

System Application (IEC)

C&I PowerKeeper Series



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Abbreviations

Abbreviation	Definition
AC	Alternating current
ATS	Automatic transfer switch
BESS	Battery Energy Storage System
BMS	Battery management system
CT	Current transformer
DC	Direct current
DI	Digital input
DRM	Demand response management
ESS	Energy storage system
EV	Electric vehicle
MPPT	Maximum power point tracking
PV	Photovoltaic
PV ESS	Photovoltaic energy storage system
RCD	Residual current device
RCR	Ripple control receiver
RSD	Rapid shutdown device
SOC	State of charge
VPP	Virtual power plant

1 Introduction

This document introduces the applications, configurations, features, and requirements of the C&I PowerKeeper series energy storage system (ESS), applicable to the following models:

Device	Model	Short Name
Hybrid inverter	SH50CX, SH80CX, SH100CX, SH110CX, and SH125CX	SHCX series
BESS	ST050CF, ST062CF, ST075CF, ST087CF, ST100CF, ST112CF, ST125CF, ST137CF, ST150CF, ST162CF, ST175CF, ST187CF, ST200CF, ST212CF, ST225CF, ST237CF, and ST250CF	ST050CF–ST250CF
Logger1000	Logger1000A, Logger1000A-EU, and Logger1000B	Logger1000
Communication box	COM100D, COM100D-EU, and COM100E	-
RSD	SR20D-M	-
Transceiver	SR200T-BM	-

Users can visit <http://support.sungrowpower.com> for User Manual of each component.

2 Scenario Summary

The C&I PowerKeeper series ESS consists of the SHCX series hybrid inverter, ST050CF–ST250CF stackable BESS, Logger1000, among others. It supports various C&I energy storage scenarios, including pure grid-connected, grid-connected/off-grid switching, and pure off-grid systems.

Sungrow Power Supply Co., Ltd. (hereinafter referred to as "SUNGROW") offers multiple solutions, particularly for PV systems where grid feed-in is restricted or no longer intended due to restrictions from grid operators. By connecting the BESS

directly to the inverter, traditional PV systems can be upgraded to PV ESSs. These solutions maximize self-consumption and minimize grid electricity costs.

Note:

Only the scenarios listed in this document are supported. If other scenarios are required, please contact SUNGROW technical support.

Figures are intended for conceptual understanding and may differ from the physical products.

2.1 Pure Grid-Connected PV & ES Integration Scenario

2.1.1 Application Scenarios

This solution is suitable for C&I scenarios, such as rooftops, factories, and industrial parks that operate in the pure grid-connected mode. Through the integrated operation of energy storage and PV, the system achieves localized self-consumption of PV generation and increases returns.

When PV output exceeds load demand, the ESS absorbs surplus power, reducing grid-feed-in at low or negative prices. In the evening, when load demand is high and PV output is low, the ESS discharges to reduce energy purchases from the grid, minimizing overall energy costs.

2.1.2 System Characteristics

- All loads are connected on the **grid side** of the inverter. The system operates in grid-connected mode only and does not provide backup power. No loads are connected on the **off-grid** side, and loads will not be supplied during a grid outage.
- The plant supports absorption and reuse of surplus PV energy, improving overall system revenue.
- Logger1000 dynamically schedules charging and discharging based on PV power, load power, and grid tariff.

- Logger1000 supports multiple energy management strategies, including self-consumption, peak shaving, demand control, and feed-in power limit.

2.1.3 Typical Configuration

In a pure grid-connected PV & ES integration system, the subscenarios and their typical configurations are shown in the table below:

Tab.2-1 Subscenarios and Typical Configurations

Subscenario	PV Module	Hybrid Inverter	BESS	Logger 1000	Fast Meter	Transceiver and RSD
DC-coupled PV ESS (new)	●	●	●	●	●	○
DC-coupled PV ESS (retrofitted SUNGROW PV system)	√○	●	●	√ ^[1]	√ ^[1]	○
DC-coupled PV ESS (retrofitted third-party PV system)	√○	●	●	●	●	○
AC-coupled PV ESS (retrofitted SUNGROW PV system)	√○	●	●	√ ^[1]	√ ^[1]	○
AC-coupled PV ESS (retrofitted third-party PV system)	√○	●	●	●	●	○

√ Reused ● Required ○ Optional × Unnecessary

In pure grid-connected applications, the dual-power ATS and generators are not required.

For retrofit scenarios:

PV modules: Existing PV modules can be reused, or additional PV modules can be added for the hybrid inverter based on the existing installation.

^[1] **Logger1000 and fast meter:** If the existing data logger is **SUNGROW** Logger1000, the existing data logger and meter can be reused. Otherwise, a new Logger1000 and fast meter must be connected to the hybrid inverter.

2.2 On/Off-Grid Switching PV & ES Integration Scenario

2.2.1 Application Scenarios

This solution is suitable for C&I customers, such as factories, data centers, and supermarkets that need to achieve both local PV self-consumption and backup power for backup loads.

During normal grid-connected operation, the system prioritizes utilizing PV and the BESS to supply local loads, achieving energy self-sufficiency and electricity cost reduction. In the event of a grid outage, the system quickly switches to the off-grid or microgrid mode to ensure continuous power supply for backup loads.

2.2.2 System Characteristics

- Loads can be connected to both the **grid-connected** side and the **off-grid** side of the hybrid inverter, enabling the system to operate in either grid-connected or off-grid mode.
- For systems without on/off-grid switching cabinets, up to six hybrid inverters can be connected in parallel. The inverters perform seamless on/off-grid switching autonomously, ensuring uninterrupted power supply to backup loads.
- **Backup loads** or **all loads** can be connected to the **off-grid side** of the hybrid inverter to enable **partial** backup power or **full-plant** backup power.
- The hybrid inverter can automatically detect grid status and switch control modes accordingly.

2.2.3 Typical Configuration

In a grid-connected/off-grid switching PV & ES integration system, the subscenarios and their typical configurations are shown in the table below:

Tab.2-2 Subscenarios and Typical Configurations

Subscenario	PV Module	Hybrid Inverter	BESS	Logger 1000	Fast Meter	Dual- Power ATS	Gen- erat- or	Transcei- ver and RSD
Partial power backup (new)	●	●	●	●	●	○	○	○
Plant-level power backup (new) ^[2]	●	●	●	●	●	○	○	○
Retrofit on the grid side (SUNGROW PV system)	√○	●	●	√ ^[1]	√ ^[1]	○	○	×
Retrofit on the grid side (third-party PV system)	√○	●	●	●	●	○	○	×

√ Reused ● Required ○ Optional × Unnecessary

In grid-connected/off-grid switching scenarios, if a generator is configured, a dual-power ATS must also be configured.

For retrofit scenarios:

PV modules: Existing PV modules can be reused, or additional PV modules can be added for the hybrid inverter based on the existing installation.

^[1] **Logger1000 and fast meter:** If the existing data logger is **SUNGROW** Logger1000, the existing data logger and meter can be reused. Otherwise, a new Logger1000 and fast meter must be connected to the hybrid inverter.

^[2] The customer must prepare the manual changeover switch independently. For details, please contact the SUNGROW service team.

2.3 Pure Off-Grid PV & ES Integration Scenario

2.3.1 Application Scenarios

This solution is designed for remote areas, farms, and islands with no access to the grid or with unstable grid power supply. It aims to achieve independent power supply and self-generation for self-consumption based on clean energy.

2.3.2 System Characteristics

- All loads are connected to the **off-grid side**. The system is not connected to the grid and operates in off-grid mode only.
- The hybrid inverter operates in the voltage/frequency control mode, providing an off-grid voltage source.
- The BESS serves as the primary energy storage equipment.
- Logger1000 supports management of the hybrid inverter and battery operating status and data only, and does not perform energy management strategies.

2.3.3 Typical Configuration

In a pure off-grid PV & ES integration system, the subscenarios and their typical configurations are shown in the table below:

Tab.2-3 Subscenarios and Typical Configurations

Subscenario	PV	Hybrid Inverter	BESS	Logger 1000	Fast Meter	Dual-Power ATS	Generator	Transceiver and RSD
Pure off-grid DC-coupled PV ESS (new)	●	●	●	●	○	×	○	○

√ Reused ● Required ○ Optional × Unnecessary

Note: If the system is connected to a generator, a fast meter is required. Connecting a transceiver and RSD is optional. If the system is not connected to a generator, a fast meter is not required, and transceivers and RSDs are not supported.

3 System Components

3.1 Key Components

The key system components are shown in the following table:

Tab.3-1 Key Components

Device Name	Description
PV module	Monocrystalline silicon PV modules, polycrystalline silicon PV modules, or thin-film PV modules that do not require grounding.
Hybrid inverter	SHCX series Europe, Middle East and Africa, and Southeast Asia: SH50CX, SH80CX, or SH125CX
BESS	ST050CF–ST250CF
Battery junction box	SJC160-02
Fast meter	Any meter model compatible with Logger1000 (or COM100D/E/D-EU) can be used (for details, see "Electrical Connections" in User Manual for the selected model). DTSU666-20 is recommended.
Logger1000	Europe: Logger1000A-EU or COM100D-EU; Middle East and Africa, and Southeast Asia: Logger1000B or COM100E The specific model is subject to local availability.
Grid	Grid grounding system types include TT, TN, TN-C-S, TN-S, and TN-C. The applicable grounding system depends on local regulations.
Dual-power ATS	Prepared by the customer.
Diesel generator	With a controller. Prepared by the customer.
Transceiver and RSD	Transceiver SR200T-BM and RSD SR20D-M

Device Name	Description
Accessory	CT, AC circuit breaker, manual changeover switch (for the full-plant power backup scenario), an emergency stop device, cable, among others

3.2 Hybrid Inverters

The hybrid inverter, serving as the core power conversion unit of the PV ESS, integrates AC/DC conversion and grid-connected/off-grid control functions. It efficiently supports a wide range of PV module configurations and battery energy storage solutions, enabling MPPT of PV array output as well as charge and discharge management of batteries, thereby improving overall system efficiency and energy utilization. The figure and descriptions of each component are shown below:



Fig.3-1 Hybrid Inverter (For Reference Only)

Tab.3-2 Component Description

Name	Description
LED indicator	Indicates the current status of the inverter.
AC terminal box	Connects with AC cables.
External grounding terminal	Two grounding terminals are provided. Use at least one of them for grounding.
Bottom handle	Two handles, used for inverter handling
Mounting hanger	Four, used to hang the inverter onto the mounting bracket

Name	Description
Wiring area	Houses the DC switch, DC terminals, battery terminals, and communication terminals
Labels	Includes the nameplate, warning signs, and QR code

The SHCX series hybrid inverter features the following:

- 24-hour PID prevention solution
- Suitable for both retrofit and new scenarios
- Supports multiple energy management strategies
- Higher input current, compatible with all mainstream PV modules
- Flexible scalability from kilowatt to megawatt levels
- Supports backup power applications
- AFCI 3.0+ DC arc-fault circuit breaker with a detection range of up to 600 m
- Supports string-level protection to enhance system safety
- Self-cleaning air duct design to reduce maintenance costs and improve efficiency
- IP66 protection rating and C5-M anti-corrosion rating, suitable for harsh environments
- High-precision string analysis and I–V curve diagnostics for rapid fault localization

3.3 BESS

The PowerKeeper series BESS adopts a stacked modular design, featuring flexible deployment and easy installation, operation, and maintenance. It is available in single pack version, pre-built version, and long-duration version (formed by paralleling two to four single-pack-version or pre-built-version BESS units) to accommodate diverse application scenarios. Each BESS consists of one Rack, as shown below:



Fig.3-2 BESS (Taking Single Pack Version as Example)

Note: The figure above takes the ST200CF BESS as an example. The numbers 1–4 marked in the figure correspond to the following modules:

Tab.3-3 BESS Composition

No.	Module Name	Remarks
1	Switch gear	Each Rack is equipped with one switch gear installed at the top of the main battery stack. It mainly includes components such as the battery cluster management unit (CMU), cooling fans, and indicator lights.
2	Upper cover	If the BESS contains multiple battery stacks, those other than the main stack are auxiliary battery stacks. The upper cover is installed at the top of the auxiliary battery stacks (if any) and mainly includes components such as fuses, cooling fans, top controllers, and indicator lights.
3	Pack	Located in the middle of the battery stacks. Each Pack has a capacity of 12.5 kWh and includes components such as cells, battery management unit (BMU), and safety modules.

No.	Module Name	Remarks
4	Base	The base is installed at the bottom of the battery stacks. It mainly includes components such as the power board and bottom controller.

The models and technical parameters of ST050CF–ST250CF are as follows.

Tab.3-4 Technical Data of Rack

Model	Configuration	Pack Quantity	Initial Nominal Energy (kWh)	Nominal Voltage (V)	Voltage Range (V)
ST050CF	48S1P	4	49.92	153.6	129.6–175.2
ST062CF	60S1P	5	62.40	192.0	162.0–219.0
ST075CF	72S1P	6	74.88	230.4	194.4–262.8
ST087CF	84S1P	7	87.36	268.8	226.8–306.6
ST100CF	96S1P	8	99.84	307.2	259.2–350.4
ST112CF	108S1P	9	112.32	345.6	291.6–394.2
ST125CF	120S1P	10	124.8	384.0	324.0–438.0
ST137CF	132S1P	11	137.28	422.4	356.4–481.8
ST150CF	144S1P	12	149.76	460.8	388.8–525.6
ST162CF	156S1P	13	162.24	499.2	421.2–569.4
ST175CF	168S1P	14	174.72	537.6	453.6–613.2
ST187CF	180S1P	15	187.20	576.0	486.0–657.0
ST200CF	192S1P	16	199.68	614.4	518.4–700.8
ST212CF	204S1P	17	212.16	652.8	550.8–744.6
ST225CF	216S1P	18	224.64	691.2	583.2–788.4
ST237CF	228S1P	19	237.12	729.6	615.6–832.2
ST250CF	240S1P	20	249.6	768.0	648.0–876.0

3.4 Battery Combiner Box

A single battery combiner box enables the parallel connection of two Racks. The ESS can achieve parallel connection of 2–4 Racks (ST050CF–ST250CF) through multiple battery combiner boxes. The battery combiner box features short-circuit protection and is equipped with a load switch, allowing for manual disconnection of the power circuit. The appearance and key parameters of the battery combiner box are shown in the following figure and table:



Fig.3-3 Battery Combiner Box (For Reference Only)

Tab.3-5 Component Description

Item	Specifications
IP rating	IP66
Corrosion protection class	C5-M
Number of inputs and outputs	Two inputs and one output
Short-circuit protection	Yes
Switch	Load switch

3.5 Logger1000

Logger1000 is a cloud-edge coordinated energy management system that can be applied to C&I ESS-only and PV-ESS scenarios. With an open and modular design, the system enables refined energy dispatch management and O&M for PV-ESS plants, enhancing overall power generation efficiency.

Logger1000 supports two product forms: the Logger1000 controller and the COM100D/E/D-EU enclosure (**choose one from the two**). The Logger1000 controller is designed for indoor installation only, while the COM100D/E/D-EU enclosure is suitable for outdoor installation and provides a convenient installation solution.



Fig.3-4 Logger1000A Appearance (For Reference Only)



Fig.3-5 COM100D Appearance (For Reference Only)

■ Local Functions

● Data Acquisition

Logger1000 or COM100D/E/D-EU offers a Web-based user interface accessible through computer browsers. It supports commissioning and configuration of ESS, BESS, PV equipment, and other devices, along with real-time data acquisition and fault and alarm display.

● Control Strategy

Energy management (self-consumption, time plan, compulsory mode, and VPP), power regulation (power limiting, DRM regulation, DI emergency stop, and RCR regulation)

■ Cloud Functions

● Data Acquisition

Logger1000 supports the transmission of local data to iSolarCloud, enabling online management through the iSolarCloud Web and App. It offers a visualized display on a large screen and a convenient human-machine interface, and supports commissioning and configuration, real-time data acquisition, and real-time fault and alarm display for ESS, BESS, PV equipment, and other devices across a single plant or multiple plants. Historical data can be displayed in various types of reports. Customized report templates, including but not limited to ESS reports, PV reports, overall plant reports, and revenue reports, are available.

● Control Strategy

The cloud side supports automated dispatching and scheduled power outage functions (for South Africa only). The local control strategy data and execution status will be displayed on the cloud synchronously, while the local control strategy can be configured on the cloud.

The technical parameters of Logger1000 are shown as follows.

