

ECE 480 - DESIGN TEAM 1

Power Supply Circuit Design

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Abstract

The Raspberry Pi and the Piezoelectric Sensor are powered by two different voltage levels of 5V and 2V respectively. However, using two voltage sources would take up too much space. To fix this problem, a multi-voltage power supply is built. Two voltage regulators are used to step down the voltage from a 9V battery. Finally, capacitors are placed in parallel with each voltage regulator from where the new voltages are supplied. Circuit design theory will be an important part of this application note.

Keywords

Raspberry Pi, Piezoelectric Sensor, voltage regulator, capacitor, LM2940, LP5952

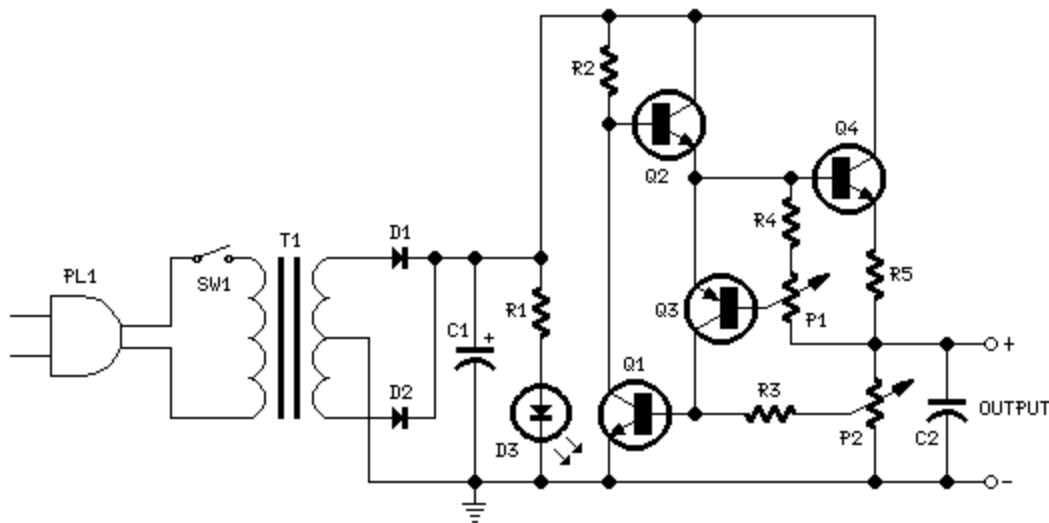
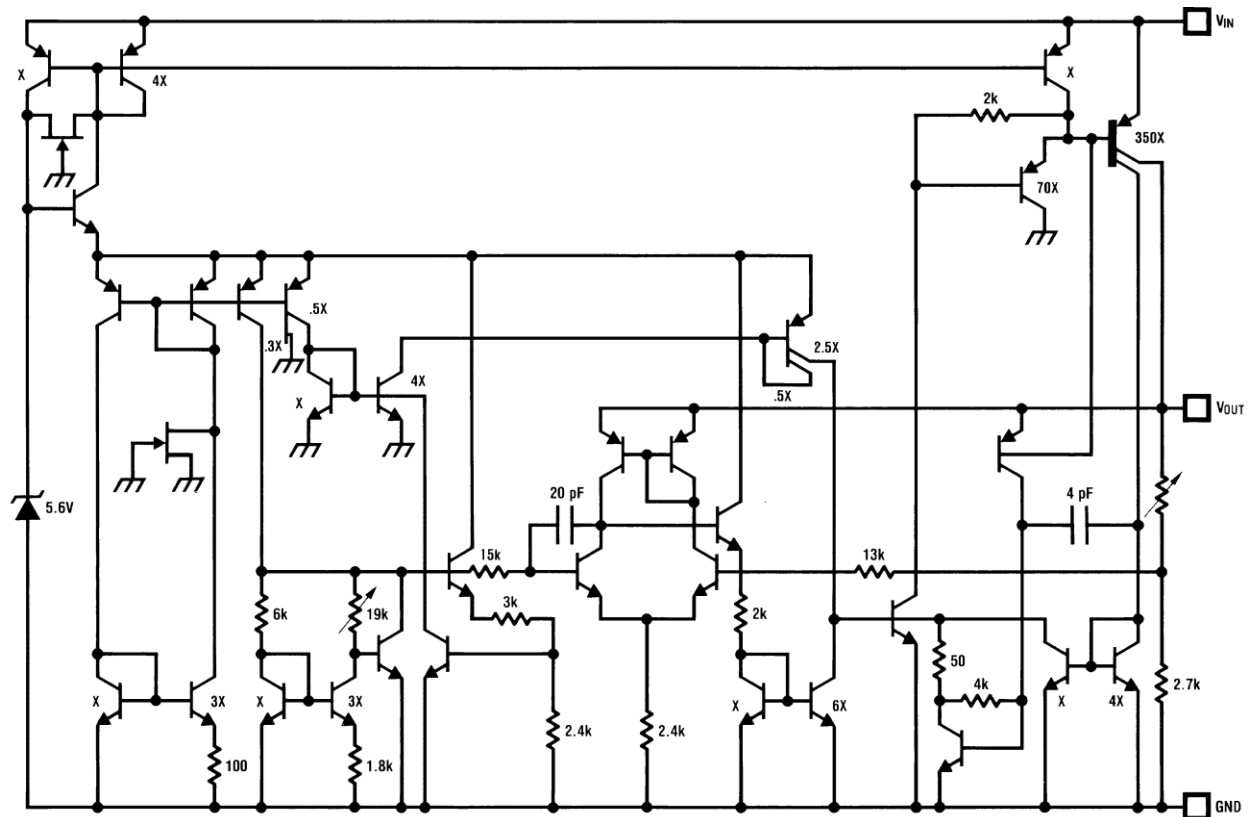


