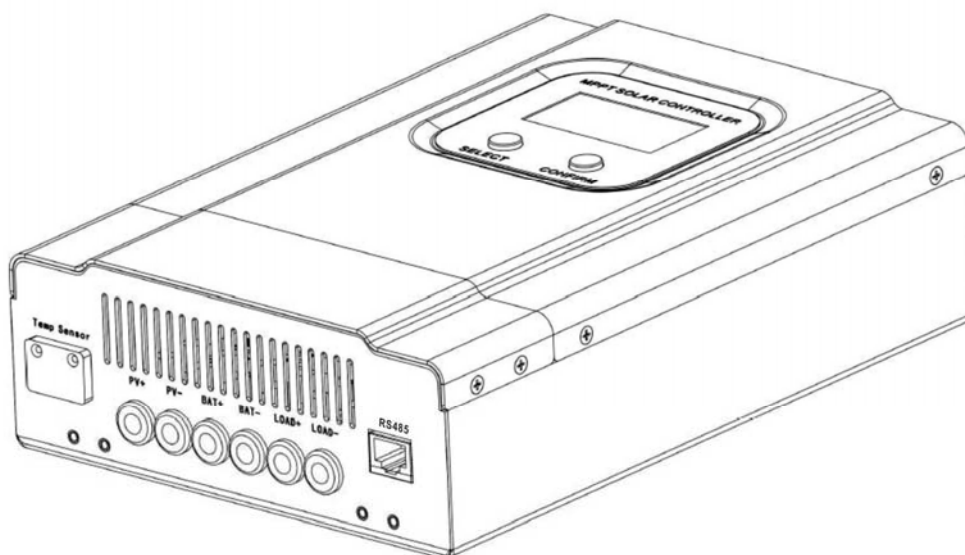


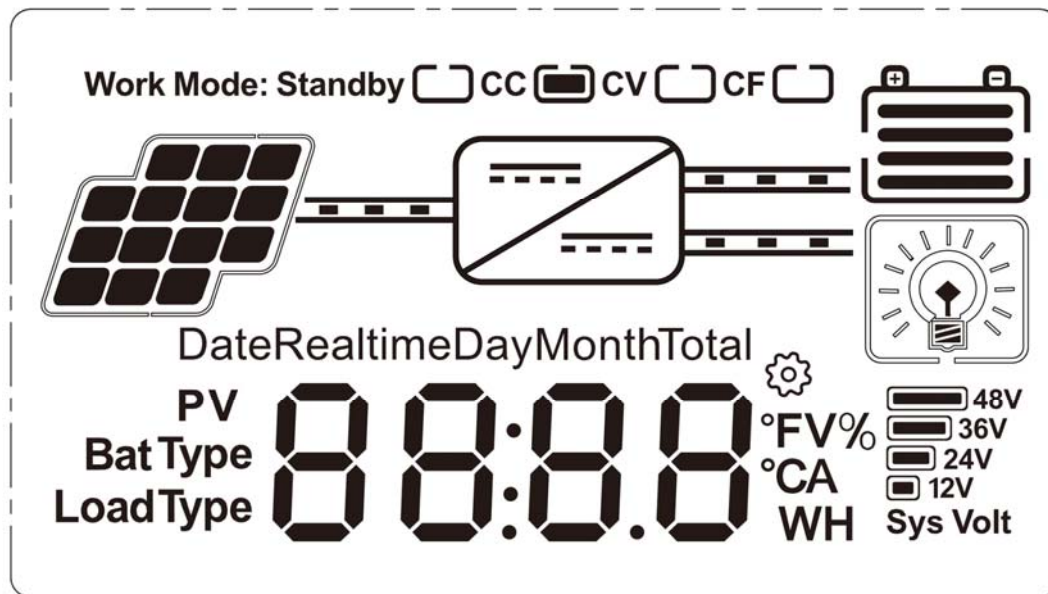
User Manual of MPPT Solar Charge Controller

PJSmart3-20A 30A 40A 50A 60A

Maximum PV(voc) Voltage: DC150V



LCD display:



As follow is MPPT controller's LCD digital tube display number corresponding meaning.

On	Mean "ON"	FLD	Mean "FLD"
OFF	Mean "OFF"	GEL	Mean "GEL"
USER	Mean "USER"	SEL	Mean "SEL"

In order to check clearly, as follow is the digital tube display character and the English comparison table for reference:

A	b	C	d	E	F	G	H	I	J	K	L
M	n	o	P	q	r	S	t	U	v	W	X
Y	Z	1	2	3	4	5	6	7	8	9	0

Important Safety Instructions

Please reserve this manual for future review.

This manual contains all instructions of safety, installation and operation for Maximum Power Point Tracking (MPPT) controller in eSmart3 series ("the controller" is referred in this manual).

General Safety Information

- Please read carefully all the instructions and warnings in the manual before installation.
- Mount the controller indoors. Prevent exposure to the elements and do not allow wet or water to enter the controller.
- Install the controller in well ventilated places, the controller's case temperature may become very hot during operation.
- Suggested to install appropriate external breakers.
- Power connections must remain tight to avoid excessive heating from a loose connection.

Contents

1. MPPT Controller General Information	
1.1 Overview.....	5
1.2 Characteristics.....	6
1.3 Accessories Instruction.....	6
1.4 Maximum Power Point Tracking Technology.....	7
1.5 Battery Charging Stage.....	9
2. Installation Instructions	
2.1 Operator.....	10
2.2 Selecting the Mounting Location.....	10
2.3 Dimensions and Weight.....	11
2.4 Safety Distance.....	12
3. MPPT Controller Connection	
3.1 Safety.....	12
3.2 Connection of the PV Power System.....	13
3.3 Serial connection (string) of PV modules.....	13
3.4 PV Array Input Total Power.....	14
3.5 System Voltage and Battery Type.....	14
3.6 DC Load Output Voltage and Max. Discharge Current.....	15
3.7 Specifications for Cables and Breakers.....	15
3.8 Steps of Switch on and off.....	17
4. Operation	
4.1 Button Function.....	18
4.2 LCD Display.....	18
5.Parameters.....	20
6. Storage and Waste Disposal.....	22
7. Warranty and Repair.....	22
8. Dimensions.....	23

