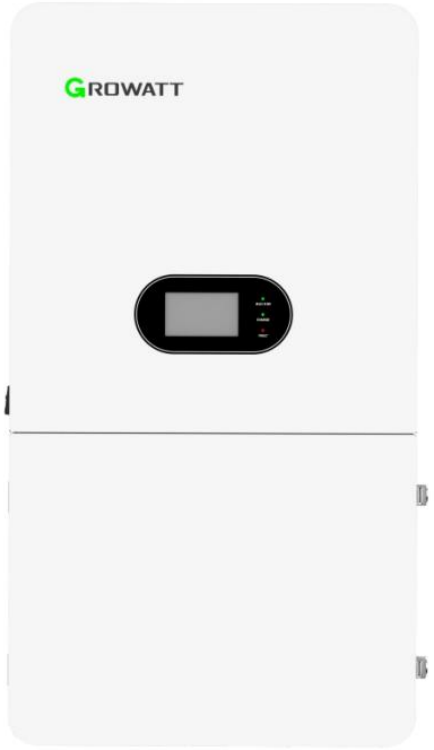
GROWATT



Grid-Hybrid Inverter
SPH 9600-18000TL-HU-US
User Manual

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1 Information on this Manual

1.1 Overview

This manual is intended to introduce the SPH 9600-18000TL-HU-US Inverters manufactured by GROWATT USA INC. (hereinafter referred to as Growatt) in terms of the installation, operation, commissioning, maintenance and troubleshooting. Please read this manual carefully before using the product, and keep it in a place that is easily accessible to installation, operation and maintenance personnel. The content is continually reviewed and amended as necessary. Growatt reserves the right to make changes to the material at any time and without notice.

1.2 Intended Audience

Only qualified electrical technicians are allowed to install SPH 9600-18000TL-HU-US Inverters. Reading through this manual and observing all the precautions, qualified electrical technicians will be able to properly install, troubleshoot and configure the SPH 9600-18000TL-HU-US Inverters. If any questions arise during installation, you can visit us.growatt.com and leave a message.

1.3 Safety Instructions

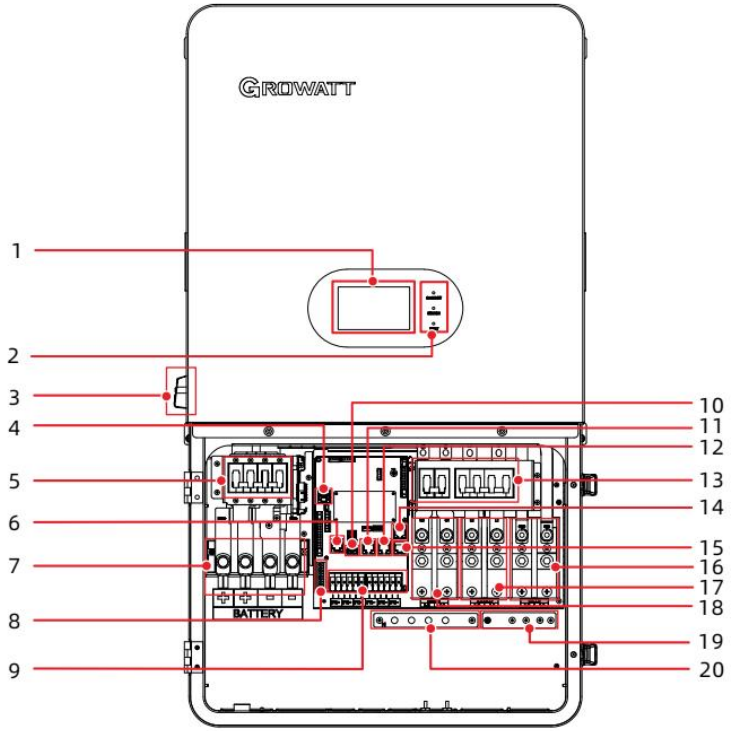
- Please read this manual carefully before installation. Damages caused by failure to follow the instructions in the manual are beyond the warranty scope.
- Only qualified and trained electrical technicians are allowed to perform operations on the Storage inverter.
- During installation, please do not touch other parts inside the equipment except wiring terminals.
- Ensure that all electrical connections comply with local electrical standards.
- For maintenance, please contact designated local installation and maintenance personnel.
- Before operating the inverter in the on-grid mode, ensure that you have obtained any permission needed from the local electricity grid network operator.

 **DANGER**	• Electrical installation, repairs and conversions may only be carried out by electrically qualified persons. • DO NOT connect the grid to the Load Output Breaker. • DO NOT reverse the polarity of batteries. Damage will occur. • The components in the inverter are live. Touching live components can result in serious injury or death. • Only qualified personnel are permitted to open the inverter. • Beware of high PV voltage. Please turn off the DC switch of PV Panel output before and during the installation to avoid electric shock. • Beware of high grid voltage. Please turn off the AC switch at the grid connection before and during the installation to avoid electric shock.

 **DANGER**	• Beware of large current of the battery output. Please turn off the battery module before and during the installation to avoid electric shock.
 **WARNING**	• Make all electrical connections (e.g. conductor termination, fuses, PE, connection, etc.) in accordance with prevailing regulations. When working with the inverter powered on, adhere to all prevailing safety regulations to minimize risk of accidents. • Systems with inverters typically require additional control (e.g. switches, disconnects) or protective devices (e.g. fusing circuit breakers) depending upon the prevailing safety rules. • All terminals/breakers including battery, MPPT, and AC breaker inputs should only have one conductor connecting to them. • Anytime the inverter has been disconnected from the power network, use extreme caution as some components can retain charge sufficient to create a shock hazard; to minimize occurrence of such conditions, comply with all corresponding safety symbols and markings present on the unit and in this manual. • Ensure all covers and doors are closed and secure during operation. All operations regarding transport, installation and start-up, including maintenance must be operated by qualified, trained personnel and in compliance with all prevailing codes and regulations. • Although designed to meet all safety requirements, some parts and surfaces of inverter are still hot during operation. To reduce the risk of injury, do not touch the heat sink at the back of the PV-inverter or nearby surfaces while Inverter is operating.
 **NOTICE**	• Please carefully read this manual before any work is carried out on this inverter, the installation, please keep this manual carefully stored and easy to access at any time. • The qualified personnel should have had training in the installation and commissioning of the electrical system as well as dealing with hazards, also they should have the knowledge of the manual and other related documents. As the installer or operator they are required to be familiar with local regulations and directives.

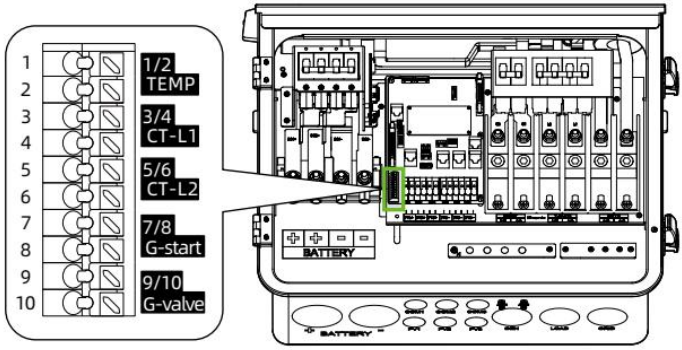
2 Product Introduction

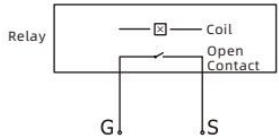
2.1 Product Overview



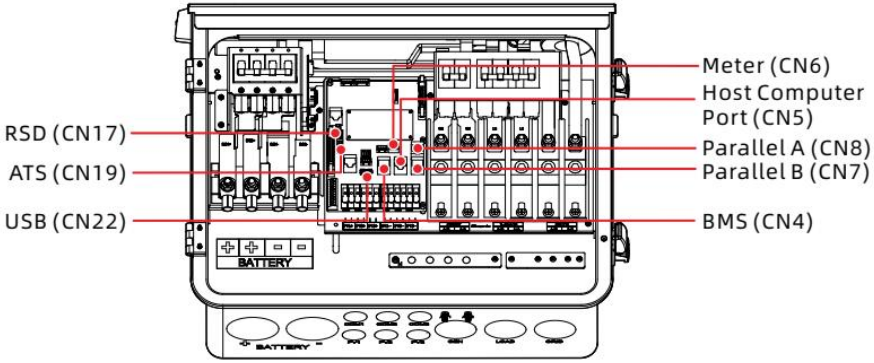
No.	Description	No.	Description
1	LCD Display	11	BMS Port
2	Inverter Indicators	12	Host Computer Port
3	PV Switch	13	AC Port Switch
4	DRMS Port	14	Parallel-A Port
5	Battery Switch	15	Parallel-B Port
6	LAN Port	16	Grid Port
7	Battery Input	17	Load Port
8	Function Port	18	Smart Port
9	PV Input	19	Ground Busbar
10	USB Port	20	N Busbar

2.2 Function Port Definition



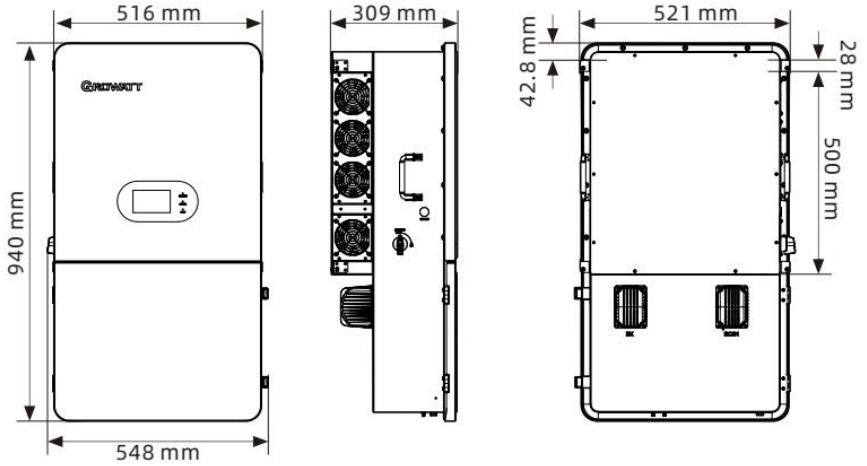
Item	Description
TEMP (1, 2)	Battery temperature sensor for lead acid battery.
CT-L1 (3, 4)	Current transformer (CT1) for "Export Limit to Home Load" mode.
CT-L2 (5, 6)	Current transformer (CT2) for "Export Limit to Home Load" mode.
G-start (7, 8)	Generator start signal should be connected to the Function Port (CN1) terminal 7/8 position. 
G-valve (9, 10)	Under developed

2.3 Other Function Port



Item	Description
RSD (CN17)	Used for install an external quick shutdown start switch.
ATS (CN19)	240 V output port when inverter is on. • G-Start engages and ATS disconnects (0 Vac). • G-Start disconnects and ATS engages (240 Vac).
BMS (CN4)	RS485 (1B, 2A)/CAN (4H, 5L) port for battery communication.
Parallel A (CN8)	Parallel communication port 1 (CAN communication).
Parallel B (CN7)	Parallel communication port 2 (CAN communication).
Meter (CN6)	For energy meter communication.
USB (CN22)	USB port (Used for upgrading machine firmware via USB flash drive DIP switch (SW1): 1+2-ON, 3+4-OFF).
Host computer port (CN5)	Host computer port, RS485 communication (1B,2A).
LAN (CN2)	Ethernet interface of the built-in collector.

2.4 Product Dimensions



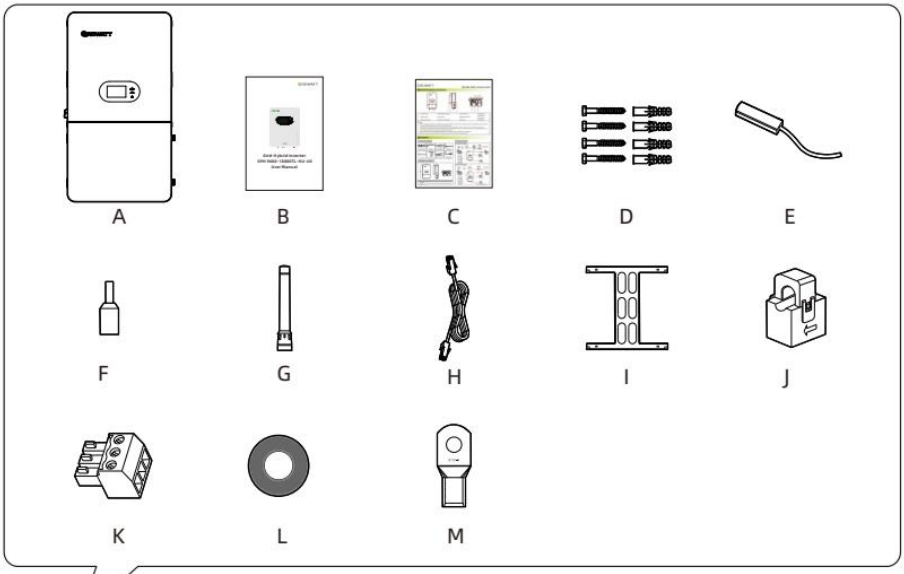
Inverter Size (1mm=0.03937 inch)

Installation 3

3.1 Packing List

Check the equipment before installation. Please make sure nothing is damaged in the package. You should receive the following items:

Packing List					
Item	**Description**	**Qty**	**Item**	**Description**	**Qty**
A	Hybrid inverter	1	H	Parallel communication line	2
B	User manual	1	I	Mounting bracket	1
C	Quick guide	1	J	CT (250A/4000:1/10m)	2
D	Expansion bolt M8×80	4	K	ATS, Meter terminals	2
E	Battery temperature sensor	1	L	Magnetic ring (see chapter 3.9)	1
F	Tubular terminal (10 AWG)	12	M	Wire terminals (SC70-10, SC35-6, SC25-6)	4+3 +4
G	WIFI antenna	2	/		



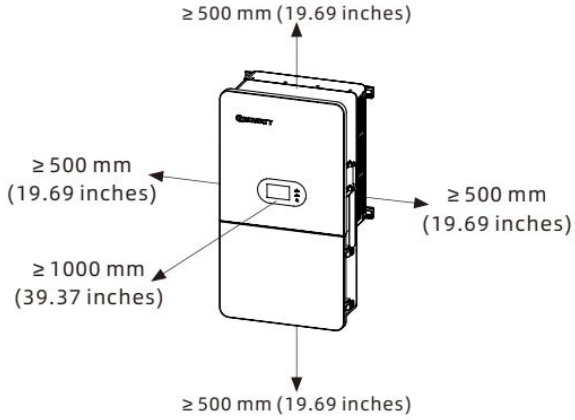
3.2 Mounting Instructions

3.2.1 Mounting Location

- Exposure to direct sunlight may cause output power derating due to overheating. It is recommended to avoid installing the inverter in direct sunlight. The ideal location is one where the ambient temperature does not exceed 40°C (104°F).
- It is also recommended to install the inverter somewhere the rain and snow will not land directly on it. The ideal installation location is on a north-facing wall under an eave.
- Do not install in small, closed rooms where air cannot freely circulate. To prevent overheating, always ensure that the air flow around the inverter is not blocked.
- Do not install near flammable substances. Maintain a minimum distance of ten feet (three meters) from such substances.
- Do not install in a living area where the prolonged presence of people or animals is expected.
- Depending on where the inverter is installed (for example: the type of surface around the inverter, the general properties of the room, etc.) and the quality of the electricity supply, the sound level from the inverter can be quite high.

3.2.2 Mounting Notes

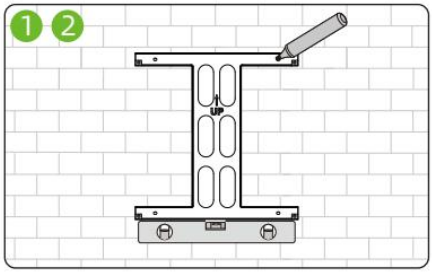
- Please select a vertical wall with load-bearing capacity for installation, suitable for installation on concrete or other non-flammable surfaces.
- The inverter must be mounted upright on a vertical structure with a tilt of 90°. A tilt greater or less than 90 may cause the inverter output power to derate.
- Install this inverter at eye level in order to allow touch screen display to be read at all times.
- If using CTs included in the package, takes the length of the CTs into consideration. CTs included in the package are 10 m (32.8 feet) long.
- For proper air circulation to dissipate heat, allow a clearance of approx. 500 mm to the side and approx. 500 mm above and below the unit. And 1000 mm to the front.

