



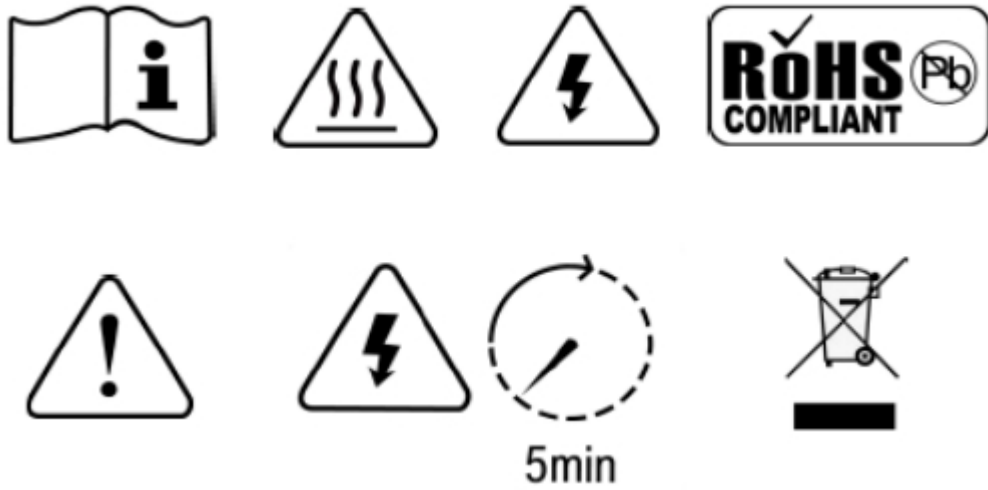
PURSUIT OF PERFECTION



# Solar Mate

## MPPT charge controller

A4.2



**WARNING: HIGH VOLTAGE INSIDE**

**CAUTION: THE DC FUSE MUST HAVE BEEN TURNED OFF BEFORE SERVICING**

**MADE IN CHINA**

## Disclaimer

Unless specially agreed in writing, TBB Power Co.,Ltd

- Take no warranty as to the accuracy, sufficiency of suitability of any technical or other information provided in this manual or other documentation.
- Assumes no responsibility or liability for loss or damage, whether direct, indirect, consequential or incidental, which might arise out of the use of such information.
- TBB offer standard warranty with its products, taking no responsibility for direct or indirect loss due to equipment failure.

## About this Manual

This manual describes our product features and provides procedure of installations. This manual is for anyone intending to install our equipment.

## General Instruction

Thanks for choosing our products and this manual were suitable for Solar Mate series MPPT.

This chapter contains important safety and operation instructions. Read and keep this User Guide well for later reference.

MPPT charge controller will have high voltage inside, Solar Mate MPPT charge controller needs to be installed by professionals and only authorized electrician can open the case.

# Contents

1. General Safety Instruction.....	1
1.1 Safety Instruction .....	1
1.2 General Precaution .....	1
1.3 Precaution regarding battery operation .....	1
2. Instruction .....	2
2.1 Brief Instruction .....	2
2.1.1 General Description .....	2
2.1.2 Naming Rules .....	3
2.2 Structure .....	3
2.2.1 Front .....	3
2.2.2 Control panel.....	4
2.2.3 Connection compartment .....	5
2.2.4 Dimension.....	6
2.3 Function .....	7
2.3.1 Maximum Power Point Tracking.....	7
2.3.2 Battery charging control .....	7
2.3.3 Auxiliary Output.....	7
2.3.4 TBB premium III charging algorithm .....	8
2.3.5 Comprehensive Protection.....	9
2.3.6 Equalization Charging (EQ charging) .....	10
3. Installation and Wiring.....	11
3.1 Pre-installation inspection .....	11
3.1.1 Check outer packing .....	11
3.1.2 Check deliverables.....	11
3.2 Instrument Preparation.....	11
3.3 Select installation location .....	12
3.3.1 Requirement .....	12
3.3.2 Installation space requirements.....	12
3.3.3 Installation Angle.....	13
3.4 Installation.....	14
3.5 Preparation Before Wiring .....	15
3.5.1 Wiring Diagram .....	15
3.5.2 PV Array Preparation .....	15
3.5.3 Breaker Preparation .....	17
3.5.4 Cable Preparation .....	18
3.5.5 Preparation before wiring .....	18

---

3.6 Grounding Connection .....	19
3.7 PV Array Connection.....	20
3.8 Battery Connection .....	21
3.9 Communication Connection .....	21
3.10 Connecting the multiple units .....	22
4. Configuration .....	24
4.1 Check Before Operation.....	24
4.2 Power ON Test.....	24
4.3 Power OFF .....	24
4.4 Setup Wizard .....	25
5. Operation .....	26
5.1 Menu introduction .....	26
5.2 Initial interface.....	27
5.3 Real-time information interface .....	27
5.4 Information query interface .....	27
5.5 Parameter setting interface .....	30
5.6 User Config.....	34
6. FAQ .....	35
6.1 Fault code.....	35
7. Specification.....	38

# 1. General Safety Instruction

## 1.1 Safety Instruction

As dangerous voltage and high temperature exist within the charge controller, only qualified and authorized maintenance personnel are permitted to open and repair it.

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. Please follow the local stipulation meantime.

Any operation against safety requirement or against design, manufacture, safety standard, and are out of the manufacturer warranty.

## 1.2 General Precaution

- Do not expose to rain, snow or liquids of any type, it is designed for indoor use.
- To avoid fire and electric shock, make sure all cables selected with right gauge and being connected well. Smaller diameter and broken cable are not allowed to use.
- Please do not put any inflammable goods near to charge controller.
- Never place unit directly above batteries, gases from a battery will corrode and damage the charge controller.
- Do not place battery over charge controller.

## 1.3 Precaution regarding battery operation

- Use plenty of fresh water to clean in case battery acid contacts skin, clothing, or eyes and consult with doctor as soon as possible.
- The battery may generate flammable gas during charging. Never smoke or allow a spark or flame in vicinity of a battery.
- Do not put the metal tool on the battery, spark and short circuit might lead to explosion.
- Remove all personal metal items such as rings, bracelets, necklaces, and watches while working with batteries. Batteries can cause short-circuit current high enough to make metal melt, and could cause severe burns.

## 2. Instruction

### 2.1 Brief Instruction

#### 2.1.1 General Description

Solar Mate is a solar charge controller with built in Maximum Power Point Tracking (MPPT) technology, which can optimize the PV's output eliminate the fluctuation due to shading or temperatures variables. It tracked the maximum power point of a PV array to deliver the maximum charging current for battery, enabling PV array to increase the output by as much as 30% compared with PWM design.

Solar Mate is a multi-voltage MPPT with built in sophisticated battery charging algorithm for various kinds of lead acid batteries, including AGM, GEL, Traction. Data management with a year of history record was offered as well. Meantime, version for Lead-Carbon battery and lithium ion battery were available upon request.

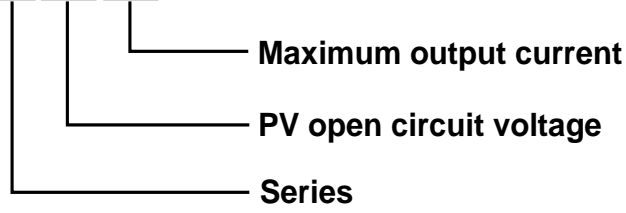
SP can operate at their full rating in ambient temperatures as high as 40°C.

- Maximum MPPT efficiency up to 99.9%, Maximum dynamic MPPT efficiency up to 99%.
- Maximum efficiency up to 98%, and European weighted efficiency up to 97.3%.
- Maximum charging current up to 120A.
- High reliability with electronic protections.
- Wide MPPT operating voltage range.
- Up to 7056W of charging power at 40°C.
- Parallel function, up to 4 units can operate in parallel.
- Easy installation and commissioning.
- Flexible charge algorithm.
- Extensive networking and communication capabilities.
- Auxiliary contact RS485 : communication among TBB products or with other.

## 2.1.2 Naming Rules

SPXXX-YYY

SP 150-120



Field	Character	Description	
SP	SP	SP series MPPT solar charge controller	
XXX	150	PV open circuit voltage:(V)	150
	250		250
YYY	120	Maximum output current:(A)	120
	100		100
	80		80
	70		70
	60		60

## 2.2 Structure

### 2.2.1 Front



Figure 2-1 MPPT charge controller structure in front view



## 2.2.2 Control panel

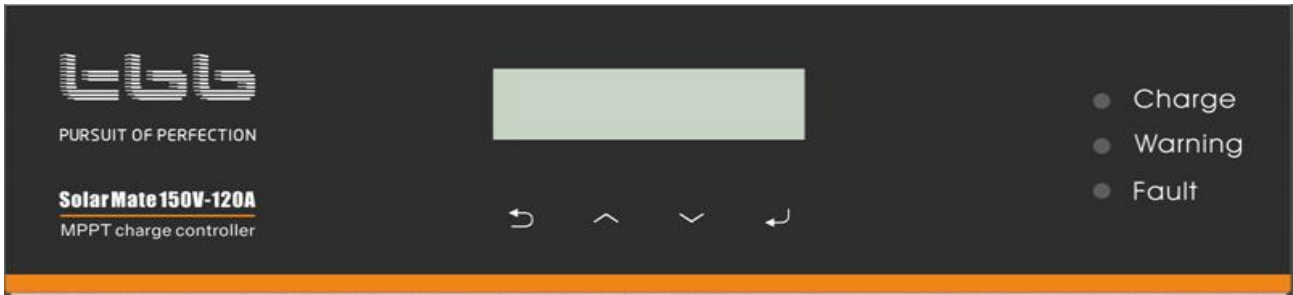


Figure 2-2 MPPT Control buttons

Table 2-1 Control Buttons





Button	Function
	<ul style="list-style-type: none"> <li>➤ Cancel the selection</li> <li>➤ Display the previous level of menu</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Display the previous page</li> <li>➤ Increase the value of the selected item</li> <li>➤ Press the button for more than 2 seconds to scroll the page up</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Display the next page</li> <li>➤ Decrease the value of the selected item</li> <li>➤ Press the button for more than 2 seconds to scroll the page down</li> </ul>
	<ul style="list-style-type: none"> <li>➤ Enter into this menu, displaying the next level</li> <li>➤ Select and confirm the selection of a menu item</li> </ul>

Table 2-2 LED directive function

LED	Function
<b>Charge</b>	<ul style="list-style-type: none"> <li>➤ It Flash when SP is in standby.</li> <li>➤ It Flash when SP is in float charging state.</li> <li>➤ It illuminate when SP is perform charging .</li> </ul>
<b>Warning</b>	<ul style="list-style-type: none"> <li>➤ It Flash when SP have warning.</li> </ul>
<b>Fault</b>	<ul style="list-style-type: none"> <li>➤ It Flash when SP have error.</li> </ul>

### 2.2.3 Connection compartment

External interface terminal as shown in Figure 2-3.

