GPS Booster Station Signal Strength Calculation
High Bay 8H
Reference file # 0268-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 8H location is in compliance with the NTIA requirement.

The signal strength is defined by:

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

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 = 146 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.

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

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 8H, and the 30 meter margin, the Path Loss is:

$$L_{space} = 20*Log(.1904/(4*\pi*(30+13.64))) = -69.2 \text{ dB}$$

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

$$P_{sig} = -130 + 35 + -7.3 + 23 + -10 + -69.2 = -158.5 \text{ dBm}$$

Maximum Power   -140 dBm

Margin   18.5 dB

GPS Booster Station (Re-Radiation System) Link Margin Evaluation
High Bay 8H
Reference # 0268-EX-PL-2009

L1 Frequency (MHz)	1575.42	
Wavelength (m)	0.1904	
Distance (m) (re-rad antenna to exterior wall)	13.64	
GPS Signal Strength	-130	dBm
Roof Antenna/LNA Gain	35.0	dB
RF Cable Loss	-7.3	dB
LNA Gain	23.0	dB
Re-Rad Antenna Gain	-10.0	dBi
Power at Re-Rad Antenna	-89.3	dBm
Space Loss to Distance	-69.2	dB
Power at Specified Distance	-158.5	dBm
Specified Maximum	-140.0	dBm
Margin	**18.5**	**dB**

GPS Booster Station Illustration
High Bay 8H

Active Antenna
Roof

Coaxial Cable

Re-radiating Antenna

Exterior Wall

Low Noise
Amplifier

30 m

Distance from antenna
to exterior wall

High Bay