

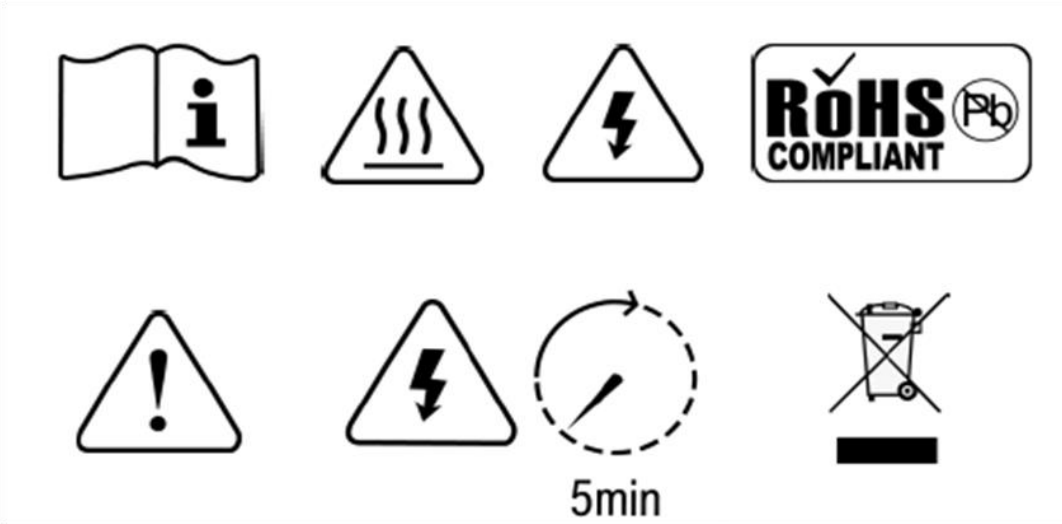


MPPT CHARGE CONTROLLER

USER MANUAL

Solar Mate





WARNING: HIGH VOLTAGE INSIDE

CAUTION: THE DC FUSE MUST BE TURNED OFF BEFORE SERVICING

MADE IN CHINA

Preface

Thank you for choosing the SF100 series MPPT charge controller which is safe and reliable in design and usage. This manual includes information on the solar controllers' electrical performance and protection mechanisms. Please read this manual carefully before installing and operating the controller. Following the guidelines outlined in this manual will extend the controllers service life.

The installation, operation, and maintenance of this series of controller should be carried out by trained technical person. The following requirements MUST be verified:

- PV input voltage MUST be less than the nominal working voltage of the controller.
- Please ensure that the positive and negative of the DC output are correctly connected; Avoid the reverse polarity on the BAT.
- Please ensure that the connection cable between the controller and the battery is as short as possible and avoid short circuit on the connection.
- There are no internal parts that are field serviceable. Disassembling the controller will VOID warranty.

Statement:

Please understand due to the continuous update and improvement of products and technology, the manufacturer reserves the right to make changes to the product at any time.

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1. General Safety Instruction

1.1 Safety Instruction

Removing the casing from the controller is forbidden, and will void warranty.

This manual contains information concerning the installation and operation of the charge controller. All relevant parts of the manual should be read prior to commencing the installation. All local regulations and guide lines must be followed.

Any operation against safety requirement or against design, manufacture, safety standard will avoid the manufacturer warranty.

1.2 General Precaution

- This solar controller must be installed in a dry location. Ventilation requirements must also be met to prevent the controller from overheating.
- To avoid fire and electric shock, please ensure all cables are properly sized, and have good insulation. Do NOT use damaged or undersized cables.
- Any items that need to be fireproof around the controller.
- Never touch uninsulated cable ends.
- Use only insulated tools.
- In final usage, an isolation measure can be implemented on communication port for extra level safety.

1.3 Precaution regarding battery operation

- If the skin and clothing are contaminated with battery acid, wash them immediately with soap and water. If acid splashes into eyes, flush with cold water for at least 20 minutes and seek medical attention immediately
- Do not smoke or set a fire near the battery or engine.
- Do not place metal tools on the battery, otherwise there is a risk of explosion caused by sparks or short circuit.
- Do not wear jewelry such as rings, bracelets, necklaces, watches, etc. when operate the battery. The short-circuited current will generate high heat, which can melt metal objects and cause severe burns.

