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10A / 15A / 20A Solar Charge Controller

PU1024 / PU1524 / PU2024 series

INSTRUCTION MANUAL

Dear Customer,

Thank you very much for choosing our product.

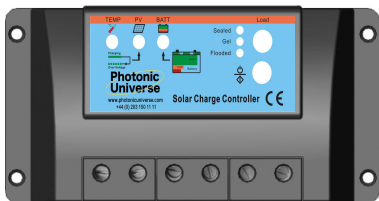
This manual contains important information about the installation and operations of your charge controller.

Please read this manual carefully **before installation** and pay special attention to the safety recommendations.



10A /15A / 20A Solar Charge Controller

PU1024 / PU1524 / PU2024 series



Specification Summary

Nominal system voltage	12 / 24VDC *
Maximum PV input voltage	50V
Nominal charge / discharge current	
PU1024	10A
PU1524	15A
PU2024	20A

* The controller will determine the system voltage at start up. If the battery voltage is lower than 18V, it will work in 12V mode. If the battery voltage is higher than 18V, it will work in 24V mode.

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1. Important Safety Information

Read this carefully

This manual contains important information about the safe installation and operations of the charge controller.

The following signs are used throughout this manual to indicate potentially dangerous conditions or mark important safety recommendations. Please pay special attention when you see these signs:



WARNING: Indicates potentially dangerous conditions. Extreme caution required when performing this task.



CAUTION: Indicates a critical procedure for correct installation and safe operations of the solar charge controller.



NOTE: Indicates a procedure or function that is important for the safe and proper operation of the controller.

General Safety Information

- Read the full instruction manual before you begin the installation.
- There are no parts serviceable by users. Do not disassemble or attempt to repair the controller.
- Install external fuses/breakers as required.
- Disconnect the solar module and fuse / breakers before installing or adjusting the controller.
- Confirm that power connections are tightened, secure, and properly insulated if applicable.

2. General Information

2.1 Product Overview

Thank you for choosing this **Photonic Universe** solar charge controller which uses advanced digital technologies and operates in a fully automated mode. One of the features of this controller is *Pulse Width Modulation (PWM)* battery charging technique which can increase the lifetime of your battery and improve performance of the solar system. Other features of this controller include:

- 12V/24V automatic recognition
- Use of MOSFET as an electronic switch, without any mechanical switch
- Gel, Sealed and Flooded battery type selection
- Temperature compensation, when the controller corrects the charging and discharging parameters automatically depending on the ambient temperature for more delicate charging
- Electronic protection: overheating, over charging, over discharging, overload, and short circuit.
- Reverse protection: any combination of solar module and battery.

The controller is designed for off-grid solar systems, and protects the battery from being over charged by the solar module and over discharged by the load. The charging process is optimised for long battery life and improved system performance. The comprehensive self-diagnostics and electronic protection functions can prevent damage from installation mistakes or system faults.

Though the controller is easy to operate and use, please take your time to read this manual and become familiar with it. This will help you make full use of all the functions and the improve performance of your solar PV system.



NOTE: The controller is suitable for solar panels only. Do not use it with any other source of energy such as wind turbines or a mains charger.

2.2 Product Features

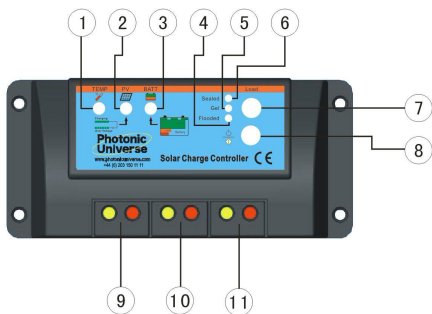


Figure 2-1 Controller features

1. Temperature sensor

Measures ambient temperature and makes temperature compensation for charging and discharging.

2. Charging status LED indicator

An LED indicator that shows charging status and also indicates when battery voltage is higher than battery over-voltage disconnect voltage.

3. Battery status LED indicator

An LED indicator that shows battery status and remaining charge.

4. Flooded battery indicator

The indicator will be on when you select 'Flooded battery'.

5. Gel battery indicator

The indicator will be on when you select 'Gel battery'.

6. Sealed battery indicator

The indicator will be on when you select 'Sealed battery'.

7. Load status indicator

Displays the load status.

8. Setting button

Controls the load On / Off and selects the battery type.

9. Solar module terminals

Terminals for connecting solar modules.

10. Battery terminals

Terminals for connecting batteries.