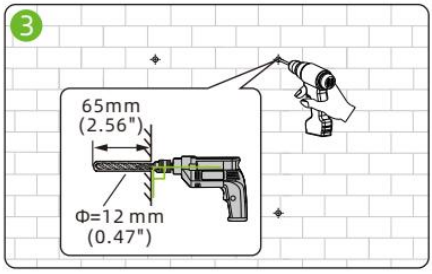


3.2.3 Mounting Steps

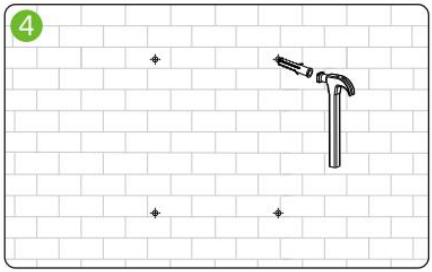
Remember that this inverter is heavy! Caution when lifting out from the package.

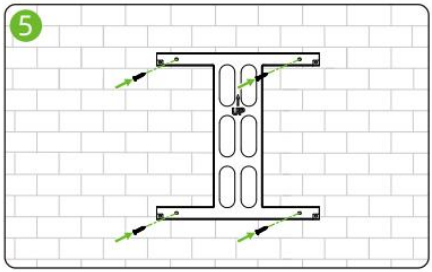
1. Please place the mounting bracket horizontally on the wall and confirm the level by level.
2. Please mark the holes in the mounting bracket.
3. Drill a hole with a depth of 65 mm at the mark with a drill of 12 mm.



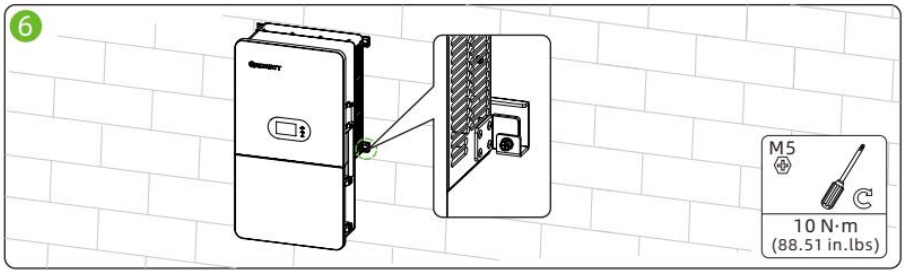


4. Please knock the expansion screw rubber sleeve into the hole on the wall.
5. Hang the mounting bracket on the expansion screws, and then tighten the expansion screws.





6. Hang the machine on the mounting bracket and secure it with M5 screws (10 N·m / 88.51 in·lbs).



⚠ NOTE:

If you need to install a magnetic ring, please read section **3.9 Installing Filter Rings** first.

3.3 Battery Connection

For safe operation and compliance, a separate DC over-current protector or disconnect device is required between the battery and the inverter.

Model	Wire Size
SPH 9600-18000TL-HU-US	2/0 AWG

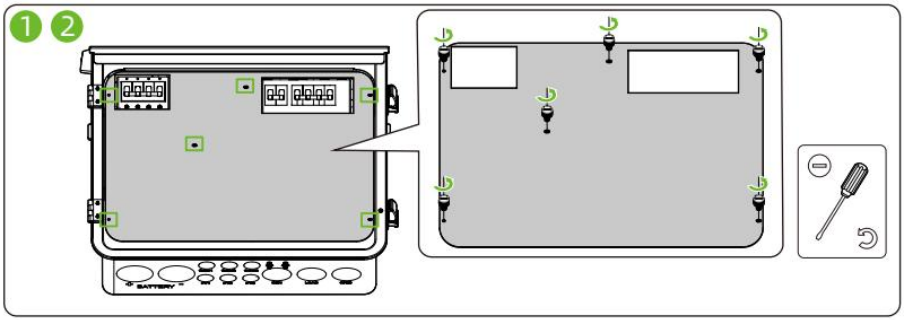
⚠ NOTE:

SPH 18000TL-HU-US has two built-in 200 A DC circuit breakers at the battery end. Two battery circuit breakers are connected in parallel, and the maximum capacity of one circuit breaker is 200 A.

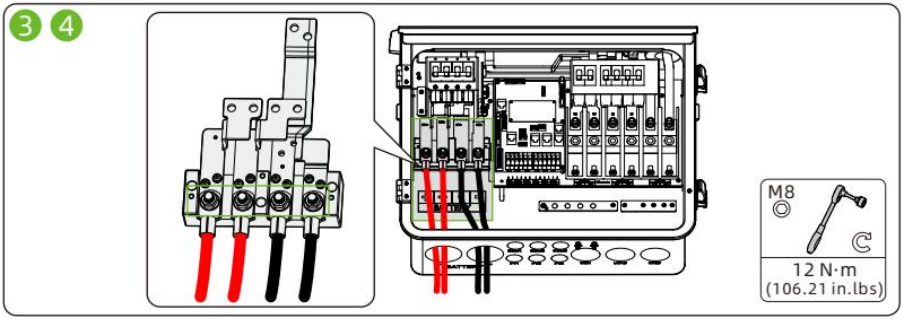
WARNING	• All wiring must be performed by a professional person. • Connecting the battery with a suitable cable is important for safe and efficient operation of the system. To reduce the risk of injury, refer to chart for recommended cables. • Installers are reminded that adherence to local electrical codes and regulations is mandatory. • Installers are encouraged to exercise caution, seek professional advice when necessary, and undertake installations with due diligence and in accordance with established electrical standards and regulations.

Please follow below steps to implement battery connection:

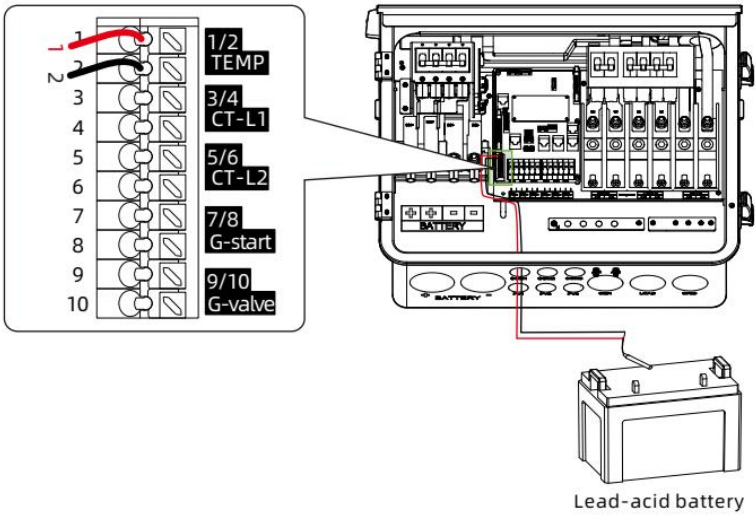
1. Please choose a suitable battery cable with correct connector which fits into the battery terminals.
2. Use a screwdriver to remove the protective cover.



3. Use a sleeve to unscrew the nuts and fit the battery connectors in, then fasten the nuts by the sleeve, make sure the nuts are tightened in clockwise direction.
4. Make sure polarity at both the battery and inverter is correctly connected.



Temperature sensor connection for lead-acid battery



Lead-acid battery

3.4 PV Connection

Before connecting to PV modules, please install a separate DC circuit breaker between inverter and PV modules. It is very important for system safety and efficient operation to use appropriate cable for PV module connection. To reduce risk of injury, please use the proper recommended cable size as below.

Model	Wire Size
SPH 9600-18000TL-HU-US	10 AWG

 **WARNING**	• Before installing the PV cables, be sure that the PV array is disconnected. • Use a multimeter to verify that the PV string voltages are 0 V before proceeding. • If rapid shutdown is being used, then under 30 Vdc per string is safe.

3.4.1 PV Module Selection

Please verify the following before connecting the PV strings to the inverter:

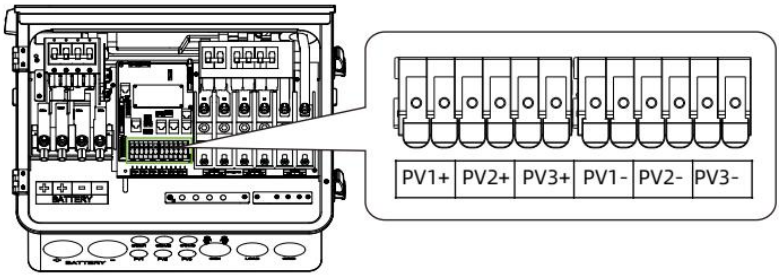
- Ensure the DC voltage of the PV strings will not exceed the maximum DC input voltage (550 Vdc). Violating this condition will void the inverter warranty.
- Ensure the polarity of the PV strings are correct (ex: positive is positive).
- Ensure the DC-switch, battery, AC-Backup, and AC-Grid disconnects are all off
- Ensure the PV resistance to ground is higher than 30 k ohms.
- Ensure that the Isc of the strings will not exceed the maximum DC input current (40 Adc).
- Ensure that the number of PV panels and their orientation are the same, when the same MPPT has two strings.

Inverter Model	SPH 9600-18000TL-HU-US
PV Input Voltage	370 V (130 V-550 V)
PV Array MPPT Voltage Range	150 V-450 V
No. of MPPT Trackers	3
No. of Strings per MPPT Tracker	2+2+2

3.4.2 PV Module Wire Connection

Please follow below steps to implement PV module connection:

1. Strip 0.5 inches (12.7 mm) of PV cable insulation.
2. Use crimping pliers to press the 10 AWG cable onto the attached tubular terminal to form a square.
3. Check correct polarity of wire connection from PV modules and PV input connectors. Then, connect positive pole (+) of connection wire to positive pole (+) of PV input connector. Connect negative pole (-) of connection wire to negative pole (-) of PV input connector. Close the switch and make sure the wires are tightly fixed.
4. Terminate the PV strings to the appropriate terminal.



NOTICE	Make sure the wire is tight and secure.

3.4.3 Rapid Shutdown

This inverter series is PVRSS-certified with several brands that manufacture rapid shutdown equipment. The certification includes the inverter, the PLC transmitter, and the receivers. The transmitter is located within the inverter, the receivers are installed with the PV modules. To avoid violating the PVRSS certification, the same brand of receivers must be installed as the internal transmitter. (Ex: Tigo transmitter with Tigo TS4-A-F/2F receivers).

⚠ NOTE:

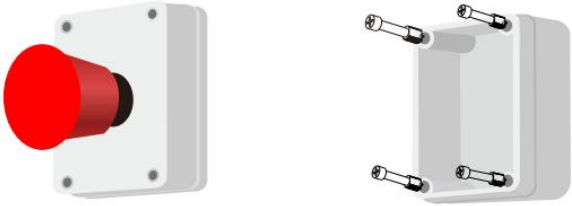
The brand of the internal transmitter of the machine can be checked in the order information or by contacting the manufacturer for consultation.

There can be no mixing of different brands without violating both the PVRSS certification and the rapid shutdown equipment warranty. For this reason, please be sure to check the Compatibility Sheet and only install equipment that is matched under the same brand.

In case of emergency, press the rapid shutdown button that cuts off the RSD power supply, thus stopping the inverter AC output, and the PV conductors voltage will be reduced to less than 30 V within 30 seconds outside the PV array. Inside the PV array, the conductors can be as high as 80 V.

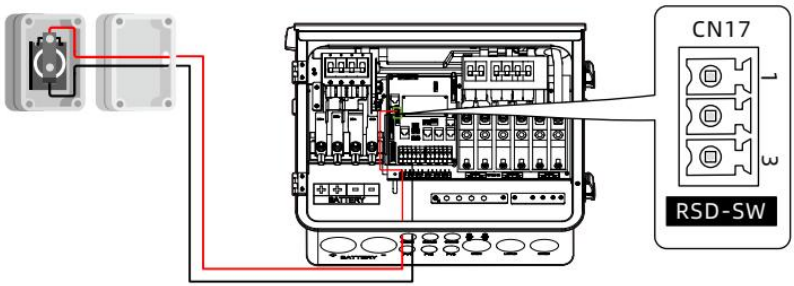
Mounting the RSD initiation switch

1. Using a Philips head screwdriver, unscrew the 4 plastic screws of the assembled RSD initiation switch to open the enclosure.
2. Use the base of the enclosure to mark 4 holes on the wall and drill the holes out. Insert the wall anchors into the holes.
3. Align the holes of the RSD initiation switch base with the holes in the wall. screw the self-tapping screws through the enclosure base into the wall anchors.



Wiring the RSD initiation switch

1. Install RSD switch wire to the COM input, use appropriate conduit fittings and bond where necessary.
2. Connect the wire to the RSD switch as shown.
3. Reinstall the RSD initiation switch cover and tighten the plastic screws to secured.
4. Remove the 3-pin connector from terminal CN17 and remove the jumper across the pins.
5. Insert the wire in the 3-pin conductor's positions 1 and 3, as shown.
6. Insert the connector in the terminal CN17.



3.5 Grid and Backup Connection

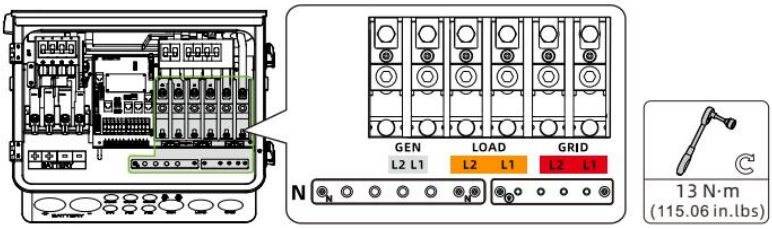
Before connecting to the grid, please install a separate AC breaker between the inverter and grid. Also, it is recommended to install an AC breaker between backup load and inverter. This will ensure the inverter can be securely disconnected during maintenance and fully protected from overcurrent. The recommended size of the AC breaker is 200 A. The maximum grid pass-through current is 200 A. There are three terminal blocks with "Grid", "Load" and "GEN" markings. Please do not misunderstand input and output connectors.

WARNING	All wiring must be performed by qualified personnel. It is very important for system safety and efficient operation to use appropriate cable for AC input connection. To reduce the risk of injury, please use the proper recommended cable as below.

Model	Terminal Rating	Wire Size
SPH 9600-18000TL-HU-US	200 Aac	4/0 AWG-2/0 AWG

Please follow below steps to implement AC input/output connection

1. Before making Grid, load and Gen port connection, be sure to disconnect AC breaker first.
2. Strip 0.6 inches (15.2 mm) of the AC cable insulation.
3. Terminate the AC conductors to the appropriate terminal. Loosen the screw of AC port with hexagon socket tool. Insert the wire. Then tighten the screws of the AC port clockwise.



NOTICE	Be sure that AC power source is disconnected before attempting to wire it to the unit.

Appliances such as air conditioner are required at least 2-3 minutes to restart because it is required to have enough time to balance refrigerant gas inside of circuit. If a power shortage occurs and recovers in short time, it will cause damage to your connected appliances. To prevent this kind of damage, please check manufacturer of air conditioner if it is equipped with time-delay function before installation. Otherwise, this inverter will trigger overload fault and cut off output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

3.6 Generator Connection (Smart Port)

The Gen terminals may be used for the following mutually exclusive purposes:

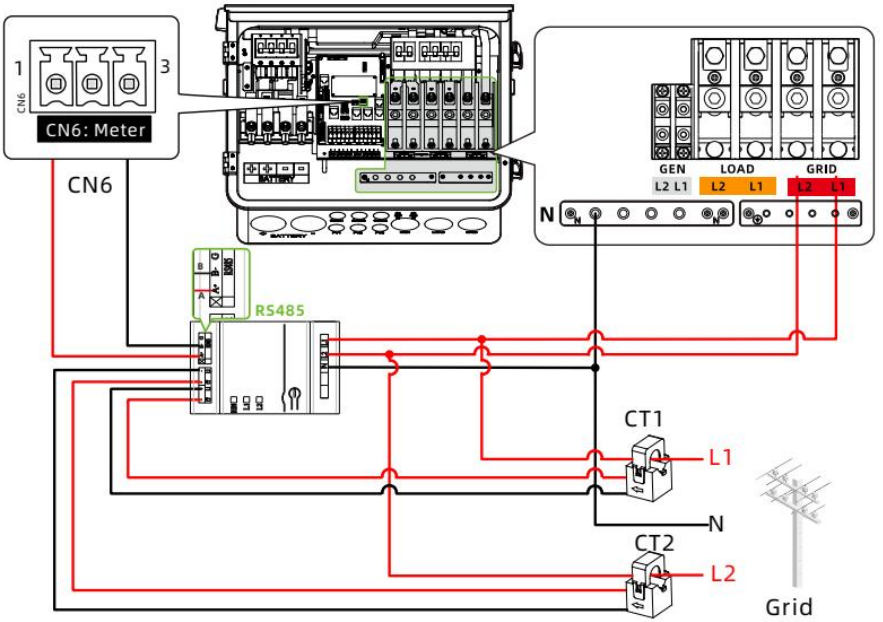
1. Connect a Generator to over take the loads and charge the battery during off-grid mode.
2. Use it to connect a Smart Load.
3. To connect an AC coupled PV system.

