Sinexcel

Sinexcel Static Var Generator (SVG)

–User's Manual

Sinexcel Electric Co., Ltd.

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Chapter I Safety Instructions

Thank you for choosing Sinexcel SVG module. Please read the safety instructions carefully before use and ensure that the unit is operated according to the instructions contained in this manual. The safety instructions contain important information, which ensure that you can safely and properly use the product and prevent personal injury or property damage. Please keep this manual accessable near the unit so that users can easily reference this information.

This manual uses the following illustrations and symbols to highlight important safety information. Please ensure that you are very familiar with these procedures and follow these instructions carefully.

 Danger	Failure to comply with the instructions or improper operation may cause serious injury and can be fatal.
 Warning	Failure to comply with the instructions or improper operation may cause serious injury and can be fatal.
 Caution	Failure to comply with the instructions or improper operation may cause personal injury and damage to the equipment.

1.1 Safety precautions

 Danger	Do not expose it to where rain or moisture is heavy, and keep it away from combustible liquid, gas or explosive.
 Danger	To avoid high voltage risks, the discharge time of DC capacitors should be above 15 minutes. Make sure the operation is performed after full discharge.
 Warning	Installation must be done by well-trained and qualified personnel in a controllable environment.
 Warning	Any maintenance work must be carried out by qualified technical personnel; all power must be cut off before maintenance.

 Caution	Reserve enough space around the equipment, so as to maintain good ventilation and easy maintenance access and operation.
 Caution	The conductors in cabinet will still be powered when emergency button is bushed down.
 Caution	Read the user manual carefully before connecting the power, and keep it easily accessible for future reference.

1.2 Wiring precautions

 Warning	The equipment should be grounded properly to prevent any risk of leakage current.
 Warning	Compensation capacity and current-carrying capacity must be taken into full consideration for wiring.
 Caution	The cables connected to the power terminals must be connected to a circuit breaker or other protective devices and the capacity of protective devices should match the capacity of Static Var Generator.

1.3 Precautions for use

 Caution	SVG is used to compensate reactive power and three-phase unbalance. The capacity of SVG should be selected in accordance with reactive power content.
 Caution	SVG must be used with external current transformers.
 Caution	To ensure SVG has good reliability and to avoid overheat, do not block or cover the air inlet/outlet.

 Caution	No corrosive gas and conductive dust is allowed in the working environment.
 Caution	The working temperature should be -10℃ and 45℃. SVG may derate if beyond this range;
 Caution	If the THDu (Total Harmonic Distortion of Voltage) of the grid is higher than 15%, please contact Sinexcel.

1.4 Storage precautions

 Caution	Seal SVG with its original packing materials in case of damage caused by rat invasion.
 Caution	If immediate installation is not required, make sure to store the equipment in dry and well-ventilated indoor environment, the storage temperature should be -40℃~70℃, and relative humidity should be 5％～95％.

1.5 Product standards

The product complies with the following safety and electromagnetic compatibility standards:

1) IEEE519-1992: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems;

2) GB 7251.1, GB/T 7251.8: Low-Voltage Switchgear and Controlgear Assemblies--General Technology Requirement for Intelligent Assemblies;

3) GB 15576-2008: The Specifications of Low-Voltage Reactive Power Steady Compensation Equipments;

4) EMC: IEC61000-6-2: Electromagnetic Compatibility (EMC)-Part 6-2: Generic Standards-Immunity for Industrial Environments;

5) EMC: IEC61000-6-4: Electromagnetic Compatibility (EMC) -- Part 6-4: Generic Standards -- Emission Standard for Industrial Environments (only for 50A model to pass);

6) ESD: IEC61000-4-2: Electromagnetic Compatibility – Testing and Measurement Techniques – Electrostatic Discharge Immunity Test;

7) RS: IEC61000-5-1: Electromagnetic Compatibility – Testing and Measurement

Techniques – Radiated, Radio-Frequency, Eletromagnetic Field Radiation Immunity Test;

8) EFT: IEC61000-4-4: Electromagnetic Compatibility – Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test;

9) SURGE: IEC61000-4-5: Electromagnetic Compatibility – Testing and Measurement Techniques – Surge Immunity Test;

10) DIP: IEC61000-5-9: Electromagnetic Compatibility – Testing and Measurement Techniques –Voltage Dips, Short Interruptions and Voltage Variations Immunity Test;

11) CS: IEC61000-4-6: Electromagnetic Compatibility – Testing and Measurement Techniques – Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields;

12) IEC60068-2-6: Environment Testing Part 2-6: Tests -- Test Fc: Vibration (Sinusoidal);

13) IEC60068-2-27: Environment Testing Part 2-27: Tests -- Test Ea and Guidance: Shock;

14) EN 50178:1998: Electronic Equipment for Use in Power Installations;

15) EN 61000-6-2:2005: Part 6-2: Generic standards – immunity for industrial environments.

Chapter II Product Description

Sinexcel launched the innovative SVG of independent intellectual property in response to the 400V low-voltage distribution network. Using full-digital control technology with DSP, Sinexcel SVG can compensation reactive power in a dynamic way and maintain three-phase imbalance compensation at the same time, fully improving the quality of power energy. Meanwhile, Sinexcel SVG supports Modbus protocol. For relevant description and wiring method of Modbus protocol, refer to Appendix 4. The single module of Sinexcel SVG contains 3 capacity levels: 30kVAr, 50kVAr and 100kVAr.

2.1 Nomenclature

Description of Sinexcel SVG is listed in Figure 2-1. Modules of capacities including 30kVAr, 50kVAr and 100kVAr are listed in table 2-1.

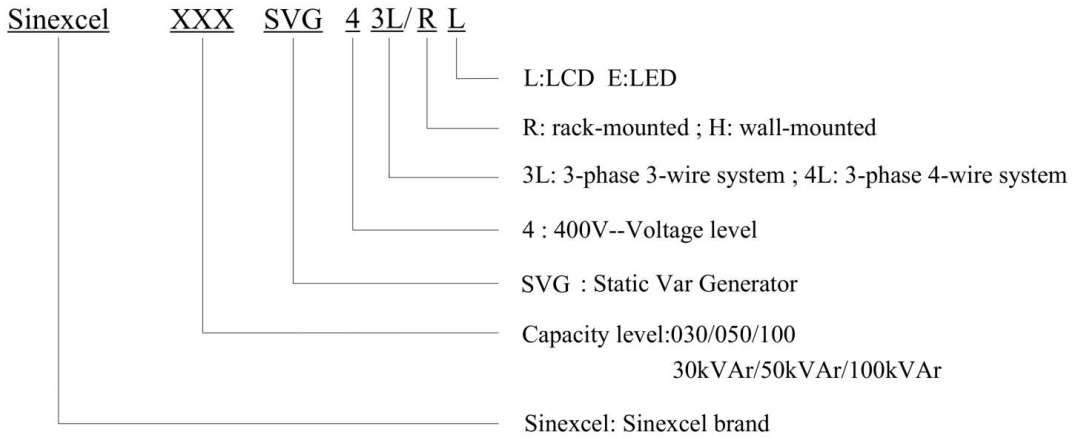

Figure 2-1 Sinexcel SVG production description

2.2 Module description

There are two models available of the 400V Static Var Generator (SVG) and both of these are available in all capacity levels.

One is a wall-mounted LCD model with a touch monitoring screen which can be wall-mounted for independent operation. The other is rack-mounted LED model with only one

LED indicating state, which can be installed in a cabinet. A monitoring system is required for the cabinet application to achieve centralized monitoring. For details regarding the recommended cabinet, please contact Sinexcel.

Refer to Figure 2-3 for details regarding the appearance and dimensions of the rack-mounted LED model.

Refer to Figure 2-4 for details regarding the appearance and dimensions of the wall-mounted LCD model.

2.3 Principle of operation

As shown in Figure 2-2, Sinexcel SVG detects load current on a real-time basis through external CT, and analyze the reactive power content. After data analysis, the controller of SVG drives internal IGBT by using PWM signals and makes the inverter produce inject compensating current into the power grid to compensate reactive power.

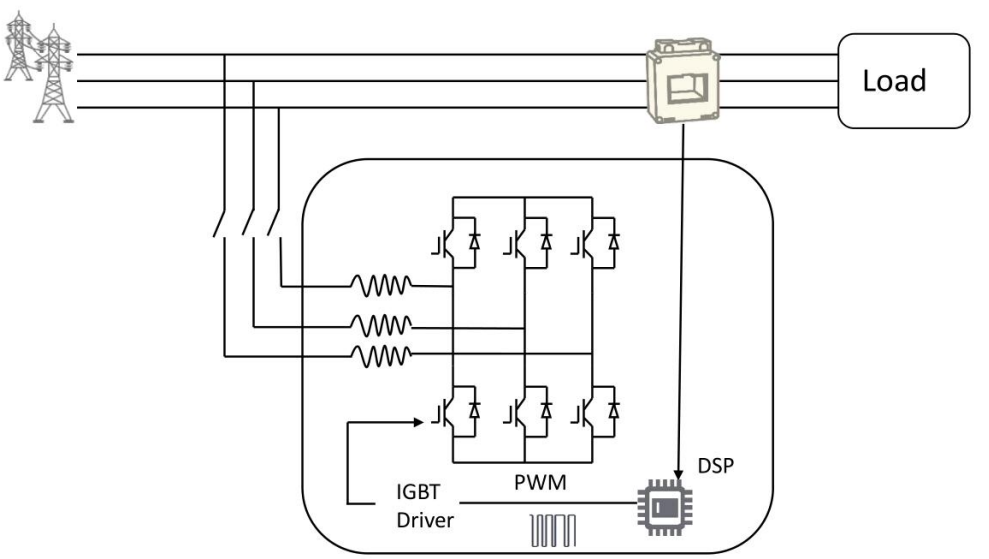

Figure 2-2 SVG operation principle

2.4 Product features

- Modular design: ultra-compact design providing easy installation and maintenance.
- High adaptability: suitable for site of bad power supply, operation upper voltage limit 456V

and lower limit 228V.

- Wide range: from 1.0 lagging to 1.0 leading power compensation.
- Multi-function: Static Var Generator allows reactive power compensation and three-phase unbalance compensation at the same time.
- User-friendly interface: real-time data display, simultaneous multiple waveform display and spectrum display with percentage.

2.5 Appearance and dimensions

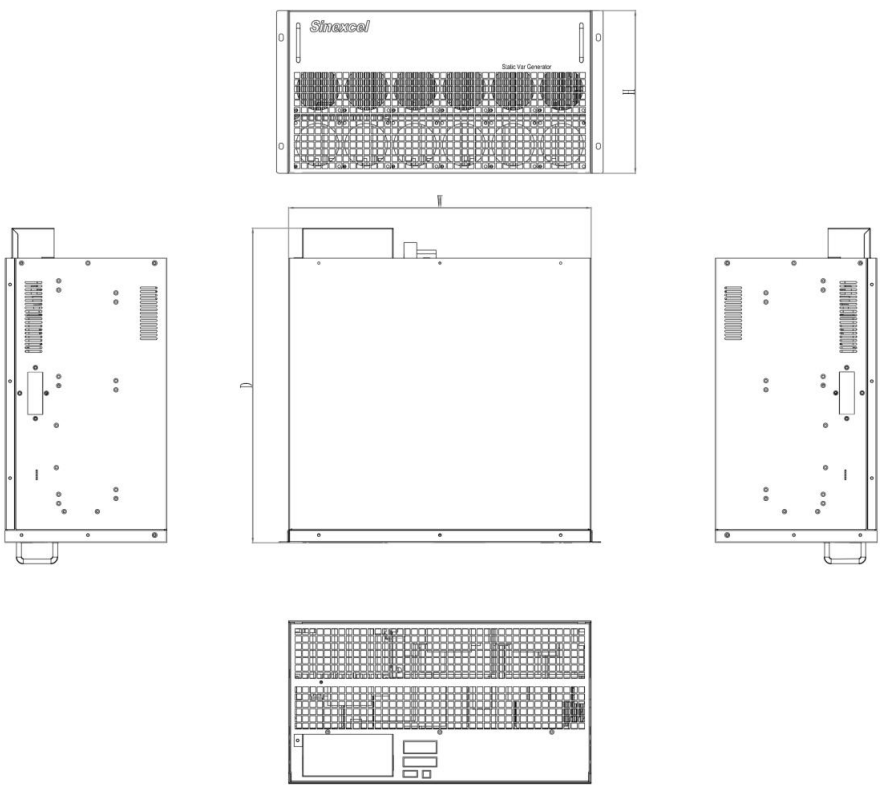

Figure 2-3 Appearance of rack-mounted module

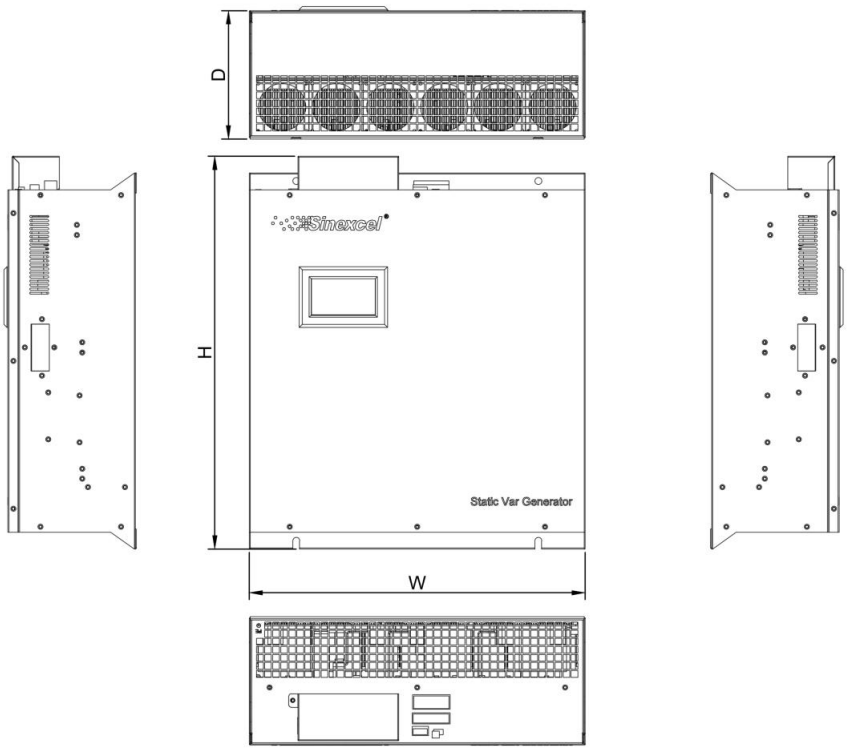

Figure 2-4 Appearance of wall-mounted module

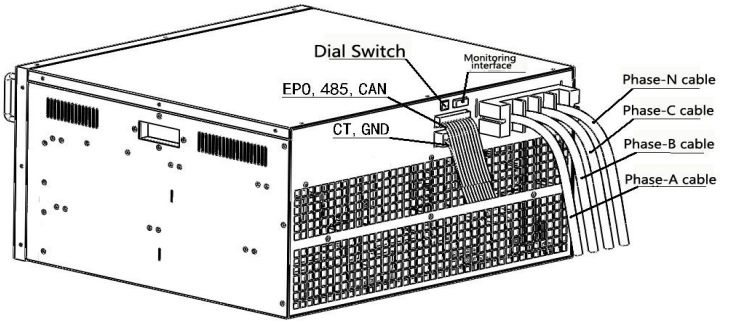

Figure 2-5 Wiring terminals

Figure 2-6 External view of Sinexcel SVG module

Model	Description					
	Capacity	Wiring	Installation	Display	W*D*H/mm	Weight /kg
Sinexcel 030 SVG 43L/RL	30kvar	3-phase 3-wire	Rack-mounted	LCD	440*445*150	36
Sinexcel 030 SVG 44L/RL		3-phase 4-wire				
Sinexcel 030 SVG 43L/RE		3-phase 3-wire		LED		
Sinexcel 030 SVG 44L/RE		3-phase 4-wire				
Sinexcel 030 SVG 43L/HL		3-phase 3-wire	Wall-mounted	LCD	481*440*160	
Sinexcel 030 SVG 44L/HL		3-phase 4-wire				
Sinexcel 050 SVG 43L/RL	50kvar	3-phase 3-wire	Rack-mounted	LCD	500*560*190	36
Sinexcel 050 SVG 44L/RL		3-phase 4-wire				
Sinexcel 050 SVG 43L/RE		3-phase 3-wire		LED		
Sinexcel 050 SVG 44L/RE		3-phase 4-wire				
Sinexcel 050 SVG 43L/HL		3-phase 3-wire	Wall-mounted	LCD	500*191*585	
Sinexcel 050 SVG 44L/HL		3-phase 4-wire				
Sinexcel 100 SVG 43L/RL	100kvar	3-phase 3-wire	Rack-mounted	LCD	500*520*269	62
Sinexcel 100 SVG 44L/RL		3-phase 4-wire				
Sinexcel 100 SVG 43L/RE		3-phase 3-wire		LED		
Sinexcel 100 SVG 44L/RE		3-phase 4-wire				
Sinexcel 100 SVG 43L/HL		3-phase 3-wire	Wall-mounted	LCD	500*286*557	

Sinexcel 100 SVG 44L/HL		3-phase 4-wire				

Table 2-1 Sinexcel SVG models

Chapter III Installation and Wiring

For different modules (30kVAr, 50kVAr and 100kVAr), the power interfaces of them are identical; so do signal interfaces.

3.1 Pre-installation checks

All installation, assembly and powering on of the unit must be performed by qualified personnel or supervised by qualified personnel on-site.

The equipment must be transported with a forklift or other suitable appliance. The weight of the module can be found in Table 2-1, 2-2.

Before installing wire or connecting terminals, make sure that the input of the SVG has been turned off so as to avoid accidents.

The SVG must be grounded to avoid personal injury caused by leakage current.

Check that the diameter of the input cables is correct and that the correct CT has been selected. Check that the diameter of the CT secondary cables is correct and that the phase sequence is correct. Ensure that the connection conforms with the Australian Wiring Standards. For the specifications of the input cables, please refer to Appendix 2.

Before installing the SVG, check the following:

1. Visually check if the exterior of the SVG has been damaged in transport. If yes, please notify the carrier immediately and do not use the unit.

2. Check the product label and confirm that you have the correct equipment. The label states the model, capacity and main parameters of the SVG.

3.2 Environment requirements

The 400V SVG should be installed in a clean, well-ventilated indoor environment.

The 400V SVG uses air cooling provided by internal fans.

The cold air enters SVG through the front grid of the module and hot air is discharged through the rear grid of the module. Do not block the ventilation holes on either side and clean the front grid every 3 months to prevent blockage by dust.

To ensure the long-term reliability and stable operation of the SVG, the following environmental requirements must be met:

1. The ambient temperature at the time of installation must be -20℃~50℃.

2. Ensure that there is no dust (can be conductive) or corrosive/explosive gases in the installation environment.

3. The SVG MUST NOT be installed in an environment with strong magnetic fields, nuclear radiation or high-power RF noise.

4. The relative humidity in the environment should be lower than 95%. The presence of steam or condensation may result in permanent damage to the device or endanger personal safety.

5. The installation altitude should be lower than 1500m. If it is over 1500m, the equipment must be de-rated 1% per 100m increase in altitude. Contact Sinexcel for advice.

6. Avoid severe physical shock, violent impact and large angle tilting in the installation process as this may cause damage and operational failure of the unit;

7. During installation, leave sufficient operating space for cooling, maintenance and operation.

8. For the LED model, the distance from the rear side of the unit to the wall should be at least 500mm, and the front side should be at least 800mm from the wall to allow for module extraction or insertion. Please contact Sinexcel if other occasions.

9. For the LCD model, the distance from top side of the unit to the ceiling should be at least 500mm, and the bottom side should be at least 800mm from the floor. Please contact Sinexcel if other occasions.

3.3 Module fixing

Sinexcel SVG can be classified into 6 sorts by LCD & LED, 3-phase 3-wire & 3-phase 4-wire system, and rack-mounted & wall-mounted. The LCD module contains a LCD screen at its front panel, while the LED module has two LED indicators at its front panel; they are monitored and debugged in different ways. Because their chassis are almost of the same-size, we only introduce the installation and electrical connection of one of the LCD and LED model of the same capacity level.

As shown in following Figures, rack-mounted module is fixed in the cabinet. The fixed hole site for installation of a single module is marked in the Figures; wall-mounted model is fixed on hardened wall or directly in the cabinet, and the fixed size and fixed hole site for installation are marked in following Figures as well.