Tab.3-6 Logger1000 Technical Parameters

Item	Value
System	
Configuration	Logger1000 and COM100D/E/D-EU (choose one from the two)
Communication	
RS-485 interfaces	3

DI	5
Ethernet interface (FE)	1 × RJ45, 10/100 Mbps
Access to iSolarCloud	Select a wired network, WLAN, or 4G connection to access iSolarCloud, depending on the model and actual project requirements.
Mechanical Data	
Mounting Method	Logger1000 supports guide rail mounting or wall mounting. COM100D/E/D-EU supports outdoor wall mounting, bracket mounting, and pole mounting.

3.6 Fast Meter

The SUNGROW fast meter is a key component of energy management. It is used to measure electrical parameters at the grid connection point and communicate with the hybrid inverter.

DTSU666-20 is a dual-channel three-phase meter featuring a standard DIN 35 mm guide rail mounting and a modular design. It offers a compact size, easy installation, and convenient networking. The active power update rate is less than 100 ms.



Fig.3-6 DTSU666-20 Appearance

The technical parameters of DTSU666-20 are shown as follows:

Tab.3-7 DTSU666-20 Technical Parameters

Item	Parameters
Rated voltage	240 Vac (phase voltage) / 415 Vac (line voltage)
Input voltage range	50 Vac – 280 Vac (phase voltage) / 85 Vac – 485 Vac (line voltage)
Measurement accuracy	1
Communication	RS-485
Communication protocol	Modbus-RTU
CT selection	Select the appropriate CT for DTSU666-20, with a range of 250 A to 3000 A, or use a Rogowski coil ^[1] .
Dimensions	72 mm × 65 mm × 100 mm

Note 1: The customer must purchase CTs or Rogowski coils compatible with DTSU666-20 separately from SUNGROW. The specifications shall be selected according to the current at the point of connection (PoC).

The list of meters compatible with Logger1000 is shown below.

Tab.3-8 List of Meters Compatible with Logger1000

Manufacturer	Model	Communication Port and Protocol
Jiangsu SFERE	PD194E/Z	Modbus RUT/RS-485
Acrel	PZ96-E3	
	DTSD1352	
Weidmüller	EM610	
SUNGROW	DTSU666	
	DTSU666-20	
Schneider	IEM3255	
Janitza	UMG604/UMG104	UMG604: Modbus RTU/RS-485 UMG104: Modbus TCP/ETH

Note 1: The meter models listed above may be subject to update delays. For the latest supported meter models, refer to the "Meter Connection" section of the Logger1000 *User Manual*.

Note 2: If the plant has strict zero export requirements, or if the meter needs to be connected to two sets of CTs (or Rogowski coils), DTSU666-20 is recommended. Otherwise, any supported meter model can be used.

4 Pure Grid-Connected PV & ES Integration Scenario

4.1 System Configuration

Tab.4-1 Pure Grid-Connected System Configuration

Component	Model	Quantity	Remarks
Hybrid inverter	SHCX series	1–24	Europe, Middle East and Africa, and Southeast Asia: SH50CX, SH80CX, or SH125CX Parallel connection of different hybrid inverter models is allowed.
BESS	ST050CF– ST250CF	Several	One inverter can be directly connected to one Rack of SUNGROW same-series BESS. Through a battery junction box, one inverter can be connected to 2–4 Racks of SUNGROW same-model BESSs. The capacity of each BESS is optional from 50 kWh to 250 kWh.
Battery junction box	SJC160-02	Several	One inverter requires a battery junction box to connect more than one BESS. A single battery junction box allows for two inputs and one output. When one inverter is connected to two, three, or four Racks of SUNGROW same-model BESSs, one,

Component	Model	Quantity	Remarks
			two, or three battery junction boxes are required respectively.
Logger1000	Logger1000 or COM100D/E/D- EU	1	Europe: Logger1000A-EU or COM100D-EU; Middle East and Africa, and Southeast Asia: Logger1000B or COM100E The specific model is subject to local availability.
Fast meter	DTSU666-20, etc.	1	If the plant has strict zero export requirements, or if the meter needs to be connected to two sets of CTs or Rogowski coils (AC-coupled retrofitted third-party PV system), DTSU666-20 must be used . In other scenarios, any meter model compatible with Logger1000 can be used (for details, see "Electrical Connections" in User Manual for the selected model).
CT	-	1 set or 2 sets ^[1]	Selected according to the current at the PoC If DTSU666-20 is used: The customer must purchase the meter separately from SUNGROW. The specifications of the CT (250 A – 3000 A) or Rogowski coil (above 3000 A) shall be selected based on the current at the PoC. If other meters are used: The customer must purchase the corresponding CT or Rogowski coil compatible with the selected

Component	Model	Quantity	Remarks
			meter. The specifications shall be determined based on the current at the PoC.
AC circuit breaker	-	Several	The customer must procure circuit breakers of the recommended specifications and install them on the designated ports of the hybrid inverter in accordance with the "Electrical Connections" section of User Manual for inverters. The recommended specifications shall be referred to User Manual for the hybrid inverter.
PV module	-	-	The customer must procure the parts separately.
Transceiver	SR200T-BM	One transceiver for each hybrid inverter	Optional. Customers can purchase it as needed. Available only in the Thailand region, and supported exclusively by SH125CX. It is currently not supported for other regions or models.
RSD	SR20D-M	One RSD for every two PV modules	
Emergency stop device	-	1	SUNGROW does not provide the emergency stop device, so the customer must procure one of the recommended specifications. The emergency stop device is connected to the DI5 port of Logger1000 to receive the DI signal from the device.

Component	Model	Quantity	Remarks
Miscellaneous	-	Several	RS-485 cable, CAN communication cable, and power cable, etc. The customer must procure the parts separately.

Note 1: When a third-party PV system uses an AC-coupled retrofit solution, two sets of CTs are required, and the fast meter must be DTSU666-20. For other requirements, refer to ["4.4.3 System Requirements"](#).

4.2 DC-Coupled PV ESS (New)

4.2.1 Application Scenarios

This configuration is specifically designed for a new PV ESS, in which the PV array and ESS are integrated on the DC side of the hybrid inverter. PV power can be used directly to charge the BESS without additional AC conversion, thereby improving overall system efficiency and reducing conversion losses. Logger1000 can manage the energy flow among the hybrid inverter, the BESS, and the loads, enabling a higher self-consumption rate and providing backup power during grid outages.

Since the communication topology for one hybrid inverter connected to 1–4 BESSs only differs on the DC side of the inverter (refer to ["4.2.3.4 Battery Combiner Box"](#)), the plant-level communication topology diagrams in this document all take "one hybrid inverter connected to one BESS" as an example.

The plant-level system communication topology is shown below.

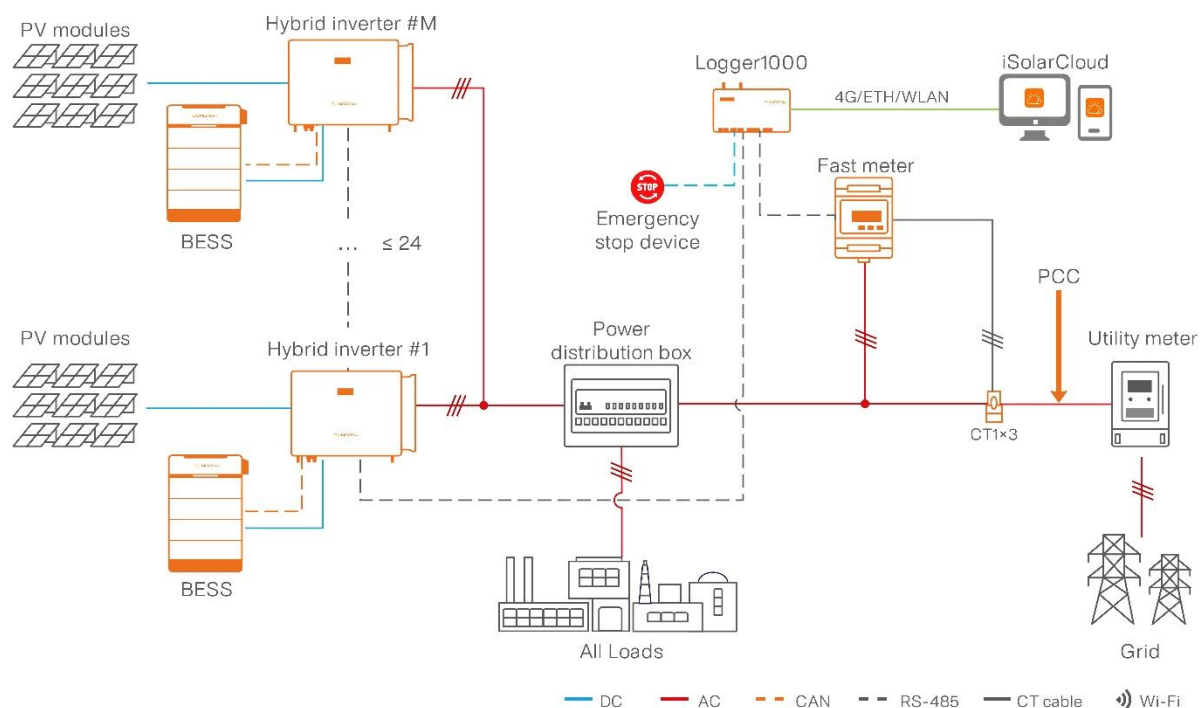


Fig.4-1 Plant-Level Communication Topology

4.2.2 System Characteristics

A new DC-coupled PV ESS features the characteristics shown in the table below:

Tab.4-2 System Characteristics

Item	Characteristic
Energy management mode	Self-consumption (default), time plan, compulsory mode, VPP, etc.
Power regulation	Power limitation, DRM regulation, DI emergency stop, and RCR regulation
Feed-in power limitation	Power regulation time: ≤ 2 s (when used with DTSU666-20) Power control accuracy: 1.5% of the rated power Power control response time: 0.8 s Support split-phase feed-in control and total feed-in control
Unbalanced output	Supports 100% unbalanced loading in the grid-connected mode

Item	Characteristic
Online update	Supported Firmware updates for the hybrid inverter, BESS, and Logger1000 (or COM100D/E/D-EU) can be performed while the system is operating in the grid-connected mode.
Energy purchase power limit	Supported ≥ Total connected load power of the system
Max. grid-connected power	3 MW
Number of inverters connected in parallel	Pure grid-connected scenario, up to 24 inverters connected in parallel are supported The capacity of each BESS is optional from 50 kWh to 250 kWh.
Energy storage capacity	Pure grid-connected scenario, maximum 24 MWh

4.2.3 System Requirements

4.2.3.1 Firmware Updates

This scenario is supported only after the system components are updated to the following versions:

System Component	Firmware Version
SH50CX	GARNET-H_B001.V001.P202
SH80/100/110/125CX	GARNET-H_B001.V001.P003 or later
ST050CF–ST250CF	STCFBCU-S_B000.V000.P006 or later
Logger1000A/B	LOGGER-SV300.001.00.P062 or later
Logger1000A-EU	LOGGER-SV500.001.00.P015 or later

Online updates are supported for the hybrid inverter, BESS, and Logger1000.

4.2.3.2 Hybrid Inverter

- During inverter installation, heat dissipation, specific clearances, ventilation rates, and other plant-level layout requirements must be considered. For details, refer to the "Mechanical Installation" section of User Manual for inverters.
- An AC circuit breaker must be installed at the AC terminal of each inverter. For recommended specifications, refer to the "Electrical Connection" section of User Manual for inverters.
- In accordance with local regulations, residual current devices (RCDs) of appropriate specifications must be installed at the required locations in the system for leakage current protection. Recommended specifications can be found in User Manual and relevant local regulations.
- The grounding point on the inverter enclosure must be reliably connected. Refer to the "Electrical Connection" section of User Manual for inverters.
- When the battery capacity assigned to the SH80/100/110/125CX hybrid inverter is 100 kWh or above, the inverter supports black start. When the battery capacity assigned to the hybrid inverter is below 100 kWh, PV input is required for startup.
- When the battery capacity assigned to the SH50CX hybrid inverter is 50 kWh or above, the inverter supports black start (the battery SOC $\geq$ 10%). When the battery capacity assigned to the hybrid inverter is below 50 kWh, PV input is required for startup.
- The voltage difference between the maximum MPPT voltage and the minimum MPPT voltage shall be $\leq$ 250 V. The MPPT current is not limited.
- When two or more hybrid inverters are connected in parallel, the AC cable lengths from the inverter grid or backup port to the bus are equal. For details, refer to User Manual for inverters.
- In pure grid-connected applications, parallel connection of different SHCX series hybrid inverter models is allowed.

- SH125CX supports the rapid shutdown device (RSD) + transceiver solution, whereas SH50/80/100/110CX models do not. For SH125CX, using a RSD + transceiver system requires a battery capacity of 100 kWh or higher.

4.2.3.3 BESS

- Each hybrid inverter must be connected to a BESS. The inverter can be directly connected to one ST050CF–ST250CF BESS, or connected to 2–4 ST050CF–ST250CF BESSs in parallel via the battery junction box.
- Reliable grounding of the BESS must be ensured. For detailed procedures, please refer to the ST050CF–ST250CF *User Manual*.
- The BESS communicates with the hybrid inverter via CAN. The communication port (in the S/G) of the BESS shall be connected to the corresponding communication port of the inverter. The battery DC input terminals P+ and P- of the BESS must be connected to the hybrid inverter BAT+ and BAT- terminals via DC cables.
 - When one hybrid inverter is connected to only one BESS, the maximum length of the communication cable between the BESS S/G and the hybrid inverter is 40 meters. When one hybrid inverter is connected to multiple BESSs, the total length of the communication cables between the BESS S/Gs and between the BESS S/G and the hybrid inverter must not exceed 40 meters.
 - For further electrical connection requirements, recommended cable specifications, and detailed procedures, please refer to the ST050CF–ST250CF *User Manual*.
- During installation of the BESS, sufficient space must be reserved for heat dissipation and maintenance of the BESS, as well as for heat dissipation between the BESS and the hybrid inverter. Depending on site conditions, the BESS supports flexible layout. Specific requirements for layout clearance, ventilation rate, and other plant-level layouts must comply with *System Layout Guide*.

- When the hybrid inverter is not configured with PV inputs, it is recommended to configure the relevant parameters to prevent deep discharge of the BESS. For details, refer to the ST050CF–ST250CF *User Manual*.

4.2.3.4 Battery Combiner Box

- When one hybrid inverter is connected to more than one Rack of BESS, a battery combiner box must be used to achieve parallel connection of the Racks. A single battery combiner box allows for two inputs and one output. When one hybrid inverter is connected to two, three, or four BESSs (taking ST200CF as an example), the system diagrams are shown below:

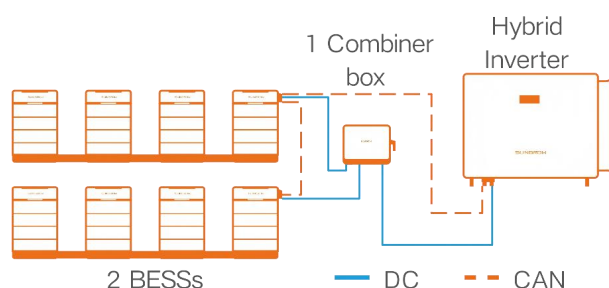


Fig.4-2 Two BESSs Connected to One Hybrid Inverter

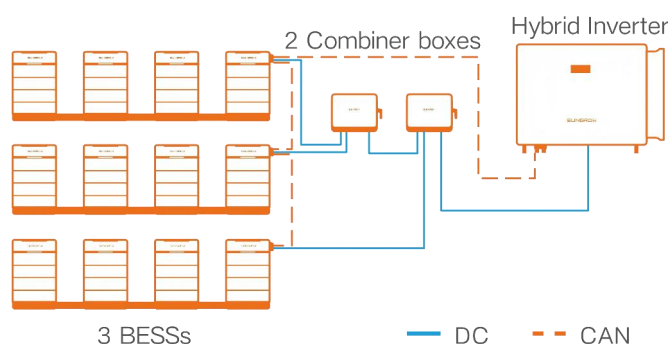


Fig.4-3 Three BESSs Connected to One Hybrid Inverter

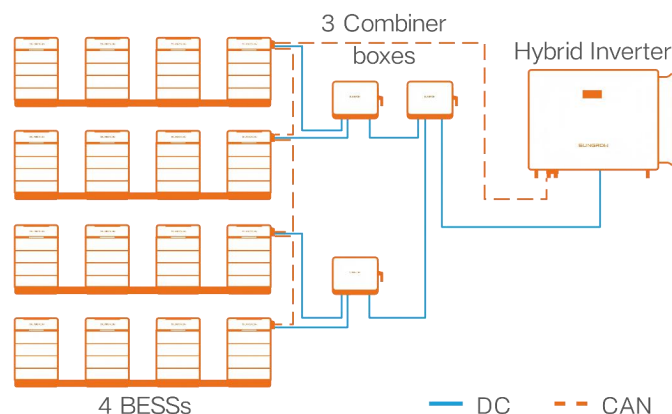


Fig.4-4 Four BESSs Connected to One Hybrid Inverter

- The cable length from each BESS to the battery combiner box must be kept as consistent as possible (with an error within ± 0.5 m) to prevent circulating current.

