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:

$P_{sig} = P_{rec} + G_{roof} + L_{cable} + G_{lna} + G_{ant} + L_{space}$ 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.

$L_{space} = 20 \, Log(\lambda/4\pi D)$ 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*Log(.1904/(4*\pi*(30+.3))) = $ -66.0 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 dBm

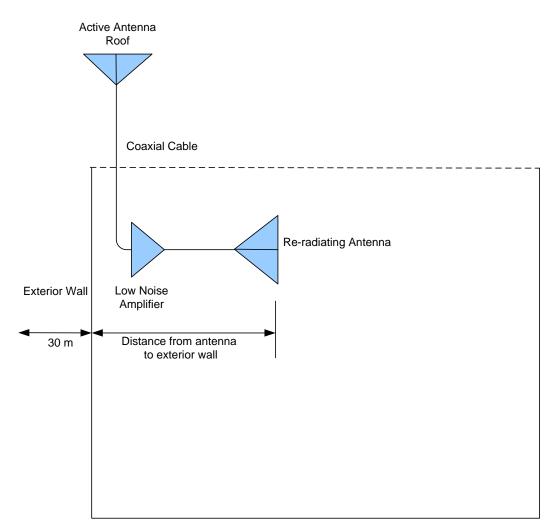Maximum Power   -140 dBm

Margin   10.8 dB

GPS Booster Station (Re-Radiation System) Link Margin Evaluation
High Bay 8C
Reference # 0218-EX-PL-2009

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

Active Antenna
Roof

Coaxial Cable

Re-radiating Antenna

Exterior Wall

Low Noise
Amplifier

30 m

Distance from antenna
to exterior wall

High Bay