AS160 series special inverter for water pump

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Preface

Thank you very much for your purchase of **AS160** series special inverter for water pump.

In order to guarantee to correctly install and use **AS160** series inverter, please carefully read the instructions. Safety cautions of the product must be understood prior to its application.

General Statement

During the editing, Shanghai Sigriner STEP Electric Co., Ltd (herein referred to as "STEP") has checked the conformity between the contents in this manual and the software & hardware mentioned. But there still have the contradictions and mistakes, which can't guarantee their complete consistency. We will regularly examine the contents covered in this manual, and make the necessary corrections during the revised edition in the future. We welcome your improved suggestions.

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No chemical solvent is used during the printing and binding.

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Introduction to the contents	Contents in this manual will be complemented and modified, please pay attention to our website to update it. Company website: www.stepelectric.com/sigriner. Contact address: if you have any doubt or problem during reading this manual, please contact STEP according to the address on the back cover of this manual.

About the Warranty

Duration of the warranty

Duration of the warranty will be 18 months from the date of delivery to your company or your customer, or 30 months from the date of delivery, the earlier time will be taken.

Scope of warranty

In principle, the initial fault diagnosis will be implemented by the user.

Fault diagnosis

But as required by the user, STEP or its service network can provide charging service. At this time, according to the negotiation result with the user, the service will be free if the fault is caused by STEP.

If the faults occurred need to repair or replace, STEP can send its workers to provide the free door-to-door service, except for the following occasions:

Fault repair

- The occasion where the fault is caused by the improper storage, use or design of the user and its customer;
- The occasion where the fault is caused by the changes made by the user without permission when STEP doesn't know these conditions;
- The occasion where the fault is caused by application beyond the scope of product specifications of STEP.
- The occasion where the fault is caused by the natural disasters and fire.
- The occasion where the fault is caused by the reasons other than STEP.

Beyond the guaranteed liabilities

The inconvenience brought to the user and its customer or the damage of the product other than STEP due to the fault of STEP products will be the scope of warranty of STEP. STEP won't undertake any responsibility for the contingent loss.

Introduction to the marks related to safety

In this manual, the following marks will be applied for the contents related to safety. The statement and contents with safety marks are very important, so that please observe them.

Danger： Danger or personal death will be caused due to improper use.

Note： Danger, personal minor or serious injury and equipment damage will be caused due to improper use.

Important: The part that the user needs to observe and pay particular attention to

Content

Chapter 1 Notice for Use of the Inverter

In this chapter, general information of the inverter is described, including voltage grade of the inverter, capacity of adapter motor and how to carry out the unpack inspection, etc. In addition, considerations during the installation, wiring, use, maintenance and rejection of the inverter are described in details, which are helpful to apply the inverter safety and lengthen its service life. Please read this chapter carefully.

1.1 Grade of voltage and capacity of applicable motor

Grade of voltage of AS160 series inverter is grade 400V (380V-460V), which is applicable to three-phase AC asynchronous motor with capacity of 2.2-560kW. Please contact our engineering center for the configuration beyond this range of power.

1.2 Unpacking inspection

Note

◎ The inverter damaged and in shortage of parts shall not be installed, otherwise the dangers of fire and personal injury will be caused.

Please carefully confirm during packing: whether there is damage during transportation; whether the model and specifications on the nameplate conform to the order requirements. If the type is different or elements omissions appear, please contact the manufacturer or the supplier immediately for solution.

1.3 Introduction to the nameplate

The nameplate is attached to side of the inverter, on which, the model, specifications, batch number and manufacturing code are recorded.

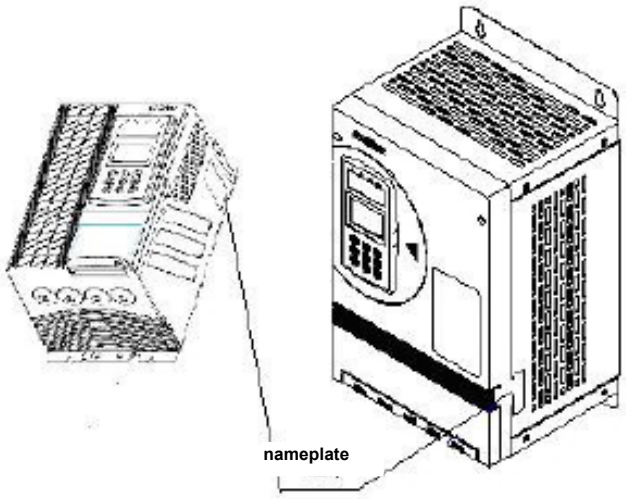


Figure 1-1 Inverter Nameplate (example)

1.3.1 Introduction to product nameplate

See Figure 1-2 for the inverter nameplate.

Model, specifications and batch number of the inverter are recorded on the nameplate.

Model of inverter: model: →	AS160 4T 0022
Power of applicable motor: →	power: 22kW
Input specification: →	input: AC 380V-460V 50-60HzZ 51A
Output specification: →	output: AC 380V-460V 0-120Hz 44A
Machine No.: →	No.:
Manufacturing No.: →	serial No.:
	Shanghai Sigriner STEP Electric Co., Ltd

Figure 1-2 Introduction to inverter nameplate

1.3.2 Description of product (order No.)

In the column of Model of Inverter on nameplate, specifications, voltage grade of the inverter as well as type and maximum capacity of the applicable motor are indicated with figures and letters.

See Figure 1-3 for the introduction to model of the inverter.

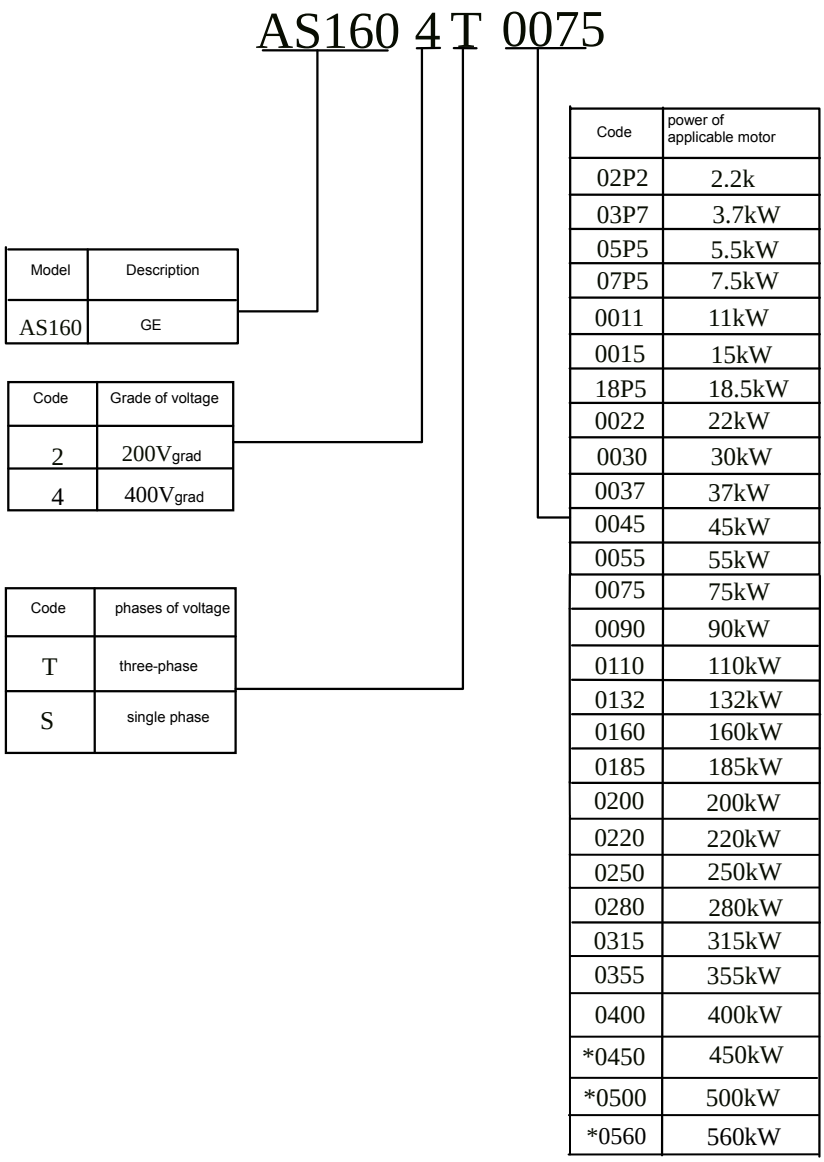


Figure 1-3 Introduction of model of inverter

Note: To order the inverters with "*" before the models, contact the company to verify the cycle time.

1.4 Safety cautions

Danger

◎ The inverter shall be mounted on the objects not easy to burn such as metal, otherwise the danger of fire will be caused.

◎ The inverter shall not be mounted in the environment with explosive gas, otherwise the danger of explosion will be caused.

◎ Combustible materials shall not be placed nearby the inverter, otherwise

the danger of fire will be caused.

Note

◎ Please support the bottom of the inverter during handling, otherwise the danger of personal injury or inverter damage will be caused when its main body falls.

◎ Bearing capacity of the platform shall be considered during installation, otherwise the danger of personal injury or inverter damage will be caused when its main body falls.

◎ The inverter shall not be installed at the occasion with splash water such as water pipe, otherwise the danger of inverter damage will be caused.

◎ Foreign body such as screw, spacer and metal bar shall not be fallen into the inverter, otherwise the dangers of fire and inverter damage will be caused.

Danger

◎ Please confirm that the input power supply is in state of complete disconnection prior to wiring, otherwise the danger of electric shock will be caused.

◎ Wiring must be done by the electrical professionals, otherwise the danger of electric shock will be caused.

◎ Protection ground terminal E of the inverter must be reliably grounded, otherwise the danger of electric shock will be caused.

◎ Input terminal and output terminal of the main circuit of the inverter shall not be confused, otherwise the inverter may by damaged, with the danger of explosion.

◎ Terminal ⊕1/⊕2 shall not be short connected to ⊖, otherwise the dangers of fire and explosion will be caused.

◎ Put the cover plate well before power on, otherwise the dangers of electric shock and explosion will be caused.

◎ Don’t operation the inverter with wet hands, otherwise the danger of electric shock will be caused.

◎ When the inverter is connected to emergency stop safety circuit, the wiring shall be examined carefully after operation, otherwise the danger of unsafety will be caused.

Danger

◎ For the inverter which has been stored for more than 2 years, power supply shall be realized by means of slow boosting via voltage regulator, otherwise the dangers of electric shock and explosion will be caused.

◎ Don't operate the inverter improperly during its operation, otherwise the danger of high voltage electric shock will be caused.

◎ Don't open the cover plate or touch the wiring terminal if there is dangerous high voltage inside the inverter within a period after the power supply is cut off. Otherwise the danger of high voltage electric shock will be caused.

◎ Only the trained and authorized qualified professionals can carry out maintenance for the inverter, otherwise the dangers of inverter damage and electric shock will be caused.

◎ The maintenance personnel must take down all the metal articles such as watch and ring before the operation is started. During the operation, the clothes and tools conforming to insulation requirement must be applied, otherwise the dangers of electric shock and explosion will be caused.

1.5 Considerations for use

Please pay attention to the following when AS160 series inverter is used.

1.5.1 Absorption elements are forbidden on output side

Because the inverter output is pulse, if the capacitor to improve the power factor or piezoresistance for lightning protection is mounted on the output side, which will cause fault trip or element damage to the inverter. It must be considered during line design. Refer to Figure 1-4 for Schematic of No Capacitor Connected On the Output Side of Inverter

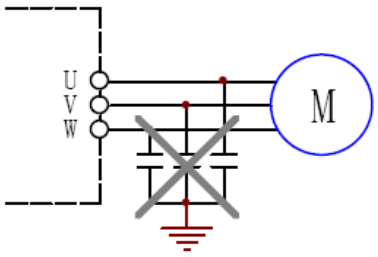


Figure 1-4 Schematic of No Capacitor Connected On the Output Side of Inverter

1.5.2 Working voltage of the inverter

AS160 series inverter only applies to its rated range of voltage, if the voltage of power supply is different from its rated voltage, then transformation treatment shall be done via voltage regulator.

1.5.3 Two-phase input is unfavorable

It is unfavorable to change three-phase input into two-phase input, otherwise the fault will be caused.

1.5.4 User control of the output contactor

When the output contactor is controlled by the user program, it shall be closed before the operation command is sent to the inverter in order to guarantee that the contactor can make and break without any current. Disconnect the contactor after the elevator stop signal is output for a while.

1.5.5 Altitude and derating use

Radiation performance of the inverter will become poor due to the thin air at the areas with its altitude exceeding 1000m. At this time, it is necessary to carry out derating use for the inverter. Relationship curve between the rated output current and altitude of inverter is shown in Figure 1-5 during derating use.

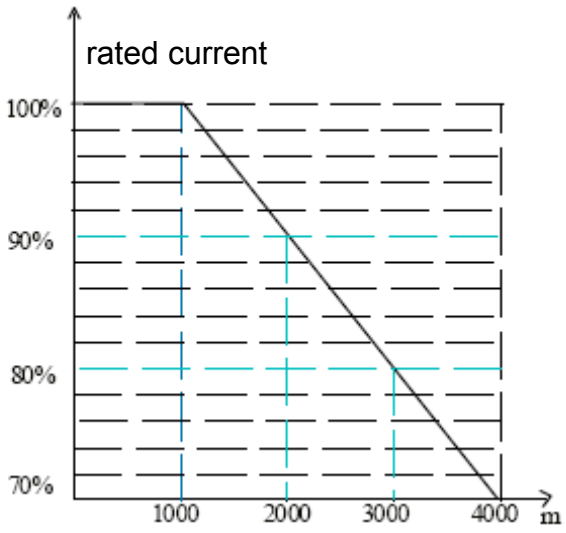


Figure 1-5: Relationship curve between the rated output current and altitude of inverter

1.5.6 Ambient temperature and derating use

Normal operating temperature of the inverter is -10---+40℃. If the operating temperature exceeds 40℃, 1% derating will be applied for every 1℃ exceeded, the maximum reaches 50℃.

1.6 Considerations for abandonment

The inverter shall be treated as industrial waste when it will be abandoned.

1.6.1 Treatment of capacitor

Electrolytic capacitor of the main circuit and that on the printed board may explode during burning. Therefore the capacitor is forbidden to burn.

1.6.2 Treatment of plastic parts

There are many plastic parts on the inverter, which will generate poisonous gas during burning. Therefore the plastic parts are forbidden to burn.

Chapter 2 Model and Specifications

Model, specifications and installation dimensions of AS160 series inverter are provided in this chapter.

2.1 Model of inverter

Model of **AS160** series inverter refers to Table 2-1.

Table 2-1 Table of model of **AS160** series inverter

Rated input	Dimensions	Steady operating temperature 40℃, standard			
		Model of inverter AS160	Rated output current (A)	Applicable motor (kW)	Overload current (A) 120% 1min
200~240V	1	2T02P2	7.5	2.2	9
		2T03P7	15	3.7	18
		2T05P5	22	5.5	27
380~460V		4T02P2	5	2.2	6
		4T03P7	7.5	3.7	9
		4T05P5	11	5.5	13
		4T07P5	16	7.5	19
	2	4T0011	22	11	26
		4T0015	30	15	36
	3	4T18P5	36	18.5	43
		4T0022	44	22	53
		4T0030	57	30	68
	4	4T0037	72	37	86
		4T0045	90	45	108
	5	4T0055	112	55	134
		4T0075	150	75	180
	6	4T0090	176	90	211
		4T0110	210	110	252
		4T0132	250	132	300
	7	4T0160	302	160	362
		4T0185	346	185	415
		4T0200	390	200	468
		4T0220	414	220	497
		4T0250	515	250	618
		4T0280	520	280	624
	8	4T0315	600	315	720
		4T0355	650	355	780
		4T0400	740	400	888
	9	*4T0450	820	450	984
		*4T0500	920	500	1104
		*4T0560	1030	560	1236

Note: To order the inverters with "*" before the models, contact the company to

verify the cycle time.

2.2 Technical index and specifications

Table 2-2 Technical index and specifications of AS160 series special inverter for water pump

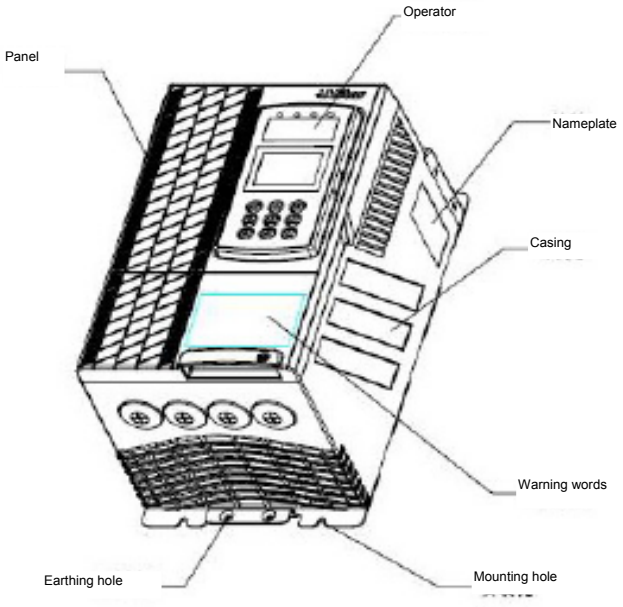
Item		Descriptions
Input	Rated voltage	380V-460V(-150%---+10%), three-phase power supply, 200-240V single phase or three-phase, optional
	Input frequency	45-65hZ
Output	Rated voltage	0-rated input voltage
	Frequency	0-300Hz
	Overload capacity	120% rated current 60s, 150% rated current 3s
Main control functions	Control mode	V/F control
	Governing range	1:100
	Starting torque	150% rated torque at 1Hz
	Speed control accuracy	+/-0.5%
	Frequency accuracy	Digital setting: +/-0.01%, analog setting: +/-0.02%
	Frequency resolution	Digital setting: 0.01Hz, analog setting: 0.05/50Hz
	Torque lifting	Automatic torque lifting, manual torque lifting 0.1%-30.0%
	V/F curve	Five modes: one setting mode for V/F curve by the user and four kinds of drop torque characteristic curve modes (power of 2.0, power of 1.5, power of 1.2 and straight line)
	Acceleration and deceleration curve	Three modes: linear acceleration and deceleration, acceleration and deceleration of S curve and mode of automatic acceleration and deceleration; found kinds of acceleration and deceleration time, with time unit of s.
	DC braking	DC braking start frequency: 0.50-60.00Hz Braking time: 0.0-30.0s Braking current: 0.0-100.0%
	Multi-speed operation	Multi-speed is realized through control terminals
	Built-in process PID	Process closed loop control system can be formed easily, 2 groups of parameters of PID can be switched over
	Automatic current limiting	Automatically limit the current during operation, to prevent the frequent trips due to current fault
Run	Run command channel	Operation panel given, control terminal given and serial port given, which can be switched over in various ways.
	Frequency given channel	Digital given, analog voltage/current given and communication given, which can be switched over in various ways at any time.
	Digital input	8 digital inputs X0-X7, whose functions can be defined
	Digital output	4 relay outputs and 2 transistor outputs, whose functions can be defined
	Analog input	2-way analog signal input, A0 is 0-10V, A1 is 0-10V or 0-20ma, the voltage and current are chosen via the jumper
	Analog output terminal	2-way analog signal output, 0-10V, which can realize the output of physical quantity such as setting frequency and output frequency

Operation panel	LED display	20 parameters can be displayed such as setting frequency, output frequency, output voltage and output current, etc.
	LCD display	Optional, point out the display contents in Chinese/English
	Parameter copy	Quickly copy the parameters with the help of LCD operation panel
	Selection of lock function of the keys	Lock the keys partly or completely and define the scope of functions of partial keys, to avoid misoperation
Control of built-in fan water pump		Control logic of the built-in fan water pump, repeated soft starting, and two modes of one main and multi-auxiliary. A relay for a motor, six motors can be controlled furthest.
MODBUS communication		Support MODBUS protocol communication, one communication address corresponds to one parameter code.
Protection functions		Protection functions of open phase, overcurrent, overvoltage, undervoltage, overheating and overload, etc.
Optional accessories		LCD operation panel, brake assembly, remote control box, remote cable, communication bus adaptor, etc.
Environment	Location	Indoor, free from direct sunlight, no dust, corrosive gas, combustible gas, oily mist, water vapor, dropping water or salt, etc.
	Altitude	Lower than 1000m. In the area within 1000-4000m, derating use is required when radiation performance of the inverter becomes poor due to the thin air, 1% derating for every 100m increased.
	Ambient temperature	-10--+40℃(ambient temperature 40℃ - 50℃, derating use)
	Humidity	Below 95%RH, without condensed water
	Vibration	Below 5.9m/s2 (0.6g)
	Storage temperature	-40 - +60℃
Structure	Level of protection	IP20
	Cooling mode	Forced air cooling, with fan control.
Installation method		Wall mounting type
Efficiency		≥93% for 45kW and below; ≥95% for 55kW and above

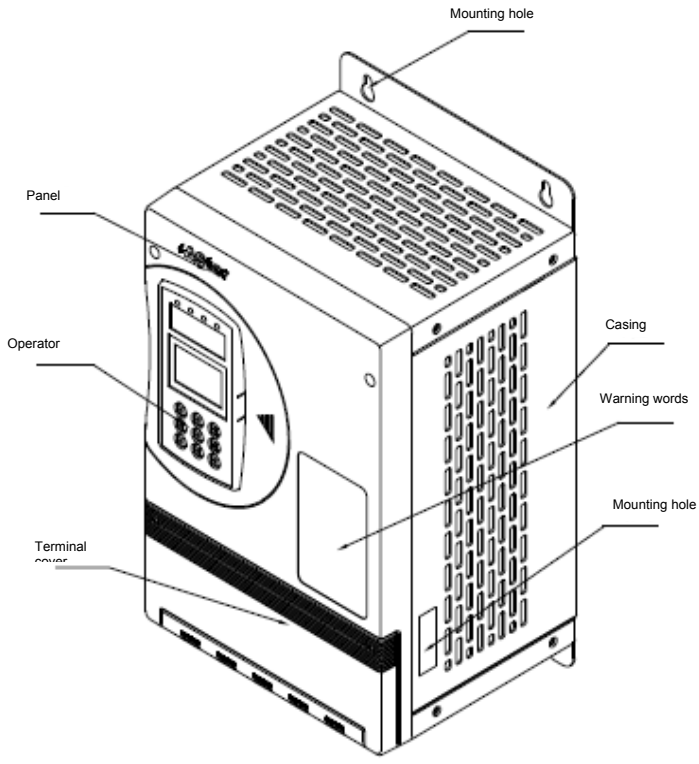
2.3

2.4 Profile of the inverter and the name of each part

See Figure 2-1 for profile of the inverter and the name of each part.



(a) Power grade of 4T07P5 and below of AS160



(b) Power grade of 4T0011 and above of AS160

Figure 2-1 Profile of the inverter and the name of each part

2.5 Installation dimensions and mass of the inverter

Installation dimensions and mass of specification 1 of AS160 series inverter refer to Table 2-3 and Figure 2-2.

Table 2-3 Installation dimensions and mass of specification 1 of AS160 series inverter

Specifications	Model of inverter: AS160	A (mm)	B (mm)	H (mm)	W (mm)	D (mm)	Mounting aperture	Installation			Tightening torque	Mass (kg)
								Bolt	Nut	Washer		
1	2T02P2 2T03P7 2T05P5 4T02P2 4T03P7 4T05P5 4T07P5	100	288.5	300	160	166	5.0	4M4	4M4	4Φ4	3	4.5

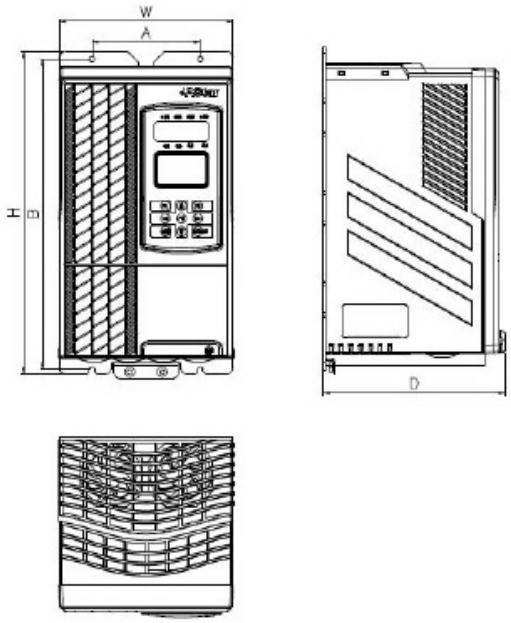


Figure 2-2 Installation dimensions figure of specification 1 (2.2-7.5kW)

Installation dimensions and mass of specifications 2-7 of **AS160** series inverter refer to Table 2-4 and Figure 2-3.

Table 2-4 Installation dimensions and mass of specifications 2-9 of **AS160** series inverter

Specifications	Model of inverter: AS160	A (mm)	B (mm)	H (mm)	W (mm)	D (mm)	Mounting aperture	Installation			Tightening torque	Mass (kg)
								Bolt	Nut	Washer		
2	4T0011 4T0015	165.5	357	379	232	182	7.0	4M6	4M6	4Φ6	4	8
3	4T18P5 4T0022 4T0030	165.5	392	414	232	182	7.0	4M6	4M6	4Φ6	4	10.3
4	4T0037 4T0045	200	518	540	332	247	9.0	4M8	4M8	4Φ8	7	23 31
5	4T0055 4T0075	200	587	610	330	310	9.0	4M8	4M8	4Φ8	9	42 42
6	4T0090 4T00110 4T0132 4T0160	320	718 768	750 800	430	350	11.0	4M10	4M10	4Φ10	14	50 55 60 72
7	4T0185 4T0200 4T0220 4T0250 4T0280	374	844	880	500	350	13.0	4M12	4M12	4Φ12	18	80 80 80 88 88
8	4T0315 4T0355 4T0400	500	997	1030	630	370	14.0	4M12	4M12	4Φ12	18	117 125 135

Figure 2-3 Installation dimensions figure of specifications 2-7 (11kW and above)

2.6 Dimensions of operator

Dimensions of the inverter operator refer to Figure 2-4.

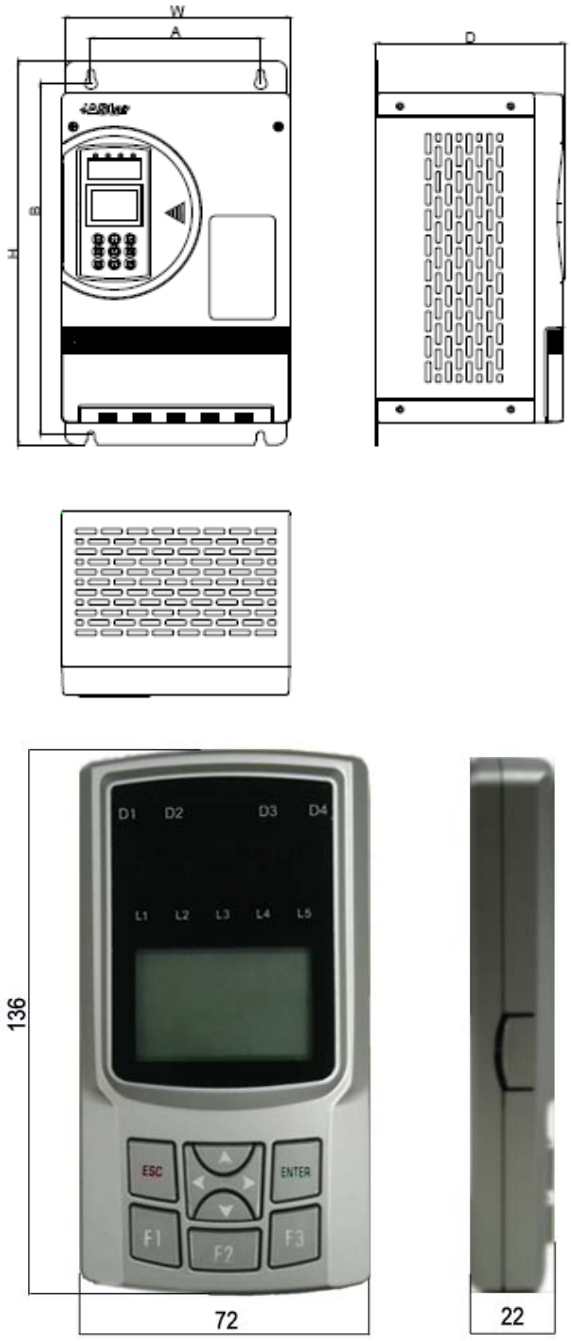


Figure 2-4 Dimensions of the inverter operator

Chapter 3 Installation of Inverter

Installation requirements and matters needing attention of the inverter as well removal and installation of its panel, etc are provided in this chapter.

3.1 Installation place of the inverter

Danger

◎ The inverter shall be mounted on the objects not easy to burn such as metal, otherwise the danger of fire will be caused.

◎ Combustible materials shall not be available nearby the inverter, otherwise the danger of fire will be caused.

◎ The inverter shall not be mounted in the environment with explosive gas, otherwise the danger of explosion will be caused.

◎ Cabinet for installing the equipment shall conform to EN 50178.

Note

◎ Don't lift the operation panel or cover plate during handling, otherwise the danger of inverter damage due to fall will be caused.

◎ Bearing capacity of the platform shall be considered during installation, otherwise the danger of inverter damage due to fall will be caused.

◎ The inverter shall not be installed at the occasion with splash water, otherwise the danger of inverter damage will be caused.

◎ Foreign body such as screw, spacer and metal bar shall not be fallen into the inverter, otherwise the dangers of damage and explosion will be caused to it.

◎ Don't install or rotate the inverter when it is damaged or the parts are in shortage, otherwise the danger of inverter damage will be caused.

◎ The inverter shall not be installed in the place with direct sunlight, otherwise the dangers of overheating and accident will be caused to it.

Installation place of the inverter must satisfy the following conditions:

a) The clean place free from oily mist or dust, or inside the fully closed cabinet that the suspended matters can't enter.

b) The place where the metal powder, oil or water won't enter the inside of inverter.

c) The place free from combustible materials such as wood.

d) The place free from radioactive substance.

e) The place free from poisonous gas or liquid.

f) The place with small vibration.

g) The place with less salt.

h) The place free from direct sunlight.

When the inverter needs to install inside the closed box, the cooling fan or air conditioner must be provided, to keep below 40℃.

3.2 Installation direction of the inverter and requirement of spacing distance

In order not to reduce the cooling effect of the inverter, the inverter shall be mounted in the place with good ventilation and its installation direction will be vertical typically.

