

Instruction Manual for the Gen4 AC/DC Hybrid EH Series Controllers

Product model	Product description
SR-EH120	All-in-one 120 W AC power complementary PWM charging constant current controller
SR-EH120-ES	All-in-one 120 W AC power complementary PWM charging constant current controller with sensing function
SR-EL2415	15 A AC power complementary PWM charging controller with regulated voltage load output
SR-CU-ALL6	Remote control

Manual version: V1.01
Contents are subject to changes without prior notice.

I. Product introduction

The SR-EH120 series waterproof all-in-one PWM charging AC power complementary constant current controller integrates the functions such as solar charging and discharging management of lead-acid/lithium battery, LED boost constant current drive, and intelligent control switching between battery power and AC power for load. This series controller applies to lead-acid/lithium/gel battery, etc., and is widely used for solar street lights, solar garden lights, etc. It has advantages including high reliability, high efficiency, high precision, simple installation and convenient maintenance.

The SR-EL2415 series waterproof PWM charging AC power complementary controller with the load output voltage equal to the battery voltage or DC supply voltage has the function of automatic intelligent seamless switching, and applies to solar monitors, solar street lights, etc.

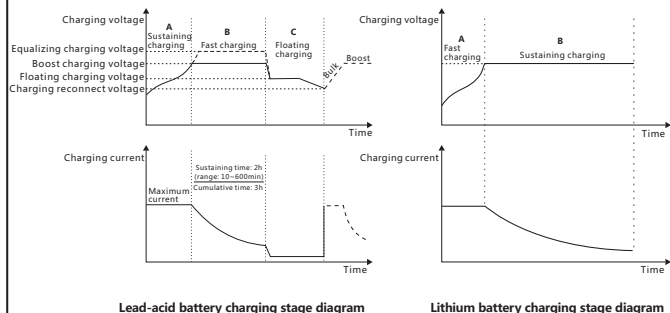
Features

- ◆ It has DC detection function. If there is DC supply, the power supply will automatically switch to DC mode when the battery voltage drops to the DC switching voltage point; otherwise, the battery will continue to discharge to the over-discharge point and then turn off the output.
- ◆ The switching voltage can be set.
- ◆ Lead-acid battery and lithium battery are interchangeable, and operation parameters can be set by remote control.
- ◆ Very low static current allows more energy saving, facilitating long-distance transportation and storage.
- ◆ Multi-stage constant voltage charging with temperature compensation is available for lead-acid batteries.
- ◆ 10-time period programmable load power/time control.
- ◆ The high and low temperature protection function is provided for battery charging and discharging, and the operating temperature can be set.
- ◆ Multiple intelligent power modes can be selected, and the load power can be automatically adjusted according to the battery level.
- ◆ High precision digital boost constant current control algorithm enables high efficiency and high constant current precision.
- ◆ Infrared/2.4G wireless communication is provided to set/read parameters, read status, etc.
- ◆ Multiple protection functions such as battery/PV reverse-connection protection, load short circuit/open circuit/power limiting/overload protection are available.
- ◆ Expandable with sensing function (- ES series).
- ◆ All-aluminum metal housing at IP67 waterproof level makes the product applicable to various harsh environments.

II. Instructions for use

2.1 Charging description:

Pulse width modulation (PWM) is used to charge batteries (lead-acid battery and lithium battery). The battery type can be selected through the remote control. The controller will adopt three-stage charging in case of lead-acid battery, and two-stage charging in case of lithium battery. Charging curves are shown:



➤ Fast charging

In the fast charging stage, when the battery voltage has not reached the set value of full voltage (i.e. equalizing/boost voltage), the controller will adopt MPPT charging to provide the maximum solar power to charge the battery. When the battery voltage reaches the preset value, constant voltage charging will be conducted.

➤ Sustaining charging

When the battery voltage reaches the set value of sustaining voltage, the controller will adopt constant voltage charging rather than MPPT charging. Meanwhile, the charging current will gradually decrease over time. There are two stages for sustaining charging, namely, equalizing charging and boost charging. The two charging processes are not repeated. The equalizing charging is started once every 30 days.