2. Introduction

2.1 Brief Introduction

2.1.1 General Description

With MPPT technology, the SF100 series solar charge controller enables maximum energy tracking for solar charging. This technology allows the controller to track the maximum power point of an array quickly and accurately in any environment, obtain the maximum energy of solar panel in real time, and charge the battery at maximum current.

The SF100 series controller has a built-in multi-stage battery charging algorithm, along with an MPPT algorithm that allows for wide voltage input ranges. This makes this controller suitable for charging various types of batteries, including Gel, AGM, Lithium, and traditional Lead-acid batteries. It has built in RS485 and CAN communication capabilities for system integration, as well as built in Bluetooth transmitter for monitoring and controlling from a smartphone or tablet via the Solar Mate app. The controller will also store data regarding historical events, daily power generation, monthly power generation, and total power generation. The main features are as follows:

- Wide MPPT voltage range;
- High conversion efficiency, the Max. efficiency $\geq 97.2\%$
- High MPPT efficiency, the Max. efficiency $\geq 99.9\%$
- Adaption on 12Vdc/ 24Vdc battery
- Built-in battery temperature compensation feature
- Support RS485, CAN and Bluetooth communication
- Support wide operation temperature, charging during $-40\sim 60^{\circ}\text{C}$
- Support 365 days real-time data recording, event recording and power statistics;

2.1.2 Model Name

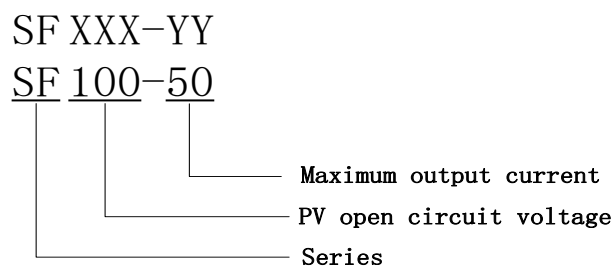


Table 2-1 Product Code and Description

Field	Character	Description	
SF	SF	SF series, MPPT solar charge controller, force cooling	
XXX	100	PV open circuit voltage (V)	100V
YYY	50	Max. output current (A)	50A
	30		30A

e.g. SF100-50 is a MPPT controller with max. Voc at 100V, max. output current at 50A.

2.2 Appearance & Ports

2.2.1 Front View

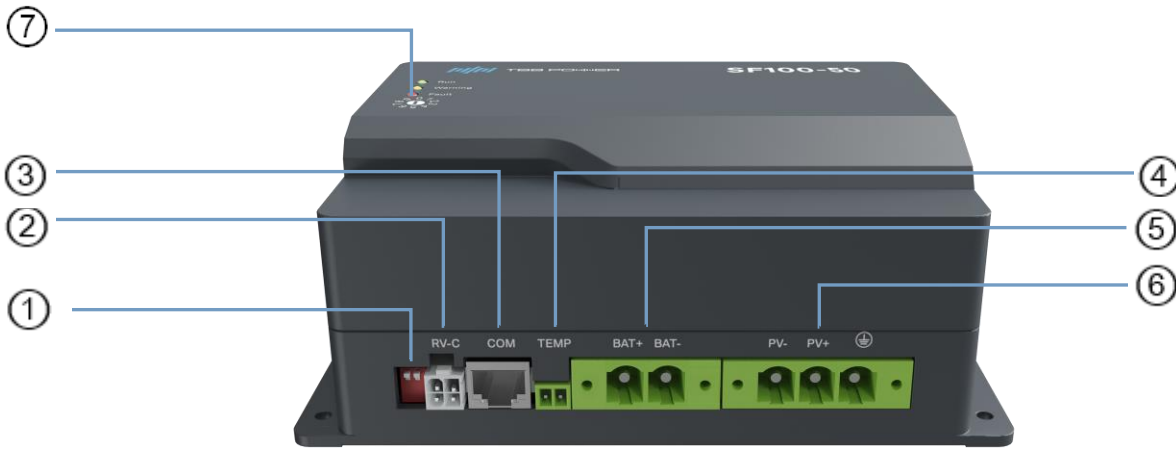


Figure 2-1 MPPT Solar Charge Controller Front View

2.3 Connectors & Ports

Table 2-2 Connectors & Ports

No.	Print	Function	Mark
1		RV-C instance setting	DIP switch
2	RV-C	RV-C communication connector	For US market only
3	COM	RS485 communication port	
4	TEMP	Temperature sampling connector	
5	BAT+	Battery "+" output	
	BAT-	Battery "-" output	
6	PV-	PV "-" input	
	PV+	PV "+" input	
	⊕	Ground Connection	
7	Knob switch	Battery type settings	

