Engineering Statement

1) Introduction

Intelsat North America LLC ("Intelsat") proposes to launch and operate a new satellite designated as Intelsat 18 ("IS 18") from 180° E.L. Intelsat 18 will utilize the C-band frequencies of 5925 – 6425 MHz and 3700 – 4200 MHz and Ku-band frequencies of 14000 – 14500 MHz, 10950 – 11200 MHz, 11450 – 11700 MHz, 12250 – 12500 MHz and 12500 – 12750 MHz. At C-band, Intelsat 18 will provide service to East Asia, Australia, New Zealand, the Pacific Ocean region, Hawaii and western North America. At Ku-band, Intelsat 18 will provide service to western North America, Australia, New Zealand and the islands in the southern Pacific Ocean. Intelsat 18 will replace the Intelsat 701 spacecraft, which is also licensed to Intelsat (*see* FCC File Number: SAT-A/O-20000119-00014 and SAT-MOD-20050610-00122).

Intelsat requests a continued waiver of the provisions of footnote NG 104 of the U.S. Table of Allocations and footnote 2 of Section 25.202(a)(1) of the Commission's rules concerning the use of the frequency bands 10950-11200 MHz and 11450-11700 MHz for domestic services. Intelsat also requests waiver of the provisions of section 25.114(d)(3) which requires a specific format for the presentation of space station contours and section 25.202(g) which requires telemetry, tracking and telecommand functions to be allocated at the band edge.

On September 30, 2005, the Commission granted a waiver of footnote NG 104 of the U.S. Table of Allocations with respect to the use of Intelsat 701 frequencies 10950-11200 MHz and 11450-11700 MHz from 180.0º E.L. Specifically, in its 2005 authorization, the Commission permitted the use of these two frequency bands for domestic use subject to a number of conditions, among which was that operation of Intelsat 701 in these bands would be on an unprotected, non-interference basis relative to fixed stations and that Intelsat would not cause interference to, or claim protection from, fixed stations to which frequencies in the 10950-11200 MHz and 11450-11700 MHz bands have either been already assigned or to which frequencies in the 10950-11200 MHz and 11450-11700 MHz bands may be assigned at a later date (*see Intelsat's Request for Waiver of Rule for Intelsat 701*, SAT-MOD-20050610-00122 (filed June 10, 2005) (stamp grant with conditions Sept. 30, 2005)).

As part of its overall satellite fleet management, Intelsat now proposes to launch and operate Intelsat 18 to replace the Intelsat 701 satellite at 180.0º E.L. Intelsat therefore requests continued waiver of footnote NG 104 of the U.S. Table of Allocations and footnote 2 of Section 25.202(a)(1) of the rules concerning the frequency bands 10950-11200 MHz and 11450-11700 MHz for domestic services subject to the same conditions specified by the Commission in its authorization for Intelsat 701 (see above). Waiver of NG 104 and footnote 2 of Section 25.202(a)(1) would allow Intelsat to provide domestic services from 180.0º E.L. similar to those currently provided by Intelsat 701 from 180.0º E.L. on these two frequency bands.

2) Spacecraft Overview

Intelsat 18 is an Orbital Star-2.4E spacecraft that operates on the C-band frequencies of 5925 – 6425 MHz and 3700 – 4200 MHz; and the Ku-band frequencies of 14000 – 14500 MHz, 10950 – 11200 MHz, 11450 – 11700 MHz, 12250 – 12500 MHz and 12500 – 12750 MHz. At C-band, it utilizes 12x72 MHz transponders, 10x36 MHz transponders and 2x41MHz transponders. At Ku-band, Intelsat 18 utilizes 12x72 MHz transponders.

Intelsat 18 is a 3-axis stabilized type spacecraft, with a main body that supports the antennas and electronics for the various subsystems. It utilizes two deployable reflector antennas, a nadir mounted antenna, two 4-panel deployable solar array wings and a bi-propellant propulsion system. The on-orbit configuration of the Intelsat 18 spacecraft is provided in Exhibit 1. A summary of the basic spacecraft characteristics is provided in Exhibit 2.

2.1) Structure

The structural design of Intelsat 18 provides mechanical support for all subsystems. The structure externally supports the communication antennas, command and telemetry antennas, solar arrays, and thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

The spacecraft takes advantage of a modular design for ease of manufacturing and integration. The primary structure consists of two separate modules: the core module and the payload module. When mated, these modules form the basic cubical structure of the spacecraft.

The core module is comprised of a central cylinder, a north and south bus panel, a base panel and a number of ancillary panels that attach to the central cylinder. The core module structure establishes the primary load path between the launch vehicle and the rest of the satellite and houses the various components associated with the bus subsystem, *i.e.,* propellant tanks, bus electronics, reaction wheels, etc.

The payload module consists of the north and south equipment panels and the earth (or nadir) panel. These panels provide mounting surfaces for the payload equipment, *e.g.,* amplifiers, receivers, etc.