4.2.3.5 Logger1000

- Data display and energy management are performed using Logger1000 (indoor installation) or COM100D/E/D-EU (outdoor installation).
- It is recommended to use Ethernet communication between Logger1000 (or COM100D/E/D-EU) and the router, with a communication distance ≤ 100 m.
- Logger1000 (or COM100D/E/D-EU) communicates with the inverter via RS-485, with a communication distance ≤ 1000 m.
- For specific cabling and installation requirements of Logger1000 (or COM100D/E/D-EU), refer to *User Manual* of the selected model.

4.2.3.6 Meter and CT

- Use meters compatible with Logger1000. For details, refer to the Logger1000 *User Manual*. Select a meter with appropriate accuracy based on requirements. For details, see "[3.6 Fast Meter](#)".
- Refer to the Logger1000 *User Manual* for cable connection details.
- Ensure the phase sequence of the meter's output wire is correct. Connect L1, L2, and L3 to their corresponding phases.

- Note the CT connection direction. Incorrect orientation may cause system failure. For detailed connection, refer to the quick installation manual of the respective meter.
- Determine the CT specifications based on the maximum current at the PoC.
- To ensure correct energy flow and zero-export functions, place the CT between the meter and the power distribution box, as shown in the system diagram.

4.2.3.7 PV Modules

- When the hybrid inverter is configured with PV inputs: the lower limit of **full-load MPPT voltage range** $\leq$ the number of PV modules per string $\times$ MPPT voltage $\leq$ the upper limit of **full-load MPPT voltage range**. For the **full-load MPPT voltage range**, refer to the "Technical Data" section of the inverter *User Manual*. For the open-circuit voltage of the PV modules, refer to the PV module datasheet.
- For PV module cable connection requirements, refer to the corresponding *User Manual* of the PV modules.
- When the SH80CX, SH100CX, SH110CX, and SH125CX hybrid inverters are connected to batteries with a capacity of 100 kWh or above, PV modules are not required. When the SH50CX hybrid inverter is connected to batteries with a capacity of 50 kWh or above, PV modules are not required.

4.2.3.8 Loads

- All loads are connected to the grid-side of the inverter. In the event of a grid failure, these loads will not operate.
- For the phase sequence connection of motor-type loads, refer to the "Electrical Connection" section in the inverter *User Manual*.
- The total power of emergency loads cannot exceed the load capacity of the "load" port. Refer to *Load Carrying Capacity Table* for details.

4.2.3.9 Transceiver and RSD

- System connections (showing only parts related to the transceiver and RSD) are as follows:

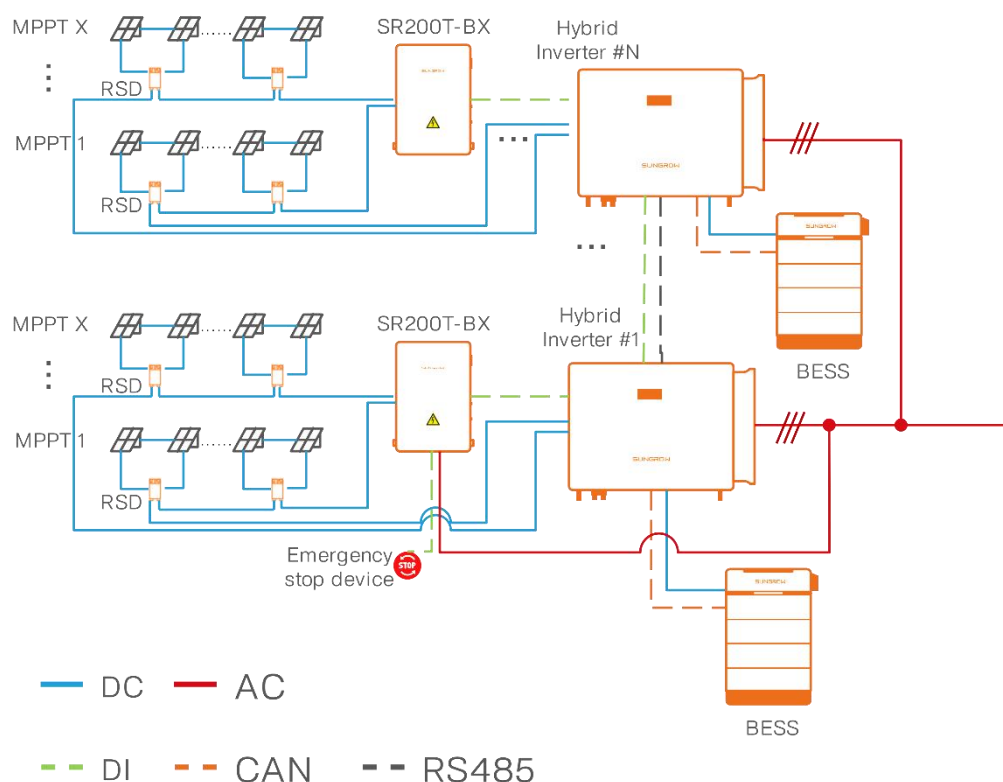


Fig.4-5 System Connections of Transceiver and RSD

- Connect the hybrid inverter to the emergency stop switch and the transceiver respectively according to User Manual for hybrid inverters. Do not connect the emergency stop switch to the logger.
- It is recommended to install the transceiver next to the inverter.
- The communication cable length between the furthest RSD and the inverter must be ≤ 450 m.
- Only full RSD deployment is supported. Partial MPPT connection with RSDs is not supported.
- Shutdown trigger conditions:

- Press the emergency stop button.
 - When an arc fault occurs on the DC side, the PV side will not shut down.
 - Firmware updates for the RSD, transceiver, or other components may cause shutdown failure.
 - Grid power outage.
- The RSD and transceiver are compatible only with SHCX series hybrid inverters, and are not compatible with SUNGROW PV inverters or third-party inverters.
 - For other requirements, see User Manual for RSDs and transceivers respectively.

4.3 DC-Coupled PV ESS (Retrofitted)

4.3.1 Scenario Description

This scenario is applicable to the updating and retrofitting of existing PV systems, supporting the retrofit of three-phase PV systems from SUNGROW or third-party brands. The plant-level communication topology is shown below.

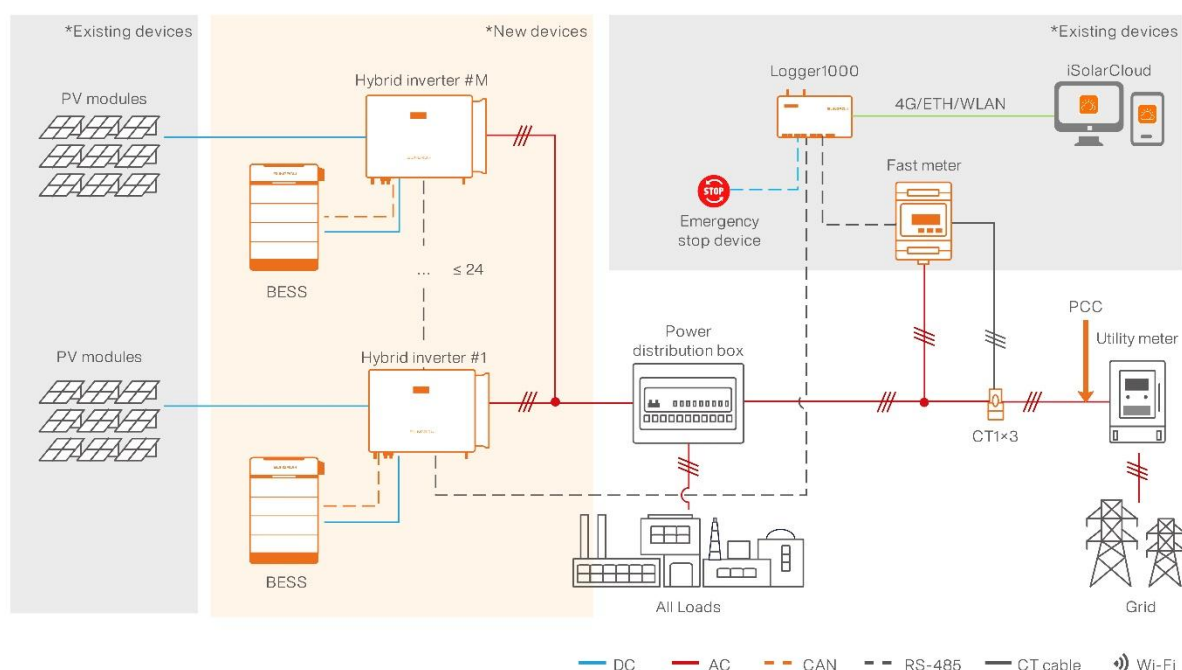


Fig.4-6 Plant-Level Communication Topology (SUNGROW PV System)

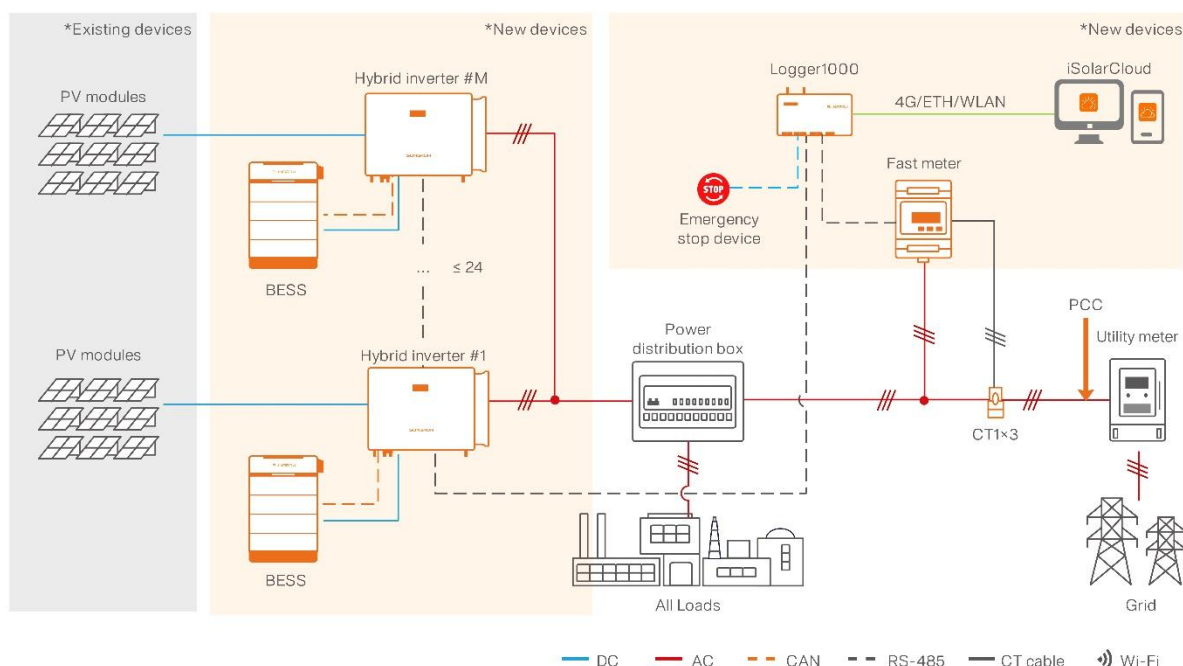


Fig.4-7 Plant-Level Communication Topology (Third-Party PV System)

4.3.2 System Characteristics

In addition to the characteristics described in ["4.2.2 System Characteristics"](#), the grid-connected retrofit system also has the following characteristics:

- Functional three-phase PV systems from SUNGROW or third-party brands can be retrofitted.
- PV inverters can be replaced with hybrid inverters using existing PV modules and wiring. Alternatively, hybrid inverters can be added to the existing PV system with optional PV modules configured for the inverters.
- For third-party PV retrofit systems, the original third-party data loggers and meters must be removed. The hybrid inverters must be connected to the SUNGROW Logger1000 and meters.
- BESSs must be connected to the hybrid inverters to maximize self-consumption.

4.3.3 System Requirements

In addition to the requirements described in ["4.2.3 System Requirements"](#), the grid-connected retrofit system must also meet the following extra requirements:

- For a SUNGROW PV retrofit system:
 - Replace existing PV inverters (up to 24 units) with SHCX series hybrid inverters.
 - If a Logger1000 is already present, it and the fast meter can be reused. Otherwise, a new Logger1000 and compatible fast meter must be installed. For specific models, refer to ["3.6 Fast Meter"](#).
 - If a new fast meter is installed, CT1 of the fast meter must be installed on the grid-side.
 - Hybrid inverters and PV inverters must be installed within the same PV plant.
- For a third-party PV retrofit system:
 - Replace existing PV inverters (up to 24 units) with SHCX series hybrid inverters, and install a new compatible fast meter and Logger1000.
 - The SUNGROW dual-channel fast meter DTSU666-20 is recommended.
 - Install CT1 of DTSU666-20 on the grid-side. Do not connect CT2 of DTSU666-20.
- When the system is operating in the grid-connected mode, firmware updates for the inverters or BESSs must be performed. Otherwise, backup loads connected to the **load port** may experience power outages or the update may fail.

4.4 AC-Coupled PV ESS (Retrofitted)

4.4.1 Scenario Description

This scenario is applicable to the updating and retrofitting of existing PV systems, where existing PV modules and inverters from SUNGROW or third-party brands can

be retained. The communication topologies for the plant-level retrofit of SUNGROW and third-party PV systems are shown below.

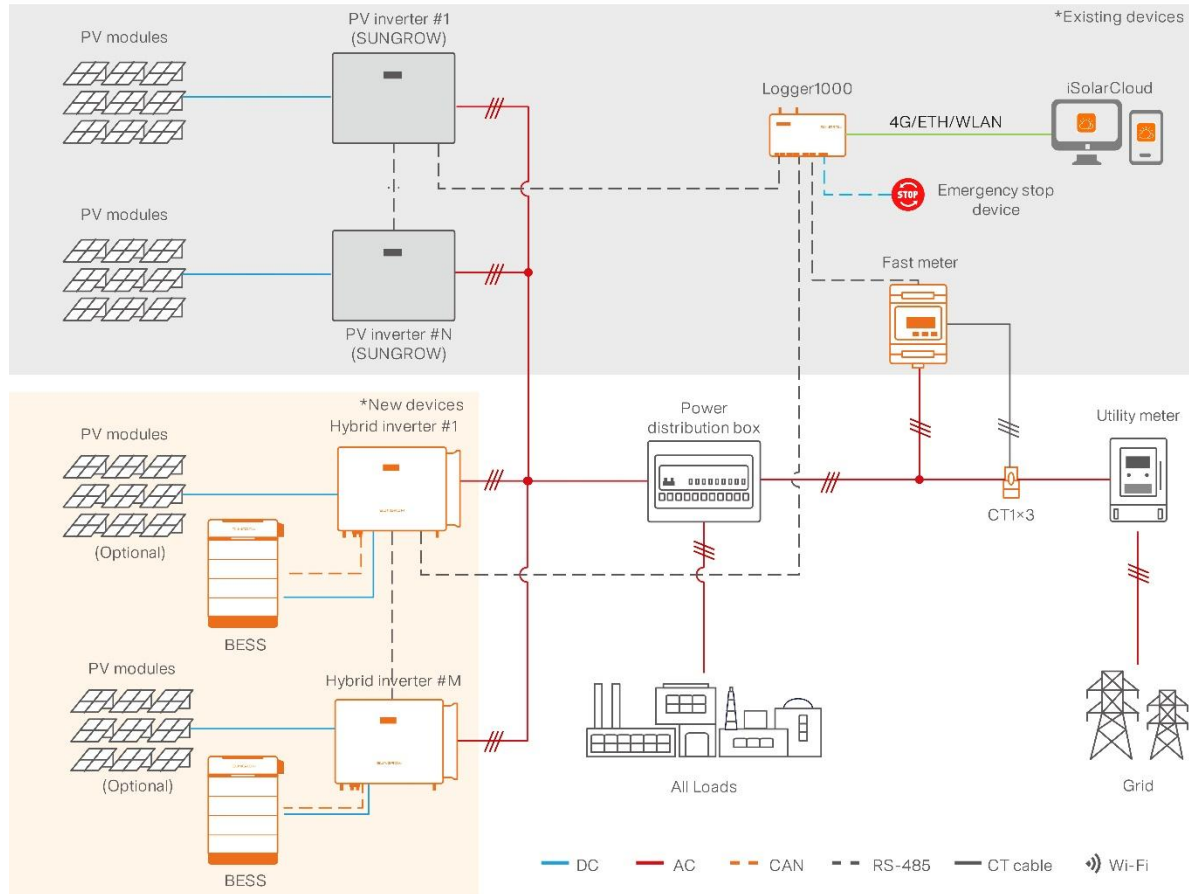


Fig.4-8 Plant-Level Communication Topology (Retrofit SUNGROW PV System, and Add Hybrid Inverters)