11. Load terminals

Terminals for connecting loads.

3. Installation Instructions

3.1 General Installation Notes

- Read the entire installation section first before beginning the installation.
- Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash with immediately and clean any contact with battery acid.
- Use insulated tools and avoid placing metal objects near the batteries.
- Batteries might produce some explosive gasses during charging. Make sure there is sufficient ventilation in the work area.
- Do not install the controller in direct sunlight, close to a heating element or where contact with water is possible.
- Loose power connections and/or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or even cause fire. Ensure tight connections and use cable clamps to secure cables and prevent them from unnecessary movement.
- Use this controller with Gel, Sealed or Flooded lead acid batteries only.
- Battery connection may be wired to one battery or a bank of batteries. This manual refers to a single battery, but the battery connection can be a group of batteries in a battery bank.
- Select an appropriate type of cable according to the power rating of your system / length of cable required.

3.2 Mounting



NOTE: When mounting the controller, ensure air can circulate through the controller heat sink. There should be at least 6 inches (150 mm) of clearance above and below the controller to allow for cooling. If you work in closed premises ventilation is highly recommended.



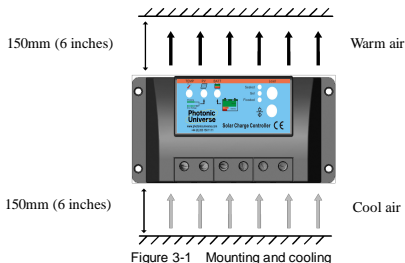
WARNING: Risk of explosion! Never install the controller in a closed place with flooded batteries. Do not install the controller in any closed area where battery gas can accumulate.

Step 1: Choose mounting location

Locate the controller on a vertical surface protected from direct sunlight, high temperature and water / high humidity. Ensure there is adequate ventilation.

Step 2: Check for clearance

Place the controller in the location where it will be mounted. Verify that there is sufficient room to run wires and clearance above and below the controller for air flow.



Step 3: Mark holes

Use a pencil or pen to mark four (4) mounting hole locations on the

mounting surface.

Step 4: Drill holes

Remove the controller and drill holes in the marked locations.

Step 5: Secure controller

Place the controller on the surface and align the mounting holes with the drilled holes in step 4. Secure the controller in place using suitable screws.

3.3 Wiring



NOTE: A recommended connection order has been provided for maximum safety during installation.



NOTE: The controller is a common positive ground controller. If your system (e.g. vehicle or boat) is a negative common ground system, you can still use the controller, but you **SHOULD NOT** use earthing of any “+” or “-” cables, even if it’s shown on the diagrams below.



CAUTION: Do not connect any loads with surge power exceeding the ratings of the controller.



CAUTION: For mobile applications, make sure you secure all wiring. Use cable clamps to prevent cables from unnecessary movement. Unsecured cables create loose and resistive connections which may lead to excessive heating and/or fire.

Step 1: Battery wiring



WARNING: Risk of explosion or fire! Never short circuit battery positive (+) and negative (-) or cables.

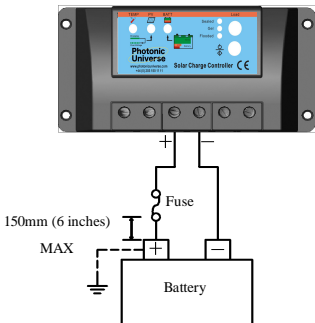


Figure 3-2 Battery connection

Before connecting the battery, make sure that the battery voltage is greater than 6V so as to start up the controller. If system is 24V, make sure battery voltage is not less than 18V. System voltage can only be automatically recognized when controller starts up for the first time. When installing a fuse, make sure that the maximum distance between the fuse holder and the positive terminal of battery is 150mm.

Do not insert a fuse at this time.

Step 2: Load wiring

The controller load terminals can be connected to electrical equipment, such as lights, pumps, motors and others. The equipment must have the same working voltage as the battery.

Connect the positive (+) and negative (-) of loads to the controller load terminals as shown in Figure 3-3.

An in-line fuse holder should be wired in series in the load positive (+) or negative (-) wire as shown in Figure 3-3.

Do not insert a fuse at this time.