Table 2-3 DIP Switch Definition (RV-C instance for US market only)

PIN1	PIN2	Instance
OFF	OFF	1
ON	OFF	2
OFF	ON	3
ON	ON	4

Table 2-4 RV-C Connector Designation (For US market only)

PIN	Designation
1	CAN_H
2	CAN_L
3	NC
4	NC

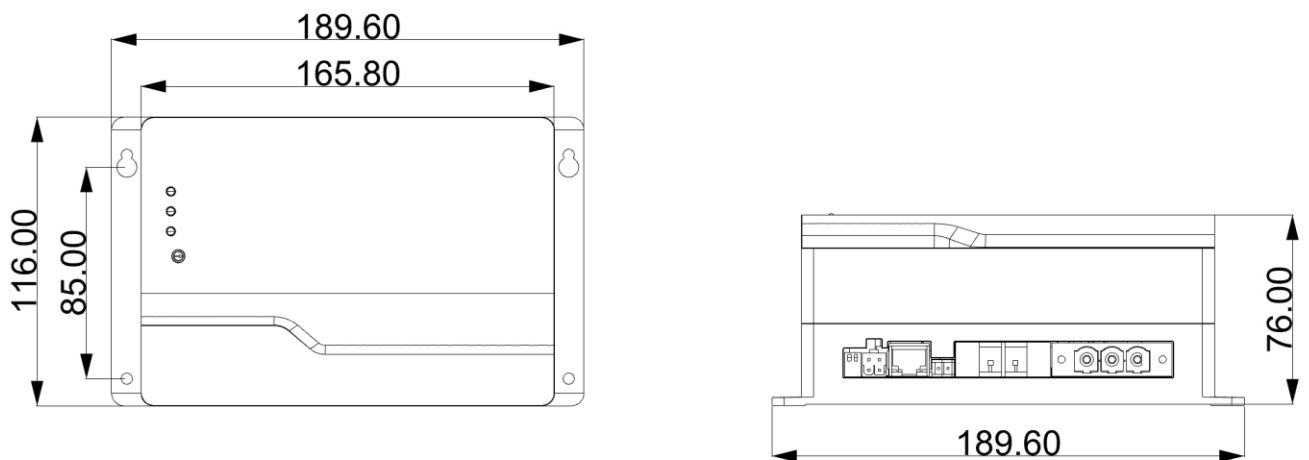
Table 2-5 COM Port Designation

PIN	Designation
1	--
2	--
3	RS485_A
4	--
5	--
6	RS485_B
7	--
8	--

Table 2-6 Knob Switch Designation

Knob po- sition	Designation
0	GEL/OpzV
1	AGM
2	LFP
3	WET
other	GEL/OpzV

2.4 Dimensions


Figure 2-2 Dimension of SF Controller

2.5 Functions

2.5.1 Maximum Power Point Tracking

With a built-in high-speed maximum power point tracking (MPPT) technology allows the controller to track the maximum power point of solar panels even in a complex environment. Compared with the PWM controller or traditional MPPT tracking technology, SF controller boasts faster response speed and higher tracking efficiency to improve the energy utilization from 10% to 30%.

2.5.2 Multistage Charging Algorithm

The SF series is designed with multi-stage charging algorithm, bulk-absorption-float-recycle, which can ensure that the battery is fully charged quickly. Float and cycle charging options ensure the battery is properly maintained during extended connection time.

