SUN2000-600-IA0-460 Smart Module

User Manual

Issue	01
Date	2024-06-30

HUAWEI DIGITAL POWER TECHNOLOGIES CO., LTD.

Trademarks and Permissions


and other Huawei trademarks are the property of Huawei Technologies Co., Ltd.
All other trademarks and trade names mentioned in this document are the property of their respective holders.

Notice

The purchased products, services and features are stipulated by the contract made between Huawei Digital Power Technologies Co., Ltd. and the customer. All or part of the products, services and features described in this document may not be within the purchase scope or the usage scope. Unless otherwise specified in the contract, all statements, information, and recommendations in this document are provided "AS IS" without warranties, guarantees or representations of any kind, either express or implied. The information in this document is subject to change without notice. Every effort has been made in the preparation of this document to ensure accuracy of the contents, but all statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Huawei Digital Power Technologies Co., Ltd.

Address: Huawei Digital Power Antuoshan Headquarters

Futian, Shenzhen 518043

People's Republic of China

Website: https://e.huawei.com

About This Document

Purpose

This document describes the functions, features, electrical specifications, and product structure of the Smart Module.

Figures in this document are for reference only.

Intended Audience

This document is intended for:

- Sales engineers
- Technical support engineers
- Maintenance engineers

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.

Symbol	Description
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

Change History

Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

Issue 01 (2024-06-30)

This issue is the first official release.

Contents

About This Document ii

1 Safety Information 1

1.1 Personal Safety 2
1.2 Electrical Safety 4
1.3 Environment Requirements 7
1.4 Mechanical Safety 8

2 Product Introduction 13

2.1 Overview 13
2.2 Structure 15
2.3 Configuration Principles 16
2.4 Application Scenarios 18

3 Smart Module Quick Guide 19

4 System Maintenance 20

4.1 Setting the Physical Layout of Optimizers 20
4.2 Detecting Optimizer Disconnection 21
4.3 Rapid Shutdown 22
4.4 Troubleshooting Optimizers 23
4.5 Replacing an Optimizer 24
4.6 Monitoring Smart Modules 26
4.7 Maintaining Smart Modules 27
4.8 Replacing a Smart Module 29

5 Technical Specifications 32

A Acronyms and Abbreviations 34

1 Safety Information

Statement

Before transporting, storing, installing, operating, using, and/or maintaining the equipment, read this document, strictly follow the instructions provided herein, and follow all the safety instructions on the equipment and in this document. In this document, "equipment" refers to the products, software, components, spare parts, and/or services related to this document; "the Company" refers to the manufacturer (producer), seller, and/or service provider of the equipment; "you" refers to the entity that transports, stores, installs, operates, uses, and/or maintains the equipment.

The **Danger**, **Warning**, **Caution**, and **Notice** statements described in this document do not cover all the safety precautions. You also need to comply with relevant international, national, or regional standards and industry practices. **The Company shall not be liable for any consequences that may arise due to violations of safety requirements or safety standards concerning the design, production, and usage of the equipment.**

The equipment shall be used in an environment that meets the design specifications. Otherwise, the equipment may be faulty, malfunctioning, or damaged, which is not covered under the warranty. The Company shall not be liable for any property loss, personal injury, or even death caused thereby.

Comply with applicable laws, regulations, standards, and specifications during transportation, storage, installation, operation, use, and maintenance.

Do not perform reverse engineering, decompilation, disassembly, adaptation, implantation, or other derivative operations on the equipment software. Do not study the internal implementation logic of the equipment, obtain the source code of the equipment software, violate intellectual property rights, or disclose any of the performance test results of the equipment software.

The Company shall not be liable for any of the following circumstances or their consequences:

- The equipment is damaged due to force majeure such as earthquakes, floods, volcanic eruptions, debris flows, lightning strikes, fires, wars, armed conflicts, typhoons, hurricanes, tornadoes, and other extreme weather conditions.
- The equipment is operated beyond the conditions specified in this document.

- The equipment is installed or used in environments that do not comply with international, national, or regional standards.
- The equipment is installed or used by unqualified personnel.
- You fail to follow the operation instructions and safety precautions on the product and in the document.
- You remove or modify the product or modify the software code without authorization.
- You or a third party authorized by you cause the equipment damage during transportation.
- The equipment is damaged due to storage conditions that do not meet the requirements specified in the product document.
- You fail to prepare materials and tools that comply with local laws, regulations, and related standards.
- The equipment is damaged due to your or a third party's negligence, intentional breach, gross negligence, or improper operations, or other reasons not related to the Company.

1.1 Personal Safety

DANGER

Ensure that power is off during installation. Do not install or remove a cable with power on. Transient contact between the core of the cable and the conductor will generate electric arcs or sparks, which may cause a fire or personal injury.

DANGER

Non-standard and improper operations on the energized equipment may cause fire, electric shocks, or explosion, resulting in property damage, personal injury, or even death.

DANGER

Before operations, remove conductive objects such as watches, bracelets, bangles, rings, and necklaces to prevent electric shocks.

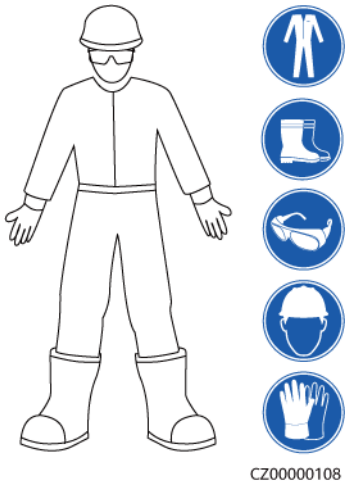
DANGER

During operations, use dedicated insulated tools to prevent electric shocks or short circuits. The dielectric withstanding voltage level must comply with local laws, regulations, standards, and specifications.

WARNING

During operations, wear personal protective equipment such as protective clothing, insulated shoes, goggles, safety helmets, and insulated gloves.

Figure 1-1 Personal protective equipment



General Requirements

- Do not stop protective devices. Pay attention to the warnings, cautions, and related precautionary measures in this document and on the equipment.
- If there is a likelihood of personal injury or equipment damage during operations, immediately stop, report the case to the supervisor, and take feasible protective measures.
- Do not power on the equipment before it is installed or confirmed by professionals.
- Do not touch the power supply equipment directly or with conductors such as damp objects. Before touching any conductor surface or terminal, measure the voltage at the contact point to ensure that there is no risk of electric shock.
- Do not touch operating equipment because the enclosure is hot.
- Do not touch a running fan with your hands, components, screws, tools, or boards. Otherwise, personal injury or equipment damage may occur.
- In the case of a fire, immediately leave the building or the equipment area and activate the fire alarm or call emergency services. Do not enter the affected building or equipment area under any circumstances.

Personnel Requirements

- Only professionals and trained personnel are allowed to operate the equipment.
  - Professionals: personnel who are familiar with the working principles and structure of the equipment, trained or experienced in equipment operations and are clear of the sources and degree of various potential hazards in equipment installation, operation, maintenance

  - Trained personnel: personnel who are trained in technology and safety, have required experience, are aware of possible hazards on themselves in certain operations, and are able to take protective measures to minimize the hazards on themselves and other people
- Personnel who plan to install or maintain the equipment must receive adequate training, be able to correctly perform all operations, and understand all necessary safety precautions and local relevant standards.
- Only qualified professionals or trained personnel are allowed to install, operate, and maintain the equipment.
- Only qualified professionals are allowed to remove safety facilities and inspect the equipment.
- Personnel who will perform special tasks such as electrical operations, working at heights, and operations of special equipment must possess the required local qualifications.
- Only authorized professionals are allowed to replace the equipment or components (including software).
- Only personnel who need to work on the equipment are allowed to access the equipment.

1.2 Electrical Safety

DANGER

Before connecting cables, ensure that the equipment is intact. Otherwise, electric shocks or fire may occur.

