1.03.02.10038-1

Magic series

MPPT Solar Controller

12/24/48V，750/1500/3000W

IoT　RS485　Bluetooth

User Manual

User Manual_Magic series_MJ
CE, Rohs, ISO9001:2015
Subject to change without notice!

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Dear Clients,

Thanks for selecting the Magic series solar controller.

Please take the time to read this user manual, as it will help you take full advantage of the controller's features. This manual gives important recommendations for installing, programming, using and so on. Read it carefully in your own interest and pay attention to the safety recommendations in it please.

1, Safety instructions and waiver of liability

1.1 Safety Instructions

WARNING: Danger of explosion from sparking.
Danger of electric shock.

CAUTION: Indicates a critical procedure for safe and proper operation of the controller.

1) There are no user serviceable parts inside the controller. Do not disassemble or attempt to repair the controller.
2) Keep children away from batteries and the charge controller.

(1) It is advised to read this manual carefully before the product is installed and put into use.
(2) There are no user serviceable parts inside the controller. Do not disassemble or attempt to repair the controller.
(3)Install the controller at well ventilated places, the controller's heat sink will be very hot during operation.
(4)Refer to the specifications provided by the manufacturer of the battery to ensure that the battery is suitable for use with this product. The battery manufacturer's safety instructions should always be observed.
(5)Protect the solar modules from incident light during installation, e.g. cover them.
(6)Ensure that the connection cables are provided with fuses or circuit breakers.
(7)Please make sure to switch off all connections of the PV array and the fuse/breakers which close to the battery before the controller installation and adjustment.
(8)Power connections must remain tight to avoid excessive heating from the loose connection.
(9)The installer of the product must provide a means for cable strain relief to prevent the transmission of stress to the connections.
(10)Do not open the controller casing. Only the terminal cover may be removed by a technical professional for installation.

1.2 Liability Exclusion

The manufacturer shall not be liable for damages, especially on the battery, caused by use other than as intended or as mentioned in this manual or if the recommendations of the battery manufacturer are neglected. The manufacturer shall not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation, or bad system design.

2, Product Overview

Magic series solar controller is based on an advanced maximum power point tracking (MPPT) technology developed, dedicated to the solar system, the controller conversion efficiency up to 98%. The controller can rapidly track the maximum power point(MPP) of PV array to obtain the maximum energy of the panel, especially in case of a clouded sky, when light intensity is changing continuously, an ultra fast MPPT controller will improve energy harvest by up to 30% compared to PWM charge controllers.

The limitation function of the charging power and current, and automatic power reduction function fully ensure the stability when works with oversize PV modules and operate under high temperature environment.

2.1 Outstanding features

- Innovative Max Power Point Tracking(MPPT) technology, tracking efficiency >99.9%
- Full digital technology, high charge conversion efficiency up to 98%
- LCD display design, read operating data and working condition easily
- LCD can display lastest daily/monthly/yearly charging data, total 5 years
- 12/24/48V automatic recognition
- Liquid, Gel, AGM and Lithium battery for selection
- The separate ports for remote temperature sensor and voltage sensor, make battery temperature compensation and voltage detection more accurate
- Automatic power reduction when over-temperature
- Relay control the switching signals of external loads and chargers for hybrid power supply system like solar energy with utility electricity or gas generation
- Dual automatic restriction function when exceeding rated charging power and charging current
- 5-year memory battery voltage and historical charging data
- Android APP version for Bluetooth communication
- IoT wireless or RS485 communication functions optional
- Monthly charging data can be calculated and displayed by grouping and graphs
- Modbus protocol based on RS485 standard for remote communication need
- Multi-functional AUX port can meet customized requirements
- Common positive design, suitable for telecom applications
- Perfect EMC & thermal design
- Full automatic electronic protect function

2.2 MPPT

MPPT profile

The full name of the MPPT is maximum power point tracking. It is an advanced charging way which could detect the real-time power of the solar Modulel and the maximum point of the I-V curve that make the highest battery charging efficiency.

Current Boost

Under most conditions, MPPT technology will "boost" the solar charge current.

MPPT Charging: Power Into the controller **(Pmax)**=Power out of the controller **(Pout)**

Iin x Vmp= Iout x Vout

* Assuming 100% efficiency. Actually, the losses in wiring and conversion exist.

If the solar module's maximum power voltage (Vmp) is greater than the battery voltage, it follows that the battery current must be proportionally greater than the solar input current so that input and output power are balanced. The greater the difference between the Vmp and battery voltage, the greater the current boost. Current boost can be substantial in systems where the solar array is of a higher nominal voltage than the battery as described in the next section.

High Voltage Strings and Grid-Tie Modules

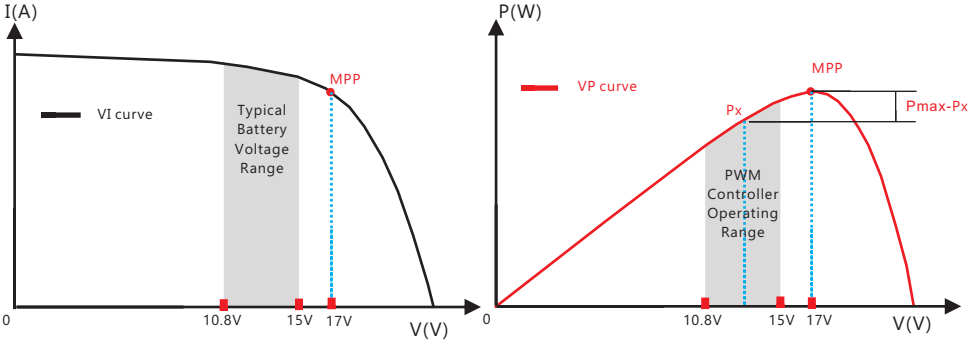
Another benefit of MPPT technology is the ability to charge batteries with solar arrays of higher nominal voltages. For example, a 12 Volt battery bank may be charged with a 12-, 24-, 36-, or 48-Volt nominal off-grid solar array. Grid-tie solar modules may also be used as long as the solar array open circuit voltage (Voc) rating will not exceed the maximum input voltage rating at worst-case (coldest) module temperature. The solar module documentation should provide Voc vs. temperature data.

Higher solar input voltage results in lower solar input current for a given input power. High voltage solar input strings allow for smaller gauge solar wiring. This is especially helpful and economical for systems with long wiring runs between the controller and the solar array.

An Advantage Over Traditional Controllers

Traditional controllers connect the solar module directly to the battery when recharging. This requires that the solar module operate in a voltage range that is usually below the module's Vmp. In a 12 Volt system for example, the battery voltage may range from 10.8-15 Vdc, but the module's Vmp is typically around 16 or 17V.

Because traditional controllers do not always operate at the Vmp of the solar array, energy is wasted that could otherwise be used to charge the battery and power system loads. The greater the difference between battery voltage and the Vmp of the module, the more energy is wasted.



Nominal 12 Volt Solar Module I-V curve and output power graph.

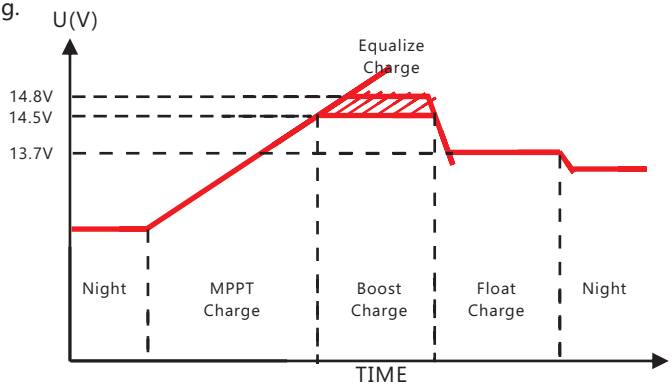
Contrast with the traditional PWM controller, MPPT controller could play a maximum power of the solar panel so that a larger charging current could be supplied. Generally speaking, the MPPT controller's energy utilization efficiency is 15%~20% higher than PWM controller.

Conditions That Limit the Effectiveness of MPPT

The Vmp of a solar module decreases as the temperature of the module increases. In very hot weather, the Vmp may be close or even less than battery voltage. In this situation, there will be very little or no MPPT gain compared to traditional controllers. However, systems with modules of higher nominal voltage than the battery bank will always have an array Vmp greater than battery voltage. Additionally, the savings in wiring due to reduced solar current make MPPT worthwhile even in hot climates.

2.3 MPPT—Four Charging Stage

Magic series controller has a 4-stage battery charging algorithm for rapid, efficient, and safe battery charging.



MPPT Charge

In this stage, the battery voltage has not yet reached boost voltage and 100% of available solar power is used to recharge the battery.

