

Raytheon Request for FCC Experimental License

File Number: 0983-EX-CN-2021

Date: November 8, 2021

Raytheon Program Office request a 24-month license 12/15/2021 – 12/16/2023

Purpose of Operation:

Frequency authorization is being requested for X-band at frequencies 9010 and 9190 MHz, in order to test prototype radar arrays in a relevant environment. Outdoor testing, using both frequencies as noted above is required to assess hardware compliance with requirements and to continue research and development. Up to two units may be tested over this range simultaneously.

Technical Synopsis:

- Spectrum needed: 9010 MHz and 9190 MHz
- Power levels requested: 360 W output power, 1744 kW ERP (peak)
- Antenna Gain: 39 dB
- Location of use: Blacksburg, VA

- **Direction of radiation:**
- Fixed Antenna: Northwest (Normal boresight 260°) (Requested Coverage: 180° to 0°)

Stop buzzer contacts:

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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%. See the detailed waveform explanation in a later section. Each operational frequency requires up to 15 MHz of spectrum. Frequencies 9010 MHz and 9190 MHz are necessary to conduct our research and development effort. It is expected that the radar will be operated periodically, < 24 hours a day, up to 7 days a week.

New Raytheon Technical Point of Contact:

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Equipment Information:

Indicate all equipment that will be involved in this operation.

Transmitter info:

Manufacturer: Raytheon
Model: LPR3
Number of fixed units:
Number of mobile units: 1
Experimental (Y/N): Y

For each frequency band:

RF output at the transmitter terminals:
360 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 1744 kW (peak power).

$EIRP = \text{Power} * \text{gain}$, Power = 360 W, gain = 39 dBi, $EIRP = 360 * 7043 = 2859480 \text{ W}$

$ERP = EIRP/1.64 = 1743585 \text{ W}$ or 1744 kW

Frequency Tolerance:

Less than 0.001 %

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

For each tunable frequency authorized, the LPR3 has the following emission designators:
4M70Q3N – 55µsec FM-Pulsed (LP) with a 2 MHz LFM chirp, centered at Ftune – 3 MHz
7M10Q3N – 6µsec FM-Pulsed (SP) with a 2.5 MHz NLFM chirp, centered at Ftune + 3 MHz
15M0W8N – Chained long/short pulse with up to 9 MHz separation (4.7/2 + 7.1/2 +9 MHz)

List as appropriate for the type of modulation:

LP: Linear Frequency-Modulated Pulsed (Chirp)

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

Chained waveform consisting of sequential LP and SP

Necessary bandwidth. Explain how determined.

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

Locations:

- Ground elevation: 626 meters (2054 ft) above sea level.
- Antenna Height: 24.4 meters (80 ft) above ground.
- Antenna Feed Point Height: 648.4 meters (2134 ft) above sea level.

The radar will be located in an open field (lat/long 37°12'46.71"N 80°29'17.19"W) with mobile units operating within 10 kilometers around the lat/long center point.

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?

Yes.

Overall height above ground to tip of antenna in meters:

About 24.4 meters when mounted on a tower.

Necessary Bandwidth Calculation Table for each emission:

	FM-Pulsed Radar		
Modulation	LFM	NLFM	LFM+NLFM
Pulse Width (µsec)	55	6	61
Rise Time (µsec)	0.128	0.128	0.128
Fall Time (µsec)	0.128	0.128	0.128
Chirp BW (MHz)	2	2.5	2+2.5
Necessary BW (MHz)	4.7	7.1	15
Designator	4M70Q3N	7M10Q3N	15M0W8N