DANGER

Non-standard and improper operations may result in fire or electric shocks.

DANGER

Prevent foreign matter from entering the equipment during operations. Otherwise, equipment short-circuits or damage, load power derating, power failure, or personal injury may occur.

WARNING

For the equipment that needs to be grounded, install the ground cable first when installing the equipment and remove the ground cable last when removing the equipment.

WARNING

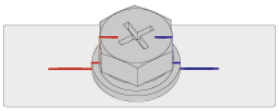
During the installation of PV strings and the inverter, the positive or negative terminals of PV strings may be short-circuited to ground if the power cables are not properly installed or routed. In this case, an AC or DC short circuit may occur and damage the inverter. The resulting device damage is not covered under any warranty.

CAUTION

Do not route cables near the air intake or exhaust vents of the equipment.

General Requirements

- Follow the procedures described in the document for installation, operation, and maintenance. Do not reconstruct or alter the equipment, add components, or change the installation sequence without permission.
- Obtain approval from the national or local electric utility company before connecting the equipment to the grid.
- Observe the power plant safety regulations, such as the operation and work ticket mechanisms.
- Install temporary fences or warning ropes and hang "No Entry" signs around the operation area to keep unauthorized personnel away from the area.
- Before installing or removing power cables, turn off the switches of the equipment and its upstream and downstream switches.
- Before performing operations on the equipment, check that all tools meet the requirements and record the tools. After the operations are complete, collect all of the tools to prevent them from being left inside the equipment.
- Before installing power cables, check that cable labels are correct and cable terminals are insulated.
- When installing the equipment, use a torque tool of a proper measurement range to tighten the screws. When using a wrench to tighten the screws, ensure that the wrench does not tilt and the torque error does not exceed 10% of the specified value.
- Ensure that bolts are tightened with a torque tool and marked in red and blue after double-check. Installation personnel mark tightened bolts in blue. Quality inspection personnel confirm that the bolts are tightened and then mark them in red. (The marks must cross the edges of the bolts.)



- If the equipment has multiple inputs, disconnect all the inputs before operating the equipment.
- Before maintaining a downstream electrical or power distribution device, turn off the output switch on the power supply equipment.

- During equipment maintenance, attach "Do not switch on" labels near the upstream and downstream switches or circuit breakers as well as warning signs to prevent accidental connection. The equipment can be powered on only after troubleshooting is complete.
- Do not open equipment panels.
- Check equipment connections periodically, ensuring that all screws are securely tightened.
- Only qualified professionals can replace a damaged cable.
- Do not scrawl, damage, or block any labels or nameplates on the equipment. Promptly replace labels that have worn out.
- Do not use solvents such as water, alcohol, or oil to clean electrical components inside or outside of the equipment.

Grounding

- Ensure that the grounding impedance of the equipment complies with local electrical standards.
- Ensure that the equipment is connected permanently to the protective ground. Before operating the equipment, check its electrical connection to ensure that it is reliably grounded.
- Do not work on the equipment in the absence of a properly installed ground conductor.
- Do not damage the ground conductor.

Cabling Requirements

- When selecting, installing, and routing cables, follow local safety regulations and rules.
- When routing power cables, ensure that there is no coiling or twisting. Do not join or weld power cables. If necessary, use a longer cable.
- Ensure that all cables are properly connected and insulated, and meet specifications.
- Ensure that the slots and holes for routing cables are free from sharp edges, and that the positions where cables are routed through pipes or cable holes are equipped with cushion materials to prevent the cables from being damaged by sharp edges or burrs.
- Ensure that cables of the same type are bound together neatly and straight and that the cable sheath is intact. When routing cables of different types, ensure that they are away from each other without entanglement and overlapping.
- Secure buried cables using cable supports and cable clips. Ensure that the cables in the backfill area are in close contact with the ground to prevent cable deformation or damage during backfilling.
- If the external conditions (such as the cable layout or ambient temperature) change, verify the cable usage in accordance with the IEC-60364-5-52 or local laws and regulations. For example, check that the current-carrying capacity meets requirements.
- When routing cables, reserve at least 30 mm clearance between the cables and heat-generating components or areas. This prevents deterioration or damage to the cable insulation layer.

1.3 Environment Requirements

DANGER

Do not expose the equipment to flammable or explosive gas or smoke. Do not perform any operation on the equipment in such environments.

DANGER

Do not store any flammable or explosive materials in the equipment area.

DANGER

Do not place the equipment near heat sources or fire sources, such as smoke, candles, heaters, or other heating devices. Overheat may damage the equipment or cause a fire.

WARNING

Install the equipment in an area far away from liquids. Do not install it under areas prone to condensation, such as under water pipes and air exhaust vents, or areas prone to water leakage, such as air conditioner vents, ventilation vents, or feeder windows of the equipment room. Ensure that no liquid enters the equipment to prevent faults or short circuits.

WARNING

To prevent damage or fire due to high temperature, ensure that the ventilation vents or heat dissipation systems are not obstructed or covered by other objects while the equipment is running.

General Requirements

- Store the equipment according to the storage requirements. Equipment damage caused by unqualified storage conditions is not covered under the warranty.
- Keep the installation and operating environments of the equipment within the allowed ranges. Otherwise, its performance and safety will be compromised.
- The operating temperature range provided in the equipment's technical specifications refers to the ambient temperatures in equipment's installation environment.

- Do not install, use, or operate outdoor equipment and cables (including but not limited to moving equipment, operating equipment and cables, inserting connectors to or removing connectors from signal ports connected to outdoor facilities, working at heights, performing outdoor installation, and opening doors) in harsh weather conditions such as lightning, rain, snow, and level 6 or stronger wind.
- Do not install the equipment in an environment with dust, smoke, volatile or corrosive gases, infrared and other radiations, organic solvents, or salty air.
- Do not install the equipment in an environment with conductive metal or magnetic dust.
- Do not install the equipment in an area conducive to the growth of microorganisms such as fungus or mildew.
- Do not install the equipment in an area with strong vibration, noise, or electromagnetic interference.
- Ensure that the site complies with local laws, regulations, and related standards.
- Ensure that the ground in the installation environment is solid, free from spongy or soft soil, and not prone to subsidence. The site must not be located in a low-lying land prone to water or snow accumulation, and the horizontal level of the site must be above the highest water level of that area in history.
- Do not install the equipment in a position that may be submerged in water.
- If the equipment is installed in a place with abundant vegetation, in addition to routine weeding, harden the ground underneath the equipment using cement or gravel (the area shall be greater than or equal to 3 m x 2.5 m).
- Do not install the equipment outdoors in salt-affected areas because it may be corroded. A salt-affected area refers to the region within 500 m of the coast or prone to sea breeze. Regions prone to sea breeze vary with weather conditions (such as typhoons and monsoons) or terrains (such as dams and hills).
- Before installation, operation, and maintenance, clean up any water, ice, snow, or other foreign objects on the top of the equipment.
- When installing the equipment, ensure that the installation surface is solid enough to bear the weight of the equipment.
- After installing the equipment, remove the packing materials such as cartons, foam, plastics, and cable ties from the equipment area.

1.4 Mechanical Safety

⚠ WARNING

Ensure that all necessary tools are ready and inspected by a professional organization. Do not use tools that have signs of scratches or fail to pass the inspection or whose inspection validity period has expired. Ensure that the tools are secure and not overloaded.

WARNING

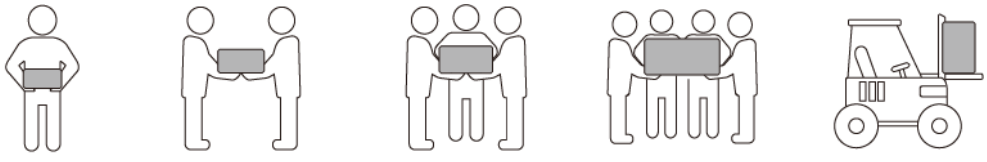
Do not drill holes into the equipment. Doing so may affect the sealing performance and electromagnetic containment of the equipment and damage components or cables inside. Metal shavings from drilling may short-circuit boards inside the equipment.

