

# SmartCharger

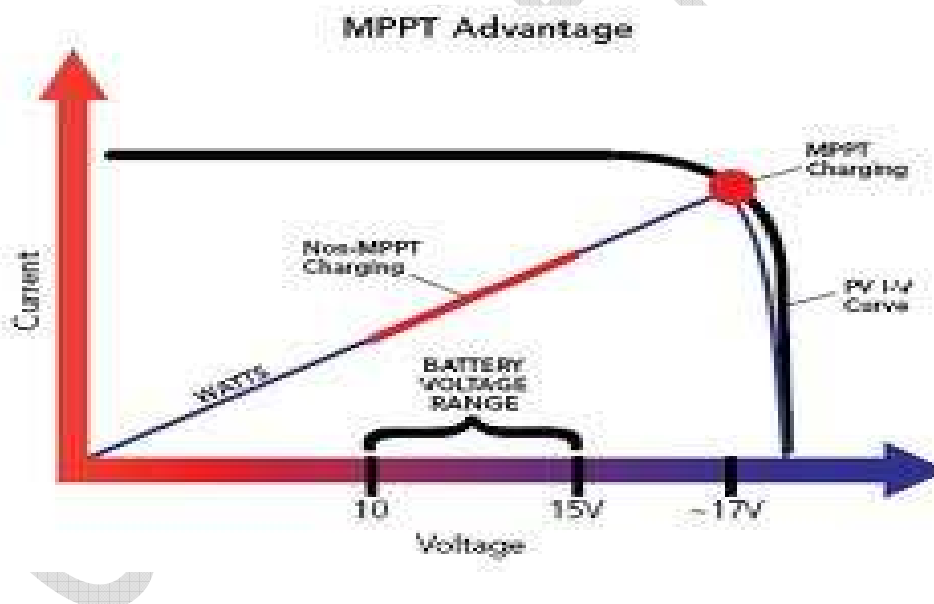
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## Features

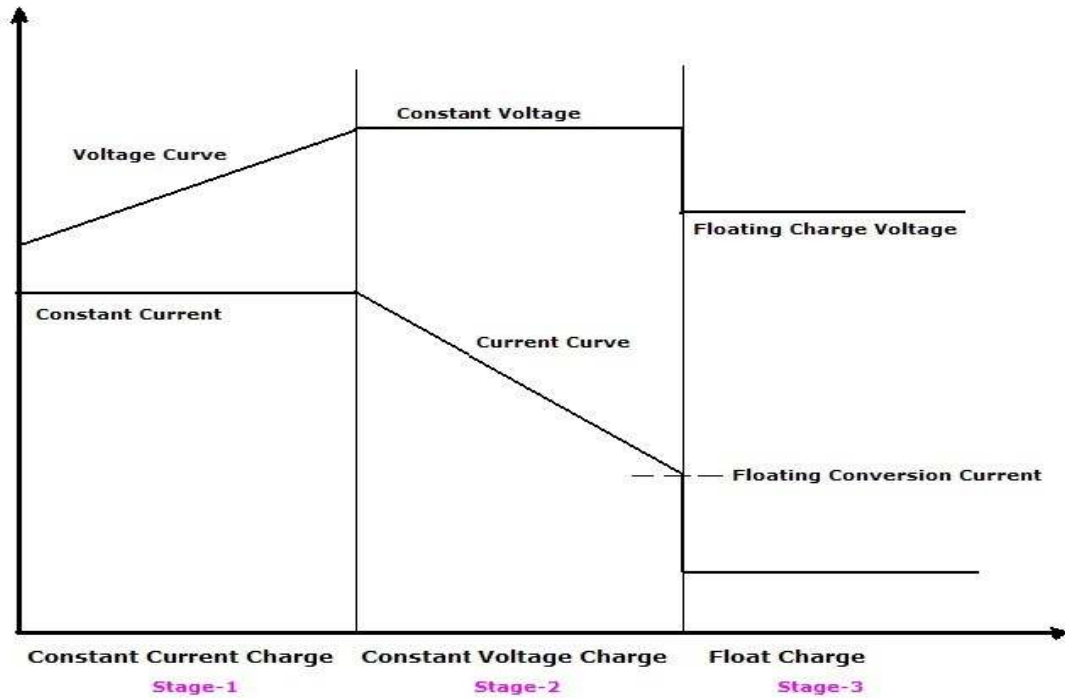
- MCU based buck converter.
- MPPT Technology, efficiency is improved by more than 20%.
- First in its class LCD with Power and Energy measurement.
- Menu settable configuration using 2x16 LCD and 3 push buttons.
- Menu settable Battery voltage, battery current, Float voltage and Float current.
- Three stage Charging.
- Over voltage/Over current protection.
- Optically Isolated output to control Mains charger and Inverter.

