User Manual (V3.5)

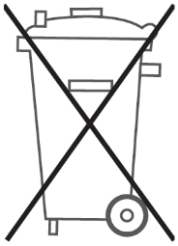
SD2 Series Drive

WARNINGS

WARNING: Separate as much as possible the probe and digital input signal cables from the cables carrying inductive loads and power cables to avoid possible electromagnetic disturbance. Never run power cables (including the electrical panel wiring) and signal cables in the same conduits.

DISPOSAL

INFORMATION FOR USERS ON THE CORRECT HANDLING OF WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE)



In reference to European Union directive 2002/96/EC issued on 27 January2003 and the related national legislation, please note that:

- WEEE cannot be disposed of as municipal waste and such waste must be collected and disposed of separately;
- The public or private waste collection systems defined by local legislation must be used. In addition, the equipment can be returned to the distributor at the end of its working life when buying new equipment;
- The equipment may contain hazardous substances: the improper use or incorrect disposal of such may have negative effects on human health and on the environment;
- The symbol (crossed-out wheeled bin) shown on the product or on the packaging and on the instruction sheet indicates that the equipment as been introduced onto the market after 13 August 2005 and that it must be disposed of separately;
- In the event of illegal disposal of electrical and electronic waste, the penalties are specified by local waste disposal legislation.

SYMBOLS

 **Dangerous voltage**

 **Caution, hot surface**

 **Important:** brings critical subjects regarding use of the product to the user's attention

 **Note:** when attention must be given to subjects of relevant importance, in particular regarding practical use of the various product functionality.

Content

1. WARNINGS

1.1 General warnings

- Check whether the service voltage (rated voltage) matches with the power voltage before installing or using the drives. If not, damages may be caused to the drive, and worse situations like fire disaster may take place as well.
- Prior to the installation of drives, the capacity of power supply shall be figured out, making sure it is no less than the working current required by those devices.
- Installation and operation must be carried out after power off to safeguard personal safety and avoid electric shock. After installation, check the devices to get rid of any fault and then power on for test run, during which, the device performance and electric leakage shall be checked. Devices with body leakage shall be maintained in time and must not be used in case of electric shock or personal injury.

1.2 Fundamental safety rules

Before performing any maintenance work:

 Disconnect drive and external control circuits from the power supply, moving the main system switch to “off”. Wait at least 5 minutes.

 Always check, use a suitable multimeter, that there is no dangerous voltage across the terminals.

 Always make sure the motor has stopped completely. Motors that are still freely rotating may produce dangerous voltages at the drive terminals, even when this is disconnected from the power supply.

 Check the temperature of the heat sink: coming in contact with the heat sink may cause burns.

 When drive is connected to the mains, motor terminals (U, V, and W) are live, even if the motor is not running. Do not measure insulation resistance or dielectric rigidity directly on drive, or with drive connected.

 The control terminals are isolated from the mains voltage. Nonetheless, the relay outputs may have a dangerous control voltage even when drive is not connected to the mains.

 The level of safety provided by the enabling inputs on drive (excluding the “Safety Torque Off “input when used in compliance with the standards) is not sufficient in critical applications without adopting further independent safety measures. For all applications where malfunctions may cause serious harm to people and damage to things, the risks must be assessed and additional safety measures adopted.

 Product is required to be assembled by person with professional certificate according to certain electrical principle. Any repair or replacement is required to done by manufacturer or its approved organizations.

 Ensure correct earthing connections and cable selection as per defined by local legislation or codes. The earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or magnetic MCB. Suitably rated fuses or MCB should be fitted in the mains supply to the drive, according to any local legislation or codes.

 Observe all the general and local safety standards concerning installations of high voltage devices, as well as the regulations for the correct use of the personal protective equipment.

Use this device only for the purposes specified by the manufacturer. Do not make any modifications or replace any components unless recommended by the manufacturer, as these actions may cause fire, electric shock or other damage.

Drives must be installed in a pollution degree of 1, 2 or 3 environment, mounted in a cabinet with IP54 or better. When the product is IP00 (without cover), ensure that there is no plastic 50mm away from the parts or these plastics meet the flame retardant requirements of IEC/EN 60335-1.

2. INTRODUCTION

SD2 is a drive designed to control compressors with sensor-less brushless permanent magnet motors (BLDC) or synchronous permanent magnet motors.

2.1 Functions and main features

- Sensor-less SVPWM sine wave control, which can effectively reduce the high-order harmonic, motor vibration, torque fluctuation and noise.
- The weak magnetic control and MTPA control scheme can improve the compressor operating frequency range.
- Double closed-loop feedback using for control strategy: Outer loop (speed) ensures the stable operating frequency; Inner loop (current) ensures accurate torque output in real time.
- High energy efficiency, miniaturization and high integration, which is convenient for production, testing and maintenance.
- A variety of protection functions (under voltage, over voltage, over current, over temperature, etc.) are implemented through the DSP chip, which ensure the protection response quickly by various digital signal processing algorithms.
- Power factor correction function can reduce the impact on the power grid and increase the voltage of the dc bus as required to improve the operating frequency range, which could help drive to operate at ultra-wide input voltage range (1-Phase Model only).
- USB Programming Function (With external USB Programing tools).
- Reinforced Isolation MODBUS communications.
- Reinforced Isolation High pressure switch interface.
- Reinforced Isolation discharge temperature sensor (DLT) interface.
- Reinforced Isolation 0-10V Analog Input interface.
- The distances are designed based on Pollution degree 3.
- Applicable to the following refrigerant systems:
  A1 refrigerant:
  R410A/R448A/R744/R134a/R22/R417C/R404A/R407C…
  A2L refrigerant:
  R32/ R454A/R454B/R454C/R1234yf/R1234e… (Refrigerant with hot surface ignition temperature higher than 350℃)
  A3 refrigerant:
  R290/R600/R600a/R1270… (Refrigerant with hot surface ignition temperature higher than 350℃)

Note:

- USB Programming function is realized by USB Off-line Programmer, disconnect drive and external control circuits from the power supply, moving the main system switch to “off”.
- This main function of this drive module is compressor drive and control, so that it does not include outdoor fan and electronic expansion valve control, and not supply power to upper computer or other controllers. In principle, these functions are performed by another master board or the upper controller provided from users.

2.2 Models

Considering the development of the new platform, combined with customer demand survey data and power device specifications, the new platform series can be reasonably divided into the following power parts:

Drive Type	Label Name	Rated Voltage	MAX Input Current [A]	MAX Output Current [A]
1-PH Drive	SD2011A2	AC 220-240V 50/60Hz	13	11
	SD2015A2	AC 220-240V 50/60Hz	20	14.5
	SD2020A2	AC 220-240V 50/60Hz	25	20
3-PH Drive	SD2015B4	AC 380-415V 50/60Hz	8	15
	SD2020B4	AC 380-415V 50/60Hz	11	20
	SD2025B4	AC 380-415V 50/60Hz	18	25
	SD2032B4	AC 380-415V 50/60Hz	25	32

Operating environment:-25 ~ 65℃ &Relative humidity 0~95% (no frost & condensation), drive should not be installed in direct sunlight, contaminants such as metal powder, dust, oil and water shall not enter the drive.
Storage environment: -40 ~ 85℃ &Relative humidity 0~95% (no condensation)

Tab.2.1

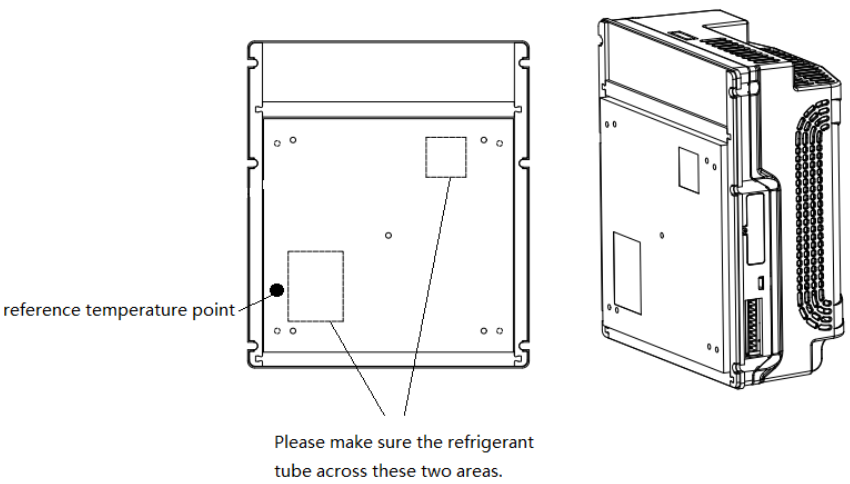
Note:

- MAX Output Current will be affected by environment temperature, heat dissipation and other factors during operation. Therefore, it will have power derating under high temperatures, for reference:

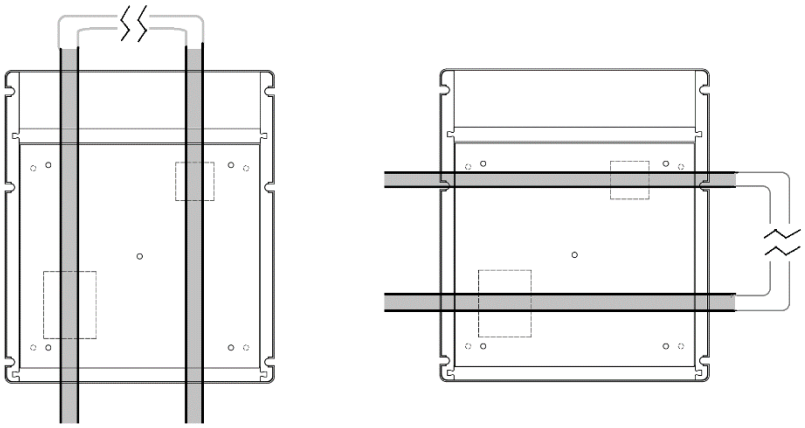
Ambient temperature/℃	≤46	50	55	≥60
Horizontal & vertical heatsink inlet airflow temperature/℃	60	65	69	73
Flat plate reference temperature/℃	65	68	70	75
Load rate	100%	80%	50%	30%

Tab.2.2

For horizontal & vertical heatsink models (SD20****H******& SD20****V******):
SD2011A2, SD2015A2, SD2020A2, SD2015B4, SD2020B4 and SD2025B4 are required to be used when the speed of airflow is at least 1m/s which is measured at the outlet of heat sink in the direction of airflow. SD2032B4 is required to be used when the speed of airflow is at least 2m/s.
For plat plate heatsink models (SD20****F******):
The drive shall be liquid cooled. Additional liquid tube and cover plate should be mounted to the SD2 drive. These components shall be designed by user. Please make sure that the reference point temperature of flat plate need to be lower than the reference value. Avoid condensation, the liquid temperature in the tube should not be too low.



Recommended liquid tube layout：



- The output mechanical frequency range depends on specific compressors.

2.2.1 Power supply of drive

The drive can be used in the following power supply environments:

	1-PH	3-PH	Remark
Fully Load Operation Voltage	AC200V~240V	AC360V~440V	Nominal
Working Voltage range	AC176V~264V	AC320V~480V	Not marked on Nameplate
Allowable input range	≤AC 300V	AC240V~520V	No damage at 1sec transient
Power Supply Frequency: 50/60Hz ±5%			

Tab.2.3

2.2.2 Accessories

Drive Type	Label Name	Accessories
1-PH Drive	SD2011A2	/
	SD2015A2	/
	SD2020A2	/
3-PH Drive	SD2015B4	Choke: 3*LE76-0825
	SD2020B4	Choke: 3*LE105-1325
	SD2025B4	Choke: 3*LE85.8-2503B
	SD2032B4	Choke: 1*R3515

Tab.2.4

2.3 Naming rules

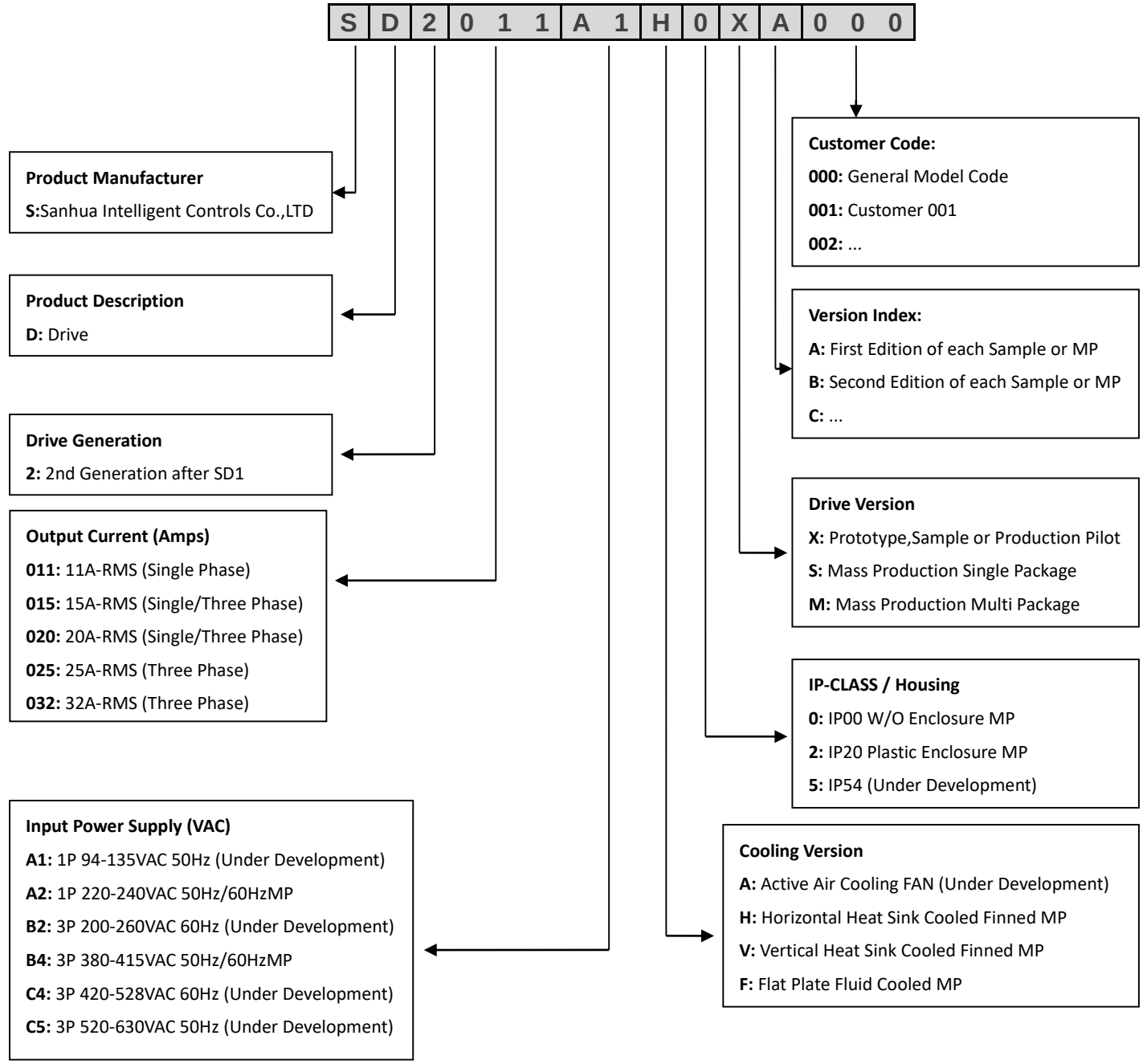


Fig.2.1

3. INSTALLATION

3.1 SD2011A2/ SD2015A2

Single-Phase Series Variable Speed Drives applied for DC compressor. It is composed of EMI/EMC Filter, rectification, SMPS circuit, PFC circuit, IPM module, microprocessor control, charging circuit, communication circuit, and chokes for harmonic.

