

### Experiment Description:

Two transmitters will be utilized as part of a federal research contract, one mounted on a high altitude balloon and one mounted on a Mobile Ground Station (MGS). The launch point of the balloon/payload is in Roswell, New Mexico and current predictions are that the balloon will move east with flight termination (impact) possibly as far as the New Mexico / Texas border area, though it is more probable the balloon will not travel that far and stay inside New Mexico. The maximum altitude of the balloon will be 68,000 feet. Maximum duration of the flight (payload/MGS transmitters active) is 6 hours. Minimum duration of the flight is 2 hours. Only one flight will occur in a launch window as specified in the Start/Stop dates of this application filing.

The balloon/payload transmitter will be connected to a low gain omni directional antenna. The radio system (RFM69HCW module from Hope RF, which is based on the Semtech SX1231 RFIC) will have a maximum power level of +20dBm, into a 3.5dBi omni antenna, for a maximum Effective Isotropically Radiated Power (EIRP) level of +23.5 dBm.

The Mobile Ground Station will 'chase' the balloon on the ground with a small directional antenna mounted on a vehicle. The directional antenna will track the balloon payload and thus Azimuth and Elevation angles of the ground system will be constantly changing as the geometry between the MGS and Balloon changes throughout the flight. The MGS is primarily intended for receive only applications, except in the case of suspected payload malfunction. Should such a malfunction occur, override and/or reset commands will be transmitted from the MGS via the directional antenna. Maximum power of the radio is +20 dBm, into an 11.5dBi directional yagi antenna, for a maximum EIRP of +31.5dBm.

All transmissions (periodic 1 minute burst from balloon, and intermittent command uplinks from the MGS) will be short duration (approximately 50 milliseconds), narrowband (<25 kHz), 9600 baud, and GMSK modulated.

### Applicability of Experimental / STA licensing:

The radio system will be used as part of a high altitude balloon mission under federal contract (FA8002-17-C-0196). The radio system exceeds FCC limits for use as an unlicensed lower power system, and since it is being operated under a federal contract, it is not acceptable to operate under Part 97 Rules due to monetary compensation for operation of the radio as part of the larger federal contract goals. However, the radio system will be used in future missions as a cube satellite crosslink radio system, which will likely be licensed under Part 97 rules (or Part 5 Rules as details of the mission become more defined). For the Federal Contract, to which this application for an STA pertains, the radio is being utilized as a backup system as described in the Experiment Description section of this exhibit. As a byproduct of this operation, experimental data will be collected concerning the utility of these low power radios for long range communications (10-100 km), which is relevant to the future cubesat crosslink mission.

Below are Excerpts from '§ 5.3 Scope of service' showing the relevant applicability of the Experimental Service (and due to the short duration of the mission, specifically the Special Temporary Authority license) for this license request. Sections below in brackets [] indicate comments inserted from the author of this exhibit.

§ 5.3 Scope of service:

Stations operating in the Experimental Radio Service will be permitted to conduct the following type of operations:

(a) Experimentations in scientific or technical radio research.

[Testing future experimental cubesat crosslink radio system.]

(c) Experimentations under contractual agreement with the United States Government, or for export purposes.

[Virginia Tech research program under Federal Contract: FA8002-17-C-0196]

(d) Communications essential to a research project.

[Yes, radio system required as backup system to help ensure test objectives are achieved.]

(e) Technical demonstrations of equipment or techniques.

[Testing future experimental cubesat crosslink radio system.]

j) Development of radio technique, equipment, operational data or engineering data, including field or factory testing or calibration of equipment, related to an existing or proposed radio service.

[In future use of this technology, and based on the data collected during the mission, the specific radio system will be used aboard a cube satellite licensed in the Amateur Radio Service under Part 97 Rules in the spirit of advancing the radio art which is a fundamental tenant of the Amateur Radio Service.]

Stop Buzzer / Questions:

Transmissions under this License may be stopped by contacting Zach Leffke at (540) 231-4174 or (540) 808-6305.