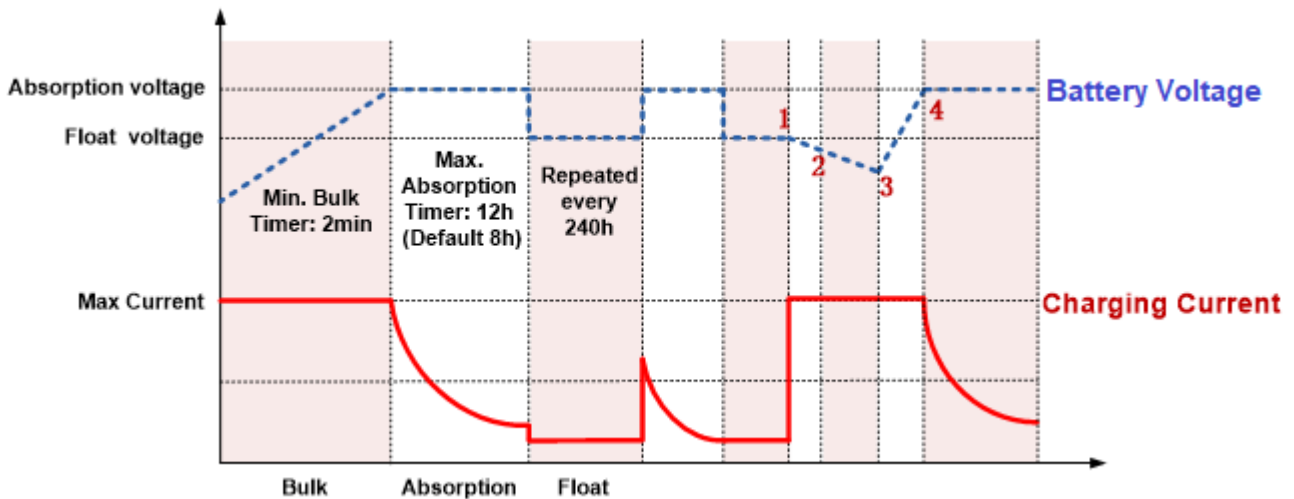


Figure 2-3 BAT Charging Curve

Note 1: At this moment, the battery external load exceeds this charging current, and the battery voltage begins to drop.

Note 2: At this moment, the controller will switch from Float stage to Bulk stage.

Note 3: At this moment, the battery stops discharging and the controller keep Bulk charging.

Note 4: At this moment, the controller performs Absorption charging.

Mark: There are four types of batteries that can be set for the SF100 series controller: GEL/OpzV, AGM, LFP, WET; the default is GEL/OpzV. The Users can also set the battery type, maximum charging current, equalizing charging voltage, floating charging voltage, cycle equalizing charging time, etc. on the APP to match different battery types and ensure that the battery can be charged accurately without overcharging or undercharging.

2.5.3 Battery Temperature Compensation

Battery temperature is a key factor affecting battery charging. The battery charging voltage must be adjusted in real time according to the battery temperature to ensure that the battery is fully charged and will not be overcharged or undercharged. Battery temperature compensation range is $-10^{\circ}\text{C}\sim 50^{\circ}\text{C}$

BTS (battery temperature sensor) can measure the battery temperature, and the SF100 series controller can adjust the charging voltage in real time according to the measured battery temperature. The temperature compensation is based on 25°C , and the default compensation coefficient is $-18\text{mV}/^{\circ}\text{C}@12\text{V}$.

The factory default setting on battery temperature compensation function is “OFF” status. The user can enable this feature on the APP and the temperature compensation coefficient can be set as well. For details, check the APP parameter settings

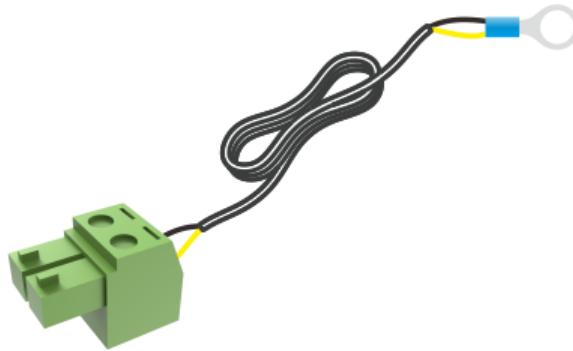


Figure 2-4 BTS (battery temperature sensor)

Note: BTS is an optional accessory.

2.5.4 Battery Voltage adaptability

The default battery voltage on SF controller is 12Vdc; 24Vdc battery is configurable on the app.

2.5.5 Multiple machines in parallel

Through the RV-C ports, SF MPPT controller can support 4 devices wired in parallel.

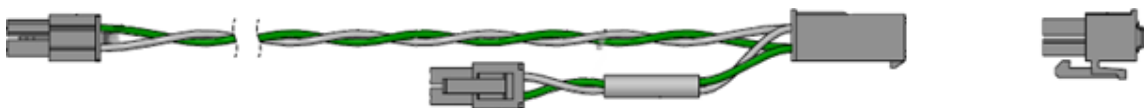


Figure 2-5 Parallel Cable

2.5.6 Protections

PV input reversed polarity protection

When the polarity of PV array is reversed, the controller will shut down; **the short circuit current can't exceed 20A**; the normal operation will continue after wiring error is corrected.