3.1.1 Label information

SD2 is identified by a rating plate located on the right side of the device, which describes the code, serial number, and production date and revision number.

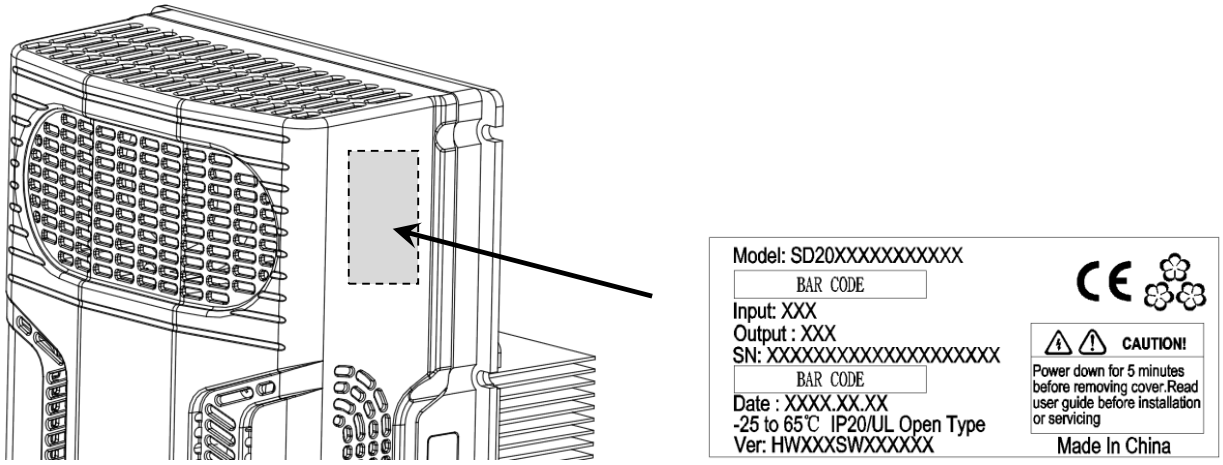


Fig.3.1

3.1.2 Structure

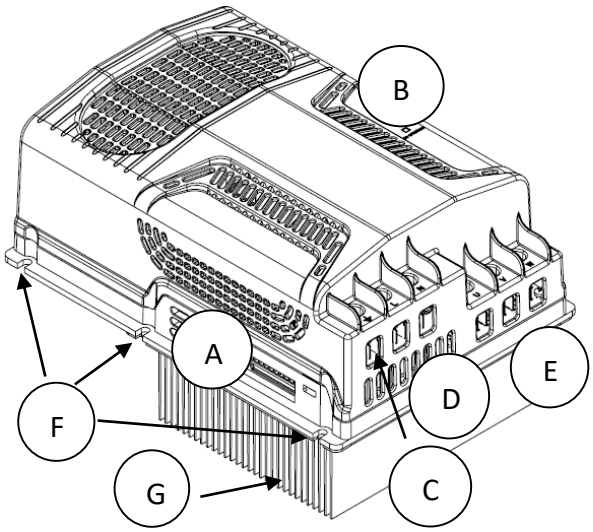


Fig.3.2

Ref.	Description
A	Terminal block for control connections (SELV)
B	Operating status LED
C	PE
D	Terminal block for power connections(L,N)
E	Terminal block for output connections(U,V,W)
F	Fastening brackets
G	Heat sink(sizes vary from different models)

Tab.3.1

3.1.3 Dimensions

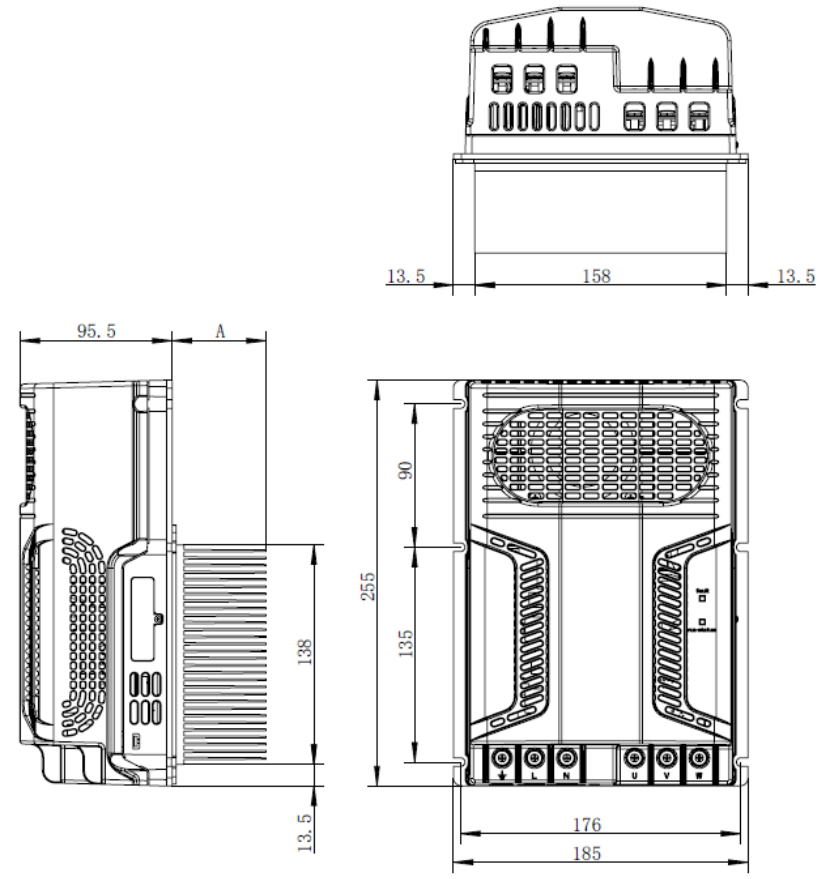


Fig.3.3

Dimensions (mm)

Model	Size	A(height of different Cooling version)			Weight(kg)		
		H-horizontal	V-vertical	F-flat plate	H-horizontal	V-vertical	F-flat plate
SD2011A2	255*185*(95.5+A)	39.5	39.5	8	2.38	2.38	2.24
SD2015A2	255*185*(95.5+A)	59	59	8	3.59	3.59	2.79

Tab.3.2

3.1.4 Drilling and assembly

Make a hole with dimensions of the dashed area, where the heat sink will be fitted, and holes for fastening the left and right side brackets. Use M4 screws for drives installation.

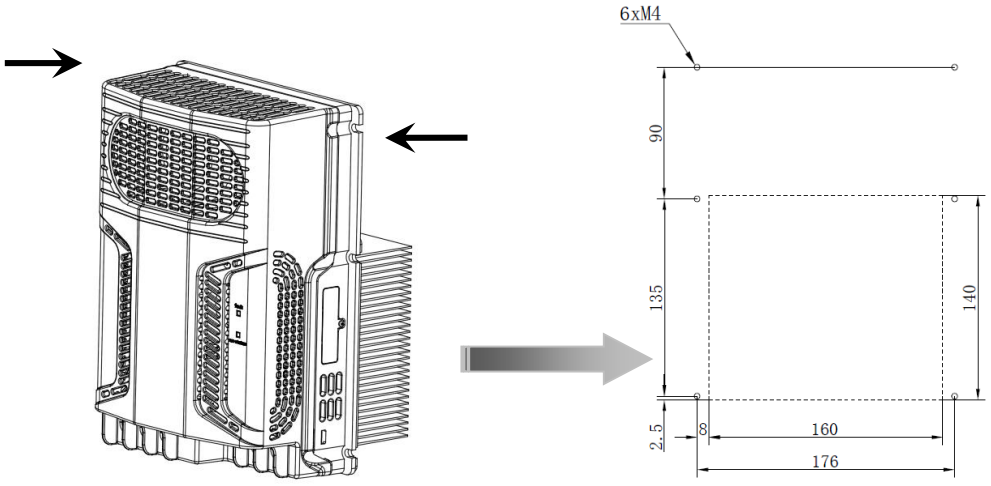


Fig.3.4

- **Installation of cold plate**

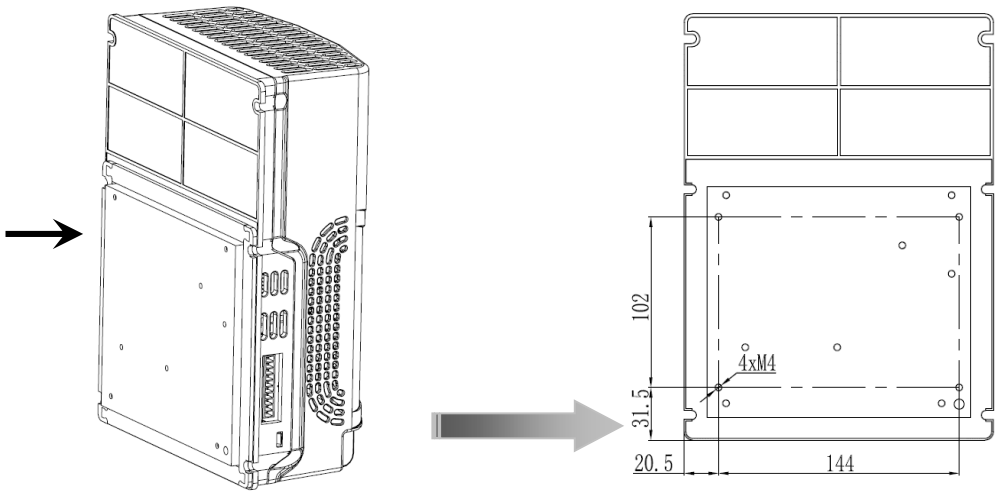


Fig.3.5

Note: The size and position of installation screw holes can be customized by customer.

3.1.5 Cooling

Figure3.5 shows the minimum clearances to other components near the drive. To have a better cooling it is recommended to mount the drive in the lower or middle part of the cabinet. Please insure that the drive is mounted in a way to have a possibility of good natural convection.

