

1. Additional NITA Calculations:

Table 1-1 contains calculations supporting compliance with the NTIA emissions limit of -140dBm/24MHz. All parameters listed in the table and show in Figure are either defined per the equipment manufacturer or measured by Qualcomm engineers. Prior to transmission, the conducted transmit power will be measured at the re-radiation antenna to verify that the conducted power is less then -88 dBm (line h) and thus verify the EIRP is less then -88dBm (line j). This EIRP results in a received power level of 153.2dBm/24 MHz at a distance of 100 feet providing 13.2 dB of margin to the NTIA requirement of -140dBm/24MHz.

Not included in the interference calculations is the attenuation provided by the building walls where the re-radiation devices will be located. All systems are inside commercial office buildings which will offer additional attenuation to the re-transmitted GPS signal. This additional attenuation will add to the 13.2dB of margin calculated in respect to the NTIA emissions limit.\

Table 1-1 NTIA -140 dBm/24 MHz Calculation

Line	Parameter	Value	Unit	Equation
a	Received Power @ Roof	-130	dBm / 20.4MHz	Measured parameter
b	GPS antenna gain + internal amplifier	50	dB	Measured parameter
c	Cable Loss (100' of LMR-400)	-5.5	dB	Measured parameter
d	Amplifier Gain	30	dB	Measured parameter
e	Attenuator between Amplifer and splitter	-10	dB	Measured parameter
f	16 way Splitter	-14.3	dB	Measured parameter
g	Cable Loss between splitter and re-radiation antenna	-8.3	dB	Measured parameter
h	GPS Re-radiated Conducted power	-88	dBm	a+b+c+d+e+f+g
i	GPS Re-radiation antenna gain	0	dB	Measured parameter
j	GPS Re-radiated TX power	-88	dBm EIRP / 20.4MHz	h+i
k	Path loss at 100 ft (30m) @ 1575 MHz	65.9	dB	FSL=20*log [4dp/l], d=30m=100ft
l	Received power at 100 ft (30m)	153.9	dBm/20.4 MHz	j+k
m	GPS BW	20.2	MHz	Given
n	NTIA Limit BW	24.0	MHz	Given
o	BW correction	0.749	dB	BW(corrected)=10*log[n/m]
p	Received power at 100 ft (30m)	153.2	dBm/24 MHz	o+l
q	NTIA Limit =-140 dBm/24MHz	-140	dBm/ 24 MHz	Given
r	Margin	13.2	dB	q-p

2. Support Equations

Free Space Loss

Equivalent isotropically radiated power (EIRP)= $P_{\text{EIRP}} = P_{\text{conducted}}(\text{dBm}) + \text{Antenna Gain (dBi)}$

$$\text{Free Space Loss} = FSL = 20 * \log \left[\frac{4\pi d}{\lambda} \right]$$

Figure 0-1 GPS Indoor Re-radiation setup

QUALCOMM GPS INDOOR RERADIATED SYSTEM