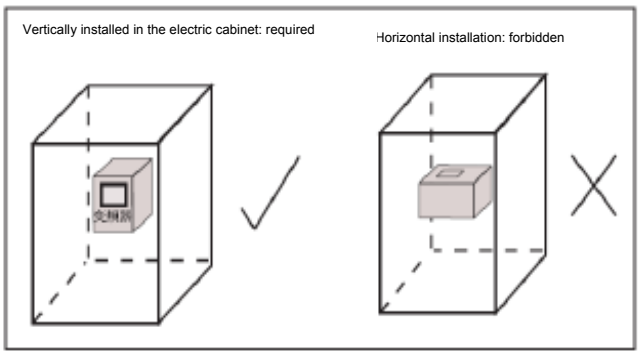


Figure 3-1: Installation direction schematic of the inverter

During the inverter installation by the user, included angle between it and the horizontal

plane will be 87°-90°. Refer to Figure 3-2 for details

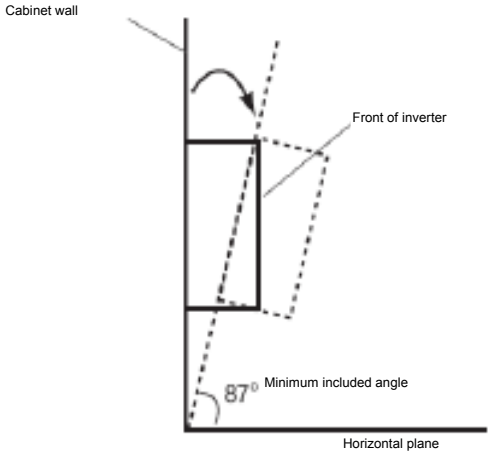


Figure 3-2: Angle of installation permitted of the inverter

Requirements of spacing distance of the inverter with 37kW and below are shown in Figure 3-3, and those of the inverter with 45kW and above are shown in Figure 3-4.

Fan ventilation, > 35cm, > 15cm

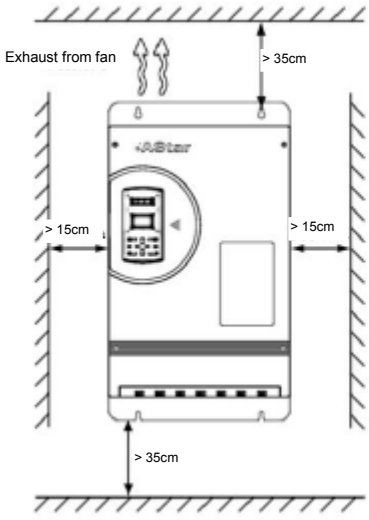


Figure 3-3 Schematic of installation spacing distance of 37kW and below

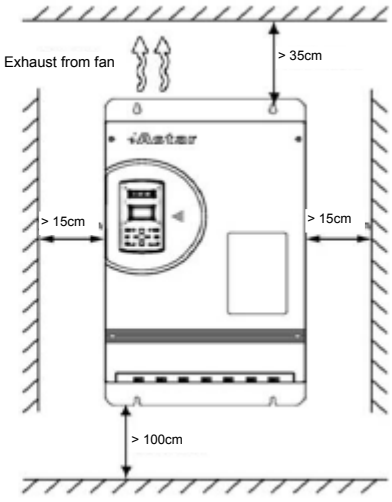


Figure 3-4 Schematic of installation spacing distance of 45kW and above

When two inverters are to be installed one above another, a partition plate for diversion shall be provided in the middle, as shown in Figure 3-5.

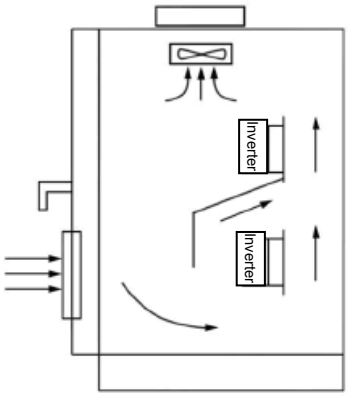


Figure 3-5: Installation of several inverters

3.3 Installation of inverter

Installation sequence of the inverter is shown as:

1) Determine the four mounting holes of the inverter and refer to Figure 2-1 *Installation dimensions and mass of the inverter*; firstly mount the upper two screws, please note that don't tighten them, reserved with a clearance of few millimeters;

2) Hang the two gourd-type mounting holes in the upper of inverter on the screws installed well;

3) Then mount the lower two screws, and tighten all the four ones.

Important

The fastener must be provided with anti-vibration parts, such as spring washer;

Four screws of the inverter must be ensured to tighten.

Installation sequence of the inverter refers to Figure 3-6.

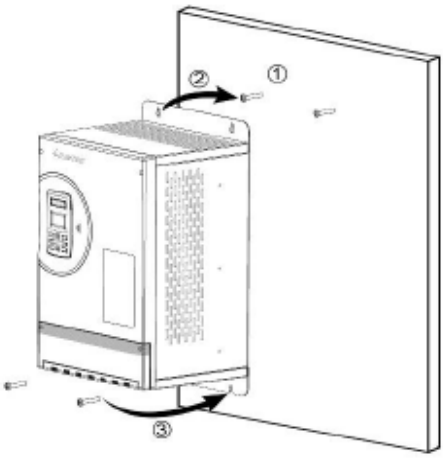


Figure 3-6 Installation Sequence Diagram of Inverter

3.4 Disassembly of the inverter

3.4.1 Disassembly of operator

Take down the operator.

1.Press down the lock latches on both sides of the operator, making them to be disconnected from the panel, then the operator can be taken down.

2.A connecting wire is provided on back of the operator, whose plug shall be pulled out from the operator. Please note that the force won't be exerted on the connecting wire, otherwise it will be damaged.

Disassembly of the operator refers to Figure 3-7.

Figure 3-7 Disassembly of the operator

Installation of the operator

Insert the plug of connecting wire into the socket on back of the operator, then embed the lock latch on one side into the side channel of the panel, finally press the operator to the panel, until clicking sounds is heard, indicating the lock latches on both sides of the operator are embedded into the panel.

3.4.2 Open and close of wiring cover

When it needs to open the wiring cover during wiring for the main circuit, it also will be opened when removing the front panel.

Open the wiring cover

1) Loosen two screws on the wiring cover;
2) Open the wiring cover downward.

Refer to Figure 3-9 to open the wiring cover.

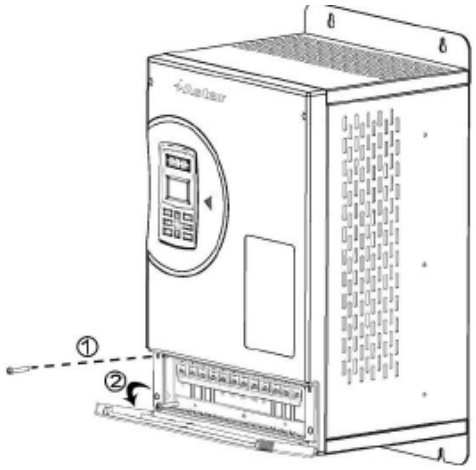


Figure 3-8 Open the wiring cover

3.4.3 Close the wiring cover

Contrary to open the wiring cover, close the cover and tighten the two fastener screws on it.

3.4.4 Disassembly and assembly of front panel

The front panel must be removed before the control circuit is connected, the same to the main circuit for the convenience of its wiring.

Removal of front panel

The steps to remove the front panel are shown as:

1) Take down the operator. Refer to 3.4.1 Disassembly of Operator in Chapter 3.

2) Open the wiring cover. Refer to 3.4.2 Open and Close of Wiring Cover in Chapter 3.

3) Loose the two screws on panel and those inside the wiring cover, to take down the panel.

Removal steps of the front panel are shown in Figure 3-9.

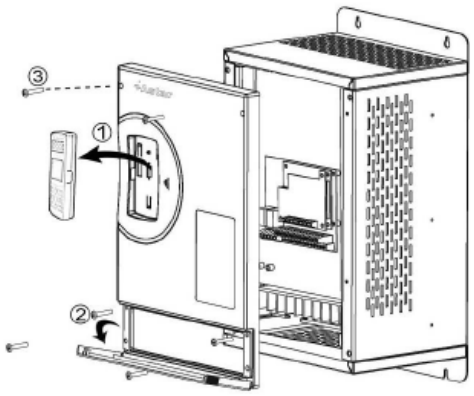


Figure 3-9 Removal of Front Panel

Assembly of front panel

It is contrary to the disassembly sequence of front panel.

Chapter 4 Wiring of the Inverter

Connection of the inverter to the peripheral equipment, overview of wring of the inverter terminals, wiring of the terminals of main circuit and control circuit are described in details in this chapter.

Danger

◎ Please confirm whether the power supply is in state of complete disconnection before wiring, otherwise the danger of electric shock will be caused.

◎ Wiring task must be done by the electric professionals, otherwise the danger of electric shock will be caused.

◎ Earthing terminal E must be reliably earthed, otherwise the danger of electric shock will be caused.

◎ Don't touch the terminals directly with hands, output line of the inverter shall not be touched with the outer cover, otherwise the danger of electric shock will be caused.

◎ Don't connect the power supply to output terminals U/T1, V/T2 and W/T3, otherwise the danger of inverter damage will be caused.

◎ Terminal ⊖1/⊖2 shall not be short connected to ⊖, otherwise the danger of explosion will be caused.

Note

◎ Please confirm whether voltage of the AC main circuit is the same as the rated voltage of the inverter, otherwise the dangers of fire and personal injury will be caused.

◎ Please correctly connect the brake resistor according to the wiring diagram, otherwise the danger of fire will be caused.

◎ Terminals of the main circuit must be firmly connected to the conductor or its crimp terminals, otherwise the danger of inverter damage will be caused.

4.1 Connection of the inverter to the peripheral equipment

4.1.1 Connection diagram of the inverter to the peripheral equipment

Refer to Figure 4-1 for connection diagram of the inverter to the peripheral equipment.

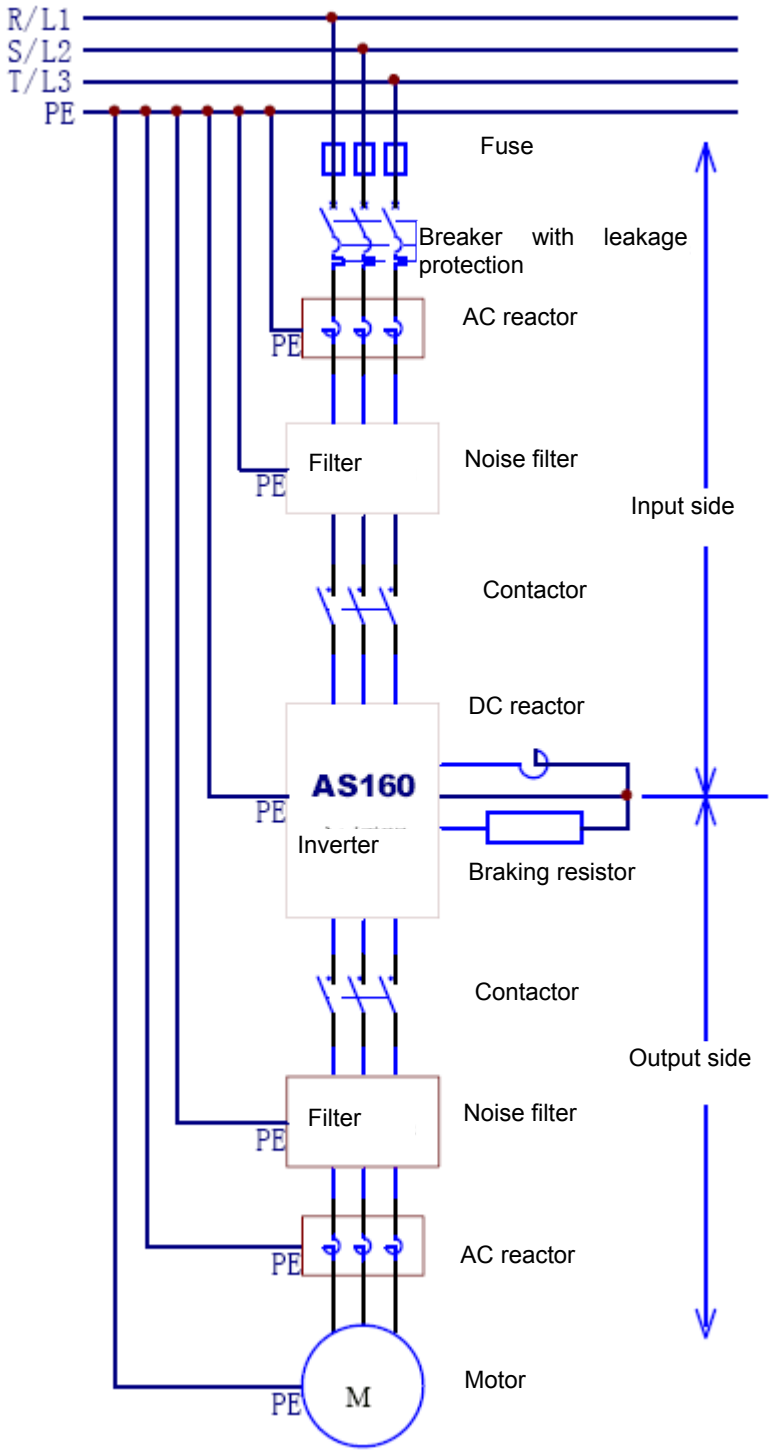


Figure 4-1 Connection diagram of the inverter to the peripheral equipment

Note: the diagram is based on input of three-phase power supply.

4.1.2 Connection of the inverter to the peripheral equipment

4.1.2.1 Connection of input power

Danger

The inverter shall not operate beyond the rated voltage range of input line, otherwise it will be damaged permanently due to overvoltage.

Technical requirements for input power

Technical requirements for connection of input power (main circuit)	
Input voltage	Voltage is 380/400/415/440/460V AC three-phase, -15%-+10%
Short current (IEC 60909)	If the incoming cable of inverter is provided with the proper fuse protection, then the maximum permitted short current within 1s will reach 100kA.
Frequency	50/60+/- 5%Hz
Temperature of cable	Under 90℃ for a long time.

4.1.2.2 Input protection

Input protection includes breaker, fuse and emergency stop equipment, etc.

Breaker

The inverter itself won't be provided with the breaker equipment, so that breaker equipment shall be installed between the AC input power and inverter, which must guarantee:

◎ Type selection shall conform to the actually applied safety regulations, including (but not limited to) the domestic and local electrical codes.

◎ During the installation and maintenance of inverter, the breaker equipment must be able to keep at off position and locked.

Breaker equipment shall not be used to control the start and stop of the motor, the motor shall be controlled by use of the keys on operator or commands of I/O terminals. Capacity of the breaker shall be chosen as 1.5-2 times of rated current of the inverter.

Time characteristics of the inverter shall adequately consider those of overheating protection of the inverter (150% of rated output current for 1min).

Fuse

The final user must provide the circuit protection device, whose type selection shall conform to the domestic and local electrical codes.

The recommended models of fuse for 2.2-75kW is provided in the following table, which is used to provide short circuit protection for the power of incoming line of the inverter.

AS160	Input current (A)	Main fuse IEC269 gG(A)	UL Grade T (A)	Model of Bussmann
4T02P2	7.2	10	10	CT10
4T03P7	10	10	10	CT10
4T05P5	14	16	15	CT16
4T07P5	19	20	20	CT20
4T0011	28	35	30	FE35
4T0015	35	35	40	FE40
4T18P5	42	45	50	FE45
4T0022	49	50	50	FE50
4T0030	66	71	71	FE71
4T0037	81	80	80	FE80
4T0045	98	100	100	FE100
4T0055	129	160	160	FEE160
4T0075	166	200	200	FEE200

Emergency stop equipment

General design and installation of the equipment must include emergency stop equipment and other necessary safety equipment. Motor control realized via the keys of inverter operator or commands of I/O terminals can't guarantee:

◎ Emergency stop the motor.

◎ Separation of inverter from the dangerous voltage.

4.1.2.3 Input power cable/connection

Connection of input cable can be any of the following:

◎ Quad cable (three-phase and grounding protection wire).

◎ Quad insulated conductor is installed inside the conduit.

The proper power cable shall be chosen according to the local safety regulations, grade of input voltage and load current of the inverter. At any cases, the conductor must be less than the maximum limit value defined by dimensions of terminal (refer to 4.5.4 Conductor Specifications for Wiring of Main Circuit in chapter 4). Models of the copper core cable at different load current are listed in the following table. The recommended models only are applicable to the conditions listed on its top. We recommend not use the aluminum core cable.

IEC	NEC
◎ Based on: ◎ EN 60204-1 and IEC 60364-5-2/2001 ◎ PVC insulation ◎ Ambient temperature 30℃ ◎ Surface temperature 70℃ ◎ Symmetric cable with copper net shielding ◎ Number of cable arranged side by side within the same cable tray shall not exceed 9 pieces	◎ Based on: ◎ See the following table for copper core cable ◎ 90℃ cable insulation ◎ Ambient temperature 40℃ ◎ Number of current-carrying conductor within the same trough, cable trench or embedded cable shall not exceed 3 pieces ◎ Copper core cable with copper net shielding

Maximum load current (A)		Copper core cable (mm2)	
11	3x1.5	208	3x95
16	3x1.5	250	3x95
22	3x2.5	296	3x120
30	3x4	362	3x185
36	3x6	390	3x240
44	3x10	414	3x95x2P
57	3x16	515	3x150x2P
72	3x25	520	3x150x2P
90	3x35	600	3x95x4P
112	3x50	650	3x95x4P
150	3x70	740	3x150x4P

In order to ensure the personnel safety, correct operation and reduce the electromagnetic radiation, the inverter and motor must be earthed at the place of installation.

◎ Diameter of the conductor must meet the requirements in safety regulations.

◎ Shielding layer of power cable must be connected to PE terminal of the inverter, to satisfy the safety rules.

◎ Only the specifications of the shielding layer of power cable meet the requirements in safety regulations, can it be used as the ground wire of the equipment.

◎ When installing several inverters, their terminals of the inverters can't be connected in series.

4.1.2.4 Output power cable/connection

Connection of motor

Danger

Don't connect the incoming power supply to the output terminals of inverter: U, V and W, otherwise it will cause the permanent damage to the converting unit.

Note

Don't connect the motor whose rated voltage is less than half of that of the inverter to the inverter.

Note

Before the voltage withstand test or insulation resistance test for the motor or motor cable, the inverter must be disconnected from the motor cable. The tests aforementioned can't be done for the inverter.

Technical requirements for motor connection

Technical requirements for connection of output power (motor)	
Output voltage	0-input voltage, symmetric three-phase voltage
Current	Refer to 2.2 *Technical Indexes and Specifications of Inverter* in chapter 2
Switching frequency	Set as 2-11kHz
Rated temperature of cable	Under 90℃ for a long time.
Relation between length of motor length and switching frequency	Refer to 4.4.4 Relation Between Length of Wiring and Carrier Frequency in chapter 4

Earthing and wiring

Wiring conduit, armoring cable or shielded cable shall be applied by the motor cable for shielding.

1) Wire conduit

①） Each end of the wire conduit shall be provided with a bridge with earthing conductor.

②） Fix the wire conduit to the enclosure.

③） Lay the motor cable with an independent wire conduit (at the same time the input cable and control cable shall be laid respectively).

④） Each inverter will apply an independent conduit pipeline.

2) Armoring cable

①） Each end of the wire conduit shall be provided with a bridge with earthing conductor.

②） 6 pieces of conductors will be applied (3 pieces for the power line and ground line respectively), MC continuous rippled aluminum armor is provided with the symmetric ground wire.

③） A cable tray can be commonly used by the armoring motor cable and input power cable, but other than with the control cable.

3) Shielded cable

Recommend the user to use the cable with symmetric PE conductor satisfying the standard VE or CE-Tick.

Grounding

Refer to **grounding connection of input power cable** aforementioned.

4.1.2.5 Input side AC reactor

AC reactor on input side can be chosen to improve its power factor and reduce the higher harmonic current.

4.2.1.6 Input side interference filter

The special input side interference filter can be chosen to control the high frequency noise jamming from the power line of inverter to power supply.

4.1.2.7 Input side contactor

In order to protect the power supply and prevent expansion of fault, control the power supply of inverter though opening or closing the input side contactor.

Don’t control the start and stop of motor with this contactor.

4.2.1.8 Output side contactor

In order to satisfy the national safety standard GB7588-2003 that the motor can’t pass through current when it stops, output side contactor is installed on output side.

4.1.2.9 Output side interference filter

The special output side interference filter can be chosen to control the interference noise and conductor leakage current generated from output side of the inverter.

4.1.2.10 Output side AC reactor

Output side AC reactor can be chosen to control RFI of the inverter.

When the connection wire between the inverter and motor is too long (>20m), output side AC reactor can be used to prevent the inverter overcurrent caused by distributed capacitance of the conductor.

4.1.2.11 DC reactor

DC reactor can be chosen to improve power factor.

4.2 Terminal wire of the inverter

Refer to Figure 4-2 for internal view of the inverter.

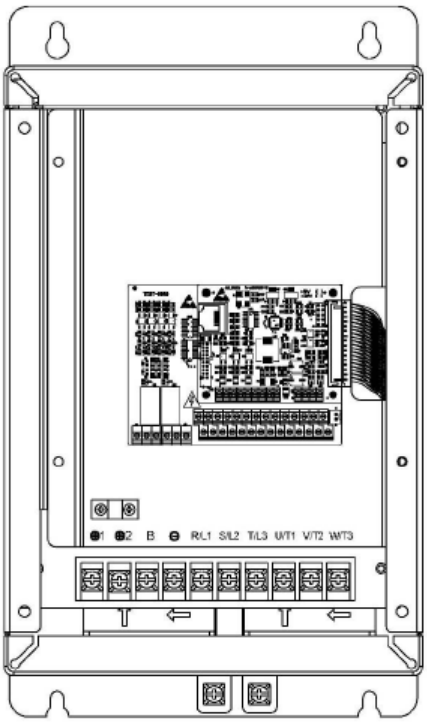


Figure 4-2 Internal View of Inverter

Note: except for the power input/output terminals, whose location and arrangement are slightly different, those of the terminals of the inverter with different power grade are the same. The figure takes 11kW as an example.

4.2.1 Terminal wire diagram of the inverter

It applies to the basic wire diagram for the models without built-in DC reactor or built-in braking unit, as shown in Figure 4-3.

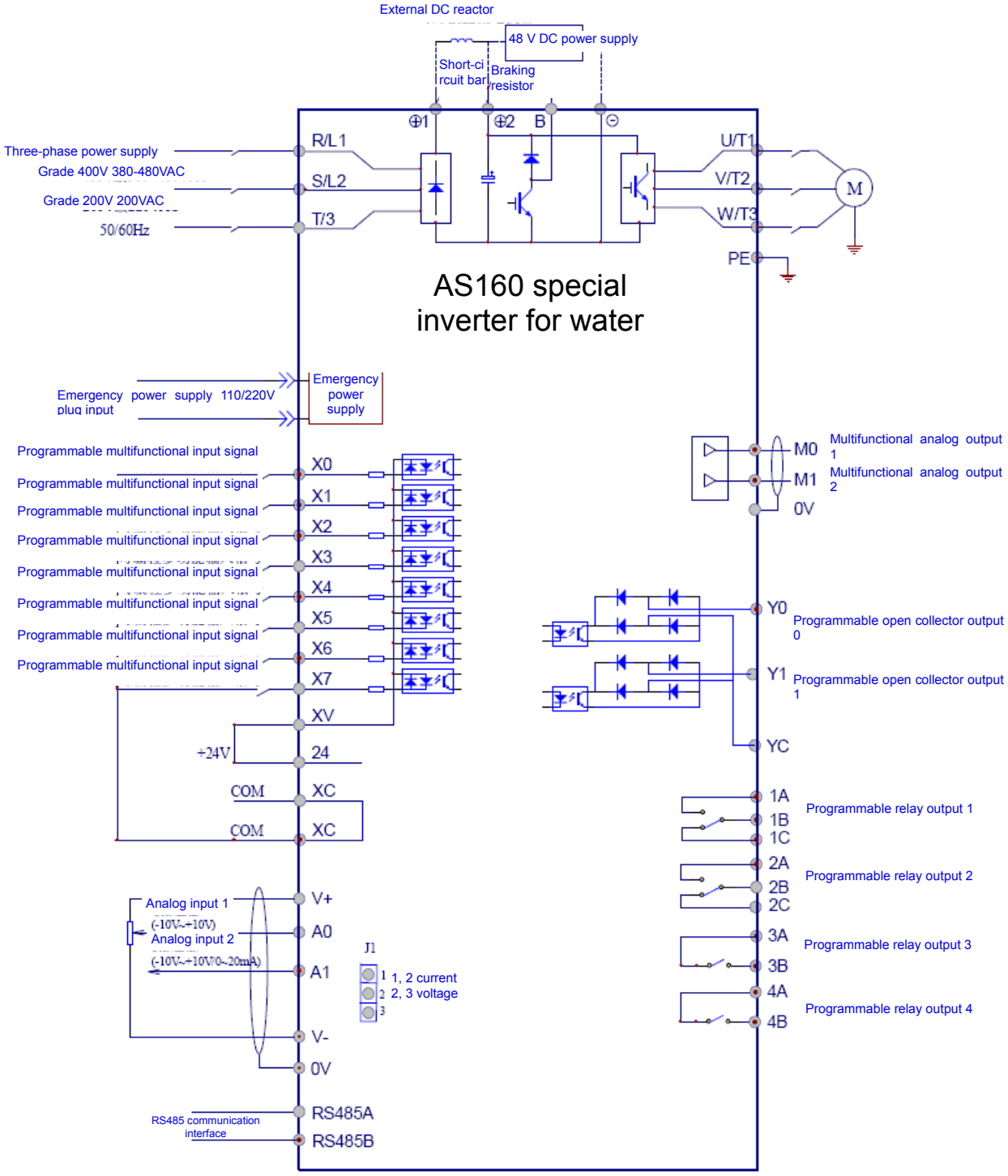


Figure 4-3 Terminal Wire Schematic 1 of the Inverter (<37kW)

Notes:

1. A0/1 can input the analog voltage signal, A1 can input analog current signal (jumper J1 setting). A0 and A1 can input the signals simultaneously.

2. The inverter of this specification shall not be equipped with built-in DC reactor,

but with braking unit, which needs the external braking resistor.

The basic wiring diagram for the models with applicable built-in DC reactor and built-in braking unit is shown in Figure 4-4.

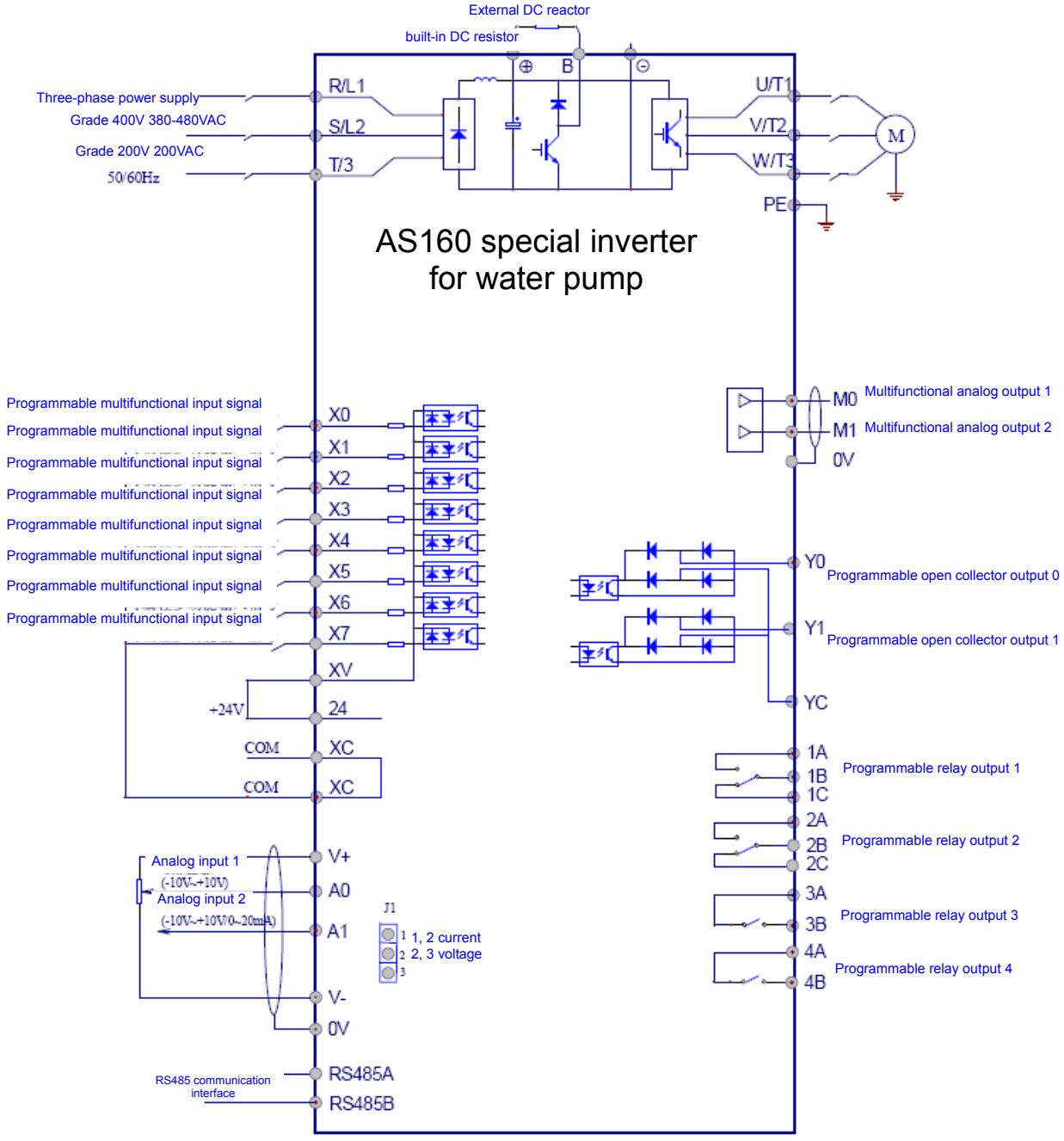


Figure 4-4 Terminal Wiring Schematic 2 of Inverter (≥37kW)

Notes:

1. A0/1 can input the analog voltage signal, A1 can input analog current signal (jumper J1 setting). A0 and A1 can input the signals simultaneously.

2. The inverter of this specification is equipped with built-in DC reactor and braking unit, but the external braking resistor is needed.

Notes:

1. A0/1 can input the analog voltage signal, A1 can input analog current signal (jumper J1 setting). A0 and A1 can input the signals simultaneously.

2. The inverter of this specification isn't equipped with built-in braking unit, but with the terminals of external braking unit.

Matters needing attention for inverter terminal wiring

Important:

Specifications of wiring shall meet the regulations in electrician standard.

After completion of wiring, please examine whether the wiring is correct or the connection is reliable. The wiring shall be examined in terms of the following:

Whether the wiring has any error;

Whether the wire scraps or screws are left inside the inverter;

Whether the screws are loose;

Whether the stripped bare wire of the terminal contacts with other terminals.

If built-in braking unit is provided, the external braking resistor is needed, which is mounted between terminal B and $\oplus 2$. External braking resistor can't be connected to other terminals except for aforementioned two, otherwise the braking resistor and inverter will be damaged.

If no built-in DC reactor is provided, DC reactor chosen will be mounted between terminal $\oplus 1$ and $\oplus 2$. At the same time, short block between them shall be removed.

Grounding point PE of the inverter shall be connected to the ground electrode, with grounding impedance below 10Ω.

Grounding cable shall be as shortest as possible.

