
ZEZ
SILKO
Get energized with us
Static Var Generator

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter I Safety Instructions

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 accessible 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	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	The THDu (Total Harmonic Distortion of Voltage) of the grid should not be higher than 15 %.

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) GB 7251. 1, GB/T 7251.8: Low-Voltage Switchgear and Controlgear Assemblies--General Technology Requirement for Intelligent Assemblies;

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

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

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

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

6) RS: IEC61000-5- 1: Electromagnetic Compatibility – Testing and Measurement Techniques – Radiated, Radio-Frequency, Eletromagnetic Field Radiation Immunity Test;

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

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

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

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

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

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

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

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

Chapter II Product Description

Using full-digital control technology with DSP, 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, SVG supports Modbus protocol. For relevant description and wiring method of Modbus protocol, refer to Appendix 4. The single module of SVG contains 2 capacity levels: 30kVAr, 50kVAr.

2.1 NOMENCLATURE

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

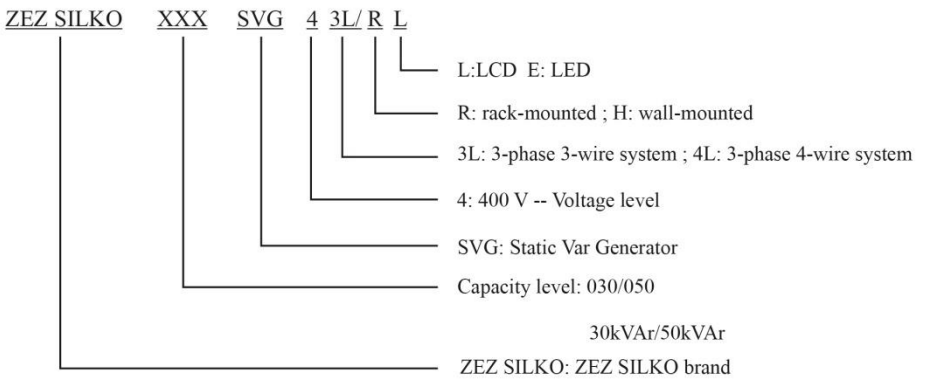

Figure 2-1 SVG production description

2.2 MODULE DESCRIPTION

Wall-mounted LCD model with a touch monitoring screen which can be wall-mounted for independent operation.

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, 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.

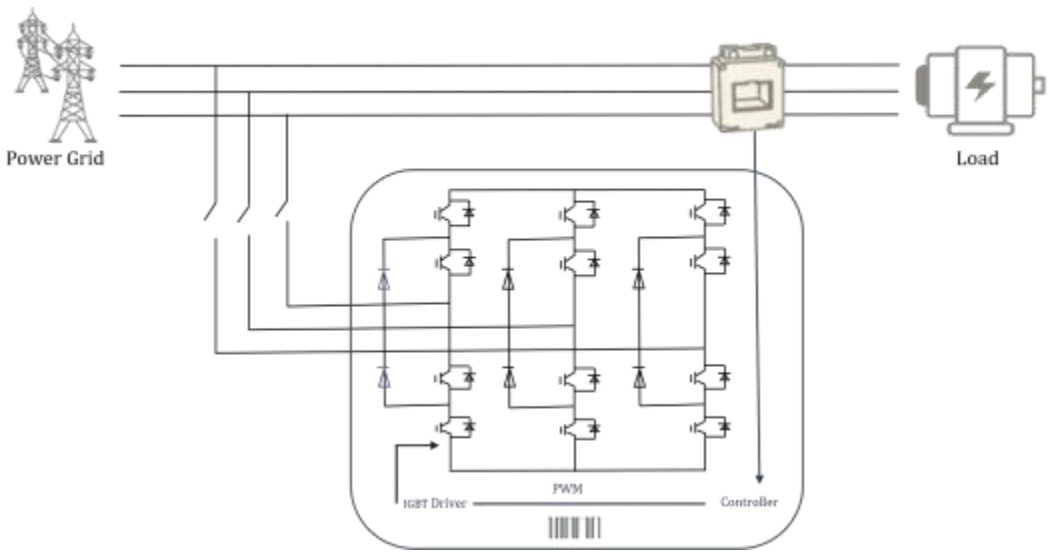

Figure 2-2 SVG operation principle

2.4 PRODUCT FEATURES

- Modular design: ultra-compact design providing easy installation and maintenance.
- High adaptability: suitable for site of poor 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

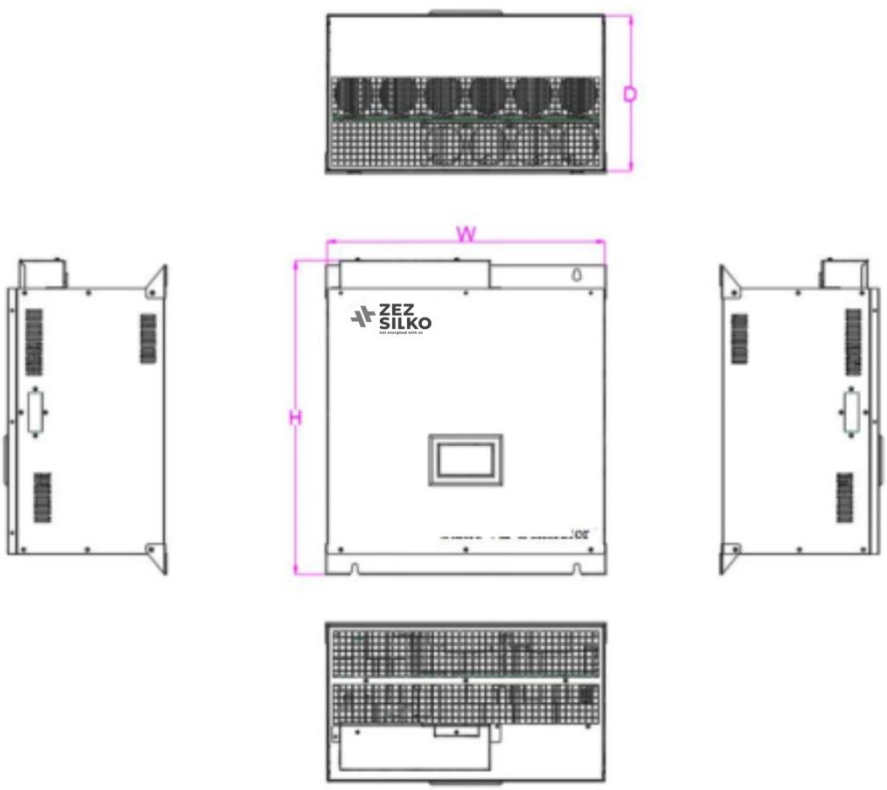

Figure 2-4 Appearance of wall-mounted module

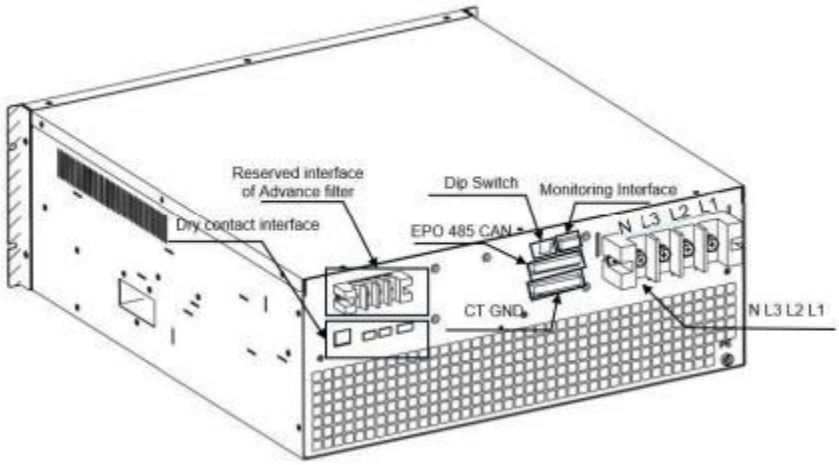

Figure 2-5 Wiring terminals

Figure 2-6 External view of SVG module

Model	Description					
	Capacity	Wiring	Installation	Display	W*D*H/mm	Weight /kg
SVG 030 43L/HL	30 kvar	3-phase 3-wire	Wall-mounted	LCD	500*180*540	23
SVG 030 44L/HL		3-phase 4-wire				
SVG 050 43L/HL	50 kvar	3-phase 3-wire	Wall-mounted	LCD	500*190*571	28
SVG 050 44L/HL		3-phase 4-wire				

Table 2-1 SVG models

Chapter III Installation and Wiring

For different modules (30kVAr, 50kVAr), 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.

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 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.

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.

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.

3.3 MODULE FIXING

SVG can be classified into 6 sorts by LCD & LED, 3-phase 3-wire & 3-phase 4-wire system, and 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, 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.

