PROJECT REPORT ON

"MPPT CHARGE CONTROLLER"

Submitted By:

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Under The Guidance Of :

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Department of Electrical & Instrumentation

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DEPARTMENT OF ELECTRICAL & INSTRUMENTATION,

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<u>CERTIFICATE</u>

This is to certify that **Ayush Anand (Roll No. 4230302) and Manish Kumar (Roll No. 6220024)** have successfully completed the project titled "**MPPT CHARGE CONTROLLER**" at **DEPARTMENT OF ELECTRICAL & INSTRUMENTATION**

 Under my supervision and guidance in the fulfilment of requirements of 6th Semester, **B.Tech (ELECTRICAL & INSTRUMENTATION Engineering)** of **DEPARTMENT OF ELECTRICAL & INSTRUMENTATION, KURUSHETRA UNIVERSITY, KURUSHETRA.**

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Prof. Surinder Singh   **Prof.**

  (CHAIRPERSON)   **(Project Guide)**

<u>ACKNOWLEDGEMENT</u>

We deem it a pleasure to acknowledge our sense of gratitude to our project guide Prof._____ under whom we have carried out the project work. His incisive and objective guidance and timely advice encouraged us with constant flow of energy to continue the work.

We wish to reciprocate In full measure the kindness shown by **Prof. Surinder Singh** (Chairperson, DEPARTMENT OF ELECTRICAL & INSTRUMENTATION Engineering) who Inspired us with his valuable suggestions in successfully completing the project work.

Finally, we must say that no height Is ever achieved without some sacrifices made at some end and It Is here where we owe our special debt to our parents and our friends for showing their generous love and care throughout the entire period of time.

Date:30/06/2023   _____

                                                                          Ayush Anand

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INTRODUCTION

An MPPT (Maximum Power Point Tracker) is an electronic DC to DC converter (Synchronous Buck Converter) that optimizes the match between the solar array (PV panels), and the battery bank or utility grid. To put it simply, they convert a higher voltage DC output from solar panels (and a few wind generators) down to the lower voltage needed to charge batteries.

The main advantage of MPPT Solar charge Controller is while charging it convert the extra voltage into current which make it to operate at maximum power point and also make it more efficient.

BLOCK DIAGRAM:
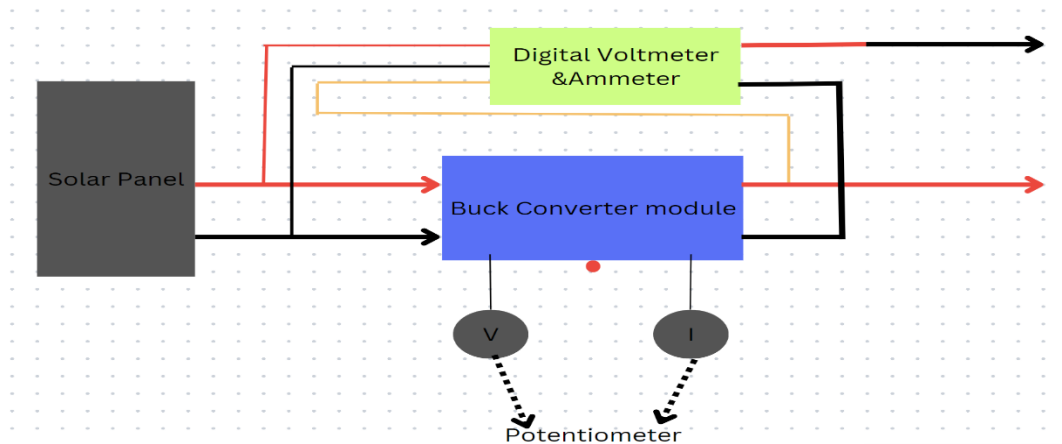
SPECIFICATIONS:

Based on MPPT algorithm:

LED indication for the state of charging

Over Voltage Protection

Short-Circuit Protection

Electrical SPECIFICATIONS:

Input Supply Voltage – 5 to 40 volt

Output Voltage -1.2 to 35 volt

Output Current – 8 A (10 A max)

Power 300 W (max)

