

Raytheon Company (Missiles & Defense – M)
Experimental License Renewal Application
Call Sign: WI2XVQ
File Number: 0333 - E X - C R - 2021

Exhibit 1 – Overview and Explanation

Overview: Raytheon Company (Missiles & Defense – M) (Raytheon) is filing this application to renew an experimental license for GPS testing indoors at a production facility in Louisville, Kentucky. In recent years, virtually every product developed by Raytheon has begun to incorporate one or more GPS receivers, so there is an on-going need to use GPS re-radiation systems to test receivers across the company. This application is being filed for use of a GPS re-rad system to test the GPS receivers incorporated into the Raytheon products built in Louisville.

This application is for indoor use. A link budget is attached showing compliance with the power limitations of Section 8.3.27 of the NTIA Manual.

General compliance with NTIA section 8.3.27:

Set forth below are Raytheon's responses to the requirements of 8.3.27 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.

Compliance with the Requirements of NTIA Manual Section 8.3.27

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

This is an indoor installation.

- 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. The proposed installation 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 a renewal for two years. It anticipates that it will renew this authorization as appropriate.

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 Raytheon's 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: Attached at the end of this Exhibit is an L1 and L2 link budget showing the calculations applicable to the proposed installation of a GPS re-radiation system.

Location in building: the proposed installation is inside a building at a Raytheon plant site. This installation is 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.

- 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 has posted signs where the re-radiation system is installed alerting those in the area that there is a GPS re-radiation system 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 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
520-794-0227 (office)
james.e.ortega@raytheon.com

Louisville, Kentucky, Latitude 38-10-13 N Longitude 85-45-15 W

Use: Re-radiation system used 100% for testing installed antennas

installed: indoors

Manufacturer: all components are part of GPS Source Reradiation System

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	33	dB	-97	2E-13	0.20
GPS RF Amplifier gain	30	dB	-67	2E-10	199.53
GPS RF Attenuator	-20	dB	-87	2E-12	2.00
LMR400 Coax loss per foot	-0.11	dB			
Coax Length	100	feet			
Total Coax Loss	-11	dB	-98	2E-13	0.158
GPS Transmitting Antenna Gain	3	dB	-95	3E-13	0.316
Distance from transmit antenna	1	meters			
Distance from transmit antenna	3.2808399	feet			
Pathloss to unit under test	-36.38969194	dB	-131.4	7E-17	7.26E-05
Signal level at unit under test EIRP to ERP			-133.5	4E-17	4.44E-05
Distance from transmit antenna	30.48	meters			
Distance from transmit antenna	100.0000002	feet			
Pathloss to 100 ft	-66.06999119	dB	-161.1	8E-20	7.82E-08
Signal level at 100 ft ERP			-163.2	5E-20	4.78E-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	33	dB	-97	2E-13	0.20
GPS RF Amplifier gain	30	dB	-67	2E-10	199.53
GPS RF Attenuator	-20	dB	-87	2E-12	2.00
LMR400 Coax loss per foot	-0.11	dB			
Coax Length	100	feet			
Total Coax Loss	-11	dB	-98	2E-13	0.158
GPS Transmitting Antenna Gain	3	dB	-95	3E-13	0.316
Distance from transmit antenna	1	meters			
Distance from transmit antenna	3.2808399	feet			
Pathloss to unit under test	-34.22290244	dB	-129.2	1E-16	0.00012
Signal level at unit under test EIRP to ERP			-131.4	7E-17	7.31E-05
Distance from transmit antenna	30.48	meters			
Distance from transmit antenna	100.0000002	feet			
Pathloss to 100 ft	-63.9032017	dB	-158.9	1E-19	1.29E-07
Signal level at 100 ft ERP			-161	8E-20	7.86E-08