

Raytheon Missile Systems
Experimental License Renewal Application
Call Sign: WH2XLY
File Number: 0160-EX-CR-2016

Explanation of Experiment

Background:

Raytheon Missile Systems, through its wholly owned subsidiary Raytheon K-Tech, is seeking to renew its experimental license WH2XLY for testing of the K-Tech telemetry systems. Raytheon K-Tech has developed highly specialized telemetry receiving systems that are sold to all branches of the US military and other federal agencies. The telemetry systems use advanced technology to deliver exceptional performance over distance.

The purpose of the testing to be conducted under this renewed experimental license is to use radio signals to calibrate the telemetry receivers and to work to advance the telemetry systems. Therefore, the application seeks authorization for both activities, described in more detail below.

Description of Experimentation:

There are two types of experimentation – 1. antenna calibration/purity and 2. telemetry testing – that will be conducted to test the telemetry antennas built by Raytheon K-Tech.

1. Antenna Calibration/Purity Testing:

- Spectrum needed: 1000 MHz to 10,000 MHz
- Purpose: calibration and verification of receive antennas
- Power levels: 1 nanowatt to 1 milliwatt, most frequently power will be 1 microwatt
- Emission designator: 200HN0N, CW transmissions
- Test Time: Sweep from 1-10 GHz takes 1 millisecond, no more than 10 sweeps per day

Raytheon K-Tech infrequently plans to use continuous wave signals in the 1000 MHz to 10000 MHz range. The CW testing is planned to determine the characteristics, e.g., in band and out of band gain, sidelobe levels, etc. of the receive antenna. The radio signals are transmitted to the receive antenna and the engineers are able to determine if the antenna is functioning properly.

The testing sweeps through the frequencies 1-10 GHz in a millisecond. The transmitter, operating at its normal ERP of 2 microwatts, will use a CW signal with emission designator 200HN0N. Once a sweep is conducted, the system requires a minimum of five (5) minutes to reset. The maximum number of sweeps that would ever be conducted is 10 in a day. The total test time for any day that the system is in use is 10 milliseconds. It is important to note that this system is in use sporadically, not every day. The antenna used is a directional antenna with a half power bandwidth of 80 degrees.

Table 1 on the next page explains how little time the spectrum will be in use, particularly on frequencies being coordinated with the FAA

Time Calculations for K-Tech Antenna Verification Testing									
Testing sweeps across spectrum 1 GHz to 10 GHz									
Time for Sweep, In seconds	# of 1 MHz frequencies, 1 GHz to 10 GHz	Time on frequency (1 MHz)/sweep 5 minutes	Cur time (time between sweeps)	Duty Cycle	Max Tests Per Day	Total Time per day			
0.001	9000	0.0000001111111111 milliseconds	5000	0.00000002	10	0.01	0.1111 microseconds/1 MHz frequency as the system sweeps across the whole band		
FAA Bands:	# of MHz in Band	Fraction of time per sweep in FAA Band	Total Time, in seconds, in FAA band	time between sweeps					
1000-1020 MHz	20	0.0022222222	0.00000222						
1030 MHz	1	0.000111111	0.00000011						
1031-1087 MHz	56	0.006222222	0.00000622						
1090 MHz	1	0.000111111	0.00000011						
1104-1146 MHz	42	0.004666667	0.00000467						
1157-1213 MHz	56	0.006222222	0.00000622						
1215-1390 MHz	175	0.019444444	0.00001944						
2700-3000 MHz	300	0.033333333	0.00003333						
5000-5250 MHz	250	0.027777778	0.00002778						
9000-9200 MHz	200	0.022222222	0.00002222						
All FAA Spectrum	1101	0.122333333	0.00012233		Total time: in and out of FAA bands				
NON-FAA Spectrum	7899	0.877666667	0.00087767		0.00100000				

Table 1: Test time calculations

2. Telemetry Testing of Receive Antenna Performance:

Raytheon K-Tech also needs to use the spectrum requested here to test the receive antenna performance specifically in the L, S, and C bands. These tests will operate only on the following frequency bands:

- 1435-1525 MHz
- 2200-2290 MHz
- 2360-2395 MHz
- 4440-4940 MHz
- 5091-5150 MHz
- 5925-6700 MHz

The telemetry tests will use emission designators: 33M6F1D with signal modulation of PCM/FM and 36M4G1D with signal modulation of SOQPSK.

For the telemetry testing, the Quasonix transmitter is used to send actual telemetry data to the telemetry receive antennas being tested. Raytheon K-Tech gathers data on the performance of the receive antennas, analyzes the data reception, and uses the results to improve its antenna technology.

The maximum ERP used for this testing is 20 mW, although much of the testing is conducted at a much lower power level to test the performance of the receivers.

The telemetry testing sends PCM/FM and SOQPSK signals to the telemetry receivers. Testing of the receivers takes place one day every 2-3 weeks, with a test lasting about 2 hours on the day of testing.

Test Configuration:

Raytheon K-Tech built a test site which has the receive antennas – the ones being tested – at the southeast corner of the test area. A fixed transmitter pointed west directs its signals east to the receivers. To test the receivers' capabilities when receiving signals from mobile transmitters, Raytheon K-Tech has developed a mobile transmitter area to the north. The transmitters are mounted on low trailers, no more than 15 feet in height over all, and the signals are directed to the fixed receive site.

In Figure 1 below, there is an annotated photo of the test site.



Figure 1: Fixed and Mobile Transmitter Locations

Stop Buzzer Point of Contact:

In the event that it is necessary to reach a stop buzzer, the person to contact is:

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Raytheon Missile Systems
(520) 794-0227 – office
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Conclusion:

Raytheon K-Tech is seeking to renew its experimental license to conduct two types of telemetry tests: first, a test of the calibration/purity of its telemetry receive antennas, and second testing of the actual performance of the telemetry receive antennas. The testing is conducted at the Raytheon K-Tech headquarters. Fixed and mobile transmitters are used for the testing.

For additional information about this application, please contact Thomas J. Fagan, Spectrum Manager, Raytheon Missile Systems, 520-794-0227 or tjfagan@raytheon.com or Anne Linton Cortez, WFS, 520-360-0925 or alc@conspecinternational.com.