

Explanation of Experiment

Background:

Raytheon Missile Systems, through its wholly owned subsidiary Raytheon K-Tech, is seeking an experimental license 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 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.

Synopsis:

- Spectrum needed: 1000 MHz to 10,000 MHz
- Test time: workday testing, sporadic use of spectrum, at most one day every 2-3 weeks, and only 2 hours per day
- Test range configuration: very localized, directionalized testing in lot adjacent to headquarters
- Purpose: receive antenna calibration and testing for advanced development of telemetry systems
- Power levels: 1 nanowatt to 1 milliwatt

Description of Experimentation:

Antenna Calibration/Purity Testing:

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.

This testing is only expected to be conducted for an hour each week. The spectrum is in use only sporadically during each test, as the signal generator sweeps through the frequencies quickly. Given the nature of the testing, the time on any frequency is less than 10 milliseconds, with a duty cycle of 10 %.

The antenna used is a directional antenna with a half power bandwidth of 80 degrees. The maximum ERP is 6 milliwatts. More typically, the transmitter will operate with an ERP that is less than 2 microwatts.

Telemetry Testing:

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

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

The tests will use emission designators: 200H0N0N CW, 33M6F1D with signal modulation of PCM/FM and 36M4G1D with signal modulation of SOQPSK.

For the telemetry testing, the Quasonix transmitter will be used to send actual telemetry data to the receivers being tested. Raytheon K-Tech will gather data on the performance of the receivers, analyze the data reception, and use the results to improve its technology.

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

The transmit antennas used are ETS Lindgren Conical Log Spiral left and right polarized models with 3-4 dBi of gain.

The parabolic receive antennas have 35 dB of gain, so for any parabolic receive antennas being tested, the signal reflection will be limited to about 1 picowatt of signal.

Raytheon K-Tech will also test some flat panel antennas. Those receive antennas will be facing north, and should there be any signal reflection off the flat panel receive antennas, that RF energy will dissipate to the north out over the field where the transmitter is located.

Test Configuration:

Raytheon K-Tech is building a test site which will have its receive antennas – the ones being tested – at the southeast corner of the test area. A fixed transmitter to the west will direct its signals east to the receivers. To test the receivers' capabilities when receiving signals from mobile transmitters, Raytheon K-Tech is also developing a mobile transmitter area to the north. The transmitters will be mounted on low trailers, no more than 15 feet in height over all, and the signals will be 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

The fixed transmitter is approximately 300 feet from the receive antenna being tested. The mobile transmitters will be at most about 1200 feet from the receive antenna. The transmitters are low to the ground, and the area is filled with industrial buildings, which provide shielding for any transmitted signals.

Transmit power is low:

As noted above, most of the transmissions will be very low powered, less than 2 microwatts ERP. The testing tries to mimic the real-world reception characteristics that the receive antennas will face, so the low powered transmissions actually simulate a telemetry signal that has traveled a great distance.

Time of use is limited:

To conduct the receive antenna testing, Raytheon K-Tech will transmit signals in the relevant bands, then analyze the data received and antenna performance, then it will transmit again. The spectrum will only be in use – at most – 500 hours per year, which is the equivalent of 10 hours per week. It is more likely that the spectrum will be in use **only 2 hours** once every 2 weeks. The telemetry testing proposed here will not use all the requested spectrum for all of the test time. Review of the proposed test plan shows that the real telemetry testing will likely divide up the testing equally across each of the five telemetry bands. Thus, use of the RF for any telemetry band is likely to be limited to no more than 2 hours per week.

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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Conclusion:

Raytheon K-Tech is seeking an 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 to be conducted at the Raytheon K-Tech headquarters. Fixed and mobile transmitters will be used for the testing. The use of the RF will only be for limited amounts of time. The signal strength will be limited, with most transmissions less than 2 microwatts ERP. 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.