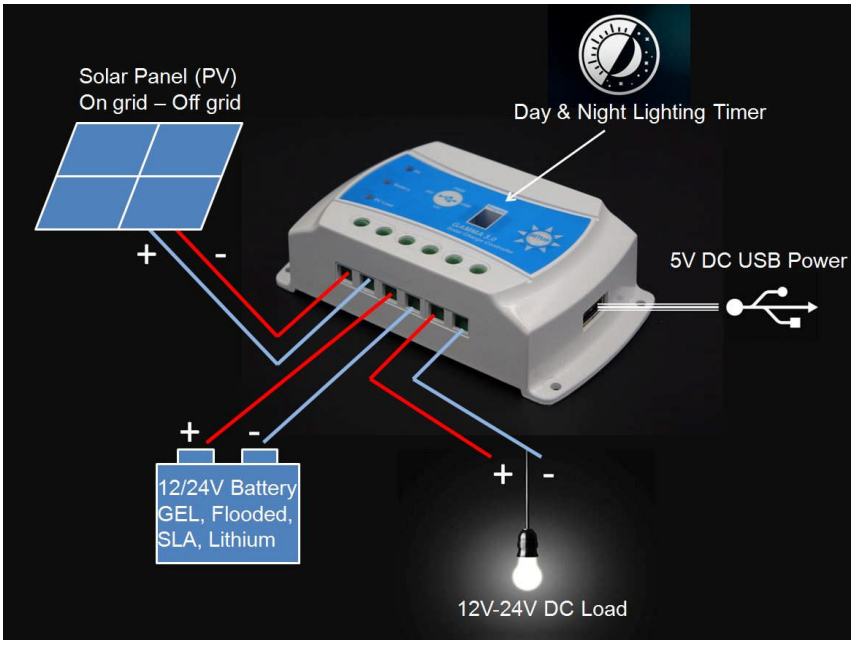


GAMMA 3.0 Solar Charge Controller With USB Power

Thank you for choosing our product!

This manual offers important information and suggestions about the installation, use and troubleshooting, etc. Please read this manual carefully before using the product and pay attention to the safety recommendations within.

USER MANUAL

GAMMA 3.0 3A - 10A
USB POWER SOLAR CHARGE CONTROLLER

RATINGS (Automatic 12V and 24V)

NOTES: For use with solar panels and battery only

TECHNICAL INFORMATION

Auto 12 / 24 Volt DC

Nominal System Voltage	**12 / 24VDC**
Maximum PV Input Voltage	**50V**
Nominal Charge / Discharge Current	**3A, 5A and 10A**

The controller will recognize the system rated voltage when started up. If the battery voltage is lower than 18V, it will recognize the system as 12V. If the battery voltage is greater than 18V, it will recognize the system as 24V.

Notes, Cautions and Warnings

This manual contains important safety, installation and operating instructions. The following symbols are used throughout this manual to indicate potentially dangerous conditions or mark important safety instructions, please take note of them.

WARNING: Indicates a potentially dangerous condition. Use extreme caution when performing this task.

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

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

General Safety Guideline

- Read all of the instructions and cautionary symbols in the manual before beginning installation.
- There are no serviceable parts inside the controller. Do not disassemble or attempt to repair it.
- Install external fuses/Mini Circuit Breaker (MCB) as required.
- Disconnect the solar panel (module/PV) and fuse/MCB near the battery before installing or adjusting the controller.
- Do not allow water to enter the controller.
- Confirm that power connections are tightened to avoid excessive heating from a loose connection.

General Information

Thank you for selecting GAMMA 3.0 series solar controller that adopts the most advanced digital techniques programming and is fully automatic. The Pulse Width Modulation (PWM) battery charging can greatly increase the lifetime of the battery. It has various unique functions, such as:

- 12/24V automatic recognition.
- Highly efficient Series PWM charging increases the battery life and improves the solar PV system's performance.
- Uses MOSFET as electronic switch.
- Widely used, automatically recognize day/night technology for 12/24V and 5V.
- New SOC method of calculating accurately displays the available battery capacity.
- Intelligent timer function with 1-14 hours for both 12/24V and 5V USB
- Unique USB Power timer function, enhance the flexibility of lighting system
- Automatic select battery type (No equalization charge) and design for: Gel, Sealed, Flooded and Lithium (in house battery).
- Adopts temperature compensation, corrects the charging and discharging parameters automatically and improves battery life.
- Electronic protection from overheating, over charging, over discharging, overload, and short circuit.
- Reverse protection: any combination of solar module and battery.
- Support On Grid (grid-tie) solar panel (maximum PV voltage input 50V).

The controller is for multipurpose off-grid solar systems and enhances off grid solar system, protects the battery from being over charged by the solar module and over discharged by the loads. The charging process has been optimized 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.

Although the controller is easy to operate and use, please kindly study this user manual before you begin. This will help you make full use of the functions and you can improve your solar system.

Product Features

1. PV (Solar Panel) Charging Status LED indicator
   A LED indicator that shows charging status and also indicates warning signal when solar array connect wrongly.