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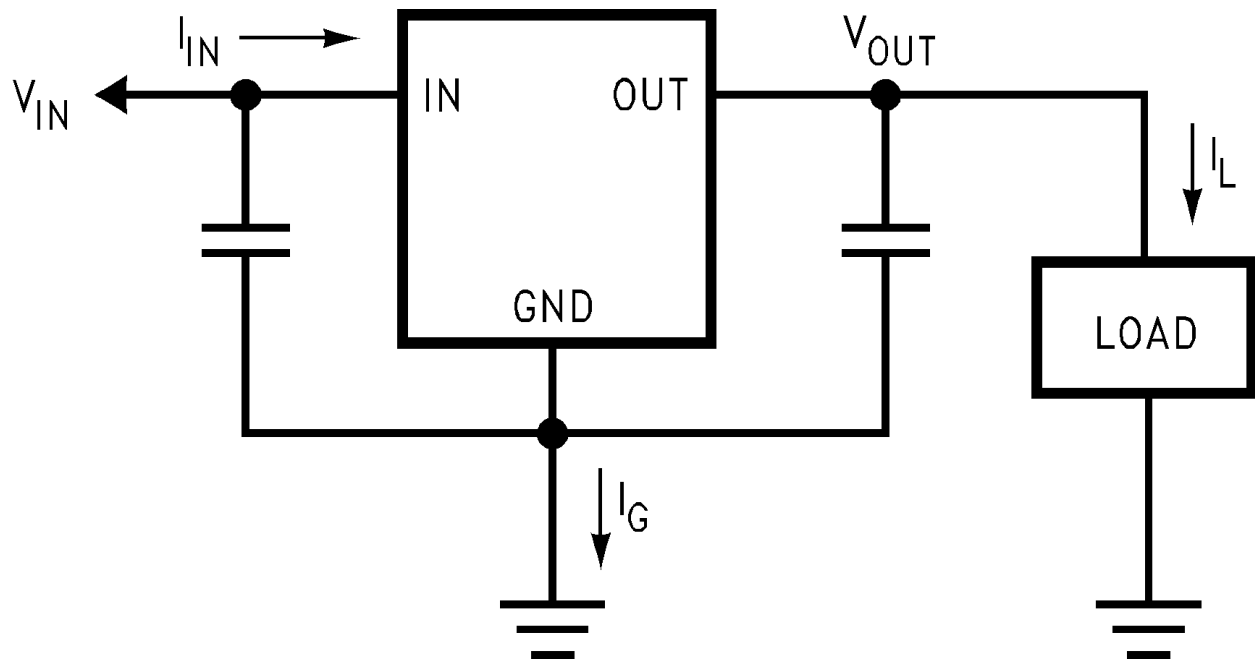
Voltage Regulator

Voltage regulators are designed to decrease an input voltage by a certain quantity. There is a pin for the input voltage, a pin for the output voltage, and a pin to stabilize current. The two voltage regulators used are the LM2940 and the LP5952. The LM2940 steps down the 9V battery to 5V, and the LP5952 steps down the 5V source to 2V.



This is a schematic of the LM2940. As shown here, transistors are the most effective way to regulate voltage. A minimum capacitance of 22 uF, connected to the output, is required to prevent oscillations.

It changes the voltage by outputting 1A of current. The minimum dropout voltage is .5V. There are three pins – an input pin, an output pin, and a ground pin.



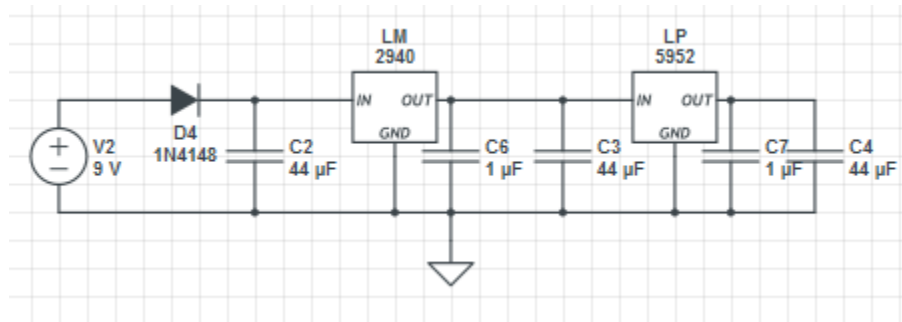
This is a diagram for the power dissipation. The relevant equations are

$$I_{IN} = I_L + I_G$$

$$PD = (V_{IN} - V_{OUT}) I_L + (V_{IN}) I_G$$

Circuit Design

A diode is placed right after the 9V battery. This is to control the voltage. Capacitors of appropriate size are placed in parallel with the voltage regulators to make it easy to supply voltage to the device.



This is how the final designed circuit looks like. 44μF capacitors are chosen to output the voltage. 1μF capacitors are chosen in parallel to help filter out noise. Finally, the components are all connected to ground to complete the circuit.

Conclusion

Overall, voltage regulators are very useful in stepping down an inputted DC voltage. Capacitors are placed in parallel to provide storage for the new voltage. It is useful to have multiple voltage sources stemming from the same source to save space and money.

References

<http://www.ti.com/lit/ds/symlink/lm2940-n.pdf>

The LM2940 Data Sheet