General Requirements

- Repaint any paint scratches caused during equipment transportation or installation in a timely manner. Equipment with scratches must not be exposed for an extended period of time.
- Do not perform operations such as arc welding and cutting on the equipment without evaluation by the Company.
- Do not install other devices on the top of the equipment without evaluation by the Company.
- When performing operations over the top of the equipment, take measures to protect the equipment against damage.
- Use correct tools and operate them in the correct way.

Moving Heavy Objects

- Be cautious to prevent injury when moving heavy objects.



- If multiple persons need to move a heavy object together, determine the manpower and work division with consideration of height and other conditions to ensure that the weight is equally distributed.
- If two persons or more move a heavy object together, ensure that the object is lifted and landed simultaneously and moved at a uniform pace under the supervision of one person.
- Wear personal protective gears such as protective gloves and shoes when manually moving the equipment.
- To move an object by hand, approach to the object, squat down, and then lift the object gently and stably by the force of the legs instead of your back. Do not lift it suddenly or turn your body around.
- Do not quickly lift a heavy object above your waist. Place the object on a workbench that is half-waist high or any other appropriate place, adjust the positions of your palms, and then lift it.
- Move a heavy object stably with balanced force at an even and low speed. Put down the object stably and slowly to prevent any collision or drop from scratching the surface of the equipment or damaging the components and cables.

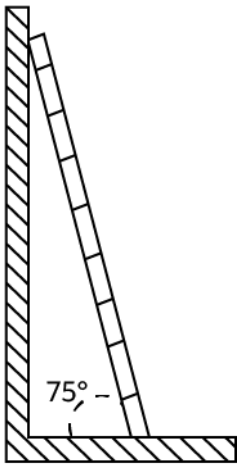
- When moving a heavy object, be aware of the workbench, slope, staircase, and slippery places. When moving a heavy object through a door, ensure that the door is wide enough to move the object and avoid bumping or injury.
- When transferring a heavy object, move your feet instead of turning your waist around. When lifting and transferring a heavy object, ensure that your feet point to the target direction of movement.
- When transporting the equipment using a pallet truck or forklift, ensure that the tynes are properly positioned so that the equipment does not topple. Before moving the equipment, secure it to the pallet truck or forklift using ropes. When moving the equipment, assign dedicated personnel to take care of it.
- Choose sea, roads in good conditions, or airplanes for transportation. Do not transport the equipment by railway. Avoid tilt or jolt during transportation.

Using Ladders

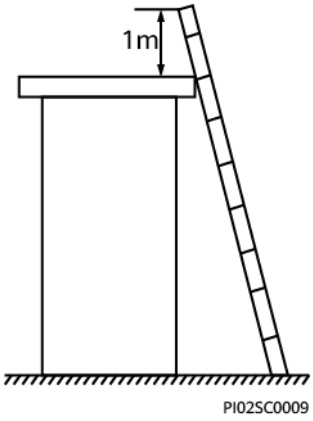
- Use wooden or insulated ladders when you need to perform live-line working at heights.
- Platform ladders with protective rails are preferred. Single ladders are not recommended.
- Before using a ladder, check that it is intact and confirm its load bearing capacity. Do not overload it.
- Ensure that the ladder is securely positioned and held firm.

CZ00000107

- When climbing up the ladder, keep your body stable and your center of gravity between the side rails, and do not overreach to the sides.
- When a step ladder is used, ensure that the pull ropes are secured.
- If a single ladder is used, the recommended angle for the ladder against the floor is 75 degrees, as shown in the following figure. A square can be used to measure the angle.

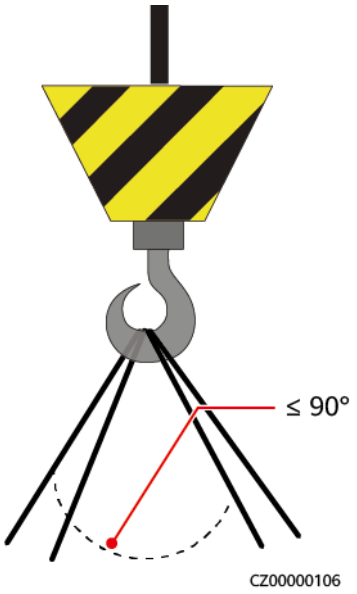


- If a single ladder is used, ensure that the wider end of the ladder is at the bottom, and take protective measures to prevent the ladder from sliding.
- If a single ladder is used, do not climb higher than the fourth rung of the ladder from the top.
- If you use a single ladder to climb up to a platform, ensure that the ladder is at least 1 m higher than the platform.



Hoisting

- Only trained and qualified personnel are allowed to perform hoisting operations.
- Install temporary warning signs or fences to isolate the hoisting area.
- Ensure that the foundation where hoisting is performed on meets the load-bearing requirements.
- Before hoisting objects, ensure that hoisting tools are firmly secured onto a fixed object or wall that meets the load-bearing requirements.
- During hoisting, do not stand or walk under the crane or the hoisted objects.
- Do not drag steel ropes and hoisting tools or bump the hoisted objects against hard objects during hoisting.
- Ensure that the angle between two hoisting ropes is no more than 90 degrees, as shown in the following figure.



Drilling Holes

- Obtain consent from the customer and contractor before drilling holes.
- Wear protective equipment such as safety goggles and protective gloves when drilling holes.
- To avoid short circuits or other risks, do not drill holes into buried pipes or cables.
- When drilling holes, protect the equipment from shavings. After drilling, clean up any shavings.

2 Product Introduction

2.1 Overview

A Smart Module is a PV module that integrates a Smart PV Optimizer (mounted on the rear side of the module) to manage the maximum power point (MPP) of the module individually in real time, improving the energy yield of the PV system. In addition, the Smart Module supports module-level shutdown and management.

Functions and Features

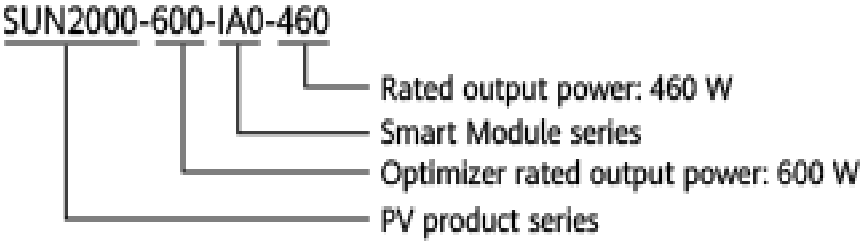
- Safer: Huawei Smart PV Optimizer is pre-integrated to implement rapid shutdown, reducing voltage to a safe level on the rooftop and ensuring personal and property safety.
- More efficient: The efficiency of a Smart Module can reach 22.58%.
- More reliable: The entire rear side is welded to improve the capability of preventing microcracks. The Smart Module has passed reliability verification tests such as hail impact test, thermal cycling test, salt spray test, and dynamic load test.
- More intelligent:
  - Customization is supported for houses with various directions and rooftop types.
  - The FusionSolar Smart PV Management System (SmartPVMS) or FusionSolar app facilitates module-level physical layout, monitoring, and disconnection detection.
- More beautiful: The Smart Module is colored black, with no grid lines on the front side.

