| **LINK BUDGET for GRB on GOES-R SERIES SATELLITES to USER STATIONS** | | | | | | | | Peter Woolner - GSP/Noblis Rev.A | 25-Jul-17 |
|---|---|---|---|---|---|---|---|---|---|
| **UPLINK** | | | | **DOWNLINK** | | | | | |
| **WCDAS Transmit (per polarization)** | | | | **Space-craft Transmit (per polarization)** | | | | **NOTE 1:** | |
| Frequency (MHz) | 7216.6 | NASA Spec | | Frequency (MHz) | 1686.6 | NASA Spec | | Based on NTIA filing but modified for expected value versus the limit condition that was filed | |
| Total user data rate (kbps) | 31000 | NASA Spec | | Peak Antenna Gain (dBi) | 17.1 | Note 1 | | | |
| Data rate/polarization (kbps) | 15500 | | | Antenna Gain Reduction at EOC (dB) | 2 | Note 1,2 | | **NOTE 2:** | |
| Modulation Type | 8PSK | NASA Spec | | Net antenna EOC gain (dBi) | 15.1 | Note 1 | | Includes nadir pointing uncertainty | |
| Coding Type | DVB-S2 | NASA Spec | | Antenna Polarization Isolation dB) | 34.2 | Note 1 | | | |
| Nominal Coding Rate | 3-Feb | NASA Spec | | Antenna 3 dB beamwidth (deg) | 24 | Note 1 | | **Uplink XPI Calculation** | |
| Symbol Transmit Rate/polarization (ksps) | 7826 | | | Pointing Loss (dB) | 0 | Estimate | | Space XPI (dB) | Gnd XPI (dB) |
| Excess Bandwidth Factor | 0.25 | NASA Spec | | **EOC EIRP (per Polarization) (dBm)** | **63.5** | Note 1 | | 30 | 30 |

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|---|---|---|---|---|---|---|---|---|---|
| Occupied Bandwidth (kHz) | 9782 | | | | | | | XPI Due to Antennas (dB) | 24 |
| **Probable Ground Station EIRP (dBm)** | **103** | NASA Spec | | **Downlink** | | | | Uplink XPI (dB) with environmental depolarization | |
| WCDAS Pointing Loss (dB) | 0 | | | Downlink Polarization Orientation | RCP & LCP | NASA Spec | | Uplink Environmental XPI (dB) | 25 |
| Uplink Polarization Orientation | H and V | NASA Spec | | Altitude (km) | 35784 | | | Total Uplink XPI (dB) | 21.4 |
| Antenna Polarization Isolation (dB) | 30 | NASA Spec | | Ground elevation angle (deg) | 5 | NASA Spec | | | |
| | | | | Range (km) | 41125 | | | **Downlink XPI Calculation** | |
| **Uplink** | | | | Free Space Loss (dB) | 189.3 | | | Spacecraft XPI (dB) | Gnd XPI (dB) |
| Altitude (km) | 35786 | | | All Atmospheric Losses (dB) | 2.5 | NASA Spec | | 34.2 | 27 |
| GOES-West Ground elev. angle (deg) | 13.5 | | | | | | | XPI Due to Antennas (dB) | 23.9 |
| Range WCDAS to GOES-West (km) | 40219 | | | **Ground Station Receive** | | | | Downlink XPI (dB) with environmental depolarization | |

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|---|---|---|---|---|---|---|---|---|---|
| Space loss (dB) | 201.7 | | | Ground Antenna Polarization | RCP & LCP | NASA Spec | | Downlink Environmental XPI (dB) | 22 |
| All Atmospheric Losses (dB) | 4.2 | NASA Spec | | Pointing loss (dB) | 0.5 | NASA Spec | | Total Downlink XPI (dB) | 19.8 |
| Margin for Uplink Interference (dB) | 2 | NASA Spec | | Antenna Polarization Isolation (dB) | 27 | NASA Spec | | | |
| Uplink RSSi / Carrier (dBm) | -104.9 | | | **System G/T (dB/K)** | **15.2** | NASA Spec | | | |
| | | | | Downlink C/No (dB/Hz) | 85 | | | **HRIT/EMWIN Adjacent Channel Interference** | |
| **Spacecraft Receive** | | | | P Downlink Interference due to XPI (dB) | 19.8 | | | HRIT/EMWIN Occ bandwidth (kHz) | 1205 |
| Spacecraft Polarization Orientation | H and V | NASA Spec | | Downlink C/(No+Po) (dB/Hz) | 83.8 | | | HRIT/EMWIN EIRP (dBm) | 56.7 |
| S/C pointing loss to WCDAS (dB) | 0 | | | Total Link C/(No+Po) (dB/Hz) | 82.9 | | | HRIT/EMWIN EIRP per 4 kHz (dBm) | 31.9 |
| Antenna Polarization Isolation (dB) | 30 | NASA Spec | | Total Link C/(No+Po+Ao) (dB/Hz) | 82.89 | | | GRB EIRP (dBm) | 63.5 |

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| Antenna Gain (dBi) | 34.4 | Note 1 | | Satellite Degradations (dB) | 0.5 | Estimate | | Average H/E output in GRB BW relative to H/E peak (dB) | -37.1 |
| System Noise Temp (dB-K) | 30 | Note 1 | | **Avail Eb/No (dB)** | **10.5** | | | | |
| **System G/T (dB/K)** | **4.4** | | | Theoretical Eb/No (dB) | 3.9 | | | Average H/E output in GRB BW per Hz relative to GRB Cxr power (dB) | 104.7 |
| C/No (dB-Hz) | 98.1 | | | Implementation loss (dB) | 0.9 | NASA Test | | | |
| P Uplink Cross-Polarization Interference (dB) | 21.4 | | | **Calculated Margin (dB)** | **5.7** | | | | |
| Uplink C/(No+Po) (dB-Hz) | 90.5 | | | | | | | | |