## Description.

This charger is MCU based Buck converter with menu settable charge parameters. It uses MPPT charging algorithm to maximize harvested energy.



Smart Charger incorporates three stage charging algorithm. Charging pattern is graphically depicted below. All set points can be configured using menu.



Recommended settings for battery charging		
PARAMETER	12V NORMAL BATTERY	12 V TUBULAR BATTERY
Maximum charging voltage	14.4	14.4
Charging Current	10 % of AH value	10 % of AH value
Float Voltage	13.6	13.6
Floating Current	3% of charging Current	3% of charging Current

## 1. Connection Diagram

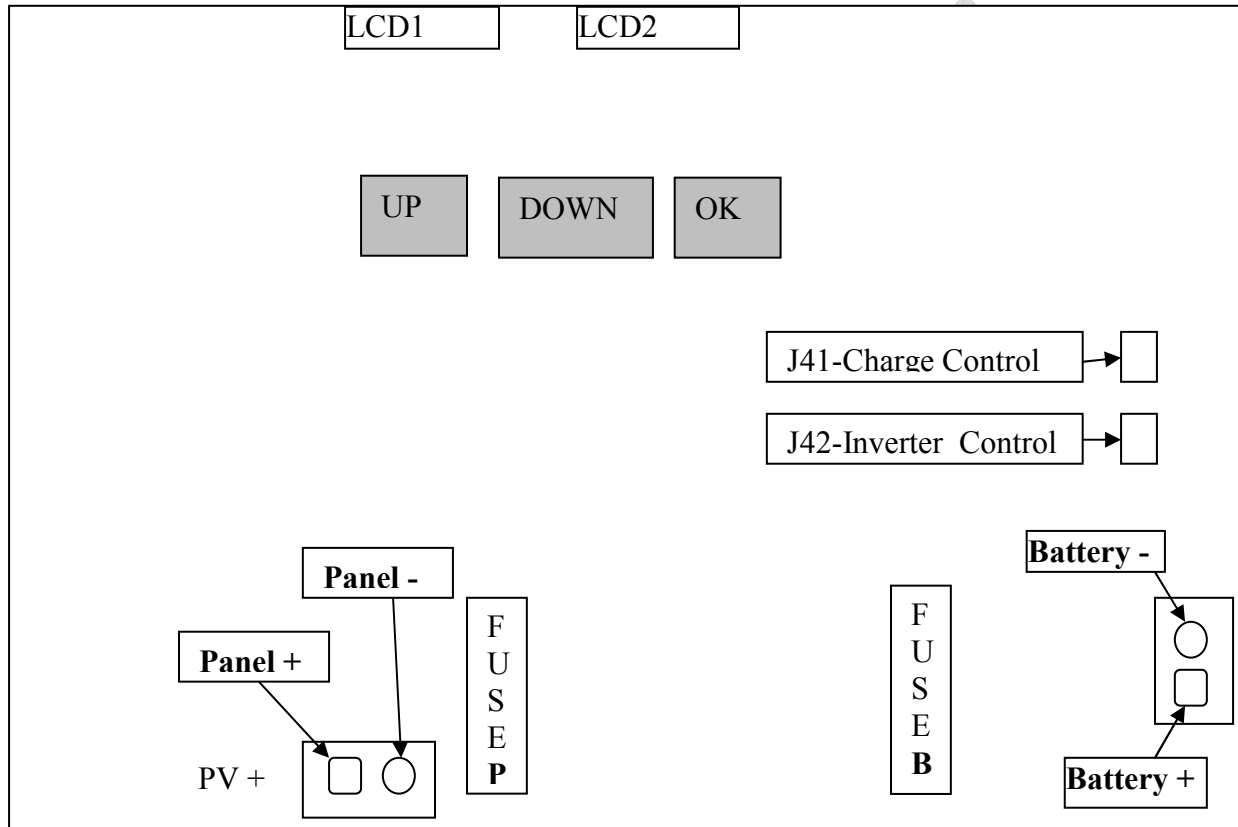
Board layout is shown below. Connection details are as below.

- LCD1 : Connection to LCD.
- LCD2 : Connection to LCD.
- UP : Push Button UP. Used to move Menu data UP.
- DOWN : Push Button DOWN. Used to move Menu DOWN. Pressing UP and DOWN button for 3 seconds would enable Menu for view/edit.
- OK : Push Button OK. Used to make Menu in edit mode and accept changes.
  