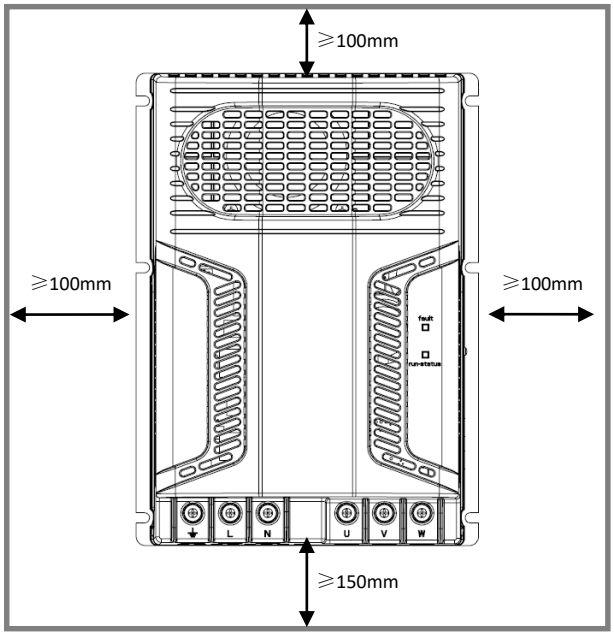


Fig.3.6

3.1.6 Functional layout

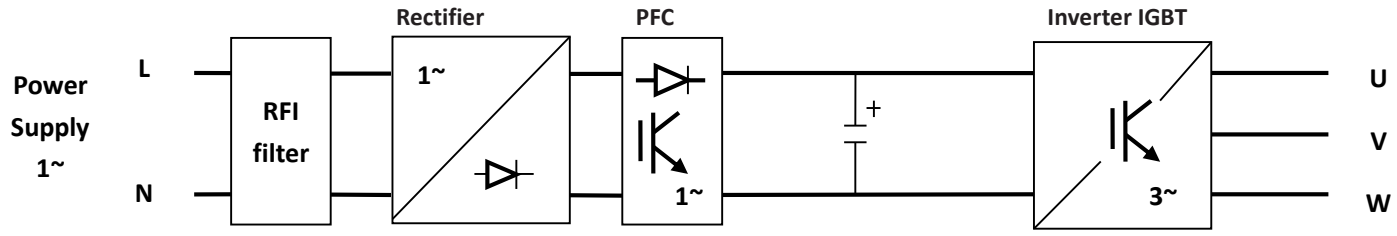


Fig.3.7

3.1.7 Electrical installation

3.1.7.1 General connection diagram

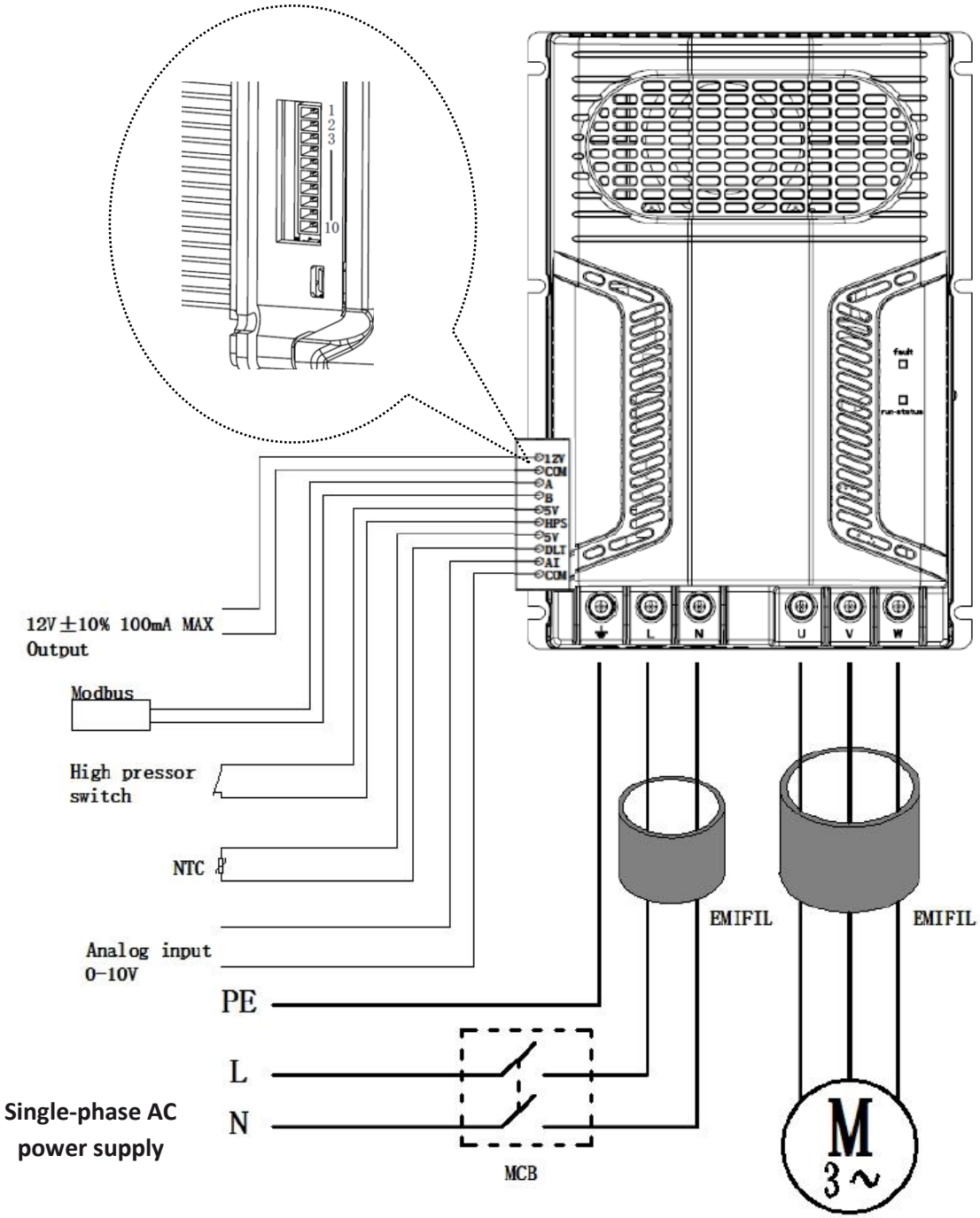


Fig.3.8

3.1.7.2 Description of the terminal

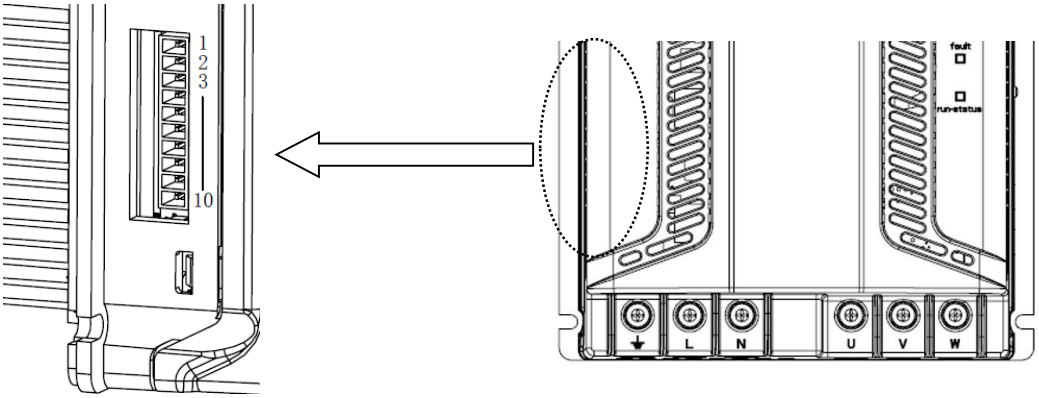


Fig.3.9

Ref.	Description	
⏚Earth	Single-phase power supply input	
L,N		
U,V,W	Motor output	
Communication interface(CN21)		
1	12Vdc	12Vdc Output,100mA Max
2	COM_GND	
3	A	RS485/ModBus
4	B	
5	5Vdc	High pressure switch input
6	HPS	
7	5Vdc	Input of discharge temperature sensor
8	DLT	
9	AI	0~10Vdc detecting input
10	COM_GND	
LED display	Fault(red)	drive alarm
	run-status(yellow/green)	drive standby/ drive running

Tab.3.3

Important: If communication interface of high pressure switch input (No.5&6) is not used by customer, short circuit must be implemented in between No.5&6, otherwise, drive will not work.

Note: The type of communication terminal is EC381V-10P, which is not included in accessories.

3.1.7.3 Electrical connection

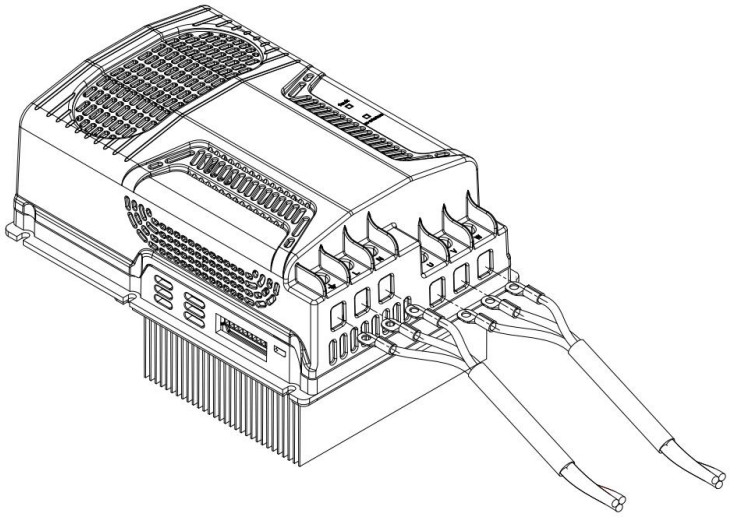


Fig.3.10

- **Cable selection**

Model	Max drive Input Current [A]	Min power cable cross section(mm2)	Max drive output Current [A]	Min motor cable cross-section (mm2)	Max motor cable length (m)
SD2011A2	13	1.5	11	1.5	15
SD2015A2	20	2.5	14.5	2.5	15

Tab.3.4

- **O terminal recommendation**

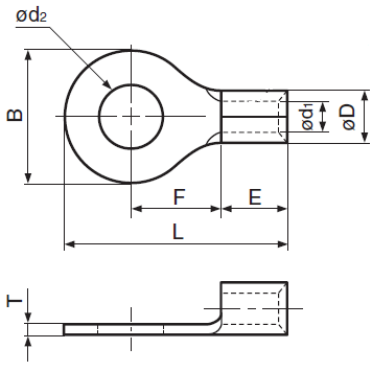


Fig.3.11

Dimension (mm)	Φd2	B	F	E	ΦD	Φd1	T
	5.3	8~10	≥8.3	4.8~6.8	Determined by cable selection		1.0~1.2

Tab.3.5

Important: the max tightening torque is:

- Power terminals: 1.5 Nm;
- Control terminals: 0.5 Nm.

Important: O terminal should be used together with heat shrink tube in case of bare wire.

3.2 SD2020A2

Single-Phase Series Variable Speed Drive is applied for DC compressor. It is composed of EMI/EMC Filter, rectification, SMPS circuit, PFC circuit, IPM module, microprocessor control, charging circuit, communication circuit, and chokes for harmonics.

3.2.1 Label information

SD2 is identified by a rating plate located on the right side of the device, which describes the code, serial number, production date and revision number.

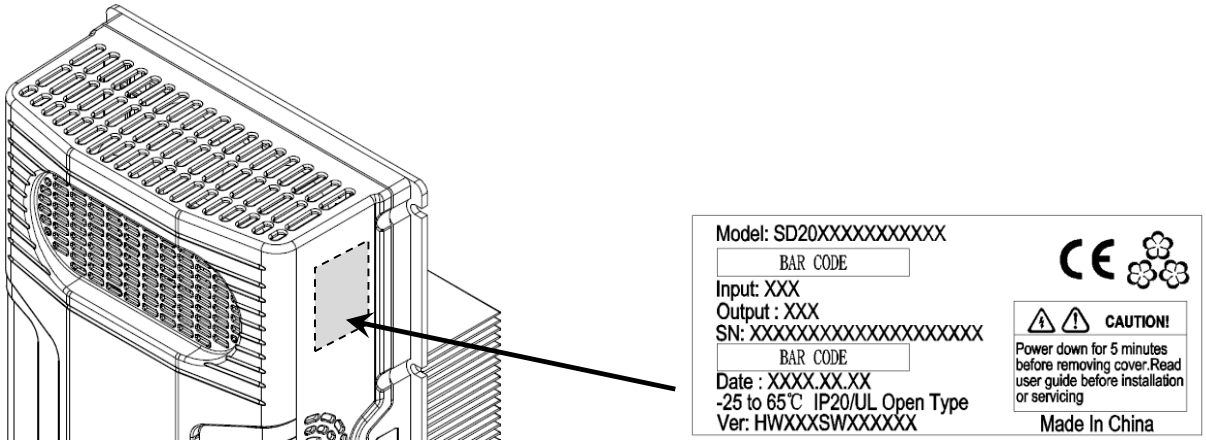


Fig.3.12

3.2.2 Structure

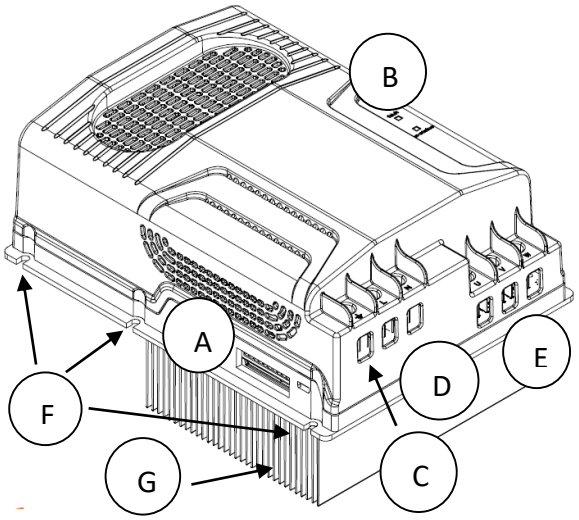


Fig.3.13

Ref.	Description
A	Terminal block for control connections (SELV)
B	Operating status LED
C	PE
D	Terminal block for power connections(L,N)
E	Terminal block for output connections(U,V,W)
F	Fastening brackets
G	Heat sink(sizes vary from different models)

Tab.3.6

3.2.3 Dimensions

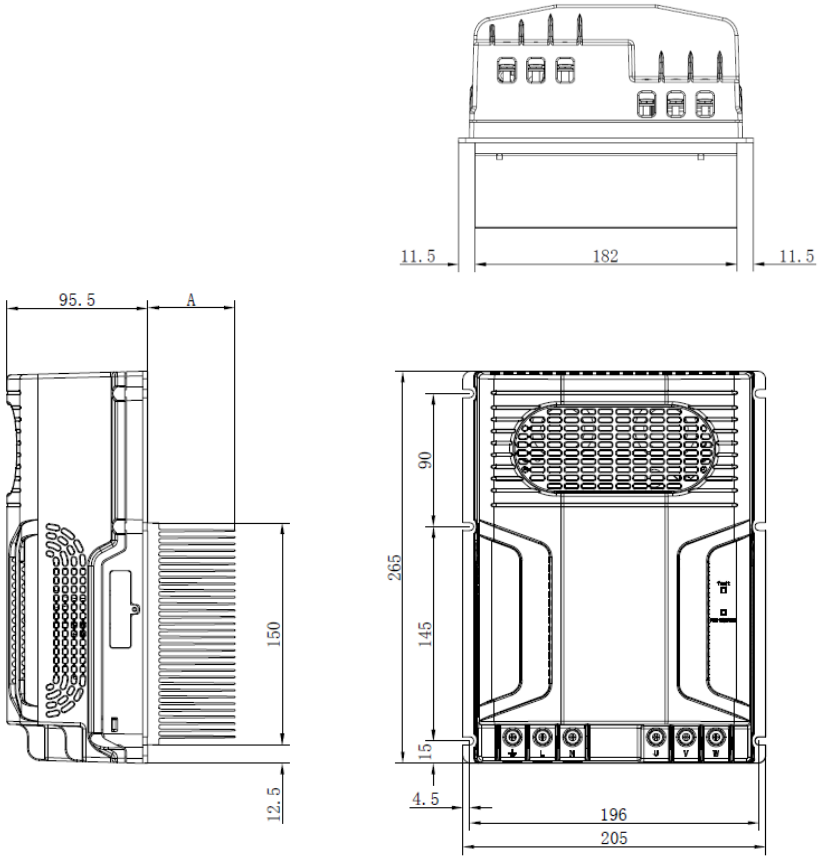


Fig.3.14

Dimensions (mm)

Model	Size	A(height of different Cooling version)			Weight(kg)		
		H-horizontal	V-vertical	F-flat plate	H-horizontal	V-vertical	F-flat plate
SD2020A2	265*205*(95.5+A)	59	59	8	3.95	3.95	2.95

Tab.3.7

3.2.4 Drilling and assembly

Make a hole with dimensions of the dashed area, where the heat sink will be fitted, and holes for fastening the left and right side brackets. Use M4 screws for drives installation.

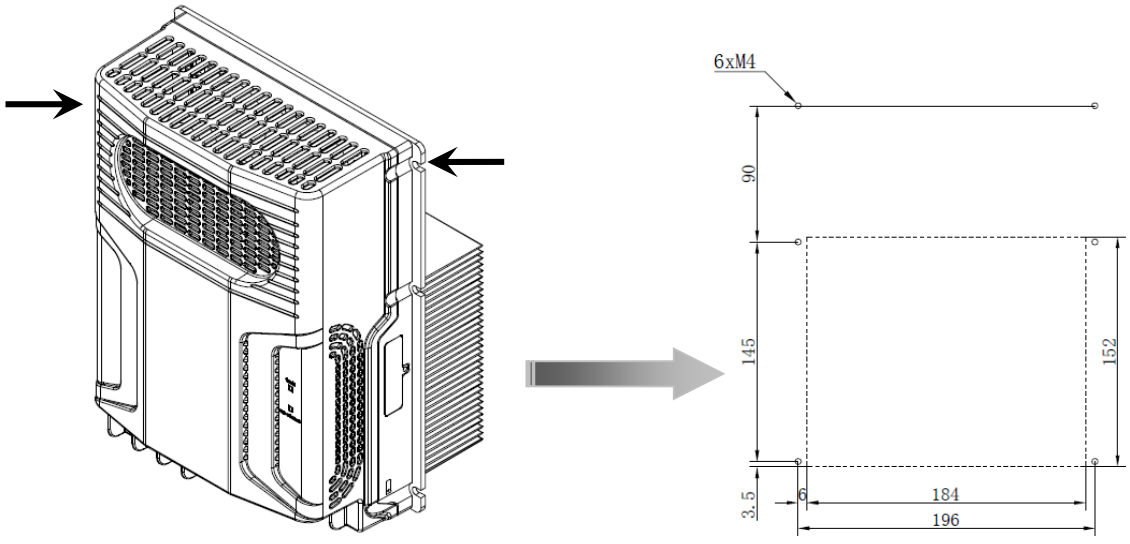


Fig.3.15

- **Installation of cold plate**

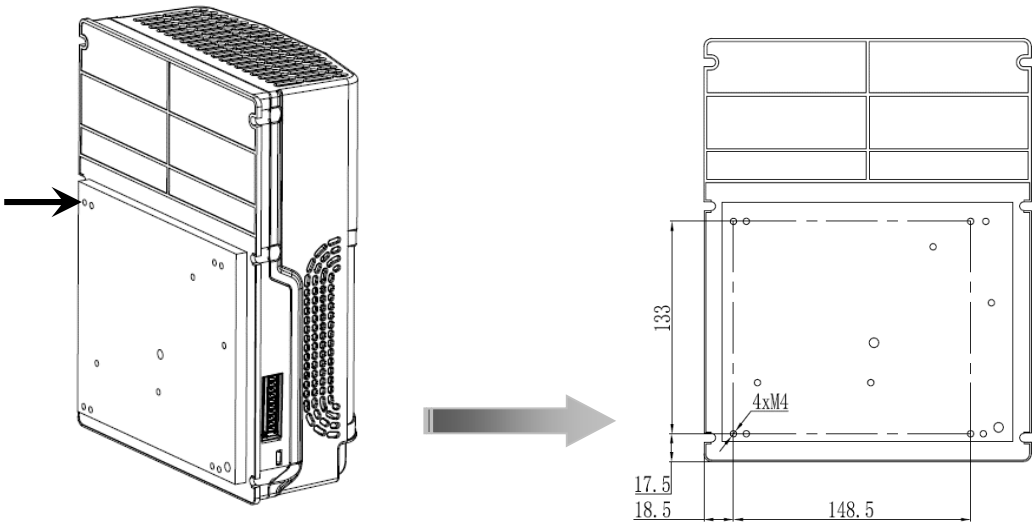


Fig.3.16

Note: The size and position of installation screw holes can be customized by customer.

