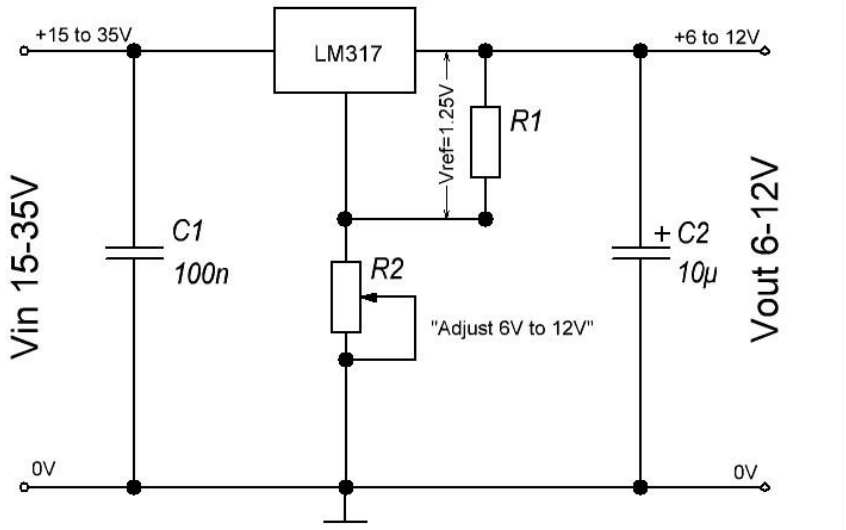
Question #75900

Design and draw the circuit of a voltage regulator using LM 317 to provide an adjustable voltage between 6 to 12V.

Solution.

Let's draw a diagram from datasheet on LM317:



According to specification: $V_{out} = V_{ref} * \left(1 + \frac{R_2}{R_1}\right) + \left(I_{ADJ} * R2\right)$;

$\left(I_{ADJ} * R2\right) - is\ very\ low, can\ be\ neglected$

$V_{ref} = 1.25V, R_1 = 240\ Ohm - according\ to\ specification\ on\ LM317$

1) Let us find the resistance R_2 at an output voltage 6v:

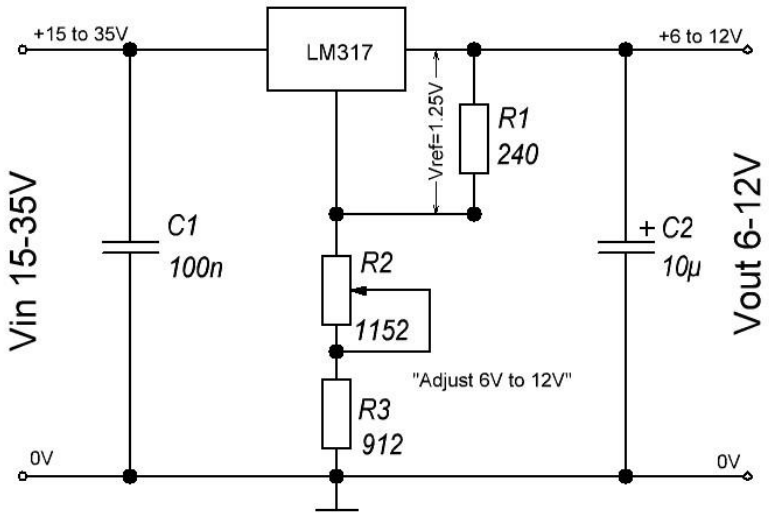
$$1.25V * \left(1 + \frac{R_2}{240}\right) = 6V;$$
$$1.25 + \frac{1.25 * R_2}{240} = 6;$$
$$\frac{1.25 * R_2}{240} = 4.75;$$
$$1.25 * R_2 = 1140;$$
$$R_2 = 912\ Ohm;$$

2) Let us find the resistance R_2 at an output voltage 12v:

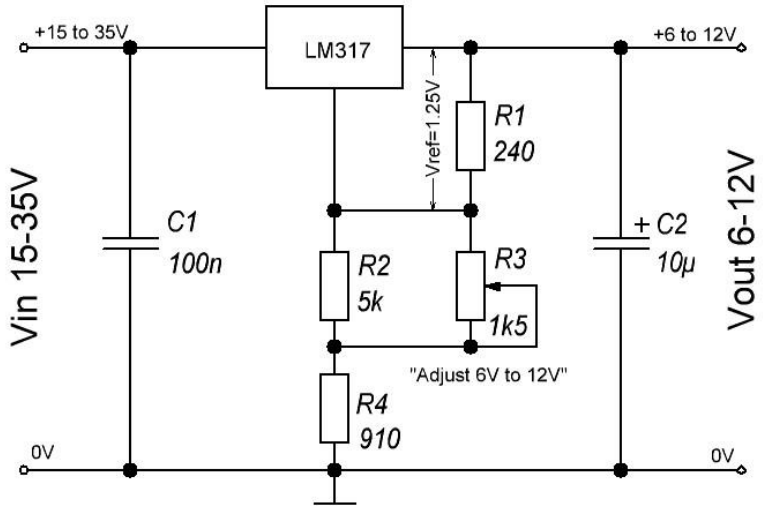
$$1.25V * \left(1 + \frac{R_2}{240}\right) = 12V;$$
$$1.25 + \frac{1.25 * R_2}{240} = 12;$$

$$\frac{1.25 * R_2}{240} = 10.75;$$
$$1.25 * R_2 = 2580;$$
$$R_2 = 2064\ Ohm;$$

Since the minimum voltage is 6V, we limit it to a constant resistor R_3=912Ohm; R_2= 2064-912=1152 Ohm, scheme below.



Since in the standard series of resistors the value of 1152 Ohm does not exist, then we will include two resistors in parallel on scheme below. R_3 we take from a number of available is 910 Ohm (the value V_{out_min} in this case is 5.99V).



Total resistance of R_2 and R_3 in parallel is $\frac{5k*1.5k}{5k+1.5k} = 1.154\ Ohm$

At such values of resistance, the adjustment limits will be 5.99V-12V.