1. MPPT Controller General Information

1.1 Overview

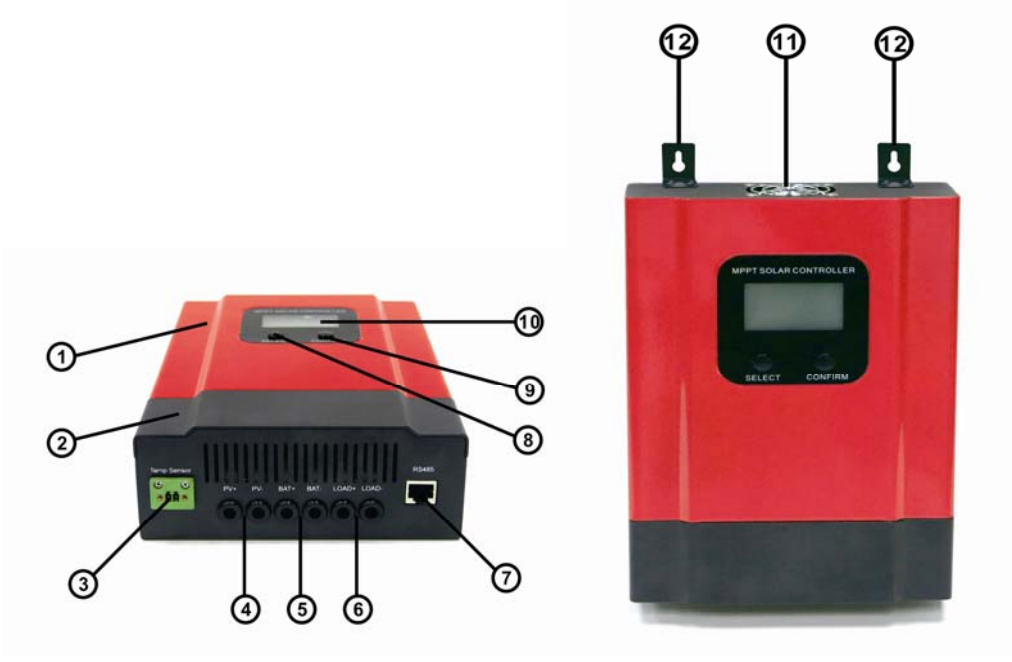
Appreciate you for choosing MPPT solar charge controller. PJSmart3 series with high conversion efficiency, back-light LCD display, control mode, connect way, internal structure etc.features, also optimized the following points:

1. Increase all kinds of protection function to be used more reassuring.
2. Add the LOAD sampling to be used more clear of output load.
3. Wider PV Input voltage 150V, so it suitable for more kinds of PV modules.
4. Reduce the static standby self-consumption, energy saving and more simply for small system.
5. Add Red casing for User to choose.

Features:

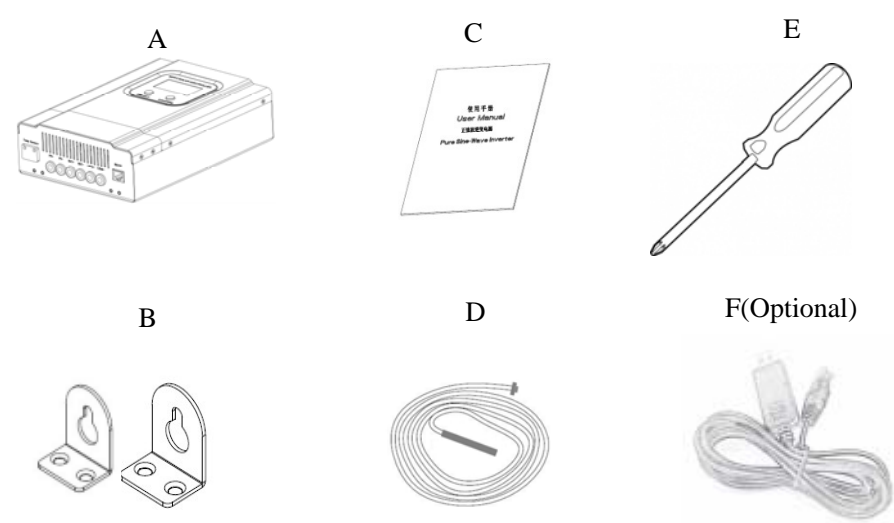
- ◆ High efficiency MPPT control algorithm, MPPT efficiency $\geq 99.5\%$, whole Machine conversion efficiency up to 98%;
- ◆ Charge mode: three stages (fast charge, constant charge, floating charge), improve boost voltage charge(activate the battery performance), it prolongs service life of the batteries;
- ◆ Discharge mode: ON/OFF mode, PV voltage control mode, Dual Time control mode, PV&Time control mode;
- ◆ Customers can choose battery types: (Flooded, Sealed lead acid, Gel battery) charging, Other types of the batteries can also be defined;
- ◆ Most information could be provided by LCD like: System type, PV input voltage, PV input current, Day/Month/Total generated energy, battery type, battery voltage, charging current, charging power, Load current, Load power and so on;
- ◆ RS485 communication, we also can offer communication protocol , it's convenient for user's integration management.
- ◆ CE, RoHS, FCC certifications approved. We can help clients to approve other certifications.
- ◆ 3 years warranty.And 3~10 years extended warranty service also can be provided.

1.2 Characteristics



Item	Name	Item	Name
①	Case	⑦	RS485 port
②	Terminal Cover	⑧	Select Button
③	Bat. Temp Sensor	⑨	Confirm Button
④	PV Terminals	⑩	LCD Display
⑤	Battery Terminals	□	Cooling Fan
⑥	Load Terminals	□	Hang Bracket

1.3 Accessories Instruction



MPPT Solar Charge Controller Accessories Diagram

Object	Quantity	Description
A	1 unit	MPPT solar charge Controller
B	2 pcs	Hang Bracket
C	1 pcs	User Manual
D	1 pcs	Temperature sensing wire
E	1 pcs	Screwdriver
F	1 pcs(Optional)	RS485 to USB cable

If there is any part missing, please contact your dealer.

Remark:

Extra accessories can be purchased

1. RS485 to USB cable
2. Meter
3. RS485 to wifi modular

1.4 Maximum Power Point Tracking Technology

Due to the nonlinear characteristics of solar array, there is a maximum energy output point (Max. Power Point) on its curve. eSmart3 series solar charge controller with Maximum Power Point Tracking (MPPT) Technology can lock on the point to harvest the maximum energy and deliver it to the battery. Traditional controllers, with switch charging technology and PWM charging technology, can't charge the battery at the maximum power point, so can't harvest the maximum energy available from PV array.