After power on, if the wiring needs to change, firstly the power supply shall be cut off. Because discharging from the charging capacitor of the main circuit of inverter

needs some time, so that DC voltage on both sides of the charging capacitor shall be measured with DC voltmeter after the charging indicator goes out in order to avoid the danger, and the next step can be started after the voltage measured is less than DC 24V safe voltage.

4.3 Wiring for the terminals of main circuit

4.3.1 Terminal arrangement of the main circuit

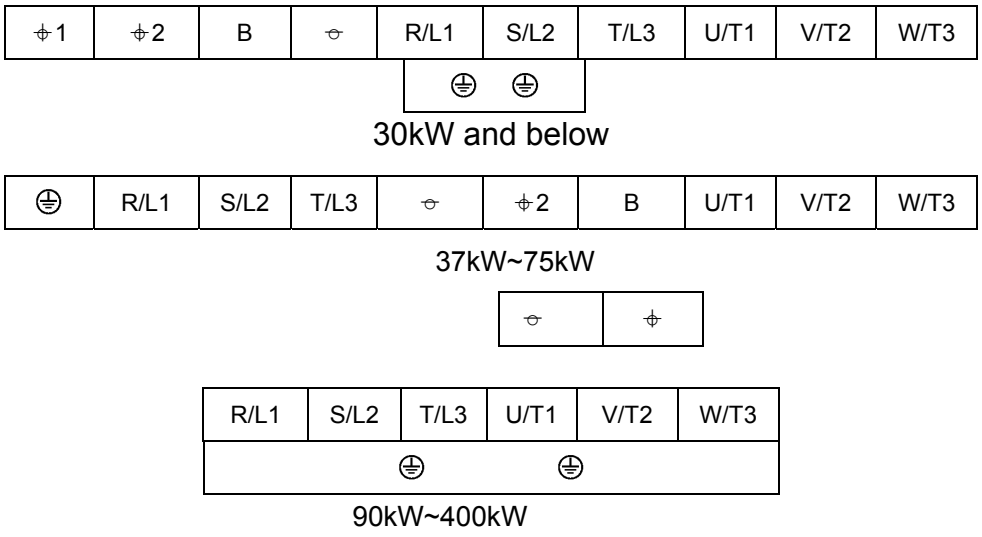


Figure 4-6 Terminal Blocks of Main Circuit

4.3.2 Terminal label of the main circuit and its function description

Refer to Table 4-1 for the function description of the terminals of main circuit.

Table 4-1 Function Description of the Terminals of Main Circuit

Terminal label	Function description
⊕1	Connect to the external DC reactor, short connected at factory.
⊕2	
⊕2（⊕）	Connect to the external braking resistor
B	
⊖	Negative output terminal of DC bus
R/L1	AC power input of the main circuit, connected to three-phase input power supply
S/L2	
T/L3	
U/T1	Inverter output, connected to three-phase synchronous/asynchronous motor
V/T2	
W/T3	

4.3.3 Conductor specifications of the wiring of main circuit

The insulated conductor such as 600V copper core plastic will be applied for power supply. Refer to Table 4-2 for the specifications and tightening torque of the conductor.

Table 4-2 Specifications and Tightening Torque of Grade 400V Conductor

Model of inverter AS160	Specifications of the wire connected (mm^2)	Specifications of recommended conductor (mm^2)	Tightening torque (N.m)
2T02P2	1.5～2.5	3X2.5	2.5
2T03P7	4～8	3X6	2.5
2T05P5	6～10	3X8	2.5
4T02P2	1.5～2.5	3X2.5	1.5
4T03P7	1.5～2.5	3X2.5	1.5
4T05P5	2.5～4	3X4	2.5
4T07P5	4～8	3X6	2.5
4T0011	4～8	3X6	2.5
4T0015	4～8	3X6	2.5
4T18P5	8～16	3X16	4.0
4T0022	8～16	3X16	4.0
4T0030	25～35	3X25	6.0
4T0037	35～50	3X35	9.0
4T0045	50～70	3X50	9.0
4T0055	70～95	3X70	14.0
4T0075	95	3X95	14.0
4T0090	85～115	3x95	20
4T00110	85～115	3x95	20
4T0132	95～135	3x120	36
4T0160	165～205	3x185	36
4T0185	205～265	3x240	36
4T0200	85～115(x2P)	3x95x2P	36
4T0220	85～115(x2P)	3x95x2P	36
4T0250	125～175(x2P)	3x150x2P	36
4T0280	125～175(x2P)	3x150x2P	36
4T0315	85～115(x4P)	3x95x4P	36
4T0355	85～115(x4P)	3x95x4P	36
4T0400	85～175(x4P)	3x150x4P	36

Important:

Specifications of the conductor are based on the ambient temperature 50℃ and its permissible temperature 75℃.

Open-type terminal blocks are adopted by the main circuit of the inverter. And round crimping terminals will be applied by them. Selection of round crimping terminals refers to Table 4-3.

Table 4-3 Specifications of Round Crimping Terminals

Section area of cable (mm^2)	Specifications of terminal screw	Specifications of round crimping terminal
0.5	M3.5	1.25/3.5
	M4	1.25/4
0.75	M3.5	1.25/3.5
	M4	1.25/4
1.25	M3.5	1.25/3.5
	M4	1.25/4
2	M3.5	2/3.5
	M4	2/4
	M5	2/5
	M6	2/6
	M8	2/8
3.5/5.5	M4	5.5/4
	M5	5.5/5
	M6	5.5/6
	M8	5.5/8
8	M5	8/5
	M6	8/6
	M8	8/8
14	M6	14/6
	M8	14/8
22	M6	22/6
	M8	22/8
30/38	M8	38/8
50/60	M8	60/8
	M10	60/10
80	M10	80/10
100		100/10
120	M12	120/12
185	M12	185/12
240	M12	240/12
300	M12	300/12
380	M12	380/12

Important:

Voltage drop of the wire must be fully considered when determining its sectional area.

The typical selection principle is to keep the voltage within 2% of rated voltage. When the voltage drop is too big, sectional area of the wire shall be increased. Calculation formulation of the voltage drop is shown as:

Line-to-line voltage drop $(V) = \sqrt{3} *$ wire resistance (Ω)*current (A)

4.3.4 Detailed descriptions of terminal wiring of the main circuit

4.3.4.1 Ground terminal (E) /(PE)

a) The ground terminal shall apply the special ground electrode preferably, with good grounding and ground impedance below 10Ω.

b) The ground wire can't be commonly used with the welding machine or other power equipment.

c) Ground wire shall conform to the specifications regulated in technical standard for electrical equipment, and shall be the as shortest as possible. If the distance between the ground wire and grounding point is far, leakage current of the inverter will cause the unstable potential to the ground terminal.

d) Stranded copper core cable above 3.5mm2 shall be applied to the ground wire, yellow-green ground wire is proposed.

e) When several inverters are grounded, loop must be avoided in order to prevent that the ground wire forms the return loop.

Refer to Figure 4-6 for the grounding method of several inverters.

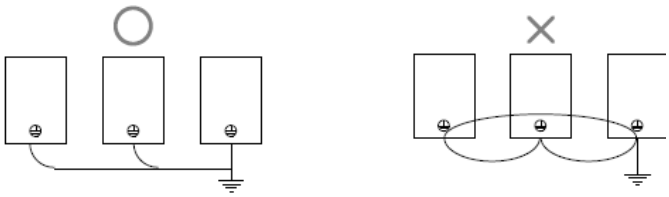


Figure 4-7 Grounding Method of Several Inverters

4.3.4.2 Power input terminals of the main circuit (R/L1, S/L2, T/L3)

a) Three-phase AC power is connected to the terminals R/L1, S/L2 and T/L3 of the main circuit through the breaker. Phase sequence of input power is unrelated to that of the terminals R/L1, S/L2 and T/L3, any of them can be connected.

b) In order to reduce the conduction and radiated interference of the inverter to the input power, noise filter can be provided on the power supply side. The noise filter can reduce the electromagnetic noise to be intruded into the inverter from the power line, also that coming out from the inverter to the power line.

Note

Special attention: Please use the special noise filter for inverter.

Refer to Figure 4-7 for the correct setting of noise filter on the power supply side.

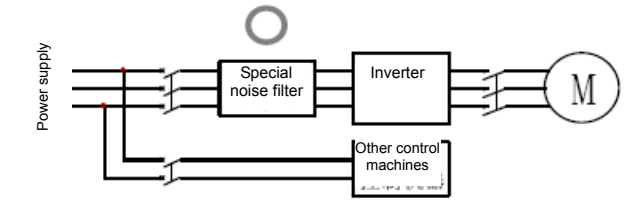


Figure 4-7 Correct Setting of Noise Filter on Power Supply Side

Refer to Figure 4-8 and 4-9 for the incorrect setting of noise filter on the power supply side.

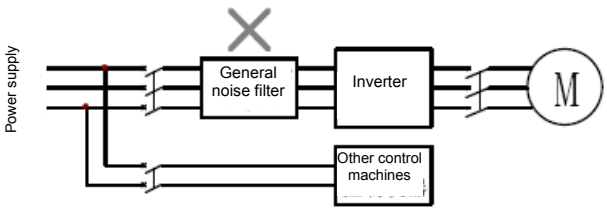


Figure 4-8 Example 1 of Incorrect Setting of Noise Filter on Power Supply Side

In figure 4-8, the expected effect can't be achieved if the general noise filter is provided on the power supply side, so that it shall be avoided.

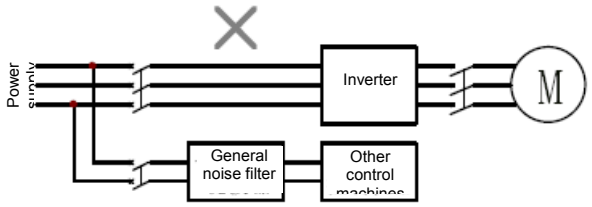


Figure 4-9 Example 2 of Incorrect Setting of Noise Filter on Power Supply Side

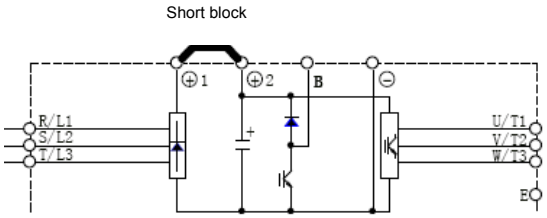
In figure 4-9, the expected effect can't be achieved if the general noise filter is provided on the receiving side, so that it shall be avoided.

4.3.4.3 External DC reactor terminals (⊕1, ⊕2)

a) In order to improve the power factor of inverter, the external DC reactor can be connected. Short block is provided between terminal ⊕1 and ⊕2 at factory. If DC reactor is connected, the short block must be taken down firstly prior to connection.

b) If no DC reactor is applied, don't take down the short block, otherwise the inverter can't operate normally.

Figure 4-10 Connection Diagram of Short Block



Refer to Figure 4-11 for the connection of external DC reactor.

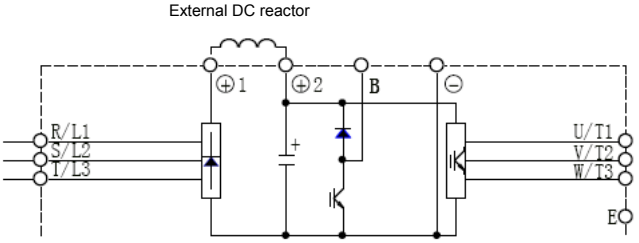


Figure 4-11 Connection Diagram of External DC Reactor

4.3.4.4 External braking resistor terminals （⊕2， B）

a) Built-in braking unit less than 37kW is provided in AS160 inverter. If the energy feedback during motor braking must be released, the external braking resistor shall be connected. Refer to chapter 1 Configuration Table of 400V Grade braking resistor for the specifications of braking resistor.

b) Braking resistor is mounted between terminals ⊕2 and B.

c) Radiation conditions of braking resistor must be fully considered in order to make it work properly, to ensure its good ventilation.

d) Length of wiring of the braking resistor shall not exceed 5m.

Connection of external braking resistor refers to Figure 4-12.

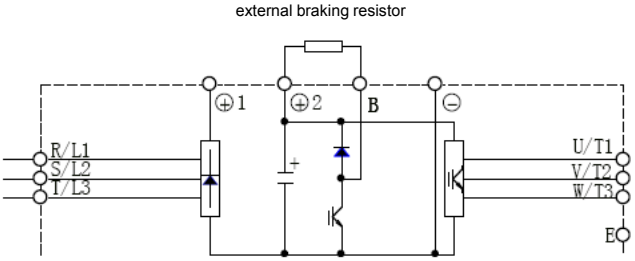


Figure 4-12 Connection Diagram of External Braking resistor

4.3.4.5 Output terminals of the inverter (U/T1, V/T2, W/T3)

a) Output terminals U/T1, V/T2 and W/T3 of the inverter are connected to terminals U, V and W of the motor. If the rotating direction of the motor isn't correct, please exchange the wiring of any two phases of the output terminals of inverter or the motor terminals.

b) It is forbidden to connect the power supply input to the output terminals U/T1, V/T2 and W/T3 of inverter.

c) The output terminals are forbidden to ground or short connect.

d) It is forbidden to connect the capacitor and/or surge filter on the output side of inverter, otherwise overheating or damage will be caused to it due to higher

harmonic of the inverter output.

Refer to Figure 4-13 for the schematic of no capacitor connected on output side of the inverter.

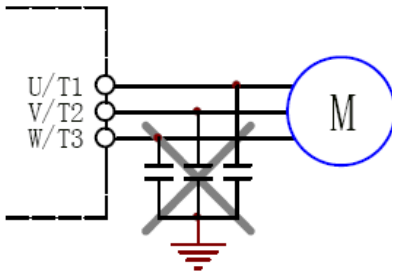


Figure 4-13 Schematic of No Capacitor Connected on the Output Side

4.4 Measures against interference

4.4.1 Special noise filter for connection on output side

In order to control the noise produced from the output side of inverter, special noise filter will be connected on output side of the inverter. Refer to Figure 4-14 for the wiring of noise filer of the inverter on the output side.

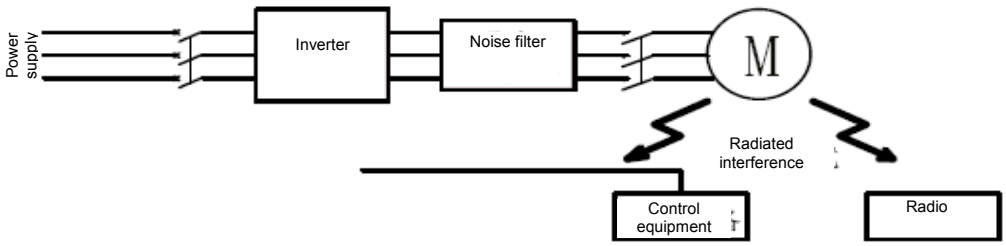


Figure 4-14 Wiring of noise filter on the output side of inverter

4.4.2 Layout of the wiring of main circuit

In order to control the radiated interference produced from the output side of inverter and enhance the anti-interference performance, so the main control and that of the control circuit must be separated; wiring of the main circuit penetrates into the grounding metal tube, with a distance above 10cm to the signal wire. Schematic of layout of the wiring of main circuit refers to Figure 4-15.

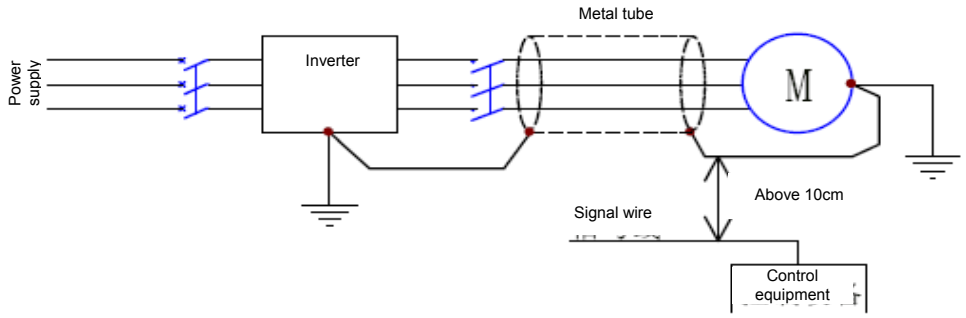


Figure 4-15 Schematic of Layout of Wiring of the Main Circuit

4.4.3 Perfect anti-interference measures

The perfect anti-interference measures are to provide the noise filters on input and output side of the inverter, and shield the inverter body in the iron box. Refer to Figure 4-16.

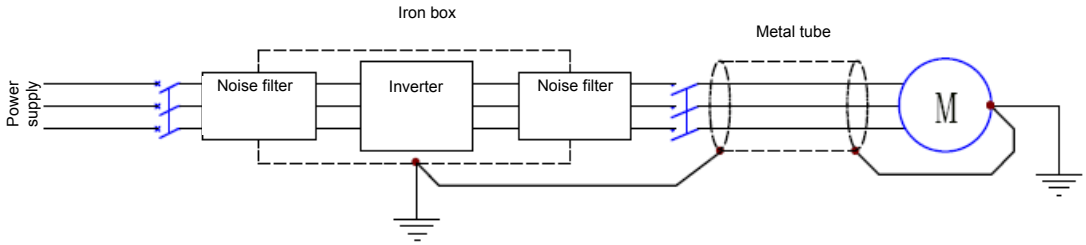


Figure 4-16 Perfect Anti-interference Measures

4.4.4 Relation between the length of wiring and the carrier frequency

If the wiring between the inverter and the motor is too long, higher harmonic leakage current will be increased due to the influence of distributed capacitance of the wire, which makes overcurrent protection to be output from the inverter, with bad influence on the equipment and motor nearby. Therefore if the length of wiring is greater than 100m, output side filter and reactor must be provided.

Wiring distance between inverter and motor	**below 50m**	**below 100m**	**above 100m**
Carrier frequency	below 11kHz	below 8kHz	below 5kHz

4.5 Wiring of the control circuit terminals

4.5.1 Arrangement of control circuit terminals

See arrangement of control circuit terminals in Figure 4-17 Picture of Control Circuit Terminals.

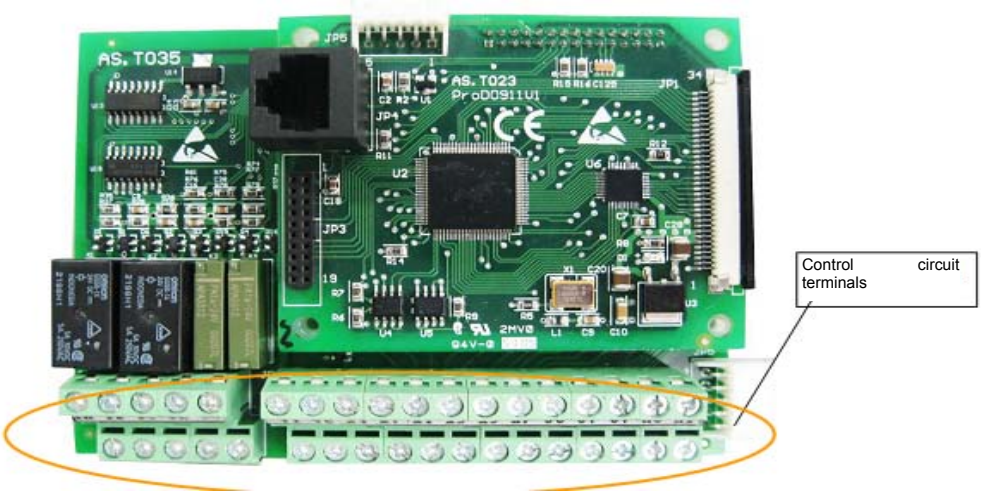


Figure 4-17 Picture of control circuit terminals

4.5.2 Terminal label of control circuit

Refer to Figure 4-18 for terminal label of the control circuit.

2A	2B	2C	4A	4B	Y1	YC	24	XV	X1	X3	X5	X7	SC	0V	0V	A0	A1
1A	1B	1C	3A	3B	Y0	XC	XC	X0	X2	X4	X6	A+	B-	M0	M1	V+	V-

Figure 4-18 Terminal label of the control circuit

4.5.3 Function descriptions of the control circuit terminals

Function descriptions of the control circuit terminals refer to Table 4-5.

Table 4-5 Function descriptions of the control circuit terminals

Name	Terminal label	Name of signal	Remarks
Digital input	X0	Multifunctional input 1 (function code P03.00)	Input signal is effective when the connection point inputs and closes. Function will be chosen by the functional code P03.00-P03.07. Specifications of digital input circuit is shown as: Internal power supply: +24VDC Maximum load current: 20mA See 4.5.5.2 for the details of connection mode.
	X1	Multifunctional input 2 (function code P03.01)	
	X2	Multifunctional input 3 (function code P03.02)	
	X3	Multifunctional input 4 (function code P03.03)	
	X4	Multifunctional input 5 (function code P03.04)	
	X5	Multifunctional input 6 (function code P03.05)	
	X6	Multifunctional input 7 (function code P03.06)	
	X7	Multifunctional input 8 (function code P03.07)	
	24	Internal +24VD power output	
	XV	Input signal common port 24V	
	XC	Input signal common port 0V	
Analog input	A0	Analog input 1	Input signal: 0 - +10V, used as analog speed given.
	A1	Analog input 2	JP1: 2 - 3 input signal -10 - +10V, used as analog speed given. JP1: 1 - 2 input signal 0 - 20mA, used as analog speed given.
	V+	+10V power output	+10VDC power output end for analog input, permissible maximum current 50mA
	V+	-10V power output	-10VDC power output end for analog input, permissible maximum current 50mA
	0V	Reference ground of analog input signal	Reference ground of analog input signal
Relay output	1A/1B/1C 2A/2B/2C	1A/1B and 2A/2B are normally open contacts 1A/1B and 1A/2B are normally closed contacts Functional code: P04.00, P04.01	Specifications of switching contacts are shown as: Item: Description Rated capacity: 5A/250VAC, 5A/30VDC Switching frequency 120 cycles/min: Fault rate P level 10mA/5V Action duration: below 10ms
Open collector terminal of the transistor	3A/3B 4A/4B	3A/3B and 4A/42B are normally open contacts Functional code: P04.02, P04.03	
	Y0	Programmable open collector output 1 (functional code P04.04)	Functions of programmable open collector output are chosen by the functional code P04, Drive capability: not greater than
	Y1	Programmable open collector output 2 (functional code P04.05)	

			DC30V, 50mA
Analog output terminal	YC	Programmable open collector output common port	
	M0	Programmable analog output 1 (functional code P04.18)	Functions of programmable analog output are chosen by the functional code P04.18 and P04.21. For output monitoring and input of other equipment.
	M1	Programmable analog output 2 (functional code P04.21)	
	0V	Reference ground for analog output signal	Reference ground for analog output signal
485 Communication terminals	A+	485 communication signal +	Signal terminal of 485 communication.
	B-	485 communication signal-	
	SC	Signal ground	485 communication signal ground

Note: +24V and XV must be short connected when internal 24V power supply is applied.

4.5.4 Detailed introduction to terminal wiring of the control circuit

4.5.4.1 Analog input terminal

Two analog input ports are provided for AS160 inverter, of which, A0 is an input port for analog voltage signal and A1 is optional (analog voltage/current signal) input port, to choose with the jumper JP1 (2, 3/1, 2). Of which, range of signal of A0 and A1 analog input port is 0V - +10V, and range of current signal of A1 analog port is 0-20mA.

When analog signal connection is applied, wiring between the analog signal and inverter shall be the as shortest as possible (not exceeding 30m), and shielded wire shall be used. Shielding layer of the shielded wire shall be grounded, to ground to 0V terminal of analog input signal of the inverter. Figure 4-20 shows the schematic of grounding of the shielding layer of analog signal shielded wire.

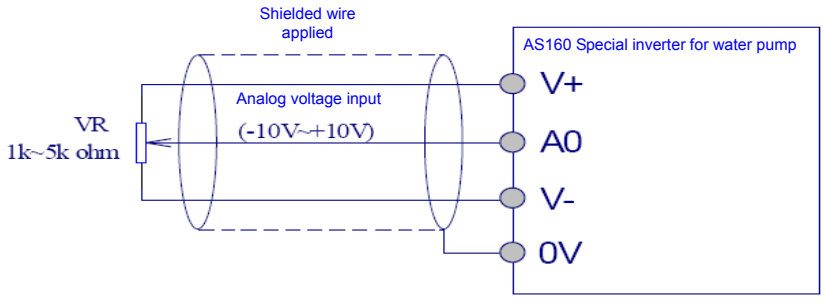


Figure 4-20

Schematic of Grounding of the Shielding Layer of Analog Signal Shielded wire

In Figure 4-20, analog voltage signal is provided by the inverter, with range of 0V-+10V. In the most actual applications, voltage signals of analog input are provided by the controller sending out analog signals, and if they are voltage signals, the range of 0-10V will be adopted mostly. The wiring schematic is shown in Figure 4-21.

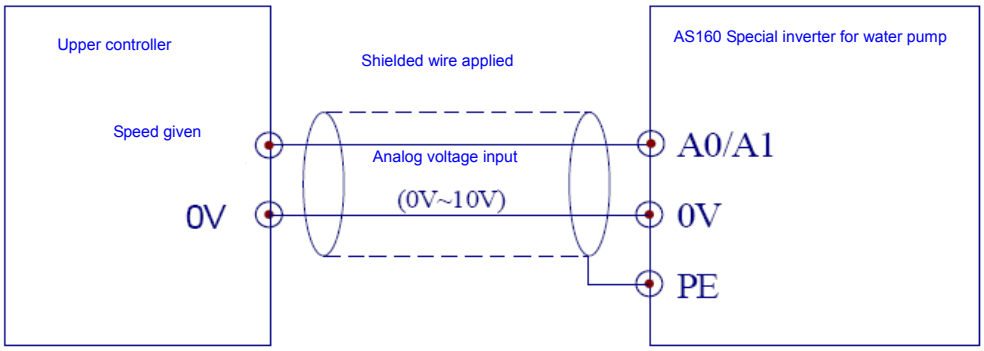


Figure 4-21 Wiring Schematic of A0 Analog Signal

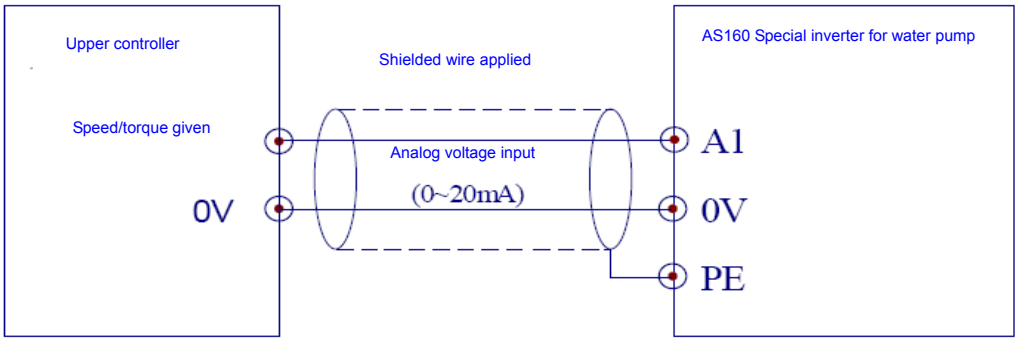


Figure 4-22 Wiring Schematic for A1 Analog Current Signal

When analog input signal is applied, the parameters such as gain, offset and signal filter time of the signal of each related input port can be chosen through setting of parameters P03.08-P03.16, so as to apply the analog input port better.

4.5.4.2 Digital input terminal

Each multifunctional digital input terminal can be set through the parameters of the functional code P03.00-P03.07, to define its input function.

The specific mode of wiring:

The wiring mode that +24V inside the inverter and NPN sinking current for the

external controller is adopted.

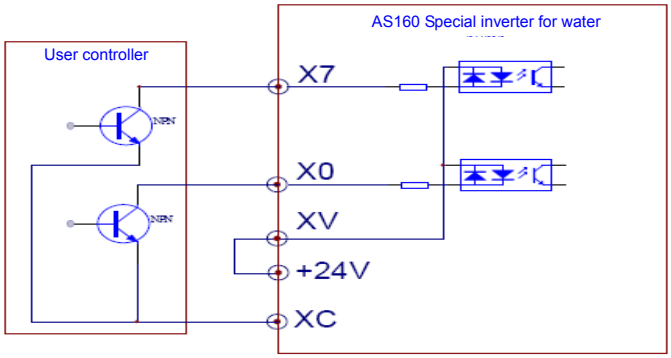


Figure 4-21 Wiring Schematic for NPN sinking current

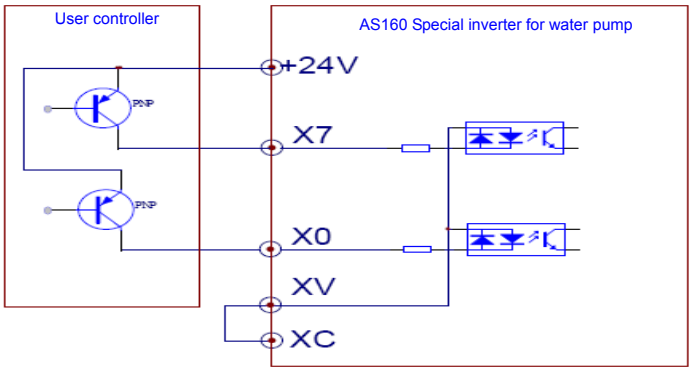


Figure 4-22 Wiring Schematic for PNP sourcing current

Note: short block between +24V and XV terminal must be removed, and connect it between terminals XC and XV.

- The wiring mode of external power supply and NPN sinking current for the external controller is adopted.

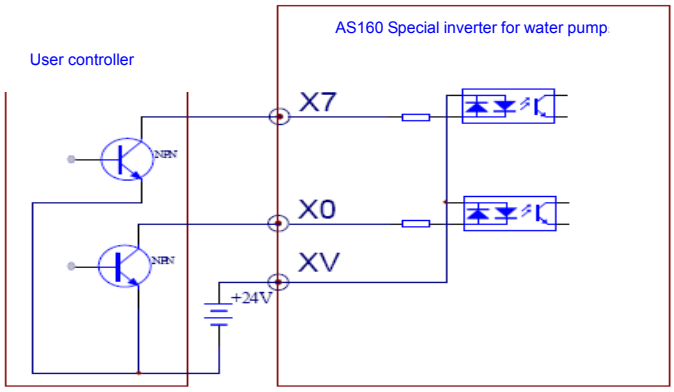


Figure 4-23 Wiring Schematic for NPN sinking current

Note: short block between +24V and terminal XV must be removed.

- The wiring mode of external power supply and PNP source current for the external controller is adopted.

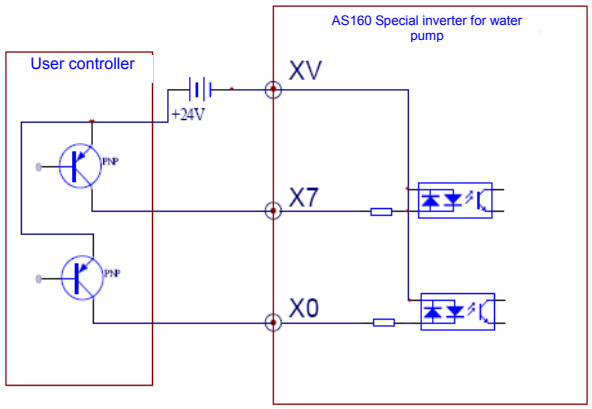


Figure 4-24 Wiring Schematic for PNP sinking current

Note: short block between +24V and terminal XV must be removed.

