

Small Unmanned System Data Link Usage for Research and Development

RE: Antenna Registration Question 5: FAA Antenna Sketch

File Number: 0118-EX-CN-2021

Confirmation Number: EL479667

Date: February 04, 2021

Experiment Overview

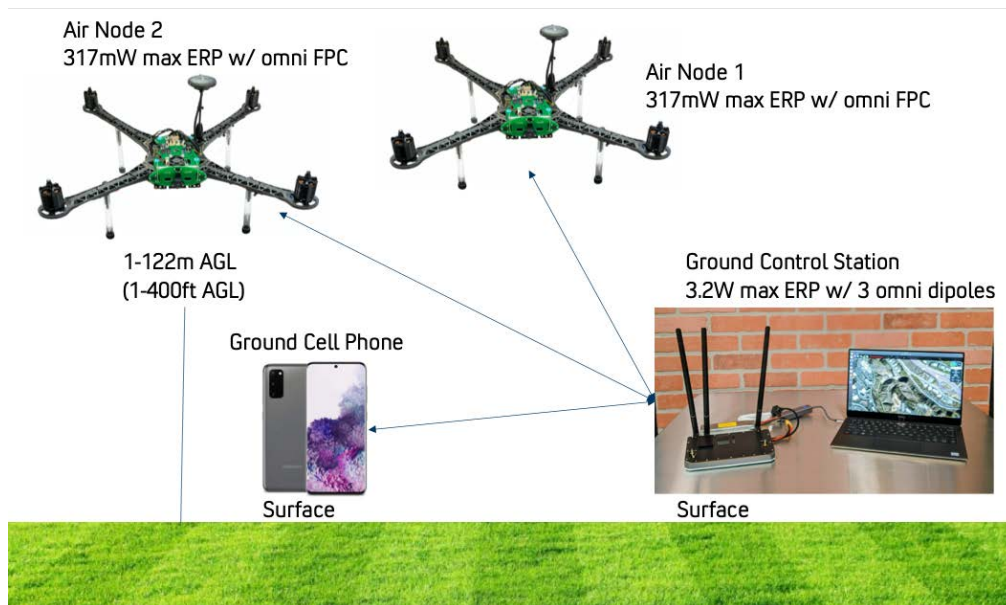
Systems & Technology Research (STR) is leading efforts on the Defense Innovation Unit research and development (R&D) project called “Artificial Intelligence for Small Unit Maneuver” (AISUM).

The goal of AISUM is to design and develop Artificial Intelligence (AI) enabled unmanned systems for the purpose of multi-agent cooperative autonomy. This effort seeks to develop multi-agent systems capable of autonomous operation in highly dynamic, unstructured, and unknown environments.

We require a minimum of one of the following 5MHz pairs in LTE Band 3: (1715 MHz/1810 MHz), (1720 MHz/1815 MHz), (1725 MHz/1820 MHz).

This effort will be expected to begin in March 2021 and extend for 6 months. Depending on the preliminary results, we may file for an Experimental license to enable the effort to continue.

For all computations we consider the highest desired bandwidth and ERP of the systems in the band requested.



Aerial Platform Description

To support this effort, we require multi-node data communications between multiple (up to 14) small UAV aircraft and a ground-based station. Each aircraft, a ModalAI VOXL m500 are approximately 24 inches in total wingspan and 2 lbs in weight, will carry LTE modems onboard and will share telemetry, video, and tasking data between each other and a ground control station using the ModalLink LTE Femtocell. Further information on the UAV can be found here:

<https://www.modalai.com/products/voxl-m500?variant=31790290599987>.



Antenna Parameters:

We are asking to use several systems, each outfitted with antennas.

The airborne systems will be outfitted with Sierra Wireless WP7607 LTE modem. The peak output power is 200mW.

<https://www.sierrawireless.com/products-and-solutions/embedded-solutions/products/wp7607/>.

Each airborne LTE modem is connected to a linearly polarized omni-directional FPC antenna. The antenna will be mounted to the bottom of the each aircraft in the vertical direction, thus vertical polarization. The antenna selected is the Yageo Pulse Electronics Gemini W3907 LTE FPC Antenna. The peak gain is 2 dBi in the LTE band of operation (between 1715 and 1820 MHz). The datasheet for this antenna is online at

https://productfinder.pulseeng.com/doc_type/WEB301/doc_num/W3907XXXX/doc_part/W3907XXXX.pdf.