The MPPT algorithm of eSmart3 series continuously compares and adjusts the operating points to attempt to locate the maximum power point of the array. The tracking process is fully automatic and does not need user adjustment.

As the Figure shown below, the curve is also the characteristic curve of the array, the MPPT technology will "boost" the battery charge current through tracking the MPP(Max. Power Point). Assuming 100% conversion efficiency of the solar system, in that way, the following formula is established:

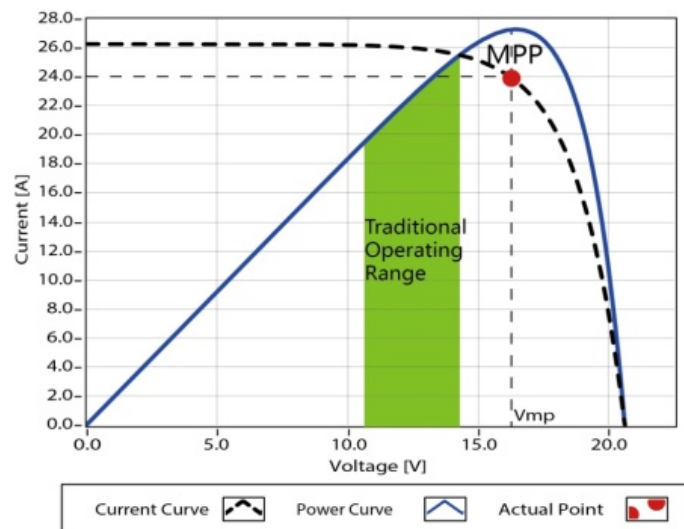
Controller Input Power (PV input power) (P_{PV}) = Controller Output Power (P_{Bat})
--



Input Voltage(V_{Mpp})* Input Current (I_{PV})=Battery Voltage (V_{Bat})*Battery Current (I_{Bat})
--

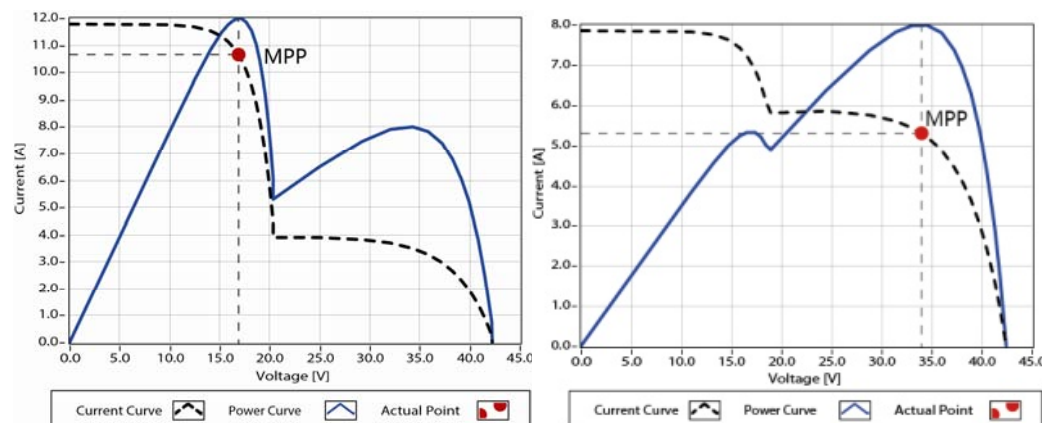
Normally, the V_{Mpp} is always higher than V_{Bat} . Due to the principle of conservation of energy, the I_{Bat} is always higher than I_{PV} . The greater the discrepancy between V_{Mpp} & V_{Bat} , the greater the discrepancy between I_{PV} & I_{Bat} . The greater the discrepancy between array and battery. This is also the simplest way to distinguish whether the real MPPT controller.

As the Figure shown below, is the maximum power point curve, the shaded area is charging range of traditional solar charge controller (PWM Charging Mode), it can obviously diagnose that the MPPT mode can improve the usage of the solar energy resource. According to our test, the MPPT controller can raise 20%-60% efficiency compared to the PWM controller. (The efficiency may be change due to the different use environment background.)



Maximum Power Point Curve

In actual application, as shading from cloud, tree and snow, the panel maybe appear Multi-MPP, but in actually there is only one real Maximum Power Point. As the below Figure shows:

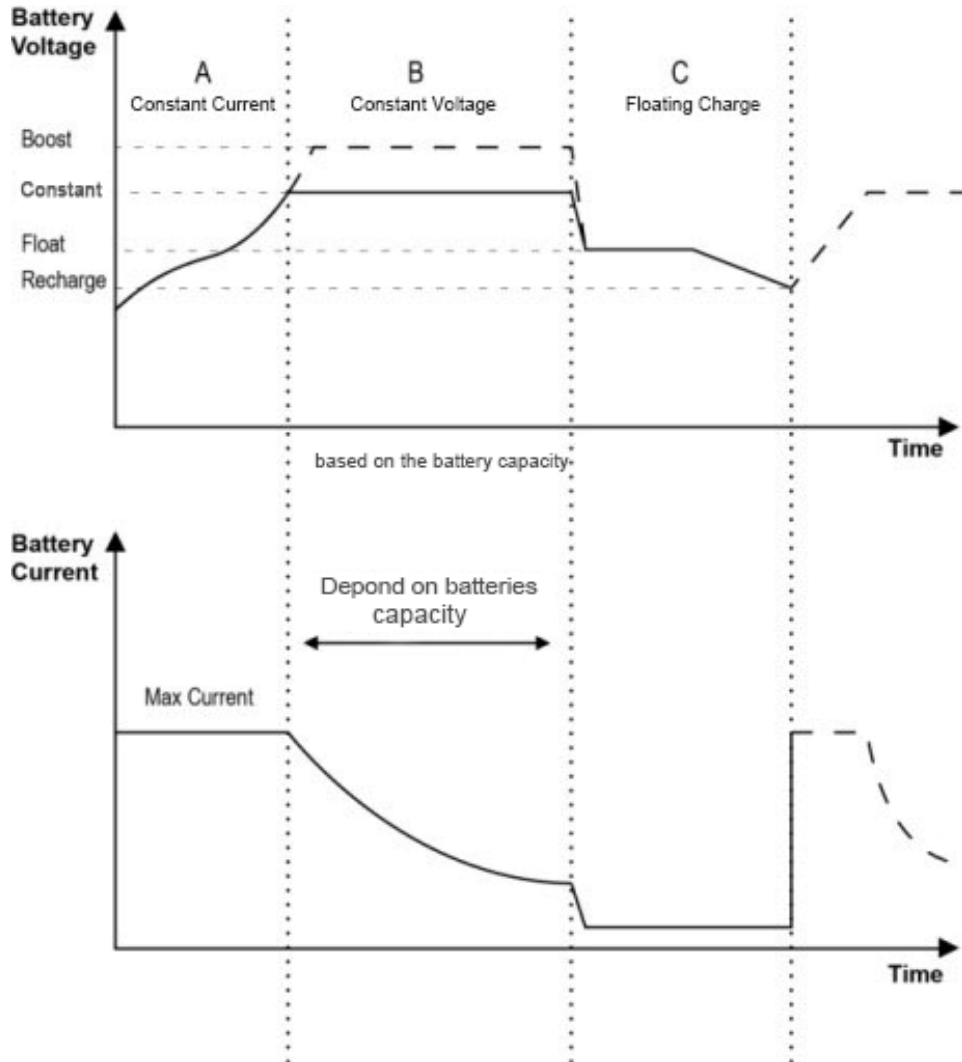


Mutil-MPP Curve

If the program works improperly after appearing Multi-MPP, the system will not work on the real max power point, which with low conversion efficiency. The typical MPPT algorithm, designed by our company, can track the real MPP quickly and accurately, improve the utilization rate of the array and avoid the waste of resources.

1.5 Battery Charging Stage

The controller have 3 stages charge mode, Constant Current Charging(Bulk Charging), Constant Voltage Charging(CV) and Floating Charging(CF) for rapid, efficient, and safe battery charging.



Battery Changing Stage Curve

a) Constant Current Charging_CC(Bulk Charging)

In this stage, the battery voltage has not yet reached constant voltage (Constant or Boost Voltage), the controller operates in constant current mode, delivering its maximum current to the batteries (MPPT Charging).

b) Constant Voltage Charging_CV(Constant and Boost Charging)

When the battery voltage reaches the constant voltage set point, the controller will start to operate in constant voltage charging mode, this process the charging current will drop gradually. The constant charge voltage will increase 0.2V on the basis of constant voltage at 1st of each month, charge time is 60 mins. (The data of boost charge voltage can be set via PC software and APP)

c) Floating Charging_CF

After the constant voltage stage, the controller will reduce charging current to maintaining the battery voltage on the Floating Voltage set point. Charging the battery with a smaller current and voltage on Floating Voltage stage, while maintaining full battery storage capacity.

In Floating charging stage, loads are able to obtain almost all power from solar panel. If loads exceed the power, the controller will no longer be able to maintain battery voltage in Floating charging stage. If the battery voltage remains below the Recharge Voltage, the system will leave Floating charging stage and return to Bulk charging stage.

2. Installation Instructions

2.1 Operator

Professional Technical Personnel;

2.2 Selecting the Mounting Location



Danger:

Danger to life due to fire or explosion.

The charge controller enclosure will be hot during operation.

- Do not mount the charge controller on flammable construction material.
- Do not mount the charge controller near highly flammable materials.
- Do not mount the charge controller in potentially explosive areas.
- Do not expose the charge controller to direct sunlight to avoid power loss due to overheating.



Caution:

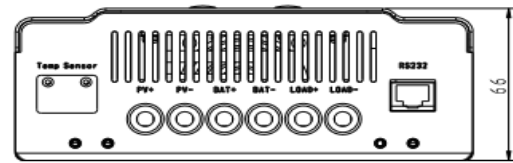
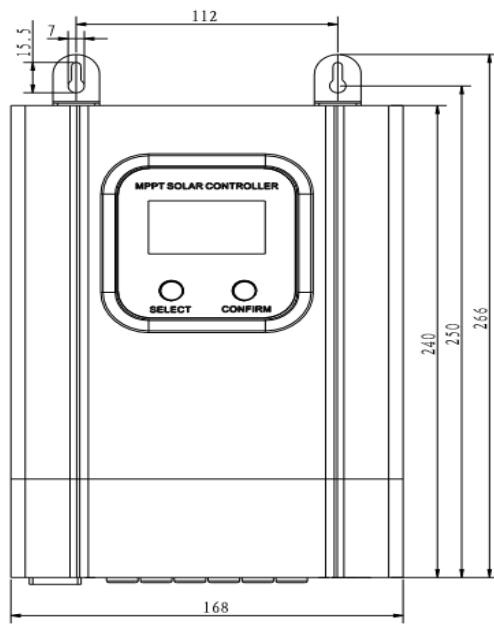
Danger of burn injuries due to hot enclosure parts.

- Mount the charge controller in such a way that it cannot be touched inadvertently during operation.

The mounting location must be suitable for the weight and dimensions.

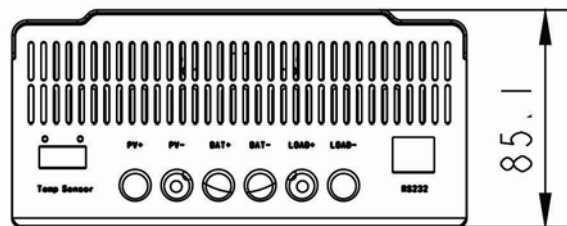
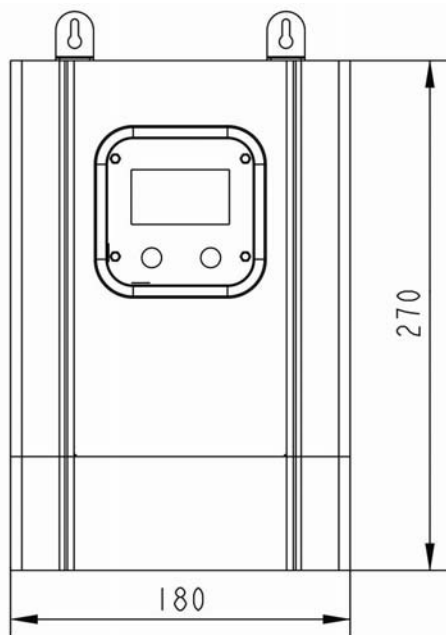
- Mount on a solid surface.
- The mounting location must be accessible at all times.
- The charge controller must be easy to remove from the mounting location at any time.
- The ambient temperature should be between -20 °C ~ +50 °C to guarantee optimal operation.
- Do not expose the charge controller to direct sunlight to avoid power losses due to overheating.