3.2.5 Cooling

Figure 3.13 shows the minimum clearances to other components near the drive. To have a better cooling it is recommended to mount the drive in the lower or middle part of the cabinet. Please insure that the drive is mounted in a way to have a possibility of good natural convection.

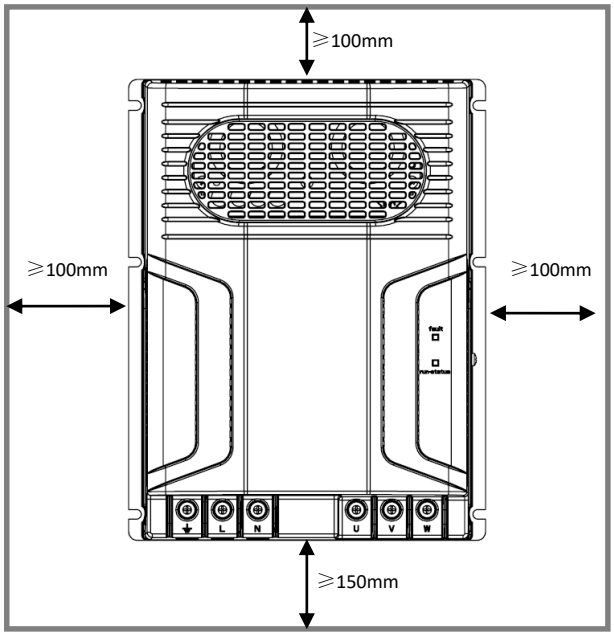


Fig.3.17

3.2.6 Functional layout

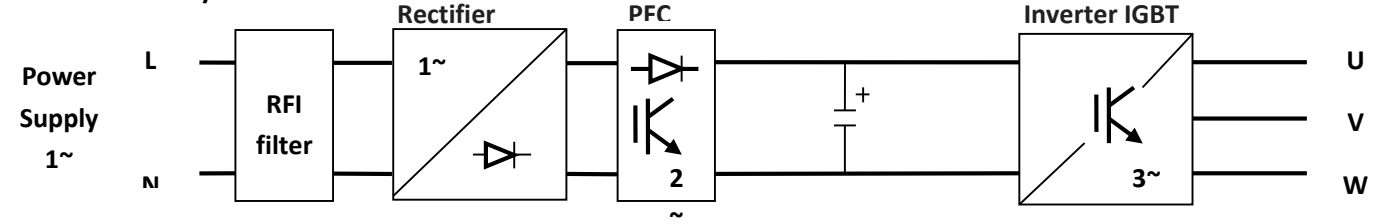


Fig.3.18

3.2.7 Electrical installation

3.2.7.1 General connection diagram

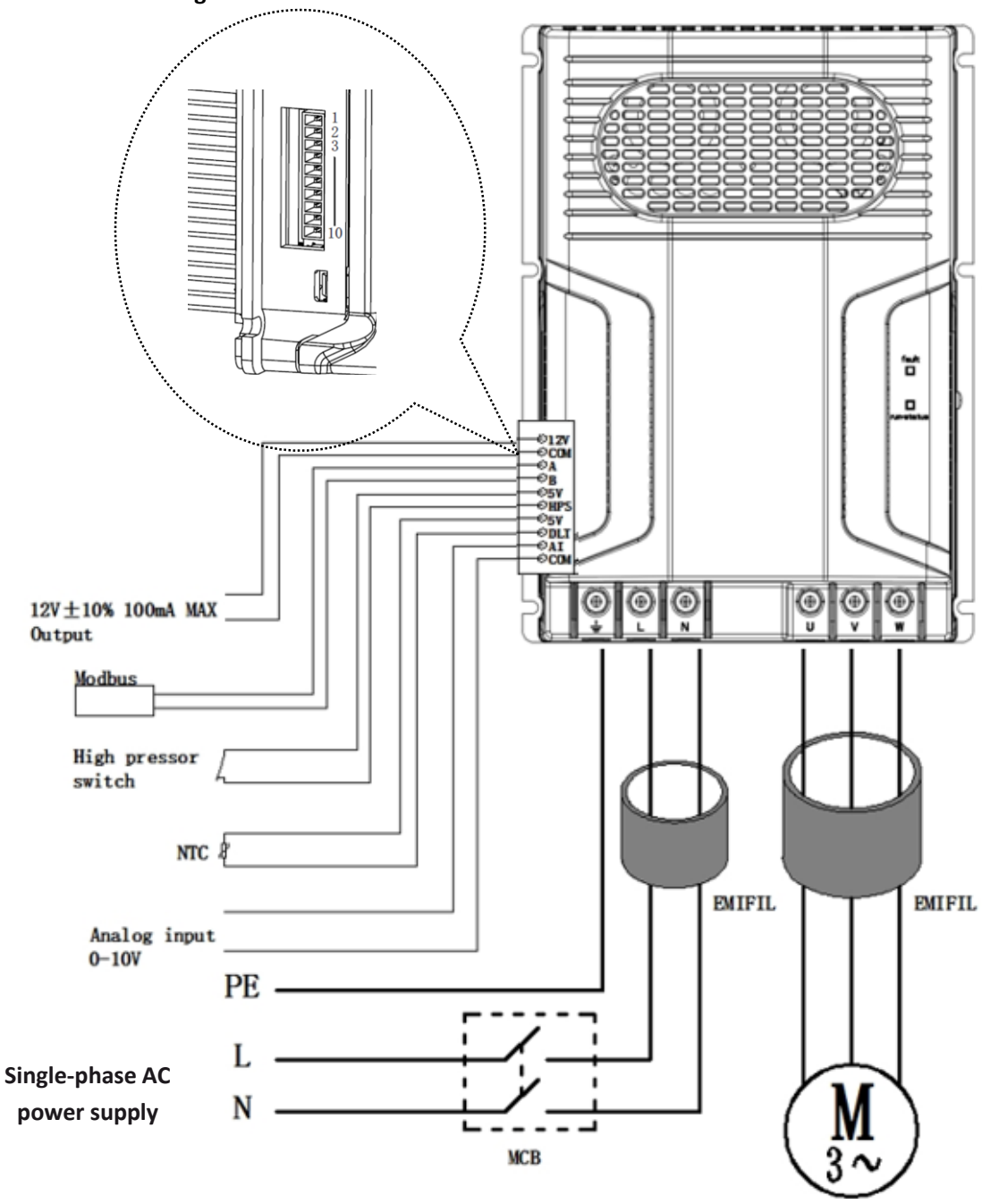


Fig.3.19

3.2.7.2 Description of the terminals

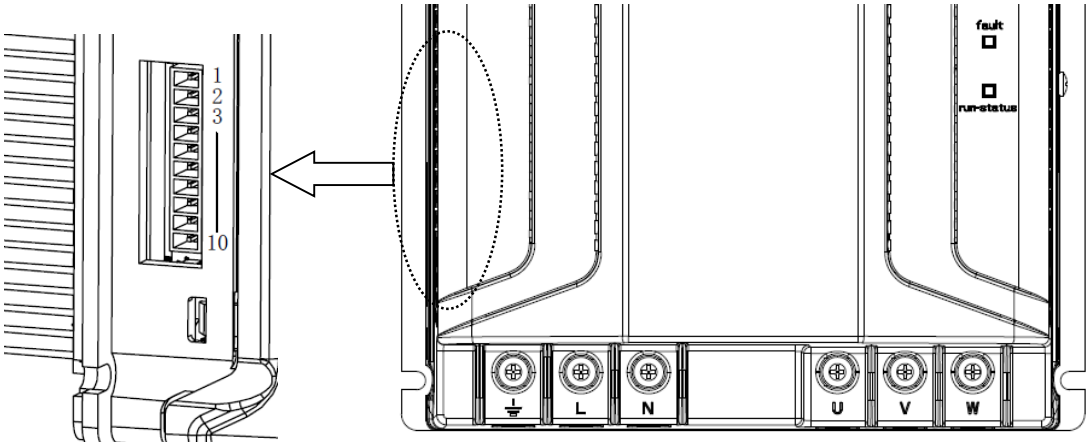


Fig.3.20

Ref.	Description	
⏚ Earth	Single-phase power supply input	
L,N		
U,V,W	Motor output	
Communication interface(CN21)		
1	12Vdc	12Vdc Output,100mA Max
2	COM_GND	
3	A	RS485/ModBus
4	B	
5	5Vdc	High pressure switch input
6	HPS	
7	5Vdc	Input of discharge temperature sensor
8	DLT	
9	AI	0~10Vdc detecting input
10	COM_GND	
LED	Fault(red)	drive alarm
display	run-status(yellow/green)	drive standby/ drive running

Tab.3.8

Important: If communication interface of high pressure switch input (No.5&6) is not used by customer, short circuit must be implemented in between No.5&6, otherwise, drive will not work.

Note: The type of communication terminal is EC381V-10P, which is not included in accessories.

3.2.7.3 Electrical connection

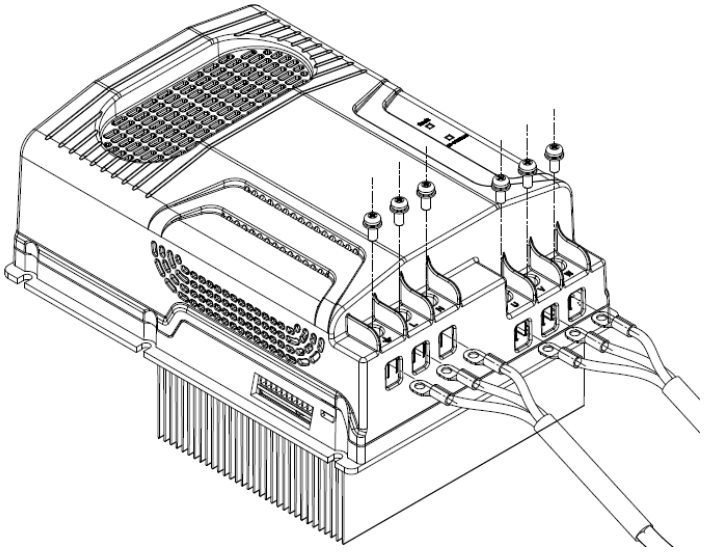


Fig.3.21

- **Cable selection**

Model	Max drive Input Current [A]	Min power cable cross section(mm2)	Max drive output Current [A]	Min motor cable cross-section (mm2)	Max motor cable length (m)
SD2020A2	25	4	20	2.5	15

Tab.3.9

- **O terminal recommendation**

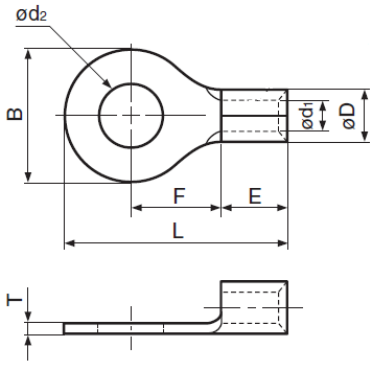


Fig.3.22

	Φd2	B	F	E	ΦD	Φd1	T
Dimension (mm)	5.3	8~10	≥8.3	4.8~6.8	Determined by cable selection		1.0~1.2

Tab.3.10

Important: the max tightening torque is:

- Power terminals: 1.5 Nm;
- Control terminals: 0.5 Nm.

Important: O terminal should be used together with heat shrink tube in case of bare wire.

3.3 SD2015B4/SD2020B4/SD2025B4/SD2032B4

Three-Phase Series Variable Speed Drive is applied for BLDC compressor. It is composed of EMI/EMC Filter, rectification, SMPS circuit, PIM module, microprocessor control, charging circuit, communication circuit, and external chokes as optional parts for harmonics.

3.3.1 Label information

SD2 is identified by a rating plate located on the right side of the device, which describes the code, serial number, production date and revision number.

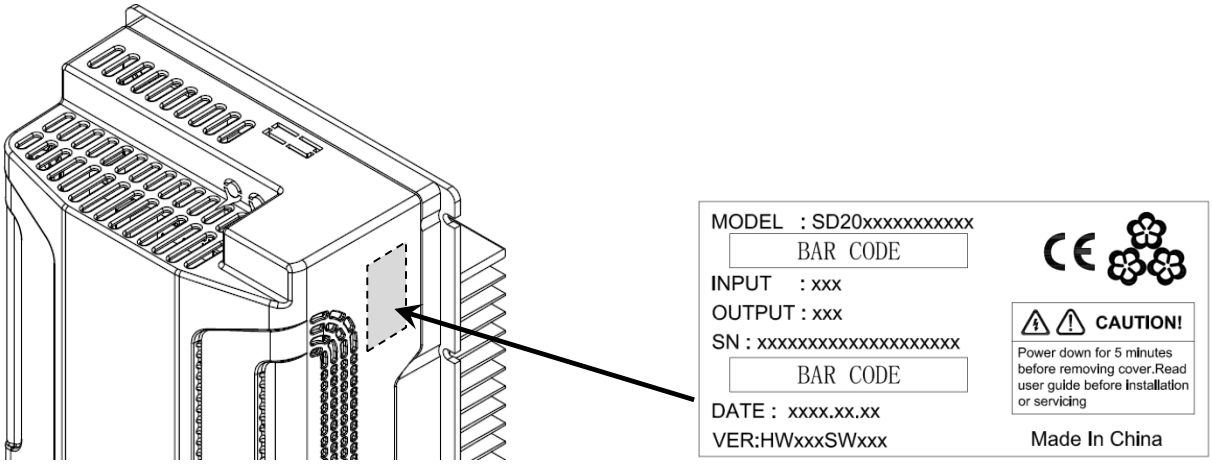


Fig.3.23

3.3.2 Structure

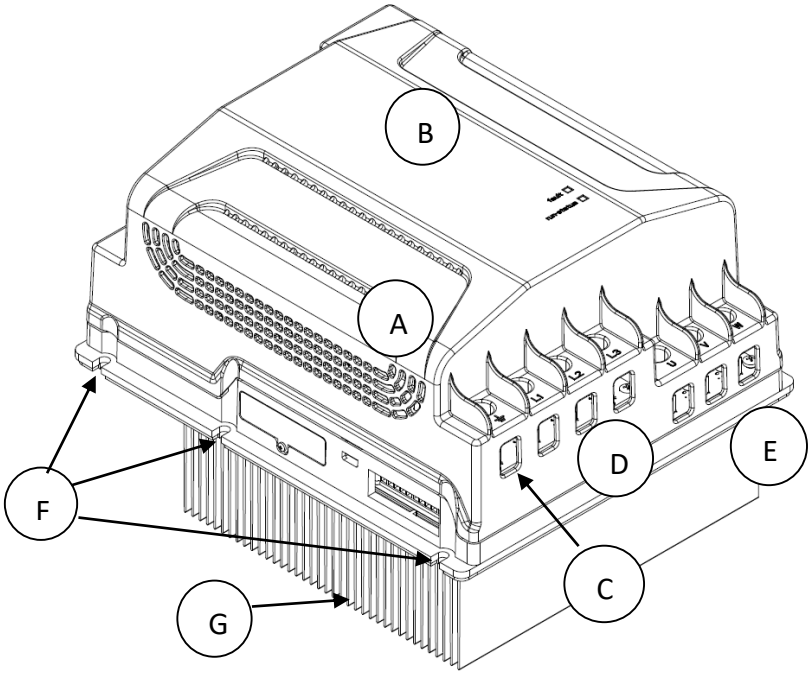


Fig.3.24

Ref.	Description
A	Terminal block for control connections (SELV)
B	Operating status LED
C	PE
D	Terminal block for power connections(L1,L2,L3)

