Important Safety Instructions

Please save these instructions.

This manual contains important safety, installation, and operating instructions for the charge controller. The following symbols are used throughout the manual to indicate potentially dangerous conditions or important safety information.

- **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 to the safe and proper operation of the controller.

### General Safety Information
- Read all of the instructions and cautions in the manual before beginning the installation.
- There are no serviceable parts for this controller. Do NOT disassemble or attempt to repair the controller.
- Do NOT allow water to enter the controller.
- Make sure all connections going into and from the controller are tight.

### Charge Controller Safety
- **NEVER** connect the solar panel array to the controller without a battery. Battery must be connected first.
- Ensure input voltage does not exceed 150 VDC to prevent permanent damage. Use the Open Circuit Voltage (Voc) to make sure the voltage does not exceed this value when connecting panels together.
Battery Safety

- Use only sealed lead-acid, flooded, gel or lithium batteries which must be deep cycle.

- Explosive battery gases may be present while charging. Be certain there is enough ventilation to release the gases.

- Be careful when working with large lead acid batteries. Wear eye protection and have fresh water available in case there is contact with the battery acid.

- Carefully read battery manuals before operation.

- Do NOT let the positive (+) and negative (-) terminals of the battery touch each other.

- Recycle battery when it is replaced.

- Over-charging and excessive gas precipitation may damage the battery plates and activate material shedding on them. Too high of an equalizing charge or too long of one may cause damage. Please carefully review the specific requirements of the battery used in the system.

- Equalization is carried out only for non-sealed / vented/ flooded / wet cell lead acid batteries.

- Do NOT equalize VRLA type AGM / Gel / Lithium cell batteries UNLESS permitted by battery manufacturer.

WARNING

Connect battery terminals to the charge controller BEFORE connecting the solar panel(s) to the charge controller. NEVER connect solar panels to charge controller until the battery is connected.

Do NOT connect any inverters or battery charger into the load terminal of the charge controller.

Once equalization is active in the battery charging, it will not exit this stage unless there is adequate charging current from the solar panel. There should be NO load on the batteries when in equalization charging stage.
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General Information

The Rover Series charge controllers are intelligent controllers suitable for various off-grid solar applications. It protects the battery from being over-charged by the solar modules and over-discharged by the loads. The controller features a smart tracking algorithm that maximizes the energy from the solar PV module(s) and charge the battery. At the same time, the low voltage disconnect function (LVD) will prevent the battery from over discharging.

The Rover's 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.

Key Features

- Automatically detect 12V/24V/36V/48V DC system voltages
- Innovative MPPT technology with high tracking efficiency up to 99% and peak conversion efficiency of 98%
- Deep cycle Sealed, Gel, Flooded and Lithium battery option ready
- Electronic protection: Overcharging, over-discharging, overload, and short circuit
- Reverse protection: Any combination of solar module and battery, without causing damage to any component
- Customizable charging voltages
- RS232 port to communicate with BT-1 Bluetooth Module or DM-1 4G Data Module
- Charges over discharged lithium batteries

MPPT Technology

The MPPT Charge Controller utilizes Maximum Power Point Tracking technology to extract maximum power from the solar module(s). The tracking algorithm is fully automatic and does not require user adjustment. MPPT technology will track the array's maximum power point voltage (Vmp) as it varies with weather conditions, ensuring that the maximum power is harvested from the array throughout the course of the day.

Current Boost

In many cases, the MPPT charge controller will “boost” up the current in the solar system. The current does not come out of thin air. Instead, the power generated in the solar panels is the same power that is transmitted into the battery bank. Power is the product of Voltage (V) x Amperage (A).
Therefore, assuming 100% efficiency:

\[
\text{Power In} = \text{Power Out} \\
\text{Volts In} \times \text{Amps In} = \text{Volts out} \times \text{Amps out}
\]

Although MPPT controllers are not 100% efficient, they are very close at about 92-95% efficient. Therefore, when the user has a solar system whose Vmp is greater than the battery bank voltage, then that potential difference is proportional to the current boost. The voltage generated at the solar module needs to be stepped down to a rate that could charge the battery in a stable fashion by which the amperage is boosted accordingly to the drop. It is entirely possible to have a solar module generate 8 amps going into the charge controller and likewise have the charge controller send 10 amps to the battery bank. This is the essence of the MPPT charge controllers and their advantage over traditional charge controllers. In traditional charge controllers, that stepped down voltage amount is wasted because the controller algorithm can only dissipate it as heat. The following demonstrates a graphical point regarding the output of MPPT technology.

