

## GPS Satellite to GPS Satellite Link Budget Calculation

### Link Budget Calculation

Project specifications required ground controllers on earth to be able to communicate with individual satellites for monitoring and system maintenance. In order to accomplish this, 4 satellites carry transceivers capable of communicating with earth. Data is then passed between satellites using a 100 MHz link carried by all satellites. The quarter wave monopole antenna used for this link allows each satellite to communicate with all of its neighbors. This link is capable of reaching up to 28850 km, which is the maximum distance possible between a satellite and its nearest neighbor. Thus the satellites form a mesh network through which data is passed hop by hop. Because all satellites use the same frequency, this link is shared by all satellites using TDMA. A ½ turbo code is used to provide a maximum bit error rate of  $10^{-8}$  with the designed minimum C/N of .62 dB. A bit rate of 1.5 Mbps was chosen for this link to match the long haul earth link.

<b>Received Signal Power</b>	
Transmit Output Power	16.5 dBW
Receive Antenna Gain	5 dB
Transmit Antenna Gain	5 dB
Propagation Loss at 100 MHz	161.6 dB
Miscellaneous Losses	-1 dB
Received Power	-136.1 dBw
<b>Receiver Noise Power</b>	
Boltzmann's constant K	-228.6 dBW/K/Hz
System Noise Temperature 243 K	23.9 dBK
Receiver Noise Bandwidth 6 MHz	67.8 dBHz
Noise Power	-137.0 dBW

Figure 1.0 Link Budget: Earth to GPS Satellites