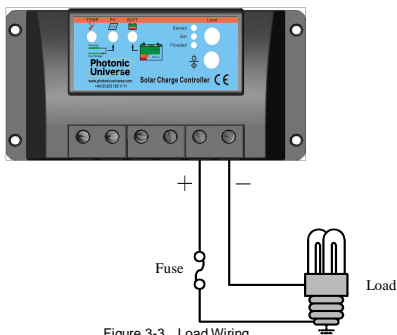


Figure 3-3 Load Wiring

When wiring the load connection to a load distribution panel, each load circuit should be fused separately. The total combined current draw of loads should not exceed the rated load current of controller. It is not necessary to connect any load to the load terminals of the controller if your system is intended for battery charging only.

Step 3: Solar wiring



WARNING: Risk of electric shock! Exercise caution when handling solar wiring. The solar module(s) high voltage output can cause severe shock or injury. Cover the solar module(s) before wiring them to the charge controller.

The controller can accept 12V, 24V nominal off-grid solar module(s). Grid-tie solar module(s) may be used if their open circuit voltage does not exceed the maximum PV input voltage of the controller.



NOTE: The controller cannot work with non-PV sources of power such as wind turbines or other chargers.

The solar module(s) working voltage must be equal to or greater than the system voltage. For example, it is not possible to use an 18V solar panel to charge a 24V battery – the controller will require the

solar panel voltage to be 24V or higher.

Cover the solar module(s) before you link the battery circuit with a fuse.

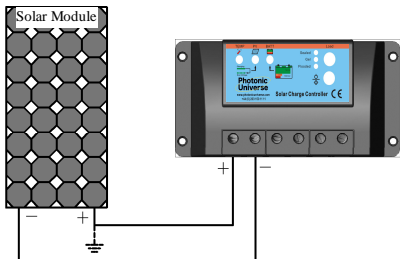


Figure 3-4 Solar wiring

Step 4: Check wiring

Double-check the wiring in steps 1 to 3. Make sure polarity is correct at each connection. Check that all six terminals and other connections are secure and tight.

Solar Module

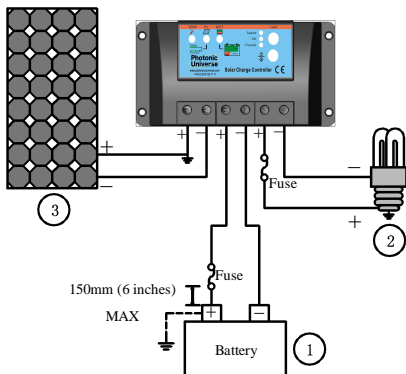


Figure 3-5 System wiring review

Step 5: Install fuses and remove cover from solar module(s)

Install a suitable fuse (fuse rating depends on the maximum solar and load current) in each fuse holder in the following order:

1. Battery circuit
2. Load circuit

Then remove the cover from the solar module(s).

Step 6: Check power LED

When battery power is applied and the controller starts up, the battery LED indicator will turn to green. If the controller does not start up, or the battery status LED error appears, please refer to section 5 for troubleshooting.

Step 7: Disconnection

If you need to disconnect the system, follow the order reverse to the order of connection (solar panel, load, battery).

4. Operation

4.1 PWM Technology (Series Pulse Width Modulation)

The controller adopts the advanced series pulse width modulation.

The operating principle of PWM charging mode is as follows:

Firstly, the battery is charged with pulse current. It then stops charging for a short period, and then it resumes again. It is repeated in this way several times until the battery is fully charged. Breaks allow some oxygen and hydrogen generated by chemical reaction to be chemically combined again and then absorbed, which can eliminate concentration polarization and ohm polarization naturally, and reduce the internal pressure of the battery. This makes subsequent charging smoother and more power is charged to the battery. Intermittent pulse current charging mode leaves the battery time to react, which reduces the gas volume and improves the acceptance rate of charging current.

4.2 Battery Charging Information

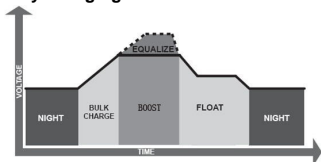


Figure 4-1 PWM Charging mode

- **Bulk charge**

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

- **Boost charge**

When the battery has recharged to the Boost voltage set point, constant-current regulation is used to prevent heating and excessive battery gassing. The Boost stage lasts for 120 minutes and then passes to Float Charge.

- **Float charge**

After the battery is fully charged at the Boost voltage stage, the controller reduces the battery voltage to Float voltage set point. When the battery is fully charged, there will be no more chemical reactions and all the charge current becomes heat and gas. Then the controller reduces the voltage to the Float stage, charging with a smaller voltage and current. This reduces the temperature of the battery and prevents gassing, whilst 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 drawing power from the battery. In the event that the system load(s) current exceeds the solar charge current, the controller will no longer be able to maintain the battery at the Float set point. Should the battery voltage remain below the Boost set point, the controller will exit Float stage and return to Bulk charge.

