

LINK BUDGET:

Downlink(CW)

Mode	CW	
Spacecraft		
Antenna Type	Monopole	
Orbit Altitude	413	[km]
Maximum Transmission Distance	1480.80	[km]
Elevation Angle	10	[deg]
Spacecraft Transmitter Power Output	0.1	[watts]
Downlink Frequency	437.245	[MHz]
Spacecraft Total Transmission Line Losses	1.6	[dB]
Spacecraft Antenna Gain	2.0	[dBi]
Spacecraft EIRP	-9.6	[dBW]
Downlink Path		
Spacecraft Antenna Pointing Loss	0.0	[dB]
S/C-to-Ground Antenna Polarization Loss	0.5	[dB]
Path Loss	148.4	[dB]
Atmospheric Loss	1.1	[dB]
Ionospheric Loss	0.8	[dB]
Rain Loss	0.0	[dB]
Isotropic Signal Level at Ground Station	-155.6	[dBW]
Ground Station(EbNo Method)		
Ground Station Antenna Pointing Loss	0.2	[dB]
Ground Station Antenna Gain	18	[dBi]
Ground Station Total Transmission Line Losses	1.9	[dB]
Ground Station Effective Noise Temperature	490	[K]
Ground Station Figure of Merit(G/T)	-7.0	[dB/K]
G.S. Signal-to-Noise Power Density(S/No)	66.2	[dBHz]
System Desired Data Rate	100	[bps]
Telemetry System Eb/No for the Downlink	46.2	[dB]
Demodulation Method Selected	CW	
Forward Error Correction Coding Used	None	
System Allowed or Specified Bit-Error-Rate		
Demodulator Implementation Loss	1	[dB]
Telemetry System Required Eb/No	16.0	[dB]
Eb/No Threshold	15.0	[dB]
System Link Margin	30.2	[dB]
Ground Station Alternative Signal Analysis Method(SNR Computation)		
Ground Station Antenna Pointing Loss	0.2	[dB]
Ground Station Antenna Gain	18	[dBi]
Ground Station Total Transmission Line Losses	1.9	[dB]
Ground Station Effective Noise Temperature	490	[K]
Ground Station Figure of Merit(G/T)	-7.0	[dB/K]
Signal Power at Ground Station LNA Input	-135.5	[dBW]
Ground Station Receiver Bandwidth(B)	3	[kHz]
G.S. Receiver Noise Power(Pn=kTB)	-166.9	[dBW]
Signal-to-Noise Power Ratio at G.S. Rcvr	31.5	[dB]
Analog or Digital System Required S/N	16.0	[dB]
System Link Margin	15.5	[dB]

Downlink(FM)