Model

This document involves the following product model:

SUN2000-600-IA0-460

Figure 2-1 Model description

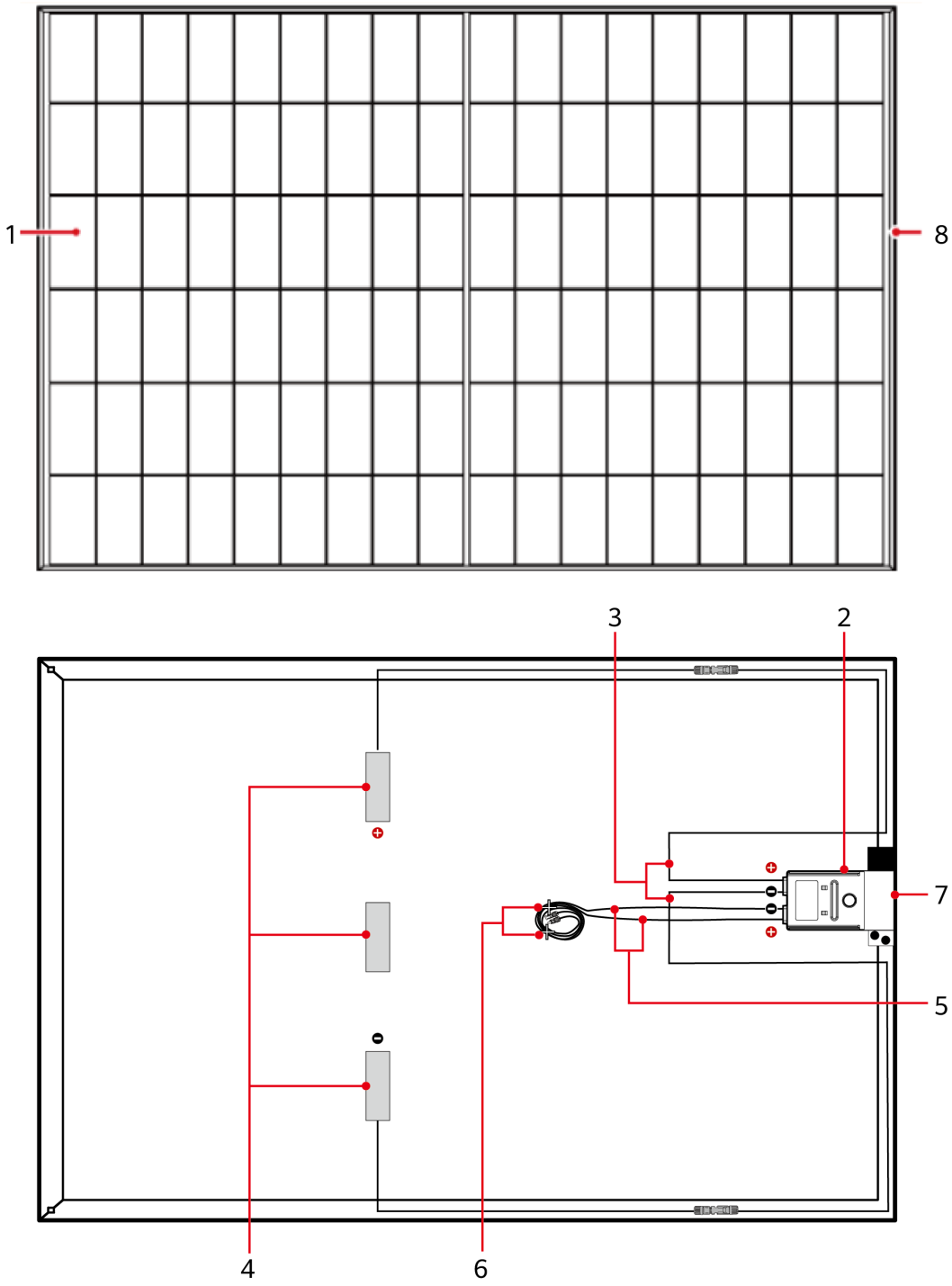


Model	Dimensions (L x W x D)	Rated Output Power (STC[a])
SUN2000-600-IA0-460	1757 mm x 1134 mm x 40 mm	460 W
Note a: The standard test conditions (STC) are as follows: AM = 1.5, E = 1000 W/m^2, Tc = 25°C.		

2.2 Structure

Smart Module Appearance

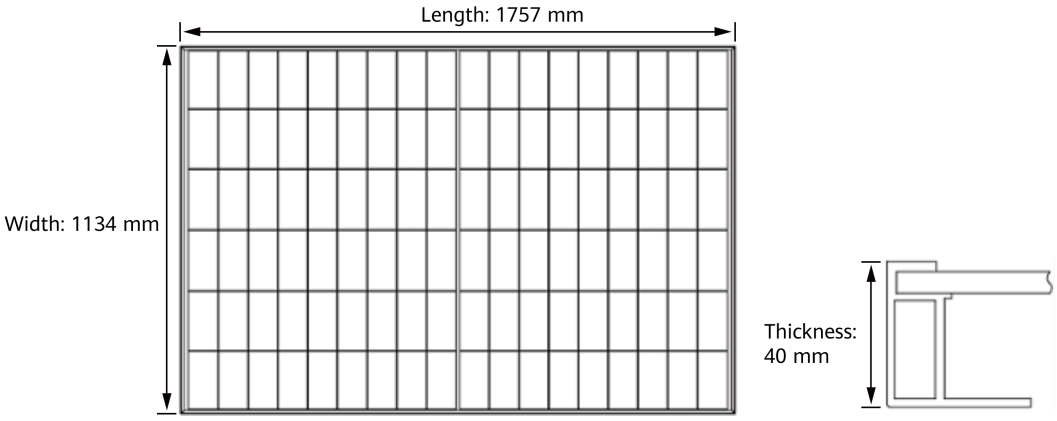
Figure 2-2 Appearance



(1) Smart Module coated glass
(2) Optimizer
(3) Optimizer input power cables
(4) Junction box
(5) Optimizer output power cables
(6) Cable tie
(7) Optimizer connecting bracket
(8) Aluminum alloy frame

Smart Module Dimensions

Figure 2-3 Dimensions



2.3 Configuration Principles

When configuring inverters of different models for Smart Modules, comply with the following principles:

NOTE

- One MPPT connects to only one PV string. Smart Modules in different directions and shading conditions can connect to the same PV string.
- If both MPPT circuits of one inverter need to connect to PV strings, the Smart Modules of the two PV strings can follow different configuration principles.

Table 2-1 Configuration principles

Supported Inverter Model	Maximum Power Per String	Quantity of Smart Modules Per String
SUN2000-3/4/5/6KTL-L1	6 kW	4–25
SUN2000-5/6/8/10/12KTL-M1	10 kW	6–35
SUN2000-12/15/17/20/25K-MB0	12 kW[a]	6–35
SUN2000-15/17/20/25K-MB0-ZH	12 kW[a]	6–35
SUN2000-8/10K-LC0	6 kW	4–25

Supported Inverter Model	Maximum Power Per String	Quantity of Smart Modules Per String
SUN2000-8/10K-LC0-ZH	6 kW	4–25
SUN2000-5/6/8/10/12K-MAP0	12 kW	6–35
SUN2000-5/6/8/10/12K-MAP0-ZH	12 kW	6–35
Note a: The power difference between PV strings connected to the same inverter is less than or equal to 2 kW.		

For better experience of the Smart Module functions and features, upgrade the inverter and FusionSolar app to the following versions.

Table 2-2 Version mapping

Equipment	Version
SUN2000-3/4/5/6KTL-L1	SUN2000L V200R001C00SPC142 or later
SUN2000-5/6/8/10/12KTL-M1	SUN2000MA V100R001C00SPC165 or later
SUN2000-12/15/17/20/25K-MB0	SUN2000MB V200R023C10SPC204 or later
SUN2000-15/17/20/25K-MB0-ZH	SUN2000MB V200R023C10SPC204 or later
SUN2000-8/10K-LC0	SUN2000LC V100R023C10SPC104 or later
SUN2000-8/10K-LC0-ZH	SUN2000LC V100R023C10SPC104 or later
SUN2000-5/6/8/10/12K-MAP0	SUN2000MA V200R024C00SPC100 or later
SUN2000-5/6/8/10/12K-MAP0-ZH	SUN2000MA V200R024C00SPC100 or later
FusionSolar app	6.24.00.110 or later

2.4 Application Scenarios

CAUTION

- Stay away from the equipment when preparing cables to prevent cable scraps from entering the equipment. Cable scraps may cause sparks and result in personal injury and equipment damage.
- The positive and negative DC PV string cables within 1.5 m of the inverter shall be routed in separate pipes to prevent cable damage and short circuits caused by improper operations during construction.