Model	Terminal Rating	Wire Size
SPH 9600-18000TL-HU-US	125 Aac	2 AWG

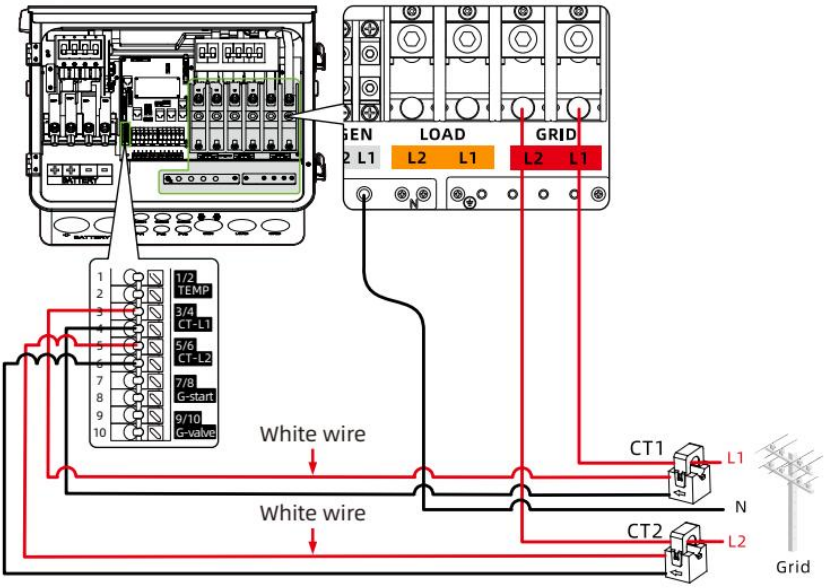
3.7 Meter or CT Connection

Cable name	Function	Conductor cross sectional area range
Meter-L1/L2/N	L1/L2 voltage sampling of the electricity meter & power supply to the electricity meter	22-16 AWG or CAT6 (> 30 m)
CT-L1+/-	L1 CT wires for grid current sensing	
CT-L2+/-	L2 CT wires for grid current sensing	
Communications cable	RS485 communication wire between the meter and the inverter	CAT5E or better

Meter Connection



CT Connection (How to set CT, please refer to 5.8)



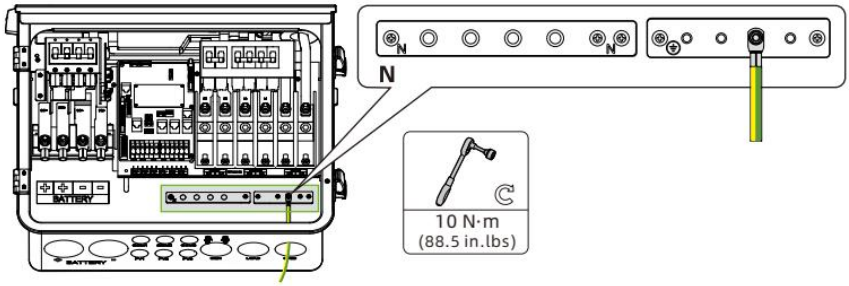
3.8 Ground Connection (Mandatory)

An equipment grounding conductor cable shall be connected to the ground plate on the grid side to prevent electric shock.

Model	Wire Size
SPH 9600-18000TL-HU-US	4 AWG-6 AWG

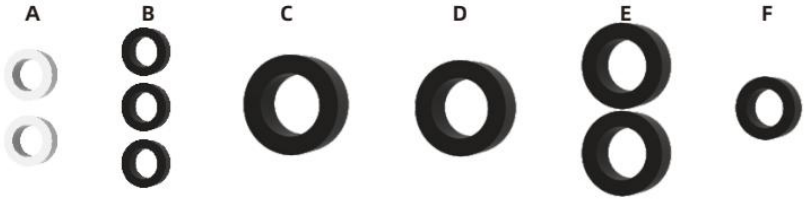
Please follow below steps to implement Ground cable connection:

1. Strip 0.6 inches (15.2 mm) of cable insulation. and use terminal SC25-6.
2. Loosen the screw, insert the ground wire and then tighten the screw. Please make sure that the ground cable is firmly connected to the ground bar.



3.9 Installing Filter Rings

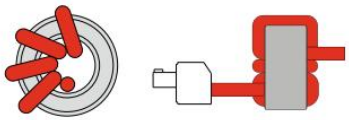
If your inverter came with a set of filter rings, follow the steps on the next page to install them on the battery conductors. Make sure that both (+) and (-) wires pass through both toroids simultaneously. When there are 4 wires, all conductors must go through the toroids as shown.

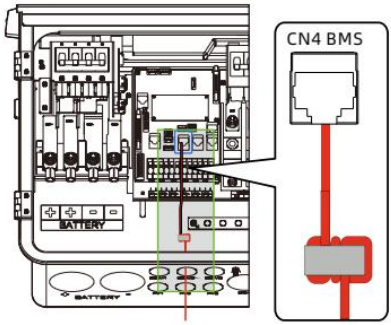


A	**2 small white filter rings** for BMS and Meter (outside diameter 33 mm)
B	**3 small black filter rings** for wiring area (outside diameter 30 mm)
C	**1 medium black filter ring** for load or generator (outside diameter 60 mm)
D	**1 medium black filter ring** for grid port (outside diameter 54 mm)
E	**2 large black filter rings** for battery (outside diameter 80 mm)
F	**1 small black filter ring** for PV terminal (outside diameter 50 mm)

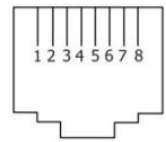
3.9.1 Filter Ring A (2 small white filter rings--outside diameter 33 mm)

1. Pass the BMS 485/CAN communication line through filter ring A and wrap it around four times.
   a. Pass the BMS communication cable through the magnetic ring and wrap it around the magnetic ring four times.
   b. Please use the BMS communication cable provided by the corresponding battery manufacturer.
   c. Ensure that the battery and machine are well grounded, and guaranteeing correct connection to the communication ground (NO.6).

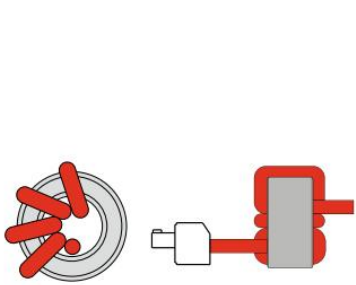


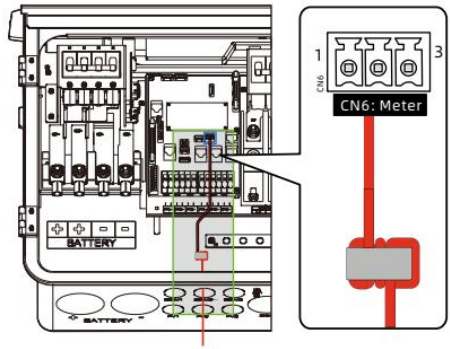


NO.	BMS	NO.	BMS
1	RS485B	5	CAN-L
2	RS485A	6	GND
3	/	7	/
4	CAN-H	8	/



2. Pass the Meter-485 communication wires through the other filter ring A and wrap them around four times.



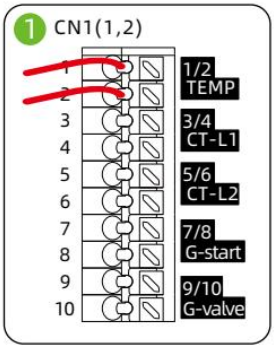


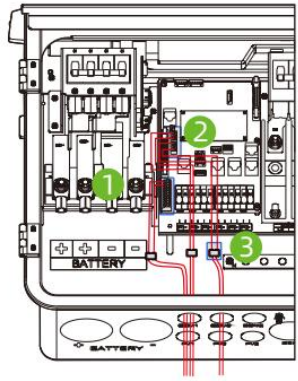
3.9.2 Filter Ring B (3 small black filter rings--outside diameter 30 mm)

For each of the three filter rings B: wrap the wires around twice, then thread the end of the wires through the filter ring.

Do this for each of these components:

1. Batt_Temp_in (1,2), CT_L1_in (3,4), CT_L2_in (5,6): Wrap these wires around one filter ring B.
2. Gen_Start_relay (7,8): Wrap these wires around one filter ring B.
3. RSD_input (B, B, +, -), RSD 12V_out (15+, 16-): Wrap these wires around one filter ring B.



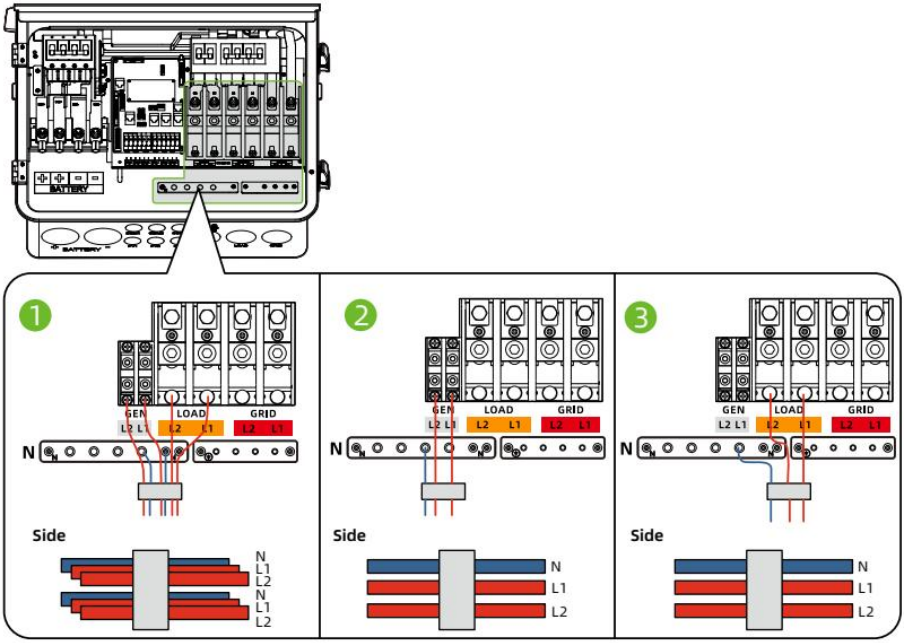




3.9.3 Filter Ring C (1 medium black filter ring--outside diameter 60 mm)

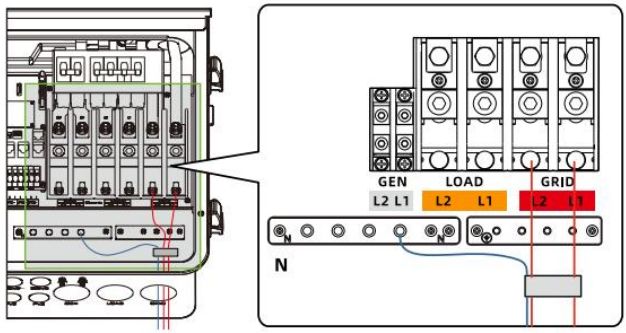
Filter ring C is the generator and load port ring. Follow the steps that apply to your setup.

- If using the GEN and LOAD port: pass all 6 GEN and LOAD conductors through filter ring C.
- If using only the GEN port: pass GEN and LOAD conductors through filter ring C.
- If using only the LOAD port: Pass all LOAD conductors through filter ring C.



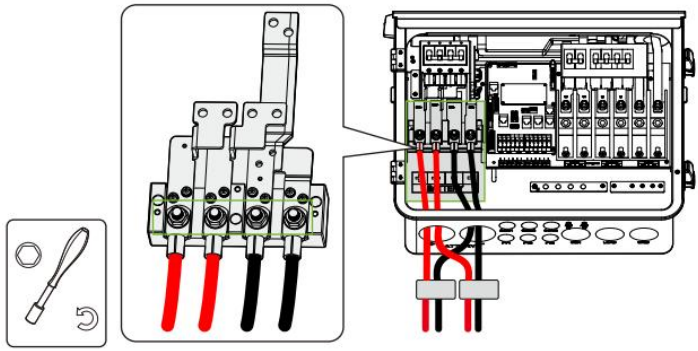
3.9.4 Filter Ring D (1 medium black filter ring--outside diameter 54 mm)

Pass GRID conductors (L1, L2, Neutral) through filter ring D, as shown below.



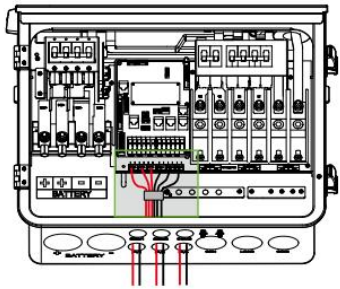
3.9.5 Filter Ring E (2 large black filter rings--outside diameter 80 mm)

Pass one positive and one negative battery power cables through filter ring E. Do the same for the other set of conductors.



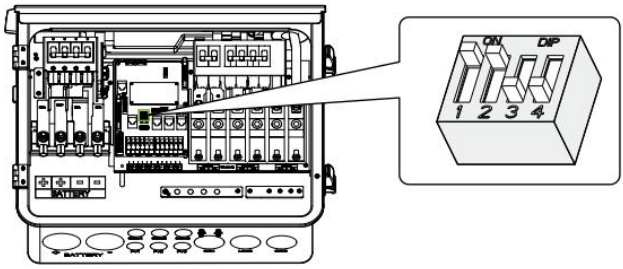
3.9.6 Filter Ring F (1 medium-small filter ring--outside diameter 50 mm)

Thread the wires of the PV terminal through Filter Ring F.



3.10 DIP Switch Status (SW1)

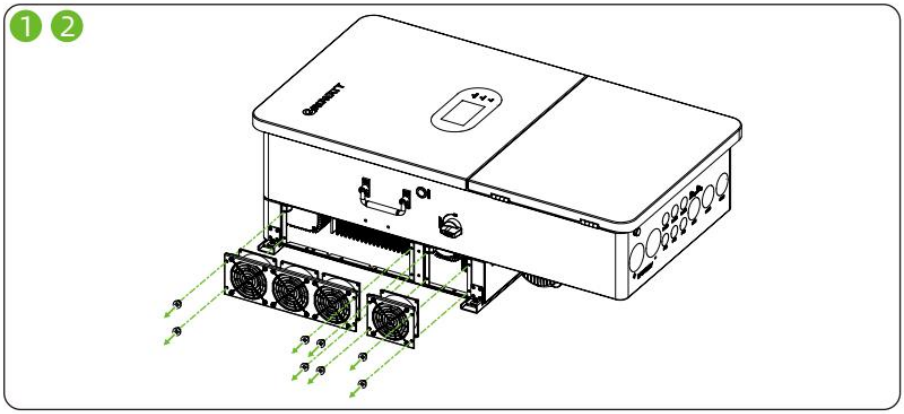
Working condition	Switch status
Datalogger (Default)	1/2: OFF; 3/4: ON
USB firmware upgrade	1/2: ON; 3/4: OFF



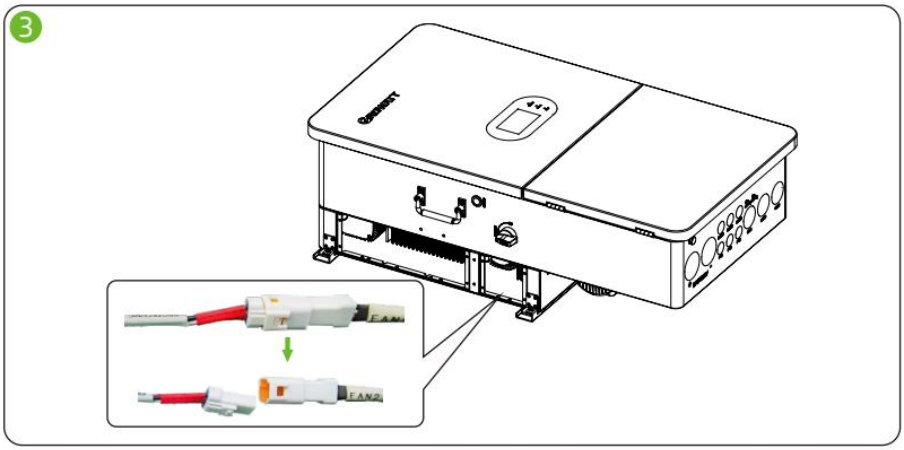
3.11 Fan Replacement

Please check and clean the fans regularly. The recommended period is 6 months Please replace the fan following up the below diagram if there is problem with the fans. Turn off the system and wait for more than 5 minutes before disassembling the machine.

