Circuitry and Soldering Laboratory Manual

Introduction to Product Development and Management for Engineers
GNG 2101
Faculty of Engineering
University of Ottawa
Fall 2017

Checks required by TA:

Group Member	Board soldered

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Objective
The purpose of this lab is to teach students how to properly solder and to introduce students to various electrical components used in the circuit. Students will learn how to solder, de-solder, use a solder-wick as well as test circuits for continuity and functionality.

Apparatus and Equipment Overview
The following components will be used in this lab:

- 1 x Voltage regulator (LM7805)
- 1 x Diode 1N4004
- 1 x 5mm LED
- 2 x 51k Ω resistor
- 2 x 75k Ω resistor
- 1 x 330 Ω resistor
- 1 x USB type A socket
- 1 x MFS201N-9-Z switch
- 1 x 9V battery connector
- 1 x 9V battery
- Various lengths of hook-up wire
- Soldering iron
- Lead-free solder
- Solder wick
- De-soldering tool
- Multimeter
- Sensor
- Bluetooth

Pre-Lab Preparation

Before arriving in the lab, students should review the lab manual and familiarize themselves with the lab setup and procedures. Also please watch the following videos to review the basics of soldering.

- How to solder:
  https://www.youtube.com/watch?v=j0At9NZwrqk
- How to de-solder:
  https://www.youtube.com/watch?v=Z38WsZFmq8E

Prelab Questions

Why is it important to have a well-ventilated area when soldering?

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Why is it important to use lead-free Solder?

How can you tell which is the negative terminal when looking at a diode?

Why is it important to build a circuit on a breadboard before soldering everything onto a proto-board?

Describe in your own words what an electrical "node" is in an electrical circuit?

Overview

The following circuit diagram should be referenced throughout the lab, it is a circuit for a USB charger. Each team member should do a part of this lab.

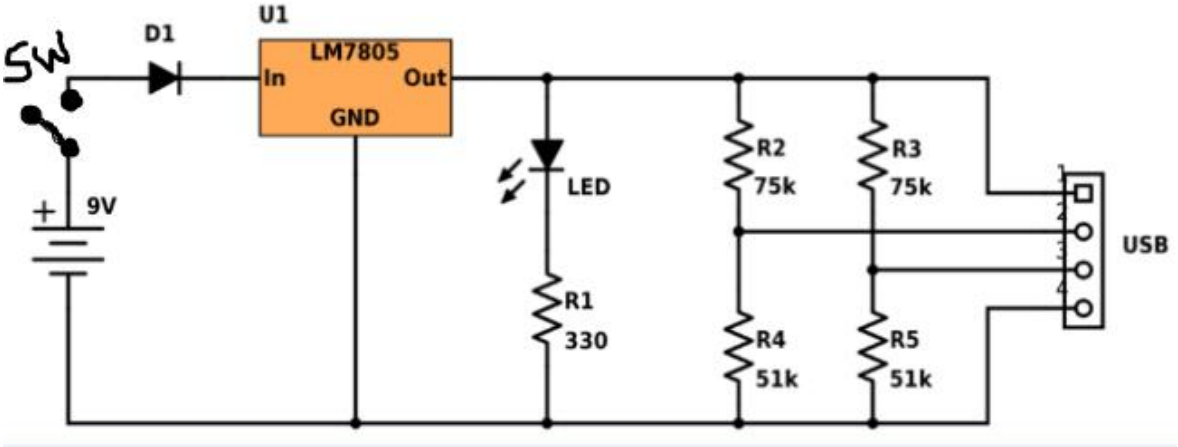


Figure 1. Circuit diagram

IMPORTANT: Chips that are shipped or stored in anti-static Styrofoam or anti-static plastic containers can be static-sensitive. Often there is a yellow sticker to indicate the fact, but not always. Touching such devices with parts of your body can potentially destroy them. Before removing any chip from its packaging, you can maintain contact with something that is electrically connected to the ground to discharge any static charge that is generated on your body. The best method is to use a special wristband that is grounded or connected to an antistatic mat (that is also grounded). Static discharge is what is happening when you touch a door handle in some carpeted rooms or when getting out of certain cars and you get a little shock. That tiny spark is hundreds or even thousands of volts, which is a voltage that is easily large enough to damage sensitive electronic components. Even if you don't 'feel' or hear a static discharge as a

spark, damage can still be done when you touch sensitive components, creating problems that can take a lot of time to debug.