2. Battery Status LED Indicator
   A LED indicator that shows battery status and other crucial information.

3. Load On & Off Switch, Setup & Program
   Manually turn on or turn off the DC load.

4. DC Load LED Indicator
   Display the load status.

5. Solar Module Terminals
   Connect solar modules.

6. Battery Terminals
   Connect batteries.

7. Load Terminals
   Connect loads.

8. Display
   Program display for timer and modes.

9. USB Power Socket

Connect to USB devices (5VDC, 1.2A).

Installation

General Installation Notes:

- Read through the entire installation section first before beginning installation.
- Be careful when working with batteries. Wear eye protection if necessary. Have fresh water available to wash and clean any contact with battery acid.
- Uses insulated tools and avoid placing metal objects near the batteries.
- Explosive battery gasses may be present during charging. Be certain there is sufficient ventilation to disperse the gasses.
- Avoid direct sunlight and do not install in locations where water can enter the controller.
- Loose power connections and/or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or even cause fires. Ensure tight connections and use cable clamps to secure cables and prevent them from swaying from mobile applications.
- Use with Lithium (our in house product), Gel, Sealed or Flood batteries only.
- Battery may be wired to one battery or more batteries. The following instructions refer to the use of a single battery, but the battery connection can be made to either one battery or a group of batteries in a battery bank.
- Select the system cables accordingly or consult us for more details.

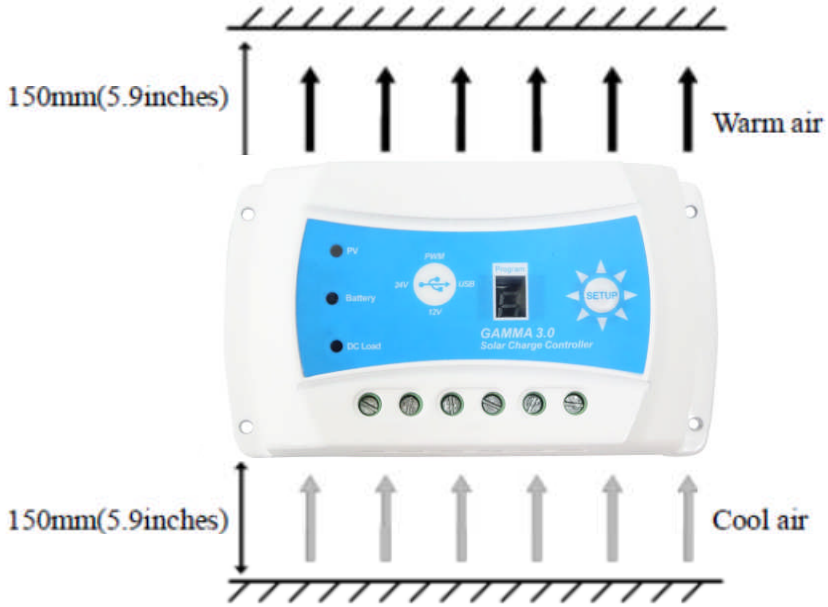
Mounting Requirements

NOTE: When mounting the controller, ensure there is free air flow through the controller heat sink fins. There should be at least 6 inches (150 mm) of clearance above and below the controller to allow for cooling. If mounted in an enclosed space, providing ventilation is highly recommended.

WARNING: Risk of explosion! Never install the controller in a sealed enclosed area with flood batteries! Do not install in a confined area where battery gases can accumulate.

Step 1: Choose Mounting Location

Place the controller on a vertical surface protected from direct sunlight, high temperature, and moisture. Provide good ventilation.



Step 2: Check for clearance

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

Step 3: Mark Holes

Use a pencil or pen to mark the four (4) mount points on the surface.

Step 4: Drill Holes

Remove the controller and drill 3.6mm 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 the mounting screws.

Wiring

NOTE: A recommended connection order (step by step) has been created to provide maximum safety during installation.

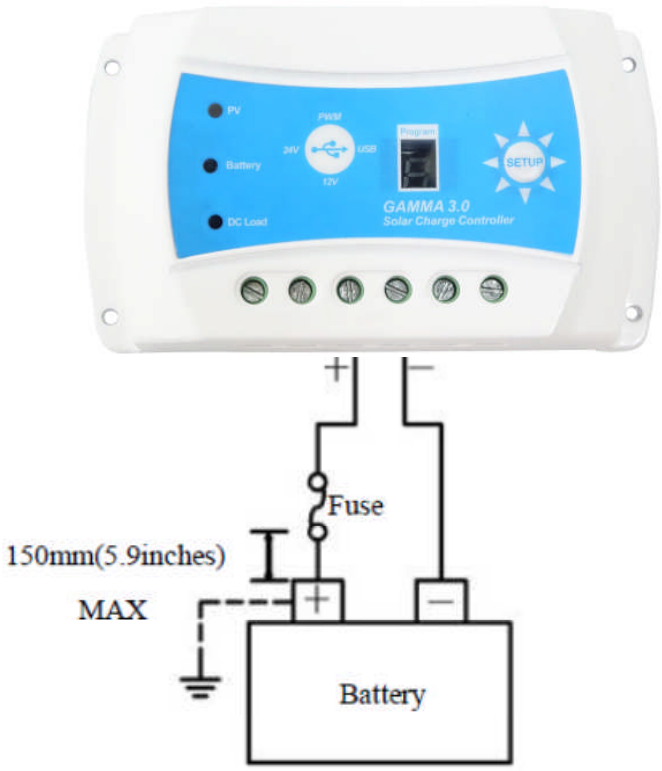
NOTE: The controller is a common positive ground controller.

