Design Review: Airport battery charger

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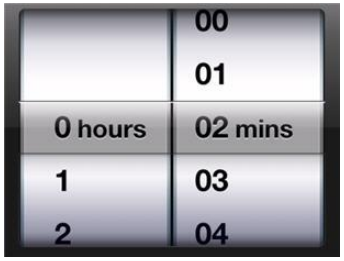
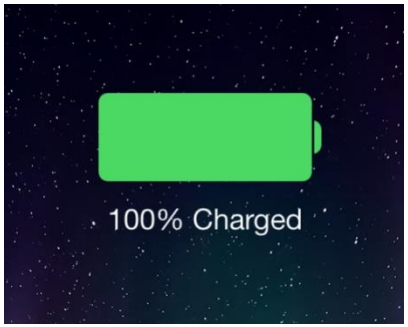
Overview of Presentation

- Present the specifications , needs, constraints, and deliverables for the project.
- What we have learned from our project learning.
- Our design ideas with schematics.
- Estimate of the project costs.
- Timeline of our project schedule with deliverables.
- Identifying potential problems with the project and our approach to dealing with them.

Specifications

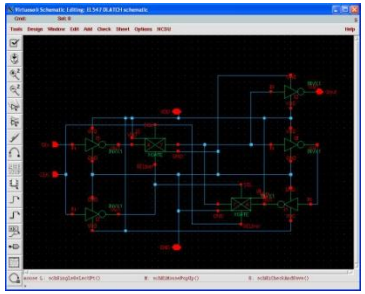
- Two minutes to charge the device.
- Should be able to carry it in a back pack or carry on.
- Needs to be able to carry a charge twice the time it takes to charge the phone.





Needs

- Parts to assemble a circuit model



- An analyzable simulation model

- A working prototype (that's what we don't want to happen)

Constraints

- Time
- Obtaining parts from manufacturers (eg. Eagle for PCBs)
- Creating an accurate model for both prototype and final product
- Learning tools (Cadence, PCBs, etc.)

Deliverables

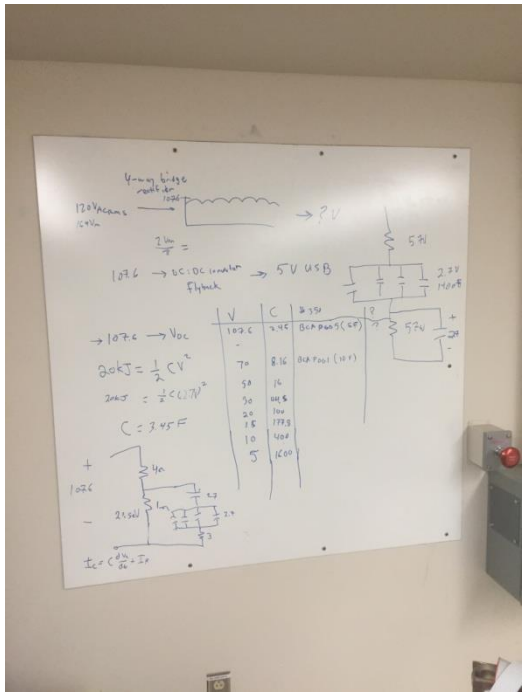
- Battery charger meeting specifications
- Reporting design process of device