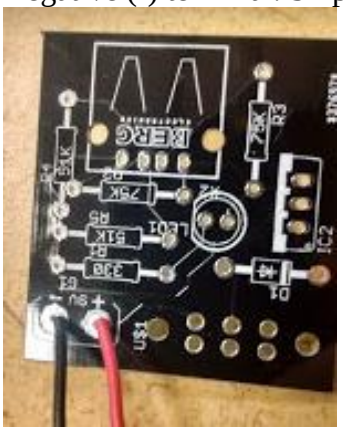
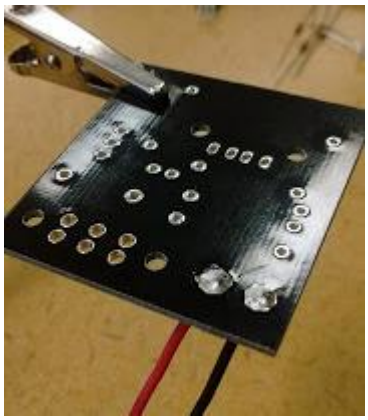
IMPORTANT: Diodes are polarized (i.e. have a negative and a positive terminal); always make sure that the negative sign is the same way as shown in the circuit diagram.

IMPORTANT: When building a circuit it's important to test it on a breadboard before soldering it. However in the interest of time you will be soldering the components directly.

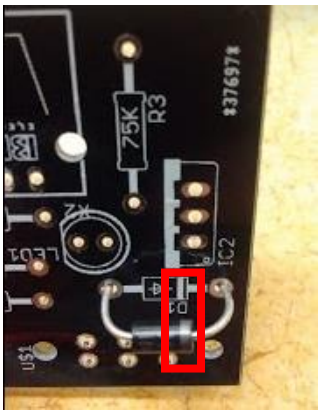
Procedure

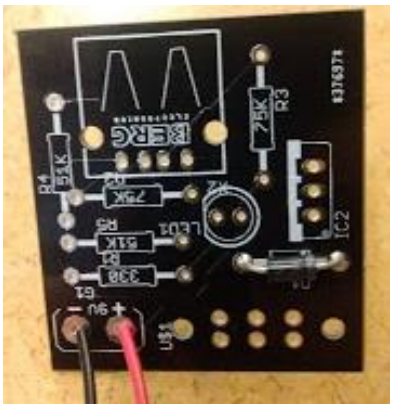
<u>Part A – Testing the 5V regulator power circuit</u>

1. Start with the battery connector, make sure the red wire is connected to the positive (+) and black to negative (-) terminal. Snip the ends when soldered in place.

2. Next solder the diode, make sure to match the side with the grey band (negative) with the orientation on the PCB. Snip the ends.

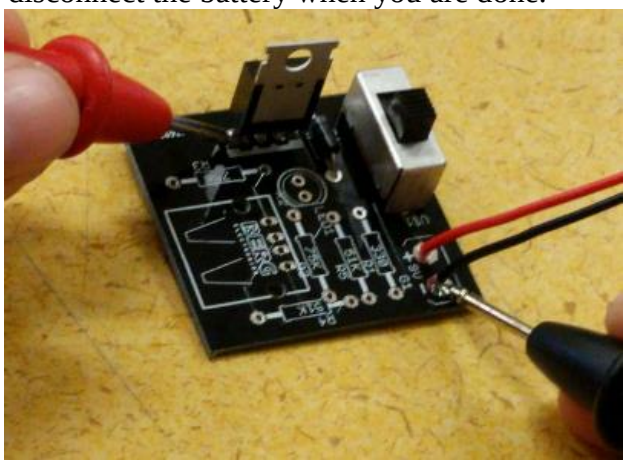




3. Solder the voltage regulator in place. When soldering the regulator, it is important that you do not apply too much heat or you will ruin the component. Do not apply heat to the contact for more than 4 seconds. Stay aware of how hot the metal tab (the heat sink) becomes on the regulator. If the heat sink is hot let it cool down before you continue. Snip the ends.