Boost Charge

When the battery has recharged to the Boost voltage setpoint, constant-voltage regulation is used to prevent heating and excessive battery gassing. The Boost stage remains 120 minutes and then goes to Float Charge. Every time when the controller is powered on, if it detects neither over discharged nor overvoltage, the charging will enter into boost charging stage.

Float Charge

After the Boost voltage stage, the controller will reduce the battery voltage to Float voltage setpoint. When the battery is fully recharged, there will be no more chemical reactions and all the charge current transmits into heat and gas at this time. Then the controller reduces the voltage to the floating stage, charging with a smaller voltage and current. It will reduce the temperature of battery and prevent the gassing, also charging the battery slightly at the same time. The purpose of Float stage is to offset the power consumption caused by self consumption and small loads in the whole system, while maintaining full battery storage capacity.

In Float stage, loads can continue to draw power from the battery. In the event that the system load(s) exceed the solar charge current, the controller will no longer be able to maintain the battery at the Float setpoint. Should the battery voltage remains below the boost reconnect charging voltage, the controller will exit Float stage and return to Bulk charging.

Equalization Charge

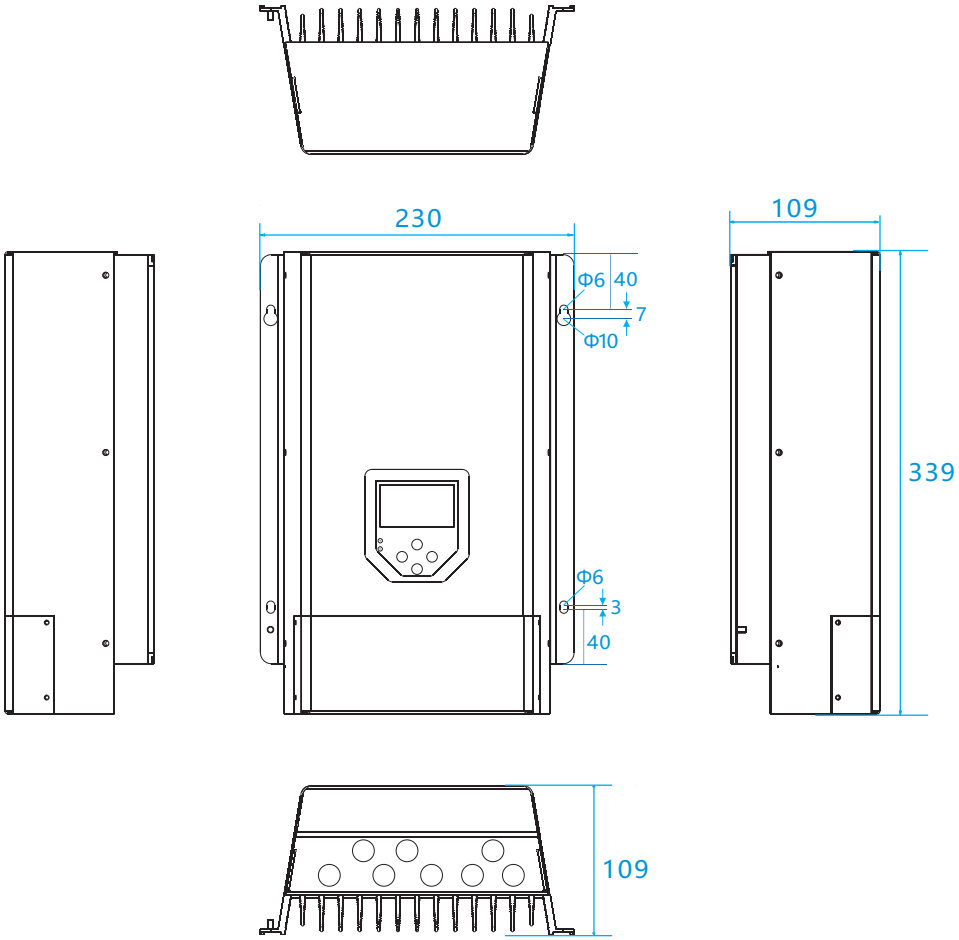
Certain types of batteries benefit from periodic equalizing charge, which can stir the electrolyte, balance battery voltage and complete chemical reaction. Equalizing charge increases the battery voltage, higher than the standard complement voltage, which gasifies the battery electrolyte. If it detects that the battery is being over discharged, the solar controller will automatically turn the battery to equalization charging stage, and the equalization charging will be 120mins. Equalizing charge and boost charge are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of battery.

Risk of explosion!

Equalizing flooded battery can produce explosive gases, so well ventilation of battery box is necessary.

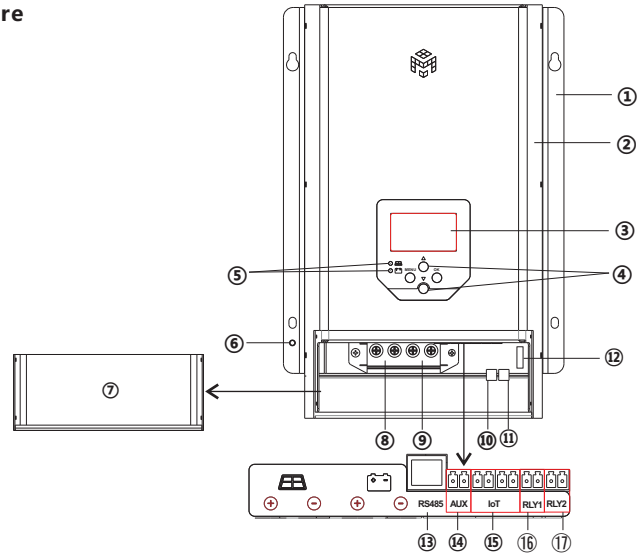
3,Dimensions

Unit:mm



4, Structure & Accessory

4.1 Structure



Component		Description
1	Heat Sink	Dissipate controller heat
2	Sheet metal case	Internal PCBA protection
3	LCD	Display settings and operating status
4	Operating keys	MENU OK ▲ ▼
5	Indicator lights	Operating state indication of controller
6	Grounding point	If a grounding point is not already present then this must be created
7	Terminal cover	The case to cover the terminals and wires connections
8	Solar module terminals	Connected solar modules
9	Battery terminals	Connected the battery
10	External temperature sensor	Collect temperature information for temperature compensation
11	Battery voltage sensor	Connect the cable directly to the battery for checking the battery voltage
12	Button Cell	Data can still be saved after the battery is disconnected
13	RS485 interface	Communication through RS485 interface
14	AUX	Multi-functional AUX port can meet customized requirements
15	IoT interface	Connect with IoT module
16	Load Control Relay1	Control Load ON/OFF
17	Utility/Generator Relay2	Control Utility/Generator ON/OFF

4.1.1 Battery voltage sensor

For compensating possible cable losses during charging, two sense wires can be connected to measure voltage directly on the battery. Use wire with a cross-section of 0.75mm² and insert a 0.1 Amp fuse close to the battery.

During battery charging, the charger will compensate the voltage drop over the DC cables up to a maximum of 3 Volt. If the voltage drop threatens to become larger than 3V, the charging current is limited in such a way that the voltage drop remains limited to 3V. The "Bat.ext.volt" on the LCD will display "--- " if the voltage drop exceeds 3 Volt. At this time, you need to connect the voltage sensor or check whether the wiring is correct.

4.1.2 Load control relay1 and Utility/Generator relay2

The relay outputs are potential-free, normally-open contacts. Rated Value：3A/30VDC.

(1) Load control relay1

The initial state of the contacts is normally-open. The relay outputs can be used for switching devices or loads. Heavy loads connected directly to the battery can be switched using an additional power relay connected to this relay.

When the battery voltage is lower than the low-voltage protection voltage, the relay will be turned off. When the battery voltage is higher than the low-voltage recovery voltage, the relay will be opened again.

(2)Utility/Generator relay2

The initial state of the contacts is normally-close. The relay outputs can be used for connecting power generation equipment, such as diesel engine and so on.

When the battery voltage is lower than the low-voltage protection voltage + 0.2V, the relay will be turned on to access to external power generation equipment. When the battery voltage is higher than the low-voltage recovery voltage, the relay will be turned off again.

You can choose whether to start the automatic maintenance function of the diesel engine. For specific operations, please refer to **6.6 Main menu display**.

The working time of the diesel shall not be less than 15 minutes each time it is started.

4.1.3 AUX

Multi-functional AUX port can meet customized requirements. Aux is defined as current sensor by default. Please customize it if you need other functions.

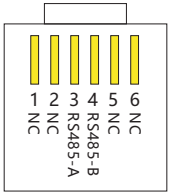
The current of the external equipment is calculated by setting the parameters of the current sensor such as the maximum measuring current and the maximum output voltage. After the correct setting, the external current will be displayed on the LCD screen of the controller.

For specific operations, please refer to **6.6 Main menu display**.