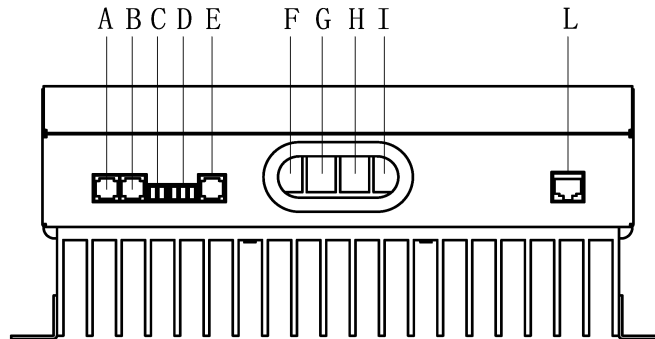


Figure 2-3 Connection terminals

Table 2-3 Connection terminal introduction

	<b>Silk-screen</b>	<b>Definition</b>
A	Com In	Connection terminal for parallel communication input.
B	Com Out	Connection terminal for parallel communication output.
C	EPO	EPO contacts, defined for remote on/off.
D	Relay	Output dry contacts.
E	RS485	Connection terminal for RS485 communication.
F	BAT+	Battery Connection Positive
G	BAT-	Battery Connection Negative
H	PV-	PV array Negative
I	PV+	PV array Positive
L	BTS	Connection terminal for battery temperature sensor.

Table 2-4 Pin definition of PCB Connector A,B

Pin	Definition
Pin1	--
Pin2	RS485_A
Pin3	RS485_B
Pin4	--

Table 2-5 Pin definition of PCB Connector E

Pin	Definition
Pin1	RS485_B
Pin2	RS485_A
Pin3	GND
Pin4	RS485_A
Pin5	RS485_B
Pin6	GND
Pin7	RS485_A
Pin8	RS485_B

2.2.4 Dimension

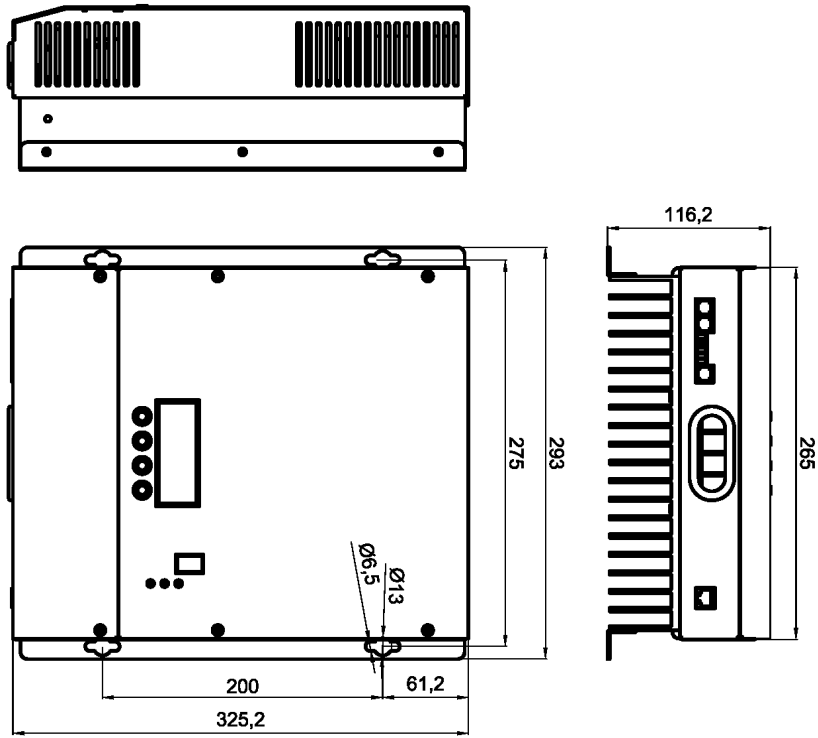


Figure 2-4 Dimension of Solar Mate MPPT charge controller (SP250-70、SP150-100、SP150-80、SP150-60)

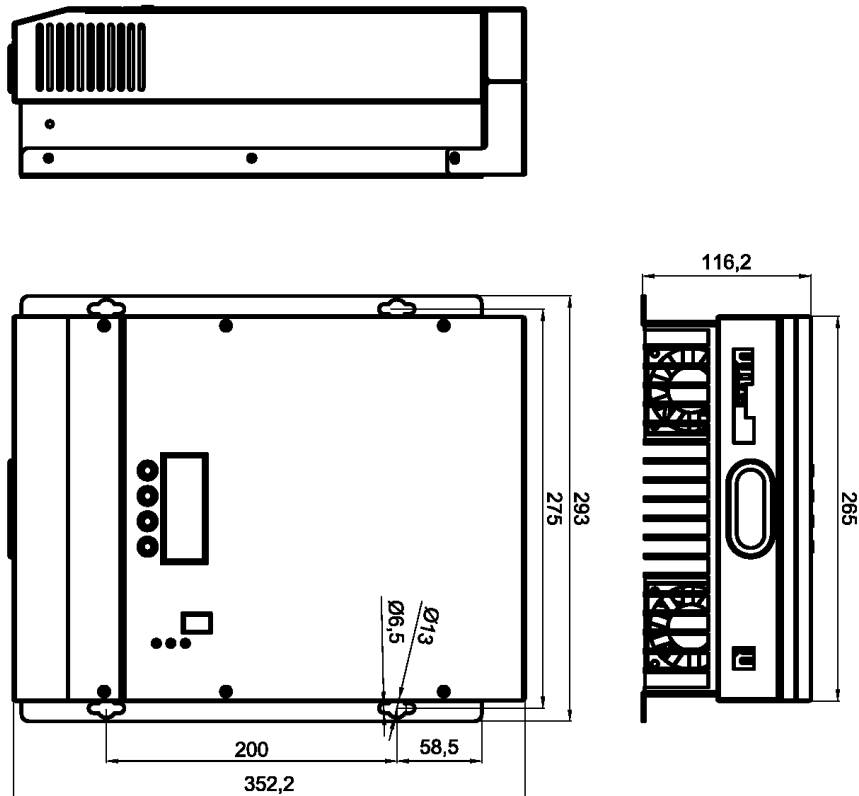


Figure 2-5 Dimension of Solar Mate MPPT charge controller( only SP250-100)

## 2.3 Function

### 2.3.1 Maximum Power Point Tracking

The output power of PV array was affected by sun irradiation level and environment temperature. The max power point varies a lot under different weather condition.

Max Power Point Tracking allows the maximum harvest of energy from PV array and delivered it into battery. The MPPT software will continuously adjusts the operating points in an attempt to find the maximum power point of the array no matter how the weather changes. With MPPT, we can maximize the usage of the PV array, increasing the system efficiency by maximum 30%.

### 2.3.2 Battery charging control

With built in TBB premium III charging algorithm, SP automatically regulated the voltage and current according to the DC source available from PV array.

The SP is able to charge a lower nominal voltage battery from a higher nominal voltage array. For example, a 110VDC PV array to charge a 48VDC battery. This gives the flexibility to use longer wires without compromising the efficiency of PV system.



The SP was not able to charge a higher voltage battery from a lower voltage array.

### 2.3.3 Auxiliary Output

The SP has a configurable auxiliary output (relay contact, nominal switching capacity is 2A up to 30VDC), of which can be used for default wake up, or remote switch devices such as alarm . Only one function can be designed at a time. Please refer to chapter 5.5.



The auxiliary contact output was designed to energize a low current circuit. Connecting to a high amperage device will possibly damage the equipment and it is out of warranty.

#### Default

The auxiliary contact can be configured to default wake up, if the connection is detected in the DC Coupling system, take one puff every 5 minutes to wake up Kinergier Pro (Connected to the input dry contacts of the Kinergier Pro).

#### Alarms

The auxiliary contact can be configured to switch the alarm circuit or indicator light on upon preset condition occurs, such as MPPT failure, battery low voltage, high PV input voltage etc.

### 2.3.4 TBB premium III charging algorithm

#### Adaptive charging

Fitted with multistage charging algorithm (bulk-absorption-float-recycle), the TBB premium III charging algorithm is designed to charge battery quickly and fully. Microprocessor controlled charging algorithm with variable absorption charging timer guarantee the optimal charging for batteries of different discharged state.

Float charging and Recycle charging program guarantee your battery could get proper maintenance in case of long time connected.

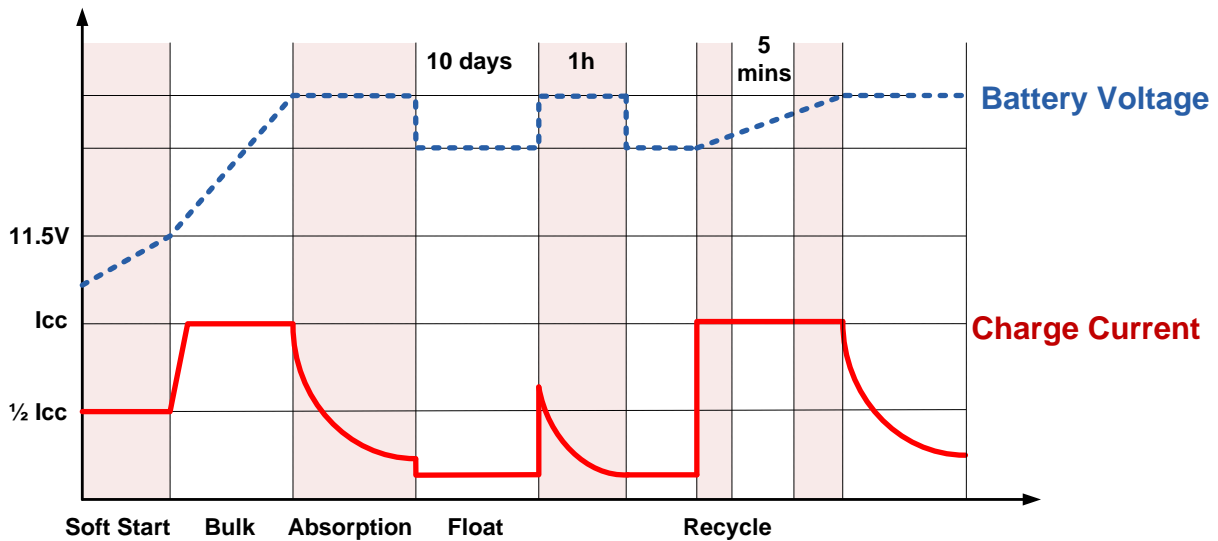


Figure 2-6 TBB standard battery charging curve

#### Battery temperature compensation

Battery temperature is a key factor in correct charging, the charging formula must be adjusted (automatically and in real time) according to the actual battery temperature to ensure that battery are fully charged but not overcharged or undercharged. All charging voltages recommended by battery manufacture are in fact only applied at 20°C-25°C.

The BTS (Battery Temperature Sensor) supplied with SP measures the temperature of battery and automatically makes adjustments at real time to properly charge your batteries at the default compensation rate of  $-3\text{mv}/^{\circ}\text{C}/\text{cell}$ .

In case of BTS was not present, the SP will use 25°C as default setting.



Figure 2-7 Battery Temperature Sensor(BTS)

### Multi battery chemical available

Commonly encountered lead acid battery chemicals include AGM, GEL, Traction. The voltage required for a proper charging of different battery varies. SP offer premium charging for above commonly encountered battery categories, of which you can set through the LCD and control button.

### 2.3.5 Comprehensive Protection

The equipment is being protected against many failures through hardware and software making it robust and reliable.

#### PV array reverse polarity protection

When PV reverse polarity is detected, SP will shut down.

#### PV over voltage protection

If PV voltage beyond the scope can be operating voltage, the charger will shut down output, and by sound and light alarm prompt, to ensure that the charger will not damage.



When the PV voltage exceeds SP charger allows the highest PV open circuit voltage range, beyond specification use may cause damage, if the customer use undeserved cause damage, do not provide warranty service.