4.5.4.3 Digital output terminal

Digital output terminals include relay contact output terminal and open collector output terminal. Functions of each digital output terminal can be defined by parameter setting of the functional code P03 group.

Four ways of output for the relay contact output and two ways for the open collector output, whose circuit schematic is shown in Figure 4-22.

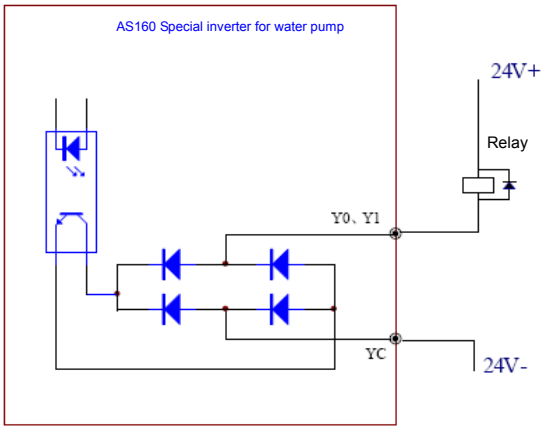


Figure 4-22 Circuit Structure of Open Collector Output

External power supply mode is applied by the open collector output, its polarity must be noted during connection. Specifications of the output power: the maximum voltage +30VDC and the maximum load current 50mA. The danger of output circuit damage will be caused if the specifications are exceeded.

4.5.4.4 Multifunctional analog output terminal

Output functions of the multifunctional analog output terminal will be defined by parameter setting of the functional code P04.18 and P04.12

4.5.5.5 Other considerations for wiring

Wiring of the control terminals must be far from the power line of the main circuit, otherwise the false operation will be produced due to electromagnetic interference.

Chapter 5 Operator

Terms description related to control, operation and status of inverter would be mentioned many times in the following sections.

Please read this chapter carefully before application of products to understand and apply functions in the following sections correctly.

Danger

Close the input power only after the casing to inverter is well installed. After power on, do not disassemble the casing to avoid electric shock.

In case the inverter is set with restart function upon power off, do not close to drive equipments to avoid personnel injuries by the equipments after the inverter is power on.

In case the dynamic braking resistor is installed, do not touch the resistor to avoid electric shock or burn.

Before motor and mechanical equipments are started, make sure their scope of application; otherwise it may cause danger.

Caution

When the inverter is running, do not check the measuring signal; otherwise it may cause equipment damages.

Do not change parameter setting of the inverter without permit; otherwise it may not reach proper running effect and cause damages of drive equipments.

Before switching channels, perform the toggle debug first; otherwise it may cause equipment damage and personnel injury.

5.1 Run command given

5.1.1 Run command channel

It assigns physical channel for start, stop, etc. of run command. The command channel is divided into three types:

Operation panel: control by RUN, STOP, LOC/REM key on the panel;

Control terminal: control by X0~X7 (digital), A0~A1 (analog);

Communication port: perform start, stop control through upper computer with control terminals A+, B- (RS485).

Command channel can be set up through function code P01.01.

Note: Before switching of command channel, perform toggle debug first. Otherwise it may cause equipment damage and personnel injury.

5.1.2 Frequency given channel

AS160 normal running mode has five frequencies given for physical channels, respectively:

Operation panel ▲, ▼ key given;

Terminal speed given;

Communication given;

Analog voltage, current given.

PID given.

5.1.3 Operating status

AS160 operating mode is divided into stop status, running status.

Stop status: in case there is no input of running command, or stop command during running after the inverter is initialized with power on, it would go to stop status.

Running status: the inverter would go to running status after receiving running command.

5.1.4 Running mode

AS160 inverter has four different running modes, which, by priority, is: jog frequency > multi-speed > common frequency running

Jog frequency running

Set P00.09 jog frequency, X0～X7 with function 56, 57, perform jog control through external terminal.

Multi-speed running

With opening/closing combination of multifunction terminal (No 3, 4 5 function), choose multi-frequency 1～7 (P05.09～P05.15) to perform multi-speed running. Note: three terminals can not be under "OFF" status at the same time; otherwise it would be normal running mode.

Common frequency running

Set P00.01 or P00.03, and for the inverter, choose 1～7 any frequency given mode.

5.2 Operation guidance

The operator is a main unit for receiving the command, displaying parameter and running status. LCD is for displaying tip information, which can be in Chinese or English.

With the operation panel, the user can:

- Monitor motor status
- Perform monitor self-tuning (normally not used)
- Control motor running (start/stop, speed, rotating clockwise/counterclockwise, etc)
- View and response to fault or alarm
- Set and modify parameter
- Switch between local mode and remote mode

5.2.1 Introduction to operator functions

For terms and functions of each part, refer to Figure 5-1.

Figure 5-1 Terms and functions

5.2.2 LED light

There are four LED lights at top side, respectively D1 "Running", D2 "Forward/Reverse", D3 "Local/remote" and D4 "Fault". These lights would indicate the status of motor. For indication of mechanical motor status, refer to Table 5-1.

Table 5-1 Indication of motor running status

Motor status	D1 (running)	D2 (forward/reverse)	D3 (local/remote)	D4 (fault)
Forward	ON	ON	OFF	OFF
Reverse	ON	OFF	OFF	OFF
Fault/warning	OFF	Not related	Not related	Flashing
Panel running	ON	ON/OFF	ON	OFF

5.2.3 LED digital tube

There are four LED digital tubes at the top, which, by default, would display real-time running frequency of motor. Choose display contents by parameter.

5.2.4 LCD display

There is an LCD in the middle, which is a main window for parameter setting, display of motor running parameter and view of inverter fault code.

5.2.5 Keyboard

There are nine keys below. For functions, refer to Table 5.2.

Table 5.2 Key function

Key	Description	Function
>	Right key	For running status, choose next display parameter; For function selection, choose next function group; For parameter modification, modify (cursor) position by moving right.
<	Left key	For running status, choose previous display parameter; For function selection, choose previous function group; For parameter modification, modify (cursor) position by moving left.
^	Add key	For running status, add running frequency; For function selection, choose next function code; For parameter modification, add parameter.
v	Subtract key	For running status, subtract running frequency; For function selection, choose previous function code; For parameter modification, subtract parameter.
ENTER	Enter key	For running status, go to "function selection" status; For function selection, go to "parameter modification" status; For parameter modification, parameter modification confirmed.
ESC	ESC key	For function selection, return to "running status"; For parameter modification, return to "function selection" status.
F1	F1 function key	Under monitor status, adjust the display brightness to dark. Under LOCAL status, RUN function.
F2	F2 function key	Under monitor status, adjust the display brightness to bright. Under LOCAL status, STOP function.
F3	F3 function key	Switch key between LOCAL running mode of operator and REMOTE running mode of control circuit terminal.

5.3 Operation of LCD operator

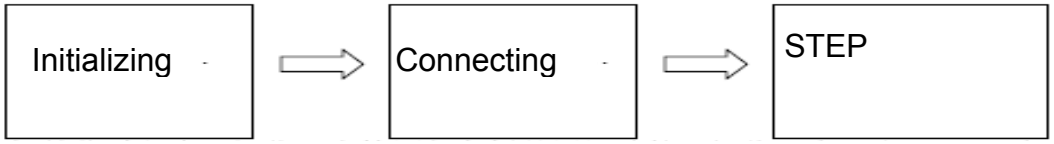
There are three statuses respectively "monitor status", "function selection" and "parameter modification" for the operator. And the menu is displayed in Chinese and English. The factory setting is Chinese, and by setting parameter value of "Language selection" in the advanced menu to 0, switch to English.

5.3.1 Power on initialization

There would be initialization for several seconds after the operator is power on,

during which, "splash screen" would be displayed.

"Splach screen" is as below:



Note: the operator would check communication connection with main board during initialization, and it would always display "Connecting" till it is connected successfully.

5.3.2 Display after power on

It would display "monitor status" interface after power on for 5s, which displays currently recorded given speed (Vref), feedback speed (V/Fbk), current status (Irms)

5.3.3 Description of "monitor status"

Monitor status interface can be switched by pressing  and  or  and  in the "monitor status" interface. 10 real time data of motor running can be displayed by default in the monitor status, which can only be displayed, nor modified.

Table 5.3 Default running status data table

Display	Description
Given	Display the given frequency in HZ.
Frequency	Display the output frequency in HZ. For reversing, there is minus sign in front.
Current	Display the output current in A.
Torque	Display the output torque through percentage of rated torque.
Speed	Display the output speed in RPM.
Bus	Display the DC bus voltage in V.
Voltage	Display the output voltage in V.
Temperature	Display the radiator temperature in degree.
Power consumption	Display the power consumption in KWh.
Power on	Display the accumulated power on time in h.
Running	Display the accumulated running time in h.

SV	Display PID set value, with unit to be set by P6.03.
PV	Display PID feedback value with unit to be set by P6.03.
MV	Display PID output value in percentage.
A0	Display the value of analog input A0 in percentage of 10V.
A1	Display the value of analog input A1 in percentage of 10V or 20ma.
M0	Display the value of analog output M0 in percentage of 10V.
M1	Display the value of analog output M1 in percentage of 10V.
DI	Display status of digital input X0-X7, and DI is displayed as "XXXXXXXX", where, "X" = 0, means power off, "X" = 1, means power on.
DO	Display status of relay output 1-4, transistor output Y0, Y1. And DO is displayed as "XXXXXX", where, "X" = 0, means output no action; "X" = 1, means output action.

5.3.4 Description of "panel control"

The "monitor status" and "panel control" can be switched by pressing F3 in the "monitor status" interface, and the LED light D3 on the operator would be ON under "panel control" status. Press F1, the inverter would go to running status, and LED light D1 would be ON; press F2, the inverter would go to stop status, and LED light D1 would be off. Press ⌃ and ⌄ key to switch the monitored contents under "panel control" interface. Two running parameters of panel control and four real-time data of motor running can be modified under the "panel control" interface. Panel operation speed Vref and motor running director Vdir can be modified, and other four data can be displayed only, nor modified.

Table 5-4 Panel control data table

Display	Description
Given	Display the given frequency in HZ.
Frequency	Display the output frequency in HZ. For reversing, there is minus sign in front.
Current	Display the output current in A.
Direction	Set the motor forward rotation or reversing, 1 for forward rotation and 0 for reversing.
Bus	Display the DC bus voltage in V.
Voltage	Display the output voltage in V.

5.3.5 Operation status of the operator

There are four operation statuses for the operator, respectively "parameter setting", "motor tuning", "fault check" and "parameter processing". Under any monitor status interface, press Enter to go to the following function selection interface

* 1: Parameter setting

2: Motor tuning

3: Fault check

4: Parameter processing

1) Description of "parameter setting" status

Used for parameter modification. For setting range, refer to Chapter 6.

Select parameter group by pressing ◁ or ▷ under "parameter setting". Select parameter code by pressing △ and ▽. After selection of the parameter to be modified, press ENTER, and the cursor for modification would be at that parameter position. Change the position by pressing ◁ or ▷, and increase or decrease the parameter value to be modified by pressing △ and ▽. Press ENTER to confirm the modification. If not, modification would not take effect.

Press ESC, return to the previous menu.

2) Description of "motor tuning"

1: Parameter setting

* 2: Motor tuning

3: Fault check

4: Parameter processing

Start self-learning of motor (asynchronous) parameter manually under "motor tuning" condition, and select corresponding method through modification of X value in the ATun = X.

Generally for water pump, self-tuning is not required for the motor. Press ESC, return to the previous menu.

3) Description of "fault check"

1: Parameter setting

2: Motor tuning

* 3: Fault check

4: Parameter processing

Check the contents of eight faults that occur recently, and voltage, current, given speed, feedback speed conditions that are recorded at the time of fault under "fault check" condition. Press ENTER to display ER0=X under main condition menu, and press ⏶ or ⏷, it would change between ER0 to ER7. ER0 refers to recent fault serial number, and ER7 refers to the farthest serial number, and X refers to fault code under the current serial number. Meanwhile, fault meaning of this code would be displayed in Chinese below. Press ENTER again under display conditions, it would display DC bus voltage (Udc), output current (Irms), given speed (Vref), feedback speed (V/Fbk) that is recorded under the current fault, and press ENTER again, it would return the display condition. Press ESC, return to the previous menu.

4) Description of "Parameter processing"

1: Parameter setting

2: Motor tuning

3: Fault check

* 4: Parameter processing

Carry out parameter upload, download, initialization and troubleshooting under "parameter processing" condition. Select corresponding operation method through modification X value of Init = X. Press ENTER, and the cursor for modification would be at that parameter position. Select corresponding operation method by pressing ⏶ or ⏷. Press ENTER to confirm. There are four modes for parameter processing, with meaning as below:

1: parameter upload to the operator

2: parameter download to the inverter

7: reset parameter

8: reset fault

Press ESC, return to the previous menu.

5.4 Quick debugging guidance

This section describes common and necessary debugging steps regarding speed control in the common mode of AS160 series inverter based on the ex-work value.

1) Public parameter setting for each control mode

1. Select run command channel: see P00.00 "selection for run command and given command";

2. Select frequency given channel and setting given frequency: see P00.01 "frequency speed given method";

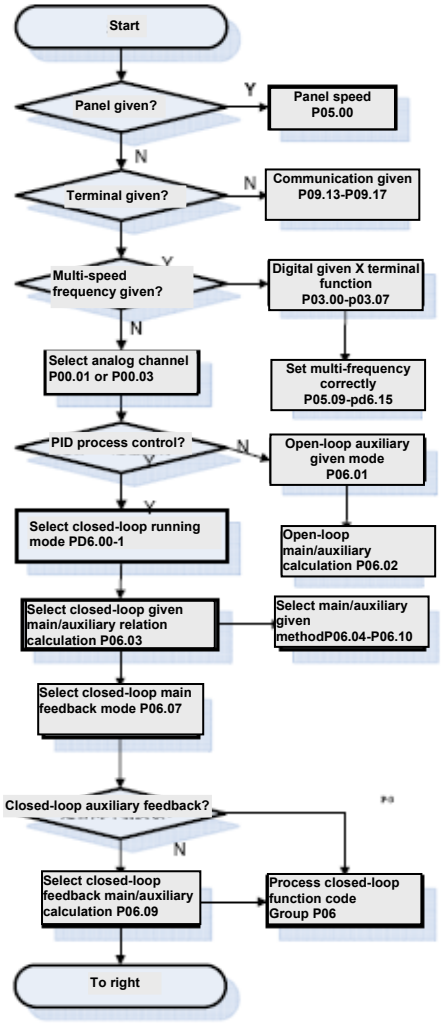
3. Set P00.07 "Upper limit frequency", P00.08 "Lower limit frequency" correctly;

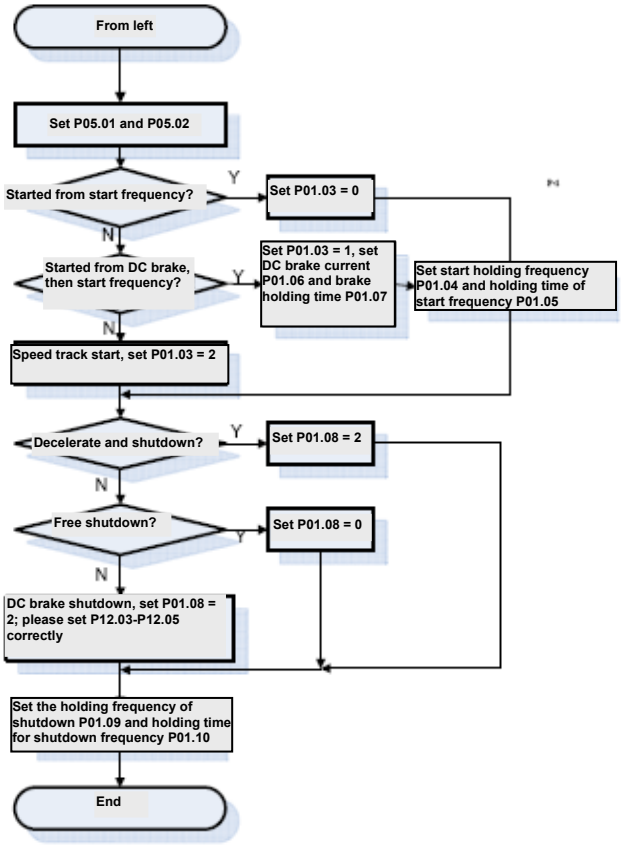
4. Acceleration/deceleration time: set P01.11 "acceleration time" and P01.12 "deceleration time" as long as possible while meeting requirements. If too short, it would cause too large torque then damaging the load or causing overcurrent;

5. Startup mode and shutdown mode: see P01.00 "startup mode" and P01.05 "shutdown mode";

6. Motor nameplate parameter: set P02.00-P02.03 rated current, rated frequency, rated voltage, rated speed;

2) V/F control quick debugging

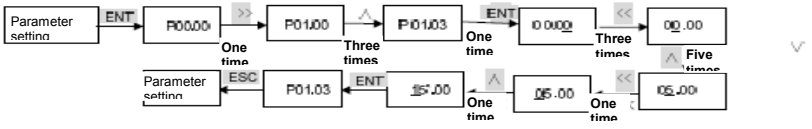




5.5 Operation examples

For below example, set the start holding frequency and ex-work setting is 0.00Hz. Those with underline mean the current editing position.

For example, set P01.03=15.00Hz.



5.6 Fault display

When the inverter fails, the fault indicating light D4 at top of the operator will flash. And LED digital tube would display the current fault code at real-time. For fault code and name, see Table 5-6.

Table 5-6 Fault code and name

Fault number	Fault display	Fault number	Fault display
1	Module overcurrent protection	2	ADC fault
3	Radiator Overheat	4	Braking unit fault
5	Fuse blown fault	6	Output overtorque
7	Speed deviation	8	Bus overvoltage protection
9	Bus undervoltage	10	Output open-phase
11	Motor low-speed overcurrent	12	Encoder fault
13	Current detected when stopped	14	Speed reversing during running
15	Speed detected when stopped	16	Wrong phase sequence
17	Overspeed with the same direction	18	Reversing overspeed
19	UVW encode phase sequence fault	20	Encoder communication fault
21	Abc overcurrent	22	Brake check fault
23	Input overvoltage	24	UVW encoder disconnection
25	Backup	26	Encoder unlearned
27	Output overcurrent	28	Sincos encoder fault
29	Input open-phase	30	Overspeed protection
31	Motor high-speed overcurrent	32	Earthing protection
33	Capacitor aging	34	External fault
35	Output unbalanced	36	Parameter setting error
37	Current sensor fault	38	Braking resistor short-circuit
39	Current instant value too large	40	Parameter fault
41	Water pump fault	42	PFC start fault 1
43	PFC start fault 2	44	All motors stopped
45	IGBT drive fault	46	Sensor disconnection
47	Communication fault alarm	48	Communication fault stop
49	Relay fault	50	Backup

Chapter 6 Function parameter table

This chapter describes all function codes and relevant information related to special inverter for reference.

6.1 About the main menu

* 1: Parameter setting

2: Motor tuning

3: Fault check

4: Parameter processing

6.1.1 Parameter setting

After entering, parameter from Group P0X to Group P9X would be displayed. If the logging password is correct, it can be modified. For specific meaning, see below.

Field	Explanation
Function code number	Means the number of function code, such as P00.00
Name of function code	Name of function code, explaining its function
Option of function code	Parameter setting list
Setting range	Minimum to maximum value that is allowed for setting the function code
Unit	V: voltage; A: current; ℃: degree; Ω: ohm; mH: millihenry; rpm: =revolutions per minute; %: percentage; bps: baud rate; Hz, kHz: frequency; ms, s, min, h, kh: time; kW: power; /: no unit, etc.
Exworks value	Setting value after function code is restored with exworks value operation (P00.04)
Attribute	○: this function code can be modified during running; ×: this function code can be modified only during shutdown; *: this function code is read-only parameter, and cannot be modified.
User setting	For the users to record parameter

6.1.2 Motor learning

This option performs motor self-learning. For the different motors that connects to the inverter for the first time, and chooses constant-torque mode, have self-learning.

For known motor nameplate parameter and others, please write to the corresponding parameter directly; if the motor internal parameter is unknown, please execute parameter self-tuning. Press ENT, determine self-learning plan; usually 5 or 6 is recommended:

0: normal running

1: encoder static self-learning

Usually angle learning of the synchro motor on the encoder shall be started first.

2: encoder dynamic self-learning

For the sin/cos encoder, this function is required for learning the center point.

3: simple motor self-learning

1-3 is for self-learning of synchro motor

4: rotating motor self-learning

If the motor is relieved from the load, choose rotating self-learning 4; otherwise it can only choose static self-learning. When the parameter self-learning is started, ensure the motor is under static condition. In case of overcurrent, overvoltage fault during self-learning, extend the acceleration, deceleration time P01.11, P01.12 properly.

1. Static motor self-learning

In case the inverter does not match with motor power, please choose static self-learning. After learning, change the no-load current into about 30% of motor rated current P02.00 manually. The small the motor power is, the larger this value

would be.

2. Advanced motor static self-learning

Normally, the advanced static self-learning is recommended for connecting to new motor to check the motor parameter automatically.

During self-tuning process, the data is displayed as 9-8-7-6-5-4-3-2-1-0 on the panel, and then, parameter condition returns to 0 (normal running) automatically.

6.1.3 Fault check

Press ENT key, go to fault list. According to time reverse order, it can display eight faults. When a certain fault is detected, press ENT key to display the bus voltage, output current, running frequency, etc. at the time of occurrence.

There are totally 49 fault codes. For corresponding fault types, see Table 5-6.

6.1.4 Parameter processing

Press ENT key to enter. This function is used for setting the parameter change authority and initialization level.

0: all parameter is allowed for change.

1: all parameter is not allowed for change.

2: restore P00 area parameter as exworks set value.

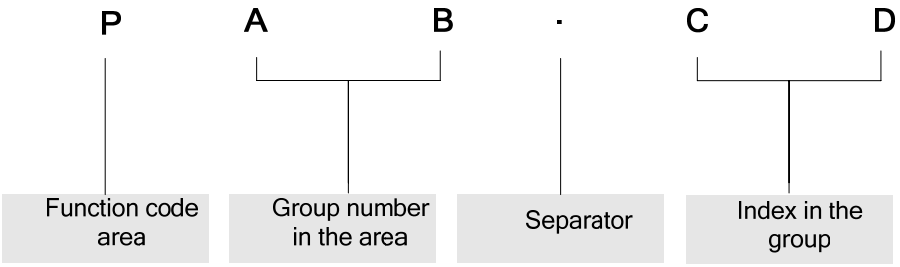
3: restore all non-P00 area parameter (function code display invisible area self-defined by the user) to exworks setting value.

4: restore all user parameter to exworks setting value.

Note: after the parameter is initialized, the password set by the user would be reset. Press ESC key, return to main menu.

6.2 Parameter group classification and format

6.2.1 Parameter group format



6.2.2 6.2.2 Parameter group area division

For function area grouping, see Table 6-1:

Table 6.1 Function grouping table

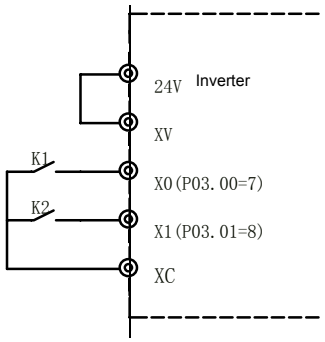
Function group	Description
P00	Basic parameter
P01	Start/stop parameter
P02	Motor and VF
P03	Input channel parameter
P04	Output channel parameter
P05	Detection value and multispeed
P06	Process PID setting 1
P07	Process PID setting 2
P08	Fan pump control
P09	Communication and display

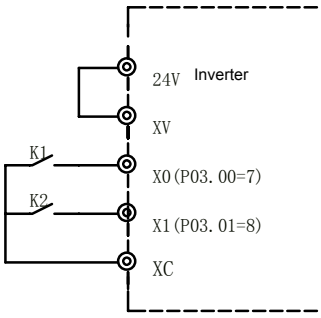
6.2.3 Function parameter group

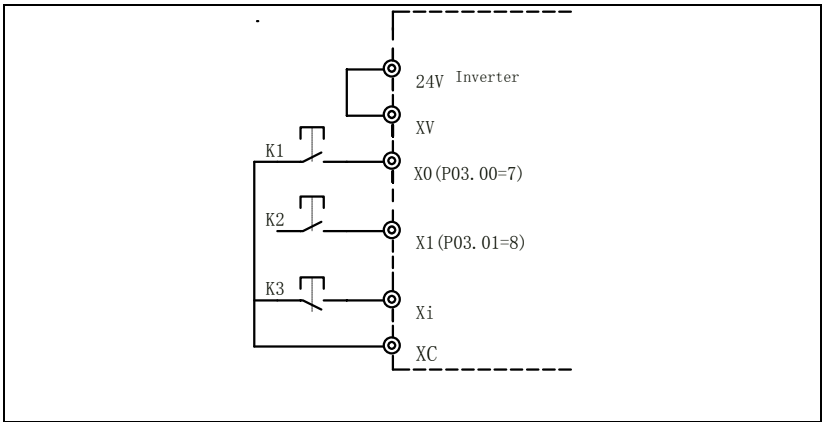
For detailed function parameter group, see Appendix B.1.

6.3 Function specification and description

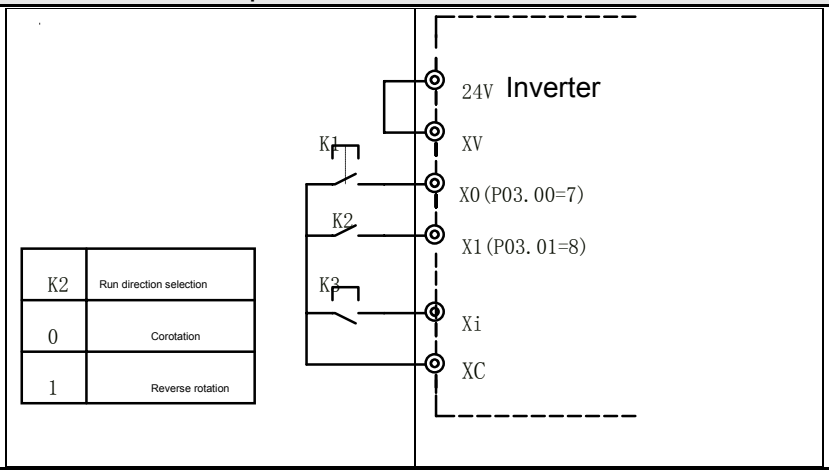
Code	Name	Parameter description
Group P00 basic parameter		
P00.00	Run command 1	Define run command 1, and set the source of start/stop command of inverter. 0: panel, F1 for corotation start, F2 for stop. 1: terminal, by default, X0 for corotation start, X1 for reverse rotation start, which can be defined via group P03. 2: communication, control start/stop of inverter through MODBUS communication. See communication.
P00.01	Frequency command 1	Define frequency command 1, and set the frequency signal source of the inverter. 0: panel, set the frequency signal source of the inverter. 1: A0, inverter frequency comes from A0. 2: A1, inverter frequency comes from A1. 3: A0+A1, inverter frequency comes from the sum of A0 and A1. 4: A0-A1, inverter frequency comes from the difference of A0 and A1. 5: UPDN terminal, inverter frequency comes from the terminal, such as set X3 as UP, X4 as DOWN, then X3 turns on the inverter, the setting frequency would increase, and for X4, setting frequency would decrease. If the inverter is started after stop, then setting frequency is 0. When X3 is set as UP (memory), X4 as DOWN (memory), the inverter is started after stop, then setting frequency is that of last time.during running. Define it through group P03. 6: MODBUS communication; see communication set value. 7: PID inverter frequency comes from PID output. See PID setting of group P06. 8: A0+PID set speed; see PID setting of group P06. 9: A1+PID set speed; see PID setting of group P06. 10: A0-PID set speed; see PID setting of group P06. 11: A1-PID set speed; see PID setting of group P06.
P00.02	Run command 2	Define run command 2. Same as run command 1.
P00.03	Frequency command 2	Define frequency command 2. Same as frequency command 1. 7: PID; see PID setting of group P07. 8: A0+PID set speed; see PID setting of group P07. 9: A1+PID set speed; see PID setting of group P07. 10: A0-PID set speed; see PID setting of group P07. 11: A1-PID set speed; see PID setting of group P07.
P00.04	Command 1/2 selection	Define selection of command 1 and command 2, and default run command 1 and frequency command 1. 0: select command 1. 1: select command 2. 2: select through input terminal of digital quantity, and define it through group P03.

