Colorado Space Grant Consortium
Independent Study Credit
Final Report

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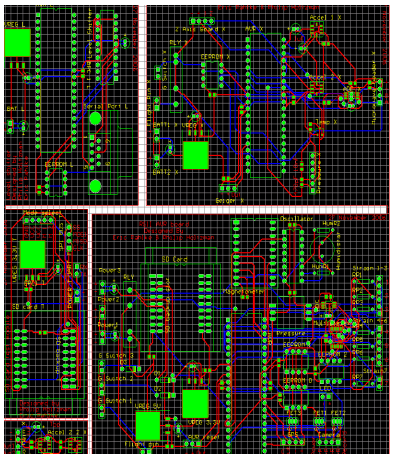

RocketSat II
C&DH

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1.0 Student Background

During high school, my favorite classes were always math and science classes, and I took the most advanced physics, chemistry, and math classes available. I've known for a long time that I wanted to be an engineer. I've always wanted to be able to build things, and I've always been fascinated and slightly irritated by all the complex electronics that I could not begin to understand.

RocketSat was an opportunity to begin fulfilling those two things. I got to build something useful and interesting, and I got to know exactly how it works.

My qualifications before I began work were minimal. I had quite a few honors classes, but no experience outside of class and virtually no hands-on experience.

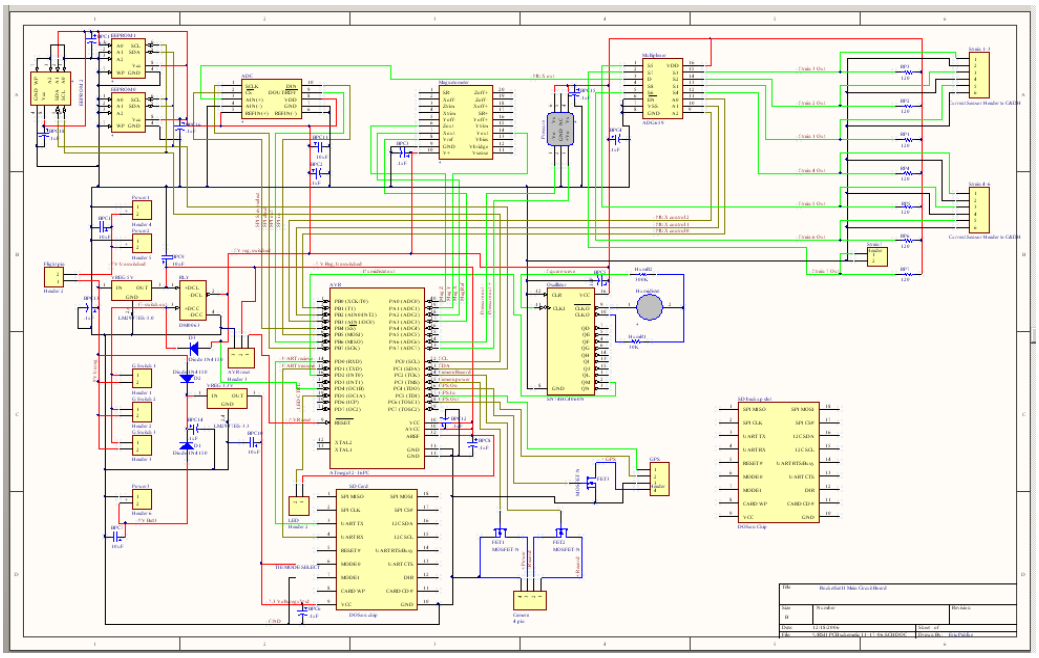
2.0 Overview of Semester Work and Assignments