**Limiting Effectiveness**

Temperature is a huge enemy of solar modules. As the environmental temperature increases, the operating voltage (Vmp) is reduced and limits the power generation of the solar module. Despite the effectiveness of MPPT technology, the charging algorithm will possibly not have much to work with and therefore there is an inevitable decrease in performance. In this scenario, it would be preferred to have modules with higher nominal voltage, so that despite the drop in performance of the panel, the battery is still receiving a current boost because of the proportional drop in module voltage.
Four Charging Stages

The Rover MPPT charge controller has a 4-stage battery charging algorithm for a rapid, efficient, and safe battery charging. They include: Bulk Charge, Boost Charge, Float Charge, and Equalization.

**Bulk Charge**: This algorithm is used for day to day charging. It uses 100% of available solar power to recharge the battery and is equivalent to constant current. In this stage the battery voltage has not yet reached constant voltage (Equalize or Boost), the controller operates in constant current mode, delivering its maximum current to the batteries (MPPT Charging).

**Constant Charging**: When the battery reaches the constant voltage set point, the controller will start to operate in constant charging mode, where it is no longer MPPT charging. The current will drop gradually. This has two stages, equalize and boost and they are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of the battery.

➢ **Boost Charge**: Boost stage maintains a charge for 2 hours by default. The user can adjust the constant time and preset value of boost per their demand.

**Float Charge**: After the constant voltage stage, the controller will reduce the battery voltage to a float voltage set point. Once the battery is fully charged, there will be no more chemical reactions and all the charge current would turn into heat or gas. Because of this,
The charge controller will reduce the voltage charge to smaller quantity, while tightly charging the battery. The purpose for this is to offset the power consumption while maintaining a full battery storage capacity. In the event that a load drawn from the battery exceeds the charge current, the controller will no longer be able to maintain the battery to a Float set point and the controller will end the float charge stage and refer back to bulk charging.

⚠️ **Equalization:** Is carried out every 28 days of the month. It is intentional overcharging of the battery for a controlled period of time. 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.

---

**WARNING**  Once equalization is active in the battery charging, it will not exit this stage unless there is adequate charging current from the solar panel. There should be NO load on the batteries when in equalization charging stage.

**WARNING**  Over-charging and excessive gas precipitation may damage the battery plates and activate material shedding on them. Too high of equalizing charge or for too long may cause damage. Please carefully review the specific requirements of the battery used in the system.

**WARNING**  Equalization may increase battery voltage to a level damaging to sensitive DC loads. Ensure that all load allowable input voltages are greater than the equalizing charging set point voltage.

---

**Lithium Battery Activation**

The Rover MPPT charge controller has a reactivation feature to awaken a sleeping lithium battery. The protection circuit of lithium battery will typically turn the battery off and make it unusable if over-discharged. This can happen when storing a lithium battery pack in a discharged state for any length of time as self-discharge would gradually deplete the remaining charge. Without the wake-up feature to reactivate and recharge batteries, these batteries would become unserviceable and the packs would be discarded. The Rover will apply a small charge current to activate the protection circuit and if a correct cell voltage can be reached, it starts a normal charge.
Additional Components

Additional components included in the package:

**Remote Temperature Sensor:**
This sensor measures the temperature at the battery and uses this data for very accurate temperature compensation. Accurate temperature compensation is important in ensuring proper battery charging regardless of the temperature.

*NOTE* Do Not use this sensor when charging lithium battery.

**Mounting Brackets:**
These brackets can be used to mount the Rover charge controller on any flat surface. The screws to mount the brackets to the charge controller are included, screws to mount charge controller to surface are not included.

Optional Components

Optional components that require a separate purchase:

**Renogy BT-1 Bluetooth Module:**
The BT-1 Bluetooth module is a great addition to any Renogy charge controllers with a RS232 port and is used to pair charge controllers with the Renogy BT App. After pairing is done you can monitor your system and change parameters directly from your cell phone or tablet. No more wondering how your system is performing, now you can see performance in real time without the need of checking on the controller’s LCD.