4.1.4 RS485

The charger is equipped with a RS485 port with RJ11 sockets, the RJ11 interface is defined as follows:

Pin No.	Definition
1	NC
2	NC
3	RS485-A
4	RS485-B
5	NC
6	NC



RJ11 for controller

The RS485 interface on this charger is not galvanically isolated and can not be grounded. Do not short circuit unused pin (Note NC).

4.2 Accessories(Included)

Item	Accessory	Model	Number
1	Local temperature sensor	2P-3.81mm	1Pcs
2	Battery voltage sensor terminal	2P-5.08mm	1Pcs
3	AUX terminal	2P-3.81mm	1Pcs
4	Load control relay1 terminal	2P-3.81mm	1Pcs
5	Utility/Generator relay2 terminal	2P-3.81mm	1Pcs
6	Mounting screws	M8*40mm	4Pcs
7	RS485 interface cable	RJ11*1m	1Pcs

4.3 Accessories(Optional)

4.3.1 Remote Temperature Sensor

The controller is shipped with a temperature sensor of length 80mm. If you need other components you need to purchase separately.

The remote temperature sensor can measure the temperature at the battery and use this data for very accurate temperature compensation. The standard length of the cable is 3m (length can be customized). The temperature sensor connected via interface ⑩.

1. The connection polarity is irrelevant.

2. If the external temperature sensor is not connected or damaged, the internal temperature will be used for temperature compensation during charging.

3. If the controller and battery are not located in the same room then an external temperature sensor for measuring the battery temperature must be installed.

4.3.2 IoT module

After the controller is connected with the IoT module through the IoT interface, the operating status and related parameters of the controller can be changed and monitored by the mobile APP software or PC program.

Please contact with our sales about IoT wireless communication information.

5, Installation

Please read all instructions and precautions in the manual before installing. It is recommended to remove the acrylic protective film covering the LCD screen before installation.

5.1 Installation Notes

(1)Do not open the controller sheet metal case, only the terminal cover may be removed by a technical professional for installation.

(2)Before wiring installation and adjustment of controller, Always disconnect the solar modules and insurance or circuit breaker of battery terminal.

(3)Only to comply with the range of the battery charge controller.

(4)Batteries store a large amount of energy, never short circuit a battery under all circumstances. We strongly recommend connecting a fuse directly to the battery to avoid any short circuit at the battery wiring.

(5)Batteries can produce flammable gases. Avoid making sparks, using fire or any naked flame. Make sure that the battery room is ventilated.

(6)Uses insulated tools and avoid placing metal objects near the batteries.

(7)Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.

(8)Avoid touching or short circuiting wires or terminals. Be aware that the voltages on special terminals or wires can be as much as twice the battery voltage. Use isolated tools, stand on dry ground, and keep your hands dry.

(9)Prevent water from entering the internal controller, outdoor installation should avoid direct sunlight and rain penetration.

(10)After installation check that all connections are tight line, avoid heat accumulation caused by virtual access danger.

(11)Multiple same models of controllers can be installed in parallel on the same battery bank to achieve higher charging current. Each controller must have its own solar module(s).

(12)Select the system cables according to 5A/mm² or less current density.

5.2 Battery cables and battery fuse

Cable strain relief must be provided, close to battery and PV connectors.

In order to utilize the full capacity of the product, battery cables with sufficient cross section and a fuse of sufficient current rating should be used.

Rated charge current	Battery Fuse Rating	Cable Length	Wire Size
60A	80A	2 * 1.5m	16mm²/5AWG
		2 * 2.5m	25mm²/3AWG
		2 * 5.0m	Not recommended

1.The battery wire size recommended is for battery terminal without inverter.
2.Please consult local regulations regarding maximum allowed current carrying capacity of cables.

5.3 PV Array

The voltage on the PV input should never exceed 190V under any condition. The charger will be permanently damaged if the input voltage is too high. Cable strain relief must be provided, close to PV and battery connectors.

5.3.1 PV cables

As the core component of PV system, controller could be suitable for various types of PV modules and maximize converting solar energy into electrical energy. According to the open circuit voltage (Voc) and the maximum power point voltage (Vmpp) of the MPPT controller, the series number of different types PV modules can be calculated.

The required PV cable cross section depends on array power and voltage. The table below assumes that maximum PV power has been installed. Cable cross section can be reduced in case of smaller solar arrays.The best efficiency is reached at a PV input voltage that is twice the battery voltage. DC circuit breakers or fuses must be installed in the positive and negative PV cables, to enable isolation of the charger during installation or maintenance.

12V System(Solar array up to 750W)				
Solar array MPP-Voltage[V]	Solar array MPP-Current[A]	Cable Length 2 * 5m	Cable Length 2 * 10m	Cable Length 2 * 20m
18	42	16mm²/5AWG	35mm²/2AWG	Not recommended
36	21	10mm²/7AWG	16mm²/5AWG	25mm²/3AWG
54	14	6mm²/10AWG	16mm²/5AWG	25mm²/3AWG
72	10	4mm²/11AWG	6mm²/10AWG	16mm²/5AWG
90	8	2.5mm²/13AWG	4mm²/11AWG	6mm²/10AWG
108	7	2.5mm²/13AWG	4mm²/11AWG	6mm²/10AWG
≥126	6	2.5mm²/13AWG	4mm²/11AWG	6mm²/10AWG

24V System(Solar array up to 1500W)				
Solar array MPP-Voltage[V]	Solar array MPP-Current[A]	Cable Length 2 * 5m	Cable Length 2 * 10m	Cable Length 2 * 20m
36	42	16mm²/5AWG	35mm²/2AWG	Not recommended
54	28	16mm²/5AWG	25mm²/3AWG	35mm²/2AWG
72	21	10mm²/7AWG	16mm²/5AWG	35mm²/2AWG
90	17	6mm²/10AWG	16mm²/5AWG	25mm²/3AWG
108	14	6mm²/10AWG	10mm²/7AWG	25mm²/3AWG
≥126	12	4mm²/11AWG	6mm²/10AWG	16mm²/5AWG

48V System(Solar array up to 3000W)				
Solar array MPP-Voltage[V]	Solar array MPP-Current[A]	Cable Length 2 * 5m	Cable Length 2 * 10m	Cable Length 2 * 20m
72	42	16mm²/5AWG	35mm²/2AWG	Not recommended
90	34	16mm²/5AWG	35mm²/2AWG	Not recommended
108	28	16mm²/5AWG	25mm²/3AWG	35mm²/2AWG
≥126	24	10mm²/7AWG	16mm²/5AWG	35mm²/2AWG

please consult local regulations regarding maximum allowed current carrying capacity of cables.

5.3.2 PV array maximun power

The MPPT controller has the function of current/power-limiting, that is during the charging process, when the charging current or power exceeds the rated charging current or power, the controller will automatically limit the charging current or power to the rated charging current or power, which can effectively protect the charging parts of controller, and prevent damages to the controller due to the connection of some over-specification PV modules.

If "Actual charging power of PV array > Rated charging power of controller" or "Actual charging current of PV array > Rated charging current of controller" , the controller will carry out the charging as per the rated current or power.

According to "Peak Sun Hours diagram", if the power of PV array exceeds the rated charging power of controller, then the charging time as per the rated power will be prolonged, so that more energy can be obtained for charging the battery. However, in the practical application, the maximum power of PV array shall not be greater than 1.2 x the rated charging power of controller. If the maximum power of PV array exceeds the rated charging power of controller too much, it will not only cause the waste of PV modules, but also increase the open-circuit voltage of PV array due to the influence of environmental temperature, which may increase the probability of damage to the controller rise. Therefore, it is very important to configure the system reasonably.

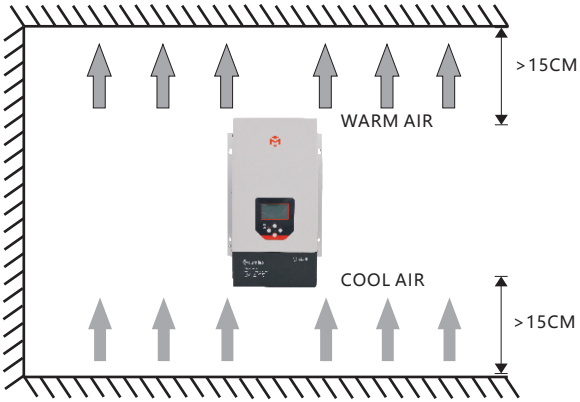
5.4 Mounting

Step 1: Determination of Installation Location and Heat-dissipation Space

Do not mount the solar charge controller outdoors or in wet rooms. Do not subject the solar charge controller to direct sunshine or other sources of heat. Protect the solar charge controller from dirt and moisture. Mount upright on the wall on a non-flammable substrate. Maintain a minimum clearance of 15cm below and around the device to ensure unhindered air circulation. Mount the solar charge controller as close as possible to the batteries.

