SH15T / SH20T / SH25T

System Application Manual

Summary

More detailed information for SH15-25T, that may not be included in user manual.

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Version 1.2

EN

About This Manual

This document mainly describes the application scenarios and the system configuration of three-phase hybrid inverter. It also describes the components and related materials in the hybrid system. Users can visit support.sungrowpower.com to get the user manual for each component.

Validity

This manual is valid for the following inverter models:

Model	Hereinafter Referred to as
SH15T-V11 / SH20T-V11 / SH25T-V11	SH15-25T-V11

Target Group

This manual is intended for professional technicians who are responsible for installation and they must have the following qualifications:

- Knowledge of electronic, electrical wiring and mechanical expertise, and be familiar with electrical and mechanical schematics.
- Professional skills of installation and commissioning of electrical equipment.
- Knowledge of how to deal with hazards or emergencies that occur during installation and commissioning.
- Be familiar with local standards and relevant safety regulations of electrical systems.

Abbreviation

- ATS: Auto Transfer Switch
- EV: Electric Vehicle
- EMS: Energy Management System
- CT: Current Transformer
- PV: Photovoltaic
- ESS: Energy Storage System
- FCAS: Frequency Control Ancillary Service

Contents

1 Scenario Overview

The three-phase hybrid inverters are applicable to both on-grid and off-grid PV energy storage systems (PV ESS). With the integrated Energy Management System (EMS), they can control and optimize the energy flow so as to greatly increase the self-consumption of the system.

SUNGROW offers a variety of solutions especially for PV systems that are no longer allowed or intended to feed PV power into the grid due to restrictions imposed by the grid operator. These solutions will maximize self-consumption and reduce grid purchase costs to a minimum. The following tables list the application scenarios and system configurations.

Single Hybrid On-grid

Scenario	System Configuration							
	PV Panel	SBR/SBH Battery	Energy Meter	WiNet-S2	External switch	Generator	EV Charger	External EMS
Self-consumption	●	●	●	●				
Emergency backup	●	●	●	●				
On-grid retrofit / AC coupled	○	●	●	●				
Backup retrofit / AC coupled off-grid (1)	○	●	●	●				
VPP	●	●	●	●				●
Whole home backup	●	●	○	●	●(2)			
PV + ESS + EV Charging(3)								
FCAS (3)								
Pure PV-Load (3)								

● Included ○ Optional

(1) Not applicable to Europe.

(2) Three-pole or four-pole manual switch and prepared by customer. Contact SUNGROW service for details.

(3) Not support yet.

Single Hybrid Micro grid

Function developing and will be released in the future.

Multi-hybrid Parallel On-grid (2 pcs)

Scenario	System Configuration							
	PV Panel	SBR/SBH Battery	Energy Meter	WiNet-S2	External switch	Generator	EV Charger	External EMS
Self-consumption	●	●	●	●				
Emergency backup	●	●	●	●				
On-grid retrofit / AC coupled	●	●	●	●				
Backup retrofit / AC coupled off-grid *								
DC side in parallel *								
Pure PV-Load*								
VPP/FCAS*								
Third-party ESS*								

● Included ○ Optional

* Not support yet.

Multi-hybrid Parallel Micro grid

Function developing and will be released in the future.

2 System Configuration

SUNGROW Smart Energy Meter DTSU666-20 is the standard delivery with hybrid inverter, while DTSU666 is optional and needs to be purchased separately. The figures in this document show DTSU666-20 as an example unless specifically specified.

2.1 Single Hybrid On-grid System

2.1.1 Self-Consumption

The following figure shows the system diagram for self-consumption scenario. The current transformer (CT) of SUNGROW Smart Energy Meter detects the current direction and communicates with the inverter via RS485. Then inverter performs battery charging and discharging control for self-consumption.

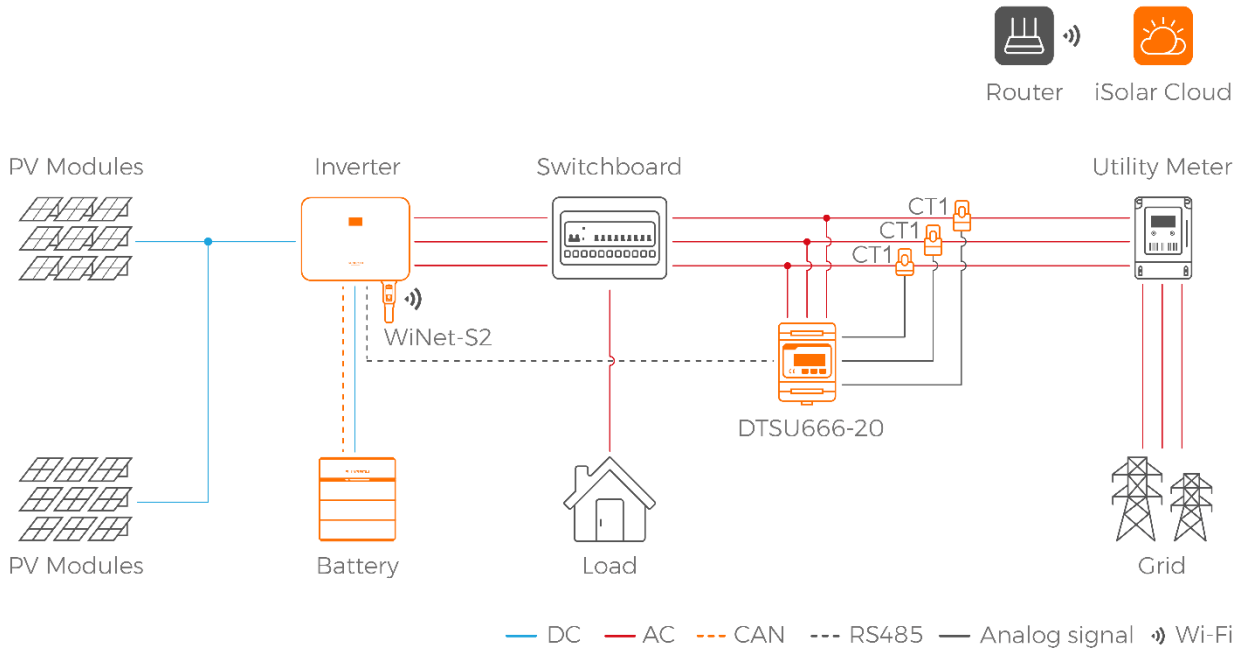


Figure 1 Self-Consumption System

The PV power consumption priority is: load > battery > grid feed-in.

During daytime,

- when the PV power generation is greater than load power consumption, the PV power will firstly go to the loads, then the battery. Moreover, if the battery is fully charged, the excess power will go to the grid.
- when the PV power generation is less than load power consumption, the battery will discharge and provide the energy shortfall. If the power from the PV and battery is not enough for load consumption, the inverter will draw power from the mains.

During night, the battery discharges to provide energy to loads. If the battery is empty or there is not enough energy from the battery, the mains shall supply the power.

Note: When there is charging/discharging time control setting, the PV power consumption priority will be changed.

Features

- Closed-loop adjustment time less than 2s for zero-export control when used with the smart energy meter DTUS666/DTSU666-20 and the communication cable length is less than 10 m
- Power control accuracy: 1.5% of the rated power
- Response time of power control: 0.8s
- Energy flow show for PV, battery and loads via iSolarCloud App or Web
- Multiple energy modes supported, including self-consumption, Compulsory Mode, etc.
- Each-phase zero-export and partial-export control
- 100% power to unbalanced loads in on-grid mode
- Maximum battery capacity 160 kWh (5 kWh/module, max. 8 modules form a battery unit, max. 4 units supported by a hybrid inverter)

Requirements

1) To ensure the correct energy flow and zero-export function, DTSU666 with built-in CT should be installed in the position between the Utility meter and the Switchboard. If DTSU66-20 and external CTs are used, place CT1 between the Utility meter and the Switchboard, as shown in the system diagram **(Figure 1)**.
2) During high-power loads running, the residential overcurrent protector may trip due to battery forced charging with high charging power from the grid. You should set the **Import Power Limit** according to the specification of the overcurrent protector. After import power limit setting, the loads take consumption priority to the battery and the battery charging power from the grid will be not greater than the difference between the Import Power Limit and total load power, i.e. **Battery Charging Power** <= (**Import Power Limit – Total Load Power).**
3) Check the CAN connection between the battery and hybrid inverter carefully for reliable connection.
4) After switching off the DC breaker on the battery, observe that the battery status indicator is off and wait at least 5 minutes before any operation for personal safety.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase** (either-or). If the Feed-in Limitation for Each Phase is enabled, the 100% unbalanced output function will be enabled automatically.	*3.2 Feed-in Limitation*

No.	Parameter Setting	Procedure
3	Set the **Feed-in Limitation** parameters.	
4	Set the **Import Power Limit.**	*3.8 Import Power Limit*

2.1.2 Emergency Backup

In the event of a grid failure, the loads connected to the grid are no longer supplied with energy. A long-period grid outage may cause serious consequences to some key loads, such as emergency light, refrigerator, etc. A possible solution for bridging this supply gap is to connect the emergency loads to the BACK-UP port on the hybrid inverter, as shown in the following figure.