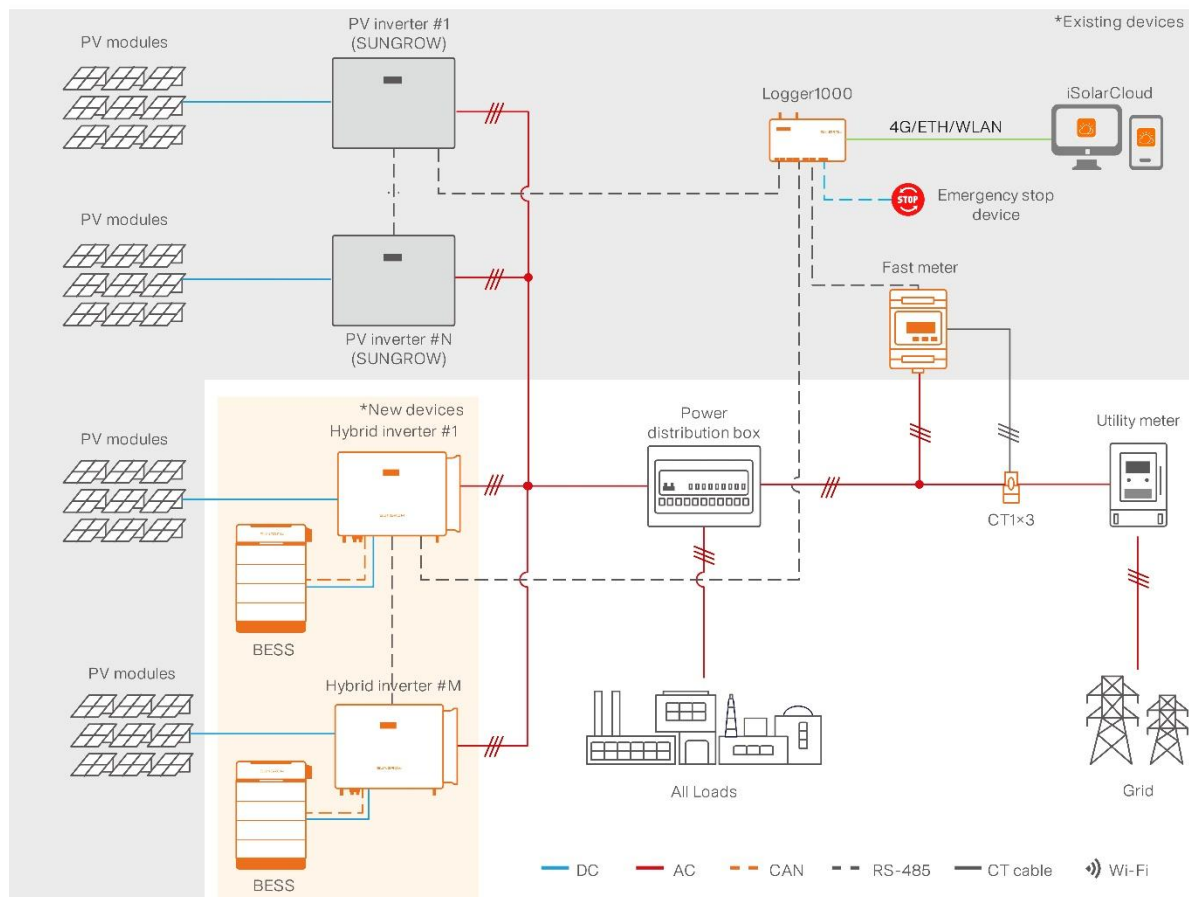


Fig.4-9 Plant-Level Communication Topology (Retrofit SUNGROW PV System, and Replace Several PV Inverters)

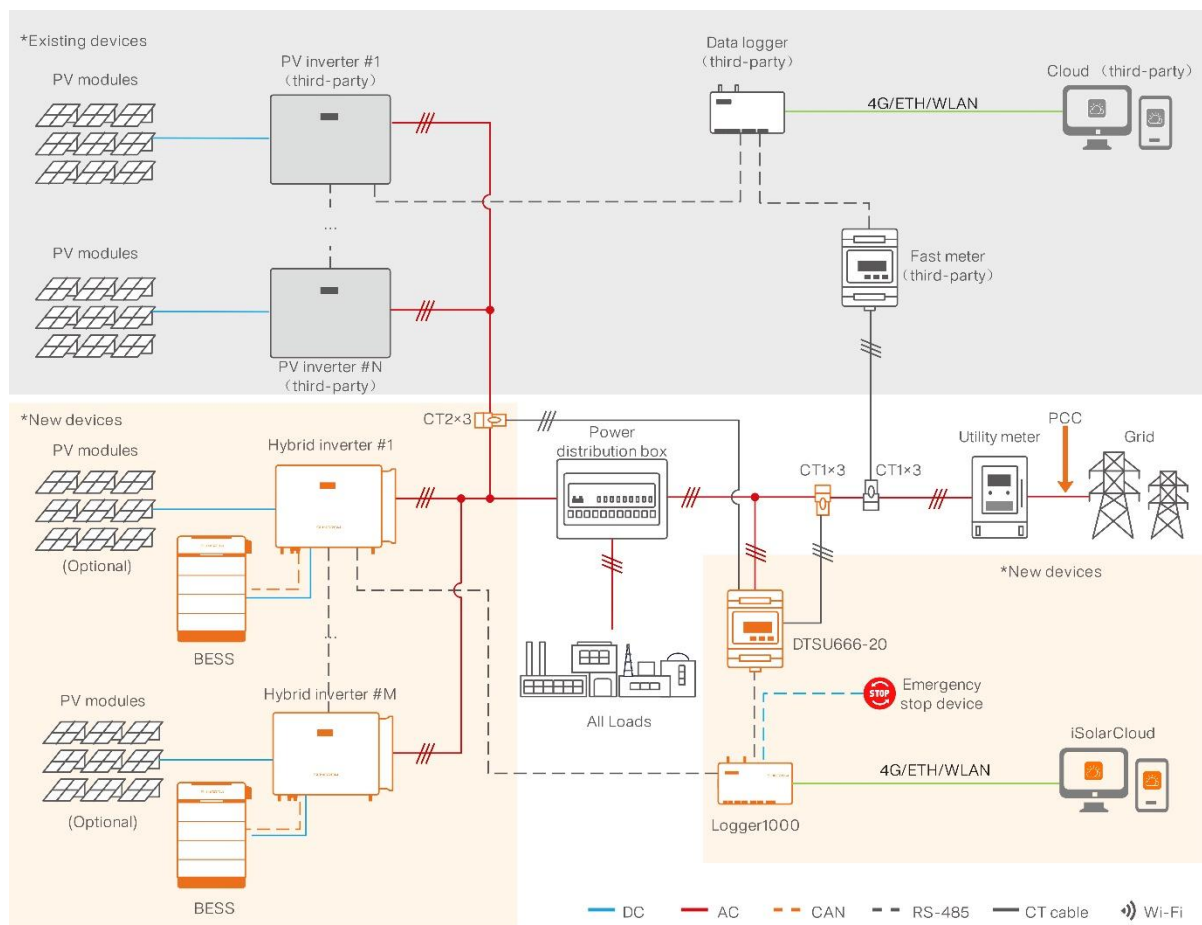


Fig.4-10 Plant-Level Communication Topology (Retrofit Third-Party PV System, and Add Hybrid Inverters)

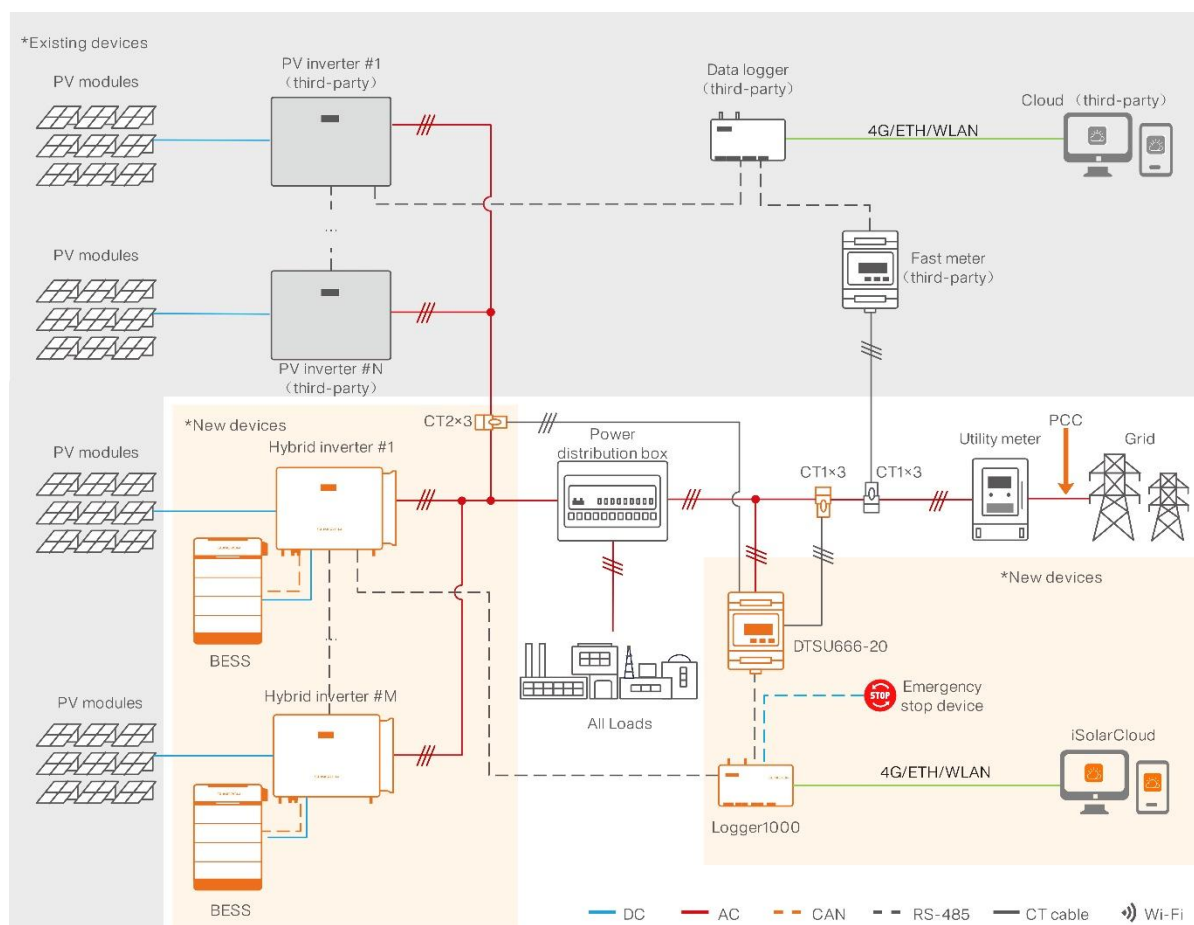


Fig.4-11 Plant-Level Communication Topology (Retrofit Third-Party PV System, and Replace Several PV Inverters)

4.4.2 System Characteristics

In addition to the characteristics described in ["4.2.2 System Characteristics"](#), the grid-connected retrofit system also has the following characteristics:

- Functional three-phase PV systems from SUNGROW or third-party brands can be retrofitted.
- The existing PV modules and inverters can be retained, with hybrid inverters added on the AC side. These hybrid inverters can be connected to PV modules (optional) and BESSs, as shown in ["Fig.4-8 Plant-Level Communication Topology \(Retrofit SUNGROW PV System, and Add Hybrid Inverters\)"](#) and ["Fig.4-10 Plant-Level Communication Topology \(Retrofit Third-Party PV System, and Add Hybrid Inverters\)"](#).

Hybrid Inverters)". Alternatively, **some** PV inverters can be **replaced** by hybrid inverters. These hybrid inverters can be connected to PV modules (reused) and BESSs, as shown in *"Fig.4-9 Plant-Level Communication Topology (Retrofit SUNGROW PV System, and Replace Several PV Inverters)"* and *"Fig.4-11 Plant-Level Communication Topology (Retrofit Third-Party PV System, and Replace Several PV Inverters)"*. The total number of SUNGROW PV inverters and hybrid inverters connected in parallel must be ≤ 24 .

- For third-party PV retrofit systems, the existing third-party data loggers and meters can be retained. SUNGROW Logger1000 and meters must be installed. Users must use both iSolarCloud and the third-party cloud for plant management.

4.4.3 System Requirements

In addition to the requirements described in *"4.2.3 System Requirements"*, the grid-connected retrofit system must also meet the following extra requirements:

- For a SUNGROW PV retrofitted system:
 - For compatible SUNGROW PV inverter models, refer to the SHCX series Single-Inverter System Application Manual.
 - Number of PV inverters + Number of hybrid inverters ≤ 24
 - If a Logger1000 is already present, it and the fast meter can be reused. Otherwise, a new Logger1000 and compatible fast meter must be installed. For specific models, refer to *"3.6 Fast Meter"*.
 - If a new fast meter is installed, CT1 of the fast meter must be installed on the grid-side.
 - Hybrid inverters and PV inverters must be installed within the same PV plant.
- For a third-party PV retrofitted system:
 - Existing third-party PV inverters remain connected to their original data loggers and meters.

- New hybrid inverters (≤ 24 units) must be connected to a SUNGROW fast meter and Logger1000, and the SUNGROW dual-channel fast meter DTSU666-20 is mandatory.
- Install CT1 on the grid-side and CT2 on the AC side of the existing PV inverters. Connect both to the SUNGROW fast meter to collect third-party PV data and upload it to iSolarCloud via Logger1000.
- The zero export control accuracy must be set separately for SUNGROW Logger1000 and the third-party data logger to control their respective inverters. For stable control, the SUNGROW Logger1000's zero export feed-in accuracy is typically set **slightly lower than** that of the third-party's data logger to prioritize the zero export strategy of SUNGROW. The hybrid inverter only ensures zero power output to the grid, but it cannot guarantee zero-export of the existing PV inverters. Contact the PV inverter manufacturer for their feed-in power limit solutions.

Example: The zero export control accuracy of Logger1000 is set to $K1 \times$ the rated output power of the hybrid inverter ($K1$ is negative, allowing a small amount of energy purchase from the grid), while the zero export control accuracy of the third-party data logger is set to $K2 \times$ the rated output power of the hybrid inverter, where $K1 < K2 = 0$.

- When the hybrid inverter has no PV input, the depth of discharge (DOD) of the BESS must be set for battery protection. Refer to the ST050CF–ST250CF User Manual for details.
- In a pure grid-connected retrofit scenario involving both SHCX series hybrid inverters and PV inverters (SUNGROW or third-party models), RSDs and transceivers can be configured only on the PV side of the SHCX series hybrid inverters, but not on the PV side of the PV inverters.

5 On/Off-Grid Switching PV & ES Integration Scenario

5.1 System Configuration

Tab.5-1 Grid-Connected/Off-Grid Switching System Configuration

Component	Model	Quantity	Remarks
Hybrid inverter	SHCX series	1–6	Europe, Middle East and Africa, and Southeast Asia: SH50CX, SH80CX, or SH125CX For a parallel configuration with a centralized load, the inverters must be of identical models; for a parallel configuration with distributed loads, the inverter models can be different. Only SH110/125CX supports connection to a diesel generator.
BESS	ST050CF–ST250CF	Several	One inverter can be directly connected to one Rack of SUNGROW same-series BESS. Through a battery junction box, one inverter can be connected to 2–4 Racks of SUNGROW same-model BESSs. The capacity of each BESS is optional from 50 kWh to 250 kWh.
Battery junction box	SJC160-02	Several	One inverter requires a battery junction box to connect more than one BESS. A single battery junction box allows for two inputs and one output. When one inverter is connected to two, three, or four Racks of SUNGROW same-model BESSs, one, two, or three battery junction boxes are required respectively.
Logger1000	Logger100	1	Europe: Logger1000A-EU or COM100D-EU;

Component	Model	Quantity	Remarks
	0 or COM100		Middle East and Africa, and Southeast Asia: Logger1000B or COM100E The specific model is subject to local availability.
Fast meter	DTSU666-20, etc.	One or two ^[1]	If the meter needs to be connected to two sets of CTs or Rogowski coils, the dual-channel meter DTSU666-20 is required. If the meter needs to be connected to three sets of CTs or Rogowski coils, the dual-channel meter DTSU666-20 and a single-channel meter compatible with Logger1000 are required. In other scenarios, any meter model compatible with Logger1000 can be used (for details, see "Electrical Connections" in User Manual for the selected model). The fast meter must be connected to the main inverter.
CT	-	Several ^[1]	Selected according to the current at the PoC If DTSU666-20 is used: The customer must purchase the meter separately from SUNGROW. The specifications of the CT (250 A – 3000 A) or Rogowski coil (above 3000 A) shall be selected based on the current at the PoC. If other meters are used: The customer must purchase the corresponding CT or Rogowski coil compatible with the selected meter. The specifications shall be determined based on the current at the PoC.
Manual	-	1	The customer must procure the parts separately.

