Solutions

Controller may have following faults or malfunctions during operation, please refer to the following solutions.

No display after power on:

●Inspect whether the voltage of power supply is the same as the controller rated voltage or not with multi-meter. If the power supply has problem, inspect and solve it.

●Inspect whether the three-phase rectify bridge is in good condition or not. If the rectification bridge is burst out, ask for support.

●Check the CHARGE light. If the light is off, the fault is mainly in the rectify bridge or the buffer resistor. If the light is on, the fault may be lies in the switching power supply. Please ask for support.

Power supply air switch trips off when power on:

● Inspect whether the input power supply is grounded or short circuit. Please solve the problem.

● Inspect whether the rectify bridge has been burnt or not. If it is damaged, ask for support.

Motor doesn't move after controller running:

●Inspect if there is balanced three-phase output among U, V, W. If yes, then motor could be damaged, or mechanically locked. Please solve it.

●If the output is unbalanced or lost, the controller drive board or the output module may be damaged, ask for support.

Controller displays normally when power on, but switch at the input side trips when running:

●Inspect whether the output side of controller is short circuit. If yes, ask for support.

●Inspect whether ground fault exists. If yes, solve it.

●If trip happens occasionally and the distance between motor and controller is too far, it is recommended to install output AC reactor.

7 MAINTENANCE

●Maintenance must be performed according to designated maintenance methods.

●Maintenance, inspection and replacement of parts must be performed only by authorized personnel.

●After turning off the main circuit power supply, waiting for 10 minutes before performance maintenance or inspection

●DO NOT directly touch components or devices of PCB board. Otherwise controller can be damaged by electrostatic.

● After maintenance, all screws must be tightened.

7.1 Daily Maintenance

In order to prevent the fault of controller to make it operate smoothly in high-performance for a long time, user must inspect the controller periodically (within half year). The following table indicates the inspection content.

Items to be checked	Main inspections		Criteria
	Inspection content	Frequency	Means/methods
Operation environment	1.Temperature 2.Humidity 3.Dust 4.Vapor 5.Gases	1.Point thermometer hygrometer; 2.Observation; 3.Visual examination and smelling	1.Ambient temperature shall be lower than 40℃, otherwise, the rated values should be decreased. Humidity shall meet the requirement; 2.No dust accumulation, no traces of water leakage and no condensate; 3.No abnormal color and smell
Controller	1.Vibration 2.Cooling and heating 3.Noise	1.Point thermometer; 2.Comprehensive observation; 3.Listening	1.Smooth operation without vibration; 2.Fan is working in good condition. Speed and air flow are normal. No abnormal heat; 3.No abnormal noise
Motor	1.Vibration 2.Heat 3.Noise	1.Comprehensive observation; 2.Point thermometer; 3.Listening	1.No abnormal vibration and no abnormal noise; 2.No abnormal heat; 3.No abnormal noise
Operation status parameters	1.Power input voltage 2.Controller output voltage	1.Voltmeter; 2.Rectifying voltmeter; 3.Ammeter;	1.Satisfying the specification; 2.Satisfying the specification; 3.Satisfying the specification;

	3.Controller output current 4.Internal temperature	4.Point thermometer	4.Temperature rise is lower than 40℃

7.2 Periodic Maintenance

Customer should check the drive every 3 months or 6 months according to the actual environment.

(1) Check whether the screws of control terminals are loose. If so, tighten them with a screwdriver.

(2) Check whether the main circuit terminals are properly connected; whether the mains cables are over heated.

(3) Check whether the power cables and control cables are damaged, check especially for any wear on the cable tube.

(4) Check whether the insulating tapes around the cable lugs are stripped.

(5) Clean the dust on PCBs and air ducts with a vacuum cleaner.

(6) For drives that have been stored for a long time, it must be powered on every 2 years. When supplying AC power to the drive, use a voltage regulator to raise the input voltage to rated input voltage gradually. The drive should be powered for 5 hours without load.

(7) Before performing insulation tests, all main circuit input/output terminals should be short-circuited with conductors. Then proceed insulation test to the ground. Insulation test of single main circuit terminal to ground is forbidden; otherwise, the drive might be damaged. Please use a 500V Mega-Ohm-Meter.

(8) Before the insulation test of the motor, disconnect the motor from the drive to avoid damaging it.

7.3 Replacement of wearing parts

Fans and electrolytic capacitors are wearing part, please make periodic replacement to ensure long term, safety and failure-free operation. The replacement periods are as follows:

◆Fan: Must be replaced when using up to 20,000 hours.

◆Electrolytic Capacitor: Must be replaced when using up to 30,000~40, 000 hours.

8 SELECTION of PERIPHERAL ELECTRICAL Device

8.1 Cable

Motor cables must be arranged away from other cables. The motor cables of several controller can be arranged in parallel. It is recommended that you arrange the motor cables, input power cables, and control cables separately in different trays. The output dU/dt of the controller may increase electromagnetic interference on other cables. Do not arrange other cables and the motor cables in parallel.

If a control cable and power cable must cross each other, ensure that the angle between them is 90 degrees.

The cable trays must be connected properly and well grounded. Aluminum trays can implement local equipotential.

Model	Recommended Cable Dimensions (mm²)		Screw	
	R, S, T, U, V, W	⏚	Terminal Screw Specification	Torque of Torque Driver (N.m)
W505-2001	1.0	1.0	M4	1.2~1.5
W505-2002	1.5	1.5	M4	1.2~1.5
W505-2003	1.5	1.5	M4	1.2~1.5
W505-2004	2.5	2.5	M4	1.2~1.5
W505-2005	4	4	M4	1.2~1.5
W505-2007	4	4	M4	1.2~1.5
W505-2010	6	6	M5	2~2.5
W505-2015	10	10	M5	2~2.5
W505-2020	16	16	M5	2~2.5
W505-2025	25	16	M6	4~6
W505-2030	35	16	M6	4~6