### Ambient temperature derating curve

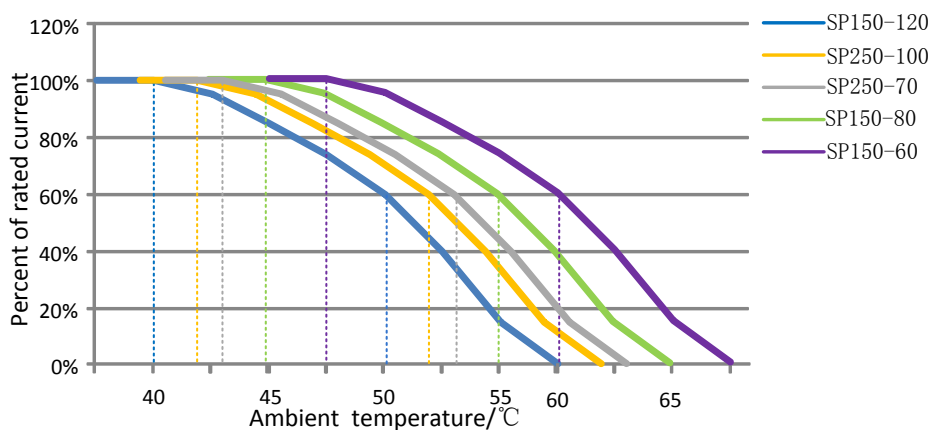


Figure 2-7 Temperature derating curve

### Battery over temperature protection

During charging, The SP in the process of charging battery temperature real time acquisition, when the battery temperature is too high, it will reduce the charging current and shut down, and fault warning , in order to prevent thermal runaway of battery.

### 2.3.6 Equalization Charging (EQ charging)



It is strongly recommended to read this section carefully before you start the EQ charging and Don't leave battery unattended while performing desulfuration.



Always check if your battery supplier recommended EQ charging. Only start when it is suitable.



If battery type was set at AGM, GEL or Lead-Carbon , this charging can't be triggered on.

Over a period of time, the cells in a traction battery can develop uneven chemical states. This will result in a weak cell which in turn can reduce the overall capacity of battery. To improve the life and performance of these non sealed battery, SP include a manual equalization program that can be used, if recommended by battery manufacturer.

Through this page, you can initiate the desulfuration program manually. After entering this page, please press "ENTER" button to trigger on the EQ charging. Detailed operation, please refer to chapter 5.5 "Para\_Battery".

- After 30 minutes, it will quit EQ and enter into float charge.
- Check electrolyte level and refill battery with distilled water if necessary.
- If you want to come to normal charging, you need stop equalization charging and switch off the unit.
- Switch on the unit again, then you will have your equipment back to normal charging.



During equalization, the battery generates potentially flammable gases. Follow all the battery safety precautions listed in this guide. Ventilate the area around the battery thoroughly and ensure that there are no sources of flame or sparks in the vicinity



Turn off or disconnect all loads on the battery during equalization. The voltage applied to the battery during equalization may be above the safe levels for some loads.

**Frequency:** Maximum once a month, for heavily used battery, you may wish to equalize your battery. For battery with light service only need to be equalized every 2-3 months.

**Important:**

- 1) Equalization can damage your batteries if it is not performed properly. Always check battery fluid before and after equalization. Fill batteries only with distilled water.
- 2) Always check the equalization switch is set back to OFF after each time's equalization.
- 3) Battery manufactures' recommendations on equalization vary. Always follow the battery manufacturer's instructions so batteries are properly equalized. As a guide, a heavily used battery may require equalization once a month while a battery in light duty service, only needs equalizing once every 2 to 4 months.

**Battery type:** As a protection, equalization charging can be performed if and Only if you set the battery to be traction, Flooded /OPzS batteries. If you choose AGM, GEL or Lead-Carbon, EQ charging can't be performed.

### 3. Installation and Wiring

#### 3.1 Pre-installation inspection

##### 3.1.1 Check outer packing

- Please check the outer packing for damage before unpacking, and check the machine model. If there have something wrong, please don't open it and contact your dealer.
- Please check the quantity of accessories, if there have something wrong, please contact your dealer.

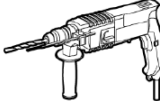
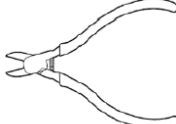
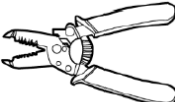








##### 3.1.2 Check deliverables

- After unpacking, please check the deliverable for completeness and any apparent damage.
- If any item is missing or there is any damage, please contact your dealer.

#### 3.2 Instrument Preparation

Please prepare tools and instruments following the Table 3-1 in advance.

Table 3-1 tools and instruments

Classify	Tools and instruments		
Installing	 Percussion drill (φ6mm)	 Diagonal pliers	 Wire stripper
	 Wire cutters (25mm <sup>2</sup> ~35mm <sup>2</sup> )	 Hydraulic pliers (25mm <sup>2</sup> ~35mm <sup>2</sup> )	 Cross screwdrivers (M4、M6)
	 Universal meter (600V)	 Heat-shrinkable tubing	 Heat gun
Personal safety equipment	 Protective gloves	 Protective shoes	



### 3.3 Select installation location

#### 3.3.1 Requirement

- The protection level of charger is IP21, which can only be installed indoors.
- During the operation of the radiator, the temperature of the chassis and radiator will be relatively high. Please do not install it in the place where it is easy to touch.
- Do not install in the place where inflammable and explosive articles are stored.
- Do not install in the place where children can touch it.
- Solar Mate MPPT charge controller should be installed in a well-ventilated environment to ensure good heat dissipation.
- Please install vertically so that the charger can dissipate heat. Do not place the charger horizontally.
- Do not install on flammable building materials
- Please ensure that the mounting surface is firm enough to meet the load bearing requirements of charger installation



Do not install SP in a sealed compartment containing batteries.

#### 3.3.2 Installation space requirements

A good ventilation can guarantee the normal operation of equipment. Please always guarantee the enough clearance around SP upon installation. Please refer to following Figure 3-1 for minimum clearance.

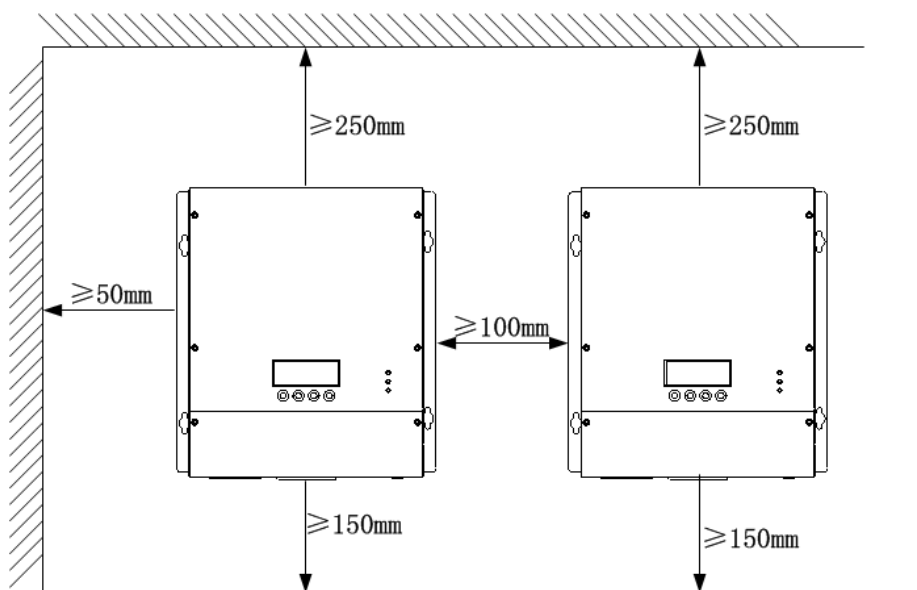


Figure 3-1 Requirement of minimum clearance

### 3.3.3 Installation Angle

A good ventilation can guarantee the normal operation of equipment.

- Please vertical or back 15 ° or less installation, for cooling machine.
- Do not use the charger forward too much, level, upside down, back and side installation