1. Loosen the screws and remove them.
2. Remove the fan fixing.

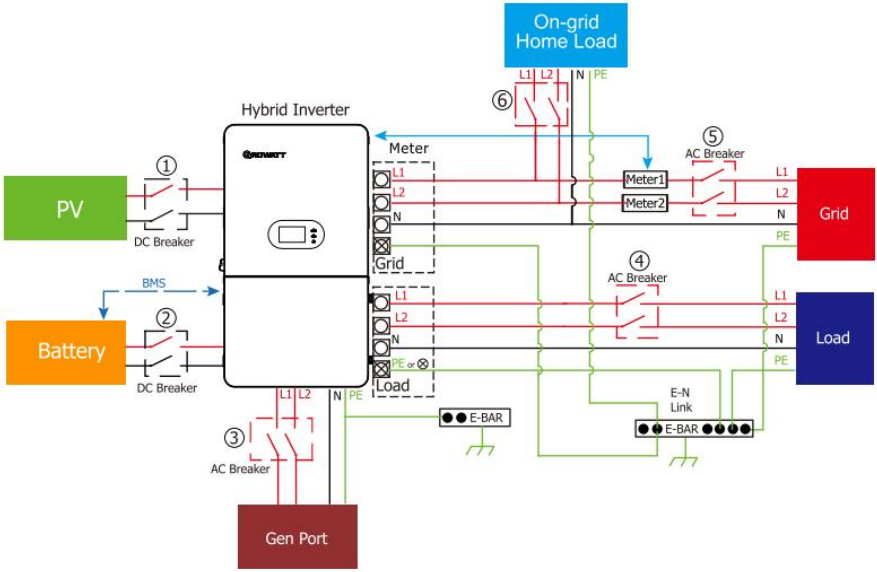


3. If you want to replace the broken fan, Then you need to press the snap-fit of the fan, untie the snap-fit of the fan, and then replace it as the picture shows. Pull out the fan bracket completely, and use a soft brush to clean the fans or replace the damaged fan.



4. Remove the fan and replace it.
5. After the fan is installed, follow the steps just now to push back and assemble it back.

3.12 Wiring System For One Inverter



SPH 9600-18000TL-HU-US internal breaker

Internal	SPH 9600-18000TL-HU-US
PV Breakers	600 V/50 A
Battery Breaker	80 V/200 A*2
Generator Breaker	240 V/125 A
Load Breaker	240 V/200 A

If an external circuit breaker needs to be installed, the selection can be made according to the recommendations below.

Breakers selection recommendation for both DC and AC.

External	SPH 9600-18000TL-HU-US
PV Breakers (①)	600 V/40 A
Battery Breaker (②)	80 V/350 A
Generator Breaker (③)	240 V/125 A
Load Breaker (④)	240 V/100 A
AC Breaker(⑤)	240 V/100 A
On-Grid Home Load Breaker(⑥)	240 V/100 A

SPH 9600-18000TL-HU-US supports a maximum input of 200 A for the mains bypass.
If necessary, it is recommended to increase the capacity of circuit breakers No. 4 and No. 5 to 240 V/200 A or higher.
The No. 6 circuit breaker selects the appropriate model based on the actual home load.
This recommendation only applies to single-unit operation conditions, while parallel operation conditions are selected based on installed power.

3.13 Paralleling Rules

In order to ensure normal operation and the safety of the equipment, the following rules must be followed when paralleling multiple inverters on the backup-side.

1. When connecting inverters in parallel, it is mandatory to match their sizes. For example, pair a 18 kW inverter with another 18 kW inverter. Do not parallel inverters of different sizes on the backup-side.
2. Before parallel connection, verify that both inverters are operating on the same firmware version. The inverters must never be on different versions of firmware.
3. The energy meter and the datalogger only need to be connected to the master. But to update the firmware, each inverter datalogger must be connected to the internet.
4. All inverters in the system must be connected to the same ground point to eliminate the possibility of a voltage potential existing between inverter grounds.
5. Each inverter must have its own PV strings connected to it, as per the DC input PV specifications of the inverter. It is ok to have some inverters with only battery and no PV.
6. The parallel settings for each inverter must be configured prior to initiating operation.
7. Prior to initiating full system operation it is essential to verify that each inverter operates normally. Set each inverter one-by-one for single operation, ensure there are no alarms during operation, shut it down, and then go to the next inverter.

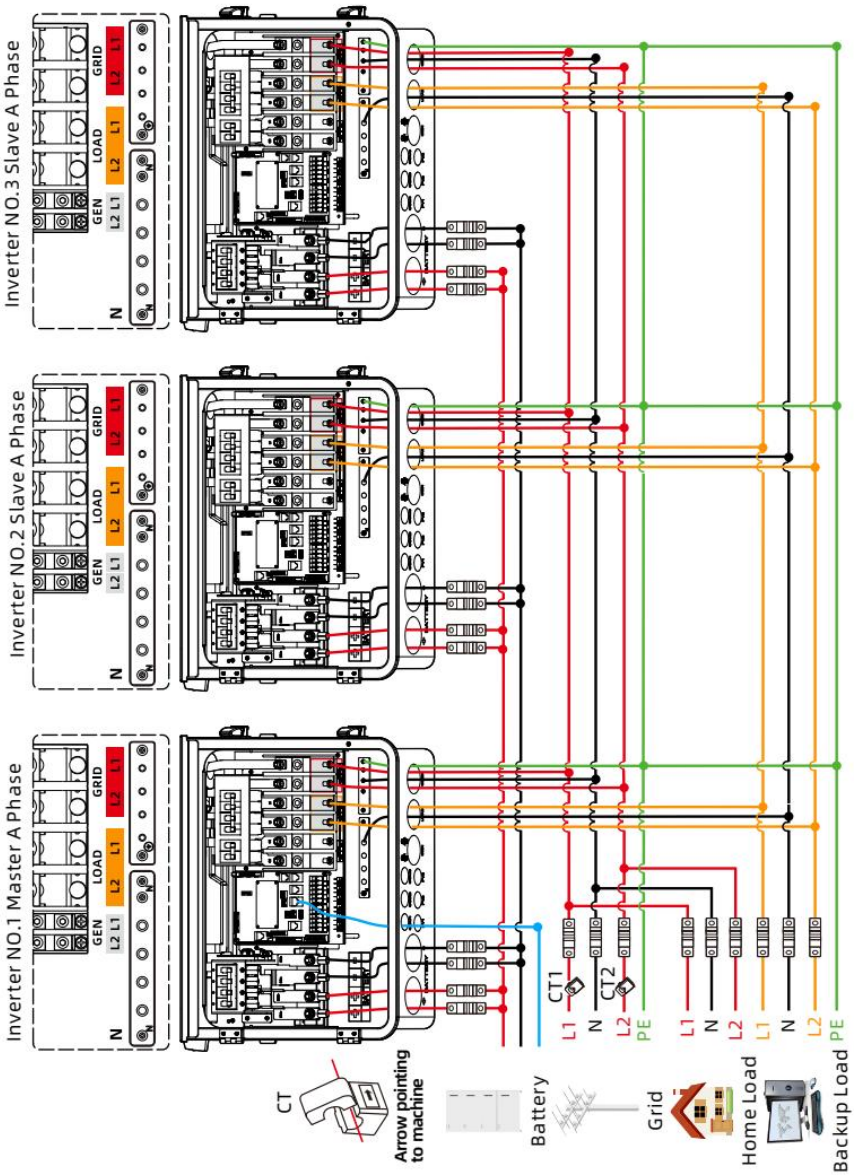
⚠ NOTE:

These rules apply only to paralleling the backup ports of the inverters together. If the inverters are being paralleled on the grid-side only then these rules can be ignored.

3.14 3Pcs Parallel Connection for 120/240 Split Phase

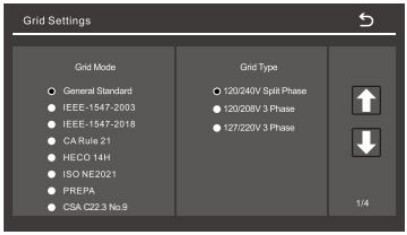
For additional details on how to parallel multiple SPH systems, please refer to: SPH 9600-18000TL-HU-US Parallel Solutions available at: community.growatt.com/white-paper Capacity expansion supports 2-6 units.

3.14.1 Power Connection

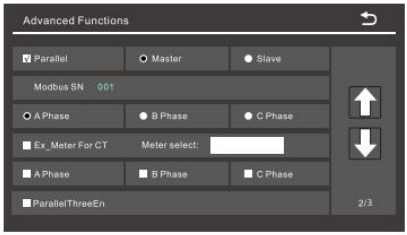


3.14.2 LCD Setting Steps

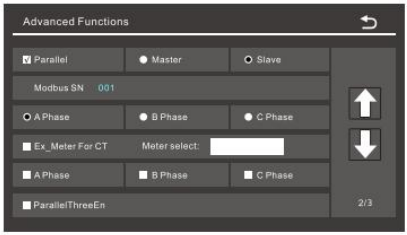
Grid Type: 120/240 Split Phase



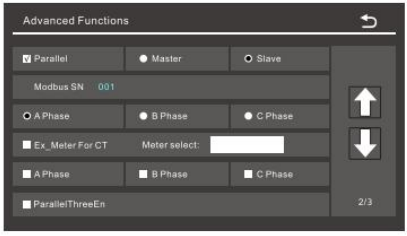
Parallel Setting Inverter NO.1



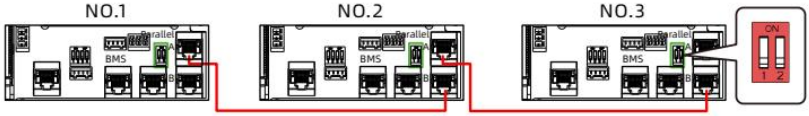
Parallel Setting Inverter NO.2



Parallel Setting Inverter NO.3



3.14.3 Communication Connection



Modbus SN: This feature is currently not available.

The status of the PARALLEL Dip Switch (SW2)-PARALLEL needs to be turned on.

- **CT1:** Measure L1 of the mains bus and connect it to the CT sampling port (CN4 pin 3&4) of the Inverter NO.1 (Master Phase A).
- **CT2:** Measure L2 of the mains bus and connect it to the CT sampling port (CN4 pin 5&6) of the Inverter NO.1 (Master Phase A).

How to connect CT, please refer to chapter 3.7. How to set CT, please refer to chapter 5.8. If using an electric meter, install the CT as shown and connect the meter's communication line to the host.

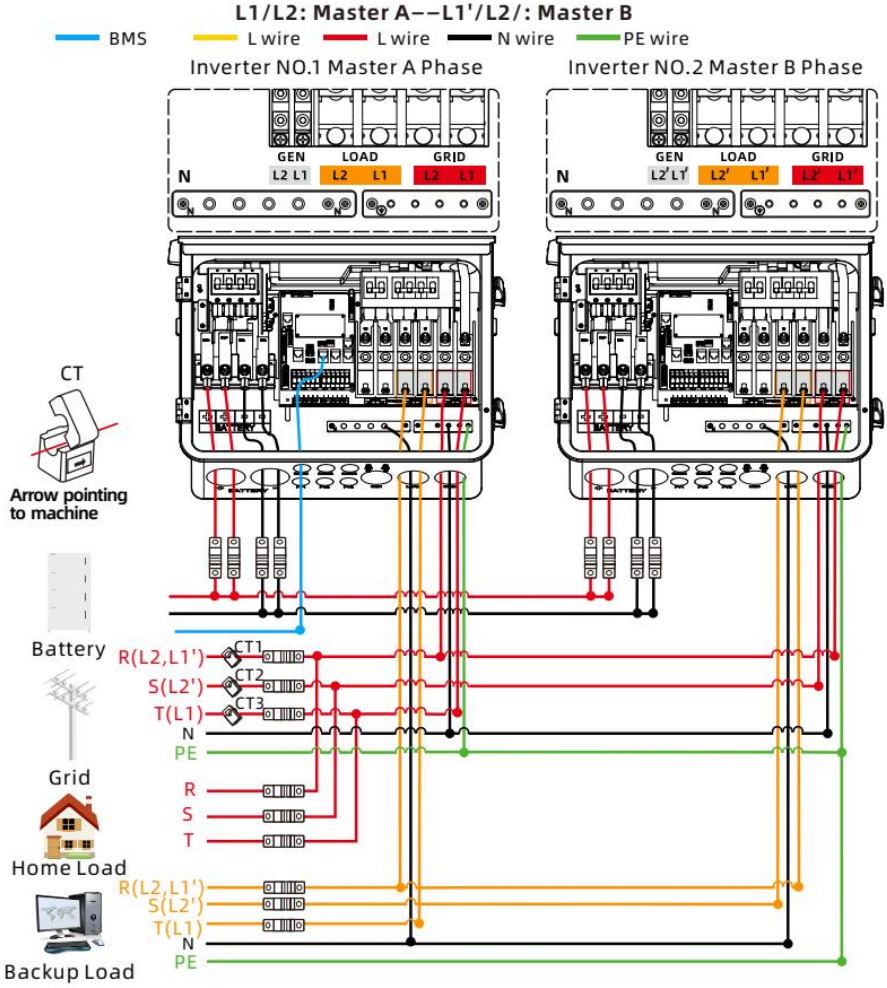
⚠ NOTE:

The wiring reference for the expansion of six units is based on that of three units.

3.15 2Pcs Parallel Connection for 120/208 Three Phase (Unbalanced)

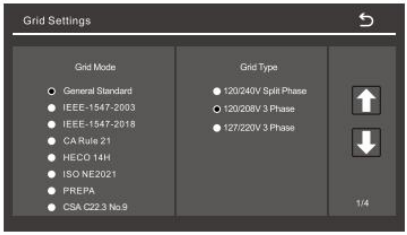
Three Phase supports 2, 3, or 6 units.
*Unbalanced: two 18kW units can only form a 27 kW three-phase system.

3.15.1 Power Connection

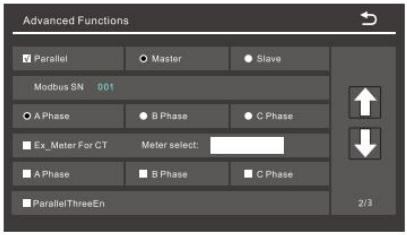


3.15.2 LCD Setting Steps

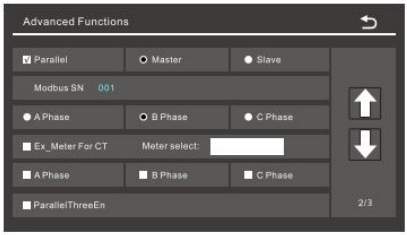
Grid Type: 120/208 3 Phase



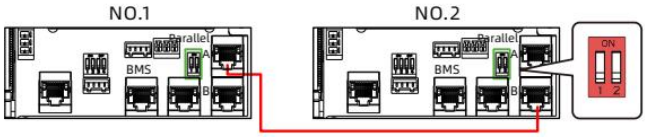
Parallel Setting Inverter NO.1



Parallel Setting Inverter NO.2



3.15.3 Communication Connection



Modbus SN: This feature is currently not being used.

The status of the PARALLEL Dip Switch(SW2)-PARALLEL needs to be turned on.

- **CT1:** Measure R of the mains bus and connect it to the CT sampling port (CN4 pin5&6) of the Inverter NO.1 (Master Phase A).
- **CT2:** Measure S of the mains bus and connect it to the CT sampling port (CN4 pin 5&6) of the Inverter NO.2 (Master Phase B).
- **CT3:** Measure T of the mains bus and connect it to the CT sampling port (CN4 pin 3&4) of the Inverter NO.1 (Master Phase A).