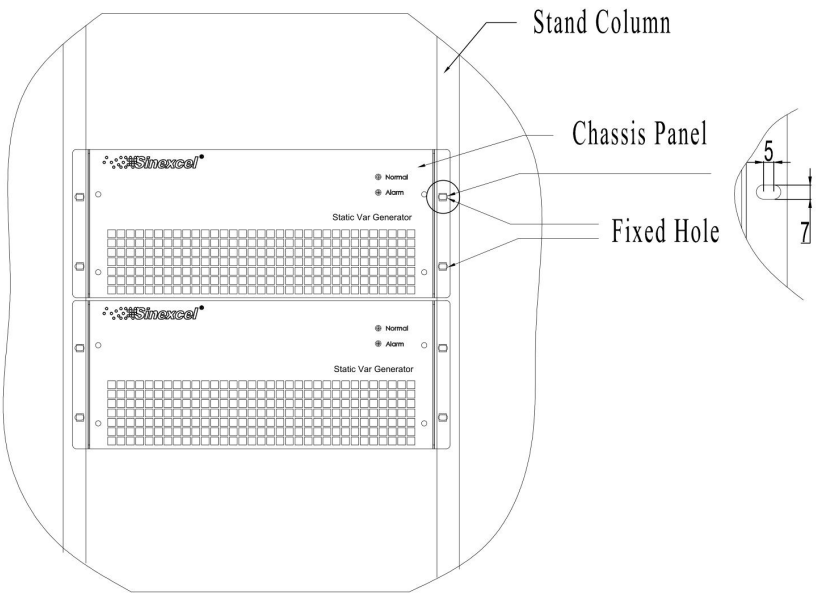

Figure 3-1 Installation sketch of rack-mounted module

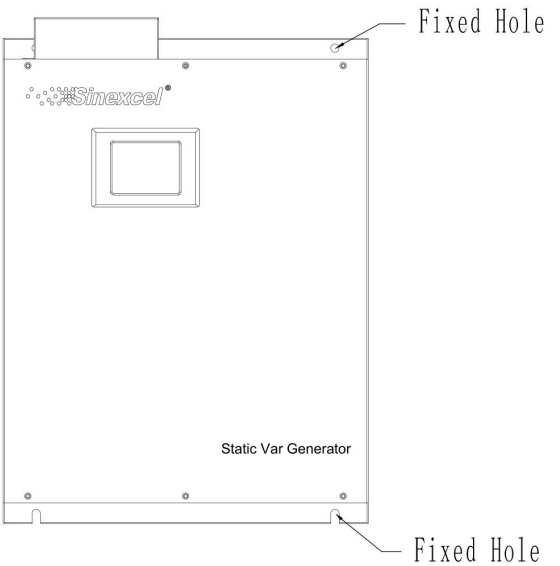

Figure 3-2 Installation sketch of wall-mounted module

3.3 Single module wiring

Normal operation of Sinexcel SVG requires wiring and installation of power cable and external CT cable.

All wiring terminals of Sinexcel 400V SVG are located at the back of the module. The main

wiring terminals include:

1. A: Phase A power terminal;
2. B: Phase B power terminal;
3. C: Phase C power terminal;
4. N: Neutral wire terminals;
5. PE: Ground terminal. System housing is made with metal. To prevent any accident against personal safety, the house must be connected to the ground via the terminal before the system is started.
6. CT: Used to connect the secondary side of CT's. The maximum allowable input current for each phase is 5A rms.

Power terminals are shown in Figure 3-3

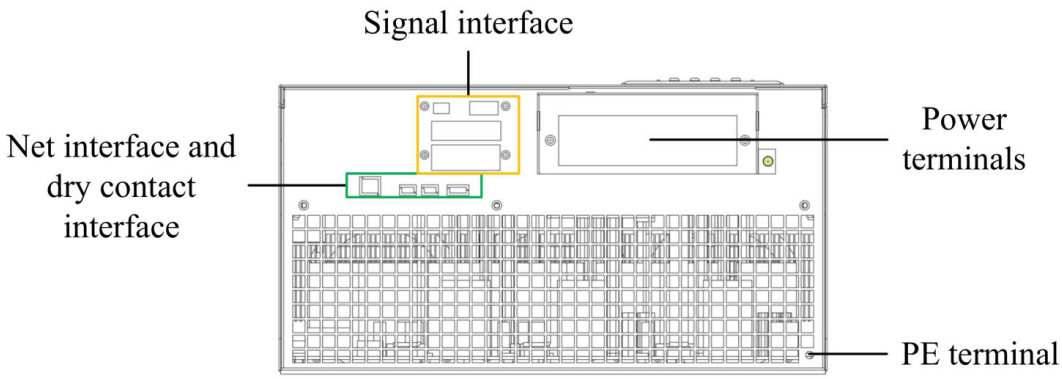

Figure 3-3 Power and signal interface distribution

3.3.1 Power cable wiring

The marks at the back of the module indicates the power terminals. Make sure the power input corresponds with SVG power terminals.

Refer to Appendix 1 for the selection of the diameter of A/B/C/N/PE power cables.

Danger	Before connecting the cables or electronics, please be sure to cut off the input power of the SVG device to avoid accidents.
Caution	When applied in 3-phase 3-wire system, the N line must be disconnected. If not, the equipment may not operate properly.

3.3.2 CT cable wiring

An open circuit of CT secondary polarity is not allowed. To avoid an open circuit occurring during installation, maintenance or disassembly, users are advised to use a CT wiring terminal

block during wiring. Place S1 and S2 in the wiring terminal block until all wiring is completed. Then, S1 and S2 can be disconnected at the wiring terminal block. The wiring diagram is shown in Figure 3-4 and Figure 3-5.

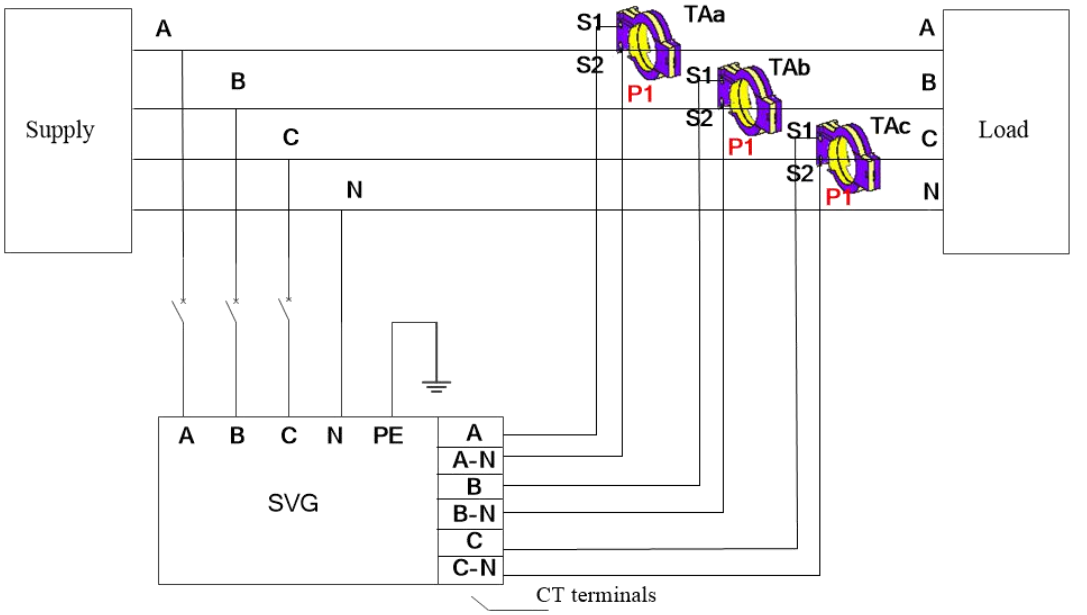

Figure 3-4 Wiring of single power module (3-phase 4-wire system)

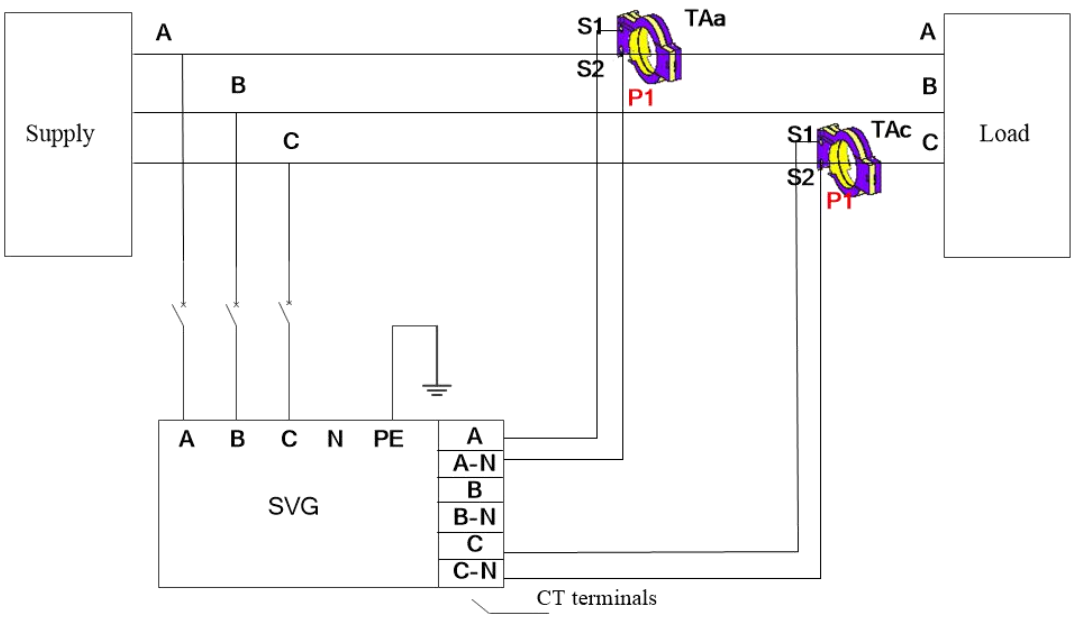

Figure 3-5 Wiring of single power module (3-phase 3-wire system)

CT and signal interfaces are shown in Figure 3-6. Refer to Table 3-1 for a description of the CT and communication signal.

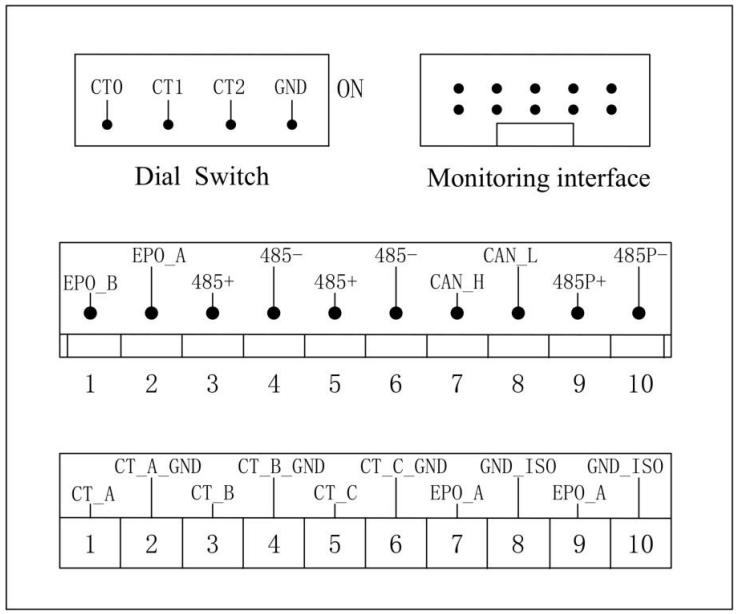

Figure 3-6 Signal interface

Mark	Description
CT_A	Connected to S1 of phase A CT
CT_A_GND	Connected to S2 of phase A CT
CT_B	Connected to S1 of phase B CT
CT_B_GND	Connected to S2 of phase B CT
CT_C	Connected to S1 of phase C CT
CT_C_GND	Connected to S2 of phase C CT
EPO_A	Connected to EPO button when not connected to centralized monitor / To realize signal communication of EPO among modules
GND_ISO	To realize signal communication of EPO among modules
EPO_B	Connected to EPO button when not connected to centralized monitor

485+	Signal 485 used for connection between modules and monitoring
485-	Signal 485 used for connection between modules and monitoring
485P+	Signal 485 used for connection between module and background
485P-	Signal 485 used for connection between module and background
CAN_H	Reserved channel (CAN signal)
CAN_L	Reserved channel (CAN signal)

Table 3-1 Description of CT signal and communication signal

3.4 Multiple modules connecting

3.4.1 CT cable wiring

In parallel operation, the power cables of all single modules are connected exactly the same way as that in single module system.

Note the mode of connection of signal interface. Series connection of CT signal interface of two modules in parallel operation is illustrated in Figure 3-8, S1 and S2 indicating the two interfaces of the CT of one of the phases. Parallel connection of CT in parallel operation is illustrated in Figure 3-8. It is recommended that series mode be adopted for connection of CT signal interface among all modules. Please contact Sinexcel if CT parallel connection required.

To ensure current sharing between the modules, such mode of connection requires the same Cable length from S1 and S2 to the two module signal interfaces. Generally, the parallel cable should not be more than 15m in length. If the parallel operation cable with a length of over 30m is required, please contact Sinexcel in advance.

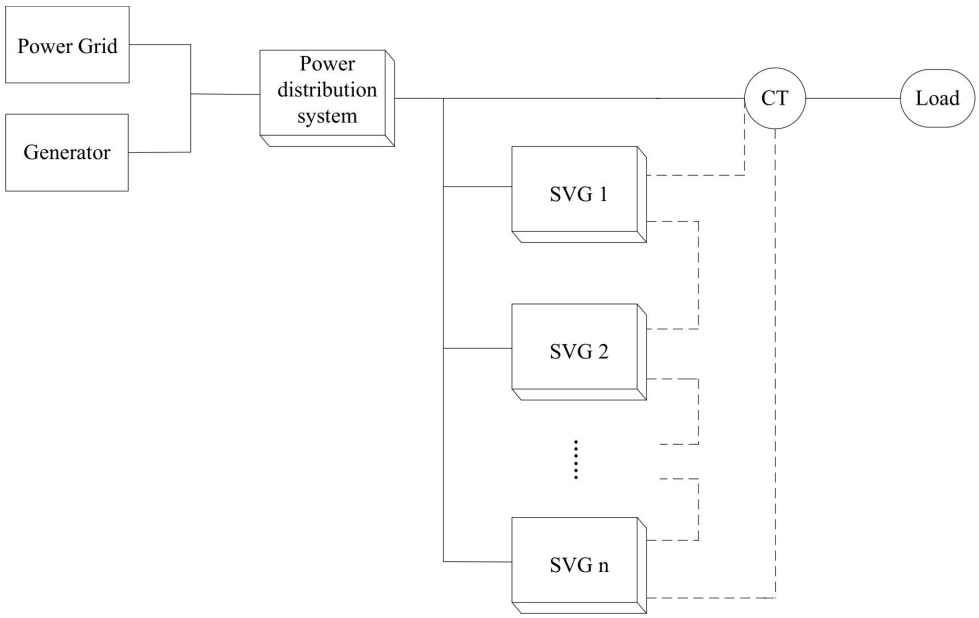

Figure 3-7 Typical topology for multiple modules parallel operation

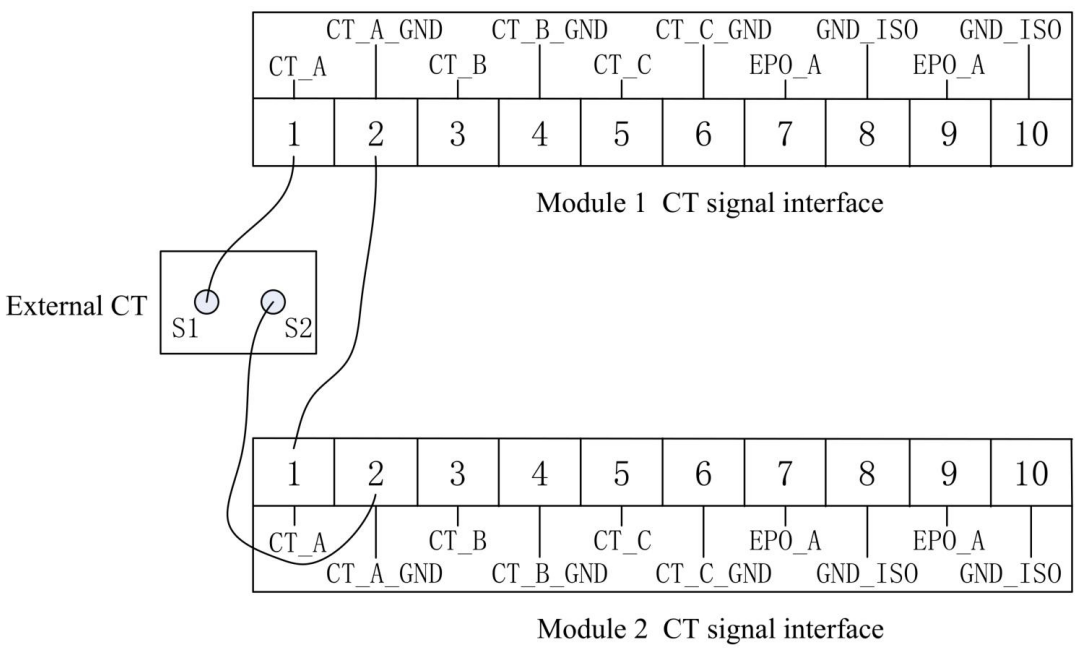

Figure 3-8 CT signal interface connected in series

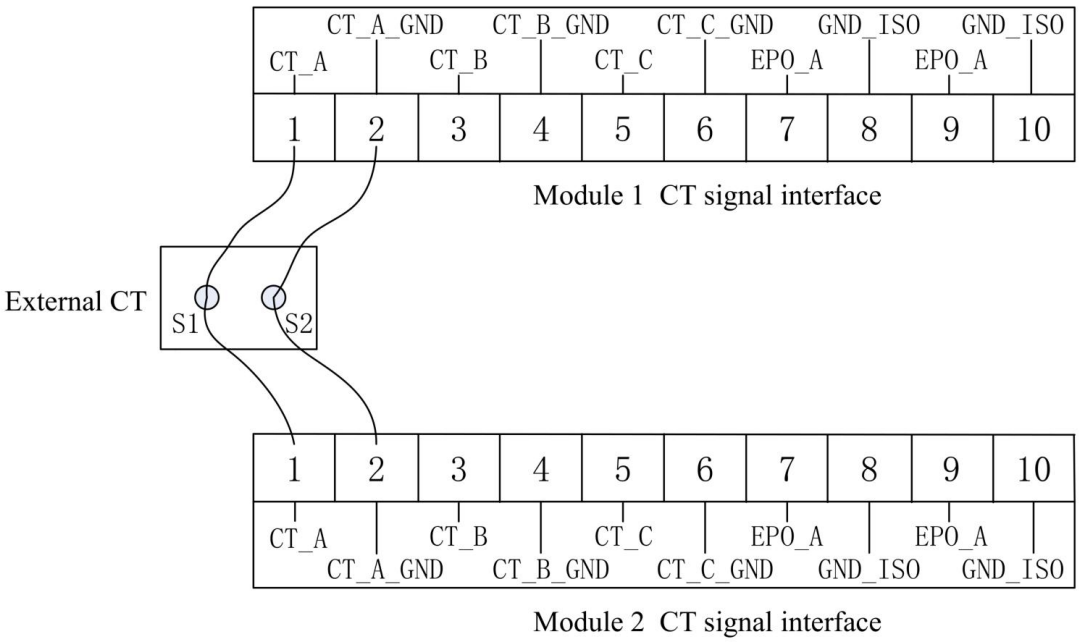

Figure 3-9 CT signal interface connected in parallel

Remark: Only one phase is drawn in the diagram, the wiring method for the other phases is the same.

Figure 3-10 is the wiring for rack-mount LED modules parallel operation. Two sets of 485+ and 485- interfaces are respectively parallel connected inside the module. The same with two sets of EPO interfaces.