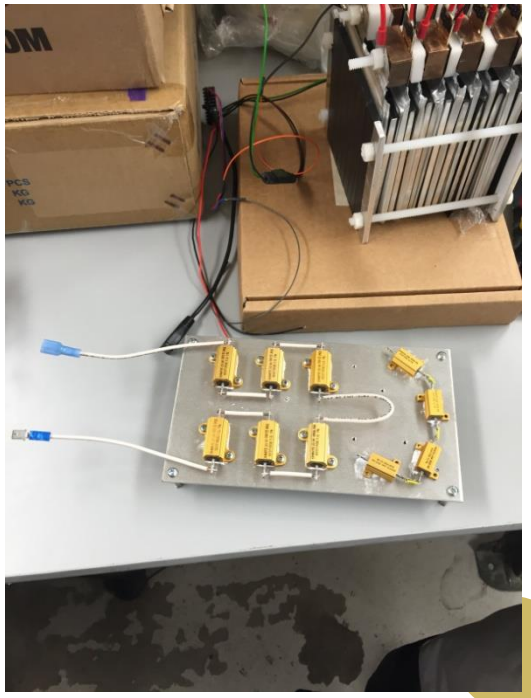
Project Learning

- Research Meetings
- Personal Research
- Lead Instructor/mentor meetings

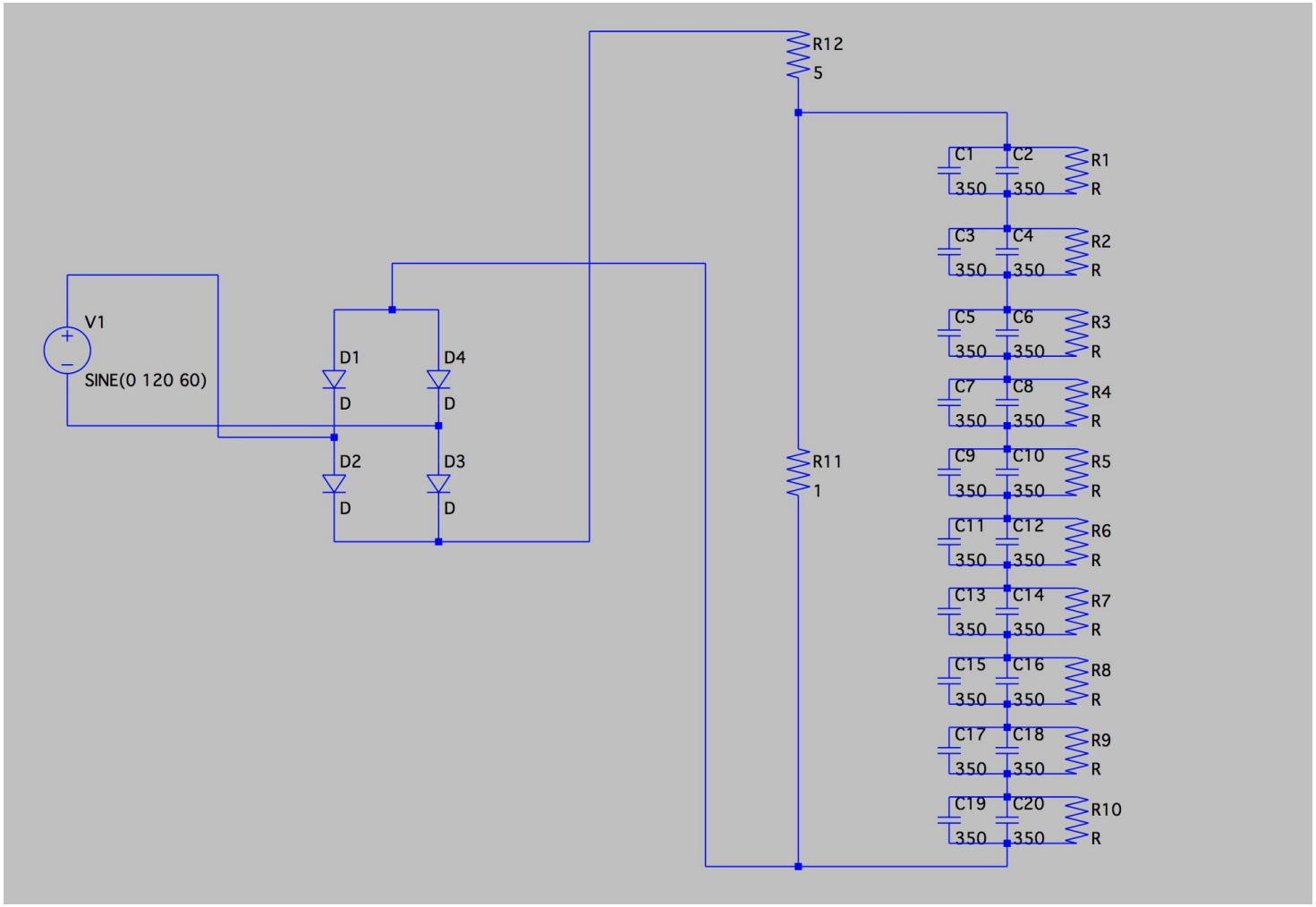
Research Meetings

As a result of our research meetings every week, we were able to make our specifications and brainstorm a variety of ideas for our circuit design, specifically our capacitor bank design.





Eventually we were able to come up with a schematic for the capacitor bank that fits relatively close to our specifications