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

CAUTION: For mobile applications, be sure to secure all wiring. Use cable clamps to prevent cables from swaying when the vehicle/object is in motion. Unsecured cables create loose and resistive connections which may lead to excessive heating and/or fire.

Step1: Battery Wiring

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



Before battery is connected, make sure that the battery voltage is greater than 6V to start up the controller. If the system is 24V, make sure battery voltage is not less than 18V. During the first start up, the controller will automatically recognize the system voltage.

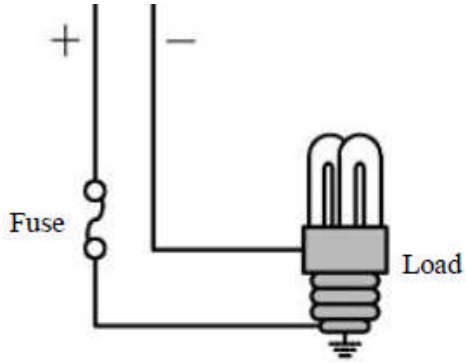
When installing a fuse or Mini Circuit Breaker (MCB), make sure that the distance between the fuse holder and the positive terminal of battery does not exceed 150mm. **Do not insert a fuse (MCB) at this time.**

Make sure the battery cable is less than 0.5 meter long to prevent power loss. Always keeps the controller as close as possible so that it can sense the battery temperature for effective charging (temperature compensation).

Step 2: Load Wiring

The controller can be connected to electrical equipments such as lights, pumps, and motors. The controller draws power from the battery.

USB 5VDC , 1.2A



Connect the positive (+) and negative (-) controller load terminals as shown in above Figure. A fuse holder (MCB) should be wired in series with the load positive (+) or negative (-) wire as shown in above Figure. **Do not insert a fuse (turn off the MCB) at this time.**

When wiring the load connection to a load distribution panel, each load circuit should be fused separately. The total load draw should not exceed the rated load current of the controller.

When connect the USB (5VDC), please plug in the USB socket at the right side of the controller.

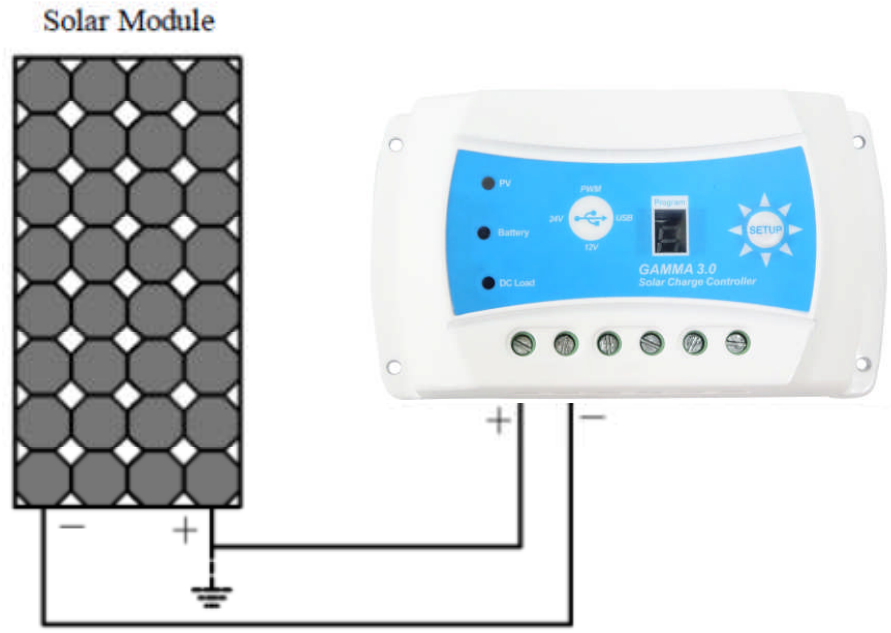
Step 3: Solar wiring

WARNING: Risk of electric shock! Be caution when handling solar panel wiring. The high voltage from solar panel's can induce electric shock and injury. Keep the solar panel away from sunlight before installing the solar wiring.

The controller cans accept 12V or 24V nominal off-grid solar panel(s). Grid-tie solar panel(s) may be used if the open circuit voltage of solar panel doesn't exceed the Maximum PV input voltage (50V) of the controller.

If using Grid-tie (On-Grid) solar panel, the battery system must be 24V.

The solar panel(s) work voltage must be equal to or greater than the system voltage.