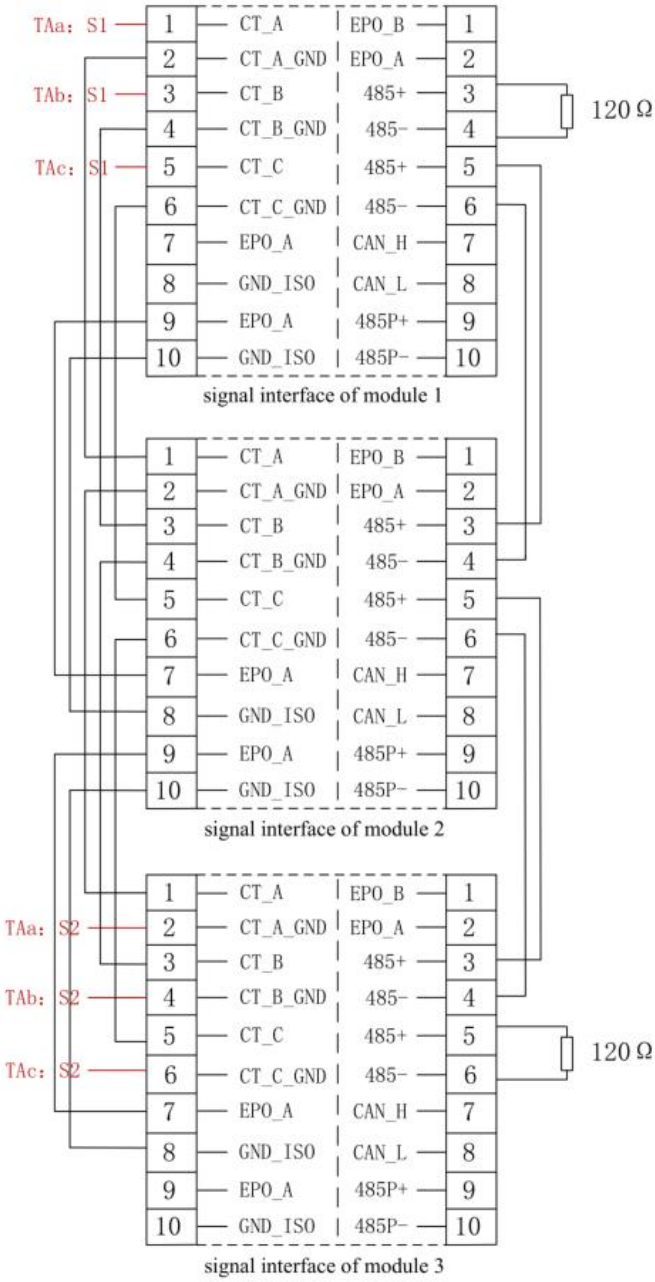

Figure 3-10 Signal interface connection of three modules in parallel

Remark: TAa, Tab and TAc separately represent CTs detecting load current of phase A/B/C. TAa:S1, TAb:S1 and TAc:S1 represent interface S1 of CT. Similarly，TAa:S2, Tab:S2 and TAc:S2 represent interface S2 of CT.

3.4.2 Dial switch

The dial switch on the back of the module is used when the LED modules are parallel connected for use with the 7-inch touch screen. This method is to identify the individual modules by giving them an address via the dial switch and this is done by using a binary system. Refer to Table 3-2 for specific dial code operation.

Remark: When applying wall-mount modules, dial codes must be 0000. No modification to the commissioned dial codes allowed.

CT2	CT1	CT0	Module No.
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

Table 3-2 Description of the dial switch and module number

Chapter IV Current transformer

As one of external components of SVG, current transformer (CT) plays a key role in the normal operation of SVG, so the selection of external CT is extremely important. In 3-phase 3-wire system, two CTs are required, each installed on phase A and phase C; while in 3-phase 4-wire system, three CTs are required, each installed on the circuits of phase A, phase B and phase C.

4.1 CT type

SVG can use external CT ratio between 150:5~10000:5. Practical CT ratio should be selected within this range in accordance with actual load current. The setting of the CT ratio can be programmed into SVG via the settings during the commissioning phase.

Split-core or Solid-core CTs are both suitable for use. The accuracy of current transformer should be higher than 0.2 (Solid-core) or 0.5 (Split-core). Lower degree of accuracy may affect the compensation accuracy.

 Caution	Before power on, check if the CT ratio of the external CT is correct according to the settings in the touch screen. If not, SVG will not operate correctly.
 Caution	The CT primary should be selected to be 1.5~4 times of the actual load current. Too small may result in equipment alarm; too large may affect the compensation performance. If special needs, please contact Sinexcel.

4.2 CT cable

As an accessory of Sinexcel SVG system, CT cable may contain three groups of shielded twisted pair (STP): yellow + black, green + black and red + black, each group consisting of two cables, twisted in pair to constitute CT cable. When the external CT is connected and installed, the yellow twisted pair is connected to phase A, the green to phase B and the red to phase C. Take the yellow as example, yellow pair is connected to S1 of external CT1, and the black to S2 of external CT1, ensuring the same direction of current straight through CT. Otherwise it may fail to achieve effect of compensation.

For CT cable shorter than 15m, recommended sectional area is 2.5mm^2. From 15m to 30m, recommended sectional area is 4mm^2. Above 30m, please contact Sinexcel.

Refer to Appendix 2 for CT cable selection details.

4.3 CT connection on secondary side

When connecting the secondary CT cables to SVG module, for A phase the S1 terminal of the CT is connected to the CT_A marked terminal on SVG and the S2 terminal of the CT is connected to the CT_A_GND marked terminal of SVG. This is duplicated for each phase. Please refer to Figure 3-5 for connection of the CT secondary polarity in parallel operation.

4.4 CT installation

Current transformers can be installed at load side(most recommended) or source side. The key principle of CT installation is that SVG only “sees” the load current. Refer to following information for more details.

4.4.1 CT installation at load side

It is recommended to install the CT’s for SVG between SVG point of connection and the load. Such installation only requires one set of CT’s installed on phase A, B and C of the load side (two CTs for 3-phase/3-wire system), as shown in Figure 4-1.

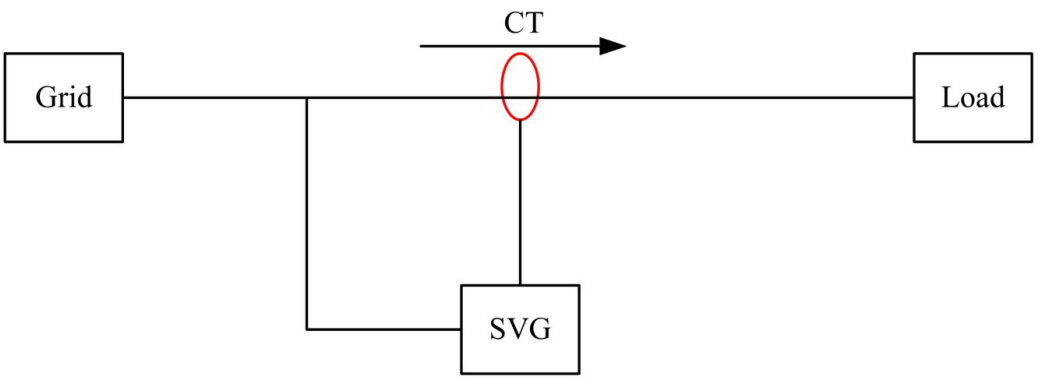

Figure 4-1 Wiring of CT installed at load side

4.4.2 CT installation at source side

If it is not convenient for user to install CT at load side, it is required to adopt an equivalent method to collect load current. We know from Kirchhoff's current law that the current flowing

into circuit node at any moment is equivalent to the current flowing out of this node. So, the same effect can be achieved when CT is installed at source side. When CT is installed at source side, user at least needs to use two groups of CTs (6CTs, in 3-phase 4-wire system). Two groups of CTs are installed on phase cable at source side and power cable at SVG side and are connected in parallel.

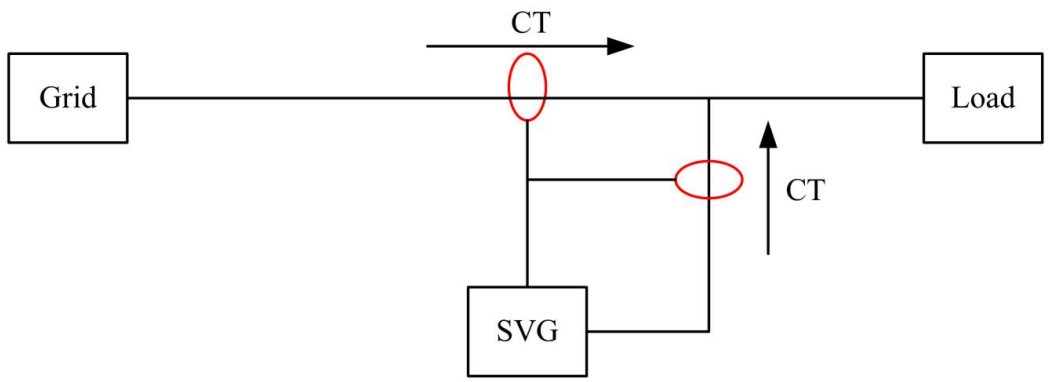

Figure 4-2 Wiring of CT installed at source side

4.4.3 CT installation with existing capacitor banks

When there are existing capacitor banks in the system, current of capacitor banks must be omitted by SVG. Please contact Sinexcel for more details

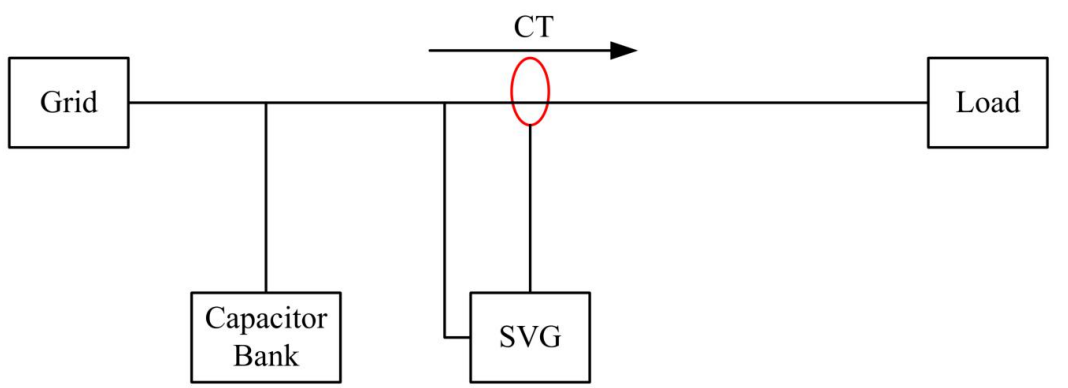

Figure 4-3 Wiring of CT installed at load side with existing capacitor banks

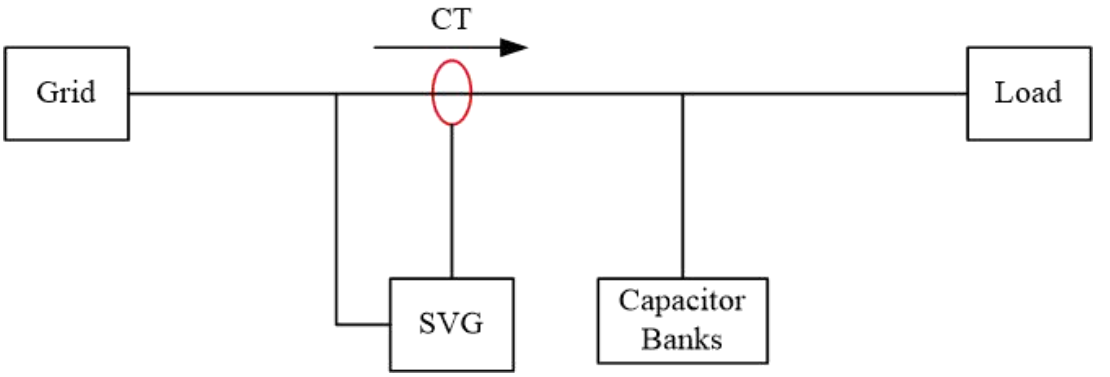

Figure 4-4 Wiring of CT installed at source side with existing capacitor banks

4.4.4 CT installation when SVG and AHF installed together

When SVG and AHF are installed together, serial connection of CT secondary is recommended. Through this method, SVG and AHF are "seeing" the same current and respectively doing harmonic suppression and reactive power compensation. Please contact Sinexcel for details.

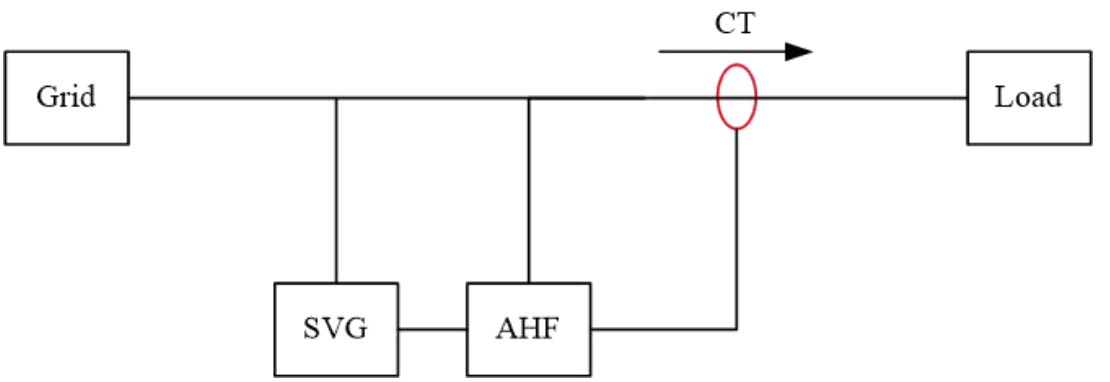

Figure 4-5 Wiring of CT when SVG and AHF installed together

4.4.5 CT installation with double bus power supply

As shown in Figure 4-6, four groups of CTs are used to detect current at different areas under double bus power supply, two groups installed at both sides of load, connected in parallel.

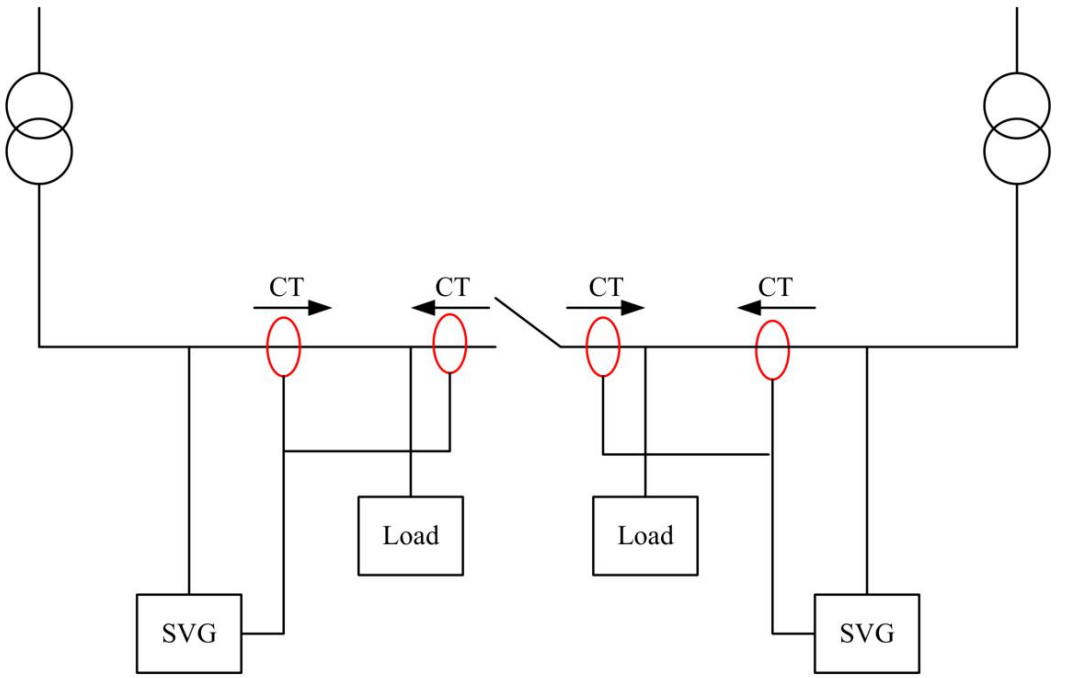

Figure 4-6 Wiring of CT under double bus power supply

Remark:

1. If multi-group CTs in parallel CTs (more than one group) are required, it must be ensured all CT ratios are the same.

2. When external CT is installed to detect load current, if multi-group CTs are required, their interfaces should be connected in parallel manner. However, when LCD modules or LED modules are in parallel, the CT signal interfaces of parallel modules are connected in series manner. User should tell the difference.

Chapter V Stand-alone monitor operation

5.1 Quick guide

For standard installations using one wall mount module, please follow the following steps (for questions please contact Sinexcel).

1. Ensure and connections are correct, safe and follow the manufacturer's instructions.

2. Apply power to SVG. Monitoring screen starts initialising.

3. After the monitoring screen is initialised, click 'Settings' on the monitoring screen. When a prompt for entering password appears, enter the initial password '080808' and click 'Log in'.

4. Check whether the 'CT Ratio', the 'CT Location' and the 'Total Capacity' settings are consistent with the actual installation. If not, they should be set to be consistent with the actual installation.

Please pay attention that the total capacity set on HMI is the current value. For example , for a 400V 100vkar SVG , the rated current is 150A ,so on HMI the total capacity should be set a s 150 instead of 100.

5. Set the parameters that need to be set up beforehand, refer to 5.3 for details:

6. Return to the main page, click 'Power on' and confirm it in the pop-up dialog box. SVG will now start to operate.

Figure 5-1 Initializing

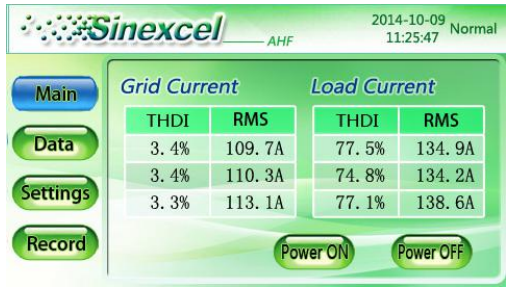

Figure 5-2 Main interface

5.2 Data interface

- Click "**Data**" on the main menu and enter the main interface of data, as shown in Figure 5-3;
- Click "**Voltage**" in Figure 5.3 to check the waveform and spectrum of grid voltage,

displayed in Figure 5-4 and 5-4;

Figure 5-3 Main interface of data

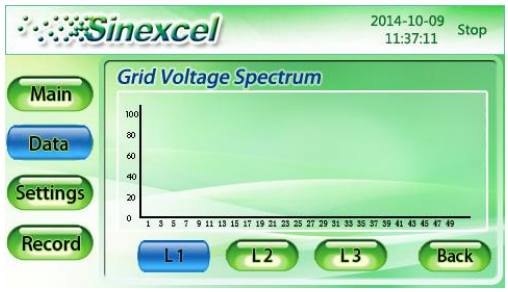

Figure 5-5 Spectrum of grid voltage

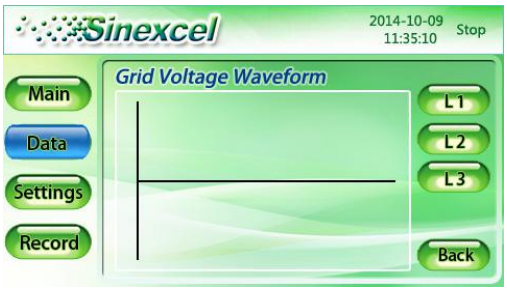

Figure 5-4 Waveform of grid voltage

Figure 5-6 Main interface of Current

- Click "**Current**" in Figure 5-5 and enter the main interface of current, as shown in Figure 5-6;
- Click "**Grid Current**" in Figure 5-6 to check the information of grid current, as shown in Figure 5-7;
- Click "**Waveform**" and "**Spectrum**" in Figure 5-7 to check the waveform and spectrum of grid current, as shown in Figure 5-8 and 5-9;
- Similarly, click "**Load Current**" and "**Comp. Current**" in Figure 5-6 to check data information about load current and compensation current;
- Click "**Power Analysis**" in Figure 5-5 to check power data at grid side and load side, including apparent power, active power and reactive power, as shown in Figure 5-10;
- Click "**IO/Temp.**" in Figure 5-5 to check IO status and node temperature, as shown in Figure 5-11.

Remark: during operation, the temperature can be very high. Displayed temperature below 95℃ is considered normal.