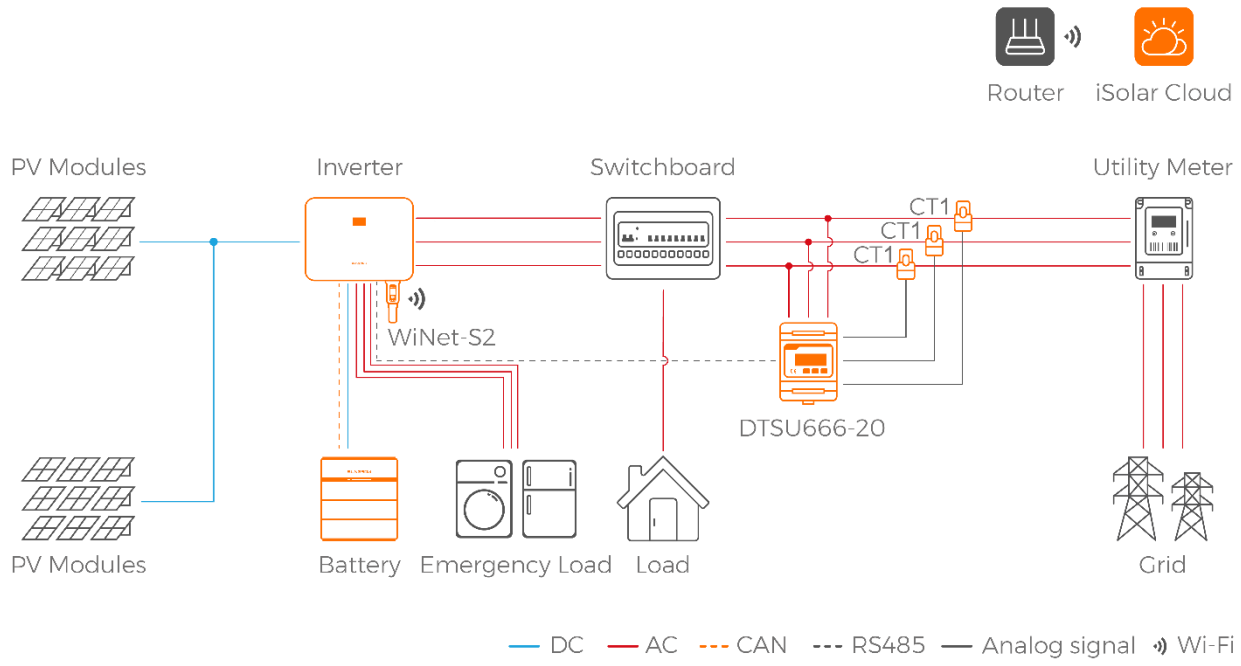


Figure 2 Emergency Backup System

If a grid failure happens, the on-grid relay will disconnect and the PV system is disconnected from the utility grid. A backup grid then is created and the PV system can thus continue to supply power to the emergency loads connected to the BACK-UP port. When the energy demand of the active loads exceeds the current power of the PV system, the battery will discharge and provide the energy shortfall.

Features

- Uninterrupted power supply to emergency loads connected to the BACK-UP port
- Less than 10ms on-/off- grid switchover time
- 100% power to unbalanced loads in both on-grid mode and backup mode, maximum one-third of the rated output power on each phase
- Single-phase half-wave load not greater than 1200 W is supported
- Up to 200% backup overload output, maximum 35 kW for 10s
- Integrated 63 A bypass switch for full home backup

- Maximum battery capacity 160 kWh (5 kWh/module, max. 8 modules form a battery unit, max. 4 units supported by a hybrid inverter)

Requirements

1) Set a reasonable **Reserved Battery SOC for Off-Grid** based on the power of the emergency loads, expected running time and the battery capacity so as to reserve enough battery power. For example, an emergency load with the power of 300 W running for 24 hours will need a total energy of 7.2 kWh. If the battery capacity is 15.0 kWh, to ensure enough energy for the load in the event of a grid failure, then the **Reserved Battery SOC for Off-Grid** will be set at 48% (7.2 kWh / 15.0 kWh), i.e., **Reserved Battery SOC for Off-Grid** = Load power * Running time / Battery capacity).
2) It is recommended to install a bypass maintenance switch with the specification of 63 A to the backup port.
3) During high-power loads running, the residential overcurrent protector may trip due to battery forced charging with high charging power from the grid. You should set the **Import Power Limit** according to the specification of the overcurrent protector. After import power limit setting, the loads take consumption priority to the battery and the battery charging power from the grid will be not greater than the difference between the Import Power Limit and total load power, i.e. **Battery Charging Power** <= (**Import Power Limit – Total Load Power).**
4) The total power of the emergency loads cannot exceed the load capacity of the BACKUP port, as described in *5 Backup Capability with Load*.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**(either-or). If the Feed-in Limitation for Each Phase is enabled, the 100% unbalanced output function will be enabled automatically.	*3.2 Feed-in Limitation*
3	Set the **Feed-in Limitation** parameters.	
4	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
5	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
6	Set the **Import Power Limit.**	*3.8 Import Power Limit*

2.1.3 On-grid Retrofit / AC Coupled

If a three-phase PV inverter is installed in the existing system, the system can be upgraded to a PV ESS with the addition of the hybrid inverter and a compatible battery. The new home ESS will maximize the use of the PV power, increase the self-consumption ratio and cost down the electricity charges.

Any functional three-phase PV system can be retrofitted to a PV ESS. There are two ways to retrofit an existing system, on-grid port retrofit and backup port retrofit.

On-grid port retrofit is the system where the AC terminal of the existing PV inverter and the GRID terminal of the hybrid inverter are connected in parallel, as shown in the following figure.

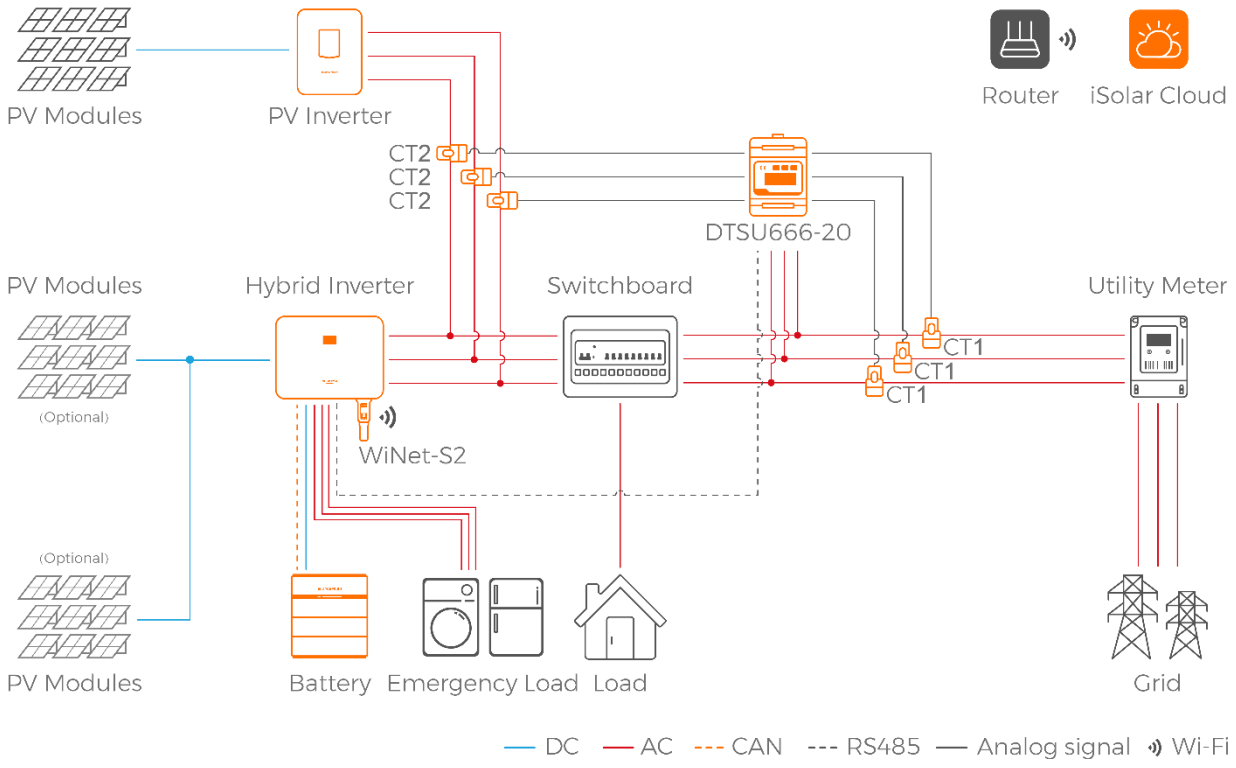


Figure 3 On-grid Port to Retrofit a PV System (AC Coupled)

* The three-phase PV inverter in the existing system can be from SUNGROW or other manufacturers. The figure shows SUNGROW PV inverter as an example.

Features

- Optional PV modules to the hybrid and lower the system cost
- Retrofit any functional three-phase PV system, SUNGROW or a third-party
- Maximize self-consumption

Requirements

1) In a retrofit system, the generated energy is regulated by the hybrid inverter. The SUNGROW dual-channel Smart Energy Meter DTSU666-20 and external CTs must be used for a third-party system retrofit. CT1 should be installed on the grid side and CT2 on the AC side of the existing PV inverter to collect information. Only in this way can we

ensure the correct energy flow and zero-export function.

