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Lamp control circuit

2 messages

Christopher Thomas <christopher.thomas.webmail@gmail.com> Wed, Nov 27, 2019 at 11:46 AM
To: "Haniff, Isaac J" <isaac.j.haniff@vanderbilt.edu>

Here are cleaned-up schematics and layout drawings for the lamp control circuit. It'll work as a general purpose "let a TTL line control a power supply" widget, so I figured you might eventually find it useful elsewhere.

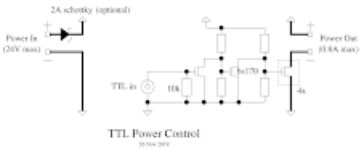
My rating limits (24V 0.8A) are conservative. The actual limits are probably about 30V and 1.5A. The parts' absolute limits are 40V and 2A, but going anywhere near those is a bad and fire-prone idea.

The FETs are BS170 TO-92 ones (very common). The resistors should be at least 10k but other than that can be anything. The tiny 1" breadboard I used is Digikey part number 1568-1652-ND or SparkFun part number PRT-08808. The tiny box I used is Digikey part number HM-375-ND. The BNC pigtail was Digikey part number 314-1190-ND (handy to stock for many projects, but pricy). If you're screwing the board down rather than leaving it free-hanging, you'll want a 1/8" #4 stand-off, a #4-40 screw (1/2" or 5/8"), and a #4-40 hex nut as well.

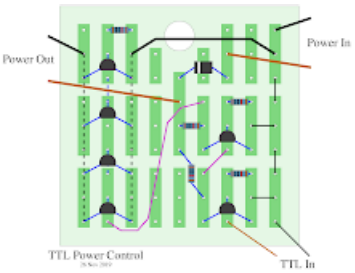
I hope that you find this useful!

Regards,
-Christopher Thomas

2 attachments



lamp-control-schem.png
36K



lamp-control-bread-layout.png
133K

Christopher Thomas <christopher.thomas.webmail@gmail.com> Wed, Nov 27, 2019 at 11:59 AM
To: "Haniff, Isaac J" <isaac.j.haniff@vanderbilt.edu>

In case you're wondering about some of the resistors: The BS170's maximum gate voltage is 20V. The resistors divide down the pull-up voltage, to tolerate a maximum of 40V. If you made the top resistors 20k and kept the others at 10k, you could tolerate up to 60V in, which is the same as the BS170's maximum drain-to-source voltage. This would only be a good idea if you knew the supply voltage was going to be high, though, as you want the gate voltage to be about 10V or higher to get decent current output.

For power calculations, the worst-case output resistance per transistor is 5 ohms, and absolute maximum power is 0.8W. That gives an absolute maximum current of 0.4A per transistor (at the worst-case resistance). If you've ever touched a 1W resistor with bare fingers, you'll understand why I added headroom. Junction-to-ambient thermal resistance is 150 degC/W, giving a 30 degC rise at my de-rated value (or 120 degC at their maximum; water boils at 100 degC).

Long story short, you can scale up output current by adding more FETs in parallel. FETS, unlike bipolars, have a negative temperature coefficient and so don't suffer from current hogging or thermal runaway. For much larger than this, you'd probably instead use a TO-220 FET bolted to a heat sink as the output driver.

Regards,
-Christopher Thomas