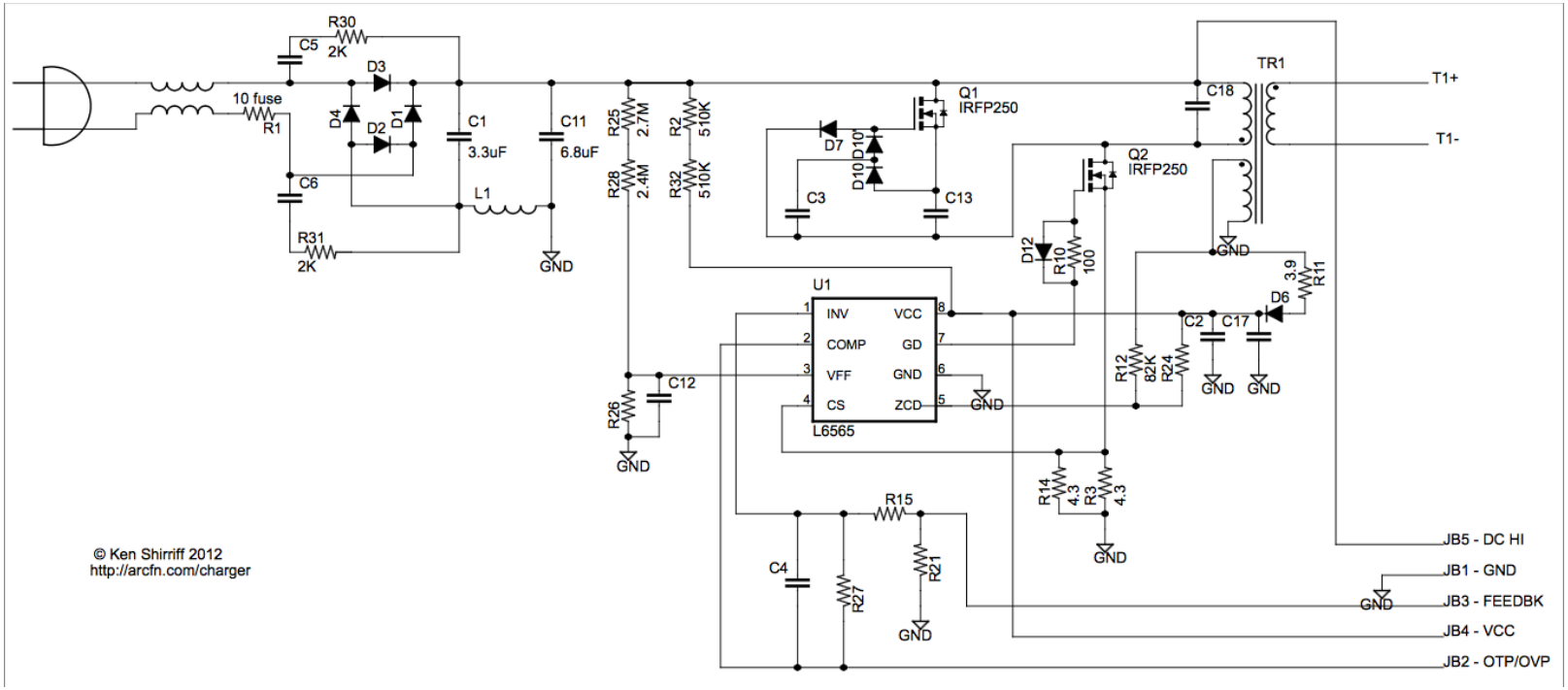


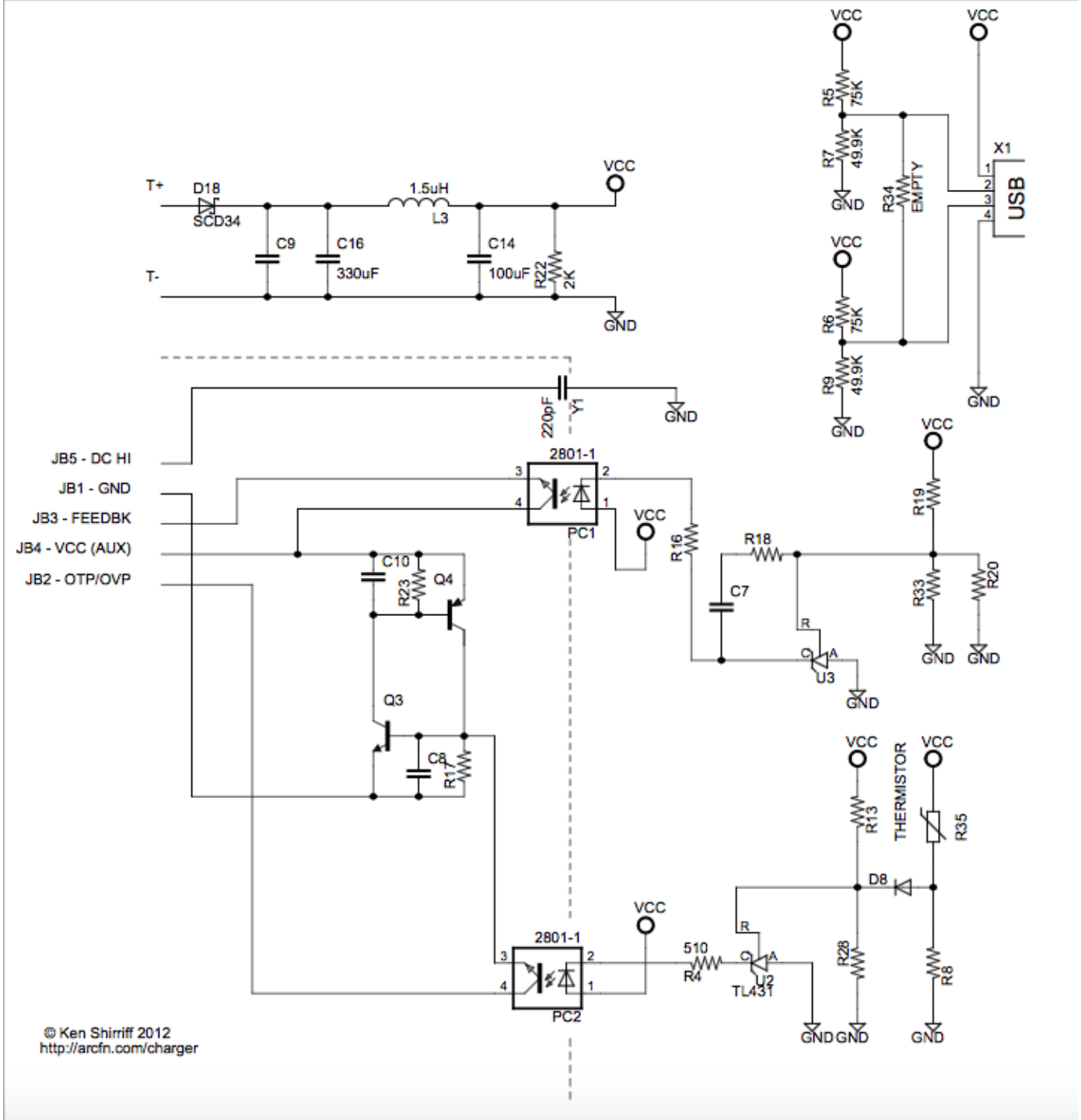
Personal Research

All of us had to do research outside of the group meetings. Most of the research included:

- Capacitor Bank designs
- Discussions with Fairchild Engineer
- USB pins
- USB Interface
- 12W Power Chargers
- Adafruits designs
- Apple Product designs

Our greatest benefit from our personal research was discovering how the apple 12W power charger worked. Here is the schematic for the design




T+
T-
D18
SCD34
1.5uH
L3
C9
C16
330uF
C14
100uF
R22
2K
VCC
GND
R5
75K
R7
49.9K
R34
EMPTY
X1
USB
R6
75K
R9
49.9K
220pF
Y1
JB5 - DC HI
JB1 - GND
JB3 - FEEDBK
JB4 - VCC (AUX)
JB2 - OTP/OVP
2801-1
PC1
R16
R18
R19
C7
C10
R23
Q4
Q3
C8
R17
R33