Model	Recommended Cable Dimensions (mm²)		Screw	
	R, S, T, U, V, W	⏚	Terminal Screw Specification	Torque of Torque Driver (N.m)
W505-2040	50	25	M12	31~40
W505-2050	70	35	M12	31~40
W505-2060	95	50	M12	31~40
W505-2075	120	70	M12	31~40
W505-4001	1.0	1.0	M4	1.2~1.5
W505-4002	1.0	1.0	M4	1.2~1.5
W505-4003	1.0	1.0	M4	1.2~1.5
W505-4005G/4007P	1.5/2.5	1.5/2.5	M4	1.2~1.5
W505-4007G/4010P	2.5/4	2.5/4	M4	1.2~1.5
W505-4010G/4015P	4/4	4/4	M4	1.2~1.5
W505-4015G/4020P	4/6	4/6	M5	2~2.5
W505-4020G/4025P	6/10	6/10	M5	2~2.5
W505-4025G/4030P	10/10	10/10	M5	2~2.5
W505-4030G/4040P	10/16	10/16	M5	2~2.5
W505-4040G/4050P	16/25	16/16	M6	4~6
W505-4050G/4060P	25/35	16/16	M6	4~6
W505-4060G/4075P	35/50	16/25	M12	31~40
W505-4075G/4100P	50/70	25/35	M12	31~40
W505-4100G/4120P	70/95	35/50	M12	31~40
W505-4120G/4150P	95/120	50/70	M12	31~40
W505-4150G/4180P	120/120	70/70	M12	31~40
W505-4180G/4215P	120/150	70/70	M12	31~40
W505-4215G/4250P	150/185	70/95	M12	31~40
W505-4250G/4270P	185/185	95/95	M12	31~40
W505-4270G/4300P	185/2×95	95/95	M12	31~40

Notice:

1. If the conductivity of the motor cable shield cannot meet the requirements, grounding conductor is must be used exclusively.

2. Please check the insulation of power cable according to the local regulations before connecting the AC drive with power cable

3. The cable for main circuit with recommended dimension can be used on the condition of ambient temperature 40℃ below and wiring distance 1 meter long.

8.2 Circuit breaker and Contactor

You need to configure a manually manipulated molded case circuit breaker (MCCB) between the AC power supply and controller. The breaker must be locked in the open state to facilitate installation and inspection. The capacity of the breaker needs to be 1.5 to 2 times the rated current of the controller.

⚠	According to the working principle and structure of breakers, if the manufacturer’s regulation is not followed, hot ionized gases may escape from the breaker enclosure when a short-circuit occurs. To ensure safe use, exercise extra caution when installing and placing the breaker. Follow the manufacturer’s instructions.

To ensure safety, you can configure an electromagnetic contactor on the input side to control the switch-on and switch-off of the main circuit power, so that the input power supply of the controller can be effectively cut off when a system fault occurs.

Model	MCCB (A)	Contactor (A)
W505-2001	10	9
W505-2002	10	9
W505-2003	20	18
W505-2004	25	25
W505-2005	32	32
W505-2007	50	38
W505-2010	63	50
W505-2015	80	80
W505-2020	100	80
W505-2025	125	115
W505-2030	140	115
W505-2040	180	150
W505-2050	225	185
W505-2060	250	225
W505-2075	315	265
W505-4001	6	9
W505-4002	6	9
W505-4003	10	9
W505-4005G/4007P	20/25	18/25
W505-4007G/4010P	25/32	25/32
W505-4010G/4015P	32/50	32/38
W505-4015G/4020P	50/63	38/50
W505-4020G/4025P	63/63	50/65
W505-4025G/4030P	63/80	65/80
W505-4030G/4040P	80/100	80/80
W505-4040G/4050P	100/125	80/115
W505-4050G/4060P	125/140	115/115
W505-4060G/4075P	140/180	115/150
W505-4075G/4100P	180/225	150/185
W505-4100G/4120P	225/250	185/225
W505-4120G/4150P	250/315	225/265
W505-4150G/4180P	315/400	265/330
W505-4180G/4215P	400/400	330/400
W505-4215G/4250P	500/500	400/400
W505-4250G/4270P	500/630	400/400
W505-4270G/4300P	630/630	500/500

9 LIST OF FUNCTION PARAMETERS

W505 series controller functional parameters divide into group, consists of F0 to FE total 16 groups, each functional group includes some functional code. The functional code uses 3 levels menu, such as “F8.08” is expressed as the eighth functional code of the F8 group function, FE group is the factory functional code, the user have no right to access this group parameter.

In order to set the functional code conveniently, when using operation panel, the number of the functional group corresponds to the first level menu, the functional code corresponds to the second level menu, the parameter of the functional code corresponds to the third level menu.

1. The explanation of the column content of list of function parameters follow below:

The first column “functional code” : As function parameter group and the serial number of parameters.

The second column “Name” : As a complete name of functional parameter

The third column “the description of parameter” :As a detailed description of this function parameter.

The forth column “the default value” : As the original setting value of function parameter before factory delivery.

The fifth column “modification” : As the modification property of function parameter, that is if allow to modify and modify condition or not, the description follows below:

“○” indicates that this parameter can be modified all the time, whatever it is stop/running status.

“◎” indicates that this parameter cannot be modified during the controller is running.

“●” indicates that this parameter is read only.

The controller already has auto restrained modification property of each parameter, in case of modification by mistake.

2. Parameter system is decimalism (DEC), if parameter use hexadecimal system to present, when editing the parameter, the data of any digit is individual, some of data range may be hexadecimal system (0~F).

3. “Factory Setting” indicates the value of each parameter while restoring the factory parameters, but those detected parameters or record values cannot be restored.

4. In order to protect parameter more efficiently, the controller provide password protection for the functional code. After setting the password (that is F7.00 is not set to 0), the user press PRG/ESC key to access to function code edit status, the system will access to password authentication status, will display “0.0.0.0.0.”, the operator must input correct password to access. (Remind the user does not try to modify the default setting, if not set properly, it is easy cause the controller abnormal or even damaged). In the status of password unlock-out, can modify the password anytime, the last password is as the criterion. If F7.00 is set to 0, can cancel the password, if F7.00 is nonzero value, the password protection takes effect when the controller powers on.

5. When using serial communication to modify password, the password protection also obeys the above-mentioned rules.

9.1 Function Parameters of W505

Function Code	Name	Description	Factory Setting	Modify
F0 Group: Basic Function				
F0.00	Control mode selection	0: Sensorless vector control 1: V/F control 2: Torque control	1	◎
F0.01	Run command source	0: Keypad (“LOC/REM” LED extinguished) 1: Terminal (“LOC/REM” LED flickering) 2: Communication (“LOC/REM” LED lights on)	0	○
F0.02	A frequency source selection	0: Digital setting (Keyboard Setting Frequency F0.10, press UP/DOWN key to modify, value lost when power off) 1: Digital setting (Keyboard Setting Frequency F0.10, press UP/DOWN key to modify, value save when power off) 2: AI1 3: AI2 4~5: Reserved 6: Multi-step speed 7: Simple PLC 8: PID 9: Communications control	0	◎
F0.03	B frequency source selection	0: Digital setting (Keyboard Setting Frequency F0.10, press UP/DOWN key to modify, value lost when power off) 1: Digital setting (Keyboard Setting Frequency F0.10, press UP/DOWN key to modify, value save when power	0	◎

