

TECHNICAL APPENDIX

AMC-2 AT 84.85° W.L.

1.0 Overall Description (§25.114(d)(1))

This technical appendix is submitted in support of the modification application of SES Americom, Inc. (“SES”) seeking authority to relocate AMC-2 to 84.85° W.L. SES incorporates by reference the technical information it has already provided with respect to AMC-2,¹ and provides here technical information relating to operation of AMC-2 at 84.85° W.L consistent with the proposed modification.

AMC-2 is equipped with twenty-four 36 MHz C-band transponders and twenty-four 36 MHz Ku-band transponders. The Ku-band transponders will provide coverage of North America. SES has no current plans to provide C-band communications service at 84.85° W.L. Limited C-band frequencies will be used for Telemetry, Tracking and Command (“TT&C”) and will operate pursuant to an International Telecommunication Union (“ITU”) filing of the Netherlands Administration, NSS-G4-10.

2.0 Schedule S (§25.114(c))

The Schedule S database is included with this filing.² This section describes the main updates in the Schedule S relating to the proposed operation of AMC-2 at 84.85° W.L. with respect to previous Schedule S submissions for this spacecraft, and addresses some items not covered in the Schedule S.

¹ The most recent technical information regarding AMC-2 is found in File Nos. SAT-MOD-20140207-00020 and SAT-MOD-20130225-00024. *See also* File Nos. SAT-LOA-19940310-00008; SAT-AMD-19941114-00065; SAT-MOD-20050527-00110; SAT-MOD-20080124-00030; SAT-AMD-20080311-00070; SAT-MOD-20100324-00056; SAT-MOD-20101215-00261; SAT-MOD-20111025-00209 & SAT-MOD-20120524-00087.

² In completing the Schedule S, SES has relied on the most recent Schedule S instructions. Consistent with those instructions, in cases where the Schedule S software requests information that space station applicants are no longer required to provide, SES has omitted data elements, or where necessary to permit validation of the Schedule S file, has entered a “1” or “-1000” as a placeholder. SES specifies that these “1” and “-1000” data entries are outside the scope of the certifications herein regarding accuracy of the information provided with this application.

1. *Transponder frequency plan.* No Change.
2. *TT&C frequencies and beams.* The TT&C link budgets are included in the Schedule S.

The communication antennas (“CTH” and “CTV”) are used for transmitting telemetry carriers in C-band, while a global horn antenna is used for receiving the C-band telecommand carrier (“GBLRV”) with a horizontal polarization. The communication antenna (“KTV”) is used for transmitting the telemetry carrier in Ku-band. Table 1 below shows the TT&C carrier center frequencies and bandwidths.

Table 1: TT&C Carrier Frequencies

| Frequency, MHz | | Nominal polarization |
|---|--------|----------------------|
| Command carriers (bandwidth: 800KHz, 1.2 MHz capture range) | | |
| C-band | 6423.5 | H |
| Beacons/Telemetry (bandwidth: 300 KHz) | | |
| C-band pair | 3700.5 | H |
| | 4199.5 | V |
| Ku-band | 12198 | V |

Note: C-band telemetry carriers can also be transmitted through the omni (horn) antennas. In that case, the 3700.5 MHz carrier is vertically polarized and the 4199.5 MHz carrier is horizontally polarized.

3. *PFD limits in C-band.* The C-band PFD values for the TT&C carriers are provided in Section S8 of Schedule S, and Section 3.0 below (Table 2) demonstrates that these values comply with §25.208.
4. *Carrier parameters and link budgets.* The carrier parameters and link budgets as displayed in Sections S11 and S13 have been updated based on the planned operations of AMC-2 at 84.85° W.L.

5. *Beam diagrams.* The Schedule S and accompanying gxt files reflect the projected coverage areas at 84.85° W.L.

3.0 PFD limits (§25.114(c)(8) and §25.208)

Table 2 demonstrates that the PFD values for the C-band TT&C carriers from AMC-2 at 84.85° W.L. comply with §25.208.

Table 2: Maximum PFD values of C-band TT&C carriers and margins relative to permissible limits of §25.208

| CTH Beam | | | | | | |
|--|--------|--------|--------|--------|--------|--------|
| Elevation angle, deg | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 90.0 |
| Max. EIRP, dBW | 18.4 | 18.4 | 18.4 | 18.4 | 18.4 | 18.4 |
| Gain roll-off at elevation angle, dBi | -2.6 | -2.5 | -2.3 | -2.0 | -1.8 | 0.0 |
| EIRP at elevation angle, dBW | 15.8 | 15.9 | 16.1 | 16.4 | 16.6 | 18.4 |
| Carrier bandwidth, MHz | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| EIRP density at elevation angle dBW/4kHz | -3.0 | -2.9 | -2.7 | -2.4 | -2.2 | -0.4 |
| Minimum spreading loss, dB/m2 | -163.3 | -163.2 | -163.1 | -162.9 | -162.8 | -162.1 |
| 25.208(a) pfd limit (3650-4200 MHz), dBW/m2/4kHz | -152.0 | -149.5 | -147.0 | -144.5 | -142.0 | -142.0 |
| | | | | | | |
| pfd, dBW/m2/4KHz | -166.2 | -166.0 | -165.7 | -165.3 | -165.0 | -162.4 |
| Margin, dB, relative to 25.208 | 14.2 | 16.5 | 18.7 | 20.8 | 23.0 | 20.4 |

| CTV Beam | | | | | | |
|--|--------|--------|--------|--------|--------|--------|
| Elevation angle, deg | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 90.0 |
| Max. EIRP, dBW | 19.5 | 19.5 | 19.5 | 19.5 | 19.5 | 19.5 |
| Gain roll-off at elevation angle, dBi | -4.3 | -4.2 | -4.0 | -3.4 | -2.2 | 0.0 |
| EIRP at elevation angle, dBW | 15.2 | 15.3 | 15.5 | 16.1 | 17.3 | 19.5 |
| Carrier bandwidth, MHz | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| EIRP density at elevation angle dBW/4kHz | -3.6 | -3.5 | -3.3 | -2.7 | -1.5 | 0.7 |
| Minimum spreading loss, dB/m2 | -163.3 | -163.2 | -163.1 | -162.9 | -162.8 | -162.1 |
| 25.208(a) pfd limit (3650-4200 MHz), dBW/m2/4kHz | -152.0 | -149.5 | -147.0 | -144.5 | -142.0 | -142.0 |
| | | | | | | |
| pfd, dBW/m2/4KHz | -166.8 | -166.6 | -166.3 | -165.6 | -164.3 | -161.3 |
| Margin, dB, relative to 25.208 | 14.8 | 17.1 | 19.3 | 21.1 | 22.3 | 19.3 |