2) In zero-export scenario, the hybrid inverter can only ensure no power exported to grid itself but does not ensure zero export for the third-party PV inverter. Please contact the PV inverter manufacturer for its zero-export solution. Otherwise, the **Feed-in Limitation Value** should be set to a value at least equal to the rated power of the existing system.
3) When there are no PV inputs to the hybrid inverter, pay attention to the **Reserved Battery SOC for Off-Grid** for the emergency loads. Set the **Battery Forced Charge Time** to a period with valley tariff to make sure the battery can be recharged with solar energy or low-cost electricity for grid. Otherwise, if the battery enters forced charging mode, electricity with peak tariff may be drawn from the grid to charge the battery.
4) The total power of the emergency loads cannot exceed the load capacity of the BACKUP port, as described in *5 Backup Capability with Load*.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**. (either-or)	*3.2 Feed-in Limitation*
3	Set the **Feed-in Limitation** parameters.	
4	Set the **Rated Power of the Existing System**.	
5	Set **Battery Forced Charge Time** via iSolarCloud App or Web.	*3.7 Battery Forced Charge Time*
6*	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
7*	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
8	Set the **Import Power Limit.**	*3.8 Import Power Limit*

* The settings are required if there are emergency loads connected to the BACK-UP port.

2.1.4 BACK-UP Port Retrofit

BACK-UP port retrofit is the system where the AC terminal of the existing PV inverter and the BACK-UP terminal of the hybrid inverter are connected in parallel, as shown in the following figure.

The existing PV inverter in a backup retrofit system should be capable of regulating the generated power according to frequency shift.

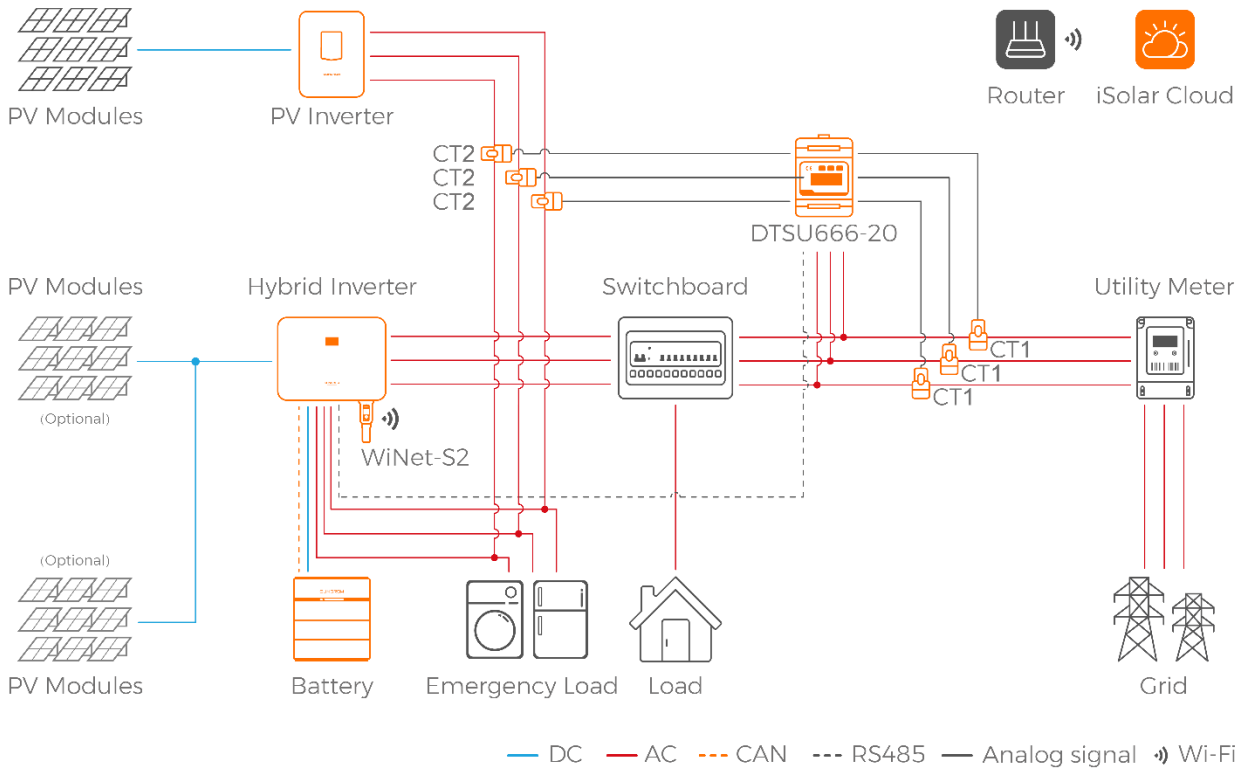


Figure 4 Backup Port to Retrofit an On-grid PV System

* The three-phase PV inverter in the existing system can be from SUNGROW or other manufacturers. The figure shows SUNGROW PV inverter as an example.

Note: The backup port retrofit is not applicable to Europe.

Features

1) The existing PV inverter will work normally even when there is a grid failure. So, this system will maximize the use of PV energy.
2) When the grid fails, if the battery is fully charged and the power available from the PV system exceeds the power requirement of the connected loads, to prevent excess energy from overcharging the battery, the hybrid inverter automatically detects the problem and changes the frequency at the AC output. This frequency adjustment is analyzed by the PV inverter. As soon as the power frequency of the battery-backup grid increases beyond the specified frequency, the PV inverter limits its output power accordingly. The following figure shows the requirements described in the standard.

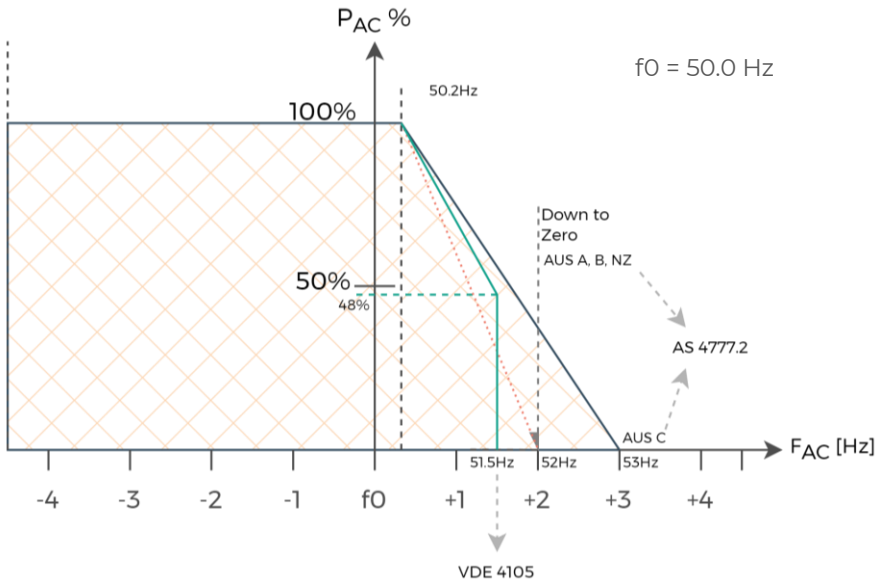


Figure 5 Reference in VDE-AR-N 4105:2018-11 for Germany and AS/NZS 4777.2 for Australia

Requirements

1) Here, it is important that the maximum AC power of the existing PV inverter should be less than or at most equal to the smaller value between the hybrid inverter rated power and battery maximum charging power.
2) The existing PV inverter should be capable of regulating the generated power according to frequency shift.
3) SUNGROW dual-channel Smart Energy Meter DTSU666-20 and external CTs must be used for a third-party system retrofit.
4) When there are no PV inputs to the hybrid inverter, pay attention to the **Reserved Battery SOC for Off-Grid** for the emergency loads. Set the **Battery Forced Charge Time** to a period with valley tariff to make sure the battery can be recharged with solar energy or low-cost electricity for grid. Otherwise, if the battery enters forced charging mode, electricity with peak tariff may be drawn from the grid to charge the battery.
5) The total power of the emergency loads cannot exceed the load capacity of the BACKUP port, as described in *5 Backup Capability with Load*.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**. (either-or)	*3.2 Feed-in Limitation*
3	Set the **Feed-in Limitation** parameters.	
4	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
5	Set the **Reserved Battery SOC for Off-Grid**.	

No.	Parameter Setting	Procedure
6	Set **Battery Forced Charge Time** via iSolarCloud App or Web.	*3.7 Battery Forced Charge Time*
7	Enable the "**Frequency Shift Power Control**" function via **Local Access** mode in iSloarCloud App. This function is disabled by default.	*3.4 Frequency Shift Power Control*
8	Set the **Import Power Limit.**	*3.8 Import Power Limit*

2.1.5 VPP

In some countries, the VPP (Virtual Power Plant) company need to manage available energy to meet the varying supply-demand requirements and maintain the stability of the grid. So they need to communicate with the hybrid inverter for external dispatching, for example, frequency control or charging/discharging control.