NOTE

- To ensure reliable communication between the inverter and Smart Modules, route DC and AC power cables in different cable slots with a spacing of more than 10 cm.
- To reduce the impact of electromagnetic interference, the positive and negative cables of optimizers must be routed close to the home-run cable.

Figure 2-4 Required cabling

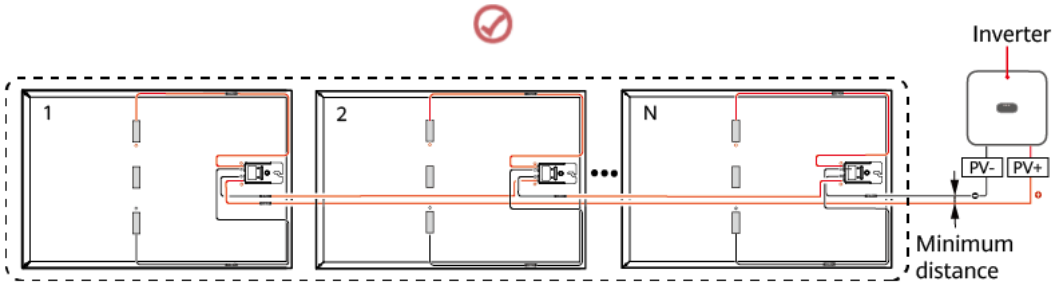
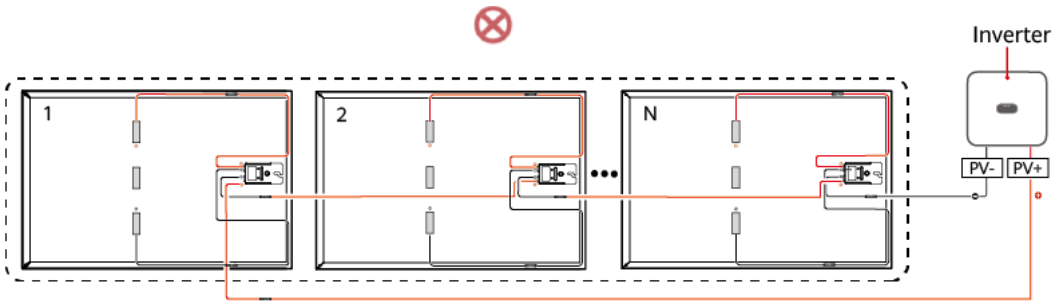


Figure 2-5 Prohibited cabling



3 Smart Module Quick Guide

DANGER

- The site must be equipped with qualified fire fighting facilities, such as fire sand and carbon dioxide fire extinguishers.
- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.

NOTICE

After placing the equipment in the installation position, unpack it with care to prevent scratches. Keep the equipment stable during unpacking.

For details about how to unpack, install, and connect cables to Smart Modules, see **SUN2000-600-IA0-460 Smart Module Quick Guide** or scan the following QR code to obtain the latest quick guide.

4 System Maintenance

WARNING

- Before performing maintenance, power off the equipment, follow the instructions on the delayed discharge label, and wait for a period of time as specified to ensure that the equipment is not energized.

NOTICE

Before the equipment is put into operation for the first time, ensure that the parameters are set correctly by professional personnel. Incorrect parameter settings may result in noncompliance with local grid connection requirements and affect the normal operations of the equipment.

4.1 Setting the Physical Layout of Optimizers

The physical layout must be configured for optimizers. If an optimizer is faulty, it can be quickly located and replaced based on the physical layout.

For details, see the **FusionSolar Physical Layout User Guide**.

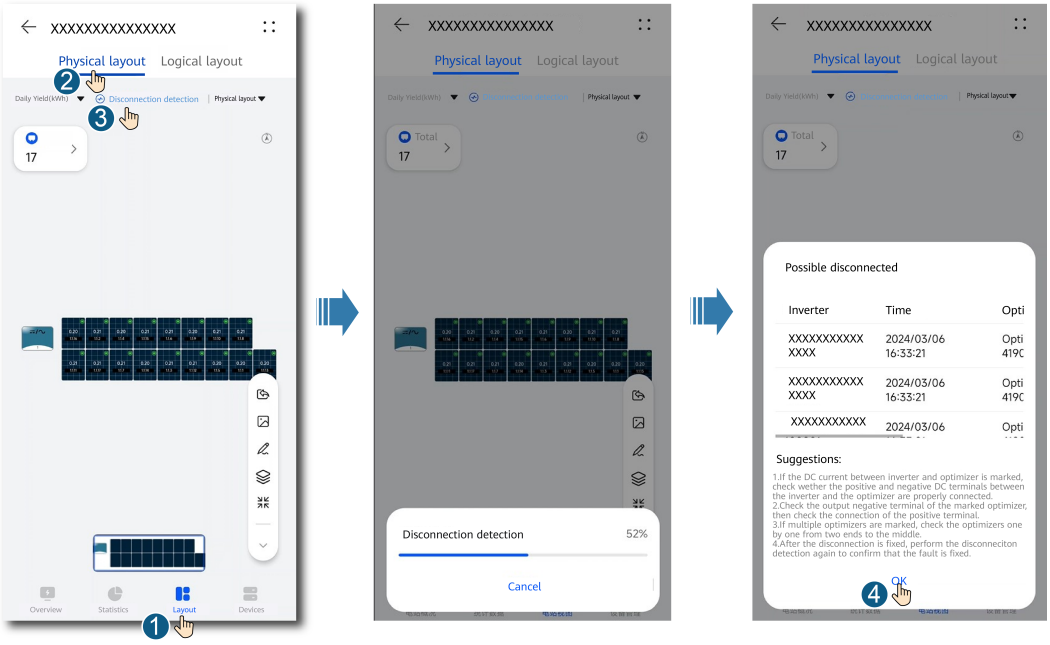
NOTE

- If Smart PV Optimizers are configured for PV strings, ensure that the Smart PV Optimizers have been successfully connected to the inverter before performing other operations.
- Check that the SN labels of Smart PV Optimizers are correctly attached to the physical layout template.
- Take and save a photo of the physical layout template. Keep your phone parallel to the template and take a photo in landscape mode. Ensure that the four positioning points at the corners are in the frame and that each QR code is attached within the frame.

4.2 Detecting Optimizer Disconnection

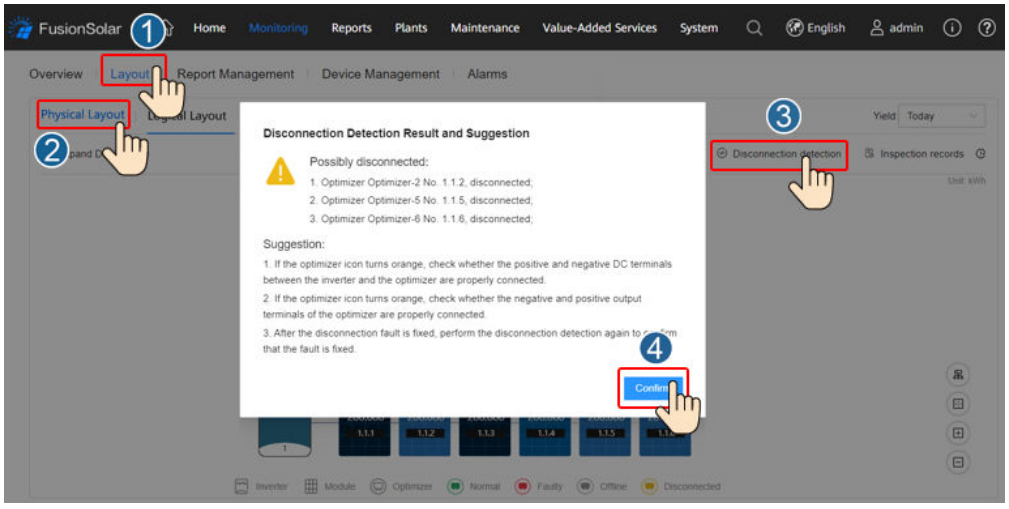
- Log in to the FusionSolar app and tap the plant name on the **Home** screen to access the plant screen. Choose **Layout**, tap **Disconnection detection** to check optimizer disconnection, and rectify the fault based on the result.