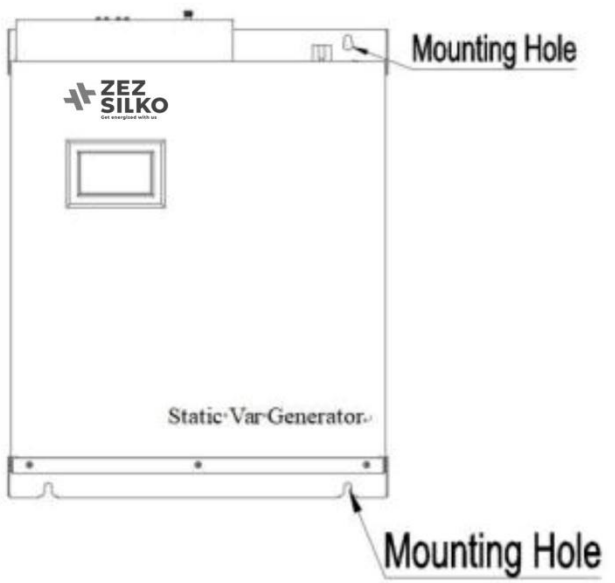

Figure 3-2 Installation sketch of wall-mounted module

3.4 SINGLE MODULE WIRING

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

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

1. L1: Phase L1 power terminal;
2. L2: Phase L2 power terminal;
3. L3: Phase L3 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 5ARMS.

Power terminals are shown in Figure 3-3

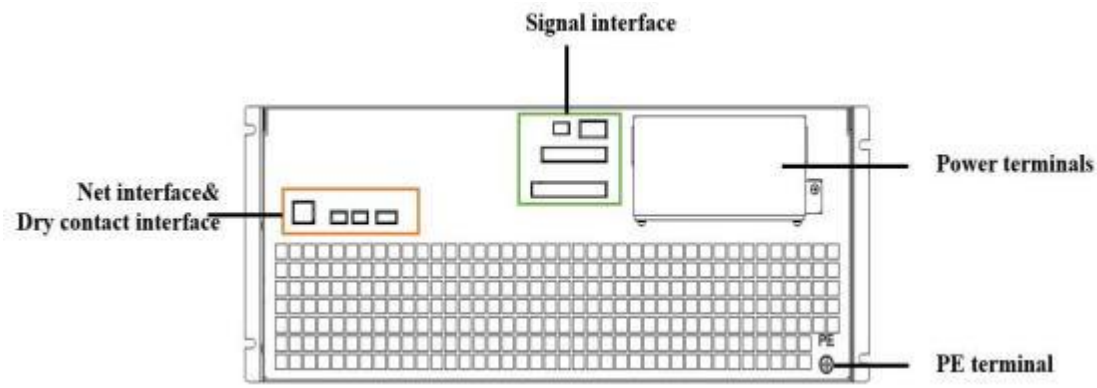

Figure 3-3 Power and signal interface distribution

3.4.1 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 L1/L2/L3/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.

3.4.2 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.

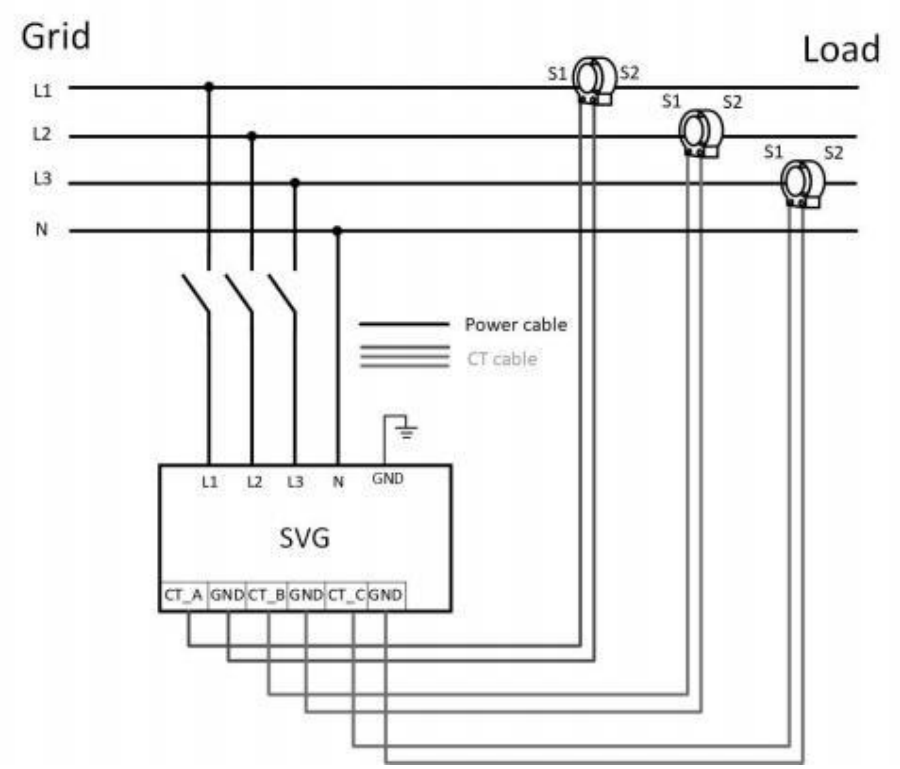

Figure 3-4 Wiring of single power module (3-phase 4-wire system)

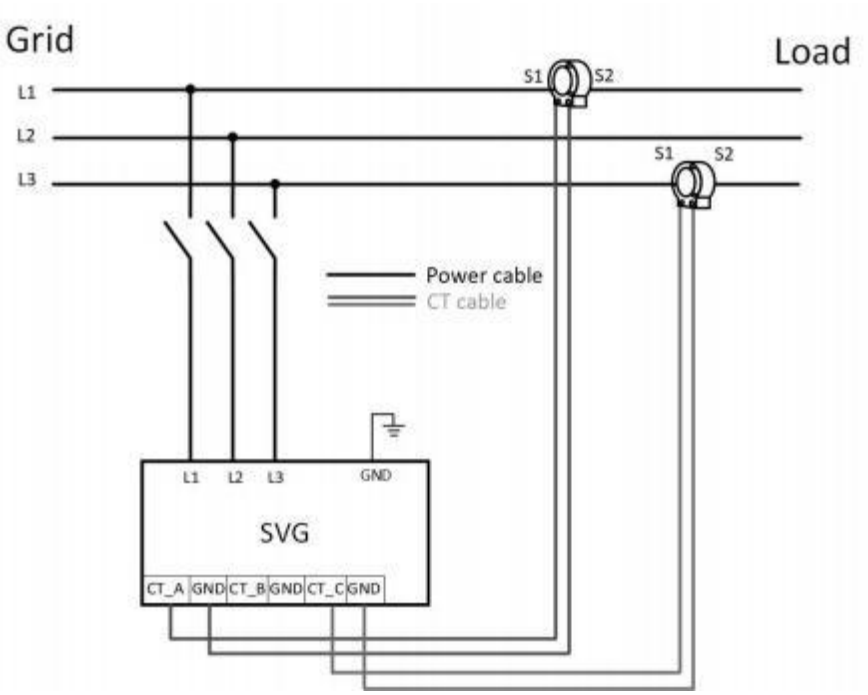

Figure 3-5 Wiring of single power module (3-phase 3-wire system)

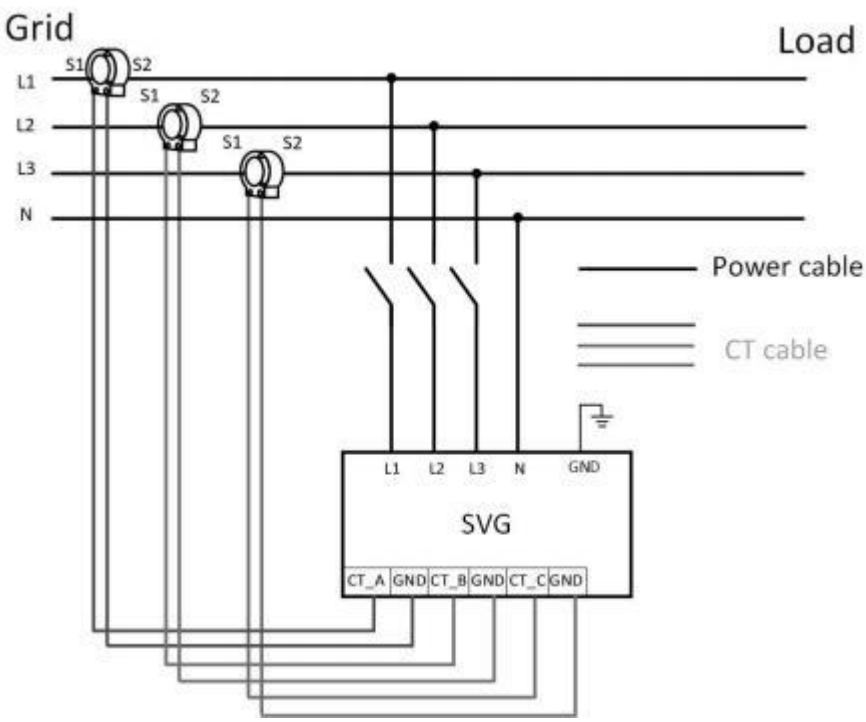

Figure 3-6 Wiring of single power module (Grid side of 3-phase 4-wire system)