R20
U3
R
A
C
THERMISTOR
R35
R13
D8
R28
R8
510
R4
U2
TL431
PC2
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http://arcfn.com/charger

Lead Instructor/ Mentor Meetings

We went over the following with our instructor and mentor in these meetings and exchanged ideas:

- Circuit Design
- Project Development
- Timelines
- Budgeting
- Action Items

Project Designs

For the USB interface we have three design ideas

- Adafruit Design
- iWatt Design
- Apple Design

For the interface that connects to the capacitor we have two design ideas:

- Resistor Network
- LLC Resonant Converter

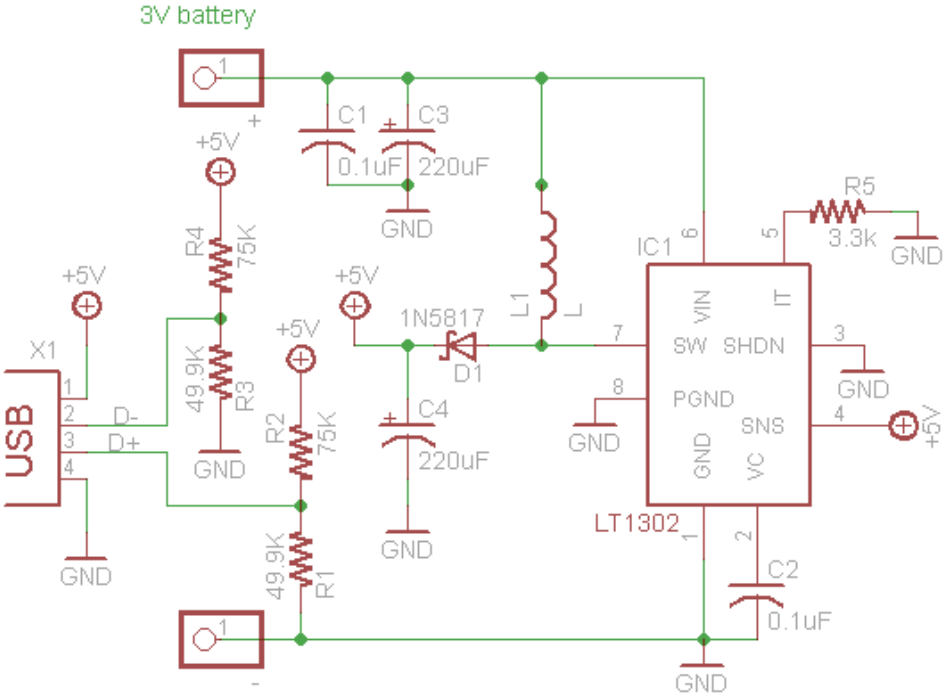
Adafruit Design

Pros

- Simple and a design we are familiar with
- USB interface is already made for us.