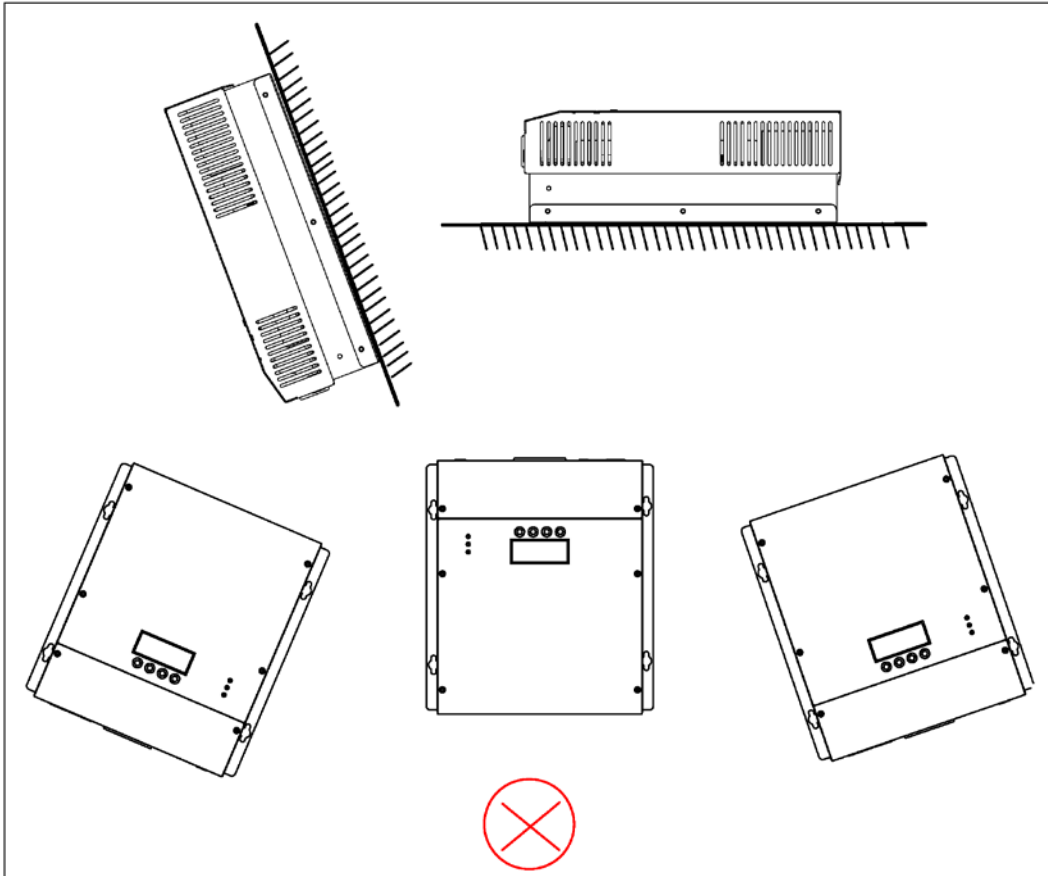


Figure 3-2 angle of installation

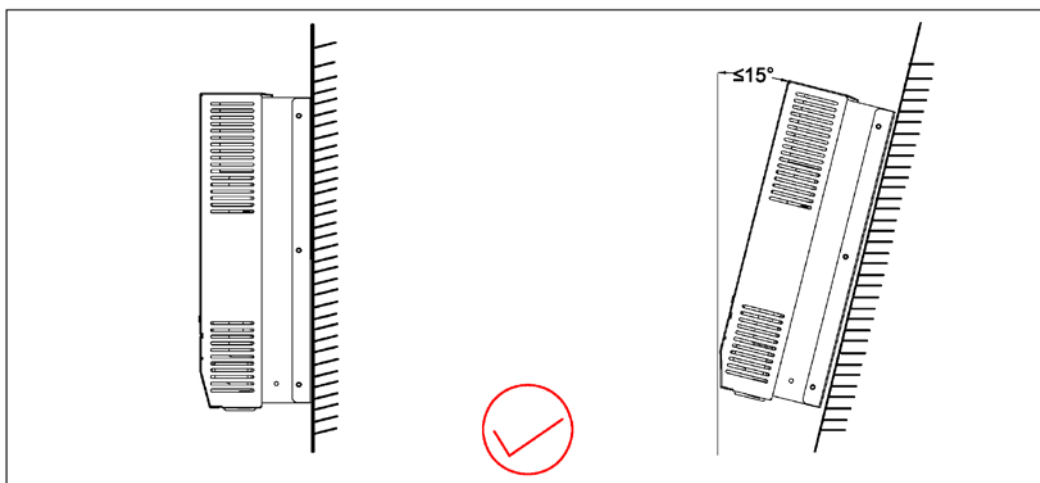


Figure 3-3 angle of installation

### 3.4 Installation

- The Solar Mate need to be installed vertically, please choose a flat surface and with 4xM6 supplied to install following Figure 3-4.
- Install the SP as close to the batteries as possible reducing the voltage drop on cable for the better performance of the equipment.
- Please install four feet supplied in the accessory pack on side of the charge controller.
- Please place the SP on your preference location and mark the location of four feet.
- Screw the four screws on the wall, leaving about 6mm (1/4").
- Hanging the SP on the four screws and screw tight the four screws afterwards.

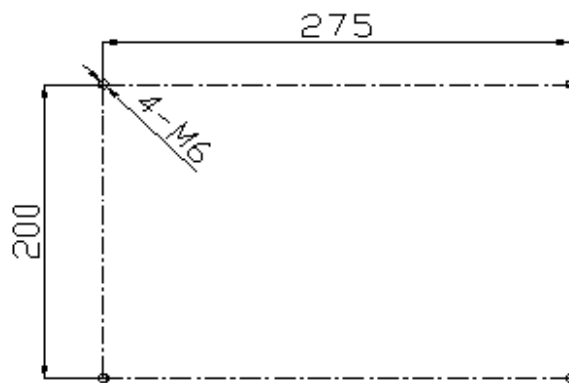


Figure 3-4 Illustration of installation

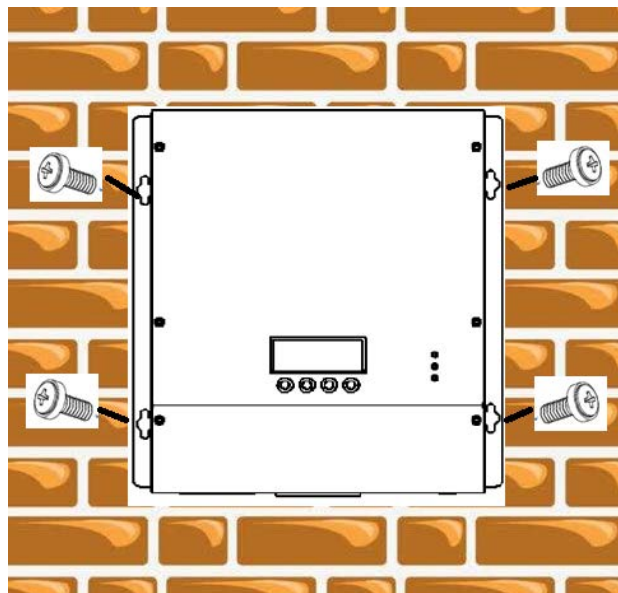


Figure 3-5 After installation



Please double check the SP is securely mounted on the wall.

### 3.5 Preparation Before Wiring

#### 3.5.1 Wiring Diagram

Please refer to following overall wiring diagram of SP as shown in Figure 4-1.

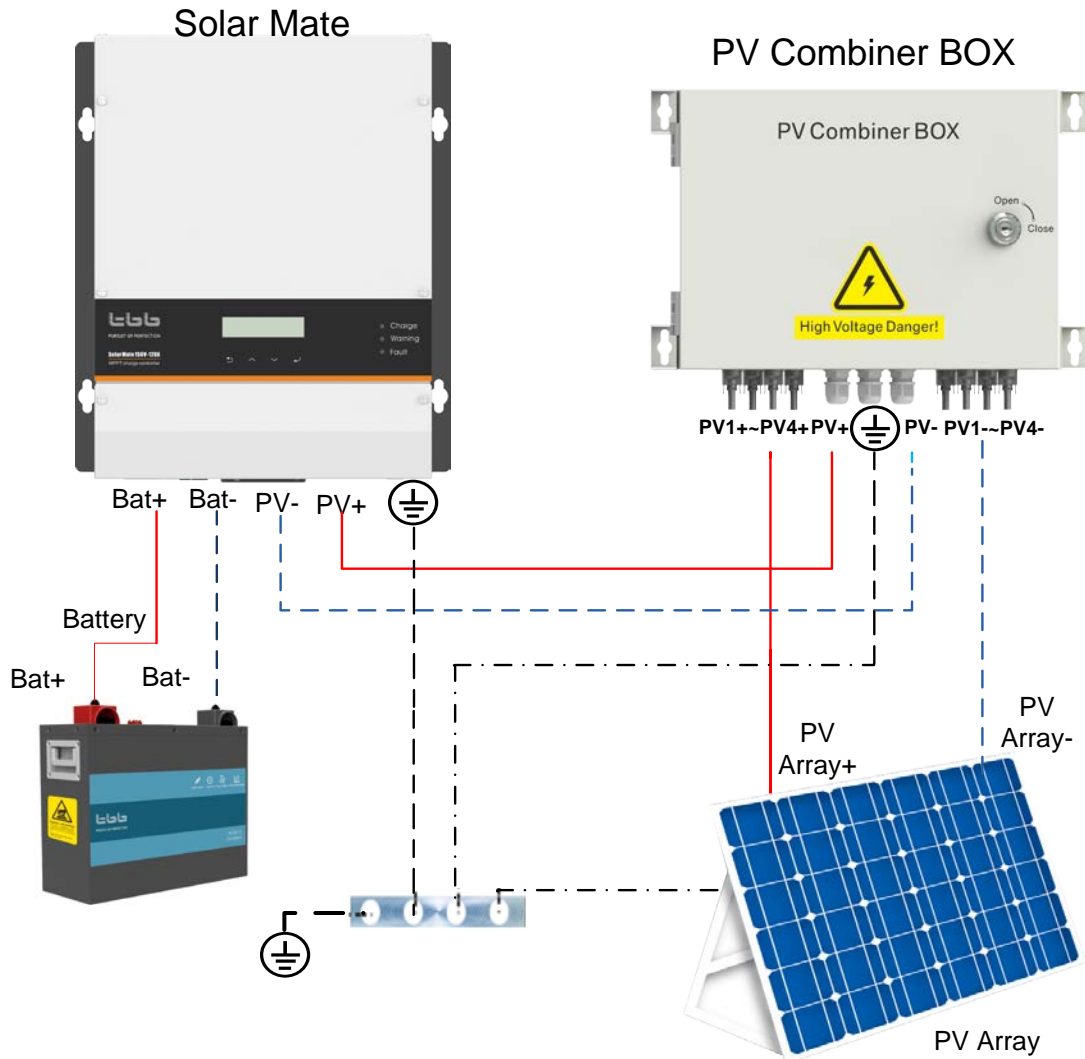


Figure 3-6 Wiring diagram of Solar Mate

#### 3.5.2 PV Array Preparation

PVB Series PV combiner box is designed for solar off-grid system available with series of MAX VOC 150Vdc and 250Vdc. It can be used between PV Array and Solar Mate series MPPT charge controller. With Built in MC4 connector, fuse, circuit breaker and SPD, it can facilitate the installation as well as improve the system safety.

Each SP must be connected to its own PV array. Please find following maximum PV array can be connected under various DC systems.

Table 3-1 PV allowance for SP

Solar Mate	SP150-120	SP150-80	SP150-60	SP250-100	SP250-70
Applicable PV combiner box	PVB150-8	PVB150-6	PVB150-4	PVB250-5	PVB250-3
PV open circuit voltage (Voc)	150	150	150	250	250
Max. PV short circuit current	80A	80A	40A	80A	80A
Maximum charging current (40°C)	120A	80A	60A	100A	70A
Maximum charging power	7056W	4704W	3528W	5880W	4116W
Recommended PV	9000W	6000W	4500W	7500W	5400W



The Voc of PV array must never exceed 150V for SP150-YYY and 250V for SP250-YYY ;The PV array Isc must not exceed 80A at any time.



The Voc or Vmpp of solar panel was rated at 25°C with normal weather condition. Along with temperature reduced, the Voc/Vmpp of solar array will increase. Please consult with PV manufacturer for Voc/Vmpp of the lowest possible environment temperature and making sure it is below 150VDC for SP150-YYY and 250VDC for SP250-YYY.

- PV array with Isc up to 80A was recommended for SP series to allow for increase of Isc caused by irradiance enhancement under certain condition.
- Please ensure the PV array used in the system operates within the MPPT operational window. Following table shows effects of different PV array voltage.

Table 3-2 Effects of different PV array voltage

Model	Voltage	Effect	SP mode
SP150-120	Vmpp = 65VDC to 145VDC	Maximize the harvest of solar energy	Charging
SP150-80			
SP150-60			
SP150-120	Voc > 145VDC	SP shut down when Vmpp is higher than 145VDC. Unit might damage if Voc>150VDC	Overvoltage fault
SP150-80			
SP150-60			
SP250-100	Vmpp = 65VDC to 245VDC	Maximize the harvest of solar energy	Charging
SP250-70			
SP250-100	Voc > 245VDC	SP shut down when Vmpp is higher than 245VDC. Unit might damage if Voc>250VDC	Overvoltage fault
SP250-70			

### 3.5.3 Breaker Preparation

- An over current protection devices DC fuse or DC circuit breaker needs to be installed on positive cable, of which rated for 125% of the nominal rating.
- The voltage resistance of DC circuit breaker on the battery side should be greater than 63V.
- Voltage withstand of PV array side DC circuit breaker should be greater than PV open circuit voltage.

Circuit breaker requirements are shown in the Table 3-3

Table 3-3 Breaker Requirement

Number	Parts	Description	Requirement
1	Battery breaker	SP150-120	(1) The voltage requirement is greater than 63V. (2) The current requirement is greater than 150A.
		SP150-80	(1) The voltage requirement is greater than 63V. (2) The current requirement is greater than 100A.
		SP150-60	(1) The voltage requirement is greater than 63V. (2) The current requirement is greater than 80A.
		SP250-100	(1) The voltage requirement is greater than 63V. (2) The current requirement is greater than 125A.
		SP250-70	(1) The voltage requirement is greater than 63V. (2) The current requirement is greater than 100A.
2	PV array breaker	SP150-120	(1) The voltage requirement is greater than 150V. (2) The current requirement is greater than 100A.
		SP150-80	(1) The voltage requirement is greater than 150V. (2) The current requirement is greater than 80A.
		SP150-60	(1) The voltage requirement is greater than 150V. (2) The current requirement is greater than 63A.
		SP250-100	(1) The voltage requirement is greater than 250V. (2) The current requirement is greater than 80A.
		SP250-70	(1) The voltage requirement is greater than 250V. (2) The current requirement is greater than 63A.