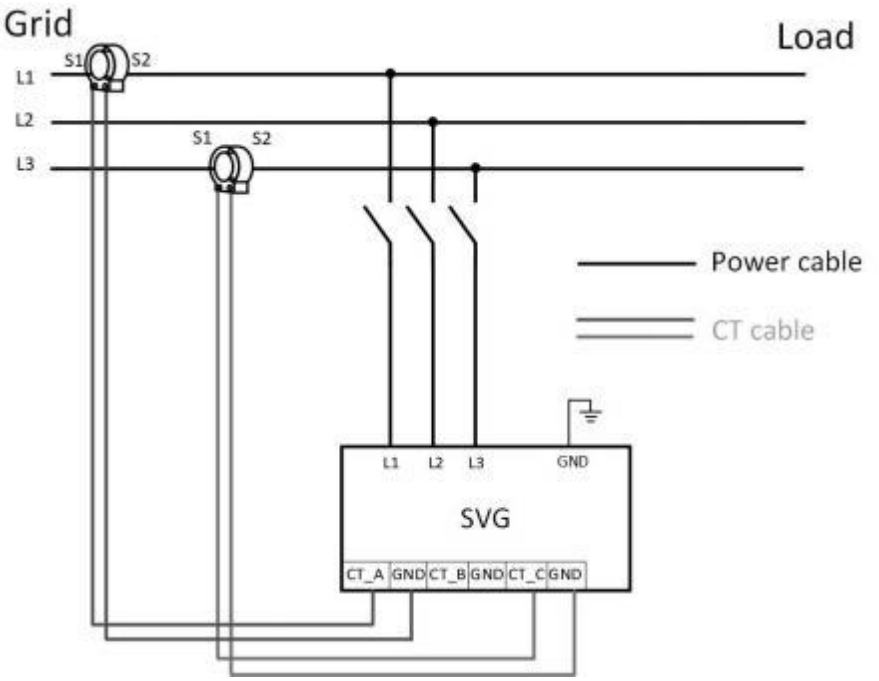

Figure 3-7 Wiring of single power module (Grid side of 3-phase 3-wire system)

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

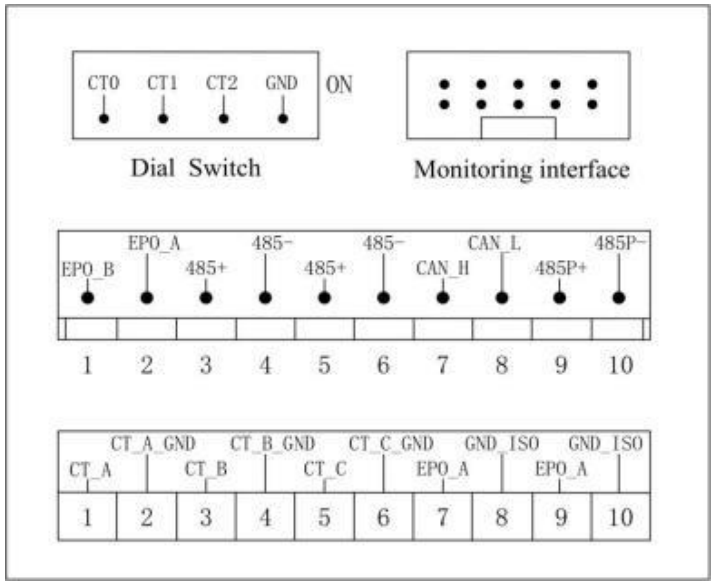

Figure 3-8 Signal interface

Table 3-1 Description of CT signal and communication signal

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)

3.5 MULTIPLE MODULES CONNECTING

3.5.1 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 3-9, 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 3-9. It is recommended that series mode be adopted for connection of CT signal interface among all modules.

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.

