

GPS Booster Station Signal Strength Calculation
High Bay 7C/D
Reference file # 0265-EX-PL-2009

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]. The re-radiated power is limited by requirement 6 which states “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.” Also, any attenuation by the building will be neglected. This worksheet shows that the re-radiated signal for the High Bay 7C/D location is in compliance with the NTIA requirement.

The signal strength is defined by:

$$P_{\text{sig}} = P_{\text{rec}} + G_{\text{roof}} + L_{\text{cable}} + G_{\text{lna}} + G_{\text{ant}} + L_{\text{space}} \quad \text{eq. 1 [2]}$$

Where

- P_{sig} = The Re-Radiated signal strength at 30 meters from the building.
- P_{rec} = The power of the received GPS signal, L1 = -130 dBm
- G_{roof} = Gain of the active receiving antenna of the GPS re-rad system, 35 dB [3]
- L_{cable} = Losses for the RF cabling of the re-rad system @5 dB/100 ft, l = 62 ft [3]
- G_{lna} = Gain of the LNA of the re-rad system. 23 dB (typical) [3]
- G_{ant} = Gain of the re-radiating antenna, -10 dBi [3]
- L_{space} = Free space loss of the re-radiated signal

The free space loss is dependent upon the distance from the re-radiating antenna to the exterior wall and from the exterior wall to the designated measurement distance, 30 meters.

$$L_{\text{space}} = 20 \text{ Log}(\lambda/4\pi D) \quad \text{eq. 2 [2]}$$

- Where
- λ = Wavelength of the GPS signal, L1 = .1904 meters
 - π = Pi
 - D = The distance from antenna to exterior wall plus 30 meter required distance

Using the measured distance from the re-radiating antenna to exterior wall of High Bay 7C/D, and the 30 meter margin, the Path Loss is:

$$L_{\text{space}} = 20 * \text{Log}(.1904/(4 * \pi * (30))) = -65.9 \text{ dB}$$

The power of the re-radiated signal at the specified distance is:

$$P_{\text{sig}} = -130 + 35 + -3.1 + 23 + -10 + -65.9 = -151.0 \text{ dBm}$$

Maximum Power -140 dBm

Margin 11.0 dB

GPS Booster Station (Re-Radiation System) Link Margin Evaluation
High Bay 7C/D

Reference # 0265-EX-PL-2009

L1 Frequency (MHz)	1575.42
Wavelength (m)	0.1904
Distance (m) (re-rad antenna to exterior wall)	0.00
GPS Signal Strength	-130 dBm
Roof Antenna/LNA Gain	35.0 dB
RF Cable Loss	-3.1 dB
LNA Gain	23.0 dB
Re-Rad Antenna Gain	-10.0 dBi
Power at Re-Rad Antenna	-85.1 dBm
Space Loss to Distance	-65.9 dB
Power at Specified Distance	-151.0 dBm
Specified Maximum	-140.0 dBm
Margin	11.0 dB

GPS Booster Station Illustration
High Bay 7C/D