➤ Boost charging

Generally, the default duration of the boost charging stage is 2h. Customers can also adjust the sustaining time and the preset value of boost charging according to actual needs. When the duration reaches the set value, the system will switch to floating charging.

➤ Equalizing charging

Some types of batteries benefit from periodic equalizing charging, which can stir electrolyte, balance battery voltage and complete chemical reaction. Equalizing charging increases the battery voltage to make it higher than the standard complementary voltage so as to vaporize the battery electrolyte. If the battery over discharge is detected, the controller will automatically control the subsequent charging to be equalizing, with the charging time of 120 minutes (by default). Equalizing charging and boost charging are not repeated during a full charge process to avoid excessive gas evolution or overheating of the battery.

➤ Floating charging

After the continuous charging stage, the controller will reduce the battery voltage by reducing the charging current and keep the battery voltage at the set value of the floating charging voltage. In the floating charging stage, the battery is charged little to ensure that the battery is maintained in a full state.

2.2 AC power switching function:

EH120/EL2415 series controllers have the AC power switching function, as follows:

- ◆ The DC input of the controller needs to be connected with AC/DC switching power supply. The DC power supply only supplies power to the load but does not charge the battery;
- ◆ In case of normal DC connection, the power supply will automatically switch to DC mode when the battery voltage drops to the DC switching voltage point; otherwise, the battery will continue to discharge to the over-discharge point and then turn off the output;
- ◆ The switching voltage can be set by the remote control. When the set switching voltage is higher than the maximum battery voltage under the current system voltage, the priority mode is AC power; otherwise it is the battery;
- ◆ During the use, when the battery and panel are removed, and AC/DC power supply is normal, the DC power supply can be used at night, so the load can work normally;
- ◆ With the intelligent power functioning, when the load is switched to DC power supply, if the output power of the load is 100% of the set power in the current operation period, then the intelligent power will not be started for DC power supply;
- ◆ Eh120 boost series will first turn off the load in the switching process, and then restart the LED light source after the switching is completed; EL2415 regulated voltage series adopts seamless switching in order to ensure the power supply requirements of monitoring and other loads;
- ◆ For a reliable and stable system, please ensure that the output power of AC/DC power supply is more than 1.2 times the maximum operating power of the load, and the output voltage is the rated system voltage (DC voltage range of 12 V system: 10-14 V, 12.0 V is recommended; DC voltage range of 24V system: 20-28 V, 24.0 V is recommended).

2.3 Sleep and wake-up:

Enter sleep mode:
Press the [OFF] button of the CU or mini remote control, and the controller will turn off all external control devices, and enter a sleep state with extremely low power consumption to avoid lithium battery feeding due to long-term non-use;

Wake-up:
1. Press the [ON] button on the CU or mini remote control after sleep to wake up the controller to resume normal operation;

2.4 PV wake-up:

A. When the [PV Wake-up] function is set to [Yes], after the controller sleeps, if the PV panel is connected and the charging conditions are met in the daytime, the controller can be woken up to charge. If the charging time is more than 1 minute, the load will automatically turn on at night. If the charging time is less than 1 minute, the light will not be on at night, and the controller will continue to sleep;

B. When the [PV Wake-up] function is set to [No], after the controller sleeps, if the PV panel is connected and the charging conditions are met in the daytime, the controller can be woken up to charge but it will continue to sleep at night.
(Note: [PV Wake-up] function can be selected by CU remote control, but the model with 2.4 G wireless remote control can only be woken up by PV)

Controller status	Sleep	Wake-up	Charging	Discharging	LED indicator status after sleep
CU-ALL5	OFF button	ON button	--	--	ALL off
CU-mini2	OFF button	ON button	--	--	ALL off
PV wake-up [Yes]	--	PV charging for 10s	Normal charging in the daytime.	After waking up, the light will automatically turn on for 10s to test whether the load is normal. Normal discharging at night.	--
PV wake-up [No]	--	PV charging for 10s	Normal charging in the daytime.	After waking up, the light will automatically turn on for 10s to test whether the load is normal. No discharging at night, and continue to sleep.	--

