

Raytheon Missile Systems  
Experimental License Modification Application  
Call Sign: WD2XKJ  
File Number: 0272-EX-CM-2019

### **Exhibit 1 – Overview and Explanation**

**Overview:** Raytheon Missile Systems is filing this application to modify its experimental license WD2XKJ, to add GPS re-radiation systems to its current license. The current license covers a number of locations that are currently using GPS re-radiation systems. However, in recent years, virtually every product developed by Raytheon Missile Systems has begun to incorporate one or more GPS receivers, so the need to use GPS re-radiation systems to test those receivers has proliferated across the company and now includes many more programs at the Tucson, AZ and Camden, AR facilities. This application is being filed to include all of the programs that currently have a need to use GPS re-radiation systems. As explained in more detail below, some of the programs will use the GPS re-radiation systems only for final testing once a hard-wired connection to the GPS receiver is disconnected when the program needs to test the GPS receive antenna and receiver to prove that the whole system is working.

There are 4 additional locations to be added to the license. The locations, all indoors, are listed in the chart below. Each location has a separate link budget for the installation of the GPS re-radiation kit.

| <b><u>Location</u></b> | <b><u>Latitude</u></b> | <b><u>Longitude</u></b> |
|------------------------|------------------------|-------------------------|
| Site 1a                | 32-05-50 N             | 110-48-47 W             |
| Site 2a                | 32-06-12 N             | 110-56-50 W             |
| Site 3a                | 32-06-31 N             | 110-57-25 W             |
| Site 4a                | 32-05-42 N             | 110-55-37 W             |

General compliance with NTIA section 8.3.28: set forth below are Raytheon's responses to the requirements of 8.3.28 as those answers apply across all the locations. For any information that must be provided on a site-specific basis and for the link budgets, that information follows Attachment A and the information is provided on a location by location basis.

For any questions about this application, please contact Anne Linton Cortez, 520-360-0925 or [alc@conspecinternational.com](mailto:alc@conspecinternational.com).

#### **Compliance with the Requirements of NTIA Manual**

- 1. Individual authorization is for indoor use only and is required for each device at a specific site.**

Each installation is an indoor installation, and the location of each is specified in the chart above. This application is requesting individual authorizations for each device.

- 2. Applications for frequency assignment should be applied for as an XT station class with a note indicating the device is to be used as an “Experimental RNSS Test Equipment for the purpose of testing GPS receivers” and describing how the device will be used.**

Raytheon requests the assistance of the FCC and NTIA to properly classify the frequency authorizations. All of the proposed installations will be used for the testing of GPS receivers installed on Raytheon products.

- 3. Approved application for frequency assignment will be entered in the GMF.**

Raytheon requests the assistance of NTIA and the FCC in entering this data into the GMF.

- 4. the Maximum length of the assignment will be two years, with possible renewal.**

Raytheon is seeking an authorization for two years, and it will seek renewals when timely.

- 5. The area of potential interference to GPS reception (e.g., military or contractor facility) has to be under the control of the user.**

All of the proposed installation locations are in buildings at Raytheon facilities. All of the Raytheon facilities are secured facilities, and each building is under the control of Raytheon, no unauthorized visitors are permitted.

- 6. The maximum equivalent isotropically radiated power (EIRP) must be such that the calculated emissions are no greater than -140 dBm/24 MHz as received by an isotropic antenna at a distance of 100 feet (30 meters) from the building where the test is being conducted. The calculations showing compliance with this requirement must be provided with the application for frequency assignment and should be based on free space propagation with no allowance for additional attenuation (e.g., building attenuation.)**

Link Budgets: For each location there are L1 and L2 link budgets attached to this application showing the calculations applicable to that proposed installation of a GPS re-radiation system.

Location in building: Each installation is inside a building at a Raytheon plant site. All installations are far from any outside wall of the building. The attached link budgets for each location show that the signal strength *at 100 feet from the re-radiating antenna* is far below -140 dBm/24 MHz. Thus, the signal strength at 100 feet from the building is going to be significantly lower still, but Raytheon wanted to ensure that the signal strength was attenuated so much that there would be no chance of interference.

Power levels are very low: The link budgets provide information on the signal strength at 1 meter from the re-radiating antenna. This information is provided because at each installation, the antennas being tested are never more than 1 meter from the re-radiating antenna. The calculations then show the signal strength at 100 feet from the re-radiating antenna as well.