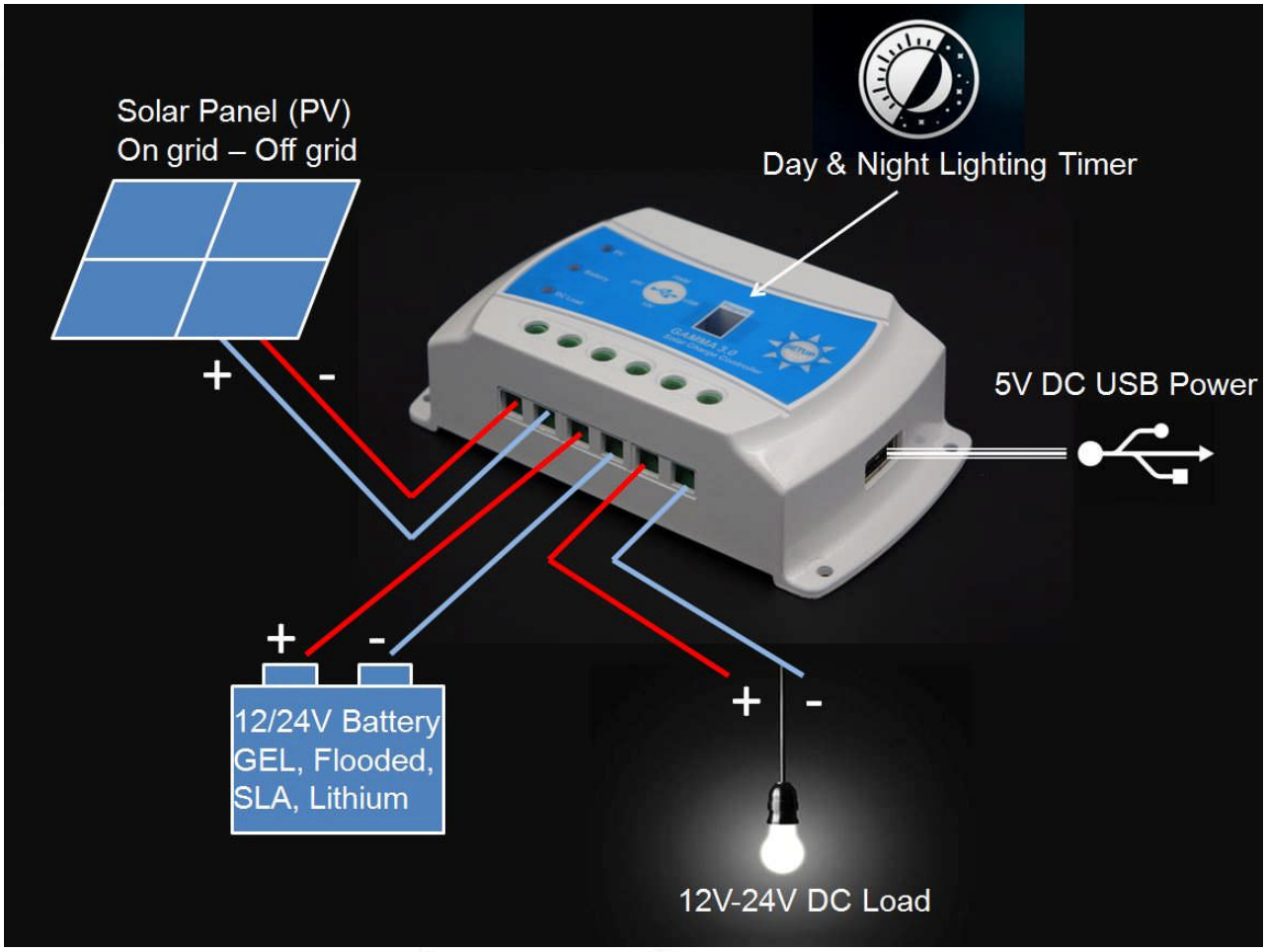
For a good set up, please kindly use solar connector like the MC4 solar connector.

Do not connect the solar connector (MC4) immediately.

A MCB can be installed in between solar panel and the controller as a fuse or circuit breaker.

Step 4: Confirm Wiring

Double-check the system wiring from step 1 through 3. Confirm correct polarity at each connection. Make sure all six terminals are tightened.



Step 5: Install Fuse/Turn on MCB

Install a suitable fuse in each fuse holder in the following order:

1. Battery circuit
2. Load circuit
3. Connect the solar panel connector (MC4).

Step 6: Power up the controller

When the controller starts up, the battery LED indicator will be green. If the controller doesn't start up, or the status LED error is active, please refer to **Troubleshooting Section**.

ADVANCE CHARGING TECHNOLOGY

PWM Technology (Series Pulse Width Modulation)

The controller adopts Advanced Series Pulse Width Modulation (PWM) technology. PWM is the most effective means to achieve constant voltage battery charging by switching the solar system controller's power devices. When in PWM regulation, the current from the solar array tapers according to the battery's condition and recharging needs.

The operating principle of PWM charging mode is as follows:

PWM solar charge controller use technology similar to other modern high quality battery chargers.

When a battery voltage reaches the regulation set point, the PWM algorithm slowly reduces the charging current to avoid heating and gassing of the battery, yet the charging continues to return the maximum amount of energy to the battery in the shortest time. The result is a higher charging efficiency, rapid recharging, and a healthy battery at full capacity.