Function Code	Name	Description	Factory Setting	Modify
		off) 2: AI1 3: AI2 4~5: Reserved 6: Multi-Step speed 7: Simple PLC 8: PID 9: Communications control		
F0.04	When stacking, B frequency source range	0: Relative to maximum output frequency 1: Relative to the A frequency source	0	◎
F0.05	When stacking, B frequency source range	0%~150%	100%	○
F0.06	Frequency source selection	**Ones position** **(Frequency source selection)** 0: A frequency source selection 1: A and B operation (operation relationship determined by tens position) 2: Switchover between A and B 3: Switchover between A and "A and B operation" 4: Switchover between B and "A and B operation" **Tens digit** **(A and B operation relationship)** 0: A+B 1: A-B 2: MAX (A, B) 3: MIN (A, B)	00	○
F0.07	Maximum output frequency	50.00Hz~600.00Hz	50.00Hz	◎
F0.08	Upper frequency limit	Lower frequency limit to Maximum output frequency (F0.09 ~F0.07)	50.00Hz	○
F0.09	Lower frequency limit	0.00Hz~F0.08 (Upper frequency limit)	0.00Hz	○
F0.10	Keyboard Setting Frequency	0.00Hz~F0.07 (Maximum output frequency)	50.00Hz	○
F0.11	Acceleration time 0	0.0s~6500.0s	Depend on model	○
F0.12	Deceleration time 0	0.0s~6500.0s	Depend on model	○
F0.13	Running direction selection	0: Forward 1: Reverse	0	○
F0.14	Carrier frequency	0.5kHz~16.0kHz	Depend on model	○
F0.15	Motor parameters auto tuning	0: No action 1: Asynchronous motor static auto-tuning 2: Asynchronous motor complete auto-tuning	0	◎
F0.16	Restore parameters	0: No action 1: Restore factory setting 2: Clear fault records	0	◎
F1 Group: Start/ Stop Control				
F1.00	Start mode	0: Direct start	0	○

Function Code	Name	Description	Factory Setting	Modify
		1: Rotational speed tracking restart 2: Pre-excited start (asynchronous motor)		
F1.01	Starting frequency of direct start	0.00 Hz ~10.00Hz	0.00Hz	○
F1.02	Hold time of starting frequency	0.0s~100.0s	0.0s	◎
F1.03	DC braking current before start/Pre-excited current	0%~100%	0%	◎
F1.04	DC braking time before start/Pre-excited time	0.0s~100.0s	0.0s	◎
F1.05	Stop mode	0: Deceleration to stop 1: Coast to stop	0	○
F1.06	Starting frequency of DC braking after stop	0.00Hz~Maximum output frequency (F0.07)	0.00Hz	○
F1.07	Waiting time of DC braking after stop	0.0s~100.0s	0.0s	○
F1.08	DC braking current of stop	0%~100%	0%	○
F1.09	DC braking time of stop	0.0s~100.0s	0.0s	○
F1.10	Dead time of FWD/REV	0.0s~3000.0s	0.0s	○
F1.11	FWD/REV enable option when power on	0: Enabled 1: Disabled	0	○
F2 Group: Motor Parameters				
F2.00	G/P option	0: G model 1: P model	Depend on model	◎
F2.01	Motor rated power	0.0~1000.0kW	Depend on model	◎
F2.02	Motor rated frequency	0.01Hz~F0.07 (Maximum output frequency)	Depend on model	◎
F2.03	Motor rated speed	1rpm~65535rpm	Depend on model	◎
F2.04	Motor rated voltage	1V~2000V	Depend on model	◎
F2.05	Motor rated current	0.01A~655.35A (Motor Power≤55kW) 0.1A~6553.5A (Motor Power>55kW)	Depend on model	◎
F2.06	Motor stator resistance	0.001Ω~65.535Ω (the controller power≤55kW) 0.0001Ω~6.5535Ω (the controller power>55kW)	Depend on model	◎
F2.07	Motor rotor resistance	0.001Ω~65.535Ω (the controller power≤55kW) 0.0001Ω~6.5535Ω (the controller power>55kW)	Depend on model	◎
F2.08	Motor leakage inductance	0.01mH~655.35mH (the controller power≤55kW) 0.001mH~65.535mH	Depend on model	◎

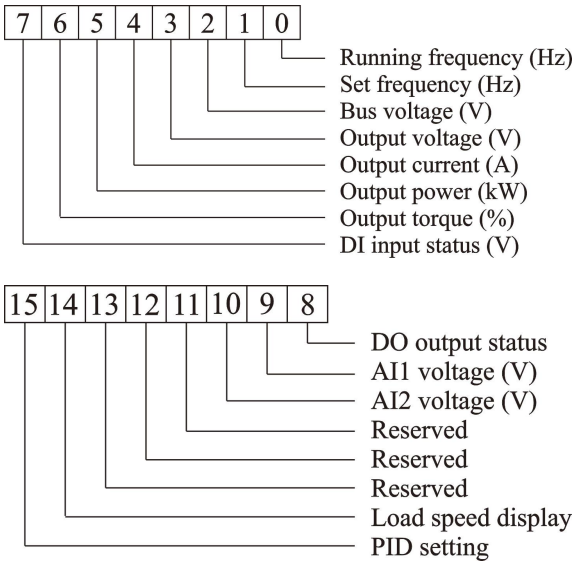
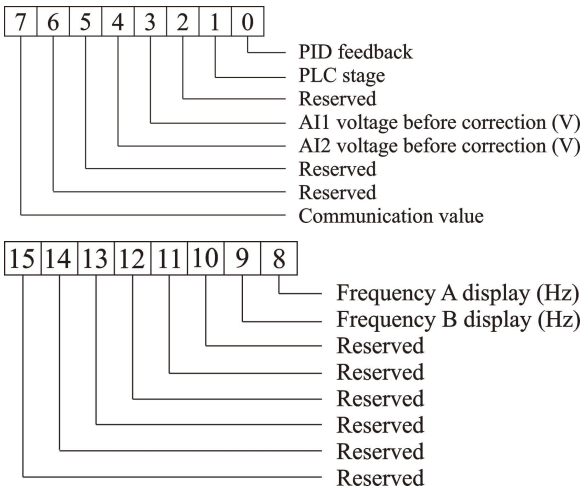
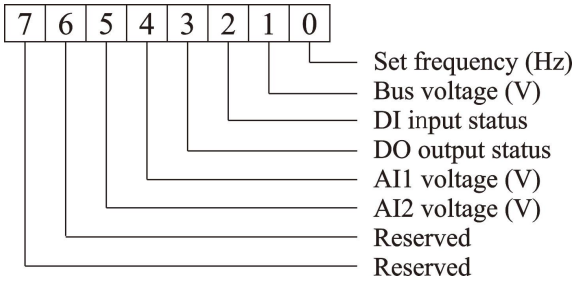
Function Code	Name	Description	Factory Setting	Modify
		(the controller power>55kW)		
F2.09	Motor mutual inductance	0.01mH~655.35mH (the controller power≤55kW) 0.001mH~65.535mH (the controller power>55kW)	Depend on model	◎
F2.10	Current without load	0.01A~F2.05 (the controller power≤55kW) 0.1A~F2.05 (the controller power>55kW)	Depend on model	◎
F3 Group: Vector Control				
F3.00	ASR proportional gain 1	0~100	30	○
F3.01	ASR integral time 1	0.01s~10.00s	0.50s	○
F3.02	ASR switching point	0.00Hz~F3.05	5.00Hz	○
F3.03	ASR proportional gain 2	0~100	20	○
F3.04	ASR integral time 2	0.01s~10.00s	1.00s	○
F3.05	ASR switching point	F3.02~F0.07 (Maximum output frequency)	10.00Hz	○
F3.06	Slip compensation rate of VC	50%~200.0%	100%	○
F3.07	Torque limit	0.0~200.0%	150.0%	○
F3.08	Torque setting source in torque control	0: Digital setting (F3.09) 1: AI1 2: AI2 3~4: Reserved 5: Communication setting 6: MIN (AI1, AI2) 7: MAX (AI1, AI2) Full range of 1~7 correspond to F3.09 digital Settings.	0	◎
F3.09	Torque keyboard setting in torque control	-200.0%~200.0%	150.0%	○
F3.10	Forward maximum frequency in torque control	0.00Hz to maximum output frequency (F0.07)	50.00Hz	○
F3.11	Reverse maximum frequency in torque control	0.00Hz to maximum output frequency (F0.07)	50.00Hz	○
F3.12	Acceleration time in torque control	0.00s~650.00s	0.00s	○
F3.13	Deceleration time in torque control	0.00s~650.00s	0.00s	○
F4 Group: V/F Control				
F4.00	V/F curve setting	0: Linear V/F 1: Multi-point V/F 2: Square V/F 3: 1.2-power V/F 4: 1.4-power V/F	0	◎