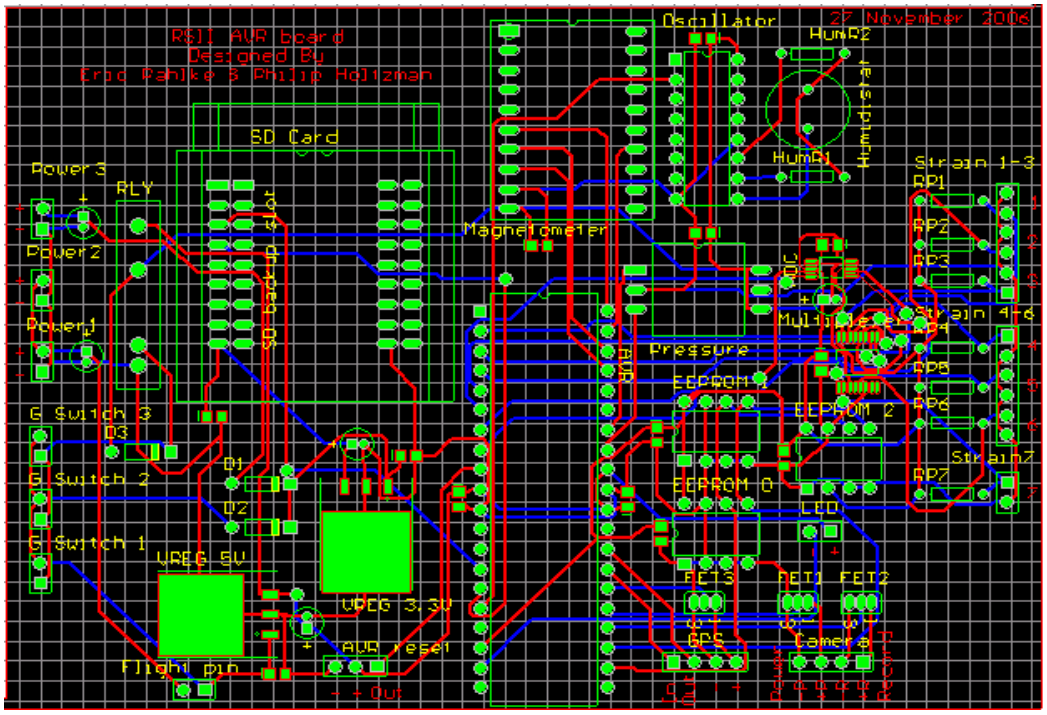
My job for most of the semester has been working on designing the PCB. I have needed to research and create parts, figure out wirings, and finally work on final assembly. I have also worked on dozens of smaller but nevertheless essential details for the design, including finding the right resistors to use with the humidistat, researching the use of capacitors to filter power, figuring out the various switches to make sure the payload is turned on at the right time, and testing to the extent that it could be done without the PCB.

3.0 Detailed Description of Work Completed

My main accomplishment has been the design of the PCB. It includes RocketSat II, RocketSat X, and two non-flight boards. The two non-flight boards include a level shifter which can be used to extract data from an EEPROM and a test board for the DOSon chip and SD card. The designs and schematics shown below are the final designs which were sent in for manufacturing.

