

GPS L1 Link Budget

Satellite Transmitter

Transmitter Power (25 Watts)	14 dBW
RF Losses in transmitter path	-1.25 dB
Antenna Gain (with respect to a dipole)	11.35 dBd
Satellite ERP	24.10 dBW

Propagation

Atmospheric and Polarization Losses	-0.5 dB
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$$\text{Free Space Path Loss} = -10 \times \log_{10} \left[\left(\frac{4\pi d}{\lambda} \right)^2 \right]$$

where d = distance (25236 km)
lambda = wavelength = c/f
c = speed of light (3x10⁸ m/sec)
f = frequency (1.57542 GHz)

$$\begin{aligned} &= -10 \log [317.125 \times 10^6 / 190.425 \times 10^{-3}]^2 \\ &= -10 \log [1.665 \times 10^9]^2 \\ &= -184.43 \text{ dB} \end{aligned}$$

Received Power on Earth	-160.83 dBW
	-130.83 dBm

Gain of Receive Antenna	38 dBic
RF loss for 100 feet LMR400 cabling and connectors from Receive Antenna to Line Amplifier	-5 dB
Gain of Line Amplifier	20 dB
Gain of Passive Radiating Antenna	3 dBic

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

where d = 100 feet distance (30.48m)
lambda = wavelength = c/f
c = speed of light (3x10⁸ m/sec)
f = frequency (1.57542 GHz)

$$\begin{aligned} &= -10 \log [383.023 / 190.425 \times 10^{-3}]^2 \\ &= -10 \log [2011.41]^2 \\ &= -66.07 \text{ dB} \end{aligned}$$

100 foot distance

RF power level at 100 ft distance	-140.90 dBm
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-76.53

22.23