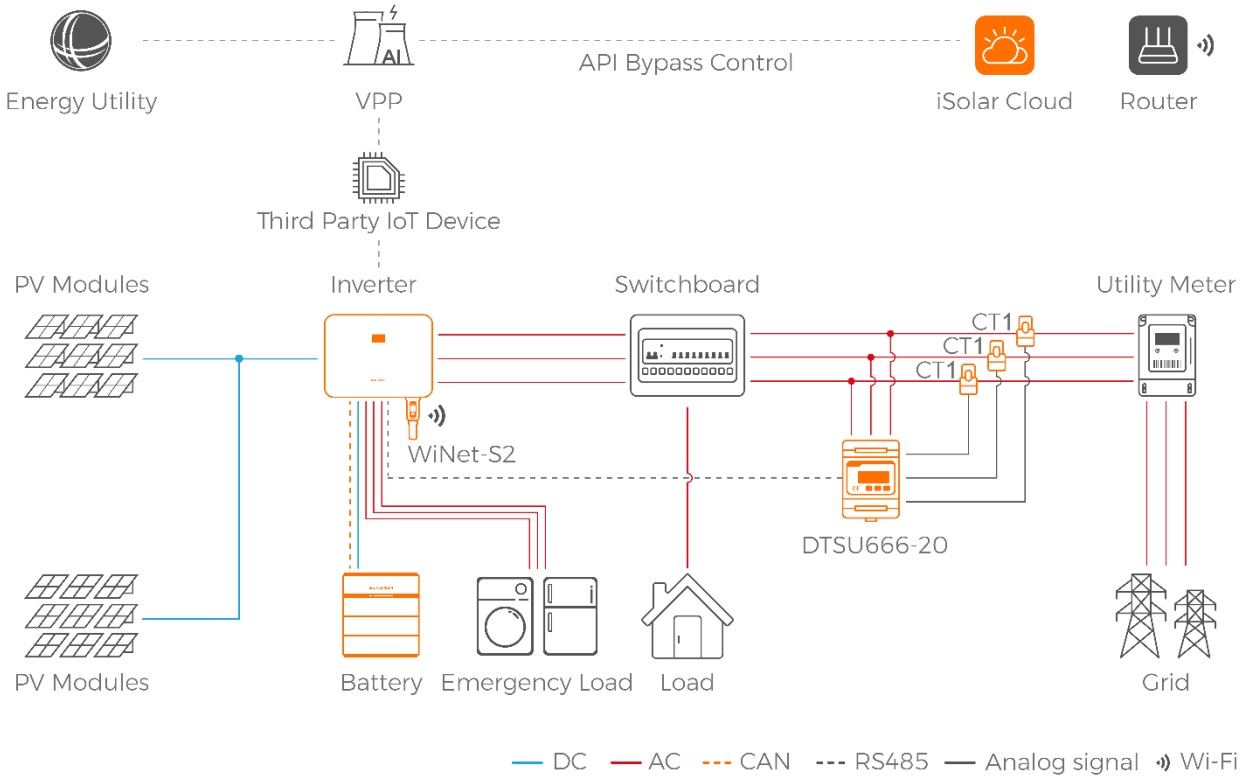


Figure 6 VPP Scenario

* Both a new system and a retrofit system support VPP function. The figure shows the new system as an example.

Features

- Maximum charging power 30 kW
- Maximum discharging power 25 kW (SH25T)
- 100% power to unbalanced loads in both on-grid mode and backup mode, maximum one-third of the rated output power on each phase
- API interface compatible with local monitor

Requirements

1) Contact SUNGROW for API permission and account first. Complete API interface debugging with the VPP company and the power retailer. Make sure that the performance and function should meet the requirements. Then the bypass control instructions can be delivered by iSolarCloud API service.
2) If a third-party IoT device is adopted, the Modbus protocol debugging should be completed first.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **VPP** via iSolarCloud App or Web.	*3.6 VPP Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**. (either-or)	*3.2 Feed-in Limitation*
3	Set the **Feed-in Limitation** parameters.	
4	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
5	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
6	Set the **Import Power Limit.**	*3.8 Import Power Limit*

Note:

The VPP scheduling takes priority to the settings on the inverter. When the VPP scheduling times out (the time is preset by the firmware) or the VPP scheduling ends, the inverter automatically switches to the Self-Consumption mode.

2.1.6 Whole Home Backup

In this scenario, all the household loads are connected to the Backup port of the hybrid inverter via the switchboard. The power energy to the load does not come directly from the grid. If a grid failure happens, the household loads are still supplied with energy from PV or battery. This solution is especially useful for areas where the electricity is scarce.

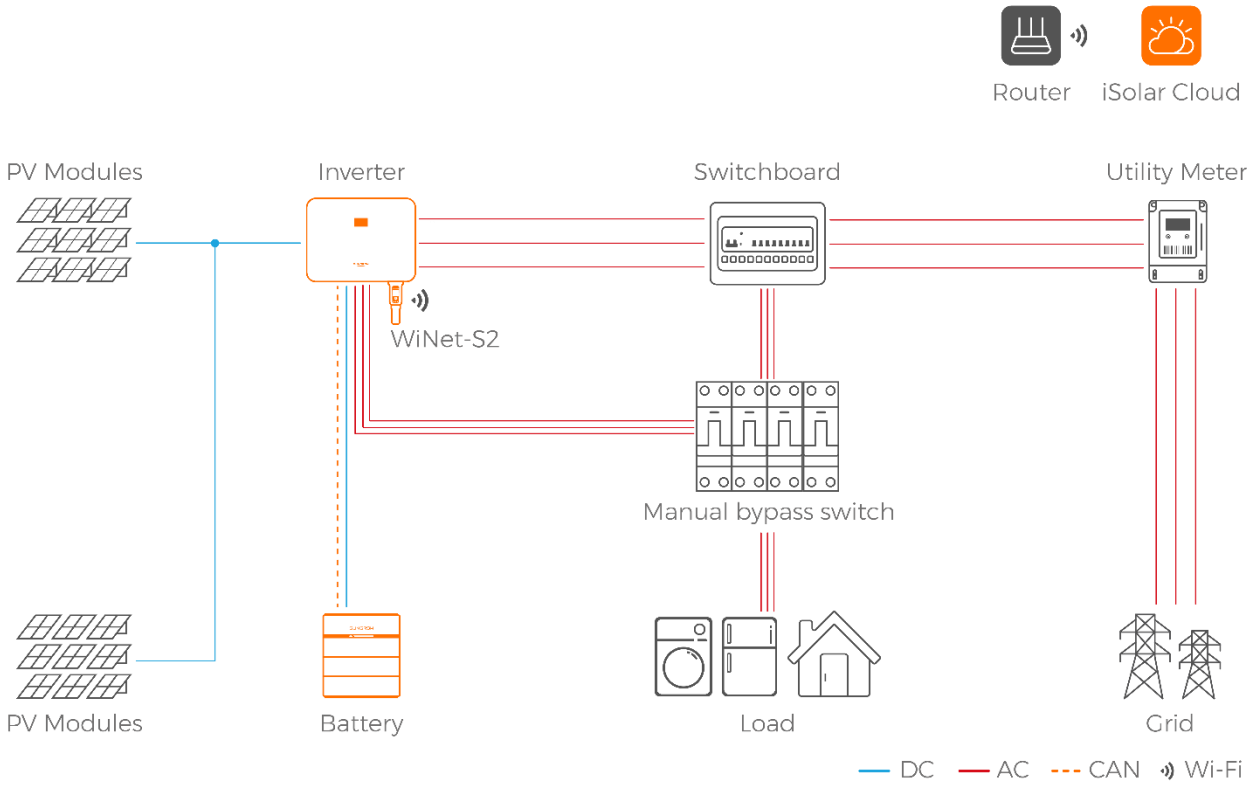


Figure 7 Whole Home Backup Scenario

Features

- Great independence from the grid and significantly reduce the electricity cost
- No change to the existing distribution box
- No need to install smart meter
- Maximize the use of PV power and battery power during outages
- Less than 10ms on-/off- grid switchover time
- 100% unbalanced output in both on-grid mode and backup mode, maximum one-third of the rated output power on each phase
- Single-phase half-wave load <=1250 W is supported
- Up to 200% backup overload output, maximum 35 kVA for 10s
- Integrated 63 A bypass switch for full home backup

Requirements

1) The total power of all household loads should not be higher than 43 kVA for on-grid operation.
2) For off-grid operation, the total power of all household loads should not be higher than the rated backup output of inverter and not exceed the load capacity of the BACKUP port, as described in *5 Backup Capability with Load*.
3) If an overload occurs, the inverter will stop for protection and automatically restart. The system may fail to black start when an overload occurs or may shut down when loads are suddenly connected. If so, notice that the startup load or the sudden switching load power should be less than 50% of the nominal power of the system, and the rest of load

can be connected after the system operate normally 1 minute later.

4) It is recommended to install a three-pole or four-pole manual bypass switch (specification: 63 A, prepared by customer). When the backup system fails to provide power, you can manually switch to the grid to provide energy for the household loads.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**. (either-or)	*3.2 Feed-in Limitation*
3	Set the **Feed-in Limitation** parameters.	
4	If no Smart Energy Meter is installed, you should enable **Whole Home Backup**.	
5	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
6	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
7	Set the **Import Power Limit.**	*3.8 Import Power Limit*

Black Start

When the **Reserved Battery SOC for Off-Grid** is higher than 50% (recommended value), in the event of grid failure and no PV available, you can touch the black start button on battery side three times to perform black start and the system will be forcibly started. The system will supply power to the loads for a short time.

2.2 Multi-hybrid Parallel On-grid System (2 PCS)

2.2.1 Self-Consumption

Maximum two hybrid inverters with the same model can be connected in parallel in the PV ESS via RS485 communication.