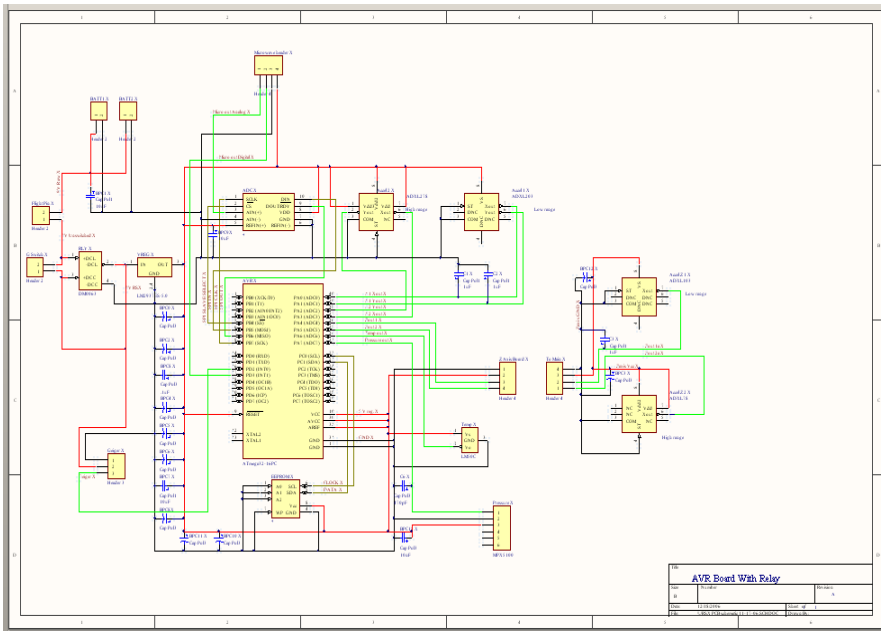
3.1 RocketSat II

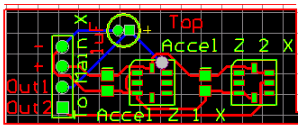


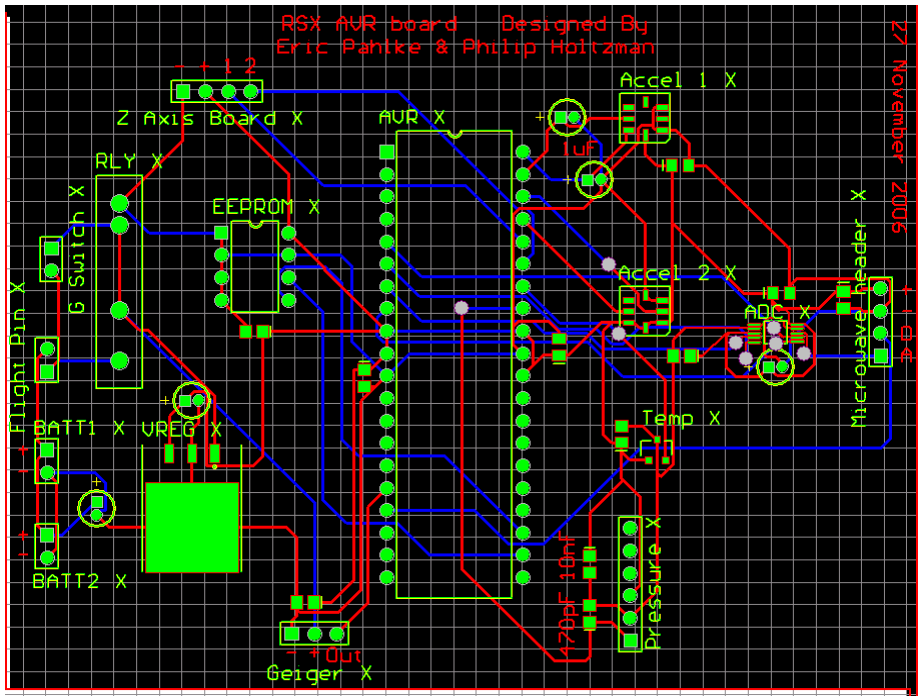


This schematic shows the complexity of the new system. Using a chip that requires 3.3 volts added a lot to our power supply system. The circuitry for the strain gauges was also very complex, and, unfortunately, we have not yet been able to test it, though we will soon. Adding the three EEPROMs as a backup memory storage system due to the uncertain functionality of the DOSon chip did not complicate the design much, but it certainly used up all the extra space we had on the board. We have one major problem with the holes for the magnetometer and DOSon chip, but we are well on our way to finding a solution.