In addition, this new method of solar battery charging promises some very interesting and unique benefits from the PWM pulsing. These include:

1) Ability to recover lost battery capacity and desulfate a battery.
2) Dramatically increase the charge acceptance of the battery.
3) Maintain high average battery capacities (90% to 95%) compared to on-off regulated state of charge levels that are typically 55% to 60%.
4) Reduce battery heating and gassing.
5) Automatically adjust for battery aging.
6) Self-regulate for voltage drops and temperature effects in solar systems.

Battery Charge Information

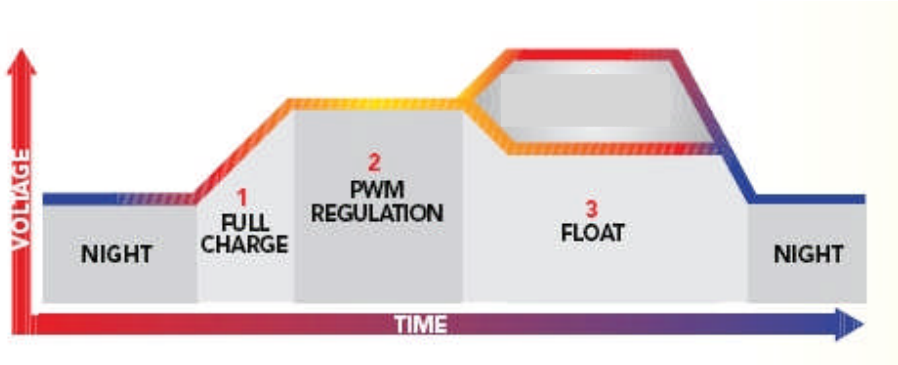
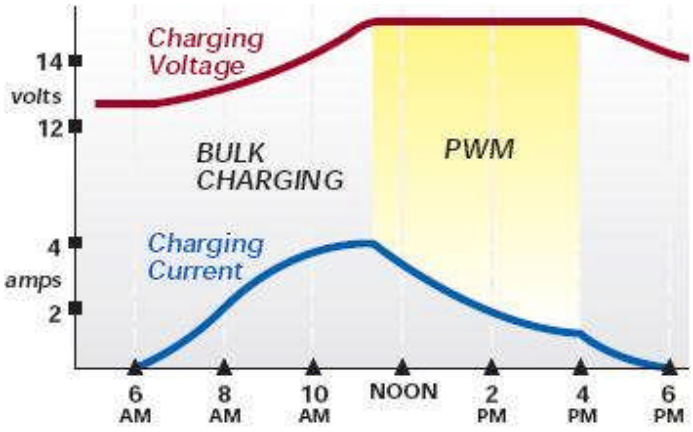


Figure: PWM charging mode

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

Boost Charge/ PWM Regulation
When the battery has been charged to boost voltage point, constant-voltage regulation is used to prevent over-heating and excessive battery gas releases. The boost stage remains for 120 minutes and then reduces into a float charge. This is where the PWM technology applies.



Float Charge
After the battery is fully charged in 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 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 gas release, and also charges the battery with a low current.
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 set point. Should the battery voltage remains below the boost set point, the controller will exit float stage and return to bulk charge.

No Equalize Charge For This Model

LED INDICATION

	Color	Indicator	Status
PV Charging Status LED Indicator	Red	On Solid	Normal
	Red	Slowly Flashing	In charging
	Red	Fast Flashing	Overload or System Error
	Off	OFF	No charge
Battery Status LED Indicator	Red	On Solid	Normal
	Red	Slowly Flashing	Battery weak & low voltage
	Red	Fast Flashing	Battery over discharged
	Off	Off	Battery Not connected
DC Load Status Indicator	Red	On Solid	Load is on
	Red	Fast Flashing	Overload or Short Circuit
	Off	Off	Load is off

OVERLOADING AND SHORT CIRCUIT PROTECTION

Load status	Times of Rated Current	Time of duration (s)
Overload	1.02 ~ 1.05	50
	1.05 ~ 1.25	30
	1.25 ~ 1.35	10
	1.35 ~ 1.5	2
	1.5 ~ 2	0.5
	2 ~ 3	0.3
Short circuit	3 ~ 4.2	0.005
	≥4.2	0.001

CONTROLLER OVERHEATING PROTECTION AND SYSTEM VOLTAGE ERROR INDICATION

Color	Indicator	System status
Red	PV, DC Load and Battery indicator flashing simultaneously	System voltage error
Red	PV, DC Load and Battery Indicator flashing simultaneously	Controller overheating

WARNING: When the controller heat sink exceeds 85˚C, controller will cut off and output circuit;

WARNING: When controller is set to a fixed rated voltage, controller will stop working if battery voltage mismatch with the set voltage;

DC Load Mode Setting

This mode is to turn ON and OFF the load by manual setting (Please refer to Load Programming Mode). For instance, manual on & off with Program setting to 5. (5 with a dot).
For continue on the DC load (24 hours by 7, 365 days), please program to 6. (6 with a dot).
DC load can be both 12/24V and 5V. 12/24V via DC load terminal and 5V via USB power socket.

