

GPS Booster Station Signal Strength Calculation

Reference file # 0250-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.

$$(1) \quad P_{\text{sig}} = P_{\text{Rec}} + G_{\text{rant}} + G_{\text{amp}} - L_1 + G_{\text{La}} - L_2 + G_{\text{rrant}} + L_S$$

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, Antcom PN: 3G1215A-XN-1, antenna gain = 3.5 dBi
G_{amp}	= Roof active antenna amplifier gain = 36 dB
L_1	= Coaxial cable attenuation, roof antenna to line amplifier = 0.35 dB/m x 25 m (cable type: RG213/U) = 8.8 dB
G_{La}	= Line amplifier, GPS Networking PN: LA20, gain = 26 dB
L_2	= N-type plug-to-plug adapter attenuation = 0.1 dB
G_{rrant}	= Re-radiating antenna, Antcom PN: 2G1215P-XN-1, antenna gain = -2.3 dBi, at 10° elevation (conservative assumption of worst case gain, since closest wall is behind antenna)
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 = 0.4 m + 30 = 30.4 m

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

$$L_S = 20\text{Log}(19.04E-2/4\pi(30.4)) \\ = -66.0 \text{ dB}$$

Inserting these values into equation (1) yields

$$P_{\text{sig}} = -130 + 3.5 + 36 - 8.8 + 26 - 0.1 - 2.3 - 66 \\ = -141.7 \text{ dBm}$$