**Renogy DM-1 4G Data Module:**
The DM-1 4G Module is capable of connecting to select Renogy charge controllers through an RS232, and is used to pair charge controllers with Renogy 4G monitoring app. This app allows you to conveniently monitor your system and charge system parameters remotely from anywhere 4G LTE network service is available.
Identification of Parts

Key Parts

1. Charging Indicator
2. Battery Indicator
3. Load Indicator
4. Abnormality Indicator
5. LCD Screen
6. Operating Keys
7. Installation Hole
8. Solar panel “+” Interface
9. Solar panel “-“ Interface
10. Battery “-“ Interface
11. Load “-“ Interface
12. Battery “+“ Interface
13. Load “+“ Interface
14. External Temperature Sampling Interface
15. Battery Voltage Compensation Interface
16. Controller Parallel Port
17. RS232 Communication Interface
18. RS485 Communication Interface
Recommended tools to have before installation:

<table>
<thead>
<tr>
<th>Screwdriver</th>
<th>Multi-Meter</th>
</tr>
</thead>
</table>

**WARNING** Connect battery terminal wires to the charge controller FIRST then connect the solar panel(s) to the charge controller. NEVER connect solar panel to charge controller before the battery.

**WARNING** Do NOT connect any inverters or battery chargers into the LOAD TERMINAL of the charge controller.

**CAUTION** Do not over tighten the screw terminals. This could potentially break the piece that holds the wire to the charge controller.

**CAUTION** Refer to the technical specifications for max wire sizes on the controller and for the maximum amperage going through wires.
Remove Cover

Battery
- Bluetooth Module Communication (optional)

- Temperature Sensor (optional, not polarity sensitive)

Place the sensor close to the battery

- Install Cover
Mounting Recommendations

**WARNING**

NEVER install the controller in a sealed enclosure with flooded batteries. Gas can accumulate and there is a risk of explosion.

1. **Choose Mounting Location**—place the controller on a vertical surface protected from direct sunlight, high temperatures, and water. Make sure there is good ventilation.

2. **Check for Clearance**—verify that there is sufficient room to run wires, as well as clearance above and below the controller for ventilation. The clearance should be at least 6 inches (150mm).

3. **Mark Holes**
4. **Drill Holes**
5. **Secure the charge controller.**

The controller can be mounted using the existing mounting holes or using the included mounting brackets.
Using Mounting Holes

**Step 1.**
Measure the distance between each mounting hole on the Rover. Using that distance drill 4 screws onto desired surface.

![Diagram of mounting holes]

**Step 2.**
Align the Rovers mounting holes with the screws

![Diagram of Rovers aligned with screws]
Step 3.
Verify all screw heads are inside the mounting holes. Release controller and check if mounting feels secure
Using Mounting Brackets

Step 1.
Install the brackets using the provided components
Step 2.
Align the mounting brackets to desired surface and use the appropriate screws to drill into surface (screws not included)

Step 3.
Verify mounting is secure
Operation

Rover is very simple to use. Simply connect the batteries, and the controller will automatically determine the battery voltage. The controller comes equipped with an LCD screen and 4 buttons to maneuver though the menus.

Main Display

Main menu

Real-time monitoring

Load

Load mode

Parameters setting

Statistic data

Historical data of the current day

Device information

NOTE The Battery Capacity (SOC%) is an estimation based on the charging voltage.
Main Menu

- **Page Up/ Increase parameter value**
- **Page Down/ Decrease parameter value**
- **Return to the previous menu**
- **Enter sub menu/ save parameter value/ turn load on or off in manual mode**
<table>
<thead>
<tr>
<th>Icon or Value</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌚</td>
<td>Steady on</td>
<td>Nighttime</td>
</tr>
<tr>
<td>🌞</td>
<td>Steady on</td>
<td>Daytime</td>
</tr>
<tr>
<td>🔌</td>
<td>Steady on</td>
<td>A dynamic arrow indicates charging is in progress.</td>
</tr>
<tr>
<td></td>
<td>0-100%</td>
<td>Current battery capacity</td>
</tr>
<tr>
<td></td>
<td>0% Slow Flashing</td>
<td>Battery over-discharged</td>
</tr>
<tr>
<td></td>
<td>100% Flash Flashing</td>
<td>Battery over-voltage</td>
</tr>
<tr>
<td>🌟</td>
<td>Steady on</td>
<td>Load Terminal in on</td>
</tr>
<tr>
<td>⇣</td>
<td>Steady on</td>
<td>Load Terminal is off</td>
</tr>
<tr>
<td>🕯</td>
<td>Fast Flashing</td>
<td>Overload or short-circuit protection</td>
</tr>
</tbody>
</table>

