

Raytheon Request for FCC Special Temporary Authorization (STA)

Line-of-Sight Developmental Testing

STA File Number: 0314-EX-ST-2014

Date: 4/14/2014

Purpose of Operation:

Frequency authorization for 14.4 – 14.83 GHz (Ku Band) is being requested for the period of May 12 to November 10, 2014. Frequency authorization is required for developmental testing of a line-of-sight communications system.

STA Explanation:

The demonstration will be conducted at the Raytheon Test Facility in Marlboro, MA over the period of May 12 to November 10, 2014.

Test Summary:

An experimental license is required for developmental testing of a line-of-sight communications system. The testing includes transmissions of modulated communications waveforms from up to four (4) Ku band horn antennas.

The testing trials and dry runs are planned for approximately the first two (2) months. End-to-end system performance evaluation is planned for the remaining four (4) months. If there is a need to conduct testing for a longer period of time, a permanent experimental license will be requested to support the activity over the desired time frame. Each Ku band horn will transmit a 100% duty cycle modulated communications waveform.

Site Safety Measures:

Raytheon's RF safety group is involved in this demonstration to ensure that no personnel are subjected to RF power density levels exceeding the Maximum Permissible Exposure (MPE) limits of the Part 1.1310 of the FCC Rules and the guidelines in FCC's OET Bulletin Number 65. Using the equation 3 in the OET Bulletin, the MPE limit can be exceeded at 80 cm using average power and 140 cm using peak power.

Raytheon has a Company Policy and an Environmental, Health and Safety Standard which address electromagnetic energy exposure control. It is Raytheon's policy to ensure that our personnel, the general public and our customers are not exposed to RF levels which exceed applicable standards. To that end, we will have an RF Safety Control Plan in place for the testing. The Plan will define the procedures and controls required to prevent personnel exposure to levels which exceed the MPE. To verify the safety of personnel, an RF survey will be performed at the initial turn-on of the system. All measured levels, where personnel have access, must be below the MPE limits before testing can proceed.

Raytheon Technical Point of Contact:

Name: Tom McGree

Title: Engineering Fellow

Phone: 508-490-3271

Email: thomas_p_mcgree@raytheon.com

Raytheon Spectrum Manager filing application:

Name: Karen Dyberg

Title: Spectrum Management and RF Safety

Phone: 978-440-4022

Email: karen_i_dyberg@raytheon.com

Period of Use:

Start date: May 12, 2014

End date: November 10, 2014

Equipment Information:**Common Data Link (CDL) modems:**

Manufacturer: L3 Comm West

Model: Mini-CDL-200 Transceiver

Number of units: 8

Experimental (Y/N): No

Ku band Horn Antenna:

Manufacturer: Rozendal Associates

Model: Model RA-4100

Number of units: 4

Experimental: No

For each transmitter:

RF output at the CDL transmit terminals: 2.5 Watts peak, 0.8 Watts average

Effective radiated power from each transmit antenna (100% duty cycle emissions):

(Antenna gain = 20 dBi)

ERP for Ku band horn/CDL transmit modem: 152 Watts

Frequency Tolerance:

Less than 0.0001 %

List each type of emission separately for each frequency

The transmit waveform from each Ku band horn emitter is a 100% duty cycle Offset QPSK modulated waveform. The bandwidth of each emitter is a function of the selected information transmission rate as given below under the section heading Necessary BW Formula as defined by Annex J of the NTIA Manual.

List as appropriate the type of modulation:

Maximum speed of keying in bauds: 44.73 Mbps

Maximum audio modulating frequency: Not Applicable

Modulation type of each carrier: O-QPSK (Offset-QPSK)

Frequency deviation of carrier: Not Applicable

Pulse duration and rep rate: 100% duty cycle transmission

For complex emissions, describe in detail: Not Applicable

Necessary bandwidth. Explain how determined.

See below.

Location:

The Raytheon Marlboro, MA test facility is located at North 42°20'34.26", West 71°29'33.95" and ground elevation of 80 meters above sea level. The street address is 1001 Boston Post Road, Marlboro, MA 01752.

Is a directional antenna used?

Yes – the Ku band horn antennas

If yes, give the following info:

Width of beam in degrees at the half-power point:

16.5 degrees Azimuth; 16.5 degrees Elevation

Orientation of horn antenna:

0 to 30 degrees tilted off horizon

Will the antenna extend more than 6 meters above ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building?

Yes - The horn antennas will be mounted on separate tripods within the field of view of the phased array receive antenna. The tripods will provide the necessary height above ground for each of the horn antennas to mitigate multipath degradation. This test will occur next to a three story Raytheon building which is about 11 meters tall. The existing building is higher than the proposed antenna structures, so no sketch is provided.

If Yes,

Overall height above ground to tip of antenna in meters:

Maximum of 30 feet or 9.1 meters

Elevation of ground at antenna site above mean sea level in meters:

80m (Marlboro, MA Raytheon Test Facility)

Distance to nearest aircraft landing area in km:

Marlboro Airport - Marlboro, MA (MXG) 1.3km

List any natural formations or existing man-made structures (hills, trees, water tanks, etc) which in the opinion of the applicant would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna:

The existing building is higher than the proposed antenna structures so no sketch is provided.

Necessary BW:

O-QPSK is a form of Phase Shift Keying with $K=0.7$ and S , the number of signaling states equal to 4. The CDL waveform implements a rate $\frac{1}{2}$ forward error correction code, therefore R is equal to twice the information signaling rate.

$$B_n = 2RK / \log_2 (S) \\ = 0.7R$$

The demonstration will implement CW links at three different information rates. The information rates and resultant bandwidths of each link are given in the following table. The emissions are G1D.

Information Rate	Total Bit Rate, R	Bandwidth, B_n
44.73 Mbps	89.46 Mbps	63 MHz
21.42 Mbps	42.84 Mbps	30 MHz
10.71 Mbps	21.42 Mbps	15 MHz