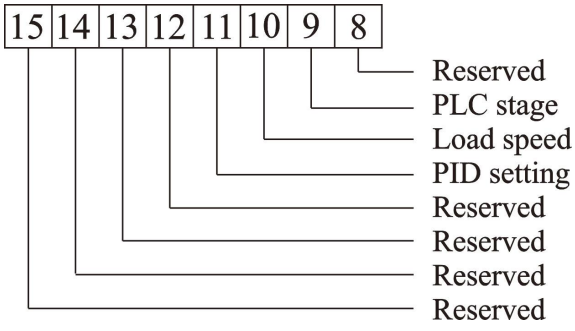
Function Code	Name	Description	Factory Setting	Modify
		6: 1.6-power V/F 8: 1.8-power V/F 9: Reserved 10: V/F complete separation 11: V/F half separation		
F4.01	Torque boost	0.0%: (auto) , 0.1%~30.0%	Depend on model	○
F4.02	Torque boost cut-off	0.00Hz~F0.07 (Maximum output frequency)	50.00Hz	◎
F4.03	Multi-point V/F frequency 1	0.00Hz~F4.05	0.00Hz	◎
F4.04	Multi-point V/F voltage 1	0.0%~100.0%	0.0%	◎
F4.05	Multi-point V/F frequency 2	F4.03~F4.07	0.00Hz	◎
F4.06	Multi-point V/F voltage2	0.0%~100.0%	0.0%	◎
F4.07	Multi-point V/F frequency 3	F4.05 to motor rated frequency (F2.02)	0.00Hz	◎
F4.08	Multi-point V/F voltage 3	0.0%~100.0%	0.0%	◎
F4.09	Voltage source for V/F separation	0: Digital setting (F4.10) 1: AI1 2: AI2 3~4: Reserved 5: Multi-step 6: Simple PLC 7: PID 8: Communication setting Remark:100.0% corresponds to the motor rated voltage.	0	○
F4.10	Voltage digital setting for V/F separation	0 V to motor rated voltage	0V	○
F4.11	Voltage rise time of V/F separation	0.0s~1000.0s Remark: it means the times that 0Vchange to the motor rated voltage.	0.0s	○
F4.12	V/F slip compensation gain	0.0%~200.0%	0.0%	○
F4.13	V/F over-excitation gain	0~200	64	○
F5 Group: Input Terminals				
F5.00	DI1 function selection	0: No- function 1: Forward run (FWD) 2: Reverse run (REV) 3: Three-line control 4: Forward JOG (FJOG) 5: Reverse JOG (RJOG) 6: Terminal UP 7: Terminal DOWN 8: Coast to stop 9: Fault reset (RESET)	1	◎
F5.01	DI2 function selection		4	◎
F5.02	DI3 function selection		9	◎
F5.03	DI4 function selection		12	◎
F5.04	Reserved			
F5.05	DI6 function selection		0	◎
F5.06	DI7 function selection		0	◎

Function Code	Name	Description	Factory Setting	Modify
		10: Run pause 11: Reserved 12: Multi-speed 1 13: Multi-speed 2 14: Multi-speed 3 15: Multi-speed 4 16: Terminal 1 for acceleration/ deceleration time selection 17: Terminal 2 for acceleration/ deceleration time selection 18: Frequency source switch-over 19: UP and DOWN setting clear (terminal, operation panel) 20: Command source switch-over terminal 21: Acceleration/Deceleration prohibited 22: PID pause 23: PLC status reset 24: Swing pause 25~28: Reserved 29: Torque control prohibited 30~31: Reserved 32: Immediate DC braking 33: Reserved 34: Frequency modification forbidden 35: Reverse PID action direction 36: External STOP terminal 1 37: Command source switch-over terminal 2 38: PID integral pause 39: Switch-over between A frequency source and keyboard setting 40: Switch-over between B frequency source and keyboard setting 41~45: Reserved 46: Speed control/Torque control switch-over 47: Emergency stop 48: External stop terminal 2 49: Deceleration DC braking		
F5.07	DI filter time	0.000s~1.000s	0.010s	○
F5.08	Terminal command mode	0: Two-line mode 1 1: Two-line mode 2 2: Three-line mode 1 3: Three-line mode 2	0	◎
F5.09	UP/DOWN setting change rate	0.001Hz/s ~65.535Hz/s	1.000Hz/s	○
F5.10	AI1 lower limit	0.00V~F5.12	0.00V	○
F5.11	AI1 lower limit corresponding setting	-100.0%~100.0%	0.0%	○
F5.12	AI1 upper limit	F5.10~10.00V	10.00V	○
F5.13	AI1 upper limit	-100.0%~100.0%	100.0%	○