**Real-Time Monitoring**

To view this screen in the main menu, tap the Right arrow button. To change between screens, press the up or down buttons. To return to the main menu screen press the left arrow button.
<table>
<thead>
<tr>
<th>Screen</th>
<th>Displayed Item/Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1      | Chag State: Idle         | Charging State Indicators:  
  “Idle”, no charging  
  “MPPT”, MPPT charging  
  “EQU”, Equalization charging  
  “BST”, Boost charging  
  “FLT”, Float charging  
  “LIMIT”, current-limited charging |
|        | BatVol: 11.6V            | Battery Voltage |
|        | PvVol: 0V                | Solar Panel Voltage |
|        | ChagCrt                  | Charging Current |
| 2      | LoadState: OFF           | Load in “ON” or “OFF” |
|        | LoadCrt: 0A              | Load current |
|        | BatSoc: 100%             | Remaining battery capacity |
|        | Dev Temp: 27°C           | Controller Temperature |
| 3      | ChagPower: 0W            | Current Wattage |
|        | LoadPower: 0W            | Load Wattage |
|        | MinBatVol: 12.5V         | The current day’s minimum battery voltage |
|        | MaxBatVol: 13.5V         | The current day’s maximum battery voltage |
| 4      | Fault: NULL              | Controller Error Codes:  
  “BAT-LDV” over-discharge  
  “BAT-OVD” over-voltage  
  “BAT-UVW” under-voltage warning  
  “L-SHTCRTC” load short-circuit  
  “L-OVRCRT” load over-current  
  “DEV-OVRTMP” internal over-temperature  
  “BAT-OVRTMP” battery over-temperature  
  “PV-OVP” solar panel over wattage  
  “PV-OC-OVD” solar panel over-voltage  
  “PV-REV” solar panel reverse-polarity  
  “BAT-REV” battery reverse-polarity |
Programming Load Terminal

1. If the characters displayed on top of "<Mode>" are "ON", it indicates that the load is switched on.

2. Tap "Right Arrow Button" to enter the load setting mode, and right below the "<Mode>", the mode characters or digits will begin to flash. Use "Up and Down Arrow Buttons" to select any one from the load modes listed in the following table and tap "Right Arrow Button" again to complete the load mode setting.

3. Press and hold "Right Arrow Button" in any menu but not the setting mode; if the current load mode is "manual mode", pressing and holding the key will switch on/off the load; if the current load mode is not "manual mode", pressing and holding the key will cause the display to skip to the load mode setting interface and a reminder will pop up telling the user in this mode, pressing and holding the key will not switch on/off the load.

Load Mode Options

<table>
<thead>
<tr>
<th>Load Mode</th>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light+ On</td>
<td>Solar Light Control Mode</td>
<td>The load will turn on at night when the solar panel is no longer producing any power after a short time delay. The load will turn off when the panel starts producing power.</td>
</tr>
<tr>
<td>Light+ 01H-14H</td>
<td>Time control</td>
<td>When the panel is no longer producing power the load will be ON for 1-14 hours or until the panel starts producing power.</td>
</tr>
<tr>
<td>Manual</td>
<td>Manual Mode</td>
<td>In this mode, the user can turn the Load On/Off by pressing the Enter button at any time.</td>
</tr>
<tr>
<td>Debug</td>
<td>Test</td>
<td>Used to troubleshoot load terminal (No Time Delay). When voltage is detected load will be off and when no voltage is detected load will be on.</td>
</tr>
<tr>
<td>Normal On</td>
<td>24Hr</td>
<td>The load will be on for 24 hours a day.</td>
</tr>
</tbody>
</table>
## Parameter Settings

To enter the following settings, in the parameters setting screen press the Right arrow button.