E	Terminal block for output connections(U,V,W)
F	Fastening brackets
G	Heat sink(sizes vary from different models)

Tab.3.11

3.3.3 Dimensions

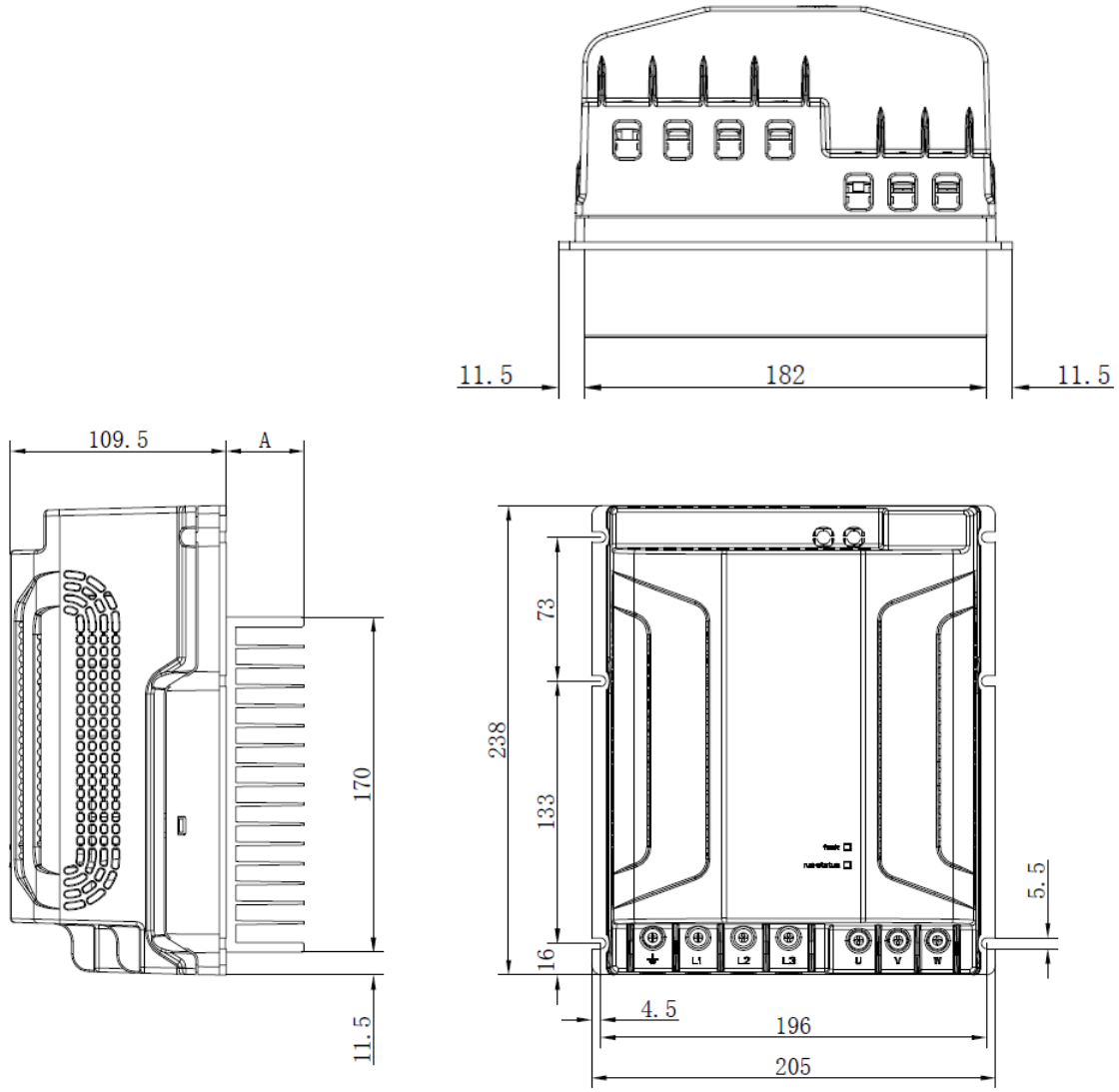


Fig.3.25

Dimensions (mm)

Model	Size	A(height of different Cooling version)			Weight(kg)		
		H-horizontal	V-vertical	F-flat plate	H-horizontal	V-vertical	F-flat plate
SD2015B4	238*205*(109.5+A)	39.5	39.5	8	3.10	3.10	2.40
SD2020B4	238*205*(109.5+A)	59	59	8	3.84	3.84	2.61
SD2025B4	238*205*(109.5+A)	59	59	8	4.46	4.46	2.98
SD2032B4	238*205*(109.5+A)	69	69	8	4.14	4.14	3.13

Tab.3.12

Three-phase models are supplied together with chokes to be externally connected to the drives.

Dimensions (mm)

Model	Name	A	B	C	D	E	F	Weight(kg)
SD2015B4	LE76-0825	64	64	78	76.2	65	5.2	1.5
SD2020B4	LE105-1325	88	90	105	110	89	6	3.9
SD2025B4	LE85.8-2503B	64	64	76.2	78	73	4	2
SD2032B4	R3515	79	88	93.2	112.5	73.5	5.8*16	1.86

Tab.3.13

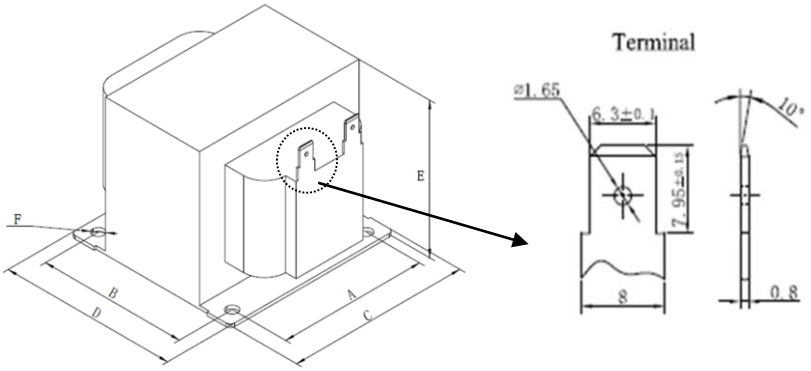
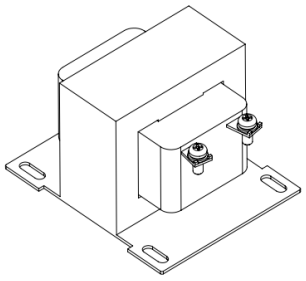


Fig.3.26

*Note: This choke use different connection style with M5 screw (see the figure below).



Note **:For the SD2025B4 and SD2032B4, the grid must provide a RSCE ⩾ 120Ω, together with a system input current of ⩾ 16A on each phase to be in line with the EN 61000-3-12.**

3.3.4 Drilling and assembly

Make a hole with dimensions of the dashed area, where the heat sink will be fitted, and holes for fastening the left and right side brackets. Use M4 screws for drives installation.

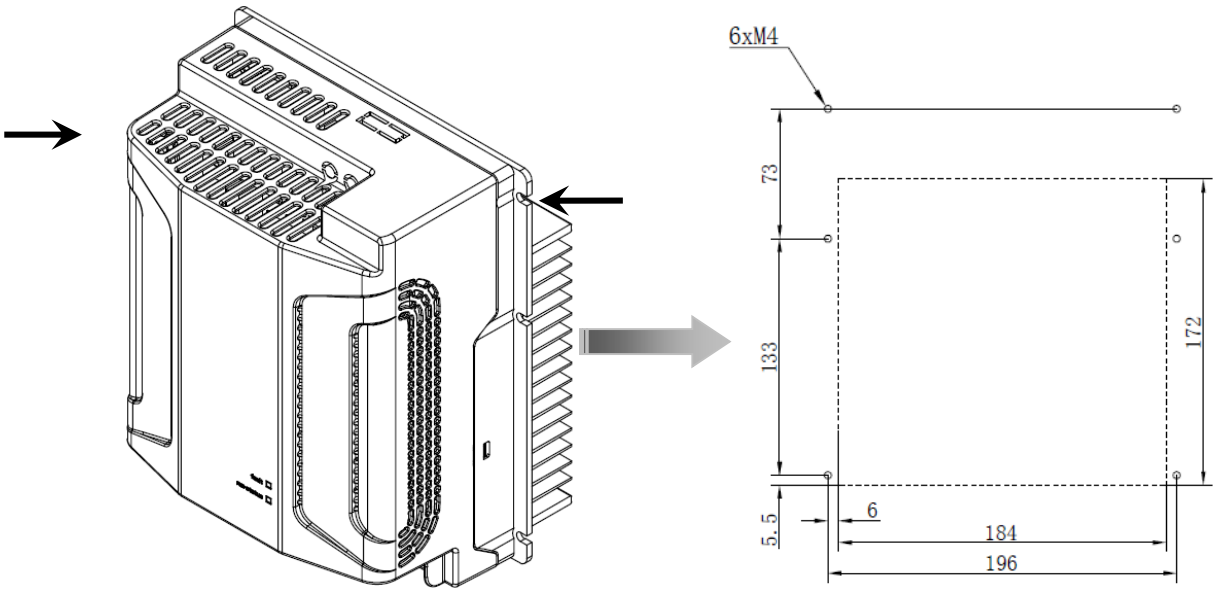


Fig.3.27

- **Installation of cold plate**

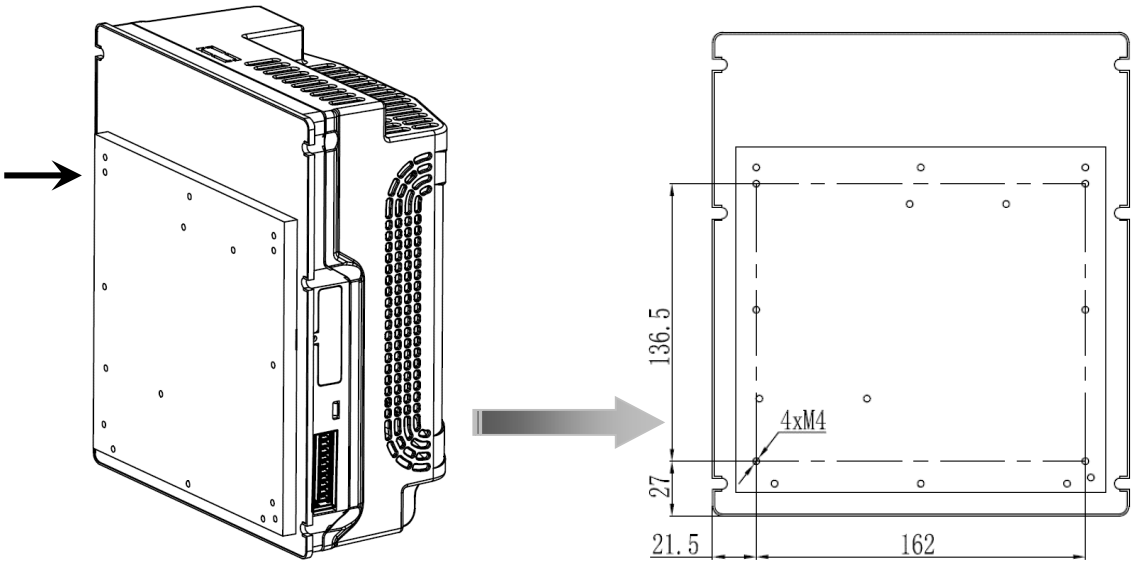


Fig.3.28

Note: The size and position of installation screw holes can be customized by customer.

3.3.5 Cooling

Figure 3.22 shows the minimum clearances to other components near the drive. To have a better cooling it is recommended to mount the drive in the lower or middle part of the cabinet. Please insure that the drive is mounted in a way to have a possibility of good natural convection.

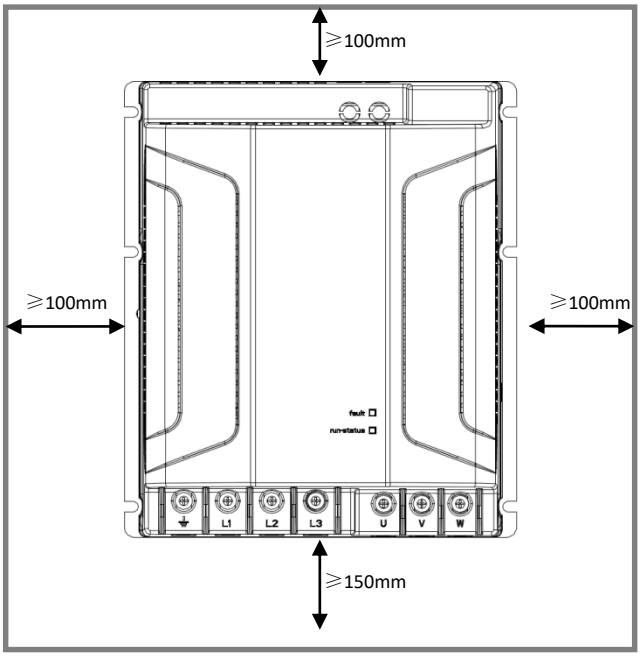
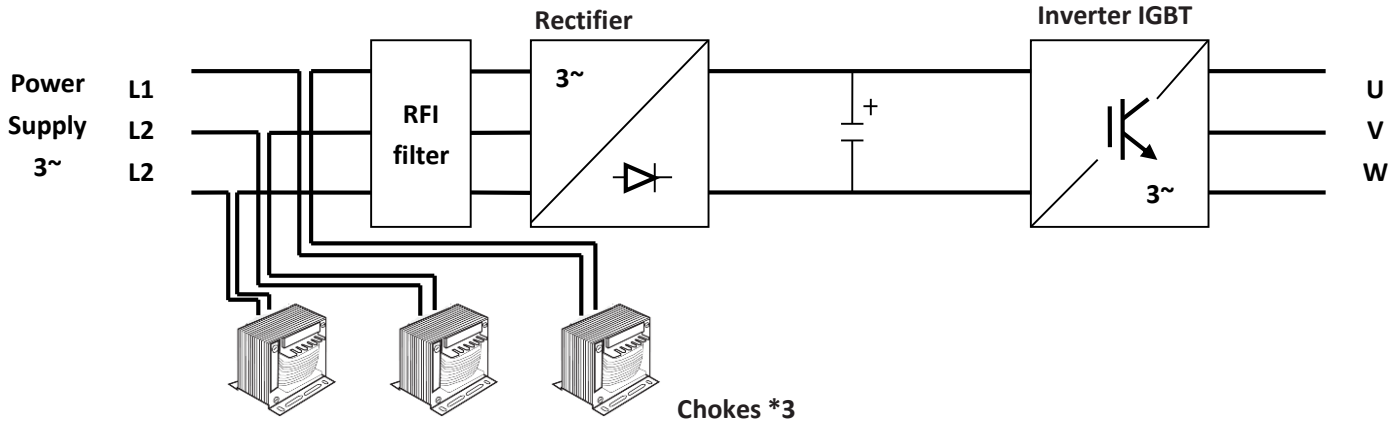


Fig.3.29

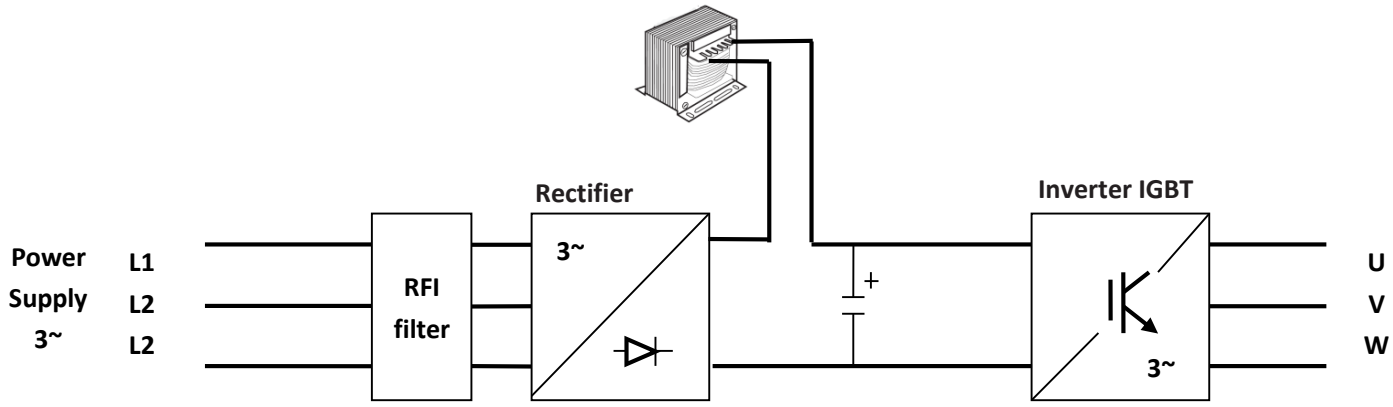
3.3.6 Functional layout(SD2015B4/SD2020B4/SD2025B4)



Note：These chokes are to be installed externally to the Drive.