3.2 RocketSat X





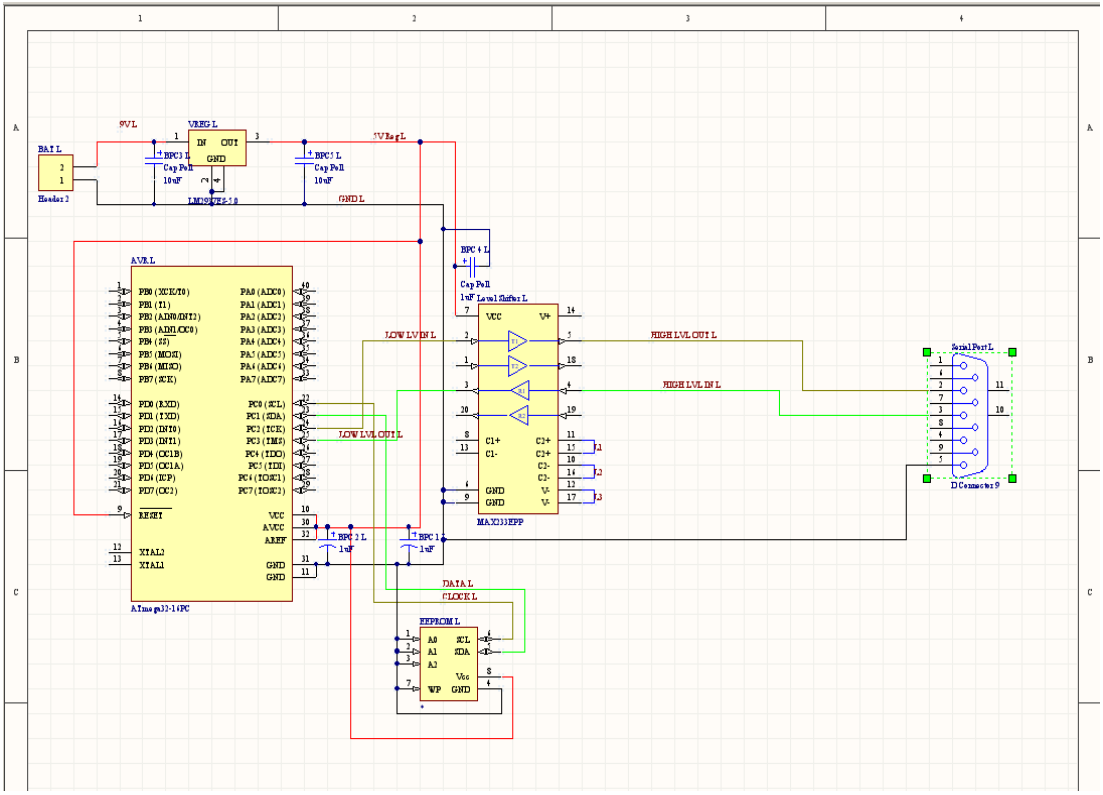


RocketSat X was considerably less time-consuming than RocketSat II, but still took more work than expected. Most of the PCB design was left over from RocketSat I,

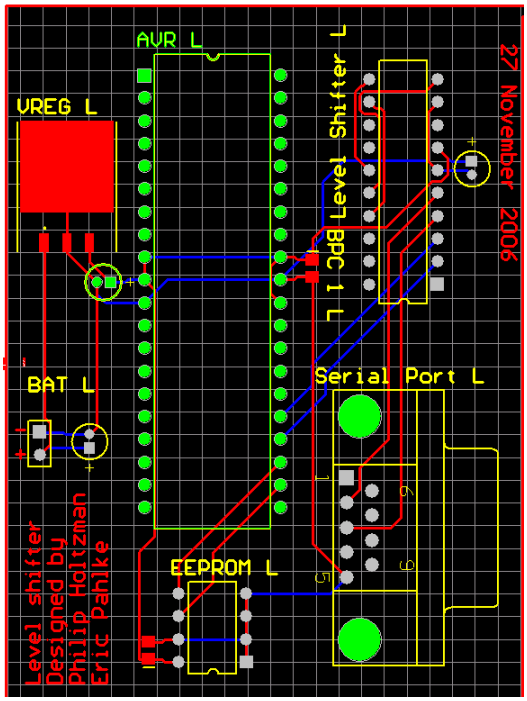
but we did make a few changes. For example, the Microwave detector also has an analog output now, so we added an ADC for greater precision. The original plan was to update the pressure sensor, but due to pin shortages the new one was moved to RSII and the old one stayed on RSX. I also created a Z-axis accelerometer board since we did not have the design for the old one. One problem (an incorrect trace) has since been discovered and repaired.

