

### Ku-band typical link budgets

Ku-band uplink frequency	14250	MHz
Ku-band downlink frequency	12000	MHz
Convolution FEC rate	0.921569	
Block FEC rate	0.75	
Rx ES temperature	120	K

<b>S13.c.</b>	<b>K_A</b>	<b>K_B</b>	<b>K_C</b>	<b>K_D</b>
	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W
Data Rate (dB-Hz)	76	75	69	67.6
Throughput rate (Mbps)	40	32	8	6
Symbol rate (MSPS)	28.8	22.9	5.7	4.2
<b>Uplinks:</b>				
Transmit Power (dBW)	20	20	8.9	8.9
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5
Antenna diameter	6.1	6.1	3.7	3.7
Antenna Gain (dBi)	57.3	57.3	53.0	53.0
Ground Station EIRP (dBW)	74.8	74.8	59.4	59.4
Uplink Rain Loss (dB)	-2	-2	-2	-2
Free Space Loss (dB)	-207	-207	-207	-207
Satellite G/T (dB/K)	3	3	3	3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6
Eb/N0 (dB)	21.4	22.4	13.0	14.4
Eb/I0 (dB)	18	18	16	16
Total Eb/(N0 + I0) (dB)	16.4	16.7	11.2	12.1
<b>Downlinks:</b>				
Satellite Carrier EIRP (dBW)	49.4	48.1	35.7	34.3
Interference bandwidth (MHz)	36	27	6.95	5
Satellite EIRP density (dBW/4KHz)	9.86	9.81	3.30	3.33
Downlink Rain Loss (dB)	-3	-3	-3	-3
Free Space Loss (dB)	-205.4	-205.4	-205.4	-205.4
Ground station antenna dia, m	0.9	0.9	2.4	2.4
Ground Station G/T (dB/K)	18.4	18.4	26.9	26.9
Eb/N0 (dB)	12.0	11.7	13.8	13.8
C/IM			18	18
Eb/Imo (dB)			16.6	16.6
C/I	15	15	15	15
Eb/I0 (ASI) (dB)	13.6	13.6	13.6	13.6
Eb/I0 (dB)	13.6	13.6	13.6	13.6

Eb/(N0 + I0) (dB)	9.7	9.5	9.7	9.7
Total Up/Down Eb/(N0+I0)(dB)	8.9	8.8	7.4	7.7
Required Eb/N0	5.4	5.4	5.4	5.4
Margin	3.5	3.4	2.0	2.3

<b>K_E</b>	<b>K_F</b>	<b>K_F</b>
		Digital TV
		MCPC
56 Kbps	1.544 Mbps	50 Mbps
QPSK $\frac{3}{4}$ RS	QPSK $\frac{3}{4}$ RS	8PSK $\frac{2}{3}$ RS
100KG1W	1M60G1W	36M0G7W
47.5	61.9	77
0.056	1.544	50
0.041	1.117	27.2
-2	8	20
-2.5	-2.5	-2.5
1.8	1.8	6.1
46.7	46.7	57.3
42.2	52.2	74.8
-2	-2	-2
-207	-207	-207
3	3	3
-228.6	-228.6	-228.6
17.3	12.9	20.4
16	16	18
13.6	11.2	16.0
18.5	28.5	49.4
0.1	1.6	36
4.52	2.48	9.86
-3	-3	-3
-205.4	-205.4	-205.4
1.2	2.4	2.4
20.9	26.9	26.9
12.1	13.7	19.5
18	18	
16.6	16.6	
15	15	15
13.6	13.6	12.3
13.6	13.6	12.3

9.0	9.7	11.6
7.7	7.4	10.3
5.4	5.4	7.2
2.3	2.0	3.1

### C-band typical link budgets

Ku-band uplink frequency	6250	MHz
Ku-band downlink frequency	3950	MHz
Convolution FEC rate	0.92157	
Block FEC rate	0.75	
Rx ES temperature	100	K