TIMER SETTING FUNCTION

Timer Function

The default night length setting is 10 hours. The controller can learn the night period by referring the night before. It also can adapt to the different seasons (day light saving). However, it may require time to adjust and learn.

Load Controller Settings

1. Dusk to Dawn
When solar module voltage goes below the point of Night Time Threshold Voltage (NTTV) at dusk/sunset, the controller will recognize the starting voltage and turn on the load after 10 minutes.

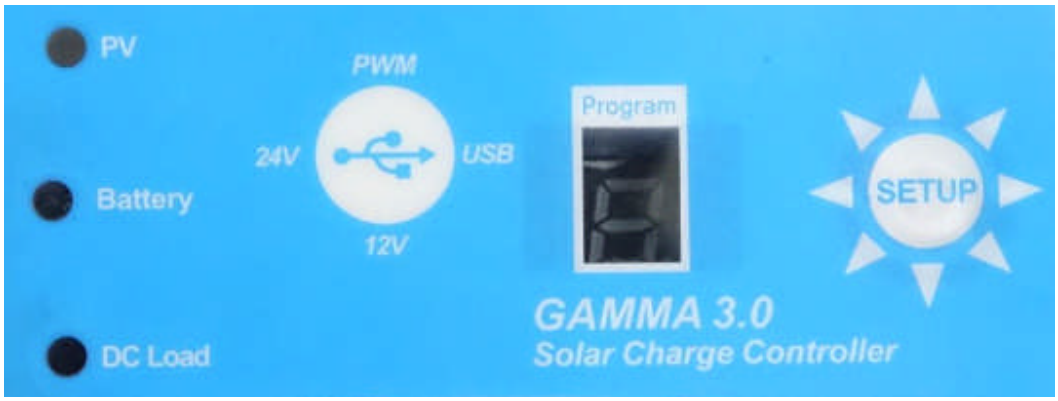
When solar module voltage goes above point of Day Time Threshold Voltage (DTTV), the solar controller will recognize the starting voltage and turn off the load after 10 minutes.

2. Light ON + Timer
When solar module voltage goes below the point of NTTV (Night Time Threshold Voltage) at sunset; the solar controller will recognize the starting voltage and turn on the load after 10 minutes delay. The load will be on for several hours which users set through LED digital display. The controller has dual timer function. Please refer to table "**Load Programming Mode Settings**".

3. Test Mode
This mode is similar to Dusk to Dawn setting, but there is no 10 minutes delay when controller recognizes the starting voltage. When below the starting voltage, the controller will turn on the load, if higher, it will turn off load. The test mode makes it easy to check the solar lighting system during installation.

4. ON/OFF Mode (Manual Switcher)
This mode is to turn ON and OFF the load by manual setting.

Load Program Mode Setting



Setting Operation Indicator

Press the SETUP button once and the display LED indicators will show the program modes.

When Timer setting indicator is on, press the setting button for 5 seconds till the LED digital display flashes. Then press the setting button till the desired number appears according to the following table. The setting is finished when the digital display stops flashing.

Load Programming Mode

Timer 1	LED Digital No.
Dusk to Dawn, load will be on all night or Test Mode	0
Load will be on for 1 hour (with 10 minutes delay) after dusk.	1
Load will be on for 2 hours (with 10 minutes delay) after dusk.	2
Load will be on for 3 hours (with 10 minutes delay) after dusk.	3
Load will be on for 4 hours (with 10 minutes delay) after dusk.	4
Load will be on for 5 hours (with 10 minutes delay) after dusk.	5
Load will be on for 6 hours (with 10 minutes delay) after dusk.	6
Load will be on for 7 hours (with 10 minutes delay) after dusk.	7
Load will be on for 8 hours (with 10 minutes delay) after dusk.	8
Load will be on for 9 hours (with 10 minutes delay) after dusk.	9
Load will be on for 10 hours (with 10 minutes delay) after dusk.	0. (0 with a dot)

Load will be on for 11 hours (with 10 minutes delay) after dusk.	1. (1 with a dot)
Load will be on for 12 hours (with 10 minutes delay) after dusk.	2. (2 with a dot)
Load will be on for 13 hours (with 10 minutes delay) after dusk.	3. (3 with a dot)
Load will be on for 14 hours (with 10 minutes delay) after dusk.	4. (4 with a dot)
On/Off Mode with Manual Switcher (SETUP Button)	5. (5 with a dot)
Continue On Mode (24 hours by 7 (365 days)	6. (6 with a dot)

TROUBLESHOOTING

Protection

P.V Array Short Circuit

If PV array short circuit occurs, clear it to resume normal charge automatically.

Load Overload

If the load current exceeds the rated current of controller（≥1.05 times rated discharge current), the controller will disconnect the load. Overloading must be cleared up, then pressing the switch button.

Load Short Circuit

Fully protected against load wiring short-circuit (≥2 times rated discharge current). After one automatic load reconnect attempt, the fault must be cleared by restarting the controller or pressing the switch button.