As shown in the following figure, with two hybrid inverters connected in parallel, the system will provide more power for more loads. To increase self-consumption, more loads can be added to this system.

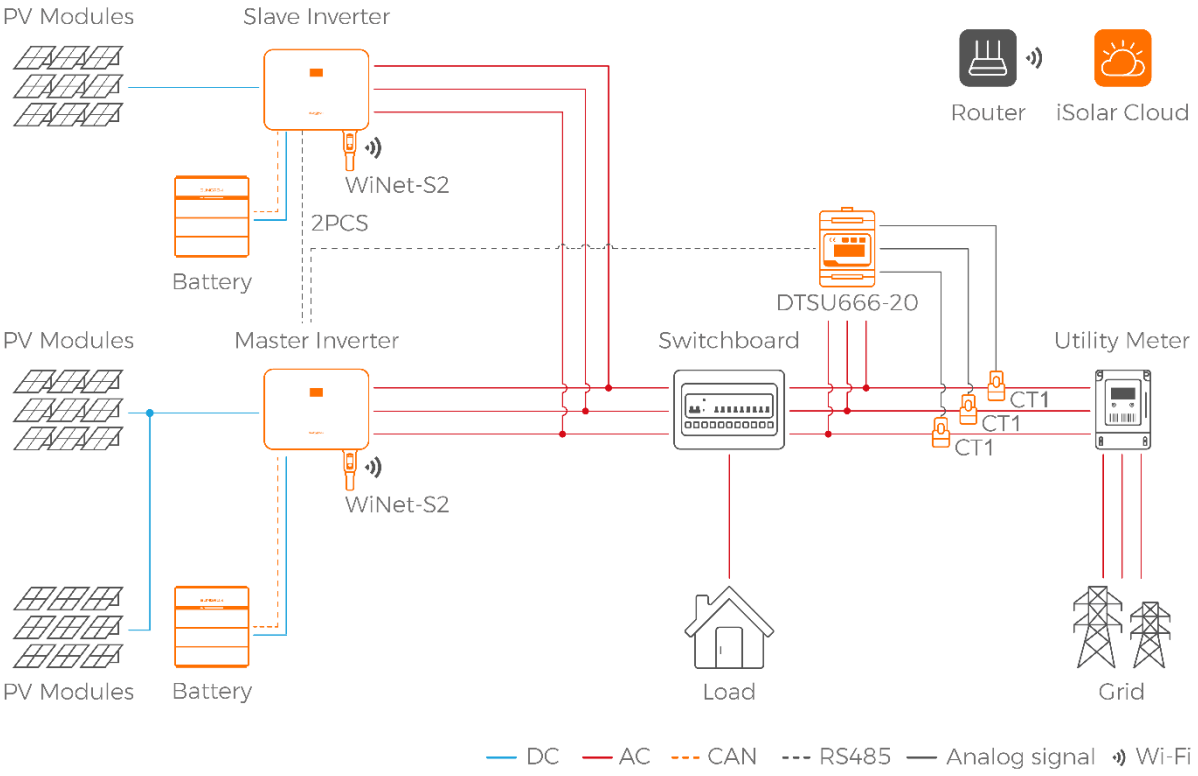


Figure 8 Self-consumption Parallel System without Backup Function

Features

- In an on-grid parallel system, the master inverter collects information from Smart Energy Meter and slave inverter and performs the energy management including Feed-in power control, battery charging/discharging, maximum power limitation, etc.
- Maximum system power 50 kW
- Maximum battery capacity 320 kWh (5 kWh/module, max. 8 modules form a battery unit, max. 4 units supported by a hybrid inverter, max. 2 hybrid inverters in a parallel system)

Requirements

1) The hybrid inverters in parallel must be of the same model.
2) The Smart Energy Meter must be connected to the Master.
3) The total inverter number setting on the Master must be consistent with the actual, otherwise, the system will fail to start.
4) The Feed-in Limitation function must be enabled for each inverter.
5) Only when the feed-in power is greater than 500 W, the energy circulation among inverters can be realized and the SOC balance of the battery can be achieved.
6) For Ripple Control in Germany, the Ripple Control device only needs to be connected to the Master, which will perform unified scheduling.
7) During high-power loads running, the residential overcurrent protector may trip due to battery forced charging with high charging power from the grid. You should set the Import Power Limit according to the specification of the overcurrent protector. After import power limit setting, the loads take consumption priority to the battery and the battery charging power from the grid will be not greater than the difference between the Import Power Limit and total load power, i.e. Battery Charging Power <= (Import Power Limit – Total Load Power).

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable the **Master/Slave** mode.	*3.5 Master-Slave Setting*
3	Set the **Master** and the parameters including **Feed-in Limitation**, **Total Number of Master and Slaves** and **Lower Limit of SOC Permitting Charging Other Inverters**.	
4	Set the **Slave 1** and enable the **Feed-in Limitation** function.	
5	Set **Import Power Limit**.	*3.8 Import Power Limit*

2.2.2 Emergency Backup

For two hybrid inverters in parallel for emergency backup, only the GRID terminals can be connected in parallel, the BACK-UP terminals and the battery terminals cannot be connected together. As shown in the following figure, each hybrid inverter will independently provide power to loads attached at the BACK-UP port in the event of a grid outage.

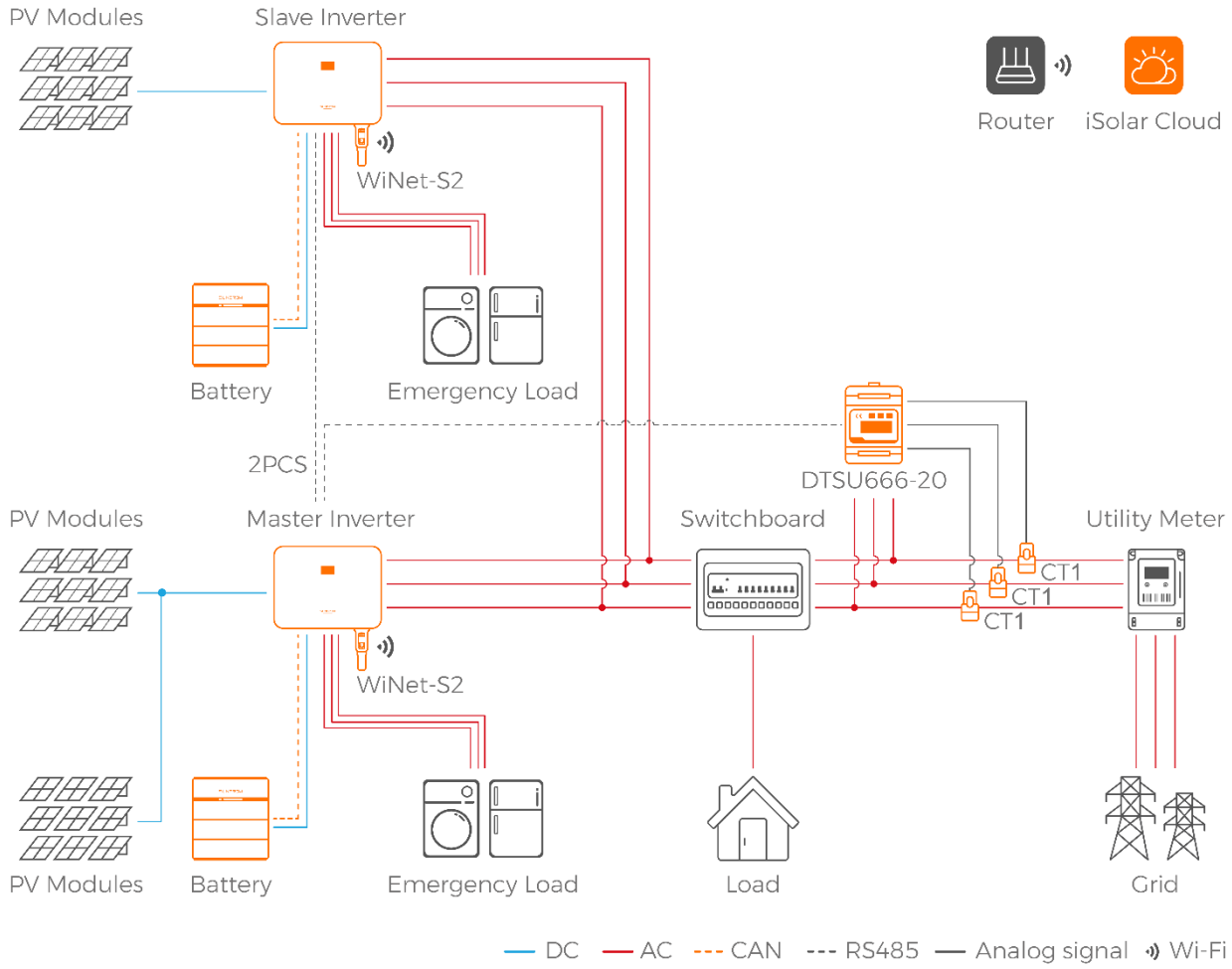


Figure 9 Backup Port Separately to Loads

Features

1) Uninterrupted power supply to emergency loads connected to the BACK-UP port
2) Less than 10ms on-/off- grid switching time
3) Maximum system power 50 kW
4) Maximum battery capacity 320 kWh (5 kWh/module, max. 8 modules form a battery unit, max. 4 units supported by a hybrid inverter, max. 2 hybrid inverters in a parallel system)

Requirements

1) Each hybrid must have its own BACK-UP loads. The Backup loads of each inverter should not exceed the load capacity of the BACKUP port, as described in *5 Backup Capability with Load*.
2) The Feed-in Limitation function must be enabled for each inverter.
3) Only when the feed-in power is greater than 500 W, the energy circulation among inverters can be realized and the SOC balance of the battery can be achieved.
4) During high-power loads running, the residential overcurrent protector may trip due to battery forced charging with high charging power from the grid. You should set the Import Power Limit according to the specification of the overcurrent protector.