- J41- : Opto output connector for mains charger control. Square pad should be connected to negative.
- J42- : Opto output connector for inverter control. Square pad should be connected to negative.

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- Panel+/- : Positive and negative terminals for Solar Panel(Ensure correct Polarity).  
Battery +/- : Positive and negative terminals for battery(Reverse connection would : blow Fuse-B)  
FUSEP : Panel side Fuse.  
FUSEB : Battery side Fuse.



## 2. Normal Operation.

1. During normal operation LCD scrolls between Voltages and currents of PV and Battery on page 1 and Power and Energy on page 2 if power/Energy display is enabled on Menu.

- LCD displays BA(battery), PV(Solar panel) parameters as below.
- Press UP key to watch any page continuously.
- Press Down key to start scrolling again

BA	12.9V	09.6A
PV	17.5V	07.0A

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- See push button layout below.



- LCD displays Solar Power and energy parameters on page-2 as below. Energy data is stored in nonvolatile memory so it is not lost while charger is OFF or no light condition.

```
Power :115.03 W
Kwh   :7342.23 U
```

### 3. Configuration Setting.

Charger configuration parameters can be viewed and edited using MENU keys. charger parameters are stored in EEPROM to avoid data loss during power failure. See explanation for each configuration parameter below.

<b>Configuration Parameters.</b>		<b>Range</b>
<i>Voltage and Current setting should be multiplied by 10. Eg: To set 13.6 volt enter 13.6*10=136, similarly to set 500ma(0.5A) enter 0.5A *10 =5</i>		
<b>max_BV</b>	Maximum Battery Voltage. This is the constant voltage in stage-2 of the above graph. Unit will not allow charge voltage go above this level.	100-355
<b>max_BI</b>	Maximum charge current. This is the constant current in Stage-1 of the above graph. This can be used to limit charging current to the recommended level.	0-500
<b>minPV</b>	Minimum PV voltage to start charging.	0-255
<b>minBI</b>	Minimum battery current to switch off Mains charger output.	0-255
<b>FL_BV</b>	Float Charge Voltage. This refers to the floating charge voltage in stage-3 of the above graph. Once charger reaches stage 3 and charge current fall below float current, charger will try to maintain terminal voltage to this level.	100-355
<b>FL_BI</b>	Float Charge Current. When charge current falls below this level and battery terminal voltage is above float voltage	

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	stage -3 is initialized and terminal voltage is maintained at or below float voltage.	
<b>invON</b>	Battery Voltage at which Inverter Output is ON.	100-355
<b>invOF</b>	Battery Voltage at which Inverter Output is OFF.	100-355
<b>DELAY</b>	Delay for Inverter and Mains Changeover.	0-255
<b>BKLT.</b>	LCD switch off time in seconds. If 0 LCD will never be switched OFF.	0 -255
<b>MODE_</b>	Power/Energy Display enable. To enable set to 001, or 000 to disable Power/Energy display.	000-001