Fig.3.30

3.3.7 Functional layout (SD2032B4)



Choke *1

Note：This choke is to be installed externally to the Drive.

Fig.3.31

3.3.8 Electrical connections

3.3.8.1 General connection diagram (SD2015B4/SD2020B4/SD2025B4)

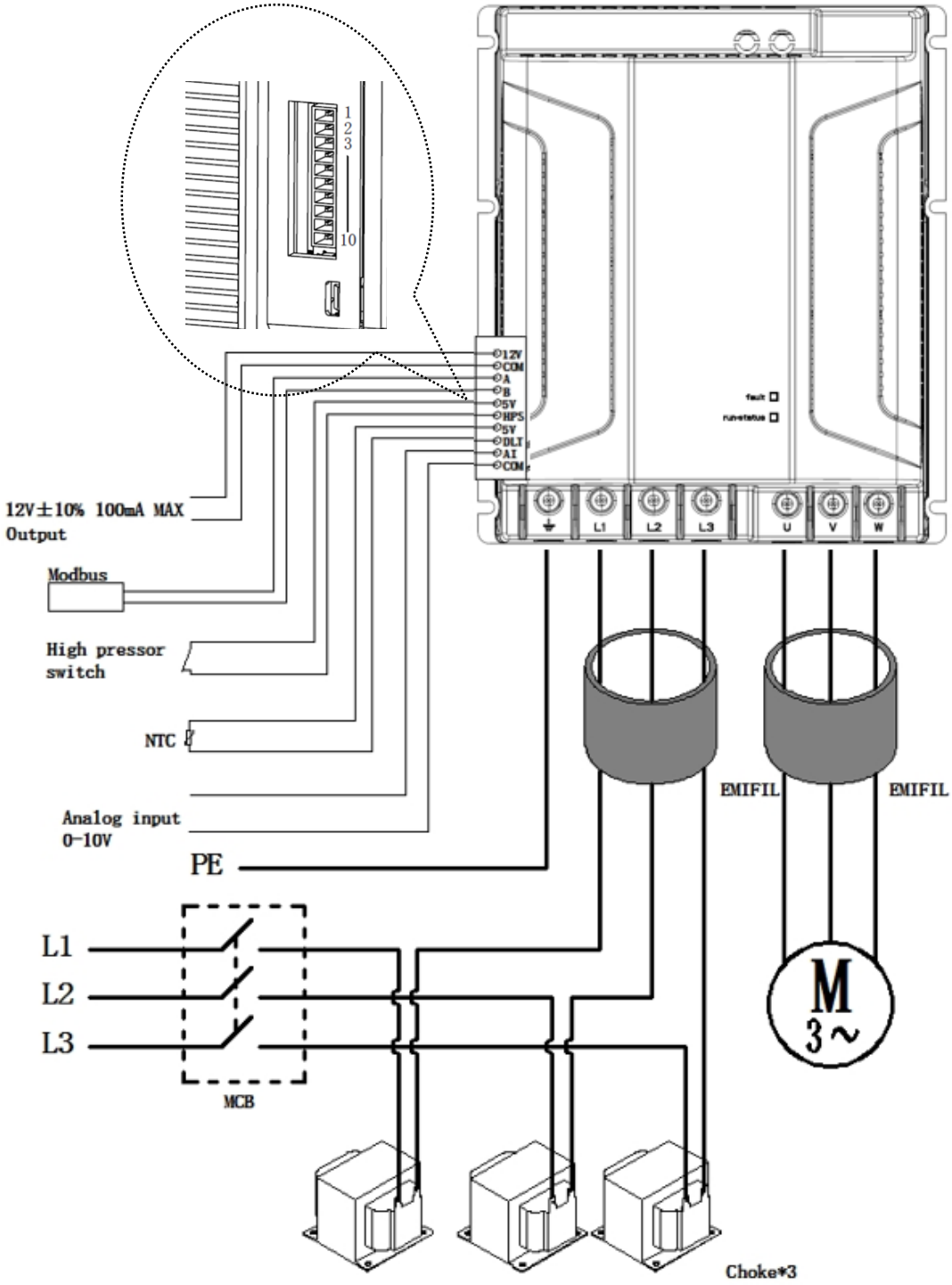
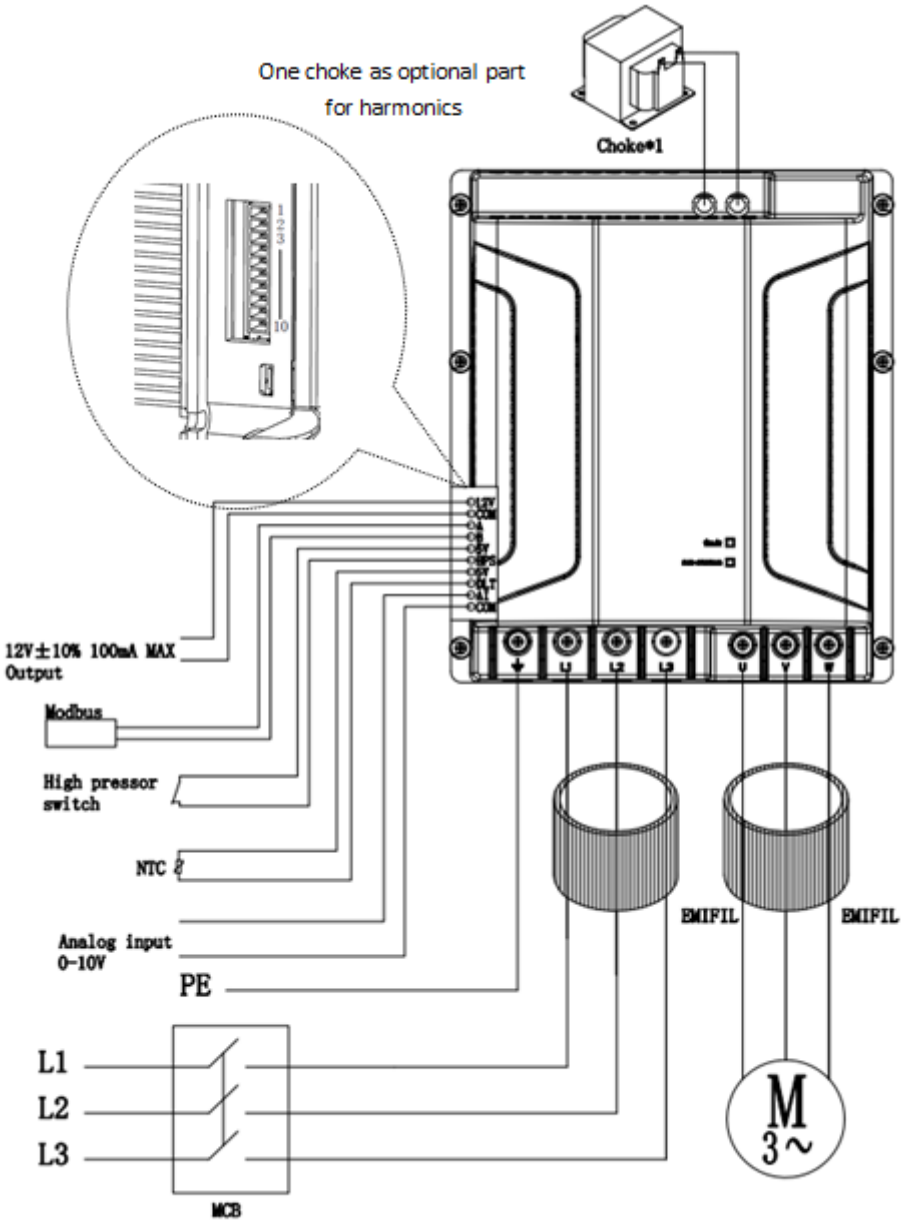


Fig.3.32

3.3.8.2 General connection diagram (SD2032B4)



EMIFIL could be assembled according to EMI requirement

Fig.3.33

3.3.8.3 Description of the terminals

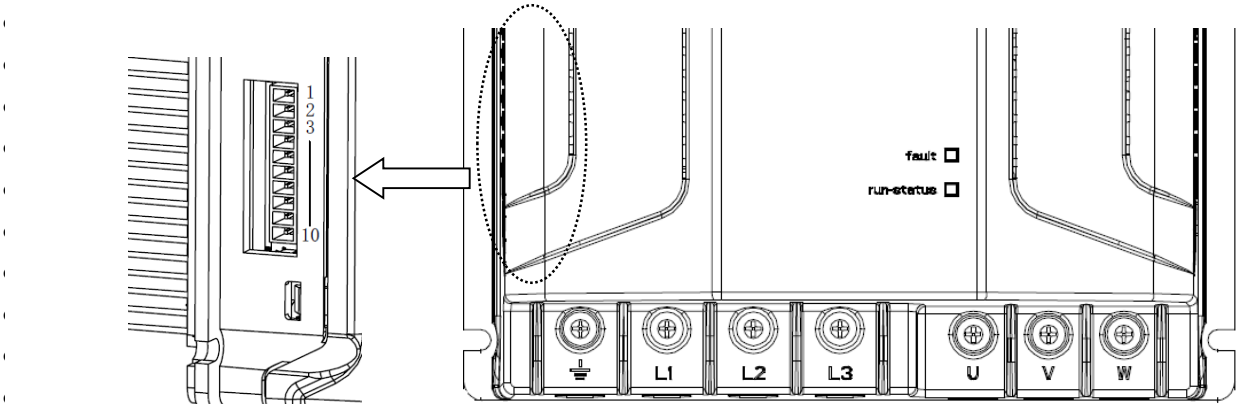


Fig.3.34

Ref.	Description	
⏚ Earth	Three-phase power supply input	
L1,L2,L3		
U,V,W	Motor output	
Communication interface(CN21)		
1	12Vdc	12Vdc Output,100mA Max
2	COM_GND	
3	A	RS485/ModBus
4	B	
5	5Vdc	High pressure switch input
6	HPS	
7	5Vdc	Input of discharge temperature sensor
8	DLT	
9	AI	0~10Vdc detecting input
10	COM_GND	
LED	Fault(red)	drive alarm
display	run-status(yellow/green)	drive standby/ drive running

Tab.3.14

Note: The type of communication terminal is EC381V-10P, which is not included in accessories.

3.3.8.4 Electrical connection

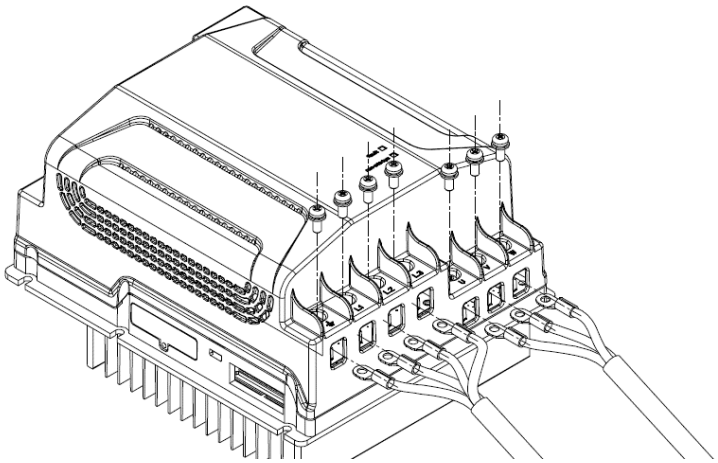


Fig.3.35

- **Cable selection**

Model	Max drive Input Current [A]	Min power cable cross section(mm2)	Max drive output Current [A]	Min motor cable cross-section (mm2)	Max motor cable length (m)
SD2015B4	8	1	15	1.5	15
SD2020B4	11	1.5	20	2.5	15
SD2025B4	18	2.5	25	4	15
SD2032B4	22	4	32	4	15

Tab.3.15

- **O terminal recommendation**

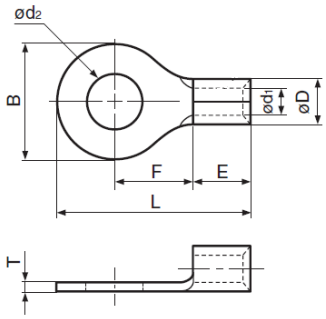


Fig.3.36

Dimension (mm)	Φd2	B	F	E	ΦD	Φd1	T
	5.3	8~10	≥8.3	4.8~6.8	Determined by cable selection		1.0~1.2

Tab.3.16

Important: the max tightening torque is:

- Power terminals: 1.5 Nm;
- Control terminals: 0.5 Nm.

Important: O terminal should be used together with heat shrink tube in case of bare wire.

4. START-UP

Before starting up, the drive needs configuration settings including communication and compressor parameters.

4.1 Default communication parameters setting and update

Communication interface: RS485, Modbus RTU slave, half-duplex, baud rate: 300~57600bps.
When Registe1. bit0=1, drive will use the communication parameters in user parameters.
The Modbus functions are:

Function number	Description
03(0x03)	Holding register reading
04(0x04)	Input register reading
06(0x06)	Single register writing
16(0x10)	Multiple register writing

Tab. 4.1

Mod. Add.	R/W	Description	Def	Min	Max	U.M.
1	R/W	Bit0:0-Do nothing;1-Updata communication config. (Inverter auto clear this Bit.)	0	0	1	-
		Bit1:0-Do nothing; 1-Initial user parameters. (Inverter auto clear this Bit.)	0	0	1	
		Bit15-2: Reserved	0	0	0	
128	R/W	Bit7-0: Set modbus address.	1	1	246	-
	R/W	Bit15-8: Reserved.	0	0	0	-
129	R/W	Bit11-0:Set baudrate 1-300;2-600;3-1200;4-2400;5-4800;6-9600; 7-19200; 8-38400; 9-57600; others-19200.	7	0	9	-
	R/W	Bit13-12:Set parity/stop 0-noparity/2stop; 1-odd/1stop; 2-even/1stop; 3-no parity/1stop.	2	0	2	
	R/W	Bit15-14: Reserved.	0	0	0	
130	R/W	Lost communication with host timeout.	30	0	600	s

Tab. 4.2

The default communication setting in 5s after power up is address 247, baud rate 19200bps, even parity and 1 stop bit. If communication data received from the host during this 5s, the communication setting is in use. If not, the communication setting of user parameters applies.