- **Equalise charge**



WARNING: Risk of explosion!

Equalising a flooded battery can produce explosive gases. Good ventilation around the battery is essential.



CAUTION: Equipment damage!

Equalisation may increase battery voltage to the level

damaging to sensitive DC loads. Ensure that all load allowable input voltages are greater than the equalizing charging set point voltage.



CAUTION: Equipment damage!

Over-charging and excessive gas precipitation may damage the battery plates and activate material shedding on them. Equalising charge may cause damage if it is too high or lasts too long. Please carefully review the specific requirements of the battery used in the system.

Certain types of batteries benefit from periodic equalizing charge, which can stir the electrolyte, balance battery voltage and complete chemical reaction. Equalising charge increases the battery voltage to the level higher than the standard voltage, which gasifies the battery electrolyte.

If the battery is being over discharged, the solar controller will automatically turn to equalising charging stage, which lasts for 120 minutes. Equalising charge and boost charge are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of battery.

4.3 LED Indicators

Charging Status LED indicator

Battery Status LED indicator

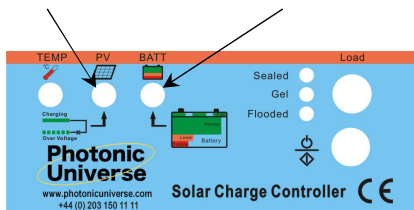


Figure 4-2 LED indicators

- **Charging status indicator**

GREEN (ON) - sunlight is available for battery charging.

GREEN (FAST FLASHING) - system over-voltage.

Please refer to section 5 for troubleshooting.

Charging Status LED indicator

Table 4-1

Colour	Indicator	Charging Status
Green	On Continuous	Charging
Green	Fast Flashing	Battery over voltage

- **Battery status indicator**

GREEN (ON) - battery voltage within normal range.

GREEN (SLOWLY FLASHING) – battery is full.

ORANGE (ON) - battery under-voltage.

RED (ON) - battery over-discharged.

Please refer to section 5 for troubleshooting.

Battery status LED indicator

Table 4-2

Colour	Indicator	Battery Status
Green	On Continuous	Normal
Green	Slowly Flashing	Full
Orange	On Continuous	Under-voltage
Red	On Continuous	Over-discharged

- **Load status indicator**

When the load current is 1.25 times of rated current for 60 seconds, or the load current is 1.5 times of rated current for 5 seconds (overload); or load current is more than 3.5 times of rated current (Short Circuit), the load status indicator will flash red. Please refer to section 5 for troubleshooting.

Load status indicator

Table 4-3

Colour	Indicator	Load status
Red	On Continuous	Load power is on

Red	Flashing	Overload or short circuit
-----	----------	---------------------------

- Overheating protection indicator:**

When the temperature of the controller heat sink exceeds 85 °C, the controller will automatically cut input and output off. Sealed, Gel and Flooded indicators will flash red simultaneously. Please refer to section 5 for trouble shooting.

Overheating protection indicator

Table 4-4

Colour	Indicator	System status
Red	Sealed, Gel, Flooded flashing simultaneously	Controller overheating

4.4 Setting Operation

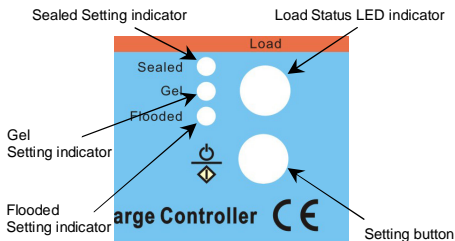


Figure 4-3 Setting operation indicators

- Load On/Off switch**

When the controller is on, press the settings button to control the output to load terminals. Press the button once, to switch the load terminals On/Off. The load LED will turn red when the load is on.

- Battery type setting**

Press and hold the settings button for more than 5 seconds, and the original battery type indicator will start flashing. Press the setting button again to cycle through Sealed, Gel or Flooded battery type. To

select the correct battery type, illuminate the corresponding LED and wait – the indicator will stop flashing after a few seconds and record the settings.

Battery type selection

Table 4-5

Battery type	LED indicator
Sealed battery	Sealed
Gel battery	Gel
Flooded battery	Flooded

5. Protection, Troubleshooting and Maintenance

5.1 Protection

- **PV array short circuit**

If a PV array short circuit occurs, clear it to resume normal operation.

