

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)

$$\lambda = \text{wavelength} = c/f$$

$c = \text{speed of light } (3 \times 10^8 \text{ m/sec})$

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	33 dBic
RF loss for 40 feet (-2dB) LMR400 cable from Receive Antenna to Splitter and also from Splitter Output 3, 265 feet (-13dB) to Line Amplifier Plus Splitter Amplification (+6 dB)	
Net Gain/Loss=	-9 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)

$$\lambda = \text{wavelength} = c/f$$

$c = \text{speed of light } (3 \times 10^8 \text{ m/sec})$

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

-149.90 dBm