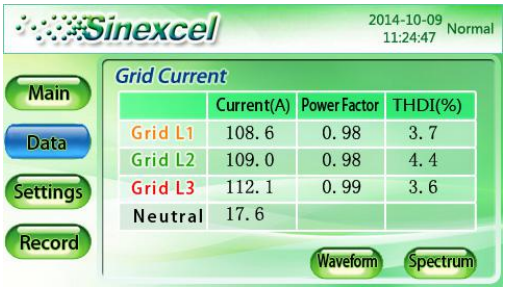

Figure 5-7 Information of grid current

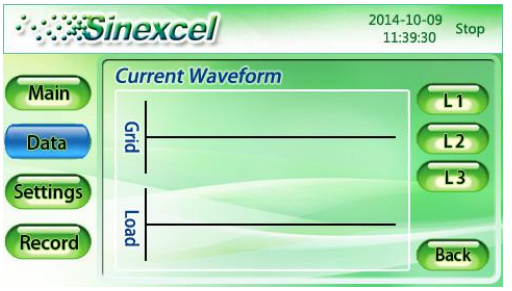

Figure 5-8 Waveform of grid current and load current

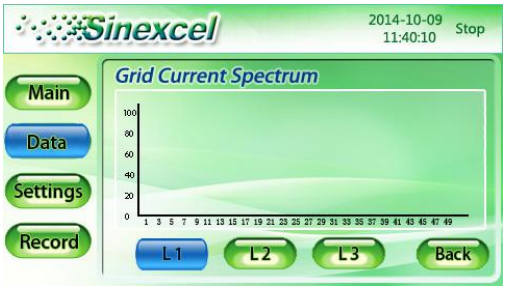

Figure 5-9 Spectrum of grid current

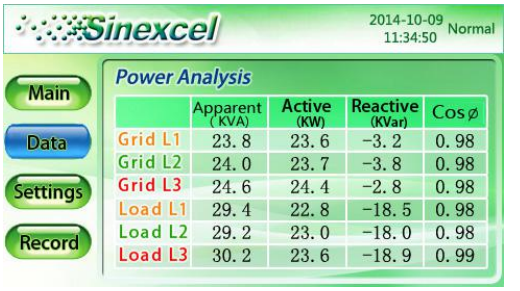

Figure 5-10 Power analysis

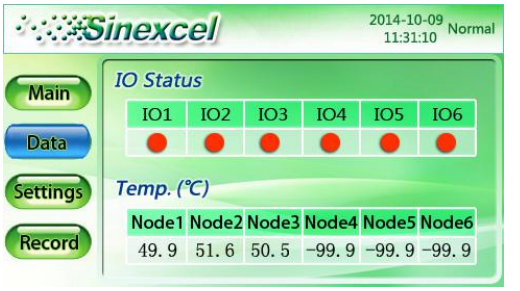

Figure 5-11 I/O status and node temperature

Figure 5-12 Log in interface of settings

5.3 Parameter settings

- Click "**Settings**" to enter the login interface, as shown in Figure 5-12. User input password to login and enter the main interface to set parameter (Figure 5-13);
- Click "**System Parameter**" in Figure 5-13 to enter the interface of system parameter, as shown in Figure 5-14. It includes **Operation Mode**, **Power ON Mode**, **CT Location**, **Quantity, Total Capacity** and **Comp. Rate**. (For "Total Capacity" setting, please refer to 7.2.4)
- When compensation rate needs to be set, click the number box at the right side of word "**Comp. Rate**" and an interface for entering number pops up. After the number is input,

click “**OK**” and you’ll see word “**Success**” on the interface.

Remark: SVG has two main functions: reactive compensation (Q) and three-phase imbalance compensation (B). However, SVG provides as many as “Operation Mode”: Q; Q+B; B+Q; B; Auto-aging.

Auto-aging function is reserved for special occasions. It turns SVG into a reactive power source. Do not switch to this mode under normal operation.

Different function combinations represent different priorities, e.g. the combination of Q+B means preferential compensation of reactive power, and three-phase imbalance.

- Click the “**Page Down**” button in Figure 5-14 to enter the “**Power Saving Function**” and “**Rest day**” interface, as shown in Figure 5-16;
- In Figure 5-16, click the “**Settings**” on the main menu to return to the login interface (Figure 5-12). User may click “**log in**” directly to enter the main interface of parameter settings (Figure 5-13);
- Click “**Monitor Parameter**” in Figure 5-13 to enter the interface of monitor parameter, as showed in Figure 5-15. User may set language and time displayed.
- Click “**Exit**” in Figure 5-13, the “**Settings**” interface will exit. If you need to re-modify the options under “**Settings**”, enter password to login again;
- After finishing setting parameter, click “**Main**” on the main menu to return to the interface of Figure 5-2. Click “**Power On**” and words “**Are you sure?**” interface will pop up. Click “**Enter**”, and SVG will be turned on; click “**Cancel**”, it will be still in standby status（status of “**Stop**”）.

Figure 5-13 Main interface of Parameter settings

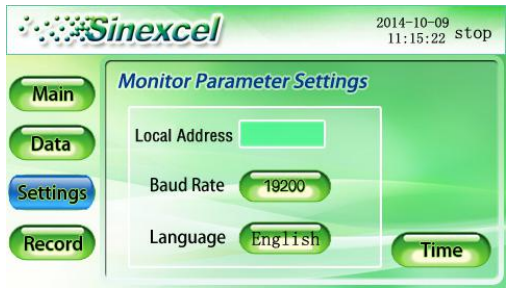

Figure 5-15 Interface of monitor parameter

Figure 5-14 Interface of system parameter

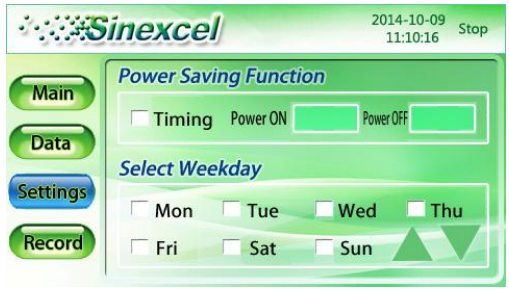

Figure 5-16 Power saving function

5.4 Record interface

- Click "**Record**" on the main menu to enter the record interface, as shown in Figure 5-17;
- Click "**Alarm**" in Figure 5-17 to enter the alarm interface, as shown in Figure 5-18; click "**Active**" and '**History**" in Figure 5-18 to check information of active and history alarm;
- Click "**Operations**" in Figure 5-17 to enter the operations interface. As shown in Figure 5-20, the name, start time, original and set value of history operations are displayed.

Remark: Usually it is not allowed to delete alarm information; otherwise it may cause total loss of history record.

Figure 5-17 Interface of Record

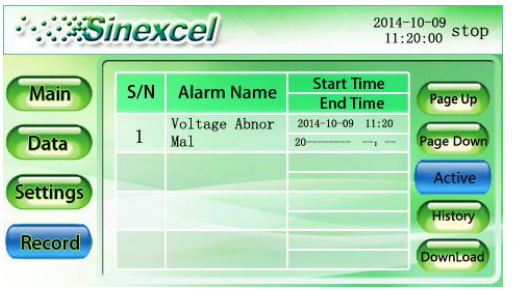

Figure 5-18 Active alarm

Figure 5-19 History alarm

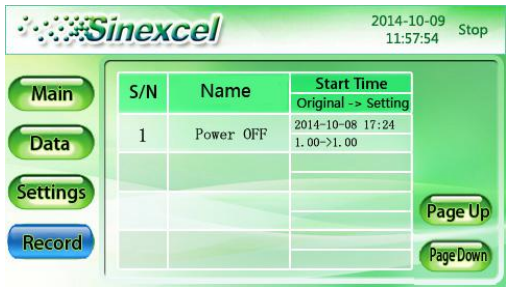

Figure 5-20 Interface of Operations

Chapter VI 7-inch HMI operation

6.1 Quick guide

Ensure SVG is correctly connected to the site electrical reticulation system, with all phase, neutral (if required), earth and CT cabling correctly sized and connected.

Then follow the steps below:

1. Apply power to SVG cabinet. The touch screen starts initialising.

2. After touch screen initialisation, click  on the touch screen and select setting. When a prompt for entering the password appears, enter initial password 080808.

3. Check whether the settings wiring system, CT ratio, CT location and total capacity are consistent with the actual installation. If not, they should be set to be consistent with the actual installation.

4. Set the parameters that need to be set up beforehand, refer to 6.4 for details:

5. Click  in any page of the monitoring screen, and click 'Power on' in the pop-up auxiliary menus to start the system.

6.2 Basic interface

Basic touch/monitoring interface is composed of the title bar and page.

6.2.1 Title bar

The title bar is the strip area at the top of the screen. Its contents will vary with the pages. The title bar of the home page is shown in Figure 6-1. The system has four states:

1. Stop: The system is powered on but compensation function hasn't started (it's live).
2. Run: The system is compensating.
3. Alarm: System failure.
4. Offline: Communication between monitor and control board is abnormal.

Click  on interface to pop out main menu.

Click  in any page to pop up the auxiliary menu and then perform the operations for SVG such as start up, shut down and clear fault.

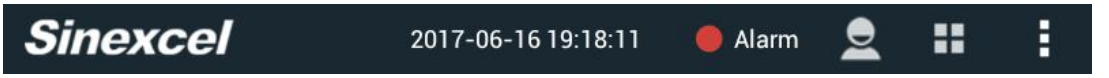

Figure 6-1 Title bar of the homepage

Figure 6-2 Title bar in other pages

6.2.2 Basic operation

The main operations on the touch/monitor screen include click and slide.

Click: Tap the screen with your finger and release.

Slide: Tap the screen with your finger and drag on the screen. Slide left and right in the blank space of the page to change the pages of the secondary menu. Slide up and down to scroll to other content that isn't displayed

6.3 Data interface

- Click "**BASIC**" button on the bottom menu in the main interface to enter the real-time info interface (real-time info includes basic information of voltage and current, dry contacts information, harmonic analysis information and power information). As shown in Figure 6-3, user can check information about grid voltage, grid current, load current and compensation current;
- Click "**I/O**" button in the title bar to check the dry contacts information. As shown in Figure 6-5, the different statuses of dry contacts are distinguished by color, red indicating normal operation, red indicating alarm and grey indicating stop;
- Click "**HARMO**" button in the title bar, monitor enters the interface of harmonic analysis. As shown in Figure 6-4, user may check THD of grid voltage, grid current and load current.
- Click "**POWER**" button in the title bar, monitor enters the interface of power information. As showed in Figure 6-6, user may check power information at grid and load side, including apparent power, active power and reactive power.
- Click "**WAVES**" button in the title bar; user may check the grid voltage waveform, as showed in Figure 6-7. Similarly, user may check the waveform of grid current, load

current and compensation current by clicking other "**Waveform**" buttons.

- Click "**BASIC**" at the top to return to "Real time info"

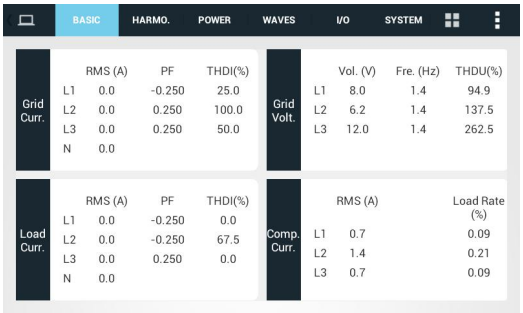

Figure 6-3 Real time info

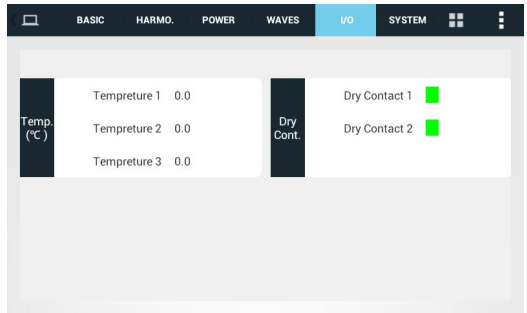

Figure 6-5 Temperature and Dry contact info

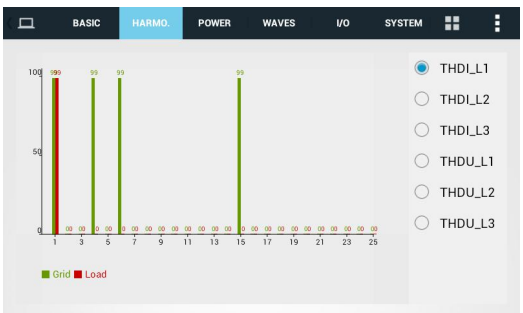

Figure 6-4 Harmonic analysis

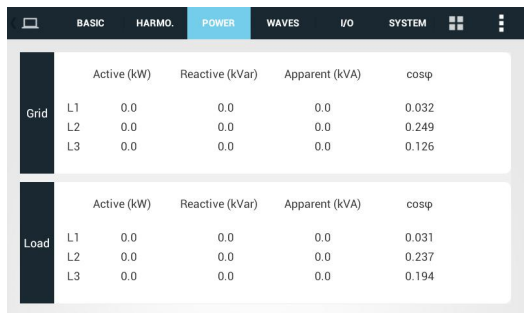

Figure 6-6 Power information

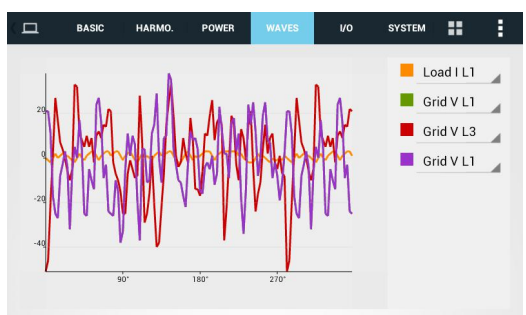

Figure 6-7 Waveform

6.4 Parameter setting

- Click "**SYSTEM**" button in the title bar to enter the login interface of setting, and input password to enter the interface of system setup. "**SYSTEM**" is displayed in Figure 6-8, Operation Mode, Power On Mode, CT location, Slave Module Quantity and Total Capacity can be set up;

- During the operation, if user is not satisfied with the compensation performance of real-time info displayed in Figure 6-3, the settings can be changed by clicking "**SYSTEM**" button.

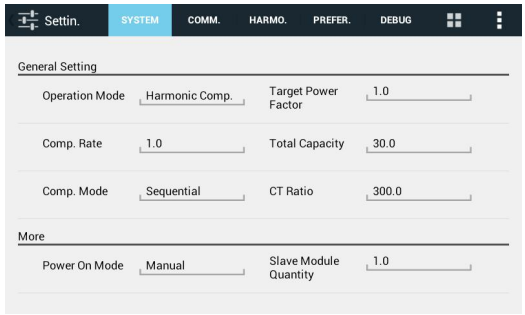

Figure 6-8 Interface of system setup

Remark: Click "**Operation Mode**"in the interface of system setup as shown in Figure , user can also see "**Operation Mode**" which is equivalent to in 4.3-inch screen. Besides, other modes are completely the same display between 7-inch screen and 4.3-inch screen.

- Click "**COMM.**" button in the top of Figure 6-8 to enter the interface of communication setup, as shown in Figure 6-9.

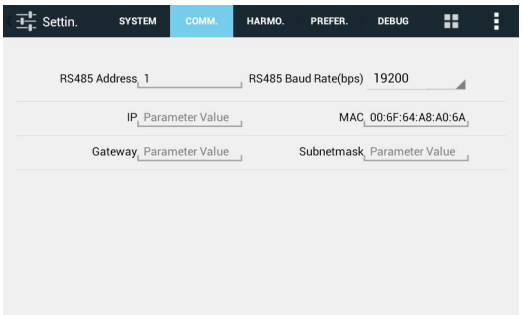

Figure 6-9 Interface of communication setup

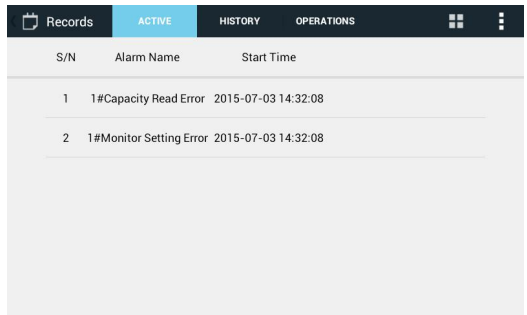

Figure 6-10 Alarm info

6.5 Other information

- Click "**Records**" button in the main interface to enter the interface of alarm info, as shown in Figure 6-10,6-11,6-12. User may check active alarm info, history alarm info and operations;
- Click "**About**" button to enter the version interface, as shown in Figure 6-13.
- Click "**Help**" button to enter the help information interface, as shown in Figure 6-14.

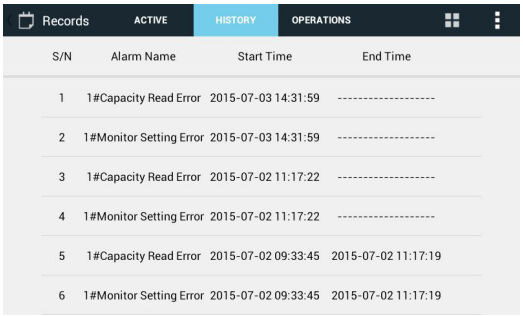

Figure 6-11 History alarm

Figure 6-13 About page

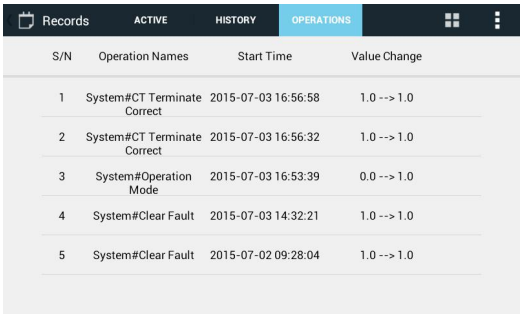

Figure 6-12 Operation records

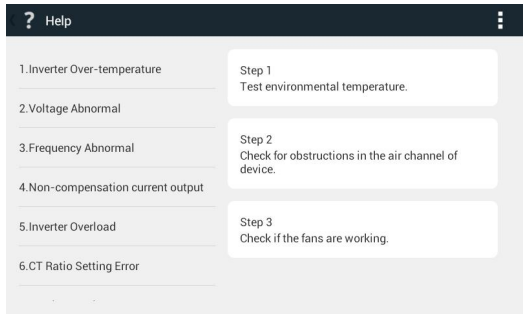

Figure 6-14 Help page

6.6 Dimensions

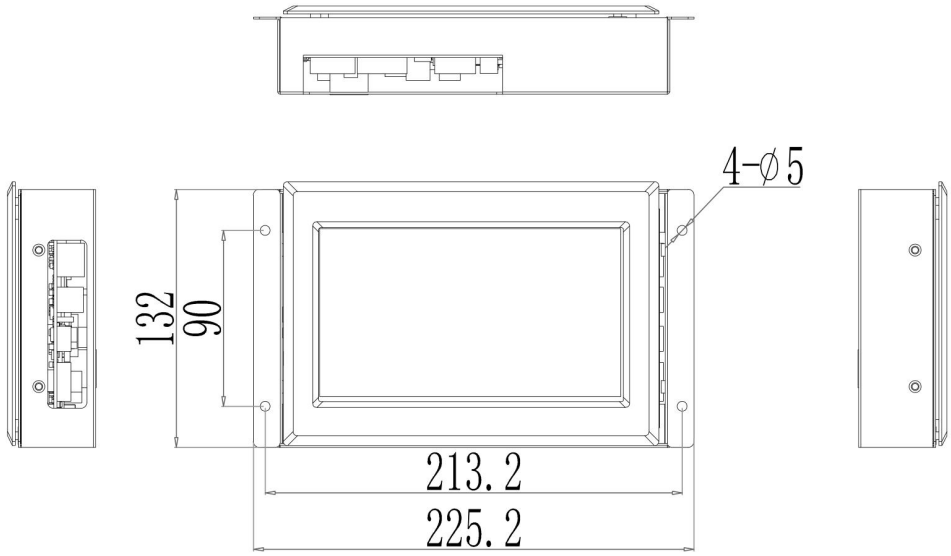

Figure 6-15 Dimensions of 7-inch HMI

Chapter VII SVG System

7.1 Standard SVG cabinet options

7.1.1 Nomenclature

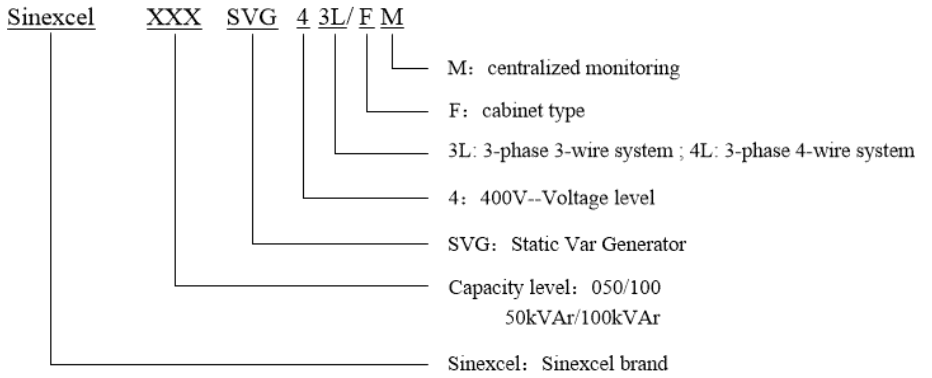

Figure 7-1 Sinexcel SVG system description

7.1.2 Sinexcel standard cabinet

Type	Dimension (W*D*H)	Module number	Cable entry	IP level
Flexi Cabinet 1	600*1000*2200	50kVAr, 5 units in max 100kVAr, 4 units in max	top/bottom special occasions in notes below	IP21
Flexi Cabinet 2	800*800*2200	50kVAr, 5 units in max 100kVAr, 5 units in max		
Flexi Cabinet 3	800*1000*2200	50kVAr, 5 units in max 100kVAr, 5 units in max		
600depth Cabinet	800*600*2200	50/100kVAr , 3 units in max, rack-mounted modules used	top cable entry	IP21
IP54 Cabinet-2100H	1000*600*2100	50kVAr, 3 units in max 100kVAr, 3 units in max	bottom cable entry	IP 54
IP54 Cabinet-1800H	700*900*1800	50kVAr, 3 units in max 100kVAr, 3 units in max		

Table 7-1 Sinexcel standard cabinet

Remarks:

Flexi cabinets	1. All flexible cabinet could be installed with 5 units of 50kVAr SVG module
	2. Flexi cabinet 2&3, when installed with 5 units of 100kVAr SVG modules, top cable entry is more recommended. It needs special breaker and extra cost if going with bottom cable entry.
	3. Flexi cabinet 1,2,3 could all be designed into hybrid way, which means AHF and SVG together, above module capacity is still valid, and 150A and 100kVAr SVG could be considered same because the dimension and ventilation is similar.
	4. All flexible cabinet could be upgraded to IP31 in maximum, max capacity would be same, but it needs extra cost and more produce time.
Others	1. 600depth cabinets and IP54 cabinets have ventilation fans inside, power supply of fans is different in 3P3W system and 3p4w system, the wiring type must be determined before sending order.
	2. IP54 cabinet- 2100H , HMI is internal, but there is a transparent cover on front door, position of which is opposite the HMI.