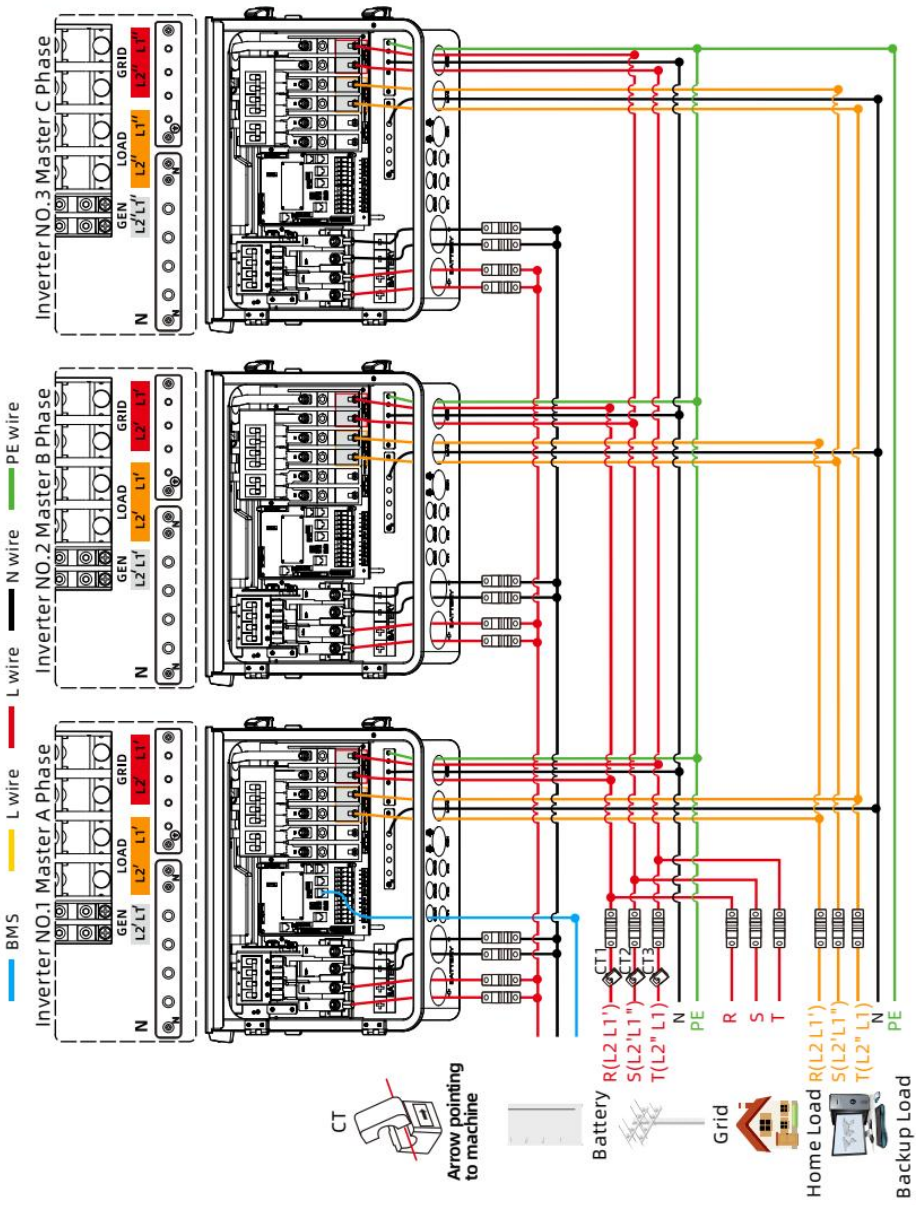
How to connect CT, please refer to chapter 3.7. How to set CT, please refer to chapter 5.8. If using an electric meter, install the CT as shown and connect the meter's communication line to the host.

3.16 3Pcs Parallel Connection for 120/208 Three Phase

Three Phase supports 2, 3, or 6 units.

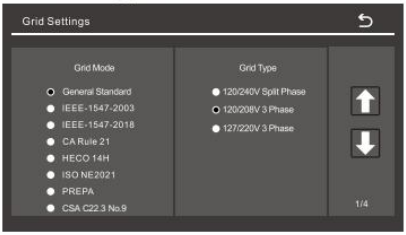
3.16.1 Power Connection

L1\L2–Master A L1'\L2'–Master B L1"\L2"–Master C

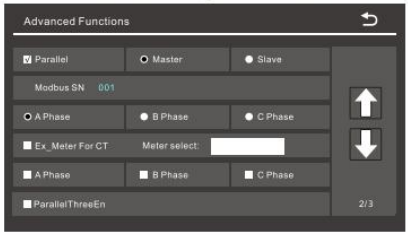


3.16.2 LCD Setting Steps

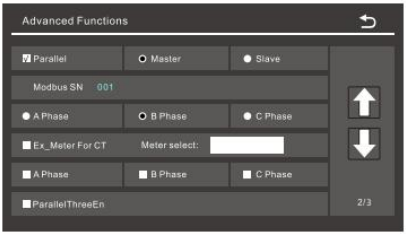
Grid Type: 120/208 3 Phase



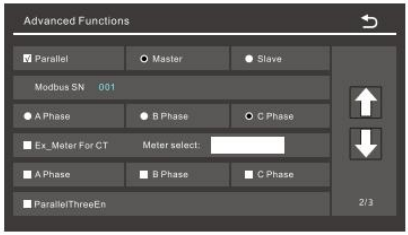
Parallel Setting Inverter NO.1



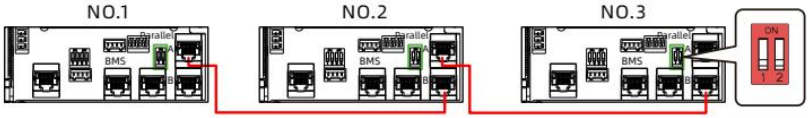
Parallel Setting Inverter NO.2



Parallel Setting Inverter NO.3



3.16.3 Communication Connection



Modbus SN: This feature is currently not being used.

The status of the PARALLEL Dip Switch (SW2)-PARALLEL needs to be turned on.

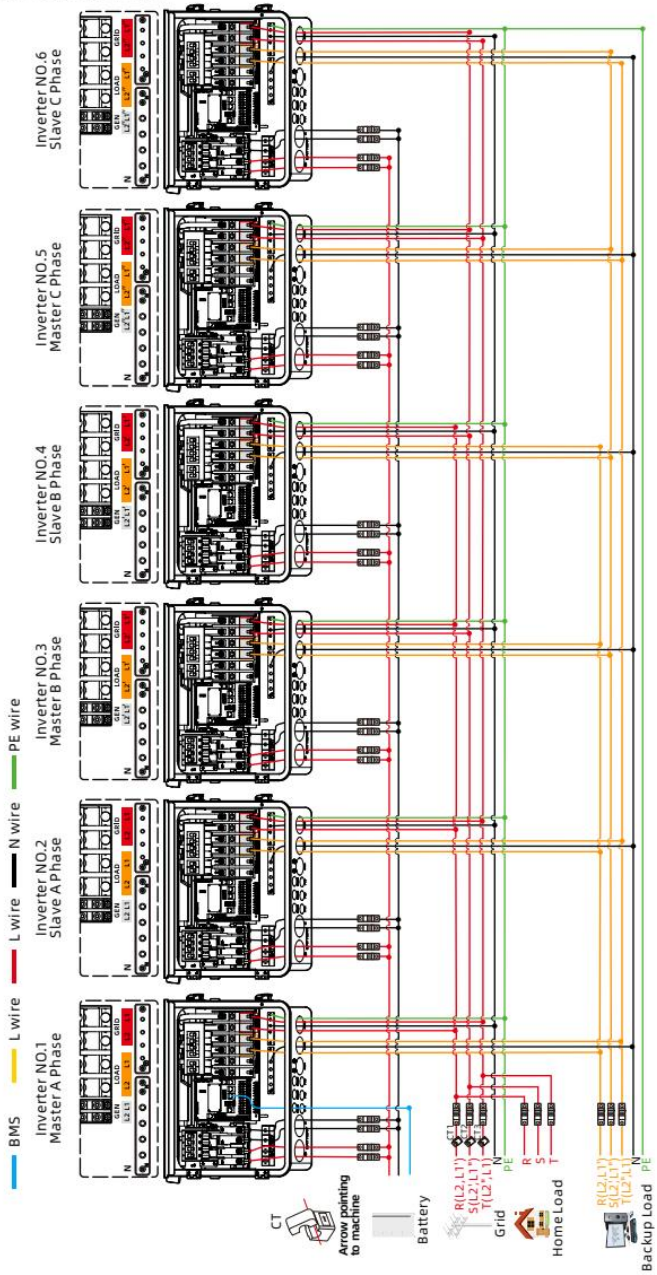
- **CT1:** Measure R of the mains bus and connect it to the CT sampling port (CN4 pin 5&6) of the Inverter NO.1 (Master Phase A).
- **CT2:** Measure S of the mains bus and connect it to the CT sampling port (CN4 pin 3&4) of the Inverter NO.3 (Master Phase C).
- **CT3:** Measure T of the mains bus and connect it to the CT sampling port (CN4 pin 3&4) of the Inverter NO.1 (Master Phase A).

How to connect CT, please refer to chapter 3.7. How to set CT, please refer to chapter 5.8. If using an electric meter, install the CT as shown and connect the meter's communication line to the host.

3.17 6 Pcs Parallel Connection for 120/208 Three Phase

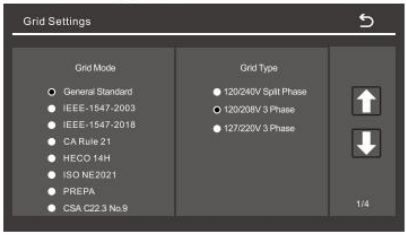
Three Phase supports 2, 3, or 6 units.

3.17.1 Power Connection

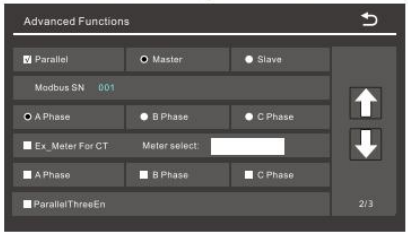


3.17.2 LCD Setting Steps

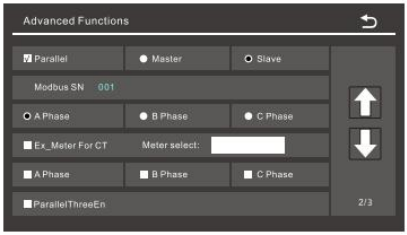
Grid Type: 120/208 3 Phase



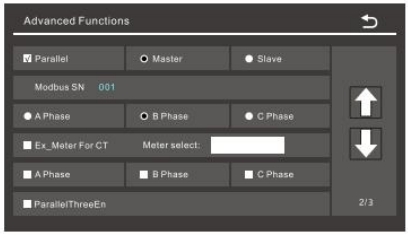
Parallel Setting Inverter NO.1



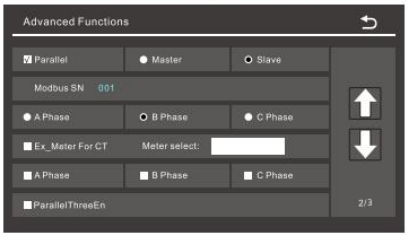
Parallel Setting Inverter NO.2



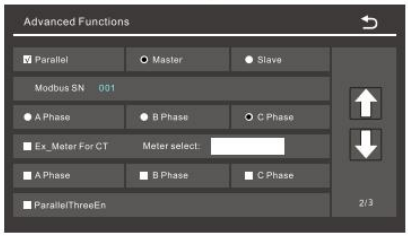
Parallel Setting Inverter NO.3



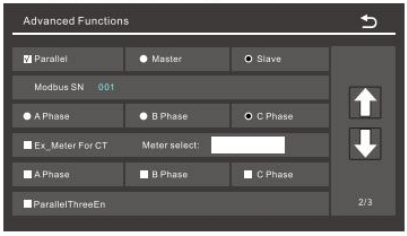
Parallel Setting Inverter NO.4



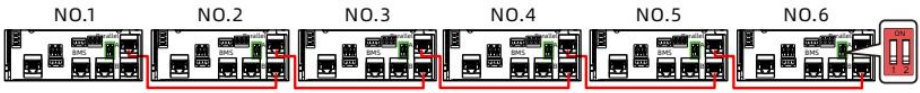
Parallel Setting Inverter NO.5



Parallel Setting Inverter NO.6



3.17.3 Communication Connection



Modbus SN: This feature is currently not being used.

The status of the PARALLEL Dip Switch (SW2)-PARALLEL needs to be turned on.

- **CT1:** Measure R of the mains bus and connect it to the CT sampling port (CN4 pin5&6) of the Inverter NO.1 (Master 0 Phase A).
- **CT2:** Measure S of the mains bus and connect it to the CT sampling port CN4 pin 3&4) of the Inverter NO.3(Master Phrase C).
- **CT3:** Measure T of the mains bus and connect it to the CT sampling port (CN4 pin 3&4) of the Inverter NO.1 (Master Phase A).

How to connect CT, please refer to chapter 3.7. How to set CT, please refer to chapter 5.8. If using an electric meter, install the CT as shown and connect the meter's communication line to the host.

4 Operation

4.1 Power ON/OFF

Once the unit has been properly installed and the batteries are connected well, simply press On/Off button (located on the left side of the case) to turn on the unit. When either the grid or PV is connected the screen will light up even if the battery is not connected.

- In the off-grid state, if this button is not pressed, the inverter will not support backup loads.
- If it is grid-connected, this button will not affect the power supply of the backup loads.

If there is no battery, you can support off-grid loads after selecting the No Battery Mode.

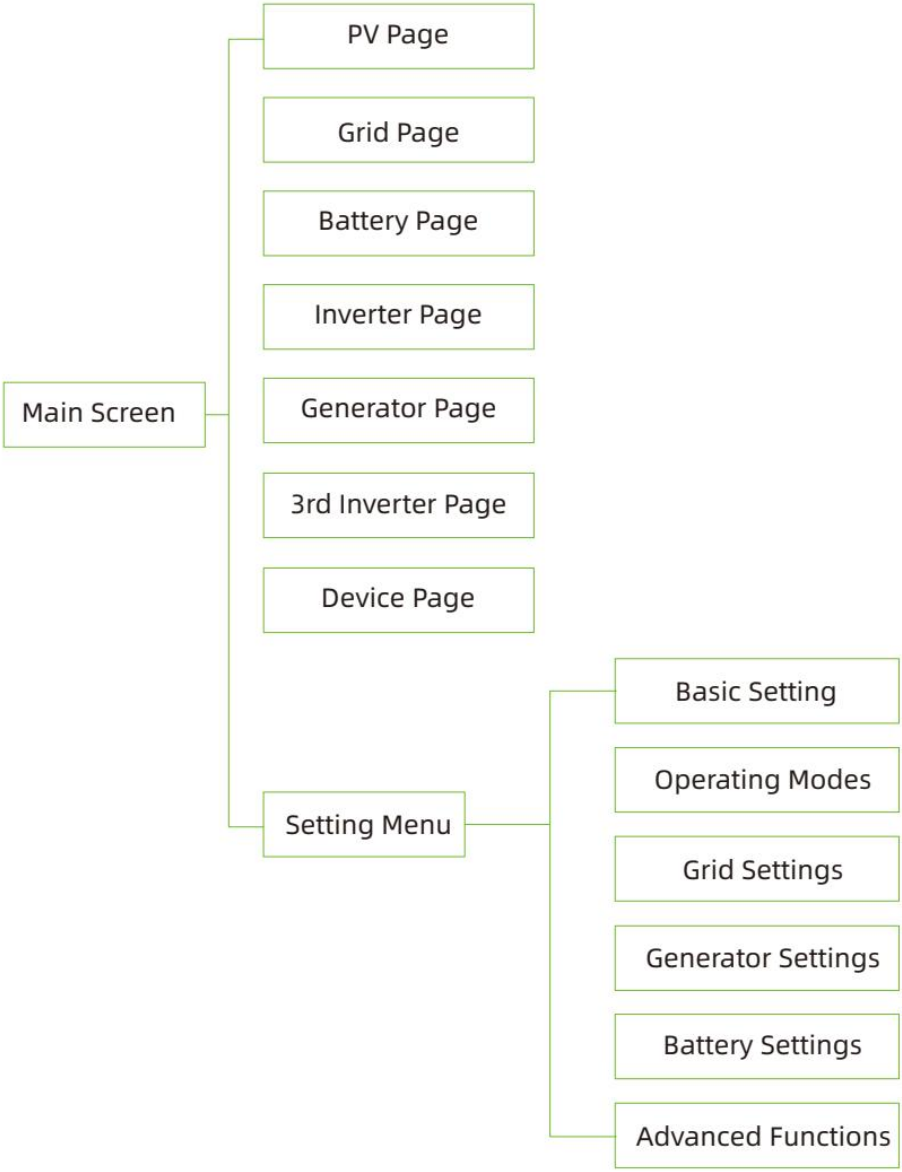
4.2 Operation and Display Panel

The operation and display panel, shown in below chart, is on the front panel of the inverter. It includes three indicators and a touch screen display, indicating the operating status and input/output power information.