2.4 Indicator & remote control statuses

2.4.1 EH120/EL2415 controllers have four red indicators, with the indicator statuses as follows:

Indicator	Indicator status	Description of indicator	Remote control status
③PV indicator	Normally on	The panel voltage is greater than the light control voltage	Idle
	Off	The panel voltage is less than the light control voltage	Idle
	Double flashing	Full charge	Full charge
	Slow flashing	Charging	Charging
③BAT indicator	Quick flashing	BMS protection or BAT overvoltage or PV overvoltage or over-temperature (ambient temperature) or limited power/current charging	E-BMS BV overvoltage PV overvoltage Over-temperature Overcurrent
	Normally on	The battery works normally	Idle
③DC indicator	Off	Battery not connected or over-discharge protection from lithium battery protection board	Discharging
	Quick flashing	Battery over discharge	Over discharge
	Off	No DC connection	Discharging
	Slow flashing	DC connected but not switched to AC power	Idle
	Normally on	DC connected and load powered by DC	Open circuit
③LOAD indicator	Quick flashing	Abnormal DC voltage	Short circuit
	Normally on	Load started	Discharging
	Off	Load shutdown	Idle
	Slow flashing	Load open circuit	Open circuit
Quick flashing	Load short circuit	Short circuit	

2.4.2 There are four red indicators on the EH120-ES series controller with sensing function, and a red indicator on the probe. The PV indicator, DC indicator and LOAD indicator on the controller have the same indication methods as EH120. The indication statuses of BAT indicator and probe indicator are shown as follows:

Indicator	Indicator status	Description of indicator	Remote control status
Red	Normally on	Normal system	Idle/Discharging
	Slow flashing	Charging	Charging
	Quick flashing	System failure	Short circuit/Open circuit/Over discharge/PV overvoltage/BV overvoltage/EBMS/Over temperature

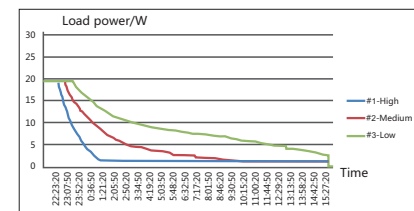
2.5 Intelligent power:

The controller can select the intelligent power mode according to the actual battery capacity, rainy days and other factors. The specific intelligent power modes include: High, Medium, Low, Auto, USE (Custom), No (Off). Intelligent power level:

Intelligent power level

High - The battery capacity at the starting point of power reduction is higher, and the load lighting time is the longest. This level is applicable to areas with more rainy days or poor sunlight;
Medium - The battery capacity at the starting point of power reduction is moderate, and the load lighting time is moderate. This level is applicable to the situations that need to consider both brightness and rainy days;
Low - The battery capacity at the starting point of power reduction is low, and the load lighting time is the shortest. This level is applicable to the situations requiring higher lighting effect;

Intelligent power curve



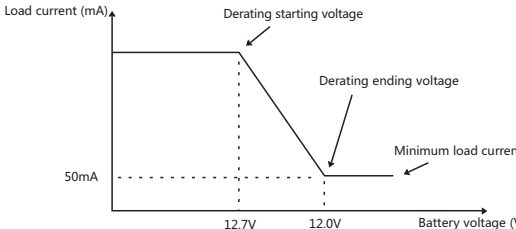
Intelligent power test data

Comparison of intelligent power consumption and rainy days		
Intelligent power level	Power consumption per day	Continuous operating days
No	100%	1
Low	50%	2
Medium	25%	4
High	15%	6

Test notes: 1. The test battery is fully charged, with consistent maximum load power and operating time.
2. Assume that the power consumption is 100% when the intelligent power mode is turned off.
3. The test results are obtained under a single condition (0 charge per day). The actual use conditions may be different from the test condition. Therefore, the test results are for reference only.

Auto - The intelligent power mode automatically selects high/medium/low level for operation according to the charging capacity and power consumption of the day; For example: In summer, it requires much power, so the intelligent mode - Low will be selected for better lighting effect; in winter, it requires less power, so the intelligent mode - High will be selected, and the load operates in power saving mode, which can last for more rainy days.