Cons

- Doesn't meet half of our requirements
- Slow Charge time



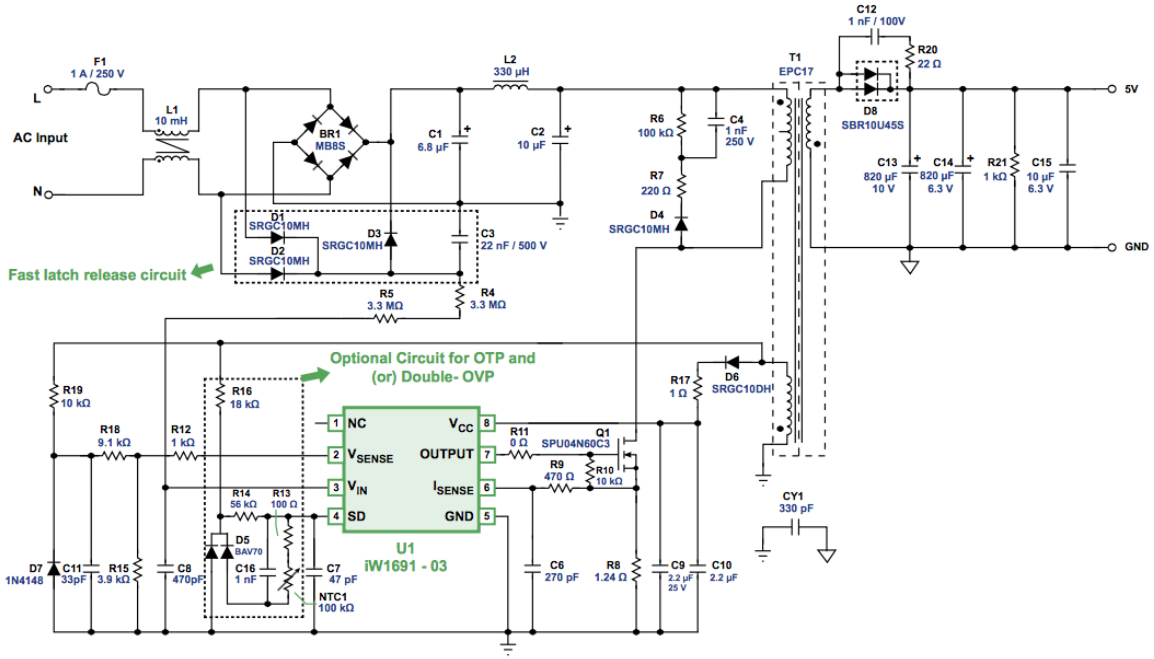
IWATT DESIGN

Pros

- Outputs high amps (2.1A) which meets better than our requirements.
- Data sheet for design has schematic with parts list to go with it.

Cons

- This is a knock-off item that is not commonly sold.
- Has no guarantee life time usage such as apple or Samsung chargers