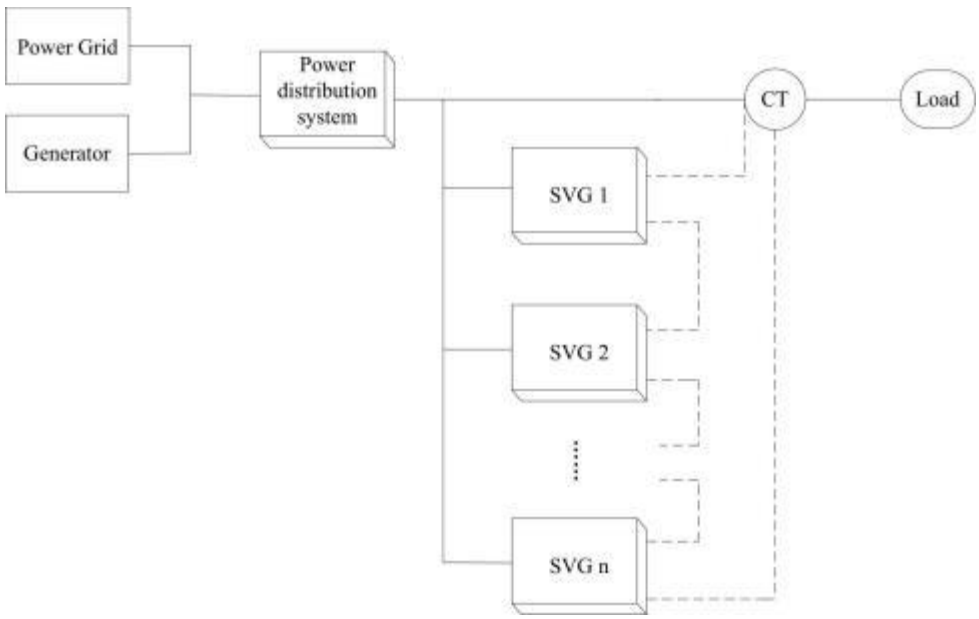

Figure 3-9 Typical topology for multiple modules parallel operation

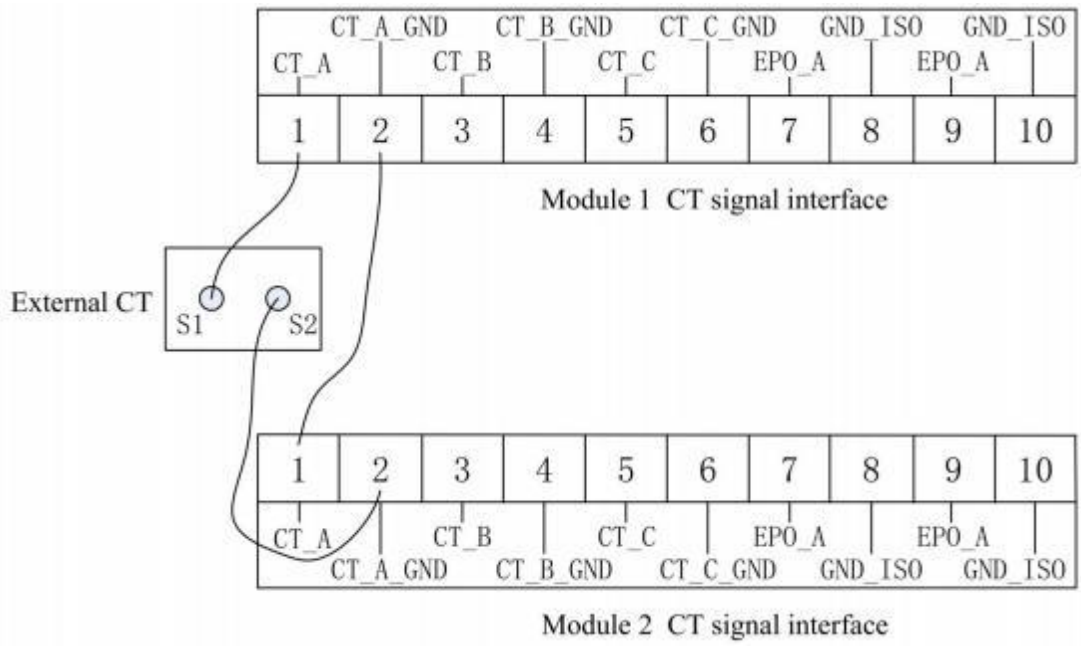

Figure 3-10 CT signal interface connected in series

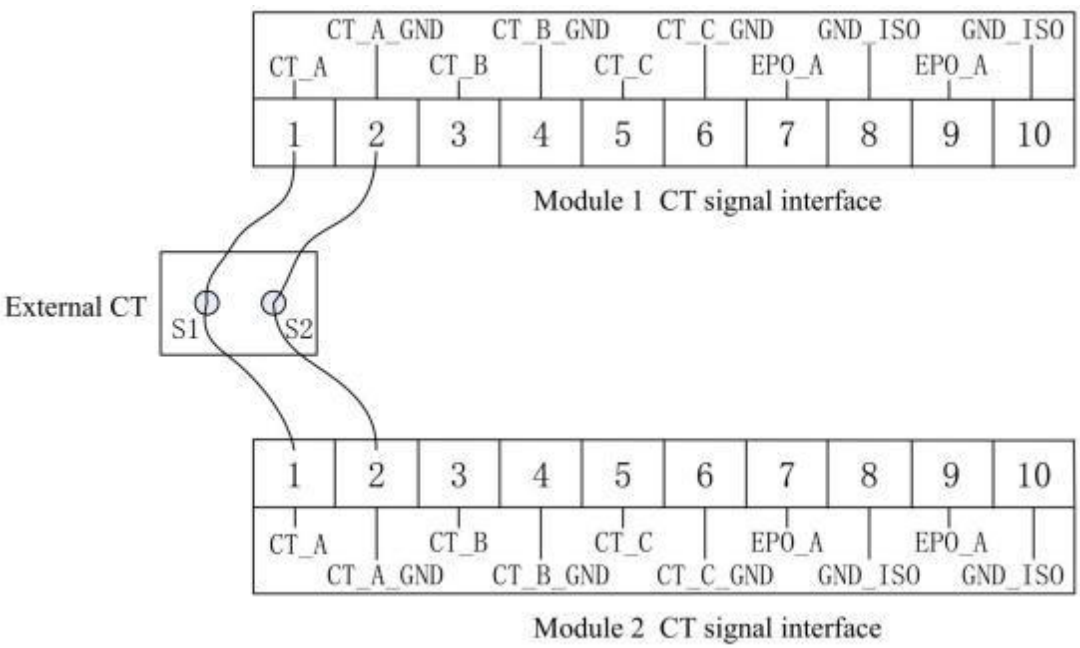

Figure 3-11 CT signal interface connected in parallel

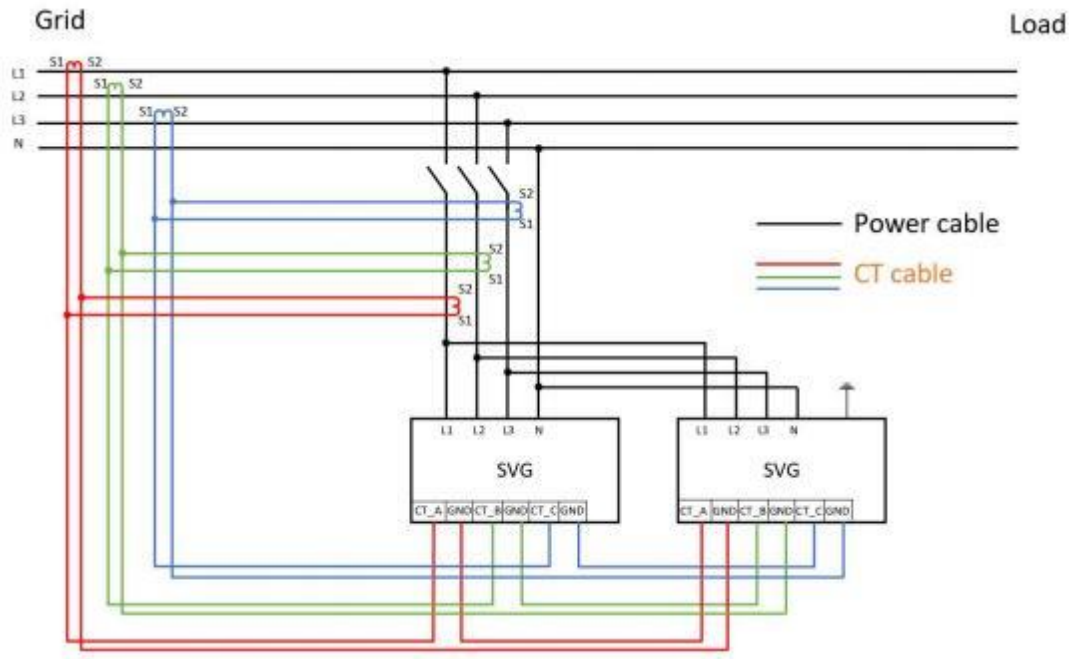

Figure 3-12 CT connection to parallel multiple modules at grid side

Figure 3- 13 is the wiring for multiple 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.

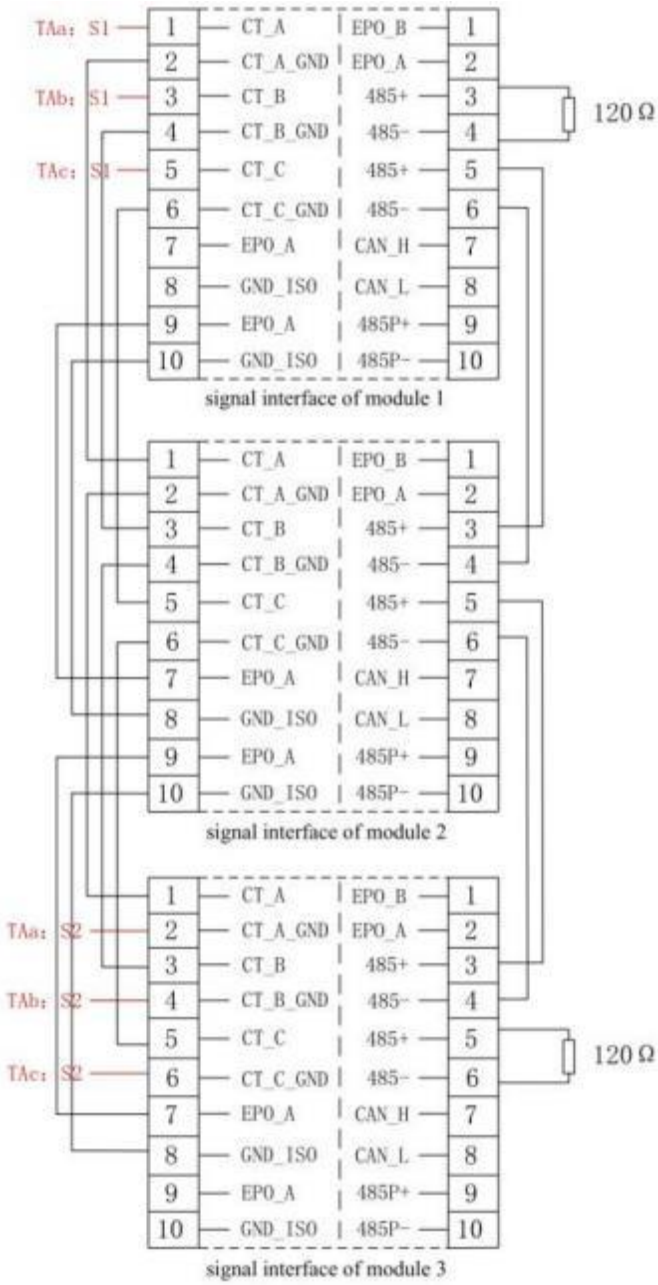

Figure 3-13 Signal interface connection of three modules in parallel

Remark: TAa, Tab and TAc separately represent CTs detecting load current of phaseL1/L2/L3. 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.

3.5.2 DIP SWITCH

The dip 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 dip 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. (Except V316 and V317 HMI version, dip switch needs to be set as well as the “local address” setting)

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

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

Figure 3-14 Dip switch on the module

Setting the dip switch down means its value is 0, and up means the value is 1.

Note: Please pay attention to the sequence of the CT0, CT1, CT2 on the modul

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 L1 and phase L3; while in 3-phase 4-wire system, three CTs are required, each installed on the circuits of phase L1, phase L2 and phase L3.

4.1 CT TYPE

SVG can use external CT ratio between 50:5~30000:5. 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.

4.2 CT CABLE

As an accessory of 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 L1, the green to phase L2 and the red to phase L3. 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 2.5mm2. From 15m to 30m, recommended sectional area is 4mm2.

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 L1 phase the S1 terminal of the CT is connected to the CT_L1 marked terminal on SVG and the S2 terminal of the CT is connected to the CT_L1_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 L1, L2 and L3 of the load side (two CTs for 3-phase/3-wire system), as shown in Figure 4- 1.

Note: Only one set of CT is required for a single module installed on the load side and multi-modules parallel installed on the load side.

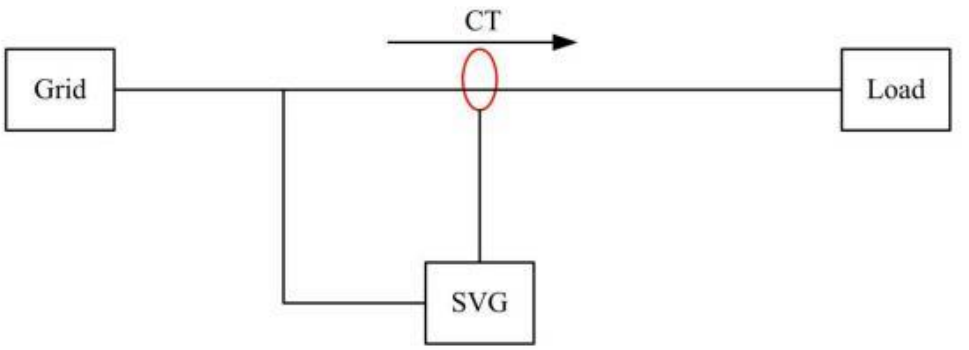

Figure 4-1 Wiring of CT installed at load side

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.

Note: Two sets of CTs are required when multi-modules in parallel installed on the source side, and only one set of CTs is required for a single module to be installed on the source side.

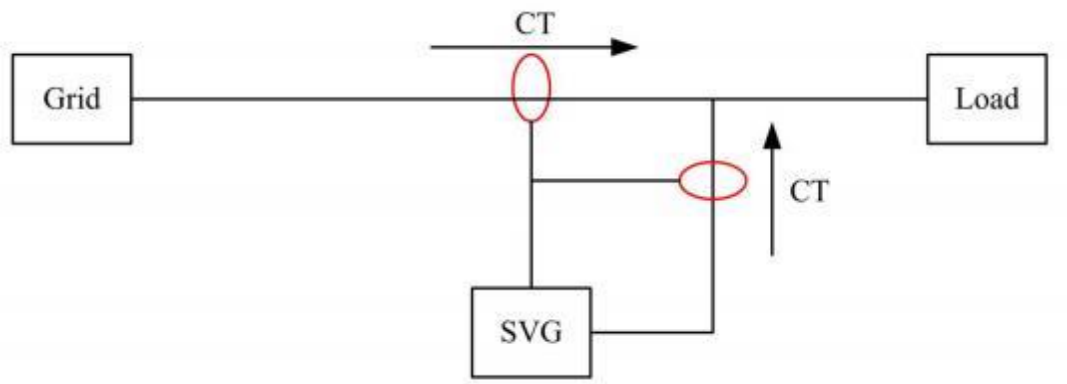

Figure 4-2 Wiring of CT installed at source side

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.