5) The Smart Energy Meter must be connected to the Master.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable the **Master-Slave operation mode**.	*3.5 Master-Slave Setting*
3	Set the **Master** and the parameters including **Feed-in Limitation**, **Total Number of Master and Slaves**, **Load Connection Type** and **Lower Limit of SOC Permitting Charging Other Inverters**.	
4	Set the **Slave 1** and enable the **Feed-in Limitation** function.	
5	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
6	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
7	Set **Import Power Limit**.	*3.8 Import Power Limit*

2.2.3 On-grid Retrofit / AC Coupled

Connect the AC terminal of the existing PV inverter and all the GRID terminals of the hybrid inverters in parallel, as shown in the following figure.

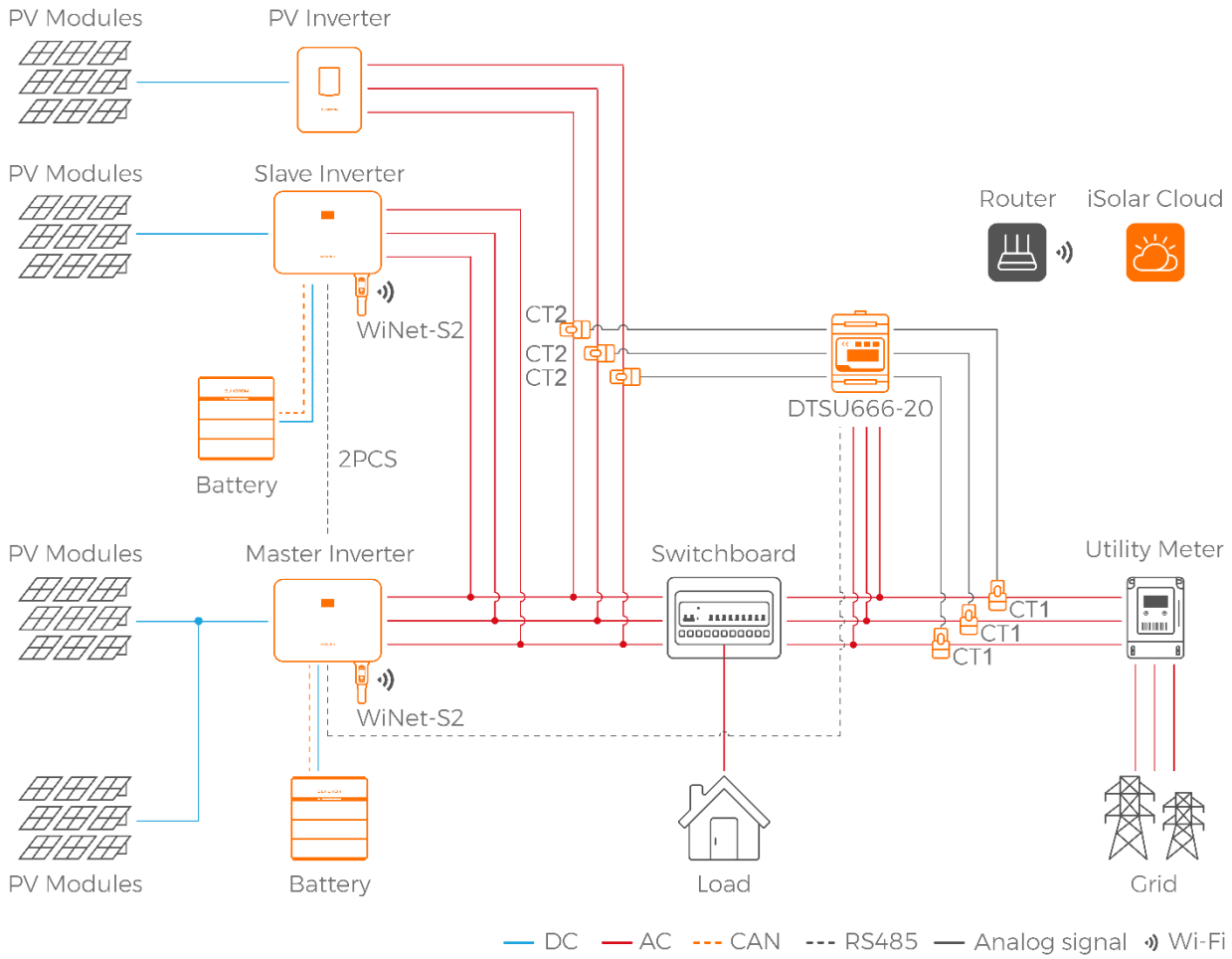


Figure 10 Multi-hybrid Parallel Retrofit System

* The three-phase PV inverter in the existing system can be from SUNGROW or other manufacturers. The figure shows SUNGROW PV inverter as an example.

Features

- Maximum power of the newly added system 50 kW
- Maximum battery capacity 320 kWh (5 kWh/module, max. 8 modules form a battery unit, max. 4 units supported by a hybrid inverter, max. 2 hybrid inverters in a parallel system)

Requirements

1) In a retrofit system, the generated energy is regulated by the hybrid inverter. The SUNGROW dual-channel Smart Energy Meter DTSU666-20 and external CTs must be used for a third-party system retrofit. CT1 should be installed on the grid side and CT2 on the AC side of the existing PV inverter to collect information.

2) The Feed-in Limitation function must be enabled for each inverter. In zero-export scenario, the hybrid inverter can only ensure no power exported to grid itself but does not ensure zero export for the third-party PV inverter. Please contact the PV inverter manufacturer for its zero-export solution.

3) The PV power generated from the existing PV inverter will be consumed in this order: load, grid feed-in, battery.

4) During high-power loads running, the residential overcurrent protector may trip due

to battery forced charging with high charging power from the grid. You should set the Import Power Limit according to the specification of the overcurrent protector.

Settings

No.	Parameter Setting	Procedure
1	Set the energy mode to **Self-consumption** via iSolarCloud App or Web.	*3.1 Self-consumption Mode*
2	Enable the **Master/Slave** mode.	*3.5 Master-Slave Setting*
3	Set the **Master** and the parameters including **Feed-in Limitation**, **Total Number of Master and Slaves**, **Load Connection Type** and **Lower Limit of SOC Permitting Charging Other Inverters**.	
4	Set the **Slave 1** and enable the **Feed-in Limitation** function.	
5	Set the rated power of the existing system.	
6*	Enable the **Backup Mode** via iSolarCloud App or Web. This function mode is disabled by default.	*3.3 Backup Mode*
7*	Set the **Reserved Battery SOC for Off-Grid** via iSolarCloud App or Web.	
8	Set **Import Power Limit.**	*3.8 Import Power Limit*

* The settings are required if there are emergency loads connected to the BACK-UP port.

3 Parameter Setting

For the parameter setting described in this document, please log in iSolarCloud App via **Local Access** mode and with admin permission.

3.1 Self-consumption Mode

Tap **"More"** -> **"Settings"** -> **"Energy Management Parameters"** -> **"General Parameters"** -> **"Energy Management Mode"** -> **"Self-consumption"**.

3.2 Feed-in Limitation

1) Tap **"More"** -> **"Settings"** -> **"Power Regulation Parameters"** -> **"Feed-in Limitation".**
2) Enable **Feed-in Limitation** or **Feed-in Limitation for Each Phase**. They are either-or options.
3) Set the **Feed-in Limitation Value** and **Feed-in Limitation Ratio.**
4) For on-grid port retrofit systems, set the parameter **"Rated Power of Original Power Generation Systems"**.
5) For parallel system, enable **Master-Slave operation mode** and set the feed-in parameters on the master inverter.
6) For whole home backup scenario, enable **Whole Home Backup.**

3.3 Backup Mode

1) Tap **"More"** -> **"Settings"** -> **"Operation Parameters"** -> **"Off-grid Parameters"** -> **"Backup Mode"**.
2) Set **Reserved Battery SOC for Off-grid**.

   After the backup mode is enabled, the battery can always reserve at least the setting SOC when the grid is available, to make sure a certain battery capacity is guaranteed when grid fails. Once the SOC reaches this setting value and the grid is available, the battery will stop discharging even though the system may still be in the set discharge time period.

3.4 Frequency Shift Power Control

Tap **"More"** -> **"Settings"** -> **"Operation Parameters"** -> **"Other Parameters"** -> **"Frequency Shift Power Control".**

3.5 Master-Slave Setting

1) Tap **"More"** -> **"Settings"** -> **"Power Regulation Parameters"** -> **"Feed-in Limitation" –> "Master-Slave Operation Mode"** and enable the mode.
2) Set parameters for the master inverter.

