Colorado Space Grant Consortium
Independent Study Credit
Progress Report

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1.0 Overview of Semester Work and Assignments

In my brief tenure with the power team for CO^3 this semester, much has changed in the overall design of our subsystem. I began the semester just becoming familiar with the current overall design of the subsystem, but quickly moved into research and design. The power conversion section of our subsystem needed to be completely redesigned, which became my primary task. I worked extensively on researching different converter options available, and ultimately chose two DC/DC buck and boost converters. After choosing my main component, I then needed to choose on passive components and switches for the converters. My next task was to learn Altium. Doing so, I was able to integrate the new DC/DC converters into the preexisting schematic. Finally, I was shown the documentation to prepare for CDR.

2.0 Detailed Description of Work Completed

Below in Table 1 is a list of task for the semester thus far, as well as due dates, completion dates, and notes about the task.

Task	Due Date	Completion Date	Notes
Recalculate Solar Panel and Battery needs based on new power and MOPS info	1/30/07	In Progress	Living document that gets updated with new info.
Research and select DC/DC buck and boost converters	2/2/07	1/31/07	Buck-LTC1148 Boost-MAX1771
Complete passive component and switching calculations for DC/DC converters	2/2/07	2/1/07	Calculations shown in design document
Update Altium with buck/boost converters	2/2/07	2/2/07	Updated schematic in systems folder
Assist with component selection for entire power subsystem	2/2/07	2/7/07	Finished by CDR - parts list in power folder
Update design document to reflect updated buck/boost information and calculations	2/2/07	2/7/07	Finished by CDR- design document in power folder
Update FFMEA with new buck/boost information	2/2/07	2/2/07	Finished by CDR- FFMEA in power folder

Table 1: Task due dates and completion dates.

To begin work on this project, I initially needed to complete a lot of research. I began by first reading the current design document for the power subsystem, as well as the power section in *Space Mission Analysis and Design*. After my initial reading, I was assigned the DC/DC converters of the power system. I began by doing initial research on converters, and reading data sheets. I finally chose the converters that I thought would best fit our needs: correct power scaling, extremely high efficiency, low pin count, and low external component counts. After choosing my chips, I needed to determine the exact values for our external components. I used the typical application circuits shown in the manufacture's data sheets, as well as specific given equations for certain components to determine the optimum values for each component. There are a total of five boost converters (three at 7.4V, one each at 5V and 3.3V output) and two boost converters (in parallel for fault protection) in our subsystem design.

Once the components were selected, I needed to update many of the power and system documents to reflect the changes. This began by updating the system schematic in Altium. These components were then integrated with the rest of the power schematic, and a overall power system schematic was created.

After completing the schematic, we began, as a team, choosing all the component values that were needed. Due to manufacturing restraints, several values needed to be changed to reflect what components were actually available. Once all values were finalized, the schematic was again updated to reflect these changes. Because of the large volume of components needed for our subsystem (nearly 300 parts) it took us longer than expected to find exact part numbers for each piece. Because of this, we had a ripple effect delay through all of our documentation. However, all documents were up to date before CDR on February 9th.

Simultaneous with part selection I was also working on updating the FFMEA documentation. There are two main concerns with the converters:

1) Too much output noise on the line, resulting in too much output ripple for the receiver
2) Too much/not (dependant upon boost or buck converter) enough output voltage, resulting in damage or non-functionality of the recipient.

These are thoroughly outlined in the FFMEA, as well as their level of severity and likelihood.

Finally, after all components were selected, efficiencies of the converters were calculated, and the FFMEA was completed, I worked on the design document. In this document I thoroughly outlined my reasons for choosing each component, and how they were calculated. If at any point anything needs to be changed, it should be easy to determine how the changes should be made, based on the information that is provided there. We then gave a basic overview of this information at CDR.

3.0 Work to Be Completed

Despite all the work that has already been done on our subsystem, there is a lot left to complete. From CDR we have more information to gather on our components such as radiation hardness. I also need to determine all the parts that we need for prototyping. Once these tasks have been completed, we will build the FlatSat model of system, and begin to work on our test list.

4.0 Issues, Concerns, Questions, and Comments

I have learned an incredible amount over the last three weeks. I had never heard of a DC/DC converter, and I now feel quite versed in them. I have also learned a new software package, as well as the amount of work that it takes to keep a project like this going. Although we have an extremely strong team, I feel as though I have made a large impact. I have been able to help shoulder a lot of the responsibility of designing a crucial section of the subsystem, as well as complete documentation. I completely designed the DC/DC conversion for the power system, as well as helped with component selection and documentation. Because of this, the power team's design and documentation was able to be completed in time for CDR. I am also learning as much as I can about the rest of the power system so that I can be another reference for other teams when they have questions. I currently have a fairly basic, but functional working knowledge of all parts of the power system.