4.2 Compressor parameters selection

During standby status, user can choose different compressor parameters by changing Register 2 code.

- When Register 2=0, drive will run the user defined compressor parameter.
- When Register2 is not 0, the value is the selected compressor number in EEPROM. If the selected number does not exist, the drive will have an EE abnormal fault alarm.

Mod. Add.	R/W	Description	Def	Min	Max	U.M.
2	R/W	Bit7-0: 0-Select user-set compressor parameters; x-Select the compressor parameters corresponding to the number in EEPROM.(The setting takes effect when the inverter is stopped.)	0	0	255	-
		Bit15-8: Reserved	0	0	0	
12	R	Bit7-0:0-User-set compressor parameters; x-The compressor parameters corresponding to the number in EEPROM.	-	0	255	-
		Bit15-8: The total number of compressor parameters available in EEPROM.	-	0	255	-

Tab. 4.3

4.3 Compressor start control

Only when [0~10V I/F Enable] Registe0.bit15=0, the Modbus can be used to control the drive, otherwise, the drive is controlled by the 0~10V interface voltage as follows:

0-10V interface voltage	Functions
V＜0.4V	Stop/restore
0.4V≤V＜0.6V	Stop/stator heater (10%)
0.6V≤V＜1.5V	Stator heater: Target frequency= The Max frequency of stator heater *(V-0.5)
1.5V≤V＜2.0V	Stator heater (100%)/compressor working frequency(12.5%)[15Hz]
2.0V≤V＜9.0V	Compressor running: Target frequency= Max frequency*(V-1.0)/8.0
9.0V≤V	Compressor running: Target frequency= Max frequency

Tab. 4.4

When using Modbus protocol control drive:

- If the drive has a shutdown fault, register 10. bit7 will be set to 1, the relative flag shows. The drive can't be enabled until faults have been cleared by setting register0. bit7 to 1. When the drive is in the faults status, faults led will flash. The flashing rules and failure cause show in tab 6-6-2.
- The compressor can be started when there's no one fault alarm, register0. bit1-0=1 and the register3 is not 0.
- The compressor will immediately shut down when there's a fault or register0. bit1-0 is set to 0.
- The compressor will decelerate and shut down when register3 is set to 0.

Mod. Add.	R/W	Description	Def	Min	Max	U.M.
0	R/W	Bit1-0: 00-Stop compressor; 01-Run compressor; 10-Motor reversal; 11-Run Stator Heater.(10-Not currently implemented.)	0	0	3	-
		Bit2:0-PFC Disable; 1-PFC Enable.	0	0	1	
		Bit3: 0-Do nothing; 1-Clear compressor re-startup Bit. (Inverter auto clear this Bit.)	0	0	1	
		Bit6-4:Reserved	0	0	0	
		Bit7: 0-Do nothing; 1-Clear fault Bits.(Inverter auto clear this Bit.)	0	0	1	
		Bit14-8:Reserved	0	0	0	
		Bit15:0-0~10V I/F Disable; 1-0~10V I/F Enable.(If want to use	1	0	1	

		communication to control the inverter, this Bit must be set to 0.)				
3	R/W	Compressor target frequency.	0	0	1200	0.1Hz
10	R	Bit1-0: 00-Compressor stop; 01-Compressor running; 10-Motor reversal; 11-StatorHeater running.	-	0	3	-
		Bit2:0-PFC stop; 1-PFC running.	-	0	1	
		Bit3: 0-/; 1-Compressor was shut down and re-start up again.	-	0	1	
		Bit4:0-/; 1-Compressor is running in Speed-Limiting/Speed-Reducing state.(It may not reach the set frequency);	-	0	1	
		Bit5:0-/; 1-Compressor is running in Field-Weakening state. (It does not affect the use of the inverter)	-	0	1	
		Bit6: Reserved.	-	0	0	
		Bit7: 0-No fault; 1-The inverter has been shut down due to a fault.(See the register32/33/34/35 for specific fault information)	-	0	1	
		Bit9-8:Reserved	-	0	0	
		Bit10:0-Main relay opened; 1-Main relay closed.(if the main relay opened, the inverter is not allowed to startup)	-	0	1	
		Bit14-11: Reserved.	-	0	0	
		Bit15: 0-0~10V I/F Disable; 1-0~10V I/F Enable.	-	0	1	
13	R	Compressor frequency.	-	0	1200	0.1Hz
29	R	0-10V I/F voltage.	-	0	100	0.01V

Tab. 4.5

4.4 Steps to start drive test for prototype

During prototype phase of customer system, in order to run and test the drive, the following steps are required:

1. Sanhua will need corresponding compressor (Provide by customer or compressor supplier) to test and modify program in drive. The program in drive related to corresponding compressor will be prepared and uploaded by Sanhua.
2. Then, this drive sample with specific program will be sent to customer. Also Sanhua could send sample first，the program and EEPROM will be sent to customer after matching test. Customer need to update the program and EEPROM by USB programmer（Chapter 7 in “SD2 Series Drive User Manual”）.
3. After receiving the drive sample, customer will need to setup electrical installation according to Chapter 3 installation in “SD2 Series Drive User Manual”.
4. Customer can run and control the drive by three means:
   ① By control program in customer control board. (Sanhua will provide extra doc,” Sanhua Inverter Communication Protocol”.)
   ② By using Sanhua VFD Monitor Tool program on PC. (Sanhua will provide extra doc-” Sanhua VFD Monitor Tool Instructions”, and program- “Sanhua VFD Monitor Tool.exe”)
   ③ By using communication interface of 0~10Vdc detecting input.

5. FUNCTIONS

For more function logic and details, please refer to document" SD2 Series drive Function Spec.pdf".

5.1 Control

5.1.1 Compressor control
5.1.1.1 Maximum and minimum output frequency
5.1.1.2 Compressor speed profile
5.1.1.3 Speed profile execution mode
5.1.1.4 Compressor normally running
5.1.2 Inverter PWM frequency control
5.1.3 PFC control
5.1.4 Stator heater control
5.1.5 Status monitor
5.1.6 User parameters initialization
5.1.7 Status/ history fault record

5.2 Protections

5.2.1 Frequency-skip frequency
5.2.2 Current limitation
5.2.2.1 Compressor current limitation
5.2.2.2 AC current limitation
5.2.2.3 IPM temperature limitation
5.2.2.4 PFC temperature limitation
5.2.2.5 Low DC voltage limitation（Three-phase models only）
5.2.3 Compressor current protection (SW)
5.2.4 AC current protection
5.2.5 IPM over-temperature protection
5.2.6 PFC over-temperature protection
5.2.7 DLT protection
5.2.8 HPS protection
5.2.9 Compressor current protection (HW)
5.2.10 AD-offset abnormal fault
5.2.11 Compressor/VAC lost-phase protection
5.2.12 Compressor frequency abnormal fault
5.2.13 VDC over/under-voltage protection
5.2.14 VAC over/under-voltage protection
5.2.15 Charge circuit fault
5.2.16 EEPROM data abnormal fault
5.2.17 Communication fault
5.2.18 MCU self-check fault
5.2.19 IPM temperature sensor abnormal fault
5.2.20 PFC temperature sensor abnormal fault

5.3 Communication Protocol

For communication protocol, please refer to document" Sanhua Inverter Communication Protocol.pdf"

6. FAULT CODE TABLE

6.1 Status indicator description

Indicator	Color	Description
Running/Stop Indication	Green/Yellow	Green: The inverter is in running state; Yellow: The inverter is in stop state; (When this light flashes, it indicates that the host computer communication is received, the fastest flashing interval is 0.5s)
Fault indicator	Red	Always off: No fault; Flashing: Faulty; (fast flashing is ten digits, slow flashing is ones digit, the meaning of the fault code is shown in the table below)

Tab 6.1

6.2 Fault code table

#	Fault Name	Fault Code
1	Lost Communication	11
2	EEPROM Data Abnormal	12
3	AD-Offset Abnormal	13
4(*)	AC Lost-Phase(HW)	23
5(*)	AC Lost-Phase/Unbalance(SW)	14
6	AC Over-Voltage	15
7	AC Under -Voltage	16
8	Charge Circuit Fault	17
9	DC Over-Voltage(HW)	24
10	DC Over-Voltage(SW)	18
11	DC Under-Voltage	19
12	HPS Protection	21
13	DLT Protection	22
14	IPM HW-OC Protection	32
15(**)	PFC HW-OC Protection	51
16	Motor Over-Current	33
17	Lost-Phase Protection	34
18	Startup Failure	35
19	Speed-Misalignment Protection	36
20	AC Over-Current	52
21	IPM Temp. Sensor Fault	37
22	IPM Over-Temp.	38
23(**)	PFC Temp. Sensor Fault (Reserved)	53
24(**)	PFC Over-Temp. (Reserved)	54
25	MCU self-check Fault	81

Tab 6.2

1） *Three-Phase model only

2）**Single-Phase model only

6.3 All major fault summary and possible cause checklist

#	Fault Name	Possible Causes
1	Lost Communication	1. AOC hardware damage; 2. Poor connected MOC communication cable or communication cable damage; 3. The MOC circuit is damaged;
2	EEPROM Data Abnormal	1. The data in the EEPROM is damaged; 2. The MOC circuit is damaged;
3	AD-Offset Abnormal	1. The MOC circuit is damaged;
4(*)	AC Lost-Phase(HW)	1. The power supply is lost phase, or the power supply voltage is unbalance, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
5(*)	AC Lost-Phase/Unbalance(SW)	1. The power supply is lost phase, or the power supply voltage is unbalance, or the power supply voltage jump is too drastic; 2. The input reactor is not connected
6	AC Over-Voltage	1. The power supply voltage is too high, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
7	AC Under -Voltage	1. The power supply voltage is too low, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
8	Charge Circuit Fault	1. The power supply voltage is too low; 2. The MOC circuit is damaged;
9	DC Over-Voltage(HW)	1. The power supply voltage is too high, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
10	DC Over-Voltage(SW)	1. The power supply voltage is too high, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
11	DC Under-Voltage	1. The power supply voltage is too low, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
12	HPS Protection	1. The high pressure exceed protection pressure; 2. High-pressure switch damaged; 3. Poor connected HPS cable or cable damaged; 4. The MOC circuit is damaged;
13	DLT Protection	1. External DLT signal trigger; 2. External DLT signal abnormal; 3. The AOC hardware damage; 4. Poor connected MOC communication cable or communication cable damage; 5. The MOC circuit is damaged;
14	IPM HW-OC Protection	1. The refrigerant pressure is too high; 2. Poor connected compressor cable; 3. The compressor is damaged (Stalling, wear, motor demagnetization, winding open/short circuit etc.); 4. The MOC circuit is damaged;
15(**)	PFC HW-OC Protection	1. PFC inductance short circuit; 2. The MOC circuit is damaged;
16	Motor Over-Current	1. The refrigerant pressure is too high; 2. Poor connected compressor cable; 3. The compressor is damaged (Stalling, wear, motor demagnetization, winding open/short circuit etc.);

		4. The MOC circuit is damaged;
17	Lost-Phase Protection	1. Poor connected compressor cable; 2. The compressor is damaged (winding open/short circuit); 3. The MOC circuit is damaged;
18	Startup Failure	1. Poor connected compressor cable; 2. The compressor is damaged (Stalling, wear, motor demagnetization, winding open/short circuit etc.); 3. The MOC circuit is damaged;
19	Speed-Misalignment Protection	1. Poor connected compressor cable; 2. The compressor is damaged (Stalling, wear, motor demagnetization, winding open/short circuit etc.); 3. The MOC circuit is damaged;
20	AC Over-Current	1. The power supply voltage is too low, or the power supply voltage jump is too drastic; 2. The MOC circuit is damaged
21	IPM Temp. Sensor Fault	1. The MOC circuit is damaged
22	IPM Over-Temp.	1. The ambient temperature is too high; 2. Poor system heat dissipation; 3. The screws of the IPM module of the MOC are not locked; 4. The MOC circuit is damaged;
23(**)	PFC Temp. Sensor Fault (Reserved)	1. The MOC circuit is damaged
24(**)	PFC Over-Temp. (Reserved)	1. The ambient temperature is too high; 2. Poor system heat dissipation; 3. The screws of the PFC module of the MOC are not locked; 4. The MOC circuit is damaged;
25	MCU self-check Fault	1. The driver is greatly disturbed; 2. The MOC circuit is damaged;

Tab 6.3

1）*Three-Phase model only

2）**Single-Phase model only

7. USB PROGRAMMING

7.1 Introduction

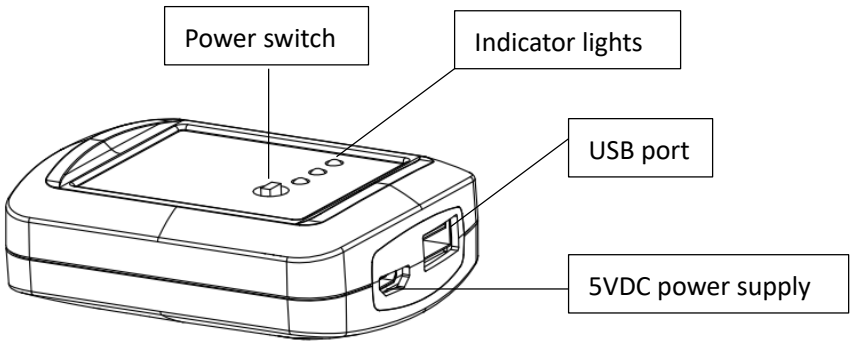
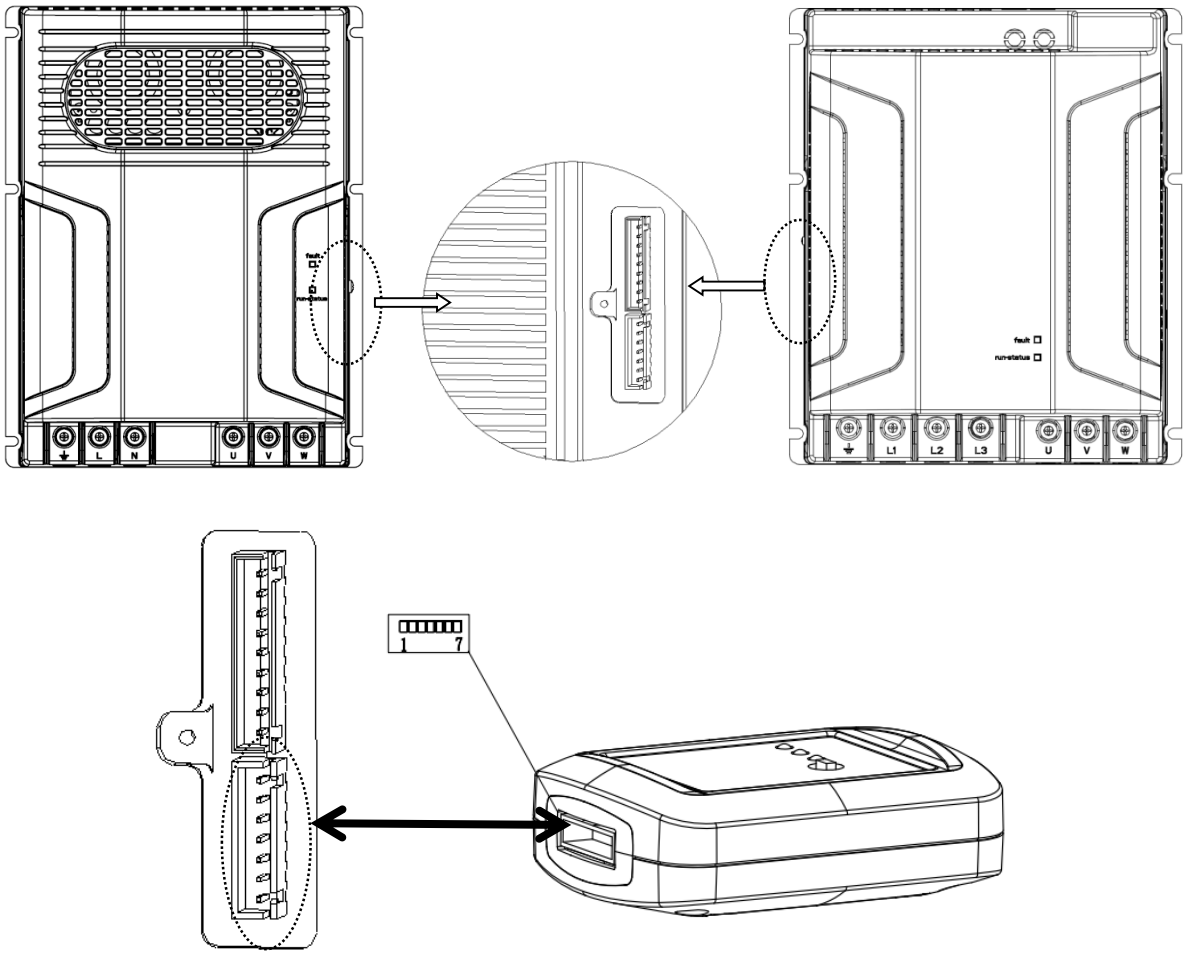


Fig.7.1

7.2 Programming

SD2 drive can be programmed through USB, follow the steps below:

Step1: Disconnect all the electrical wire from power input of SD2 drive, and wait for 10 minutes for electrostatic discharge. Remove the cover of programming terminal, then connect the drive and USB programmer correctly as shown in the figure below.