<b>S13.c.</b>	<b>C_A</b>	<b>C_B</b>	<b>C_C</b>	<b>C_D</b>
	Digital TV MCPC 40 Mbps QPSK $\frac{3}{4}$ RS	Digital TV MCPC 32 Mbps QPSK $\frac{3}{4}$ RS	Digital TV SCPC QPSK $\frac{3}{4}$ RS	Digital TV SCPC QPSK $\frac{3}{4}$ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W
Data Rate (dB-Hz)	76	75	69	69
Throughput rate (Mbps)	40	32	8	8
Symbol rate (MSPS)	28.8	22.9	5.7	5.7
<b>Uplinks:</b>				
Transmit Power (dBW)	25.1	20	9.6	12
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5
Antenna diameter (m)	9	9	9	9
Antenna Gain (dBi)	53.5	53.5	53.5	53.5
Ground Station EIRP (dBW)	76.1	71.0	60.6	63.0
Uplink Rain Loss (dB)	-1	-1	-1	-1
Free Space Loss (dB)	-199.7	-199.7	-199.7	-199.7
Satellite G/T (dB/K)	1.3	1.3	1.3	1.3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6
Eb/No (dB)	29.3	25.2	20.8	23.2
Eb/Io (dB)	18	18	18	16
Total Eb/(No + Io) (dB)	17.7	17.2	16.2	15.2
<b>Downlinks:</b>				
Satellite Carrier EIRP (dBW)	37	37	25.8	25.8
Interference bandwidth (MHz)	36	27	6.95	5
Satellite EIRP density (dBW/4KHz)	-2.54	-1.29	-6.60	-5.17
Downlink Rain Loss (dB)	-0.5	-0.5	-0.5	-0.5
Free Space Loss (dB)	-195.8	-195.8	-195.8	-195.8
Ground station antenna dia, m	3.8	3.8	3.8	3.8
Ground Station G/T (dB/K)	22.1	22.1	22.1	22.1
Eb/No (dB)	15.4	16.4	11.2	11.2
C/IM			18	18
Eb/Imo (dB)			16.6	16.6
C/I(ASI)	16	16	16	16
Eb/Io(ASI)	14.6	14.6	14.6	14.6
Eb/Io (dB)	14.6	14.6	14.6	14.6

Eb/(No + Io) (dB)	11.9	12.4	8.8	8.8
Total Up/Down Eb/(No+Io)(dB)	10.9	11.2	8.0	7.9
Required	5.4	5.4	5.4	5.4
Margin	5.5	5.8	2.6	2.5

C_E	C_F	C_G
		Digital TV
		MCPC
56 Kbps	1.544 Mbps	50 Mbps
QPSK $\frac{3}{4}$ RS	QPSK $\frac{3}{4}$ RS	8PSK $\frac{2}{3}$ RS
100KG1W	1M60G1W	36M0G7W
47.5	61.9	77
0	2	50
0.0	1.1	27.2
-3.4	11.8	25.1
-2.5	-2.5	-2.5
4.5	4.5	9
47.5	47.5	53.5
41.6	56.8	76.1
-1	-1	-1
-199.7	-199.7	-199.7
1.3	1.3	1.3
-228.6	-228.6	-228.6
23.3	24.1	28.3
16	16	18
15.3	15.4	17.6
6.8	22	37
0.1	1.6	36
-7.18	-4.02	-2.54
-0.5	-0.5	-0.5
-195.8	-195.8	-195.8
3.8	3.8	3.8
22.1	22.1	22.1
13.7	14.5	14.4
18	18	
16.6	16.6	
16	16	16
14.6	14.6	13.3
14.6	14.6	13.3

10.0	10.3	10.8
8.9	9.2	10.0
5.4	5.4	5.4
3.5	3.8	4.6

### Ka-band link budgets

Ka-band uplink freq	25000	MHz
Ka-band downlink freq	17500	MHz
Rx ES noise temperature	150.0	K