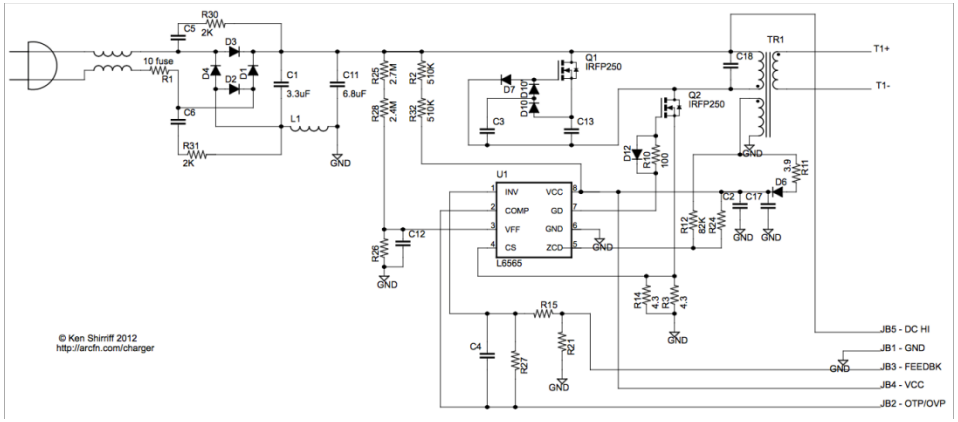
Apple Charger

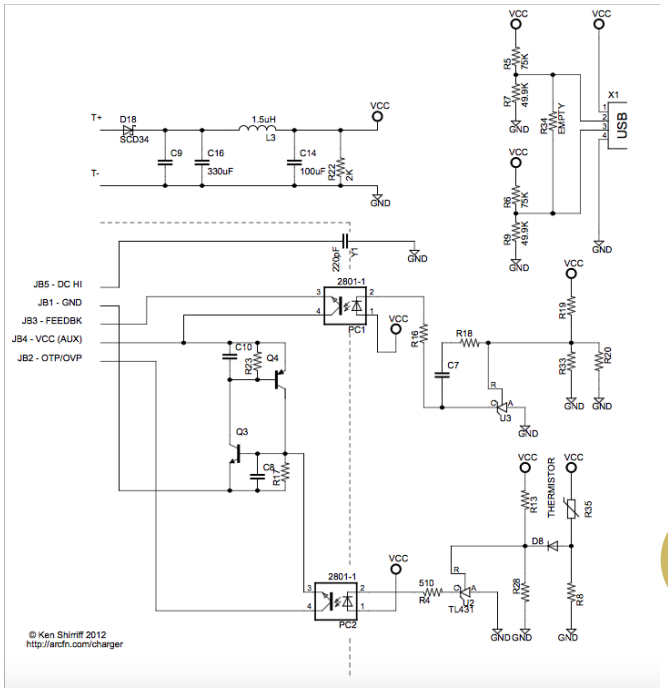
Pros

- Meets our exact specifications for our output for the device.
- Its well known for its quality
- Works for both phones and tablets.

Cons

- Although we have a schematic for the design, there are quite a few part numbers that we are missing.





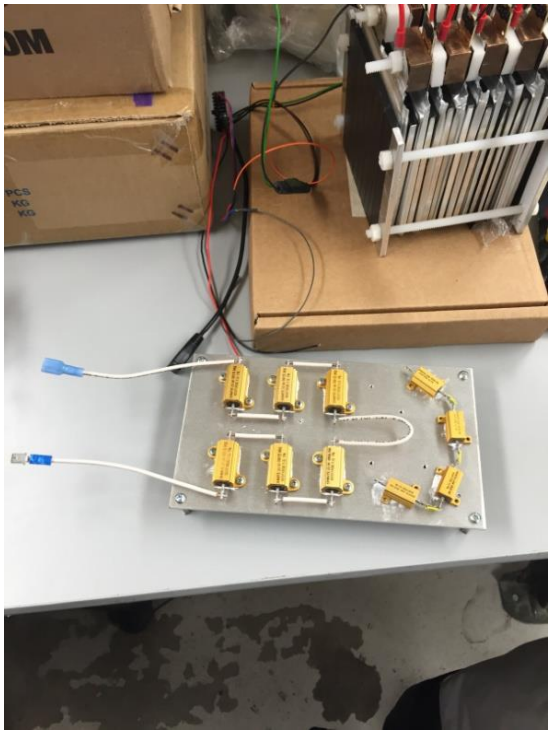
Resistor Network

Pros

- Cheap
- Easy to Design

Cons

- Inefficient
- Generates a lot of heat
- Not conductive to a small package



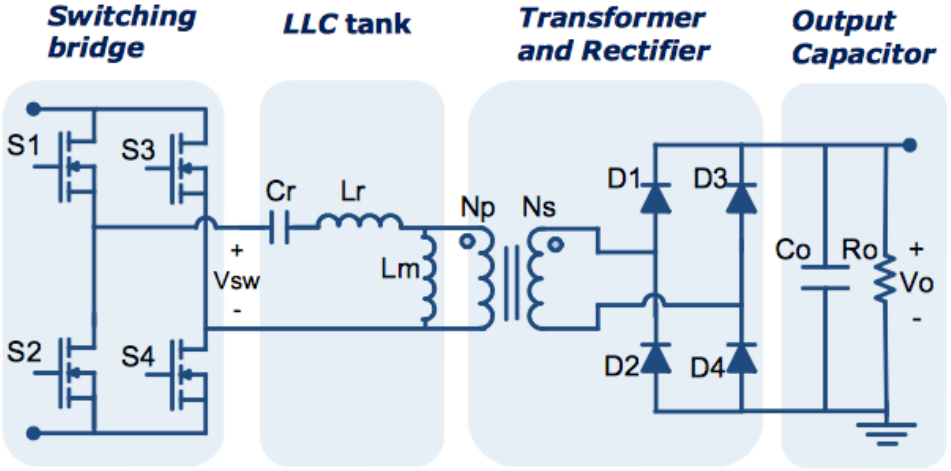
LLC Resonant Converter

Pros

- Efficient
- Contains protection circuitry

Cons

- Unknown whether it meets our needs
- Size challenges
- Design space limitations



