



User's Manual

Rail Guard MPPT Solar Power Unit

RGSPU-12.8V-50A-110V-1.5A

Systellar Innovations

Shankar Chowk, Delhi Road, Meerut – 250002

Ph: +91 121 434 2043 | Email: info@systellar.in

Website: www.systellar.in

1. Introduction

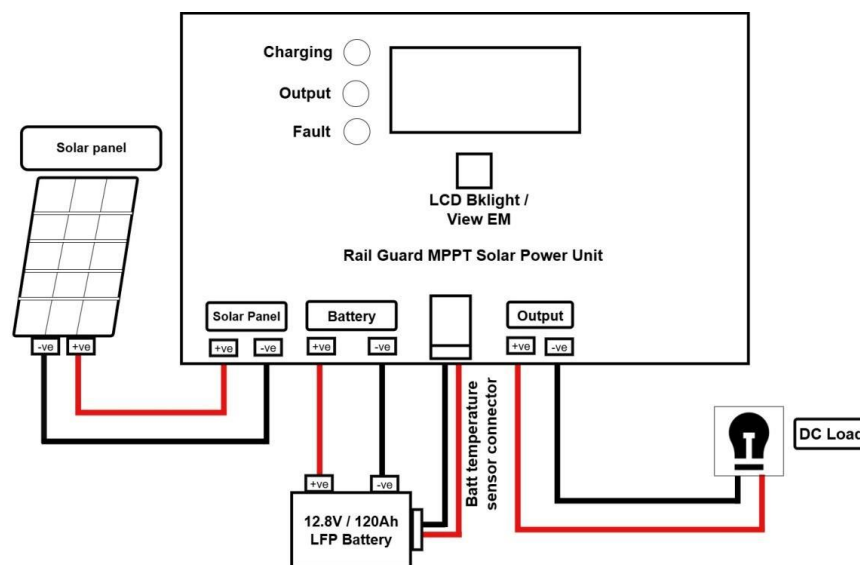
The Rail Guard MPPT Solar Power Unit is a compact, high-efficiency, solar-powered solution specifically engineered to meet the continuous power requirements of a railway guard van. The system integrates an MPPT solar charge controller for a 12.8 V LiFePO4 battery and a regulated 12.8 V to 110 V DC–DC converter in a single enclosure. It provides reliable power to lights and fans in the van without the need to connect to mains AC power or rely on regular movement with trains.

The unit is powered by a 550 Wp solar panel (maximum 750 Wp) mounted on the roof of the railway van. This panel charges a 12.8 V, 120 Ah LiFePO4 battery using a smart MPPT solar charge controller under varying solar irradiance conditions. The maximum charging current is 50 A. Bulk and trickle charging modes are implemented to ensure long battery life.

Salient Features

- **Integrated design** — MPPT solar charge controller and 12.8 V to 110 V DC–DC converter in a single enclosure.
- **High efficiency** — Charge controller efficiency >95%; DC–DC converter efficiency >90%.
- **Battery care** — Two-stage bulk and trickle charging for long LiFePO4 battery life.
- **Graphic display** — 128×64 pixel backlit display showing all running parameters and energy meter values.
- **Comprehensive protection** — Reverse polarity, overload, short circuit and overheat protection on all ports.
- **Mains independent** — No AC supply and no reliance on regular movement with trains.

2. Connection Diagram



File: Rail Guard MPPT Solar Power Unit Connection Block diagram

Rail Guard MPPT Solar Power Unit — connection block diagram

3. Installation Procedure

1. Install the RGSPU unit in the battery cabinet.
2. Connect the battery with correct polarity. The display should turn on.
3. Ensure that the solar panel array voltage is below 85 V.
4. Connect the solar panel with correct polarity.
5. Charging will start automatically during daytime.

6. Check the output for solar panel voltage and current; battery voltage and current; output voltage and current. Check that 110 V output is present.
7. Connect the load at the output and check that it is functioning normally.
8. Check the front panel key functions as described in Section 4.

4. Front Panel Key Functions

The unit has a single front panel key marked **LCD Bklight / View EM**. Its function depends on how it is pressed.

Key action	Function
Single press	The display backlight is turned off after 5 minutes of inactivity. Press the key once to turn the backlight on.
Two presses in quick succession	Energy meter readings are displayed.
Three presses in quick succession	The unit asks whether the user wants to reset the energy meter. If the user presses the key again three times in quick succession, the energy meter is reset.
Long press (longer than 1.2 seconds)	The unit asks whether the user wants to restart the system. If the key is again pressed for more than 1.2 seconds, the system restarts. This feature may be useful in the unlikely event of a stuck fault condition.

5. LCD Display

During normal operation the display shows the charging status, the MPPT charging mode, solar panel voltage and current, battery voltage, battery charging and discharging currents, output voltage, current and power, and the charge controller, battery and DC-DC converter temperatures.



Typical LCD display during operation

6. LED Indication

Green LED — Charger Status

Indication	Meaning
Off	Not charging
1 blink every 2 seconds	Low charging (< 5 A)
2 blinks every 2 seconds	High charging (≥ 5 A)

Indication	Meaning
Solid On	Battery fully charged

Blue LED — DC–DC Converter Status

Indication	Meaning
Solid On	Normal output
1 blink every 2 seconds	Output overload
2 blinks every 2 seconds	DC–DC converter heat sink temperature high (above 70 °C) / temperature sensor disconnected.
3 blinks every 2 seconds	Output voltage too high — shutoff

Note: The DC–DC converter is shut off for all the above faults. It restarts automatically when the fault is removed.

Red LED — Charge Controller Status

Indication	Meaning
Off	Normal operation
1 blink every 2 seconds	Battery discharged (battery voltage below 12.0 V). Charging continues, load is off. Once the battery voltage rises above 12.8 V, this fault is reset and the output starts coming.
2 blinks every 2 seconds	Solar charger heat sink temperature high (above 70 °C) / temperature sensor disconnected. Charging stops.
3 blinks every 2 seconds	Solar panel voltage too high. Charging is stopped.
Solid On	Battery voltage too high

7. Charging Stages

Two-stage charging is implemented for maximum battery care.

Stage	Description
Bulk charging	The battery is charged at the maximum available current until the battery voltage reaches about 14.5 V.
Trickle charging	The battery is held at 13.6 V. The charging mode is changed back to bulk charging if the battery voltage goes below 13.0 V.

Battery Temperature Sensor

A temperature sensor for the battery is provided and the battery temperature is displayed on the LCD. However, for LiFePO4 no temperature compensation is recommended by the manufacturer. **Note:** If this temperature increases above 50 °C, there is some problem in the battery which should be attended to.

8. Troubleshooting

Symptom	Probable cause	Action
Display does not turn on when the battery is connected.	Battery not connected, or connected with reverse polarity.	Check the battery connections and polarity at the Battery terminals.

Symptom	Probable cause	Action
Green LED off during daytime; battery not charging.	Solar panel not connected or connected with reverse polarity.	Check the solar panel connections and polarity at the Solar Panel terminals.
Red LED blinks 3 times every 2 seconds; charging stopped.	Solar panel voltage too high.	Check the solar panel array open circuit voltage. It should be below 85 V.
Red LED blinks 2 times every 2 seconds; charging stopped.	Charge controller heat sink temperature above 70 °C, or the temperature sensor is disconnected.	Improve ventilation around the unit and check that the temperature sensor is connected. Charging resumes automatically when the fault is removed.
Red LED blinks once every 2 seconds; no output.	Battery discharged (battery voltage below 12.0 V).	Allow the battery to charge. The output resumes once the battery voltage rises above 12.8 V.
Red LED solid on.	Battery voltage too high.	Check the battery and the battery bank connections.
Blue LED blinks once every 2 seconds; no output.	Output overload or short circuit.	Reduce the connected load and check the output wiring for a short circuit.
Blue LED blinks 2 times every 2 seconds.	DC–DC converter heat sink temperature above 70 °C, or the temperature sensor is disconnected.	Improve ventilation around the unit and check that the temperature sensor is connected.
Unit remains in a fault condition after the fault has been removed.	Stuck fault condition.	Press and hold the front panel key for more than 1.2 seconds, then press it again for more than 1.2 seconds to restart the system.

9. Ordering Information

Model code:

RGSPU-12.8V-50A-110V-1.5A

- **RGSPU** — Rail Guard Solar Power Unit
- **12.8V** — Battery voltage — 12.8 V LiFePO4
- **50A** — Maximum battery charging current — 50 A
- **110V** — Regulated DC output voltage — 110 V DC
- **1.5A** — Maximum output current — 1.5 A

10. Detailed Technical Specifications

S No	Item	Description
1.	Battery	12.8 V, 120 Ah LiFePO4. Recommended connection wires: 10 mm sq.
2.	Solar panel maximum V_{oc} (open circuit solar panel voltage)	85 V
3.	Recommended solar panel capacity	550 Wp
4.	Solar panel maximum allowed capacity	750 Wp. Recommended connection wires: 4 mm sq.
5.	Maximum battery charging current	50 A
6.	Load output	110 V DC, 1.5 A. Recommended connection wires: 1.5 mm sq.
7.	Display	128×64 pixel backlit graphic display which can display 8 rows of about 22 characters each, for display of running parameters during operation and the energy meter values.
8.	Keyboard	1 key Single press: LCD backlight on Double presses quickly: Display energy meter values Three presses quickly: Option to reset energy meter Long press: System restart
9.	LED indicators	Green (charger status), Blue (DC–DC converter status) and Red (charge controller status). Refer to Section 6, LED Indication.
10.	2-stage charging for maximum battery care	1. Bulk charging mode, till the battery voltage reaches about 14.5 V. 2. Trickle charging mode at 13.6 V. Charging mode is changed to bulk charging mode if the battery voltage goes below 13.0 V.
11.	Temperature compensation of charging thresholds	Temperature sensor for battery is provided and the battery temperature is displayed on LCD. However, for LiFePO4, no temperature compensation is recommended by the manufacturer. If this temperature increases above 50 °C, there is some problem in the battery which should be attended to.
12.	Protections	• Battery reverse polarity • Solar panel reverse polarity • Output overload • Output short circuit • Charge controller overheat • DC–DC converter overheat
13.	Idle power	By battery charger: Max 1.3 W. By DC–DC converter: Max 12 W.
14.	Charge controller efficiency	>95%
15.	DC–DC converter efficiency	>90%
16.	Technology	Solar charger: Two interleaved synchronous buck converter channels. DC–DC converter: Transformer based forward converter.
17.	Microcontroller	ARM M4 core based 32-bit advanced microcontroller

** For continuous product improvement, product specifications can change without notice.*

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