7.2 Standard SVG cabinet operation

7.2.1 Mechanical transport and installation

There are two methods for cabinet transport:

1. Handling facilities are applied for transport through the 4 hanging rings on the top of the cabinet;

2. Corresponding handling facilities are applied for transport through the bottom of the cabinet.

Note: when moving the cabinet from the bottom of its front, disassemble the front and rear panel at the bottom. Figure 7-2 shows what it is like after disassemble; when the cabinet is moved to the designated position, reattach the front and rear panel.

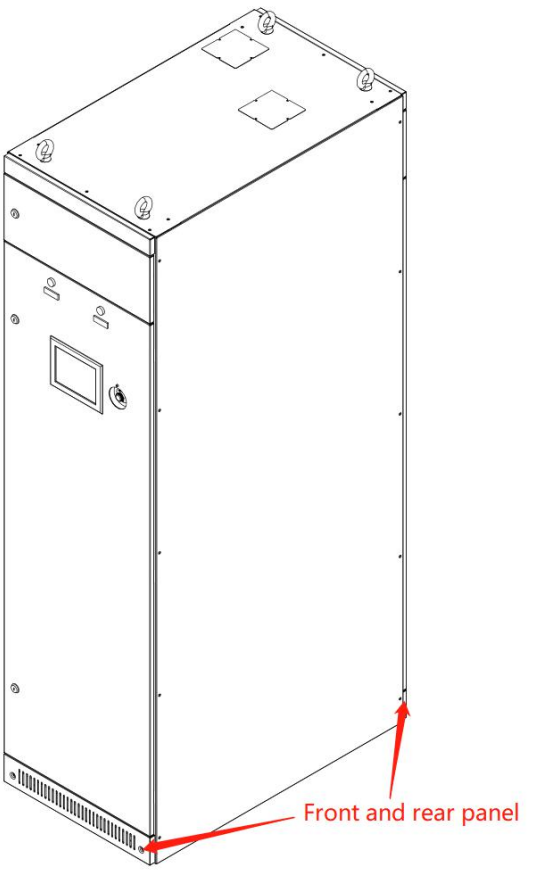

Figure 7-2 Front and rear panel of Sinexcel SVG system

Perform the following inspection before installation:

1. Check if there are damages from transport inside and outside the system; if there are, contact the carrier immediately.

2. Check product label and confirm system model. The label is attached to the side wall, and information about SVG model, capacity and main parameter is marked on the label.

7.2.2 Environment requirement

The system is designed to be installed indoor. Please keep the room clean and well-ventilated.

Don’t keep the system indoor before installation.

The internal system provides smart air cooling to allow cool air to enter through the grid before the cabinet, and hot air to be exhausted from the gird behind the cabinet. Do not block the vent.

To ensure long term and stable operation, the following environmental requirements must be met:

- The environmental temperature for SVG must be between -10℃ and 40℃; extra heating radiating device must be provided if the allowable value is exceeded;
- Do not keep SVG in environment with thick dust or conductive dust, or with corrosive or explosive gas;
- Do not keep SVG in environment with strong magnetic field, nuclear radiation or high-power RF interference from other devices;
- The environmental humidity for SVG should be less than 95%; no drip, steam and condensate water is allowed, otherwise it may cause permanent damage to SVG and danger to personal safety;
- The installation altitude of SVG should be <1,500m; if it is beyond 1,500m, use the device after derating;
- No drastic vibration, violent impact or large inclination of angle is allowed during the installation of SVG, otherwise it may cause permanent failure of system;
- Sufficient operating space must be provided during the installation of SVG to facilitate operation and allow ventilation and heat radiation;
- The distance of the front and rear of the whole device from the wall should not be less than 500mm, and the distance of the top from the roof should not be less than 500mm.

Note: The system is only installed on concrete or other non-flammable surfaces.

7.2.3 Electrical connecting

 Warning	Must be performed by qualified engineers. For any other devices not covered in this guide, detailed mechanical and electrical installation materials are attached upon shipment.

7.2.3.1 User wiring

 Warning	Before wiring, make sure the switch in distribution room of SVG system input power and city power are in “off” state, and warning label is attached to prevent any other person from handling the switch.

Follow the procedures below to connect cable after correctly installing the system:

1. Confirm all input distribution power switches are completely off.

2. Open the front door of the cabinet and you’ll see the busbar connecting to power cable: electrical connection listed in Figure 3-4.

3. Connect protective grounding and other necessary ground cables to earth point PE; all SVG cabinets must be connected to user grounding.

4. Connect and mark input power cable and external CT signal cable according to the type of installation.

5. Close the front door.

Warning	Earth wire connection must comply with international relevant standards.
Warning	Failure to conduct ground installation according to requirement may lead to electromagnetic interference, electric shock and fire.

For selection of system power and signal line diameter, please refer to Appendix 2.

7.2.3.2 CT secondary side short-circuited terminal row

Once external CT is connected to power distribution, CT secondary side terminal must be short-circuited and disconnected after CT secondary side cable is connected to the corresponding terminal. Users need to configure this short circuit device by themselves when connecting CT. Make sure that all secondary side GND ends of three-phase are short-circuited and connected to SVG PE line before CT is connected to the system, so as to ensure the safety of operator.

CT secondary side cable short circuit is listed in Figure 7-4:

The following procedures need to be taken when the device needs maintenance:

1) Before drawing out the module, push gliding slab 3, 8 and 13 of CT terminal to “connecting” state;

2) After installing the new module, push gliding slab 3, 8 and 13 of CT terminal to “breaking” state.

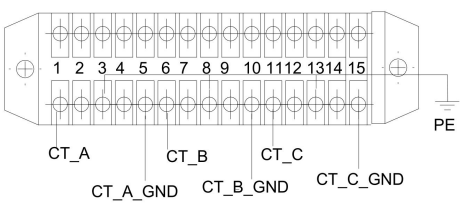

Figure 7-3 CT user short-circuit terminal

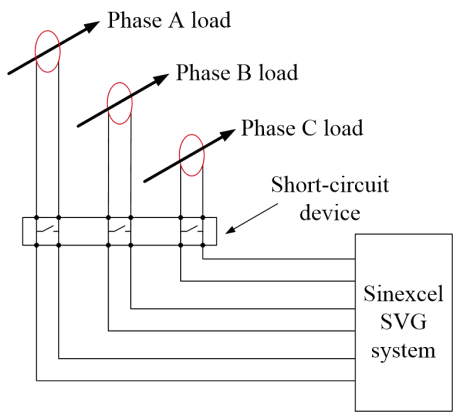

Figure 7-4 CT secondary short-circuit

7.2.3.3 CT wiring

Sinexcel 400V SVG system adopts three CTs separately connected to phase A, phase B and phase C. CT cable should be STP (shielded twisted pair) and separated from power cable so as to improve the accuracy of test and reduce interference from signal.

The system is supportive of CT source and load side connection. Refer to chapter IV for details of CT. Refer to Appendix 2 for selection of CT cable diameter.

7.2.3.4 External protective device

Breaker or other protective devices must be installed where external AC power is input.

Install appropriate overcurrent protection device on the input power distribution.

Current capacity of power cable and the system's overload capacity should be considered during installation.

Note: The system's earth leakage current (RCD) should be below 3.5mA.

7.2.4 HMI operation

When controlling SVG system, we suggest using a central monitor (7-inch HMI). This section focused on monitor parameter setting in several special situations. For more details about 7-inch HMI, please refer to Chapter VI.

7.2.4.1 Multiple wall-mounted modules parallel system

When using a 7-inch HMI to control paralleled wall-mounted modules, the 4.3-inch panel on each module will become unable to control the module. All parameters should be set through the 7-inch HMI. The "Slave Module Quantity" shall be the number of all modules that are under this HMI's control. The "Total Capacity" shall be the sum of all modules that are under this HMI's control. And dial switch of all modules shall be set "0000".

7.2.4.2 Multiple cabinets with one HMI system

A 7-inch HMI can control at maximum 8 SVG modules. When multiple cabinets contains no more than 8 modules, a 7-inch HMI is applicable. The "Slave Module Quantity" shall be the number of all modules that are under this HMI's control. The "Total Capacity" shall be the sum of all modules that are under this HMI's control. And please pay attention that total capacity setting is in A ,not kvar.

for example , there are 2 cabinets used together and 4 units of 100kvar SVG in each

cabinet ,one HMI controls 8 modules . the rated current of each module is 150A. the total capacity should be set as 1200 , and slave module should be set as 8 .

7.2.4.3 Multiple cabinets with multiple HMI system

In a system consisting only SVG modules, for different HMI, the “Slave Module Quantity” shall be the number of all modules that are under this HMI’s control and the “Total Capacity” shall be the sum of all modules of the system.

In a system consisting both AHF and SVG modules, different HMI shall be applied for AHF cabinet and SVG cabinet. The “Slave Module Quantity” shall be the number of all modules that are under this HMI’s control and the “Total Capacity” shall be the sum of all modules that are under this HMI’s control.

for example , there are 2 cabinets used together and 4 units of 100kvar SVG in each cabinet. one HMI controls 4 units and 2 HMI in total . the rated current of each module is 150A.for each HMI , the total capacity should be set as 1200 , and slave module should be set as 4..

7.3 Cabinet designing instructions

7.3.1 Mechanical designing

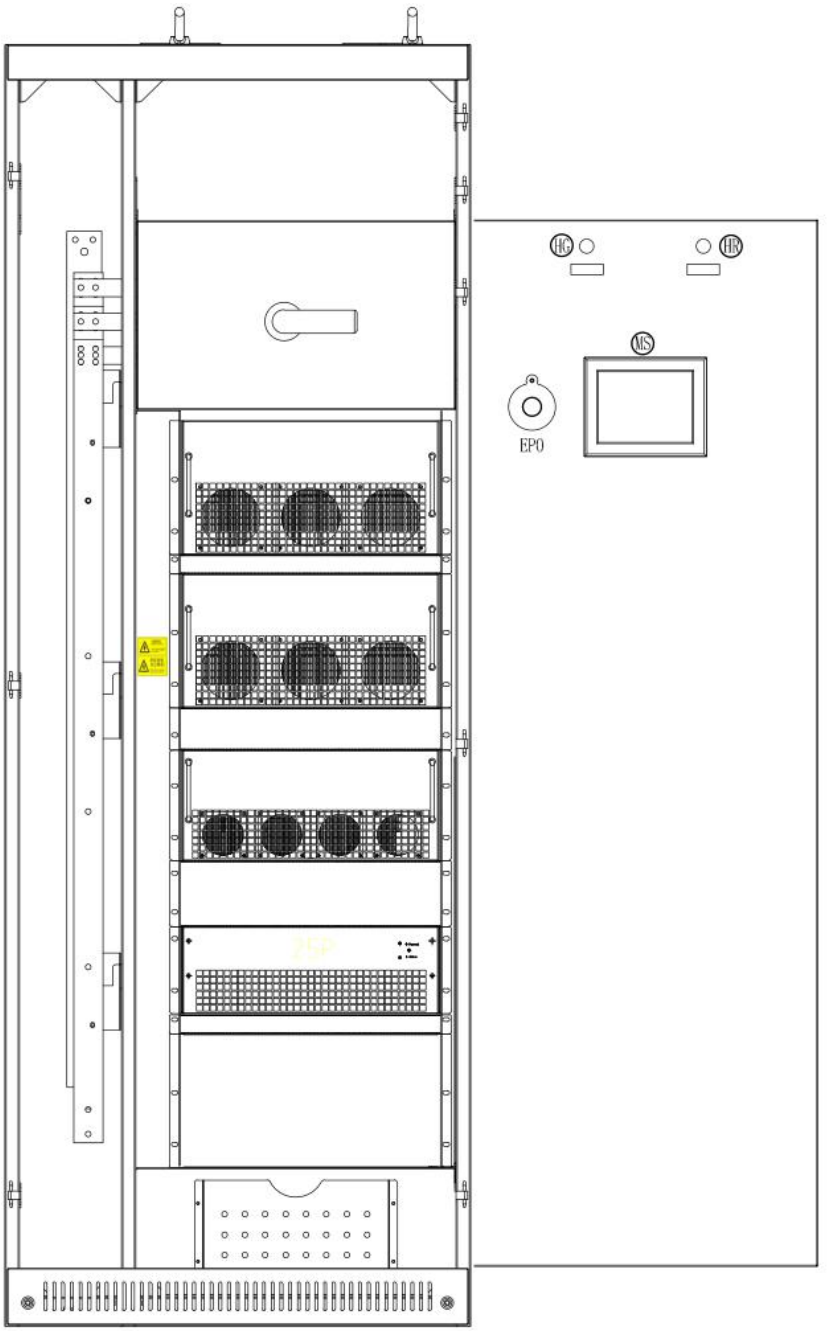

Figure 7-5 Structure of Sinexcel Flexi-cabinet

7.3.2 Cabinet ventilation designing

Heat dissipation is very important when designing cabinet. Because poor heat dissipation will influence the compensating capacity of device, even cause a great damage to the lifetime of the device.

Following requirement should be followed when designing AHF/SVG cabinet.

7.3.2.1 Natural Air cooling

SVG module has fans installed inside itself for cooling. When modules are installed in cabinet, there should be enough ventilation area on both front door and backdoor. When there are no special requirements on cabinet appearance and protection class, natural air cooling should be first choice. Natural air cooling should meet the following items:

1) Cabinet's front ventilation area should be no less than 1.5 times of the summary of all modules' front ventilation area.
2) Cabinet's rear ventilation area should be no less than 1.5 times of summary of all modules' rear ventilation area.
3) Definition of effective ventilation area
   - Module's front effective ventilation area: summary area of all the ventilation holes on the front side of module
   - Module's rear effective ventilation area: summary area of all the ventilation holes on the rear side of module
   - Cabinet's front effective ventilation area: summary area of all the ventilation holes on the front door of cabinet
   - Cabinet's rear effective ventilation area: summary area of all the ventilation holes on the rear door of the cabinet.
4) The position of the ventilation hole in front and rear door of the cabinet should face against module ventilation hole position.

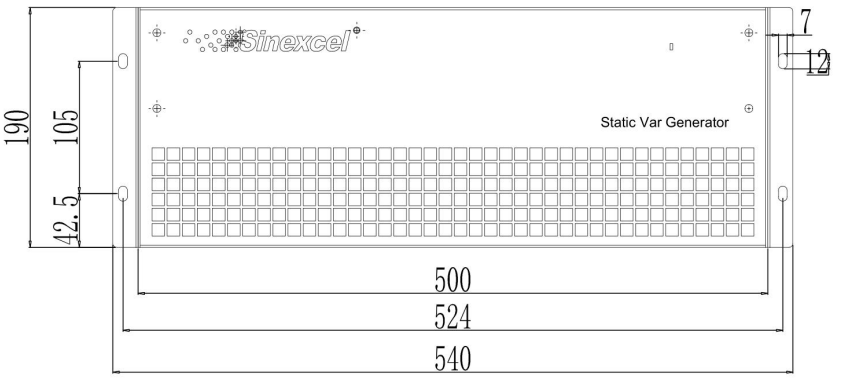

Figure 7-6 Module's ventilation holes on front side of 50kVAr SVG

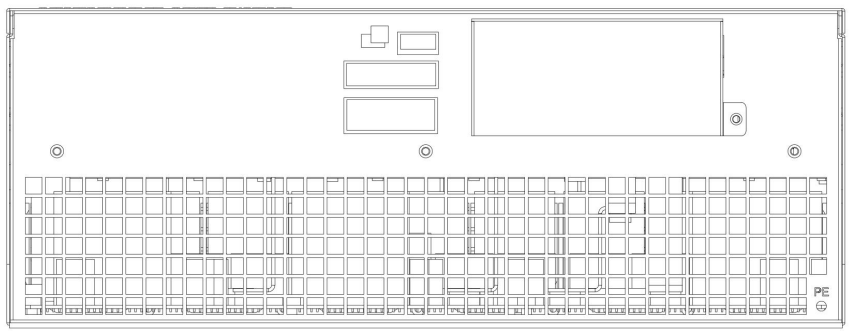

Figure 7-7 Module's ventilation holes on the rear side of 50kVAr SVG

5) Above standards apply to IP2X or IP3X cabinet, a higher IP level cabinet may need to add extra fans to improve heat dissipation, please contact module manufacturer for more support .

Figure 7-8 Cabinet's front ventilation holes

7.3.2.2 Fan-forced air cooling

Installing fans in cabinet to help vent is called fan-forced air cooling, 2 common design are listed below, and the following requirement should be followed:

1) Natural air cooling on front side, fan-forced cooling on rear side.
   Cabinet's front ventilation area should not be less than 1.5 times the module's front ventilation area. The exhaust air volume of the fans in the rear should not be less than 1.5 times than summary heat volume of all modules. The cooling requirement of single

module please refer user manual.

2) Fan-forced air cooling on both front and rear side
3) The exhaust air volume of the fans on front and rear door should both not be less than 1.5 times than summary heat volume of all modules.
4) Cabinet's ventilation hole position should face against module ventilation hole position, and the fan's installing position should face against module's front or rear ventilation hole position.

7.3.3.3 Attention

For cabinets with IP level higher than IP4X, the drawing of cabinet is suggested to be sent to module manufacturer for confirmation. The following information is required:

1) Appearance drawing of cabinet. the ventilation hole and fan installing position should be clearly shown in the drawing.
2) For cabinet with fans, the exhaust air volume of fans is required.
3) For cabinet with ventilation holes, cabinet' effective ventilation area is required.

Chapter VIII System power on and shutdown

8.1 Power on steps

 Warning	Only after SVG is installed and commissioned by an engineer and the external power switch has been closed, can the power on steps be executed.

These power on steps are applicable to SVG when it is at off-position. Operation steps are as follows:

1. Apply power to SVG by closing the disconnecting switch or breaker between the power grid and SVG.

2. Close the load break switch in the cabinet. The touch/monitoring screen displays power on. If the green running indicator light of main cabinet flickers, it will indicate that SVG is normally energised. In case of any failure, the red alarm indicator light on the cabinet will come on, and the running indicator light will be off.

3. When powered on and normal supply is established and if SVG has been set as 'Automatic power on' and power conditions are met, the system will start automatically.

4. If it is set as 'manual power on' and after the monitoring screen has started upon the energising process, click 'turn on' in the menu. After a normal soft power on, the system will switch on the power module.