PV Reverse Polarity

Fully protection against PV reverse polarity, no damage to the controller will result. Correct the miswire to resume normal operation.

Battery Reverse Polarity

Fully protection against battery reverse polarity, no damage to the controller will result. Correct the miswire to resume normal operation.

Battery working voltage error

If battery voltage does not match controller working voltage, controller will stop working. After correcting the voltage, the failure can be eliminated through pushing load button.

Damaged Temperature Sensor

If the temperature sensor short-circuited or damaged, the controller will be charging or discharging at the default temperature 25℃ to prevent the battery damaged from overcharging or over discharged.

Overheating Protection

If the temperature of the controller heat sink exceeds 85℃, the controller will automatically start the overheating protection and stop the charging and discharging. When the temperature is below 75℃, the controller will resume to work.

High Voltage Transients

PV is protected against smaller high voltage surge. In lightning prone areas, additional external suppression is recommended.

Faults	Possible reasons	Troubleshooting
PV Charging LED indicator off during daytime when sunshine falls on PV modules properly.	PV array disconnection	Check that PV and battery wire connections are correct and tight.
Battery LED indicators slow flashing	Battery under voltage	Load output is normal. Charging LED indicator will return to normal automatically when fully charged.
Battery LED indicators fast flashing	Battery over discharged	The controller cut off the output automatically. LED indicator will return to normal automatically when fully charged.
Load status indicator red and fast flashing	Over load	Remove or cut out the additional load and press the button, the controller will resume to work after 3s.
Load status indicator red and fast flashing	Short circuit	Clear short circuit and press the button, the controller will resume to work after 3s.
All the led indicator flashing (battery red indicator flashing)	System voltage error	Check whether the battery voltage match with the controller working voltage. Please change to a suitable battery or reset the working voltage. If there is no abnormal, please press load button to clear the malfunction.
SOC value incorrect	Choose the wrong battery type; Using the reconfigured profile of the user defined battery type.	Correct the right battery type; Using the configuration of the charging voltage compensation if choosing the user defined battery type and ignore the SOC.

Notes: No LED indicator.
Measure battery voltage with multimeter. Min. 6V can start up the controller.

Notes: No charging status LED indicator with normal connection. Measure the input voltage of solar module, the input voltage must be higher than battery voltage!

MAINTENANCE

The following inspections and maintenance tasks are recommended at least two times per 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 on the heat sink.
- Check all the naked wires to make sure insulation is not damaged for serious solarization, 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 digital tube is consistent with required. Pay attention to any troubleshooting or error indication. Take necessary corrective action.
- Confirm that all the system components are ground connected tightly and correctly.
- Confirm that all terminals have no corrosion, insulation damaged, high temperature or bum/discolored sign, tighten terminal screws to the suggested torque.
- Inspect for dirt, insects and corrosion, and clear up.
- Check and confirm that lighting arrester is in good condition. Replace a new one in time to avoid damaging of the controller and even other equipment.

Notes: Dangerous with electric shock! Make sure that all power source of controller is cut off when operate above processes, and then make inspection or other operations!

TECHNICAL SPECIFICATION

Electrical Parameters

Description	Parameter
Nominal System Voltage	12 /24VDC
Max. PV input voltage	50V
Max. Battery Terminal Voltage	34V
Rated Battery Current	10A
Charge Circuit Voltage Drop	≤0.28V
Discharge Circuit Voltage Drop	≤0.20V
Self-consumption	≤8.4mA/12V ; ≤7. 8mA/24V
Temperature compensation coefficient	-3mV/℃/2V (Default)
Grounding	Positive grounding

Battery Voltage Parameters (parameters is in 12V system at 25℃, please use X 2 in 24V system）

Control Parameters				
Battery charging setting	Gel	Sealed	Flooded	Lithium
Over Voltage Disconnect Voltage	16.0V	16.0V	16.0V	Consult US
Charging Limit Voltage	15.0V	15.0V	15.0V	Consult US
Over Voltage Reconnect Voltage	15.0V	15.0V	15.0V	
Equalize Charging Voltage	——	——	——	——
Boost Charging Voltage	14.2V	14.4V	14.6V	Consult US
Float Charging Voltage	13.8V	13.8V	13.8V	Consult US

Boost Reconnect Charging Voltage	13.2V	13.2V	13.2V	Consult US
Low Voltage Reconnect Voltage	12.6V	12.6V	12.6V	Consult US
Under Voltage Warning Reconnect Voltage	12.2V	12.2V	12.2V	Consult US
Under Voltage Warning Voltage	12.0V	12.0V	12.0V	Consult US
Low Voltage Disconnect Voltage	11.1V	11.1V	11.1V	Consult US
Discharging Limit Voltage	10.6V	10.6V	10.6V	Consult US
Equalize Duration	——	——	——	——
Boost Duration	2 hrs.	2 hrs.	2 hrs.	Consult US

Environmental Parameters

Environmental parameters	Parameter
Working temperature	-35℃ to +50℃
Storage temperature	-35℃to +80℃
Humidity	≤95% NC
Enclosure	IP30

Mechanical Parameters

Mechanical Parameter	Parameter
Overall dimension	124.7 x 69.4 x 34 mm
Mounting dimension	112.4 x 54.0 mm
Mounting hole size	Φ3.6
Terminal	6mm2
Net weight	0.16kg

WARRANTY

The GAMMA 3.0 charge controller is warranted to be free from defects for a period of ONE (1) year from the date of shipment to the original end user. We will, at its option, repair or replace any such defective products.

