Capacitor dropper power supply

GITHUB LINK
https://github.com/Ci-Daniels/CAPACITOR-DROPPER-SUPPLY

INTRODUCTION

As the name defines, a transformerless power supply circuit provides a low DC from the mains high voltage AC, without using any form of transformer or inductor.

It works by using a high voltage capacitor to drop the mains AC current to the required lower level which may be suitable for the connected electronic circuit or load.

The voltage specification of this capacitor is selected such that its RMS peak voltage rating is much higher than the peak of the AC mains voltage in order to ensure the safe functioning of the capacitor. An example capacitor that is normally used in transformerless power supply circuits is shown below:

This capacitor is applied in series with one of the mains inputs, preferably the phase line of the AC.

When the mains AC enters this capacitor, depending on the value of the capacitor, the reactance of the capacitor comes into action and restricts the mains AC current from exceeding the given level, as specified by the value of the capacitor.

However, although the current is restricted the voltage isn't, therefore if you measure the rectified

output of a transformerless power supply you will find the voltage to be equal to the peak value of the mains AC, approximately 230V.

But since the current may be sufficiently dropped level by the capacitor, this high peak voltage could be easily tackled and stabilized by using a Zener diode at the output of the bridge rectifier.

The Zenner diode wattage must be appropriately selected according to the permissible current level from the capacitor.

BILL OF MATERIALS:

-Capacitors(2)

- 1 to drop down the voltage from the AC source.
- 1 to act as a filter.

-Zener diode(will be my voltage regulator)

-Diode(4)

- To make the full bridge rectifier.

-Resistor(2)

- 1 to aid in discharging the capacitor on the input side.
- To protect the circuit from power surges.

The rectifier circuit will drop down an AC voltage from 230-240 Vrms to a 5V DC voltage that will be sufficient to power on the ATMEGA328P without damaging it.

CALCULATION OF THE REQUIRED VALUES OF CAPACITOR:

$$Vpeak = VRMS\sqrt{2}$$

$$Vpeak = 240\sqrt{2}$$

$$= 339\text{V}$$

From Ohm's law we need to get the resistance that will be equal to the reactance and from there we can calculate the capacitor value that we need.

$$R = \frac{Vsupply - Vload}{Iload}$$

The load is a bulb rated 12W and 100-250V,50HZ. The current through it is 120mA. The atmega328p requires 5V and a maximum of 800mA.

The choice of the capacitor depends on the:

- Reactance
- The current to be withdrawn

To get the current that will be flowing in the circuit, you need to know the reactance of the capacitor, the AC frequency, and the AC voltage supply.

$$X\ Reactance = \frac{1}{2\Pi*50*2.2\mu F} = 1447\ ohm$$

Value of the current flowing in the circuit:

$$I = \frac{240V}{1447} = 165mA$$

This is the capacitor that will be connected directly to the AC source of power in place of a transformer. Across it a bleeder resistor 470K/1W resistor will be connected to discharge the stored current in the capacitor when the circuit is switched off, thus preventing electric shock.

Rectification

Diodes used for rectification should have sufficient Peak inverse voltage (PIV). The peak inverse voltage is the maximum voltage a diode can withstand when it is reverse biased. 1N4001 diode can withstand up to 50 Volts and 1N4007 has a toleration of 1000 Volts.

The rectifier bridge purpose is to convert sinusoidal AC supply voltage from the mains into pulsating DC voltage.

DC Smoothing

A Smoothing Capacitor is used to generate ripple free DC. Smoothing capacitor is also called Filter capacitor and its function is to convert half wave / full wave output of the rectifier into smooth DC. The power rating and the capacitance are two important aspects to be considered while selecting the smoothing capacitor.

The power rating must be greater than the off load output voltage of the power supply.The capacitance value determines the amount of ripples that appear in the DC output when the load takes current.