## 4. Menu Operation.

2. Press and hold UP and DOWN Button.
  - LCD displays Charger parameters as below.

```
maxBV 145 145
```

3. Use UP/DOWN Key to scroll thru menu.
  - For example to set maxBI to 16.0 volt.
  -

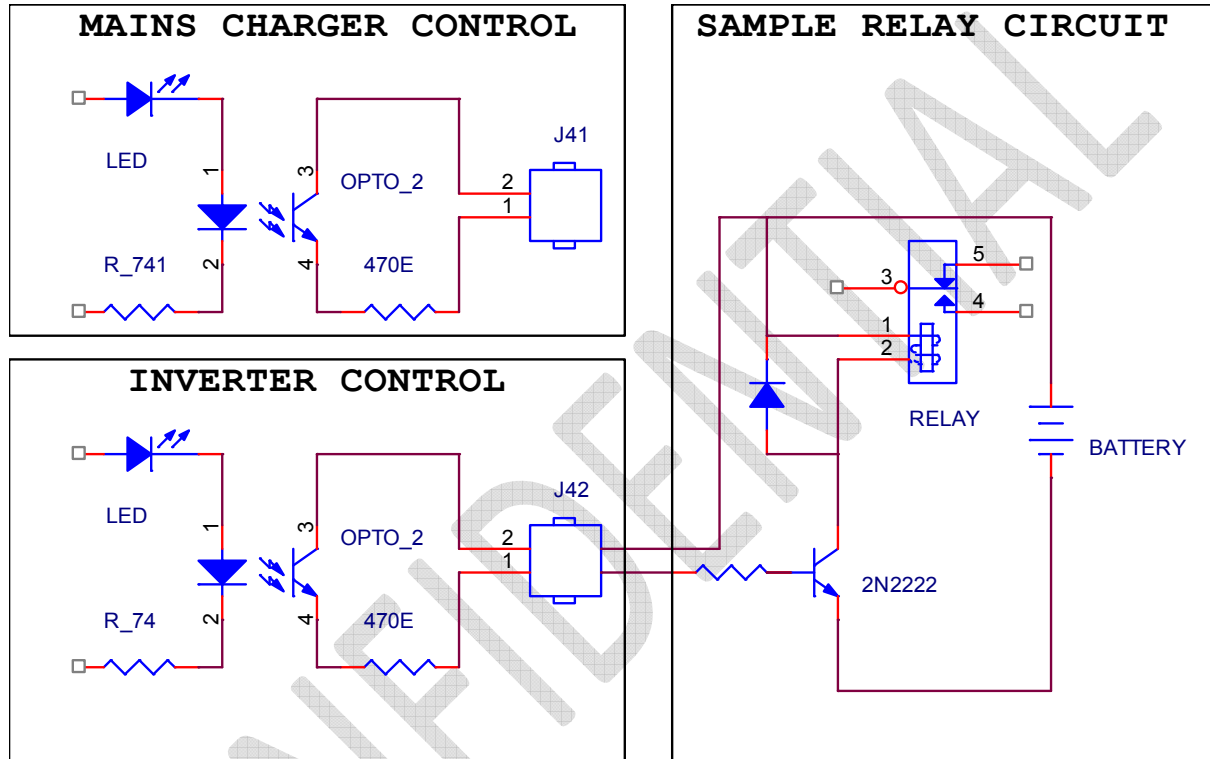
```
maxBI 145 145
```

4. Press OK key if Parameter need to be changed.
  - For example to change maxBI press Ok key
5. Use UP/DOWN and OK key to change the parameter.
  - Use UP/DOWN key to change the first digit of parameter.
  - Use OK key to change the second digit.
  - Use the UP/DOWN and Ok key combination to change all the three digits.
6. Use OK Key again to confirm the change and store the new parameter in EEPROM.

```
maxBI 160 160
```

## Control outputs.

Smart Charger has two optically isolated outputs to control Mains charger and inverter. Figure below shows its connection diagram.



*\*J41/J42 Pin 1(Square pad on PCB) should be connected to the negative side.*

## Mains Charger Control.

First output(J41) is used control mains charger. When the charge current exceeds minBI set in Menu for more than set delay time (Menu item DELAY) OPTO\_1(J41) switches ON. This output can be used to switch OFF Mains charger. When the charging current falls below minBI for more than DELAY seconds J41 switches OFF. DELAY( in seconds) should be set properly to avoid oscillation.

## Inverter Control.

Second output(J42) is used to control inverter. When battery voltage exceeds invON voltage set in Menu for more than DELAY J42 output is

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switched ON. This can be used to switch ON inverter to drain the battery. When battery voltage falls below invOF voltage set in Menu for more than DELAY J42 output is switched OFF. This can be used to switch OFF inverter.

## **How to connect Relay using opto outputs.**

Opto out put can be used to control mains charger/inverter in many ways. We use 4N33 opto with 470E current limiting resistor at the output. This can be used to switch ON a relay using transistor circuit as shown in the diagram. When the output is ON opto output transistor conducts and provide base bias to the transistor to switch On the relay. When opto output is OFF it acts like open circuit and stop base current to the transistor and thus switch OFF the relay.

Important Parameters of 4N33	
VCEO(break down $i_F = 0$ )	30Volt
ICEO Collector emitter Leakage current( $I_F = 0$ )	100nA
VCE(saturation)	1volt
Collector current - $I_C$ (max)	125ma
Current Transfer Ratio(CTR)	500

## **Technical specification:**

Model	12V/20A/40 A	24V/20 A/40A
Min PV input Voltage	14.5(Recommend 20-25volt panel)	28(Recommend 40-50Volt Panel)
Max PV Input Voltage	25	50
MPPT	YES	YES
Battery V and I Display	Only in LCD model	Only in LCD Model
PV V and I Display	Only in LCD Model	Only in LCD model
Charge Indication	LED	LED
Battery Over Voltage protection	Yes/Field settable*	Yes/Field settable*
Battery Over Current protection	Yes/Field settable*	Yes/Field settable*
Battery Reverse Protection	Yes	Yes
Panel Reverse Protection	Yes	Yes