<table>
<thead>
<tr>
<th>Screen</th>
<th>Parameter</th>
<th>Displayed Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Battery system voltage</td>
<td>BatSysVol:</td>
<td>12V/24V/36V/48V, AUTO</td>
</tr>
<tr>
<td></td>
<td>Battery type</td>
<td>BatType:</td>
<td>“SLD” Sealed lead-acid battery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“FLD” Flooded lead-acid battery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“GEL” Gel battery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“LI” Lithium battery</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“USE” user defined</td>
</tr>
<tr>
<td></td>
<td>Nominal battery capacity</td>
<td>Capacity:</td>
<td>0-9999</td>
</tr>
<tr>
<td></td>
<td>Device address</td>
<td>Address:</td>
<td>1-60</td>
</tr>
<tr>
<td>2</td>
<td>Overvoltage threshold</td>
<td>OverVolDsc:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Charging limit voltage</td>
<td>ChgLimitVol:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Equalization Voltage</td>
<td>EquChgVol:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Boost charging voltage</td>
<td>BstChgVol:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td>3</td>
<td>Float charging voltage</td>
<td>FltChgVol:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Boost charging recovery voltage</td>
<td>BstChgRev:</td>
<td>0-60s</td>
</tr>
<tr>
<td></td>
<td>Over-discharge recovery voltage</td>
<td>LowVolRev:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Under-voltage warning level</td>
<td>UndVolWrn:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td>4</td>
<td>Low voltage disconnect</td>
<td>LowVolDisc:</td>
<td>9.0-17.0V</td>
</tr>
<tr>
<td></td>
<td>Low voltage disconnect delay</td>
<td>LVD Delay:</td>
<td>0-60s</td>
</tr>
<tr>
<td></td>
<td>Equalization time</td>
<td>Equ-Time:</td>
<td>0-300 Min</td>
</tr>
<tr>
<td></td>
<td>Boost time</td>
<td>Bst-Time:</td>
<td>0-300 Min</td>
</tr>
</tbody>
</table>
### Statistical Data

![Statistics icon](image)

<table>
<thead>
<tr>
<th>TOTAL</th>
<th>DAYS:</th>
<th>LVDC:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of operating days:</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Number of over-discharges:</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

To enter the following settings, in the Statistical Data screen press the Right arrow button.

<table>
<thead>
<tr>
<th>Battery</th>
<th>Displayed Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C-chg: 0AH</td>
<td>Total amp hours produced</td>
</tr>
<tr>
<td></td>
<td>C-ld: 0AH</td>
<td>Total amp hours consumed</td>
</tr>
<tr>
<td></td>
<td>E-chg: 0KWH</td>
<td>Total power generated</td>
</tr>
<tr>
<td></td>
<td>E-ld: 0KWH</td>
<td>Total power consumed</td>
</tr>
<tr>
<td>2</td>
<td>Run days: 10D</td>
<td>Total number of operating days</td>
</tr>
<tr>
<td></td>
<td>LVD-Count: 0</td>
<td>Total number of over-discharges</td>
</tr>
<tr>
<td></td>
<td>FUL-Count: 0</td>
<td>Total number of full-charges</td>
</tr>
</tbody>
</table>

### Historical Data

![Historical data icon](image)

Historical data of day xxxx (counting backwards)

The current day’s min. battery voltage is 11.5V

The current day’s max. battery voltage is 11.6V

To enter the following settings, in the Historical Data screen press the Right arrow button.
<table>
<thead>
<tr>
<th>Screen</th>
<th>Displayed Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;History Data&gt; xxxx Days Ago</td>
<td>xxxx: select the historical data of day xxxx (counting backwards)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0000: current day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0001: yesterday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0002: the day before yesterday</td>
</tr>
<tr>
<td>2</td>
<td>MinBatVol: 11.5V</td>
<td>The selected day’s min. battery voltage</td>
</tr>
<tr>
<td></td>
<td>MaxBatVol: 11.6V</td>
<td>The selected day’s max. battery voltage</td>
</tr>
<tr>
<td></td>
<td>MaxChgVol: 0A</td>
<td>The selected day’s max. charging current</td>
</tr>
<tr>
<td></td>
<td>MaxLodVol: 0A</td>
<td>The selected day’s max. discharge current</td>
</tr>
<tr>
<td>3</td>
<td>MaxChgPow: 0W</td>
<td>The selected day’s max. generated power</td>
</tr>
<tr>
<td></td>
<td>MaxLodPow: 0W</td>
<td>The selected day’s max. discharged power</td>
</tr>
<tr>
<td></td>
<td>C-D-Chg: 0AH</td>
<td>The selected day’s total charged amp hours</td>
</tr>
<tr>
<td></td>
<td>C-D-Lod: 0AH</td>
<td>The selected day’s total discharged amp hours</td>
</tr>
<tr>
<td>4</td>
<td>E-D-Chg: 0KWh</td>
<td>The selected day’s total power generated</td>
</tr>
<tr>
<td></td>
<td>E-D-Lod: 0KWh</td>
<td>The selected day’s total power consumed</td>
</tr>
</tbody>
</table>