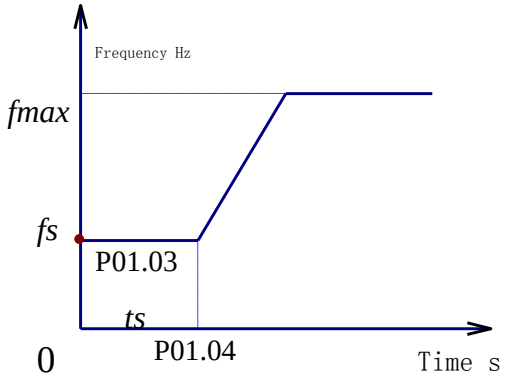
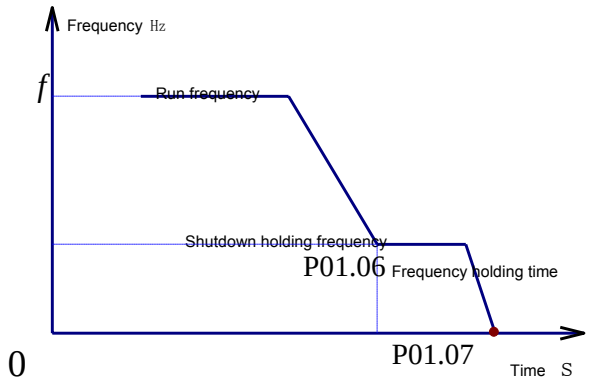
<table>
<tr><th>Code</th><th>Name</th><th>Parameter description</th></tr>
<tr><td></td><td></td><td>3: select through MODBUS communication; see communication control word.</td></tr>
<tr><td>P00.05</td><td>Run mode selection</td><td>
0: double wire type 1
<table>
<tr><th>K2 K1</th><th>Run command</th></tr>
<tr><td>0 0</td><td>Stop</td></tr>
<tr><td>1 0</td><td>Reverse rotation</td></tr>
<tr><td>0 1</td><td>Corotation</td></tr>
<tr><td>1 1</td><td>Stop</td></tr>
</table>


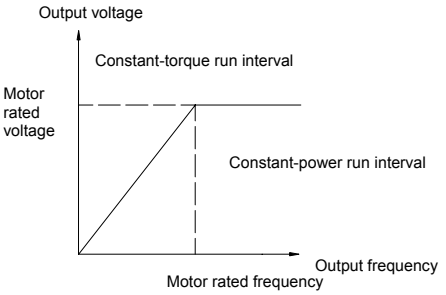
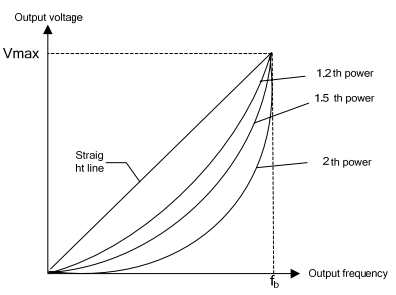
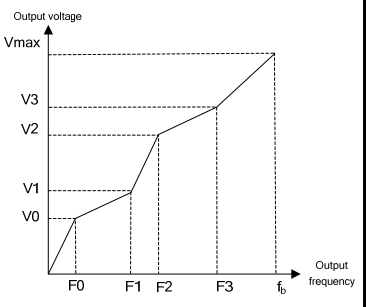
1: double wire type 2
<table>
<tr><th>K2 K1</th><th>Run command</th></tr>
<tr><td>0 0</td><td>Stop</td></tr>
<tr><td>1 0</td><td>Reverse rotation</td></tr>
<tr><td>0 1</td><td>Corotation</td></tr>
<tr><td>1 1</td><td>Stop</td></tr>
</table>


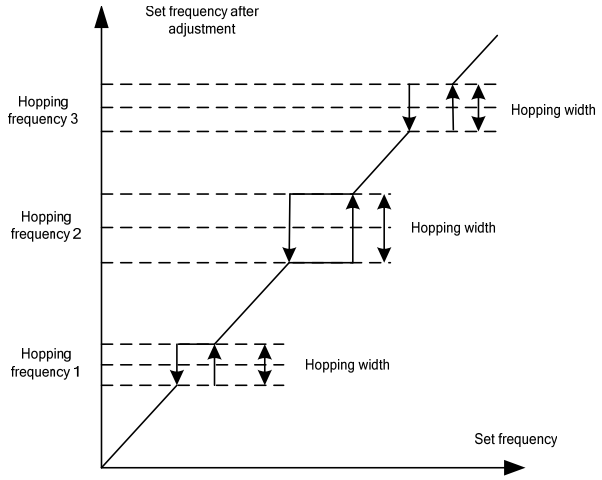
2: three-wire type 1
Xi（i=0～7）terminal set up "9: three-wire type run control" function.
Xi is NC button, stop for disconnection; X0 is corotation triggered by the button, X1 is reverse rotation triggered by the button.


3: three-wire type 2
Xi（i=0～7）terminal set up "9: three-wire type run control" function.
Xi is NC button, stop for disconnection; X0 is run triggered by the button, X1 is corotation for disconnection, and reverse rotation for closing.
</td></tr>
</table>

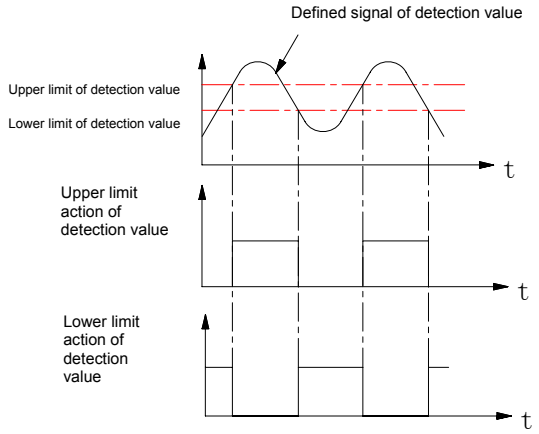
Code	Name	Parameter description
		
P00.06	Reverse rotation setting	0: inverter allows revere rotation, 1: inverter forbids reverse rotation.
P00.07	Frequency upper limit	Define maximum output frequency of the inverter.
P00.08	Frequency lower limit	Define minimum output frequency of the inverter, i.e. Regardless of set frequency lower than this frequency, the actual output frequency would not be lower than this frequency.
P00.09	Inching frequency	Set up inching frequency; priority: inching frequency > multispeed > Other frequency
P00.10	Torque rising	The torque rises when the inverter is started.
P00.11	Password logging	Password logging
P00.12	Inverter software edition	Refer to the inverter software edition
Group P01 basic parameter		
P01.00	Start mode	Define start mode of the inverter. 0: normal start; direct start. 1: restart after DC braking; the inverter would inject start DC braking current to the motor within the start DC braking time, and the motor would be started after DC braking.
P01.01	Start DC injection current	When the start mode is set as restart after DC braking, the inverter would inject DC current to the motor, and after the start DC braking time, the inverter would be started. Suitable for the load that the motor needs to stop while starting.
P01.02	Start DC injection time	
P01.03	Holding time of start frequency	When started, the inverter would accelerate to start holding frequency, and then after holding time of start frequency, it would accelerate according to the set acceleration time.
P01.04	Holding time of start frequency	

Code	Name	Parameter description
		
P01.05	Shutdown mode	Define the shutdown mode of the inverter. 0: inertia shutdown: the inverter would stop output immediately, and the motor would shutdown with inertia. 1: deceleration shutdown: the inverter would stop output according to deceleration time. 2: deceleration + DC braking shutdown: refer to DC braking parameter.
P01.06	Shutdown holding frequency	The inverter decelerates to shutdown holding frequency, and after holding time of shutdown frequency, it then decelerates to zero according to the set deceleration time.
P01.07	Shutdown frequency holding time	
P01.08	Start frequency of DC braking	When the inverter decelerates to start frequency of DC braking, it would inject shutdown DC braking current to the motor, and after shutdown DC braking time, the DC current would disappear. The inverter is built in with brake unit, which needs braking resistance outside.
P01.09	shutdown DC braking current	
P01.10	Shutdown DC braking time	
P01.11	Acceleration time 1	The time required for 0HZ linear rising to upper limit of frequency.
P01.12	Deceleration time 1	The time required for upper limit of frequency decreasing to 0HZ.
P01.13	S curve 1	Add S curve time based on the linear acceleration/deceleration time, and acceleration/deceleration runs according to S curve.
P01.14	Acceleration time 2	Defines acceleration/deceleration time curve of the second group.

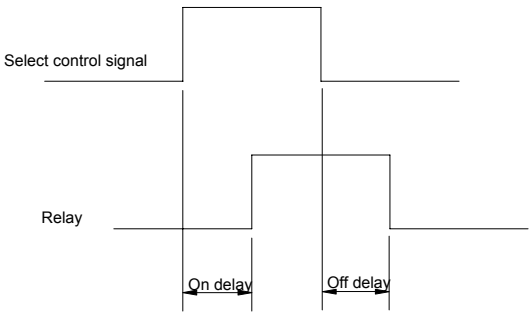
Code	Name	Parameter description
P01.15	Deceleration time 2	
P01.16	S curve 2	
P01.17	Acceleration/deceleration time selection	Select acceleration/deceleration time curve 1 or 2. 0: acceleration/deceleration time 1; 1: acceleration/deceleration time 2: 2: select through the terminal. Defined through group P03. 3: select through communication; see communication control word.
Group P02 Motor and VF curve		
P02.00	Motor rated current	Exworks value differs as the inverter power is different. Used for motor overload protection, e.g. Set 30A, the inverter would then output 30*120%=36A, and report overload for one continuous minute.
P02.01	Motor rated frequency	
P02.02	Motor rated voltage	
P02.03	Motor rated speed	Set up the motor speed
P02.04	Acceleration current threshold value	If the current exceeds this value during acceleration, it then stops acceleration, till the current is reduced below this value, then accelerate again. The current is the percentage of rated current of the inverter.
P02.05	Deceleration voltage threshold value	If the voltage exceeds this value during deceleration, it then stops deceleration, till the voltage is reduced below this value, then decelerate again.
P02.06	V/F curve setting	Select the type of VF curve. 0: straight line, suitable for constant-torque load; 1: 1.2 capital; 2: 1.5 capital; 3: 2 capital; 4: self-defined;
P02.07	Self-defined F0	 
P02.08	Self-defined V0	
P02.09	Self-defined F1	
P02.10	Self-defined V1	
P02.11	Self-defined F2	
P02.12	Self-defined V2	

Code	Name	Parameter description
P02.13	Self-defined F3	VF curve comparison Self-defined VF curve
P02.14	Self-defined V3	
P02.15	Self-defined F4	
P02.16	Self-defined V4	
P02.17	Frequency hopping speed 1	Output frequency of the inverter hops out of the machinery resonant frequency point, and the set frequency shall not fall on within the frequency hopping interval. 
P02.18	Frequency hopping speed 2	
P02.19	Frequency hopping speed 3	
P02.20	Frequency hopping width	
P02.21	Fault auto reset time	For disorderly shutdown, execute fault reset restart function. The number of auto reset means the number that the inverter can be reset automatically within half an hour. Auto reset time means the time interval between two auto resets.
P02.22	Fault auto reset times	
P02.23	PWM carrier frequency	Inverter carrier frequency
Group P03 Input channel parameter		
P03.00	Input terminal X0 function	Defines the function of input terminal of digital quantity of the inverter. In which, 0-64 is high level valid, 100-164 is low level valid. 0: not defined. The terminal has no definition function. 1: acceleration/deceleration time 2 selection; define the terminal's function as acceleration/deceleration time 2 selection, and for the valid terminal, run according to acceleration/deceleration time 2; for invalid, run according to acceleration/deceleration time 1. 3-5: multispeed terminal 0-2, define the terminal's function as multispeed terminal. See the multispeed of group P05. 7: corotation start: when the terminal is valid, the inverter is started with corotation. 8: reverse rotation start: when the terminal is valid, the inverter is started with reverse rotation. 9: three-wire control selection: when the terminal is valid, the inverter is three-wire control mode. See the wiring mode of P00 terminal. 13: external reset signal: when the terminal is valid, the inverter would be fault
P03.01	Input terminal X1 function	
P03.02	Input terminal X2 function	
P03.03	Input terminal X3 function	
P03.04	Input terminal X4 function	
P03.05	Input terminal X5 function	
P03.06	Input terminal X6 function	
P03.07	Input terminal X7	

Code	Name	Parameter description
	function	reset. 14: external fault signal: when the terminal is valid, , external fault signal would be switched on, and the inverter would be fault shutdown. 18: base set block signal: when the terminal is valid, the inverter would stop output immediately. 49: command 2: when the terminal is valid, the run and frequency command of the inverter comes from command 2. 50: PID setting 2: when the terminal is valid, the inverter PID would run according to PID setting 2. 52: up: when the terminal is valid, the inverter setting frequency would increases. 53: down: when the terminal is valid, the setting frequency would decrease. UP and DOWN would appear in pairs. No memory means that the inverter is restarted after stop, with setting frequency as 0. 54: up (memory): when the terminal is valid, the setting frequency would increase. 55: down (memory): when the terminal is valid, the setting frequency would decrease. Memory means the inverter is restarted after stop, with the setting frequency as the same as last time. UP (memory) and DOWN (memory) would appear in pairs. 56: corotation inching: when the terminal is valid, the inverter would inch with corotation. 57: reverse rotation inching: when the terminal is valid, the inverter would inch with reverse rotation.
P03.08	Analog input A0 minimum value	Only input analog voltage signal. Minimum value refers to that of analog input relative to the percentage of 10V. Maximum value refers to the percentage of 10V relative to actual input maximum value. For input of 0-10V, minimum value is 0% and maximum value is 100%; for input of 0-5V, minimum value is 0% and maximum value is 200%; for input of 1-10V, minimum value is 10% and maximum value is 100%. Input offset of analog quantity corresponds to 0HZ, and 10V to upper limit of frequency.
P03.09	Analog input A0 maximum value	
P03.10	Analog input A0 filtering	Define filtering time of A0.
P03.11	Analog input A0 disconnection value	Input disconnection detection value is relative to the percentage of 10V or 20ma. Assume the input is 4-20ma, this value is set as 20%, then the input is less than 4ma, which is considered as input disconnection of analog quantity, then the inverter is shutdown after disconnection.
P03.12	Analog input A1 type	Voltage and current input selected through a jumper, 0: 0-10V, 2: 0-20mA.
P03.13	Analog input A1 minimum value	Minimum value refers to that of analog input, which is relative to the percentage of 10V or 20ma. Maximum value is the percentage of 10V or 20ma which is relative to maximum value of analog input. For input of 0-20ma, minimum value is 0%, and maximum value is 100% ; for input of 4-20ma, minimum value is 20% and maximum value is 100%; voltage is the same as A0.
P03.14	Analog input A1 maximum value	

<table>
<tr><th>Code</th><th>Name</th><th>Parameter description</th></tr>
<tr><td>P03.15</td><td>Analog input A1 filtering</td><td>Defines filtering time of A1.</td></tr>
<tr><td>P03.16</td><td>Analog input A1 disconnection value</td><td>Same as A0.</td></tr>
<tr><td colspan="3">Group P04 Output channel parameter</td></tr>
<tr><td>P04.00</td><td>Relay 1 function</td><td rowspan="6">Defines the function of output relay and transistor of digital quantity of the inverter.
0: not defined: the terminal does not have definition function.
33: dormancy: acts when the inverter is in dormancy.
40: upper limit action of detection value 1;
41: lower limit action of detection value 1;
42: upper limit action of detection value 2;
43: lower limit action of detection value 2;
44: upper limit action of detection value 3;
45: lower limit action of detection value 3;
 

Logic diagram of upper/lower limit action of detection value
46: power on self-check normal: the inverter powers on for self-check, without fault action.
47: fault output: the inverter acts for fault.
48: during running: the inverter runs during running.
49: target frequency reached: the inverter acts when its output frequency reaches setting frequency.</td></tr>
<tr><td>P04.01</td><td>Relay 2 function</td></tr>
<tr><td>P04.02</td><td>Relay 3 function</td></tr>
<tr><td>P04.03</td><td>Relay 4 function</td></tr>
<tr><td>P04.04</td><td>Output terminal Y0 function</td></tr>
<tr><td>P04.05</td><td>Output terminal Y1 function</td></tr>
<tr><td>P04.06</td><td>Relay 1 on delay</td><td rowspan="6">Define on off delay output by the relay and transistor.</td></tr>
<tr><td>P04.07</td><td>Relay 1 off delay</td></tr>
<tr><td>P04.08</td><td>Relay 2 on delay</td></tr>
<tr><td>P04.09</td><td>Relay 2 off delay</td></tr>
<tr><td>P04.10</td><td>Relay 3 on delay</td></tr>
<tr><td>P04.11</td><td>Relay 3 off delay</td></tr>
</table>

Code	Name	Parameter description
P04.12	Relay 4 on delay	
P04.13	Relay 4 off delay	
P04.14	Output terminal Y0 on delay	
P04.15	Output terminal Y0 off delay	
P04.16	Output terminal Y1 on delay	
P04.17	Output terminal Y1 off delay	
P04.18	Analog output M0 function	Define the function of output M0 of analog quantity, and the output is 0-10V. 71: output frequency: 0 - frequency upper limit corresponding to minimum value and maximum value of analog quantity output. 72: analog input A0: 0-100% of A0 corresponding to minimum value and maximum value of analog quantity output. 73: analog input A1: same as A0. 74: output current: 0 - motor rated current corresponding to minimum value and maximum value of analog quantity output. 75: PID feedback value: lower limit of sensor range - upper limit of sensor range corresponding to minimum value and maximum value of analog quantity output. 76: output speed: 0 - motor rated speed corresponding to minimum value and maximum value of analog quantity output.
P04.19	Analog output M0 minimum value	Minimum value of analog quantity output is default as 0%, which is relative to the percentage of 10V; assume that analog quantity output is defined as output frequency, minimum value is 20%, and maximum value is 100%, then output is 2V-10V, corresponding to output frequency as 0 - frequency upper limit.
P04.20	Analog output M0 maximum value	Maximum value of analog quantity output is default as 100%, which is relative to the percentage of 10V. Assume that maximum value is 50%, minimum value is 0%, then output is 0-5V, corresponding to output frequency as 0 - frequency upper limit. Maximum value of analog quantity output is 10V.
P04.21	Analog output M1 function	Same as M0.
P04.22	Analog output M1 minimum value	
P04.23	Analog output M1 maximum value	
Group P05 Detection value and multispeed		
P05.00	Detection value 1	Defines the function of detection value 1, and set the action of output relay. See output channel parameter. 0: output frequency (Hz); 1: analog quantity input A0(%); 2: analog quantity input A1(%);

<table>
<tr><th>Code</th><th>Name</th><th>Parameter description</th></tr>
<tr><td></td><td></td><td>3: output current (A);
4: PID feedback value;
5: output speed (rpm)</td></tr>
<tr><td>P05.01</td><td>Upper limit of detection value 1</td><td>Upper limit of detection value 1, upper limit ≥ lower limit.</td></tr>
<tr><td>P05.02</td><td>Lower limit of detection value 1</td><td>Lower limit of detection value 1.</td></tr>
<tr><td>P05.03</td><td>Detection value 2</td><td rowspan="3">Defines detection value 2; see detection value 1.</td></tr>
<tr><td>P05.04</td><td>Upper limit of detection value 2</td></tr>
<tr><td>P05.05</td><td>Lower limit of detection value 2</td></tr>
<tr><td>P05.06</td><td>Detection value 3</td><td rowspan="3">Defines detection value 3; see detection value 1.</td></tr>
<tr><td>P05.07</td><td>Upper limit of detection value 3</td></tr>
<tr><td>P05.08</td><td>Lower limit of detection value 3</td></tr>
<tr><td>P05.09</td><td>Multispeed 1</td><td rowspan="8">Defines the multispeed, with maximum seven sections. Priority: inching frequency > multispeed > P01.01 frequency command. For example, P01.01 selects 1, and the frequency command comes from A0. When the multispeed terminal is valid, the inverter would output frequency based on multispeed. For below table, 1 stands for valid multispeed terminal, and 0 for invalid multispeed terminal. See input terminal of digital quantity. valid can be high level valid, or low level valid.
Such as: X5=5, X4=4, X3=3
<table><tr><th>X5 multispeed terminal2</th><th>X4 multispeed terminal1</th><th>X3 multispeed terminal0</th><th>function</th></tr><tr><td>0</td><td>0</td><td>0</td><td>No multispeed</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Multispeed 1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Multispeed 2</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Multispeed 3</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Multispeed 4</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Multispeed 5</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Multispeed 6</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Multispeed 7</td></tr></table></td></tr>
<tr><td>P05.10</td><td>Multispeed 2</td></tr>
<tr><td>P05.11</td><td>Multispeed 3</td></tr>
<tr><td>P05.12</td><td>Multispeed 4</td></tr>
<tr><td>P05.13</td><td>Multispeed 5</td></tr>
<tr><td>P05.14</td><td>Multispeed 6</td></tr>
<tr><td>P05.15</td><td>Multispeed 7</td></tr>
<tr><td colspan="3">Group P06 process PID setting 1
AS500 inverter is built in with a PID to realize closed-loop process control. This PID has two groups of parameter, which can be interswitched.</td></tr>
<tr><td>P06.00</td><td>PID set channel</td><td>Define the source of PID set value.
0: internal: set value comes from the parameter P06.02.</td></tr>
</table>

Code	Name	Parameter description
		1: A0: set value comes from A0. 2: A1: set value comes from A1.
P06.01	PID feedback channel	Defines the source of PID feedback value. 0: A0: feedback value comes from A0. 1: A1: feedback value comes from A1. 2: A0+A1: feedback value comes from A0+A1. 3: A0—A1: feedback value comes from A0-A1. 4: max(A0, A1): feedback value comes from maximum value of A0 and A1. 5: min(A0, A1): feedback value comes from minimum value of A0 and A1.
P06.02	Internal set value	Set up an internal set value for PID, with the unit to be set by P06.03
P06.03	Unit selection	1：% 2：Mpa 3：degree(℃) Defines the unit of PID set value, feedback value, wake-up deviation, upper/lower limit of sensor range. 1: % 2: Mpa 3: degree (℃)
P06.04	Positive and negative features	Defines positive and negative features of PID. 0: positive features: PID output increases along with decreasing feedback, such as heating and pressurizing. 1: negative features: PID output increases along with increasing feedback, such as refrigeration and depressurizing.
P06.05	Scale Kp	Set up the PID scale.
P06.06	Integral Ki	Set up the PID integral.
P06.07	Differential Kd	Set up the PID differential.
P06.08	Upper limit of sensor range	One sensor range is 0-1.6mpa as the source of PID feedback value, output 0-10V or 4-20ma, then the value corresponding to 0V or 4ma is 0mpa, and the value for 10V or 20ma is 1.6mpa; at this point, upper limit of sensor range is 1.6mpa, and lower limit is 0mpa. Its unit is set up by P06.03.
P06.09	Lower limit of sensor range	
P06.10	Dormancy selection	Define if PID has dormancy function. 0: without dormancy; 1: dormancy based on output frequency: the inverter output frequency is reduced below dormancy frequency, and after dormancy delay, the inverter shuts down, and goes to dormancy condition.
P06.11	Dormancy frequency	Set up PID dormancy frequency.
P06.12	Dormancy delay	Set up PID dormancy delay.
P06.13	Wake-up deviation	With positive features, when feedback value < PID set value - wake-up deviation, after wake-up delay, PID wakes up, and the inverter restarts. With negative features, when feedback value > PID set value + wake-up deviation, after wake-up delay, PID wakes up, and the inverter restarts. The unit of wake-up deviation is set up by P06.03
P06.14	Wake-up delay	Set up PID wake-up delay.
Group P07 Process PID setting 2		

Code	Name	Parameter description
P07.00	PID parameter group selection	Defines PID built-in the inverter to choose which group of parameter.
P07.01—P07.15	Refer to PID setting 1 (P06.00-P06.14).	
Group P08 Fan and water pump control		
P08.00	Motor control mode	Select fan and water pump motor control mode. To use this function, the frequency command must come from PID. 0: circulating soft-start: all as main motors to be controlled by one inverter. AS160 supports circulating soft-start below 6 sets (included). 1: one for main and several for auxiliary: only one main motor is running, and others for auxiliary motors, with power supplied directly by power frequency, and start/stop to be controlled by the inverter. AS160 supports running of below six (included) auxiliary motors.
P08.01	Motor numbers	Defines the number of motors and by default, one motor. When ≥2 is set, fan and water pump control is valid. For circulating soft start, the number of motors is set 2, then it goes to one for dragging and two for circulating soft-start control mode, with maximum 6 motors. In case of one for main and several for auxiliary, the number of motors is that of auxiliary motors.
P08.02	Start frequency	When water supply pressure is lower than setting pressure, the output frequency would go up. If larger than start frequency, the system would add the pump after start delay.
P08.03	Start delay	Start delay
P08.04	Switching interval time	Defines interval time of relay action.
P08.05	Stop frequency	When water supply pressure is larger than setting pressure, the output frequency reduces; if lower than stop frequency, then after stop delay, the system would remove the power frequency pump that has been put into use at the earliest.
P08.06	Stop delay	Stop delay
P08.07	Forbiddening time	After one pump addition or subtract action is completed, do not add or subtract during the forbiddening time.
P08.08	Even load time	When the time with water pump under variable frequency or power frequency running reaches even load time, in case of spare water pump, stop the pump with due running time, and start the spare one.
P08.09	Fan Control	0: fan rotating during running 1: fan rotating always
Group P09 Communication and display		
P09.00	U01 display data	Defines the display of interface manipulator of "monitor condition". U01 displays data, and defines the value to be displayed at line 1 of page 1 of the liquid crystal display. Each page can display three lines, and the rest may be deduced by analogy. LED displays data, and defines the value to be displayed
P09.01	U02 display data	
P09.02	U03 display data	

Code	Name	Parameter description
P09.03	U04 display data	for the digitron display. Select definition function, and those in bold is Chinese abbreviation on the display. 0: not defined 2: output frequency (Hz); 4: output current (A) 5: output voltage (V); 6: output torque (%) 7: bus voltage (V); 8: analog quantity A0 input (%) 9: analog quantity A1 input (%); 10: accumulated power expenditure (kWh); 13: set frequency (Hz); 14: accumulated Power On Hours (h) 21: analog quantity M0 output (%); 22: analog quantity M1 output (%); 24: current output speed (rpm); 25: accumulated running time (h); 26: inverter temperature (degree); 27: PID set value SV 28: PID feedback value PV; 29: PID output value MV(%) 30: input terminal condition DI; 31: output terminal condition DO
P09.04	U05 display data	
P09.05	U06 display data	
P09.06	U07 display data	
P09.07	U08 display data	
P09.08	U09 display data	
P09.09	U10 display data	
P09.10	U11 display data	
P09.11	U12 display data	
P09.12	LED display data	
P09.13	Communication baud rate	Defines baud rate for MODBUS communication, in Bps. 0: 1200; 1: 2400; 2: 4800; 3: 9600; 4: 19200; 5: 38400; 6: 57600; 7: 76800;
P09.14	Odd even parity	Define verification for MODBUS communication. The inverter only supports 8 data bits and 1 stop bit. 0: no parity, 1: even parity, 2: odd parity
P09.15	Transmission mode	Defines two modes of MODBUS communication. 0: ASCII 1: RTU
P09.16	Data system selection	Data system of MODBUS address. 0: hexadecimal system; 1: decimal system
P09.17	Local address	Defines inverter address for MODBUS communication.
P09.18	User-defined data 0	5 user free data. The user can set the value at will.
P09.19	User-defined data 1	
P09.20	User-defined data 2	
P09.21	User-defined data 3	
P09.22	User-defined data 4	
P09.23	Processing method for communication overtime	0: if no action, the inverter would continue to run according to the condition before communication fault. Please confirm if the condition at this point is safe. 1: fault shutdown. For communication fault, the inverter shuts down.
P09.24	Communication overtime time	Time break less than communication overtime would be considered as normal communication interval, instead of communication fault.
P09.25	Number of successful	For successful communication, count value would always increase, then reset till reaching 65535, and then continue to count.

Code	Name	Parameter description
	communication	

6.4 6.4 Communication description

MODBUS protocol is widely applied for communication between main controller and slave device, and supports communication between one main station and several slave stations. AS160 is built-in with MODBUS communication protocol, and RS485 is used for physical interface of MODBUS.

Communication address of AS160 inverter is corresponding to parameter code, and its all parameter has been mapped to MODBUS register. Take P09.00 for example (U01 display data), its communication address is 0901 (parameter code adds 1), then the number that is mapped to MODBUS holding register is 40901. 30901-30913 is input register, and is the value of display data defined by P09.00-P09.12. If P09.00 is defined as set frequency, the value of 30901 is that of set frequency.

As not all the data of the inverter is integral number, such as set frequency 50.00HZ, the read value is 5000. For decimal point position of value of all parameter, see the parameter list.

Communication control word	410001	bit0 1: corotation 0: invalid bit1 1: reverse rotation 0: invalid bit2 1: run 0: stop bit3 reserve bit4 1: fault reset command bit7~5 reserve bit8 reserve bit10~9 acceleration/deceleration time selection 0: curve 1 1: curve 2 bit11 reserve bit12 0: select run and set command 1 1: select run and set command 2 bit13 0: select PID parameter group 1 1: select PID parameter group 2 bit15~14 not used
Communication set value	410002	0~30000 corresponding to 0.00~300.00Hz
Parameter update request	410106	85: after parameter modification via MODBUS, write 85 to 410106 and save parameter; otherwise the modification would be invalid. After each update, this unit would be reset automatically. 170: inverter parameter is restored with exworks value
Communication status word	411137	bit0 1: with run signal 0: without run signal bit1 1: during running bit2 1: during zero-speed bit3 1: during corotation 0: during reverse rotation bit4 1: inverter power on normal 0: inverter power on unusual bit5 1: base electrode locked bit6 not used bit7 1: during fault bit8 reserve bit9 reserve bit10 1: during self-tuning bit11 1: request for self-tuning bit15~12 not used

Chapter 7 Operation guidance for water pump

7.1 General

AS160 series is a special inverter researched and developed according to the users' demands according to lead features of the pump, with constant pressure water supply, sleep control, multi-pump switching. It changes pump rotor speed, modifies features of pump curve and adjust the flow to meet process requirements at any time, which is significant to realize optimization in energy saving and installation. One AS160 can control six circulating pumps at the same time by default.

7.1.1 Product features

- Password set, which effectively improves system operation safety;
- User parameter, which greatly facilitates field operation;
- New PWM dead zone compensation technology, which effectively reduce motor loss;
- Low inductance bus technology, which greatly improves module safety;
- Several frequency set methods, which meets complicated and various field requirements;
- Automatic slipping compensation, which reduces the effect of load changes on motor speed;
- Parameterization set of acceleration/deceleration curve time, which effectively avoids water-hammer effect;
- Special PID control function, which can conveniently realize process closed-loop control;
- Jump frequency control function, which can effectively avoid resonance point of machinery load;

- Speed track restart function, which realizes smooth start without shock on the rotating motor;
- Auto voltage regulating function, which can keep the output voltage constant automatically while the grid voltage changes.

7.1.2 Water supply function

- Several V/F curves, which is especially suitable for different torque load application;
- Realize several common water supply functions without PLC or water supply controller;
- Support two water supply modes: fixed frequency control pump and circulating frequency control pump;
- Configure routine pump, sleep pump, drainage pump, and fire pump flexibly, which can realize control on seven pumps at maximum;
- Time pressure set with more than eight sections, which is suitable for water pressure changes.
- 16-section given pressure through combination of input terminal;
- Support flexible sleep mode, and start sleep pump automatically under sleep condition, which can maintain sleep pressure needs effectively; after meeting wake-up conditions, it would exit sleep automatically and stop the sleep pump;
- Regular alternation control, making each pump working in balance, which can prevent rustiness effectively and one pump always under running;
- Realize water level control in the cesspit through check and control;
- Check the level in the cesspit and control pressure amount of adjust pump automatically;
- Pipe network over/under voltage alarm function, and inverter supports over, under voltage alarm output function, which can output through the

programmable relay;

- Serial communication interface, which can realize free communication with the inverter and upper computer system, and automatic control and management.

7.2 Frequency set method

7.2.1 Set running frequency through input analog

PID is used for calculation for external controller, and running frequency of the inverter is set by the analog of the external controller. Confirm the running frequency through given A0, A1 analog. For conversion from analog to set frequency, see the figure below: there are usually four analog respectively 0-5V, 0-10V, 0-20mA, 4-20mA, which can be main or main/auxiliary set.

Note 1: Set of relevant adjust parameter at input port of A0 voltage analog

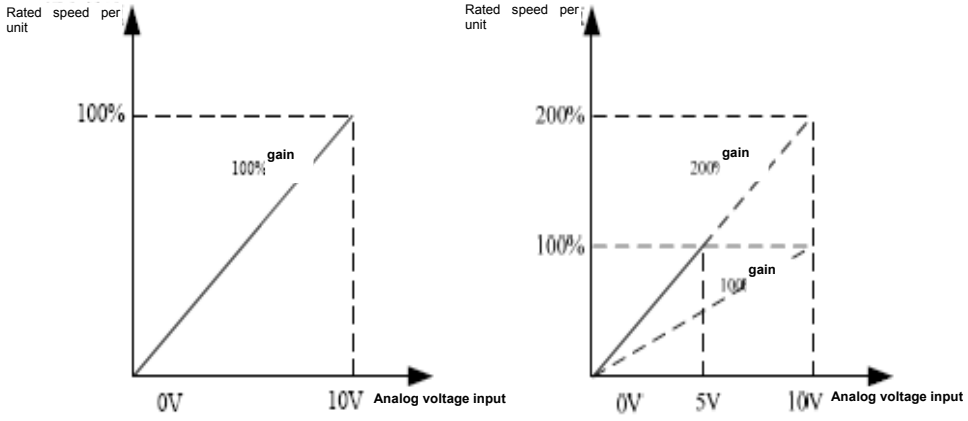
P03.08 is correction of zero bias at analog input port of A0, with the set value to be calculated through below formula:

P03.08= 10.0 - actual zero bias at analog input port of A0 (minimum of input)

Generally, the minimum value of A0 analog input is 0, thus, P03.08 ex-work is 10.0 by default.