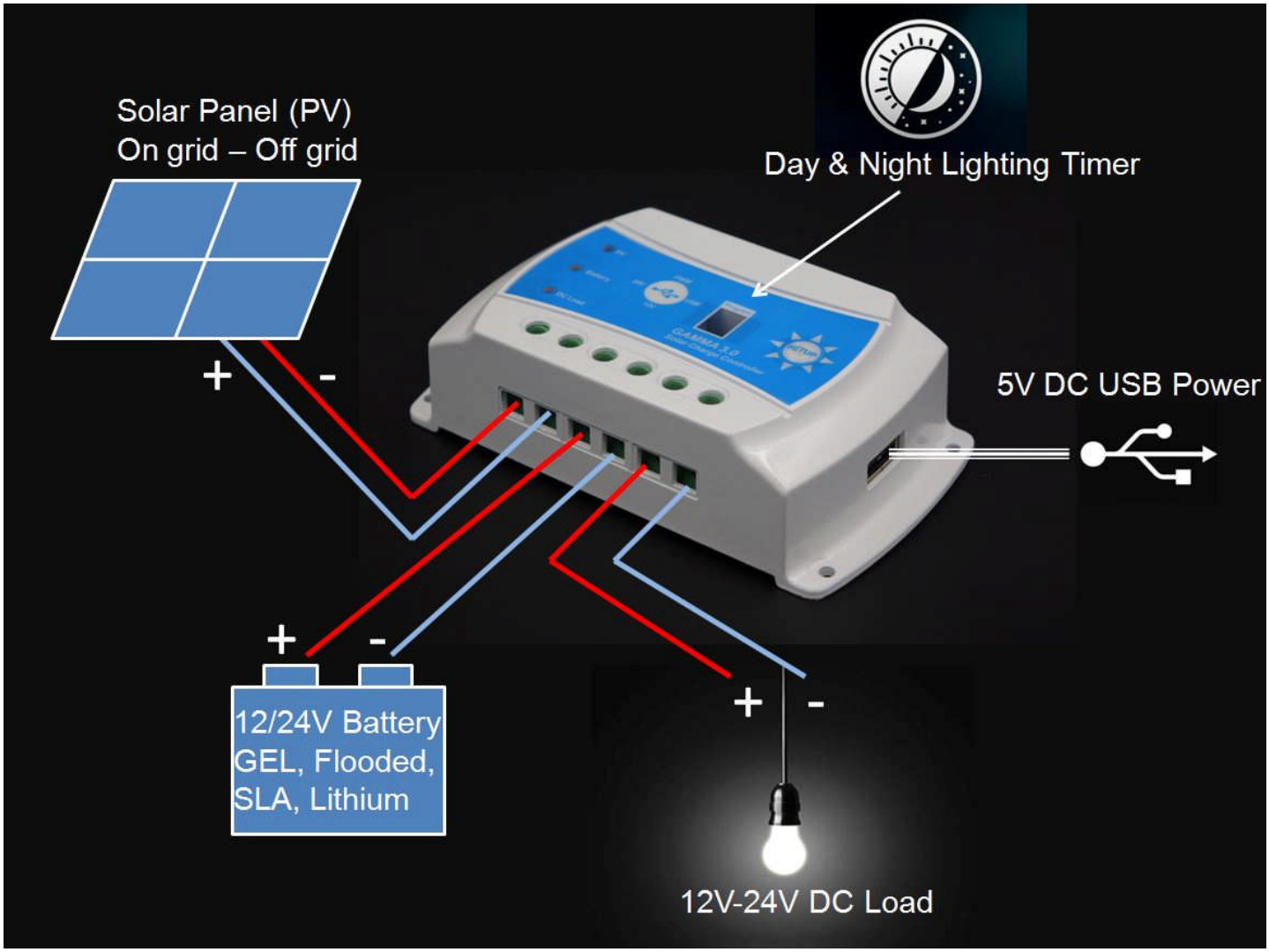
Claim procedure: Before requesting warranty service, check the User Manual to be certain that there is a problem with the controller.

Return the defective product to us with shipping charges prepaid if problem cannot be solved.

Provide proof of date and place of purchase. To obtain rapid service under this warranty, the returned products must include the model, serial number and detailed reason for the failure, the module type and size, type of batteries and system loads. This information is critical to a rapid disposition of 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. Unauthorized product modification or attempted repair.
4. Damaged occurring during shipment.
5. Damage results from acts of nature disaster such as lightning, floods, etc.
6. Irreclaimable mechanical damage.


Solar Panel (PV)
On grid – Off grid
Day & Night Lighting Timer
5V DC USB Power
+
-
+
-
12/24V Battery
GEL, Flooded,
SLA, Lithium
+
-
12V-24V DC Load

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