Function Code	Name	Description	Factory Setting	Modify
	corresponding setting			
F5.14	AI1 filter time constant	0.00s~10.00s	0.10s	○
F5.15	AI2 lower limit	0.00V~F5.17	0.00V	○
F5.16	AI2 lower limit corresponding setting	-100.0%~100.0%	0.0%	○
F5.17	AI2 upper limit	F5.15~10.00V	10.00V	○
F5.18	AI2 upper limit corresponding setting	-100.0%~100.0%	100.0%	○
F5.19	AI2 filter time constant	0.00s~10.00s	0.10s	○
F5.20 ~ F5.24	Reserved			
F5.25	DI valid mode selection 1	0: High level valid 1: Low level valid Ones position: DI1 Tens position: DI2 Hundreds position: DI3 Thousands position: DI4	00000	◎
F5.26	DI valid mode selection 2	0: High level valid 1: Low level valid Ones position: DI6 Tens position: DI7	00	◎
F6 Group: Output Terminals				
F6.00	Reserved			
F6.01	Reserved	0: No output		
F6.02	Relay function 1	1: Controller running	2	○
F6.03	Relay function 2	2: Fault output (stop) 3: Frequency-level detection FDT output 4: Frequency reached 5: Zero-speed running (no output at stop) 6: Motor overload pre-warning 7: Controller overload pre-warning 8~10: Reserved 11: PLC cycle reached 12: Accumulative running time reached 13: Swing frequency limited 14: Torque limited 15: Ready for RUN 16: AI1>AI2 17: Upper frequency limit reached 18: Lower frequency limit reached (no output at stop) 19: Under-voltage state output. 20: Load becoming 0 21: Reverse running 22: Lower frequency limit reached (having output at stop) 23: Zero-speed running 2 (having output at stop) 24: Alarm output (continue to run)	0	○

Function Code	Name	Description	Factory Setting	Modify
		25: Reserved		
F6.04	Reserved	0: Running frequency		
F6.05	AO1 Output selection	1: Set frequency	0	○
F6.06	AO2 output selection	2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Reserved 7: AI1 8: AI2 9~11: Reserved 12: Communication setting 13: Motor rotation speed 14: Output current (100.0% corresponding to 1000.0A) 15: Output voltage (100.0% corresponding to 1000.0V)	1	○
F6.07	Reserved			
F6.08	AO1 lower limit	0.0%~100.0%	0.0%	○
F6.09	AO1 lower limit corresponding output	0.00V~10.00V	0.00V	○
F6.10	AO1 upper limit	0.0%~100.0%	100.0%	○
F6.11	AO1 upper limit corresponding output	0.00V~10.00V	10.00V	○
F6.12	AO2 lower limit	0.0%~100.0%	0.0%	
F6.13	AO2 lower limit corresponding output	0.00V~10.00V	0.00V	○
F6.14	AO2 upper limit	0.0%~100.0%	100.0%	○
F6.15	AO2 upper limit corresponding output	0.00V~10.00V	10.00V	○
F6.16	Reserved			
F6.17	Relay 1 output delay time	0.0s~3600.0s	0.0s	○
F6.18	Relay 2 output delay time	0.0s~3600.0s	0.0s	○
F7 Group: Display Interface				
F7.00	User password	0~65535	0	◎
F7.01	key function selection	0: Invalid 1: Switchover between keypad control and remote command control (terminals or communication) 2: FDW/REV switchover 3: FDW jog 4: REV jog	0	◎
F7.02	STOP/RST key function option	0: Valid when keypad control 1: Always valid	1	○

Function Code	Name	Description	Factory Setting	Modify
F7.03	Running status display selection 1	0~0xFFFF  If a parameter needs to be displayed during the running, set the corresponding bit to 1, and set F7.03 to the hexadecimal equivalent of this binary number.	0x001F	○
F7.04	Running status display selection 2	0~0xFFFF  If a parameter needs to be displayed during the running, set the corresponding bit to 1, and set F7.04 to the hexadecimal equivalent of this binary number	0x0000	○
F7.05	Stop status display selection	0~0xFFFF 	0x0033	○

Function Code	Name	Description	Factory Setting	Modify
		 If a parameter need to be displayed during the stop, set the corresponding bit to 1, and set F7.05 to the hexadecimal equivalent of this binary number.		
F7.06	Rectifier module temperature	0.0℃~100.0℃	——	●
F7.07	IGBT module temperature	0.0℃~100.0℃	——	●
F7.08	Software version			●
F7.09	Accumulated running time	0h~65535h		●
F7.10	First fault type	0: Fault free		●
F7.11	Second fault type	1: Controller Unit Fault		●
F7.12	Third (latest)fault type	2: Over-current During Acceleration 3: Over-current During Deceleration 4: Over-current at Constant Speed 5: Over-voltage During Acceleration 6: Over-voltage During Deceleration 7: Over-voltage at Constant Speed 8: Control Power Supply Fault 9: Under-voltage 10: Controller Overload 11: Motor Overload 12: Input Phase Fault 13: Output Phase Fault 14: IGBT Overheat 15: External Equipment Fault 16: Communication Fault 17: Contactor Fault 18: Current Detection Fault 19: Motor Auto-tuning Fault 20: Reserved 21: EEPROM Read-write Fault 22: Controller Hardware Fault 23: Shot Circuit to Ground 24~29: Reserved 30: Load Becoming 0 31: PID Feedback Lost During the Running 40: Pulse-by-pulse Current Limit Fault 41: Motor Switchover Fault During Running 42: Too Large Speed Deviation		●