Mark the position of the solar charge controller fastening holes on the wall, drill 4 holes and insert dowels, fasten the solar charge controller to the wall with the cable openings facing downwards.

If the controller is to be installed in an enclosed box, it is important to ensure reliable heat dissipation through the box.



Step 2: Preparing the cables

(1)Label the cable ends with M+, M-, B+ and B-.

(2)Lay the battery and module cables directly next to each other. Do not yet connect the cables.

(3)Connect the external battery fuse to the "B–" battery cable, in an easily accessible position close to the battery.

(4)Switch off the external battery fuse: Remove the fuse insert from the fuse holder (safety fuse) or switch off the DC line circuit breaker and secure it against being switched on again.

(5)Connect the DC load circuit breaker to the module cables "M-" , in an easily accessible position close to the controller.

(6)Switch off the DC load circuit breaker and secure it against being switched on again.

(7)Remove the terminal cover (release the 4 fastening screws with a screwdriver).

Step 3: Connecting the battery

Connect the battery cable and external battery fuse to the battery connection of the controller and to the battery.

We recommend installing the external battery fuse in the "B–" cable and the current is 1.25 to 2 times the rated current of the controller.

Step 4: Connecting the battery voltage sensor

The external battery voltage sensor cable allows the controller to directly measure the voltage at the battery. This voltage value can be used for compensation of voltage drops across the battery cables. This means that the voltage measurement is not affected by powerdependent voltage drops across the battery cables.

A 2-pin plug with screw terminals for connecting the sensor cable is supplied with the device.

A cable with a cross-section of 0.14-1.5mm² (AWG 28-16) can be used.

The battery voltage sensor cable is not supplied with the device.

1. The connection polarity is irrelevant.

2. Install a fuse(< 1A) in the connection between the battery voltage sensor cable and the battery. This protects the cable from burning in the case of a short-circuit in the battery voltage sensor cable.

Step 5: Grounding

This product is a common-positive controller, if any of one positive is grounded, all the positive terminals of PV and battery will be grounded simultaneously. However, according to the practical application, all the positive terminals of PV array and battery can also be ungrounded, but the grounding terminal on its case must be grounded, which may effectively shield the electromagnetic interference from the outside, and prevent some electric shock to human body due to the electrification of the case.

The positive pole of the controller and the shell cannot be grounded at the same time

Step 6: Connecting the solar module

(1)Safely cover the module (ensure that wind cannot blow off the covering).

(2)Connect the module cable with the (open) DC load circuit breaker to the solar module connection of the controller and the solar module.

(3)Remove the covering from the solar module.

Step 7: Connecting accessories

(1)Connect the remote temperature sensor cable

Connect the remote temperature sensor cable to the interface ⑩ and place the other end close to the battery.

(2)Connect the accessories for RS485 or IoT communication, refer to the accessories list.

Step 8: Supplying the controller with voltage

(1)Please make sure the battery and the solar module have been connected as described previously.

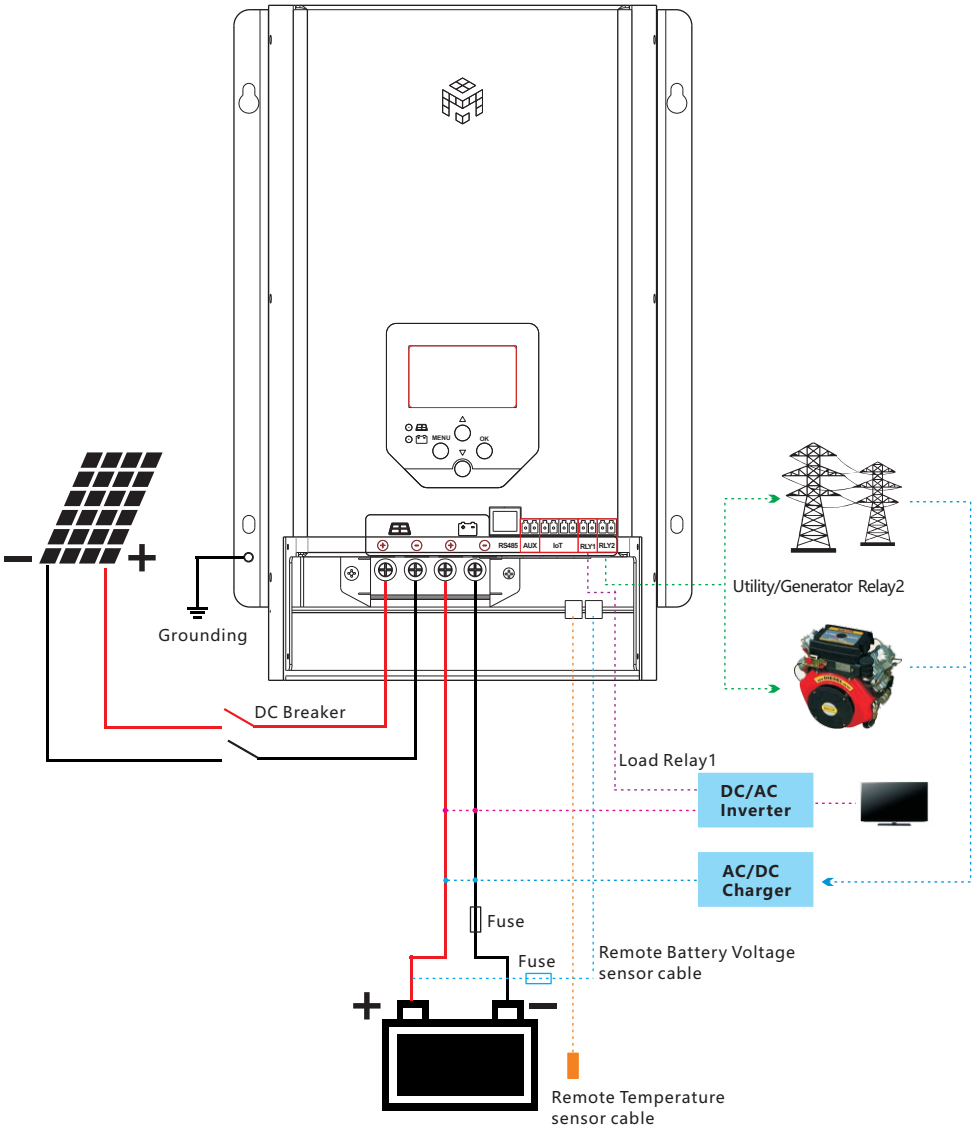
(2)Fit the terminal cover.

(3)Fit the fastening screws.

(4)Switch on the external battery fuse: Insert the fuse insert into the fuse holder (safety fuse) or switch on the DC line circuit breaker. The controller automatically starts operating and then displays the system states.

(5)Switch on the DC load circuit breaker of the solar module, if the PV is charging, the green charge indicator will flash.

If the controller is not operating properly or the battery indicator on the controller shows an abnormality, please refer to "7.2 Troubleshooting".



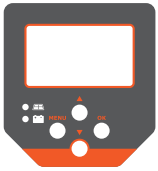
Wiring Diagram

6, Operation

6.1 LED indicator

LED	Status	Function
Green (PV Panel)	On	Solar panel is connected, but not charged
	Off	PV reverse connection or PV overvoltage protection
	Fast flash(0.1/0.1s)	MPPT charging
	Flash(0.5/0.5s)	Equal or Boost Charging
	Slow flash(0.5/2s)	Float Charging
Yellow (Battery)	On	Battery is normal
	Off	Over voltage protection
	Fast flash(0.1/0.1s)	Low voltage protection
	Slow flash(0.5/2s)	Battery voltage is low

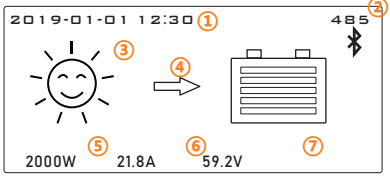
6.2 Key function

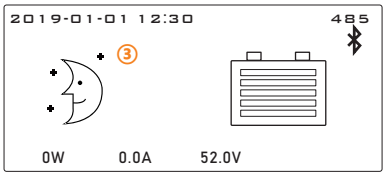


Key	Function
MENU	Enter or exit settings menu. Stop blinking the selected number to confirm the change
OK	Navigates one menu level down. Causes the selected numeral to blink so that it can be modified.
▲ ▼	Moves the selection bar or the display content upwards/downwards. Increases/decreases a setting value by 1 step.

6.3 Status display

The status display consists of data, time, communication mode, PV power/ current and battery voltage.





The figures show the respective basic settings when battery chargingis switched on and when the charging is switched off.

①Date and time can be set.