Figure 4-1 Detecting optimizer disconnection



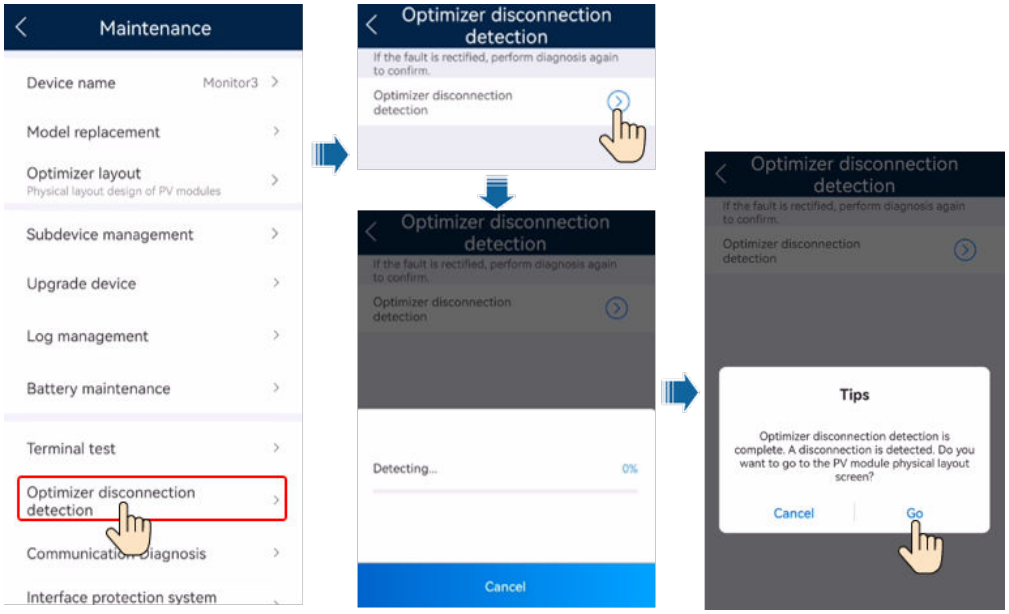
- Log in to https://intl.fusionsolar.huawei.com to access the WebUI of the FusionSolar SmartPVMS. On the **Home** page, click the plant name to go to the plant page. Choose **Layout**, click **Disconnection detection** to check optimizer disconnection, and rectify the fault based on the result.

Figure 4-2 Detecting optimizer disconnection



- Log in to the FusionSolar app. On the **Device commissioning** screen, choose **Maintenance** > **Optimizer disconnection detection**, tap the detection button, and rectify the fault based on the detection result.

Figure 4-3 Detecting optimizer disconnection



4.3 Rapid Shutdown

When the inverter output is disconnected or the inverter shuts down, the optimizer can adjust the module output voltage to a safe range to ensure the safety of the construction and O&M personnel as well as firefighters.

When the PV system performs a rapid shutdown, it decreases the string output voltage to below 120 V within 15s and to below 30 V within 30s.

Perform the following steps to trigger a rapid shutdown:

- Method 1: Turn off the AC switch between the inverter and the power grid.
- Method 2: Turn off the DC switch on the inverter.
- Method 3: Connect a switch to the DI and GND ports of the inverter to form a circuit. (For details about which DI port is used, see the corresponding inverter user manual.) The switch is turned on by default. Turn off the switch to trigger a rapid shutdown.

4.4 Troubleshooting Optimizers

Table 4-1 Common alarms and troubleshooting measures

Alarm Name	Cause	Suggestion
Input overvoltage	Optimizer input overvoltage occurred.	Check whether the open-circuit voltage of the PV module exceeds the maximum input voltage of the optimizer.
Internal hardware fault	The internal hardware of the optimizer is faulty.	Contact your vendor or Huawei technical support to replace the faulty optimizer.
Output backfeed	Optimizer output backfeed occurred.	1. Check whether Smart Modules are shaded when PV strings are connected in parallel. 2. If the fault persists, contact your vendor or Huawei technical support.
Abnormal output voltage	The optimizer output voltage is abnormal.	1. Perform optimizer search again when the irradiance is normal. 2. Check whether the optimizer output extension cable is correctly prepared (positive connector at one end and negative connector at the other). 3. Check whether the PV string is correctly connected to the inverter or whether there is a breakpoint in the PV string. 4. If the fault persists, contact your vendor or Huawei technical support. Note: The polarity at the two ends of an extension cable must be opposite (positive connector at one end and negative connector at the other). For details about how to determine the polarity of the PV string, see section 5 "Connecting Smart Module Cables" in the *Smart Module Quick Guide*.

Alarm Name	Cause	Suggestion
Upgrade failed	The optimizer software upgrade failed.	1. Perform optimizer upgrade again when the irradiance is normal. 2. If the fault persists, contact your vendor or Huawei technical support.

NOTE

If you cannot rectify faults with the measures listed in the "Suggestion" column, contact your vendor or Huawei technical support.

4.5 Replacing an Optimizer

Prerequisites

- Use dedicated insulated tools, and wear insulated shoes and insulated gloves before performing operations. l
- Prepare a new optimizer.

Procedure

Step 1 Wear insulated gloves.

Step 2 Power off the inverter.

Step 3 Disconnect the input terminals of the optimizer.

Step 4 Remove the old optimizer.

NOTE

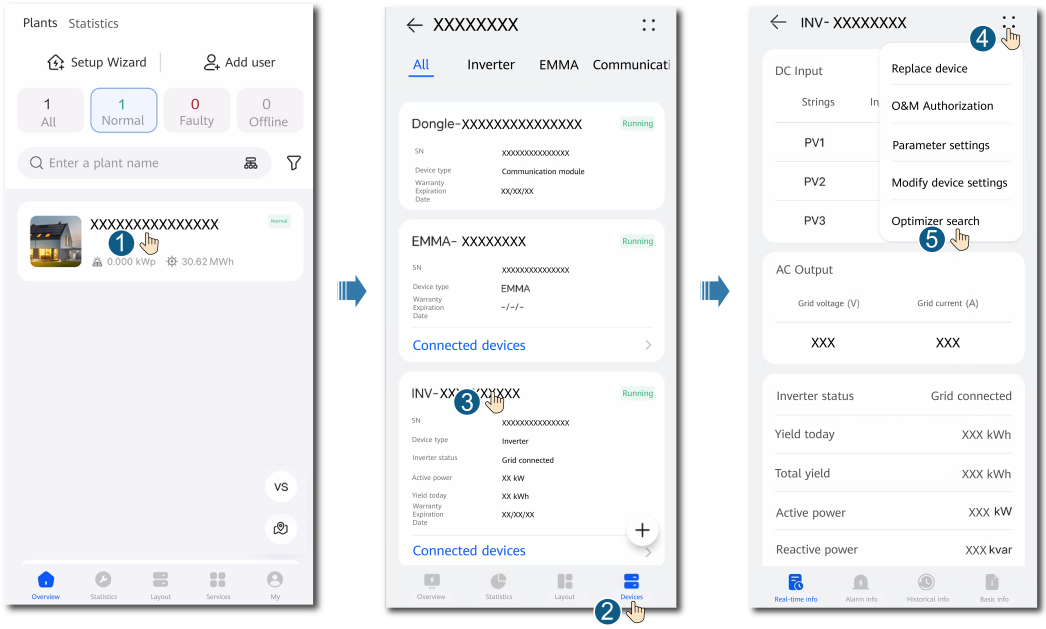
Record the cable connection positions on the optimizer and disconnect the cables.

