CUBESAT GROUND STATION RADIO FREQUENCY CHAIN - ELECTRICAL SYSTEM

by

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ECE4416 Electrical/Computer Engineering Project

Technical Project Proposal

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Proposal Summary

One document per design, printed in 12 point font, 1.5 spaces between lines, justified.

A maximum half page summary of the document.

We will complete this summary after the components of the proposal are done

1. Problem Statement - Sarah

Need to find a means of communicating with the CubeSat while it is in space. The communication link should be able to transmit information to, and receive and process information from the CubeSat.

2. Background Information - Ruhmaa

The Canadian CubeSat project is 15 grants awarded by the Canadian Space Agency to postsecondary institutions across Canada. The objectives of this initiative directly align with the University of Western Ontario and Nunavut Arctic College CubeSat Team: Ukpit-1. The mission statement is the following:

1) Provide an experiential learning and training opportunities for students in spacecraft development and operations, and in STEM outreach program development and delivery
2) Integrate and operate the Canadensys Nano VR camera in orbit for space and education

The CubeSat is a miniature cube-shaped satellite, with major advantages such as off-the-shelf components, simplistic design, low cost, therefore, can be designed for many various missions including research, technology demonstration, or for commercial use.

The CubeSat is comprised of systems, mechanical, and electrical engineering subsystems, including Communications (Comms), Attitude Determination and Control (ADCS), and O__ B__ C__ (OBC).
*Need to confirm the list of subsystems from Nick
Each system must work in a cohesive unit or order for the mission objectives to be reached. Mechanical Systems are responsible for the structural design of rails, cover plates, and antenna, as well as the mounting and solar panel plates. It is vital for students to understand the structural design to ensure their respective designs physically fit into or around the CubeSat. The Electrical Systems will be focused on power generation, signals, and monitoring status, for Comms, OBC, ADCB, etc.

Now shift focus to Ground station subsystem, cover concepts like filters, power amplifiers, second/third harmonic output
(maximum 1 page)

3. Project Objectives - Sarah

The overall goal of this project is to establish a means of communicating with the CubeSat, where we transmit data to and receive data from the device. Communication will be performed through a ground station antenna that we will be designing, building and testing. The antenna will be modelled as an RF chain that will include a transmitter and receiver, junction circulator, power amplifiers, various signal filters and protective components.

The transmitter will need to send out a 1 watt signal through the antenna at a frequency of around 450MHz. Since the transmitter is sending such a high power signal it will emit unwanted Third Harmonic frequencies. In order to eliminate these unwanted frequencies we will need to design and apply a bandpass and multiple notch filters to the transmitted signal.

The receiver will be also be functioning around 450MHz. We will need to design a bandpass filter for the receiver in order to eliminate some of the noise and interfaced that will be received along with the desired signal.

The junction circulator is a device that will prevent leakage between the transmitter and receiver. It will need to function around 430-440MHz and will be placed between the transmitter and receiver on the RF chain.

Power amplifiers will be used to amplify both the transmitted and received signals. The transmitted signal needs to be amplified to about 1 Watt in order to provide enough power for the signal to reach the CubeSat in space. The received signal will be very weak coming for space and will need to be amplified in order to recover and process the information.

As mentioned above, we will need to design various filters that will be used on the transmitted and received signals. The two main types will be bandpass and notch filters. The bandpass filters will need to be designed to isolate a certain band of frequencies around the transmitted and received signals. This filtering will keep the transmitted signal in the allowable frequency band and will help to eliminate unwanted noise from the received signal. The notch filters will be designed to eliminate the unwanted third harmonic frequency components that will be emitted by the transmitted signal.

For safety, all of the antenna components will need to be weather and lightning proofed, and we will need to incorporate a surge protector into the RF chain design.

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4. Methodology - Alex/Nick/Team

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5. Project Tasks and Responsibilities of the Team Members - Zoee/Team

(maximum two pages)

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6. Preliminary Budget and Parts List/Software Tools - Nick/Team

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7. Gantt Chart - Zoee

(See separate document for details. You can use any equivalent Gantt chart software)

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8. References - Team

(Refer to separate reference formatting document for details)