②Communication mode can be set, default RS485.
If Bluetooth is connected to the mobile phone, the LCD will display the Bluetooth icon.

③The solar module is illuminated , the controller recognizes as daytime.
The solar module is not illuminated , the controller recognizes as nighttime.

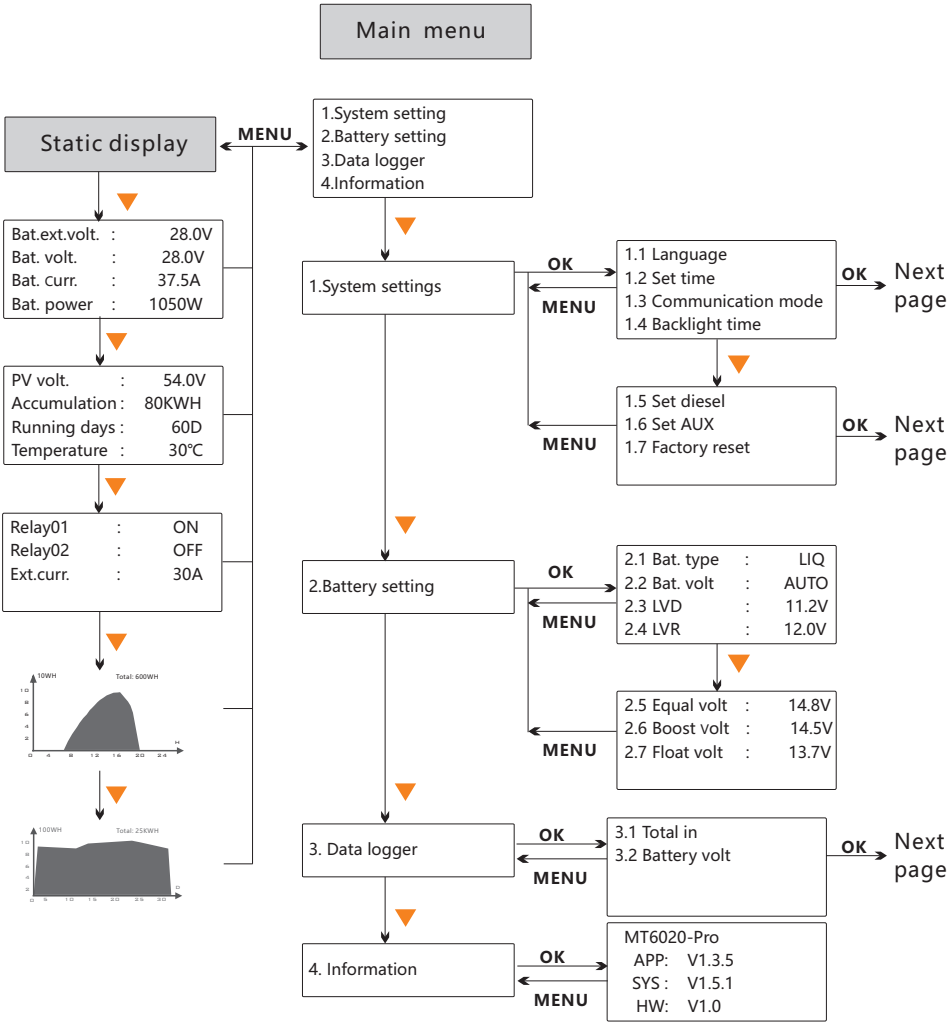
④The arrow symbol indicates charging of the battery.

⑤Actual charging power.

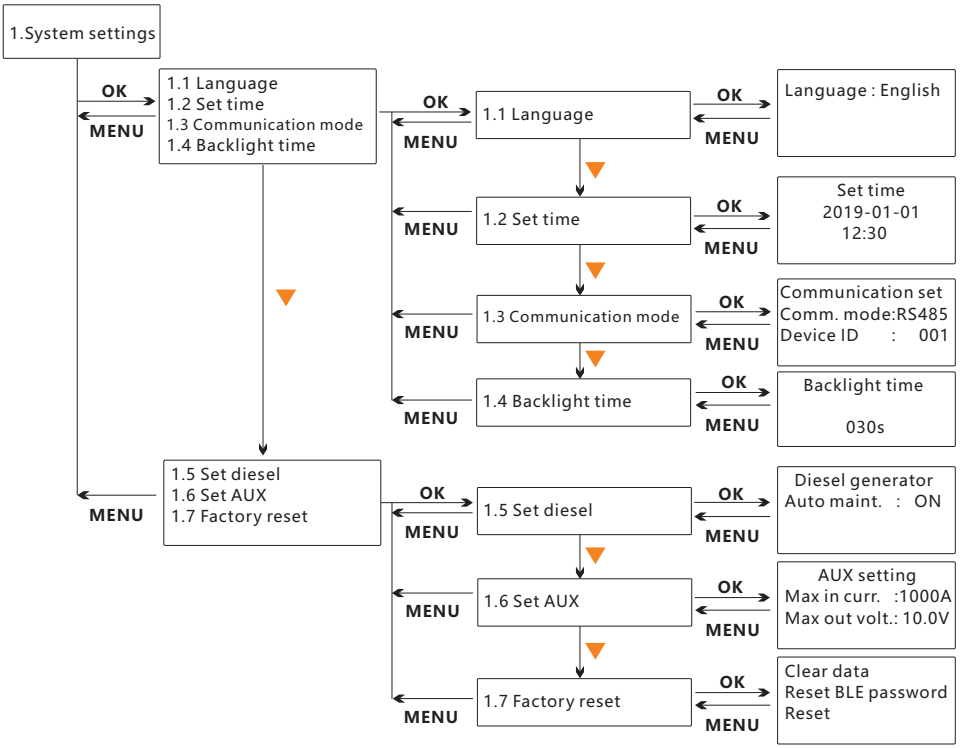
⑥Actual charging current.

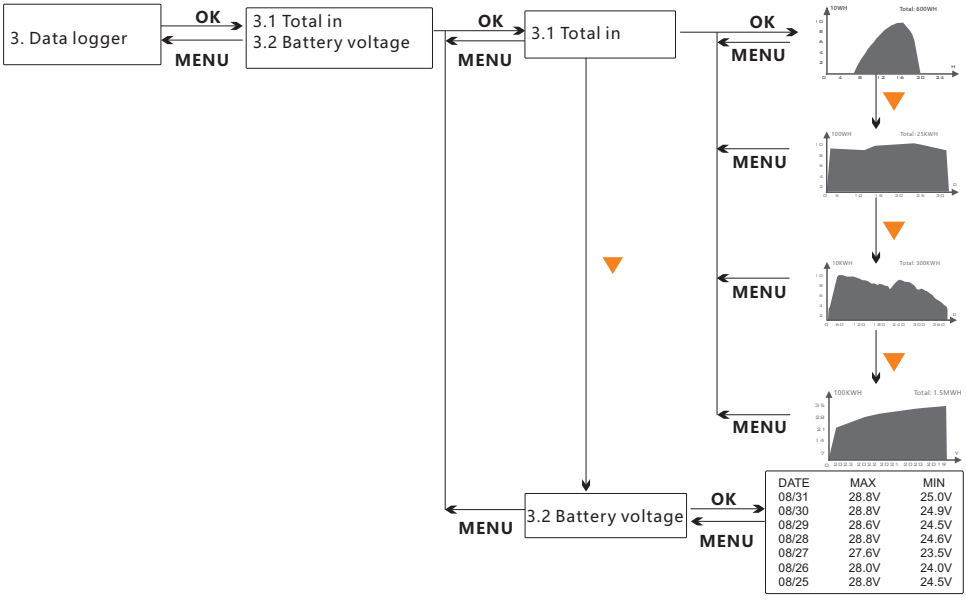
⑦Battery voltage.

6.4 Menu structure



For the sake of clarity, only the OK, MENU and ▼ operating keys are illustrated.


1.System settings
OK
MENU
1.1 Language
1.2 Set time
1.3 Communication mode
1.4 Backlight time
1.1 Language
Language : English
1.2 Set time
Set time
2019-01-01
12:30
1.3 Communication mode
Communication set
Comm. mode:RS485
Device ID : 001
1.4 Backlight time
Backlight time
030s
1.5 Set diesel
1.6 Set AUX
1.7 Factory reset
Diesel generator
Auto maint. : ON
AUX setting
Max in curr. :1000A
Max out volt.: 10.0V
Clear data
Reset BLE password
Reset


3. Data logger
OK
MENU
3.1 Total in
3.2 Battery voltage
3.1 Total in
3.2 Battery voltage
DATE MAX MIN
08/31 28.8V 25.0V
08/30 28.8V 24.9V
08/29 28.6V 24.5V
08/28 28.8V 24.6V
08/27 27.6V 23.5V
08/26 28.0V 24.0V
08/25 28.8V 24.5V

6.5 Operation status display

Press ▲ or ▼ to enter this operation status interface.