USE (Custom) - The user sets the derating starting voltage, the derating ending voltage, and the minimum load current value of the intelligent power;



No (Off) - Turn off the intelligent power, and the load power will be output according to the power in the set time period.

Note: If the intelligent power mode is turned on, the intelligent power will only function when the load is powered by the battery; when switched to DC power supply, the intelligent power will fail, that is, the load power is equal to the power in the set time period. 2.6 Operation of remote control:

Remote control model: CU-ALL6
Infrared or wireless remote control can be used for communication between the controller and the handheld remote control CU-ALL6. Press the [+] and [-] buttons of the remote control at the same time to select [Remote Control Type] (infrared/wireless) for remote operation. In actual use, the infrared remote control signal is easy to attenuate in outdoor strong light with remote communication distance of 5-6 M, but the distance is 8-10 M at night. The wireless remote control signal can penetrate the plastic or aluminum shell, and the wireless remote control distance can be adjusted for 0.3-20 M by the remote control. The specific [Parameter Setting] and [Operating Status] of the remote control are as follows:

Controller model	EH120	EH120-ES	EL2415	Parameter range
	Parameter range			
Parameter name	Parameter range			Parameter range
Type of battery	Lead	Lead	Lead	Lead/Lithium 12V
Sensing delay	No	10S	No	No/1s-60 min
PV wake-up	Yes	Yes	Yes	No/Yes
Light control voltage	5V	5V	5V	3V-11V
Light control delay	10s	10s	10s	5s-60min
Over-discharge voltage	11.0V	11.0V	11.0V	7.50V-17.0V
Over-discharge reconnect voltage	12.6V	12.6V	12.6V	7.50V-17.0V
Boost charging	14.4V	14.4V	14.4V	7.50V-17.0V
Floating charging	13.8V	13.8V	13.8V	7.50V-17.0V
Low-temperature charging	-35°C	-35°C	-35°C	-35°C-0°C
High-temperature operation	65°C	65°C	65°C	40°C-90°C
Load current	0.33A	0.33A	*0.33A	0.15A-7.0A
Intelligent power	Medium	Medium	*Medium	No/High/Medium /Low/Auto/USE
Load parameter setting	The Nth time	The Nth time	The Nth time	00:00-15:00
	The Nth power	The Nth power with or without people present	The Nth power	0%-100%
Restore default	No	No	No	No/Yes
AC power switching	11.5V	11.5V	11.5V	7.50V-17.0V

Notes:

- For the EH120-ES series sensing controller, when the [Sensing Delay] is selected as any value of 1s~60min, the power in [Load Parameter Setting] is set to power with or without people present;
- For EL2415 series with regulated voltage load output, the settings of [Load Current] and [Intelligent Power] are invalid;
- For EL2415 series with regulated voltage load output, three load operating modes can be set in [Load Parameter Setting];

When [The 1st Time] is 15:00, the load is in the normal mode, and operates in both day and night, so the power setting is invalid;

When [The 1st Time] is 00:00, the load is in the normal off mode, and the controller can charge normally in the daytime and enter the low-power sleep mode at night;

when [The 1st Time] is any value from 00:01 to 14:59, it is in the light control + time control mode, the power set to 0% is to shut down the load, and 1%~100% is to start the load, the time/power of 10 operating periods can be set, and the load can run for up to 15 hours every night.