- **Load overload**

If the load current exceeds the maximum load current rating, the controller will disconnect the load. Disconnect the system in the order reverse to the order of connection, reduce the load and reconnect the system.

- **Load short circuit**

Fully protected against load wiring short-circuit. After one automatic load reconnect attempt, the fault must be cleared by rewiring or pressing the setting button.

- **PV reverse polarity**

Full protection against PV reverse polarity, no damage to the controller as a result. Correct and rewire to resume normal operation.

- **Battery reverse polarity**

Full protection against battery reverse polarity, no damage to the controller as a result. Correct and rewire to resume normal operation.

- **Damaged local temperature sensor**

If the temperature sensor is damaged or short-circuited, the controller will assume the default temperature 25°C to prevent battery damage.

- **Overheating protection**

If the temperature of the controller heat sink exceeds 85°C, the controller will automatically start the overheating protection.

- **High voltage transients**

PV input is protected against high voltage transients. In lightning-prone areas, additional external suppression is recommended.

5.2 Troubleshooting

Troubleshooting

Table 5-1

Faults	Possible reasons	Troubleshooting
No LEDs on the controller are lit	The controller can't detect the battery	Check that the battery voltage is more than 6V; check polarity of battery connection; make sure nothing else is connected to battery
Charging (PV) LED indicator off, even in sunny conditions	PV array disconnection or polarity problem	Check that PV and battery wire connections are correct and tight. Check polarity of PV cables.
Green charging LED indicator is fast flashing	Battery voltage higher than over voltage disconnect voltage (OVD)	Check if the battery voltage is too high. Disconnect the solar module.
Battery LED indicator is orange	Battery under voltage	Turn off the load. The LED indicator will return to green automatically as the battery is charged.
Battery LED indicator is red, loads are not working	Battery over-discharged	The controller automatically cuts off the output. LED indicator will return to green automatically when the battery is charged.

Load status indicator is red and flashing	Overload or short circuit	Overload: reduce the load and press the button once, the controller will resume working after 3 seconds. Short circuit: when the first short-circuit occurs, the controller will automatically resume working after 10 seconds; if a second short-circuit occurs, press the button once - the controller will resume working after 3 seconds.
Sealed, Gel, Flooded indicators are flashing simultaneously	The temperature of controller is too high	When the temperature of the heat sink of the controller exceeds 85 °C, the controller will automatically cut input and output circuits. When the temperature falls below 75 °C, the controller will resume working



NOTE: If no LED indicators are lit, measure the battery voltage with a multimeter. Min. 6V is needed to start up the controller.



NOTE: If the charging status LED indicator is not lit with normal connection, measure the input voltage of solar module - the input voltage must be higher than battery voltage



CAUTION: Do not try to measure the output of the battery terminals of the controller by a multimeter with no battery connected. The controller will not work properly if it cannot detect the battery.

5.3 Maintenance

The following inspections and maintenance tasks are recommended at least twice every year for best controller performance.

- Check that the controller is securely mounted in a clean and dry environment.
- Check that the air flow and ventilation around the controller is not blocked. Clear all dirt or fragments from the heat sink.
- Check all the wires to make sure insulation is not damaged due to constant exposure to sunlight, frictional wear, dryness, insects or rats etc. Maintain or replace the wires if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Check and confirm that LED indicators are consistent with your requirements. Pay attention to any error messages and take the necessary corrective actions.
- Confirm all the system components are ground connected correctly and securely (**remember: no earthing in negative common ground systems**).
- Confirm that all the terminals have no signs of corrosion, insulation damage, high temperature or burnt/discolored signs; and tighten terminal screws to the suggested torque.
- Inspect for dirt, insects and corrosion. Tidy and clean if necessary.
- Check and confirm that lightning arrester is in good condition. If required replace immediately to avoid damaging the controller and other equipments.



CAUTION: Danger - electric shock!

Make sure that the power is OFF when carrying out the above tasks.

6. Warranty

The Photonic Universe solar charge controller is guaranteed to be free from defects for a period of **one year** from the date of shipment to the original end user. We will either repair or replace any defective products at our discretion.

- **Claim procedure**

Before requesting warranty services, check this operation manual to be certain that there is a problem with the controller. Notify us about the defects by email / phone. If the problem cannot be solved remotely by our technical team, return the defective product to us with shipping charges prepaid. Provide proof of date and place of purchase with your item.