Component	Model	Quantity	Remarks
changeover switch			Used for the plant-level power backup scenario. The recommended specifications shall be referred to User Manual for the hybrid inverter. Used to switch the power supply for all loads from the inverter to the grid when the hybrid inverter requires maintenance.
AC circuit breaker	-	Several	The customer must procure circuit breakers of the recommended specifications and install them on the designated ports of the hybrid inverter in accordance with the "Electrical Connections" section of User Manual for inverters. The recommended specifications shall be referred to User Manual for the hybrid inverter.
PV module	-	-	The customer must procure the parts separately.
Dual-power automatic transferring switch (ATS)	-	1	This device is required for scenarios where both the grid and a generator are connected. Prepared by the customer. Select according to the specifications of the main circuit breaker in the system.
Diesel generator (with a controller)	-	1	In scenarios involving a generator, the customer must provide their own diesel generator. For legacy generators without a DI port, a diesel generator controller with a DI port must be purchased.
Transceiver	SR200T-B M	One transceiver for each hybrid	Optional. Customers can purchase it as needed. Available only in the Thailand region , and supported exclusively by SH125CX. It is currently not supported for other regions or

Component	Model	Quantity	Remarks
		inverter	models.
RSD	SR20D-M	One RSD for every two PV modules	In grid-connected/off-grid switching scenarios, RSDs and transceivers are only applicable to systems containing exclusively SHCX series hybrid inverters, and are not applicable to systems containing PV inverters.
Emergency stop device	-	1	SUNGROW does not provide the emergency stop device, so the customer must procure one of the recommended specifications. The emergency stop device is connected to the DI5 port of Logger1000 to receive the DI signal from the device.
Miscellaneous	-	Several	RS-485 cable, CAN communication cable, and power cable, etc. The customer must procure the parts separately.

Note 1: When a third-party PV inverter retrofitted system (with no diesel generator connected), two sets of CTs are required, and the fast meter must be the DTSU666-20 dual-channel meter. For third-party PV inverter retrofitted systems (with a diesel generator connected), three sets of CTs are required, and the fast meter configuration requires one DTSU666-20 dual-channel meter plus one single-channel meter compatible with Logger1000.

5.2 Partial Home Backup (New)

5.2.1 Scenario Description

The partial power backup solution is suitable for regions with unstable grids, providing dual-mode operation with grid dependence and energy independence. This solution connects backup loads to the off-grid side of the hybrid inverter. When the grid is normal, the system prioritizes PV power consumption and provides power backup for

backup loads. During a grid interruption, it switches seamlessly to off-grid or microgrid mode, and the system continues to supply power to backup loads connected to the off-grid side. When load demand exceeds the current power of the PV system, the BESS discharges to fill the energy gap.

The parallel system using the SH100CX, SH110CX, or SH125CX inverter supports two load connection modes: **distributed load** (one backup port connected to one load); **centralized load** (all backup ports connected to one load). The parallel system using the SH50CX or SH80CX inverter supports the **distributed load**.

Distributed load: All grid terminals of the hybrid inverter are connected in parallel, while the load terminals and battery terminals are not, as shown below. In the event of a grid outage, each hybrid inverter independently supplies power to the load connected to its own load port.

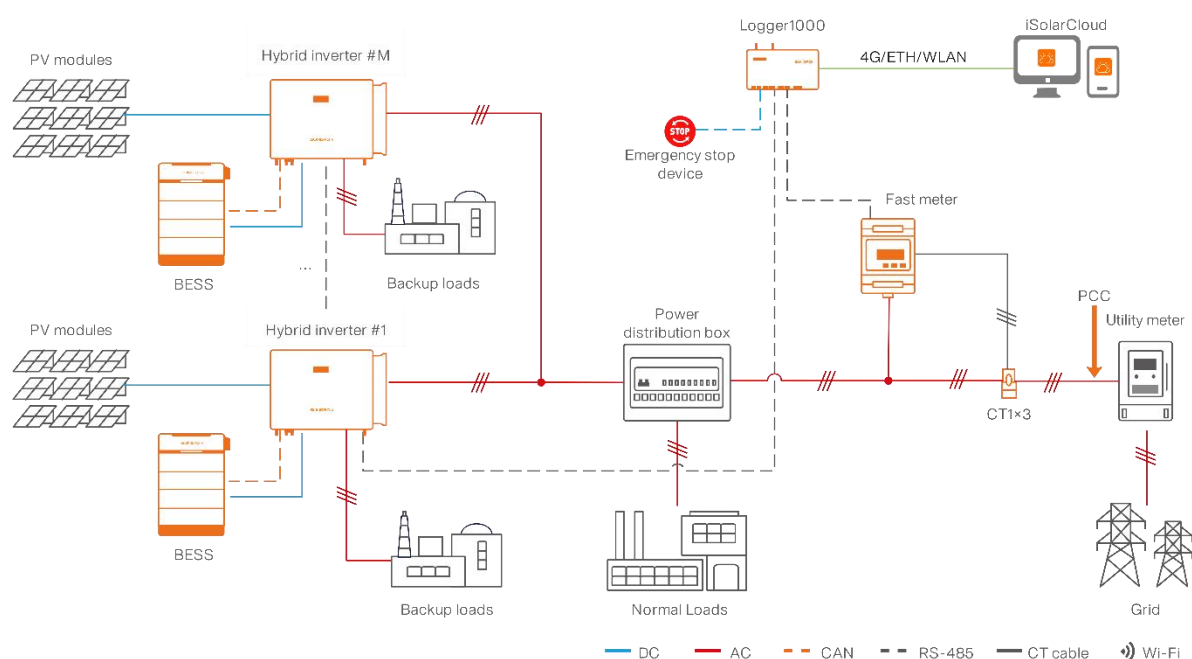


Fig.5-1 Partial Power Backup Plant-Level Communication Topology (One for One)

Centralized load: The grid terminals and load terminals of the hybrid inverter are connected in parallel separately, as shown below:

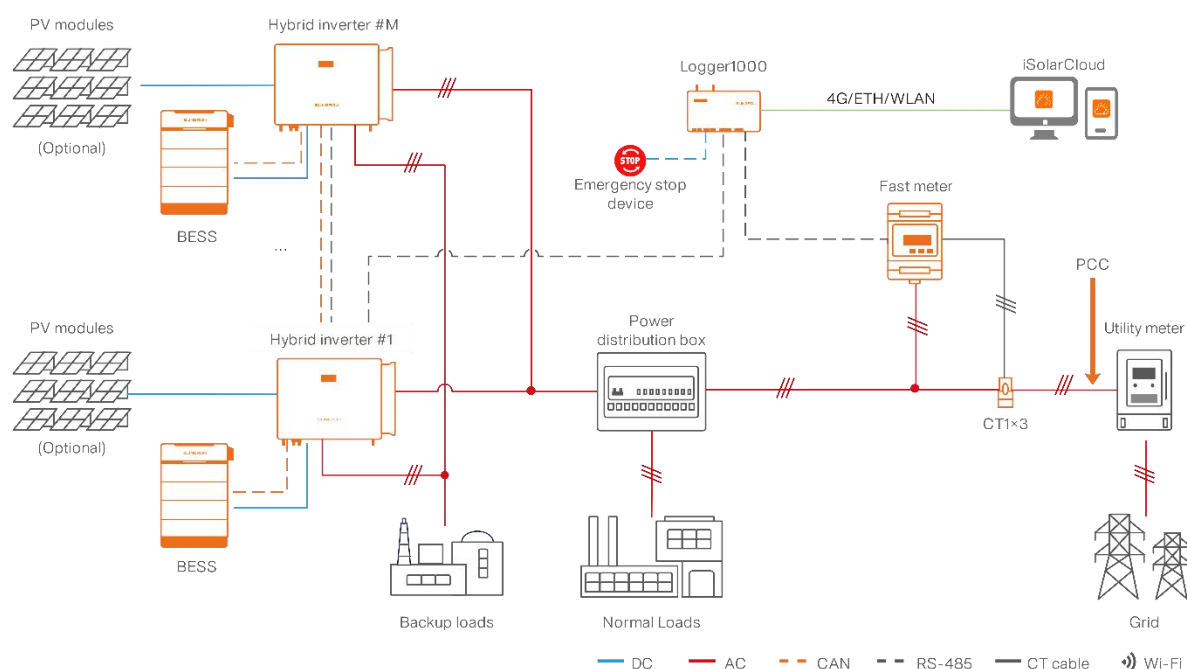


Fig.5-2 Partial Power Backup Plant-Level Communication Topology (All for One)

Note: The SH110/125CX hybrid inverter supports connection to a diesel generator. For the relevant topology, refer to ["5.2.3.10 Diesel Generator"](#).

5.2.2 System Characteristics

In addition to the characteristics described in ["4.2.2 System Characteristics"](#), the partial power backup system also has the following characteristics:

- The system supports both grid-connected and off-grid operations. In the event of a grid outage, the system switches seamlessly to off-grid mode; grid-connected loads will lose power, while off-grid loads remain operational.
- For systems without an on/off-grid switching cabinet, up to six inverters can be connected in parallel, and the master-slave mode must be set.
- The SH100CX, SH110CX, and SH125CX hybrid inverters support parallel configuration with centralized or distributed loads. The SH50CX and SH80CX hybrid inverters only support distributed loads and do not support parallel configuration with a centralized load.

- Grid-connected/off-grid switching: Single-inverter switching time is ≤ 10 ms, and multi-inverter switching time is ≤ 20 ms.
- In both grid-connected and off-grid modes, the inverter can supply 100% power to unbalanced loads, with each phase delivering up to one-third of the rated output power.
- SH80CX, SH100CX, SH110CX, and SH125CX support single-phase half-wave loads of up to 6 kW; SH50CX supports single-phase half-wave loads of up to 3 kW.
- In single-inverter off-grid mode, the maximum power can reach 1.5 times the rated power for 10 seconds, provided that the combined PV power and BESS discharge power is ≥ 1.5 times the rated power. The actual peak output power is determined by the PV power and BESS discharge power.
- Off-grid backup time: Determined based on backup load power, expected runtime, and BESS capacity, where Power backup SOC = Load power $\times$ Runtime/BESS capacity.

Systems connected to a generator and the grid also feature the following:

- After grid connection is enabled and the generator is connected to the grid port, the system can automatically switch among grid-connected, off-grid, and microgrid modes.
 - When the grid is normal, the system operates in grid-connected mode and the generator will not start unless manually turned on externally.
 - When the grid fails, the system operates in microgrid or off-grid mode depending on the generator control mode. The operation of the generator can be controlled via dry contact control (SOC control or mandatory control) or manual control to determine whether the generator starts. If the generator does not start, the system operates in off-grid mode; if the generator starts, the system operates in microgrid mode.

- The system includes a feature to prevent PV power from feeding into the generator. Once the generator starts running, PV power is used exclusively to charge the battery, not to supply power to loads. Battery charging power comes from PV generation first; if PV generation is insufficient, the remaining power from the generator will be used to charge the battery. The battery charging power from the generator is the lower value between the actual remaining power of the generator and the preset maximum charging power.
- A generator silent mode is available by enabling "Generator night mode" and setting a start/stop time period, during which the generator will not operate. Generator silent mode is available only when the control mode is set to SOC control—that is, controlled via the inverter DO.

5.2.3 System Requirements

5.2.3.1 Firmware Updates

For system component version requirements, refer to the version requirements in ["4.2.3.1 Firmware Updates"](#).

- It is recommended to perform firmware updates under grid-connected conditions to avoid update failure.
- Updates are supported for the hybrid inverter, Logger1000, and BESS.

5.2.3.2 Hybrid Inverter

In addition to the requirements described in ["4.2.3.2 Hybrid Inverter"](#) in the pure grid-connected scenario, the following must be met:

- The total power of the backup loads connected to the hybrid inverter's off-grid side cannot exceed the inverter's load capacity. Refer to Load Capacity Table for details.
- When backup loads are connected to the off-grid side, enable the "Automatic recharge to backup SOC for off-grid operation" function. When the system is in grid-connected operation and PV power is insufficient, the system can purchase

power from the grid to charge the batteries, maintaining the BESS SOC at the preset backup SOC value for off-grid operation.

- For a parallel configuration with a centralized load, the inverters must be of identical models; for a parallel configuration with distributed loads, the inverter models can be different.
- SH125CX supports the rapid shutdown device (RSD) + transceiver solution, whereas SH50/80/100/110CX models do not. For SH125CX, using a RSD + transceiver system requires a battery capacity of 100 kWh or higher.
- In grid-connected/off-grid switching scenarios, SH50/80/100CX models do not support diesel generator integration. In contrast, SH110/125CX models support diesel generator integration.

5.2.3.3 BESS

In addition to the requirements described in ["4.2.3.3 BESS"](#) in the pure grid-connected scenario, the following must be met:

- When the hybrid inverter has no PV input, the following settings must be applied to protect the BESS from deep discharge.
 - Set the SOC lower limit to a value higher than 10%.
 - Automatic recharge to backup SOC for off-grid operation must be enabled.
 - Set the BESS forced charging time during off-peak electricity price periods to ensure the BESS is charged using low-cost grid power. Otherwise, if the BESS enters forced charging mode, it may purchase power from the grid during peak price periods.
- For a parallel system with all backup ports connected to one load, the battery capacity assigned to each hybrid inverter shall be consistent.

5.2.3.4 Battery Combiner Box

For detailed requirements regarding the battery combiner box, refer to the system requirements in the pure grid-connected scenario in ["4.2.3.4 Battery Combiner Box"](#).

5.2.3.5 Logger1000

In addition to the requirements described in ["4.2.3.5 Logger1000"](#) in the pure grid-connected scenario, the following must be met:

- Connect Logger1000 (or COM100D/E/D-EU) to the backup port of the hybrid inverter to ensure power supply during a grid outage.

5.2.3.6 Meter and CT

For detailed requirements regarding the meter and CT, refer to the system requirements in the pure grid-connected scenario: ["4.2.3.6 Meter and CT"](#).

5.2.3.7 PV Modules

For detailed requirements regarding PV modules, refer to the system requirements in the pure grid-connected scenario: ["4.2.3.7 PV Modules"](#).

5.2.3.8 Transceiver and RSD

System connections (showing only parts related to the transceiver and RSD) are as follows:

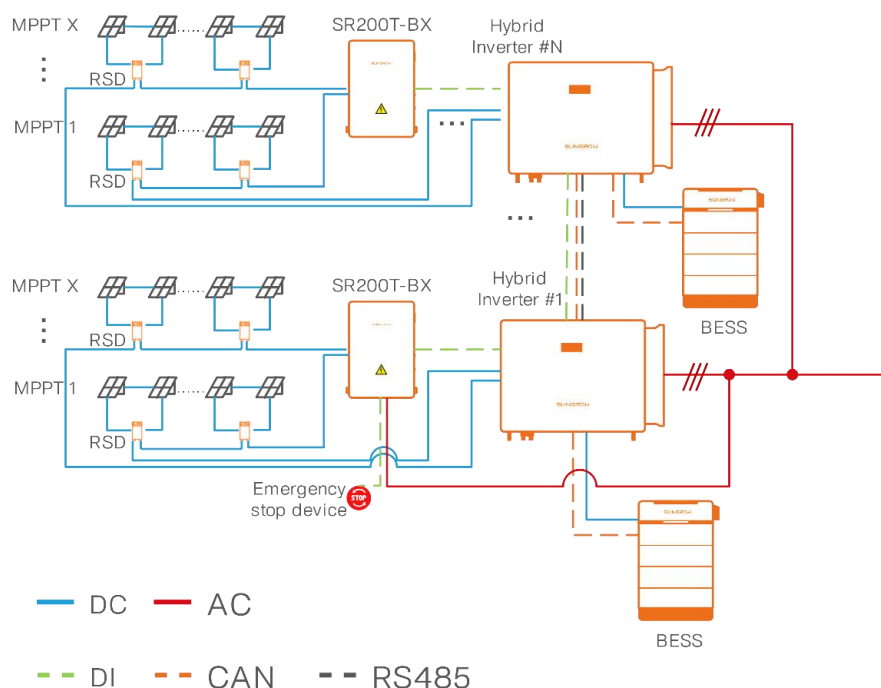


Fig.5-3 System Connections of Transceiver and RSD

In addition to the requirements described in "[4.2.3.9 Transceiver and RSD](#)" in the pure grid-connected scenario, the following must be met:

- If the hybrid inverter is connected to a backup load, connect the transceiver to the load.
- Shutdown conditions: Can only be triggered by emergency stop or arc fault.

