

Raytheon Request for FCC Experimental License

Prototype Radar Testing

File Number: 0557-EX-PL-2013

Confirmation Number: EL283282

Date: 16 August 2013

Purpose of Operation:

Frequency authorization for 5.412, 5.442, and 5.472 GHz in the 5.4 to 5.5GHz band (C-Band) is being requested. It will be used to perform developmental testing and calibration measurements of a prototype radar system (hereafter referred to as “the prototype” or “the radar”). Current development efforts are internally funded. There is no active government contract.

Explanation:

The measurements will be performed at the Raytheon Test Facility in Sudbury MA. The purpose is to perform developmental testing as well as calibration measurements of a prototype radar system. This test phase is a continuation of previous efforts intended to develop the maturity of key technologies being designed and developed by Raytheon under STA call sign WG9XKM, File Number 0188-EX-ST-2013.

Test Summary:

Transmit measurements will be made at low power using a subset of the radar array. These measurements will be in the operating frequency range of 5.4 GHz to 5.5 GHz.

These measurements will require transmission of pulsed linear Frequency Modulated (FM Chirp) waveforms. The pulse duration range from 6.3μsec to 123μsec and the maximum duty factor is 10%. These transmissions will occur between the radar array and a standard gain horn. It is expected that the radar will be operated 24 hours a day, seven days per week for the duration of the testing.

Site Safety Measures:

Calculations show that general public exposure limits will be reached at about a 2 meter distance using formula (6) from FCC OET Bulletin 65 “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, dated August 1997.

Raytheon’s RF safety group is involved in this test 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. 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.

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Period of Use:

From: September 16, 2013

To: September 15, 2014

Equipment Information:**Prototype Radar Transmitter:**

Manufacturer: Raytheon Company

Model: Prototype C-Band Radar

Number of units: One

Experimental (Y/N): Yes

For each frequency:

RF output at the transmitter terminals:

Prototype Radar: 260 W peak, 26 W average

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

Prototype Radar: 856 W peak

Frequency Tolerance:

Less than 0.001 %

List each type of emission separately for each frequency

The transmit waveform of the prototype radar is programmable is Linear FM-Pulsed with a programmable 2.5 MHz chirp and programmable pulse width from 6.3µsec to 123µsec. The maximum duty factor is 10%, and the maximum pulse repetition frequency is 29.762kHz for all waveform types.

List as appropriate the type of modulation:

Maximum speed of keying in bauds: *Not Applicable, not a communication device*

Maximum audio modulating frequency: *Not Applicable*

Frequency deviation of carrier: *Not Applicable*

Pulse duration and rep rate: 6.3 -123μsec maximum pulse width, 29.762kHz maximum rep rate (10% duty factor maximum at any pulse duration/rep rate combination)

For complex emissions, describe in detail: 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 (see below).

Location:

The Raytheon facility in Sudbury, MA, is located at North 42°21'57", West 71°25'56" with a ground elevation of 50 meters above sea level. The street address is 528 Boston Post Rd, Sudbury, MA 01776. The approximate location of the radar will be at North 42.366019°, West 71.431975°.

Is a directional antenna (other than radar used)?

No

If yes, give the following info:

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

Radar: 3.8 degrees Azimuth; 2.8 degrees Elevation

Orientation in horizontal plane:

0°

Orientation in vertical plane:

0°

Is a directional antenna (other than radar used)?

Yes

If yes, give the following info:

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

Standard Gain Horn Antenna: 19.2 degrees, (ERP not to exceed values listed above)

Orientation in horizontal plane:

0°

Orientation in vertical plane:

0°

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

If Yes,

Overall height above ground to tip of antenna in meters:

N/A

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

50m (Sudbury, MA Test Facility)

Distance to nearest aircraft landing area in km:

Sudbury, MA Test Facility:

- Marlboro Airport - Marlboro, MA (MXG) 8km
- Minute Man Airfield - Stow, MA (MMN) 13km
- Waltham Airport - Waltham, MA (WLT) 13km
- Laurence G. Hanscom Field - Bedford, MA (BED / KBED) 15.5km
- Laurence Hanscom - Burlington, MA (BBF) 15.5km
- Boston City Heliport - Boston, MA (JBC) 15.5km
- Waltham Hospital Heliport - Waltham, MA (WLM) 15.5km
- Route 128 Airport - Route 128, MA (REM) 19.3km
- Woburn Airport - Woburn, MA (WBN) 22.5km
- Logan International Airport – Boston, MA (BOS/KBOS) 33.8km
- Manchester-Boston Regional Airport – Manchester, NH (MHT / KMHT) 61.2km

List any natural formations of 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:

None

Waveform	Center Frequency (GHz)	Az Scan Coverage (deg)	El Scan Coverage (deg)	Pulse Width (us)	Pulse Rise/Fall Time (us)	Max Duty Cycle (%)	Transmitter Output, Peak	ERP, Peak	Max FM Chirp BW, Bc (MHz)	Necessary BW (MHz)	Emission Designator
Calibration Linear FM Chirp	5.412 5.442 5.472	Fixed	Fixed	6.3- 123.0	0.1	10	260 W	856 W	25	27.3	27M3Q1N

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.

t_r = Emitted pulse rise time in µsec from the 10% to the 90% amplitude points on the leading edge.

t_f = Emitted pulse fall time in µsec from the 90% to the 10% amplitude points on the trailing edge.

FM-Pulsed Radar:

$$B_n = B(-20dB) = \frac{1.79}{\sqrt{t_r t_f}} + 2B_c$$

*If t_f is less than t_r, then t_f is to be used in place of t_r when performing the necessary bandwidth calculations

Emission Designators (NTIA)

Linear and FM Pulsed Radar

Type of Modulation Main Carrier	Q	In which the carrier is angle-modulated during the period of the pulse (i.e. chirp, FM).
Nature of signals modulating	1	Single channel containing quantized or digital information without the use of a modulating sub-carrier, excluding time-division multiplex.
Type of Info transmitted	N	No Information Transmitted.