

Raytheon Request for FCC Experimental License

File Number: 0352-EX-CR-2021

Date: 06/03/2021

Raytheon Program Office Request a 24 Month renewal application.

09/04/2021 – 09/04/2023

Purpose of Operation:

Frequency authorization is being requested for X-band at frequencies between 9000 – 9200 MHz, 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.

Technical Synopsis:

- Spectrum needed: 9000 - 9200 MHz.
- A minimum of 2 frequencies separated by at least 12 MHz.
- Power levels requested: 160 W output power, 953.4 kW ERP (peak)
- Location of use: Raytheon Facility in Burlington, MA
- Direction of radiation: Boresite $288^{\circ} \pm 20^{\circ}$ with a ± 45 degree scan angle

New Stop buzzer contacts:

- Michael Dubois
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Test Summary:

The system will transmit pulsed Frequency Modulated (Chirp) waveforms. For all waveform types, the maximum pulse duration is 55 μ s and the maximum duty factor is 22%. See the detailed waveform explanation in a later section. Each operational frequency requires approximately 12 MHz of spectrum. At least 2 separate frequencies are necessary to conduct our research and development effort, however 4 frequencies are preferred. It is expected that the radars will be operated periodically, < 8 hours a day, up to 7 days a week.

New Raytheon Technical Point of Contact:

Michael Dubois

System Engineering Test Lead

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New Raytheon Spectrum Manager filing application:

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RIS Spectrum Management

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Equipment Information:

Indicate all equipment that will be involved in this operation.

Transmitter info:

Manufacturer: Raytheon
Model: LPR3
Number of units: 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, $EIRP = 160 * 9772.37 = 1563579.2$ W
 $ERP = EIRP/1.64 = 953402$ 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:

12M0Q3N - 55µsec FM-Pulsed (LP) with a 2 MHz LFM chirp, centered at Ftune – 3 MHz

12M0Q3N - 6µsec FM-Pulsed (SP) with a 2.5 MHz NLFM chirp, centered at Ftune + 3 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 street address for the Raytheon location is 3 Van de Graaff Drive, Burlington, MA 01803.

The ground elevation of the facility is 69 meters above sea level. The radars will be located on mounted on a rooftop at following coordinates: 42° 28' 57.61" North, 071° 11' 57.27" 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:

About 11 meters when mounted on the rooftop. 4

Necessary Bandwidth Calculation Table

FM-Pulsed Radar		
Modulation	LFM	NLFM
Pulse Width (μsec)	55	6
Rise Time (μsec)	0.128	0.128
Fall Time (μsec)	0.128	0.128
Chirp BW (MHz)	2	2.5
Necessary BW (MHz)	12	12
Designator	12M0Q3N	12M0Q3N

Necessary BW Formula

Symbols:

t = Emitted pulse duration at 50% amplitude (voltage) points. The 100% amplitude point is the nominal peak level of the pulse.

tr = Emitted pulse rise time in μ sec from the 10% to the 90% amplitude points on the leading edge.

tf = Emitted pulse fall time in μ sec from the 90% to the 10% amplitude points on the trailing edge.

FM-Pulsed Radar: *If tf is less than tr, then tf is to be used in place of tr when performing the necessary bandwidth calculations.