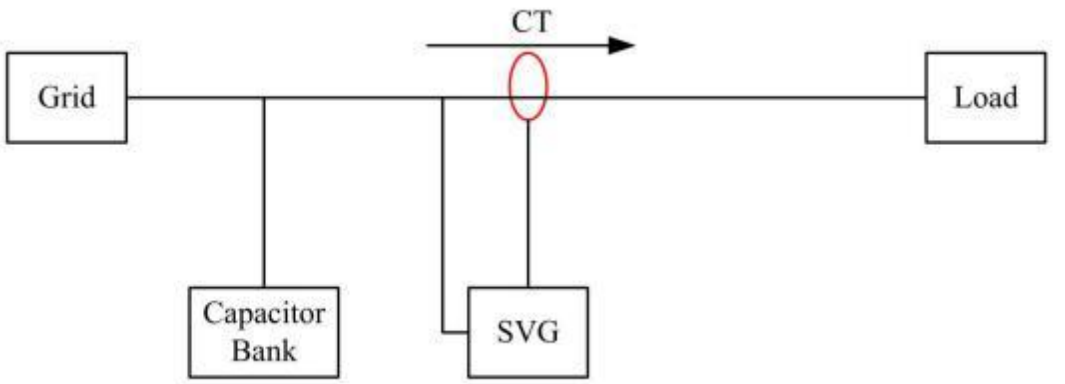

Figure 4-3 Wiring of CT installed at load side with existing capacitor banks

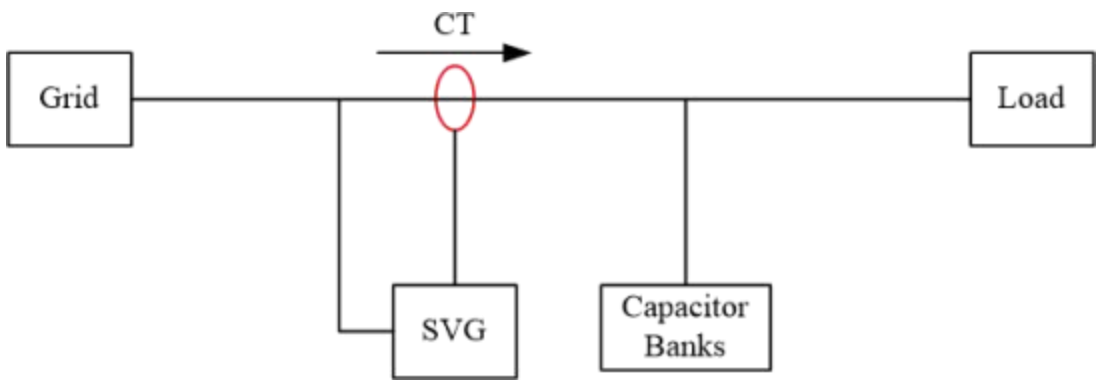

Figure 4-4 Wiring of CT installed at source side with existing capacitor banks

4.4.5 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.

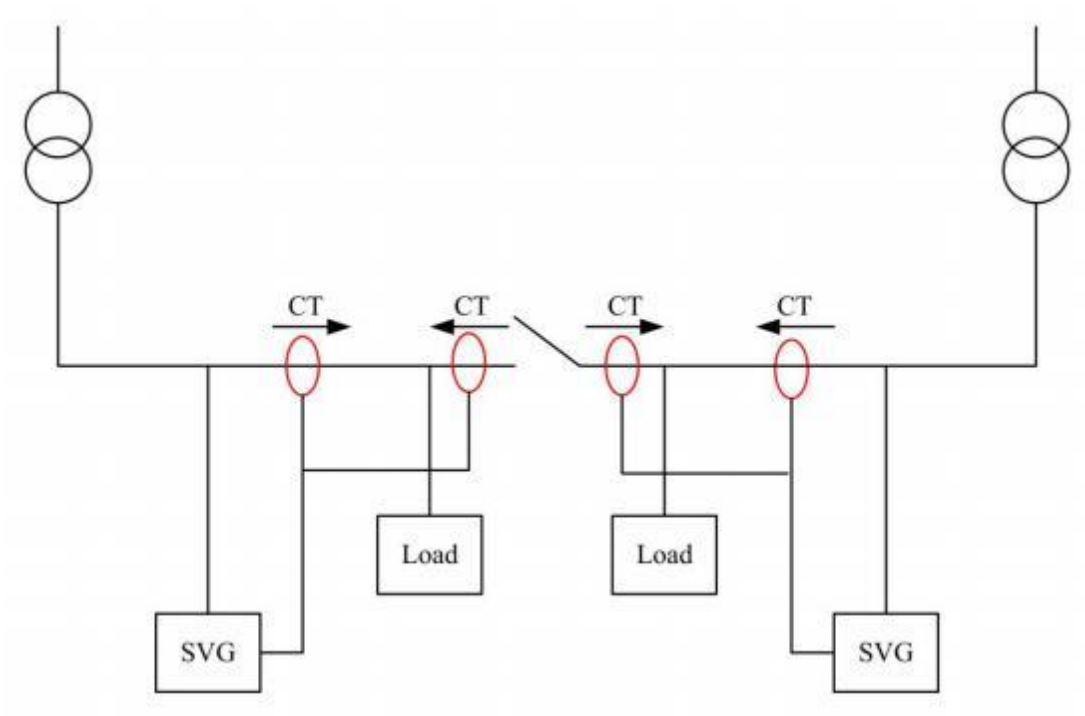

Figure 4-6 Wiring of CT under double bus power supply

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.

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

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

3. After the monitoring screen is initialized, 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 50vkar SVG , the rated current is 75A, so on HMI the total capacity should be set a s 75 instead of 50.

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 5-4 Waveform of grid voltage

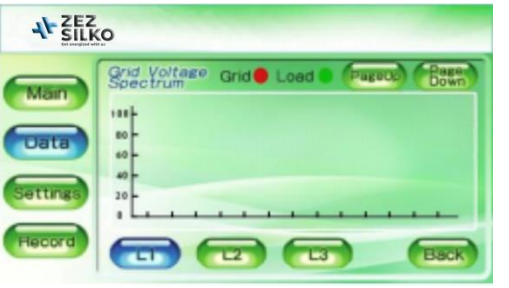

Figure 5-3 Main interface of data

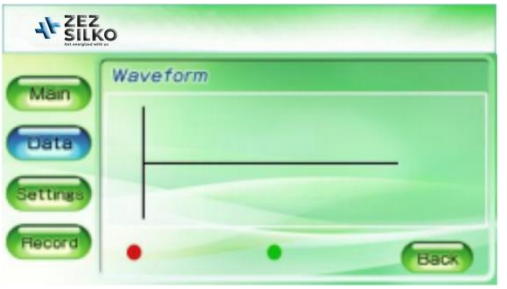

Figure 5-5 Spectrum of grid voltage

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.

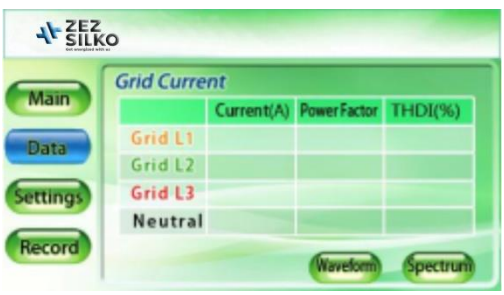

Figure 5-7 Information of grid current

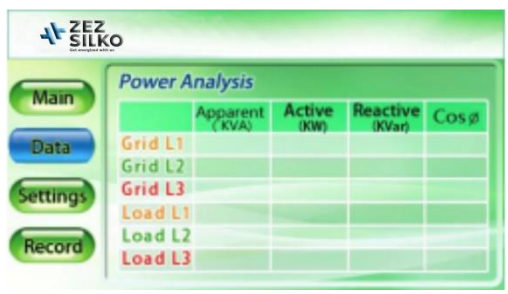

Figure 5-8 Waveform of grid current

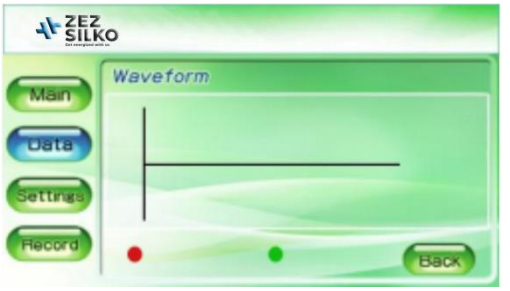

Figure 5-9 Spectrum of grid current

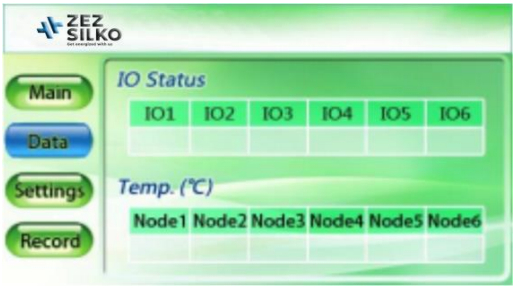

Figure 5-10 Power analysis

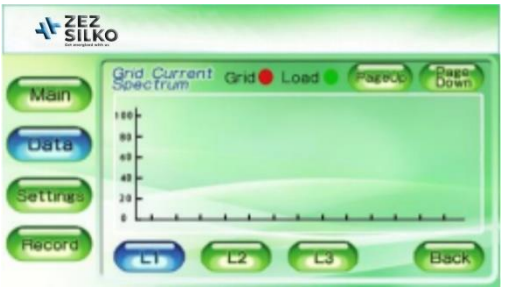

Figure 5-11 I/O status and node temperature

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, asshown 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: ASVG has two main functions: reactive compensation (Q), harmonic mitigation (H) and three-phase imbalance compensation (B). However, ASVG provides as many as 5 “Operation Mode” : Q+H; Q+B+H; B+H; B+Q+H; Auto-aging.