Voltage Regulation

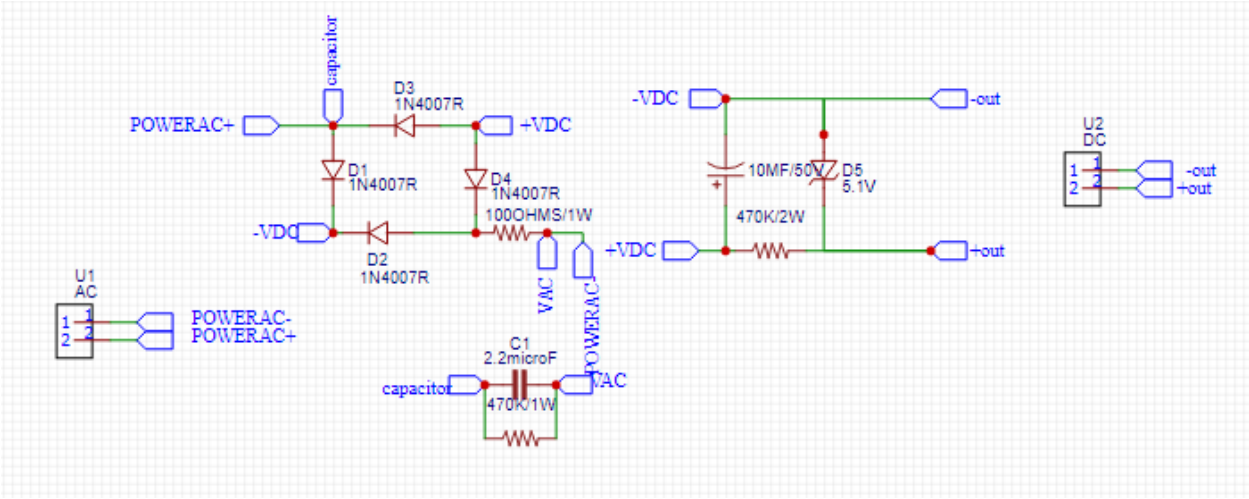
Zener diode is used to generate a regulated DC output. A Zener diode is designed to operate in the reverse breakdown region. If a silicon diode is reverse biased, a point reached where its reverse current suddenly increases. The voltage at which this occurs is known as the “Avalanche or Zener“ value of the diode. Zener diodes are specially made to exploit the avalanche effect for use in ‘Reference voltage ‘regulators.

A Zener diode can be used to generate a fixed voltage by passing a limited current through it using the series resistor (R). The Zener output voltage is not seriously affected by R and the output remains as a stable reference voltage. But the limiting resistor R is important, without which the Zener diode will be destroyed.

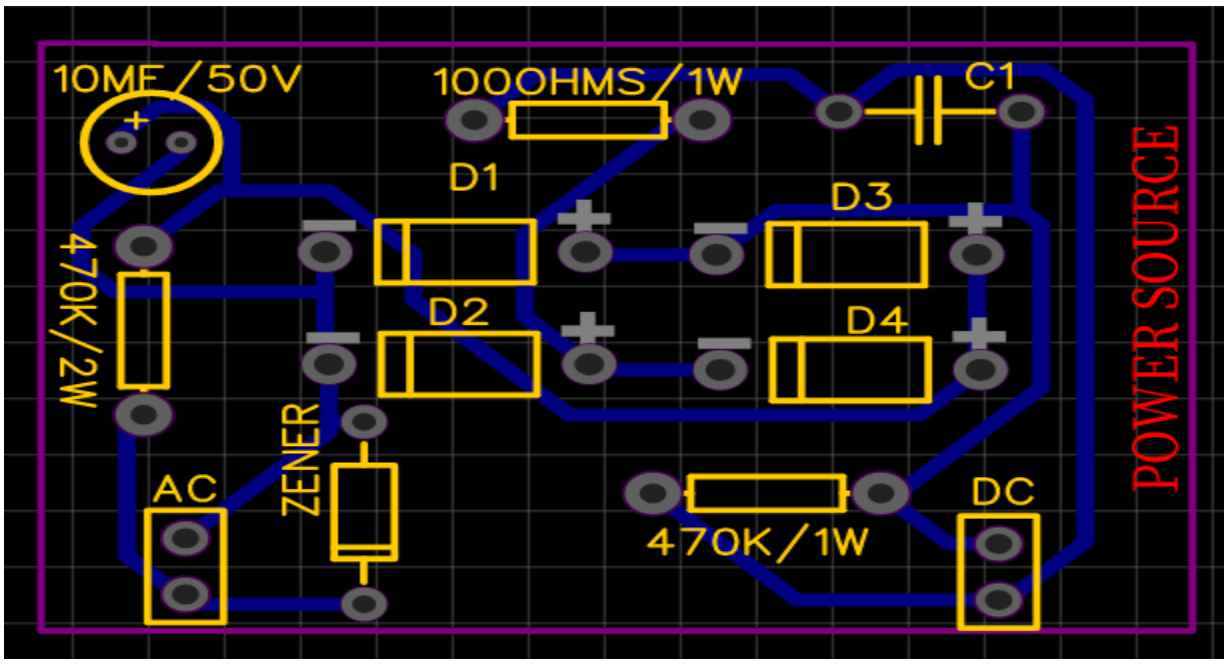
The power rating of the Zener is also an important factor to be considered while selecting the Zener diode. In my case, I needed a Zener diode with a voltage rating of 5V since I was using the Atmega chip.