**Device Information**

To enter the following settings, in the Device Information screen press the Right arrow button.
<table>
<thead>
<tr>
<th>Screen</th>
<th>Displayed Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model: ROVER60</td>
<td>Controller model</td>
</tr>
<tr>
<td></td>
<td>HW-ver: 00.02.07</td>
<td>Hardware version</td>
</tr>
<tr>
<td></td>
<td>SW-ver: 00.00.04</td>
<td>Software version</td>
</tr>
<tr>
<td></td>
<td>Serial: 123456789</td>
<td>Controller serial number</td>
</tr>
</tbody>
</table>

**LED Indicators**

- ①–PV array indicator: Indicating the controller's current charging mode.
- ②–BAT indicator: Indicating the battery’s current state.
- ③–LOAD indicator: Indicating the loads' On/Off state.
- ④–ERROR indicator: Indicating whether the controller is functioning normally.
<table>
<thead>
<tr>
<th>PV Indicator (1)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Solid</td>
<td>The PV system is <strong>charging</strong> the battery bank</td>
</tr>
<tr>
<td>White Slow Flashing</td>
<td>The Controller is undergoing boost stage</td>
</tr>
<tr>
<td>White Single Flashing</td>
<td>The Controller is undergoing float stage</td>
</tr>
<tr>
<td>White Fast Flashing</td>
<td>The Controller is undergoing equalization stage</td>
</tr>
<tr>
<td>White Double Flashing</td>
<td>The oversized PV system is <strong>charging</strong> the battery bank at the rated current.</td>
</tr>
<tr>
<td>Off</td>
<td>The PV system is <strong>not charging</strong> the battery bank. PV not detected.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BATT Indicator (2)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Solid</td>
<td>Battery is normal</td>
</tr>
<tr>
<td>White Slow Flashing</td>
<td>Battery over-discharged</td>
</tr>
<tr>
<td>White Fast Flashing</td>
<td>Battery <strong>over-voltage</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOAD Indicator (3)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Solid</td>
<td>Load is on</td>
</tr>
<tr>
<td>White Fast Flashing</td>
<td>Load is <strong>over-loaded</strong> or short-circuited</td>
</tr>
<tr>
<td>Off</td>
<td>Load is off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ERROR Indicator (4)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Solid</td>
<td>System Error, Please check LCD for Error code</td>
</tr>
<tr>
<td>Off</td>
<td>System is operating normally</td>
</tr>
</tbody>
</table>
## Rover Protections

<table>
<thead>
<tr>
<th>Protection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV Array Short Circuit</td>
<td>When PV shot circuit occurs, the controller will stop charging. Clear it to resume normal operation.</td>
</tr>
<tr>
<td>PV Overcurrent</td>
<td>The controller will limit the battery charging current to the maximum battery current rating. Therefore, an over-sized solar array will not operate at peak power.</td>
</tr>
<tr>
<td>Load Overload</td>
<td>If the current exceeds the maximum load current rating 1.05 times, the controller will disconnect the load. Overloading must be cleared up by reducing the load and restarting the controller.</td>
</tr>
<tr>
<td>Load Short Circuit</td>
<td>Fully protected against the load wiring short-circuit. Once the load short (more than quadruple rate current), the load short protection will start automatically. After 5 automatic load reconnect attempts, the faults must be cleared by restarting the controller.</td>
</tr>
<tr>
<td>PV Reverse Polarity</td>
<td>The controller will not operate if the PV wires are switched. Wire them correctly to resume normal controller operation.</td>
</tr>
<tr>
<td>Battery Reverse Polarity</td>
<td>The controller will not operate if the battery wires are switched. Wire them correctly to resume normal controller operation.</td>
</tr>
<tr>
<td>Over-Temperature</td>
<td>If the temperature of the controller heat sink exceeds 65°C, the controller will automatically start the reducing the charging current and shut down when temperature exceeds 80°C.</td>
</tr>
</tbody>
</table>
System Status Troubleshooting

<table>
<thead>
<tr>
<th>PV indicator</th>
<th>Troubleshoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off during daylight</td>
<td>Ensure that the PV wires are correctly and tightly secured inside the charge controller PV terminals. Use a multi-meter to make sure the poles are correctly connected to the charge controller.</td>
</tr>
<tr>
<td>BATT Indicator</td>
<td></td>
</tr>
<tr>
<td>White Slow Flashing</td>
<td>Disconnect loads, if any, and let the PV modules charge the battery bank. Use a multi-meter to frequently check on any change in battery voltage to see if condition improves. This should ensure a fast charge. Otherwise, monitor the system and check to see if system improves.</td>
</tr>
<tr>
<td>White Fast Flashing</td>
<td>Using a multimeter check the battery voltage and verify it is not exceeding 32 volts.</td>
</tr>
<tr>
<td>Load Indicator</td>
<td></td>
</tr>
<tr>
<td>White Fast Flashing</td>
<td>The Load circuit on the controller is being shorted or overloaded. Please ensure the device is properly connected to the controller and make sure it does not exceed 20A (DC).</td>
</tr>
<tr>
<td>Error Indicator</td>
<td></td>
</tr>
<tr>
<td>White Solid</td>
<td>System Error. Please check LCD for Error code</td>
</tr>
</tbody>
</table>

Maintenance

**WARNING** Risk of Electric Shock! Make sure that all power is turned off before touching the terminals on the charge controller.

For best controller performance, it is recommended that these tasks be performed from time to time.

1. Check that controller is mounted in a clean, dry, and ventilated area.
2. Check wiring going into the charge controller and make sure there is no wire damage or wear.
3. Tighten all terminals and inspect any loose, broken, or burnt up connections.
4. Make sure LED readings are consistent. Take necessary corrective action.
5. Check to make sure none of the terminals have any corrosion, insulation damage, high temperature, or any burnt/discholoration marks.
Fusing

Fusing is a recommended in PV systems to provide a safety measure for connections going from panel to controller and controller to battery. Remember to always use the recommended wire gauge size based on the PV system and the controller.

<table>
<thead>
<tr>
<th>NEC Maximum Current for different Copper Wire Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
</tr>
<tr>
<td>Max. Current</td>
</tr>
</tbody>
</table>

**NOTE**
The NEC code requires the overcurrent protection shall not exceed 15A for 14AWG, 20A for 12 AWG, and 30A for 10AWG copper wire.

**Fuse from Controller to Battery**

Controller to Battery Fuse = Current Rating of Charge Controller
Ex. 20A MPPT CC = 20A fuse from Controller to Battery

**Fuse from Solar Panel(s) to Controller**

Ex. 200W; 2 x 100 W panels
**Utilize 1.56 (SF)**

**NOTE**
Different safety factors could be used. The purpose is to oversize.

<table>
<thead>
<tr>
<th>Series:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Amperage = Isc1 = Isc2 * SF</td>
</tr>
<tr>
<td>= 5.75A * 1.56 = 8.97</td>
</tr>
<tr>
<td>Fuse = 9A fuse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Amperage = (Isc1 + Isc2) * SF</td>
</tr>
<tr>
<td>=(5.75A + 5.75A) * 1.56 = 17.94</td>
</tr>
<tr>
<td>Fuse = 18A fuse</td>
</tr>
</tbody>
</table>

**Technical Specifications**

**Electrical Parameters**

<table>
<thead>
<tr>
<th>Model</th>
<th>RVR60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal system voltage</td>
<td>12V/24V/36V/48V Auto Recognition</td>
</tr>
<tr>
<td>Rated Battery Current</td>
<td>60A</td>
</tr>
<tr>
<td>Rated Load Current</td>
<td>20A</td>
</tr>
<tr>
<td>Max. capacitive load capacity</td>
<td>10000μF</td>
</tr>
<tr>
<td>Battery Voltage</td>
<td>9V - 70V</td>
</tr>
<tr>
<td>Max Solar Input Voltage</td>
<td>150 VDC (25°C), 145VDC (-25°C)</td>
</tr>
<tr>
<td>Max. power point voltage range</td>
<td>Battery voltage +2V to 120V</td>
</tr>
<tr>
<td>Max. Solar Input Power</td>
<td>800W/12V;1600W/24V;2400W/36V;3200W/48V</td>
</tr>
<tr>
<td>Self-Consumption</td>
<td>0.7W - 1.2W</td>
</tr>
<tr>
<td>Conversion efficiency</td>
<td>≤ 98%</td>
</tr>
<tr>
<td>MPPT tracking efficiency</td>
<td>&gt; 99%</td>
</tr>
<tr>
<td>Temp. Compensation</td>
<td>-3mV/°C/2V (default)</td>
</tr>
</tbody>
</table>
### General

<table>
<thead>
<tr>
<th>Model</th>
<th>RVR60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>285 x 205 x 102mm (11.2 x 8.1 x 4.0in)</td>
</tr>
<tr>
<td>Mounting Holes</td>
<td>4 x Ø10mm</td>
</tr>
<tr>
<td>Max Terminal Size</td>
<td>25mm² 4 AWG</td>
</tr>
<tr>
<td>Net Weight</td>
<td>3.6 kg 7.9 lbs</td>
</tr>
<tr>
<td>Working Temperature</td>
<td>-35°C to +45°C</td>
</tr>
<tr>
<td>Humidity Range</td>
<td>≤ 95% (NC)</td>
</tr>
<tr>
<td>Enclosure</td>
<td>iP32</td>
</tr>
<tr>
<td>Altitude</td>
<td>&lt; 3000m</td>
</tr>
<tr>
<td>Communication</td>
<td>RS232 RS485</td>
</tr>
</tbody>
</table>

### Battery Charging Parameters

<table>
<thead>
<tr>
<th>Battery</th>
<th>GEL</th>
<th>SEALED</th>
<th>FLOODED</th>
<th>LI (LFP)</th>
<th>USER</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Voltage Disconnect</td>
<td>16 V</td>
<td>16 V</td>
<td>16 V</td>
<td>16 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Equalization Voltage</td>
<td>——</td>
<td>14.6 V</td>
<td>14.8 V</td>
<td>——</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Boost Voltage</td>
<td>14.2 V</td>
<td>14.4 V</td>
<td>14.6 V</td>
<td>14.4 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Float Voltage</td>
<td>13.8 V</td>
<td>13.8 V</td>
<td>13.8 V</td>
<td>——</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Boost Return Voltage</td>
<td>13.2 V</td>
<td>13.2 V</td>
<td>13.2 V</td>
<td>13.2 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Low Voltage Reconnect</td>
<td>12.6 V</td>
<td>12.6 V</td>
<td>12.6 V</td>
<td>12.6 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Under Voltage Warning</td>
<td>12 V</td>
<td>12 V</td>
<td>12 V</td>
<td>12 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Low Voltage Disconnect</td>
<td>11.0V</td>
<td>11.0V</td>
<td>11.0V</td>
<td>11.0V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Discharging Limit Voltage</td>
<td>10.6 V</td>
<td>10.6 V</td>
<td>10.6 V</td>
<td>10.6 V</td>
<td>9-17 V</td>
</tr>
<tr>
<td>Over-Discharge Delay Time</td>
<td>5 s</td>
<td>5 s</td>
<td>5 s</td>
<td>5 s</td>
<td>1-30 s</td>
</tr>
<tr>
<td>Equalization Duration</td>
<td>——</td>
<td>2 hours</td>
<td>2 hours</td>
<td>——</td>
<td>0-10 Hrs.</td>
</tr>
<tr>
<td>Equalization Interval</td>
<td>——</td>
<td>30 Days</td>
<td>30 Days</td>
<td>——</td>
<td>0-250 Days</td>
</tr>
<tr>
<td>Boost Duration</td>
<td>2 hours</td>
<td>2 hours</td>
<td>2 hours</td>
<td>——</td>
<td>1-10 Hrs.</td>
</tr>
</tbody>
</table>
1. Default charging parameters in LI mode are programmed for 12.8V LFP battery. Before using Rover to charge other lithium battery, set the charging parameters according to the suggestions from battery manufacturer.

2. The above parameters are based on 12V system settings. Parameters are multiplied by 2 for 24V systems, multiplied by 3 for 36V systems, and multiplied by 4 for 48V systems.

3. For Equalization Interval setting under USER mode, 0 Day refers to close equalization function.

When selecting User, the battery type is to be self-customized, and in this case, the default system voltage parameters are consistent with those of the sealed lead-acid battery. When modifying battery charging and discharging parameters, the following rule must be followed:

- Over-voltage cut-off voltage > Charging limit voltage ≥ Equalizing voltage ≥ Boost voltage ≥ Floating charging voltage > Boost recovery voltage;
- Over-voltage cut-off voltage > Over-voltage cut-off recovery voltage;
- Low-voltage cut-off recovery voltage > Low-voltage cut-off voltage ≥ Discharging limit voltage;
- Under-voltage warning recovery voltage > Under-voltage warning voltage ≥ Discharging limit voltage;
- Boost recovery voltage > Low-voltage cut-off recovery voltage

PV Power – Conversion Efficiency Curves

**Illumination Intensity: 1000W/m²**

1. 12 Volt System Conversion Efficiency

2. 24 Volt System Conversion Efficiency

3. 48 Volt System Conversion Efficiency
Dimensions

**RVR60**

**NOTE** Dimensions in millimeters (mm)

**RVR60 with mounting brackets**