2.3 Dimensions and Weight (Unit: MM)



PJSmart3 20A/30A/40A

Controller Net Weight: 2.3KG

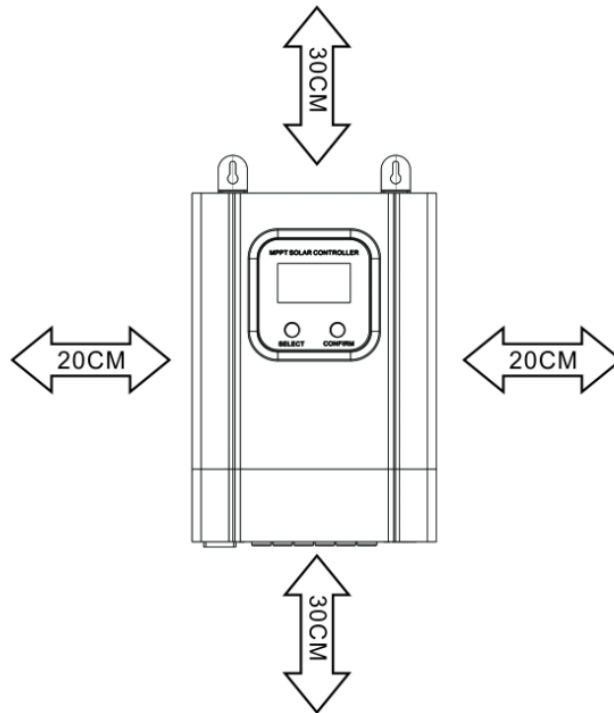


PJSmart3 50A/60A

Controller Net Weight: 2.6KG

2.4 Safety Distance

Direction	Safety Distance
Left-Right direction	>20cm
Up-Down direction	>30cm



Controller Safety Distance

3. MPPT Controller Connection

3.1 Safety



Danger!

Danger to life due to high voltage in the solar charge controller.

- Disconnect the PV array using a circuit breaker and secure it against accidental reactivation.
- Disconnect the circuit breaker and ensure that it cannot be reconnected.
- Ensure that no voltage is present in the system.



Warning:

Electrostatic discharge can damage the charging controller

- Please connect the ground wire, after the location of the fixed controller.

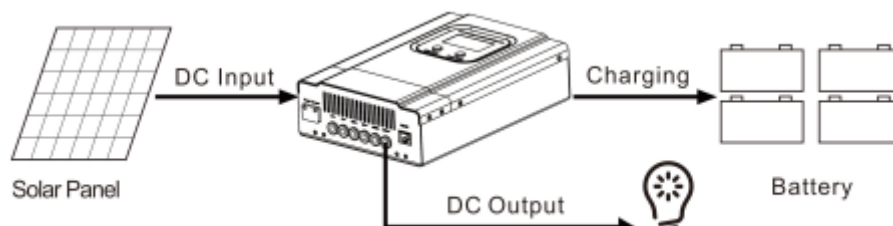


Warning:

Over voltage can damage the system.

- Use an external over voltage protector in areas with an increased risk of thunderstorm and lightning.

3.2 Connection of the PV Power System



PV Power System Connection Diagram

3.3 Serial connection (string) of PV modules

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 (V_{oc}) and the maximum power point voltage (V_{Mpp}) of the MPPT controller, the series number of different types PV modules can be calculated. The below table is for reference only.

eSmart3 Series

PV _{input} < DC 150V Prohibit the total input voltage greater than 150V								
System Voltage	36cell Voc<23V		48cell Voc<31V		54cell Voc<34V		60cell Voc<38V	
	Max.	Best	Max.	Best	Max.	Best	Max.	Best
12V	6	2	4	1	4	1	3	1
24V	6	3	4	2	4	2	3	2
36V	6	4	4	3	4	3	3	3

48V	6	5	4	4	4	3	3	3
PV _{input} <DC 150V Prohibit the total input voltage greater than 150V								
System Voltage	72cell Voc<46V		96cell Voc<62V		Thin-Fim Module 80V<Voc<150V			
	Max.	Best	Max.	Best	Max.		Best	
12V	3	1	2	1	1		1	
24V	3	2	2	1	1		1	
36V	3	2	2	1	1		1	
48V	3	2	2	2	1		1	

NOTE: The above parameter values are calculated under standard test conditions (STC (Standard Test Condition): Irradiance 1000W/m², Module Temperature 25°C, Air Mass 1.5)

3.4 PV Array Input Total Power

This MPPT controller has a limiting function of charging current, the charging current will be limited within rated range. Therefore, the controller will charge the battery with the rated charging power even if the input power at the PV exceeds. Such as: for 12V Solar System with 30A controller, no matter how many solar panels input, the charging current will not exceeds 30A.

The actual operation power of the PV array conforms to the conditions below

- 1) PV array actual power ≤ controller rated charge power x 1.2, the controller charge battery at actual maximum power point.
- 2) PV array actual power > controller rated power, the controller charge battery at rated power. If the PV array higher than rated power, the charging time at rated power to battery will be longer, more energy to battery yields. Meanwhile, it will waste the power under the fierce sunshine due to the limitation of current.

As following is the Rated Power and Max. Power of mppt solar controller

Rated Current Battery System	20A	30A	40A	50A	60A
	Rated Input Power				
12V system	260W	390W	520W	650W	780W
24V system	520W	780W	1040W	1300W	1560W
36V system	780W	1170W	1560W	1950W	2340W
48V system	1040W	1560W	2080W	2600W	3120W

3.5 System Voltage and Battery Type.

- 1) This controller can charge in DC12V, DC24V, DC36V and DC48V battery systems. Controller automatic recognize the battery voltage based on the first connection, power re-identification after power off and restart. So when the controller start, please check the system voltage displayed in LCD, if the controller automatic recognized the

system voltage is different as your connect, you need to recheck the battery voltage.

System Voltage	12V system	DC9V~DC15V
	24V system	DC18V~DC30V
	36V system	DC32V~DC40V
	48V system	DC42V~DC60V

2) The controller has been pre-programmed, it can optional 3 kinds of battery types. If need to set other battery type, please set via PC software. (parameters is in 12V system at 25°C, please use double value in 24V, use three times value in 36V and use four times value in 48V.)

Battery type	Constant voltage	Floating voltage
Flooded	14.6V	13.8V
Sealed	14.4V	13.8V
Gel	14.2V	13.8V
User (setting)	C(9V~15V)	F(9V~15V)

3.6 DC Load Output Voltage and Max. Discharge Current

The controller with DC load output function, the range of output voltage based on battery system. Such as battery system is 48V, so the DC load output voltage in the range of 48V.