| GBLTV Beam | | | | | | |
|---|--------|--------|--------|--------|--------|--------|
| Elevation angle, deg | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 90.0 |
| Max. EIRP, dBW | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Gain roll-off at elevation angle, dBi | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| EIRP at elevation angle, dBW | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Carrier bandwidth, MHz | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| EIRP density at elevation angle dBW/4kHz | -12.75 | -12.75 | -12.75 | -12.75 | -12.75 | -12.75 |
| Minimum spreading loss, dB/m2 | -163.3 | -163.2 | -163.1 | -162.9 | -162.8 | -162.1 |
| 25.208(a) pfd limit (3650-4200 MHz), dBW/m2/4kHz | -152.0 | -149.5 | -147.0 | -144.5 | -142.0 | -142.0 |
| | | | | | | |
| pfd, dBW/m2/4KHz | -176.0 | -175.9 | -175.8 | -175.7 | -175.6 | -174.8 |
| Margin, dB, relative to 25.208 | 24.0 | 26.4 | 28.8 | 31.2 | 33.6 | 32.8 |

| GBLTH Beam | | | | | | |
|---|--------|--------|--------|--------|--------|--------|
| Elevation angle, deg | 5.0 | 10.0 | 15.0 | 20.0 | 25.0 | 90.0 |
| Max. EIRP, dBW | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Gain roll-off at elevation angle, dBi | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| EIRP at elevation angle, dBW | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Carrier bandwidth, MHz | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| EIRP density at elevation angle dBW/4kHz | -12.75 | -12.75 | -12.75 | -12.75 | -12.75 | -12.75 |
| Minimum spreading loss, dB/m2 | -163.3 | -163.2 | -163.1 | -162.9 | -162.8 | -162.1 |
| 25.208(a) pfd limit (3650-4200 MHz), dBW/m2/4kHz | -152.0 | -149.5 | -147.0 | -144.5 | -142.0 | -142.0 |
| | | | | | | |
| pfd, dBW/m2/4KHz | -176.0 | -175.9 | -175.8 | -175.7 | -175.6 | -174.8 |
| Margin, dB, relative to 25.208 | 24.0 | 26.4 | 28.8 | 31.2 | 33.6 | 32.8 |

No PFD limits for the 11700 – 12200 MHz band are specified in Section 25.208 of the FCC

Rules or in No. 21.16 of the ITU Radio Regulations with respect to the operation of geostationary satellites.

4.0 Satellite Antenna Gain Contours (§25.114(c)(4)(vi)(A))

The Schedule S and accompanying gxt files provide the typical antenna gain contours for AMC-2 space station beams at 84.85° W.L. The peak EIRP and G/T values of the beams are shown in Table 3.

Table 3: Maximum EIRP and G/T

| Beam ID | Band | Pol | Link Direction | GXT filename | Max. EIRP (dBW) | Max. G/T (dB/K) |
|---------|------|-----|----------------|---|-----------------|-----------------|
| KRV | Ku | V | Receive | AMC-2 KRV.gxt | | 6.8 |
| KRH | Ku | H | Receive | AMC-2 KRH.gxt | | 7.8 |
| KTV | Ku | V | Transmit | AMC-2 KTV.gxt | 50.3 | |
| KTH | Ku | H | Transmit | AMC-2 KTH.gxt | 51.5 | |
| CTH | C | H | Transmit | AMC-2 CTH.gxt | 18.4 | |
| CTV | C | V | Transmit | AMC-2 CTV.gxt | 19.4 | |
| CRH | C | H | Receive | Not included as the global horn antenna will be used for receiving the C-band telecommand carrier | | 5.8 |
| CRV | C | V | Receive | Not included as the global horn antenna will be used for receiving the C-band telecommand carrier | | 4.1 |
| GBLRV | C | H | Receive | See Figure A-1 in Annex A | | -17.5 |
| GBLTV | C | V | Transmit | See Figure A-1 in Annex A | 6 | |
| GBLTH | C | H | Transmit | See Figure A-1 in Annex A | 6 | |

The gain characteristics for the global horn antenna (“GBLR”) and (“GBLT”) are not provided as a gxt file because the gxt data is not available from the spacecraft manufacturer. Instead, gain vs. off-set angle information is provided as Figure A-1 in Annex A. The Commission has granted a waiver to permit this substitution.

5.0 Emission Designators and Link Budgets (§25.140)

Annex B shows typical link budgets, including emissions designators. Further carrier details and the link budgets are included in the Schedule S, Section S13.

6.0 Maximum Theoretical Operation Levels

AMC-2 will be operated consistently with coordination agreements with adjacent satellites. In any case, in the 11.7-12.2 GHz band, the downlink EIRP density of the AMC-2 digital carriers will not exceed -20.3 dBW/Hz; and in the 14-14.5 GHz band, the input power density of the uplink digital carriers of earth stations operating with AMC-2 will not exceed -45 dBW/Hz.

7.0 Two Degree Spacing Analysis (§25.114(d)(7) and §25.140(a))

AMC-2 was previously stationed at 85° W.L., and the return of AMC-2 to the nominal 85° W.L. orbital position will not result in an increase in interference to adjacent operators. Furthermore, SES operates in the C- and Ku-bands at the 83° W.L. and 87° W.L. nominal orbital locations adjacent to 85° W.L.³ SES Americom will manage operations among its spacecraft to ensure that no harmful interference occurs.

8.0 Mitigation of Orbital Debris (§25.114(d)(14))

The information required under Section 25.114(d)(14) of the Commission's Rules is already on file with the Commission and is incorporated by reference herein.⁴ The only change to that information is that SES proposes to move AMC-2 to 84.85° W.L. and to operate it there in inclined orbit with an east-west stationkeeping tolerance of +/- 0.1 degrees.

³ StarOne operates a C-band spacecraft serving South America at 84° W.L. The operation of the AMC-2 TT&C frequencies in the C-band will be consistent with SES's existing coordination agreement with StarOne.

⁴ See File No. SAT-MOD-20100324-00056, Technical Appendix, Section 7 as supplemented by File Nos. SAT-MOD-20111025-00209, Technical Appendix, Section 8, & SAT-MOD-20130225-00024, Technical Appendix, Section 8.

SES is not aware of any other FCC or non-FCC licensed spacecraft that are operational or planned to be deployed at 84.85° W.L. or to nearby orbital locations such that there would be an overlap with the requested stationkeeping volume of AMC-2. AMC-16 operates at 85.0° W.L. with an east/west stationkeeping tolerance of +/-0.05 degrees. Moreover, AMC-2 will be operating with an inclined orbit. AMC-2's inclination will be 3.66 degrees at the start of its operations at 84.85° W.L. and 4.73 degrees at its estimated end of life.

