COMM SYSTEM

Subsystem Requirements

List all subsystem requirements, duplicating the requirements in the System Design Chapter that are relevant to the communications subsystem. Show how they are derived from, and their relationships to, the system-level requirements that are listed in the System Design Chapter.

Power requirement 35W, actual calculated is 33.3.

Thermal dissipation 30W, actual calculated is 28.3

Subsystem Design

Describe and illustrate the subsystem design of the communications subsystem. Show how the subsystem design, once fully implemented, will satisfy all subsystem requirements. Include Interfaces to other subsystems, relevant COTS parts cut sheets or specifications and any other documentation necessary to fully describe the communications subsystem.

In particular, the communications subsystem design description should include:

Alpha will use a Tethers Unlimited SWIFT-KTX programmable SDR transceiver with both a KA band transmitter and an X band receiver on board. The solar panels on the craft double as the antenna arrays thanks to integrated reflectarray antennas similar to that used on ISARA. These arrays have a pencil beam pattern for Ka band, and will also include a region of small antennas for X band reception.

- Complete descriptions of the ground station(s) including locations, transmitters, receivers and antenna patterns

The use of NASA DSN resources is baselined for uplink and downlink, primarily DSN-25 (Goldstone), DSN-34 (Canberra), and DSN-54 (Madrid). The capabilities of these stations are well documented in NASA records, available here: http://deepspace.jpl.nasa.gov/dsndocs/810-005/104/104H.pdf Other ground stations may be used in a backup or contest role including the equipment of HAM radio operators.

- Planned RF frequency bands, or, for optical communications, wavelengths

Uplink (command and control) activity will occur on X band at or around 7.145 GHz. The high speed downlink for telemetry, contest data packets, and payload will occur on Ka band at or around 32 GHz

- Planned transmission powers, modulation methods and coding approaches

The uplink (command and control) activity will use standard QPSK modulation at 30-50W to the dish feed, yielding a link margin of at least 19dB. Higher power transmissions are not a problem. Command and control data security will follow standard practice.

The Ka band high speed downlink will use 16QAM modulation with Reed Solomon forward Error Correction (FEC) at 5W or less. Other power settings, modulation, and FEC methods may be tried should the link fail, as these may be implemented via software commands.

- Include supporting analysis. Analysis should include environmental conditions, margins, uncertainties, assumptions, and operating states, modes and phases.

The supporting analysis is available in the included link budget. The links close, but there may be insufficient margin to achieve a reliable link in the event the receiving station(s) are occluded with heavy cloud cover. Should such conditions occur, it may still be possible to participate in the contest by increasing the transmitter power to a full 5W (intermittently and subject to thermal management) and/or slow the data rate. All of these changes may be triggered by commands on the X band system, which has a substantial margin and is largely unaffected by weather.

Subsystem Analysis

Please refer to the included link budget. The analysis tool used is mature and well documented within the spreadsheet. TRL data is available in the included Alpha Cubesat Technology Readiness Level (TRL) document.