Given the 200 mW peak transmitter output and 2dBi antenna gain, the ERP of each airborne system is calculated as 317 mW.



TECHNICAL DATA SHEET

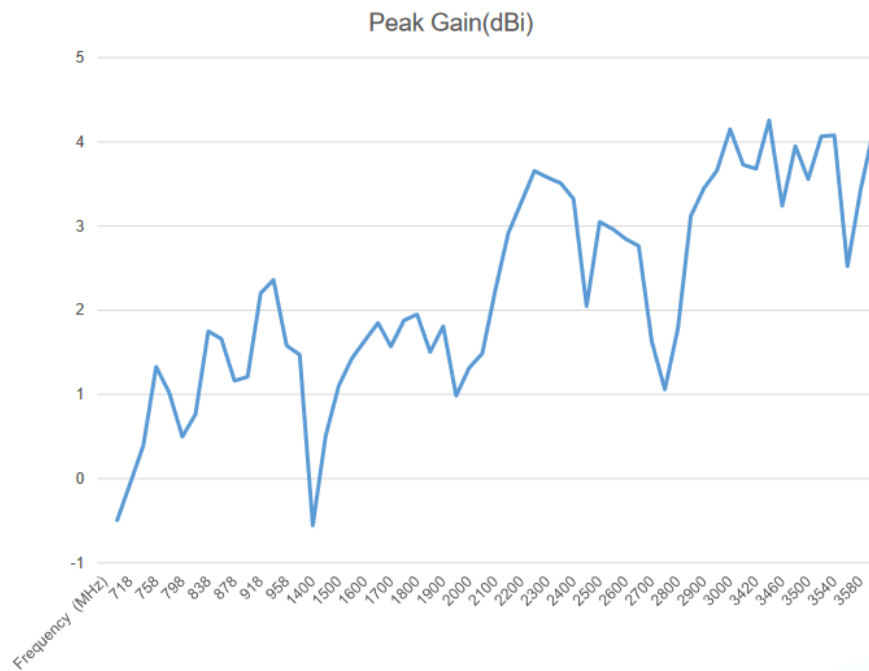
Description: LTE 698-3600MHz FPC Antenna

Series: Gemini

PART NUMBER: W3907XXXX

CHARTS

Peak Gain



Description: LTE 698-3600MHz FPC Antenna

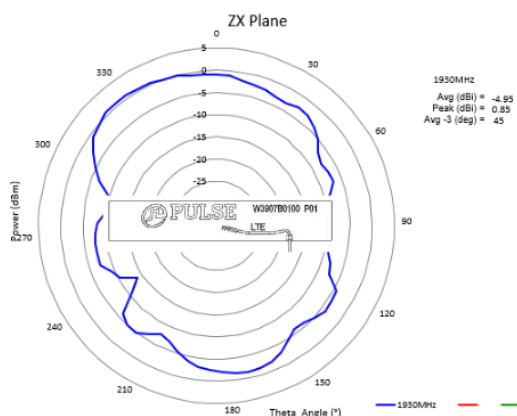
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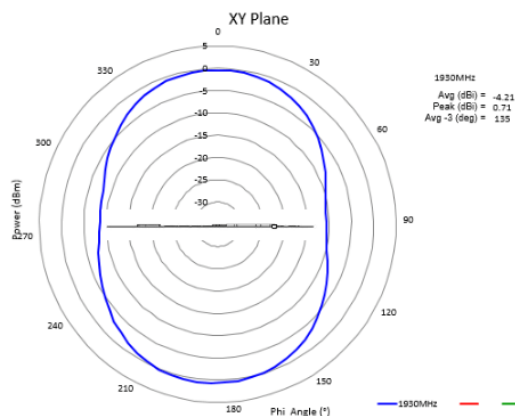
CHARTS

Typical free space radiation pattern
1695-2200MHz
(1930MHz)

Elevation Plane



Horizontal Plane



There will be a ground-based receiver/transmitter for UAV control and status. This will be the ModalAI ModalLink LTE Femtocell. The peak output from the ModalLink is 1W.