Auto-aging function is reserved for special occasions. It turns ASVG 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+H means preferential compensation of reactive power, and harmonic mitigation.

- 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 ASVG 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 5-14 Interface of system parameter

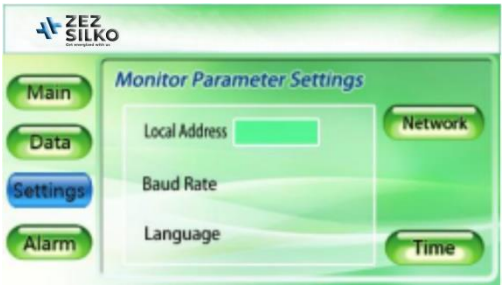

Figure 5-15 Interface of monitor parameter

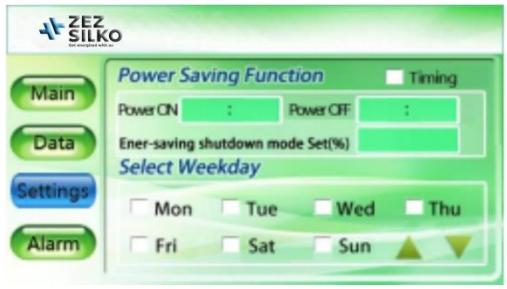

Figure 5-16 Power saving function

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 System power on and shutdown

6.1 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.

6.2 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 circuit 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.

Chapter VII 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.

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.

Table 9-1 Troubleshooting

Failures or alarms	Possible reasons	Solutions
Inverter short-circuit fault	Short-circuit, the current is beyond the tolerant range of IGBT	
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.
Monitor parameter setting fault	1. CT location is wrong 2. Total capacity setting is wrong	1. Check if the CT location setting is correct 2. Check if the total capacity setting is correct
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	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.

	turned off or can't be turned on.	
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.
Offline fault	1. The dip switch setting error 2. Internal cable wiring is not connected well.	1. Check the dial switch, change it to correspond number. The setting of dip switch could be referred to user manual

Appendix 1 Product Parameter

Table A1-1 Product parameter

Item	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	30kVAr	50kVAr		
Fast response time	＜50μs			
Complete response time	＜5ms			
Target PF	Adjustable between - 1 ～ 1			
Switching frequency	20kHz			
Reactive compensation	Supported			
Imbalance compensation	Supported			
Cooling mode (smart cooling)	115L/Sec	222L/Sec		
Noise level	＜56dB			

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			
Net weight	23kg	28kg		
Color	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			

Appendix 2 Selection of Cable and Accessories

Table A2-1 Selection of cable and accessories

Rated capacity (kVAr)	30	50								
Cable of phase L1//L2/L3 mm^2	35	35								
Cable of phase N mm^2	35	50								
PE cable mm^2	16	16								
Power terminal screw	M6	M8								
PE terminal screw	M6	M6								
Rated currentm of Breaker	100A	160A								
CT cable	Below 15m: RVVSP 2*2.5 mm^2; 15m-30m: RVVSP 2*4 mm^2									
Range of CT ratio	50/5~30000/5									
Remark	**If there is requirement for cable temperature, the specification of cable needs to be expanded**									

Note:

1. The CT ratio selection should be 1.5~4 times to maximum load current

2. The Rated current selection of breaker should be 1.2 times or above to SVG rated capacity

Appendix 3 Monitoring parameter description

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

Menu			Description	
Main interface	Grid current	THDI	Total harmonic distortion of grid current of phase L1/L2/L3	
		RMS	RMS of grid current of phase L1/L2/L3	
	Load current	THDi (%)	Total harmonic distortion of load current of phase L1/L2/L3	
		RMS	RMS of load current of phase L1/L2/L3	
	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	
		Grid current	Current (A)	RMS of phase L1/L2/L3 grid current
			PF	PF at grid side
			THDI (%)	THD of phase L1/L2/L3 grid current
			Waveform	Waveform of grid and load current of phase L1/L2/L3
			Spectrum	Harmonic analysis of grid current
			Current (A)	RMS of phase L1/L2/L3 load current

	Current	Load current	PF	PF at load side
			THDi（%）	THD of phase L1/L2/L3 load current
			Waveform	Waveform of grid and load current of phase L1/L2/L3
			Spectrum	Harmonic analysis of load current

		Comp. current	Current (A)	Current compensation of phase L1/L2/L3
			Load Rate (%)	The ratio of compensation current and rated current of system
			Waveform	Waveform of SVG compensation current of phase L1/L2/L3
	Power analysis	Apparent power	Apparent power of phase L1/L2/L3 at grid side	
			Apparent power of phase L1/L2/L3 at load side	
		Active power	Active power of phase L1/L2/L3 at grid side	
			Active power of phase L1/L2/L3 at load side	
		Reactive power	Reactive power of phase L1/L2/L3 at grid side	
			Reactive power of phase L1/L2/L3 at load side	
		Cosφ	Cosine of angle between grid voltage and fundamental current	
			Cosine of angle between load voltage and fundamental current	
		IO status		Status info of dry contact
		Temperature (The number of temperature	Node 1, 2, 3	Temperature display of phase L1/L2/L3 Inverter

	IO/temperature	node varies with different models. User needs to depend on specific module.)	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	Set The Number Of Device In Parallel
		Total capacity	Set the total capacity of the system
		Comp. Mode	Intelligent mode、Sequential mode or All mode（This mode is not relevant to SVG）
		CT Ratio	Set external CT Ratio, e.g. 600:5 etc.
		Ext. passive Filter	Reserve function

		CT secondary connection	Selection Of Method Of Connection At CT Secondary Side, Series Connection T Recommended First.
		Inductor current con.figure	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 "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 output 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 (This mode is not relevant to SVG)
		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
		Local address	Address of each module in the system

	Monitor parameter	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 A3-2 Parameter description of 7-inch LCD screen

Menu	Item			Description
Real-time info	Basic info	Grid voltage	Voltage (V)	Phase voltage of phase L1/L2/L3
			Frequency (Hz)	Voltage frequency
			THDu (%)	Total harmonic distortion of grid voltage of phase L1/L2/L3
			Waveform	Waveform of grid voltage
		Grid current	RMS (A)	RMS of grid current of phase L1/L2/L3
			PF	PF at grid side
			THDi (%)	Total harmonic distortion of grid current of phase L1/L2/L3
			Waveform	Waveform of grid current of phase L1/L2/L3
		Load current	RMS (A)	RMS of phase L1/L2/L3 load current
			PF	PF at load side
			THDi (%)	THD of phase L1/L2/L3 load current
			Waveform	Waveform of load current of phase L1/L2/L3
		Comp. current	RMS (A)	Compensation current of phase L1/L2/L3
			Load rate	The ratio of compensation current and rated current of system
			Waveform	Waveform of SVG compensation current of phase L1/L2/L3
	Harmonics Analysis		Grid THDi	THD of grid current of phase L1/L2/L3
			Load THDi	THD of load current of phase L1/L2/L3
			Grid THDu	THD of grid voltage of phase L1/L2/L3
		Apparent power		Apparent power of phase L1/L2/L3 at grid side
				Apparent power of phase L1/L2/L3 at load side

	Power analysis	Active power	Active power of phase L1/L2/L3 at grid side
			Active power of phase L1/L2/L3 at load side
		Reactive power	Reactive power of phase L1/L2/L3 at grid side
			Reactive power of phase L1/L2/L3 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 （This mode is not relevant to SVG）
		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 compensation rate; 1.0 indicates 100%, and so on （This mode is not relevant to SVG）
		Target Power Factor	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 （This mode is not relevant to SVG）
	Comm.	Background communication address	Set monitoring address
		Background	Set the number of change of carrier wave per unit time

		communication Baud rate	

		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

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.

SVG supports Modbus protocol; 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.