Step 5 Install a new optimizer.

NOTE

- Connect the cables to the new optimizer based on the recorded information.
- If multiple optimizers need to be replaced, record the optimizer numbers.

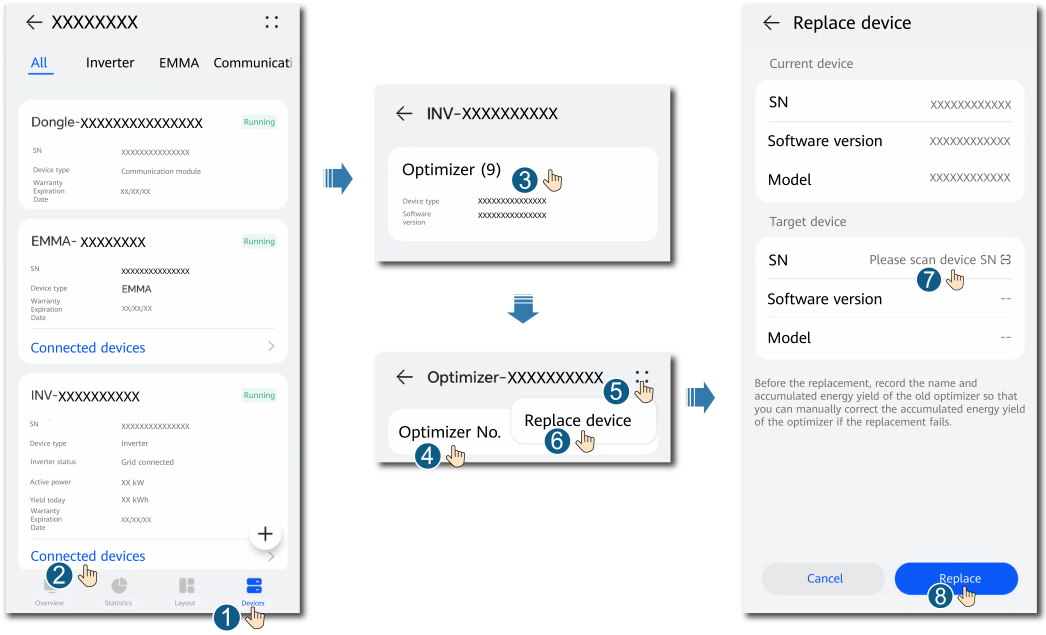
Step 6 Power on the inverter. Log in to the FusionSolar app and tap the plant name on the **Home** screen to access the plant screen. Choose **Devices** > **Inverter**, select the inverter corresponding to the faulty optimizer, tap **Optimizer Search**, and perform operations as prompted to search for optimizers.



Step 7 Choose **Devices** > **Connected devices** > **Optimizer**, tap **Optimizer No.**, select the faulty optimizer, tap **Device Replacement**, and replace the optimizer as prompted.

NOTE

- If *N* optimizers need to be replaced, perform the preceding procedure for *N* times.
- After the optimizer is replaced, the new optimizer automatically inherits the energy yield, physical layout, and logical layout of the faulty optimizer.



----End

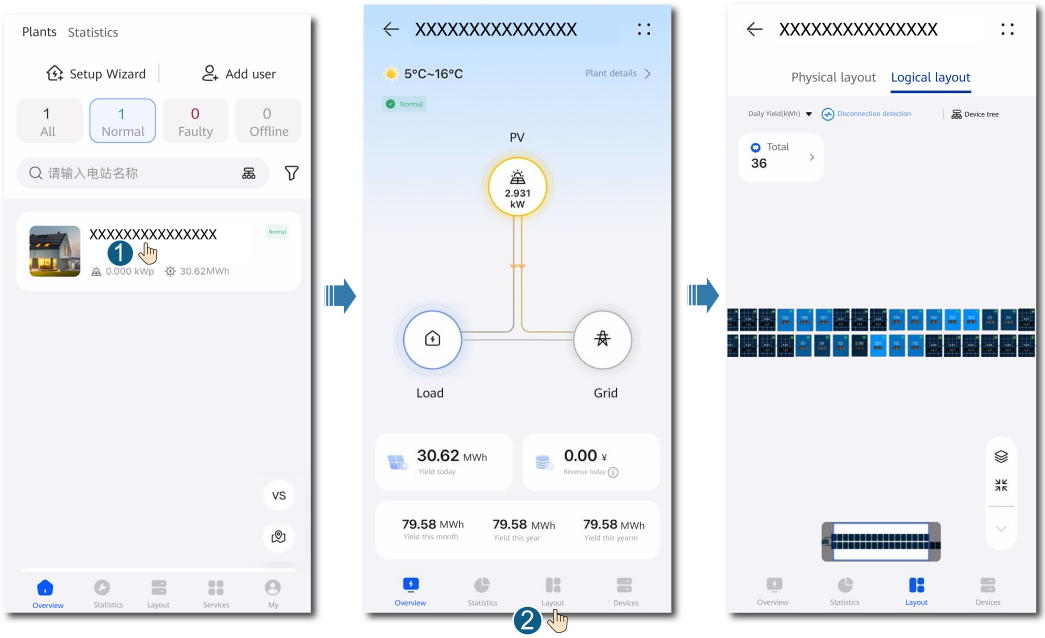
Follow-up Procedure

Pack the removed component and return it to the local Huawei warehouse.

4.6 Monitoring Smart Modules

Log in to the FusionSolar app and tap the plant name on the **Home** screen to access the plant screen. Tap **Layout** and quickly identify inefficient Smart Modules by color in the physical or logical layout.

Figure 4-4 Monitoring Smart Modules



NOTE

- When the power of Smart Modules under normal irradiance is the same and the colors of Smart Modules in the layout are similar, the Smart Modules are normal.
- When the power of Smart Modules under normal irradiance is the same but the colors of some Smart Modules are darker than those of the other Smart Modules in the layout, Smart Modules with darker colors may be inefficient if their surfaces are clean and there is no shading.

Table 4-2 Smart Module colors

Ratio Range (Smart Module Output Power/Smart Module Maximum Output Power)	Color	Description
0%–20%		Smart Module power ratio = Smart Module output power/Smart Module maximum output power. The color of a Smart Module depends on the power ratio range. A darker color indicates a smaller power ratio, and vice versa.
20%–40%		
40%–60%		
60%–80%		
80%–100%		
Default color		

4.7 Maintaining Smart Modules

To ensure the normal operation of Smart Modules, detect and rectify faults in a timely manner through regular inspection and maintenance. If any Smart Module is damaged or abnormal, contact your vendor or Huawei technical support.

For details about inspection and maintenance, see **Table 4-3**.

Table 4-3 Maintenance list

Maintenance Item	Recommended Maintenance Interval	Description
Smart Module appearance	Contact your vendor or Huawei technical support.	Check the possible appearance defects of Smart Modules. ● Check whether the Smart Module glass is broken. ● Check whether there is rust at the welding point of the cell busbars (due to moisture ingress caused by damaged outer packaging materials during installation or transportation). ● Check whether there are burn marks on the Smart Module backsheet. ● Check whether Smart Modules degrade (factors including damage by rodents, weather conditions, and loose or corroded connectors). ● Check whether Smart Modules are properly grounded. ● Check whether the Smart Module surface makes contact with sharp objects. ● Check whether Smart Modules are shaded by obstacles or foreign objects. ● Check whether the screws between Smart Modules and supports are loose or damaged. If yes, tighten or repair the screws in a timely manner.