5.2.3.9 Dual-Power ATS

- In some power backup scenarios, the grid and generator are connected to the **grid connection** port of the hybrid inverter via the dual-power automatic transferring switch (ATS).
- The wiring and configuration of the dual-power ATS must ensure that the grid input has higher priority than the generator input. For example, if AC terminal 1 on the dual-power ATS has priority over AC terminal 2, connect the grid to AC terminal 1. For the exact locations of the AC terminals, see User Manual for the dual-power ATS.
- The dual-power ATS can switch automatically based on grid status and does not require control from any other external device.

5.2.3.10 Diesel Generator

- The system connection is shown below:

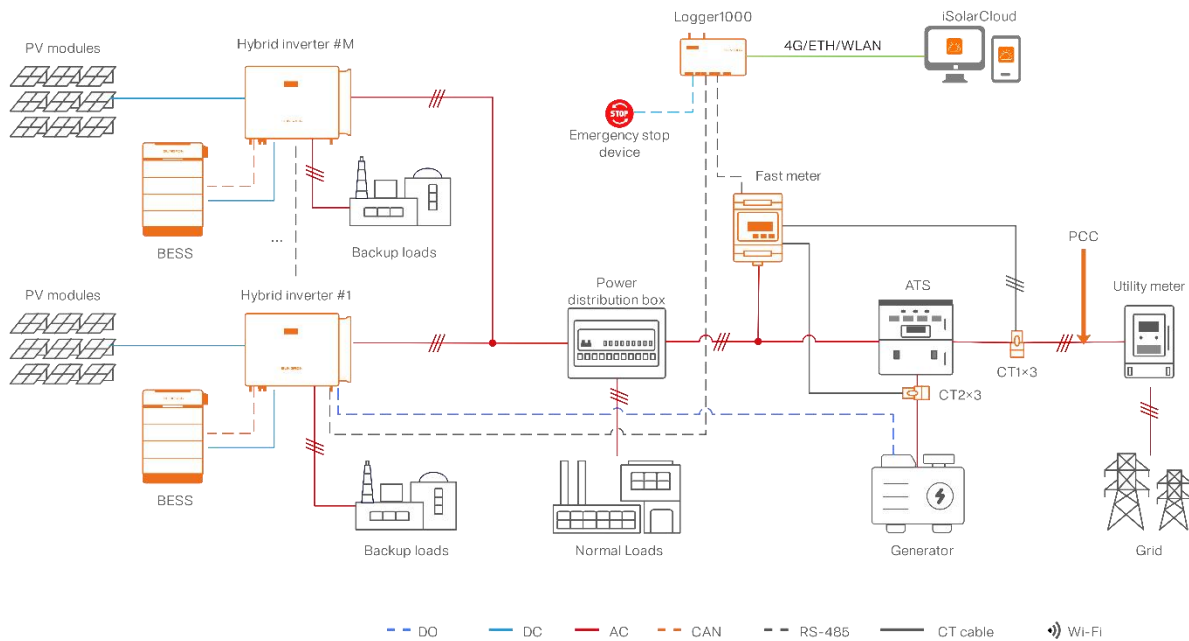


Fig.5-4 Partial Power Backup Plant-Level Communication Topology (One for One, Including Generator)

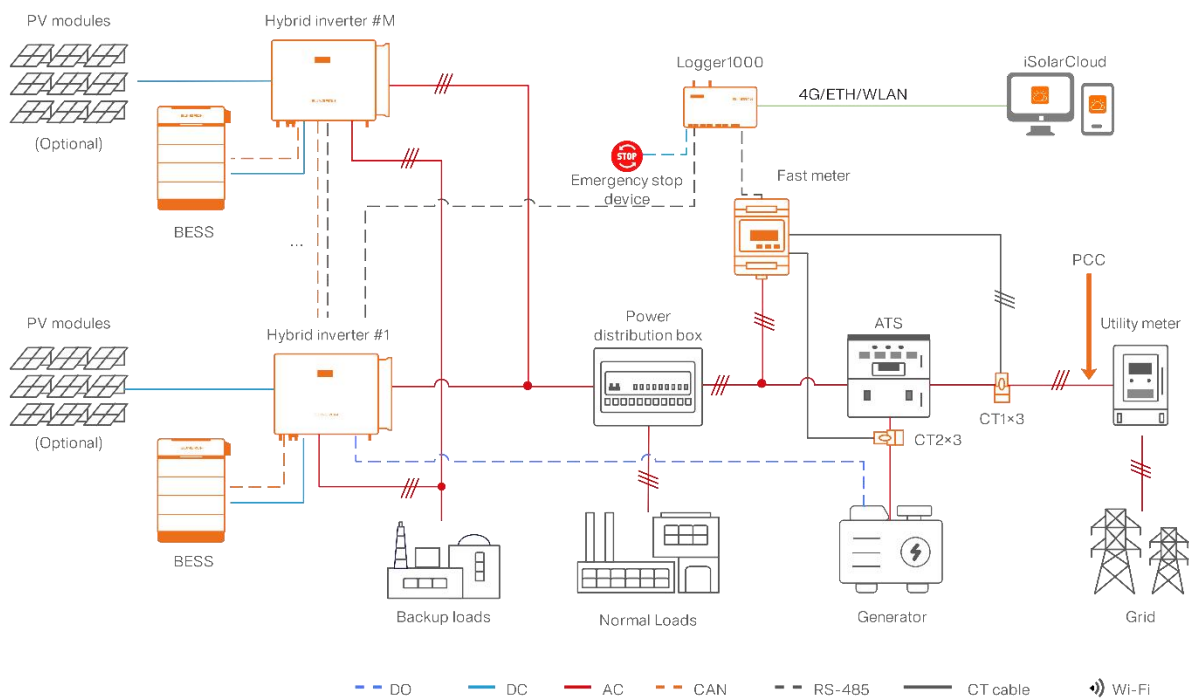


Fig.5-5 Partial Power Backup Plant-Level Communication Topology (All for One, Including Generator)

- The grid and generator are connected to the grid connection port of the hybrid inverter (for SH110/125CX only) via the dual-power ATS.
- The rated power of the generator must be at least equal to the total load power. It is recommended that the rated power of the generator be greater than the sum of the inverter power and the total load power.
- Generators with a DI port for dry contact control are recommended, as they can be connected directly to the DO port of the inverter. For a legacy generator that does not support a DI port for dry contact control, users need to install a generator controller with a DI port, or set the control mode to manual control.
- When the generator is stopped by the dry contact signal from the inverter, the interval between the stop and the next start must be greater than 30 seconds. When the generator starts or stops by an external method, see the generator manual for the required interval between a start and the previous stop.

5.2.3.11 Loads

- Normal loads are connected to the grid-side of the hybrid inverter. If the grid fails, these loads will be unable to operate.
- Backup loads are connected to the off-grid side of the hybrid inverter. Even in the event of a grid failure, uninterrupted power supply to backup loads is guaranteed.
- The total power of the loads connected to the inverter's off-grid side cannot exceed the system's off-grid load carrying capacity. Refer to *Load Carrying Capacity Table* for details.

5.3 Plant-Level Backup (New)

5.3.1 Scenario Description

This solution is particularly suitable for areas with limited grid supply. In this scenario, all loads are connected to the off-grid side of the hybrid inverter through a manual changeover switch. During normal operation of the hybrid inverter, the loads are powered from the off-grid side of the inverter and are not supplied directly by the grid.

If a grid outage occurs, all loads can still be powered by a PV system or BESS. When the inverter requires maintenance, the manual changeover switch can transfer the load supply from the inverter's off-grid side to the grid, enabling the grid to power all loads. The plant-level system communication topology is shown below:

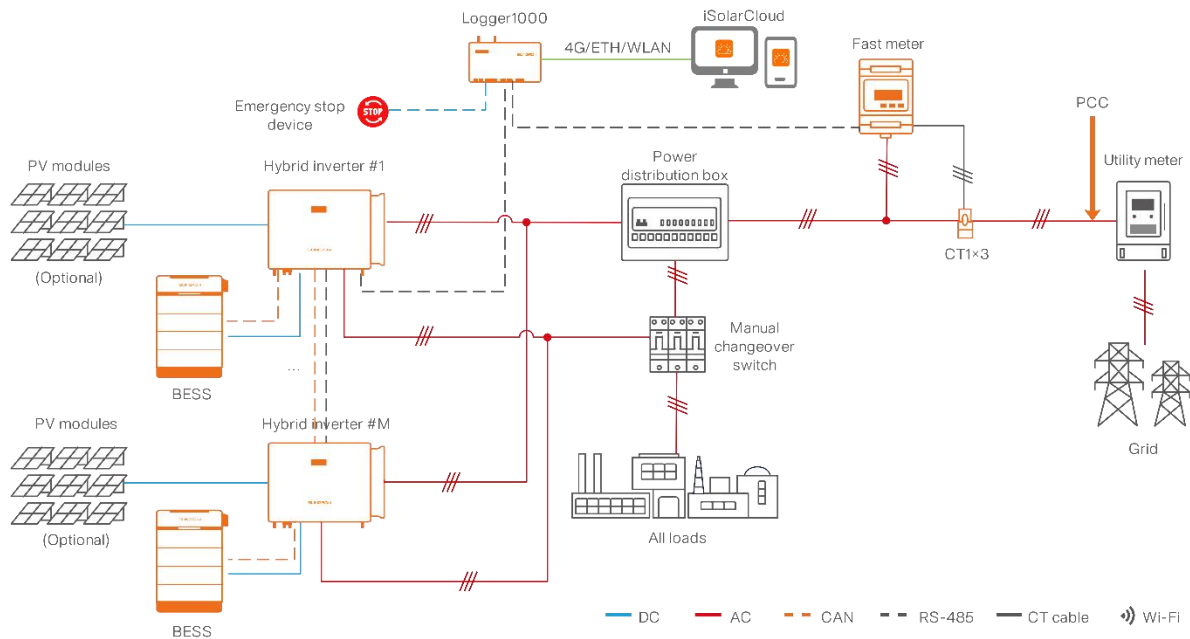


Fig.5-6 Plant-Level Power Backup Communication Topology (All for One, Without Generator)

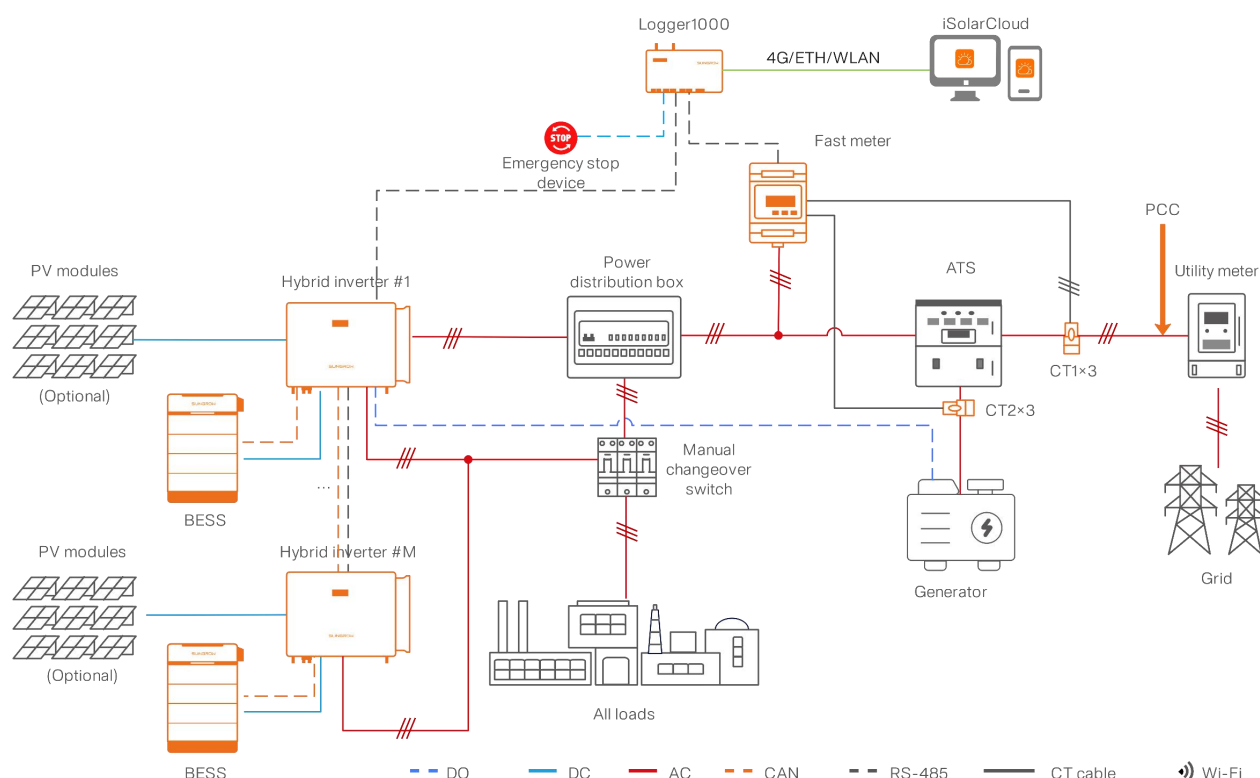


Fig.5-7 Plant-Level Power Backup Communication Topology (All for One, with Generator)

5.3.2 System Characteristics

In addition to the partial home backup characteristics described in ["5.2.2 System Characteristics"](#), the plant-level backup system also has the following characteristics:

- Whole-home loads can be connected to the off-grid side, eliminating the need for complex rewiring of load circuit breakers in the power distribution box (i.e., no need to distinguish between normal loads on the grid-side and backup loads on the off-grid side).
- During inverter maintenance, an external manual changeover switch is used to switch to the grid, providing uninterrupted power supply to all loads.
- During grid outages, PV generation and BESS power can be utilized to the maximum extent.

5.3.3 System Requirements

In addition to the partial backup system requirements described in ["5.2.3 System Requirements"](#), the plant-level backup system must also follow these requirements:

- It is recommended to install a manual changeover switch (provided by the customer) between the grid-side and off-grid side of the inverter, used to switch to grid power supply during inverter maintenance. The specifications of the manual changeover switch should refer to the current and local installation regulations.
- All loads should be connected to the off-grid side of the hybrid inverter through the external manual changeover switch. Otherwise, the loads will not be powered in the event of a grid failure.
- When maintenance is required for the BESS, the changeover switch should also be manually turned to grid power supply. At this time, the loads will be powered by the grid.
- During off-grid operation, the total power of loads running on the off-grid side cannot exceed the inverter's off-grid load carrying capacity. It is recommended to configure redundant power to handle load fluctuations. If the load power is too high, please manually shut down some loads to ensure stable system operation.