PV overvoltage protection

If the ISC rating of the PV array exceeds 20A, the controller **COULD** be damaged and this will void warranty.



When the PV voltage exceeds the maximum PV open circuit voltage range, continuous operation may cause damage to the controller. Any damage caused by the user's improper operation will VOID warranty.

Controller over temperature protection

When the internal temperature of the controller exceeds the threshold, the charger will derate and reduce the output power. If the temperature does not decrease, the charger will turn off the output to prevent internal damage.

Battery over temperature protection

During the charging process, the controller will sample the battery temperature in real time when the battery temp sensor is connected and enabled. Once the battery temperature is too high, the controller will reduce the charging current until shutting down; a fault alarm will be prompted to protect the battery from over temperature.

2.5.7 Forced Charging

The controller has a forced charging function, which is turned on by default when lithium battery is selected (the rotary switch position 2), the controller will output voltage regardless of whether the battery is connected or not (the default output is 14.2V without battery connection).

3. Installation

Warning: The DC(PV) input not isolated from battery circuit. Therefore, the PV, Battery and control circuit are considered hazardous and should not be user accessible.

Warning: The battery and PV connections must be guarded against inadvertent contact. Install the solar charger in an enclosure.

3.1 Pre-installation Inspection

3.1.1 Packing Inspection

- Before unpacking, please check whether the outer packaging is damaged and whether the charger model is correct. If there is any abnormality, please contact your dealer.
- After unpacking, please check whether the number of accessories is complete and whether the accessories are damaged. If there is any abnormality, please contact your dealer.

Package		
No.	Component	Qty
1	SF Controller	1
2	User Manual	1
3	3 Pin Combined Plug	1
4	2 Pin Combined Plug	1

3.2 Select installation location

3.2.1 Requirements

- Indoor installation only.
- Do not install the controller near flammable or explosive items.
- Do not install the controller where children can access it.
- The controller should be installed in a well-ventilated area.
- Must be installed on a non-flammable surface.
- Ensure that the mounting surface is strong enough for reliable installation.



Do not install the SF in a sealed compartment with batteries.

3.2.2 Installation Space Requirements

The controller **MUST** have adequate room on all sides for air flow. A minimum of two inches clearance from the vent cover is **REQUIRED** for proper heat dissipation. Refer to figure 3-1 for minimum spacing requirements.

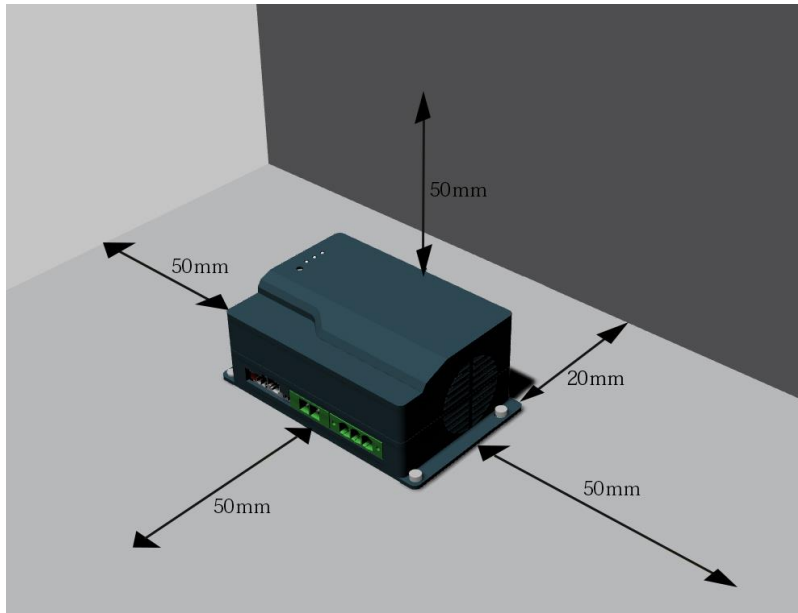


Figure 3-1 Minimal Installation Distance

3.3 Installation Guide

- The controller can be mounted in any configuration.
- Ensure the controller is flush on mounting material. Drills the holes based on the lock hole requirements. See Figure 3-2.