SCHEMATICS

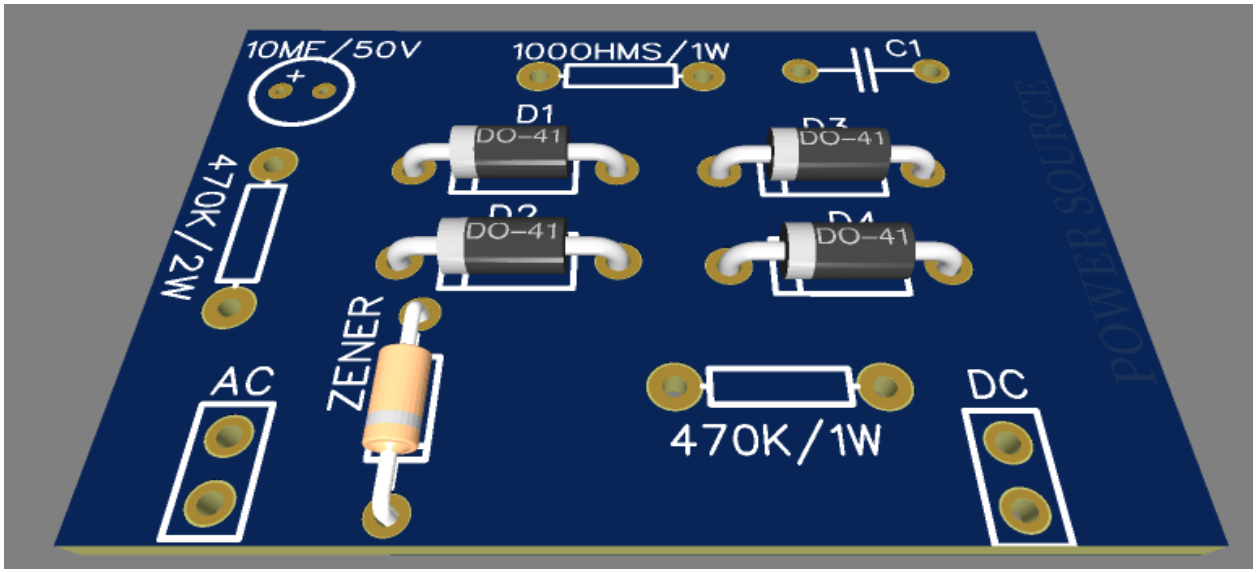
CIRCUITRY



PCB DESIGN



3D PCB DESIGN



The capacitor/transformerless power supply lit an LED during test_1.

ADVANTAGE

-Low cost

-small in size

-Economical; low cost as compared to transformers.

DISADVANTAGES

The drawback of the Capacitor power supply includes

- **No galvanic isolation** from Mains. So if the power supply section fails, it can harm the gadget.
- **Low current output**. With a Capacitor power supply. The maximum output current available will be 100 mA or less. So it is not ideal to run heavy current inductive loads.
- Output voltage and current will not be stable if the AC input varies.