

Explanation of Experiment

Background:

Raytheon Missile Systems, through its wholly owned subsidiary Raytheon K-Tech, is seeking to modify its experimental license WH2XLY to include additional spectrum needed for testing of its advanced telemetry antennas. 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. These systems are used for development of technology that is for US national security purposes. The systems use spectrum sweeps to accomplish these purposes, which are essential to the protection of the country.

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. This request to modify the license is identical to the testing authorized under 0614-EX-ST-2019.

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: 300 MHz to 1000 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 300-1000 MHz takes 1/10 milliseconds, no more than 10 sweeps per day

Raytheon K-Tech infrequently plans to use continuous wave signals in the 300 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 1 millisecond. 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 explains how little time the spectrum will be in use, particularly on frequencies that are used by the FAA.

Time Calculations for K-Tech Telemetry Testing				
<u>Time for Sweep, in seconds</u>	<u>MHz</u>	<u># of 1 MHz frequencies</u>	<u>Time on frequency (1 MHz)/sweep</u>	<u>Off Time (time between sweeps)</u>
0.00007778	700	700.0000000	0.00000011	5 minutes (300 seconds)
<u>FAA Bands:</u>	<u># of MHz in band</u>	<u>Fraction of time per sweep in FAA Band</u>	<u>Total Time, in seconds, in FAA bands</u>	<u>time between sweeps</u>
328.6-335.4	8	0.0114286	0.00000089	300 seconds
960-1000 MHz	40	0.0571429	0.00000444	"
Time in All FAA Spectrum	48		0.00000533	"
	<u>MHz - NOT FAA</u>	<u>Fraction of time NOT in FAA band</u>	<u>Total Seconds per sweep, not in FAA bands</u>	
NON-FAA Spectrum	652	0.931428571	0.00007245	
		FAA Time + Non-FAA time =	0.00007778	

Table 1: Test time calculations relative to FAA use

Table 2 explains how little time the spectrum will be in use, particularly on frequencies that are used by the FirstNet.

Time Calculations for K-Tech Telemetry Testing				
<u>Time for Sweep, in seconds</u>	<u>MHz</u>	<u># of 1 MHz frequencies</u>	<u>Time on frequency (1 MHz)/sweep</u>	<u>Off Time (time between sweeps)</u>
0.00007778	700	700.0000000	0.00000011	5 minutes (300 seconds)
<u>FirstNet Bands:</u>	<u># of MHz in band</u>	<u>Fraction of time per sweep in FirstNet Bands</u>	<u>Total Time, in seconds, in FirstNet bands</u>	<u>time between sweeps</u>
758-768 MHz	10	0.0142857	0.00000111	300 seconds
788-798 MHz	10	0.0142857	0.00000111	"
Time in All FirstNet Spectrum	20		0.00000222	"
	<u>MHz - NOT FirstNet</u>	<u>Fraction of time NOT in FirstNet band</u>	<u>Total Seconds per sweep, not in FirstNet bands</u>	
NON-FirstNet Spectrum				
	680	0.971428571	0.00007556	
		FirstNet Time + Non-FirstNet time =		
		0.00007778		

Table 2: Test time calculations relative to FirstNet use

2. Telemetry Testing of Receive Antenna Performance:

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. That testing will not be on any single frequency for the two hour period, the transmitter will be turned on and off across the band during the testing, but it will not sweep as in the checkout testing described above.

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:

Jim Ortega, Spectrum Manager
Raytheon Missile Systems
(520) 794-0227 – office
James.e.ortega@raytheon.com

Conclusion:

Raytheon K-Tech is seeking a license modification to add spectrum for its conduct of 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, Anne Linton Cortez, WFS, 520-360-0925 or alc@conspecinternational.com.