

## **Supplemental 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.

This supplemental exhibit is submitted to the FCC to clarify the two types of experimentation – antenna calibration/purity and telemetry testing – that will be conducted to test the telemetry antennas built by Raytheon K-Tech.

### **Description of Experimentation:**

#### **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,<br>in seconds                             | # of 1 MHz<br>frequencies,<br>1 GHz to 10<br>GHz | Time on frequency (1<br>MHz)/sweep<br>5 minutes | Current time<br>(time<br>between<br>sweeps) | Duty Cycle | Max<br>Tests Per<br>Day | Total<br>Time per<br>day |                                                                                         |  |  |
| 0.001                                                     | 9000                                             | 0.0000001111111111 milliseconds                 | 5000                                        | 0.00000002 | 10                      | 0.01                     | 0.1111 microseconds/1<br>MHz frequency as the<br>system sweeps across<br>the whole band |  |  |
| 1000-1020 MHz                                             | 20                                               | 0.0022222222                                    | 0.00000222                                  |            |                         |                          |                                                                                         |  |  |
| 1030 MHz                                                  | 1                                                | 0.0001111111                                    | 0.00000011                                  |            |                         |                          |                                                                                         |  |  |
| 1031-1087 MHz                                             | 56                                               | 0.0062222222                                    | 0.00000622                                  |            |                         |                          |                                                                                         |  |  |
| 1090 MHz                                                  | 1                                                | 0.0001111111                                    | 0.00000011                                  |            |                         |                          |                                                                                         |  |  |
| 1104-1146 MHz                                             | 42                                               | 0.0046666667                                    | 0.00000467                                  |            |                         |                          |                                                                                         |  |  |
| 1157-1213 MHz                                             | 56                                               | 0.0062222222                                    | 0.00000622                                  |            |                         |                          |                                                                                         |  |  |
| 1215-1390 MHz                                             | 175                                              | 0.0194444444                                    | 0.00001944                                  |            |                         |                          |                                                                                         |  |  |
| 2700-3000 MHz                                             | 300                                              | 0.0333333333                                    | 0.00003333                                  |            |                         |                          |                                                                                         |  |  |
| 5000-5250 MHz                                             | 250                                              | 0.0277777778                                    | 0.00002778                                  |            |                         |                          |                                                                                         |  |  |
| 9000-9200 MHz                                             | 200                                              | 0.0222222222                                    | 0.00002222                                  |            |                         |                          |                                                                                         |  |  |
| All FAA Spectrum                                          | 1101                                             | 0.1223333333                                    | 0.00012233                                  |            |                         |                          | Total time: in and out of FAA bands                                                     |  |  |
| NON-FAA Spectrum                                          | 7899                                             | 0.8776666667                                    | 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, and the application has been amended accordingly:

- 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 will be used to send actual telemetry data to the telemetry receive antennas being tested. Raytheon K-Tech will gather data on the performance of the receive antennas, analyze the data reception, and use the results to improve its antenna 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.

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