

## GPS Re-Radiation (Re-Rad) System Technical Description

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### Purpose for the Application

The purpose of this application is to obtain a 2-year experimental license to operate a GPS re-radiation system supporting aircraft development and testing.

### Why we are Applying for a License

The Boeing Company would like the ability to perform functional testing of receive GPS systems inside a building in order to reduce delivery delays caused by the unavailability of GPS signals inside the facilities.

### Technical Description

This technical description shows compliance with all NTIA items in Chapter 8.3.28.

1. Individual authorization is for indoor use only, and is required for each device at a specific site. **Operation will be conducted indoors. The device information is provided in application and specific site information provided below.**

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. **Description of operation provided in confidential portion of request and Boeing concurs to the XT station class.**

3. Approved applications for frequency assignment will be entered in the GMF. **Boeing concurs.**

4. The maximum length of the assignment will be two years, with possible renewal. **Boeing concurs.**

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 site is under Boeing's control.**

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 provided below and meet specified levels. Calculations do not allow for building attenuation.**

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. **GPS users in area will be notified.**

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

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. **Stop Buzzer information provided below.**

## Locations

The GPS Re-Radiation systems will be installed in the following location:

47-25-17 N 122-15-13 W

## Military Contract Numbers

The facilities identified above support work accomplished under contract. The current contract numbers are:

1) F34601-03-C-0042, U.S.A.F. ALCM/CALCM

## Technical Description

System: GLI Metro Amplifier GPS System

Frequency: L1 1575.42 MHz

Emission: 24M0G1D

Effective Radiate Power: Maximum -75.11 dBm or 30.8318 Pico watts

Frequency: L2 1227.60 MHz

Emission: 24M0G1D

Effective Radiate Power: Maximum -80.6 dBm or 8.7096 Pico watts

| L1 Link Budget - L1 (1575.4 MHz) |                              |                |            |                                                         |
|----------------------------------|------------------------------|----------------|------------|---------------------------------------------------------|
|                                  | Link Budget Parameter        | Value          | Units      | Comment                                                 |
|                                  | Receive Power on Earth       | -130.00        | dBm        |                                                         |
|                                  | Rx Antenna Gain              | 38.00          | dB         | AeroAntenna: AT2775-42W-TNCF-000-RG-36-NM               |
|                                  | Cable loss (RxAnt to L.P.)   | -0.68          | dB         | LMR-600-DB                                              |
|                                  | Lightning Protector          | -0.50          |            | Estimate                                                |
|                                  | Cable loss (L.P. to Box)     | -1.02          | dB         | LMR-600-DB                                              |
| Amp Box                          | Amplifier Gain               | <b>35.00</b>   | dB         | GPS Source Metro-F12-R2B-P110/6.8-SF (Variable Gain)    |
|                                  | Fixed Attenuators            | -20.00         |            |                                                         |
|                                  | Amp Box Misc Losses          | -0.50          |            | Estimate                                                |
|                                  | Amp Box Cables               | -0.83          |            | RG-316 Cable                                            |
|                                  | Cable loss (Box to TxAnt)    | -1.58          | dB         | LMR-400-DB                                              |
|                                  | Connector Losses             | -4.00          |            |                                                         |
|                                  | Tx Antenna Gain              | 11.00          | dB         | HG824-11LP-NF; 800MHz-2.5GHz 11dBi Log Periodic Antenna |
|                                  | Free Space Loss              | -68.74         | dB         | 136 Ft.                                                 |
|                                  |                              |                |            |                                                         |
|                                  | <b>EIRP @ 100 FT</b>         | <b>-143.85</b> | <b>dBm</b> | EIRP @ 100 FT from Building ( < -140 dBm)               |
|                                  | <b>Output PWR at Antenna</b> | <b>-75.11</b>  | <b>dBm</b> | <b>0.0308 Nano-Watts or 30.8318 Pico-Watts</b>          |

| L2 Link Budget – L2 (1227.6 MHz) |                        |         |       |                                           |
|----------------------------------|------------------------|---------|-------|-------------------------------------------|
|                                  | Link Budget Parameter  | Value   | Units | Comment                                   |
|                                  | Receive Power on Earth | -136.00 | dBm   | ~ 6 dB less than L1                       |
|                                  | Rx Antenna Gain        | 38.00   | dB    | AeroAntenna: AT2775-42W-TNCF-000-RG-36-NM |

|         |                              |                |            |                                                         |
|---------|------------------------------|----------------|------------|---------------------------------------------------------|
|         | Cable loss (RxAnt to L.P.)   | -0.59          | dB         | LMR-600-DB                                              |
|         | Lightning Protector          | -0.50          |            | Estimate                                                |
|         | Cable loss (L.P. to Box)     | -0.89          | dB         | LMR-600-DB                                              |
| Amp Box | Amplifier Gain               | <b>35.00</b>   | dB         | GPS Source Metro-F12-R2B-P110/6.8-SF (Variable Gain)    |
|         | Fixed Attenuators            | -20.00         |            |                                                         |
|         | Amp Box Misc Losses          | -0.50          |            | Estimate                                                |
|         | Amp Box Cables               | -0.73          |            | RG-316 Cable                                            |
|         | Cable loss (Box to TxAnt)    | -1.38          | dB         | LMR-400-DB                                              |
|         | Connector Losses             | -4.00          |            |                                                         |
|         | Tx Antenna Gain              | 11.00          | dB         | HG824-11LP-NF; 800MHz-2.5GHz 11dBi Log Periodic Antenna |
|         | Free Space Loss              | -66.57         | dB         | 136 Ft.                                                 |
|         |                              |                |            |                                                         |
|         | <b>EIRP @ 100 FT</b>         | <b>-147.17</b> | <b>dBm</b> | EIRP @ 100 FT from Building ( < -140 dBm)               |
|         | <b>Output PWR at Antenna</b> | <b>-80.6</b>   | <b>dBm</b> | <b>0.0087 Nano-Watts or 8.7096 Pico-Watts</b>           |

The system receives the GPS signals from a roof top antenna and re-transmits the signals inside the facility to allow production and flight test personnel to perform installation, testing and troubleshooting of the aircraft's GPS based systems. These systems will not be sold to the government or supplied to the Department of Defense as part of the contract.

**Stop Buzzer** Stop buzzer for this operation is:

Robert Shane, 253-657-6197

Ronny Anderson, 206-544-0408

John Masterson, 253-773-9476