

GPS Booster Station Signal Strength Calculation

Reference file # 0516-EX-PL-2007

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.

$$(1) \quad P_{\text{sig}} = P_{\text{Rec}} + G_{\text{rant}} + G_{\text{amp}} - L_1 - L_2 - L_3 + G_{\text{rrant}} + L_S$$

Where:

P_{sig}	= Re-radiated signal strength 30 meters (m) outside the aircraft
P_{Rec}	= Received power from GPS satellites (L1) = -130 dBm
G_{rant}	= Aircraft top of fuselage active antenna, Trimble PN: 16248-50, antenna gain = 5.0 dBi
G_{amp}	= Aircraft top of fuselage active antenna amplifier gain = 48 dB, maximum
L_1	= Coaxial cable attenuation, top of fuselage antenna to bias tee = X dB/m x Y m (cable type: RG142/U) = 4.3 dB
L_2	= Bias Tee insertion loss = 0.4 dB
L_3	= Coaxial cable attenuation, bias tee to bottom of fuselage = X dB/m x Y m (cable type: RG142/U) = 2.4 dB
G_{rrant}	= Re-radiating antenna, Trimble PN: 16185-00, antenna gain = 6.0 dBi
L_S	= Free space loss

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

Where:

λ	= $c/f = 3\text{E}8/1575.42\text{E}6 = 19.04\text{E}-2 \text{ m}$
D	= 30 meters (from re-radiating antenna) = 30 m

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

$$L_S = 20\text{Log}(19.04\text{E}-2/4\pi(30.0)) \\ = -65.9 \text{ dB}$$

Inserting these values into equation (1) yields

$$P_{\text{sig}} = -130 + 5.0 + 48 - 4.3 - 0.4 - 2.4 + 6.0 - 65.9 \\ = -144.0 \text{ dBm}$$

