

Table 13. Ku-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 MBPS QPSK $\frac{3}{4}$ RS	Digital TV MCPC 40 MBPS QPSK $\frac{3}{4}$ RS	Digital TV SCPC QPSK $\frac{3}{4}$ RS	Digital TV SCPC QPSK $\frac{3}{4}$ RS	56Kbps QPSK $\frac{3}{4}$ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W
Throughput rate, Mbps	40	32	8	6	0.0562
Symbol rate, MHz	28.8	22.9	5.7	4.2	0.0407
Uplinks:					
Transmit Power (dBW)	20	20	8.9	8.9	-2
Transmit Loss (dB)	-1	-1	-1	-1	-1
Antenna diameter	6.1	6.1	3.7	3.7	1.8
Antenna Gain (dBi)	57.2	57.2	52.9	52.9	46.6
Ground Station EIRP (dBW)	76.2	76.2	60.8	60.8	43.6
Uplink Rain Loss (dB)	-2	-2	-2	-2	-2
Free Space Loss (dB)	-207.5	-207.5	-207.5	-207.5	-207.5
Satellite G/T (dB/K)	3	3	3	3	3
Data Rate (dB-Hz)	76	75	69	67.6	47.5
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6
Eb/No (dB)	22.3	23.3	13.9	15.3	18.2
Eb/lo (dB)	18	18	16	16	16
Total Eb/(No + lo) (dB) For 10-7	16.6	16.9	11.8	12.6	14.0
Downlinks:					
Satellite Carrier EIRP (dBW)	49.4	49.4	35.7	34.3	18.5
Interference bandwidth (MHz)	36	27	6.95	5	0.1
Satellite EIRP density (dBW/4KHz)	9.84	11.09	3.28	3.31	4.50
Downlink Rain Loss (dB)	-3	-3	-3	-3	-3
Free Space Loss (dB)	-206.3	-206.3	-206.3	-206.3	-206.3
Ground station antenna dia, m	0.9	0.9	2.4	2.4	1.2
Ground Station G/T (dB/K)	17.1	17.1	25.6	25.6	19.6
Eb/No (dB)	9.8	10.8	11.6	11.6	9.9
C/IM			18	18	18
Eb/IModB)			16.6	16.6	16.6
C/I	15.0	15.0	15.0	15.0	15.0
Eb/lo(ASI)	13.6	13.6	13.6	13.6	13.6
Eb/lo (dB)	13.6	13.6	11.8	11.8	11.8
Eb/(No + lo) (dB)	8.3	9.0	8.7	8.7	7.7
Total UP/DOWN Eb/(No+lo)(dB)	7.7	8.3	7.0	7.2	6.8
Required	5.4	5.4	5.4	5.4	5.4
Margin	2.3	2.9	1.6	1.8	1.4

Table 15. Ku-band TV/FM Link Budget

Parameter	Typical TV/FM link
Carrier designation	36M0F3F
Uplinks:	
Transmit Power (dBW)	22
Transmit Loss (dB)	-1
Antenna diameter	6.1
Antenna Gain (dBi)	57.2
Ground Station EIRP (dBW)	78.2
Uplink Rain Loss (dB)	-2
Free Space Loss (dB)	-207.5
Satellite G/T (dB/K)	3
Bandwidth (dB-Hz)	75.6
Boltzmann's Constant (dBW/K-Hz)	-228.6
C/N, uplink(dB)	24.7
Downlinks:	
Satellite Carrier EIRP (dBW)	49.4
Downlink Rain Loss (dB)	-3

Free Space Loss (dB)	-206.3
Ground station antenna dia, m	1.2
Ground Station G/T (dB/K)	19.6
C/N, DL (dB)	12.7
C/I ASI (dB)	18.0
C/Ntot, dB	11.4
Required(dB)	11
Margin(dB)	0.4

Table 14. C-band Link Budgets for 7 Typical Links						
Parameter	Digital TV MCPC 40 MBPS QPSK ¾ RS	Digital TV MCPC 40 MBPS QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56Kbps QPSK ¾ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	
Throughput rate, Mbps	40	32	8	8	0.0562	
Symbol rate, MHz	28.8	22.9	5.7	5.7	0.0407	
Uplinks:						
Transmit Power (dBW)	25.1	20	9.6	12	-3.4	
Transmit Loss (dB)	-0.5	-0.5	-0.5	-1	-0.5	
Antenna diameter	9	9	9	9	4.5	
Antenna Gain (dBi)	53.2	53.2	53.2	53.2	47.2	
Ground Station EIRP (dBW)	77.8	72.7	62.3	64.2	43.3	
Uplink Rain Loss (dB)	-1	-1	-1	-1	-1	
Free Space Loss (dB)	-200.1	-200.1	-200.1	-200.1	-200.1	
Satellite G/T (dB/K)	-2	-2	-2	-2	-2	
Data Rate (dB-Hz)	76	75	69	69	47.5	
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6	
Eb/No (dB)	27.3	23.2	18.8	20.7	21.3	
Eb/Io (dB)	18	18	18	16	16	
Total Eb/(No + Io) (dB) For 10-7	17.5	16.9	15.4	14.7	14.9	
Downlinks:						
Satellite Carrier EIRP (dBW)	37	37	25.8	25.8	6.8	
Interference bandwidth (MHz)	36	27	6.95	5	0.1	
Satellite EIRP density (dBW/4KHz)	-2.56	-1.31	-6.62	-5.19	-7.20	
Downlink Rain Loss (dB)	-0.5	-0.5	-0.5	-0.5	-0.5	
Free Space Loss (dB)	-196.3	-196.3	-196.3	-196.3	-196.3	
Ground station antenna dia, m	3.8	3.8	3.8	3.8	3.8	
Ground Station G/T (dB/K)	21.8	21.8	21.8	21.8	21.8	
Eb/No (dB)	14.6	15.6	10.4	10.4	12.9	
C/IIM			18	18	18	
Eb/I ModB)			16.6	16.6	16.6	
C/I(ASI)	16.0	16.0	16.0	16.0	16.0	
Eb/Io(ASI)	14.6	14.6	14.6	14.6	14.6	
Eb/Io (dB)	14.6	14.6	12.5	12.5	12.5	
Eb/(No + Io) (dB)	11.6	12.1	8.3	8.3	9.7	
Total UP/DOWN Eb/(No+Io)(dB)	10.6	10.8	7.5	7.4	8.5	
Required	5.4	5.4	5.4	5.4	5.4	
Margin	5.2	5.4	2.1	2.0	3.1	