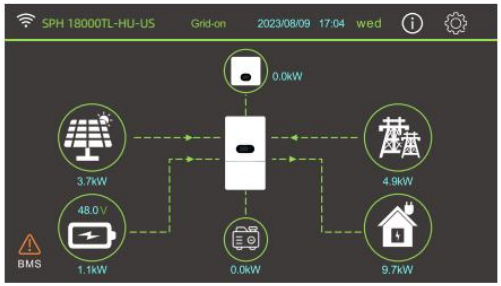
LED Indicator			Messages
AC/INV	GREEN	Solid	Powered by AC
		Flashing	Powered by DC
CHARGE	GREEN	Solid	Full battery
		Flashing	Charging
FAULT	RED	Solid	Error
		Flashing	Warning

Main Screen 5

5.1 Touchscreen Operation Flow Chart

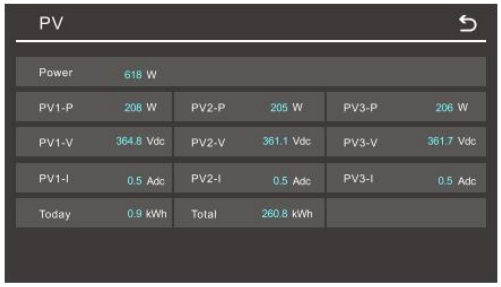


5.2 Main Screen



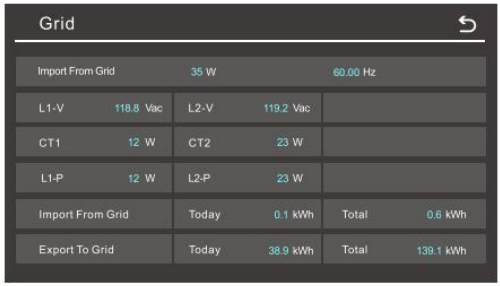
1. The "Grid-on" in the above of the home screen indicates that the system is Normal operation.
2. At the top of the screen is the time.
3. System Setting Menu, press this set button, you can enter into the system setup screen which including Basic Settings, Operating Modes, Grid Settings, Generator Settings, Battery Settings and Advanced Functions.
4. The main screen showing the info including Solar, Grid, Load and Battery. It's also displaying the energy flow direction by arrow.
5. When there is an abnormal BMS communication, a BMS alarm icon will appear in the bottom left corner of the screen. After this alarm occurs, the lithium battery automatically switches to lead-acid battery, but cannot be charged.
6. The signal icon will show whether the built-in datalogger is connected to WiFi. And display the signal strength of WiFi.

5.2.1 PV Detail Page (Tap the PV icon)



Solar Panel: Power, Voltage, Current; Solar panel energy for Day and Total.

5.2.2 Grid Detail Page (Tap the Grid icon)



Grid Status: Import From Grid, Export To Grid, Frequency.
L1-V&L2-V: Grid voltage.
CT1&CT2: External current sensor grid power.
L1-P&L2-P: Internal current sensor grid power.
Import From Grid: Today and total imported grid energy.
Export To Grid: Today and total exported grid energy.

5.2.3 Battery Detail Page (Tap the Battery icon)



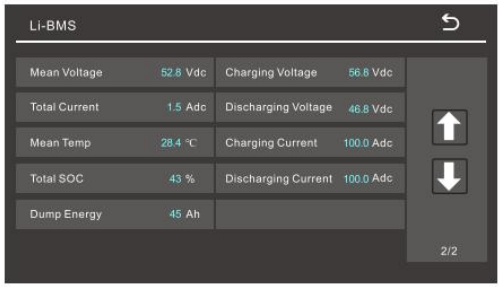
Battery mode: Use Battery %
Battery-related information is shown in the figure above.

5.2.4 Inverter Detail Page (Tap the Inverter icon)



Battery mode: Use Battery V
Battery-related information is shown in the figure above.





Battery mode: Lithium

Battery-related information is shown in the figure above.
The first page is the battery information in the inverter.
The second page is the BMS information in the battery.



Inverter Status: Power, Frequency, Voltage, Current.
AC-Temp: Temperature of Heat- sink.
DC-Temp: Temperature of DC- DC module.

5.2.5 Load Detail Page (Tap the Load icon)



Load Detail: Load voltage, power, daily consumption and total consumption of the load.

5.2.6 Generator Detail Page (Tap the Generator icon)



Generator Detail: Power, Voltage, Frequency, Total generator energy.

5.2.7 3rd Inverter Detail Page (Tap the Generator icon)



3rd Inverter Detail: Power, Voltage, Frequency, Today, Total 3rd inverter energy.

5.2.8 Device Info (Tap the gear icon)



Inverter ID: This is the ID of the inverter (SN).
HMI/M1/M2 Ver: This is the software version number of the inverter.
LCD Ver: LCD Version.
Clear Record: Clear error alarm messages.

5.2.9 Setting Menu (Tap the exclamatory mark icon)



This is Setting menu detail page.

5.3 Basic Settings

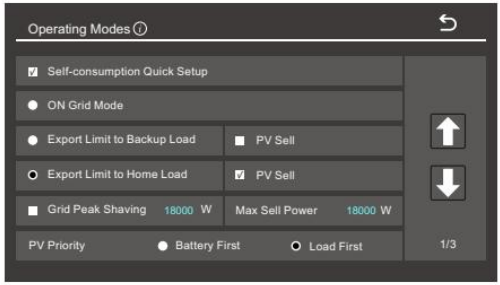


Auto Dim: Auto Screen Off.
Beep: sound for firmware upgrades.
Factory Reset: Reset all parameters of the Inverter.
Lock Out All Changes: Enable this function, the setting will be fixed and can not be changed until this item is disabled. The password for factory reset and lockout all changes are both 9999.

5.4 Operating Modes

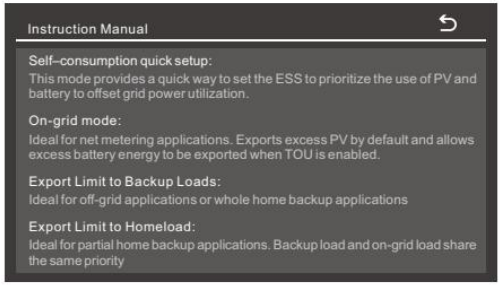
The SPH ESS has three main operating modes that can be widely customized according to the client's preferences. https://community.growatt.com/white-paper?page=3

5.4.1 Self-consumption Quick Setup

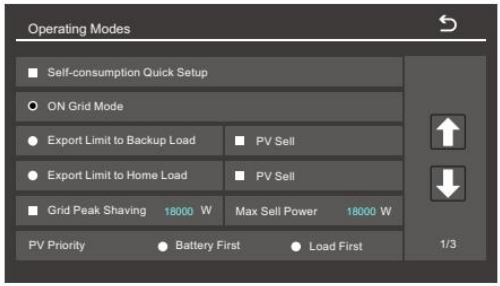


Self-consumption Quick Setup: After the setting, the mode is automatically set to Export Limit to Home Load mode→ Enable PV Sell → PV Priority (Load First);
When enabled, this mode provides a quick way to set the system to prioritize the use of PV and battery power to offset grid power utilization.

⚠ **NOTE:** This mode need use CT's measurements.



5.4.2 On Grid Mode



On Grid Mode: In this mode, PV power is used to power the backup loads connected to the load terminals and charge the battery according to the priority set at PV Priority. If there's PV power in excess after powering the backup loads and battery, power will flow to the on-grid home loads and grid. Under this mode, the battery does not discharge unless the Time Of Use function is enabled.

Grid Peak Shaving: not available or used for this mode.

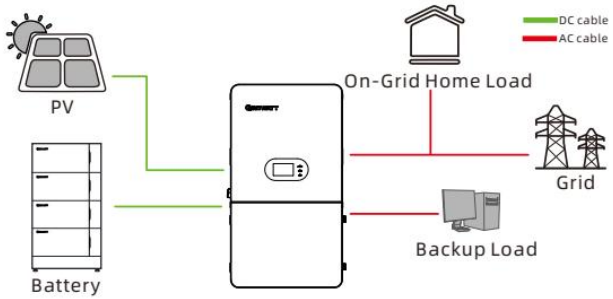
Max Sell Power: set this value to limit the power output at the inverter's grid terminals.

PV Priority: choose either Battery First or Load First to select the preferred option for PV power usage.

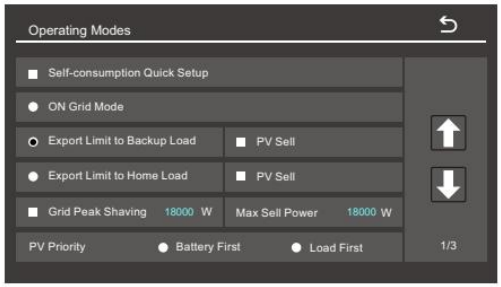
⚠ **NOTE:**

This mode does not use CT's measurements, therefore, it's not possible to control the power exported to the grid.

Use case: Ideal for PV only applications with net metering.



5.4.3 Export Limit to Backup Load



Export Limit to Backup Load: In this mode, the PV power is used to power the backup loads connected to the load terminals and charge the battery, according to the priority set at PV Priority.

Under this mode, the battery does not discharge unless the Time Of Use function is enabled.

PV Sell: If enabled, there's any excess PV power after powering backup loads and battery, power will flow to the on-grid home loads and grid.

Grid Peak Shaving: When imported grid power (at the CTs location) matches this value, the system uses available PV power and battery power to offsett the any excess. If enabled, PV priority is automatically set to Load First. The minimum setting value is 1000 W.

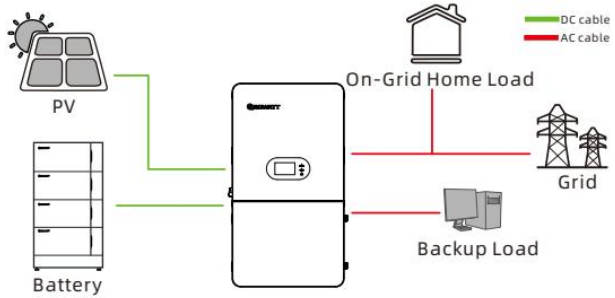
Max Sell Power: Set this value to limit the power output at the inverter's grid terminals.

PV Priority: choose either Battery First or Load First to select the preferred option for PV power usage.

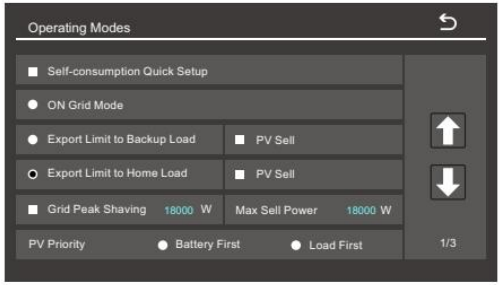
⚠ **NOTE:**

This mode does not use CT's measurements, therefore, it's not possible to control the power exported to the grid.

Use case: Used for off-grid applications where a gen is connected to the grid terminals.



5.4.4 Export Limit to Home Load



Export Limit to Home Load: In this mode, PV power is used to support backup loads, on-grid home loads, and charge the battery, according to the priority set at PV Priority.

This mode does not restrict PV power to Backup loads only (even if the PV Sell option is not marked).

Under this mode, the battery does not discharge unless the Time Of Use function is enabled.

PV Sell: This option enables inverter's power export (at the CT's location) .

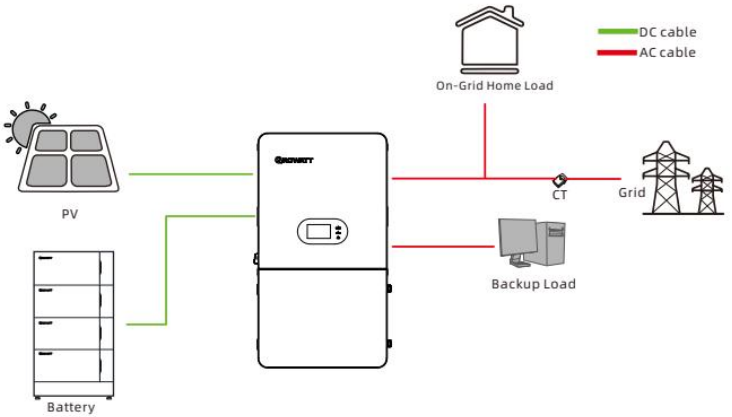
Grid Peak Shaving: When it is active, grid output power will be limited within the set value. If the load power exceeds the allowed value, it will take PV energy and battery as supplement. If still can't meet the load requirement, grid power will increase to meet the load needs.

Max Sell Power: This value limits the inverter's output power (at the CT's location).

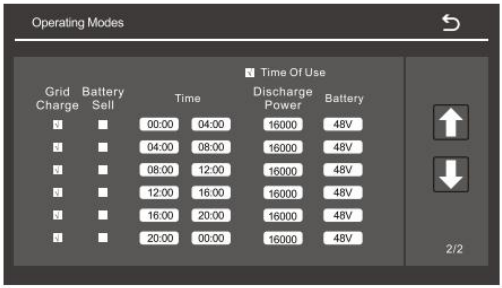
PV priority: Choose either Battery First or Load First to select the preferred options for PV power usage.

⚠ **NOTE:** This mode need use CT's measurements.

Use case: This mode is used for peak shaving applications or when there's a restriction to feed power back to the grid.



5.4.5 Time Of Use



Time Of Use: It is used to program when to use grid to charge the battery, and when to discharge the battery to power the load. The time of use function is used to charge or discharge the battery according to the set schedule.

Grid charge: Mark up grid charge to choose the power source for charging the battery.

Time: Enter the timeframe (24 h format) of your preference to either charge or discharge the battery.

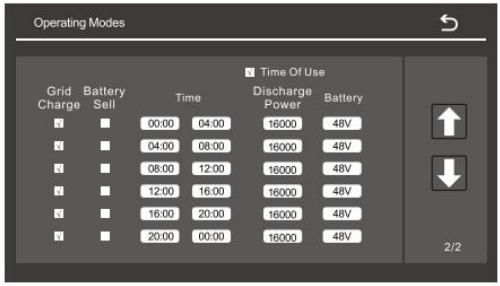
Power: This refers to the battery discharge power during the set time frame.

- In On-Grid mode: The battery charges/discharges power according to the value set.
- In Export Limit to Backup/Home load mode: The battery charges/discharges power adjusts dynamically according to the load consumption. No excess battery power is exported to the grid or the on-grid home load (when in Export Limit to Backup Loads) even when the PV sell function is enabled.

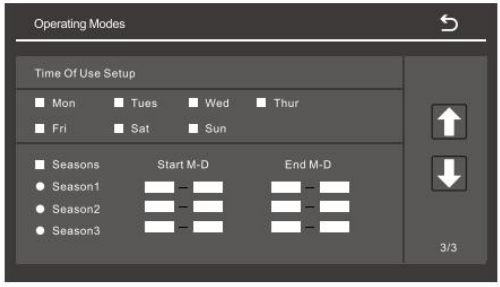
Battery: This is the value the system uses to determine whether to charge or discharge the battery during the set timeframe. This field adjusts to either, SOC or

⚠ NOTE:

This setting needs to be greater than the Low Cut Battery Off alarm in the battery settings.

