GPS L1 Link Budget

Satellite Tranmitter

Transmitter Power (25 Watts)	14	dBW	
RF Losses in trasmitter path	-1.25	dB	
Antenna Gain (with respect to an isotrope)	13.5	dBi	
Satellite EIRP (wrt isotropic radiator)	**26.25**	**dBW**	**421.70 Watts**
Satellite ERP (wrt dipole radiator)	**24.10**	**dBW**	**257.04 Watts**

Propagation

Atmoshperic and Polarization Losses	-0.5	dB

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	2.52E+07	meters
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[3.17E{+}08 \,/\, 1.90E{-}01\right]^2$$

$$= -10\log_{10}\left[1.67E{+}09\right]^2$$

Free Space Path Loss over Distance	-184.43	dB

Received Power on Earth	**-158.68**	**dBW**
	-128.68	**dBm**
Gain of Receive Antenna	37.63	dBic
RF losses in 300 feet of LMR400UF cabling and connectors from Receive Antenna to Line Amplifier	-18.95	dB
Gain of Two Line Amplifiers	37	dB
RF Power at Input to Re-Radiating Antenna	***-73.00***	***dBm***
Gain of Passive Re-Radiating Antenna	3	dBic
Re-Radiated EIRP (wrt isotropic radiator)	**-70.00**	**dBm**
Re-Radiated ERP (wrt dipole radiator)	**-72.15**	**dBm**

100.00	**pW**
60.95	**pW**

Power Levels at a Distance from the Re-Radiating Antenna

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	100	feet
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[383.023 / 1.90E\text{-}01\right]^2$$

$$= -10\log_{10}\left[2.01E+03\right]^2$$

Free Space Path Loss over Distance -66.07 dB

RF power level at 100 ft distance = -136.07 dBm

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	150	feet
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[574.5345 / 1.90E\text{-}01\right]^2$$

$$= -10\log_{10}\left[3.02E+03\right]^2$$

Free Space Path Loss over Distance -69.59 dB

RF power level at 150 ft distance = -139.59 dBm

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	200	feet
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[766.046 / 1.90E\text{-}01\right]^2$$

$$= -10\log_{10}\left[4.02E+03\right]^2$$

Free Space Path Loss over Distance -72.09 dB

RF power level at 200 ft distance = -142.09 dBm

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	250	feet
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[957.5574 / 1.90E\text{-}01\right]^2$$

$$= -10\log_{10}\left[5.03E+03\right]^2$$

Free Space Path Loss over Distance	-74.03	dB
RF power level at 250 ft distance =	**-144.03**	**dBm**

$$Free\ Space\ Path\ Loss = -10\times\log_{10}\left[\left(\frac{4\pi d}{\lambda}\right)^2\right]$$

where d = distance from antenna =	300	feet
c = speed of light =	3.00E+08	m/sec
f = frequency =	1.58E+09	Hz
lambda = wavelength = c/f =	1.90E-01	meters

$$= -10\log_{10}\left[1149.069 / 1.90E\text{-}01\right]^2$$

$$= -10\log_{10}\left[6.03E+03\right]^2$$

Free Space Path Loss over Distance	-75.61	dB
RF power level at 300 ft distance =	**-145.61**	**dBm**