

Incubator electronics

Kenneth Lausdahl
Your Company / University

The Other Dude
His Company / University

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Abstract

Short introduction to subject of the paper ...

1 Design

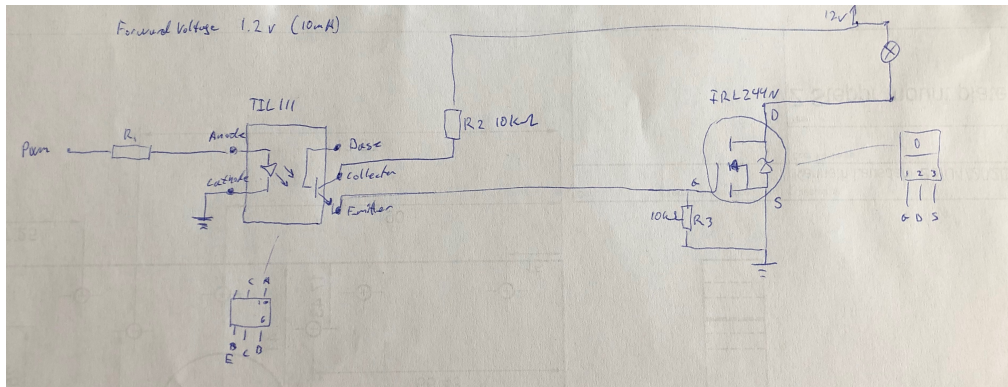


Figure 1: Overall design

1.1 Calculation of optocoupler resistor

Spec for TIL111

1. Forward Voltage 1.2v (10mA)

$$R = \frac{V}{I}$$
$$R_1 = \frac{3.3v - 1.2v}{0.010A} = 210\Omega \quad (1)$$

This means that the input resistor between the PI pin and the anode of the optocoupler must be at least 210 Ω so 220 Ω is a good candidate

1.2 MOSFET

Spec for IRLZ44N (N-channel mostfet:

1. $R_{DS_{ON}} = 0.022\Omega$ $V_{GS} = 10v$ $I_D = 25A$
2. $V_{GS} = 16V$ max gate voltage
3. $175^\circ C$ - max operation temp
4. $V_{CS(th)} = 1v$
5. $R_{\theta JA} = 62^\circ C/W$

Heat disipation assuming a heated bed plate with this spec is powered:

1. $R = 1.65\Omega$ for 12v
2. $P = 87w$
3. $A = 7.25A$

Calculate watts for when powering the heated bed

$$\begin{aligned} P &= R * I^2 \\ &= 22mA * 7.25^2 = 1156mW = 1.156W \end{aligned} \quad (2)$$

Calculate watts the MOSFET can handle withtout cooling

$$\begin{aligned} P_D &= \frac{\max(T_J) - T_A}{R_{\theta JA}} \\ &= \frac{175^\circ C - 25^\circ C}{62} = 2.4W \end{aligned} \quad (3)$$

So to use it without a heat sink we need $1.156W < 2.4W$ which it is so no heat sink required.

Calculating resistors between the optocoupler and mosfet. Two resistors are required. One to pull down the gate when not powered here a $10K\Omega$ or similar is fine the smaller the faster it turns off. The other resistor is required to make a voltage divider to protect the gate input voltage of the MOSFET which has a max input voltage of $V_{GS} = 16v$. This means if we power it by 12v then nothing is needed but for other reasons a resistor should be added, bla bla.. So we chose to design it to also allow for 24v and get both handled by the same design.

A Voltage divider is defined as

$$V_{out} = \frac{V_s * R_2}{R_1 + R_2} \quad (4)$$

So lets find a resistor

(5)

on

1.3 A first version of the schematics



Figure 2: Schematics