

# Re: luxeon led dimmer circuit

Source: <http://sci.tech-archive.net/Archive/sci.electronics.basics/2005-10/msg00153.html>

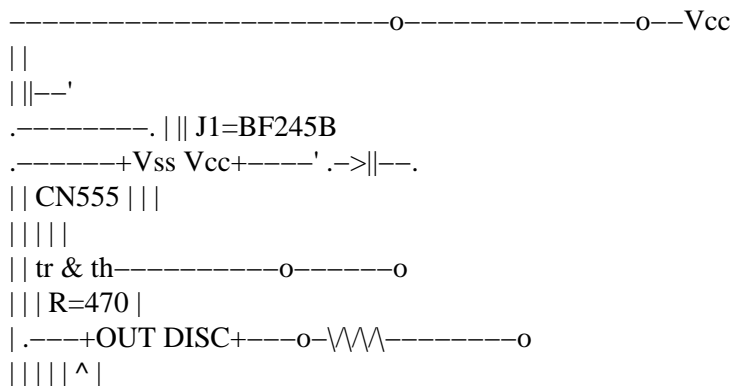
- From: Bob Monsen <[rcsurname@xxxxxxxxxxx](mailto:rcsurname@xxxxxxxxxxx)>
- Date: Wed, 05 Oct 2005 16:18:58 -0700

On Sun, 02 Oct 2005 19:10:09 +0100, andy wrote:

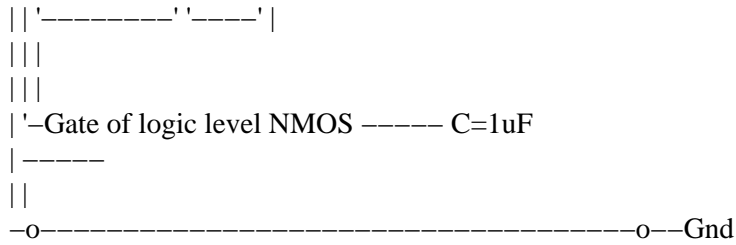
- > I've built the following circuit on breadboard as a dimmer circuit for 3
- > luxeon III Star ultrabright LEDs:
- >
- > <http://www.niftybits.ukfsn.org/electronics/luxeon-dimmer.png>
- >
- > any comments welcome. It does work at the moment, but when the battery
- > is low, the maximum current drops from 0.9 A to 0.7 A, and the op-amp
- > swings near to the top rail. The one thing I'm thinking of changing
- > before I solder it up is to change the 1 ohm sense resistor for a lower
- > value (maybe 0.5 ohm) so that the transistor has a bit more headroom to
- > work with, which should cure this I think.
- >
- > The LEDs are /very/ bright by the way - 3 of them are enough to light a
- > small room well enough to read by. The light is a bit unkind on the
- > eyes, but not too bad. 3 at full current are about equivalent to an 11
- > Watt energy saving fluorescent light bulb, which puts them in roughly
- > the same bracket as far as efficiency goes.

Another way to control brightness is to use what is called a PWM circuit. Basically, you give your pass device a pulse every once in a while, and control the percentage of time it is on. Since you aren't just burning up energy with a resistor, it is often cooler and more efficient.

A simple circuit for this consists of a cmos 555, an N-channel JFET, a cap, and a pot:



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Call the current through J1 'I'.

The period is going to be the sum of the charging time

$$T_c = (1/3 * V_{cc}) * C / I$$

and the discharge time is

$$T_d = R * C * \ln((2V_{cc} - 3RI)/(V_{cc} - 3RI))$$

The duty cycle, which is what you are interested in, will obviously be

$$T_c / (T_c + T_d)$$

since OUT is high during  $T_c$ .

The odd thing is that if you simplify this, the duty cycle doesn't depend on the size of the capacitor; it only depends on  $v_{cc}$ ,  $I_d(J1)$ , and  $R$ . Thus, you can pick a cap that is small enough so you don't see a flash, but not too so the pass transistor requires too much dynamic current. The duty cycle defined by this monster:

$$D = \frac{V_{cc}}{V_{cc} + 3RI \ln((2V_{cc} - 3RI)/(V_{cc} - 3RI))}$$

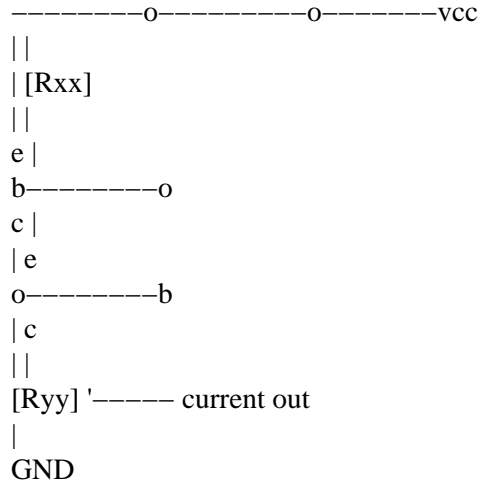
So, when  $R$  is 0,  $D$  is 1, and when  $R$  is  $V_{cc}/3I$ ,  $D$  is 0

That means that when  $R = V_{cc}/3I$ , the thing will simply stop, with output low. The reason is that the discharge pin won't be able to pull the trigger pin lower than  $V_{cc}/3$ . When  $R=0$ , it won't take any time to discharge the timing node (well, almost no time) so  $D \ll 1$ .

The N-JFET will vary as to how much current it will source in this configuration. If it is sourcing too much, put a small resistor between the drain and the point where the gate attaches; this will lower the current. However, you need to make sure that your new resistor times the current isn't bigger than  $V_{cc}/3$ . If it is, the output will get stuck trying to pull the timing cap up to  $2/3 V_{cc}$ , which means output will be high and your pass transistor will be on all the time.

If you can't find a JFET, you can use a couple of PNP transistors as a reasonable current source, like this:

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Rxx sets the current to near  $I = 0.615/R_{xx}$ . Ryy should provide 1/10 of the current through Rxx, so

$$R_{yy} = 10*(V_{cc} - 1.3)/I$$

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Regards,  
Bob Monsen

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• **References:**

- ◆ [luxeon led dimmer circuit](#)  
◇ From: andy

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