<https://docs.modalai.com/modallink-quickstart/>

The ground-based LTE Femtocell modem will be outfitted with 3 omni-directional whip dipole antennas. This is to enable high data rate data communications between the airborne platforms that are up to 3 km away from this antenna. The antenna selected is a Proxicast 3G/4G Universal Long omni-directional whip antenna. The Proxicast 3G/4G Long Aerial (Part Number ANT-120-006) is a mid/high-gain 3G/4G omnidirectional antenna. The “rubber-duck” style Long Aerial is a 11 inch (280 mm) omni-directional dipole antenna that provides 5 to 8 dBi of gain on all 3G and 4G/LTE frequency bands (698~960, 1710~2170, and 2500~2700 MHz). We expect a maximum 5 dBi of gain at the frequency of operation (2.5 dBi in azimuth, and 2.5 dBi in elevation) in the LTE band of operation

(between 1715 and 1820 MHz). The datasheet for the antenna is online at:
<https://shop.proxycast.com/shopping/proxycast-3g-4g-universal-long-aerial-5-8-dbi-omni-directional-whip-antenna.html>.

Given the 1 W peak transmitter output and 5dBi antenna gain, the ERP of each airborne system is calculated as 3.2 W.



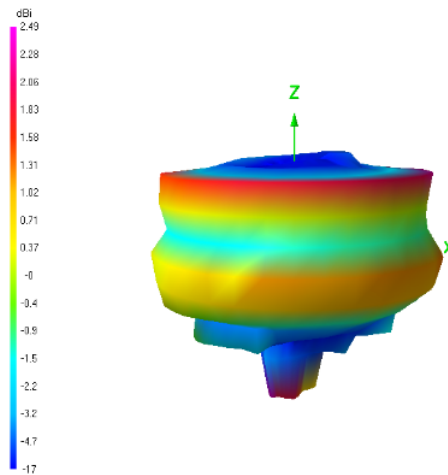
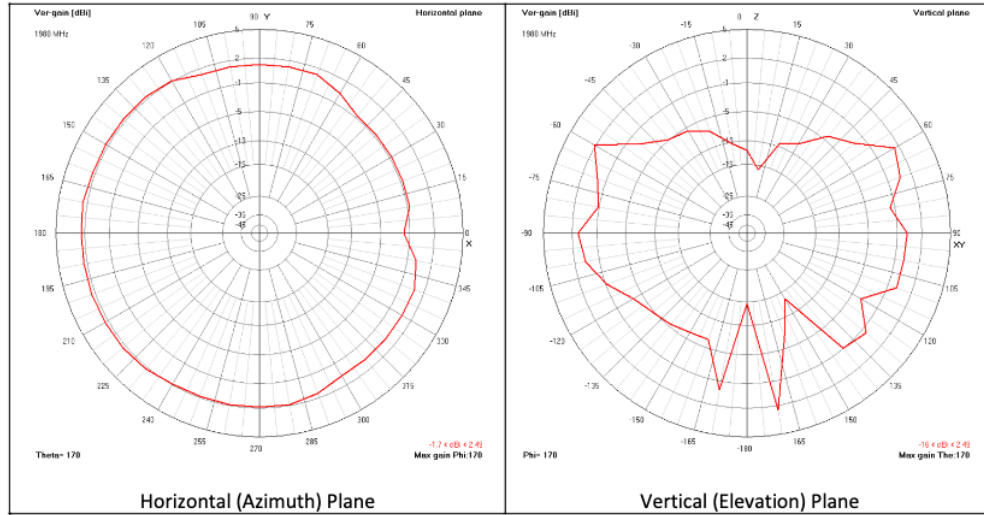
Electrical Properties	
Frequency Range	698-960 MHz 1710-2170 MHz 2500-2700 MHz
Impedance	50 ohms
Antenna Gain	5 to 8 dBi depending on frequency band
Radiation	Omni
Polarization	Vertical
VSWR	ADGP < 2.0:1
Wavelength	0.9 Wavelength 806-894 MHz / 1.95 Wavelength 1850-1990 MHz
Ground Plane	Integrated
Mechanical Properties	
Connector	SMA Male Swivel
Material	Polycarbonate / Brass RoHS compliant
Operation Temp.	-30°C to +75°C
Height	11 inches / 28 cm
Diameter	0.51 inches / 13 mm

ANT-120-006

5-8 dBi Omni-Directional 3G/4G/LTE Aerial Antenna



1980 MHz



The cellular telephones used on the ground will be standard commercial off the shelf Samsung S20 without any modification.