8.2 Power off steps

 Warning	To prevent personal injury and in case of cabinet maintenance or opening after shutdown, disconnect all input switches. Conduct relevant measurements using a multimeter to ensure personal safety.

Click turn off in the menu to stop system immediately and enter the standby state.

Please note: In a standby state, the internal system and terminal are still electrified (live). When the power is not disconnected, any maintenance or opening the cabinet is strictly prohibited.

8.3 Auto power on

In case of abnormal grid voltage or frequency, SVG will automatically stop compensating current output and enter standby state (standby mode will note operate in case of power outage).

When the following conditions are met, SVG will automatically re-run and restore output.

1. The utility power has restored to normal
2. Auto-on has been enabled in Settings-General-Start mode;
3. Auto-on delay is enabled (default: 10 sec)

Please note: If the auto power-on feature of SVG isn't enabled, the user needs to manually start SVG using the touch/monitor screen.

8.4 Emergency stop

In the case of an abnormal function or output of SVG, press the EPO button on the front panel to turn off the module. Immediately disconnect the curcuit breaker or isolation switch between SVG and the grid to cut off the system input power.

After pressing EPO and troubleshooting, if all tests appear OK, re-press the EPO button and click on the monitor screen, select 'Clear fault', and perform the startup operations if there is no alarm sounding. In the event of continued alarm please contact Sinexcel.

Chapter IX Common fault diagnosis

For common failures and solutions, please refer to Table 5-1. Some failures and alarms can be solved by the user on site. If it can't be resolved, please contact Sinexcel.

The failures caused by improper use, such as CT cable reverse, CT polarity error, power cable phase sequence error and parameter setting error, can be found by checking the data in the power on process. For poor compensation effect and no alarm information, please contact Sinexcel.

Failures or alarms	Possible reasons	Solutions
Communication failure	Communication failure between the monitoring module and SVG	Check if the communication cable is securely connected
Over-temperature	Ambient temperature is too high; Air duct is blocked; Fan failure	Check the possible reasons one by one.
Input voltage is abnormal	1. The incoming power cables are incorrectly or poorly connected or the neutral is disconnected or poorly connected; 2. Input overvoltage or undervoltage, converter is turned off or can't be turned on.	Check if the model is connected corresponding to the requirements of that model. Check that the power cable is reliably connected, and if the input phase voltage is in the range of 132V ~ 264V.
Input frequency is abnormal	Converter is turned off or can't be turned on because the input frequency exceeds the limit	Check if the frequency of AC input is in the range of 42.5-62.5Hz
DC bus overvoltage	Converter is turned off or can't be turned on due to the high DC bus voltage	Please contact our product engineers.
Auxiliary power failure	Auxiliary power failure	Please contact our product engineers.
No compensation current	1. SVG is not turned on; 2. CT wiring has problem; 3. The compensation rate is set too small	Check if SVG is turned on, check the setting of compensation rate, check the installation position of the CT and wiring method and if the CT cable is securely connected

Controller parameter setting error	Controller parameters do not match the set controller parameters	Please contact our product engineers.
Inverter overload failure	Compensation current of SVG exceeds the rated current	Check if the capacity of SVG matches the load
CT ratio setting error	External CT ratio setting error	Check if the installation direction of the CT and the cable phase sequence are correct.

Table 9-1 Troubleshooting

Appendix 1 Product Parameter

Item	Sinexcel Static Var Generator	
System parameter		
Grid voltage	380V(-40%～+20%）；228V～456V	
Grid frequency	45Hz ～ 62Hz	
Allowed number of module in parallel	Unlimited	
Overall efficiency (100% load)	≥97%	
Network configuration	3-phase 3-wire, 3-phase 4-wire,	
Setting of CT ratio	150/5 ～ 10,000/5	
Topology design	Tri-level topological structure	
Performance indicator		
Rated capacity	30/50kVAr	100kVAr
Fast response time	＜50μs	
Complete response time	＜5ms	
Target PF	Adjustable between -1 ～ 1	
Control algorithm	Intelligent FFT algorithm, instantaneous reactive algorithm	
Switching frequency	20kHz	
Reactive compensation	Supported	
Imbalance compensation	Supported	
Cooling mode (smart cooling)	220L/Sec	405L/Sec
Noise level	＜65dB	
Communication monitoring capability		
Communication interface	RS485/ network interface(RJ45)	
Communication protocol	Modbus protocol, TCP/IP	
Protective function	Overvoltage protection, under voltage protection, short-circuit protection, inverter bridge reverse protection and overcompensation protection	
CT monitoring alarm	Yes	
Fault alarm	Yes, 500 records at most	
Monitoring	Centralized monitoring supported	

Physical characteristics		
Installation method	Wall-mounted, rack-mounted and cabinet	
Net weight	35kg	48kg
Color	All modules black, cabinet: RAL7035	
Environmental requirement		
Altitude	≤1500m, between 1500 ～ 4000m, in accordance with national standard GB/T3859.2, power reducing by 1% with every increase of 100m	
Operating temperature	-10℃ ~ +40℃	
Relative humidity	95% at most, no condensation	
Level of protection	IP20, other IP levels customizable	
Storage temperature	-40℃~70℃	
Relevant qualification & standard		
Qualification	CE certified, CCIC-SET test report	
Standard	EN 50178\EN 61000-6-2\EN61000-6-4; Sinexcel corporate standard	

Table A1-1 Product parameter

Appendix 2 Selection of Cable and Accessories

Rated capacity	30	50	100	150	200	250	300	400	500
Cable of phase A/B/C mm^2	35	35	50	70	50*2	70*2	95*2	120*2	120*2
Cable of phase N mm^2	35	50	50	95	70*2	95*2	120*2	150*2	150*2
PE cable mm^2	16	16	16	50	50	50	95	120	120
Power terminal screw	M8	M8	M8	M8	M8	M8	M8	M8	M8
PE terminal screw	M6	M6	M6	M6	M6	M6	M6	M6	M6
Rated current of Breaker	100A	150A	200A	300A	630A	630A	630A	800A	800A
CT cable	Below 15m: RVVSP 2*2.5 mm^2; 15m-30m: RVVSP 2*4 mm^2; above 30m: contact Sinexcel								
Range of CT ratio	150/5~10000/5								
Remark	**If there is requirement for cable temperature, the specification of cable needs to be expanded**								

Table A2-1 Selection of cable and accessories

Note:

1. The cable size selection of N phase should 3 times to phase if the zero sequence harmonic as a main part of total harmonic current
2. The CT ratio selection should be 1.5~4 times to maximum load current
3. The Rated current selection of breaker should be 1.2 times or above to SVG rated capacity

Appendix 3 Monitoring parameter description

Menu			Description	
Main interface	Grid current	THDI	Total harmonic distortion of grid current of phase A/B/C	
		RMS	RMS of grid current of phase A/B/C	
	Load current	THDI	Total harmonic distortion of load current of phase A/B/C	
		RMS	RMS of load current of phase A/B/C	
	Power ON		Send “power on” command	
	Power OFF		Send “power off” command	
Data	Voltage	Voltage (V)	phase voltage	
		Frequency (Hz)	frequency of grid voltage	
		THDU（%）	Total harmonic distortion of voltage	
		Waveform	Waveform of grid voltage	
		Spectrum	harmonic analysis of grid voltage	
	Current	Grid current	Current (A)	RMS of phase A/B/C grid current
			PF	PF at grid side
			THDI (%)	THD of phase A/B/C grid current
			Waveform	Waveform of grid and load current of phase A/B/C
			Spectrum	harmonic analysis of grid current
		Load current	Current (A)	RMS of phase A/B/C load current
			PF	PF at load side
			THDI（%）	THD of phase A/B/C load current
			Waveform	Waveform of grid and load current of phase A/B/C
			Spectrum	harmonic analysis of load current

		Comp. current	Current (A)	current compensation of phase A/B/C
			Load Rate (%)	the ratio of compensation current and rated current of system
			Waveform	Waveform of SVG compensation current of phase A/B/C
	Power analysis	Apparent power	apparent power of phase A/B/C at grid side	
			apparent power of phase A/B/C at load side	
		Active power	active power of phase A/B/C at grid side	
			active power of phase A/B/C at load side	
		Reactive power	reactive power of phase A/B/C at grid side	
			reactive power of phase A/B/C at load side	
		cosφ	Cosine of angle between grid voltage and fundamental current	
			Cosine of angle between load voltage and fundamental current	
	IO/temperature	IO status		status info of dry contact
		Temperature (The number of temperature node varies with different models. User needs to depend on specific module.	Node 1, 2, 3	temperature display of phase A/B/C Inverter
			Node 4, 5, 6	local temperature of inductance board
	Debugging	Analog address 1		Address of DSP variable
		Analog address 2		Address of DSP variable
		Analog address 3		Address of DSP variable
	Version	Software version No.	Version No. of monitor and controller	
		System model	Display of SVG voltage level, rated capacity and 3-phase 3-wire or 3-phase 4-wire system	
Settings	System parameter	operation mode	6 operation modes available 0. Reactive; 1. Q+B; 2. Auto-aging; 3. B+Q; 4. Balancing; 5. Constant Reactive	
		power on mode	Used to set SVG power-on mode. Under the “auto ” mode, cut off the power first and then	

			turn on power again, SVG will automatically compensate load harmonic; under the “manual” mode, cut off the power first and then turn on power again, SVG won’t work automatically. Under the “manual” mode, only having received the power-on command, SVG will work.
		CT location	At either source side or load side
		Quantity	Default value is 1, can not be changed
		Total capacity	Set the total capacity of the system
		Comp. Mode	Intelligent mode、Sequential mode or All mode
		CT Ratio	Set external CT Ratio, e.g. 600:5 etc.
		Ext. passive Filter	Reserve function
		CT secondary connection	Default value is series, can not be changed
		Inductor current conFigure	Used to select compensation of inductive or capacitive reactive power, user not allowed to change it
		PT Ration	Set the ratio of external transformer
		Target Power Factor	Under “harmonic and reactive compensation” mode, set value of PF at grid side. SVG adjusts the magnitude and phase of reactive current according to its own load rate, so that grid PF approaches target value
		Controller parameter	Parameter of internal control loop. The larger the parameter, the better the stability. Conversely, the performance increases. User not allowed to change it.
		variable 1	Check DSP internal variable, user not allowed to change it
		variable 2	Check DSP internal variable, user not allowed to change it
		Comp. Rate	Set harmonic compensation rate; 1.0 indicates 100%, and so on
		Hybrid parameter	Reserve function
		Harmonics comp. setup	Compensate harmonics ranged between 2nd and 50th and their compensation rate
		Power saving function	Turn on/off the device at a regular time to save

			power
		Select weekday	Set the working time of SVG during a week
		Select holidays	Set the rest time of SVG
	Monitor parameter	Local address	Address of each module in the system
		Baud rate	9600bps or 19200bps
		Language	Set the language
		Time	Set time and date
	Clear fault		Used to clear the failure that cannot be automatically recovered
	Exit		Exit the “Settings” interface
Record	Alarm	Active alarm	Serial No., name and start time of active alarm
		History alarm	Serial No., name and start/end time of alarm
		History alarm download	Download history alarm information to USB storage device
	Operations	Serial number and name of operation, start time and specific variation of operation	

Table A3-1 Parameters description of 4.3-inch LCD screen

Menu	Item			Description
Real-time info	Basic info	Grid voltage	Voltage (V)	phase voltage of phase A/B/C
			Frequency (Hz)	voltage frequency
			THDU	Total harmonic distortion of grid voltage of phase A/B/C
			Waveform	Waveform of grid voltage
		Grid current	RMS (A)	RMS of grid current of phase A/B/C
			PF	PF at grid side
			THDI	Total harmonic distortion of grid current of phase A/B/C
			Waveform	Waveform of grid current of phase A/B/C
		Load current	RMS (A)	RMS of phase A/B/C load current
			PF	PF at load side
			THDI	THD of phase A/B/C load current
			Waveform	Waveform of load current of phase A/B/C

		Comp. current	RMS (A)	Compensation current of phase A/B/C
			Load rate	the ratio of compensation current and rated current of system
			Waveform	Waveform of SVG compensation current of phase A/B/C
	Harmonics Analysis		Grid THDI	THD of grid current of phase A/B/C
			Load THDI	THD of load current of phase A/B/C
			Grid THDU	THD of grid voltage of phase A/B/C
	Power analysis	Apparent power		apparent power of phase A/B/C at grid side
				apparent power of phase A/B/C at load side
		Active power		active power of phase A/B/C at grid side
				active power of phase A/B/C at load side
		Reactive power		reactive power of phase A/B/C at grid side
				reactive power of phase A/B/C at load side
	Dry contact info			status info of dry contact
Settings	Basic setup	operation mode		6 operation modes available 0. Reactive; 1. Q+B; 2. Auto-aging; 3. B+Q; 4. Balancing; 5. Constant Reactive
		CT Ratio		Set external CT Ratio, e.g. 600:5 etc.
		CT location		At either source side or load side according to actual CT location
		PT Ration		Set the ratio of external transformer
		Comp. mode		Intelligent mode、Sequential mode or All mode
		Hybrid parameter		Reserve function
		Slave Module Quantity		Set the number of slave device
		Total Capacity		set the total capacity of the system, indicated by the sum of the rated current of single module in parallel operation system; set before product leaving factory, user not allowed to change it
		power on mode		Used to set SVG power-on mode. Under the “auto ” mode, cut off the power first and then turn on power again, SVG will automatically compensate load harmonic; under the “manual” mode, cut off the power first and then turn on power again, SVG won’t work

			automatically. Under the “manual” mode, only having received the power-on command, SVG will work.
		Controller parameter I	Parameter of internal control loop. The larger the parameter, the better the stability. Conversely, the performance increases. User not allowed to change it.
		Comp. Rate	Set harmonic compensation rate; 1.0 indicates 100%, and so on
		Target Power Factor	Under “harmonic and reactive compensation” mode, set value of PF at grid side. SVG adjusts the magnitude and phase of reactive current according to its own load rate, so that grid PF approaches target value
		Voltage	Set the voltage level of SVG, finished when product leaving factory, user not allowed to change it
		Inductor cur.config	Used to select compensation of inductive or capacitive reactive power, user not allowed to change it
		Network Configuration	Set the input wire system of SVG (3-phase 3-wire system or 3-phase 4-wire system). This setup has been finished before product leaving factory, user not allowed to set it
		Ext. passive Filter	Reserve function
		CT secondary connection	Selection of CT secondary side wiring, series connection first recommended
		Variable 1	Check DSP internal variable, user not allowed to change it
		Variable 2	Check DSP internal variable, user not allowed to change it
	Harmonics		Compensate harmonics ranged between 2nd and 50th and their compensation rate
	Comm.	Background communication address	Set monitoring address
		Background communication Baud rate	Set the number of change of carrier wave per unit time
		Background communication protocol	Set background communication protocol, Dianzong protocol by default
		MAC address	Set MAC address of the LAN the device is in

		IP address	Set IP address
		Gateway	Set gateway
		Subnet mask	Set subnet mask
	Sleep mode		Set the running and resting time of device
	Other setup	Language	Set the language displayed
		Time	Set time
		Date	Set date
		LCD bias light	Set the length of work time for LCD brightness, 2/5/10 minutes
Record	Active alarm		Serial No., name and start time of active alarm information
	History alarm		Serial No., name and start/end time of alarm information
	History alarm download		Download history alarm information to USB storage device
	Operations		Record the type and variation of operation and time
Power on/off	Power on		Send “power on” command
	Power off		Send “power off” command
	Clear fault		Clear the failure that cannot be automatically restored
Version			Display software version No. and system model

Table A3-2 Parameter description of 7-inch LCD screen

Appendix 4 Introduction of Modbus Protocol

Due to the large number and great intensity of interference sources during electric power communication, RS485 is more reliable and stable than RS232 communication; while in RS485, Modbus protocol communication only needs to use RX and TX of serial port. Thus, Modbus RTU is adopted for transmission.

Sinexcel SVG supports Modbus protocol; Sinexcel SVG contains RS485 communication interface and can be connected to external USB or serial port via 485/USB converter or 485/232 converter. For LCD model, it needs to be connected to external USB interface or serial port via signal interfaces 485P+ and 485P- behind the chassis, as shown in Figure 1 and 2. For LED model, it needs to be connected to external USB interface or serial port via signal interfaces 485+ and 485- of centralized monitoring modules, as shown in Figure 3 and 4. Modbus bus can be applied to the collection and process monitoring of all kinds of data; via Modbus protocol, user can collect and check voltage information, current information, power information, harmonic analysis, IO status and temperature information, and collect the alarm information of SVG.

Remark: user needs to contact Sinexcel product engineer if Mosbus protocol is required.

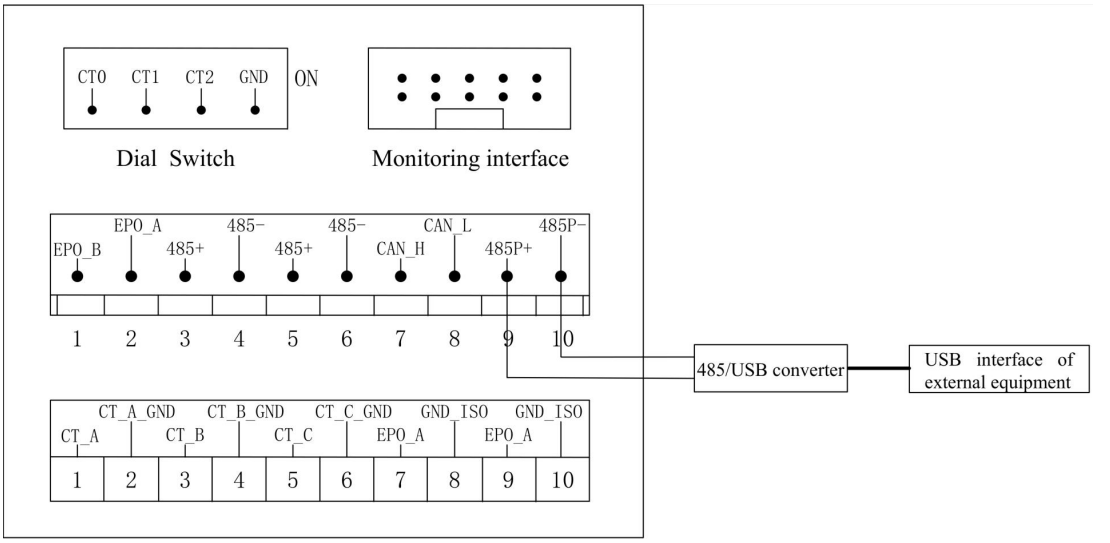

Figure A4-1 Wiring of 485 communication interface and USB interface of external equipment

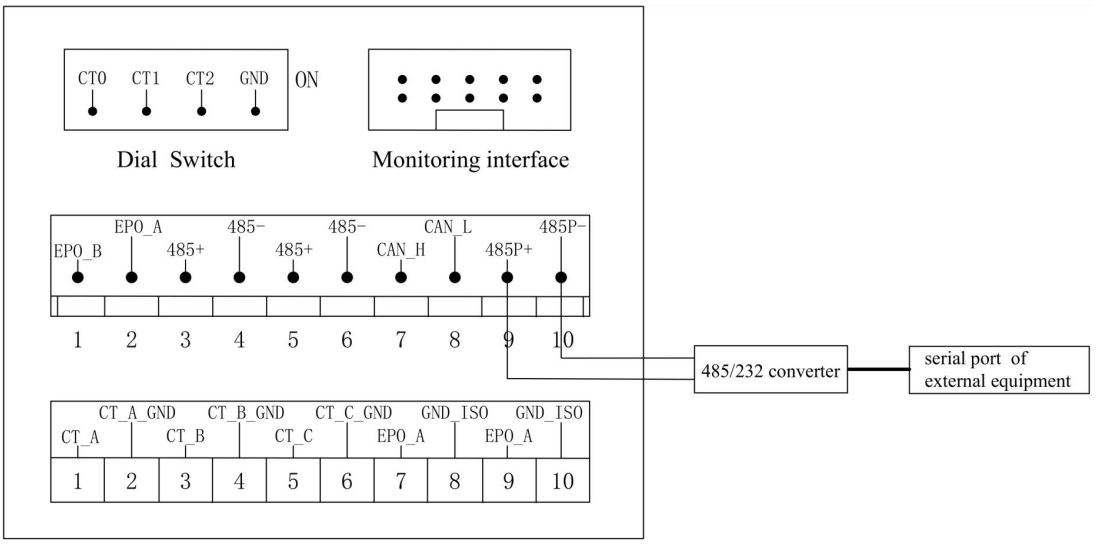

Figure A4-2 Wiring of 485 communication interface and serial port of external equipment

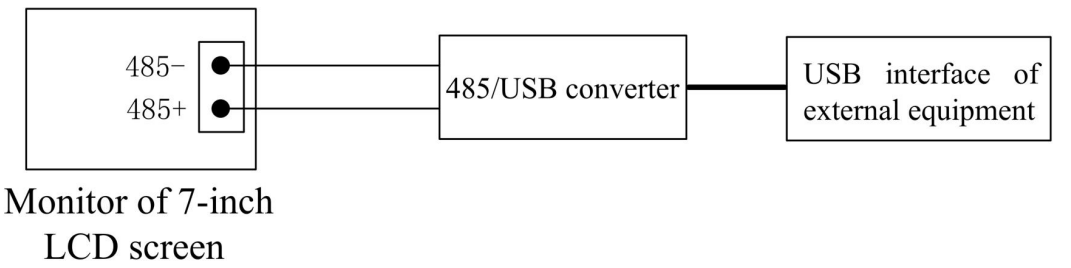

Figure A4-3 Wiring of 485 communication interface of centralized monitor and USB interface of external equipment

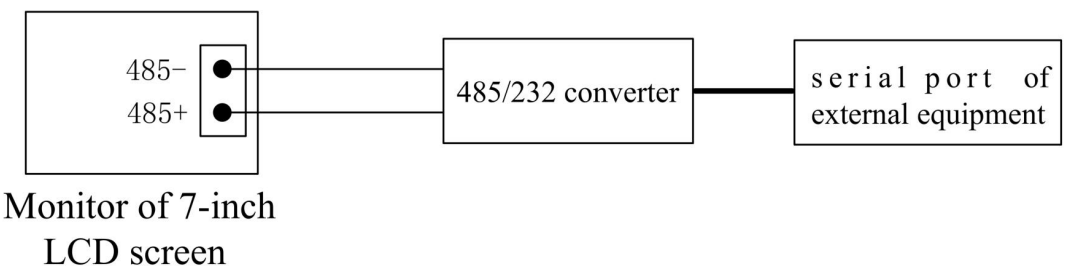

Figure A4-4 Wiring of 485 communication interface of centralized monitor module and serial port of external equipment

Appendix 5 Introduction of I/O board

In the industrial field, the operation status and safety of equipment are of concern to enterprise users. Due to the limited configuration of enterprise auditors, remote or short-range centralized control is used, that is, the operation status of each equipment in the distribution system is controlled by some means of communication. The information is collected and displayed in the monitoring room, where the dry contact is a relatively common means of short-range monitoring.