3.7 Specifications for Cables and Breakers

The wiring and installation methods must conform to all national and local electrical code requirements.

PV array specification of Wiring

Since PV array output can vary due to the PV module size, connection method or sunlight angle, the minimum wire can be calculated by the Isc of PV array. Please refer to the value of Isc in PV module specification. When the PV modules connect in series, the Isc is equal to the PV module's Isc. When the PV modules connect in parallels, the Isc is equal to the sum of PV module's Isc.

In order to easy to operation, please connect with breaker,as follows is the cable and breaker models for reference:

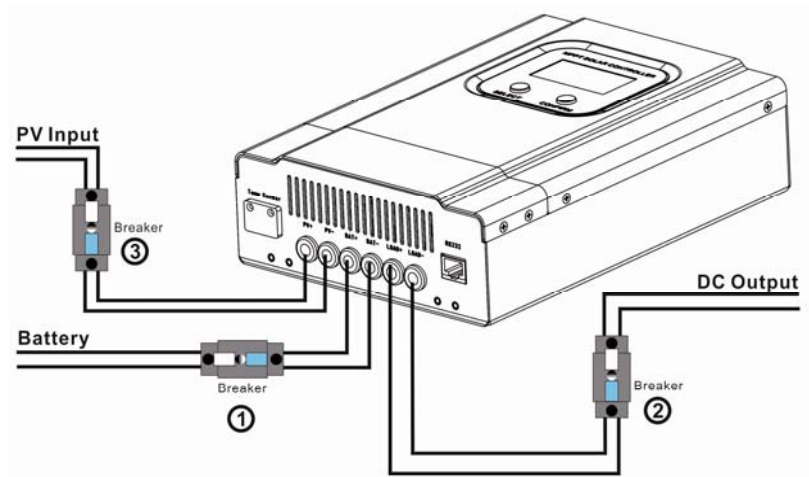
Model	Rated charge current	Rated discharge current	Battery wire (mm2/AWG)	Load wire (mm2/AWG)	Breaker
eSmart3 20A	20A	40A	4/10	14/7	>40A
eSmart3 30A	30A	40A	8/8	14/7	>50A
eSmart3 40A	40A	40A	14/7	14/7	>63A
eSmart3 50A	50A	60A	16/6	20/5	>100A
eSmart3 60A	60A	60A	20/5	20/5	>100A

Breaker should be installed to the controller and connection PV wire. Please check the below picture . (Please noted: external connect breaker not be provided)

Before you connect the wire, please open the product case. After done it, please close and locked them, it is helpful to protect the connection port.



3.8 Steps of Switch on and off



Make sure that the controller is installed and connected as above



Please noted: If not under the right operation, controller easy be damaged

Step 1:

Switch on

Please open the breaker of battery ①, ensure the controller is right connect with the battery (controller LCD display will show information)

Step 2: If used DC output to control and manage the load, please set the output control mode, and then open the Breaker of DC load output ②;

Step 3: The last step is open the breaker of PV array input ③, If the Input voltage in the range of controller working range, it will start to charging.

If you need to connect with inverter, please let the input port of inverter connect with battery directly.



Warning


If the controller in working, not allowed to switch off the breaker of battery before switch off PV input. Otherwise it will cause an unrecoverable failure to controller, this failure is not covered by the warranty;

Once you need to switch off the solar system please do as follow steps:

Step ③②①

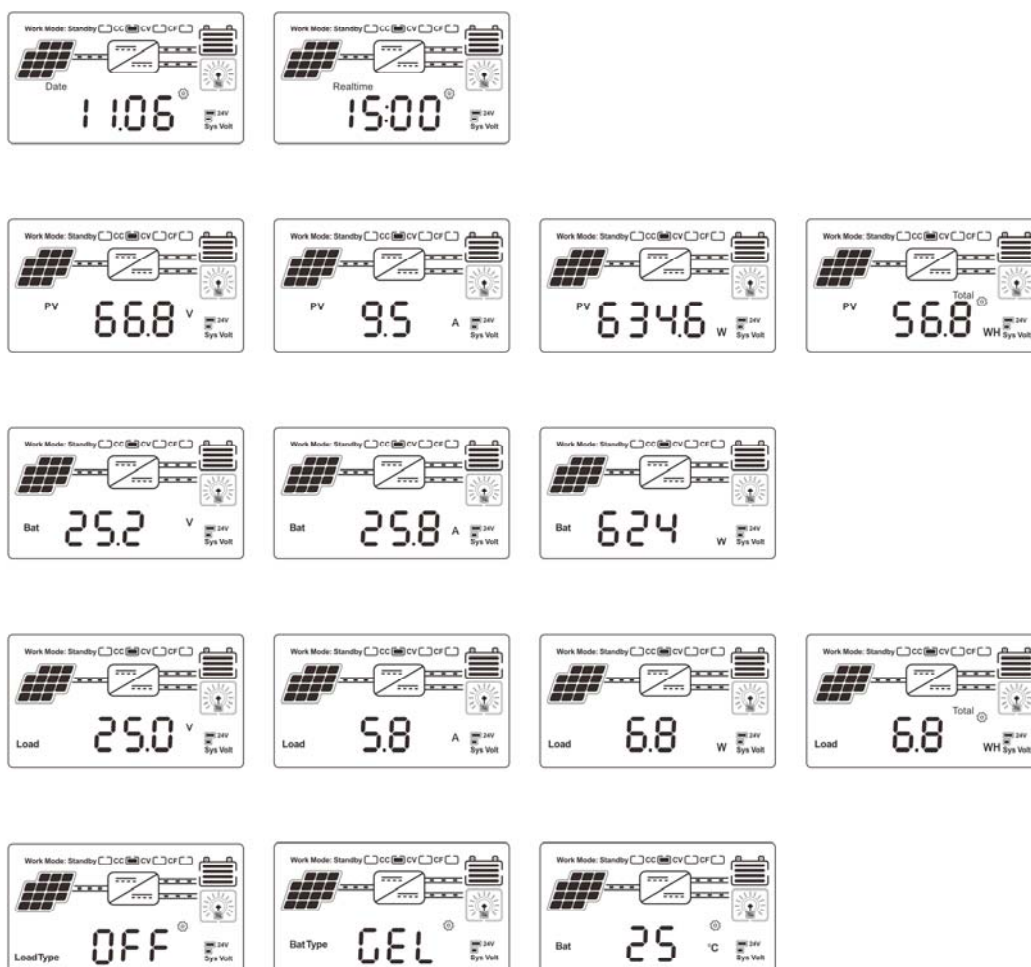
4. Operation

4.1 Button Function

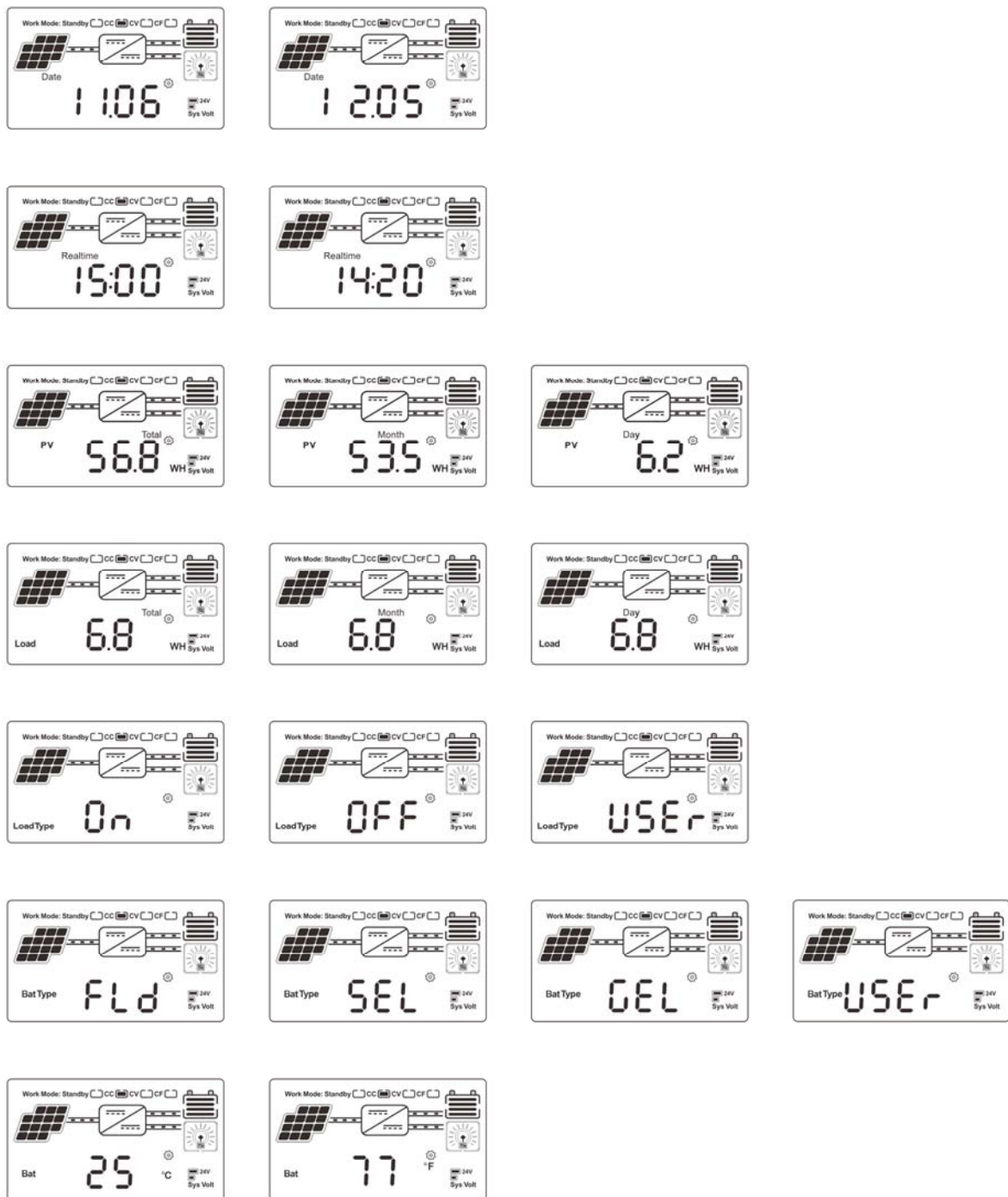
MPPT SOLAR CONTROLLER  SELECT CONFIRM	Mode	Remark
	Browse mode	Press SELECT Button
	Setting mode	Press CONFIRM button go into setting mode, short press SELECT button to set the parameter, Short press CONFIRM button to ensure, Exceed to 5s it will exit the setting mode.

4.2 LCD Display

◆ Browse Interface



◆ Setting Interface (Press CONFIRM button)



Press CONFIRM button one time, you could browse the parameter.

Under the related setting information, press CONFIRM button for 3s, you will enter into the setting mode, please select the parameter you like via SELECT button. After set it, press CONFIRM button to save and exit.

◆ DC Load setting

Controller can be set the DC load output on or off mode. For the PV voltage control mode, Dual time control mode, PV&Time control mode, please set it via PC software.

5. Parameters

MPPT controller		20A	30A	40A	50A	60A
eSmart3-12V/24V/36V/48V-series						
Charge mode	MPPT(maximum power point tracking)					
Charge method	Three stages: constant current(MPPT), constant voltage,floating charge					
System type	DC12V/24V/36V/48V	Automatic recognition				
System voltage	12V system	DC9V~DC15V				
	24V system	DC18V~DC30V				
	36V system	DC32V~DC40V				
	48V system	DC42V~DC60V				
MPPT efficiency	≥99.5%					
Input Characteristics						
Max. PV input voltage(VOC)	12V/24V/36V/48V system	150V				
Start the charge voltage point	12V/24V/36V/48V system	Higher than current battery voltage 5V				
Low input voltage protection point	12V/24V/36V/48V system	Higher than current battery voltage 3V				
Over voltage protection point	12V/24V/36V/48V system	150V				
High voltage recovery point	12V/24V/36V/48V system	145V				
Rated PV power	12V system	260W	390W	520W	650W	780W
	24V system	520W	780W	1040W	1300W	1560W
	36V system	780W	1170W	1560W	1950W	2340W
	48V system	1040W	1560W	2080W	2600W	3120W
Charge Characteristics						
Selectable Battery Types (Default Gel battery)	12V/24V/36V/48V system	Flooded, Sealed lead acid, Gel battery (Other types of the batteries also can be defined)				
Constant Voltage	12V/24V/36V/48V system	Please check the charge voltage according to the battery type form.				
Floating Voltage	12V/24V/36V/48V system					

