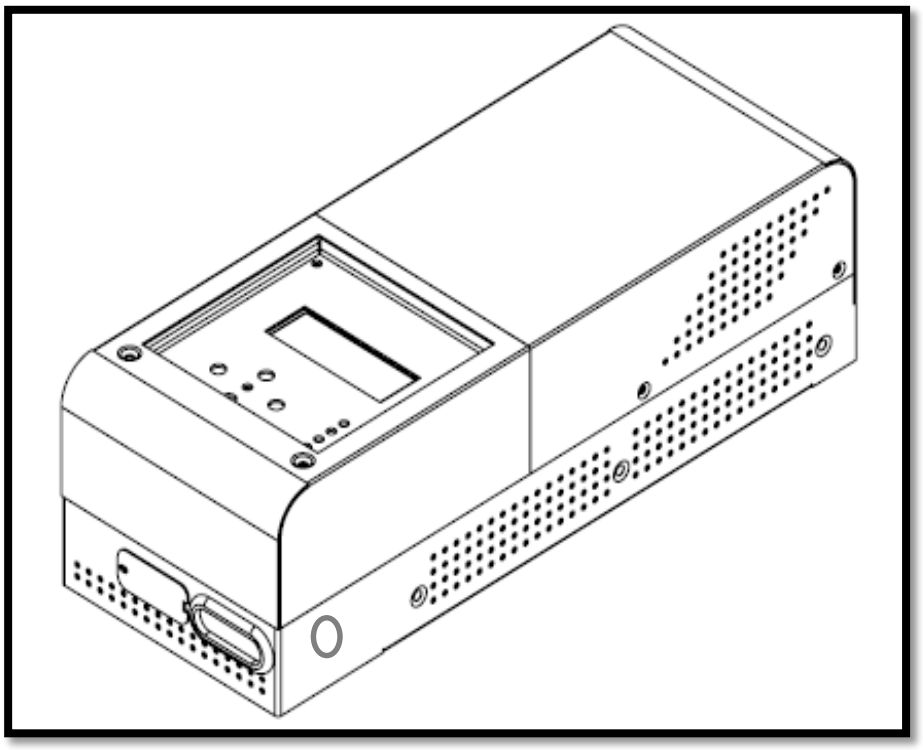
LUMINOUS
TELEINFRA LIMITED

SOLAR MPPT 60

PRODUCT INFORMATION

LUMINOUS SOLAR MPPT 60



SYSTEM OVERVIEW

Luminous Solar MPPT 60 is an advanced maximum power point tracker (MPPT) that tracks the maximum power point of PV array to deliver maximum available current to charge battery for off grid photovoltaic (PV) systems. MPPT technology tracks the array maximum power point in rapidly changing solar conditions, ensures maximum energy harvest from the PV array. The controller provides the better efficiency and significantly less power loss. It regulates the battery voltage and output current based on the amount of energy available from the PV array. MPPT features a smart tracking algorithm that constantly adjusts the operating points of the array at peak power point. The tracking algorithm is fully automatic and does not require user adjustment.

The Luminous MPPT battery charging process has been optimized for long battery life and improved system performance. It supports multi stage charging for Flooded Lead Acid (FLA), GEL and Absorbed Glass Mat (AGM) batteries. In built fault diagnostics and electronic error protections that prevent the system from damaging. The controller is featured with 20*4 liquid crystal display(LCD) with backlight, eight adjustable settings switches (DIP switch), several communication ports, temperature compensated charging and in built data logging.

FEATURES & BENEFITS

Solar Battery Charger with Maximum Power Point Tracking Technology

- High speed Piccolo microcontroller.
- Maximum power point tracking delivers maximum available power from PV array.
- Smart tracking P & O algorithm.
- Excellent performance at sunrise and low solar insolation levels.
- Four stage charging – Bulk, absorption, equalize and float.
- Battery voltage selection and battery type through selector switch (auto/manual).

High reliability & Efficiency

- Robust thermal design and convection-cooled design with no cooling fans.
- Full output current upto 45°C without thermal de-rate.
- Parallel circuit design for better performance of components.
- Integrated electronic protections - solar overload, Battery high voltage, heat sink high temperature, reverse current at night and battery reverse polarity.
- Over-temperature protection.
- Battery temperature sensor for temperature compensated battery charging.
- Peak efficiency of 98%
- Low self-consumption & low power losses.

Communication access

- RS-232 & 485 communication ports.
- Serial RS-232: connection to a personal computer.
- EIA-485 communications between multiple devices.

Data Logging & Display Functions

- 20 character and 4 line liquid crystal display (LCD) for displaying operating data, alarms and faults.
- Four LED's for system status and four buttons for system parameters.
- Up to 90 days of data logging (battery minimum/maximum voltage and charge KWH) via meters or communications ports.

TECHNICAL SPECIFICATIONS

Electrical Parameters:	
Maximum Battery Current	60Amp
Maximum Solar panel power for:	
12V	800W
24V	1600W
36V	2400W
48V	3200W
60V	4000W
Nominal System Voltage	12, 24, 36, 48, 60VDC
Peak Efficiency (Under S.T.C.)	98%
Maximum Solar Open Circuit Voltage (V_{OC})	150VDC
Maximum Solar input voltage (V_{mp})	PV Vmp must be at least 16% greater than the highest battery charge voltage set point
12V	18.56V
24V	37.12V
36V	55.68V
48V	74.24V
60V	92.80V
Battery Operating Voltage Range	10.5 – 80VDC
Stand-by power	≤ 3Watts
Maximum Self-Consumption	≤ 6Watts

Battery Charging:	
Charging Algorithm	4 – stage
Charging Stages	Bulk, Absorption, Equalize(Auto & manual) & Float
Temperature Compensation	-5mV/°C/ 2V battery Cell (ref 35°C)

Mechanical Parameters:	
Dimensions (mm)	425 x 150 x 120 (L x W x H)
Weight	5.25 kg
Maximum Wire Size	25mm²
Mounting	Wall mount
Enclosure	indoor and vented

Environmental Parameters:	
Ambient Temperature	-10°C to 45°C
Storage Temperature	-15°C to 80°C

Electronic Protections:
Solar Overload
Battery High Voltage
Heat sink high Temperature
Battery Reverse Polarity
Reverse Current at Night

Communication Ports & Data Logging
RS-232
EIA-485
Data Logging up to 90days

LED Indications: (Combination of 4 LED's)	LED1	LED2	LED3	LED4	LED STATUS
Controller OFF	0	0	0	0	OFF
High Voltage Disconnect (PV Array/Battery)	0	1	0	0	Permanent ON
Dip Switch Fault	0	1	0	1	Permanent ON
PV night Disconnect/MPPT Night mode Disconnect	0	1	1	1	Permanent ON
Battery Bulk Charging Stage	1	0	0	0	Blink
Battery Absorption charging Stage	1	0	0	1	Blink
Battery Float Charging Stage	1	0	1	0	Permanent ON
Battery Equalization Charging Stage	1	0	1	1	Permanent ON
Overload	0	0	1	0	Permanent ON
Heat sink High Temperature	1	1	1	1	Permanent ON
Batt. High Voltage	1	1	0	1	Permanent ON

Important Safety Instructions

General Safety Instructions

This contains important safety and operating instructions. Read carefully.

- Before installing or using this device, read all instructions located in (or on) this manual.
- Read all instructions and cautionary markings before using Solar Charge Controller.
- There are no user serviceable parts inside the LUM MPPT. Do not disassemble or attempt to repair the controller.
- The unit contains more than one live circuit (batteries and PV array). Power may be present at more than one source.

Installation Safety Precautions

- Mount the Solar MPPT indoors. Prevent exposure to the elements and do not allow water to enter the controller.
- Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery or other electrical current. This will greatly reduce the chance of accidental exposure to live circuits.
- To reduce the chance of short-circuits, use insulated tools when installing or working with the unit or any DC source.
- NEVER smoke or allow a spark or flame in vicinity of a battery.
- When connecting batteries, always verify proper voltage and polarity.
- All the connections must be terminated properly and there should not be any loose connections.
- To reduce the risk of electrical shock, disconnect all DC power source from the Solar Charge Controller before attempting any maintenance or cleaning or working on any circuit.

INTRODUCTION

MPPT based Solar Charge Controller

Maximum Power Point Tracking allows the Solar Charge Controller to harvest the maximum energy available from the PV array and deliver it to the batteries. The tracking algorithm is fully automatic and does not require user adjustment.

The MPPT algorithm continuously adjusts the operating points in an attempt to find the maximum power point of the array. The algorithm can then determine if it is harvesting more or less power than the previous operating points.

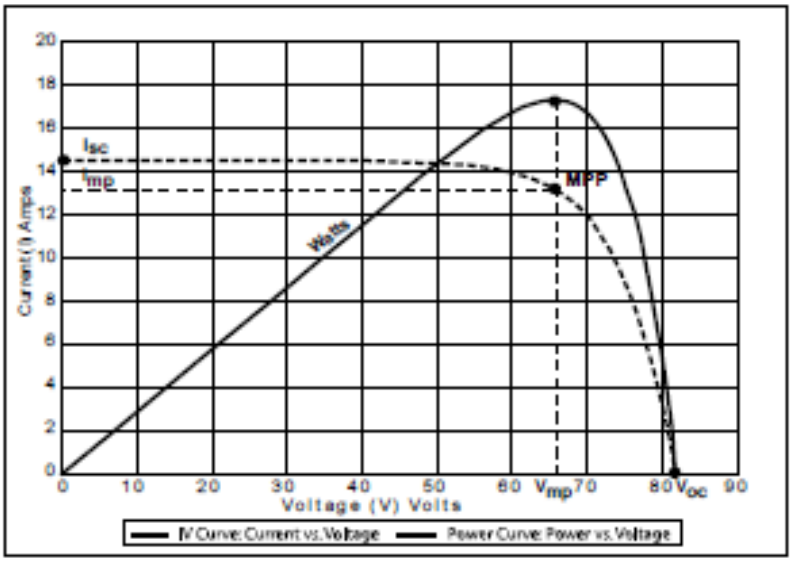


Figure1: Maximum Power Point Curve

Block Diagram:

A block diagram illustrates the arrangement and interconnections of the system.

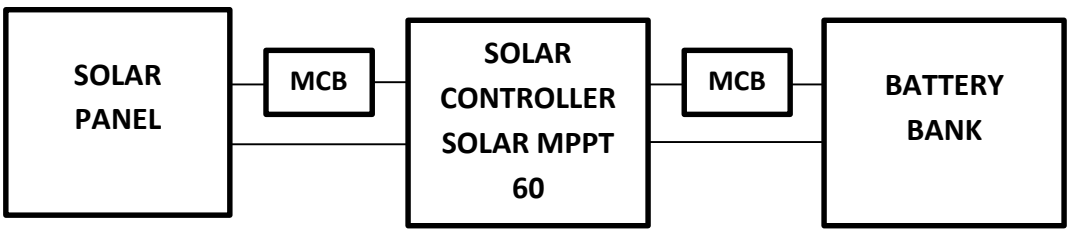


Figure 2: Basic Block Diagram of the system

BATTERY CHARGING

Luminous Solar MPPT 60 tracks the maximum power point of PV array to deliver maximum available current to charge battery @ 12, 24, 36, 48 & 60VDC. It is configured to use a 4-stage charging process to maintain the battery voltage.

When charging, Solar MPPT 60 regulates the battery voltage and the output current based on the amount of DC power available from the PV array and the state of charge of the battery.

Since power is the product of voltage and current (Volts x Amps), the following equation holds good, i.e.:

i) Input power = Output power
ii) Volts In x Amps In = Volts Out x Amps Out
(Assuming 100% efficiency)

That is, it is able to charge the lower voltage battery from the higher voltage array.

4-stage Battery Charging

Battery voltage and current vary during the different stages. The stages are:

a) Bulk Charge stage
b) Absorption charge stage
c) Float charge stage
d) Equalization charge stage

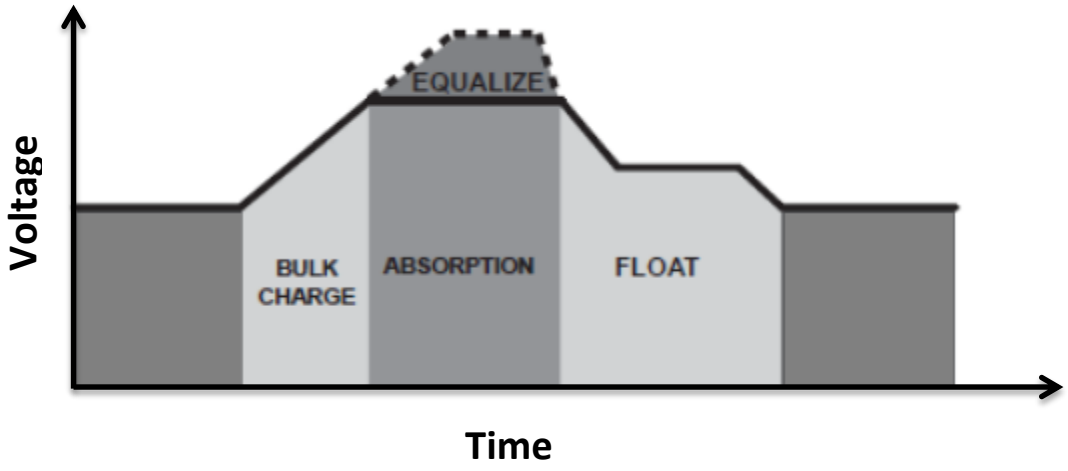


Figure 3: Battery Charging Profile

Bulk Charge stage:

In this stage, the controller will deliver 100% of available solar power to recharge the battery. The battery is not at 100% state of charge and battery voltage has not yet charged to the Absorption voltage set-point. When the battery voltage reaches the Absorption voltage setting, the controller will transition to the absorption stage.

Absorption Charge stage:

In this stage, constant-voltage regulation is used to maintain battery voltage at the Absorption set-point. This prevents heating and excessive battery gassing. The battery is allowed to come to full state of charge at the Absorption voltage set-point.

The battery must remain in the Absorption charging stage for a cumulative 120 - 150 minutes, depending on battery type, before transition to the Float stage will occur.

Float Charge stage:

The float stage provides a very low rate of maintenance charging while reducing the heating and gassing of a fully charged battery. The purpose of float is to protect the battery from long-term overcharge. The controller reduces the battery voltage to the Float voltage set-point.

Equalization Charge stage:

Solar MPPT 60 can be used to provide the battery bank with equalize charge manually by switching the position of DIP switch. Certain battery types benefit from a periodic boost charge to stir the electrolyte, level the cell voltages, and complete the chemical reactions. Equalize charging raises the battery voltage above the standard absorption voltage so that the electrolyte gasses. The duration of the equalize charge is determined by the battery type.

Dimensions: (in millimeters)

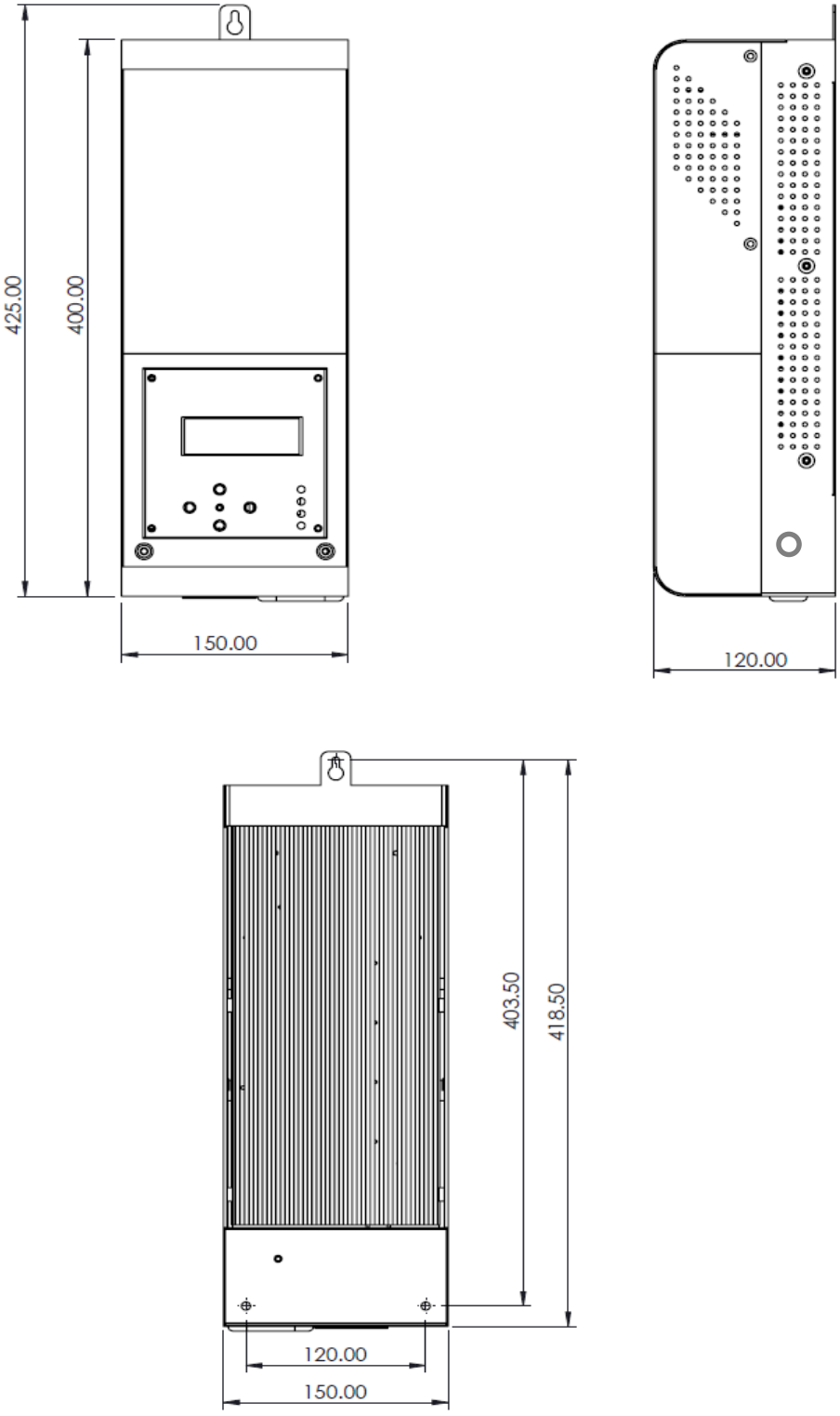


Figure 4: MPPT Dimensions

General Assembly

This section provides the information regarding outer and inner assembly of the system. The feature of each section is also explained then.

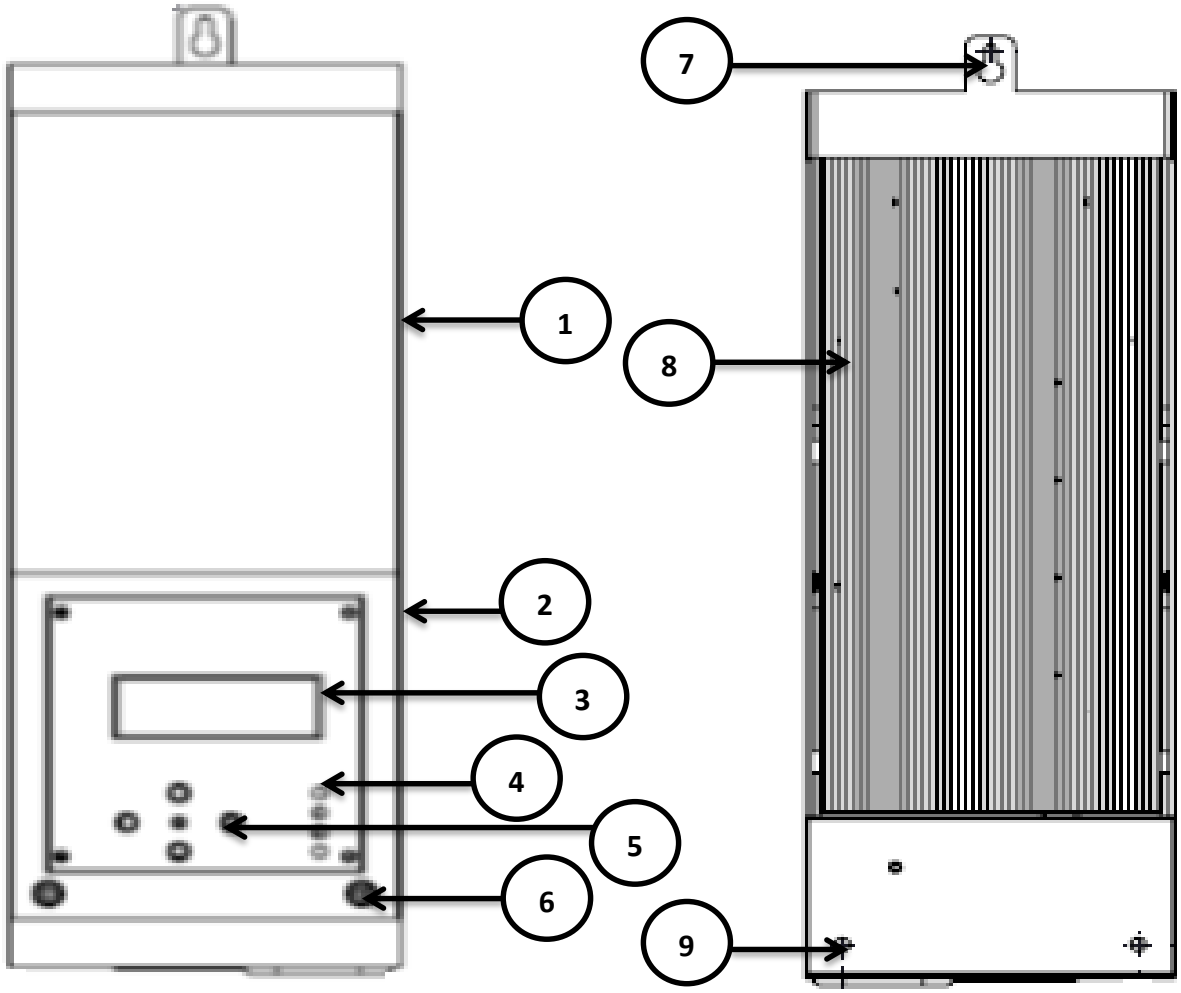


Figure 5: Outer Assembly

1 – Back Top Cover

A cabinet cover for back top assembly

2 – Front Display Cover

A cabinet cover for front display

3 – LCD screen

A 20*4 LCD display for displaying parameters

4 – LED Indication

4 LEDs for indicating different system status

5 – Push Button

4 push button for monitoring and configuring system parameters

6 – Screw Slot

A slot to screw up the front display cover

7 – Slot for Hanging

A slot for hanging vertically on the wall

8 – Heat-sink

A heat-sink for dissipating heat at bottom

9 – Mounting slot

2 slots for fixed mounting

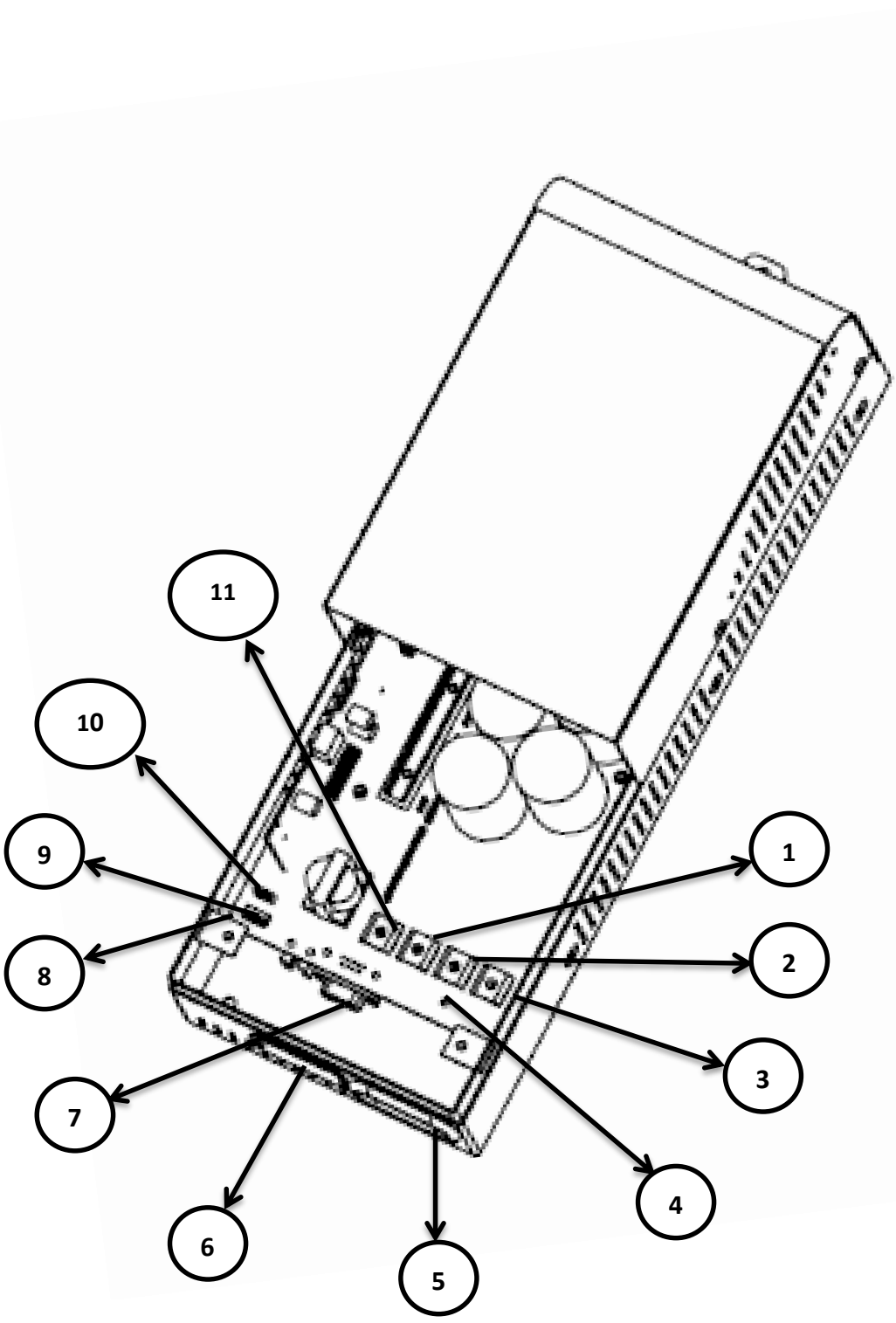


Figure 6: Inner Assembly

1 – PV negative terminal
PV array negative power connection

2 – Battery negative terminal
Battery negative power connection

3 – Battery positive terminal
Battery positive power connection

4 – Earth terminal
A ground chassis earth terminal for grounding

5 – Wiring Slot with Gourmut
A slot for all input and output wires with gourmut provided

6 – Communication slot with plastic cover
A slot for 9 pin communication cable

7 – RS-232 port
9 pin connector for communication

8 – EIA-485 port
3 pin connector for communication

9 – Sense terminal
4-position terminal for battery voltage sense and temperature sense

10 – Setting DIP switch
8-position setting switch for configuring manual operation

11 – PV positive terminal
PV array positive power connection

INSTALLATION

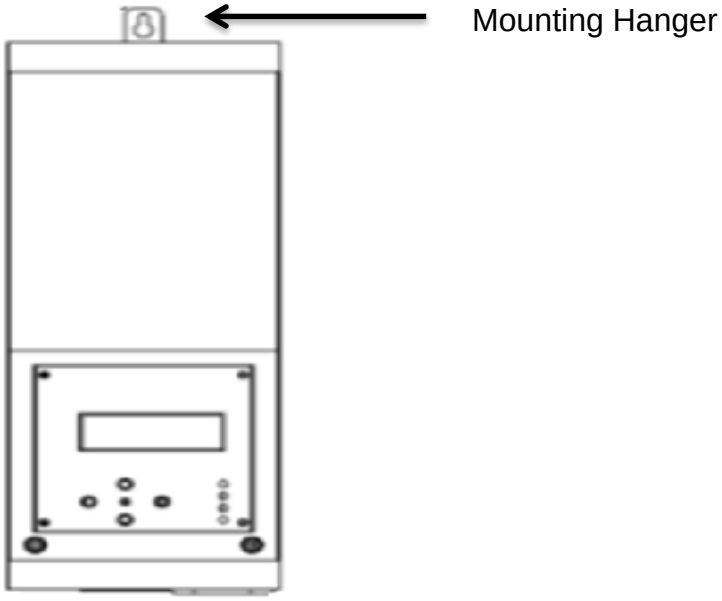
For better performance and operation, the MPPT must be installed properly and carefully. It should be installed vertical and in the clean and dry environment. There should be proper air flow and unit must be placed in ventilated enclosure. Keep unit away from the batteries.

Note: MPPT should be installed and operated in vertical position only.

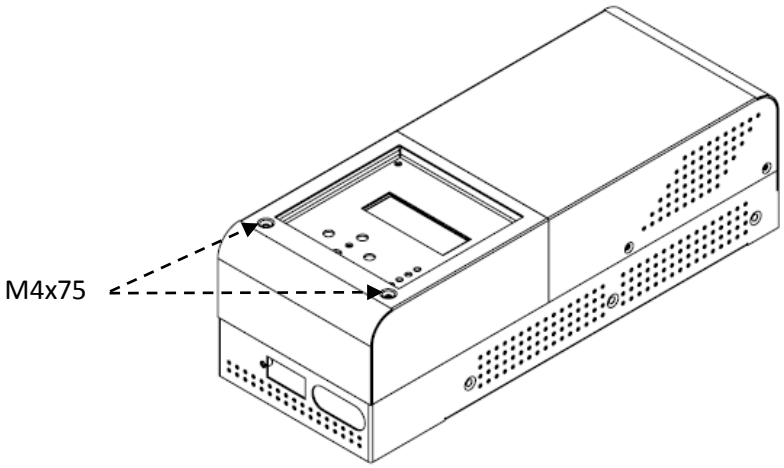
Also the multiple controllers can be installed in parallel for higher current requirement. Be careful in the installation of the unit and read all the safety instructions before proceeding.

➢ Installation Process:

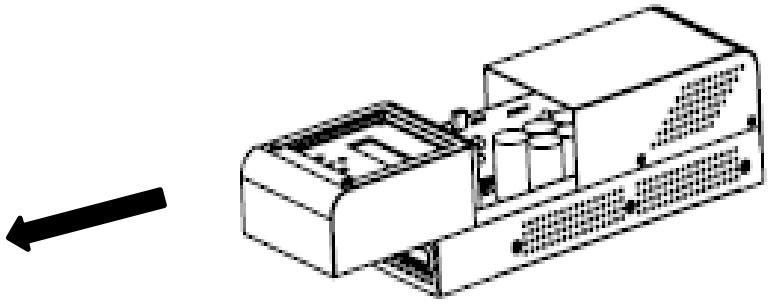
- Take the assembled unit.
- There is a mounting hanger at the top of the unit as seen below.



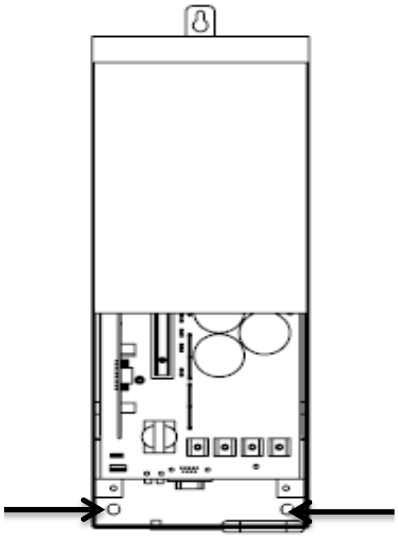
- Now open up the screw as shown:



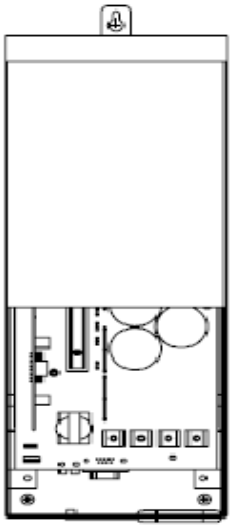
- Then remove by sliding the front display cover



- There are two mounting holes in the unit, through which the unit can be screwed up for hanging.



- Make the proper drills in the wall at the accurate position of the mounting holes.
- Now hang the unit on the mounting hanger and screw up the unit.

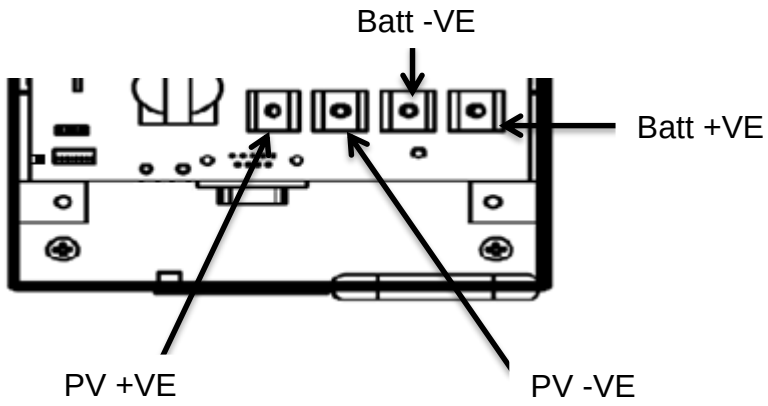


- Then required power wiring can be done and after that fix the front display cover.

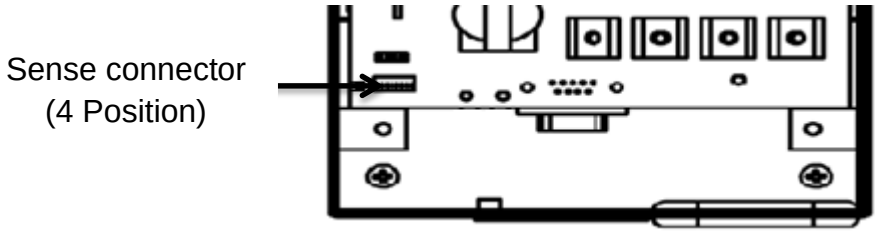
- **Wiring:**

This section clears the power, sense and communication wiring of the system.

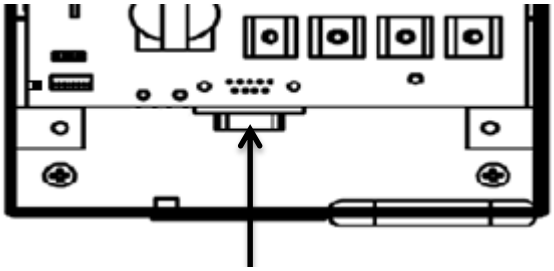
There are two connectors for the power wiring viz. CN3 & CN4. Power wiring includes battery and array connections.



There is a connector for sense wiring viz. J2. Sense wiring includes battery sense and temperature compensation.

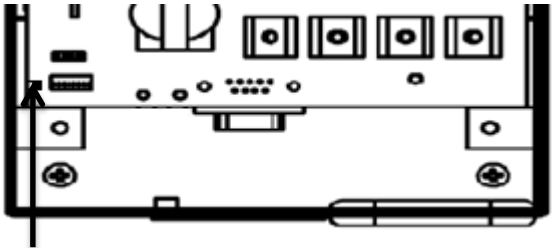


There is DB9 connector for communication wiring viz. P1. It is used for communicating with the personal computer.



RS-232 (DB9)

There is 3-pin connector for communication wiring viz. CN2. It is used for multiple units together in parallel.



RS-485

Power wiring:

Minimum wire size 16mm². Size range of 16-25mm² can be used.

Procedure:

1) Initially keep all MCBs Off.
2) Remove the front display cover.
3) Two terminals viz. CN4 & CN3 are provided for array and battery wiring.
4) Pull the wires into the unit through the gourmut hole.
5) Connect battery +ve at the Batt +ve terminal of Connector CN3.
6) Connect battery –ve at the Batt –ve terminal of Connector CN3.
7) Connect PV +ve at the PV +ve terminal of Connector CN4.
8) Connect PV –ve at the PV –ve terminal of Connector CN4.

Sense wiring :(Optional)

Minimum wire size 0.50mm². Size range of 0.50-1.00mm² can be used.

Procedure:

Temperature sensor

1. Take the sense wire harness provided with the unit.
2. Pull the wires into the unit through the gourmet hole.
3. (For AD592-Temperature sensor) Connect 2-core shielded wire +ve (red wire) at pin no.1 of J2 connector.
4. Connect its –ve (black wire) at pin no.2 of J2 connector.
5. Attach AD592 sensor at the –ve terminal of the battery.

Battery Sensing wires:

6. Take red wire & connect one end of the wire to pin no.3 of J2 connector and other at the battery +ve terminal.
7. Take black wire. Connect one end of the wire to pin no.4 of J2 connector and other at the battery –ve terminal.
8. Cover up the front display cover.

Communication wiring (Optional for displaying Data logs only)

DB9 connector wiring is used to communicate with computer. It is connected when the data is required to be stored or displayed on the computer.

Procedure:

1) Remove the plastic cover
2) Take DB9 connector cable, Insert DB9 connector through the hole.
3) After completion remove the connector.
4) Then cover up the plastic cover.

System Up-gradation (Optional)

3-pin connector wiring is used to connect multiple units which has RS485 connection. It is connected for higher current applications.

Procedure: Remove the front display cover.

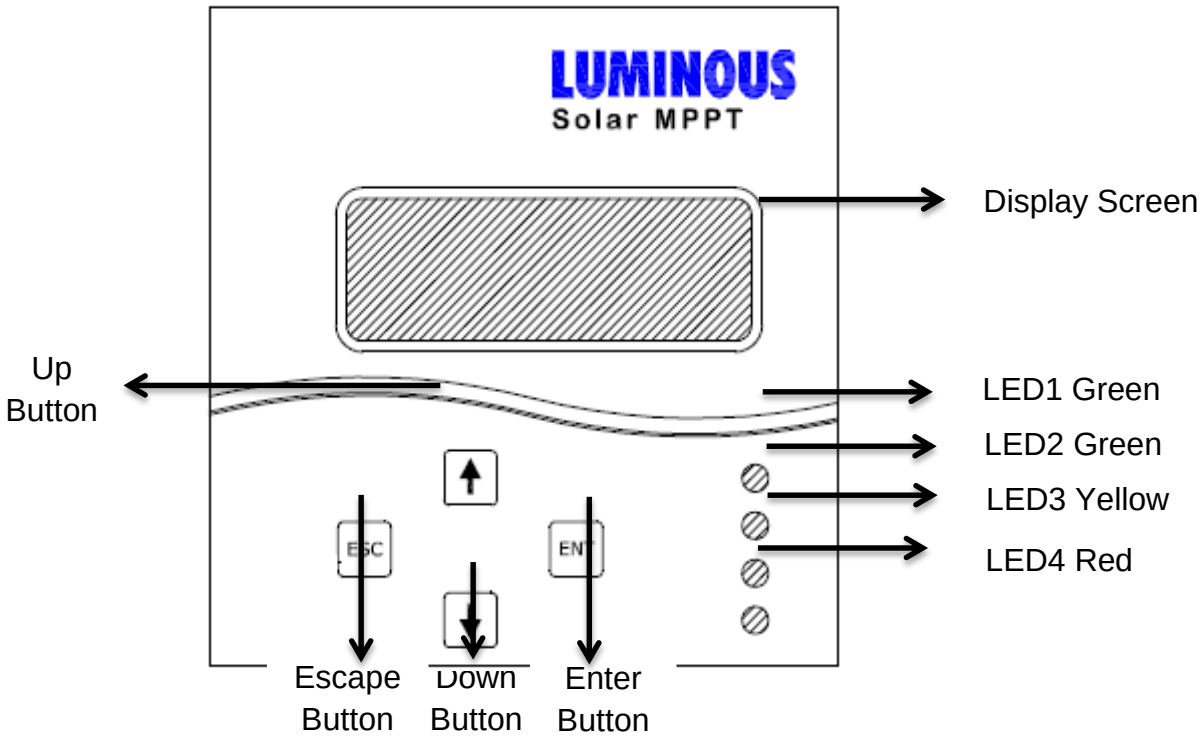
1) Take the 3-pin connector wiring and pull through the gourmet hole.
2) Insert in the 3-pin connector i.e. CN2.
3) Cover up the front display cover.

SETTINGS AND OPERATIONS

The Solar MPPT 60 operation is automatic. There are few manual operation. So, the operator should be familiar with the certain operations.

- **Front Panel**:
  The front panel cum display is designed to facilitate better interface of man and machine.

  The Solar MPPT 60 has the following features to display and operation functions:
  1) LCD display – 20x4 LCD display for displaying system parameters and features.
  2) Push Button – 4 push buttons / TACT Switches are there for operations and navigating the screen pages.
  3) LED Lights – LEDs are for indicating the system faults and battery operations.



Viewing

The Solar MPPT 60 has 20 character and 4 line LCD display for displaying system information and operation.

The front display is configured with many system parameters which can be viewed by navigating the display pages of screen using push buttons. The display shows the different window pages:

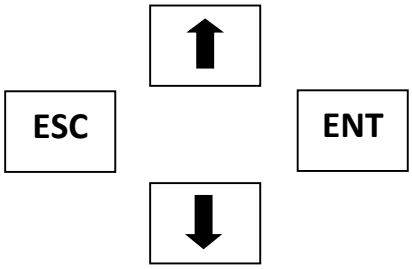
a) Operating Data P1
b) Operating Data P2
c) Operating Data P3
d) Operating Data P4
e) Config Data P1

Default screen is:

OPERATING DATA P1		
PV:	000.0V	00.0A
BATT:	000.0V	00.0A
I/P: 0000W	O/P: 0000W	

Push Buttons:

4 push buttons are for operation and navigating the screen.



The features of each button are as follows:

BUTTON	FUNCTION
UP Arrow	Displays next screen page
DOWN Arrow	Displays previous screen page
ENTER	Selects and confirms selection of the menu item.
ESC	Cancels selection of the menu item.

LED Indications:

LEDs are for indicating the system faults and battery operations. Four LEDs are there and combinations of these four represent different status of system.

LED 1 – Green LED
LED 2 – Green LED
LED 3 – Yellow LED
LED 4 – Red LED

LED Indications: (Combination of 4 LED's)	**LED1**	**LED2**	**LED3**	**LED4**	**LED STATUS**
Controller OFF	0	0	0	0	OFF
High Voltage Disconnect (PV Array/Battery)	0	1	0	0	Permanent ON
Dip Switch Fault	0	1	0	1	Permanent ON
PV night Disconnect/MPPT Night mode Disconnect	0	1	1	1	Permanent ON
Battery Bulk Charging Stage	1	0	0	0	Blink
Battery Absorption charging Stage	1	0	0	1	Blink
Battery Float Charging Stage	1	0	1	0	Permanent ON
Battery Equalization Charging Stage	1	0	1	1	Permanent ON
Overload	0	0	1	0	Permanent ON
Heat sink High Temperature	1	1	1	1	Permanent ON
Batt. High Voltage	1	1	0	1	Permanent ON

➢ DIP switch settings:

DIP switch is provided for manual selection of system functioning. Luminous Solar MPPT 60 has 8-position DIP switch which can be configured manually. The details and applications of DIP switch is:

SWITCH	APPLICATION
SW1	Not in application
SW2, SW3, SW4	System voltage selection
SW5, SW6, SW7	Battery type selection
SW8	Not in application

Switch - 2, 3 & 4:

The switches 2, 3 & 4 should be used for selection of the system voltage.

a. **Manually voltage selection** – where specific voltage is given the DIP switches position should be as per below table.
b. **Auto voltage selection -**The system should auto detect feature only be used in situations where the system voltage is unknown in system.

System Voltage Selection	Switch Selection (Digital Position)		
	SW2	SW3	SW4
Auto	0	0	0
12	0	0	1
24	0	1	0
36	0	1	1
48	1	0	0
60	1	0	1

Switch – 5, 6 & 7:

The switches 5, 6 & 7 should be used for selection of battery type.

To ensure proper charging of the battery system and long life, the settings are recommended for different battery type. Table below summarizes the major parameters of the standard charging settings (All settings are for 12 Volt nominal systems)

Switch Selection (Digital position)			Battery type	Absorption Stage (V)	Float Stage (V)	Equalize Stage (V)	Absorption Time (Minutes)
SW5	SW6	SW7					
0	0	0	GEL	14	13.7	14	150
0	0	1	Sealed-1	14.15	13.7	14.4	150
0	1	0	Sealed-2	14.3	13.7	14.6	150
0	1	1	Flooded-1	14.4	13.7	15.1	180
1	0	0	Flooded-2	14.6	13.5	15.3	180
1	0	1	Flooded-3	14.7	13.5	15.4	180
1	1	0	L-16	15.4	13.4	16	180
1	1	1	Custom	Custom	Custom	Custom	Custom

(0 for OFF position and 1 for ON position)

- **Temperature measurement & Power De-rating:**

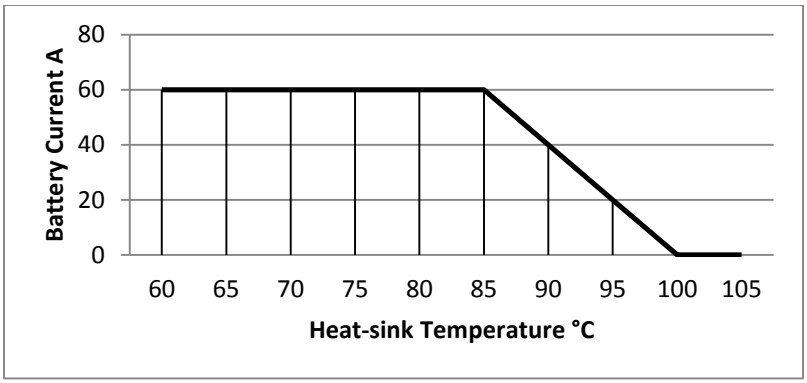
The controller senses the battery temperature as well as the heat-sink temperature.

Temperature Compensation:

Temperature Sensor is recommended to adjust charging to the actual battery temperature. Temperature compensation depends on the temperature variations, battery type, how the system is used, and other factors. All charging settings will be based on 35°C reference temperature. Luminous Solar MPPT 60 has the temperature compensation of 5mV/°C/2V Cell. If the battery temperature varies by 5°C, the charging setting will change by 0.15 Volts for a 12 Volt battery.

Heat-sink Temperature measurement (Power De-rating):

The controller measures the heat-sink temperature and de-rates the battery current when heat-sink temperature is above safe limits. If controller senses more than 85°C, the controller de-rates the power as shown in power de-rating graph and battery current will be reduced further as the heat sink temperature rises as shown in below table.



- **Battery sense:**

In power cables, voltage drops are there which are unavoidable. Due to voltage drops in the battery cables, the battery power connection voltage at MPPT terminals will be higher than the actual battery bank voltage while charging the battery.

For example, the voltage at MPPT battery terminal is 14V and the actual voltage at battery terminal is 13.7V, i.e. there is 0.3V drop due to power cables. This voltage drops will cause undercharging of the battery. So to compensate for this drop battery sense wires are used which senses the actual battery voltage.

As battery sense wires do not carry current and has the identical voltage across its length. The battery sense improves the accuracy of the charging.

Two battery sense wires of size 0.25mm^2-1.00mm^2 can be used.

Note: If Battery Sense is not used, the controller uses the voltage at the battery power terminals for regulation.

- **Communication:**

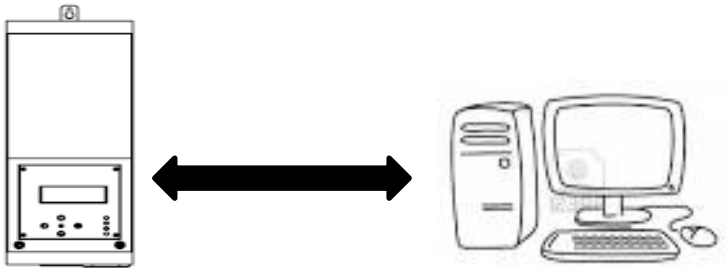
Luminous Solar MPPT 60 is featured with several communication ports. It is provided with RS-232 & EIA-485 ports for monitoring and data logging facilities.

RS232:
It is a standard 9 pin port (DB9). It establishes a connection between the controller and PC. The data logs can be viewed on the PC.

Note: PC must be installed with Hyper-terminal software.

Procedure to connect:

1) Take DB9 connector cable and insert in the connector (P1).
2) Connect other end of cable in the PC connector.
3) Then use hyper-terminal software to view data.
4) Now user can view the data logs on the PC screen.



How to use HyperTerminal

- ✓ Select ‘start’ on the PC screen
- ✓ then ‘Programs’
- ✓ then ‘Accessories’
- ✓ then ‘Communications’
- ✓ then ‘HyperTerminal’
- ✓ Then enter any name in the ‘Enter Name’ window and then select ‘OK’.
- ✓ Now, in ‘Port Settings’, select ‘Bits per second’ equal to ‘115200’ and then select ‘OK’.
- ✓ Then press ‘ENT’ button of the MPPT unit. (MPPT display shows “SENDING DATA TO PC…”
- ✓ Now user can view the logged data.

****