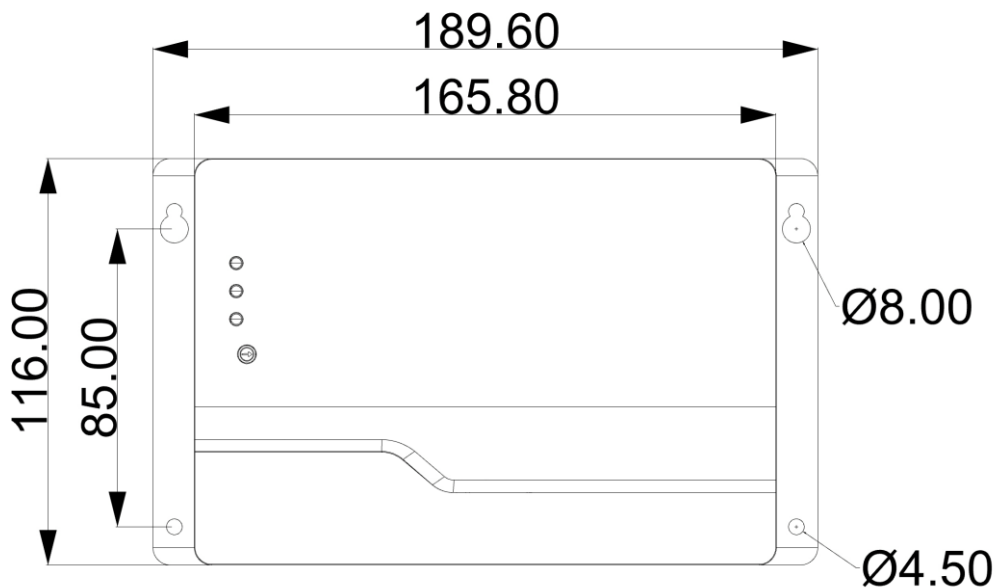


Figure 3-2 Lock Hole Requirements

- Please install the SF controller as close to the battery as possible to reduce the voltage drop and line loss between the controller and the battery.



Please make sure that the screws of the controller are firmly locked and the controller is installed well.

3.4 Preparation Before Wiring

3.4.1 PV module configuration

Each SF controller must be connected to one PV module separately. Please configure and connect the photovoltaic modules according to the maximum specifications of the PV as shown in table 3-1.

Table 3-1 SF PV Module Configuration Requirements

		SF100-30	SF100-50
Max. PV open circuit voltage		100V	100V
Max. MPPT voltage range		(Vbat+5V)- 90VDC	(Vbat+5V) - 90VDC
Max. PV short circuit current		20A	20A
Max. PV input power	12VDC	500W	800W
	24VDC	1000W	1600W

- The maximum PV short-circuit current allowed by the controller is 20A. When configuring PV modules, please ensure that the maximum short-circuit current of PV modules is less than 20A
- Please ensure that the configuration of the PV module is correct and the positive and negative wiring is correct.
- Please ensure that the maximum open-circuit voltage output of the PV module is within the MPPT voltage range, and the optimal operating point voltage > battery voltage +5V
- Please ensure PV Module Configuration under the low temperature does not exceed the max open-circuit voltage of 100V, Low temperature characteristics of PV panels shown as follows.

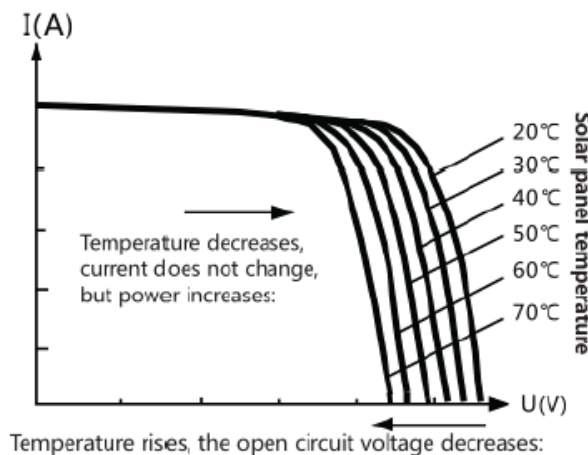


Figure 3-3 Solar Panel Changes with Varying Temperatures

3.4.2 Circuit Breaker Preparation

- A fuse or circuit breaker with a current greater than 120% of the rated charging current must be connected to the PV side and the battery side.
- Please refer to Table 3-2 for the specification requirements of the DC circuit breakers on the battery side and PV side.