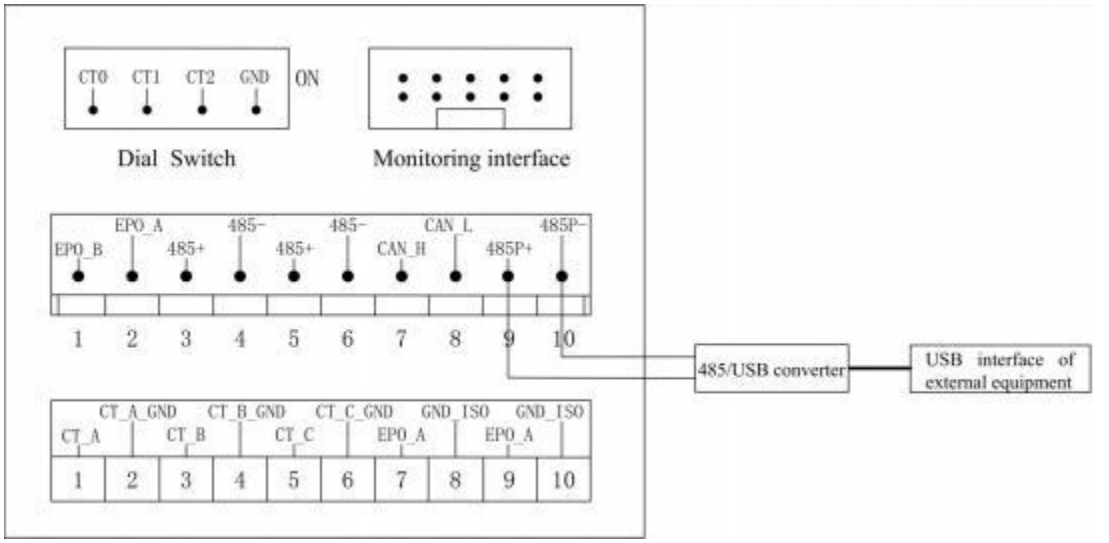

Figure A4-1 Wiring of 485 communication interface and USB interface of external equipment

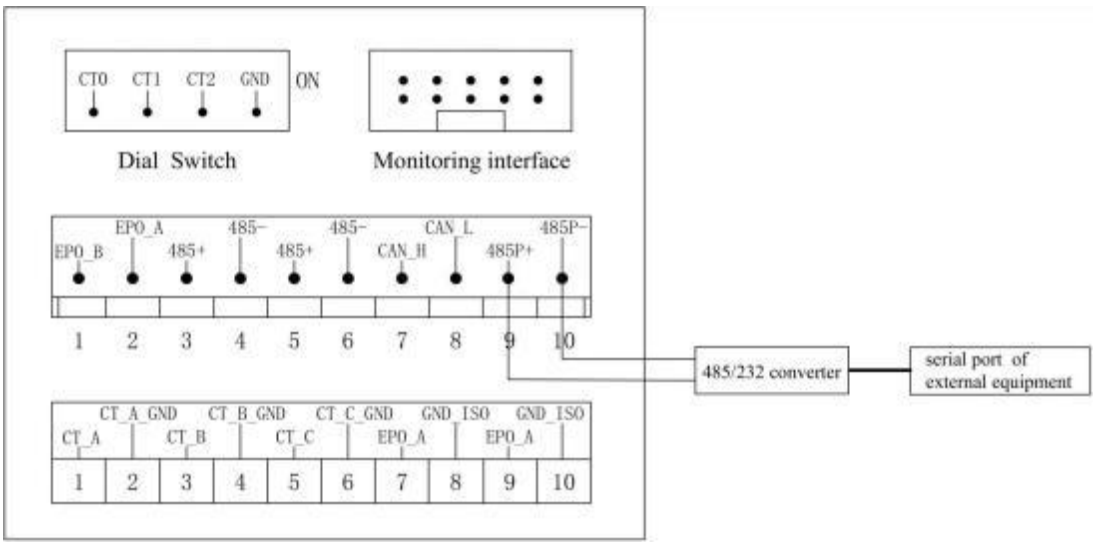

Figure A4-2 Wiring of 485 communication interface and serial port of external equipment

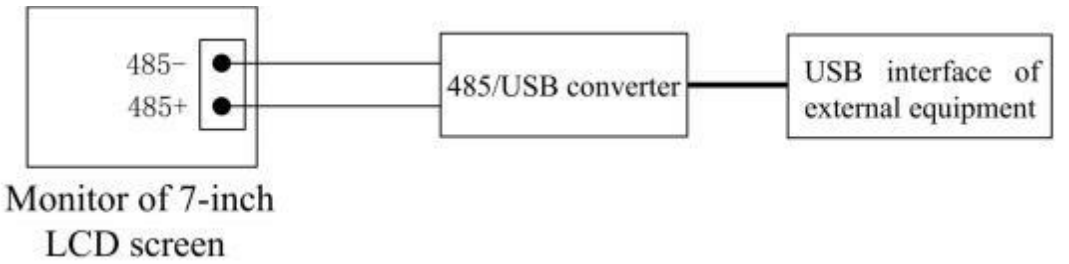

Figure A4-3 Wiring of 485 communication interface of centralized monitor and USB interface of external equipment

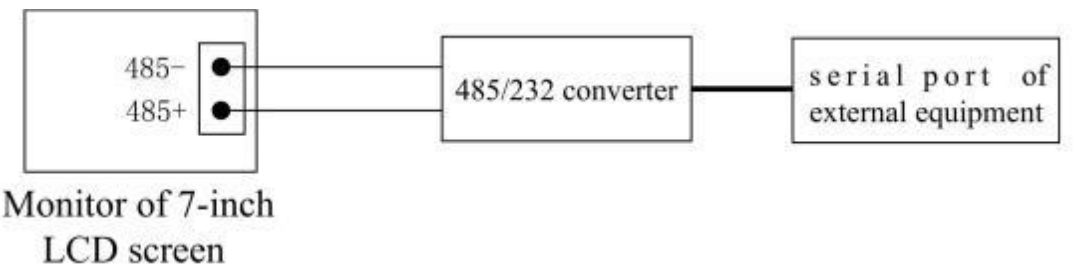

Figure A4-4 Wiring of 485 communication interface of centralized monitor module and serial port of external equipment

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.

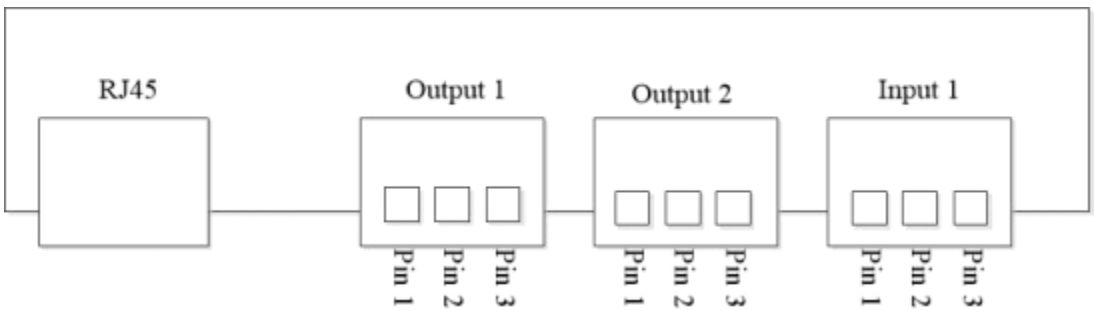

Figure A5-1 Dry contact board

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

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.

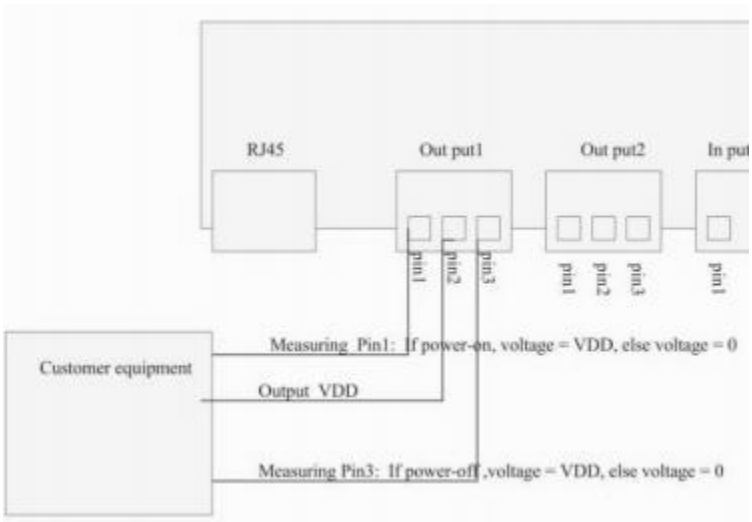

Figure A5-2 Dry contact board output 1

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.

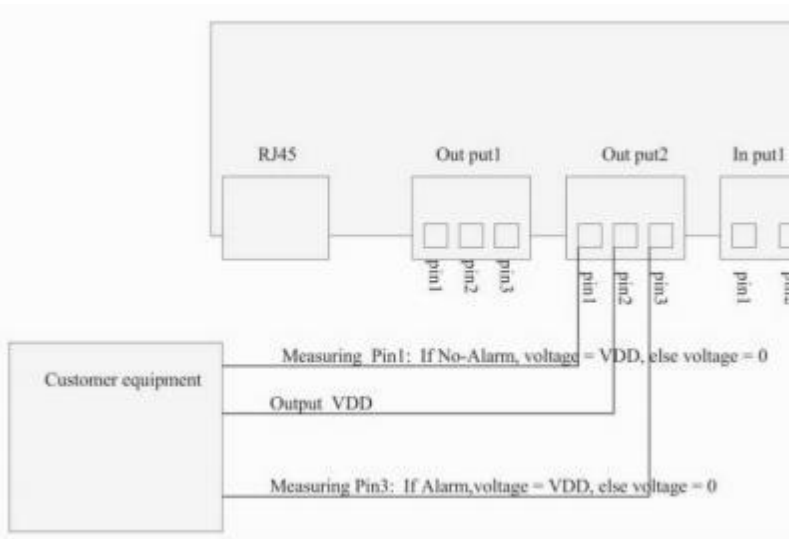

Figure A5-3 Dry contact board output 2

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.