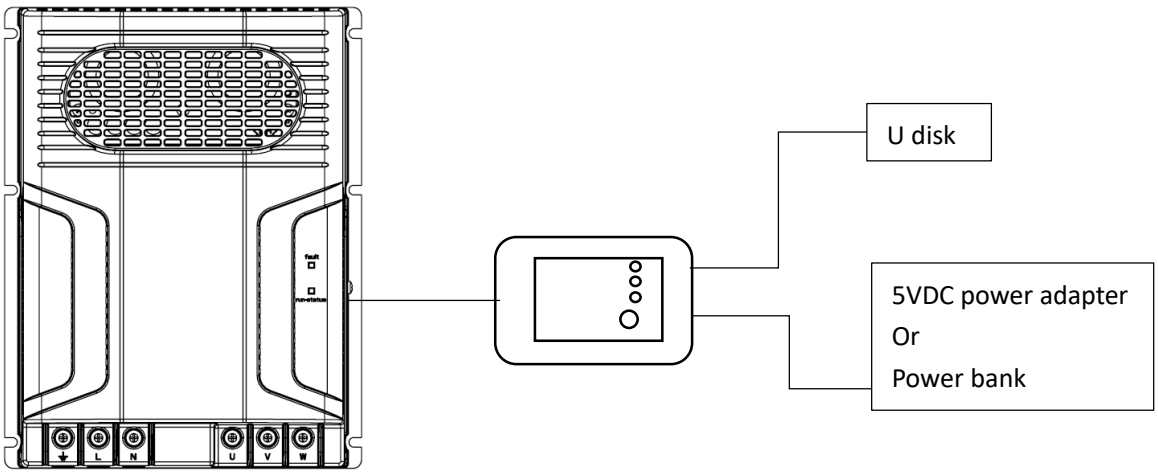


Fig.7.2

Color	Indicator* status	Description
Green	Light on	Programmer is power on.
	Light off	Programmer is power off.
Yellow	Light on	Programmer is connected to drive.
	Light off	Programmer is not connected to drive.
Red	Light on	U disk is connected to programmer.
	Light off	U disk is not connected to programmer.

***Indicator lights on the programmer.**

Tab 7.1

Step2: Turn on USB programmer (turn on the power switch and green light is steady on), then MCU will enter the USB program mode and it will automatically read main program file and/or EEPROM data file in the U disk in sequence for programing.

Step3: Wait about 20s after turning on USB programmer, observe status indicator and fault indicator on the drive to judge the programming result, see the table below.

Related file type	Color	Indicator* status	Description
Main Program file	Red	Light off	Fail, Main program file is not found.
		Flashing in red with 2Hz	Fail, Main program file is abnormal.
		Flashing in red with 6Hz	Fail, mistake during programming procedure.
		Flashing in red with 0.5Hz	Succeed, file is programmed.
EEPROM data file	Green	Light off	Fail, Main program file is not found.
		Flashing in green with 2Hz	Fail, Main program file is abnormal.
		Flashing in green with 6Hz	Fail, mistake during programming procedure.
		Flashing in green with 0.5Hz	Succeed, file is programmed.

***Indicator lights on the drive.**

Tab 7.2

Note: The main program file in the U disk need to be named as firmware.hex, The EEPROM data file in the U disk need to be named as e2data.hex, U disk needs to use FAT32 file format.

Programmer is not included in accessories.

8. CERTIFICATION

This series of drives are designed and manufactured according to the following standards and certified by CE-LVD and CB reports.

8.1 Safety standards

- **EN 60335-1:** Household and similar electrical appliances Safety –**Part 1:** General requirements.
- **EN 60335-2-34:** Household and similar electrical appliances Safety –**Part 2-34:** Particular requirements for motor-compressors.
- **EN 60335-2-40:** Household and similar electrical appliances Safety – **Part 2-40:** Particular requirements for electrical heat pumps, air-conditioners and dehumidifier.

Note: The drive software of DSP is divided into security – related parts and function – related parts. The safety – related parts are authenticated by CLASS B and have independent checksum.

Note: Compressor model selection and output current protection value setting are stored in EEPROM as function – related parts without review, so as to avoid duplicate authentication due to matching different compressors.

8.2 EMC standards

- **EN 55014-1:** Electromagnetic compatibility(EMC) – requirements for household appliances, electric tools and similar apparatus –**Part 1:** Emission CE conducted margin(Conducted Emission): 3db;RE Radiations margin(radiations emissions): 3db
- **EN 55014-2:** Electromagnetic compatibility (EMC) – Requirements for household appliances, electric tools and similar apparatus – Part 2: Immunity – Product family standard
- **EN 61000-3-2:** Electromagnetic compatibility(EMC) –**Part 3-2:** Limits – Limits for harmonic currents produced by equipment connected to public low – voltage systems(equipment input current≤16A per phase)
- **EN 61000-3-12:** Electromagnetic compatibility (EMC) –**Part 3-12:** Limits – Limits for harmonic currents produced by equipment connected to public low – voltage systems (equipment input current > 16A and ≤75A per phase)
- **EN 61000-3-3:** Electromagnetic compatibility (EMC) –**Part 3-3**: Limits– Limitation of voltage changes, voltage fluctuations and flicker in public low – voltage systems, for equipment with rated current ≤ 16A per phase and not subject to conditional connection
- **EN 61000-4-2:** Electromagnetic compatibility (EMC) –**Part 4-2:** Testing and measurement techniques – Electrostatic discharge immunity test
  8KV Contact discharge, 15KV Air discharge; Criterion B Breakpoint test (all ports of client used)
  4KV Contact discharge, 8KV Air discharge; Criterion B Charged test (all ports of client used)
- **EN 61000-4-3:** Electromagnetic compatibility (EMC) –**Part 4-3:** Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test
  10V/m, 80-1000MHz; Criterion A
- **EN 61000-4-4:** Electromagnetic compatibility (EMC) –**Part 4-4:** Testing and measurement techniques – Electrical fast transient / burst immunity test
  2KV / 5KHz (signal Line), 4KV / 5KHz (Power Line); Criterion B
- **EN 61000-4-5:** Electromagnetic compatibility (EMC) –**Part 4-5:** Testing and measurement techniques – Surge immunity test
  2KV (Difference module), 4KV (Common module); Criterion B
- **EN 61000-4-8:** Electromagnetic compatibility (EMC) –**Part 4-5:** Testing and measurement techniques – Power frequency magnetic field immunity test

3A/M @ 50Hz; Criterion A

- **EN 61000-4-11:** Electromagnetic compatibility (EMC) –**Part 4-5:** Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests
  0% for 0.5 cycle; Criterion C
  40% for 10 cycles; Criterion C
  70% for 50 cycles; Criterion C

9. APPENDIX

9.1 Product parameter

Inverter model	SD2011A2	
Compressor model	WHP07600PSDPC9KQ	WHP05500PUKQA6NT
Max freq./Hz	120	120
Min freq./Hz	15	15
PWM frequency/Hz	6000	6000
Phase current speed limit/Arms	11	11
Phase current speed reduce/Arms	12	12
Phase overcurrent(SW)/Arms	14	14
Phase overcurrent(SW)/Apeak	28	26
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	30	28
Phase overcurrent(HW)/Apeak	30	
AC current speed limit/Arms	13	
AC current speed reduce/Arms	14	
AC overcurrent/Arms	17	
AC over voltage/V	280	
AC low voltage/V	160	
IPM temp. speed limit/℃	103	
IPM temp. speed reduce/℃	105	
IPM over temp./℃	110	
DC voltage speed limit/V	/	
DC voltage speed reduce/V	/	
DC over voltage(SW)/V	420	
DC over voltage(HW)/V	415	
DC low voltage/V	200	

Tab 9.1

Inverter model	SD2015A2	
Compressor model	WHP10200PSDPC9EQ	WHP07600PSDPC9KQ
Max freq./Hz	120	120
Min freq./Hz	15	15
PWM frequency/Hz	6000	6000
Phase current speed limit/Arms	14.5	14.5
Phase current speed reduce/Arms	15	15
Phase overcurrent(SW)/Arms	16	16
Phase overcurrent(SW)/Apeak	28	28
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	30	30
Phase overcurrent(HW)/Apeak	30	
AC current speed limit/Arms	20	
AC current speed reduce/Arms	21	

AC overcurrent/Arms	24
AC over voltage/V	280
AC low voltage/V	160
IPM temp. speed limit/℃	103
IPM temp. speed reduce/℃	105
IPM over temp./℃	110
DC voltage speed limit/V	/
DC voltage speed reduce/V	/
DC over voltage(SW)/V	420
DC over voltage(HW)/V	415
DC low voltage/V	200

Tab 9.2

Inverter model	**SD2020A2**	
Compressor model	WHP13300PSDPC8FQ	WHP10200PSDPC9EQ
Max freq./Hz	120	120
Min freq./Hz	15	15
PWM frequency/Hz	6000	6000
Phase current speed limit/Arms	20	20
Phase current speed reduce/Arms	21	21
Phase overcurrent(SW)/Arms	23	23
Phase overcurrent(SW)/Apeak	35	35
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	37	37
Phase overcurrent(HW)/Apeak	37	
AC current speed limit/Arms	25	
AC current speed reduce/Arms	26	
AC overcurrent/Arms	29	
AC over voltage/V	280	
AC low voltage/V	160	
IPM temp. speed limit/℃	103	
IPM temp. speed reduce/℃	105	
IPM over temp./℃	110	
DC voltage speed limit/V	/	
DC voltage speed reduce/V	/	
DC over voltage(SW)/V	420	
DC over voltage(HW)/V	415	
DC low voltage/V	200	

Tab 9.3

Inverter model	**SD2015B4**	
Compressor model	WHP10200PSDPC9EQ	WHP07600PSDPC9KQ
Max freq./Hz	120	120
Min freq./Hz	15	15
PWM frequency/Hz	6000	6000
Phase current speed limit/Arms	15	15

Phase current speed reduce/Arms	16	16
Phase overcurrent(SW)/Arms	18	18
Phase overcurrent(SW)/Apeak	33	33
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	35	35
Phase overcurrent(HW)/Apeak	35	
AC current speed limit/Arms	8	
AC current speed reduce/Arms	9	
AC overcurrent/Arms	11	
AC over voltage/V	500	
AC low voltage/V	300	
IPM temp. speed limit/℃	103	
IPM temp. speed reduce/℃	105	
IPM over temp./℃	110	
DC voltage speed limit/V	300	
DC voltage speed reduce/V	290	
DC over voltage(SW)/V	750	
DC over voltage(HW)/V	795	
DC low voltage/V	200	

Tab 9.4

Inverter model	**SD2020B4**	
Compressor model	WHP13300PSDPC8FQ	WHP10200PSDPC9EQ
Max freq./Hz	120	120
Min freq./Hz	15	15
PWM frequency/Hz	6000	6000
Phase current speed limit/Arms	20	20
Phase current speed reduce/Arms	21	21
Phase overcurrent(SW)/Arms	23	23
Phase overcurrent(SW)/Apeak	40.5	40.5
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	42.5	42.5
Phase overcurrent(HW)/Apeak	42.5	
AC current speed limit/Arms	11	
AC current speed reduce/Arms	12	
AC overcurrent/Arms	14	
AC over voltage/V	500	
AC low voltage/V	300	
IPM temp. speed limit/℃	103	
IPM temp. speed reduce/℃	105	
IPM over temp./℃	110	
DC voltage speed limit/V	300	
DC voltage speed reduce/V	290	
DC over voltage(SW)/V	750	
DC over voltage(HW)/V	795	
DC low voltage/V	200	

Tab 9.5

Inverter model	SD2025B4
Compressor model	WHP32900VSKTQ9JK
Max freq./Hz	110
Min freq./Hz	15
PWM frequency/Hz	6000
Phase current speed limit/Arms	25
Phase current speed reduce/Arms	26
Phase overcurrent(SW)/Arms	28
Phase overcurrent(SW)/Apeak	47
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	50
Phase overcurrent(HW)/Apeak	50
AC current speed limit/Arms	18
AC current speed reduce/Arms	19
AC overcurrent/Arms	21
AC over voltage/V	500
AC low voltage/V	300
IPM temp. speed limit/℃	103
IPM temp. speed reduce/℃	105
IPM over temp./℃	110
DC voltage speed limit/V	360
DC voltage speed reduce/V	350
DC over voltage(SW)/V	750
DC over voltage(HW)/V	795
DC low voltage/V	300

Tab 9.6

Inverter model	SD2032B4		
Compressor model	WHP32900VSKTQ9JK	WHP37600VSKTQ9JK	APB87FEAMT
Max freq./Hz	110	120	120
Min freq./Hz	15	15	20
PWM frequency/Hz	6000	6000	6100
Phase current speed limit/Arms	30	30	25
Phase current speed reduce/Arms	31	31	26
Phase overcurrent(SW)/Arms	33	33	28
Phase overcurrent(SW)/Apeak	47	47	47
Phase overcurrent(HW)/Apeak (Internal comparator of chip)	50	50	50
Phase overcurrent(HW)/Apeak	55.5		
AC current speed limit/Arms	25		
AC current speed reduce/Arms	26		
AC overcurrent/Arms	28		
AC over voltage/V	500		
AC low voltage/V	300		

IPM temp. speed limit/℃	103
IPM temp. speed reduce/℃	105
IPM over temp./℃	110
DC voltage speed limit/V	380
DC voltage speed reduce/V	370
DC over voltage(SW)/V	750
DC over voltage(HW)/V	795
DC low voltage/V	330

Tab 9.7