

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

| Parameter | Digital TV MCPC 40 MBPS QPSK ¼ RS | Digital TV MCPC 40 MBPS QPSK ¼ RS | Digital TV SCPC QPSK ¼ RS | Digital TV SCPC QPSK ¼ RS | 56Kbps QPSK ¼ 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 |

| 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 |

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| 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 ¼ RS | Digital TV MCPC 40 MBPS QPSK ¼ RS | Digital TV SCPC QPSK ¼ RS | Digital TV SCPC QPSK ¼ RS | 56Kbps QPSK ¼ RS | 56Kbps QPSK ¼ 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/lo (dB) | 18 | 18 | 18 | 16 | 16 | |
| Total Eb/(No + lo) (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/IM | | | 18 | 18 | 18 | |
| Eb/IModB) | | | 16.6 | 16.6 | 16.6 | |
| C/I(ASI) | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | |
| Eb/lo(ASI) | 14.6 | 14.6 | 14.6 | 14.6 | 14.6 | |
| Eb/lo (dB) | 14.6 | 14.6 | 12.5 | 12.5 | 12.5 | |
| Eb/(No + lo) (dB) | 11.6 | 12.1 | 8.3 | 8.3 | 9.7 | |
| Total UP/DOWN Eb/(No+lo)(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 |

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|---------------------------------|--------|
| 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 |

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| 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 inut power desnsty, dBW/H | -49.03 |
| Carrier-to-Noise Ratio, dB | 24.57 |
| Required CNR, dB | 10 |
| Margin | 14.57 |

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| 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 inut power desnsty, dBW/H | -49.03 |
| Carrier-to-Noise Ratio, dB | 30.47 |
| Required CNR, dB | 10 |
| Margin | 20.47 |

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| 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 |

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|--------|----|-----|
| Margin | dB | 2.1 |
|--------|----|-----|

| 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 |

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|------------------------|--|
| 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 |

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| 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 |