ANNEX A

Space Station Global Horn Antenna Beam Diagram

Figure A-1
Global Horn Characteristics

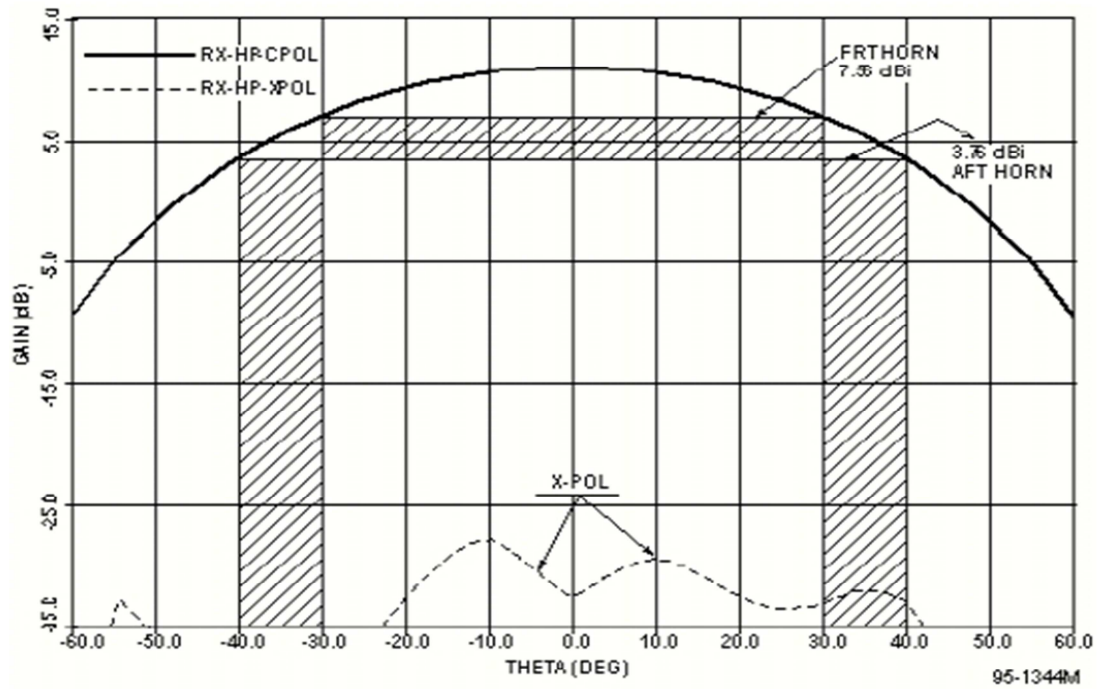


Figure 2.3-4. Measured Performance of Command Horn

ANNEX B

Link Budgets

Table B-1
Ku-Band Link Budgets

| CLEAR SKY | | | |
|--|---------------------|--|-------------------|
| SATELLITE/TRANSPONDER | | | |
| Satellite | AMC2 | Satellite gain | 182.4 dB |
| Longitude | 84.85 deg W | Satellite temperature | 179.4 dB |
| Uplink Polarity | V | Satellite temperature | 2.5E+20 degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | -86.0 dBW/m^2 | | |
| Saturation flux density at UL site | -89.0 dBW/m^2 | | |
| G/T at UL Site | 3.0 dB | | |
| Saturated maximum EIRP | 51.5 dBW | | |
| Saturated EIRP at uplink site | 48.5 dBW | | |
| Carrier EIRP @ uplink site | 48.3 dBW | | |
| Delta IBO to OBO | 0.6 dB | | |
| Transponder bandwidth | 36.0 MHz | | |
| Satellite ACL | 0.0 dB | | |
| UPLINK | | | |
| Location | Denver, CO | Azimuth | 150.3 deg |
| Latitude | 39.7 deg N | Elevation | 39.6 deg |
| Longitude | 105.0 deg W | Polarity adjustment for V | 90 deg |
| Elevation | 0.2 km | Uplink polarization (angle for horizontal) | -22 deg |
| Frequency | 14.240 GHz | Antenna gain | 60.0 dB |
| Antenna size | 9.00 meters | Uplink path loss | 207.1 dB |
| Antenna efficiency | 55.0 % | Uplink C/No | 97.3 dB-Hz |
| Antenna pointing error | 0.2 dB | Uplink C/No+I | 95.2 dB-Hz |
| HPA to antenna loss | 10.0 dB | Single carrier uplink EIRP | 73.0 dBW |
| # of carriers | 1 | Single carrier HPA power | 23.0 dBW |
| Availability required | 99.97 dB | Single carrier HPA power | 199.2 watts |
| | | Single carrier HPA size required | 251.0 watts |
| CARRIER | | | |
| Information rate | 62163.6 kb/s | Bandwidth | 36000 kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | 8PSK | Input backoff | 0.8 dB |
| FEC rate | 0.6907 S2 ACM | Output backoff | 0.2 dB |
| Spread factor | 1 | | |
| Spacing factor | 1.20 | | |
| UPLINK INTERFERENCE | | | |
| I spectral density | 9.5 dBW / 4 kHz | Uplink C/Io | 99.5 dB-Hz |
| DOWNLINK | | | |
| Location | Billings MT | Azimuth | 148.8 deg |
| Latitude | 45.8 deg N | Elevation | 32.4 deg |
| Longitude | 108.5 deg W | Polarity adjustment for V | 0 deg |
| Elevation | 0.2 km | Downlink polarization (angle for horizontal) | 69 deg |
| Saturated EIRP @ downlink site | 47.5 dBW | Downlink path loss | 205.7 dB |
| Carrier EIRP @ downlink site | 47.3 dBW | RSL at receiver | -37.0 dBm |
| Frequency | 11.940 GHz | Temperature system | 129 degrees K |
| Antenna size | 1.20 meters | G/T | 20.6 dB/deg K |
| Antenna efficiency | 65.0 % | Antenna gain | 41.7 dB |
| Antenna temperature | 45 deg K | LNB temperature | 75 degrees K |
| Antenna pointing error | 0.3 dB | Downlink C/No | 90.5 dB-Hz |
| LNB temperature | 1.0 dB or degrees K | Downlink C/No+I | 89.2 dB-Hz |
| LNB gain | 55 dB | | |
| Receiver noise figure | 15 dB | | |
| Cable loss | 5 dB | | |
| Availability required | 99.97 % | | |
| DOWNLINK INTERFERENCE | | | |
| 4 - antenna discrimination @ 2.2 degrees | 21.0 dB | Downlink C/Io | 95.3 dB-Hz |
| I spectral density | 13.00 dBW / 4 kHz | | |
| CARRIER OVERALL LINK | | | |
| Eb/No threshold | 5.3 dB | Uplink+Downlink C/No+I | 88.3 dB-Hz |
| | | Uplink+Downlink Eb/No+I | 10.3 dB |
| | | Margin to Eb/No threshold | 5.0 dB |