Some installations use re-radiation only a small percentage of their operational time: In some of these installations, the Raytheon product is tested first by connecting a roof-top antenna directly to the antenna port on the product through a hard-wired connection. In those circumstances, the re-radiating system is only used for final testing of the antenna portion of the receiver to ensure it is working properly as part of the whole navigation system on the product.

**7. GPS users in the area of potential interference to GPS reception must be notified that GPS information may be impacted for periods of time.**

Raytheon will post signs in each location where a re-radiation system is installed alerting those in the area that there are GPS re-radiation systems in use in that area.

**8. The use is limited to activity for the purpose of testing RNSS equipment/systems.**

Raytheon is requesting authorization to use re-radiation systems at these locations specifically for testing of GPS systems on its products.

**9. A “Stop Buzzer” point of contact for the authorized device must be identified and available at all times during GPS re-radiation operation of the device under any condition.**

The Stop Buzzer point of contact for all these devices is:

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

Mr. Ortega will keep a list of each location and the telephone number for the operator at each location with him at all times, so that he can initiate shut off a GPS re-radiation system at any time.

Location Number: 1a Latitude: 32-05-50 N, Longitude: 110-48-47 W

installed: indoors

Manufacturer: all components are part of GPS Networking HNRRKIT

**GPS Signal Analysis - L1 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1575.42      | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.19042541   | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 80           | feet   |              |       |           |
| Total Coax Loss                             | -5.36        | dB     | -96.36       | 2E-13 | 0.231     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.36       | 5E-13 | 0.461     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -36.38969194 | dB     | -129.7       | 1E-16 | 0.000106  |
| Signal level at unit under test EIRP to ERP |              |        | -131.9       | 6E-17 | 6.47E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -66.06999119 | dB     | -159.4       | 1E-19 | 1.14E-07  |
| Signal level at 100 ft ERP                  |              |        | -161.6       | 7E-20 | 6.97E-08  |

**GPS Signal Analysis - L2 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1227.6       | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.244379277  | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 80           | feet   |              |       |           |
| Total Coax Loss                             | -5.36        | dB     | -96.36       | 2E-13 | 0.231     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.36       | 5E-13 | 0.461     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -34.22290244 | dB     | -127.6       | 2E-16 | 0.000174  |
| Signal level at unit under test EIRP to ERP |              |        | -129.7       | 1E-16 | 0.000107  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -63.9032017  | dB     | -157.3       | 2E-19 | 1.88E-07  |
| Signal level at 100 ft ERP                  |              |        | -159.4       | 1E-19 | 1.15E-07  |

Location Number: 2a, Latitude 32-06-12 N Longitude 110-56-50 W

installed: indoors

Manufacturer: all components are part of GPS Networking HNRRKIT

**GPS Signal Analysis - L1 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1575.42      | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.19042541   | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 85           | feet   |              |       |           |
| Total Coax Loss                             | -5.695       | dB     | -96.7        | 2E-13 | 0.214     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.7        | 4E-13 | 0.427     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -36.38969194 | dB     | -130.1       | 1E-16 | 9.81E-05  |
| Signal level at unit under test EIRP to ERP |              |        | -132.2       | 6E-17 | 5.99E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -66.06999119 | dB     | -159.8       | 1E-19 | 1.06E-07  |
| Signal level at 100 ft ERP                  |              |        | -161.9       | 6E-20 | 6.45E-08  |

**GPS Signal Analysis - L2 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1227.6       | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.244379277  | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 85           | feet   |              |       |           |
| Total Coax Loss                             | -5.695       | dB     | -96.7        | 2E-13 | 0.214     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.7        | 4E-13 | 0.427     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -34.22290244 | dB     | -127.9       | 2E-16 | 0.000162  |
| Signal level at unit under test EIRP to ERP |              |        | -130.1       | 1E-16 | 9.87E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -63.9032017  | dB     | -157.6       | 2E-19 | 1.74E-07  |
| Signal level at 100 ft ERP                  |              |        | -159.7       | 1E-19 | 1.06E-07  |