To obtain rapid service under this warranty, your information should include a detailed description of the failure, solar module and battery types, connection scheme, as well as load information (type, current, usage). This information is critical to help process your warranty claim.

This warranty does not apply under the following conditions:

1. Damage by accident, negligence, abuse or improper use.
2. PV or load current exceeding the ratings of product.
3. Unauthorised product modification or attempted repair.
4. Damage occurred as a result of contact with water.
5. Damage occurred during transit.
6. Mechanical damage.
7. Damage as a result of natural disasters, lightning, extreme weather conditions

7. Technical specifications

Electrical Parameters

Table 7-1

Description	Parameter
Nominal System Voltage	12 / 24VDC Auto work
Battery Voltage Range	6-32V
Rated Battery Current	PU1024 10A PU1524 15A PU2024 20A
Charge Circuit Voltage Drop	$\leq 0.26V$
Discharge Circuit Voltage Drop	$\leq 0.15V$
Self-consumption	$\leq 6mA$

Temperature Compensation Coefficient

Table7-2

Description	Parameter
Temperature Compensation Coefficient (TEMPCO)*	-30mV/°C /12V (25°C ref)

* Compensation of equalize, boost, float and boost reconnect voltage

Charging Parameters			
Battery charging setting	Gel	Sealed	Flooded
Over Voltage Disconnect Voltage	16V; x2/24V	16V; x2/24V	16V; x2/24V
Charging Limit Voltage	15.5V;x2/24V	15.5V;x2/24V	15.5V;x2/24V
Equalize Charging Voltage	-----	14.6V;x2/24V	14.8V;x2/24V
Boost Charging Voltage	14.2V;x2/24V	14.4V;x2/24V	14.6V;x2/24V
Float Charging Voltage	13.8V;x2/24V	13.8V;x2/24V	13.8V;x2/24V
Boost Reconnect Charging Voltage	13.2V;x2/24V	13.2V;x2/24V	13.2V;x2/24V
Low Voltage Reconnect Voltage	12.6V;x2/24V	12.6V;x2/24V	12.6V;x2/24V
Under Voltage Warning Reconnect Voltage	12.2V;x2/24V	12.2V;x2/24V	12.2V;x2/24V
Under Voltage Warning Voltage	12V; x2/24V	12V; x2/24V	12V; x2/24V
Low Voltage Disconnect Voltage	11.1V;x2/24V	11.1V;x2/24V	11.1V;x2/24V
Discharging Limit Voltage	10.8V;x2/24V	10.8V;x2/24V	10.8V;x2/24V
Equalize Duration	-----	2 hours	2 hours
Boost Duration	2 hours	2 hours	2 hours

Environmental parameters

Table 7-4

Environmental parameters	Parameter
Working temperature	-35°C to +55°C
Storage temperature	-35°C to +80°C
Humidity	10%-90% NC
Enclosure	IP30

PU1024 Mechanical parameters

Table 7-5

Mechanical Parameter	Parameter
Overall dimension	140(5.51) x 65(2.56) x 34(1.34) mm/inches
Mounting dimension	130(5.12) x 45(1.77) mm/inches
Mounting hole size	Φ4.5
Terminal	6mm ²
Net weight	0.15kg

PU1524 & PU2024 Mechanical Parameters

Table 7-6

Mechanical Parameter	Parameter
Overall dimension	144(5.67) x 75.8(2.98) x 45(1.77) mm/inches
Mounting dimension	135(5.31)x55(2.16) mm/inches
Mounting hole size	Φ4.5
Terminal	10mm ²
Net weight	0.25kg

We reserve the right to change this manual at our discretion.

Please look for updated versions on our website

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mm(inches)

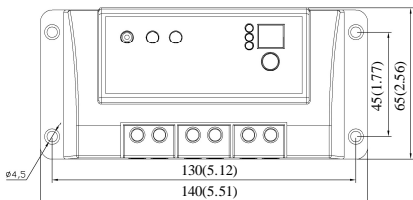


Figure1-1 PU1024 Dimensions

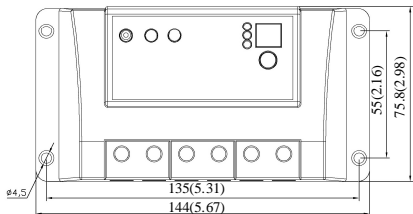
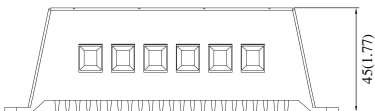


Figure1-2 PU1524 & PU2024 Dimensions



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