CLEAR SKY

SATELLITE/TRANSPONDER

| | | | | | |
|--|--------------|---------|-----------------------|----------------|-----------|
| Satellite | <u>AMC2</u> | | Satellite gain | <u>183.2</u> | dB |
| Longitude | <u>84.85</u> | deg W | Satellite temperature | <u>180.7</u> | dB |
| Uplink Polarity | <u>V</u> | | Satellite temperature | <u>3.4E+20</u> | degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | <u>-86.0</u> | dBw/m^2 | | | |
| Saturation flux density at UL site | <u>-88.5</u> | dBw/m^2 | | | |
| G/T at UL Site | <u>2.5</u> | dB | | | |
| Saturated maximum EIRP | <u>51.5</u> | dBw | | | |
| Saturated EIRP at uplink site | <u>47.5</u> | dBw | | | |
| Carrier EIRP @ uplink site | <u>30.7</u> | dBw | | | |
| Delta IBO to OBO | <u>3.0</u> | dB | | | |
| Transponder bandwidth | <u>36.0</u> | MHz | | | |
| Satellite ACL | <u>0.0</u> | dB | | | |

UPLINK

| | | | | | |
|------------------------|--------------------|--------|--|--------------|-------|
| Location | <u>Billings MT</u> | | Azimuth | <u>148.8</u> | deg |
| Latitude | <u>45.8</u> | deg N | Elevation | <u>32.4</u> | deg |
| Longitude | <u>108.5</u> | deg W | Polarity adjustment for V | <u>90</u> | deg |
| Elevation | <u>0.2</u> | km | Uplink polarization (angle for horizontal) | <u>-21</u> | deg |
| Frequency | <u>14.240</u> | GHz | Antenna gain | <u>43.2</u> | dB |
| Antenna size | <u>1.20</u> | meters | Uplink path loss | <u>207.2</u> | dB |
| Antenna efficiency | <u>65.0</u> | % | Uplink C/No | <u>78.3</u> | dB-Hz |
| Antenna pointing error | <u>0.3</u> | dB | Uplink C/No+I | <u>76.5</u> | dB-Hz |
| HPA to antenna loss | <u>1.0</u> | dB | Single carrier uplink EIRP | <u>54.7</u> | dBw |
| # of carriers | <u>1</u> | | Single carrier HPA power | <u>12.5</u> | dBw |
| Availability required | <u>99.95</u> | dB | Single carrier HPA power | <u>17.8</u> | watts |
| | | | Single carrier HPA size required | <u>22.4</u> | watts |

CARRIER

| | | | | | |
|-----------------------------------|---------------|-----------|----------------|-------------|-----|
| Information rate | <u>5000.0</u> | kb/s | Bandwidth | <u>4340</u> | kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | <u>QPSK</u> | | Input backoff | <u>19.8</u> | dB |
| FEC rate | <u>0.6912</u> | <u>RS</u> | Output backoff | <u>16.8</u> | dB |
| Spread factor | <u>1</u> | | | | |
| Spacing factor | <u>1.20</u> | | | | |

UPLINK INTERFERENCE

| | | | | | |
|--------------------|------------|-------------|-------------|-------------|-------|
| I spectral density | <u>9.5</u> | dBw / 4 kHz | Uplink C/Io | <u>81.2</u> | dB-Hz |
|--------------------|------------|-------------|-------------|-------------|-------|

DOWNLINK

| | | | | | |
|--------------------------------|-------------------|-----------------|--|--------------|-----------|
| Location | <u>Denver, CO</u> | | Azimuth | <u>150.3</u> | deg |
| Latitude | <u>39.7</u> | deg N | Elevation | <u>39.6</u> | deg |
| Longitude | <u>105.0</u> | deg W | Polarity adjustment for V | <u>0</u> | deg |
| Elevation | <u>0.2</u> | km | Downlink polarization (angle for horizontal) | <u>68</u> | deg |
| Saturated EIRP @ downlink site | <u>48.5</u> | | Downlink path loss | <u>205.5</u> | dB |
| Carrier EIRP @ downlink site | <u>31.7</u> | dBw | RSL at receiver | <u>-41.6</u> | dBm |
| Frequency | <u>11.940</u> | GHz | Temperature system | <u>144</u> | degrees K |
| Antenna size | <u>4.50</u> | meters | G/T | <u>30.8</u> | dB/deg K |
| Antenna efficiency | <u>55.0</u> | % | Antenna gain | <u>52.4</u> | dB |
| Antenna temperature | <u>60</u> | deg K | LNB temperature | <u>75</u> | degrees K |
| Antenna pointing error | <u>0.2</u> | dB | Downlink C/No | <u>85.4</u> | dB-Hz |
| LNB temperature | <u>1.0</u> | dB or degrees K | Downlink C/No+I | <u>84.0</u> | dB-Hz |
| LNB gain | <u>55</u> | dB | | | |
| Receiver noise figure | <u>15</u> | dB | | | |
| Cable loss | <u>5</u> | dB | | | |
| Availability required | <u>99.99</u> | % | | | |

DOWNLINK INTERFERENCE

| | | | | | |
|--|--------------|-------------|---------------|-------------|-------|
| 4 - antenna discrimination @ 2.2 degrees | <u>32.0</u> | dB | | | |
| I spectral density | <u>13.00</u> | dBw / 4 kHz | Downlink C/Io | <u>89.7</u> | dB-Hz |

CARRIER OVERALL LINK

| | | | | | |
|-----------------|------------|----|---------------------------|-------------|-------|
| Eb/No threshold | <u>5.8</u> | dB | Uplink+Downlink C/No+I | <u>75.8</u> | dB-Hz |
| | | | Uplink+Downlink Eb/No+I | <u>8.8</u> | dB |
| | | | Margin to Eb/No threshold | <u>3.0</u> | dB |