Location Number: 3a, Latitude 32-06-31 N Longitude 110-57-25 W

installed: indoors

Manufacturer: all components are part of GPS Networking HNRRKIT

**GPS Signal Analysis - L1 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1575.42      | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.19042541   | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 75           | feet   |              |       |           |
| Total Coax Loss                             | -5.025       | dB     | -96.03       | 2E-13 | 0.250     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.03       | 5E-13 | 0.498     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -36.38969194 | dB     | -129.4       | 1E-16 | 0.000114  |
| Signal level at unit under test EIRP to ERP |              |        | -131.6       | 7E-17 | 6.99E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -66.06999119 | dB     | -159.1       | 1E-19 | 1.23E-07  |
| Signal level at 100 ft ERP                  |              |        | -161.2       | 8E-20 | 7.52E-08  |

**GPS Signal Analysis - L2 Link Budget**

|                                             |              |        |              |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Frequency                                   | 1227.6       | MHz    | Signal Level |       |           |
| Wavelength                                  | 0.244379277  | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 75           | feet   |              |       |           |
| Total Coax Loss                             | -5.025       | dB     | -96.03       | 2E-13 | 0.250     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -93.03       | 5E-13 | 0.498     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -34.22290244 | dB     | -127.2       | 2E-16 | 0.000188  |
| Signal level at unit under test EIRP to ERP |              |        | -129.4       | 1E-16 | 0.000115  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -63.9032017  | dB     | -156.9       | 2E-19 | 2.03E-07  |
| Signal level at 100 ft ERP                  |              |        | -159.1       | 1E-19 | 1.24E-07  |

Location Number: 4a, Latitude 32-05-42 N Longitude 110-55-37 W

installed: indoors

Manufacturer: all components are part of GPS Networking HNRRKIT

**GPS Signal Analysis - L1 Link Budget**

| Frequency                                   | 1575.42      | MHz    | Signal Level |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Wavelength                                  | 0.19042541   | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 100          | feet   |              |       |           |
| Total Coax Loss                             | -6.7         | dB     | -97.7        | 2E-13 | 0.170     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -94.7        | 3E-13 | 0.339     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -36.38969194 | dB     | -131.1       | 8E-17 | 7.78E-05  |
| Signal level at unit under test EIRP to ERP |              |        | -133.2       | 5E-17 | 4.75E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -66.06999119 | dB     | -160.8       | 8E-20 | 8.38E-08  |
| Signal level at 100 ft ERP                  |              |        | -162.9       | 5E-20 | 5.12E-08  |

**GPS Signal Analysis - L2 Link Budget**

| Frequency                                   | 1227.6       | MHz    | Signal Level |       |           |
|---------------------------------------------|--------------|--------|--------------|-------|-----------|
| Wavelength                                  | 0.244379277  | meters | dBm          | Watts | picoWatts |
| GPS Input Signal Level                      | -130         | dBm    | -130         | 1E-16 | 0.0001    |
| GPS Receive Antenna amplifier gain          | 38           | dB     | -92          | 6E-13 | 0.63      |
| GPS RF Amplifier gain                       | 23           | dB     | -69          | 1E-10 | 125.89    |
| GPS RF Attenuator                           | -22          | dB     | -91          | 8E-13 | 0.79      |
| LMR400 Coax loss per foot                   | -0.067       | dB     |              |       |           |
| Coax Length                                 | 100          | feet   |              |       |           |
| Total Coax Loss                             | -6.7         | dB     | -97.7        | 2E-13 | 0.170     |
| GPS Transmitting Antenna Gain               | 3            | dB     | -94.7        | 3E-13 | 0.339     |
| Distance from transmit antenna              | 1            | meters |              |       |           |
| Distance from transmit antenna              | 3.2808399    | feet   |              |       |           |
| Pathloss to unit under test                 | -34.22290244 | dB     | -128.9       | 1E-16 | 0.000128  |
| Signal level at unit under test EIRP to ERP |              |        | -131.1       | 8E-17 | 7.83E-05  |
| Distance from transmit antenna              | 30.48        | meters |              |       |           |
| Distance from transmit antenna              | 100.0000002  | feet   |              |       |           |
| Pathloss to 100 ft                          | -63.9032017  | dB     | -158.6       | 1E-19 | 1.38E-07  |
| Signal level at 100 ft ERP                  |              |        | -160.7       | 8E-20 | 8.43E-08  |