P03.09 is a gain parameter to set input signal at analog input port of A0. When A0 is between 0~10V, if A0 maximum input voltage against actual speed needs to be 90% of rated speed, then P03.09=90.0. If A0 maximum input voltage is certain value in 0~10V against 100% of rated speed, then P03.09=100×10/A0max. For example, input voltage is 0~5V, then P03.09=200.

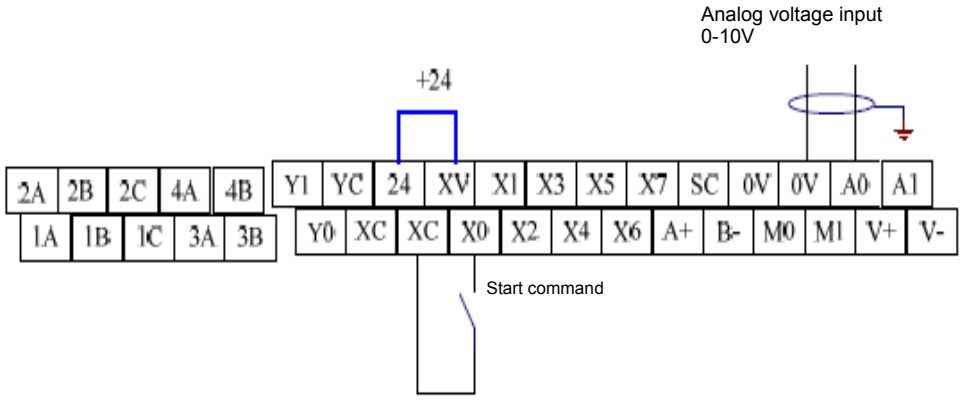
P03.10 is filtering time of analog input port of A0. The default value is 10, which means 10ms filtration.



a) 0~10V against 0~100%r rated speed

b) 0~5V against 0~100%r rated speed

Figure 7-1 Analog against the speed

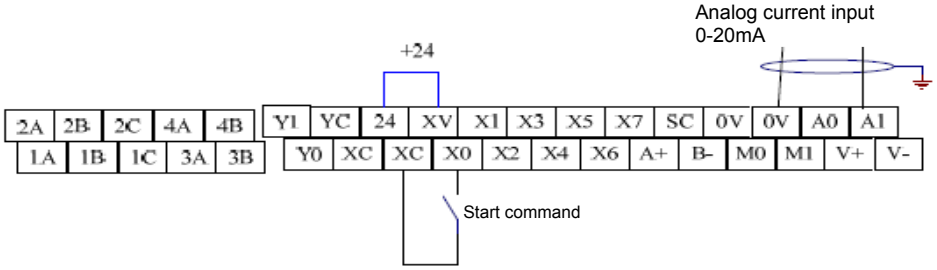


Parameter setting for analog A0/A1 voltage input (0~10V)

Function code	Function code Name	Ex-work value	Setting range	Unit	Property	Options	Remarks
P00.00	Run command 1	1	0~2	/	×	0 panel 1 terminal 2 communication	
P00.01	Frequency/speed 1	0	0~11	/	○	3:A0 analog voltage given 5:A1 analog voltage given	
P01.00	Start mode	0	0~2	/	×	0: normal start; 1: restart after DC brake; 2: speed track start	
P01.03	Start holding frequency	0.0	0.0~60.0	Hz	×	0.0~60.0	Min. speed
P01.04	Holding time of start frequency	0.00	0.0~3600.00	s	×	0.0~3600.00	Optional
P01.05	Shutdown mode	0	0~2	/	×	0: shutdown by inertia; 1: shutdown by deceleration; 2: deceleration + DC brake	
P01.11	Acceleration time 1	5.00	0.1~360.00	s	○	≤15kW: 0.1~360.00s	
P01.12	Deceleration time 1	5.00	0.1~360.00	s	○	≥18.5kw: 0.0~360.00s	
P00.07	Frequency upper limit	50.00	0.01~300	Hz	○	0.01~300	
P00.08	Frequency lower limit	20.00	0.01~P07.00	Hz	○	0.01~P07.00	
P03.00	X0 input function select	7	0~50	/	×	1~59	Coratation
P03.08	Analog input A0 bias	0.0	0.0~100.0	%	×		
P03.09	Analog input A0 gain	100.0	0.1~500.0	%	×	200%：0~5V	
P03.10	Analog input A0 filtering time	10	0~30	ms	×	0~30	
P02.00	Motor rated current	21.7	0.1~999.9	A	×	Set according to motor nameplate	Optional
P02.01	Motor rated frequency	50.00	0.00~300.00	Hz	×	Set according to motor nameplate	Optional
P02.02	Motor rated voltage	380	0~480	V	×	Set according to motor nameplate	Optional
P02.03	Motor rated speed	11.0	0.4~999.9	Hz	×	Set according to motor nameplate	Optional

Note 2: Set of relevant adjust parameter at A1 voltage analog input port, same as A0

Note 3: Set of relevant adjust parameter at A1 current analog input port



1. Set the current input mode through the jumper, and choose A1 input channel, 0-20mA against 0-50Hz

2. Set the current input mode through the jumper, and choose A1 input channel, 4-20mA against 0-50Hz

Parameter setting for analog A1 current input (0~20mA)							
Function code	**Function code Name**	**Ex-work value**	**Setting range**	**Unit**	**Property**	**Options**	**Remarks**
P00.01	Frequency/speed 1	7	0~11	/	°	7:A1 analog current given	
P03.12	Analog input A1 type	2	0~2		×	0:0~10V 1:-10~10V 2:0~20mA	
P03.13	Analog input A1 bias	0.0	0.0~100.0	%			
P03.14	Analog input A1 gain	100.0	0.1~500.0	%			
P03.15	Analog input A1 filtering time	10	0~30	ms			

7.2.2 Set running frequency through communication

Parameter P01.02 is set as 10, and communication protocol is MODBUS—RTU, and communication set value is 0~10000 against 0.00-100.00Hz.

Parameter setting for communication setting running frequency							
Function code	**Name**	**Ex-work value**	**Setting range**	**Unit**	**Property**	**Options**	**Remarks**
P00.00	Run command 1	0	0～2	/	×	0 panel 1 terminal 2 communication	
P00.01	Frequency/speed 1	0	0～11	/	○	10: communication given;	
P09.13	Communication baud rate	4	0～7	bps	○	0:1200;1:2400;2:4800;3:9600;4：19200；5：38400；6:57600；7:76800	
P09.14	Data format	0	0～2	/	○	0: 1-8-1 format, without parity check; 1: 1-8-1 format, even parity check; 2: 1-8-1 format, odd parity check	
P09.15	Transmission mode select	1	0～1	/	○	0: ASC; 1: RTU	
P09.16	Numerical system process method	1	0~1		×	MODBUS address system 0: hexadecimal 1: decimal	
P09.17	Local address	1	1～247	/	○	1-247, 0 as broadcast address	

7.3 Built-in PID function

7.3.1 PID closed-loop given mode

For P00.00 frequency given channel, select 7, or for P00.03, select 7, optional 07 PID, or select PID channel through 07.00.

P06.00 (07.01)	PID given channel	0	0～2		×	0: internal given 1: analog A0 given 2: analog A1 given	
P06.02 (07.03)	Internal given value	0.7	0.0～1000.0		○	Unit to be set by P06.03	
P06.03 (07.04)	Unit	2	1～3		×	1: % 2: Mpa 3: ℃	

7.3.2 PID closed-loop feedback mode

For P00.00 frequency given channel, select 7, or for P00.03, select 7, optional 07 PID, or select PID channel through 07.00.

P06.01 (07.02)	PID feedback channel	1	0～5		×	0: analog A0 feedback 1: analog A1 feedback 2: analog A0 + A1 feedback 3: analog A0 - A1 feedback 4: max (A0, A1) feedback 5: min (A0, A1) feedback	

7.3.3 PID adjust function

Adjust the output frequency of the inverter through proportional, integral and differential calculation based on deviation between feedback signal of controlled quantity and signal of target quantity and constitute negative feedback system, making the controlled quantity stable at the target quantity. Suitable for flow control, pressure control and temperature control.

Parameter setting for PID adjust function

Function code	Name	Ex-work value	Setting range	Unit	Property	Options	Remarks
P06.04	Positive and negative features	0	0～1		×	0: positive features 1: negative features	
P06.05	Proportional KP	0.50	0.00～10.00	/	○		
P06.06	Integral Ki	0.50	0.00～10.00	/	○		
P06.07	Differential Kd	0.00	0.00～10.00	/	○		

7.3.4 PID sleep function

When the output frequency is reduced to sleep value, the inverter goes to sleep after sleep time delay, and stops output. When the feedback is smaller than wake-up value, the inverter will be awoken after wake-up time delay.

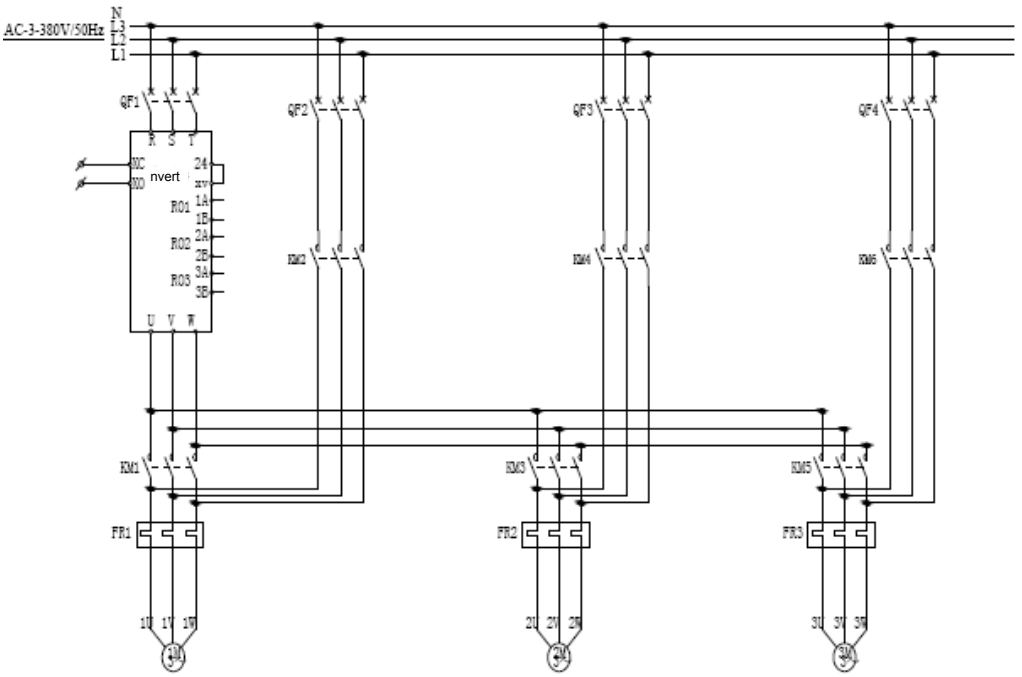
Function code	Name	Ex-work value	Setting range	Unit	Property	Options	Remarks
P06.10	Sleep selection	0	0-1	/	×	0: without sleep 1: sleep value with PID adjuster output frequency	
P06.11	Sleep frequency	0	0-100%	/	×		
P06.12	Sleep delay	15	0-3600	S	×		
P06.13	Wake-up deviation	10	0-100%	/	×		
P06.14	Wake-up delay	10	0-3600	S	×		

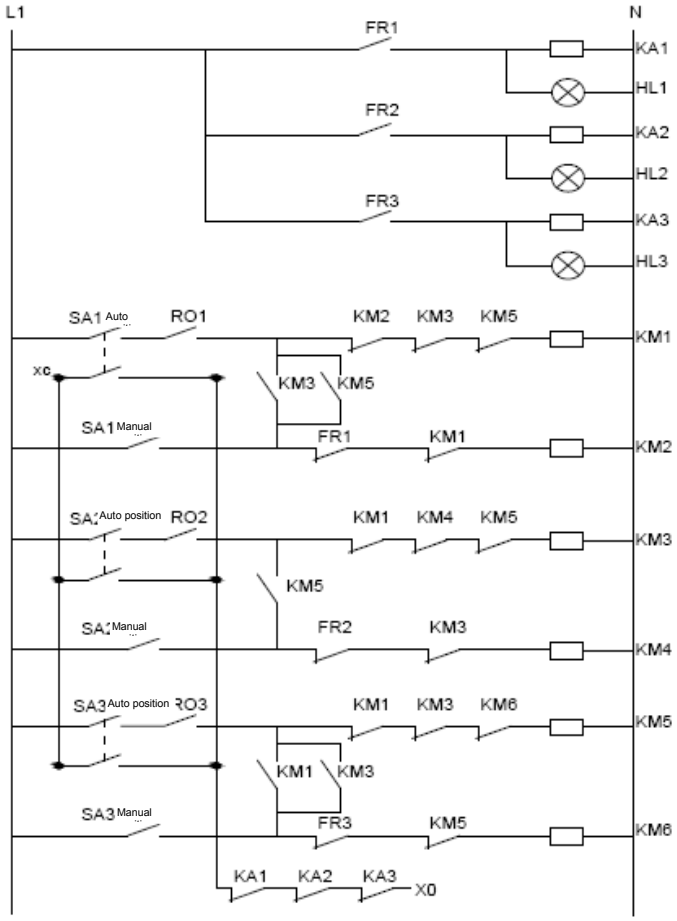
7.4 Plus minus pump function

The inverter is built with simple plus minus pump function inside, with circulating soft-start and one for main and several for auxiliary modes.

7.4.1 Circulating soft-start mode

Three main pumps are running at the same time. Take three delayed for example, see below circuit diagram.



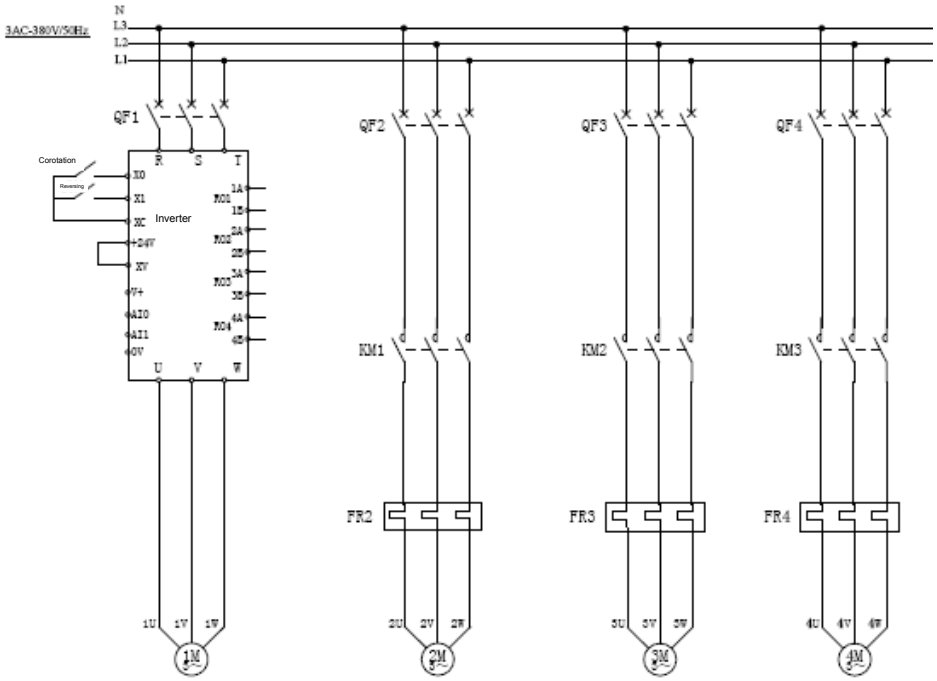


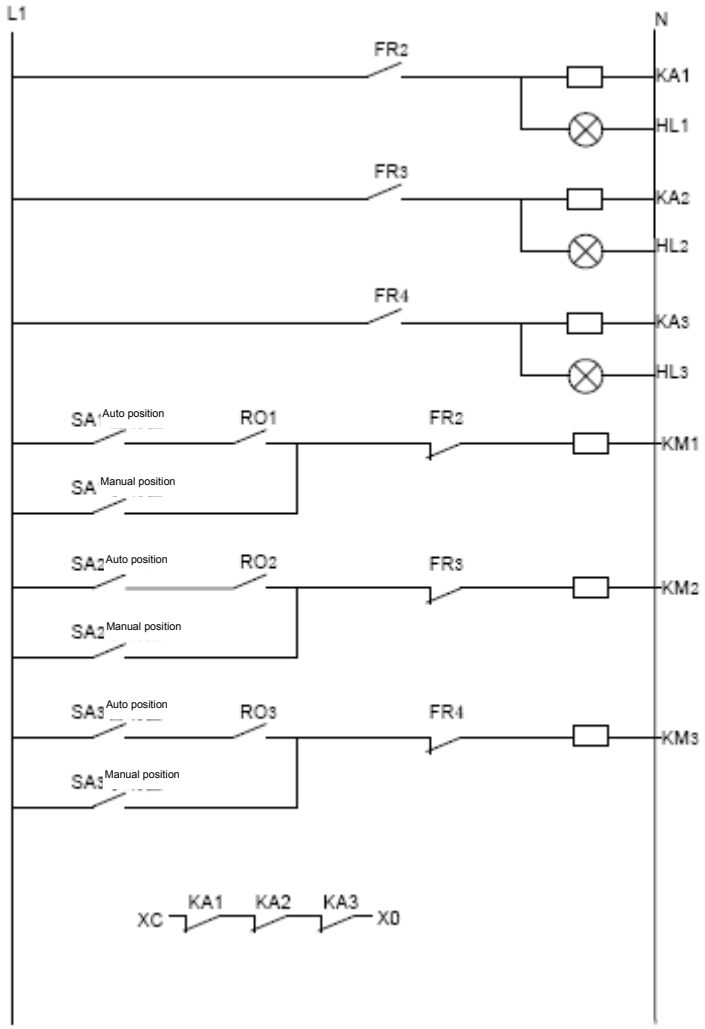
Working principle: with power of three main pumps equal or close, when the inverter is running, RO1 NO contact (1A, 1B) closes, KM1 picks up, and No. 1 inverter runs; when output frequency reaches pump start frequency, after startup delay, RO1 disconnects, and the inverter stops output immediately. After switching interval time, RO2 NO contact (2A, 2B) closes, and KM3 picks up, and No. 2 inverter runs. Then RO1 closes again, KM2 picks up and No.1 pump runs at power frequency. Plus pumps take turns.

With the pressure being exceeded, when the output frequency reduces to the stop frequency of minus pump, after time delay, disconnect the relay directly, and the pump stops running. With the load balancing time, when pump running time is reached, with the idling pump, it would switch to the idling pump automatically.

7.4.2 One for main and several for auxiliary mode

One main pump with large capacity can be used for inversion running; several auxiliary pumps with small capacity can be power supplied directly through power frequency, however, the start and stop is controlled by the inverter.





Working principle: main pump is controlled by the inverter; and when the output frequency reaches start frequency, after time delay, turn on the relay, and start one small pump; if the pressure is not enough, and output frequency reaches start frequency again, start one small pump again. The others follow by analogy. When the pressure is exceeded, frequency is reduced and reaches stop frequency, after time delay, disconnect the relay and stop small pump.

With the load balancing time, when pump running time is reached, with the idling pump, it would switch to the idling pump automatically.

Chapter 8 Fault check

This chapter describes faults, fault codes, contents, causes and measures about the inverter, and also provides analysis flow on various fault symptoms while the elevator is debugging or running.

Danger

◎ Carry out maintenance after the input power is disconnected for ten minutes, at which point, the charging indicating light is OFF or DC bus voltage is below 24VDC; otherwise it may have electric shock.

◎ Do not change the inverter without permit; otherwise it may cause electric shock, personnel injury.

◎ Have electric engineering personnel carry out maintenance. Do not leave the stub or metal substance inside the inverter; otherwise it may cause fire.

Caution

◎ When the power is ON, do not change wiring and removing terminal. Otherwise it may cause electric shock.

8.1 Protection, check function

In case the inverter fails, the trouble light LED on the digital operator flashes, and LED digital tube would real-time display the current fault code.

There are total 49 fault codes. For corresponding causes and measures, see Table 8-1 Fault List.

Table 8-1 Fault List

Fault code	Display	Possible causes	Measures
1	Module overcurrent protection	Voltage at DC end too high	Check grid power, and check; check if there is quick stop without energy consumption brake due to large mass load.
		Short-circuit	Check if motor and output connection is short-circuited, or short-circuit to ground
		Output with open-phase	Check if motor and output connection is loosening
		Encoder fault	Check if the encoder is damaged or connection is correct
		Poor or damaged hardware contact	Have technical personnel maintain
		Internal connector loosening	Have technical personnel maintain
		Power part overheating due to cooling fan or cooling system problems	Check cooling fan. Check if the cooling fan power is correct or clogged
		Warning: the inverter must be started after fault is cleared to avoid damages of IGBT.	
2	ADC fault	Current sensor damaged	Replace the current sensor
		Current sampling circuit faulty	Replace control board
3	Radiator Overheat	Environment temperature too high	Reduce environment temperature and strengthen ventilation and heat emission. Keep the surrounding temperature lower than 40°or check the inverter capacity according to this performance
		Cooling fan damaged or foreign matter entering cooling system	Check if fan power line is connected, or replace with one with the same model and remove foreign matter
		Cooling fan unusual	Check cooling fan. Check if cooling fan power is correct or clogged.
		Temperature check circuit faulty	Have technical personnel maintain
4	Braking unit fault	Braking unit damaged	Replace with corresponding drive module or control board
		External braking resistor or lines open	Replace resistor or connect the lines
5	Fuse blown	Current too large causing blown fuse	Check if fuse loop is open, or connection loosening
6	Output over-torque	Input power voltage too low	Check the input power

Fault code	Display	Possible causes	Measures
		Locked motor or load severely changed	Prevent locked motor and reduce severe change of load
		Encoder fault	Check if the encoder is damaged or connection is correct
		Output with open-phase	Check if the motor and output connection is loosening
7	Speed deviation	Acceleration time too short	Extend acceleration time
		Load to large	Reduce the load
		Current limit too low	Improve limit value properly within the permissible range
8	Bus overvoltage protection (during acceleration running)	Input power voltage abnormal	Check input power
		Quick start again when the motor is under high-speed rotation	Start again after the motor stops rotation
	Bus overvoltage protection (during	Load rotary inertia too large	Use proper energy consumption brake elements

	deceleration running)	Deceleration time too short	Extend deceleration time
		Braking resistor value too large or no connection	Connect proper braking resistor
	Bus overvoltage protection (during constant-speed running)	Input power abnormal	Check input power
		Load rotary inertia too large	Use proper energy consumption brake elements
		Braking resistor value too large or no connection	Connect proper braking resistor
9	Bus undervoltage	Power voltage lower than minimum working voltage	Check input power
		Transient power off	Check input power, and restart after reset until input voltage is normal
		Voltage change of input power too large	
		Connection terminal of power loosening	Check input connection
		Internal switch power abnormal	Have technical personnel maintain
		Load with large pickup current exists within the same power system	Change power system to make it accordance with specification value
10	Output open-phase	Connection at inverter output side abnormal; missed connection or disconnection	Check connection at output side and remove missed connection, disconnection according to operation regulations
		Output terminal loosening	
Fault code	**Display**	**Possible causes**	**Measures**
		Motor power too small, and below 1/20 of maximum applicable motor capacity	Adjust the inverter capacity or motor capacity
		Output three-phase unbalanced	Check if motor connection is complete
			With power breakdown, check features of output side and DC side terminal is consistent
11	Motor low-speed overcurrent (during acceleration running)	Grid voltage low	Check input power
		Motor parameter setting abnormal	Set the motor parameter correctly
		Direct and quick startup during motor is rotating	Start again after the motor stops rotation
		Acceleration time too short for load inertia (GD2)	Extend acceleration time
	Motor low-speed overcurrent (during deceleration running)	Grid voltage low	Check input power
		Load rotary inertia too large	Use proper energy consumption brake element
		Motor parameter setting abnormal	Set the motor parameter correctly
		Deceleration time too short for load inertia (GD2)	Extend deceleration time
	Motor low-speed overcurrent (during constant-speed running)	Load with sudden change during running	Reduce frequency and range for sudden change
		Motor parameter setting abnormal	Set the motor parameter correctly
12	Encoder fault	Encoder connection incorrect	Change the encoder connection
		Encoder without signal output	Check the encoder and power supply
		Encoder disconnection	Repair disconnection
		Function code with abnormal setting	Check if relevant function code is correctly set
13	Current detected upon shutdown	Current flow without effective cutoff	Synchronous motor slipping
			Have technical personnel maintain
14	Speed reversing during running	Speed with negative direction	Check if external load suddenly changes
		Encoder not consistent with motor phase sequence	Change motor or encoder phase sequence

Fault code	Display	Possible causes	Measures
		Motor reversing while started, and current reaches limit current	Current limit too low, or motor not matching
15	Speed detected while shutdown	Brake loosening, and motor slips	Check brake
		Encoder interfered, or loosening	Tighten the encoder and remove interference
16	Motor phase sequence incorrect	Motor connection reversing	Reverse or adjust the parameter
17	Overspeed at the same direction (within permissible maximum speed)	Galloping caused as synchronous motor is without magnetism	Check the motor
		Angle self-learning for synchronous motor not correct	Start self-learning again
		Encoder parameter setting incorrect or interfered	Check the encoder loop
		Load at forward direction too large or changes suddenly	Check external causes for sudden change
18	Overspeed at the contrary direction (within permissible maximum speed)	Galloping caused as synchronous motor is without magnetism	Check the motor
		Angle self-learning for synchronous motor not correct	Start self-learning again
		Encoder parameter setting incorrect or interfered	Check the encoder loop
		Load at backWard direction too large or changes suddenly	Check external causes for sudden change
19	UVW encoder phase sequence incorrect	Encoder connection faulty or parameter setting incorrect	Check connection or change the parameter
20	Encoder communication fault	Encoder fault	Check encoder connection and start self-learning again
21	abc overcurrent (three-phase transient value)	Motor single phase shorted circuit to ground	Check the motor and output line loop
		Encoder fault	Check if the encoder is damaged or connection is correct
		Check loop of drive board incorrect	Replace the drive board
22	Brake check fault	Output relay not functioning	Check the control loop
		Brake not open while relay is functioning	Check brake power line is loosening
		No signal detected for feedback component	Adjust the feedback component
Fault code	**Display**	**Possible causes**	**Measures**
23	Input overvoltage	Incoming voltage too high	Check if the incoming voltage matches with the inverter
		Switch power voltage detection loop fault	Have technical personnel maintain
24	UVW encoder disconnection	Encoder connection loop fault	Connection terminal loosening or lines damaged or broken
25	Backup		
26	Encoder not learning	Synchronous motor not learning from encoder angle	Start encoder self-learning
27	Output overcurrent (valid value)	Running under overload condition too long, with larger the load, shorter the time	Stop running for a while, and if it appears again after running, check if the load is within permissible range
		Locked motor	Check the motor or brake
		Motor coil short circuit	Check the motor
		Output short circuit	Check the connection or motor

28	Sincos encoder fault	Encoder damaged or lines incorrect	Check the encoder and its lines
29	Input open-phase	Voltage at input side abnormal	Check the grid voltage
		Input voltage open-phase	
		Connection terminal at input side loosening	Check the connection at input side
30	Overspeed protection (exceeding maximum speed protection limit)	Encoder parameter setting incorrect or interfered	Check the encoder loop
		Load with sudden change	Check the external causes for sudden change
		Overspeed protection parameter setting incorrect	Check the parameter
31	Motor high-speed overcurrent	Grid voltage low	Check the input power
		Load with sudden change during running	Reduce the frequency and range for sudden change
		Motor parameter setting abnormal	Set the motor parameter correctly
		Encoder parameter setting incorrect or interfered	Check the encoder loop

Fault code	Display	Possible causes	Measures
32	Earthing protection	Connection incorrect	Correct the connection according to user manual
		Motor abnormal	Change the motor and perform ground insulation test
		Earth leakage current at output side too large	Have technical personnel maintain
33	Capacitor aging	Inverter capacitor aging	Have technical personnel maintain
34	External fault	Input fault signal outside	Check the external fault causes
35	Output unbalanced	Connection at output side abnormal, with missed connection or disconnection	Check connection at output side and remove missed connection, disconnection according to operation regulations
		Motor three-phase unbalanced	Check the motor
36	Parameter setting wrong	Parameter setting incorrect	Change the inverter parameter
37	Current sensor fault	Drive board hardware fault	Have technical personnel maintain
38	Braking resistor shorted circuit	External braking resistor lines shorted circuit	Check the braking resistor connection
39	Current transient value too large	Give an alarm for too large three-phase current transient value while Ia, Ib, Ic not running	Have technical personnel maintain
40	Parameter fault	Number of motors incorrect	Check the parameter P08.01 is consistent with actual number
41	Water pump fault	Main motor stops for fan water pump logic control	As main motor overloaded while one main and several auxiliary motors are running, check the water pump is normal
42	PFC startup fault 1	All motors fault for fan water pump logic control	As all pumps fails for fan water pump control, check the water pump is normal
43	PFC startup fault 2	Main motor stops for fan water pump logic control	As main motor overloaded while one main and several auxiliary motors are running, check the water pump is normal
	All motors are stopped	All motors are stopped for fan water pump logic control	Reset with the inverter power off
45	IGBT drive fault	Power IGBT short circuit	Continue to run after reset; in case of several appearance, check IGBT and trigger board; replace it if necessary
46	Sensor disconnection	Input with analog disconnection	Check the input signal with analog

47	Communication fault alarm	485 communication fault (not protected)	Check the equipment communication connection, and check the transmit or receive data accords with the agreement; confirm if check sum is correct, and receive time interval conforms to requirements