### 3.5.4 Cable Preparation

- Cable with minimum 90° installation.

°C (194F)

Minimum wire size requirements are shown in the Table 3-4

Table 3-4 Recommended DC wiring

Model	Recommended DC wiring							
	2 meters		3 meters		5 meters		7 meters	
10A	12AWG	4mm <sup>2</sup>	12AWG	4mm <sup>2</sup>	10AWG	6mm <sup>2</sup>	8AWG	10mm <sup>2</sup>
20A	10AWG	6mm <sup>2</sup>	10AWG	6mm <sup>2</sup>	8AWG	10mm <sup>2</sup>	6AWG	16mm <sup>2</sup>
30A	10AWG	6mm <sup>2</sup>	8AWG	10mm <sup>2</sup>	6AWG	16mm <sup>2</sup>	6AWG	16mm <sup>2</sup>
40A	8AWG	10mm <sup>2</sup>	6AWG	16mm <sup>2</sup>	6AWG	16mm <sup>2</sup>	4AWG	25mm <sup>2</sup>
50A	6AWG	16mm <sup>2</sup>	6AWG	16mm <sup>2</sup>	4AWG	25mm <sup>2</sup>	4AWG	25mm <sup>2</sup>
60A	6AWG	16mm <sup>2</sup>	4AWG	25mm <sup>2</sup>	4AWG	25mm <sup>2</sup>	2AWG	35mm <sup>2</sup>
80A	4AWG	25mm <sup>2</sup>	4AWG	25mm <sup>2</sup>	2AWG	35mm <sup>2</sup>	2AWG	35mm <sup>2</sup>
100A	4AWG	25mm <sup>2</sup>	2AWG	35mm <sup>2</sup>	2AWG	35mm <sup>2</sup>		
120A	2AWG	35mm <sup>2</sup>	2AWG	35mm <sup>2</sup>				

### 3.5.5 Preparation before wiring

- Please unscrew out the two screws first as shown in the Figure 3-7-a ① and ③.
- Remove the bottom panel as shown in the Figure 3-7-a ②. And you can see the battery and PV wiring connection as shown in the Figure 3-7-b and Table 3-5.

Table 3-5 Connection terminal

Pin	Function
A	“BAT+” connection terminal for “BAT+” cable of battery
B	“BAT-” connection terminal for “BAT-” cable of battery
C	“PV-” connection terminal for “PV-” cable of PV array
D	“PV+” connection terminal for “PV+” cable of PV array

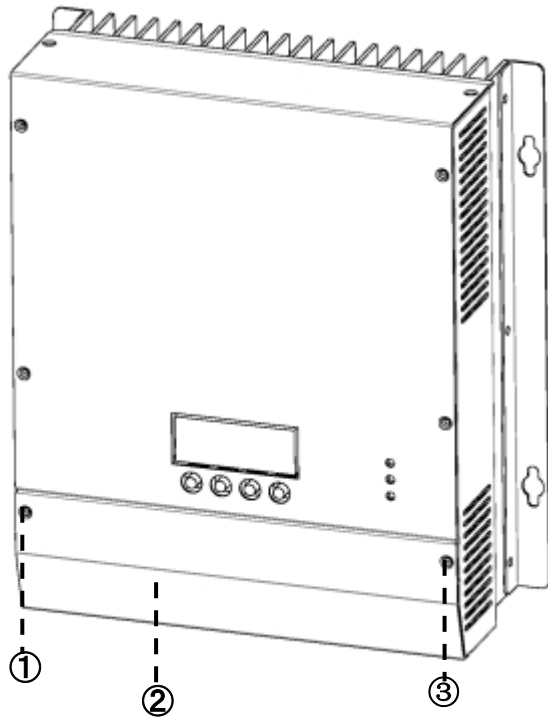


Figure 3-7-a

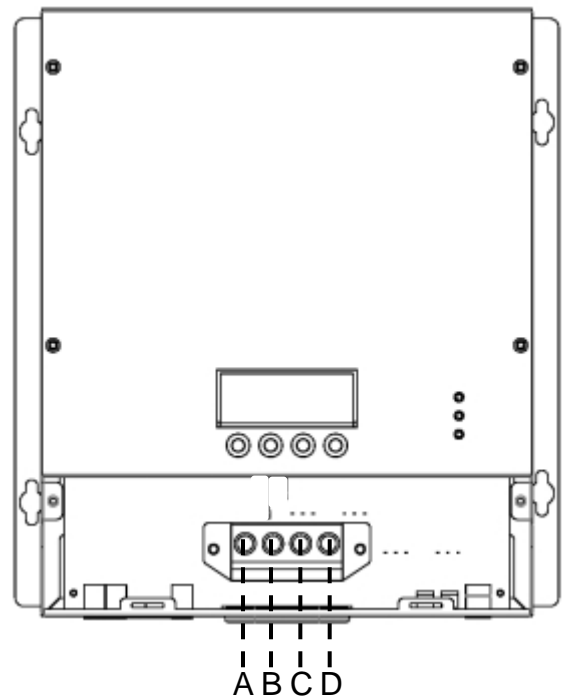


Figure 3-7-b

Figure 3-7 Remove the bottom panel

### 3.6 Grounding Connection

- Total two grounding terminal was offered within the SP charge controller. The two can both be used for SP grounding.

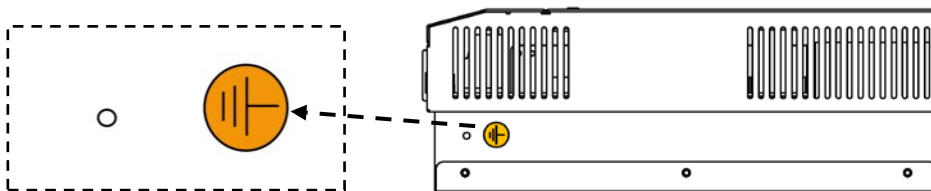


Figure 3-8 Grounding terminal

- Using proper gauges of wires for grounding, recommending  $16\text{mm}^2\sim 35\text{mm}^2$ .
- Please connect the SP grounding terminal to the system grounding bar, refer to Figure 3-6 of chapter 3.5.1.
- Please connect the frame of PV to the system grounding bar, refer to Figure 3-6 of chapter 3.5.1
- Please connect the battery frame to the system grounding bar, refer to Figure 3-6 of chapter 3.5.1.





Do not connect either the PV negative or the Battery negative to ground. They must be connected to corresponding terminal marked at connection compartment. Negative ground might cause equipment damage which is out of warranty.



Do not connect the PV negative and battery negative terminal together at any place of the system. They must be connected to corresponding terminal marked at connection compartment of SP. Wrong connection might cause equipment damage which is out of warranty.

### 3.7 PV Array Connection



The Voc (open circuit voltage) and Isc (short circuit current) of PV array must never exceed allowance. Please also consider the local temperature condition which might result in the increase of PV array Voc/Isc. Refer to chapter 3.5.2.



Whenever a PV array is exposed to light, a shock hazard exists at the output of wires or terminals. To reduce the risk, cover the array with a dark material before making the connection.

- Choose the right cable size (refer to Table 4-4) and follow polarity guide marked on the panel. Please use the shortest cable to connect and ensure the secure connection.
- Please connect PV array to MPPT charge controller. Positive terminal “+” of PV array to “PV +” of the MPPT charge controller terminal connection. Negative terminal “-” of PV array to “PV -” of the MPPT charge controller terminal connection .
- Wiring need to be protected against any potential physical damage.
- Pull through the DC cables through the holes at front panel, clamping the cable terminal on cable.
- Secure the battery cable on BAT+ and BAT- terminals respectively making sure it is tightly screwed.
- Please install the bottom panel and screw the two screws which are unscrew in chapter3.6.



Please double confirm the polarity of PV connection. SP will show fault with reverse polarity connection.

### 3.8 Battery Connection

- Please check the voltage of battery is same to the nominal input voltage of this charge controller.
- Choose the right cable size (refer to Table4-4 and follow polarity guide marked on the panel. Please use the shortest cable to connect and ensure the secure connection.
- An over current protection devices DC fuse or circuit breaker needs to be installed on positive cable, of which rated for 125% of the nominal rating. Please refer to Table 3-3 for detailed selection requirements for circuit breakers.
- Please connect battery to MPPT charge controller first. Positive terminal “+” of battery to “Bat +” of the MPPT charge controller terminal connection. Negative terminal “-” of battery to “Bat -” of the MPPT charge controller terminal connection.
- Wiring need to be protected against any potential physical damage.
- Pull through the DC cables through the holes at front panel, clamping the cable terminal on cable.
- Secure the battery cable on BAT+ and BAT- terminals respectively making sure it is tightly screwed.



Please always wiring the battery first before wiring to PV array.



Please ensure the circuit breaker was switched off or fuse was open.



Do not install SP in a sealed compartment containing batteries.



While connecting wires, please secure the connection and avoid short cut between positive terminal and negative terminal of battery, which will cause damage of battery.



Please double confirm the polarity of battery input. SP will cause damage with reverse polarity connection.

### 3.9 Communication Connection

- Please refer to chapter 2.2.3 for port definition.



Do not route the communication wire in the same conduit as the DC input/output cable.

### 3.10 Connecting the multiple units

In a multiple unit installation, each SP charge controller need to be connected to a separate PV array. And their communication must be connected to ensure the battery is charged in correct state.



Please make sure each SP charge controller was connected with its own PV array. The mixing connection will cause damage which is out of warranty.

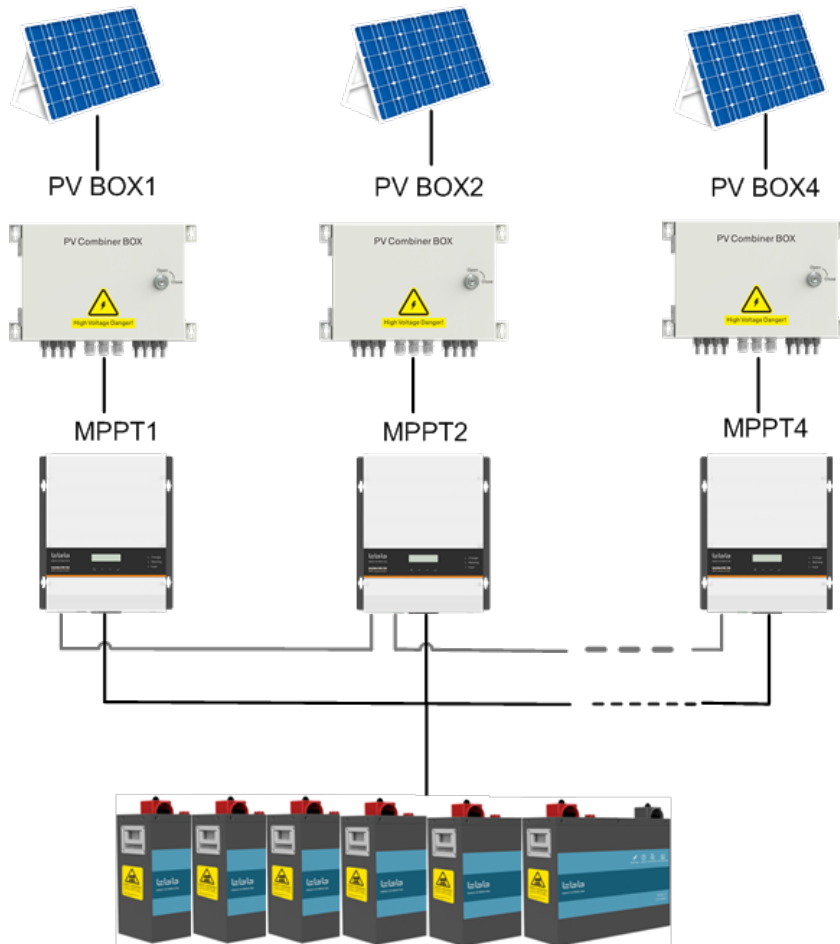


Figure 3-9 Stand-alone operation

- The communication interface of SP series MPPT charge controller must be installed which can be connected with the Kinerjier for setting up the DC coupling system. As soon as a communication connection is established, the SP series MPPT charge controller will be controlled by the Kinerjier.
- The SP series MPPT charge controller will receive the charging current and voltage from the Kinerjier, and transmit the battery charging current back to the Kinerjier. The Kinerjier will take control of battery management and make sure the battery will always be charged optimally, in the meantime, the Kinerjier will calculate the correct charging state.

