

GPS Booster Station Signal Strength Calculation

High Bay 8C

Reference file # 0218-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 8C location is in compliance with the NTIA requirement.

The signal strength is defined by:

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

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 = 56 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.

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

- 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 8A, and the 30 meter margin, the Path Loss is:

$$L_{space} = 20 * \text{Log}(.1904/(4 * \pi * (30 + .3))) = -66.0 \text{ dB}$$

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

$$P_{sig} = -130 + 35 + -2.8 + 23 + -10 + -66.0 = -150.8 \text{ dBm}$$

Maximum Power -140 dBm

Margin 10.8 dB

GPS Booster Station (Re-Radiation System) Link Margin Evaluation
High Bay 8C
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L1 Frequency (MHz)	1575.42
Wavelength (m)	0.1904
Distance (m) (re-rad antenna to exterior wall)	0.30
GPS Signal Strength	-130 dBm
Roof Antenna/LNA Gain	35.0 dB
RF Cable Loss	-2.8 dB
LNA Gain	23.0 dB
Re-Rad Antenna Gain	-10.0 dBi
Power at Re-Rad Antenna	-84.8 dBm
Space Loss to Distance	-66.0 dB
Power at Specified Distance	-150.8 dBm
Specified Maximum	-140.0 dBm
Margin	10.8 dB

GPS Booster Station Illustration
High Bay 8C