CLEAR SKY

SATELLITE/TRANSPONDER

| | | | | | |
|--|--------------|---------|-----------------------|----------------|-----------|
| Satellite | <u>AMC2</u> | | Satellite gain | <u>183.2</u> | dB |
| Longitude | <u>84.85</u> | deg W | Satellite temperature | <u>180.7</u> | dB |
| Uplink Polarity | <u>V</u> | | Satellite temperature | <u>3.4E+20</u> | degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | <u>-86.0</u> | dBw/m^2 | | | |
| Saturation flux density at UL site | <u>-88.5</u> | dBw/m^2 | | | |
| G/T at UL Site | <u>2.5</u> | dB | | | |
| Saturated maximum EIRP | <u>51.5</u> | dBw | | | |
| Saturated EIRP at uplink site | <u>47.5</u> | dBw | | | |
| Carrier EIRP @ uplink site | <u>10.0</u> | dBw | | | |
| Delta IBO to OBO | <u>3.0</u> | dB | | | |
| Transponder bandwidth | <u>36.0</u> | MHz | | | |
| Satellite ACL | <u>0.0</u> | dB | | | |

UPLINK

| | | | | | |
|------------------------|--------------------|--------|--|--------------|-------|
| Location | <u>Billings MT</u> | | Azimuth | <u>148.8</u> | deg |
| Latitude | <u>45.8</u> | deg N | Elevation | <u>32.4</u> | deg |
| Longitude | <u>108.5</u> | deg W | Polarity adjustment for V | <u>90</u> | deg |
| Elevation | <u>0.2</u> | km | Uplink polarization (angle for horizontal) | <u>-21</u> | deg |
| Frequency | <u>14.240</u> | GHz | Antenna gain | <u>41.6</u> | dB |
| Antenna size | <u>1.00</u> | meters | Uplink path loss | <u>207.2</u> | dB |
| Antenna efficiency | <u>65.0</u> | % | Uplink C/No | <u>57.6</u> | dB-Hz |
| Antenna pointing error | <u>0.3</u> | dB | Uplink C/No+I | <u>55.8</u> | dB-Hz |
| HPA to antenna loss | <u>1.0</u> | dB | Single carrier uplink EIRP | <u>34.0</u> | dBw |
| # of carriers | <u>1</u> | | Single carrier HPA power | <u>-6.6</u> | dBw |
| Availability required | <u>99.94</u> | dB | Single carrier HPA power | <u>0.2</u> | watts |
| | | | Single carrier HPA size required | <u>0.3</u> | watts |

CARRIER

| | | | | | |
|-----------------------------------|---------------|------|----------------|-------------|-----|
| Information rate | <u>56.0</u> | kb/s | Bandwidth | <u>45</u> | kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | <u>QPSK</u> | | Input backoff | <u>40.5</u> | dB |
| FEC rate | <u>0.7500</u> | FDMA | Output backoff | <u>37.5</u> | dB |
| Spread factor | <u>1</u> | | | | |
| Spacing factor | <u>1.20</u> | | | | |

UPLINK INTERFERENCE

| | | | | | |
|--------------------|------------|-------------|-------------|-------------|-------|
| I spectral density | <u>9.5</u> | dBw / 4 kHz | Uplink C/Io | <u>60.5</u> | dB-Hz |
|--------------------|------------|-------------|-------------|-------------|-------|

DOWNLINK

| | | | | | |
|--------------------------------|-------------------|-----------------|--|--------------|-----------|
| Location | <u>Denver, CO</u> | | Azimuth | <u>150.3</u> | deg |
| Latitude | <u>39.7</u> | deg N | Elevation | <u>39.6</u> | deg |
| Longitude | <u>105.0</u> | deg W | Polarity adjustment for V | <u>0</u> | deg |
| Elevation | <u>0.2</u> | km | Downlink polarization (angle for horizontal) | <u>68</u> | deg |
| Saturated EIRP @ downlink site | <u>48.5</u> | | Downlink path loss | <u>205.5</u> | dB |
| Carrier EIRP @ downlink site | <u>11.0</u> | dBw | RSL at receiver | <u>-65.3</u> | dBm |
| Frequency | <u>11.940</u> | GHz | Temperature system | <u>144</u> | degrees K |
| Antenna size | <u>3.20</u> | meters | G/T | <u>27.9</u> | dB/deg K |
| Antenna efficiency | <u>55.0</u> | % | Antenna gain | <u>49.5</u> | dB |
| Antenna temperature | <u>60</u> | deg K | LNB temperature | <u>75</u> | degrees K |
| Antenna pointing error | <u>0.2</u> | dB | Downlink C/No | <u>61.7</u> | dB-Hz |
| LNB temperature | <u>1.0</u> | dB or degrees K | Downlink C/No+I | <u>60.3</u> | dB-Hz |
| LNB gain | <u>55</u> | dB | | | |
| Receiver noise figure | <u>15</u> | dB | | | |
| Cable loss | <u>5</u> | dB | | | |
| Availability required | <u>99.98</u> | % | | | |

DOWNLINK INTERFERENCE

| | | | | | |
|--|--------------|-------------|---------------|-------------|-------|
| 4 - antenna discrimination @ 2.2 degrees | <u>29.0</u> | dB | | | |
| I spectral density | <u>13.00</u> | dBw / 4 kHz | Downlink C/Io | <u>66.0</u> | dB-Hz |

CARRIER OVERALL LINK

| | | | | | |
|-----------------|------------|----|---------------------------|-------------|-------|
| Eb/No threshold | <u>4.0</u> | dB | Uplink+Downlink C/No+I | <u>54.5</u> | dB-Hz |
| | | | Uplink+Downlink Eb/No+I | <u>7.0</u> | dB |
| | | | Margin to Eb/No threshold | <u>3.0</u> | dB |

CLEAR SKY

SATELLITE/TRANSPONDER

| | | | | | |
|--|--------------|---------|-----------------------|----------------|-----------|
| Satellite | <u>AMC2</u> | | Satellite gain | <u>183.2</u> | dB |
| Longitude | <u>84.85</u> | deg W | Satellite temperature | <u>180.7</u> | dB |
| Uplink Polarity | <u>V</u> | | Satellite temperature | <u>3.4E+20</u> | degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | <u>-86.0</u> | dBw/m^2 | | | |
| Saturation flux density at UL site | <u>-88.5</u> | dBw/m^2 | | | |
| G/T at UL Site | <u>2.5</u> | dB | | | |
| Saturated maximum EIRP | <u>51.5</u> | dBw | | | |
| Saturated EIRP at uplink site | <u>47.5</u> | dBw | | | |
| Carrier EIRP @ uplink site | <u>26.3</u> | dBw | | | |
| Delta IBO to OBO | <u>3.0</u> | dB | | | |
| Transponder bandwidth | <u>36.0</u> | MHz | | | |
| Satellite ACL | <u>0.0</u> | dB | | | |