Bat.ext.volt.	:	28.0V
Bat. volt.	:	28.0V
Bat. curr.	:	37.5A
Bat. power	:	1050W

■ Bat.ext.volt

Battery voltage measured via the battery voltage sensor cable, in volts (V). If the battery voltage sensor is not connected or the voltage drop exceeds 3V, this item will display "--- ". At this time, you need to connect the voltage sensor or check whether the wiring is correct.

■ Bat. volt

The battery voltage measured at connection "B+/B–", in volts (V).

■ Bat.curr

The current flowing from the controller to the battery, in Amperes(A).

■ Bat. Power

Actual power being used for charging the battery, in watts (W).

PV volt.	:	54.0V
Accumulation	:	80KWH
Running days	:	60D
Temperature	:	30℃

■ PV volt

Voltage present at PV array connection, in volts(V).

■ Accumulation

Actual power being used for charging the battery after the controller is working, in watt-hour (WH) or kilowatt-hour(KWH).

■ Running days

Number of operating days since initial commissioning of the device.

■ Temperature

This temperature is tested by external sensor for battery temperature compensation. If no external temperature sensor is connected, the temperature inside the controller will be displayed and used for temperature compensation during charging, in Celsius degree(℃).

Relay01	:	ON
Relay02	:	OFF
Ext.curr.	:	30A

■ Relay 01

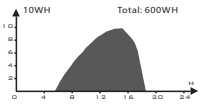
Switching state of load control relay 1.

■ Relay 02

Switching state of Utility/Generator relay 2.

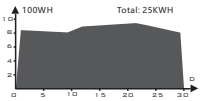
■ Ext.curr

Aux interface is connected with current transformer to display the detected current of external equipment.



■ Graphical overview representing the energy input in the last 24 hours.

■ Memory of the information on the amount of input energy in WH or KWH, the vertical axis of the figure varies according to the maximum charging energy.

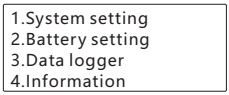


■ Graphical overview representing the energy input in the last 30 days.

■ Memory of the information on the amount of input energy in WH or KWH, the vertical axis of the figure varies according to the maximum charging energy.

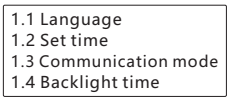
6.6 Main menu display

Press the **MENU** key to enter the main menu interface, the interface menu is shown below.

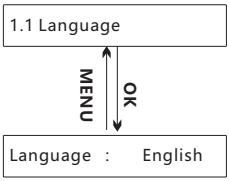


Press the **MENU** key to enter the main menu interface, the interface menu is shown as left, press ▲ and ▼ to browse the menu.
Press **OK** to enter the current menu settings

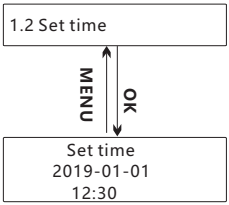
6.6.1 System settings



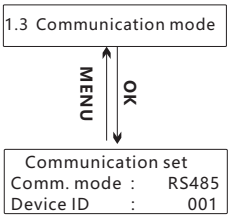
If the cursor indicates "**System settings**", you can press **OK** and the interface displayed as shown on the left.



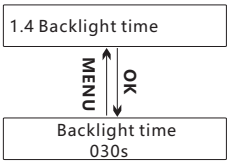
■English is set as the default menu language at the factory, now Chinese and English are available.
1.Press **OK** to enter the language settings interface, pressing the **OK** key again, the language item will flash.
2.Press ▲▼ to select the appropriate language.
3.Press **OK** or **MENU** to confirm.
4.Press **MENU** again to exit the current settings.



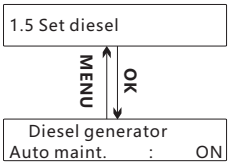
■1.Press **OK** to enter the time setting interface and the year is selected.
2.Press **OK**, the year display flashes.
3.Press ▲▼ to change the year.
4.Press **OK**. The year stops blinking and the month flashes.
5.Press ▲▼ to change the month.
6.Repeat steps 4 and 5 for the day, hour and minutes.
7.Press **MENU** again to exit the current settings.



■1.Press **OK** to enter the communication setting interface and the communication mode is selected.
2.Press **OK**, the communication mode display flashes.
3.Press ▲▼ to change the comm. mode, you can select RS485 or IoT.
4.Press **OK**. The comm. mode stops blinking and the device ID flashes.
5.Press ▲▼ to change the device ID, the setting range is 1~247.
6.Press **OK** or **MENU** to confirm.
7.Press **MENU** again to exit the current settings.



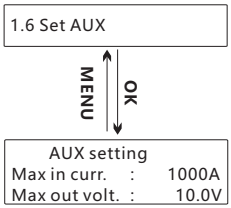
■1.Press **OK** to enter the backlight time setting interface.
2.Press **OK**, the backlight time display flashes.
3.Press ▲▼ to change the backlight time, the setting range is 0~600.
4.Press **OK** or **MENU** to confirm.
5.Press **MENU** again to exit the current settings.



■1.Press **OK** to enter the diesel setting interface.
2.Press **OK**, the auto maintain setting item flashes.
3.Press ▲▼ to select the auto maintain item from ON and OFF.
4.Press **MENU** to confirm.
5.Press **MENU** again to exit the current settings.

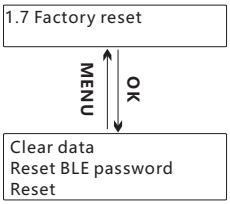
If "ON" is selected, the automatic maintenance function of the diesel will be started. If the diesel has not been started within 60 days, the diesel will be started at night. The working time of the diesel shall not be less than 15 minutes each time it is started.

If "OFF" is selected, the diesel engine will not start until Utility/Generator relay2 is turned on.

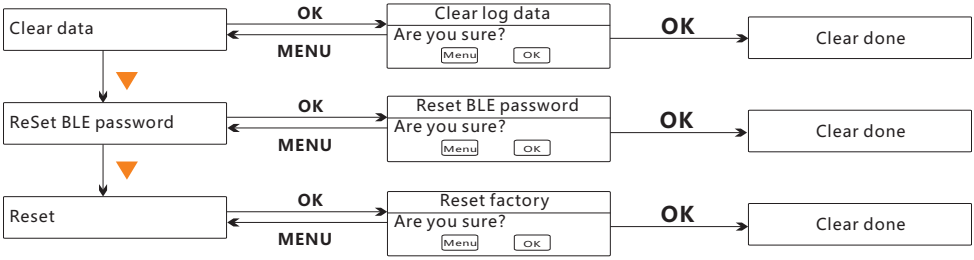


■Aux is defined as current sensor by default. The current of the external equipment is calculated by setting the parameters of the current sensor such as the maximum measuring current and the maximum output voltage. After the correct setting, the external current will be displayed on the LCD screen of the controller.

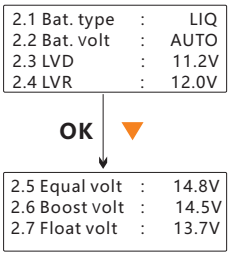
1.Press **OK** to enter the AUX setting interface.
2.Press **OK**, the max input current setting item flashes.
3.Press ▲▼ to change the max input current from 10A to 1000A.
4.Press **OK.** The max input current stops blinking and the max output voltage flashes.
5.Press ▲▼ to change the max output voltage from 0.1V to 10V.
6.Press **MENU** to confirm.
7.Press **MENU** again to exit the current settings.



■1.Press **OK** to enter the factory reset setting interface and the clear data is selected.
2.Press **OK**, the clear log data dialogue appears.
3.Press **OK**, all log data is deleted and the LCD display "Clear done".
4.Press **MENU** again to exit the current settings.
5. Repeat steps 3 and 4 for "ReSet BLE password" and "Reset".
Refer to the following figure for the operation steps.



6.6.2 Battery setting



The battery type is LiQ, AGM or GEL.

If the cursor indicates "**Battery setting**", you can press **OK** and the interface displayed as shown on the left.

■2.1 Bat. type (Battery Type)

This item can change the battery type, press the **OK** key to enter the menu, you may press ▲▼ to change the battery type.

Possibilities for programming: GEL, AGM, LIQ, LI.(default : GEL)

■2.2 Bat. Volt (Battery Voltage)

This item suitable for Gel, AGM and LIQ battery, the controller can be set to identify only fixed system voltage or automatically system voltage.

Possibilities for programming: 12V, 24V, 48V, AUTO. (default : AUTO)

■2.3 LVD (Low Voltage Disconnect)

This item can change the low voltage disconnect data, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming:
10.8~11.8V/21.6~23.6V/43.2~47.2V(default : 11.2V/22.4V/44.8V).