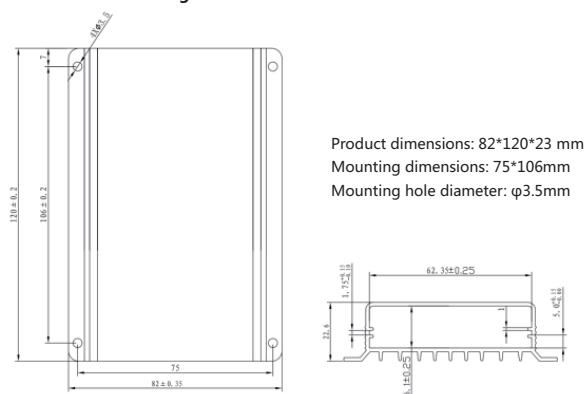
Default values in load parameter setting:

Time period	EH120 (Conventional type)		EH120-ES (Sensing type)		EL2415 (Regulated voltage type)	
	The Nth time	The Nth power	The Nth time	Power with people present Power without people present	The Nth time	The Nth power
1	00:30	50%	00:30	50% 20%	15:00	100%
2	00:30	70%	00:30	70% 30%	00:00	0%
3	02:00	100%	02:00	100% 50%		
4	00:30	70%	00:30	70% 30%		
5	00:30	50%	00:30	50% 20%		
6	04:00	30%	04:00	30% 10%		
7	00:00	0%	00:00	0%		
8						
9						
Morning lighting time						

Operating status:

Status name	Example	State value description
System status	Discharging	Current operating status: discharging/charging/idle/full/over-discharge, etc.
Battery voltage	12.3V	Current battery voltage
PV voltage	17.6V	Current solar panel voltage
Charging current	0.00A	Invalid
Charging power	0.00W	Invalid
Charging ampere-hour	0.00AH	Invalid
Load voltage	27.1V	Current load voltage
Load current	0.19A	Current load current
Load power	5.15W	Current load power
Lighting time	05:20	Total actual lighting time that night
Sensing time	01:10	Actual lighting time under power with people present that night
Discharging ampere-hour	2.05AH	Number of discharging ampere-hours that night
Ambient temperature	23°C	Current internal temperature
Operating days	15D	Cumulative operating days
Number of over discharge	2N	Total number of over discharge of lithium battery
Number of full charge	10N	Total number of full charge of lithium battery
Production date	2042	The production date of the controller: 20 means the year of 2020, and 42 means 42 weeks
Software version	1000	Software version number of the controller

2.7 Dimensional drawing:



III. Technical parameters

Parameter name	Parameter value	Adjustable parameter	Default value
Model	EH120, EH120-ES, EL2415		
Controller type	-R: Infrared remote control; -W: 2.4 G wireless remote control		
System voltage	12V/24V	√	Lead
Static power consumption	-R: <10mA/12V; <15mA/24V -W: <35mA/12V; <40mA/24V		
Load current	50mA~4000mA	≤15A	√ 330mA
Load voltage	15V~60V/12V 30V~60V/24V	≈Battery voltage or DC voltage	
Maximum load power	60W/12V, 120W/24V		
Load conversion efficiency or load circuit voltage drop	90%~96%	≤800mV	
Load current accuracy	< 3%	/	
Intelligent power	High/Medium/Low/Auto/USE/No	/	
Load operating period	Nine periods + morning lighting		
Period adjustment range	1 min/10 min		
Power adjustment range	1%/10%		
Maximum charging current	15A		
Open-circuit voltage of solar panel	≤55V		
Overvoltage	Lead-acid battery: 16 V; lithium battery: charging voltage +2 V; × 2/24 V		
Equalizing charging voltage	Lead-acid battery: 14.6 V; lithium battery: no equalizing charging; ×2/24 V		
Equalizing charging interval	30days		
Boost charging voltage (Lead-acid battery)	7.50 V~17.00 V can be set; × 2/24 V	√	14.4V
Charging voltage (Lithium battery)		√	13.8V
Floating charging voltage (Lead-acid battery)	7.50 V~17.00 V can be set; × 2/24 V	√	11.0V
Over-discharge voltage	7.50 V~17.00 V can be set; × 2/24 V	√	12.6V
Over-discharge reconnect voltage	7.50 V~17.00 V can be set; × 2/24 V	√	11.5V
Switching voltage	7.50 V~17.00 V can be set; × 2/24 V		
DC voltage input range	10~14 V/12V system; 20~28 V/24 V system		
Light control voltage	3 V~11 V	√	5V
Temperature compensation factor	Lead-acid battery: - 3.0 mV/°C/2 V; lithium battery: no temperature compensation		
Light control delay	5s~60s/2 min~60 min	√	10s
High-temperature operation	40°C~+90°C	√	65°C
Low-temperature charging	0°C~ -35°C	√	-35°C
Operating temperature	-35°C~ +65°C		
Protection level	IP67		
Protection function	Battery reverse connection protection, panel reverse connection protection, panel overvoltage protection, lithium battery over-charge & over-discharge protection, BMS over-charge detection protection for lithium battery, over-temperature protection, load open-circuit & short-circuit protection, load overcurrent protection, etc.		
Weight	300g		