Function Code	Name	Description	Factory Setting	Modify
		43: Motor Over-speed 45: Motor Overheat 51: Reserved		
F7.13	Output frequency at current fault	Output frequency at current fault	——	●
F7.14	Output current at current fault	Output current at current fault	——	●
F7.15	DC bus voltage at current fault	DC bus voltage at current fault	——	●
F7.16	Input terminal status at current fault	This value records ON-OFF input terminal status at current fault. The meaning of each bit is as below: BIT6 BIT5 BIT4 BIT3 BIT2 BIT1 BIT0 DI7 DI6 DI4 DI3 DI2 DI1 1 indicates corresponding input terminal is ON, while 0 indicates OFF.	——	●
F7.17	Output terminal status at current fault	This value records ON-OFF output terminal status at current fault. The meaning of each bit is as below: BIT4 BIT3 BIT2 BIT1 BIT0 T/C P/C 1 indicates corresponding input terminal is ON, while 0 indicates OFF.	——	●
F7.18	Controller status upon 3rd fault	reserved	——	●
F7.19	Time upon 3rd fault (Reckon from power on time)	Pow-on time for 3rd fault time	——	●
F7.20	Time upon 3rd fault (Reckon from running time)	Running time for 3rd fault time	——	●
F8 Group: Enhanced Function				
F8.00	Acceleration time 1	0.0s~6500.0s	Depend on model	○
F8.01	Deceleration time 1	0.0s~6500.0s	Depend on model	○
F8.02	Acceleration time 2	0.0s~6500.0s	Depend on model	○
F8.03	Deceleration time 2	0.0s~6500.0s	Depend on model	○
F8.04	Acceleration time 3	0.0s~6500.0s	Depend on model	○
F8.05	Deceleration time 3	0.0s~6500.0s	Depend on model	○
F8.06	Jog running frequency	0.00Hz to maximum output frequency (F0.07)	2.00Hz	○
F8.07	Jog acceleration time	0.0s~3600.0s	20.0s	○
F8.08	Jog deceleration time	0.0s~3600.0s	20.0s	○
F8.09	Skip frequency	0.00Hz~F0.07 (Maximum output frequency)	0.00Hz	○
F8.10	Skip frequency amplitude	0.00Hz~F0.07 (Maximum output frequency)	0.00Hz	○

Function Code	Name	Description	Factory Setting	Modify
F8.11	Swing Frequency Setting Mode	0: Relative to the central frequency 1: Relative to the maximum output frequency	0	○
F8.12	Swing amplitude	0.0%~100.0%	0.0%	○
F8.13	Jitter frequency amplitude	0.0%~50.0%	0.0%	○
F8.14	Swing frequency cycle	0.1~3000.0s	10.0s	○
F8.15	Triangular wave rising time coefficient	0.1%~100.0%	50.0%	○
F8.16 ~ F8.20	Reserved			
F8.21	Accumulative running time threshold	0h~65535h	0h	○
F8.22	Auto reset times	0~20	0	○
F8.23	Reset interval	0.1s~100.0s	1.0s	○
F8.24	FDT level	0.00Hz~F0.07 (Maximum output frequency)	50.0Hz	○
F8.25	FDT lag	0.0%~100.0%	5.0%	○
F8.26	Detection range of frequency reached	0.0%~100.0%(Maximum output frequency)	0.0%	○
F8.27	Load speed display coefficient	0.0001~6.5000	1.0000	○
F8.28	Droop control	0.00Hz~10.00Hz	0.00Hz	○
F8.29	Cooling fan control mode	0: Fan running while the controller is running. Start the cooling fan when the running frequency is not zero and lasts at least 1 second. Turn off the cooling fan after a 10-second delay when the running frequency is not zero and turns to zero. 1: Fan running when temperature reaches. Start the cooling fan when the running frequency is not zero and lasts at least 1second and the IGBT module temperature is higher than 40℃. Turn off the cooling fan after a 10-second delay when the running frequency is not zero and turns to zero.	0	◎
F9 Group: PID Control				
F9.00	PID setting source	0: Keypad (F9.01) 1: AI1 2: AI2 3~4: Reserved 5: Communication setting 6: Multi-step speed	0	○
F9.01	Keypad PID preset	0.0%~100.0%	50.0%	○
F9.02	PID feedback source	0: AI1 1: AI2 2: Reserved 3: AI1-AI2 4: Reserved 5: Communication setting 6: AI1+AI2 7: MAX (|AI1|, |AI2|)	0	○

Function Code	Name	Description	Factory Setting	Modify
		8: MIN (|AI1|, |AI2|)		
F9.03	PID action direction	0: Positive 1: Negative	0	○
F9.04	Proportional gain (Kp)	0.0~100.0	20.0	○
F9.05	Integral time (Ti)	0.01s~10.00s	2.00s	○
F9.06	Differential time (Td)	0.000s~10.000s	0.000s	○
F9.07	Reverse	Reverse		
F9.08	PID deviation limit	0.0%~100.0%	0.0%	○
F9.09	Feedback lost detecting value	0.0%: Doesn't judge the feedback lost 0.1%~100.0%	0.0%	○
F9.10	Feedback lost detecting time	0.0s~20.0s	0.0s	○
F9.11	Sleep delay time	0.0s~6500.0s	0.0s	○
F9.12	Sleep threshold frequency	0.00Hz~Sleep Wake-up frequency (F9.13)	0.00Hz	○
F9.13	Sleep wake-up frequency	Sleep threshold frequency (F9.12) ~Maximum output frequency (F0.07)	0.00Hz	○
F9.14	Sleep wake-up delay time	0.0s~6500.0s	0.0s	○
FA Group: Multi-step Speed Control				
FA.00	Multi-step Speed 0 source	0: Set by FA.01 1: AI1 2: AI2 3~4: Reserved 5: PID 6: Keyboard Setting (F0.10), modified via terminal UP/DOWN	0	○
FA.01	Multi-step Speed 0	-100.0%~100.0%	0.0%	○
FA.02	Multi-step Speed 1	-100.0%~100.0%	0.0%	○
FA.03	Multi-step Speed 2	-100.0%~100.0%	0.0%	○
FA.04	Multi-step Speed 3	-100.0%~100.0%	0.0%	○
FA.05	Multi-step Speed 4	-100.0%~100.0%	0.0%	○
FA.06	Multi-step Speed 5	-100.0%~100.0%	0.0%	○
FA.07	Multi-step Speed 6	-100.0%~100.0%	0.0%	○
FA.08	Multi-step Speed 7	-100.0%~100.0%	0.0%	○
FA.09	Multi-step Speed 8	-100.0%~100.0%	0.0%	○
FA.10	Multi-step Speed 9	-100.0%~100.0%	0.0%	○
FA.11	Multi-step Speed 10	-100.0%~100.0%	0.0%	○
FA.12	Multi-step Speed 11	-100.0%~100.0%	0.0%	○
FA.13	Multi-step Speed 12	-100.0%~100.0%	0.0%	○
FA.14	Multi-step Speed 13	-100.0%~100.0%	0.0%	○
FA.15	Multi-step Speed 14	-100.0%~100.0%	0.0%	○
FA.16	Multi-step Speed 15	-100.0%~100.0%	0.0%	○
FA.17	Simple PLC running mode	0: Stop after the controller runs one cycle 1: Keep final values after the controller runs one cycle 2: Repeat after the controller runs one cycle	0	○
FA.18	Simple PLC retentive selection	Ones position: retentive upon power failure 0: No	00	○