<https://www.samsung.com/us/mobile/galaxy-s20-5g/>

All use of the aerial systems will comply with FAA Part 107 operations and local airport regulations for proximity and operations to any such facility or appropriate airspace. The maximum operating height of the aerial platforms in any area within

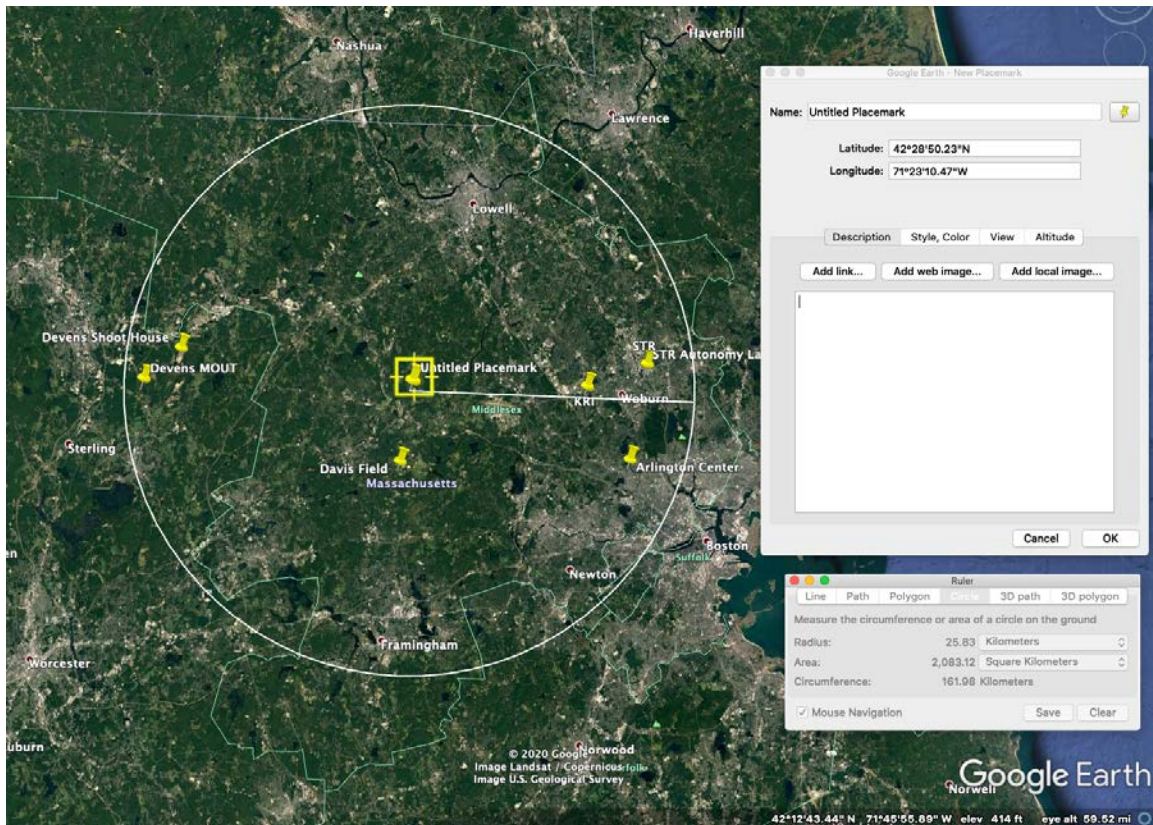
the designated areas will not exceed 400 ft AGL. The base station antenna will be on the surface.