Table 3-2 Breaker requirements

No.	Parts	Model	Requirement
1	Battery Breaker	SF100-50	(1) Voltage requirement $\geq 63V$ (2) Rated current requirement $\geq 60A$
		SF100-30	(1) Voltage requirement $\geq 63V$ (2) Rated current requirement $\geq 36A$

3.4.3 Cable Preparation

- The temperature resistance of the wire is required to be greater than 90°C (194°F)
- Wire diameter requirements, see Table 3-3.

Table 3-3 Wire Requirement

Port	SF100-30	SF100-50
Input wire diameter and length	11AWG; less than 3m	9AWG; less than 3m
Output wire diameter and length	9AWG; less than 3m	7AWG; less than 3m
Signal port	22AWG	22AWG

3.4.4 Wiring

Please refer to following overall wiring diagram of SF as shown in Figure 3-3.

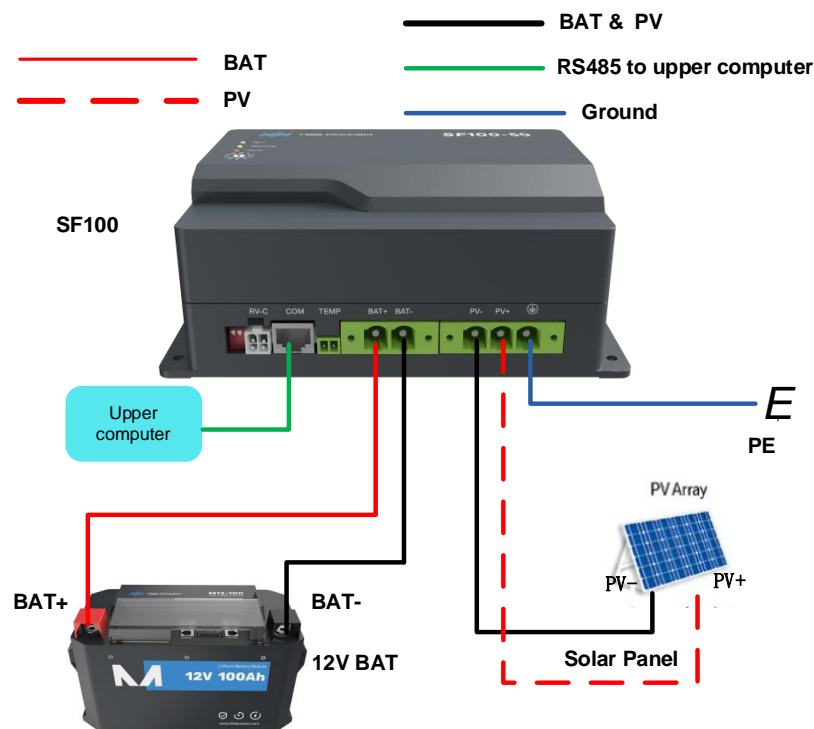


Figure 3-4 SF Wiring Diagram

4. Start up and Run

4.1 Check Before Operation

Please check the following items before starting up:

- The SF charger is installed correctly and securely, with a clean installation environment and sufficient space.
- Cable routing and layout are correct.
- Make sure the ground connection is correct and reliable.
- Please make sure that the battery circuit breaker and PV module circuit breaker are both open.
- Please ensure that the wiring between the battery and PV is correct and secure.

4.2 Start-up inspection



Please make sure that the battery voltage and PV module voltage do not exceed the SF controller specifications.

Follow the steps below to start up:

- Step 1: Close the circuit breaker between the battery and the SF controller.
- Step 2: Close the circuit breaker between the PV module and the SF controller.
- Step 3: After waiting for 30 seconds, observe the running information on the LED indicator to confirm that the device is charging normally.

4.3 Power OFF



After the MPPT controller is power OFF, there is still residual power and heat in the chassis, which may lead to electric shock or burn. Therefore, after the MPPT controller is powered off for 5 **minutes**, you should wear protective gloves before removed the MPPT controller.

Please turn off the circuit breaker between the battery and the MPPT controller.

5. Maintenance

5.1 Routine Maintenance

In order to ensure the long-term good operation on the SF controller, this chapter mainly introduces the routine maintenance is requirements.