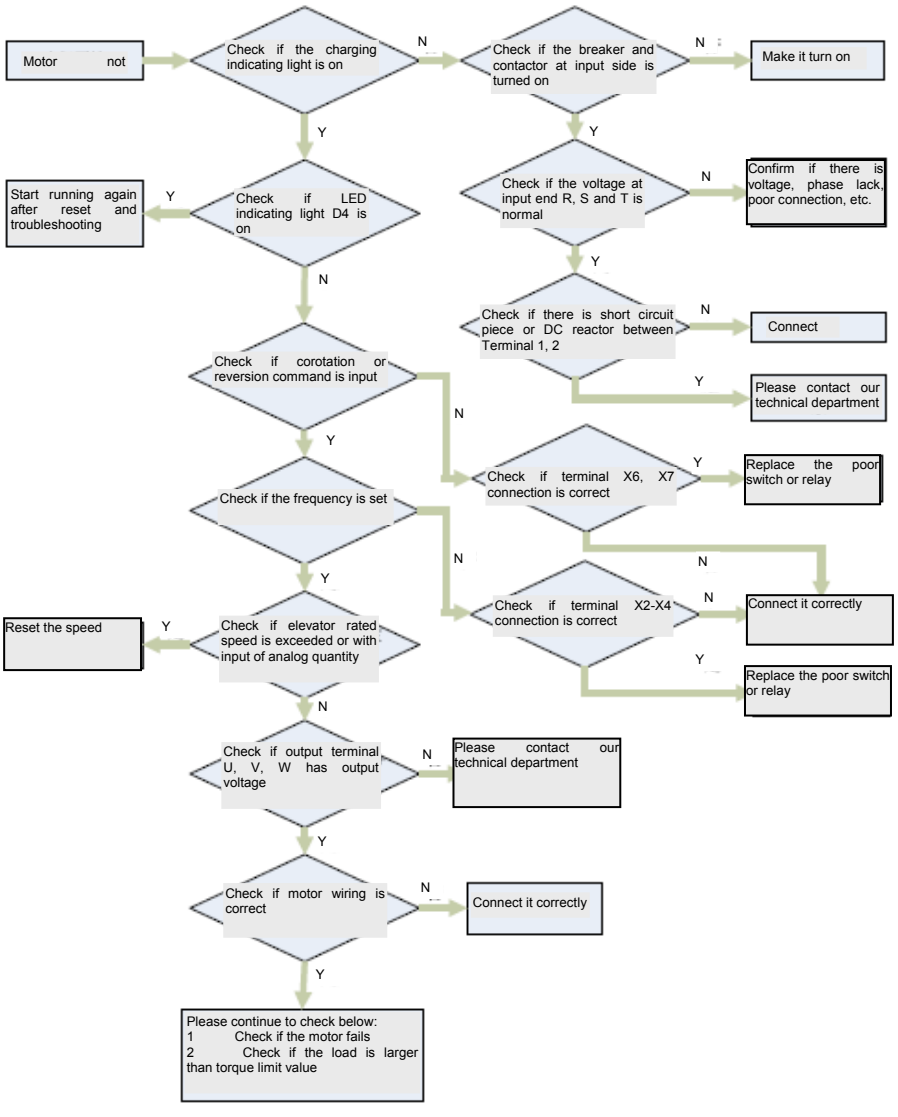
Fault code	Display	Possible causes	Measures
48	Communication fault shutdown	485 communication fault (shutdown protection)	Check the equipment communication connection, and check the transmit or receive data accords with the agreement; confirm if check sum is correct, and receive time interval conforms to requirements
49	Other faults	Relay fault	Have technical personnel maintain

8.2 Fault diagnosis flow

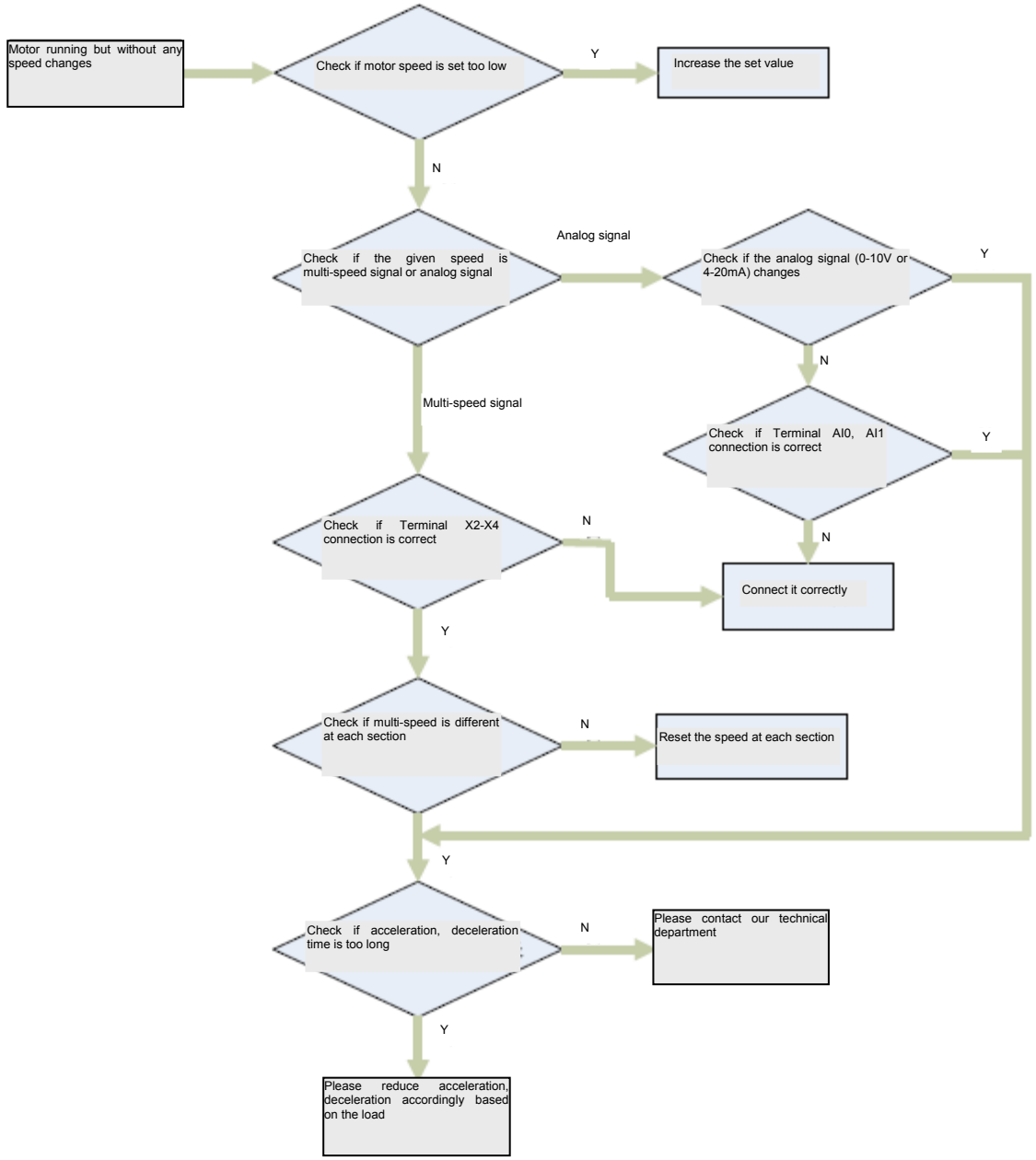
When the system is started, due to error of parameter setting and connection, the inverter and motor may not be running according to setting, under which condition, carry out analysis and processing according to fault diagnosis flow of this section.

Motor running abnormally:

When there is run command on the control terminal, the motor is not rotating.



Motor is running but without any speed change



Chapter 9 Service and maintenance

This chapter describes general information on service and maintenance.

Danger

◎ Carry out maintenance after the input power is disconnected for ten minutes, at which point, the charging indicating light is OFF or DC bus voltage is below 24VDC; otherwise it may have electric shock.

◎ Do not change the inverter without permit; otherwise it may cause electric shock, personnel injury.

◎ Have electric engineering personnel carry out maintenance. Do not leave the stub or metal substance inside the inverter; otherwise it may cause fire.

Caution

◎ When the power is ON, do not change wiring and removing terminal. Otherwise it may cause electric shock.

9.1 Guarantee period

In case of following conditions of the inverter (main body), our company would guarantee maintenance service:

In case of fault or damage under normal using conditions, the manufacturer would be responsible for warranty within the warranty period (from the ex-work date); certain maintenance fee would be charged if the warranty period is exceeded.

Certain fee would also be charged even if within the warranty period in case faults are caused due to below reasons:

Problems that are caused due to not accordance with using instructions or repairs or changes without permit.

Problems that are caused due to exceeding requirements of standards and specifications.

Damages that are caused during falling or transportation after purchasing.

Damages that are caused due to earthquake, fire, flood, lightning, abnormal voltage or other natural disasters and disaster-associated reasons.

9.2 Product inquiry

Please contact our agent or customer service department with below items in case of product damages, faults or other problems.

Inverter model

Manufacturing serial number

Purchasing date

Others include damages, unclear problems and faults, etc.

9.3 Daily check

Do not remove casing when the inverter is power ON and running. Check if the inverter is running normally via visual check. Check below daily:

a) If surrounding environment is in accordance with standards and specifications;

b) If running performance accords with standards and specifications;

c) If there is abnormal noise, vibration or abnormity;

d) If the cooling fan installed at the inverter is running normally;

e) If there is overheating;

9.4 Regular check

For regular check, stop running, cut off power source and then remove the casing. At this point, the capacitor of main circuit still has charging voltage, which needs certain time for discharging. Therefore, wait till charging indicating light is off, and then check if DC bus voltage is lower than safety value (below DC24V) via a multimeter.

There might be electric shock if you touch the terminal immediately after the power is off. For regular check items, see Table 9

Table 9.1 Regular check item

Check part		Item	Method	Judging standard
Running environment		Ensure environment temperature, humidity, vibration and check if there is dust, corrosive gas, oil mist, water dripping, etc.; Check if there is dangerous articles around	Visual check, thermometer, hygrometer; Visual check	1) Environment temperature lower than 40℃, other requirements such as humidity according with environment requirements; 2) No dangerous article
LCD		Check if LCD display is clear, backlight is even Check if LCD display lacks of character	Visual check	Even backlight Normal display
Connector Terminal bolt		1) Check if bolts are loosening 2) Check if connectors are loosening	1) Tighten 2) Visual check	1) No abnormal conditions 2) Stable installation
Main circuit	Conductor	Check if the sheath is broken or discolouring; Check if connecting copper bar is distorted	Visual check	No abnormal conditions
	Electromagnetic contactor, relay	1) If there is vibration during running 2) If the contact is well contacted	Auditory sense, visual check	No With contact sound
	Charging electrolytic capacitor	1) Check if there is leakage, discolouring, cracks or casing expansion 2) Check if safety valve comes out, or the valve body is expansive	Visual check	No abnormal conditions
	Radiator fin	Check if there is dust accumulation Check if the fan duct is clogged or with foreign matters	Visual check	No abnormal conditions
	Cooling fan	Check if there is abnormal noise Check if there is abnormal vibration Check if it is discolouring or distorted due to overheat	Auditory sense, visual check, power cutoff; Rotate fan blade with hands; Visual check; Visual check, smell;	Stable rotation 2), 3) no abnormal conditions
Control circuit	Connecting part	Check if there is dust or foreign matter on the double-row connecting part between control board and main circuit	Visual check	No abnormal conditions
	Control board	Check if control circuit board is discolouring or abnormal smell; Check if circuit board has crack, breakage, deformation	Visual smell, smell; Visual check	No abnormal conditions

Appendix A Inverter EMC installation guidance

This appendix describes inverter EMC design, installation guidance for users' reference in terms of noise suppression, wiring requirements, earthing, external equipment surge absorption, leakage current, division and precautions of installation area, uses of power filter and radiated noise processing.

A.1 Noise suppression

Due to the working principle, the inverter would generate certain noise, and its effect on peripheral equipment is related to noise type, route of transmission and design, installation, wiring and earthing of drive system.

A.1.1 Noise type

For noise type, refer to Figure A.1.

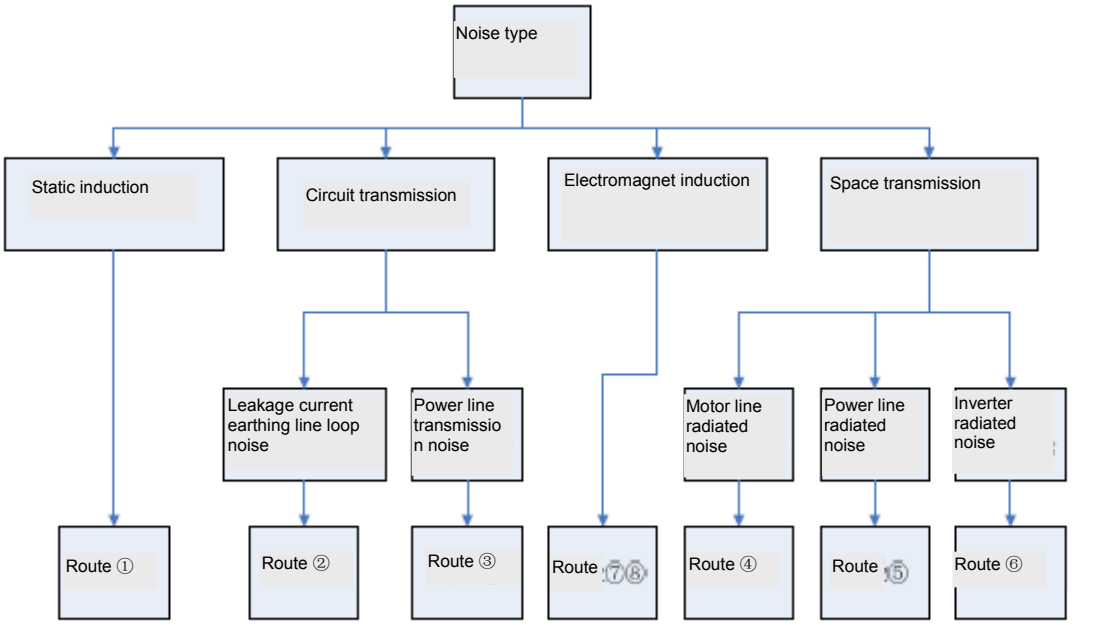


Figure A.1 Noise type schematic

A.1.2 Noise transmission route

For transmission route, see Figure A.2.

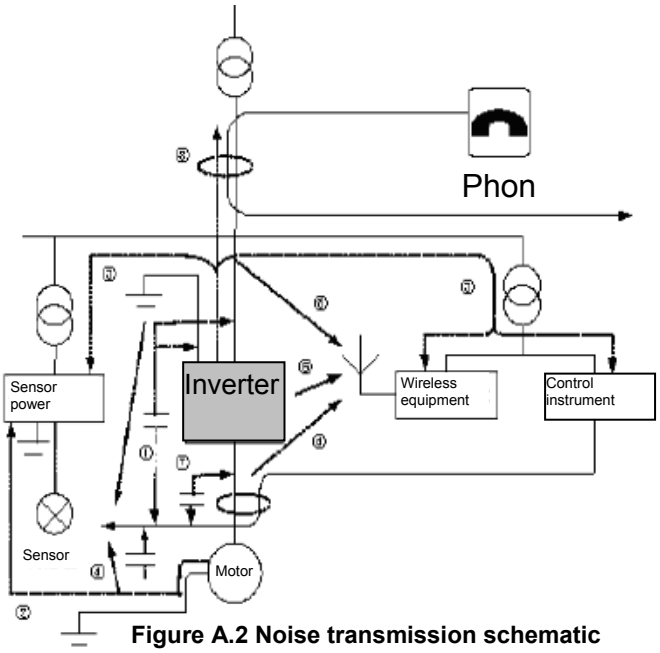


Figure A.2 Noise transmission schematic

A.1.3 Measures on noise suppression

For measures on noise suppression, see Figure A.1.

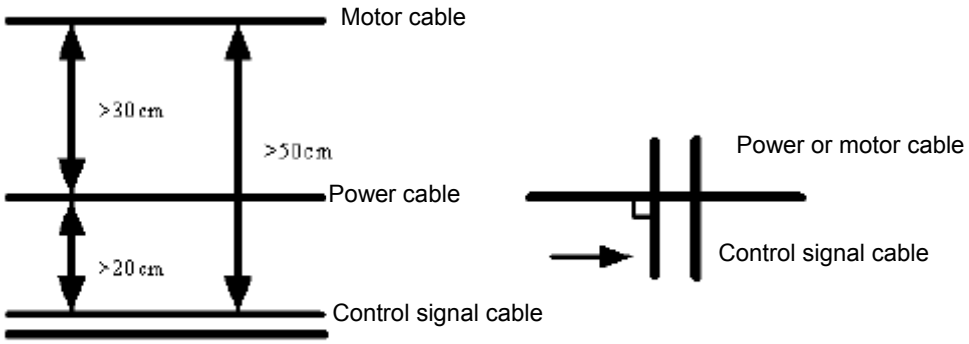
Figure A.1 Measures on noise suppression

No.	Causes	Measures
① ⑦ ⑧	If the signal line and power line is wiring in parallel or bundled into beam wiring with the power line, the noise would be transmitted due to electromagnet induction and static induction, and then cause incorrect action of peripheral equipment.	1. Avoid wiring of signal line and power line in parallel and bundle into beam wiring; 2. Make the affected peripheral equipment away from the inverter; 3. Make the affected signal line away from input and output cables of inverter; 4. Use shielded line for the signal line and power line; it can be better if with metal tube (the distance among metal tube shall be at least 20cm).
②	If the peripheral equipment constitutes closed loop circuit with the inverter wiring, the earthing line would generate leakage current, thus causing incorrect action.	If peripheral equipment is not earthed at this point, it can eliminate incorrect action caused due to leakage current.
④ ⑤ ⑥	If the light current equipment such as control computer, measuring instrument, wireless equipment and sensor and signal line is installed with the inverter at the same control cabinet, with close wiring, it would generate incorrect action due to radiated interference.	1. The peripheral equipment and its signal line that is easily affected shall be installed as far away as from the inverter. Use shielded line for the signal line, and the shielded layer shall be earthed. Cable of signal line shall be cased to metal tube, and as far away as from the inverter and its input and output cable. In case the signal line have to go through the input and output cable of the inverter, then these two must be ensured with perpendicularity; 2. Install the wireless noise filter or line noise filter (ferrite common mode choke coil) at input and output side of inverter, which can suppress noise radiation of input and output cable; 3. The cable line from inverter to motor shall be placed in the thick barrier, like the above 2mm pipeline or cement tub. The cable shall be cased into a metal tube, and shielded and earthed (for motor cable, use four core cable, with one earthed at inverter side, and the other side with motor casing).

A.2 Wiring requirements

A.2.1 Laying requirements on cables

To avoid interference and coupling, cable of control signal line shall be laid separately from the power cable and motor cable, and ensured with sufficient distance and shall be far away, as shown in Figure A.3(a). In case the cable of control signal have to go through power cable or motor cable, these two must be ensured with perpendicularity, as shown in Figure A.3(b).



(a) Wiring in parallel (b) Wiring with perpendicularity

Figure A.3 Wiring requirements

A.2.2 Requirements on cable cross section area

As the larger cross section area of the cable is, the larger ground capacitance and leakage current would be. In case the cross section area of motor cable is too large, it shall lower the rating, and reduce output current (one step the cross section area is added, 5% current would be reduced).

A.2.3 Requirements on shielded cable

Apply high-frequency low-impedance shield armoring cable, such as matted copper mesh, aluminum mesh.

A.2.4 Installation requirements

Generally, control cable shall be shielded cable, and the shield wire mesh must be

connected with metal casing with 360°through cable clips of two ends, as shown in Figure A.4. The shield earthing method as shown in Figure A.5 is incorrect.

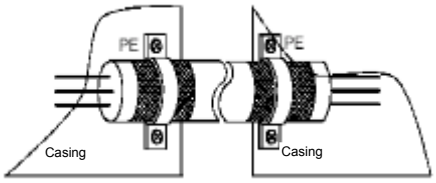


Figure A.4 Correct shield earthing method

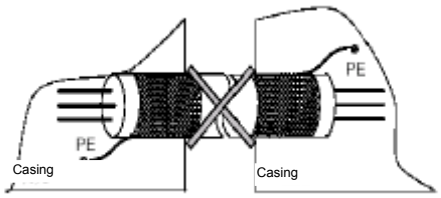


Figure A.5 Incorrect shield earthing method

A.3 Earthing

A.3.1 Earthing method

For earthing method of earthing pole, see Figure A.6.

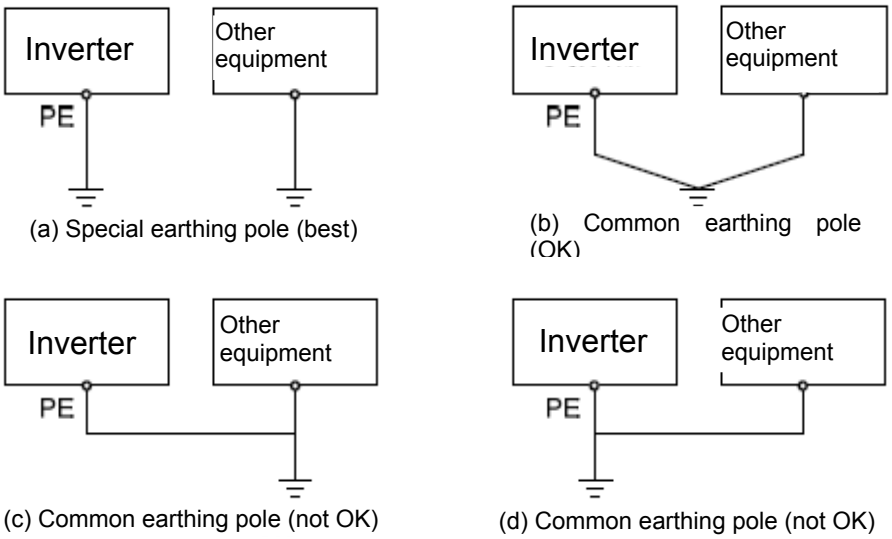


Figure A.6 Special earthing pole diagram

Among four earthing methods above, (a) is the best one. Users are recommended to apply this method.

A.3.2 Precautions

(1) Apply the earthing cable with standard cross section area to ensure minimum earthing impedance. As the high frequency impedance of the flat cable is lower than the round conductor, use the flat cable if the cross section area is the same.

(2) Earthing cable shall be as short as possible, and earthing point shall be as close

as to the inverter.

(3) In case four-core cable is used for the motor line, one cable must be earthed at the inverter side, with the other side being connected to earthing terminal of the motor; if the motor and inverter has its own special earthing pole, it can obtain better earthing effect.

(4) When the earthing terminal of each part of control system is connected together, as the noise source caused due to leakage current would affect other peripheral equipments outside the inverter, the inverter and light current equipment such as computer, sensor or audio shall be separated for earthing among the same control system.

(5) To obtain lower high-frequency impedance, use the fixed bolts of each equipment as high-frequency terminal connecting with panel behind the cabinet. Remove the insulation paint at fixing point for installation.

(6) Earthing cable shall be laid as far away as from wiring of noise sensitive equipment I/O parts. Earthing line shall be as short as possible.

A.4 Installation of surge absorber

Even if the components that would generate large noises such as relay, contactor and electromagnetic brake, are installed outside the inverter casing, a surge absorber must be installed, as shown in Figure A.7.

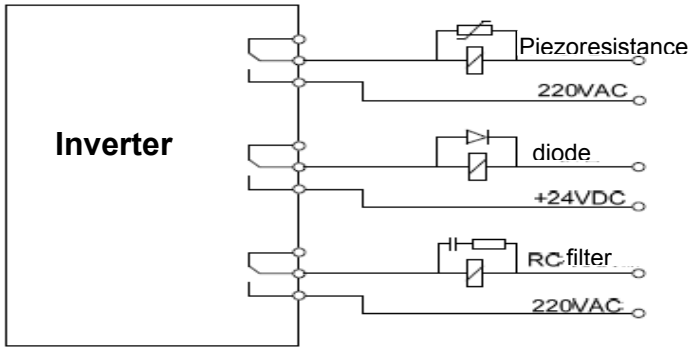


Figure A.7 Using requirements on relay, contactor and electromagnetic brake

A.5 Leakage current and its measures

Leakage current passes through line capacitor and motor capacitor of input and output sides of the inverter, including earth leakage current and line-to-line leakage current, as shown in Figure A.8. The amount of leakage current depends on that of carrier frequency and capacitance.

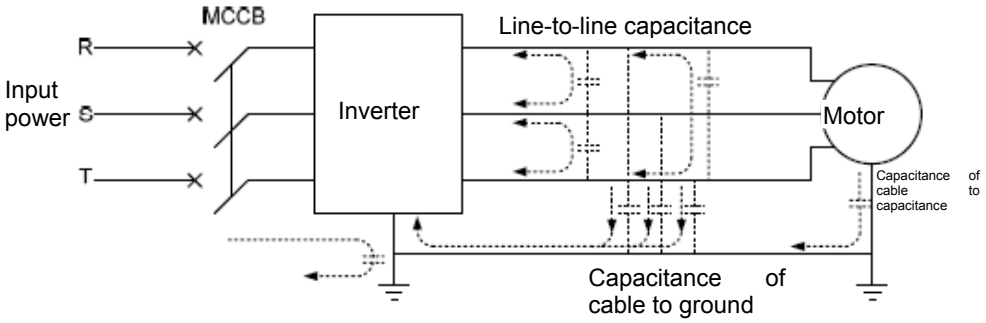


Figure A.8 Leakage current route

A.5.1 Earth leakage current

Earth leakage current not only passes through the inverter, but also through other equipments via the ground line, which may cause incorrect action of leakage breaker, relay or other equipments. The higher the carrier frequency of the inverter is, the longer the motor cable and also the larger the leakage current will be.

Suppression measures: reduce the carrier frequency and shorten the motor cable as much as possible; apply the special leakage breaker for leakage current of high harmonic wave/surge.

A.5.2 Line-to-line leakage current

For leakage current that passes through capacitor among cables at output side of the inverter, its high harmonic wave may cause incorrect action of external heat relay. Especially for small volume inverter below 7.5kW, when the wiring is very long (more than 50m), the leakage current would be increased, thus easily causing incorrect action of external heat relay.

Suppression measures: reduce the carrier frequency, and install the AC output

reactor at output side; apply the temperature sensor for direct monitor of motor temperature or replace the external heat relay with an electronic heat relay with overload protection function.

A.6 Radiation emission quenching

The inverter is usually installed at the metal control cabinet. Instruments and equipments outside the metal cabinet are not easily affected by the radiation emission of the inverter, and connecting cable is main radiation emission source. As power cable, motor cable and control cable and keyboard line has to be leaded outside the shield cabinet, make special treatment at the leadout; otherwise it would cause the shield ineffective.

As shown in Figure A.9, some cables inside the shield cabinet are used as the antenna, and after receiving noise radiation, it would transmit to shield cabinet through the cable and then radiated to the space; as shown in Figure A.10, connect the shield casing at the exit for the cable shield layer, then, the noise radiation received by the cable would pass to the ground through shield casing, thus eliminating any effect on the environment.

When the earthing method from Figure A.10 is used, the cable shield layer shall be as close as to the casing connection at exit; otherwise the cable from earthing point to exit would act as antenna. And the distance between noise earthing point and exit shall be at least less than 15cm. The better the closer distance.

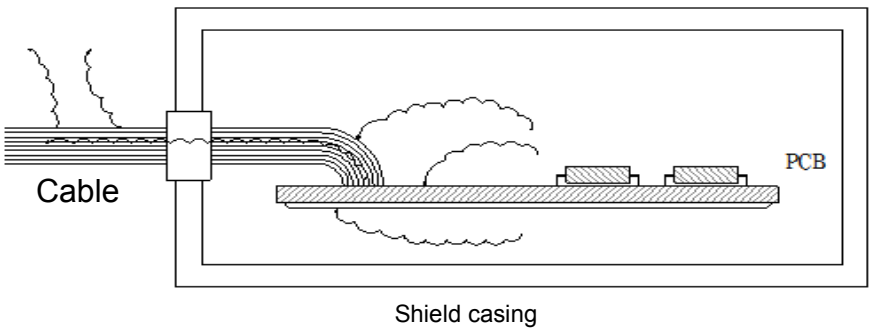


Figure A.9 Radiation by leadout cable of shield cabinet

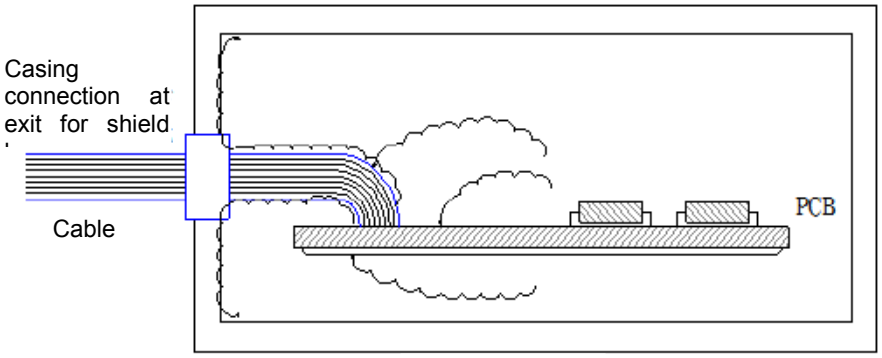


Figure A.10 Radiation quenching by the shield casing of cable shield layer

A.7 Using guidance on power line filter

For equipments that may generate strong interference and are sensitive to the interference, use the power line filter.

A.7.1 Function of power line filter

(1) As two-way low-pass filter, it only allows passing through by DC and 50Hz power current, instead of electromagnet interference current with high frequency. Therefore, it can not only suppress the electromagnet interference generated by the equipment itself from entering to power line, but also interference of the power line to the equipment.

(2) It can make the equipment meet the requirements of conducted emission and conducted susceptibility electromagnetic compatibility standard, and it can also suppress radiation interference of the equipment.

A.7.2 Installation precautions

(3) The filter shall be installed as close as to the entry end of power line, and the power input line of the filter shall be as short as possible within the control cabinet.

(4) If the input line and output line is laid too close together, the high-frequency interference would enable the filter bypass, and then make direct coupling through the input line and output line, causing the power filter ineffective.

(5) There is a special earthing terminal at the filter casing. However, if the earthing terminal is connected to the cabinet casing via a conductor, due to large high-frequency impedance of long conductor, it would not generate effective bypass action, then the filter will not function. The correct way is attach the filter to the conduct plane of metal casing, with larger contact area. For installation, remove the insulating paint, and ensure good electric contact.

A.8 EMC installation area division

For drive system made up of the inverter and motor, the inverter and peripheral equipments such as control device, sensor are usually installed within the same control cabinet. As the interference caused by the control cabinet can be suppressed at the main connection, install the wireless noise filter and inlet AC reactor at the inlet end of control cabinet. To meet EMC requirements, electromagnetic compatibility shall be realized within the control cabinet.

For drive system made up of the inverter and motor, the inverter, braking unit and contactor, etc is the strong noise source, which will affect normal function of automation device, encoder and sensor to the noise sensitive peripheral equipments. According to electric features of peripheral equipments, install them at different EMC area to realize separation of noise source and noise receiver, which is the most effective measure to reduce interference. For division of EMC area, see Figure A.11.