Function Code	Name	Description	Factory Setting	Modify
		1: Yes Tens position: retentive upon stop 0: No 1: Yes		
FA.19	Running time of simple PLC reference 0	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.20	Acceleration/deceleration time of simple PLC reference 0	0~3	0	○
FA.21	Running time of simple PLC reference 1	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.22	Acceleration/deceleration time of simple PLC reference 1	0~3	0	○
FA.23	Running time of simple PLC reference 2	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.24	Acceleration/deceleration time of simple PLC reference 2	0~3	0	○
FA.25	Running time of simple PLC reference 3	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.26	Acceleration/deceleration time of simple PLC reference 3	0~3	0	○
FA.27	Running time of simple PLC reference 4	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.28	Acceleration/deceleration time of simple PLC reference 4	0~3	0	○
FA.29	Running time of simple PLC reference 5	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.30	Acceleration/deceleration time of simple PLC reference 5	0~3	0	○
FA.31	Running time of simple PLC reference 6	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.32	Acceleration/deceleration time of simple PLC reference 6	0~3	0	○
FA.33	Running time of simple PLC reference 7	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.34	Acceleration/deceleration time of simple PLC reference 7	0~3	0	○
FA.35	Running time of simple PLC reference 8	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.36	Acceleration/deceleration time of simple PLC reference 8	0~3	0	○

Function Code	Name	Description	Factory Setting	Modify
FA.37	Running time of simple PLC reference 9	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.38	Acceleration/deceleration time of simple PLC reference 9	0~3	0	○
FA.39	Running time of simple PLC reference 10	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.40	Acceleration/deceleration time of simple PLC reference 10	0~3	0	○
FA.41	Running time of simple PLC reference 11	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.42	Acceleration/deceleration time of simple PLC reference 11	0~3	0	○
FA.43	Running time of simple PLC reference 12	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.44	Acceleration/deceleration time of simple PLC reference 12	0~3	0	○
FA.45	Running time of simple PLC reference 13	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.46	Acceleration/deceleration time of simple PLC reference 13	0~3	0	○
FA.47	Running time of simple PLC reference 14	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.48	Acceleration/deceleration time of simple PLC reference 14	0~3	0	○
FA.49	Running time of simple PLC reference 15	0.0s~6500.0s or 0.0min~6500.0min	0.0s (min)	○
FA.50	Acceleration/deceleration time of simple PLC reference 15	0~3	0	○
FA.51	Restart mode of simple PLC	0: Restart from Reference 0 1: Continue to run at the frequency of the interrupted moment		
FA.52	Time unit of simple PLC running	0: s 1: min	0	○
FB Group: Protection Function				
Fb.00	Motor overload protection selection	0: Disabled 1: Enabled	1	○
Fb.01	Motor overload protection gain	0.20~10.00	1.00	○
Fb.02	Motor overload warning coefficient	50%~100%	80%	○
Fb.03	Input phase failure protection	0: Disabled 1: Enabled	1	○

Function Code	Name	Description	Factory Setting	Modify
Fb.04	Output phase failure protection selection	0: Disabled 1: Enabled	1	○
Fb.05	Action selection at instantaneous power failure	0: Invalid 1: Decelerate 2: Decelerate to stop	0	◎
Fb.06	Action pause judging voltage at instantaneous power failure	Fb.08~100.0%		◎
Fb.07	Voltage rally judging time at instantaneous power failure	0.00s~100.00s	0.50s	◎
Fb.08	Action judging voltage at instantaneous power failure	60.0%~100.0% (standard bus voltage)	80.0%	○
Fb.09	Over-voltage stall gain	0 ~100 0: No stall over-voltage	0	
Fb.10	Over-voltage stall protective voltage	120%~150% (three phase)	130%	
Fb.11	Over-current stall gain	0~100	20	
Fb.12	Over-current stall protective current	100%~200%	150%	
FC Group: Serial Communication				
FC.00	Local address	1~247, 0 broadcast address	1	○
FC.01	Baud rate selection	MODBUS 0: 300BPS 1: 600BPS 2: 1200BPS 3: 2400BPS 4: 4800BPS 5: 9600BPS 6: 19200BPS 7: 38400BPS 8: 57600BPS 9: 115200BPS	5	○
FC.02	Data format	0: No parity check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: No parity check (8-N-1)	0	○
FC.03	Communication delay time	0ms~200ms	2ms	○
FC.04	Communication timeout delay	0.0s (Disabled), 0.1s~60.0s	0.0	○
FC.05	Reserved	Reserved		
FC.06	Reserved	Reserved		
FD Group: Supplementary Function				
Fd.00	V/F oscillation suppression gain	0~100	depend on model	○
Fd.01	PWM modulation	0: PWM mode 1	0	○

Function Code	Name	Description	Factory Setting	Modify
	mode	1: PWM mode 2		
Fd.02	DPWM switchover frequency upper limit	0.00Hz~Maximum output frequency (F0.07)	12.00Hz	○
Fd.03	Dead zone compensation selection	0: Mode 0 1: Mode 1 2: Mode 2	1	○
Fd.04	Random PWM selection	0: Invalid 1~10: Random PWM depth	0	○
Fd.05	Rapid current limit	0: Disabled 1: Enabled	1	○
Fd.06	Current detection compensation coefficient	0~100	5	○
Fd.07	SVC optimization mode selection	0: Mode 0 1: Mode 1 2: Mode 2	1	○
Fd.08	Reserved			●
FE Group: Factory Setting				
FE.00	Factory password			●

10 COMMUNICATION PROTOCOL

W505 series controller provide RS485 communication interface, using international standard ModBus protocol to communicate between the master and the auxiliary. The user can realize centralized control (setting the controller control command, running frequency, modifying relative functional code, the controller working status and monitoring the fault message etc.) through PC/PLC and the upper computer etc.to accommodate the specific application requirements.

10.1 Command and Communication Data

1. Command: 03H(0000 0011), read N words(16 words at most in one read)

For example: Auxiliary address is 01H, RAM starting address is 0004H, frame format of read two sequential words as follows:

RTU Host command information	
START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	03H
Higher nibble of start address	00H
Lower nibble of start address	04H
Higher nibble of data number	00H
Lower nibble of data number	02H
Lower nibble of CRC	85H
Higher nibble of CRC	CAH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU respond to information from the machine	
START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	03H
Returned byte number	04H
Higher byte of 0004H	00H
Lower nibble of 0004H	00H
Higher nibble of 0005H	00H
Lower nibble of 0005H	00H
Lower nibble of CRC	43H
Higher nibble of CRC	07H
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

2. Command: 06H(0000 0110), write a word

For example, write 5000(1388H) to the 0008H RAM address of auxiliary No.2 which local address is 02H, frame description as follows:

RTU Host command information	
START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
Higher nibble of data address	00H
Lower nibble of data address	08H
Higher nibble of write content	13H
Lower nibble of write content	88H
Lower nibble of CRC CHK	05H
Higher nibble of CRC CHK	6DH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU respond to information from the machine	
START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
High byte of start address	00H
Low byte of start address	08H
High byte of data number	13H
Low byte of data number	88H
Low byte of CRC CHK	05H
High byte of CRC CHK	6DH
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

3. RTU respond to information FRAME VERIFY

Frame verify method has two type, bit verify (odd/even parity verify) and entire frame data verify (CRC or LRC).