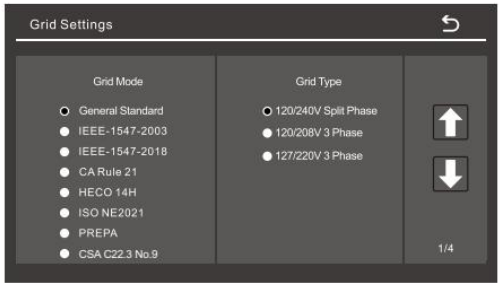


For example: All day long operation: If battery SOC > 80%, discharge to 80%; if battery SOC < 80%, charge from mains power to 80%.



Week setting: The TOU function will only take effect after selecting the week.
Seasons: Enable Button(After selecting this option), Season 1, 2, 3 will only take effect.
Season1, 2, 3: Automatically select based on the current time period.
Start M-D: Time on.
End M-D: End Time.

5.5 Grid Settings



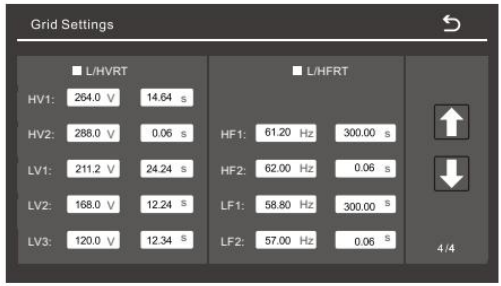
Grid Mode: Please follow the local grid code and then choose the corresponding grid profile settings.
Grid Type: Set the Grid Type.



Grid Frequency: Set the grid frequency.
Reconnection time: The waiting time period for the inverter to connect the grid again.
PF: This is used to adjust the inverter's reactive power.

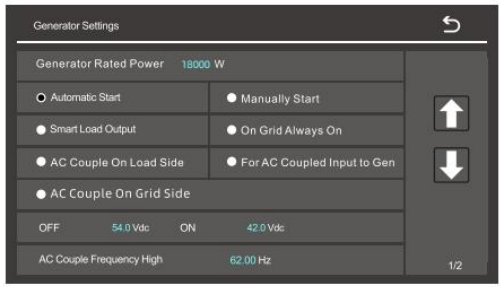


Q(V): Set Volt-Var Function
FW: Set Frequency-Watt Function
VW: Set Volt-Watt Function



L/HVRT: Set Low/High Volt Protect Function
L/HFRT: Set Low/High Frequency Protect Function

5.6 Generator Settings



The Gen terminals may be used for the following mutually exclusive purposes:

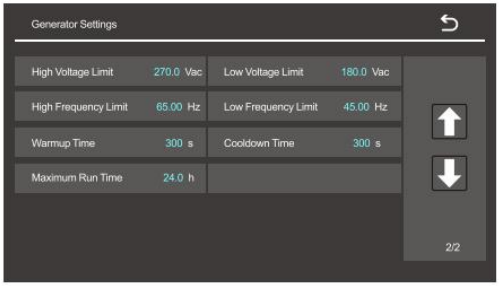
- Connect a Generator to over take the loads and charge the battery during off-grid mode.
- Use it to connect a Smart Load.
- To connect an AC coupled PV system.

Generator Rated Power: (Default 18 kva, maximun 37.5 kva)
set the generator's rated power. This setting is used to make sure the generator is not overloaded.
Automatic Start: Enable this option, Trigger the dry contact(G-Start) to start the generator according to the generator charging parameters on the second page of the battery settings.
Manually Start: Enable this option, directly activate the dry contact(G-Start) to start the generator.

⚠ **NOTE:** Ensure that G-Start is connected to the generator's dry contact.

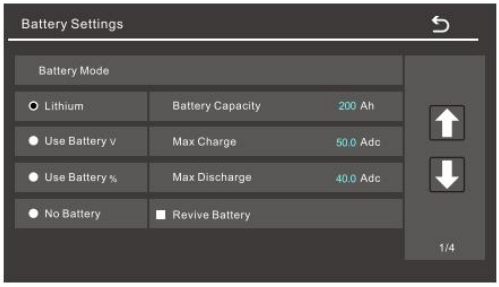
Smart Load Output: This function is used to automatically turn on/off a load based on battery SOC or V (ON/OFF values described below). Only used while the system is in off-grid mode.
On Grid Always On: When click "on Grid always on" the smart load will switch on when the grid is present.

For AC Coupled Input to Gen: A third-party inverter is connected to the generator port of the inverter to form an AC coupling, and this function needs to be enabled. For more details on this application, refer to the AC coupling with
AC Coupled on Load Side: This option is not available
AC Couple Frequency High: Represents the highest frequency that the inverter can increase when the AC coupled function is turned on.
OFF: Set the battery SOC/V value to turn the smart load OFF during off-grid mode.
ON: Set the battery SOC/V value to turn the smart load ON during off-grid mode.
(Show a screenshot with values that make sense here, OFF value should be lower than ON)

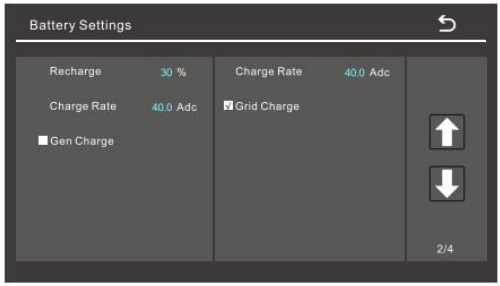


High/Low Voltage Limit: Generator-connected voltage range.
High/Low Frequency Limit: Generator-connected frequency range.
Warmup Time: After startup, the amount of time the generator runs (no-load) before the inverter is connected to the generator. The setting range is between 10 and 600 s.
Cooldown Time: The amount of time the generator runs (no load) after the shutdown command is issued before the generator is actually shut down. The setting range is between 10 and 600 s.
Maximum Run Time: When automatically started, the cumulative time allowed for continuous operation of the generator within 24 hours. The generator can be operated manually for any length of time.

5.7 Battery Settings



Lithium: Choose Lithium for Battery Mode if lithium battery is used.
Use Battery V: When using lead-acid battery, choose Use Battery V if you want to use voltage as the unit of actual battery capacity and do the setup.
Use Battery %: When using lead-acid battery, choose Use Battery %, if you want to use percentage as the unit of actual battery capacity.
No Battery: Tick this item if no battery is connected to the system.
Battery Capacity: Enter the size of the battery bank connected to the system.
Max Charge/Discharge: Set the max charge/discharge rate for the batteries.
Revive Battery: If lithium battery is used but the inverter and the battery are incompatible in communication, please enable the Revive Battery function to wake up the battery. If the lithium battery is compatible with the inverter in communication, then the inverter is able to wake the lithium battery when PV or grid is connected whether the Revive Battery function is enabled or not.



Recharge: When Automatic Start for generator is enabled and the actual battery capacity is lower than the recharge value, the generator will automatically start and charge the battery.
Charge Rate = 40 Adc (left): The maximum generator charging current is 40 A.
Gen Charge: Enable this to allow generator to charge the battery.
Charge Rate = 40 Adc (right): The maximum grid charging current is 40 A.
Grid Charge: Enable this to allow grid to charge the battery.

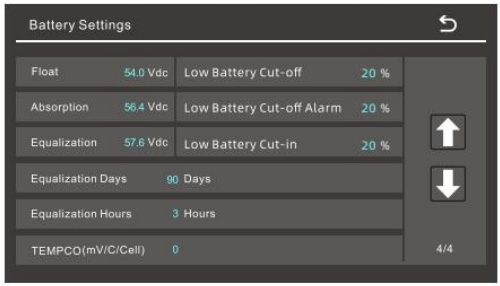


Lithium Mode: The communication protocol used between the inverter and lithium battery.
Low Battery Cut Off: The inverter will shut off its AC output if the actual battery capacity is lower than this value. The backup load can still be powered by the grid.

Low Battery Cut Off Alarm: The inverter will send alarm if the actual battery value reaches this value.
Low Battery Cut In: The inverter AC output will resume if actual battery SOC reaches this value.

⚠ **NOTE:**

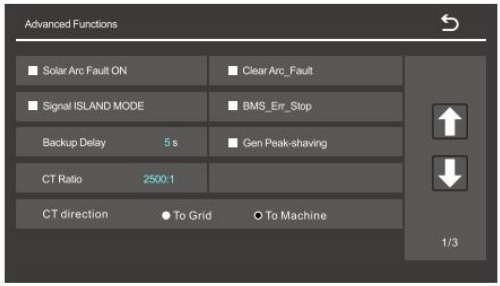
- 5 ≤ Low Battery Cut Off < Low Battery Cut Off Alarm
- 9 ≤ Low Battery Cut Off Alarm < Low Battery Cut In
- Low Battery Cut Off Alarm + 5 and 15 ≤ Low Battery Cut In ≤ 100



Float, Absorption, Equalization are three stages of charging the battery. This is for professional installers, you can keep it if you do not know Recommended battery settings:

Battery Type	Absorption	Float	Equalization
AGM (or PCC)	14.2 V (57.6 V)	13.4 V (53.6 V)	14.2 V (57.6 V)
Gel	14.1 V (56.4 V)	13.5 V (54.0 V)	
Wet	14.75 V (59.0 V)	13.75 V (55.0 V)	14.75 V (59.0 V)
Lithium	Follow its BMS voltage parameters		

5.8 Advanced Functions



The password for entering this pages is 7777.
Solar Arc Fault ON: This is AFCI function.
Clear Arc Fault: Clear AFCI error messages.

BMS_Err_Stop: When the Battery Mode is Lithium

- Enable this function, the inverter will turn off its output and send BMS error if the battery communication is abnormal. The output will be resumed after the communication is restored
- Disable this function, the Battery Mode will be changed to Use Batt V if the battery communication is abnormal, and the battery can only be discharged, not be charged.

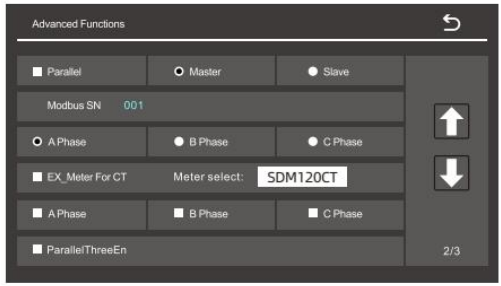
Signal ISLAND MODE: Under developed.

Backup Delay: Under developed.

Gen Peak-shaving: Under developed.

CT Ratio: The inverter supports any CT ratios within the range of 1500:1 to 7500:1, The CT ratio used in parallel connection is set according to the actual CT used. For example, if 100 A/50 mA is marked on the CT, it means the CT ratio is 2000:1.The maximum secondary current support is 62.5 mA.

CT direction: Section of CT direction.



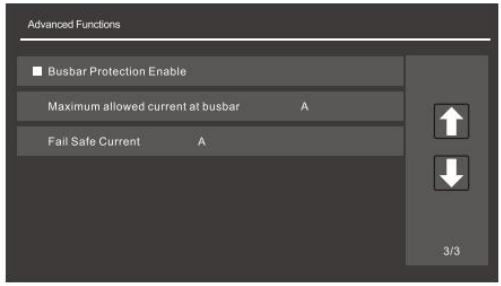
Parallel: This is the inverter's parallel function setting.

Ex_Meter For CT: This is the CT setting for the inverter, please leave it unchecked. Leave it unchecked, if using CT. Please check it if smart meter is used.

ParallelThreeEn: Under developed.

Modbus SN: Under developed.

Meter Select: If use smart meter to do the grid side sampling, please select the meter that is being used.



Maximum allowed current at busbar: Maximum value of busbar protection current.

Fail Safe Current: Can set the fault safety current value.

6 Error Information and Processing

Error codes are divided into Warning codes and fault codes.
Warning codes identify the current status of the inverter (Max), it does not affect the normal running of the inverter. When a numeric warning appears on the Main Screen, it can usually be cleared through orderly shutdown/re-set or self-corrective action performed by the inverter. Fault codes identify the possible equipment failure, incorrect setting or configuration of the inverter, all attempts to clear the fault code must be performed by qualified personnel. Typically, error codes can be cleared. Some of error codes as table shows below.

Auditing routine	Error Code	Description	Solutions
About PV	W83	PV Voltage Over Warning	1. Check whether the PV voltage is greater than 550 V. 2. If alarm message still exists, contact manufacturer.
	W89	PV Over Load	1. Check whether the single-channel PV power exceeds 13 KW. 2. If alarm message still exists, contact manufacturer.
	F33	PV Current Over	1.Check the connection between the PV module and the battery module. 2.Reduce the number of load connections in off-grid mode. 3.If the fault persists, contact the manufacturer.
	F39	Self Check Fault	1.Restart the inverter. 2.If the fault persists, contact the manufacturer.
	F40	PV Voltage Over	1.Check whether the PV voltage is greater than 555 V. 2.If the fault persists, contact the manufacturer.

Auditing routine	Error Code	Description	Solutions
About Grid, Generator	W68	Grid Relay Warning	1. Restart the inverter. 2. If alarm message still exists, contact manufacturer.
	W71	Gen Overload warning	1.Check whether the generator power exceeds the set value. 2.If alarm message still exists, contact manufacturer.
	F26	Grid Type Fault	1.If you have changed the grid type/grid frequency settings, wait for 90 seconds or restart the device. 2.If the fault persists, contact the manufacturer.
About inverter	W01	Fan lock warning	1. Check fan wiring after shutdown. 2. If alarm message still exists, contact manufacturer.
	W03	LCD Connect warning	1. Check LCD wiring after shutdown. 2. If alarm message still exists, contact manufacturer.
	W04	USB Connect warning	1. Check USB wiring after shutdown. 2. If alarm message still exists, contact manufacturer.
	W10	RSD Stop Press Alarm	1. Check if the emergency stop button is pressed. 2. If alarm message still exists, contact manufacturer.

Auditing routine	Error Code	Description	Solutions
About inverter	W12	MDSP update Alarm	1. Check if the machine is in the process of upgrading. 2. If alarm message still exists, contact manufacturer.
	W13	SDSP update Alarm	
	W67	Inverter Relay Warning	1. Restart the inverter. 2. If alarm message still exists, contact manufacturer.
	W70	GFCI Warning	1. Please charge for 10 minutes before inverter. 2. If alarm message still exists, contact manufacturer.
	W73	MDSP-METER Connect warning	1.Check whether the communication wiring between the electricity meter and the inverter is correct. 2.Check if the electricity meter supports the Growatt protocol. 3.If alarm message still exists, contact manufacturer.
	W88	AFCI Curr Over Warning	1.Shut down and check for poor contact or tearing of PV component wires. 2.If the fault persists, contact the manufacturer.
	W90	Insulation Low	1. After shutdown, check if the panel shell is reliably grounded. 2. If alarm message still exists, contact manufacturer.

Auditing routine	Error Code	Description	Solutions
About inverter	W91	AFCI Communication fail	1.After shutdown, check if the AFCI line inside the machine has fallen off. 2.If the fault still exists, please contact us for help.
	W92	AFCI selftest fail	1.Restart inverter. 2.If the fault persists, contact the manufacturer.
	F18	Inverter Over Current Fault	1. Check if the load is within the power range. 2. Restart the inverter. 3. If the fault persists, contact the manufacturer.
	F19	MSDSP Connect Fault	1. Restart the inverter. 2. If the fault persists, contact the manufacturer.
	F24	Inverter Voltage Fault	1. Test if the actual output inverter voltage is consistent. 2. Restart the inverter. 3. If the fault persists, contact the manufacturer.
	F27	GFCI Fault	1.Check for any damage to the circuit and ensure proper grounding. 2.Restart the inverter. 3.If the fault persists, contact the manufacturer.
	F34	Bus Voltage Over	1. Restart the inverter 2-3 times. 2. If the fault persists, contact the manufacturer.
	F35	Bus Volt Unbalance	

Auditing routine	Error Code	Description	Solutions
About inverter	F41	Heat Sink High Temperature Failure	1. Check that the inverter is not installed in a place where the sunshines, and ensure that the inverter is installed in a cool and ventilated place. 2. Check whether the working temperature is too high, and make sure that the inverter is installed vertically. 3. Turn off the inverter for 10 minutes, then restart the inverter. 4. If the fault persists, contact the manufacturer.
	F42	Transfer Temperature Over	
	F45	BUS Start Error	1. Restart the inverter. 2. If the fault persists, contact the manufacturer.
	F49	M3_MDSP Connect Fault	1. Shut down and check whether the communication line is firmly connected. 2. Restart the inverter. 3. If the fault persists, contact the manufacturer.
	F53	Version Different	1.Check the machine firmware version. 2.Restart the inverter. 3.If the fault persists, contact the manufacturer.
About Load	W65	Output Short Warning	1.Output is short circuit. 2.Automatically clear in 2 minutes. 3.If alarm message still exists, contact manufacturer.