Parameter	Setting
Master-Slave Setting	Master
Total Number of Master and Slaves	2
Load Connection Type	One Backup Port One Load
Lower Limit of SOC Permitting Charging Other Inverters	100%
Installed PV Power	Depending on actual system
• Feed-in Limitation • Feed-in Limitation for Each Phase	Enable one according to the actual demand
Feed-in Limitation Value	Depending on actual requirement
Feed-in Limitation Ratio	Depending on actual requirement
Rated Power of Original Power Generation Systems*	Depending on actual system

* Only for a retrofit system.

3) Set parameters for the slave inverter.

Parameter	Setting
Master-Slave Setting	Slave 1
Feed-in Limitation	Enable

3.6 VPP Mode

Tap **"More"** -> **"Settings"** -> **"Energy Management Parameters"** -> **"General Parameters"** -> **"Energy Management Mode"** -> **"VPP"**.

3.7 Battery Forced Charge Time

Tap **"More"** -> **"Settings"** -> **"Energy Management Parameters"** -> **"Battery Forced Charge Time"**.

3.8 Import Power Limit

Tap **"More"** -> **"Settings"** -> **"Operation Parameters"** -> **"Other Parameters"** -> **"Import Power Limit"**.

4 System Components

4.1 Key Components

The Smart Energy Meter and the wireless communication module are included in the inverter package. The following table shows the models of key components delivered with different inverter versions.

Hybrid Inverter	Smart Energy Meter	Communication Module
SH15-25T-V11	DTSU666-20 and three external CTs	WiNet-S2

4.2 Hybrid Inverter

Figure 11 Inverter Front View

Name	Status		Description
Breathing light		ON	The inverter is running in the on/off-grid mode.
		Blinks	The inverter is at standby or startup state (without on/off-grid operation).
		ON	A system fault has occurred.
		OFF	Both the AC and DC sides are powered down.

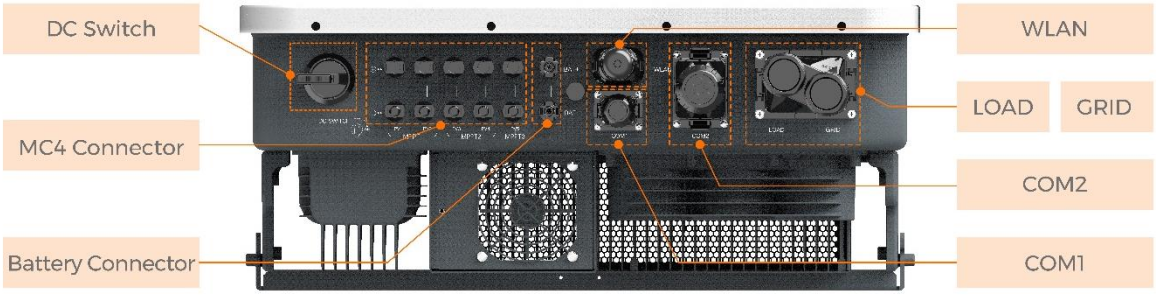


Figure 12 Inverter Terminals

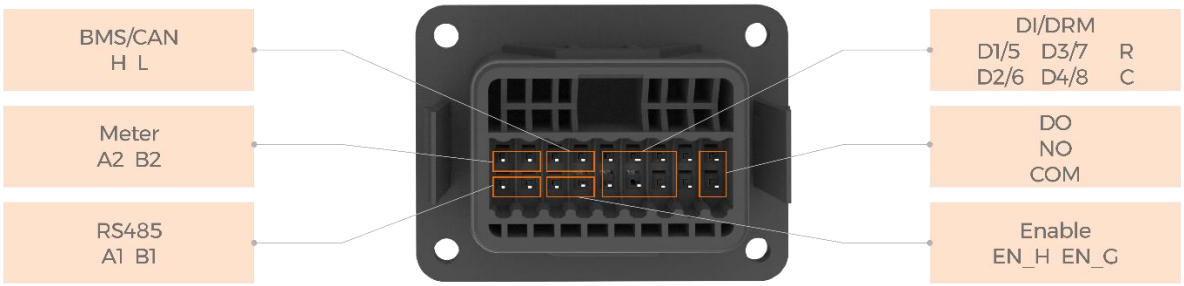


Figure 13 COM2 Terminal

4.3 Compatible Battery

Brand	Model	Firmware Version
SUNGROW	SBR096 / SBR 128 / SBR160 / SBR192 / SBR224 / SBR256	SBRBCU-S_22011.01.19 and later
SUNGROW	SBH100 / SBH150 / SBH200 / SBH250 / SBH300 / SBH350 / SBH400 (SBH100 is not recommended for SH15/20/25T)	SBRBCU-S_22011.04.01 and later
BYD*	Battery-Box Premium HVS 5.1/7.7/10.2/12.8	Battery management system: 3.16 and later Battery management unit: 3.7 and later
	Battery-Box Premium HVM 11.0/13.8/16.6/19.3/22.1	
	Battery-Box HV 5.1/6.4/7.7/9.0/10.2/11.5	V3.013 and later

* This battery is not intended for Europe.

4.4 Communication Module

Illustration	Model	Description
	WiNet-S2	• **Delivered with the hybrid inverter** • WLAN, Ethernet communication supported • Use Ethernet environment where the Wi-Fi signal is poor

4.5 Smart Energy Meter

The SUNGROW Smart Energy Meter is a key component for intelligent energy management. It detects the electrical values at the grid-connected point and communicates with the hybrid inverter. It cannot be used for billing purpose.

4.5.1 DTSU666

With three built-in current transformers, the DTSU666 should be installed in the position between the switchboard and the Utility meter.

Illustration	Parameter	Specification
	Nominal voltage	230/400 Vac
	Input voltage range	57.7/100 Vac...265/460 Vac
	Input current	3 x 5 (80) A
	Grid frequency	50 Hz/60 Hz
	Operating temperature	-30℃...+60℃
	Relative humidity	< 75%
	Dimensions (W x H x D)	72 x 65 x 100 (mm)

4.5.2 DTSU666-20 and CTs

DTSU666-20 is a dual-channel 3-phase energy meter, adopting the standard DIN 35mm din rail mounting and modular design. It is characterized with small volume, easy installation and easy networking. The update speed of active power is better than 100ms.

In a retrofit system, the DTSU666-20 must be used, with CT1 installed on the grid side and with CT2 on the AC side of the PV inverter.

Illustration	Parameter	Specification
	Nominal voltage	230/400 Vac
	Input voltage range	57.7/100 Vac...240/415 Vac
	Input current	*/0.333V, */0.333V
	Grid frequency	50 Hz/60 Hz
	Operating temperature	-25℃...+70℃
	Relative humidity	< 75% (non-condensing)
	Dimensions (W x H x D)	72 x 118 x 65.5 (mm)

The external current transformers (CT) used with DTSU666-20 are shown as below.

Illustration	Model	Description
	100A CT	100 A/333 mV
	250A CT	250 A/333 mV

5 Backup Capability with Load

The total power of the emergency loads connected to the BACKUP port cannot exceed the load capacity of the port, otherwise, the inverter will report an overload error. If an overload occurs, adjust the load power to make sure it is within the backup capability and the inverter will automatically restart.

Note: The data provided in the following tables are the load capacity under typical working conditions and are for reference only.

5.1 Configured with SBH Battery

5.1.1 Max. Power for 3-phase Resistive Load

Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBH100	140 V	6400 W	6400 W	6400 W
	160 V	7300 W	7300 W	7300 W
SBH150	200 V	9200 W	9200 W	9200 W
	220 V	10100 W	10100 W	10100 W
	240 V	11000 W	11000 W	11000 W
SBH200	260 V	11900 W	11900 W	11900 W
	280 V	12800 W	12800 W	12800 W
	300 V	13800 W	13800 W	13800 W
	320 V	14700 W	14700 W	14700 W
SBH250	320 V	14700 W	14700 W	14700 W
	340 V	15000 W	15600 W	15600 W
	360 V	15000 W	16500 W	16500 W
	380 V	15000 W	17400 W	17400 W
	400 V	15000 W	18400 W	18400 W
SBH300	380 V	15000 W	17400 W	17400 W
	400 V	15000 W	18400 W	18400 W
	420 V	15000 W	19300 W	19300 W
	440 V	15000 W	20000 W	20200 W
	460 V	15000 W	20000 W	21100 W
	480 V	15000 W	20000 W	22000 W
SBH350	460 V	15000 W	20000 W	21100 W
	480 V	15000 W	20000 W	22000 W
	500 V	15000 W	20000 W	23000 W
	520 V	15000 W	20000 W	23900 W
	540 V	15000 W	20000 W	24800 W
	560 V	15000 W	20000 W	25000 W
SBH400	520 V	15000 W	20000 W	23900 W
	540 V	15000 W	20000 W	24800 W

Battery Model	Voltage Range	SH15T	SH20T	SH25T
	560 V	15000 W	20000 W	25000 W
	580 V	15000 W	20000 W	25000 W
	600 V	15000 W	20000 W	25000 W
	620 V	15000 W	20000 W	25000 W
	640 V	15000 W	20000 W	25000 W

