Department of Electrical and Computer Engineering
Capstone 2020

July 31, 2020

University of Windsor Space & Aeronautics Team Electrical Power Systems

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WINSAT

Abstract

Electrical Power Systems division is part of WINSAT team, which is a multi-disciplinary engineering team taking part in Canadian Space Design Challenge (CSDC) 2018-2020, a national competition of Canadian universities tasked to design, test and build a 3U CubeSat for mission in Low Earth Orbit (LEO). As an Electrical Power Systems division, we were responsible for the overall power distribution, PCB designs, battery selection, and solar array operations on our satellite. To meet CSDC requirements selection of the battery, solar cells were dependent on the power estimation procedures and PCB's were designed to integrate the different electronics components.

Introduction

The task of the team had been split into 2 parts:

1. Power Estimation: to create an effective satellite power budget to accomplish the required purpose in the satellite mission. This included the selection of the battery capacity and rated space solar array by analysing the techniques for estimating the power consumed by various electronic components.

2. PCB Designing: PCBs are built using Ki-Cad for solar panels, as well as payload, spice model block diagram were developed to help render PCB configuration for payload boards. Board configurations have been built to suit properly, mount and stack in modular fashion to the necessary mechanical requirements according to CubeSat specifications.

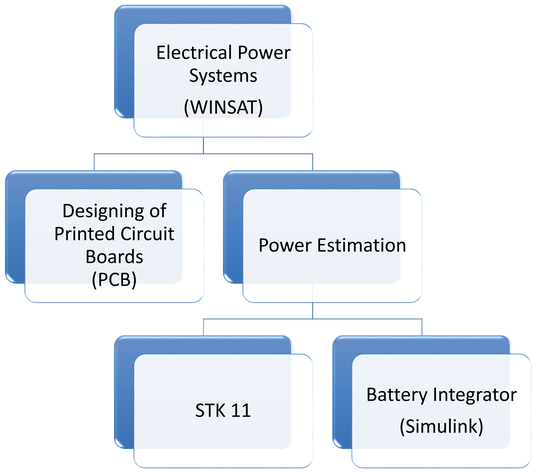

Figure1: Project Deliverables Layout

Design Methodology and Experimental Results

Involved methodologies are,

- *STK model:* to create an estimated power generation data set which could be further compared to our power budget data in order to compare it to power consumed by different modules.
- *Simulink model:* design a battery integrator to mimic the characteristics of the battery and EPS module.
- *PCB Designing:* PCB architecture required careful selection of tracing, footprints and sizing of electronic components.

Below table shows recorded power generation through 3 different techniques used for selection of battery and solar cells.

Methods	Power (W)
Power Budget Calculation	21.04
STK Simulation	21.72
Simulink Model	17.845

Table1: Power Generation Results

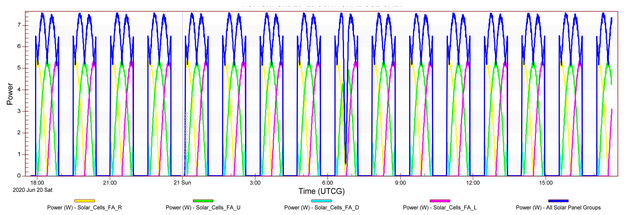

Figure2: STK Simulation for Sun Synchronous Orbit in Summer Solstice

Simulink model was created to observe the charging and discharging characteristics through the solar cells data acquired.

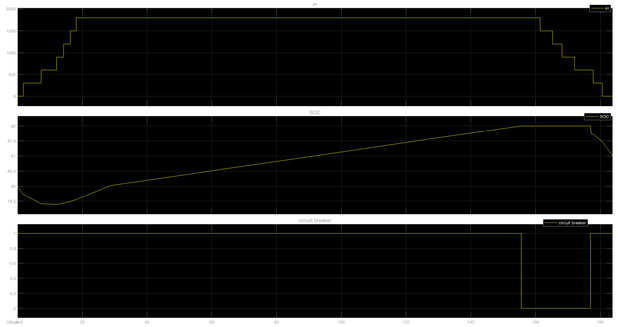

Figure3: Simulink Model Results

Designing of PCB Board

Multiple PCB's were designed for different applications in order to meet the requirements:

- Solar Panel
- Payload Module
- ADCS
- PC-104 layout

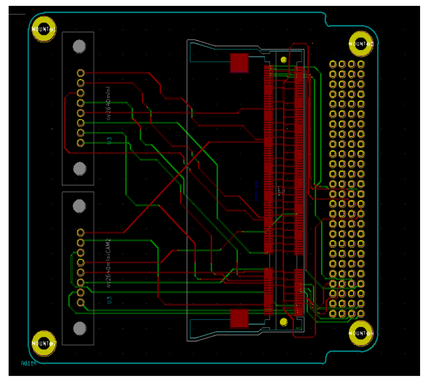

Figure4: Payload Module PCB Design

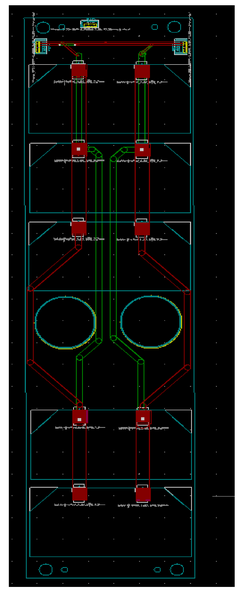

Figure5: Solar Panel PCB Design

Conclusion and Future Work

Based on the outcome of all tests carried out, the power estimation and PCB's design were considered acceptable. Because of the new global conditions, certain elements of the CSDC have been modified therefore the existing WinSAT Capstone team will not compete explicitly in the competition.

This project will be continued with further testing of the physical components after purchasing EPS module, space rated battery and solar cells where younger engineers will have the chance to bring the satellite to the competition.

Acknowledgments

EPS would like to thank Dr Maher for the support he has provided throughout the project. The team would also like to thank the team lead at WINSAT for their commitment to the whole project.