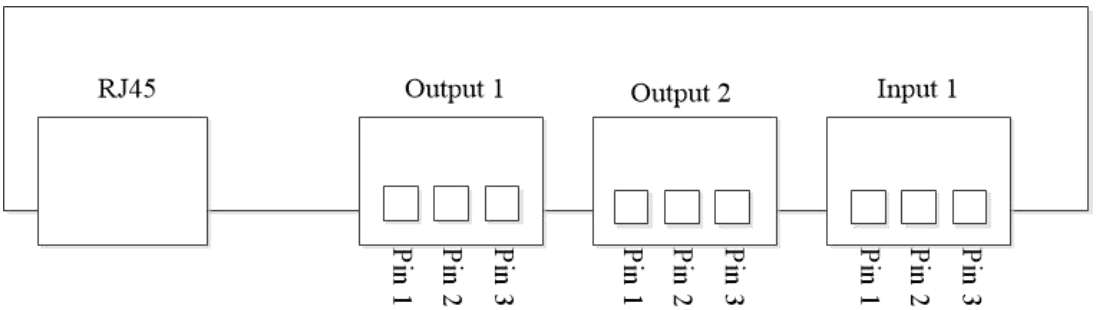

Figure A5-1 Dry contact board

Sinexcel dry contact board mainly consists of four parts: RJ45 Ethernet port, output dry contact 1, output dry contact 2, input dry contact.

1. RJ45 Ethernet port

Sinexcel offers Modbus protocol and RJ45 Ethernet port. The user can access the module to the user LAN through the network cable, then establish communication between the user Ethernet monitoring system and the module based on Modbus.

2. Output dry contact 1

This dry contact is used to monitor the on/off status of the module. As shown in the figure 1, Pin 2 always output high level: VDD. Pin 1 and Pin 3 have two level: high level “VDD” and low level “0”.

In order to monitor the module power status, there is need to measure the output level of Pin 1 and Pin 3.

1) If module power is on, Pin 1 output high level: VDD, else output low level: 0.

2) If module power is off, Pin 3 output high level: VDD, else output low level: 0.

The user can use the level change of the Pin1 and Pin 3 to design peripheral circuit to monitor the on/off status of the module.

3. Output dry contact 2

This dry contact is used to monitor whether the module have alarm or not.As shown in the

figure 2, Pin 2 always output high level: VDD. Pin 1 and Pin 3 have two level: high level "VDD" and low level "0".

1) If module has no alarm, Pin 1 output high level: VDD, else output low level: 0.

2) If module has an alarm, Pin 3 output high level: VDD, else output low level: 0.

The user can use the level change of the Pin1 and Pin 3 to design peripheral circuit to monitor whether the module have alarm or not. The maximal allowable DC current in the output end is 8A, the maximum DC voltage is 28V and the maximum AC voltage is 277V.

4. Input dry contact

As shown in figure 3, there are four input ports. Pin 2 and Pin 4 are connected to GND.

1) If input high level "VDD" to Pin 1, the module will turn off. If input low level "0" to Pin 1, the module will do nothing.

2) If input high level "VDD" to Pin 3, the module will turn on. If input low level "0" to Pin 3, the module will do nothing.

The high level range: DC 7V~36V, ideal range is: DC 10V~20V.

Appendix 6 Toxic and hazardous substances and elements

Part name	Toxic and hazardouus substances or elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr 6+)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Metal enclosure	O	O	O	O	O	O
Plastic enclosure	X	O	O	O	O	O
Printed circuit board	X	O	O	O	O	O
Outlets	X	O	O	O	O	O
Cables and wires	X	O	O	O	O	O
Connectors and circuit breakers	O	O	X	O	O	O
Sealed lead acid battery	X	O	O	O	O	O
Transformer	O	O	O	O	O	O
Other	X	O	O	O	O	O

Table A6-1 Toxic and hazardous substances and elements

O signifies that the content of the poisonous substance in all the homogeneous materials contained in this component is below the amount regulated by SJ/T11363-2006 standard.

X signifies that the content of the poisonous substance in at least one specific homogeneous material contained in this component is above the amount regulated by SJ/T11363-2006 standard

Note: Printed circuit board: including empty printed circuit board and all above-mentioned parts.

Hazardous substances	MCV
Pb，Hg，Cr6+，PBB，PBDE	1000 PPM
Cd	100APM

Appendix 7 External dimension of Sinexcel SVG

Appendix 7.1 External Dimension of 30kVAr

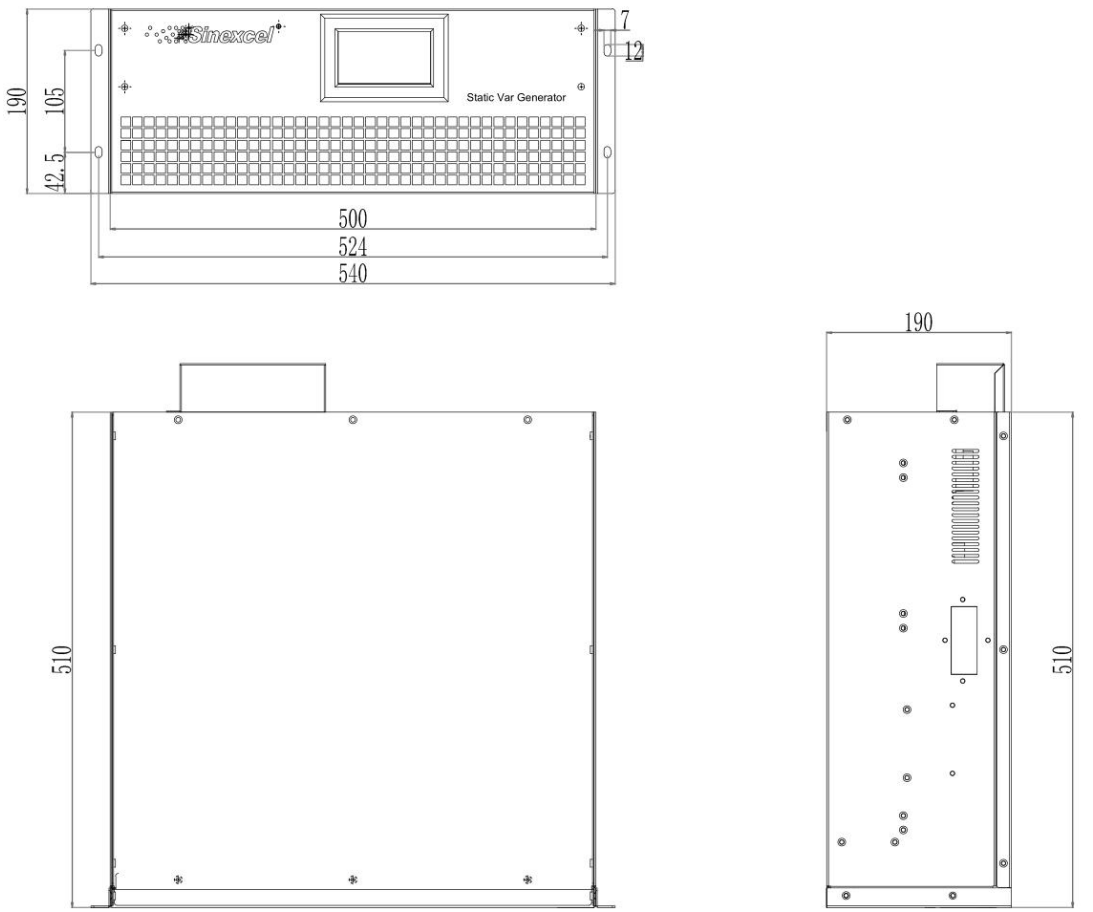

Figure A7-1 External dimension of 30kVAr LCD (rack-mounted)

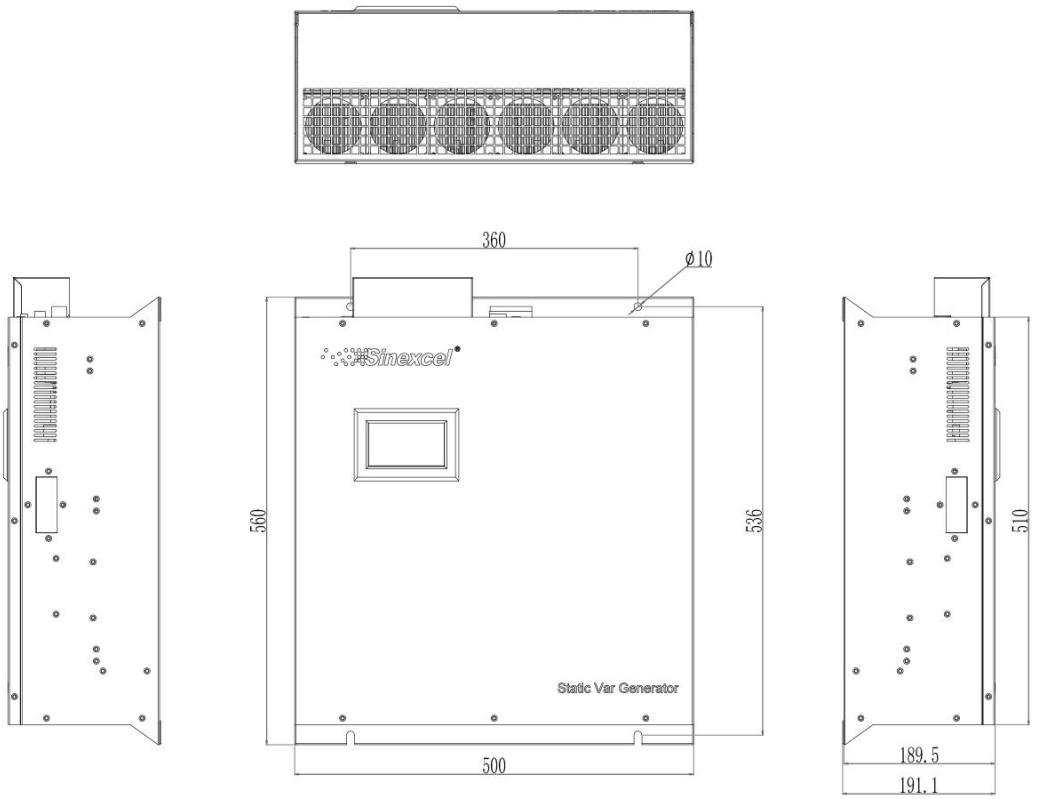

Figure A7-2 External dimension of 30kVAr LCD (wall-mounted)

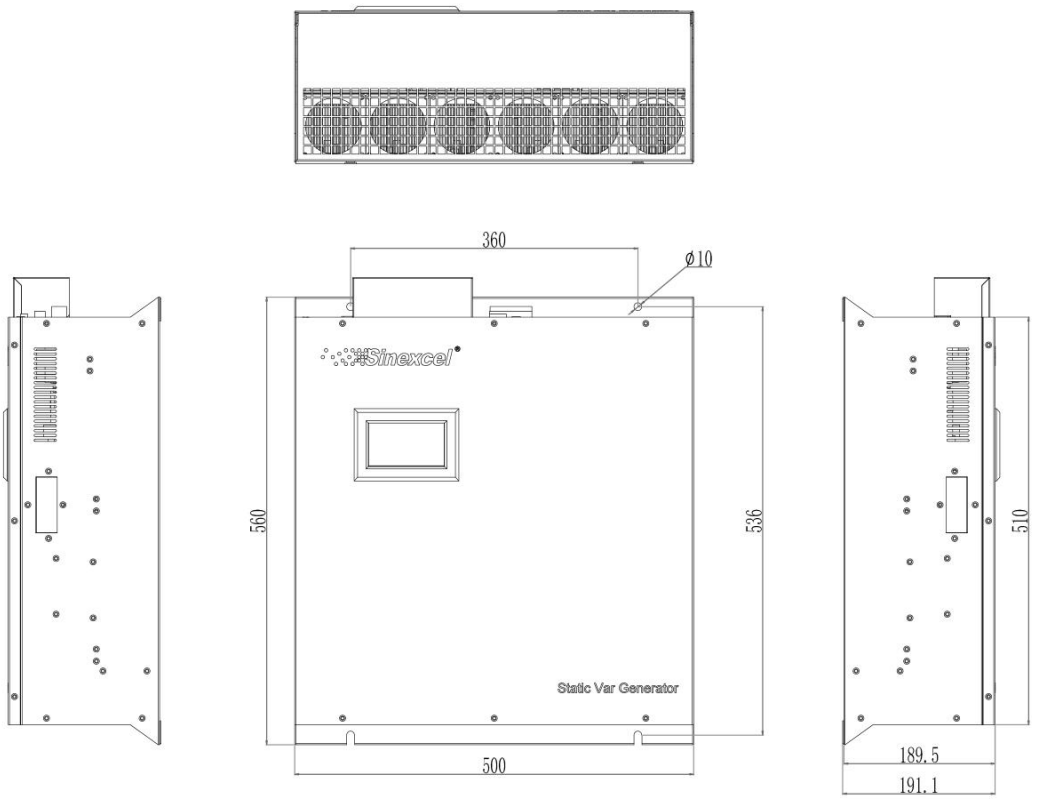

Figure A7-3 External dimension of 30kVAr LED (rack-mounted)

Appendix 7.2 External Dimension of 50kVAr

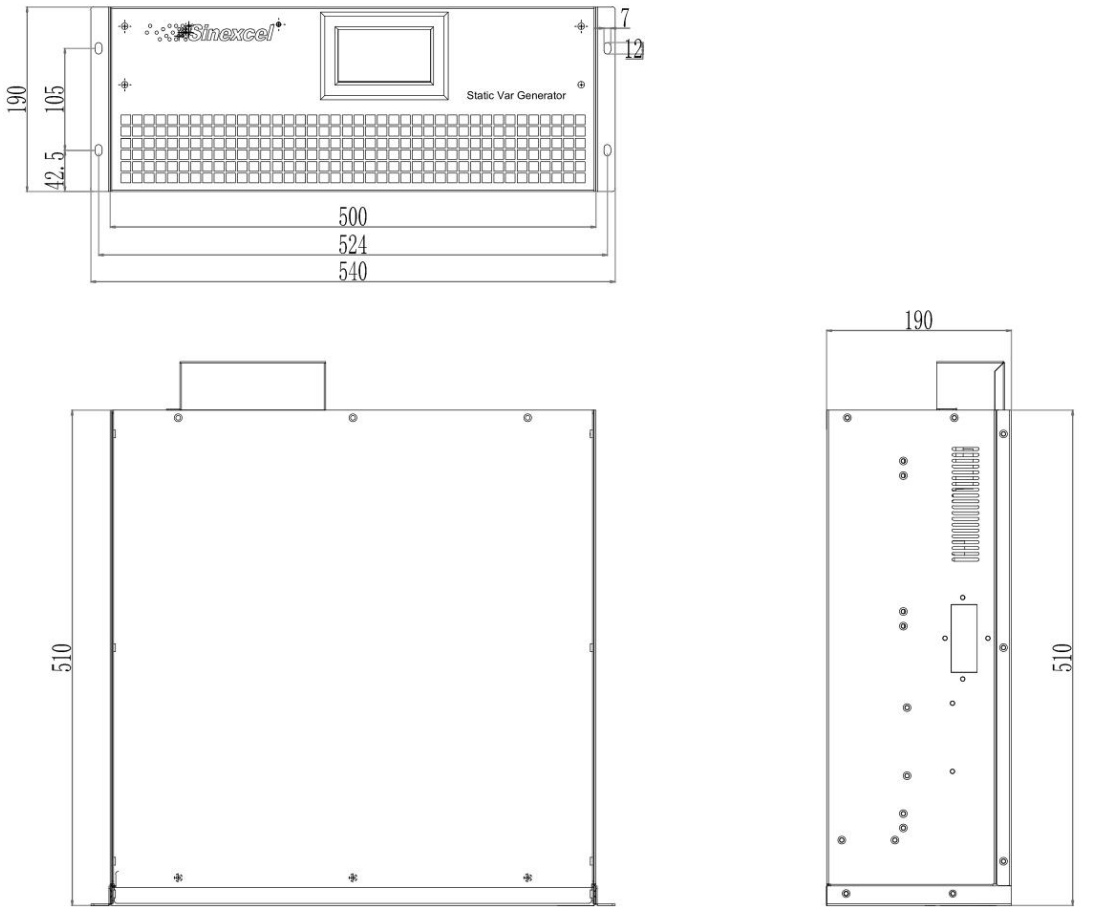

Figure A7-4 External dimension of 50kVAr LCD (rack-mounted)

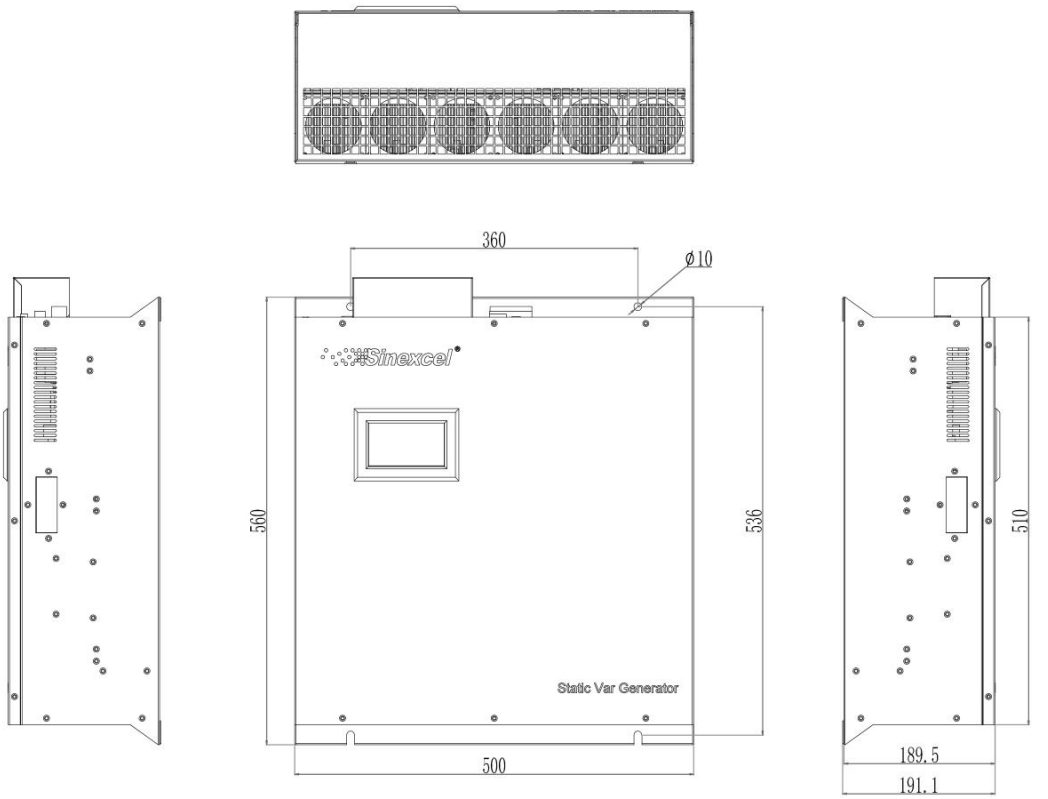

Figure A7-5 External dimension of 50kVAr LCD (wall-mounted)