Mode	FM			
Spacecraft				
Antenna Type	Monopole		Monopole	
Orbit Altitude	413	[km]	413	[km]
Maximum Transmission Distance	1480.80	[km]	1480.80	[km]
Elevation Angle	10	[deg]	10	[deg]
Spacecraft Transmitter Power Output	0.8	[watts]	0.8	[watts]
Downlink Frequency	437.405	[MHz]	437.405	[MHz]
Spacecraft Total Transmission Line Losses	1.6	[dB]	1.6	[dB]
Spacecraft Antenna Gain	2.0	[dBi]	2.0	[dBi]
Spacecraft EIRP	-0.6	[dBW]	-0.6	[dBW]
Downlink Path				
Spacecraft Antenna Pointing Loss	0.0	[dB]	0.0	[dB]
S/C-to-Ground Antenna Polarization Loss	0.5	[dB]	0.5	[dB]
Path Loss	148.7	[dB]	148.7	[dB]
Atmospheric Loss	1.1	[dB]	1.1	[dB]
Ionospheric Loss	0.8	[dB]	0.8	[dB]
Rain Loss	0.0	[dB]	0.0	[dB]
Isotropic Signal Level at Ground Station	-146.5	[dBW]	-146.5	[dBW]
Ground Station(EbNo Method)				
Ground Station Antenna Pointing Loss	0.2	[dB]	0.2	[dB]
Ground Station Antenna Gain	18	[dBi]	18	[dBi]
Ground Station Total Transmission Line Losses	1.9	[dB]	1.9	[dB]
Ground Station Effective Noise Temperature	490	[K]	490	[K]
Ground Station Figure of Merit(G/T)	-7.0	[dB/K]	-7.0	[dB/K]
G.S. Signal-to-Noise Power Density(S/No)	66.2	[dBHz]	66.2	[dBHz]
System Desired Data Rate	1200	[bps]	9600	[bps]
Telemetry System Eb/No for the Downlink	44.5	[dB]	35.5	[dB]
Demodulation Method Selected	AFSK/FM		FSK(GMSK)	
Forward Error Correction Coding Used	None			
System Allowed or Specified Bit-Error-Rate	0.00001		0.00001	
Demodulator Implementation Loss	1	[dB]	1	[dB]
Telemetry System Required Eb/No	23.2	[dB]	23.2	[dB]
Eb/No Threshold	24.2	[dB]	24.2	[dB]
System Link Margin	20.3	[dB]	11.3	[dB]
Ground Station Alternative Signal Analysis Method(SNR Computation)				
Ground Station Antenna Pointing Loss	0.2	[dB]	0.2	[dB]
Ground Station Antenna Gain	18	[dBi]	18	[dBi]
Ground Station Total Transmission Line Losses	1.9	[dB]	1.9	[dB]
Ground Station Effective Noise Temperature	490	[K]	490	[K]
Ground Station Figure of Merit(G/T)	-7.0	[dB/K]	-7.0	[dB/K]
Signal Power at Ground Station LNA Input	126.4	[dBW]	-126.4	[dBW]
Ground Station Receiver Bandwidth(B)	10	[kHz]	16	[kHz]
G.S. Receiver Noise Power(Pn=kTB)	-161.7	[dBW]	-159.7	[dBW]
Signal-to-Noise Power Ratio at G.S. Rcvr	35.3	[dB]	33.2	[dB]
Analog or Digital System Required S/N	23.2	[dB]	23.2	[dB]
System Link Margin	12.1	[dB]	10.0	[dB]

Uplink

Ground Station	
Antenna Type	Cross Yagi Antenna 2 stack
Ground Station Latitude	34.725 [deg]
Ground Station Longitude	137.725 [deg]

Elevation Angle	10	[deg]
Ground Station Transmitter Power Output	50	[watts]
Uplink Frequency	435.575	[MHz]
Ground Stn. Transmission Line Losses	3.6	[dB]
Antenna Gain	16.0	[dBi]
Ground Station EIRP	29.4	[dBW]
Uplink Path		
Ground Station Antenna Pointing Loss	0.1	[dB]
Gnd-to-S/C Antenna Polarization Loss	0.5	[dB]
Path Loss	148.4	[dB]
Atmospheric Loss	1.1	[dB]
Ionospheric Loss	0.7	[dB]
Rain Loss	0	[dB]
Isotropic Signal Level at Spacecraft	-116.9	[dBW]
Spacecraft (EbNo Method)		
Spacecraft Antenna Pointing Loss	4.7	[dB]
Spacecraft Antenna Gain	2	[dBi]
Spacecraft Total Transmission Line Losses	2	[dB]
Spacecraft Effective Noise Temperature	220	[K]
Spacecraft Figure of Merit(G/T)	-19.4	[dB/K]
S/C. Signal-to-Noise Power Density(S/No)	97.3	[dBHz]
System Desired Data Rate	1200	[bps]
Command System Eb/No	66.5	[dB]
Demodulation Method Selected	AFSK/FM	
Forward Error Correction Coding Used	None	
System Allowed or Specified Bit-Error-Rate	0.00001	
Demodulator Implementation Loss	1.0	[dB]
Telemetry System Required Eb/No	10.5	[dB]
Eb/No Threshold	11.5	[dB]
System Link Margin	56.0	[dB]
Spacecraft Alternative Signal Analysis Method(SNR Computation)		
Spacecraft Antenna Pointing Loss	4.7	[dB]
Spacecraft Antenna Gain	2.0	[dBi]
Spacecraft Total Transmission Line Losses	2.0	[dB]
Spacecraft Effective Noise Temperature	220	[K]
Spacecraft Figure of Merit(G/T)	-19.4	[dB/K]
Signal Power at Spacecraft LNA Input	-107.9	[dBW]
Spacecraft Receiver Bandwidth(B)	10	[kHz]
Spacecraft Receiver Noise Power(Pn=kTB)	-165.2	[dBW]
Signal-to-Noise Power Ratio at G.S. Rcvr	57.3	[dB]
Analog or Digital System Required S/N	10.5	[dB]
System Link Margin	46.8	[dB]