IV. Protection functions

• Waterproof

Waterproof level: IP67

• BMS over-charge detection protection for lithium battery

When the controller detects that the BMS is overcharged, the controller immediately stops charging to prevent the high voltage at the photovoltaic input side from being applied to both ends of the BMS for a long time, causing high voltage damage to the BMS.

• Low-temperature charging protection for lithium battery

When the ambient temperature drops to the set value, the controller will stop charging to prevent irreversible damage to the lithium battery caused by low-temperature charging.

• High-temperature protection

When the ambient temperature is higher than the set value, the controller will stop charging and discharging to prevent the lithium battery from being damaged due to high temperature.

• Battery reverse connection protection

The system will not work if the battery is connected reversely to prevent the controller from being burnt out.

• Photovoltaic input side overvoltage protection

If the voltage of photovoltaic input side is too high, the controller will automatically cut off the photovoltaic input.

• Photovoltaic input side short-circuit protection

When the photovoltaic array input side is short circuited, the controller will cut off the charging. When the short-circuit condition is cleared, the charging will recover automatically.

• Photovoltaic input reverse-connection protection

When the polarity of photovoltaic array is reversed, the controller will not be damaged, and it will continue to work normally after the wiring error is corrected.

• Load power limiting protection

When the power of LED lamp holder used by the customer is too high or the regulated load current is too high, the controller will limit the load power output to less than the rated power to ensure that the controller and LED load will not be damaged.

• Load overload and short-circuit protection

When the number of lamp holders & beads connected in series to the load is fewer (3 strings or below), the controller will stop output immediately to prevent damage to LED load or controller;

When a short circuit occurs, the controller will immediately cut off the load output to prevent damage to the controller.

After the load short-circuit condition is removed, the controller will automatically restore the output within 1 minute (once an hour for long-time short circuit), or the output will be automatically restored after 10s by pressing the test button of the remote control (CU or mini2).

• Load open-circuit protection

When the LED load is normally on but the load wiring is suddenly disconnected, the controller can immediately turn off the load output to protect the controller from damage. After the load connection is restored, the controller will automatically restore the output within 10s (once an hour for long-time open circuit), or the output will be automatically restored after 10s by pressing the test button of the remote control (CU or mini2).

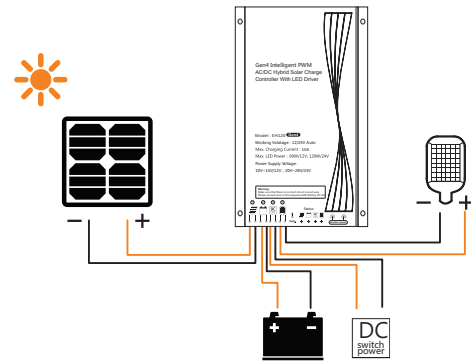
• Reverse charging protection at night

It is to prevent the battery from discharging through the panel at night.

• TVS lightning protection

V. Electrical connection diagram

Wiring sequence: Connect the load first, then the battery and the solar cell, and finally the DC power according to the lead wire identification sequence of the controller.



Connect the DC input end of the controller to the output end of 12V or 24V AC/DC switching power supply. Do not connect the 220V AC directly to the controller!