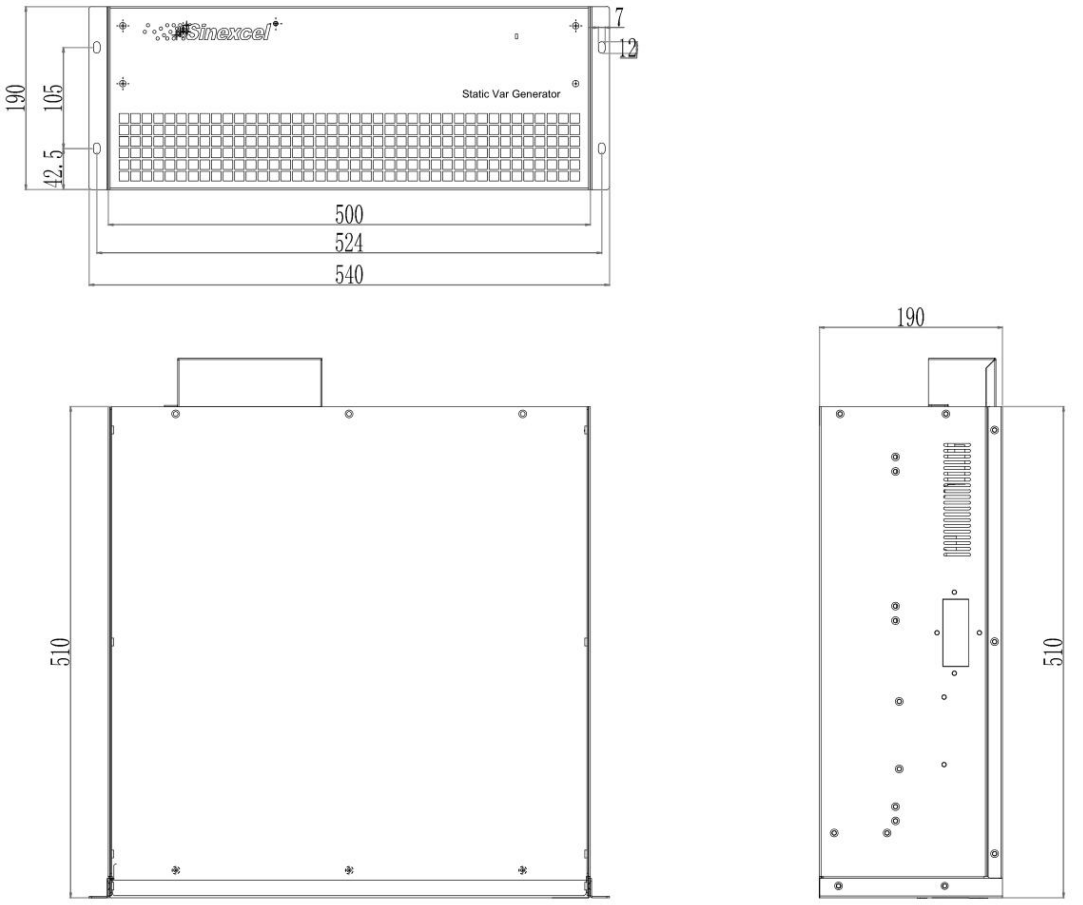

Figure A7-6 External dimension of 50kVAr LED (rack-mounted)

Appendix 7.3 External Dimension of 100kVAr

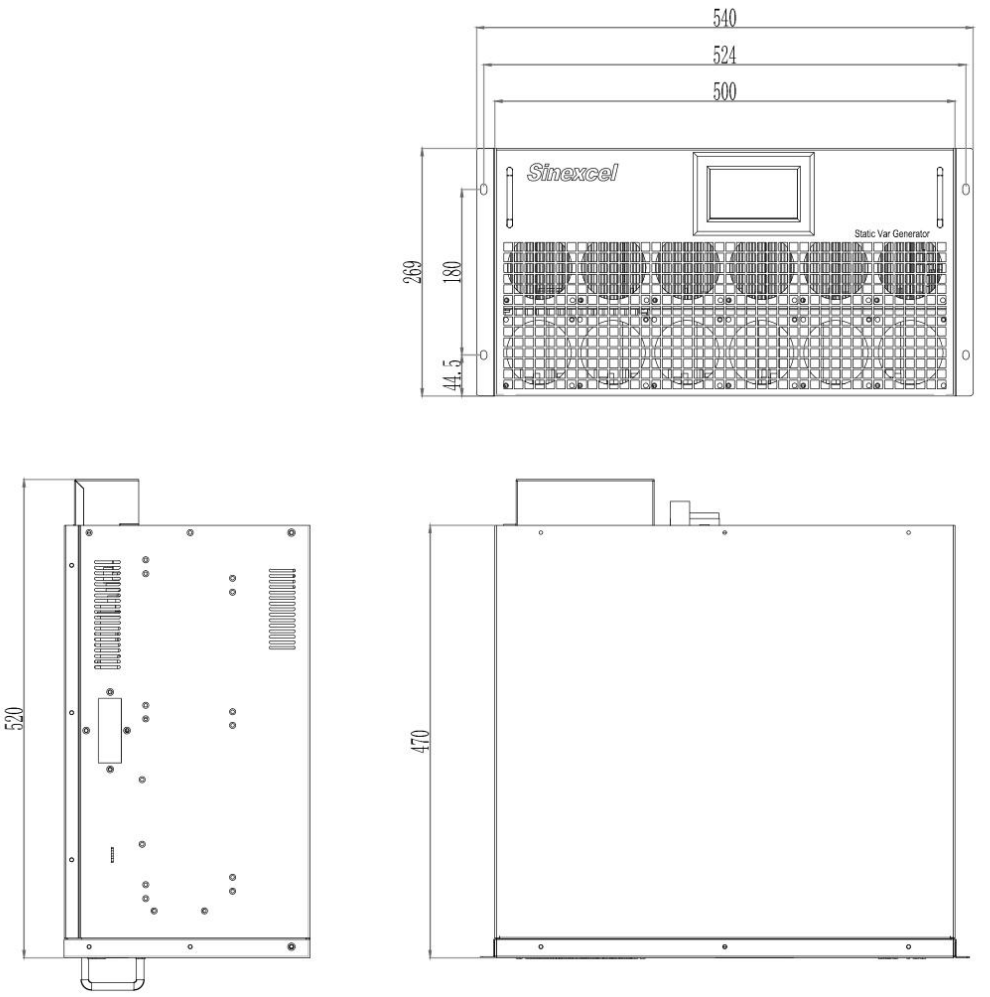

Figure A7-7 External dimension of 100kVAr LCD (rack-mounted)

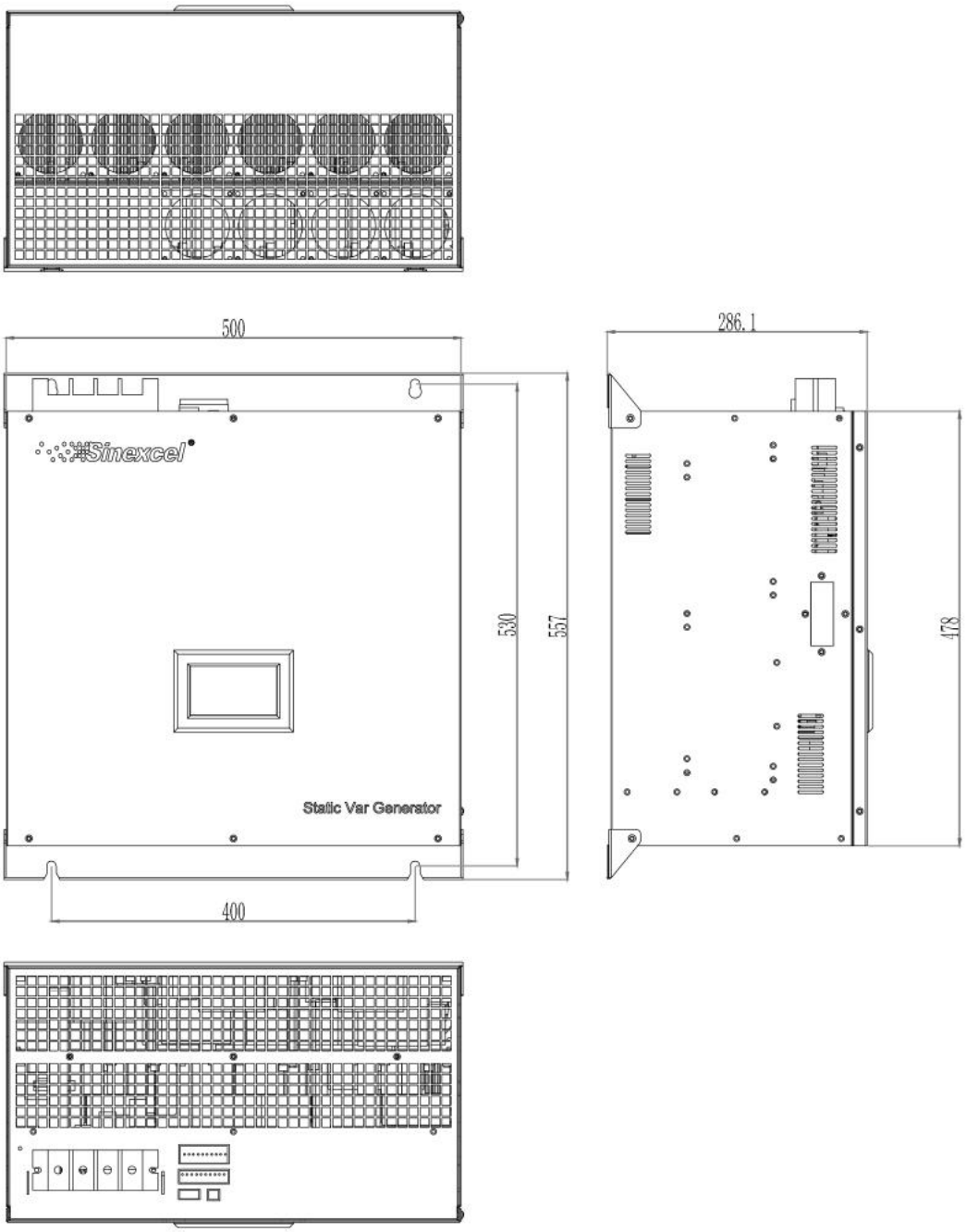

Figure A7-8 External dimension of 100kVAr LCD (wall-mounted)

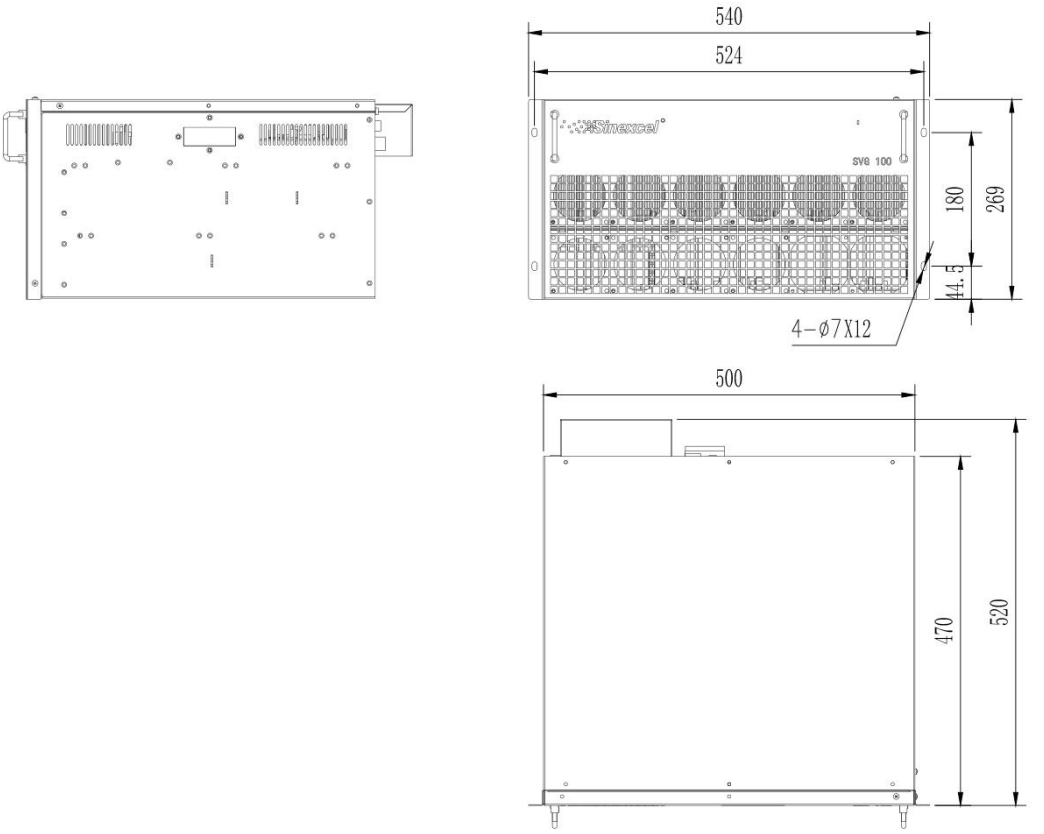

Figure A7-9 External dimension of 100kVAr LED (rack-mounted)

Appendix 7.4 External Dimension of Flexi-cabint

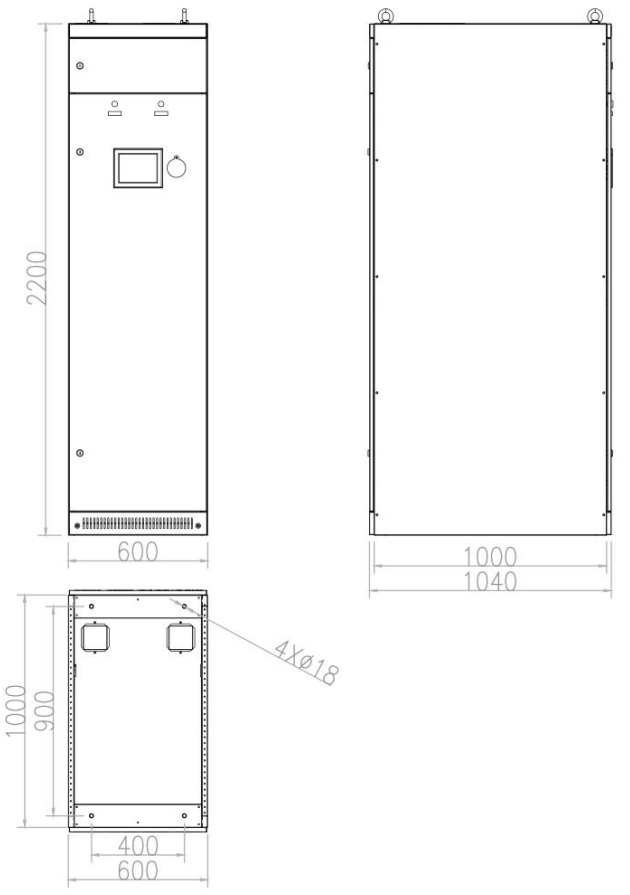

Figure A7-10 External dimension of 600*1000*2200 Flexi-cabinet

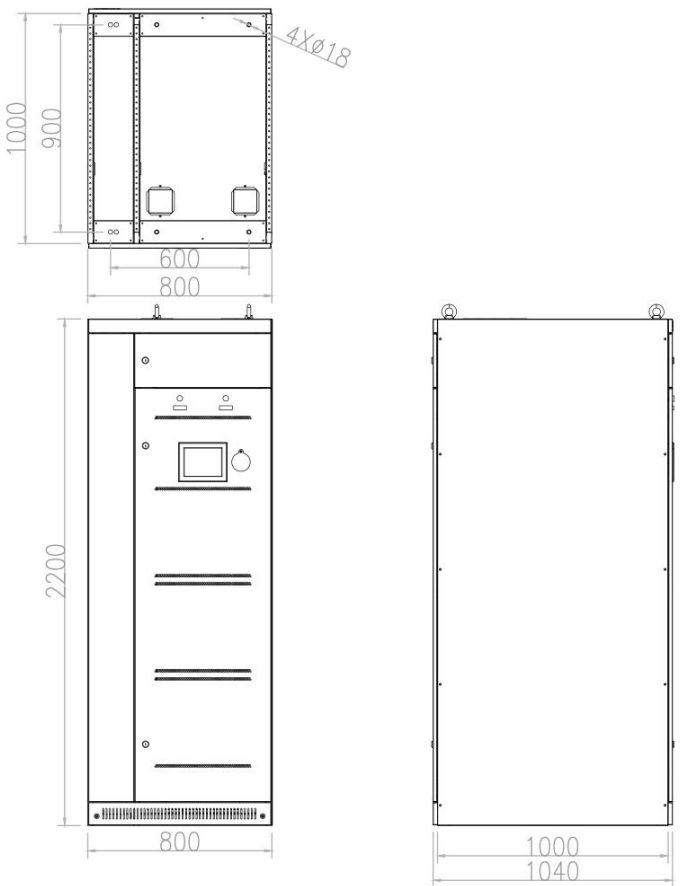

Figure A7-11 External dimension of 800*1000*2200 Flexi-cabinet

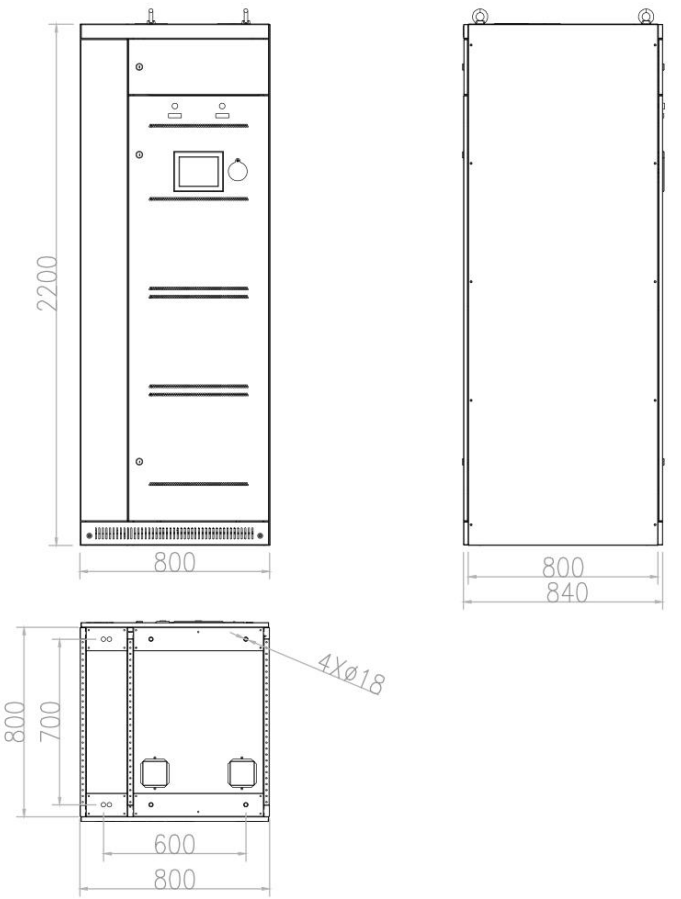

Figure A7-12 External dimension of 800*800*2200 Flexi-cabinet

Sinexcel

Sinexcel Static Var Generator

Sinexcel Electric Co., Ltd.
Web:www.en.sinexcel.com
Add:Building 6, BaiWangXin High-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong China
Tel:+86-755-8651-1588 Fax:+86-755-8651-3100