Conversion Efficiency 95 %

Operating Frequency 300 kHz

No Load Current 20 mA

Components Required:

Digital Display of Voltmeter (0 to 100 volt) & Ammeter (10 Amp)

Potentiometer (10K)

Banana Plug & Socket Connector

Connecting Lead

3-Pin LED (Red & Blue)

For Buck Converter Module(300W):

Voltage Regulator (7805)

Shunt Regulator Diode (TL431)

Op-amp (LM358)

DC to DC Converter IC (XL4016)

Schottky Diode (B2045)

Inductor (33 µH)

Capacitor (470 µF ,1000 µF)

Resistor

Heat Sink

Buck Converter
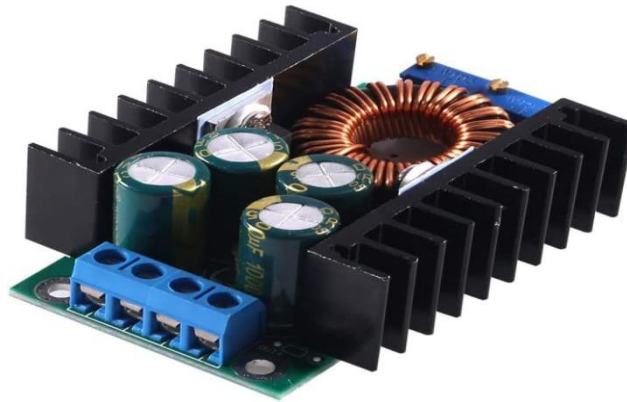
The 300W 10A DC-DC Step-down Buck Converter Adjustable Constant Voltage Module can be used to get adjustable output voltage ranges from 1.5V to 35V. The module provides a wide range of current output up to 10 A.

To enhance the stabilization in output voltage has four high-frequency capacitance which gives the lower output ripple. Double heat sink design provides easy and fast heat dissipation. MOS Schottky diode independent heat sink, which heat dissipation is good, and wont affect each other. Also using large size Sendust Core and double pure copper wiring, improve working efficiency, reduce fever.

CIRCUIT DIAGRAM:
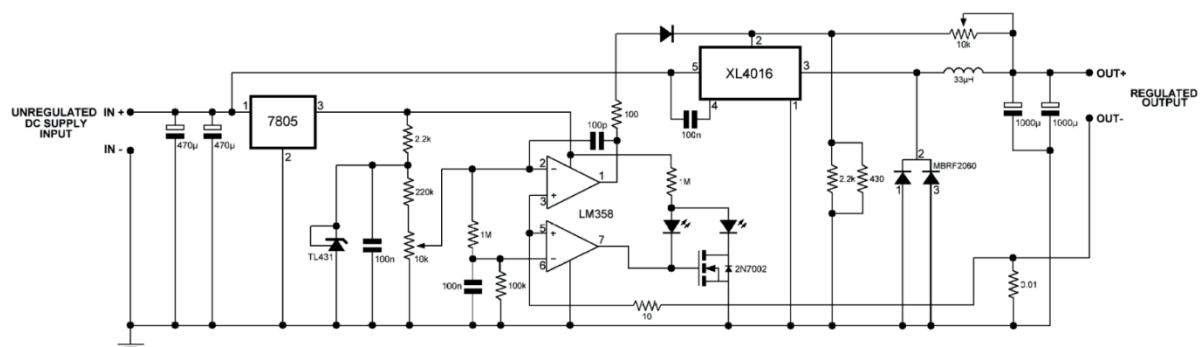

DC to DC Converter IC (XL4016):

- ❖ It is a PWM Buck (DC to DC) Converter IC.
- ❖ It's Operating Frequency is Fixed that is 180 kHz.
- ❖ PWM control circuit able to adjust the duty ratio linearly from 0 to 100 %.
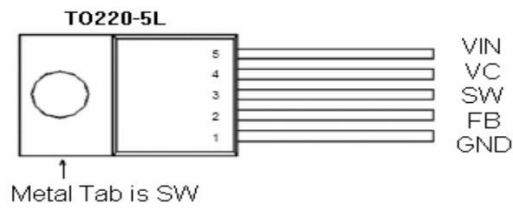
Pin Configuration of XL4016