Auditing routine	Error Code	Description	Solutions
About Load	W66	Output Overload Warning	1.Output is over load. 2.Automatically clear in 2 minutes. 3.If alarm message still exists, contact manufacturer.
	W76	Smart Load Warning	1.Check whether the output is short circuited. 2.Shut down and restart to check whether the machine can work normally 3.If alarm message still exists, contact manufacturer.
	W77	DC Weight High	1.Check whether the output is short circuited. 2.Shut down and restart to check whether the machine can work normally 3.If alarm message still exists, contact manufacturer.
	F21	Output Short	1.Output short circuit triggered 10 times consecutively. 2.Restarting the inverter will restore operation. 3.If the fault persists, contact the manufacturer.
	F22	Output Over Load	1.Output over load triggered 10 times consecutively. 2.Restarting the inverter will restore operation. 3.If the fault persists, contact the manufacturer.

Auditing routine	Error Code	Description	Solutions
About Load	F23	Output Over Current	1.Restart the inverter. 2.If the fault persists, contact the manufacturer.
About Battery	W14	BMS Update Alarm	1. Check if the machine is in the process of upgrading. 2. If alarm message still exists, contact manufacturer.
	W16	BMS update parameter alarm	1. Please set the 'Lithium Mode' to 01 in the Battery Settings on the LCD, then proceed with the battery upgrade. 2. If alarm message still exists, contact manufacturer.
	W69	Bat Energy Warning	1.Battery SOC/V is lower than the LBCO Alarm value. 2.When battery SOC/V is greater than LBCI, this alarm will be cleared automatically. 3.If alarm message still exists, contact manufacturer.
	W82	Bat Volt Low Warning	1. Check if the battery voltage is too low. 2. If alarm message still exists, contact manufacturer.
	W87	Battery Missing Warning	1. There is no electric voltage at the input end of the machine battery. 2. After confirming that the battery voltage is normal, turn on the machine to check whether it can work normally. 3. If alarm message still exists, contact manufacturer.

Auditing routine	Error Code	Description	Solutions
About Battery	F36	Battery Voltage Over	1.Check whether the actual connected battery voltage is consistent with the display. 2.If the fault persists, contact the manufacturer.
	F37	Bat Charge Current Over	1. Check whether the actual battery current is consistent with the display. 2. Restart the inverter. 3. If the fault persists, contact the manufacturer.
	F38	Bat DisCharge Current Over	
	F51	M3_BMS connect fault	1. Shut down and check whether the communication line is firmly connected. 2. Restart the invert. 3. If the fault persists, contact the manufacturer.
	F57	BMS Fault	1.The battery has a fault upload, check the battery BMS fault issue. 2.Restart the Battery. 3.If the fault persists, contact the manufacturer.
	F58	Battery Mode	
About Parallel	W05	Grid Different	1. After shutting down the inverter, check if the grid power supply cables are correctly connected. 2. If the warn persists, contact the manufacturer.
	W06	Grid Phase Error	1. After disconnecting the grid power supply from the inverter, check whether the grid connection phase sequence matches the parallel operation settings on the Main Screen. 2. Restart the inverter. 3. If the warn persists, contact the manufacturer.

Auditing routine	Error Code	Description	Solutions
About Parallel	W07	Op Phase Loss	1. Check if the parallel operation parameters settings on the inverter's LCD interface are correct. 2. Restart the inverter. 3. If error message still exists, contact manufacturer.
	W08	Parallel Version Different	1.Check whether the model nameplate and version match. 2.If the warn still exists, please contact us for help.
	W09	Parallel capacity different	1.Check if the machine power is consistent. 2.If the warn still exists, please contact us for help.
	F29	Parallel Setting Fault	1. Check if the master-slave settings in the parallel operation settings on the LCD interface of the inverter are correct . 2. Restart the inverter. 3. If error message still exists, contact manufacturer.
	F54	Can Fault	1.After shutting down the inverter, check if the parallel communication cables are securely and correctly connected. 2.Restart the inverter. 3.If error message still exists, contact manufacturer.
	F59	Parallel BMS Connect Error	1. Connect the BMS communication cable to the 'Master Phase A' port of the inverter. 2. Restart the inverter. 3. If error message still exists, contact manufacturer.

Data Sheet 7

Model / Specifications	SPH 9600TL-HU-US	SPH 11500TL-HU-US	SPH 15000TL-HU-US	SPH 18000TL-HU-US
PV Input Data				
Max PV Power	192000 W	23000 W	30000 W	36000 W
DC/AC Ratio	2			
PV Input Voltage(V)	370 V (130 V-550 V)			
MPPT Range(V)	150 V-450 V			
Start-up Voltage(V)	100 V			
PV Input Current(A)	40 A + 40 A + 40 A			
No. of MPPT Trackers	3			
No. of PV strings per MPPT trackers	2/2/2			
Battery Data				
Battery Type	Lead-acid or Li-ion			
Nominal Voltage(V)	48 V			
Battery Voltage Range(V)	40 V-60 V			
Max Charging Current(A)	200 A	240 A	312.5 A	334 A
Max Discharging Current(A)	200 A	240 A	312.5 A	334 A
Output Data(On Grid)				
Rated Voltage(V)	120 Vac/240 Vac (split phase) 120 Vac/208 Vac (three phase) 127 Vac/220Vac (three phase)			
Grid Type	Split phase (L1/L2/N/PE)			
Rated Power(W)	9600 W	11500 W	15000 W	18000 W
Rated Current(A)	40 A	47.9 A	62.5 A	75 A
Power Factor	0.8 leading to 0.8 lagging			
Output Frequency	60 Hz			
Grid Type	Split phase			
THDI	< 3%			

Model / Specifications	SPH 9600TL-HU-US	SPH 11500TL-HU-US	SPH 15000TL-HU-US	SPH 18000TL-HU-US
Input Data (On Grid)				
Max.Grid bypass Current(A)	200 A			
Backup Power (Off Grid)				
Rated Voltage	120 Vac/240 Vac (split phase) 120 Vac/208 Vac (three phase) 127 Vac/220 Vac (three phase)			
Rated Power (W)	9600 W	11500 W	15000 W	18000 W
Peak Power(grid off)	2 times of rated power, 5 s			
Rated Current (A)	40 A	47.9 A	62.5 A	75 A
Output Frequency	60 Hz			
Switch Time	< 10 ms			
Load Start Capability	185 LRA			
	Note: Load Start Capability may vary.			
Efficiency				
Max Efficiency	98.10%			
CEC Efficiency	97.0%			
MPPT Efficiency	99.90%			
Protection				
PV Switch	Yes			
BAT reverse protection	Yes			
Output over current protection	Yes			
AC short-circuit protection	Yes			
PV Input Lightning Protection	Yes			
Anti-islanding Protection	Yes			

Model / Specifications	SPH 9600TL-HU-US	SPH 11500TL-HU-US	SPH 15000TL-HU-US	SPH 18000TL-HU-US
Protection				
PV String Input Reverse Polarity Protection	Yes			
Insulation Resistance Monitoring	Yes			
Residual Current Monitoring Unit	Yes			
AFCI protection	Yes			
Surge Protection	DC Type II/AC Type II			
Certifications and Standards				
Grid Certifications	UL STD.1741,1741SA,1741SB; IEEE STD.1547,1547.1,HECO SRD-IEEE-1547.1,CSA STD C22.2 NO.107.1,CSA C22.3 NO.9			
Safety Certifications	UL 1741 PVRSS,UL 1699B			
EMC	FCC Part 15 Class B			
General Data				
Operating Temperature Range (°F)	-13 °F-140 °F, > 113°F Derating			
Cooling	Smart cooling			
Noise(dB)	< 50dB			
Communication with BMS	RS485, CAN			
Weight (kg)	63			
Size (W×H×D)	548 mm × 940 mm × 309 mm			
Protection Level	IP65			
Installation Style	Wall-mounted			
Warranty	10 years			

8 Parameter setting about Grid

	Range of Adjustment	IEEE 1547-2003	IEEE 1547-2018	CA Rule 21	HECO 14H
		Default Value	Default Value	Default Value	Default Value
Enter service delay (s)	10-610	300	300	15	300
Reconnection Time (s)	10-610	300	300	15	300
Enter Service Voltage low	183-High Value-1	220.1	220.1	211.9	211.2
Enter Service Voltage high	Low Value+1 -277	253.9	252	253.9	252
Enter Service Freq low	55-59.99	59.3	59.5	58.5	59.5
Enter Service Freq high	60.01-66	60.5	60.1	60.5	60.1
Grid Voltage Range low	0-High Value-1	211.2	211.2	211.2	211.2
Grid Voltage Range high	Low Value+1 -300	264	264	264	264
Grid Freq Range low	55-59.99	59.3	58.5	58.5	57
Grid Freq Range high	60.01-66	60.5	61.2	60.5	63
PF	/	1	1	1	1
VW Enable	/	0	0	1	0
Vstart	0-Vstop	254.4	254.4	254.4	254.4
Vstop	Vstart-280	264	264	264	264
RT	1-60	10	10	10	10

	Range of Adjustment	IEEE 1547-2003	IEEE 1547-2018	CA Rule 21	HECO 14H
		Default Value	Default Value	Default Value	Default Value
FW Enable	/	0	1	1	1
Fstart	60-65	60.03	60.03	60.03	60.03
Fstop	62-62	62	62	62	62
Normal Ramp Rate	1-1000	1	300	300	300
RT	1-10	5	5	5	0.5
Q(V) Enable	/	0	0	0	0
V1	0-V2	220.8	220.8	220.8	220.8
V2	V1-V3	235.2	235.2	235.2	235.2
V3	V2-V4	244.8	244.8	244.8	244.8
V4	V3-280	259.2	259.2	259.2	259.2
Q1	-0.6-0.6	44	44	44	60
Q2	-0.6-0.6	0	0	0	0
Q3	-0.6-0.6	0	0	0	0
Q4	-0.6-0.6	-44	-44	-44	-60
RT	1-90	5	5	5	5

	Range of Adjustment	IEEE 1547-2003	IEEE 1547-2018	CA Rule 21	HECO 14H
		Default Value	Default Value	Default Value	Default Value
L/HVRT Enable	/	0	0	0	0
HV1	0-300	264	264	264	264
HV1 Time	0-600	14.46	12.9	14.46	13
HV2	0-300	288	288	288	288
HV2 Time	0-600	0.02	0.1	0.02	0.16
HV3	0-300	288	288	288	288
HV3 Time	0-600	0.06	0.06	0.06	0.06
LV1	0-300	211.2	211.2	211.2	211,2
LV1 Time	0-600	24.24	20.9	24.24	21
LV2	0-300	168	168	168	168
LV2 Time	0-600	12.24	10.9	12.24	11
LV3	0-300	120	120	120	120
Lv3 Time	0-600	12.34	1.9	12.34	2
L/HFRT Enable	/	1	1	1	1
HF1	60-65.99	61.2	61.2	61.2	61.2

	Range of Adjustment	IEEE 1547-2003	IEEE 1547-2018	CA Rule 21	HECO 14H
		Default Value	Default Value	Default Value	Default Value
HF1 Time	0-600	300	300	300	300
HF2	60-65.99	62	62	62	62
HF2 Time	0-600	0.06	0.06	0.06	0.06
LF1	55-59.99	58.8	58.8	58.8	58.8
LF1 Time	0-600	300	300	300	300
LF2	55-59.99	57	57	57	57
LF2 Time	0-600	0.06	0.06	0.06	0.06

	Range of Adjustment	ISO NE2021	PREPA(LUMA)	CSA C22.3 NO.9
		Default Value	Default Value	Default Value
Enter service delay (s)	10-610	300	300	300
Reconnection Time	10-610	300	300	300
Enter Service Voltage low	183-High Value-1	220.1	211.2	220.1
Enter Service Voltage high	Low Value+1-277	252	254.4	252
Enter Service Freq low	55-59.99	59.5	59.5	59.5
Enter Service Freq high	60.01-66	60.1	60.1	60.1
Grid Voltage Range low	0-High Value-1	211.2	211.2	211.2
Grid Voltage Range high	low Value+1-300	264	264	264
Grid Freq Range low	55-59.99	58.5	58.5	58.5
Grid Freq Range high	60.01-66	61.2	61.2	61.2
PF		1	1	1
VW Enable	/	0	0	0
Vstart	0-Vstop	254.4	254.4	254.4
Vstop	low Value-280	264	264	264
RT	1-60	10	10	10

	Range of Adjustment	ISO NE2021	PREPA(LUMA)	CSA C22.3 NO.9
		Default Value	Default Value	Default Value
FW Enable	/	1	1	1
Fstart	60-65	60.03	60.03	60.03
Fstop	62-62	62	62	62
Normal Ramp Rate	1-1000	300	50	300
RT	1-10	5	5	5
Q(V) Enable	/	0	0	0
V1	0-V2	220.8	220.8	220.8
V2	V1-V3	235.2	235.2	235.2
V3	V2-V4	244.8	244.8	244.8
V4	V3-280	259.2	259.2	259.2
Q1	-0.6-0.6	44	44	44
Q2	-0.6-0.6	0	0	0
Q3	-0.6-0.6	0	0	0
Q4	-0.6-0.6	-44	-44	-44
RT	1-90	5	5	5

	Range of Adjustment	ISO NE2021	PREPA(LUMA)	CSA C22.3 NO.9
		Default Value	Default Value	Default Value
L/HVRT Enable	/	0	0	0
HV1	0-300	264	264	264
HV1 Time	0-600	13	13	13
HV2	0-300	288	288	288
HV2 Time	0-600	0.16	0.16	0.16
HV3	0-300	288	288	288
HV3 Time	0-600	0.06	0.06	0.06
LV1	0-300	211.2	211.2	211.2
LV1 Time	0-600	20.9	20.9	20.9
LV2	0-300	168	168	168
LV2 Time	0-600	10.9	10.9	10.9
LV3	0-300	120	120	120
LV3 Time	0-600	1.9	1.9	1.9
L/HFRT Enable	/	1	1	1
HF1	60-65.99	61.2	61.2	61.2

	Range of Adjustment	ISO NE2021	PREPA(LUMA)	CSA C22.3 NO.9
		Default Value	Default Value	Default Value
HF1 Time	0-600	300	300	300
HF2	60-65.99	62	62	62
HF2 Time	0-600	0.06	0.06	0.06
LF1	55-59.99	58.8	58.8	58.8
LF1 Time	0-600	300	300	300
LF2	55-59.99	57	57	57
LF2 Time	0-600	0.06	0.06	0.06

Appendix

- **Approved battery brand from Growatt.**

Brand	Model	RS485 or CAN	Inverter Setup
GROWATT	ALP 5.0L-E2-US	CAN	01
	AXE 5.0L-C1	CAN	05
	HOPE 5.5L-A1	RS485	00
		CAN	01
ENERSYS	OGHB 1548-Li	CAN	02
TOPBAND	TB48100F-T110AD	RS485	03
PYLON	US30000C	CAN	04
	US5000		

Please check the complete battery matching list on the official website, official website link:
https://community.growatt.com/upload/file/Growatt_Approved_LV_Battery_List.pdfraw=Growatt_Approved_LV_Battery_List.pdf

- **CT installation recommendation**

CT model	CT ratio	CT aperture	Property	Recommendation system
250A	4000:1	37mm	Standard configuration	Split-phase system

- **Meter installation recommendation**

Meter type	Property	Recommendation system
AGF-AE-D/200	Additional purchase	Split-phase system
SDM630MCT		
SDM630MCT	Additional purchase	2-6 PCS split-phase parallel systems 2,3,6 PCS three-phase parallel systems

• FCC COMPLIANCE STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

（1）This device may not cause harmful interference.

（2）This device must accept any interference received, including interference that may cause undesired operation

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Warning: Changes or modifications to this unit not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement

The device has been evaluated to meet general RF exposure requirement. The device can be used in mobile(min 20 cm) exposure condition.

• Shiner Configuration Guide

Download the configuration guide: Shiner App User Manual EN (SPH).

Datalogger	
Shiner App User Manual EN (SPH)	

Download Manual

Growatt New Energy

Growatt USA, Inc.
9227 Reseda Blvd, #435 Northridge, CA 91324, USA.

T +1-866-686-0298
E usaservice@growatt.com
W us.growatt.com

GR-UM-582-A-00 (PN:044.SK0021701)