Table 16. C-band TV/FM Link Budget	
Parameter	Typical TV/FM link
Carrier designation	36M0F3F
Uplinks:	
Transmit Power (dBW)	25
Transmit Loss (dB)	-0.5
Antenna diameter	9
Antenna Gain (dBi)	53.2

Ground Station EIRP (dBW)	77.7
Uplink Rain Loss (dB)	-1
Free Space Loss (dB)	-200.1
Satellite G/T (dB/K)	-3
Bandwidth (dB-Hz)	75.6
Boltzmann's Constant (dBW/K-Hz)	-228.6
C/N, uplink(dB)	26.6
Downlinks:	
Satellite Carrier EIRP (dBW)	37
Downlink Rain Loss (dB)	-0.5
Free Space Loss (dB)	-196.3
Ground station antenna dia, m	3.8
Ground Station G/T (dB/K)	21.8
C/N, DL (dB)	15.1
C/I ASI (dB)	16.0
C/Ntot, dB	12.3
Required(dB)	11
Margin(dB)	1.3

Table 8.Ku-band Command Carrier Link Budget	
Tx ES dia (typical),m	8.4
Tx ES gain, dBi	59.5
Tx ES antenna input power, dBW	10
Tx ES EIRP, dBW	69.5
Link loss, dB	207.5
Satellite G/T, dB/K	-7
Command carrier bandwidth, MHz	0.8
Tx ES antenna input power density, dBW/Hz	-49.03
Carrier-to-Noise Ratio, dB	24.57
Required CNR, dB	10
Margin	14.57

Table 9.C-band Command Carrier Link Budget	
Tx ES dia (typical),m	13
Tx ES gain, dBi	56
Tx ES antenna input power, dBW	10
Tx ES EIRP, dBW	66
Link loss, dB	200.1
Satellite G/T, dB/K	-5
Command carrier bandwidth, MHz	0.8
Tx ES antenna input power density, dBW/Hz	-49.03
Carrier-to-Noise Ratio, dB	30.47
Required CNR, dB	10
Margin	20.47

Table 10. Ku-band Beacon/Telemetry Link Budget		
EIRP	dBW	17.0
carrier bandwidth	MHz	0.5
EIRP density	dBW/4KHz	-3.99
RxES antenna gain	dB	55.0
RxES G/T	dB/K	33.2
Rain fade	dB	8.0
CNR	dB	11.1
CNR(required)	dB	9.0

Margin	dB	2.1
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Table 11. C-band Beacon/Telemetry Link Budget		
EIRP	dBW	12.0
carrier bandwidth	MHz	0.5
EIRP density	dBW/4KHz	-8.99
RxES antenna gain	dB	43.0
RxES G/T	dB/K	23.0
Rain fade	dB	1.0
CNR	dB	11.5
CNR(required)	dB	9.0
Margin	dB	2.5

1.544 MBPS QPSK 3/4	Digital TV MCPC 50 MBPS 8PSK 2/3 RS
1M60G1W	36M0G7W
1.5440	50
1.1	27.1
8	20
-1	-1
1.8	6.1
46.6	57.2
53.6	76.2
-2	-2
-207.5	-207.5
3	3
61.9	76
-228.6	-228.6
13.8	21.3
16	18
11.8	16.3
28.5	49.4
1.6	36
2.46	9.84
-3	-3
-206.3	-206.3
2.4	2.4
25.6	25.6
11.5	17.3
18	
16.6	
15.0	15.0
13.6	12.3
11.8	12.3
8.7	11.1
6.9	10.0
5.4	7.2
1.5	2.8

1.544 MBPS QPSK 3/4	Digital TV MCPC 50 MBPS 8PSK 2/3 RS
1M60G1W	36M0G7W
1.5440	50
1.1	27.2
11.8	25.1
-0.5	-0.5
4.5	9
47.2	53.2
58.5	77.8
-1	-1
-200.1	-200.1
-2	-2
61.9	77
-228.6	-228.6
22.1	26.3
16	16.35
15.0	15.9
22	37
1.6	36
-4.04	-2.56
-0.5	-0.5
-196.3	-196.3
3.8	3.8
21.8	21.8
13.7	13.6
18	
16.6	
16.0	16.0
14.6	13.3
12.5	13.3
10.0	10.5
8.9	9.4
5.4	7.2
3.5	2.2