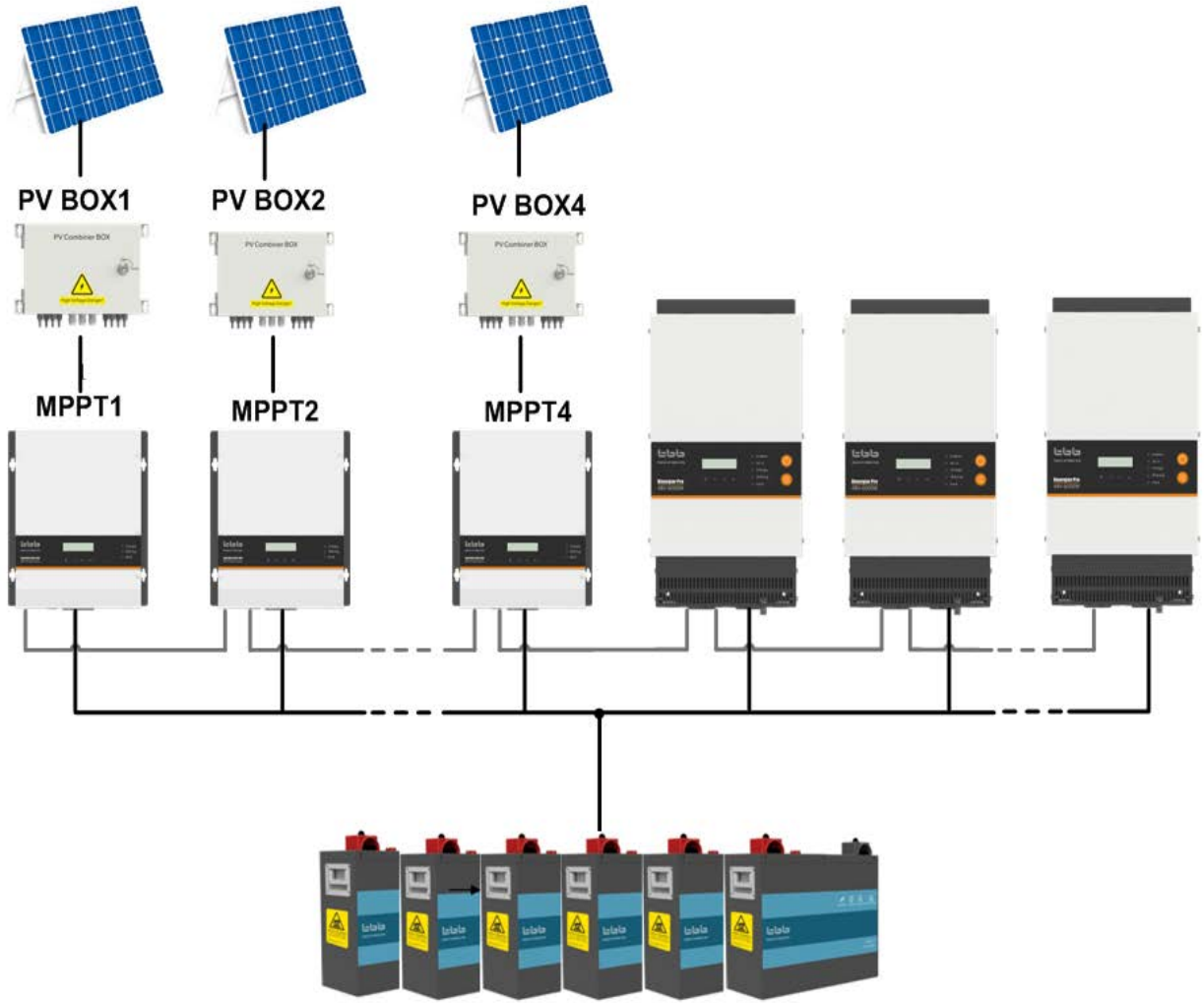


Figure 3-10 DC coupling system with power assist

## 4. Configuration

### 4.1 Check Before Operation

Please check before Operation according to the following.

- Solar Mate MPPT charge controller is installed correctly and steady.
- Reasonable cable layout to meet customer requirements.
- Make sure the grounding is reliable.
- Make sure the ground wire is properly connected and firm and reliable.
- Double check the battery breaker and PV array breaker is OFF.
- Make sure the cables are properly connected and firm and reliable.
- Reasonable installation space, clean and tidy environment, no construction residue.

### 4.2 Power ON Test



Make sure the battery voltage and PV array voltage are within the permissible range before breaker turn ON.

Please step by step as following instructions.

- Step 1: Turn on the circuit breaker between the PV array and the MPPT charger.
- Step 2: Turn on the circuit breaker between the battery and the MPPT charger.
- Step 3: Set the parameters step by step according to the setup wizard.
- Step 4: Observe the LED light to make sure the MPPT charger is running normally. (refer to Tab2-2 LED directive function)

### 4.3 Power OFF



After the MPPT charger 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 charger is powered off for 5 minutes, you should wear protective gloves before removed the MPPT charger.

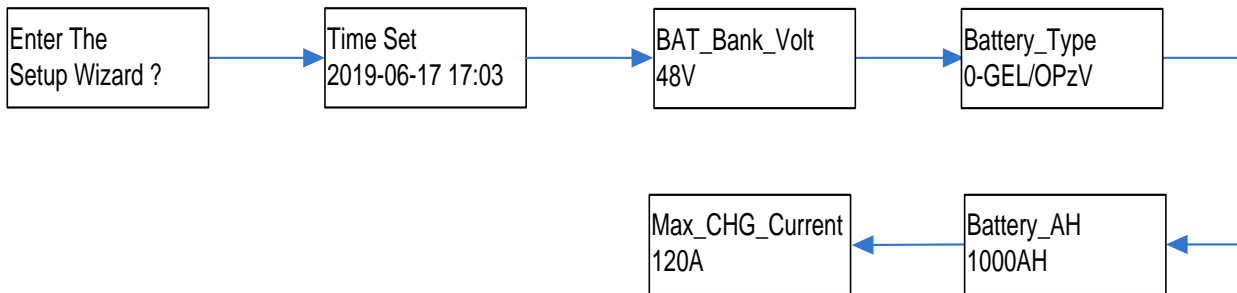
Please step by step as following instructions.

- Step 1: Remove the 2P phoenix terminal which is inserted into the EPO.
- Step 2: Turn off the circuit breaker between the PV array and the MPPT charger.
- Step 3: Turn off the circuit breaker between the battery and the MPPT charger.
- Step 4: Insert the 2P phoenix terminal in the attachment package into the EPO of the MPPT charger.

## 4.4 Setup Wizard

Power ON at the first time or after restoring factory settings, the MPPT charger needs to enter the setup wizard to work normally. The user can also reset the Setup Wizard through the Parameter Set interface.

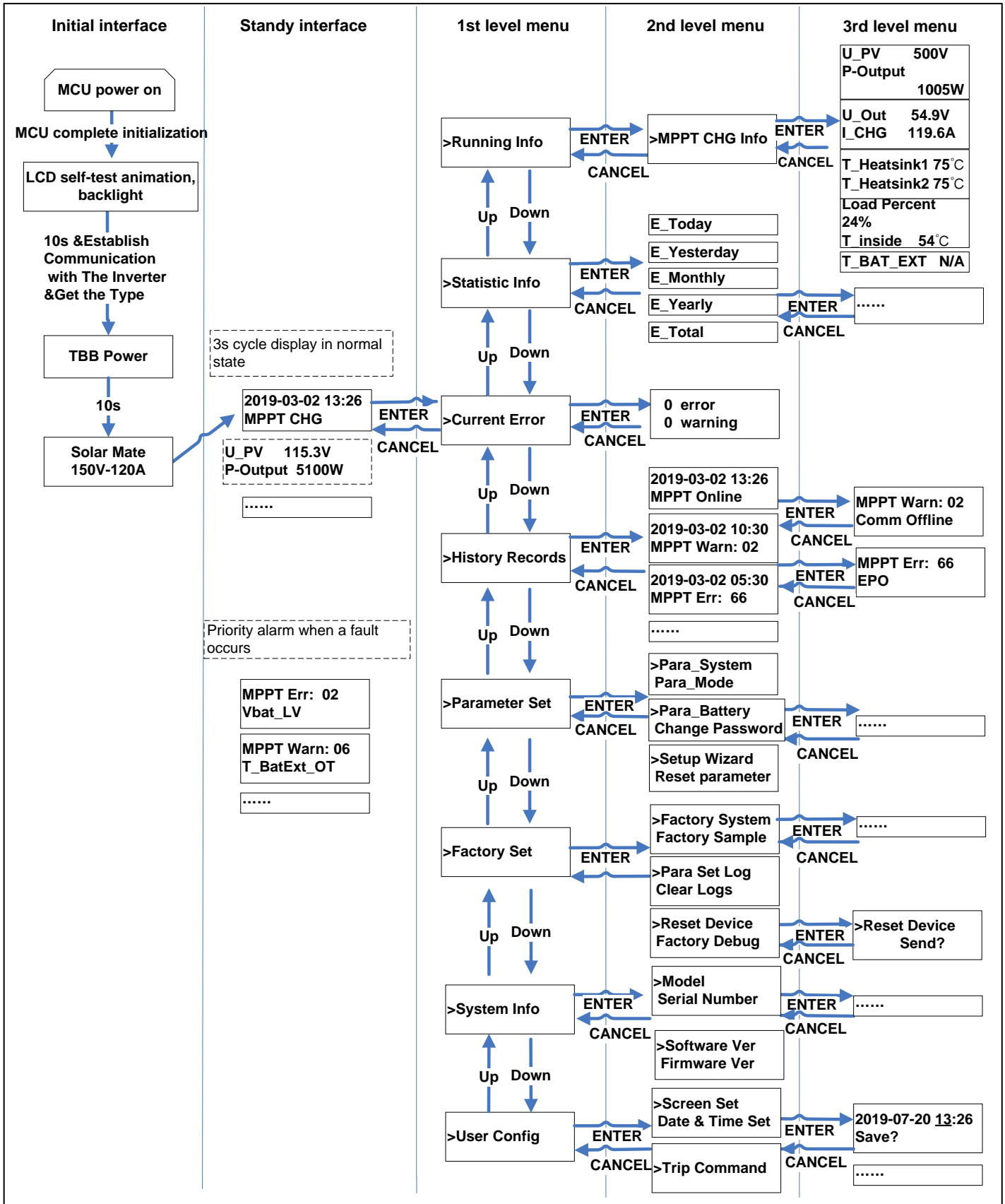
The setup wizard list is shown in the flow diagram.