### CONUS

<b>S13.c.</b>	<b>KA_1</b>	<b>KA_2</b>
Carrier designation	1M20G1W	5M50G1W
Throughput rate, Mbps	1.43	4.75
Required bandwidth, MHz	1.2	5.5
Allocated bandwidth, MHz	1.2	5.5
FEC code rate	0.5	0.5
C/N required, dB	4.7	1.3
Faded system margin, dB	0.5	0.5
<b>Uplink</b>		
Transmit Power (dBW)	4	10.5
Antenna diameter	9	9
Antenna Gain (dBi)	65.6	65.6
TxES antenna input power density, dBW/MHz	3.2	3.1
Ground Station EIRP (dBW)	69.6	76.1
Uplink Rain Loss (dB)	0	0
Uplink path loss	-212.1	-212.1
Boltzmann's constant	-228.6	-228.6
Satellite G/T (dB/K)	-8	-8
C/N, dB	17.3	17.2
C/I(X-pol uplink), dB	30	30
<b>Downlink</b>		
Satellite Carrier EIRP (dBW)	31.3	31.3
Ground station antenna dia, m	0.95	1.5
Ground Station G/T (dB/K)	21.2	25.2
Downlink path loss	-208.7	-208.7
C/N(clear weather), dB	11.6	8.9
Min C/N down, dB	2.68	0.43
C/I(ASI), dB	10	10
C/I(total), dB	9.91	9.91
Rain margin to min C/N down, dB	8.9	8.5

**Ku/C-band TV/FM link budget**

Ku-band frequencies (UL   DL)	14250	11950	MHz
C-band frequencies (UL   DL)	6250	3950	MHz
Rx ES temperature (Ku   C)	120	100	K

<b>S13.d.</b>	<b>K_H</b>	<b>C_H</b>
	Ku-band	C-band
Parameter	Typical TV/FM link	Typical TV/FM link
Carrier designation	36M0F3F	36M0F3F
<b>Uplinks:</b>		
Transmit Power (dBW)	22	25
Transmit Loss (dB)	-1	-0.5
Antenna diameter	6.1	9
Antenna Gain (dBi)	57.3	53.5
Ground Station EIRP (dBW)	78.3	78.0
Uplink Rain Loss (dB)	-2	-1
Free Space Loss (dB)	-207	-199.7
Satellite G/T (dB/K)	3	1.3
Bandwidth (dB-Hz)	75.6	75.6
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6
C/N, uplink (dB)	25.4	31.7
<b>Downlinks:</b>		
Satellite Carrier EIRP (dBW)	48.2	39.7
Downlink Rain Loss (dB)	-3	-0.5
Free Space Loss (dB)	-205.4	-195.8
Ground station antenna dia, m	1.2	3.8
Ground Station G/T (dB/K)	20.9	22.1
C/N, DL (dB)	13.7	18.5
C/I ASI (dB)	18	16
C/Ntot, dB	12.3	14.1
Required (dB)	11	11
Margin (dB)	1.3	3.1

**Ku-band & C-band TT&C links**

k	-228.6
Ku-band freq	14499
C-band freq	6423.5

**CMD**

<b>S13.d.</b>	<b>K_TC</b>	<b>C_TC</b>
Tx ES dia (typical), m	8.4	13
Tx ES gain, dBi	60.2	57.0
Tx ES antenna input power, dBW	10	10
Tx ES EIRP, dBW	70.2	67.0
Link loss, dB	207.5	200.1
Satellite G/T, dB/K	6	2
Command carrier bandwidth, MHz	1	1
Tx ES antenna input power density, dBW/Hz	-50	-50
Carrier-to-Noise Ratio, dB	37.3	37.5
Required CNR, dB	10	10
Margin	27.3	27.5

Ku-band freq	11701
C-band freq	3700

**TLM**

<b>S13.d.</b>	<b>K_TM</b>	<b>C_TM</b>
EIRP, dBW	19	16
Carrier bandwidth, MHz	0.5	0.5
EIRP density, dBW/4kHz	-1.97	-4.97
Tx ES dia (typical), m	5.7	4.5
Rx ES antenna gain, dB	55.0	43.0
Rx ES G/T, dB/K	34.6	22.5
Rain fade, dB	8	1
CNR, dB	10.21	9.16
CNR (required), dB	9	9
Margin, dB	1.2	0.2