UPLINK

| | | | | | |
|------------------------|--------------------|--------|--|--------------|-------|
| Location | <u>Billings MT</u> | | Azimuth | <u>148.8</u> | deg |
| Latitude | <u>45.8</u> | deg N | Elevation | <u>32.4</u> | deg |
| Longitude | <u>108.5</u> | deg W | Polarity adjustment for V | <u>90</u> | deg |
| Elevation | <u>0.2</u> | km | Uplink polarization (angle for horizontal) | <u>-21</u> | deg |
| Frequency | <u>14.240</u> | GHz | Antenna gain | <u>41.6</u> | dB |
| Antenna size | <u>1.00</u> | meters | Uplink path loss | <u>207.2</u> | dB |
| Antenna efficiency | <u>65.0</u> | % | Uplink C/No | <u>73.9</u> | dB-Hz |
| Antenna pointing error | <u>0.3</u> | dB | Uplink C/No+I | <u>72.1</u> | dB-Hz |
| HPA to antenna loss | <u>1.0</u> | dB | Single carrier uplink EIRP | <u>50.3</u> | dBw |
| # of carriers | <u>1</u> | | Single carrier HPA power | <u>9.7</u> | dBw |
| Availability required | <u>99.94</u> | dB | Single carrier HPA power | <u>9.3</u> | watts |
| | | | Single carrier HPA size required | <u>11.7</u> | watts |

CARRIER

| | | | | | |
|-----------------------------------|---------------|------|----------------|-------------|-----|
| Information rate | <u>1544.0</u> | kb/s | Bandwidth | <u>2010</u> | kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | <u>QPSK</u> | | Input backoff | <u>24.2</u> | dB |
| FEC rate | <u>0.4608</u> | FDMA | Output backoff | <u>21.2</u> | dB |
| Spread factor | <u>1</u> | | | | |
| Spacing factor | <u>1.20</u> | | | | |

UPLINK INTERFERENCE

| | | | | | |
|--------------------|------------|-------------|-------------|-------------|-------|
| I spectral density | <u>9.5</u> | dBw / 4 kHz | Uplink C/Io | <u>76.8</u> | dB-Hz |
|--------------------|------------|-------------|-------------|-------------|-------|

DOWNLINK

| | | | | | |
|--------------------------------|-------------------|-----------------|--|--------------|-----------|
| Location | <u>Denver, CO</u> | | Azimuth | <u>150.3</u> | deg |
| Latitude | <u>39.7</u> | deg N | Elevation | <u>39.6</u> | deg |
| Longitude | <u>105.0</u> | deg W | Polarity adjustment for V | <u>0</u> | deg |
| Elevation | <u>0.2</u> | km | Downlink polarization (angle for horizontal) | <u>68</u> | deg |
| Saturated EIRP @ downlink site | <u>48.5</u> | | Downlink path loss | <u>205.5</u> | dB |
| Carrier EIRP @ downlink site | <u>27.3</u> | dBw | RSL at receiver | <u>-53.6</u> | dBm |
| Frequency | <u>11.940</u> | GHz | Temperature system | <u>144</u> | degrees K |
| Antenna size | <u>1.80</u> | meters | G/T | <u>23.3</u> | dB/deg K |
| Antenna efficiency | <u>60.0</u> | % | Antenna gain | <u>44.8</u> | dB |
| Antenna temperature | <u>60</u> | deg K | LNB temperature | <u>75</u> | degrees K |
| Antenna pointing error | <u>0.2</u> | dB | Downlink C/No | <u>73.4</u> | dB-Hz |
| LNB temperature | <u>1.0</u> | dB or degrees K | Downlink C/No+I | <u>71.9</u> | dB-Hz |
| LNB gain | <u>55</u> | dB | | | |
| Receiver noise figure | <u>15</u> | dB | | | |
| Cable loss | <u>5</u> | dB | | | |
| Availability required | <u>99.96</u> | % | | | |

DOWNLINK INTERFERENCE

| | | | | | |
|--|--------------|-------------|---------------|-------------|-------|
| 4 - antenna discrimination @ 2.2 degrees | <u>24.0</u> | dB | | | |
| I spectral density | <u>13.00</u> | dBw / 4 kHz | Downlink C/Io | <u>77.3</u> | dB-Hz |

CARRIER OVERALL LINK

| | | | | | |
|-----------------|------------|----|---------------------------|-------------|-------|
| Eb/No threshold | <u>4.1</u> | dB | Uplink+Downlink C/No+I | <u>69.0</u> | dB-Hz |
| | | | Uplink+Downlink Eb/No+I | <u>7.1</u> | dB |
| | | | Margin to Eb/No threshold | <u>3.0</u> | dB |

CLEAR SKY

SATELLITE/TRANSPONDER

| | | | | | |
|--|--------------|---------|-----------------------|----------------|-----------|
| Satellite | <u>AMC2</u> | | Satellite gain | <u>183.2</u> | dB |
| Longitude | <u>84.85</u> | deg W | Satellite temperature | <u>180.7</u> | dB |
| Uplink Polarity | <u>V</u> | | Satellite temperature | <u>3.4E+20</u> | degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | <u>-86.0</u> | dBw/m^2 | | | |
| Saturation flux density at UL site | <u>-88.5</u> | dBw/m^2 | | | |
| G/T at UL Site | <u>2.5</u> | dB | | | |
| Saturated maximum EIRP | <u>51.5</u> | dBw | | | |
| Saturated EIRP at uplink site | <u>47.5</u> | dBw | | | |
| Carrier EIRP @ uplink site | <u>29.9</u> | dBw | | | |
| Delta IBO to OBO | <u>3.0</u> | dB | | | |
| Transponder bandwidth | <u>36.0</u> | MHz | | | |
| Satellite ACL | <u>0.0</u> | dB | | | |

UPLINK

| | | | | | |
|------------------------|--------------------|--------|--|--------------|-------|
| Location | <u>Billings MT</u> | | Azimuth | <u>148.8</u> | deg |
| Latitude | <u>45.8</u> | deg N | Elevation | <u>32.4</u> | deg |
| Longitude | <u>108.5</u> | deg W | Polarity adjustment for V | <u>90</u> | deg |
| Elevation | <u>0.2</u> | km | Uplink polarization (angle for horizontal) | <u>-21</u> | deg |
| Frequency | <u>14.240</u> | GHz | Antenna gain | <u>46.4</u> | dB |
| Antenna size | <u>1.80</u> | meters | Uplink path loss | <u>207.2</u> | dB |
| Antenna efficiency | <u>60.0</u> | % | Uplink C/No | <u>77.5</u> | dB-Hz |
| Antenna pointing error | <u>0.3</u> | dB | Uplink C/No+I | <u>75.7</u> | dB-Hz |
| HPA to antenna loss | <u>1.0</u> | dB | Single carrier uplink EIRP | <u>53.9</u> | dBw |
| # of carriers | <u>1</u> | | Single carrier HPA power | <u>8.6</u> | dBw |
| Availability required | <u>99.93</u> | dB | Single carrier HPA power | <u>7.2</u> | watts |
| | | | Single carrier HPA size required | <u>9.1</u> | watts |