VI. Common faults and solutions

No.	Phenomenon	Fault	Solution
1	Remote control does not work.	A. The password of remote control is wrong. B. The remote control mode (infrared or wireless) is selected improperly. C. Wireless remote control distance is set too short. D. The battery level of the remote control is low.	A1. Press the "+" and "-" buttons at the same time to call up the [Remote Control Setting] interface to set a correct password. B2. Press the "+" and "-" buttons at the same time to call up the [Remote Control Setting] interface to select [Infrared Remote Control] or [Wireless Remote Control]. C1. Press the "+" and "-" buttons at the same time to call up the [Remote Control Setting] interface to increase the distance. D1. Replace with two AA (No. 5) batteries.
2	The controller has no response when connected to the battery, the indicator is not on, and the remote control has no response.	A. There is something wrong with the battery power. B. The controller is in sleep mode.	A1. Check whether the battery wiring is in good condition. A2. Check whether there is voltage at the battery and whether the protection board functions well. If there is no voltage at the battery, it means that the protection board is functioning, and the battery can be activated by charging. B1. Press the "ON" button of the remote control to activate the controller. B2. Connect the panel to charge and activate the battery.
3	With normal charging in the daytime, the load does not light up at night, and the LED indicator on the controller is not on.	A. The controller is in sleep mode.	A1. Press the "ON" button of the remote control to activate the controller. A2. Set "PV Wake-up" to "Yes", and the controller will be activated automatically after charging in the daytime.
4	The battery indicator flashes quickly, and the load LED lamp holder is not on.	A. The battery level is low.	A1. Check whether the charging of the panel is normal and whether the panel is blocked. A2. Check whether the wiring of battery and panel is disconnected or loose.
5	The load has short lighting time.	A. The battery level is low. B. The load power is excessive.	A1. Check whether the charging of the panel is normal and whether the panel is configured properly. A2. Check whether the lithium battery has single protection. A3. Turn on the "Intelligent Power" option. B1. Check whether the current setting of the controller is correct and whether the load power is normal.
6	The load lighting current fails to reach the set value.	A. The intelligent power regulates the load current. B. The power of LED lamp holder exceeds the rated power.	A1. Turn off the "Intelligent Power" mode and re-test the load current. B1. Reduce the set current or replace the lamp holders with fewer series connections.
7	The load indicator is flashing and the load LED lamp is not on.	A. The load is open-circuited. B. The LED load is short-circuited or there are fewer series connections for LED lamp holder.	A1. Check whether the load wiring is correct and whether the positive and negative poles of LED are connected reversely. B1. Check whether the load is short-circuited and whether the positive and negative poles of LED are connected reversely. B2. Check whether the LED lamp strings are correct, and replace the LED lamp holders with appropriate number.
8	LED lamp holder cannot be dimmed.	A. There is a problem with the number of lamp holders in series. Three strings or step-down lamp holders are used.	A1. Replace with the boost (more than 5 strings) lamp holders
9	The light is on during the daytime, or LED load will only be on for one night.	A. The panel is not connected reversely. B. The panel is connected reversely.	A1. Check whether the panel connection is correct and the wiring is reliable. B1. Reverse the panel wiring in the daytime and observe whether the charging indicator flashes.
10	The charging indicator will not flash slowly when there is sunshine in the daytime.	A. The panel fails or has incorrect wiring.	A1. Check whether the connection of the solar panel is correct & reliable, and whether the solar panel is blocked.
11	LED load is not on, and battery indicator is normally on.	A. The panel voltage is not lower than the light control voltage or the delay time is not up. B. The controller time runs out.	A1. Wait for the panel voltage to reduce, and then the light will be on automatically. B1. The controller recharges and resets the timer.
12	The charging indicator flashes quickly and there is no charging current.	A. Lithium battery BMS protection board conducts over-charge protection	A1. Wait for the voltage of the lithium battery to reduce to the over-charge reconnect voltage, and then charging will automatically resume.
13	When switching to mains DC power supply, the load fails to work normally.	A. The AC/DC power supply is underpower, resulting in no output due to the automatic protection of DC power supply when switching to DC power supply.	A1. Ensure that the output power of AC/DC power supply is sufficient, which is recommended to be 1.2 times the rated load power. A2. Ensure that the lead wire diameter from the output end of AC/DC power supply to the DC end of the controller is sufficient. The recommended value is 4A/mm².