Possibilities for programming: 12V, 24V, 48V, AUTO.

■2.4 LVR (Low Voltage Reconnect)

This item can change the low voltage reconnect data, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Note: The solar charge controller allows the smallest difference between LVD and LVR is 0.6/1.2/2.4V. If you want to program a high level for disconnection you must first increase the reconnection level.

Possibilities for programming:
11.4~12.8V/22.8~25.6V/45.6~51.2V(default: 11.8V/23.6V/47.2V)

■2.5 Equal volt (Equalization voltage)

This item can change the equalization voltage, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Note: 1.The equalization charging can only be adjusted for batteries with liquid electrolyte, since high equalising voltages are harmful for sealed batteries. The maximum equalising voltage value should be stated on the battery manufacturer's data sheet.

2.This window is deactivated if you have selected "GEL" battery.

Possibilities for programming:
14.0~15.0V/28.0~30.0V/56~60.0V(default: 14.8V/29.6V/59.2V)

■2.6 Boost volt (Boost voltage)

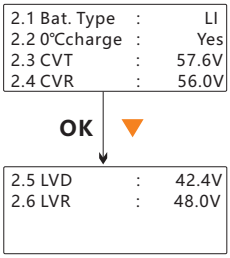
This item can change the boost voltage, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming:
14.0~14.8V/28.0~29.6V/56.0~59.2V(default: 14.5V/29.0V/58.0V)

■2.7 Float volt (Float voltage)

This item can change the float voltage, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming:
13.0~14.5V/26.0~29V/52.0~58.0V(default: 13.7V/27.4V/54.8V)



The battery type is LI.

■2.1 Bat. Type (Battery Type)

Press ▲▼ to change the battery type as LI.

■2.2 0℃ charge (0℃ charging)

"0℃ Charge" can be set to "Yes", "Slow" or "No". When the controller detects that the ambient temperature is higher than 0℃, the charging function is normal. when the ambient temperature is low than 0℃, if the "0℃ Charge" is set to "Yes", the charging function is normal, else if the "0℃ Charge" is set to "slow", the max charging current is 20% of the rated current, else if the "0℃ Charge" is set to "No", the controller does not charge the battery.

Possibilities for programming: Yes, No, Slow. (default : Yes)

■2.3 CVT (Charging target voltage)

This item can change the charging target voltage, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming: 10.0~64.0V. (default : 57.6V)

■2.4 CVR (Charging recovery voltage)

This item can change the charging recovery voltage, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming: 9.2~63.8V.(default : 56.0V)

■2.5 LVD (Low Voltage Disconnect)

This item can change the low voltage disconnect data, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Possibilities for programming: 9.0~60.0V.(default : 42.4V)

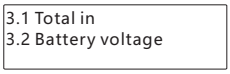
■2.6 LVR (Low Voltage Reconnect)

This item can change the low voltage reconnect data, press the **OK** key to enter the menu, you may press ▲▼ to change the value.

Note: The solar charge controller allows the smallest difference between LVD and LVR is 0.6V. If you want to program a high level for disconnection you must first increase the reconnection level.

Possibilities for programming: 9.6~62.0V.(default : 48.0V)

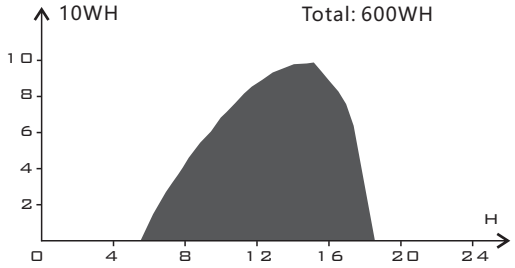
6.6.3 Data logger



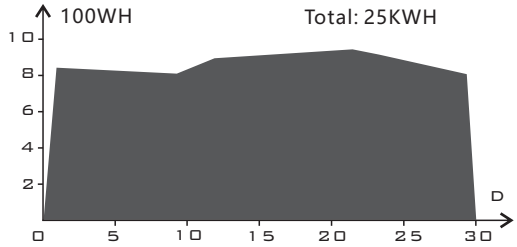
3.1 Total in

■Memory of the information on the amount of input energy in

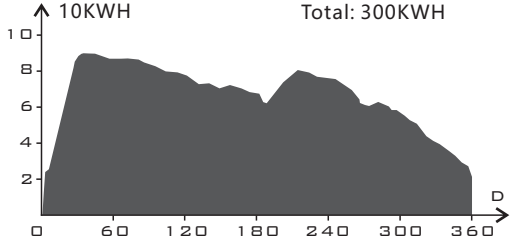
■Wh/KWh. Graphical overview representing the last 24 hours.



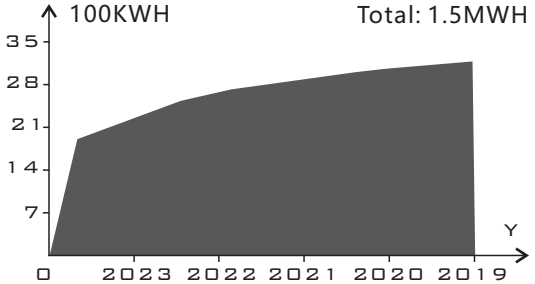
■Memory of the information on the amount of input energy in Wh/KWh. Graphical overview representing the last 30 days.



■Memory of the information on the amount of input energy in Wh/KWh. Graphical overview representing the last 360 days.



■Memory of the information on the amount of input energy in Wh/KWh. Graphical overview representing the last 5 years.



3.1 Total in
3.2 Battery volt

■3.2 Battery voltage

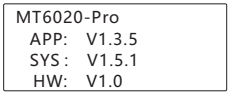
Record of the minimum and maximum battery voltage for each day over the last 60 days.

Date	Max	Min
08/31	28.8V	25.0V
08/30	28.8V	24.9V
08/29	28.6V	24.5V
08/28	28.8V	24.6V
08/27	27.6V	23.5V
08/26	28.0V	24.0V
08/25	28.8V	24.5V

.....

Date	Max	Min
07/09	28.4V	24.0V
07/08	28.8V	24.9V
07/07	28.6V	24.5V
07/06	28.8V	24.6V
07/05	27.6V	23.5V
07/04	28.0V	24.0V
07/03	28.8V	24.5V

6.6.4 Information



■This item displays the system of the controller.
MT6020-Pro: Product name
APP: Software version of the display unit.
SYS: Software version of the power unit.
HW: Hardware version of the power unit.

6.7 Fault indication

Status	Icon	Description
Battery over discharged	ⓘLow VD	Battery level shows empty, fault icon display, battery frame flashes, the LCD screen displays "**Low VD**"
Battery over voltage	ⓘOver VP	Battery level shows full, fault icon display, battery frame flashes, the LCD screen displays "**Over VP**"
PV reverse polarity	ⓘPV Reverse	Fault icon display, the LCD screen displays "**PV Reverse**"
PV over voltage	ⓘPV Over Volt.	Fault icon display, the LCD screen displays "**PV Over Volt.**"
Over temperature	ⓘCharge Over TD	Fault icon display, the LCD screen displays "**Charge Over TD**"
Controller does not correctly identify system voltage	ⓘUndefined Voltage	Controller does not correctly identify system voltage, fault icon display, the LCD screen displays "**Undefined Voltage**"
Communication failure	ⓘComm. Error	Display board failed to obtain controller data, fault icon display, the LCD screen displays "**Comm. Error**"

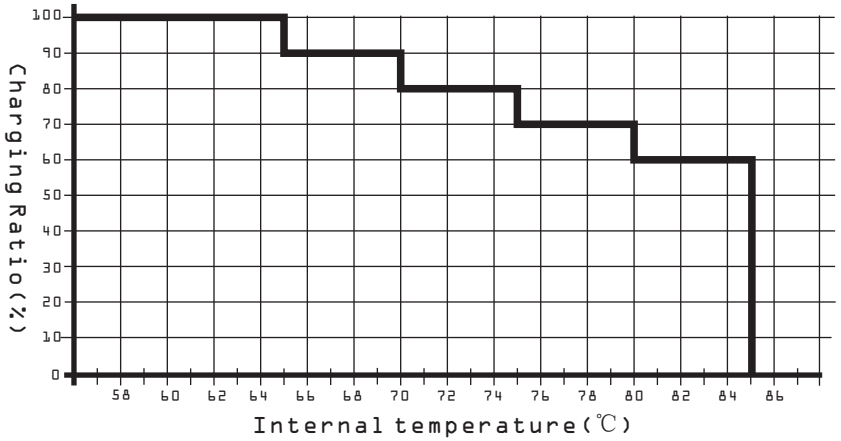
7, Protections,Troubleshooting and maintenance

