

Raytheon Request for FCC Experimental license

File Number: 0563-EX-ST-2017

Date: 7/14/2017

Purpose of Operation:

Frequency authorization is being requested for the period of May 22, 2017 – November 10, 2017 in X-band at frequencies between 9.35 – 9.45 GHz, in order to test prototype radar arrays in a relevant environment. Outdoor testing, across multiple frequencies as noted above is required to assess hardware compliance with requirements and to continue research and development. This system is capable of serving multiple surveillance roles including primary radar aircraft and weather surveillance for aircraft operations, general weather surveillance for a variety of tasks including severe weather detection and warning, and wind turbine clutter mitigation, etc.

Technical Synopsis:

- Spectrum needed: 9.35 – 9.45 GHz
- Power levels requested: 160 W output power, 953.4 kW ERP (peak)
- Location of use: Devens, MA
- Each antenna has a +/- 45 degree scan angle
- Stop buzzer contacts: Nate Miller (507-421-9830), Geoff Verbeke (508-490-1307),

Karen Dyberg (508-450-9236)

Operations Explanation:

The purpose of this request for Special Temporary Authorization is to test array compliance to RF performance requirements in a relevant environment. Testing must begin as soon as possible to meet scheduled deadlines.

Test Summary:

The system will transmit pulsed Frequency Modulated (Chirp) waveforms. For all waveform types, the maximum pulse duration is 55µs and the maximum duty factor is 22%. It is expected that the radars will be operated periodically during the STA period, < 8 hours a day, up to 7 days a week, for the duration of the STA.

RF Hazard Calculations and Site Safety Measures:

Initial calculations show that general public exposure limits will be reached at a 2.25 meters distance and occupational exposure limits at 1.0 meter, using formula (7) from FCC OET Bulletin 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", dated August 1997. These calculations take into account the highest duty factor of 22% and the raster scan pattern utilized by the radar. Raytheon's RF safety group is involved in all testing that requires free space radiation 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. An RF Safety Control Plan will be in place for the tests. 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:

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Period of Use:

Start date: May 22, 2017

End date: November 10, 2017

Equipment Information:

Indicate all equipment that will be involved in this operation.

Transmitter info:

Manufacturer: Raytheon

Model: LPR3

Number of units: up to 6

Experimental (Y/N): Y

For each frequency band:

RF output at the transmitter terminals:

160 Watts peak

Effective radiated power from the antenna (if pulsed emission, specify peak power):

The effective radiated power from the antenna, including antenna transmit gain and front-end losses, is 953.4 kW (peak power).

$EIRP = Power * gain$, Power = 160 W, gain = 39.9 dBi, $EIRP = 160 * 9772.37 = 1,563,597 \text{ W}$

$ERP = EIRP/1.64 = 953402 \text{ W}$ or 953.4 kW

Frequency Tolerance:

Less than 0.001 %

List each type of emission separately for each frequency (basically list the emission designators)

The LPR3 can tune at 1 MHz intervals within the band(s) authorized.

For each tunable frequency authorized, the LPR3 has the following emission designators:

4M7Q3N - 55µsec FM-Pulsed (LP) with a 2 MHz LFM chirp, centered at $F_{\text{tune}} - 3 \text{ MHz}$

7M1Q3N - 6µsec FM-Pulsed (SP) with a 2.5 MHz NLFM chirp, centered at $F_{\text{tune}} + 3 \text{ MHz}$

The transmit waveform chain-pulse sequence transmits a Long Pulse (LP) then a Short Pulse (SP) for each pulse repetition interval (PRI). The PRI for a pulse sequence is 256 usec (PRF = 3906.25 Hz). The Long Pulse (LP) is 55 usec pulse length using a 2 MHz linear FM chirp at a 22% duty factor. The Short Pulse (SP) is a 6 usec pulse length using a 2.5 MHz non-linear FM chirp at a 2.3% duty factor.

IMPORTANT: The pulse sequence requires 11.9 MHz (LP necessary bandwidth/2 + SP necessary bandwidth/2 + 6.0 MHz = $4.7/2 \text{ MHz} + 7.1/2 \text{ MHz} + 6.0 \text{ MHz} = 11.9 \text{ MHz}$)

List as appropriate for the type of modulation:

LP: Linear Frequency-Modulated Pulsed (Chirp)

SP: Non-Linear Frequency-Modulated Pulsed (Chirp)

Necessary bandwidth. Explain how determined.

The necessary bandwidth was calculated using the equations in Annex J of the NTIA Manual.

Locations:

The radars will be located on a rooftop or on a ground platform at Devens MA, within 0.4 km of the following coordinates: 42° 34' 08.50" North, 071° 36' 10.68" West.

Is a directional antenna (other than radar used)? No.

If yes, give the following info: (Although not necessary for this application, additional antenna detail is provided below)

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

1.98° Azimuth, 2.1° Elevation at boresight

Orientation in horizontal plane:

+/- 45° Electronically Scanned

Orientation in vertical plane:

0° to 30°, relative to ground horizontal, electronically scanned

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? No.

Overall height above ground to tip of antenna in meters:

No more 3 meters above ground level or roof top.