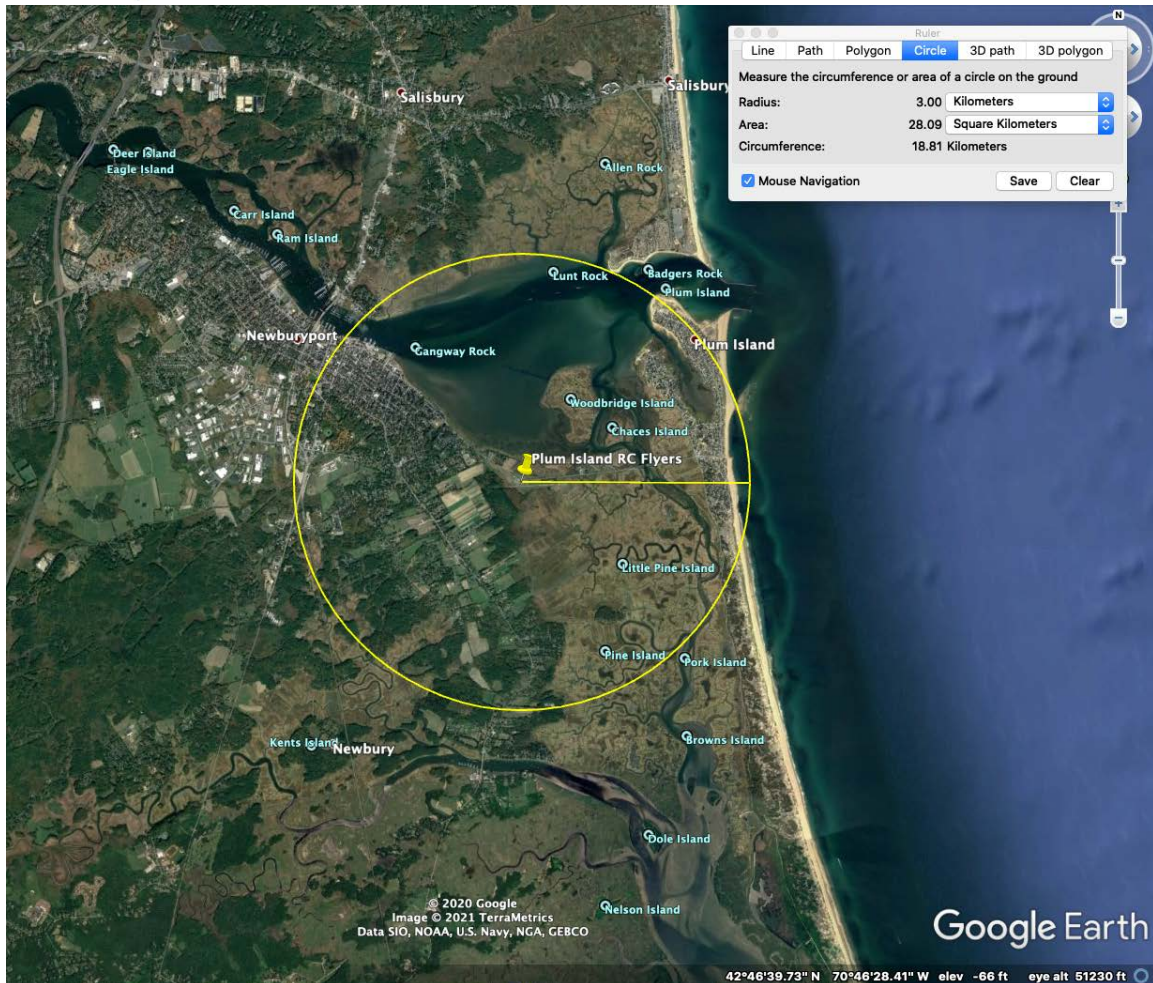
Power Parameters:

The ModalLink ground station has a maximum 1 W power output, and a 3.2W ERP. The aircraft modems have a maximum 200 mW power output, and a 317 mW ERP.

Operations / Flight Routes:

Flights are currently planned within 26 km of Concord, MA (42° 28' 50.23"N, 71° 23' 10.47"W) and 3 km of the Plum Island RC Flyers range at the Plum Island Airport (2B2) in Newburyport, MA (42° 47' 43"N, 70° 50' 22"W). Planned flight tests currently include: Ft. Devens (Devens, MA), Davis Field (Sudbury, MA), Kostas Research Institute (Burlington, MA), Systems & Technology Research (Woburn, MA), and sites in Arlington, MA. These flight operations will occur not continuously, but rather as discrete test events during the execution of the contract. Any particular mission is expected to last no more than 5 days consecutively. Aerial vehicle operations will be conducted under 14 CFR Part 107 and the certificated PIC(s) will be in contact with nearby airports as appropriate. All flight altitudes shall not exceed 400 ft AGL.





Additional Operating Locations – San Simeon, CA

STR plans to also operate at two areas near San Simeon, CA, specifically at Camp Roberts (R-2504A) and Fort Hunter Liggett (R-2513) and potentially within the lateral boundaries of the Hunter and Roberts MOAs (our UAS operations will again be limited to 400 ft AGL). Therefore, we are requesting a STA for operations within 53km of 35°43'21"N, 121°17'12"W.

The controlling agency and spectrum manager at Camp Roberts will be coordinating the airspace and with local airport operations to enable safe spectral emission and aerial operations, and has specifically asked STR to obtain a FCC STA for these operations. The requested area is for a series of distinct events (5 days maximum in duration) within the STA timeframe, not a continuous mission over the 6-month period.