Note: If you want to leave the default values unchanged during the setup process, simply press <Down> to prompt <Confirm?> , and press <Enter>.

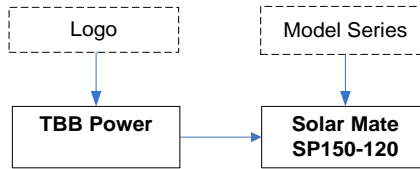
# 5. Operation

## 5.1 Menu introduction

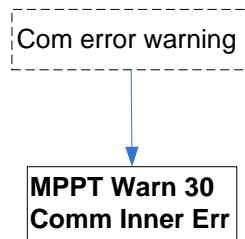


## 5.2 Initial interface

After power-ON, the LCD will have a boot animation of the screen and light the backlight, and then display the following information in sequence.





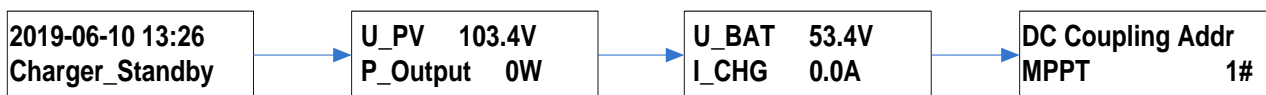
Note: In the boot interface, the LCD will establish contact with the charger. If there is a communication failure, the communication fault will be displayed.






## 5.3 Real-time information interface



The LCD standby interface is a real-time information display interface, which displays detailed device working status. The default polling display time is 5S, and the time can be set manually.

When press   to turn pages, the default will stop 30S on the current page, and the time can be set manually.

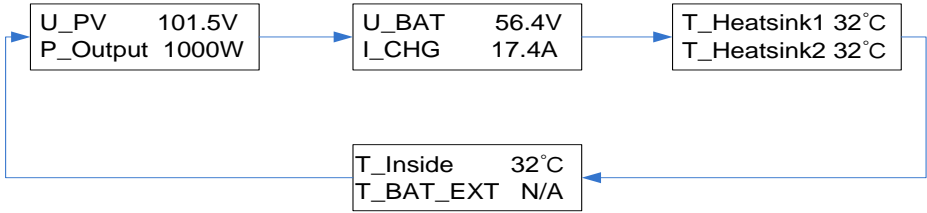




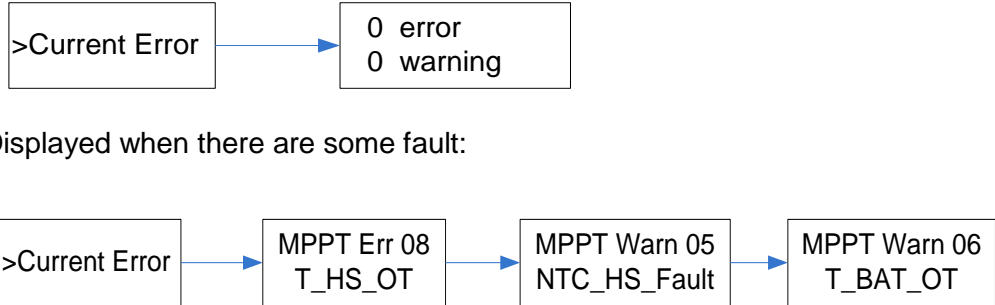






## 5.4 Information query interface

Press the  in the standby interface to enter the 1st level menu. Press the  button on the first level menu to enter the corresponding 2nd level menu. Some 2nd level menus can enter the 3rd level menu. Press the  to return the upper level menu.

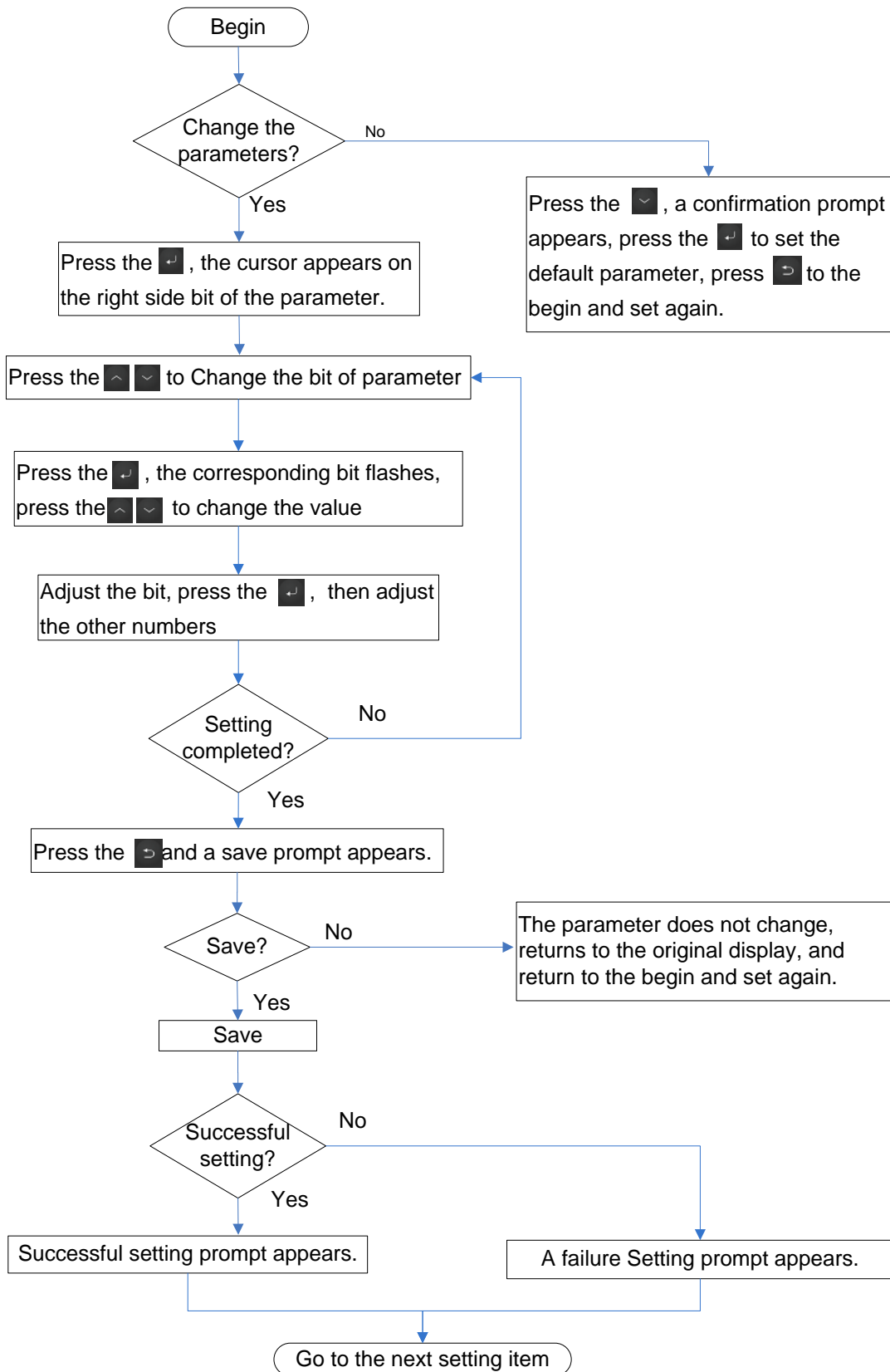
>Running Info	Enter to see more Running information. Press   to scroll through the pages.
---------------	--





				
<p>&gt;Statistic-Info</p>	<p>Enter to see more statistics information. Press   to scroll through the pages.</p>			
	<table border="1"> <tr> <td>&gt;E_Today</td> <td colspan="2">Today's statistic information</td> </tr> </table>	>E_Today	Today's statistic information	
	>E_Today	Today's statistic information		
	<table border="1"> <tr> <td>&gt;E_Yesterday</td> <td colspan="2">Yesterday's statistic information</td> </tr> </table>	>E_Yesterday	Yesterday's statistic information	
	>E_Yesterday	Yesterday's statistic information		
	<table border="1"> <tr> <td rowspan="2">&gt;E_Monthly</td> <td>&gt;E_October</td> <td rowspan="2">Every day's statistic information.</td> </tr> <tr> <td>&gt;E_Oct 16th .....</td> </tr> </table>	>E_Monthly	>E_October	Every day's statistic information.
>E_Monthly	>E_October		Every day's statistic information.	
	>E_Oct 16th .....			
<table border="1"> <tr> <td rowspan="2">&gt;E_Yearly</td> <td>&gt;E_July</td> <td rowspan="2">Every month's statistic information.</td> </tr> <tr> <td>&gt;E_August .....</td> </tr> </table>	>E_Yearly	>E_July	Every month's statistic information.	>E_August .....
>E_Yearly		>E_July		Every month's statistic information.
	>E_August .....			
<table border="1"> <tr> <td>&gt;E_Total</td> <td>&gt;E_MPPT</td> <td>Totally statistic information.</td> </tr> </table>	>E_Total	>E_MPPT	Totally statistic information.	
>E_Total	>E_MPPT	Totally statistic information.		
<p>&gt;Current Error</p>	<p>Enter to see current error information. Press   to scroll through the pages. The first line is the corresponding code for the fault or warning flag. The second line is specific information.</p>			
	 <p>Displayed when there are some fault:</p>			
<p>&gt;History Records</p>	<p>Enter to see history record information. Press   to scroll through the pages. the secondary menu when the event occur.</p>  <p>Press the  to enter the third level menu to display detailed information.</p>			

	<div> <pre> graph LR     A["2019-04-22 15:31 MPPT Err 09"] --&gt; B["MPPT Err 09 PSU_LV"]           </pre> </div>
<p>&gt;System Info</p>	<p>Enter the interface, you can view the current system information.</p> <div> <pre> graph LR     A["&gt;System Info"] --&gt; B["&gt;Model"]     A --&gt; C["&gt;Serial Number"]     A --&gt; D["&gt;Software Ver"]     A --&gt; E["&gt;Firmware Ver"]     B --&gt; B1["Solar Mate 150V-120A"]     C --&gt; C1["0123456789*#@"]     D --&gt; D1["Software V..."]     E --&gt; E1["Firmware V..."]           </pre> </div>

### 5.5 Parameter setting interface



**Note:** To enter the interface, a password is required. The initial password is "1000", and the user can modify the password according to the requirements. After logging in the interface, users can configure system parameters according to requirements. Detailed description is shown in the following table.