Pin No.	Pin Name	Description
1	GND	Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into XL4016.
2	FB	Feedback Pin (FB). Through an external resistor divider network, FB senses the output voltage and regulates it. The feedback threshold voltage is 1.25V
3	SW	Power Switch Output Pin (SW). SW is the switch node that supplies power to the output.
4	VC	Internal Voltage Regulator Bypass Capacity. In typical system application, The VC pin connect a 1uf capacity to VIN.
5	VIN	Supply Voltage Input Pin. XL4016 operates from a 8V to 40V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.

## Application Circuit:
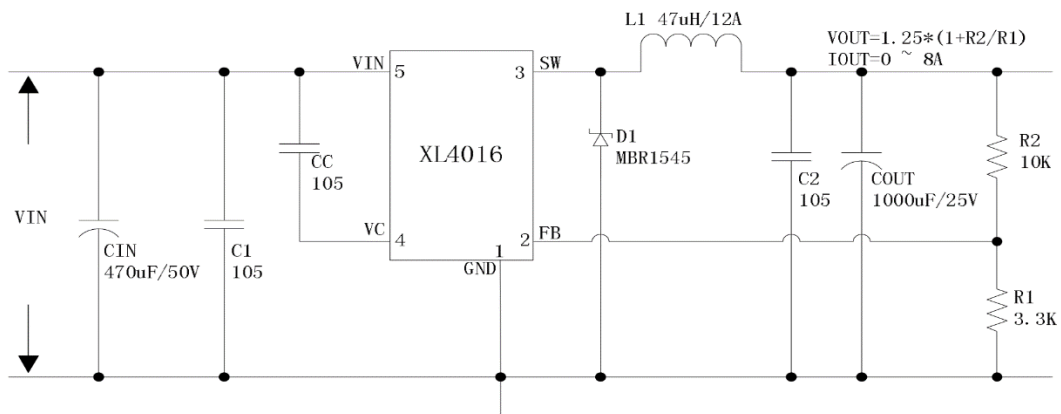
Shunt Regulator Diode (TL431):

TL431 operates as a shunt regulator, it is used as a positive voltage reference for the comparator circuit.

Internal Functional Block Diagram

TO-92 Package IC

Symbol in Circuits
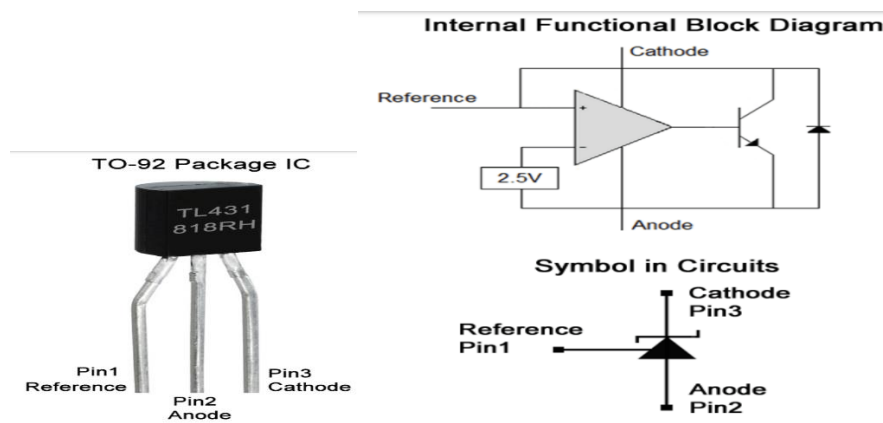
The output voltage can be adjusted from 2.5V to 36V with the help of a resistor divider connected with its reference pin or pin1.It can be used as a replacement for the zener diode in wide variety of applications because it works just like a zener diode the only difference is that its output is adjustable.