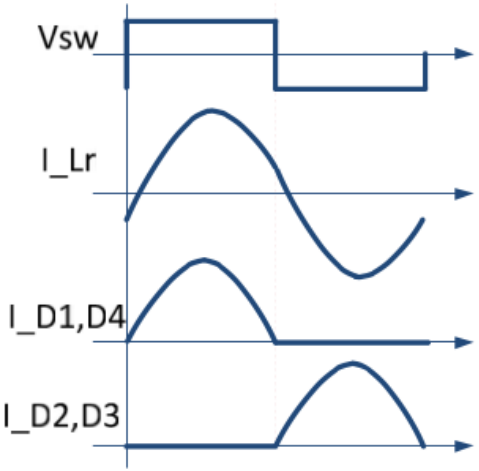


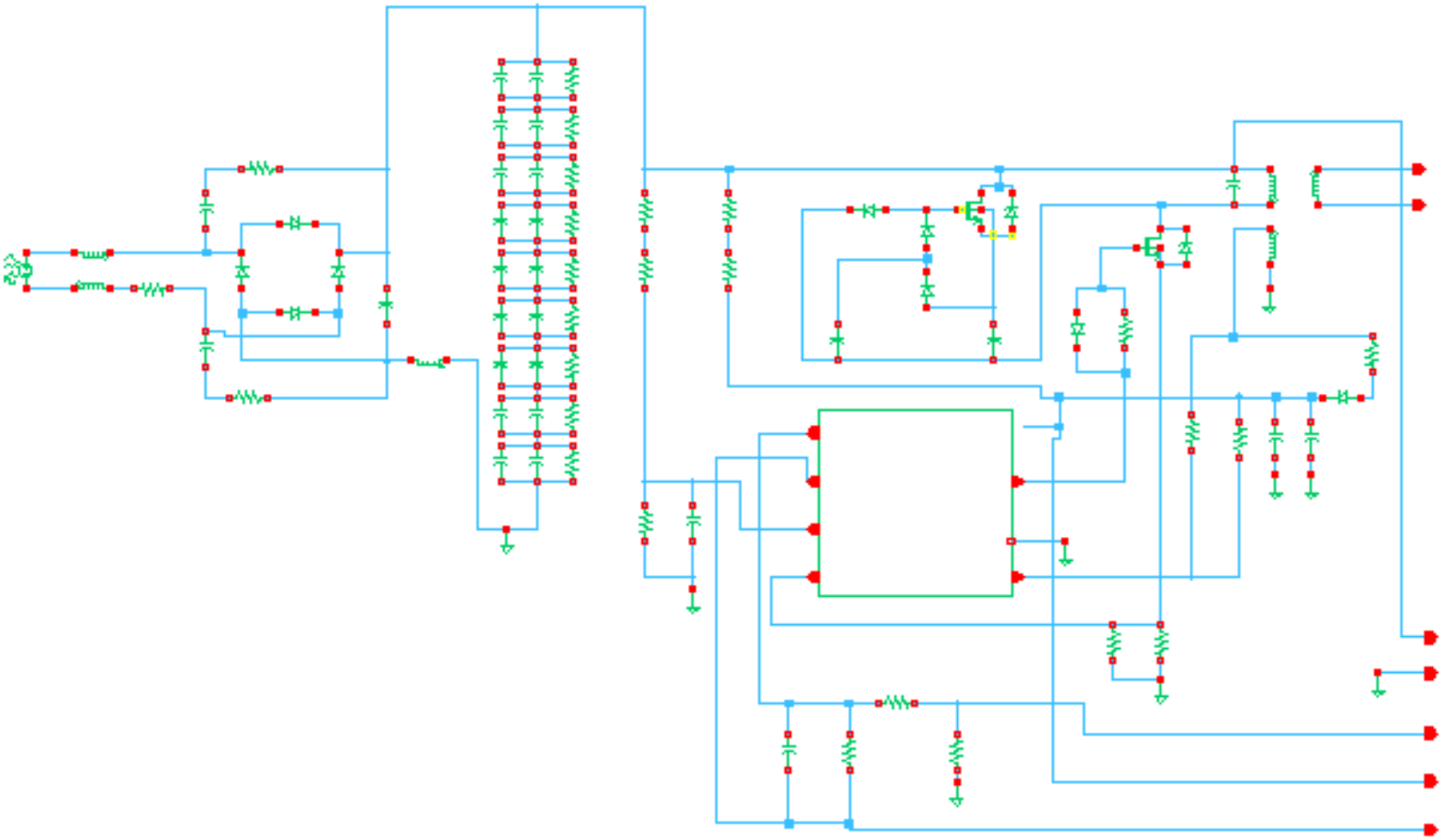
Figure 2.1 Full-Bridge LLC converter with Full-Bridge rectifier

So what is our suggested design?

After looking at our options here are the choices we made:

- The apple charger seems to be the safest design for the USB interface
- LLC or resonant converter for the interface for the capacitor bank is the most efficient choice.

