GPS L1 Link Budget

Satellite Tranmitter

Transmitter Power (25 Watts)	14.25	dBW	
RF Losses in trasmitter path	-1.25	dB	
Antenna Gain (with respect to an isotrope)	13.5	dBi	
Satellite EIRP (wrt isotropic radiator)	**26.50**	**dBW**	**446.68 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

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

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

Free Space Path Loss over Distance	-184.43	dB

Received Power on Earth	**-158.43**	**dBW**	
	-128.43	**dBm**	**1.44E-04 pW**
Gain of Receive Antenna	38	dBic	
RF losses in 300 feet of LMR400UF cabling and connectors from Receive Antenna to Line Amplifier	-6.7	dB	
Gain of Line Amplifier	20	dB	
RF Power at Input to Re-Radiating Antenna	***-77.13***	***dBm***	**19.36 pW**
Gain of Passive Re-Radiating Antenna	3	dBic	
Re-Radiated EIRP (wrt isotropic radiator)	**-74.13**	**dBm**	**38.64 pW**
Re-Radiated ERP (wrt dipole radiator)	**-76.28**	**dBm**	**23.55 pW**

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

where d = distance from antenna = 100 feet

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

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

Free Space Path Loss over Distance -66.07 dB

RF power level at 100 ft distance = -140.20 dBm wrt isotropic antenna

-142.35 dBm wrt dipole antenna