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

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

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

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

GPS L2 Link Budget

Satellite Tranmitter

Transmitter Power (4.32 Watts)	6.35	dBW	
RF Losses in trasmitter path	-1.25	dB	
Antenna Gain (with respect to an isotrope)	11.5	dBi	
Satellite EIRP (wrt isotropic radiator)	**16.60**	**dBW**	**45.71 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 =	1.23E+09	Hz
lambda = wavelength = c/f =	2.44E-01	meters

$$= -10\log_{10}\left[3.17E{+}08 \Big/ 2.44E{-}01\right]^2$$

$$= -10\log_{10}\left[1.30E{+}09\right]^2$$

Free Space Path Loss over Distance	-182.26	dB

Received Power on Earth	**-166.16**	**dBW**	
	-136.16	**dBm**	**2.42E-05 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	***-84.86***	***dBm***	**3.26 pW**
Gain of Passive Re-Radiating Antenna	3	dBic	
Re-Radiated EIRP (wrt isotropic radiator)	**-81.86**	**dBm**	**6.51 pW**
Re-Radiated ERP (wrt dipole radiator)	**-84.01**	**dBm**	**3.97 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

$$= -10\log_{10}\left[383.02298 \Big/ 2.44\text{E-}01\right]^2$$

$$= -10\log_{10}\left[1.57\text{E+}03\right]^2$$

Free Space Path Loss over Distance -63.90 dB

RF power level at 100 ft distance = -145.77 dBm wrt isotropic antenna

-147.92 dBm wrt dipole antenna