(1) BIT VERIFY

User is offered different bit verify method, or select no verify, the selection will influence every byte verify bit setting.

Even parity verify: Add one verify bit in additional before data transmit, this verify bit use for indicate the number of "1" in the transmit data, when the number is even, the verify bit is "0"; when is odd, the verify bit is "1", so as to confirm the whole number of "1" is even.

Odd parity verify: Add one verify bit in additional before data transmit, the verify bit use for indicate the number of "1" in the transmit data, when the number is odd, the verify bit is "0"; when is even, the verify bit is "1", so as to confirm the whole number of "1" is odd.

For example, when transmit "1100 1110", the number of "1" is 5, it is odd, when select even parity verify, the verify bit should be "1"; On the contrary, if select odd parity verify, the verify bit should be "0". When in transmission, parity verify bit will be set on the data frame after calculating. Receiving device get parity verify, when check out unmatched, consider it communication error.

(2) CRC Check——CRC (Cyclical Redundancy Check)

RTU frame includes error check region which base on CRC calculate. CRC region check all-frame, it consists of two bytes, insert to frame by transmission equipment after calculating. Receiving device will calculate the CRC of received frame, compare with the CRC region value received, if unequal, says transmission error.

CRC store 0xFFFF firstly, then call a subprogram process 6 bytes and above in frame with current register. Only every character bit8 valid for CRC, start bit, stop bit and parity verify bit is invalid.

In the CRC calculate, every 8-bit character XOR with the register content separated, the result shift to lower bit , and the highest bit replenish "0". LSB will be taken out for check, if LSB is "1", register XOR with the preset value, if is "0", do null. The whole process will be repeated 8 times. After the last bit (bit8) has finished, the next byte XOR with the current register value. In finally, register value will be the CRC value which produced by XOR all the frame bytes.

This calculation of CRC adopts ITS CRC rule, when user edit CRC calculation, related standard CRC calculation could be refer to program reality accord with requirements.

In ladder logic, CKSM calculate CRC value according to frame data, calculate by table look-up, this method

not only simple in program but also has high arithmetic speed, shortness is data sheet may occupy large ROM space, be caution with this.

4. COMMUNICATION DATA ADDRESS

This section introduces how to operate controller, read controller status and setting controller related parameter via communication.

(1) Functional code parameter address presentation rules

1) When the communication reads the functional code, its communication address of the high 16 nibbles directly are function group number, the lower 16 nibbles are serial number of functional group, such as F0.11 functional parameter, its communication address is F00B, of which F0H means F0 group function code, 0BH means hexadecimal data form of function code in function group with serial number of 11.

2) When the communication writes the functional code, its communication address of high 16 nibbles are divided into 00~0D and F0~FD, lower 16 nibble directly are serial number of functional code in function group, such as writing functional code F0.11

When it doesn't need to write EEPROM, its communication address is 000BH

When it needs to write EEPROM, its communication address is F00BH.

Notice: FE group is the factory parameter group, its cannot to be read or modify. Some of the parameters cannot be change while operating and some are read only. Please take cares with the range of setting, unit and related description when regulate and setting.

(2) Other functions address:

Parameter Description	Address	Meaning of value	R/W Feature
Control command	1000H	0001H: Forward	W
		0002H: Reverse	
		0003H: JOG forward	
		0004H: JOG reverse	
		0005H: Stop	
		0006H: Coast to stop	
		0006H: Reset fault	
Controller status	1001H	0001H: Forward running	R
		0002H: Reverse running	
		0003H: Standby	
		0004H: Fault	
Output terminal control	1002H	0001H: RELAY1 Output control	W
		0002H: RELAY2 Output control	
		0003H: FMR Output control	
Analog AO1 output control	1003H	0~0x7FFF means 0%~100%	W
Analog AO2 output control	1004H	0~0x7FFF means 0%~100%	W
Pulse output control	1005H	0~0x7FFF means 0%~100%	W
Communication setting	2000H	Communication Setting Range (-10000~10000) Note: the communication setting is the percentage of the relative value (-100.00% ~100.00%). If it is set as frequency source, the value is the percentage of the maximum frequency (F0.07). If it is set as PID (preset value or feedback value), the value is the percentage of the PID.	W
Status parameters	3000H	Output frequency	R
	3001H	Reference frequency	
	3002H	DC Bus voltage	
	3003H	Output voltage	
	3004H	Output current	
	3005H	Rotation speed	
	3006H	Output power	

	3007H	Output torque	
	3008H	PID preset value	
	3009H	PID feedback value	
	300AH	Input terminal status	
	300BH	Output terminal status	
	300CH	Input of AI1	
	300DH	Input of AI2	
	300EH	Reserved	
	300FH	count value	
	3010H	Length value	
	3011H	Reserved	
	3012H	Step No. of PLC	
	3013H	Input pulse frequency (0.01Hz)	
	3014H	Communication setting	
	3015H	Linear speed	
Fault info address	5000H	Fault code is same as serial number of fault type of function code menu, but here what feed back to the upper computer is hexadecimal data, not fault characters.	R
Modbus communication fault info address	5001H	0000H: No fault 0001H: Wrong password 0002H: Command code error 0003H: CRC error 0004H: Invalid address 0005H: Invalid data 0006H: Parameter change invalid 0007H: System locked 0008H: Busy (EEPROM is Storing)	R

5. EXTRA RESPONSE FOR COMMUNICATION ERROR

If communication connection incorrect, the controller will reply a message formed by failure command and error code to master control system. No matter command is 03 or 06, controller reply with command 06, and data address fix on 0x5001. For example:

RTU AUXILIARY RESPOND ERROR INFORMATION

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	06H
HIGHER NIBBLE OF ERROR RETURN ADDRESS	50H
LOWER NIBBLE OF ERROR RETURN ADDRESS	01H
HIGHER NIBBLE OF ERROR CODE	00H
LOWER NIBBLE OF ERROR CODE	05H
Low byte of CRC CHK	09H
High byte of CRC CHK	09H
END	T1-T2-T3-T4 (transmission time of 3.5 bytes)

Agent: