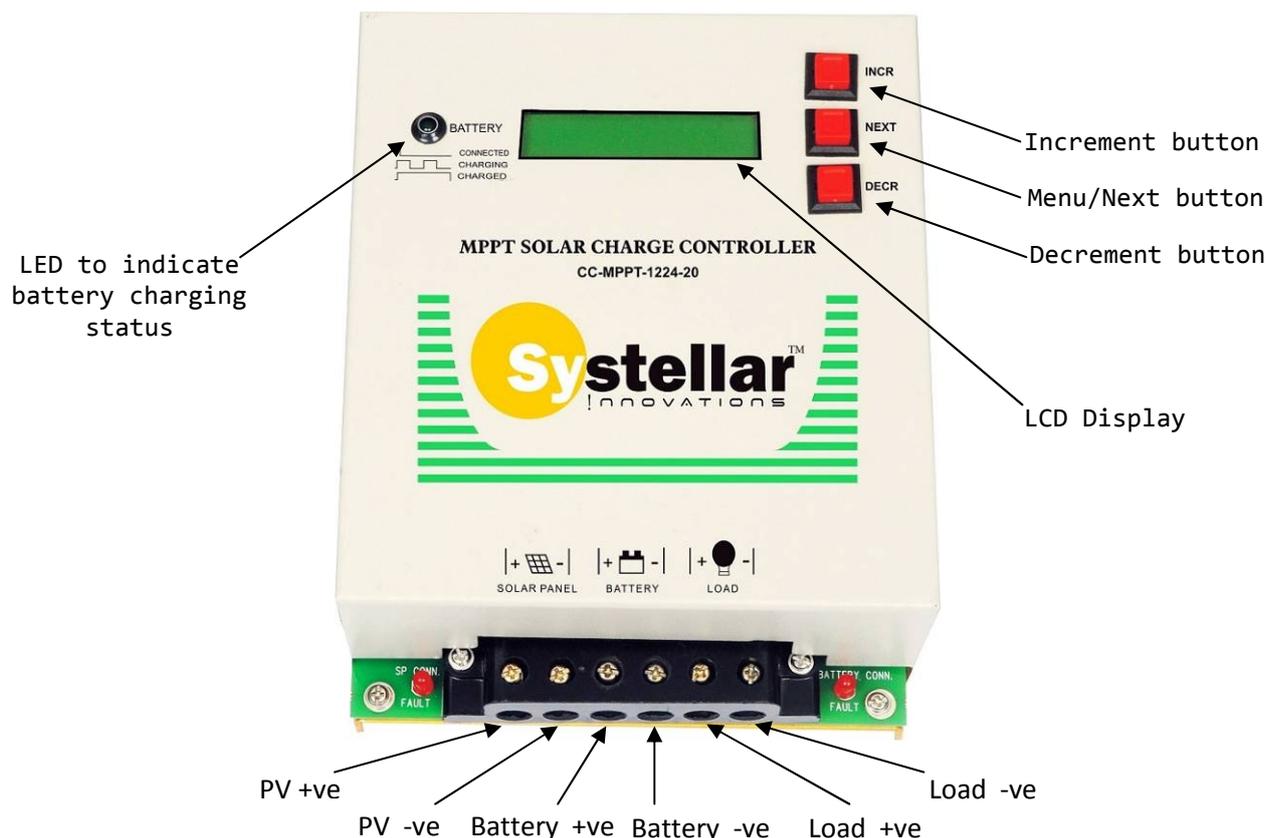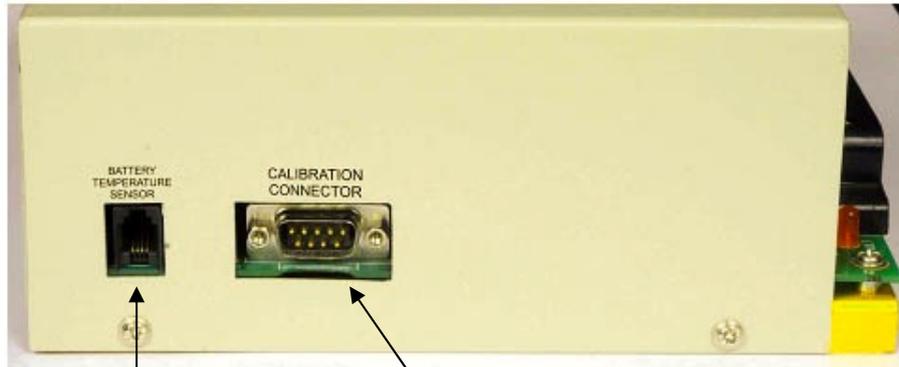# CC MPPT User's Manual

Introduction

Congratulations! You are the proud owner of one of the best MPPT charge controllers available in India. Please read this manual carefully before installing and operating the charge controller. Systellar Innovations offer MPPT charge controllers in the following models:

Product Models	Nominal Battery Voltage	Maximum Charging Current	Maximum Solar Panel Voc
1. CC-MPPT-1224-20	12 / 24 volts	20 amps	70 volts
2. CC-MPPT-36-20	36 volts	20 amps	100 volts
3. CC-MPPT-48-20	48 volts	20 amps	100 volts
4. CC-MPPT-1224-40	12 / 24 volts	40 amps	70 volts
5. CC-MPPT-36-40	36 volts	40 amps	100 volts
6. CC-MPPT-48-40	48 volts	40 amps	100 volts
7. CC-MPPT-1224-20H	12 / 24 volts	20 amps	150 volts
8. CC-MPPT-36-20H	36 volts	20 amps	150 volts
9. CC-MPPT-48-20H	48 volts	20 amps	150 volts
10. CC-MPPT-1224-40H	12 / 24 volts	40 amps	150 volts
11. CC-MPPT-36-40H	36 volts	40 amps	150 volts
12. CC-MPPT-48-40H	48 volts	40 amps	150 volts

These charge controllers can work with Solar Photo Voltaic Panels with wide power and voltage range. They track the maximum power point dynamically to extract maximum possible power from the solar panels. A three stage battery charging algorithm (Boost, Absorption and Trickle charge) is implemented which can charge battery with precise current and voltage to achieve fast battery charging yet ensuring long battery life.
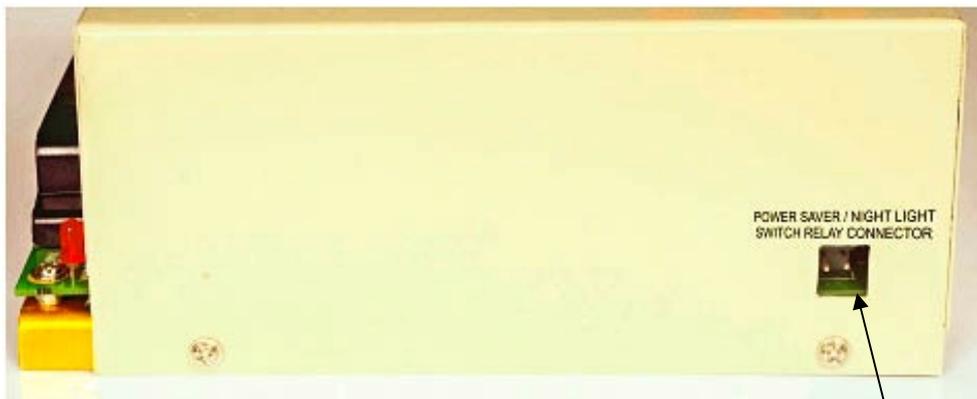

Note: For product enhancement, product parameters can be changed without notice.

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Left Side View

For connecting
external Battery
temperature
sensor(Optional

For system calibration
only. Do not connect
anything here

Right Side View

POWER SAVER / NIGHT LIGHT
SWITCH RELAY CONNECTOR

Power Saver / Night
Light Relay
Connector
(Optional Accessory)

Installing the Charge Controller

1. Install the Charge Controller indoors near the battery bank at eye level. This will make it easy to read the LCD display and make any changes in the settings.

2. Connect the battery using minimum 4 mm sq. cables for 20 amp models and 8 mm sq. for 40 amp models. It is better to use even thicker battery cable to reduce power loss in the cable. Keep cable length small to minimize losses. First connect battery cable and then the solar panel cable. Observe correct polarity while connecting wires from battery and Solar panels. If wires are connected in wrong polarity, the Batt. connection fault LED / SP connection fault LED will start glowing. Correct the polarity before proceeding further.

3. As soon as the battery cables are connected, the Charge Controller will start working and its display will start showing various messages.

4. Check open circuit voltage of the solar panels:

   For model CC-MPPT-1224-xx, maximum solar panel voltage should be less than 70 volts. This means that maximum three 12V solar panels (V_{oc} 19 – 21V) can be connected in series. Any number of such series strings may be connected in parallel to increase the power of the solar panels. If 24V solar panels are used (V_{oc} 36 – 43V), then these panels should not be connected in series. These panels should only be connected in parallel to each other.

   For model CC-MPPT-36-20 and CC-MPPT-48-20, maximum solar panel voltage should be less than 100 volts. This means that maximum four 12V solar panels (V_{oc} 19 – 21V) can be connected in series. If 24V solar panels are used (V_{oc} 36 – 43V), then two panels may be connected in series. Any number of such series strings may be connected in parallel to increase the power of the solar panels.

   *** Note 1: Connecting higher than rated solar panel voltage to the charge controller may damage it and will void warranty coverage. Max. Voc specified for a model should be 5 to10 volts less than the maximum specified solar panel voltage.

   *** Note 2: In case solar panel voltage nears the maximum solar panel voltage specified for the model (75 volts for MODEL_1224, 95 volts for MODEL_36 / MODEL_48 or 140V for 'H' suffix models) the system will not start charging the battery. Instead message 'Fault, V_SP too high' will be displayed on the LCD. Once solar panel voltage goes below 72 volts / 90 volts / 130 volts respectively, the system will be automatically reset to start normal operation.

5. Connect solar panel to the charge controller in correct polarity. If the solar panel voltage is above 60 volts, take care not to touch solar panel cable ends with bare hand. It may give electric shock. Once connections are made, if it is day time, the battery charging will start after about 30 seconds.

Setting programmable parameters

To enter "Adjust Parameter" mode, keep the NEXT key pressed for 2 seconds. It will turn on the back light of the LCD and display the first parameter with its present value. To increase the value, press INCR key. To decrease the value, press DECR key. Note that the value of the parameter will not go beyond its preset limits. When NEXT is pressed, the displayed value of the parameter is written in the MEMORY and the display goes to the next parameter. Press NEXT key for 2 seconds to come out of 'Adjust parameter mode'. If no key is pressed for 20 seconds, it automatically comes out of Adjust parameter mode. Note that in this case, the value of the last parameter is not written in MEMORY.

`LCD Display Messages*`

		LCD line 1	LCD line 2
Initial display messages:	Message 1: Company name. In case the system is uncalibrated, line 2 displays "Sys Uncalib"	Systellar	Innovations
	Message 2: Line 1 displays the CC Model and line 2 the software version	CC-MPPT-1224-20	Sw ver. 3.00
DAY time messages when battery is being charged	Message 1: Line 1 displays PV panel voltage and current. Line 2 displays PV power in Watts and the cumulative KWHr	PV:029.5V 04.6A	136W 12.345KWHr
	Message 2: Line 1 displays Battery voltage and charging current. Line 2 displays the charging mode. In case Equalizing mode has been set, line 2 displays 'E' in the last column.	Batt:12.9V 10.2A	Boost Chg
	Message 3: Line 1 displays the load current. In case the load is Off, it displays "Load is Off". Line 2 displays relay status. If Relay is set to be used as Power Saver it displays "PSaver is On/Off". In case Relay is set to be used as Night Light Switch, it displays "Night Light:On/Off"	Load cur: 12.5A	PSaver is On
	Message 4: Line 1 displays temperature. In case optional battery temperature sensor is installed, it displays battery temperature else it displays ambient temperature. Line 2	Temp: 33 deg C	Day:0.230KWHr

	displays 'Day' and the energy collected form the solar panels today in KWHr units		
Night time messages	Message 1: Line 1 displays Battery voltage. Line 2 displays "Nite" (Night) and the energy collected by the solar panels during the day which has just ended.	`Batt: 12.7V`	`Nite:  1.526KWHr`
	Message 2: Line 1 displays the load current. In case the load is Off, it displays "Load is Off". Line 2 displays relay status. If Relay is set to be used as Power Saver it displays "PSaver is Off". In case Relay is set to be used as Night Light Switch, it displays "Night Light:On/Off"	`Load cur: 12.5A`	`Night Switch: On`
Adjust Parameters messages	End of Charging Voltage: (Default: 14.2V, Range: 13.6 – 14.5V)	`End of Charging`	`Voltage: 14.2V`
*Note: The voltage shown in the table are for 12V battery bank. For 24V, 36V and 48V battery banks, these voltages will be 2, 3 and 4 times respectively.	Trickle Charging voltage: (Default: 13.6V, Range: 13.2V – 14.0V)	`Trickle Charging`	`Voltage: 13.6V`
	Equalizing Charge voltage: (Default:14.6V, Range: 14.0V – 14.8V)	`Equalizing Chg`	`Voltage: 14.6V`
	Max. Charging current: (In 20A models Default: 20A, Range: 5A – 20A, step 2.5A) (In 40A models Default: 40A, Range: 5A – 40A, step 2.5A)	`Max. Charging`	`Current: 20A`
	Absorption Time:	`Float Hold Time:`	`Min. 5-150:030`

	Default: 30 minutes, Range 5 – 150 minutes. This is the time for which the battery voltage is held at its end of charge voltage while charging, before it is reduced to the trickle charge voltage. Recommended values for this parameter are: Flat plate battery: 60 minutes Tubular battery: 150 minutes SMF (Sealed Maintenance Free) Battery: 5 minutes		
	Load Control code: Always On: 0, Dusk to dawn On: 1 2 – 14 Number of hours On after dusk	Load Ctrl Code:	A On:0, 1-14:
	Relay Usage: (0: Power Saver Normal, 1: Night Switch, 2: Power Saver Extended)	Relay Usage:	0/2 Psvr,1 NSw:1
	In case Relay usage is set as Power Saver Normal or Power Saver Extended, it displays: Power Saver Off Voltage: (Default:11.5V, Range: 11.2 – 11.8V)	Power Saver Off	Voltage: 11.5V
	In case Relay usage is set as Night Light Switch, it displays messages as shown here. Code 1 is for Dusk to Dawn operation of the night switch and 2 – 14 Number of hours On after dusk (Default: 4)	Night Light Sw:	1D-D 2-14 Hrs:04

*Note: The voltage shown in the table above are for 12V battery bank. For 24V, 36V and 48V battery banks, these voltages will be 2, 3 and 4 times respectively.

Intelligent Absorption charge time adjustment:

Absorption charge time can be set by the user from 5 to 150 minutes. Once the absorption time is over, the battery goes in Trickle charge mode and the battery terminal voltage is reduced to 13.6volts. During night, there will be no power from the solar panel and the battery may be partially discharged during the night. Next day when solar power is available, CC-MPPT will intelligently determine the Absorption Charge time based on the battery usage last night. The following logic is used to determine the absorption charge time.

In case the battery voltage is below 12.4V for say N minutes, Absorption time will be set to N minutes (subject to the maximum value set in the parameter 'Absorption time'). If the battery voltage is below 12V for N minutes, the absorption time will be increased by 2 x N minutes. And if the battery voltage is below 11.6V for N minutes, the absorption time will be increased by 4 x N minutes. However, the maximum absorption time will be the Absorption time set by the user.

Setting Equalizing charging mode:

It is useful to "overcharge" the battery bank for a limited period of time once every month. This is especially helpful when several batteries are connected in series (like 24V, 36V or 48V battery bank). It helps in equalizing the charge in all the cells of the battery bank by bringing them to full charge. The electrolyte in the batteries is also homogenised by agitation during gassing at the time of "overcharge". In Systellar MPPT charge controller, equalizing charge can be set by pressing the NEXT key twice in quick succession. To confirm that equalization charging mode has been set, check the day time display message 2. If equalizing mode is set, 'E' is displayed in the last column. In case NEXT key is pressed twice in quick succession, when equalizing mode is already set, the equalization mode is reset.

Note that when equalization mode is set, it does not go to equalization charging mode immediately. Equalization charging is the last leg of battery charging. In equalizing charging mode, instead of stopping the battery voltage at "end of charge" voltage, the system will allow the battery to go up to "Equalizing Charge voltage" and it will maintain it there for a total period of 60 minutes. Once this time period is over, the battery will go into "Trickle charging mode" and equalizing mode will be automatically reset.

Relay Usage options:

There are 3 settings for the usage of the external relay:

0: Power Saver Normal

1: Night Light Switch

2: Power Saver Extended

In Power Saver Normal (0) and Power Saver Extended (2) modes, the external relay (Common - N/C) is connected at the inverter mains input. When Power Saver is On, mains supply to the inverter is cut off.

In both these modes, power saver relay turns on at sunrise when solar panel voltage is more than 15V (or 27V / 40V and 52 volts respectively for 12V / 24V / 36V / 48V battery banks). The second condition for power saver relay turning on is that battery should be in trickle charge mode or battery voltage should be equal to or greater than 13.5V.

Note: For product enhancement, product parameters can be changed without notice.

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In **Power Saver Normal** mode, relay turns off approx. 2 hours before sunset or when battery has been discharged to 'Power Saver Off Voltage'.

In **Power Saver Extended** Mode, relay turns off only when battery has been discharged to 'Power Saver Off Voltage'. i.e. the power saver will remain on even at night if battery voltage remains above 'Power Saver Off Voltage'. This mode is useful for minimizing electricity bill if solar energy is normally sufficient to run the load during the day as well as night.

**Reading of energy collected in last 3 days:**
You can see the energy collected by CC-MPPT in last 3 days by pressing the INCR key for 2 seconds. The display will show the total energy in the first row and the energy collected in last 3 days in the second row (In KWHr units).

Sleep mode:
At night, if CC-MPPT is idle (i.e. no key is pressed for 5 minutes), the system will go in to SLEEP mode. In this mode, the LCD display will show "Sleeping… / Press NEXT". The system will "wake up" automatically the next morning or when NEXT key is pressed by the user. This is done to further reduce the idle current drawn by CC-MPPT from the battery.

Optional Accessories

1. Battery Temperature sensor
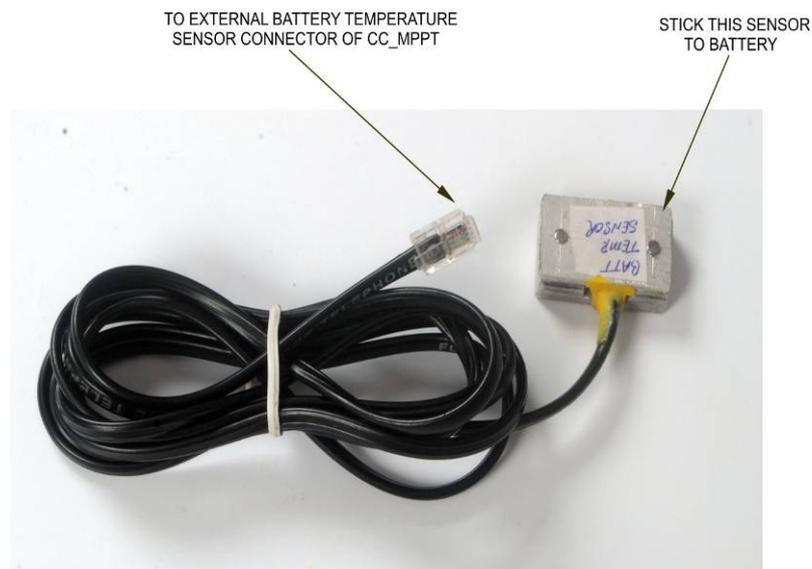

External Battery Temperature Sensor

Battery temperature sensor is supplied as an accessory. Paste the temperature sensor on the battery side using double sided tape. Insert the 4 pin RJ11 connector at the end of the temperature sensor cable in the socket provided on the left side of the charge controller.

Note: For product enhancement, product parameters can be changed without notice.

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2. Power Saver / Night Light Switch Relay box:

Power Saver/Night Light Switch Relay Box

**For use as power saver:**
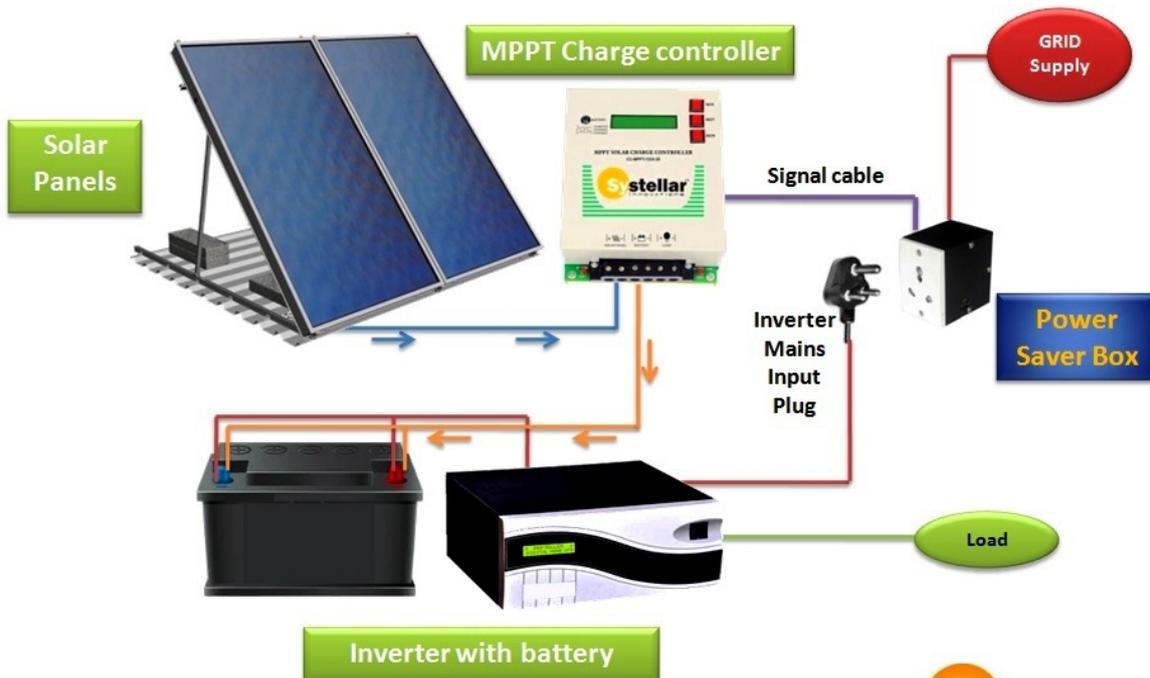
Power Saver Connection Diagram

Program the parameter 'Relay usage' to 0 (Power Saver Normal) or 2 (Power Saver Extended). Set appropriate Power Saver Off voltage. If you want to use maximum solar energy set this voltage nearer to 11.2V. However if you want to minimize the possibility of battery getting discharged (in case of grid supply failure) then set it nearer to 11.8V

Inside the relay box the tag going to the output socket should come from the N/C contact of the relay. This will cause the mains supply to the inverter to be cut when relay is On.

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Connect the power plug of the relay box in a power socket. Connect inverter mains cord to the socket provided on the Relay box. Connect the 2 pin PV connector to the relay drive output connector on the right side of the charge controller.

Now when the battery charge voltage is more than 13.5 V / 27 V / 54 V, the relay will turn on. This will cut-off the mains supply to the inverter and thus save electricity. Note that in this condition, the load connected from the inverter will be driven by the battery while the battery is being charged by the solar panels.

For use as Night Light Switch:
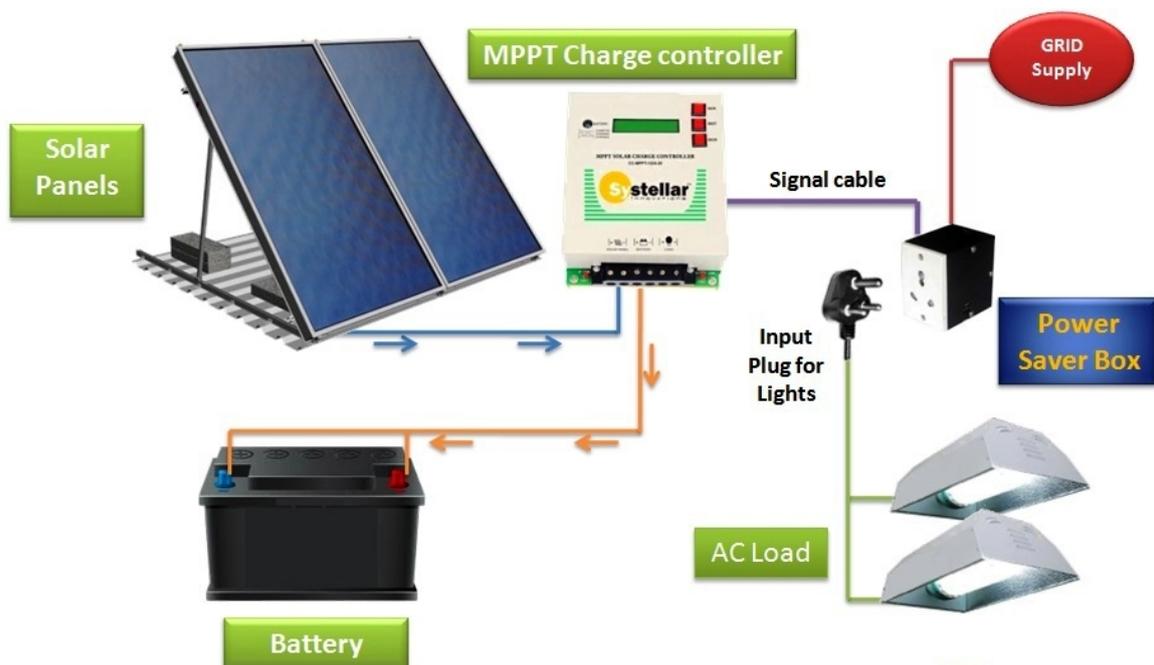
Night Light Switch Connection diagram

Program the parameter 'Relay usage' to 1 (Night Light switch). Set Night Light switch parameter to 1 for dusk to dawn operation or 2 – 14 hours of operation after dusk.

Inside the relay box the tag going to the output socket should come from the N/O contact of the relay.

Now the relay will be turned on at dusk and remain on till dawn or for number of hours as set in the parameters. When the relay is on, the night light connected on the socket of the relay box will be supplied power through the relay.

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Technical specifications

	CC-MPPT-1224-20/40	CC-MPPT-36-20/40	CC-MPPT-48-20/40
Technology	Dual Channel Interleaved Buck Converter		
Battery bank voltage	12 / 24V	36 Volts	48 Volts
Maximum charging current:	20 A / 40 A	20 A / 40 A	20 A / 40 A
Maximum solar panel voltage:	70 Volts	100 Volts	100 Volts
Maximum power point voltage range	Battery voltage to 70V	Battery voltage to 77V	Battery voltage to 77V
Buck converter duty cycle range	0 – 100%	0 - 100%	0 - 100%
Idle current from battery (typical)	21 / 18 mA (Sleep mode)	21 / 18 mA (Sleep mode)	21 / 18 mA (Sleep mode)

Other Features

1. When load is On, battery is connected to load output. Load output is designed for maximum 20A DC Current. In case this current is exceeded, the load is Shut Off. In this case "Overload Shutoff" message is displayed. Reduce load and press NEXT key for 2 Seconds to reset Overload shutoff condition.

2. In case battery voltage drop below 11.2/22.4/44.8V again the load is shut off. It will automatically reset when battery voltage rises above 12V / 24V / 48V. Press NEXT key for 2 Seconds to reset this condition manually.

3. To reset all programmable parameters to their factory default values and to reset the total energy harvested KWHr value, remove solar panel and battery connections. Then keep INCR and DECR keys pressed while connecting the battery connections. After a few seconds "Writing default parameters" message will be displayed and all parameters will be reset.

User Manual revision status: Revision date: 07/04/2015 for SW ver 3.14

Company Contact details:

Systellar Innovations
Shankar Chowk, Delhi Road, Meerut – 250002
Ph: 0121-2400394 | Email: info@systellar.in
www.systellar.in

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