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To: Anthony Serafini

Date: June 27, 2013

Subject:

Message:

(MAB B7319)

Reference file # 0357-EX-PL-2013

This GPS booster station re-radiates the GPS L1 (1575.42 MHz) signal. Calculations are performed per Section 8.3.28 of the NTIA regulations [1], where item 7 states "the maximum equivalent isotropically radiated power must be such that the calculated emissions are no greater than -140 dBm/24 MHz at a distance of 100 feet (30 meters) from the building where the test is being conducted." Additionally, building attenuation has been ignored. This calculation shows that the re-radiated signal strength is in compliance with the regulation.

(1) $P_{sig} = P_{Rec} + Grant - L1 + GLa + G_{grant} + LS$

Where: P_{sig} = Re-radiated signal strength 30 meters (m) outside the building
 P_{Rec} = Received power from GPS satellites (L1) = -130 dBm [2]
 $Grant$ = Roof active antenna, from PN: VGHNRRKIT, antenna/amp gain = 40 dBi (max)

[3]

$L1$ = Coaxial cable attenuation [4], roof antenna to line amplifier
= 5.26 dB/100 ft x 0.6 (60 ft cable length)
= 3.2 dB

GLa = Re-radiating amplifier, from PN: VGHNRRKIT, gain = 23 dB (max) [3]

G_{grant} = Re-radiating antenna, from PN: VGHNRRKIT, gain = 3.0 dBi (typ) [3]

LS = Free space loss

(2) $LS = 20\log\left(\frac{c}{4\pi f D}\right)$

Where: $c/f = 3E8/1575.42E6 = 19.04E-2$ m
 D = Distance (d) from antenna to outer wall in meters + 30
= 6.1 m + 30
= 36.1 m

Inserting the values for c/f and D into equation (2) yields

$$LS = 20\log(19.04E-2/4\pi(36.1)) \\ = -67.5 \text{ dB}$$

Inserting these values into equation (1) yields

$$P_{sig} = -130 + 40 - 3.2 + 23 - 61 - 67.5 \\ = -143.7 \text{ dBm}$$

1Closest wall is 90° from antenna boresight. Antenna gain at 90° from boresight is -6 dBi, from ref. [5].

 

REFERENCES

- [1] Manual of Regulations and Procedures for Federal Radio Frequency Management, Section 8.3.28, pg. 8-70
- [2] ICD-GPS-200, Navstar GPS Space Segment/Navigation User Interfaces
- [3] VGHNRRKIT, Technical Product Data
- [4] LMR-400 datasheet
- [5] Test Report, Model: PA175, Antenna polar plot
- [6] Memorandum, "LSG GPS RERAD LEGALITY," Chuck Smith to Richard Jeppesen, December 19, 2005.
- [7] Email correspondence with John Reed, April 4, 2006 – RE: Quantity of experimental licenses.