7.1 Protection

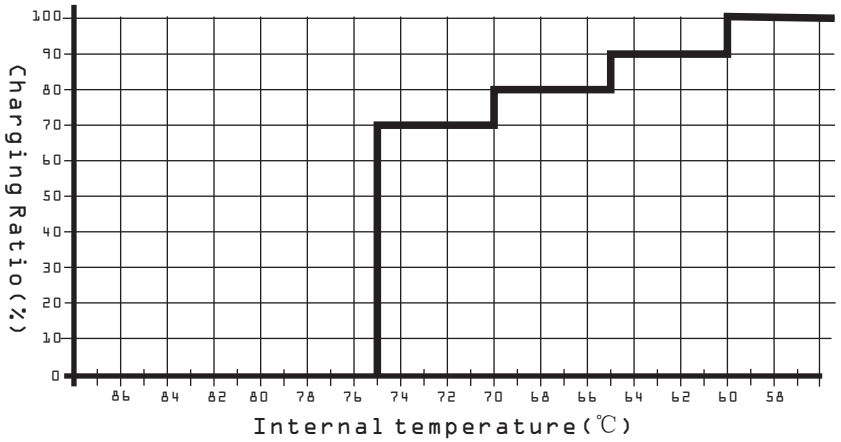
Protection	Description
PV Over Current	The controller will limit charging power in rated charge power. An over-sized PV array will not operate at maximum power point.
PV Short Circuit	When not in PV charging state, the controller will not be damaged in case of a short-circuiting in the PV array.
PV Reverse Polarity	When the polarity of the PV array is reversed, the controller may not be damaged and can continue to operate normally after the polarity is corrected.
Night Reverse Charging	Prevents the battery from discharging through the PV module at night.
Battery Over voltage	If there are other energy sources to charge the battery, when the battery voltage exceeds 15.8/31.3/62.3V, the controller will stop charging to protect the battery from overcharging damage.
Battery Reverse Polarity	Fully protection against battery reverse polarity, no damage to the controller. Correct the connection to start normal operation.
Battery Over discharge	When battery voltage drops to the setting voltage of low voltage disconnect ,the controller will turn off the load control relay1 to protect the battery from over discharging damage.
Battery Over Temperature Protection	The controller can detect the battery temperature through an external temperature sensor.The controller stops working when its temperature exceeds 65 °C and restart to work when its temperature is below 55 °C.
Controller Over Temperature Protection *	The controller detects the internal temperature through internal sensor, when the temperature exceeds the setting value, the charging current will lower down followed by the decrease of temperature, so as to control the controller's temperature rise, when the internal temperature exceeds 85℃, the controller stops working and restores after the temperature is below 75℃.
TVS High Voltage Transients	The internal circuitry of the controller is designed with Transient Voltage Suppressors (TVS) which can only protect against high-voltage surge pulses with less energy. If the controller is to be used in an area with frequent lightning strikes, it is recommended to install an external surge arrester.

*When the internal temperature exceeds 65℃, the mode of charging power reduction is started, and the charging power decreases 10% for every 5℃ increase of internal temperature. If the internal temperature is higher than 85℃, the controller will stop charging. But when the temperature drops below 75℃, the controller will resume working at 70% of rated power. When the internal temperature decreases by 5℃, the charging power increases by 10%. When the internal temperature is lower than 60℃, the full power can be recovered.

Reduce Charging Mode



Recover charging from over temperature protection



X-axis is the internal temperature, Y-axis is the charging ratio.

For example, the full charging power of the controller is 1000W, when the temperature rises to 75 ℃, the charging ratio drops to 80%, which is 800W. When the controller recovers after over temperature protection, when the temperature drops to 70 ℃, the charging power recovers to 80%, which is 800W.

7.2 Troubleshooting

Faults	Possible reason	Troubleshooting
Battery over discharged	Battery excessively discharged by loads (deep-discharge protection not installed).	Charge the battery with an external charger.
	Battery is defective.	Replace the battery.
Battery over voltage	Additional charging sources in system may be causing an excessively high voltage.	Check the external charging devices and adjust if necessary.
	Controller possibly defective.	Contact your installer.
No display	Battery voltage too low.	Pre-charge the battery.
	External fuse/circuit breaker for the battery has blown/triggered.	Replace the external battery fuse for the battery or reset the circuit breaker.
	Battery is not connected. Battery is defective. Battery reverse connection.	1. Unclamp all connections. 2. Connect a (new) battery with the correct polarity. 3. Reconnect the solar module.
	The LCD is mechanically defective.	Contact your installer. The device must be replaced.
Battery is not being charged	Solar module not connected.	Connect the solar module.
	Short circuit at solar module connection.	Rectify short circuit.
	Incorrect solar module voltage.	Use a solar module of a suitable voltage.
	Solar module defective.	Replace the solar module.
Over temperature	The temperature of the battery or controller is too high.	The controller will automatically turn the system off. When the temperature declines to be below 55 ºC, the controller will resume.
Controller does not correctly identify system voltage	The system voltage is set at 12V, 24V or 48V, but the battery voltage is not consistent with the setting system voltage.	Setting "**2. Battery Setting**" --> "**2.2 Batt. Volt**" to **AUTO** or to match the battery voltage.

7.3 Maintenance

The following inspections and maintenance tasks are recommended at least two times per year for best performance.

■ Make sure no block on air-flow around the controller. Clear up any dirt and fragments on radiator.

■ Check all the naked wires to make sure insulation is not damaged. Repair or replace some wires if necessary.

■ Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.

■ Check and confirm that LCD is consistent with required. Pay attention to any troubleshooting or error indication .Take corrective action if necessary.

■ Confirm that all the system components are ground connected tightly and correctly.

■ Confirm that all the terminals have no corrosion, insulation damaged, high temperature or burnt/discolored sign, tighten terminal screws to the suggested torque.

■ Check for dirt, nesting insects and corrosion. If so, clear up in time.

Risk of electric shock!
Make sure that all the power is turned off before above operations, and then follow the corresponding inspections and operations.

8, Technical Data

8.1 Electrical Parameters

Item	MT6020-Pro
Max charging current	60A
System voltage	12/24/48V
System voltage setting	Automatic/12V/24V/48V
MPPT charging voltage	before boost or equalization charging stage
Boost voltage@25℃	14.0~14.8V/28.0~29.6V/56.0~59.2V(default: 14.5/29.0/58.0V)
Equalization voltage@25℃	14.0~15.0V/28.0~30.0V/56.0~60.0V (default: 14.8/29.6/59.2V)
Float voltage@25℃	13.0~14.5V/26.0~29.0V /52.0~58.0V(default: 13.7/27.4/54.8V)
Low voltage disconnect	10.8~11.8V/21.6~23.6V/43.2~47.2V(default: 11.2/22.4/44.8V)
Low voltage reconnect	11.4~12.8V/22.8~25.6V/45.6~51.2V(default: 12.0/24.0/48.0V)
Overcharge protect	15.8/31.3/62.3V
Temp. Compensation	-4.17mV/K per cell (Boost, Equalization), -3.33mV/K per cell (Float)
Charging target voltage	10.0~64.0V(Lithium, default: 29.4V)
Charging recovery voltage	9.2~63.8V(Lithium, default: 28.7V)
Low voltage disconnect	9.0~60.0V(Lithium, default: 21.0V)
Low voltage reconnect	9.6~62.0V(Lithium, default: 22.4V)
Battery type	Gel, AGM, Liquid, Lithium (default: Gel)
Max volt on Bat. Terminal	65V
Max volt on PV terminal	190V(@-20℃), 170V(@25℃) *1
Max input power	750/1500/3000W
MPPT tracking range	(Battery Voltage + 2.0V) ~Voc*0.9 *2
Max tracking efficiency	>99.9%
Max charge conversion	97.0%
Efficiency at full load	96.5%
Self consumption	< 5W
Grounding	Common Positive
Data memory	5 years
Relay	3A/30VDC
Communication	BLE, IoT, RS485 (Default, RJ11 interface)

***1.The maximum PV open circuit voltage must never exceed 170V at 25℃ environment temperature.**

***2.Voc means the open circuit voltage of the solar panel.**

***3.Around oblique line value separately on behalf of 12/24/48V system's value.**

8.2 Mechanical Parameters

Item	MT6020-Pro
Dimensions	339 * 230 * 109mm
Mounting Dimensions	220*215mm
Mounting hole size	φ6mm
Weight	5Kg
Terminal size	2AWG(35mm²)
Recommended cable	6AWG(16mm²)

8.3 Environmental Parameters

Item	MT6020-Pro
Operating temperature	-20 ~ +60℃
Derating	From > 65℃ internal
Fan	Internal, temperature controlled
LCD temperature range	-20 ~ +70℃
Storage temperature	-25 ~ +80℃
Ambient humidity	5 ~ 95%RH(No condensation)
Protection degree	IP20
Max Altitude	4000m

Lumiax

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