<p>&gt;Parameter Set</p>			
<p>&gt;Para_System</p>	<p>Display</p>	<p>Setting range</p>	<p>Description</p>
	<p>SYS_Module_Addr</p>	<p>1~4; Default setting:1</p>	<p>Modul parallal address in system.</p>
<p>&gt;Para_Mode</p>	<p>Display</p>	<p>Setting range</p>	<p>Description</p>
	<p>OutCtrl_CHG</p>	<p>0- Disable 1- Enable Default setting: 0-Disable</p>	<p>Enable state of charging external control mode, read only.</p>
	<p>RlyCtrl_Config</p>	<p>0-Default 1- Alarm Switch Default setting: 0- Default</p>	<p>Output dry contact configuration.Select 0, if the connection is detected in the DC Coupling system, take one puff every 5 minutes to wake up Kinergier Pro(Connected to the input dry contacts of the Kinergier Pro). Select1,short connection at fault alarm.</p>
	<p>Silent_Mode_EN</p>	<p>0- Disable 1- Enable Default setting: 0-Disable</p>	<p>Silent mode setting</p>
	<p>Force_Charge</p>	<p>0-Disable 1-Force CHG 24V OR 48V Default setting: 0-Disable</p>	<p>Forced charge mode setting</p>
	<p>Under the Setting menu, there are three parameter Setting options, among which EQ Setting needs to select the corresponding battery type to open.</p> 		

>Para_Battery	In Basic Set, there are the following Setting options.		
	Display	Setting range	Description
	Battery_Type	GEL/OPzV AGM Lead-Carbon Flooded Traction Customerize OpzS Default setting:0-GEL/OPzV	Battery type setting Select 3,4 and 6 to unlock EQ function. The default charging voltage of different batteries is shown in Table 7-1.
	Battery_AH	100~2000AH Default setting:1000AH	Battery capacity setting
	BAT_Bank_Volt	24V 48V Default setting:48V	Battery bank voltage setting
	In Advanced Set, there are the following Setting options.		
	Display	Setting range	Description
	U_Absorp_CHG	Refer to the table 6-1 Battery charging voltage	The average charging voltage of a single battery (Battery specification by 12V/ section, 24/48V Auto Select) Note: This value will be changed when changing the battery type, users can reset it with their requirements.
	U_Float_CHG	Refer to the table 6-1 Battery charging voltage	The float charging voltage of a single battery (Battery specification by 12V/ section, 24/48V Auto Select) Note: This value will be changed when changing the battery type, users can reset it with their needs.
	BAT_OV_Warn	(U_AVE_CHG + 0.2)~15.5V (The minimum value is 12V, and the maximum value is depended by the battery type.) Default setting:14.9V	The over voltage warning of a single battery (Battery specification by 12V/ section, 24/48V Auto Select)
CHG_MAX_Current	10~Rate_CHG_CUR (The maximum value is 120A)	The maximum charging current of the system.	

>Para_Battery			Note: This value will be changed when changing the battery capacity, and users can reset it with their needs.	
	Min_Bulk_Time	1~600min Default setting:120min	Minimum bulk time setting.	
	Max_Absorp_Time	1~240h Default setting:8h	Maximum absorption time setting.	
	Auto_CHG_Cycle	24~2400h Default setting:240h	Equalization cycle time.	
	CHG_TEMP_COEF	0~30mv/ °C Default setting:18mV/°C	Enable the charging temperature compensation. (Battery specification by 12V/section, 24/48V Auto Select)	
	CHG_T_Compensate	0-Disable 1-Enable Default setting: 0-Disable	Charging temperature compensation coefficient	
	BAT_OT_WARN_Gate	35~65 °C Default setting:55 °C	The over temperature warning of BAT setting	
	In EQ Setting, there are the following Setting options.			
		Display	Setting range	Description
		EQ_Operation	0-Off 1-On Default setting: 0-Off	Equalization charging control
	EQ_Voltage	15.5~16.3V Default setting:15.6V	Equalization charging voltage range setting.	
	EQ_Sustain_Time	30~90min Default setting: 30min	Equalization charging time setting.	
>Change Password	Changing the password for parameter setting.			
>Setup Wizard	See setup wizard refer to chapter 6.7.			
>Reset Parameter	Display	Description		
	Reset User_Para	Restore Factory Defaults.		

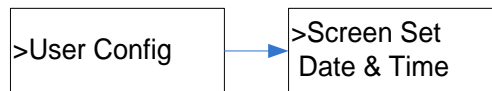
Table 6-1 Battery charging voltage

Battery type	Average voltage (Default)	Float voltage (Default)	Charging ratio	Max Charging ratio	EQ
GEL/OpzV (Default)	14.1V (Range:14.0~14.5)	13.7V (Range:13.0~14.0)	0.15C	0.25C	-
AGM	14.4V (Range:14.0~14.5)	13.5V (Range:13.0~14.0)	0.15C	0.25C	-

Lead-Carbon	14.1V (Range:14.0~14.5)	13.5V (Range:13.0~14.0)	0.2C	0.5C	-
Flooded	14.7V (Range:14.0~15.0)	13.5V (Range:13.0~14.0)	0.15C	0.25C	Enable (15.5V Default)
Traction	15.2V (Range:14.0~15.5)	13.5V (Range:13.0~14.0)	0.15C	0.25C	Enable (16.2V Default)
Customerize	14.2V (24V System) 13.5V (48V System) (Range:13.0~14.5)	13.5V (24V System) 13.3V (48V System) (Range:13.0~14.0)	0.2C	0.5C	-
OPzS	14.7 (Range:14.0~15.5)	13.4 (Range:13.0~14.0)	0.15C	0.25C	Enable (15.5V Default)

## 5.6 User Config

Users can realize the rapid configuration of the system according to requirements. The following submenus are included under this interface.



	Display	Setting range	Description
>Screen Set	Backlight_KeepOn	1-Enable; 0-Disable Default setting:0-Disable	Constant backlight enablement.
	Page_Turn_Auto	3~30s Default setting:5s	Automatic page turning time of real-time information display interface;3~30s can be set, and the page will automatically turn after timeout.
>Data & Time	From this page, you can set the current time.		

## 6. FAQ

### 6.1 Fault code

Alarm level definition:

- Fault: MPPT charger failure, into shutdown mode, no more charging.
- Warning: MPPT charger warning, but also charging normally.

Type	ID	Name	Reason	Suggestion
Fault	0	U_Bus_OV	PV voltage is too high.	<ul style="list-style-type: none"> <li>➤ Check the string of PV array.</li> <li>➤ Make sure that the PV open circuit voltage never higher than the maximum range of MPPT charger.</li> <li>➤ If it happens frequently, please contact your dealer.</li> </ul>
	1	U_BAT_OV	Battery over voltage.	<ul style="list-style-type: none"> <li>➤ Check whether the battery voltage setting of the charger is consistent with the battery configuration.</li> <li>➤ Change battery voltage of the charger, or change battery configuration.</li> <li>➤ If it happens frequently, please contact your dealer.</li> </ul>
	2	U_Bus_OV_HD		
	3	Buck_Short Cut	Battery short circuit.	<ul style="list-style-type: none"> <li>➤ Check battery wiring. And charger will return to normal operation after the failure disappears.</li> <li>➤ If no, please contact your dealer.</li> </ul>
	4	I_Buck1_OC	Buck1 of charger over current.	<ul style="list-style-type: none"> <li>➤ Check whether the maximum charging current is over range.</li> <li>➤ Check whether the charger model setting is correct.</li> <li>➤ If the settings are correct, please contact your dealer.</li> </ul>
	5	I_Buck2_OC	Buck2 of charger over current.	
	6	T_Board_OT	Temperature inside the charger is too high.	<ul style="list-style-type: none"> <li>➤ Check whether ambient temperature is in range.</li> <li>➤ Check that the charger installation environment is well ventilated.</li> <li>➤ If the ambient temperature is</li> </ul>



	7	T_HS_OT	Heat sink temperature is too high.	too high or is not ventilated well, please improve its ventilation and heat dissipation. ➤ If the ambient temperature and ventilation is normal, please contact your dealer.
	8	PSU_LV	Auxiliary power of the charger is too low.	Please contact your dealer.
	9	PSU_LV_HD		
	10	Sam_HD_Fault	The Charger has sampling failure.	
	11	EEPROM_Fail	Abnormal storage of the charger.	
	12	EPO OFF) (Remote	2P phoenix terminal didn't insert into the EPO of the charger.	➤ Insert the 2P phoenix terminal into the EPO of the charger. And charger will return to normal operation after the failure disappears. ➤ If no, please contact your dealer.
Warning	0	U_BAT_OV	Battery voltage is too high.	Check whether the battery settings of the charger are consistent with the battery configuration.
	1	U_BAT_LV	Battery voltage is too low.	Please check the battery voltage. Wait the charger charging until the battery voltage normally.
	2	Cur_Limit	Charging current over range.	➤ Check whether the maximum charging current is over range. ➤ Check whether the charger model setting is correct. If the settings are correct, please contact your dealer.
	3	BAT_UnConnect	Battery connection failure.	Please check the battery circuit breaker.

	4	NTC_HS_Fault	Heat sink temperature sampling failure.	Please contact your dealer.
	5	T_BatExt_OT	Battery temperature is too high	<ul style="list-style-type: none"> <li>➤ Check whether ambient temperature is in range.</li> <li>➤ Check that the charger installation environment is well ventilated.</li> <li>➤ If the ambient temperature is too high or is not ventilated well, please improve its ventilation and heat dissipation.</li> </ul>
	6	Fan_Fault	The Fan didn't work well.	Please contact your dealer.
	7	Type_Mismatch	The charger model setting in not correct.	<ul style="list-style-type: none"> <li>➤ Check whether the charger model setting is correct.</li> <li>➤ And change the model settings.</li> </ul>
	8	Comm_SYS_Err	The inverter miss communicated with charger.	Please contact your dealer.

## 7. Specification

Model	SP250-100	SP250-70	SP150-120	SP150-80	SP150-60
<b>Electrical</b>					
Nominal battery voltage	48VDC	24VDC/48VDC			
Maximum charging current (40 °C)	100A	70A	120A	80A	60A
Maximum charging power	5880W	4116W	7056W	4704W	3528W
Maximum PV input power	24VDC	/	2700W	4500W	3000W
	48VDC	7500W	5400W	9000W	6000W
PV open circuit voltage (Voc)	250VDC		150VDC		
MPPT voltage range	65~245VDC		65~145VDC		
Max. PV short circuit current	80A				40A
Max efficiency	98%@48VDC system				
Max MPPT efficiency	>99.9%				
Standby power consumption	<2W				
Self-consumption	37mA @ 48V				
Charge voltage 'absorption'	57.6VDC	28.8VDC/57.6VDC			
Charge voltage 'float'	54VDC	27VDC/54VDC			
Charging algorithm	TBB II multiple stages				
Temperature compensation	Default setting: -3mV/°C/cell				
Equalization charging	Programmable				
<b>Others</b>					
Display	LED+LCD				
Communication port	RS485				
Dry contact	30Vdc/2A				
Remote on/off	Yes (2 pole connector)				
Data logging	365days of history record, daily, monthly and total production; Real time figure including solar array voltage, battery voltage, charging current, charging power; Record the daily PV start charging time, absorb to floating transfer time, PV power loss time and etc; Real time fault time and information.				
Storage temperature	-40~70 °C				
Operating temperature	-25~60 °C (power derate) LCD operating temperature range-20~60 °C)				
Humidity	95%, non-condensing				
Altitude	3000m (full rated output up to 2000m)				
Dimension (LxWxH)	352.2*293*116.2 mm	325.2*293*116.2 mm			
Net Weight	7.8kg	7.0kg	7.2kg	7.0kg	6.8kg
Max wire sizes	35mm <sup>2</sup>				
Protection category	IP21				
Cooling	Forced fan	Natural cooling			
Standard	EN61000-6-1, EN61000-6-3, EN62109-1				

TBB POWER Co.,Ltd.

Web : [www.tbbpower.com](http://www.tbbpower.com)

Tel : +86-592-5212299

Fax : +86-592-5796070

Email : [service@tbbpower.com](mailto:service@tbbpower.com)