CARRIER

| | | | | | |
|-----------------------------------|---------------|-------------|----------------|-------------|-----|
| Information rate | <u>2048.0</u> | kb/s | Bandwidth | <u>1092</u> | kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | <u>8PSK</u> | | Input backoff | <u>20.6</u> | dB |
| FEC rate | <u>0.7500</u> | <u>MESH</u> | Output backoff | <u>17.6</u> | dB |
| Spread factor | <u>1</u> | | | | |
| Spacing factor | <u>1.20</u> | | | | |

UPLINK INTERFERENCE

| | | | | | |
|--------------------|------------|-------------|-------------|-------------|-------|
| I spectral density | <u>9.5</u> | dBw / 4 kHz | Uplink C/Io | <u>80.5</u> | dB-Hz |
|--------------------|------------|-------------|-------------|-------------|-------|

DOWNLINK

| | | | | | |
|--------------------------------|-------------------|-----------------|--|--------------|-----------|
| Location | <u>Denver, CO</u> | | Azimuth | <u>150.3</u> | deg |
| Latitude | <u>39.7</u> | deg N | Elevation | <u>39.6</u> | deg |
| Longitude | <u>105.0</u> | deg W | Polarity adjustment for V | <u>0</u> | deg |
| Elevation | <u>0.2</u> | km | Downlink polarization (angle for horizontal) | <u>68</u> | deg |
| Saturated EIRP @ downlink site | <u>48.5</u> | | Downlink path loss | <u>205.5</u> | dB |
| Carrier EIRP @ downlink site | <u>30.9</u> | dBw | RSL at receiver | <u>-49.7</u> | dBm |
| Frequency | <u>11.940</u> | GHz | Temperature system | <u>124</u> | degrees K |
| Antenna size | <u>1.80</u> | meters | G/T | <u>24.3</u> | dB/deg K |
| Antenna efficiency | <u>65.0</u> | % | Antenna gain | <u>45.2</u> | dB |
| Antenna temperature | <u>40</u> | deg K | LNB temperature | <u>75</u> | degrees K |
| Antenna pointing error | <u>0.3</u> | dB | Downlink C/No | <u>78.0</u> | dB-Hz |
| LNB temperature | <u>1.0</u> | dB or degrees K | Downlink C/No+I | <u>74.9</u> | dB-Hz |
| LNB gain | <u>55</u> | dB | | | |
| Receiver noise figure | <u>15</u> | dB | | | |
| Cable loss | <u>5</u> | dB | | | |
| Availability required | <u>99.97</u> | % | | | |

DOWNLINK INTERFERENCE

| | | | | | |
|--|--------------|-------------|---------------|-------------|-------|
| 4 - antenna discrimination @ 2.2 degrees | <u>21.0</u> | dB | | | |
| I spectral density | <u>13.00</u> | dBw / 4 kHz | Downlink C/Io | <u>78.0</u> | dB-Hz |

CARRIER OVERALL LINK

| | | | | | |
|-----------------|------------|----|---------------------------|-------------|-------|
| Eb/No threshold | <u>6.2</u> | dB | Uplink+Downlink C/No+I | <u>72.3</u> | dB-Hz |
| | | | Uplink+Downlink Eb/No+I | <u>9.2</u> | dB |
| | | | Margin to Eb/No threshold | <u>3.0</u> | dB |

CLEAR SKY

SATELLITE/TRANSPONDER

| | | | | | |
|--|--------------|---------|-----------------------|----------------|-----------|
| Satellite | <u>AMC2</u> | | Satellite gain | <u>183.2</u> | dB |
| Longitude | <u>84.85</u> | deg W | Satellite temperature | <u>180.7</u> | dB |
| Uplink Polarity | <u>V</u> | | Satellite temperature | <u>3.4E+20</u> | degrees K |
| Saturation flux density at G/T=0 at Nominal Attn | <u>-86.0</u> | dBw/m^2 | | | |
| Saturation flux density at UL site | <u>-88.5</u> | dBw/m^2 | | | |
| G/T at UL Site | <u>2.5</u> | dB | | | |
| Saturated maximum EIRP | <u>51.5</u> | dBw | | | |
| Saturated EIRP at uplink site | <u>47.5</u> | dBw | | | |
| Carrier EIRP @ uplink site | <u>32.2</u> | dBw | | | |
| Delta IBO to OBO | <u>3.0</u> | dB | | | |
| Transponder bandwidth | <u>36.0</u> | MHz | | | |
| Satellite ACL | <u>0.0</u> | dB | | | |

UPLINK

| | | | | | |
|------------------------|--------------------|--------|--|--------------|-------|
| Location | <u>Billings MT</u> | | Azimuth | <u>148.8</u> | deg |
| Latitude | <u>45.8</u> | deg N | Elevation | <u>32.4</u> | deg |
| Longitude | <u>108.5</u> | deg W | Polarity adjustment for V | <u>90</u> | deg |
| Elevation | <u>0.2</u> | km | Uplink polarization (angle for horizontal) | <u>-21</u> | deg |
| Frequency | <u>14.240</u> | GHz | Antenna gain | <u>48.5</u> | dB |
| Antenna size | <u>2.40</u> | meters | Uplink path loss | <u>207.2</u> | dB |
| Antenna efficiency | <u>55.0</u> | % | Uplink C/No | <u>79.8</u> | dB-Hz |
| Antenna pointing error | <u>0.3</u> | dB | Uplink C/No+I | <u>78.0</u> | dB-Hz |
| HPA to antenna loss | <u>1.0</u> | dB | Single carrier uplink EIRP | <u>56.2</u> | dBw |
| # of carriers | <u>1</u> | | Single carrier HPA power | <u>8.7</u> | dBw |
| Availability required | <u>99.95</u> | dB | Single carrier HPA power | <u>7.4</u> | watts |
| | | | Single carrier HPA size required | <u>9.3</u> | watts |