5.1.2 Max. Power for 3-phase Inductive Load

Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBH100	140 V	1000 W	1000 W	1000 W
	160 V	1000 W	1000 W	1000 W
SBH150	200 V	2000 W	2000 W	2000 W
	220 V	2000 W	2000 W	2000 W
	240 V	2000 W	2000 W	2000 W
SBH200	260 V	3000 W	3000 W	3000 W
	280 V	3000 W	3000 W	3000 W
	300 V	4000 W	4000 W	4000 W
	320 V	4000 W	4000 W	4000 W
SBH250	320 V	4000 W	4000 W	4000 W
	340 V	4000 W	4000 W	4000 W
	360 V	4000 W	4000 W	4000 W
	380 V	5000 W	5000 W	5000 W
	400 V	5000 W	5000 W	5000 W
SBH300	380 V	5000 W	5000 W	5000 W
	400 V	5000 W	5000 W	5000 W
	420 V	5000 W	5000 W	5000 W
	440 V	5000 W	5000 W	5000 W
	460 V	5000 W	5000 W	5000 W
	480 V	5000 W	5000 W	5000 W
SBH350	460 V	6000 W	6000 W	6000 W
	480 V	6000 W	6000 W	6000 W
	500 V	6000 W	6000 W	6000 W
	520 V	6000 W	6000 W	6000 W
	540 V	6000 W	6000 W	6000 W
	560 V	7000 W	7000 W	7000 W
SBH400	520 V	6000 W	6000 W	6000 W
	540 V	6000 W	6000 W	6000 W
	560 V	7000 W	7000 W	7000 W
	580 V	7000 W	7000 W	7000 W
	600 V	8000 W	8000 W	8000 W
	620 V	8000 W	8000 W	8000 W

	640 V	8000 W	8000 W	8000 W

5.1.3 Max. Power for 1-phase Inductive Load

Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBH100	140 V	1000 W	1000 W	1000 W
	160 V	1000 W	1000 W	1000 W
SBH150	200 V	2000 W	2000 W	2000 W
	220 V	2000 W	2000 W	2000 W
	240 V	2000 W	2000 W	2000 W
SBH200	260 V	3000 W	3000 W	3000 W
	280 V	3000 W	3000 W	3000 W
	300 V	3500 W	3500 W	3500 W
	320 V	3500 W	3500 W	3500 W
SBH250	320 V	3500 W	3500 W	3500 W
	340 V	3500 W	3500 W	3500 W
	360 V	3500 W	3500 W	3500 W
	380 V	4000 W	4000 W	4000 W
	400 V	4000 W	4000 W	4000 W
SBH300	380 V	4000 W	4000 W	4000 W
	400 V	4000 W	4000 W	4000 W
	420 V	4000 W	4000 W	4000 W
	440 V	4000 W	4000 W	4000 W
	460 V	4000 W	4000 W	4000 W
	480 V	4000 W	4000 W	4000 W
SBH350	460 V	4000 W	4000 W	4000 W
	480 V	4000 W	4000 W	4000 W
	500 V	4000 W	4000 W	4000 W
	520 V	4000 W	4000 W	4000 W
	540 V	4000 W	4000 W	4000 W
	560 V	4000 W	4000 W	4000 W
SBH400	520 V	4000 W	4000 W	4000 W
	540 V	4000 W	4000 W	4000 W
	560 V	4000 W	4000 W	4000 W
	580 V	4000 W	4000 W	4000 W
	600 V	4000 W	4000 W	4000 W
	620 V	4000 W	4000 W	4000 W
	640 V	4000 W	4000 W	4000 W

5.2 Configured with SBR Battery

5.2.1 Max. Power for 3-phase Resistive Load

Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBR096	170 V	4600 W	4600 W	4600 W
	190 V	5200 W	5200 W	5200 W
	210 V	5700 W	5700 W	5700 W
SBR128	220 V	6000 W	6000 W	6000 W
	240 V	6600 W	6600 W	6600 W
	260 V	7100 W	7100 W	7100 W
	280 V	7700 W	7700 W	7700 W
SBR160	270 V	7400 W	7400 W	7400 W
	290 V	8000 W	8000 W	8000 W
	310 V	8500 W	8500 W	8500 W
	330 V	9100 W	9100 W	9100 W
	350 V	9600 W	9600 W	9600 W
SBR192	330 V	9100 W	9100 W	9100 W
	350 V	9600 W	9600 W	9600 W
	370 V	10200 W	10200 W	10200 W
	390 V	10700 W	10700 W	10700 W
	410 V	11300 W	11300 W	11300 W
	430 V	11800 W	11800 W	11800 W
SBR224	380 V	10400 W	10400 W	10400 W
	400 V	11000 W	11000 W	11000 W
	420 V	11500 W	11500 W	11500 W
	440 V	12100 W	12100 W	12100 W
	460 V	12600 W	12600 W	12600 W
	480 V	13200 W	13200 W	13200 W
	500 V	13800 W	13800 W	13800 W
SBR256	440 V	12100 W	12100 W	12100 W
	460 V	12600 W	12600 W	12600 W
	480 V	13200 W	13200 W	13200 W
	500 V	13800 W	13800 W	13800 W
	520 V	14300 W	14300 W	14300 W
	540 V	14900 W	14900 W	14900 W
	560 V	15000 W	15400 W	15400 W
	580 V	15000 W	16000 W	16000 W

5.2.2 Max. Power for 3-phase Inductive Load

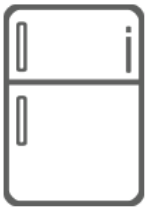
Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBR096	170 V	1500 W	1500 W	1500 W
	190 V	1700 W	1700 W	1700 W
	210 V	1900 W	1900 W	1900 W
SBR128	220 V	2000 W	2000 W	2000 W
	240 V	2200 W	2200 W	2200 W
	260 V	2300 W	2300 W	2300 W
	280 V	2500 W	2500 W	2500 W
SBR160	270 V	2400 W	2400 W	2400 W
	290 V	2600 W	2600 W	2600 W
	310 V	2800 W	2800 W	2800 W
	330 V	3000 W	3000 W	3000 W
	350 V	3200 W	3200 W	3200 W
SBR192	330 V	3000 W	3000 W	3000 W
	350 V	3200 W	3200 W	3200 W
	370 V	3400 W	3400 W	3400 W
	390 V	3500 W	3500 W	3500 W
	410 V	3700 W	3700 W	3700 W
	430 V	3900 W	3900 W	3900 W
SBR224	380 V	3400 W	3400 W	3400 W
	400 V	3600 W	3600 W	3600 W
	420 V	3800 W	3800 W	3800 W
	440 V	4000 W	4000 W	4000 W
	460 V	4200 W	4200 W	4200 W
	480 V	4400 W	4400 W	4400 W
	500 V	4600 W	4600 W	4600 W
SBR256	440 V	4000 W	4000 W	4000 W
	460 V	4200 W	4200 W	4200 W
	480 V	4400 W	4400 W	4400 W
	500 V	4600 W	4600 W	4600 W
	520 V	4700 W	4700 W	4700 W
	540 V	4900 W	4900 W	4900 W
	560 V	5000 W	5000 W	5000 W
	580 V	5000 W	5000 W	5000 W

5.2.3 Max. Power for 1-phase Inductive Load

Battery Model	Voltage Range	SH15T	SH20T	SH25T
SBR096	170 V	1500 W	1500 W	1500 W
	190 V	1700 W	1700 W	1700 W
	210 V	1900 W	1900 W	1900 W
SBR128	220 V	2000 W	2000 W	2000 W
	240 V	2200 W	2200 W	2200 W
	260 V	2300 W	2300 W	2300 W
	280 V	2500 W	2500 W	2500 W
SBR160	270 V	2400 W	2400 W	2400 W
	290 V	2600 W	2600 W	2600 W
	310 V	2800 W	2800 W	2800 W
	330 V	3000 W	3000 W	3000 W
	350 V	3200 W	3200 W	3200 W
SBR192	330 V	3000 W	3000 W	3000 W
	350 V	3200 W	3200 W	3200 W
	370 V	3400 W	3400 W	3400 W
	390 V	3500 W	3500 W	3500 W
	410 V	3700 W	3700 W	3700 W
	430 V	3900 W	3900 W	3900 W
SBR224	380 V	3400 W	3400 W	3400 W
	400 V	3600 W	3600 W	3600 W
	420 V	3800 W	3800 W	3800 W
	440 V	4000 W	4000 W	4000 W
	460 V	4000 W	4000 W	4000 W
	480 V	4000 W	4000 W	4000 W
	500 V	4000 W	4000 W	4000 W
SBR256	440 V	4000 W	4000 W	4000 W
	460 V	4000 W	4000 W	4000 W
	480 V	4000 W	4000 W	4000 W
	500 V	4000 W	4000 W	4000 W
	520 V	4000 W	4000 W	4000 W
	540 V	4000 W	4000 W	4000 W
	560 V	4000 W	4000 W	4000 W
	580 V	4000 W	4000 W	4000 W

5.3 Load Reference

The following table shows some common loads for your reference. For non-linear loads, ensure that the inrush current power is within the backup rated output power range.

Load Type	Power		Appliance Instance	Power		
	Start	Operating		Rated	Start (Inrush)	Operating
Resistive	x 1	x 1	 Incandescent lamp	100 W	100 VA (W)	100 VA (W)
			 1.5L Electric water kettle	1500 W	1500 VA (W)	1500 VA (W)
Inductive	x 3~5	x 2	 Fan	50 W	150~250 VA (W)	100 VA (W)
			 200L non-frequency conversion fridge	200 W	600~1000 VA (W)	400 VA (W)
			 2P non-frequency conversion air-conditioner	1450 W	4350~7250 VA (W)	2900 VA (W)

Note: Please check with the manufacturer for high-power inductive loads.