5.4 Retrofit on Grid Side

5.4.1 Scenario Description

This solution upgrades the existing PV system to a PV ESS by adding hybrid inverters and BESSs while retaining the existing PV system. In the grid-side retrofit configuration, the AC terminals of the existing PV inverters are paralleled with the grid-connected side of the hybrid inverter. The plant-level communication topologies are shown below:

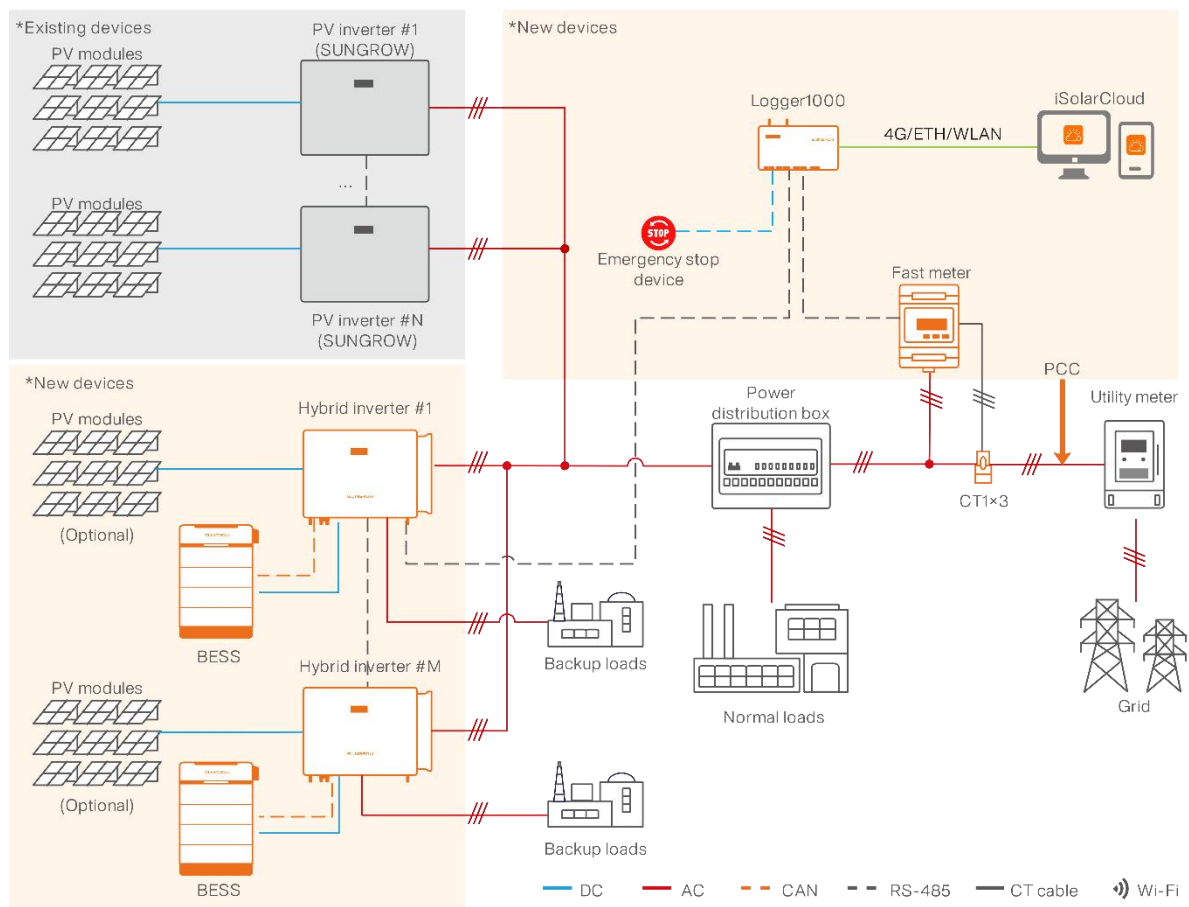


Fig.5-8 Plant-Level Communication Topology (Based on Retrofit of SUNGROW PV System, Without Generator)

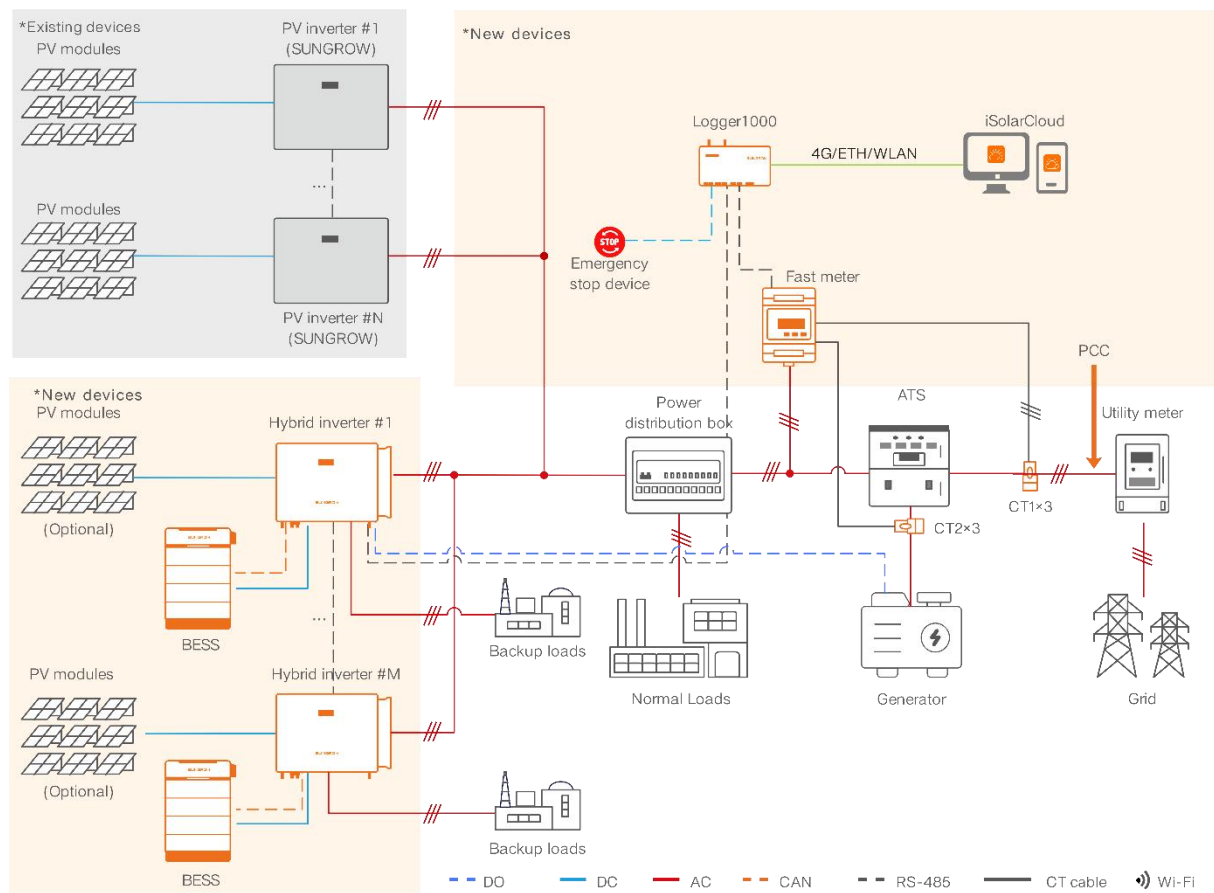


Fig.5-9 Plant-Level Communication Topology (Based on Retrofit of SUNGROW PV System, with Generator)

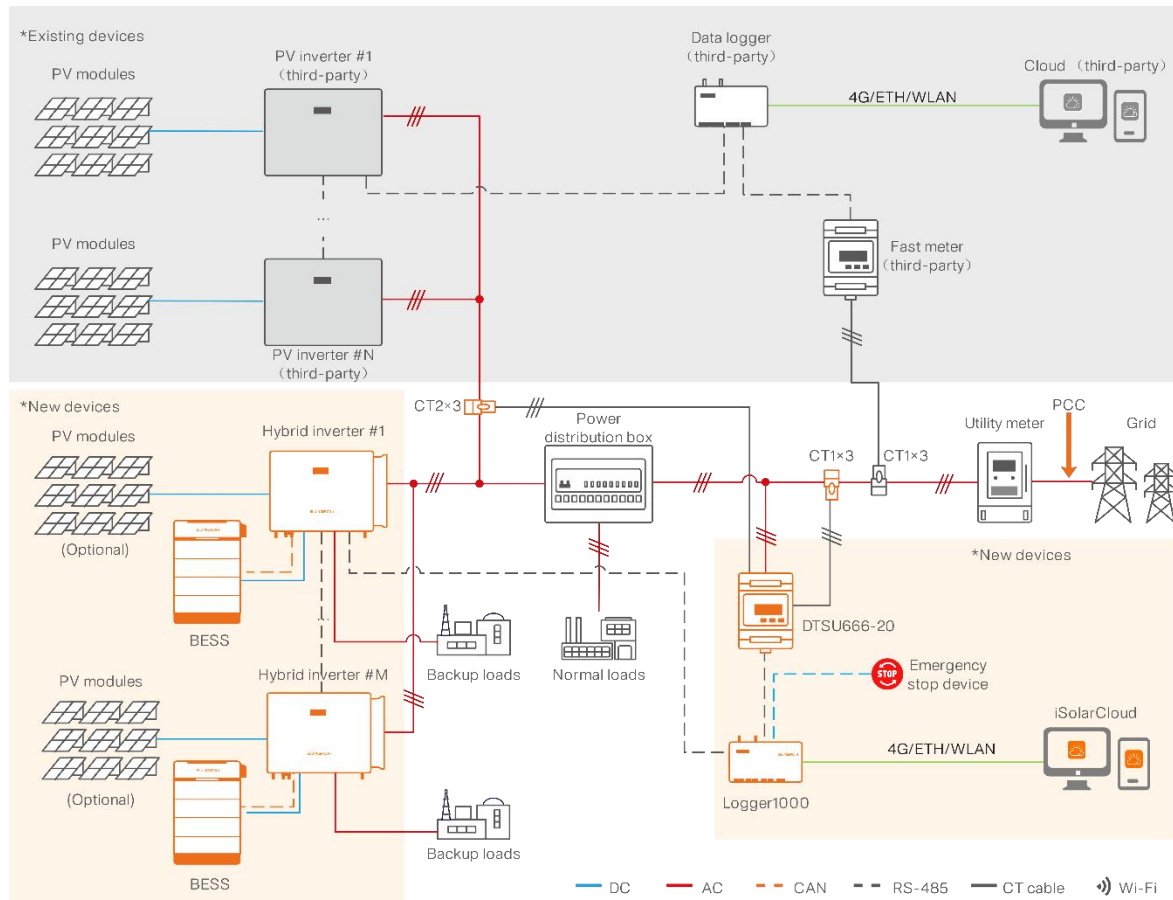


Fig.5-10 Plant-Level Communication Topology (Based on Retrofit of Third-Party PV System, Without Generator)

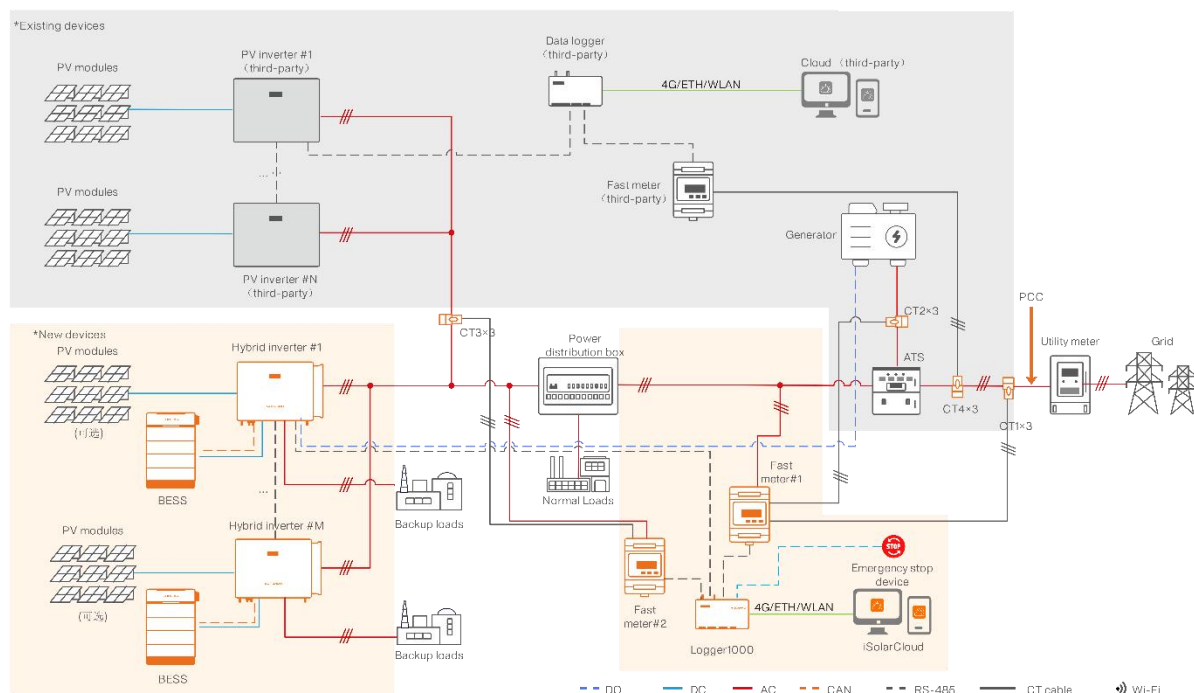


Fig.5-11 Plant-Level Communication Topology (Based on Retrofit of Third-Party PV System, with Generator)

5.4.2 System Characteristics

In addition to the partial power backup system characteristics described in ["5.2.2 System Characteristics"](#), the grid-connected side retrofitted system also has the following characteristics:

- Functional three-phase PV systems from SUNGROW or third-party brands can be retrofitted.
- The existing PV modules and PV inverters can be retained. Hybrid inverters (up to six units) can be added on the AC side, and PV modules (optional) and BESSs can be connected to the hybrid inverters.
- For third-party PV retrofit systems, the existing third-party data loggers and meters can be retained. SUNGROW Logger1000 and meters must be installed. Users must use both iSolarCloud and the third-party cloud for plant management.

5.4.3 System Requirements

In addition to some backup system requirements described in ["5.2.3 System Requirements"](#), the grid-side retrofitted system must also follow these requirements:

- For a SUNGROW PV retrofitted system:
 - For compatible SUNGROW PV inverter models, refer to the SHCX series Single-Inverter System Application Manual.
 - Number of PV inverters + Number of hybrid inverters ≤ 24 , where the number of hybrid inverters ≤ 6 .
 - If a Logger1000 is already present, it and the fast meter can be reused. Otherwise, a new Logger1000 and compatible fast meter must be installed. For specific models, refer to ["3.6 Fast Meter"](#).
 - If a new fast meter is installed, CT1 of the fast meter must be installed on the grid-side.
 - Hybrid inverters and PV inverters must be installed within the same PV plant.
- For a third-party PV retrofitted system:
 - Existing third-party PV inverters remain connected to their original data loggers and meters.
 - New hybrid inverters (≤ 6 units) must be connected to a SUNGROW fast meter and Logger1000, and the SUNGROW dual-channel fast meter DTSU666-20 is mandatory.
 - If no generator is connected to the system: Install CT1 on the grid-side and CT2 on the AC side of the existing PV inverters. Connect both to the SUNGROW dual-channel fast meter to collect third-party PV data and upload it to iSolarCloud via Logger1000.
 - If a generator is connected to the system: Install CT1 on the grid side (connected to Channel 1 of the DTSU666-20 dual-channel meter), and install CT2 on the diesel generator side (optional; connected to Channel 2 of the

DTSU666-20 dual-channel meter to measure grid-connected power and diesel generator output power). Additionally, install CT3 on the AC side of the existing PV inverter (optional; connected to a single-channel meter compatible with Logger1000).

- The zero export control accuracy must be set separately for SUNGROW Logger1000 and the third-party data logger to control their respective inverters. For stable control, the SUNGROW Logger1000's zero export feed-in accuracy is typically set **slightly lower than** that of the third-party's data logger to prioritize the zero export strategy of SUNGROW. The hybrid inverter only ensures zero power output to the grid, but it cannot guarantee zero-export of the existing PV inverters. Contact the PV inverter manufacturer for their feed-in power limit solutions.

Example: The zero export control accuracy of Logger1000 is set to $K1 \times$ the rated output power of the hybrid inverter ($K1$ is negative, allowing a small amount of energy purchase from the grid), while the zero export control accuracy of the third-party data logger is set to $K2 \times$ the rated output power of the hybrid inverter, where $K1 < K2 = 0$.

- When the hybrid inverter has no PV input, the depth of discharge (DOD) of the BESS must be set for battery protection. Refer to the ST050CF–ST250CF User Manual for details.
- In grid-connected/off-grid switching retrofit scenarios involving both SHCX series hybrid inverters and PV inverters (SUNGROW or third-party models), no RSDs or transceivers can be configured.