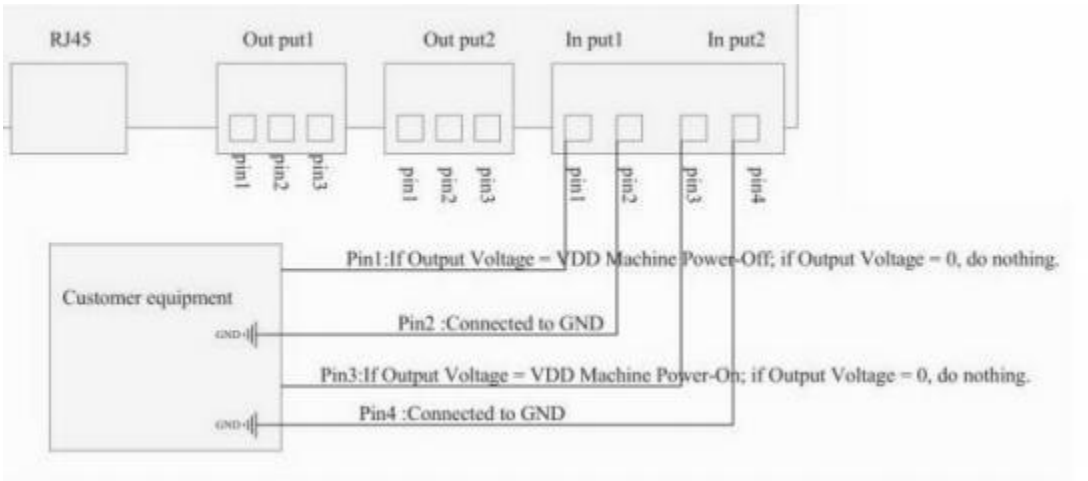

Figure A5-4 Dry contact board input

Appendix 6 External dimension of SVG

APPENDIX 6.1 EXTERNAL DIMENSION OF 30KVAR

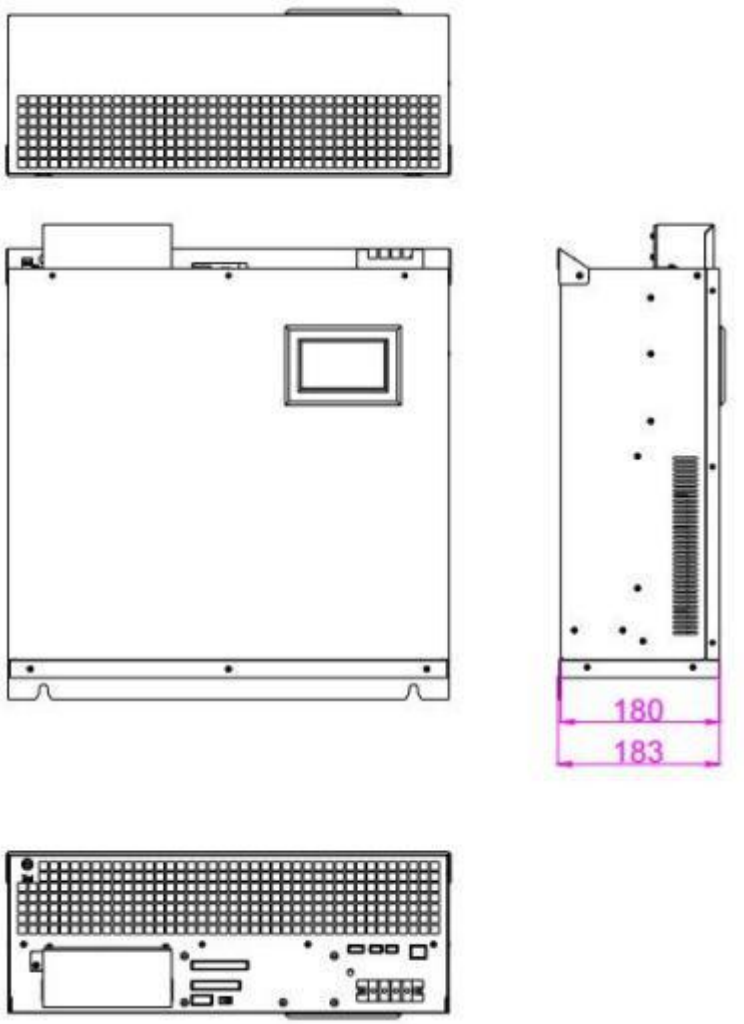

Figure A6-2 External dimension of 30kVAr LCD (wall-mounted)

APPENDIX 6.2 EXTERNAL DIMENSION OF 50KVAR

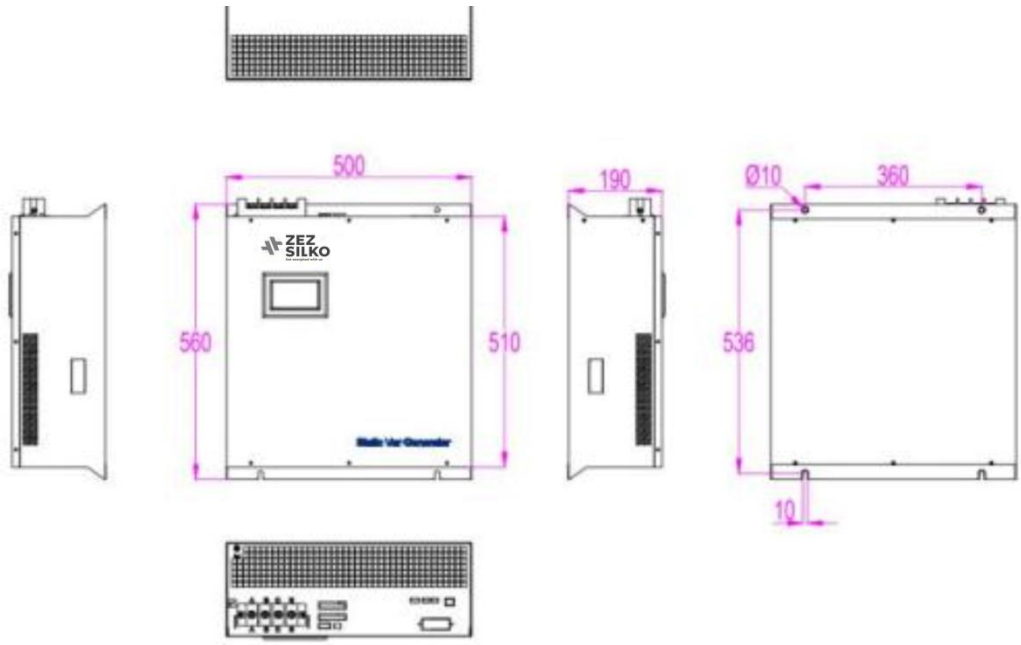

Figure A6-5 External dimension of 50kVAr LCD (wall-mounted)

Appendix 7 Quick commissioning

4.3-inch HMI is used for the single module. Below pictures are the setting interface of SVG 4.3-inch HMI.

Using password ‘080808 ’ to enter the system parameter.

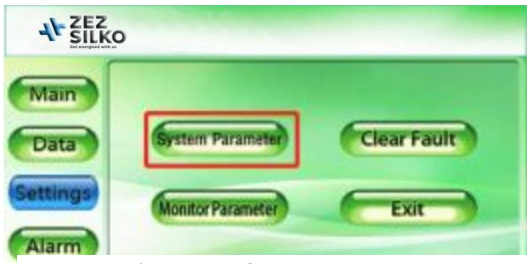

Figure A7-1 System parameter

Figure A7-2 Power on mode

Figure A7-3 CT location

Figure A7-4 Comp.mode and CT ratio

The table below are parameters needed to set up in the figure A7-2 to figure A7-4.

Table A7-1 Necessary parameters

Operation Mode
Total Capacity
Comp. Mode
CT Ratio
Power On Mode
CT Location

Take SVG 50kVAr for example, assuming SVG is used for Reactive Power compensation, and the CT ratio on site is 300:5.

In this case, the parameters should be set to:

Table A7-2 Example of the necessary parameter setting

Setting	Setting parameters
Operation Mode	Q (Q means Reactive Power Compensation)
Total Capacity	75
Comp. Mode	Intelligent
CT Ratio	300
Power On Mode	Manual or Auto
CT Location	Based on site

Power on mode depends on user's requirement. CT location depends on the CT position, for single module, it can be load side or grid side.

For SVG, the setting is a little different, especially for the 'Total capacity ' setting. The unit of 'Total capacity ' setting is A, not kVAr. But SVG unit is kVAr.

For the total capacity setting of SVG, user need to change kVAr to A. For 400V SVG, user could

use SVG capacity to multiply by 1.5 to change kVAr to A.

For example, 400V, 50kvar SVG, 50× 1.5= 75A. Then the 'Total capacity ' of SVG 50kvar should be set to 75.