

GPS Booster Station Signal Strength Calculation

Reference file # 0253-EX-PL-2006

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, 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.

$$(1) \quad P_{\text{sig}} = P_{\text{Rec}} + G_{\text{rant}} + G_{\text{amp}} - L_1 + G_{\text{rrant}} + L_S$$

Where:

P_{sig}	= Re-radiated signal strength 30 meters (m) outside the building
P_{Rec}	= Received power from GPS satellites (L1) = -130 dBm
G_{rant}	= Roof active antenna, MicroPulse PN: 2104NW, antenna gain = 4.5 dBi
G_{amp}	= Roof active antenna amplifier gain = 53 dB
L_1	= Coaxial cable attenuation, roof antenna to re-radiating antenna = 16.7 dB/100 m x 0.3 (30 m cable length, Andrew PN: FSJ2-50) = 5.1 dB
G_{rrant}	= Re-radiating antenna, Orbital-made, antenna gain = 1.0 dBi
L_S	= Free space loss

$$(2) \quad L_S = 20\text{Log}(\lambda/4\pi(D))$$

Where:

λ	= $c/f = 3E8/1575.42E6 = 19.04E-2$ m
D	= Distance (d) from antenna to outer wall in meters + 30 = 4.9 m + 30 = 34.9 m

Inserting the values for λ and D into equation (2) yields

$$L_S = 20\text{Log}(19.04E-2/4\pi(34.9)) \\ = -67.2 \text{ dB}$$

Inserting these values into equation (1) yields

$$P_{\text{sig}} = -130 + 4.5 + 53 - 5.1 + 1.0 - 67.2 \\ = -143.8 \text{ dBm}$$