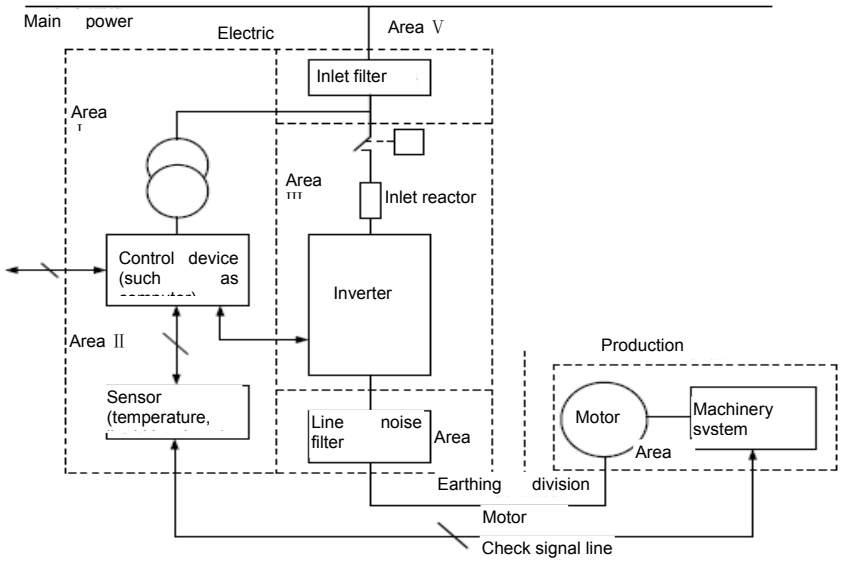


Figure A.11 EMC installation area diagram

Below is description for above-mentioned area division:

Area Ⅰ: control power transformer, control device and sensor, etc.

Area Ⅱ: control signal and its cable interface, with certain noise immunity

Area Ⅲ: main noise sources such as inlet reactor, inverter, braking unit, contactor.

Area Ⅳ: output noise filter and its wiring part.

Area Ⅴ: power (including wiring part of wireless noise filter).

Area Ⅵ: motor and its cable.

Each area shall be separated with minimum distance as 20cm to realize electromagnetic decoupling. Use a division plate for decoupling and place the cable of different areas to different cable pipe; and filter shall be installed at connection of each area.

All bus cable (such as RS485) and signal cable from the cabinet must be shielded.

A.9 Electric installation precautions

For electric installation, see Figure A.12.

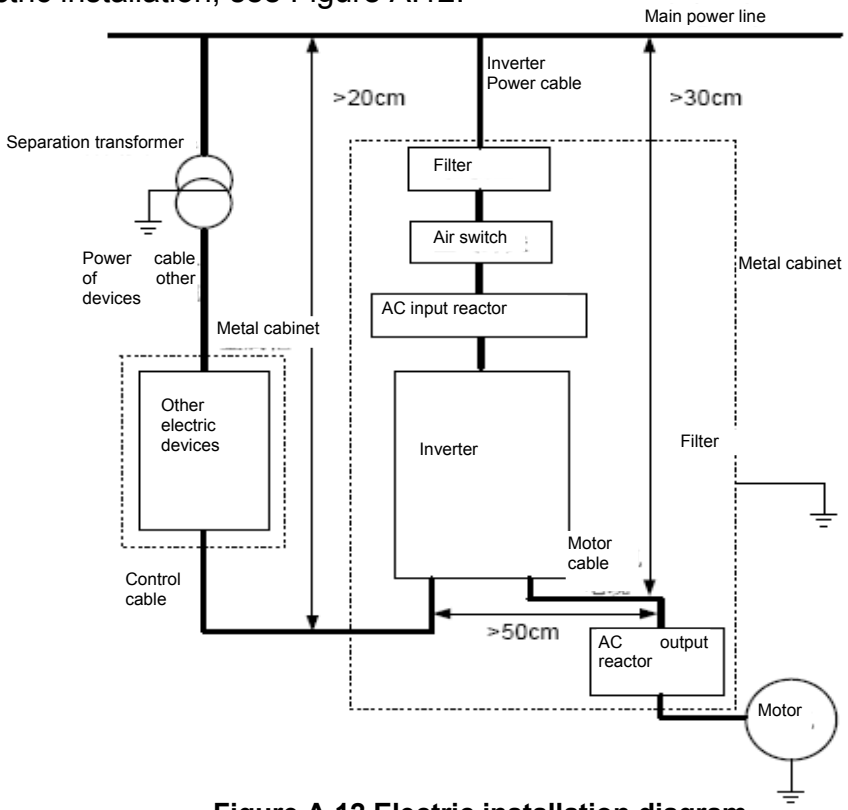


Figure A.12 Electric installation diagram

To meet EMC requirements, during installation, note that:

(1) Apply cabinet installation. And the baseplate of inverter and exterior casing of input filter shall be fixed at the back plate of control cabinet to ensure strong electric contact with the back plate; the distance between the inverter and filter shall be as short as possible, and less than 15cm, which can ensure minimum high-frequency impedance of ground wire between the inverter and input filter and reduce the high-frequency noise.

(2) Install a wide earthing line at the entry of control cabinet (no more than 5cm from the exit), and all shield layers through the cabinet cable are fixed at this line via 360° ring joint to ensure sound electric contact.

(3) For motor cable, apply shield cable, or the one with spiral metal tape and wire mesh with double layers is better. Shield layer must be fixed at the back plate through 360° ring joint (as shown in Figure A.4) with a metal cable clip at the inverter side. There should be two fixing position: one as close as to the inverter, better less than 15cm; and the other at earthing line. When the shield layer passes through motor terminal box at the motor side, connect with motor metal casing through 360° ring joint; if it is difficult, twist the shield layers into braid type, and after rolling, connect the motor earthing terminal with the rolling width larger than 1/5 of braid length.

the motor cable core and its PE leadout line shall be as short as possible, better less than 5cm.

(4) For terminal control cable, use the shield cable. The shield layer shall be connected to the earthing line at the cabinet entry with a metal cable clip through 360° ring joint; to inverter side, fix the shield layer to metal casing of inverter via a metal cable clip; if difficult, twist the shield layers into wide and short braid, and after rolling, connect to inverter PE terminal. The exposed part of cable core and leadout line of PE braid shall be as short as possible, better less than 15cm.

(5) Keyboard line shall not thread out the shield cabinet.

(6) Gap dimension of shield cabinet shall be as small as possible, no more than 15cm at maximum.

A.10 EMC standards met by Series AS 160 inverter

After installation of proper input/output filter, AC reactor (for optional filter and reactor type, see "options"), and wiring after referencing above precautions, it meet the EMC standards as shown in Figure A.2.

Figure A.2 EMC performance overview of Series AS160 inverter

Item	Standards	Standard level
Conducted interference emission	EN12015.1998	quadipeak value quadipeak value quadipeak value
Radiation interference emission	EN12015.1998	quadipeak value quadipeak value quadipeak value
Static discharge immunity	EN12016.2004	Criterion B (contact discharge 4000V, air discharge 8000V)
Radiation electromagnetic field immunity	EN12016.2004	Level 3 criterion A(3V/m)
Quick transient electropulse packet immunity	EN12016.2004	Level 4 criterion B (strong current end ±2KV/2.5kHz)
Surge immunity	EN12016.2004	Criterion B(±1KV)
Conduct immunity	EN12016.2004	Criterion A(3V,0.15～80MHz)

Appendix B Function parameter and fault table summary

This appendix summarizes function parameter, run condition and fault table for better reference and application for the inverter users.

B.1 Function parameter table

Code	Name	Exworks value	Range	Unit	Attribute	Description
Group P00 Basic parameter						
P00.00	Run command 1	1	0～2		×	0: panel set run command 1: terminal set run command 2: communication set run command
P00.01	Frequency command 1	1	0～11		×	0: panel set speed 1: analog quantity A0 set speed 2: analog quantity A1 set speed 3: A0+A1 set speed 4: A0-A1 set speed 5: UPDN terminal set speed 6: communication set speed 7: PID set speed 8: A0+PID set speed 9: A1+PID set speed 10: A0-PID set speed 11: A1-PID set speed
P00.02	Run command 2	1	0～2		×	Same as run command 1
P00.03	Frequency command 2	1	0～7		×	Same as frequency command 1
P00.04	Command 1/2 selection	0	0～3		×	0: command 1; 1: command 2; 2: select via terminal; 3:select via communication
P00.05	Run mode selection	0	0～3		×	0: two-wire system mode1 1: two-wire system mode2 2:three-wire system mode1

Code	Name	Exworks value	Range	Unit	Attribute	Description
						3:three-wire system mode2
P00.06	Reverse rotation setting	0	0～1		×	0: reverse rotation allowed 1:reverse rotation forbidden
P00.07	Frequency upper limit	50.0	0.0～300.0	Hz	○	Inverter maximum output frequency
P00.08	Frequency lower limit	20.0	0.0～300.0	Hz	○	Inverter minimum output frequency
P00.09	Inching frequency	5.00	0.0～300.00	Hz	×	Inching run to be controlled by the terminal
P00.10	Torque rising	19	0～63		×	
P00.11	Password logging	0	0~65535		×	
P00.12	Inverter software edition		160.50		*	Inverter software edition
Group P01 Start/stop parameter						
P01.00	Start mode	0	0～1		×	0: normal start 1: restart after DC braking
P01.01	Start DC injection current	30.0	0.0～120.0	%	×	Restart after DC braking parameter
P01.02	Start DC injection time	5.0	0.0～99.9	S	×	
P01.03	Start holding frequency	0.00	0.00～300.00	Hz	×	
P01.04	Holding time of start frequency	0.0	0.0～99.9	S	×	
P01.05	Shutdown mode	0	0～2		×	0: inertia shutdown 1: deceleration shutdown 2: deceleration + DC braking shutdown
P01.06	Shutdown holding frequency	0.00	0.00～300.00	Hz	×	
P01.07	Shutdown requency holding time	0.0	0.0～99.9	S	×	
P01.08	Start frequency of DC braking	0.00	0.00~30.00		×	DC braking shutdown parameter
P01.09	shutdown DC braking current	30.0	0.0～120.0	%	×	
P01.10	Shutdown DC braking	0.0	0.1～99.9	S	×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
	time					
P01.11	Acceleration time 1	15.00	0.00～360.00	S	○	Default acceleration/deceleration time 1
P01.12	Deceleration time 1	15.00	0.00～360.00	S	○	
P01.13	S curve 1	0.00	0.00～72.00	S	○	
P01.14	Acceleration time 2	5.00	0.00～360.00	S	○	
P01.15	Deceleration time 2	5.00	0.00～360.00	S	○	
P01.16	S curve 2	0.00	0.00～72.00	S	○	
P01.17	Acceleration/deceleration time selection	0	0～3		×	0: acceleration/deceleration time 1; 1:acceleration/deceleration time 2; 2: select via terminal; 3:select via communication;
Group P02 Motor & VF						
P02.00	Motor rated current	150.0	0.1～999.9	A	×	Exworks value based on the inverter power
P02.01	Motor rated frequency	50.00	0.00～300.00	Hz	×	VF curve reference frequency
P02.02	Motor rated voltage	380	0～460	V	×	Voltage corresponding to reference frequency
P02.03	Motor rated speed	1460	0～18000	rpm	×	Motor speed
P02.04	Acceleration current threshold value	110.00	0.0～200.00	%	×	Stalling to prevent current during acceleration
P02.05	Deceleration voltage threshold value	750	0～800	V	×	Stalling to prevent voltage during deceleration
P02.06	V/F curve setting	0	0～4		×	0: straight line; 1: 1.2 power; 2: 1.5 power; 3: 2 power; 4: self-defined;
P02.07	Self-defined F0	10.00	0.00～300.00	Hz	×	F0<F1
P02.08	Self-defined V0	76	0～460	V	×	V0<V1
P02.09	Self-defined F1	20.00	0.00～300.00	Hz	×	F1<F2

Code	Name	Exworks value	Range	Unit	Attribute	Description
P02.10	Self-defined V1	152	0～460	V	×	V1<V2
P02.11	Self-defined F2	30.00	0.00～300.00	Hz	×	F2<F3
P02.12	Self-defined V2	228	0～460	V	×	V2<V3
P02.13	Self-defined F3	40.00	0.00～300.00	Hz	×	F3<F4
P02.14	Self-defined V3	304	0～460	V	×	V3<V4
P02.15	Self-defined F4	50.00	0.00～300.00	Hz	×	F4≤ motor rated frequency
P02.16	Self-defined V4	380	0～460	V	×	V4≤ motor rated voltage
P02.17	Frequency hopping speed 1	0.00	0.00～300.00	Hz	○	Output frequency of the inverter hops out of the machinery resonant frequency section during running, and the set frequency shall not set within the frequency hopping interval.
P02.18	Frequency hopping speed 2	0.00	0.00～300.00	Hz	○	
P02.19	Frequency hopping speed 3	0.00	0.00～300.00	Hz	○	
P02.20	Frequency hopping width	0.00	0.00～100.00	Hz	○	
P02.21	Fault auto reset time	10.0	0.00～300.0	S	×	Fault auto reset restart function
P02.22	Fault auto reset times	0	0～10		×	
P02.23	PWM carrier frequency	3.000	1.100~13.000	kHz	×	
Group P03 Input channel parameter						
P03.00	Input terminal X0 function	7	0～64 (high level valid) 100~164 (low level valid)		×	0: not defined 1:acceleration/deceleration time 2 selection 3: multispeed terminal 0 4: multispeed terminal 1 5: multispeed terminal 2 7: corotation start 8: reverse rotation start 9:three-wire control selection 13: external reset signal 14: external fault signal 18: base set block signal 49:run and frequency command 2
P03.01	Input terminal X1 function	8			×	
P03.02	Input terminal X2 function	0			×	
P03.03	Input terminal X3 function	0			×	
P03.04	Input terminal X4 function	0			×	
P03.05	Input terminal X5 function	0			×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
P03.06	Input terminal X6 function	0			×	50: PID setting 2 selection 52: up speeding up 53: down speeding down 54:up speeding up (memory) 55: down speeding down (memory) 56:forward direction inching 57:reverse direction inching
P03.07	Input terminal X7 function	0			×	
P03.08	Analog input A0 minimum value	0.000	0～100.000	%	×	
P03.09	Analog input A0 maximum value	100.0	0.0～500.0	%	×	
P03.10	Analog input A0 filtering	10	0～30	ms	×	
P03.11	Analog input A0 disconnection value	0.0	0.0~100.0	%	×	A0 disconnection detection value
P03.12	Analog input A1 type	0	0~2		×	0: 0～10V 2: 0～20mA
P03.13	Analog input A1 minimum value	0.000	0～100.000	%	×	
P03.14	Analog input A1 maximum value	100.0	0.0～500.0	%	×	
P03.15	Analog input A1 filtering	10	0～30	ms	×	
P03.16	Analog input A1 disconnection value	0.0	0～100.0	%	×	A1 disconnection detection value
Group P04 Output channel parameter						
P04.00	Relay 1 function	46	0～64		×	0: function not defined; 33: dormancy 40: upper limit action of detection value 1; 41: lower limit action of detection value 1; 42: upper limit action of detection value 2;
P04.01	Relay 2 function	47			×	
P04.02	Relay 3 function	48			×	
P04.03	Relay 4 function	0			×	
P04.04	Output terminal Y0	0			×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
	function					43: lower limit action of detection value 2; 44: upper limit action of detection value 3; 45: lower limit action of detection value 3; 46: power on self-check normal; 47: fault output; 48: during running; 49: target frequency reached;
P04.05	Output terminal Y1 function	0			×	
P04.06	Relay 1 on delay	0.0	0.0～600.0	S	×	
P04.07	Relay 1 off delay	0.0	0.0～600.0	S	×	
P04.08	Relay 2 on delay	0.0	0.0～600.0	S	×	
P04.09	Relay 2 off delay	0.0	0.0～600.0	S	×	
P04.10	Relay 3 on delay	0.0	0.0～600.0	S	×	
P04.11	Relay 3 off delay	0.0	0.0～600.0	S	×	
P04.12	Relay 4 on delay	0.0	0.0～600.0	S	×	
P04.13	Relay 4 off delay	0.0	0.0～600.0	S	×	
P04.14	Output terminal Y0 on delay	0.0	0.0～600.0	S	×	
P04.15	Output terminal Y0 off delay	0.0	0.0～600.0	S	×	
P04.16	Output terminal Y1 on delay	0.0	0.0～600.0	S	×	
P04.17	Output terminal Y1 off delay	0.0	0.0～600.0	S	×	
P04.18	Analog output M0 function	71	0～127		×	71: output frequency; 72: analog quantity input A0; 73: analog quantity input A1; 74: output current; 75: PID feedback value; 76: output speed;

Code	Name	Exworks value	Range	Unit	Attribute	Description
P04.19	Analog output M0 minimum value	0.000	0.00～100.00	%	×	
P04.20	Analog output M0 maximum value	100.0	0.0～500.0	%	×	
P04.21	Analog output M1 function	75	0～127		×	Same as M0
P04.22	Analog output M1 minimum value	0.000	0.00～100.00	%	×	
P04.23	Analog output M1 maximum value	100.0	0.0～500.0	%	×	
Group P05 Detection value and multispeed						
P05.00	Detection value 1	0	0～5		×	0: output frequency (Hz); 1: analog quantity input A0(%); 2: analog quantity input A1(%); 3: output current(A); 4: PID feedback value; 5: output speed (rpm);
P05.01	Upper limit of detection value 1	0.0	0.0～3000.0		×	
P05.02	Lower limit of detection value 1	0.0	0.0～3000.0		×	
P05.03	Detection value 2	1	0～5		×	Same as detection value 1
P05.04	Upper limit of detection value 2	0.0	0.0～3000.0		×	
P05.05	Lower limit of detection value 2	0.0	0.0～3000.0		×	
P05.06	Detection value 3	4	0～5		×	Same as detection value 1
P05.07	Upper limit of detection value 3	0.0	0.0～3000.0		×	
P05.08	Lower limit of detection value 3	0.0	0.0～3000.0		×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
P05.09	Multispeed 1	5.00	0.0～300.0	Hz	○	
P05.10	Multispeed 2	10.00	0.0～300.0	Hz	○	
P05.11	Multispeed 3	20.00	0.0～300.0	Hz	○	
P05.12	Multispeed 4	30.00	0.0～300.0	Hz	○	
P05.13	Multispeed 5	40.00	0.0～300.0	Hz	○	
P05.14	Multispeed 6	50.00	0.0～300.0	Hz	○	
P05.15	Multispeed 7	60.00	0.0～300.0	Hz	○	
Group P06 process PID setting 1						
P06.00	PID set channel	0	0～2		×	0: internal set 1: analog quantity A0 set 2: analog quantity A1 set
P06.01	PID feedback channel	1	0～5		×	0: analog quantity A0 feedback 1: analog quantity A1 feedback 2: analog quantity A0+A1 feedback 3: analog quantity A0-A1 feedback 4: max(A0, A1) feedback 5: min(A0, A1) feedback
P06.02	Internal set value	0.7	0.0～1000.0		○	Unit to be set by P06.03
P06.03	Unit selection	2	1～3		×	1: % 2: Mpa 3: ℃
P06.04	Positive and negative features	0	0～1		×	0: positive features 1: negative features
P06.05	Scale Kp	0.50	0.00～10.00		○	
P06.06	Integral Ki	0.50	0.00～10.00		○	
P06.07	Differential Kd	0.00	0.00～10.00		○	
P06.08	Upper limit of sensor range	1.6	0.0～1000.0		×	Unit to be set by P06.03
P06.09	Lower limit of sensor range	0.0	0.0～1000.0		×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
P06.10	Dormancy selection	0	0～1		×	0: dormancy not used; 1: dormancy based on output frequency;
P06.11	Dormancy frequency	30.00	0～300.0	HZ	×	
P06.12	Dormancy delay	10.0	0～3600.0	S	×	
P06.13	Wake-up deviation	0.10	0～1000.0		×	Unit to be set by P06.03
P06.14	Wake-up delay	10.0	0～3600.0	S	×	
Group P07 Process PID setting 2						
P07.00	PID parameter group selection	0	0～3		×	0: PID setting 1; 1: PID setting 2; 2: select via terminal; 3:select via communication.
P07.01	PID set channel	0	0～2		×	Same as PID setting 1
P07.02	PID feedback channel	1	0～5		×	Same as PID setting 1
P07.03	Internal set value	0.70	0.00～100.00		○	Unit to be set by P07.04
P07.04	Unit selection	2	1～3		×	1: %　2: Mpa　3: ℃
P07.05	Positive and negative features	0	0～1		×	0: positive features 1: negative features
P07.06	Scale Kp	0.50	0.00～10.00		○	
P07.07	Integral Ki	0.50	0.00～10.00		○	
P07.08	Differential Kd	0.00	0.00～10.00		○	
P07.09	Upper limit of sensor range	1.6	0～1000.0		×	Unit to be set by P07.04
P07.10	Lower limit of sensor range	0.0	0～1000.0		×	
P07.11	Dormancy selection	0	0～1		×	0: dormancy not used; 1: dormancy based on output frequency
P07.12	Dormancy frequency	30.00	0～300.0	HZ	×	
P07.13	Dormancy delay	10.0	0～3600.0	S	×	
P07.14	Wake-up deviation	0.10	0.00～100.00		×	
P07.15	Wake-up delay	10.0	0～3600.0	S	×	

Code	Name	Exworks value	Range	Unit	Attribute	Description
Group P08 Fan and water pump control						
P08.00	Motor control mode	0	0～1		×	0: circulating soft-start 1: one for main and several for auxiliary
P08.01	Motor numbers	1	1~7		×	
P08.02	Start frequency	49.50	0～300.00	HZ	×	
P08.03	Start delay	15.0	0～3600.0	S	×	
P08.04	Switching interval time	0.50	0～3600	S	×	
P08.05	Stop frequency	20.00	0～300.00	HZ	×	
P08.06	Stop delay	15.0	0～3600.0	S	×	
P08.07	Forbiddening time	3	0～3600	S		
P08.08	Even load time	0	0～600	MIN	×	
P08.09	Fan Control	0	0～1		×	0: fan rotating during running 1: fan rotating always
Group P09 Communication and display						
P09.00	U01 display data	13	0～31		○	0: not defined 2:current output frequency (Hz) 4: output current (A) 5: output voltage (V) 6: output torque (%) 7: bus voltage (V) 8: analog quantity A0 input (%) 9: analog quantity A1 input (%) 10: accumulated power expenditure (kWh) 13: set frequency (Hz) 14: accumulated Power On Hours (h) 21: analog quantity M0 output (%) 22: analog quantity M1 output (%); 24: current output speed
P09.01	U02 display data	4			○	
P09.02	U03 display data	5			○	
P09.03	U04 display data	8			○	
P09.04	U05 display data	9			○	
P09.05	U06 display data	30			○	
P09.06	U07 display data	21			○	
P09.07	U08 display data	22			○	
P09.08	U09 display data	31			○	
P09.09	U10 display data	27			○	
P09.10	U11 display data	28			○	
P09.11	U12 display data	29			○	
P09.12	LED display data	2			○	

Code	Name	Exworks value	Range	Unit	Attribute	Description
						(rpm); 25: accumulated running time (h); 26: inverter temperature (degree); 27: PID set value SV 28: PID feedback value PV; 29: PID output value MV(%) 30:input terminal condition DI; 31:output terminal condition DO
P09.13	Communication baud rate	3	0～7	Bps	×	0: 1200bps; 1: 2400bps 2: 4800bps; 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps 7: 76800bps
P09.14	Odd even parity	0	0～2		×	only supports 8 data bits and 1 stop bit. 0: no parity, 1: even parity, 2: odd parity;
P09.15	Transmission mode	1	0～1		×	0: ASCII 1: RTU
P09.16	Data system selection	1	0~1		×	MODBUS address system 0: hexadecimal system; 1: decimal system
P09.17	Local address	1	1～247		×	1～247
P09.18	User-defined data 0	0	0~65536		○	
P09.19	User-defined data 1	1	0~65536		○	
P09.20	User-defined data 2	2	0~65536		○	
P09.21	User-defined data 3	3	0~65536		○	
P09.22	User-defined data 4	4	0~65536		○	
P09.23	Processing method for communication overtime	0	0～1		×	0:communication overtime not protected 1:communication overtime

Code	Name	Exworks value	Range	Unit	Attribute	Description
						shutdown protection
P09.24	Communication overtime time	1000	10～60000	ms	×	
P09.25	Number of successful communication	0	0～65535		*	Count value resets after reaching 65535, and then continue to count

B.2 Fault table

Fault number	Fault display	Fault number	Fault display
1	Module overcurrent protection	2	ADC fault
3	Radiator Overheat	4	Braking unit fault
5	Fuse blown fault	6	Output overtorque
7	Speed deviation	8	Bus overvoltage protection
9	Bus undervoltage	10	Output open-phase
11	Motor low-speed overcurrent	12	Encoder fault
13	Current found when stopped	14	Speed reversing during running
15	Speed found when stopped	16	Wrong phase sequence
17	Overspeed with the same direction	18	Reversing overspeed
19	UVW encode phase sequence fault	20	Encoder communication fault
21	Abc overcurrent	22	Brake check fault
23	Input overvoltage	24	UVW encoder disconnection
25	Backup	26	Encoder unlearned
27	Output overcurrent	28	Sincos encoder fault
29	Input phase lacking	30	Overspeed protection
31	Motor high-speed overcurrent	32	Earthing protection
33	Capacitance aging	34	External fault
35	Output unbalanced	36	Parameter setting error
37	Current sensor fault	38	Braking resistor short-circuit
39	Current instant value too large	40	Parameter fault
41	Water pump fault	42	PFC start fault 1
43	PFC start fault 2	44	All motors stopped
45	IGBT drive fault	46	Sensor disconnection
47	Communication fault alarm	48	Communication fault stop
49	Relay fault	50	Backup

Appendix C Inverter accordance standards

CE

European low voltage specifications

Series AS160 inverter production accords with low voltage specifications 73/23/EEC and revision items 98/68/EEC. This inverter also accords with the following standards:

EN61800-5-1: Adjustable speed electrical power drive systems Part 5-1: Safety requirements – Electrical, thermal and energy.

1. European EMC specifications

When you make installation according to suggestions in this manual, Series AS inverter product accords with the following EMC standard:

EN12015.1998 Electromagnetic compatibility-Product family standard for lifts, escalators and passenger conveyors-Emission. (22kW inverter)

EN12016.2004 Electromagnetic compatibility-Product family standard for lifts, escalators and passenger conveyors-Immunity. (22kW inverter)

EN61800-3: Adjustable speed electrical power drive systems Part 3 (5.5/7.5kW,11/15kW inverter)

TÜV

2. North American safety specifications

Series AS inverter product is in accordance with North American safety certification. This inverter accords with the following standards and specifications:

UL508: Industrial Control Equipment

UL508C: Power Conversion Equipment

3. ISO9001 quality management system

Shanghai Sigriner STEP Electric Co.,Ltd manages their quality management system according to requirements of ISO 9001 standard.

Appendix D Letter of Complaint

Name:	
Tel:	Fax:
Type: □ Sales □ Promotion □ Service □ Quality □ Business □ Product □ Others	
Complaints:	
	Complainant (signature): Unit (stamp): Date:

Appendix E Warranty card

Name:	
Tel:	Fax:
Type: □ Sales □ Promotion □ Service □ Quality □ Business □ Product □ Others	
Complaints:	
	Complainant (signature): Unit (stamp): Date:

Warranty agreement

1. Warranty period of this product is 18 months (based on bar code). Should the product is applied according to the instructions within the warranty period, our company would be responsible for free maintenance in case of faults or damages.

2. Certain maintenance fees would be collected for damages caused due to below reasons within the warranty period:

A. Machine damages caused due to incorrect application or random repairs, changes;

B. Machine damages caused due to fire, flood, abnormal voltage, other natural disasters and secondary disasters;

C. Hardware damages caused due to man-made throwing or transportation after purchasing;

D. Machine damages caused due to noncompliance with user's manual provided by our company;

E. Faults and damages caused due to obstacles other than machines (such as external equipment);

3. In case of faults or damages, please fill in Warranty Card in detail correctly.

4. Maintenance fee would be charged based on Maintenance Price List that is updated by our company.

5. Generally, this warranty card would not be reissued. Please take good care of this card, and show to the maintenance personnel for maintenance.

6. In case of any problems during service, please contact our agent or our company duly.

7. Shanghai Sigriner STEP Electric Co.,Ltd. reserves the right of final interpretation of this agreement.

Shanghai Sigriner STEP Electric Co.,Ltd

(Customer service center) service hotline: 400-820-7921 800-820-7921

Add.: No 1560 Siyi Road, Jiading District, Shanghai

Zip code: **201801**

Tel: **021-69926000**

Fax: **021-69926000**

Website: **www.stepelectric.com**

STEP®	To the Customer	Edition: A Revision: 0
		No.:

Dear Customers:

RoHS refers to the Restriction of the use of certain hazardous substances in electrical and electronic equipment, which is executed by EU on July 1, 2006. It specifies: restrictions on six hazardous substances such as lead, mercury, cadmium, hexavalent chrome, PBB and PBDE in the electric, electronic equipments that are newly launched on the market.

Ministry of Information Industry, Development and Reform Commission, Department of Commerce, the General Administration of Customs, State Administration for Industry and Commerce, General Administration of Quality Supervision and State Environmental Protection Administration issued Chinese RoHS directive - Management Methods on Control of Pollution from Electronic Information Products together on February 28, 2006, and launched compulsory execution. Measures on Pollution Prevention from Electronic Waste issued by the State Environmental Protection Administration on February 1, 2008 has executed, which states that the users of electric and electronic products shall provide electronic wastes to or entrust with qualified disposal units (including individual units of industry and commerce that are listed to the List (including temporary list) for diassembling, uses or disposal.

Our company has been in accordance with requirements of Management Methods on Control of Pollution from Electronic Information Products and RoHS directive from type selection and purchasing of electronic parts and components, PCB panel, harness materials, strcutural parts, and has been strict on six hazardous substances such as lead, mercury, cadmium, hexavalent chrome, PBB and PBDE, and welding of PCB parts and components has been executed on the lead-less welding line during production, with lead-less welding process.

Toxic and harmful elements that may be contained by the following products:

Type	Electronic part	Electronic print circuit panel (PCB)	Plate work	Radiator	Plastic part	Conductor
Toxic and harmful elements that may be contained	six hazardous substances such as lead, mercury, cadmium, hexavalent chrome, PBB and PBDE					

1. Analysis on environment effect

Electronic products of our company may generate some heat during using, and may cause micro emission of individual harmful substances, but it would not cause severe effect on the surrounding environment.

After the life cycle of electronic products is finished and after disposal, some heavy metal and chemical and toxic, harmful substances would cause severe pollution on the soil, water resources.

2. Life cycle of electronic products and equipments

Any electronic products and equipments have the service life, and will be damaged and rejected. Even it can be used, it would be wiped out due to upgrade. Electronic products and equipments of our company have the service life no more than 20 years.

3. Rejection and disposal of electronic products.

Improper disposal of rejected electronic products will cause environment pollution. Our company would request the customers to establish recycle system according to relevant specifications, and the products shall not be disposed as general domestic rubbish or industrial wastes. They shall strictly implement Measures on Pollution Prevention from Electronic Waste issued by the State Environmental Protection Administration, and store and use it through environment friendly methods; or entrust qualified units for united disposal. Unqualified individuals or units are not allowed for disassembling, uses or disposal of electronic wastes.

Do not dispose of electronic wastes with domestic rubbishes. Please call the local waste disposing institute or environment protection institute to obtain recommendations of electronic wastes.

Shanghai Sigriner STEP Electric Co., Ltd