Maintenance Item	Recommended Maintenance Interval	Description
Smart Module cleaning	Contact your vendor or Huawei technical support.	Use a sponge with clean water or a soft cloth to clean the glass surface.
Connector and cable	6 months	• Check whether the connectors are properly sealed and whether the cables are securely connected. • Check whether cracks or gaps at the sealant for the junction box.

DANGER

Do not clean a Smart Module whose glass is broken, backsheet is damaged, or wires are exposed. Otherwise, electric shocks may occur.

NOTE

- Contact professionals or trained personnel for the Smart Module inspection and maintenance.
- Do not use detergents containing alkali or acid to clean Smart Modules. In any case, do not use materials with rough surfaces to clean Smart Modules.
- To prevent electric shocks or burns, you are advised to clean Smart Modules when the irradiance is low and the Smart Module temperature is low, especially for Smart Modules installed in hot areas.

4.8 Replacing a Smart Module

Prerequisites

- Use dedicated insulated tools, and wear insulated shoes and insulated gloves before performing operations.
- Prepare a new Smart Module and ensure that the Smart Module is switched to working mode.

Procedure

Step 1 Wear insulated gloves.

Step 2 Power off the inverter.

Step 3 Disconnect the output terminals of the optimizer.

NOTE

Record the cable connection positions on the optimizer and disconnect the cables.

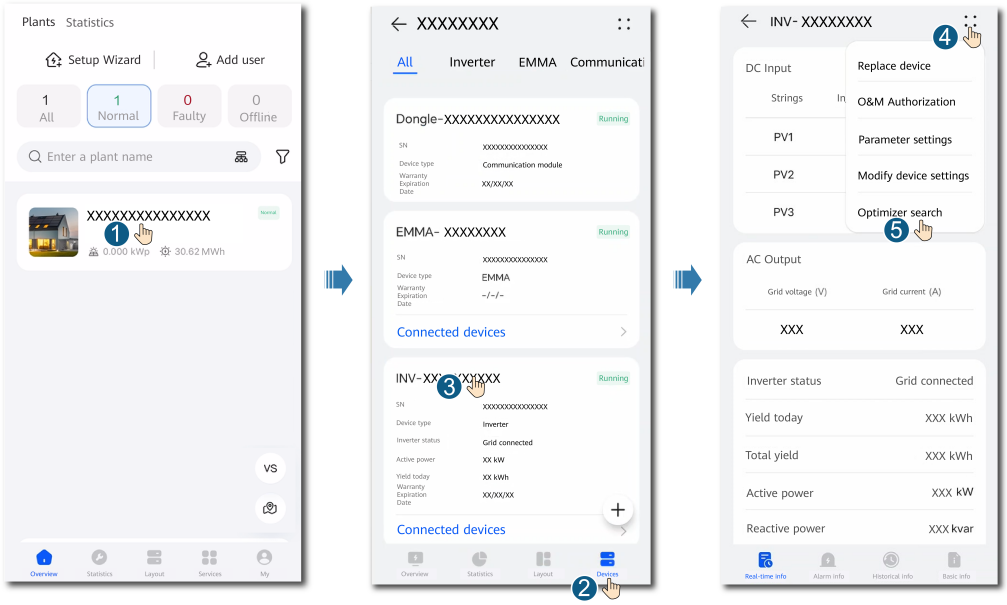
Step 4 Remove the old Smart Module.

Step 5 Install a new Smart Module.

NOTE

- Connect the cables to the optimizer of the Smart Module based on the recorded information.
- If multiple Smart Modules need to be replaced, record the optimizer numbers.

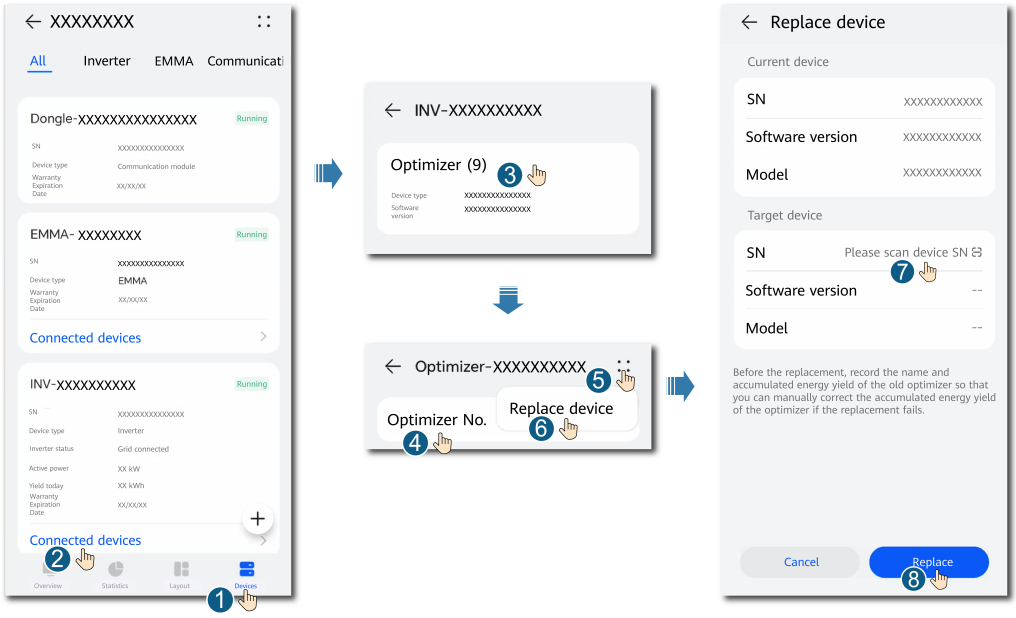
Step 6 Power on the inverter. Log in to the FusionSolar app and tap the plant name on the **Home** screen to access the plant screen. Choose **Devices** > **Inverter**, select the inverter corresponding to the optimizer, tap **Optimizer Search**, and perform operations as prompted to search for optimizers.



Step 7 Choose **Devices** > **Connected devices** > **Optimizer**, tap **Optimizer No.**, select the optimizer corresponding to the Smart Module to be replaced, tap **Device Replacement**, and perform replacement as prompted.

NOTE

- If *N* Smart Modules need to be replaced, perform the preceding procedure for *N* times.
- After the Smart Module is replaced, the new optimizer automatically inherits the energy yield, physical layout, and logical layout of the old optimizer.



----End

Follow-up Procedure

Pack the removed Smart Module and return it to the local Huawei warehouse.

5 Technical Specifications

Output

Item	SUN2000-600-IA0-460
Maximum output power	460 W (precision: 0–5 W)
Maximum system voltage	1000 V DC
Output voltage	0–45 V
Maximum output current	15 A
Output bypass	Yes
Shutdown output voltage/impedance	0 V/1 kΩ (±10%)

General Specifications

Item	SUN2000-600-IA0-460
Cell type	N-type ABC
Dimensions (L x W x D)	1757 mm x 1134 mm x 40 mm
Net weight	23.8 kg±3%
Front side	Single-glass, 3.2 mm coated semi-tempered glass
Backsheet	Highly weather-resistant backsheet
Frame	Black anodized aluminum alloy frame
Connector type	MC4
Operating temperature[a]	–40°C to +85°C
Storage temperature	–40°C to +70°C
Operating humidity	0–100% RH

Item	SUN2000-600-IA0-460
Storage relative humidity	5%–95% RH
Maximum operating altitude	4000 m
Junction box protection rating	IP68
Fire rating	IEC Class C
Note a: When the optimizer temperature ranges from 70°C to 85°C, the optimizer may shut down due to overtemperature protection. After the temperature decreases, the optimizer automatically recovers and there is no risk of damage.	

A Acronyms and Abbreviations

D	
DC	direct current
E	
EMC	electromagnetic compatibility
M	
MPP	maximum power point
MPPT	maximum power point tracking
R	
RE	radiated emission
RH	relative humidity
S	
STC	standard test conditions