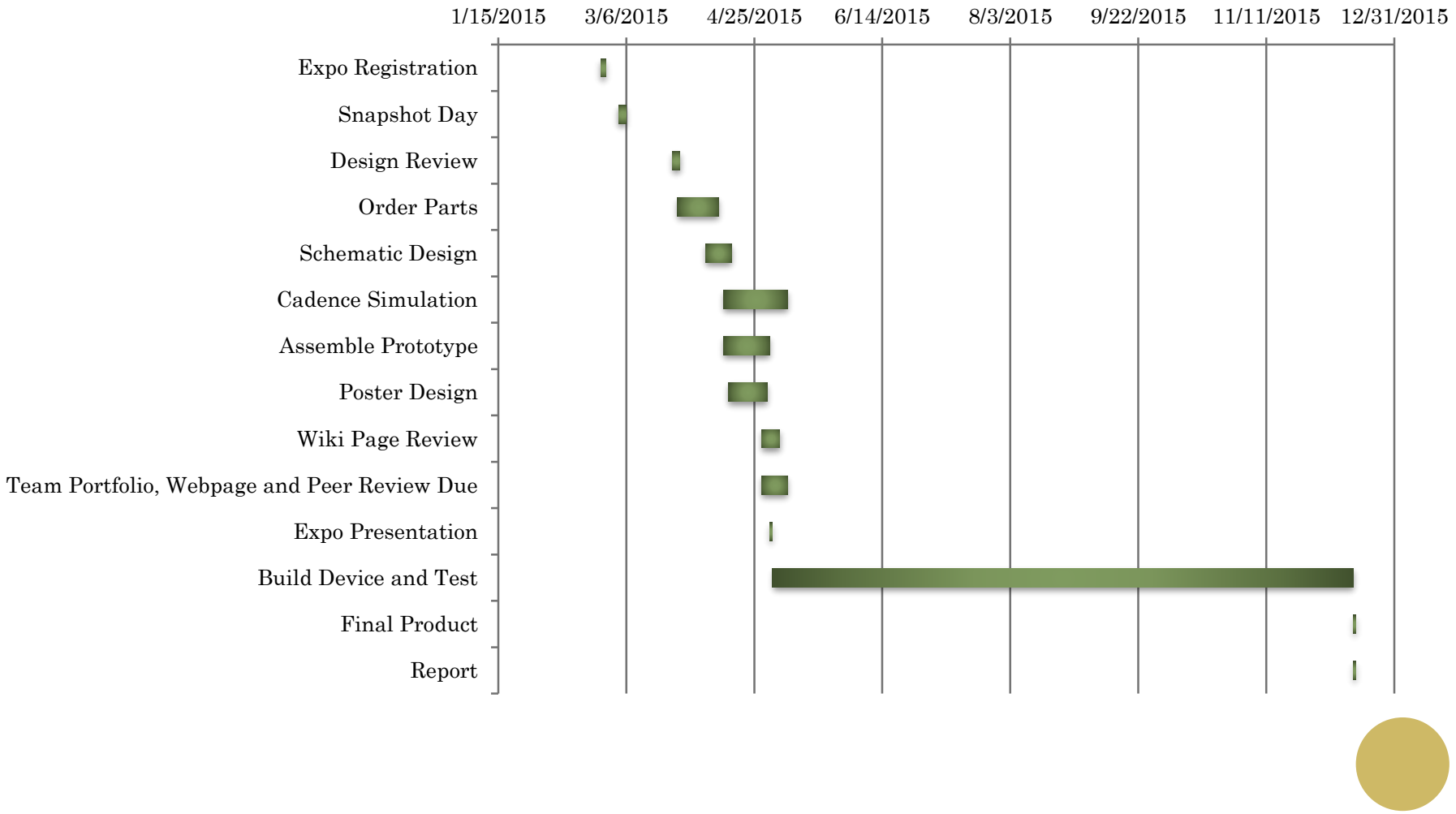
The following slide is a cadence schematic of the primary apple charger schematic using our capacitor bank design



Project Estimate Costs

Budget Items	Cost
Poster	$100.00
120VDC to 5VDC Flyback Converter	$40.00
120VAC Bridge Rectifier	$20.00
3.7V LiPoly Batteries (3)	$55.00
USB Tester	$12.00
3 way USB charging cable	$10.00
Mini Panel Current Meter	$15.00
Mini 3 wire Voltmeter	$15.00
Programmable Interface Module	$30.00
SuperCapacitors 4.5V 1F (20)	$260.00
Case	$30.00
Power Cable	$15.00
USB Adapter	$2.00
Test Phones (2)	$100.00
Push Button Power Switch	$6.00
Total	$710.00

Timeline with deliverables



Potential Problems and Risks

Problem	Solution
Getting parts in a timely manner.	Giving a longer lead time for ordering parts.
Learning curve for Cadence	Devoting more time to learning the program.
Getting the right specifications for the USB Interface.	Using the simulation to our advantage.
Safety	Use rated parts, use an accurate model, ask for guidance.

Any Questions?

The End