6 Pure Off-Grid PV & ES Integration Scenario

6.1 System Configuration

Tab.6-1 Pure Off-Grid System Configuration

Component	Model	Quantity	Remarks
Hybrid inverter	SHCX series	1–6	Europe, Middle East and Africa, and Southeast Asia: SH50CX, SH80CX, or SH125CX For a parallel configuration with a centralized load, the inverters must be of identical models; for a parallel configuration with distributed loads, the inverter models can be different.
BESS	ST050CF– ST250CF	Several	BESSs must be connected to the hybrid inverters. One inverter can be directly connected to one Rack of SUNGROW same-series BESS. Through a battery junction box, one inverter can be connected to 2–4 Racks of SUNGROW same-model BESSs. The capacity of each BESS is optional from 50 kWh to 250 kWh.
Battery junction box	SJC160-02	Several	One inverter requires a battery junction box to connect more than one BESS. A single battery junction box allows for two inputs and one output. When one inverter is connected to two, three, or four Racks of SUNGROW same-model BESSs, one, two, or three battery junction boxes are required

Component	Model	Quantity	Remarks
			respectively.
Logger1000	Logger1000 COM100	1	Europe: Logger1000A-EU or COM100D-EU; Middle East and Africa, and Southeast Asia: Logger1000B or COM100E The specific model is subject to local availability.
Fast meter	DTSU666-20, etc.	1	If the system is connected to a generator, a meter is required. Any meter model compatible with Logger1000 can be used (for details, see "Electrical Connections" in User Manual of the selected model). The fast meter must be connected to the main inverter.
PV module	-	-	The customer must procure the parts separately.
Diesel generator (with a controller)	-	1	In scenarios involving a generator, the customer must provide their own diesel generator. For legacy generators without a DI port, a diesel generator controller with a DI port must be purchased.
Transceiver	SR200T-BM	One transceiver for each hybrid inverter	Optional. Customers can purchase it as needed. Available only in the Thailand region , and supported exclusively by SH125CX. It is currently not supported for other regions or models.
RSD	SR20D-M	One RSD for every two PV	

Component	Model	Quantity	Remarks
		modules	The shutdown function is not supported in scenarios without a generator.
Emergency stop device	-	1	SUNGROW does not provide the emergency stop device, so the customer must procure one of the recommended specifications. The emergency stop device is connected to the DI5 port of Logger1000 to receive the DI signal from the device.
Miscellaneous	-	Several	RS-485 cable, CAN communication cable, and power cable, etc. The customer must procure the parts separately.

6.2 Pure Off-Grid PV ESS (New)

6.2.1 Scenario Description

This scenario is applicable to a new off-grid PV ESS, in which the PV array and ESS are integrated on the DC side of the hybrid inverter. A pure off-grid system is not connected to the grid but can be connected to a generator, and all loads must be connected to the off-grid side of the hybrid inverter. The communication topology for the plant-level retrofit is shown below:

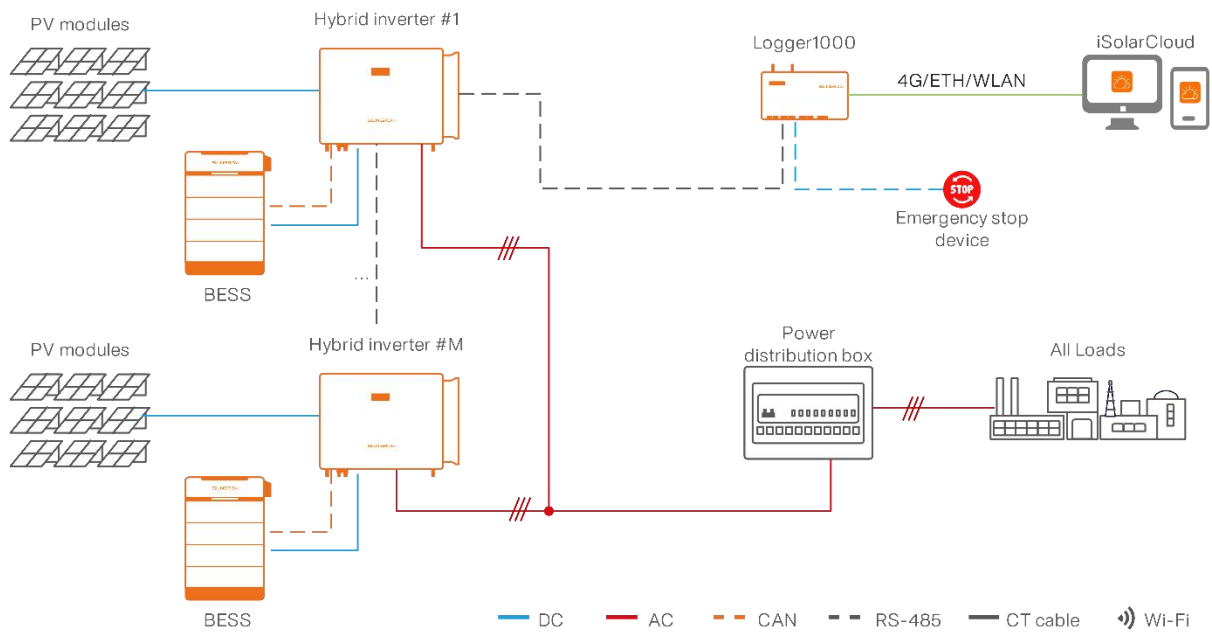


Fig.6-1 Plant-Level Communication Topology (Without Diesel Generator)

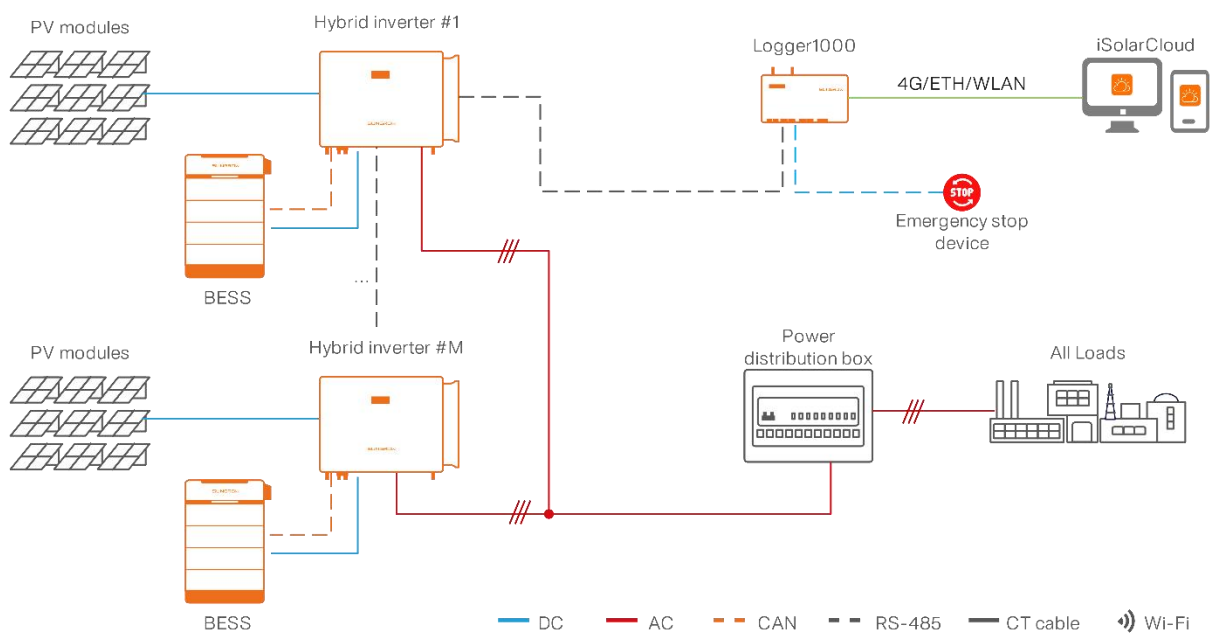


Fig.6-2 Plant-Level Communication Topology (With Diesel Generator)

6.2.2 System Characteristics

- Working mode: The hybrid inverter operates in voltage/frequency (VF) mode, providing an off-grid voltage source.

- For systems without an on/off-grid switching cabinet, up to six inverters can be connected in parallel.
- The SH100CX, SH110CX, and SH125CX hybrid inverters support parallel configuration with centralized or distributed loads. The SH50CX and SH80CX hybrid inverters only support distributed loads and do not support parallel configuration with a centralized load.
- During off-grid operation, the BESS is subject to the risk of overdischarge. When PV input is insufficient and the BESS SOC is low, the system may be unable to sustain the load, potentially resulting in frequent load start/stop events. Enable **Off-grid emergency charging** and set **Target SOC of off-grid emergency charging**. When the BESS SOC drops to the lower limit + 0.1%, the inverter stops off-grid-side output (i.e., stops supplying power to off-grid loads). PV power generation is used to charge the BESS until the SOC reaches the target SOC of off-grid emergency charging + 5%. The inverter subsequently resumes off-grid-side output, and the load is supplied jointly by PV and the BESS.
- In off-grid mode, the inverter can supply 100% power to unbalanced loads, with the maximum output power per phase limited to one third of the rated output power.
- SH80CX, SH100CX, SH110CX, and SH125CX support single-phase half-wave loads of up to 6 kW; SH50CX supports single-phase half-wave loads of up to 3 kW.
- In single-inverter off-grid mode, the maximum power can reach 1.5 times the rated power for 10 seconds, provided that the combined PV power and BESS discharge power is ≥ 1.5 times the rated power. The actual peak output power is determined by the PV power and BESS discharge power.
- Performing online updates in off-grid mode will result in load power-off. To avoid this, updates can be performed via local access mode, or the router can be supplied by an independent power source to enable online updates.

Systems connected to a generator also feature the following:

- After the generator is connected to the grid port (ensure grid connection is disabled), the system can automatically switch between off-grid and microgrid modes. Depending on the generator control mode, the system operates in either microgrid or off-grid mode. The operation of the generator can be controlled via dry contact control (SOC control or mandatory control) or manual control to determine whether the generator starts. If the generator does not start, the system operates in off-grid mode; if the generator starts, the system operates in microgrid mode.
- The system includes a feature to prevent PV power from feeding into the generator. Once the generator starts running, PV power is used exclusively to charge the battery, not to supply power to loads. Battery charging power comes from PV generation first; if PV generation is insufficient, the remaining power from the generator will be used to charge the battery. The battery charging power from the generator is the lower value between the actual remaining power of the generator and the preset maximum charging power.
- A generator silent mode is available by enabling "Generator night mode" and setting a start/stop time period, during which the generator will not operate. Generator silent mode is available only when the control mode is set to SOC control—that is, controlled via the inverter DO.
- When the generator is controlled by the inverter via dry contact signals, the system tracks both the daily number of generator start/stop cycles and the total cycle count to help evaluate the generator maintenance schedule. Users can view this information via the iSolarCloud App.

6.2.3 System Requirements

6.2.3.1 Firmware Update

For system component version requirements, please refer to ["4.2.3.1 Firmware Updates"](#).

- The system can be updated remotely via iSolarCloud or locally via Logger1000. For details, refer to the *Logger1000 User Manual*. The hybrid inverter itself can also be updated locally by establishing a communication link between the inverter's integrated Bluetooth and a mobile phone. (Note: The hybrid inverter's Bluetooth function is intended solely for firmware updates.)
- Online updates in the off-grid mode will result in load power-off. During the inverter update, Logger1000 will lose power briefly. After a successful update, the system will restart and resume the power supply.

6.2.3.2 Hybrid Inverter

In addition to the requirements in "[4.2.3.2 Hybrid Inverter](#)" in the pure grid-connected scenario, the following must be met:

- For a parallel configuration with a centralized load, the inverters must be of identical models; for a parallel configuration with distributed loads, the inverter models can be different.
- SH125CX supports the RSD + transceiver solution, whereas SH50/80/100/110CX models do not. For SH125CX, if a shutdown solution needs to be configured, the minimum battery configuration is ST100CF (with a capacity of no less than 100 kWh).
- In pure off-grid scenarios, SH50/80CX does not support diesel generator connection. SH100/110/125CX supports diesel generator connection.

6.2.3.3 BESS

In addition to the system requirements described in "[4.2.3.3 BESS](#)" in the pure grid-connected scenario, the pure off-grid system must follow these requirements:

- Each hybrid inverter must be connected to a BESS and supports connection to one Rack of ST050CF–ST250CF BESS.
- For a parallel system with all backup ports connected to one load, the battery capacity assigned to each hybrid inverter shall be consistent.

- **Off-grid emergency charging** must be enabled. It is recommended to set the target SOC of off-grid emergency charging to $\geq 20\%$. If the target SOC is set below 20% and PV input is insufficient or unavailable for an extended period, the battery may enter deep discharge due to inherent self-consumption. Prolonged deep discharge of the battery may result in:
 - reduced cycle life.
 - If the battery voltage falls below the minimum voltage allowed by the inverter, the inverter will be unable to charge the battery, which may lead to battery damage. For the allowable battery voltage range of the inverter, refer to the "Technical Data" section in the appendix of the inverter *User Manual*.
- When the BESS SOC drops to 5% and PV charging is expected to be unavailable for more than one day (for example, during continuous cloudy or rainy weather), it is recommended to manually shut down the BESS. The BESS can be manually restarted when PV charging is available to the BESS.

6.2.3.4 Battery Combiner Box

For detailed requirements regarding the battery combiner box, refer to the system requirements in the pure grid-connected scenario in ["4.2.3.4 Battery Combiner Box"](#).

6.2.3.5 Logger1000

- Connect Logger1000 (or COM100D/E/D-EU) to the backup port of the hybrid inverter to ensure power supply during a grid outage.
- Data display and energy management are performed using Logger1000 (indoor installation) or COM100D/E/D-EU (outdoor installation).
- It is recommended to use Ethernet communication between Logger1000 (or COM100D/E/D-EU) and the router, with a communication distance ≤ 100 m.
- Logger1000 (or COM100D/E/D-EU) communicates with the inverter via RS-485, with a communication distance of ≤ 1000 m. Connect RS485_1 (A1, B1) of the inverter to the RS-485 terminal (A1, B1) on Logger1000 (or COM100D/E/D-EU), as shown in the figure below:

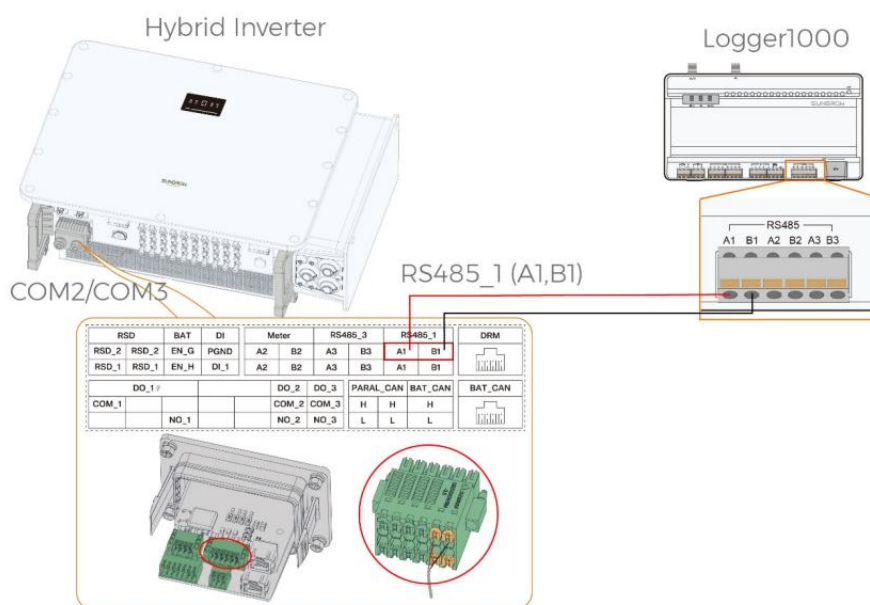


Fig.6-3 RS-485 Communication Between Inverter and Logger1000

6.2.3.6 PV Modules

- PV modules must be configured in this system.
- For other requirements regarding PV inputs, refer to the requirements in ["4.2.3.7 PV Modules"](#).

6.2.3.7 Transceiver and RSD

- Connecting transceivers and RSDs is optional only when the system is connected to a generator. If no generator is connected, transceivers and RSDs are not supported.
- For other requirements regarding the transceiver and RSD, see requirements for ["5.2.3.8 Transceiver and RSD"](#) in pure off-grid scenarios.

6.2.3.8 Diesel Generator

- The rated power of the generator must be at least equal to the total load power. It is recommended that the rated power of the generator be greater than the sum of the inverter power and the total load power.
- Generators with a DI port for dry contact control are recommended, as they can be connected directly to the DO port of the inverter. For a legacy generator that

does not support a DI port for dry contact control, users need to install a generator controller with a DI port, or set the control mode to manual control.

- When the generator starts or stops by the dry contact signal from the inverter, the interval between two consecutive starts must be greater than 30 seconds. When the generator starts or stops by an external method, see the generator manual for the required interval between a start and the previous stop.

6.2.3.9 Loads

- All loads are connected to the inverter on the off-grid side.
- The total power of the loads connected to the inverter's off-grid side cannot exceed the system's off-grid load carrying capacity. Refer to *Load Carrying Capacity Table* for details.