3.3 Level Shifter

The level shifter board is used for extracting data from the EEPROMs after flight. It has an EEPROM socket, an AVR spcket, and a MAX233 level shifter, as well as a nine pin serial header and a power system. This board was by far the least complicated of the



four, although when I first started working on it at the beginning of the semester it seemed extremely complex.



3.4 SD Card Test Module

The last board is hardly worth mentioning. It was added late simply because we had available space. Since the SD card has not been functional despite continued efforts by my teammates, the test board will probably have little use.

3.5 Other accomplishments

Nearly all of my work until the PCB was ordered led up to that point, so there is little worth talking about before then. After the PCB was ordered, I spent my time dealing with the little details that were preventing us from ordering the board. After it arrived, Phil and I, with some help from James Gorman and Tim May, have been working on assembling the board. As of when I last worked on it, it was very near completion.

The original deadline for completion of the PCB design was in late October. At this point, the design had barely been started and many of the components had not been finalized. I decided to hold back ordering the PCB until I was sure that it would not just be a waste of money.

4.0 Work to Be Completed

Our first goal is completely finishing the PCB. After that, we have quite a bit of testing to do. This has not yet been completed simply because we have not yet had time. By the end of the week, we hope to verify all the connections in the PCBs and test all of the components in conjunction with software. We will then need to perform a variety of full systems tests. Presumably we will also need to

work with science to ensure that they know exactly what data they are getting. If everything works as planned, I believe C&DH will be essentially finished.

The other thing we have not completed is documentation, for a variety of reasons. I have only done documentation that is important for my own use. As much as I have been pushed on documentation, I have been pushed more on other tasks and have therefore directed more time and attention to them.

5.0 Conclusions and Results

C&DH is the team that pulls everything together and interfaces each of the experiments. The PCB is essentially the heart of the payload, and without it none of the work by science and structures would be useful, so I believe that my work has been very important to the entire design process.

I feel that I've learned a tremendous amount. At the beginning of the semester I was shown a schematic for RocketSat 0, and I could not even begin to understand what it meant. After a semester, I can explain exactly why every connection on any of the new boards is there, because I added most of them. A few months ago I had questions about things so simple as inverters, which now seem the most trivial topic.

I've also learned a lot about PCB design in general. I've learned a tremendous amount about how to use Altium Designer effectively, and I've learned what the parts and layers of a PCB are and what their limitations are.

6.0 Conclusions and Results

At the beginning of the semester, I essentially had no idea what was going on. I'm not sure if this is because I did not hard enough to figure it out or because the staff and older students did not try hard enough to teach me, but the first month or two I was getting to worry that I would never catch on, and I was having so much trouble finding work to do that I was worried that I would not have enough hours. It might help to give new students a more thorough description of exactly what has been done and exactly what needs to be done. The problem faded away after CDR. (That cutoff is shown clearly in my hours per week.)

7.0 Hours and Outreach

I worked one outreach, a lego drop on 11/19. I also helped prepare the laptops to give to other schools, which officially counted as an outreach, but I do not know the date.

Week	Hours
08/28 to 09/03	0
09/04 to 09/10	1
09/11 to 08/17	8
09/18 to 09/24	6
09/25 to 10/01	4
10/02 to 10/08	7
10/09 to 10/15	12
10/16 to 10/22	10

10/23 to 10/29	13
10/30 to 11/05	15
11/06 to 11/12	13
11/13 to 11/19	17
11/20 to 11/26	0
11/27 to 12/03	8
12/04 to 12/10	5
12/11 to 12/17	9
12/18 to 12/22	NA

8.0 Grade

I feel that I deserve a B. I've completed a lot of work, but not necessarily on time and never perfectly, and I've done less documentation than I should have.