Through this circuit we regulate (adjust) the output voltage of the buck converter as per the need.
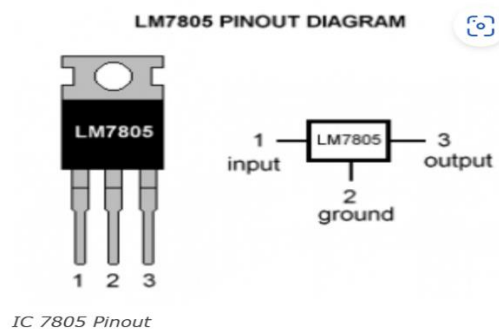
Application Circuit:
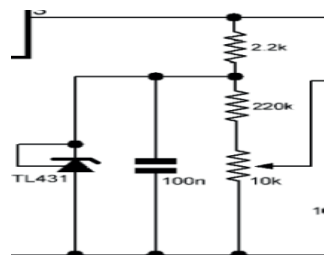
Voltage Regulator (7805):

A voltage regulator IC maintains the output voltage at a constant value. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

In this converter, LM7805 provides 5V input voltage to the op-amp (LM358) which operates as a feedback voltage comparator.

LM7805 PINOUT DIAGRAM

IC 7805 Pinout

Pin No.	Function	Description
Input	Input voltage (7V-35V)	In this pin of the IC positive unregulated voltage is given in the regulation
Ground	Ground (0V)	In this pin where the ground is given. This pin is neutral for equally the input and output.
Output	Regulated output; 5V (4.8V-5.2V)	The output of the regulated 5V is taken out at this pin of the IC regulator.

Op-amp (LM358):

A comparator is a device that compares two voltages or currents and outputs a digital signal indicating which is larger. It has two analog input terminals, V+ and V- and one binary digital output that is low when V- is greater and high when V+ is greater.

The LM358 comparator IC consists of two inbuilt operational amplifiers (Op-Amp), which means two comparators in a single IC.

To use LM358 as a comparator, we need to connect the power source with the Vcc and GND pin of the LM358 IC to activate the IC. Then, we need to provide two input voltages to the Op-Amp for comparison.

In this converter, the op-amp is used as a feedback voltage comparator to compare output voltage & regulated voltage.

Schottky Diode (B2045):

For designing a synchronous & power efficient buck converter, we replace the normal diode by the schottky diode as a freewheeling diode.

It works very efficiently in high frequency application.

It has inbuilt guard ring for over voltage protection.
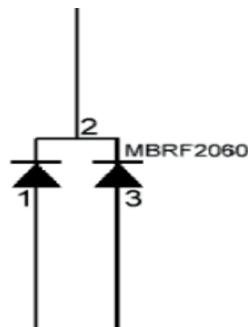
Capacitor:

- ❖ Two ratings of capacitor are used in this converter that is 470 μF & 1000 μF.
- ❖ Two 470 μF capacitor is used as filter at input side and Two 1000 μF capacitor is used as filter at output side.

Inductor:

Inductor is vital component of a buck converter as it make the converter to operate in CCM (Continuous Current Mode). CCM implies that the inductor doesn't fully discharge during the switch-off time.

Digital Display of Voltmeter & Ammeter:

It is the instrument which is used to measure the electrical potential difference & current in a circuit and display the corresponding value digitally.

Specification:

- ❖ Operating voltage (VDC) 5V
- ❖ Current Consumption (mA) 60
- ❖ Test Voltage (V): 0 to 100 V
- ❖ Test Current (A): 1 to 100 Amp
- ❖ Refresh Speed (ms) 500(one time)

Potentiometer:

In this Converter, two 10k potentiometer is used one of which is for output voltage regulation (adjustment) and another one is for output current regulation (adjustment) as per need.
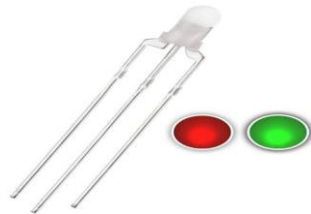
LED:

In this Converter, This LED is used for the indication of state of charging.

When the battery is in charging mode it glows red at that time.

When the battery gets full charge then converter auto cuts the supply to battery and this LED glows blue.

Banana Plug & Socket Connector:

Banana sockets connector pair is intalled at the input & output terminal

Banana plug is installed at solar panel output and battery input to attach with the charger controller.