

# **Raytheon Request for FCC Special Temporary Authorization (STA)**

Prototype Radar Calibration Test

STA File Number: 0188-EX-ST-2013

STA Confirmation Number: EL845852

Date: 5 March 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 for the period of March 26 to August 20 2013. It will be used to perform preliminary calibration measurements of a prototype radar system (hereafter referred to as “the prototype” or “the radar”).

## **STA Explanation:**

The preliminary measurements will be performed at the Raytheon Test Facility in Sudbury MA, over the period of March 26 to August 20 2013. The purpose of this request for Special Temporary Authorization is to perform preliminary calibration measurements of a prototype radar system. This effort is a precursor to a demonstration intended to show maturity of key technologies designed and developed by Raytheon. An application for licensing of the demonstration effort was submitted separately.

## **Test Summary:**

An experimental license is required to perform preliminary calibration measurements of a prototype radar system. 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. Following the subset array tests, the antenna will be fully assembled and tested in preparation for the demonstration.

These preliminary calibration 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%. 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:**

Initial 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 a 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: Lawrence Stolz  
Title: Senior Manager Systems Integration, Prototype System Test Lead  
Phone: Cell: 978-930-9484 Office: 978-858-1443  
Email: Lawrence.M.Stolz@Raytheon.com

**Raytheon Spectrum Manager filing application:**

Karen Dyberg  
Spectrum Management/RF Safety  
Phone: 978-440-4022  
Email: [Karen\\_I\\_Dyberg@raytheon.com](mailto:Karen_I_Dyberg@raytheon.com)

**Period of Use:**

Start date: 26 March 2013  
End date: 20 August 2013

**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:**

Cal Antenna if needed: 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  $\mu\text{sec}$  from the 10% to the 90% amplitude points on the leading edge.

$t_f$  = Emitted pulse fall time in  $\mu\text{sec}$  from the 90% to the 10% amplitude points on the trailing edge.

FM-Pulsed Radar:

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

\*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.