Rated charge Current	12V/24V/36V/48V system	20A	30A	40A	50A	60A
Temperature Factor	12V/24V/36V/48V system	±0.02%/℃				
Temperature Compensation	12V/24V/36V/48V system	-3mV/℃/2V (default)				
Output Ripples(peak)	12V/24V/36V/48V system	200mV				
Output Voltage Stability Precision	12V/24V/36V/48V system	≤±1.5%				
Output Discharge Characteristics						
Output voltage		Base on battery voltage				
Low voltage output Protection point		Default 10.5V; Recovery 11V; It can be adjustable.				
Load rated current		20A	30A	40A	50A	60A
The output control		On mode, Off mode, PV voltage control mode, PV&Time control mode, Time control mode				
Output control set mode		Controller button or PC software				
Display						
LCD display		System type, PV voltage, Charge voltage, Charge current, Charge power, temperature etc.				
PC software		RS485				
PC system for solareagle		Windons 7, 8, 10				
Protection						
Low voltage input protection		yes				
Over voltage input protection		yes				
Over charge power protection		yes				
Low voltage output protection		yes				
Rated output current protection		yes				
Temperature protection		yes				
PV and Battery reverse connection protection		yes				
Other Parameters						
Noise		≤40dB				
Thermal heat-dissipating method		Fan cooling				
Certification		CE\FCC\RoHS				
Physical						

Measurement DxWxH(mm)	240*168*66	270*180*85
Package size DxWxH(mm)	289*204*101	306*210*120
N.W.(kg)	2.3	2.6
G.W.(kg)	3	3.5
Mechanical Protection	IP21	
Environment		
Humidity	0~90%RH (no condense)	
Altitude	0~3000m	
Operating Temperature	-20℃ ~ +50℃	
Storage Temperature	-40℃ ~ +75℃	
Atmospheric Pressure	70~106kPa	

6. Storage and Waste Disposal

6.1 Store the charge controller in a dry place with ambient temperatures between -40 °C and +75 °C.

6.2 Disposal

Dispose of the solar charge controller at the end of its service life in accordance with the disposal regulations for electronic waste at the installation site at that time.

7. Warranty and Repair

7.1 Repair

When the controller malfunctions, please check the following questions and contact our customer service representative if you need assistance.

7.1.1 Controller Failure Mode

Please check the fault tips in the failure mode, and then proceed to the appropriate troubleshooting;

7.1.2 When the controller does not start properly:

- Check the controller external solar panels with the correct polarity.
- Check Battery Connection;
- Check Battery if working fine;
- Check circuit breaker;
- Check internal fuse;

If the problem persists, please contact customer service;

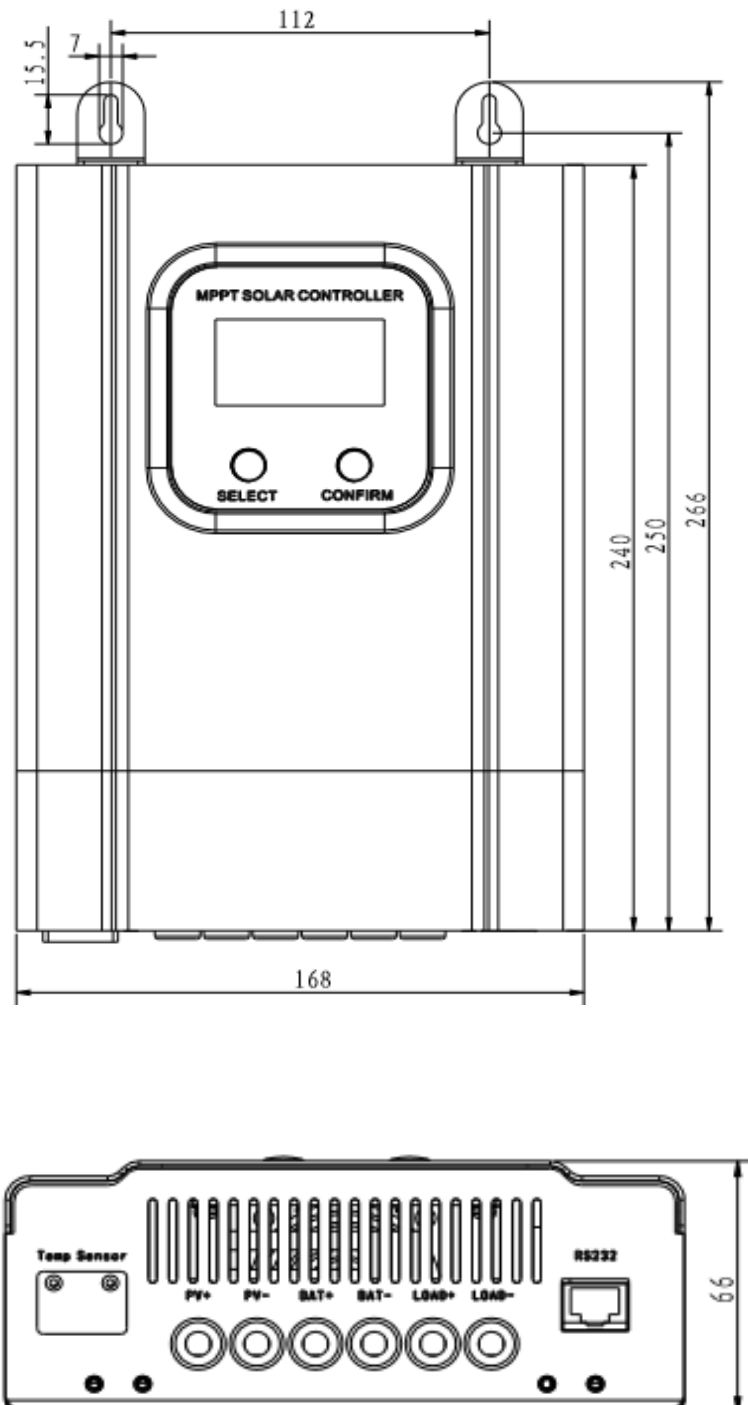
Please offer the following information: Equipment information: Model, Order No., serial-number (Stickers on the rear plate); Detailed description of the problem (Type of system, occasionally/frequent problems, indicator light, data display, and so on).

7.2 Warranty

Within the warranty period, it is free to repair for the non-human fault. Otherwise, should charge the cost of repairs. When you send back to agent, please packed the equipment properly to avoid damage to the equipment during transport.

8. Dimensions

eSmart3 series 20A 30A 40A Dimensions in Millimeters



PJSmart3 series 50A 60A Dimensions in Millimeters