Object	Method	Maintenance cycle
Cleaning	Check whether the SF controller panel is clean	Once every six months or once a year
Operation	<ul style="list-style-type: none"> ➤ The appearance is clean ➤ There is no abnormal sound during the operation ➤ The parameters are correct during operation 	Once a year
Wiring	<ul style="list-style-type: none"> ➤ Wiring connection is firm ➤ The cable insulation shall be free from damage and aging 	Once every six months or once a year
Grounding	The ground wire is firmly connected	

5.2 Quick Fault Inspection

Fault level definition:

- Fault: The SF controller has a serious fault and cannot continue charging and the Fault light flashes.
- Warning: The SF controller is abnormal, and the Warning light flashes.

Type	Code	Name	Description	Fault LED	Troubleshooting
Fault	01	U_Bus_OV	Bus voltage is too high	Flash 1 time	<ul style="list-style-type: none"> ➤ Check the string of PV array. ➤ Make sure the PV open circuit voltage lower than the maximum range of MPPT controller. ➤ If it happens frequently, please contact your dealer.
	02	U_BAT_OV	Battery over voltage	Flash 2 times	<ul style="list-style-type: none"> ➤ Check whether the controller matches to the battery voltage. ➤ If it happens frequently, please contact your dealer.
	03	U_Bat_OV_HD		Flash 3 times	
	04	Buck_ShortCut	Battery short circuit	Flash 4 times	<ul style="list-style-type: none"> ➤ Check and restore the wiring to see if the controller can operate normally. ➤ If there is no wiring error, please

					contact your dealer.
05	I_Buck1_OC	Output current over	Flash times	5	<ul style="list-style-type: none"> ➤ Check the output connection. ➤ If there is no wiring error, please contact your dealer.
07	T_Board_OT	Over-temperature inside	Flash times	7	<ul style="list-style-type: none"> ➤ Check whether ambient temperature is over limitation of the controller. ➤ Check the installation ambient ventilation.
08	T_HS_OT	Over-temperature Heat sink	Flash times	8	
09	PSU_LV	Auxiliary power under-voltage	Flash times	9	<ul style="list-style-type: none"> ➤ Please contact your dealer.
10	PSU_LV_HD		Flash times	10	
11	Sam_HD_Fault	Sampling failure	Flash times	11	
12	EEPROM_Fail	ROM abnormal	Flash times	12	


Type	Code	Name	Description	Warning LED	Troubleshooting
Warning	03	Cur_Limit	Current limiting alarm	Flash 3 times	<ul style="list-style-type: none"> ➤ Check the MPPT output or contact installer.
	05	NTC_HS_Fault	Heat sink-NTC failure	Flash 5 times	<ul style="list-style-type: none"> ➤ Contact installer.
	06	T_BAT_OT	Battery over temperature	Flash 6 times	<ul style="list-style-type: none"> ➤ Check whether the installation ambient temperature is too high. ➤ Check whether the battery wiring is tight and reliable. ➤ Check whether the battery cable matches the requirement.
	08	TypeSet_Mismatch_Err	The controller model error	Flash 8 times	<ul style="list-style-type: none"> ➤ Check whether the model is correct. ➤ Please contact your dealer.
	09	CommSys_Err	System communication is lost	Flash 9 times	<ul style="list-style-type: none"> ➤ Please contact your dealer.
	14	NTC_Board_Fault	The NTC of the controller is fault	Flash 14 times	<ul style="list-style-type: none"> ➤ Please contact your dealer.

6. Technical Parameters


Model	SF100-30	SF100-50
Electrical Properties		
Battery Voltage (Adaptive)	12V or 24V	
Rated Charging Current	30A	50A
PV Max Power, @12V 1), 2)	500W	800W
PV Max Power, @24V 1), 2)	1000W	1600W
Max. PV Open Circuit Voltage	100V	100V
PV Operation Voltage Range	Vbat+5V~90V	
Max. PV Short Circuit Current	20A	20A
Max. Conversion Efficiency	97.2%@24V	
Max. MPPT Efficiency	99.9%	
Battery Type	GEL/OpzV, AGM, LFP, WET	
Communication	RS485/ CAN (RV-C)/ Bluetooth	
Insulation Resistance	≥10 MΩ	
Protections	Output Overvoltage, PV reversed polarity, Over-temperature, Output Short Circuit	
Environment		
Operation Temp	-40°C~60°C	
Altitude	5000m	
Structure		
Cooling	Force Cooling	
IP Rating	IP20	
Dimension	189.6*116.0*76.0mm	
Weight	0.82kg	
Standard		
Safety	UL1741, IEC62109-1	
1) SF will limit the input power if the PV panels output too much energy. 2) Only the PV input voltage > battery voltage +5V, SF will start charging.		

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