

Raytheon IIS
Experimental License Renewal Application
Call Sign: WH2XHD
File Number: 0300-EX-RR-2016

Exhibit 1 – Overview and Explanation

Overview: Raytheon Intelligence, Information and Services (Raytheon) is filing this application to renew WH2XHD, its license to use a GPS re-radiation system at its 16800 E. Centretech Parkway, Aurora, Colorado facility that utilizes GPS for positioning information and timing technologies for test equipment for ground station receivers. The GPS re-radiation system is required for the testing of GPS technologies that are embedded into the communications systems that Raytheon is developing in this lab.

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 for this location.

For any questions about this application, please contact Brian Kavalari, Raytheon IIS Spectrum Manager, 317-517-998, brian_r_kavalari@raytheon.com or Anne Linton Cortez, Washington Federal Strategies, 520-360-0925, alc@conspecinternational.com.

Compliance with the Requirements of NTIA Manual Section 8.3.28

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

This GPS re-radiation system is installed indoors in a laboratory with access that is limited to Raytheon authorized personnel only.

- 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.

- 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 required.

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

The installation is inside the Raytheon facility at Aurora, Colorado. Access to the facility is limited to Raytheon personnel and limited authorized visitors. The building is a secure facility, and no unauthorized visitors can enter.

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 Budget: The link budget for the L1/L2 re-radiation is attached to this exhibit, and it shows the calculations applicable to this proposed installation of a GPS re-radiation system.

Location in building: The re-radiation device has been installed inside Raytheon building S76 at 16800 E. Centretech Parkway, Aurora, CO. The installation is deep within the building, far from any outside wall. The attached link budget shows that the signal strength *at 100 feet from the re-radiating antenna* is 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.

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 in the lab where the 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 requests authorization to use a re-radiation system 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:

Steve Beal, Raytheon IIS
720.858.4728 (office)
303.250.9324 (cell)
steve.j.beal@raytheon.com

Mr. Beal can initiate shut off the GPS re-radiation system at any time.

Raytheon IIS - Aurora GPS Rerad Link Budget

GPS Signal Analysis

Frequency - GPS L2	1227.6	MHz	Signal Level		
Wavelength	0.24	meters	dBm	Watts	picoWatts
GPS Input Signal Level	-126.7	dBm	-126.7	2E-16	0.000214
GPS Receive Antenna gain on roof	30	dB	-96.7	2E-13	0.21
GPS RF Amplifier gain	24	dB	-72.7	5E-11	53.70
RF Attenuator	0	dB	-72.7	5E-11	53.70
RG59 Coax loss per foot	-0.12	dB			
Coax Length	55	feet			
Total Coax Loss	-6.6	dB	-79.3	1E-11	11.749
GPS Transmitting Antenna Gain	3	dB	-76.3	2E-11	23.442
Distance from transmit antenna	2	meters			
Distance from transmit antenna in feet	6.56	feet			
Path loss to lab receive active antenna	-40.2	dB	-116.5	2E-15	0.002216
Signal level at lab receive active antenna EIRP to ERP			-118.7	1E-15	0.001354
GPS receive antenna gain in lab	20	dB	-98.68	1E-13	0.13541
Signal level at unit under test EIRP to ERP			-100.8	8E-14	0.082727
Distance from transmit antenna in meters	30.47	meters			
Distance from transmit antenna in feet	100.0	feet			
Freespace path loss to 100 ft	-63.9	dB			
EIRP Signal level at 100 ft from TX antenna			-140.2	1E-17	9.55E-06
ERP Signal level at 100 ft from TX antenna			-142.3	6E-18	5.83E-06

NTIA 8.3.28 compliant if EIRP signal level at 100 ft is less than -140 dBm

GPS Signal Analysis

Frequency - GPS L1	1575.42	MHz	Signal Level		
Wavelength	0.19	meters	dBm	Watts	picoWatts
GPS Input Signal Level	-134.5	dBm	-134.5	4E-17	3.55E-05
GPS Receive Antenna gain on roof	30	dB	-104.5	4E-14	0.04
GPS RF Amplifier gain	24	dB	-80.5	9E-12	8.91
RF Attenuator	0	dB	-80.5	9E-12	8.91
RG59 Coax loss per foot	-0.12	dB			
Coax Length	55	feet			
Total Coax Loss	-6.6	dB	-87.1	2E-12	1.950
GPS Transmitting Antenna Gain	3	dB	-84.1	4E-12	3.890
Distance from transmit antenna	2	meters			
Distance from transmit antenna in feet	6.6	feet			
Path loss to lab receive active antenna	-42.4	dB	-126.5	2E-16	0.000223
Signal level at lab receive active antenna EIRP to ERP			-128.7	1E-16	0.000136
GPS receive antenna gain in lab	20	dB	-108.7	1E-14	0.013645
Signal level at unit under test EIRP to ERP			-110.8	8E-15	0.008336
Distance from transmit antenna in meters	30.47	meters			
Distance from transmit antenna in feet	100.0	feet			
Freespace pathloss to 100 ft	-66.1	dB			
EIRP Signal Level at 100 ft from TX antenna			-150.2	1E-18	9.62E-07
ERP Signal level at 100 ft from TX antenna			-152.3	6E-19	5.88E-07

NTIA 8.3.28 compliant if EIRP signal level at 100 ft is less than -140 dBm

*Specification per GPS Performance Standard, dated Feb 23, 2007

*30 dB gain Symmetricom antenna on roof

*GPS Networking LA20 Maximum Amplifier Driver Gain

*No additional attenuation

*Typical loss per foot at GPS frequencies, connector/coupler loss not included

*GPS lab signal radiated power

*GPS Networking L1GPSA active antenna

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