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ENGR 460 Project: Solar Charger

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**Project Description**

The purpose of this project was to make a device so that a solar panel could be attached to it and would be able to charge an iPhone on the other end. The solar panel used was a 5 V solar panel, though by measuring it, it came out to be around 5.8 ~ 6.1 V. iPhone’s usually need to be charged around 5 V, and seeing how a little bit higher the voltage coming out of the solar panel was, it did raise some concerns on how it might potentially damage my phone. So, I decided to use a buck boost converter to bring the voltage down by 1 V, and as such, the final design of the project was simple in nature.

Solar Panel

5 V

iPhone

Device to step down voltage

**Design Process**

One of the things I had to do first was to find a way to connect the solar panel to the device. I soldered on some wires on the solar panel, and I choose a pin socket connector, as it was the easiest way to connect the wires to the board.

The main part of the device is, of course, the buck boost converter. Before going into the design for the buck boost converter, I’d like to note that using a buck boost converter was not my first choice. I had initially thought of using a voltage regulator, as it seemed to be the best way of bringing the voltage down. However, I found that using one wouldn’t be as efficient. It would take up a lot more power, and as a result, it would dissipate more heat, so it probably wasn’t a good idea if this device were to be used regularly. That’s when I found out that buck boost converters would be best for this type of application. It would function similarly to a voltage regulator, but it would be more efficient in consuming power, and would dissipate less heat as a result, so I chose the buck boost converter for my final design. In order to make the buck boost converter output 5 V, I followed a design that I found on the datasheet for the buck boost converter, and so that was how I got the values for the capacitors and resistors.

Finally, I had to find a way to connect the device to my iPhone, so I used a USB 2.0 port to connect the device. It was a bit difficult to find one that would be compatible with my iPhone cord, but I eventually found one that did fit.

**Schematic**

A screenshot of a cell phone

Description automatically generated

**Build Instructions**

When building this device, I think the best way to start is to begin with the buck boost converter. This part is probably the most difficult, as this part is a surface mount device, and it has no pins that would make it easy to attach. I would highly recommend that using a stencil and some soldering paste would be the best way to approach this step, as using just a soldering iron proved to be very difficult. This will also mean that some sort of modified toaster oven may be used, as it is the only way possible to melt the soldering paste.

After the IC chip has been placed on the board, soldering the rest of the parts on the board is fairly simple. Make sure to test the components (i.e. the resistors, inductors, and capacitors) before soldering them onto the board. Then the USB port and the 2x1 connector can be placed on the board.

Next, you can solder on wires onto the solar panel. When that’s finished, connect those wires with the 2x1 connector. Note that when connecting the wires, the positive terminal will have to go on the left most side of the connector (if you orient the board such that the 2x1 connector is on the bottom, the positive terminal should be on the left). Afterwards, place the solar panel outside while it’s still bright out (works best at around noon, though any other time before sunset or after sunrise should be fine).

**Test Results**

When I finished building the board and started testing it out, I wasn’t surprised to find out that it didn’t work. To start off, I think one major issue was that the IC chip wasn’t properly put on the board. I mentioned earlier in the build section that it was difficult to place the IC chip without any soldering paste. Another thing was that I noticed that some of the pins were connected together, so that caused issues as well. Another thing that I noticed was that one of the capacitor values I was using was wrong. I had initially used 0.1 uF for the capacitor connected between the two resistors, but I had noticed that it had to be 10 pF in order for the voltage to go up to 5 V (with the 0.1 uF, the voltage only went up as far as 4.7 V in the simulation). This was something that I had overlooked, and I had not noticed until further later on. Another issue that I may have overlooked is the USB port. I noticed that there wasn’t any voltage coming out, so I may have not properly placed the USB port on correctly.

**Future considerations**

For the first version of the device, there were a couple of issues that could not be resolved in time. Since the deadline for the project is soon, it may be a little too late to order any more parts in time, but I may continue working on this project over the summer. One thing that I could do is have an alternative design that works around a different IC, one that will be a little easier to solder on. I have already looked online for other types of IC chips, and there were a couple that would be able to function just as well as the TPS6306x, for example, the ADP1111.

The other major issue that I found was when I was simulating the device. I mentioned that there were some issues with one capacitor value and how that was affecting the overall output voltage. Another thing that I found was that the device would only output 5 V so long as the input voltage was above 6 V. This wouldn’t be a probably if the solar panel outputted 6 V, however, the solar panel voltage fluctuates between 5.8 to 6.1 V, which I think is a problem. If the voltage were to drop below 6 V, the output voltage would come out to be below 5 V, which won’t be enough to charge the phone. One obvious solution to this is to change the values of the components in the circuit so that it’ll accommodate slightly lower voltages.