4. Solder all 6 pins of the switch in place, orientation of this component isn't important since it is symmetrical. Bend the ends of the switch to secure it on the board.

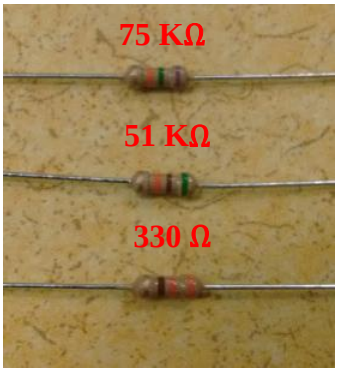

5. Now you can connect the battery and test to see if the voltage regulator works correctly with the multimeter. It's a 5V regulator so you should get around 5V when connecting the negative terminal of the battery and the output pin of the regulator. Make sure to disconnect the battery when you are done.

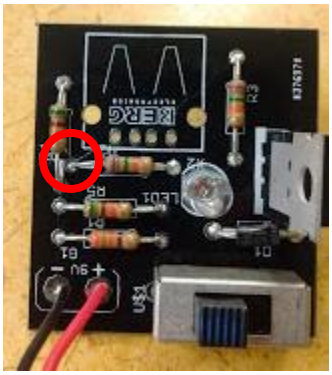



<u>Part B – Completing the circuit</u>

6. When soldering the LED make sure polarity is correct, the flat side is negative, which is connected to the 330 Ω resistor, it will match the silk screen. Snip the ends.

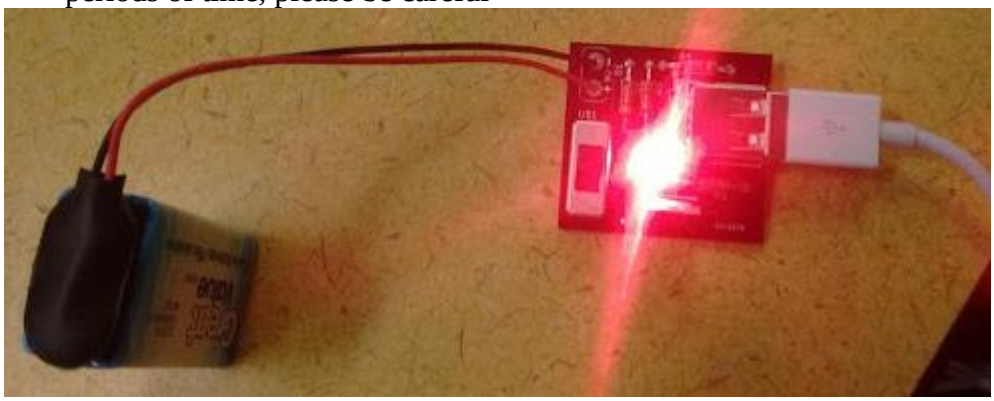
7. Next solder the resistors, their polarity doesn't matter. I usually bend the leads around my finger before fitting them in the PCB to make it easier. Be careful with the values of the resistors and not to touch R2 and R4. Snip the ends.

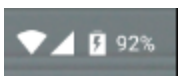




8. Last, solder the USB connector, use LOTS of solder on the 2 side pins to keep the connector in place.

9. Plug a 9V battery to the connector and turn on the switch, the LED should turn on. You can now plug your phone to the circuit and it should charge **this is untested for long periods of time, please be careful





Additional Resources

- Here are a few tips and tricks about soldering to remember, http://www.instructables.com/id/Soldering-tips-and-tricks/ and here is a more in depth tutorial on soldering https://learn.sparkfun.com/tutorials/how-to-solder-through-hole-soldering.
- For some project suggestions visit http://www.makeuseof.com/tag/learn-solder-simple-tips-projects/.