



ROCHACARDOSO
Projects

Power Supply

Documentation

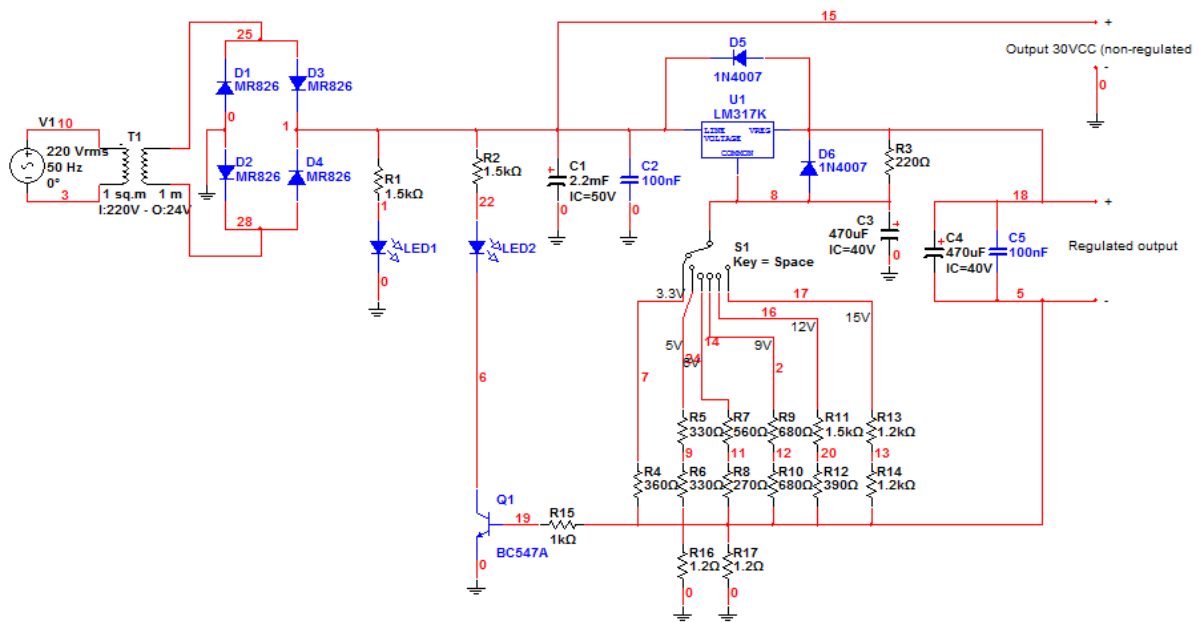
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This project was based on another one we found in internet [1]. We have made some small modifications which we will explain on the next pages.

We are going to show step by step how to build a regulated power supply with six output voltages that are more frequently used: 3.3V, 5V, 6V, 9V, 12V and 15V. The maximum current provided is 1A. The power supply will also provide a non-regulated output of 30V.

The complete circuit can be analyzed in the figure bellow. In the input of it, we have a transformer that converts an alternate voltage of 220V to an alternate voltage of 24V. The adjustment of the alternate voltage to a continuous voltage is realized by a rectifier that can be built with four diodes of type MR. The capacitor of 2200 μ F x 50V in the rectifier's output is a voltage filter that minimizes the rectified ripple voltage and supplies the tension adjust to the LM317-220 about 30V cc.



The voltage controller (LM317) output depends on the resistor that is connected with the control pin to the ground. In the datasheet [2] of the commented tension adjuster you can find the followed equation:

$$V_{out} = 1.25V \left(1 + \frac{R_2}{R_1} \right)$$

It can be explained as follow:

First of fall, we have to consider V_{REF} as the nominal reference voltage between the output and adjustment terminal. We can calculate the output voltage with the known voltage divider equation:

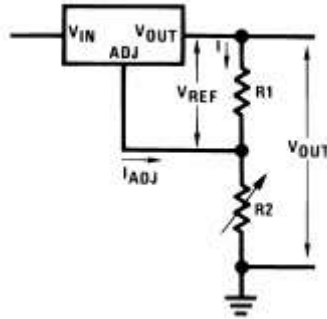
$$\frac{V_{out}}{V_{REF}} = \frac{R_1 + R_2}{R_1}$$

$$V_{out}R_1 = V_{REF}(R_1 + R_2)$$

In the data sheet is given a value of 1.25V to the nominal reference voltage (V_{REF}).

$$V_{out}R_1 = 1.25V(R_1 + R_2)$$

As in the data sheet says, the reference voltage is impressed across program resistor R_1 and, since the voltage is constant, a constant output current I then flows through the output set resistor R_2 , giving an output voltage of:



$$V_{out} = 1.25V \left(1 + \frac{R_2}{R_1} \right)$$

Then we calculated further step by step, to find the equation for R_2 :

$$V_{REF} R_2 = V_{out} R_1 - V_{REF} R_1$$

$$V_{REF} R_2 = R_1 (V_{out} - V_{REF})$$

$$R_2 = R_1 \frac{V_{out} - V_{REF}}{V_{REF}}$$

$$R_2 = R_1 \left(\frac{V_{out}}{V_{REF}} - 1 \right)$$

As we already know, the V_{REF} was given (1.25V) and we are going to use the value of 220Ω for the resistor R_1 . This value was chosen to decrease the output current of the tension controller.

$$R_2 = 220\Omega \left(\frac{V_{out}}{1.25V} - 1 \right)$$

For example, to calculate the value of the resistor R_2 for a 3.3V output voltage of the Power Supply:

$$R_{2(3.3V)} = 220\Omega \left(\frac{3.3V}{1.25V} - 1 \right) = 360.8\Omega$$

Now, we can calculate for the output voltages 5V, 6V, 9V, 12V, 15V as we did above.

$$R_{2(5V)} = 220\Omega \left(\frac{5V}{1.25V} - 1 \right) = 660\Omega$$

Because this value is not possible to buy, we can use two resistor of 330Ω in series.

$$R_{2(6V)} = 220\Omega \left(\frac{6V}{1.25V} - 1 \right) = 836\Omega$$

(It corresponds to two resistors. One of 560Ω and another one of 270Ω).

$$R_{2(9V)} = 220\Omega \left(\frac{9V}{1.25V} - 1 \right) = 1.364k\Omega$$

(It corresponds to two resistors of 680Ω).

$$R_{2(12V)} = 220\Omega \left(\frac{12V}{1.25V} - 1 \right) = 1.892k\Omega$$

(It corresponds to two resistors. One of 390Ω and another one of 1.5kΩ).

$$R_{2(15V)} = 220\Omega \left(\frac{15V}{1.25V} - 1 \right) = 2.42k\Omega$$

(It corresponds to two resistors of 1.2kΩ).

The diode (D5) that is connected between the input and output of the tension controller protects it from discharge of the capacitor between adjustment pin and ground, in case of a short circuit happens in the input of the tension controller. The diode (D6) between the output and controller pin protects the tension controller in case of a short circuit happens in the output of the tension regulator.

The transistor closes the contact with the red LED in case of a current bigger than 1A, it makes the red LED lights up and shows to the user that something wrong happened.

For more information you can visit our website <http://www.rochacardoso.de> or contact us:

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References:

[1]: <http://gvensino.com.br/wp-content/uploads/2014/10/fonteAlimBancada.pdf>

[2]: <http://www.ti.com/lit/ds/symlink/lm117.pdf>