CARRIER

| | | | | | |
|-----------------------------------|---------------|-----------|----------------|-------------|-----|
| Information rate | <u>8008.2</u> | kb/s | Bandwidth | <u>7207</u> | kHz |
| Modulation (QPSK,BPSK,MSK,FSK,FM) | <u>QPSK</u> | | Input backoff | <u>18.3</u> | dB |
| FEC rate | <u>0.6667</u> | <u>RS</u> | Output backoff | <u>15.3</u> | dB |
| Spread factor | <u>1</u> | | | | |
| Spacing factor | <u>1.20</u> | | | | |

UPLINK INTERFERENCE

| | | | | | |
|--------------------|------------|-------------|-------------|-------------|-------|
| I spectral density | <u>9.5</u> | dBw / 4 kHz | Uplink C/Io | <u>82.7</u> | dB-Hz |
|--------------------|------------|-------------|-------------|-------------|-------|

DOWNLINK

| | | | | | |
|--------------------------------|-------------------|-----------------|--|--------------|-----------|
| Location | <u>Denver, CO</u> | | Azimuth | <u>150.3</u> | deg |
| Latitude | <u>39.7</u> | deg N | Elevation | <u>39.6</u> | deg |
| Longitude | <u>105.0</u> | deg W | Polarity adjustment for V | <u>0</u> | deg |
| Elevation | <u>0.2</u> | km | Downlink polarization (angle for horizontal) | <u>68</u> | deg |
| Saturated EIRP @ downlink site | <u>48.5</u> | | Downlink path loss | <u>205.5</u> | dB |
| Carrier EIRP @ downlink site | <u>33.2</u> | dBw | RSL at receiver | <u>-40.1</u> | dBm |
| Frequency | <u>11.940</u> | GHz | Temperature system | <u>144</u> | degrees K |
| Antenna size | <u>4.50</u> | meters | G/T | <u>30.8</u> | dB/deg K |
| Antenna efficiency | <u>55.0</u> | % | Antenna gain | <u>52.4</u> | dB |
| Antenna temperature | <u>60</u> | deg K | LNB temperature | <u>75</u> | degrees K |
| Antenna pointing error | <u>0.2</u> | dB | Downlink C/No | <u>86.9</u> | dB-Hz |
| LNB temperature | <u>1.0</u> | dB or degrees K | Downlink C/No+I | <u>85.2</u> | dB-Hz |
| LNB gain | <u>55</u> | dB | | | |
| Receiver noise figure | <u>15</u> | dB | | | |
| Cable loss | <u>5</u> | dB | | | |
| Availability required | <u>99.99</u> | % | | | |

DOWNLINK INTERFERENCE

| | | | | | |
|--|--------------|-------------|---------------|-------------|-------|
| 4 - antenna discrimination @ 2.2 degrees | <u>31.0</u> | dB | | | |
| I spectral density | <u>13.00</u> | dBw / 4 kHz | Downlink C/Io | <u>90.2</u> | dB-Hz |

CARRIER OVERALL LINK

| | | | | | |
|-----------------|------------|----|---------------------------|-------------|-------|
| Eb/No threshold | <u>5.2</u> | dB | Uplink+Downlink C/No+I | <u>77.2</u> | dB-Hz |
| | | | Uplink+Downlink Eb/No+I | <u>8.2</u> | dB |
| | | | Margin to Eb/No threshold | <u>3.0</u> | dB |

Table B-2
TT&C Link Budgets

| Link Parameters | Units | TT&C | | | |
|---|-----------|---------|---------|---------|---------|
| | | 800KF9D | 300KF9D | 300KF9D | 300KF9D |
| | | TC1 | TM1 | TM2 | TM-Ku |
| Uplink Frequency | MHz | 6423.5 | | | |
| Downlink Frequency | MHz | | 3700.5 | 4199.5 | 12198 |
| Carrier Allocated Bandwidth | kHz | 800 | 300 | 300 | 300 |
| Uplink: | | | | | |
| Nominal Earth Station EIRP per carrier | dBW | 77.0 | | | |
| Earth Station Diameter | m | 11.0 | | | |
| Earth Station Gain | dBi | 54.5 | | | |
| Uplink Input Power per Carrier | dBW | 22.5 | | | |
| Input power density | dBW/4 kHz | -0.5 | | | |
| Free Space Loss | dB | 199.7 | | | |
| G/T Satellite towards E/S | dB/K | -16.0 | | | |
| C/N Thermal Uplink | dB | 30.9 | | | |
| C/I XPOL, ACI, IM, ASI | dB | 41.0 | | | |
| C/(N+I) uplink | dB | 30.5 | | | |
| Downlink: | | | | | |
| Satellite e.i.r.p. per carrier | dBW | | 17.0 | 18.0 | 18.0 |
| Maximum e.i.r.p. density | dBW/4kHz | | -1.8 | -0.8 | -0.8 |
| Free Space Loss | dB | | 194.9 | 196.0 | 205.3 |
| Earth Station Diameter | m | | 11.0 | 11.0 | 9.0 |
| Earth Station Gain | dBi | | 50.2 | 51.7 | 59.0 |
| Noise Temperature | K | | 80.0 | 80.0 | 120.0 |
| Earth Station G/T | dB/K | | 31.2 | 32.7 | 38.2 |
| C/N Thermal Downlink | dB | | 27.1 | 28.5 | 24.8 |
| C/I XPOL, ACI, IM, ASI | dB | | 25.5 | 28.0 | 24.3 |
| C/(N+I) downlink | dB | | 23.2 | 25.2 | 21.5 |
| Adjacent Satellite Interference: | | | | | |
| Uplink Inp. Pwr. Dens. @ 2 degrees | dBW/Hz | -47 | | | |
| Downlink e.i.r.p. Dens @ 2 degrees | dBW/Hz | | -37 | -37 | -26 |
| C/I up (single satellite) | dB | 44.0 | | | |
| C/I dn (single satellite) | dB | | 28.5 | 31.0 | 27.3 |
| Aggregate C/I up | dB | 41.0 | | | |
| Aggregate C/I down | dB | | 25.5 | 28.0 | 24.3 |
| Overall: | | | | | |
| C/(N+I) overall | dB | 30.5 | 23.2 | 25.2 | 21.5 |
| C/(N+I) required | dB | 10.8 | 10.8 | 10.8 | 10.8 |
| System Margin | dB | 19.7 | 12.4 | 14.4 | 10.7 |

DECLARATION

I, Pascale Dumit, hereby certify under penalty of perjury that I am the technically qualified person responsible for the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the exhibit and that it is complete and accurate to the best of my knowledge, information and belief.

/s/ Pascale Dumit

Pascale Dumit
Manager, Spectrum Development
SES

Dated: March 29, 2016