

Raytheon Request for Special Temporary Authorization

STA File Number: 0932-EX-ST-2015

8/25/2015

Purpose of Operation:

Frequency authorization is being requested for 9410 MHz in order to perform research and development activities with a Low Power X-Band Radar used to perform precipitation studies.

Technical Synopsis:

- Spectrum needed: 9410 MHz
- Power levels requested: 193 KW ERP
- Expected time of use: Anywhere from 0600 - 2200, 12-16 hours/day, 5 – 7 days/week
- Stop buzzer contact: Steven Snay (Phone: 978-934-3373, Cell: 978-995-7730)

STA Explanation:

The radar will be operated at the University of Massachusetts Lowell. The Special Temporary Authorization is required to provide hands-on study of low-power, low-infrastructure systems and to research new algorithms for low-altitude weather sensing.

Radar Mounting and Direction of Operation:

The radar will be mounted to a rooftop or balcony on one of the university buildings on campus. The rooftop mounting fixture will allow for fixed operation (non-rotating) at any azimuth (360 degrees). The antenna is 1 meter in height and will be mounted close to the roof surface. The radar electronically scans +/- 60 degrees in azimuth and will be limited to 0 to 60 degrees in elevation (relative to horizon) using software defined radiation control zones.

RF Hazard Calculations and Site Safety Measures:

Initial calculations show that power density will fall below general public exposure limits at less than 2 meters distance and occupational exposure limits at less than 1 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 less than 0.5%.

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.

In addition, the University of Massachusetts' Radiation Safety group is cooperating with the Raytheon RF safety group to ensure that the radar system meets all University standards for radiation safety. The University safety group maintains strict policies to ensure a safe, healthy, compliant and sustainable university community and environment.

Raytheon Technical Point of Contact:

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University of Massachusetts Radiation Safety Point of Contact

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Raytheon Spectrum Manager filing application:

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Period of Use:

Start date: September 15, 2015
End date: February 16, 2016

Transmitter info:

Manufacturer: First RF Corporation
Model: FRF-166
Number of units: 1
Experimental (Y/N): N

RF output at the transmitter terminals: 72 Watts peak

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

316 Kilowatts EIRP, 193 Kilowatts ERP

Frequency Tolerance: Less than 0.001 %

List each type of emission separately:

The transmit waveform pulse sequence is programmable. The FM-pulses are modulated with a programmable chirp from up to a maximum swept bandwidth of 10MHz and programmable pulse width from 1 to 55µsec, and 5000 Hz maximum repetition rate. The waveform types operate at 9.41 GHz. Both linear horizontal and vertical polarization switching is utilized by this radar. The emission designators below represent the minimum, typical, and maximum necessary bandwidths.

2M6P0N	- Pulsed CW, 1 µsec pulse duration
4M4Q3N	- Linear FM-Pulsed, 55 µsec pulse duration, 2 MHz chirp bandwidth
7M9Q3N	- Linear FM-Pulsed, 5 µsec pulse duration, 2.5 MHz chirp bandwidth
22M6Q3N	- Linear FM-Pulsed, 1 µsec pulse duration, 10 MHz chirp bandwidth

Necessary bandwidth. Explain how determined.

Using the necessary bandwidth formula for FM-pulsed radars from the NTIA Manual, with a 0.5 µsec rise time:

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

Where

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.

B_c = Bandwidth of the frequency deviation (the total frequency shift during the pulse duration) in MHz

Location:

The radar location will be located at the University of Massachusetts Lowell within 0.5 km of the following street address:

1 University Dr.
Lowell MA 01854

The coordinates of this address are: 42° 39' 9", -071° 19' 32"