There are two pairs of access panels – one pair located on the east side of the spacecraft and another pair located on the west side – that run vertically from the aft section of the structure to the nadir section. These panels close out the east and west sections of the spacecraft. They can be easily removed after the core and payload modules have been mated to permit easy access to the payload or bus equipment.

The battery assemblies are mounted on dedicated panels located on the north and south sides of the spacecraft in the aft section. These panels are integrated below the base panel and are thermally isolated to maintain optimal operating temperatures and increase capacity.

Intelsat 18 utilizes one nadir mounted antenna and two deployable reflector antennas that are located on the east and west sides of the spacecraft and two global horn communication antennas mounted on the Earth deck. For telemetry, command and ranging ("TC&R"), the spacecraft employs four wide coverage antennas ("WCAs") and a mast-mounted omni-directional antenna. The wide coverage antennas are grouped into two transmit/receive pairs, with one pair located on the nadir (Earth facing) section of the spacecraft and the other pair located in the aft section. The spacecraft also employs two global horn antennas for uplink power control.

The spacecraft utilizes two deployable solar wings, which are extended when the spacecraft reaches its on-station orbital location. One solar wing is located on the north side of the spacecraft and the other is located on the south side of the spacecraft. The solar wings provide the mounting surfaces for the solar cells. Each solar wing is connected to the main spacecraft structure through a dedicated Solar Array Drive Assembly ("SADA").

The main Liquid Apogee Engine ("LAE") is located at the aft end of the spacecraft and is attached to the central cylinder through a series of supporting struts.

The Intelsat 18 mass budget is provided in Exhibit 3.

2.2) Thermal Subsystem

Thermal control is accomplished through the use of Optical Solar Reflectors ("OSRs"), heat pipes, Multilayer Insulation ("MLI") blankets and electrical heaters. The outer surface of the north and south panels, the bus panels and the battery panels are covered with OSRs to maximize the heat rejection to space while minimizing the absorbed solar energy. The heat generated by high power units, *e.g.,* TWTAs, OMUXs, etc. is spread over the north and south (communication module) panels by means of heat pipes that are embedded in the panels. Additionally, the earth deck heat pipe network provides cross-coupling between the north and south panels for heat load sharing and increase the heat rejection capability of the spacecraft. Intelsat 18 utilizes Ku-band direct-radiation TWTAs, whereby most of the heat generated by each unit is radiated directly out to space. MLI blankets cover all external areas, except radiative areas. Heaters are used to limit the lower temperature extremes of the electronics as well as the propulsion thrusters and propellant lines.

2.3) Power Subsystem

The Electrical Power Subsystem ("EPS") generates, stores, conditions and protects the satellite's electrical power. It provides the energy required to operate the satellite during all modes of operation. The EPS consists of the solar arrays, batteries, associated power electronics, and power harnesses that integrate and regulate the systems.

Intelsat 18 utilizes two deployable solar array wings, with one wing located on the north side of the spacecraft and the other located on the south side of the spacecraft. Each solar wing is composed of four main panels. Each panel supports an array of multi-junction Gallium Arsenide solar cells. During launch, the solar array wings are in the stowed position. However, once on station, the solar wings are deployed, with each wing extending out on the north and south sides of the spacecraft. The solar array is designed to provide power to the spacecraft for at least 15 years.

Power from the solar arrays is transferred to the spacecraft through the use of two Solar Array Drive Assemblies ("SADAs") – one for each solar wing. The SADAs also control the rotation of the solar wings.

During eclipse periods, two 36 cell Lithium ion batteries are the primary source of power to the spacecraft. The battery packs are located near the aft section of the spacecraft and are mounted on the north and south battery panels below the base panel.

The Intelsat 18 EPS has been designed so that no single failure in the subsystem will cause a spacecraft failure. The EPS will provide sufficient power to the spacecraft throughout its design life to support all active communication channels as well as all necessary housekeeping loads. The beginning of life ("BOL") and end of life ("EOL") power budgets for Intelsat 18 are provided in Exhibit 4.

2.4) Attitude Control Subsystem

The Attitude Control Subsystem ("ACS") maintains the spacecraft attitude during the transfer orbit, initial acquisition period, and on-station geostationary operations. Additionally, the ACS is responsible for re-acquisition of the spacecraft in case of emergency and its placement into a safe configuration.

The ACS employs primary and redundant sun and Earth sensors as well as a Scalable Space Inertial Reference Unit ("SSIRU") to perform all attitude determination functions. Control of spacecraft attitude is accomplished through the use of 4-for-3 redundant fixed momentum/reaction wheels and pulsed or continuous firing of selected thrusters by the ACS.

2.5) Propulsion Subsystem

The propulsion subsystem provides impulse for the spacecraft maneuvering during all phases of the mission beginning with launch vehicle separation and through the operational lifetime of the satellite. The spacecraft employs a dual mode propulsion system utilizing both bi-propellant and mono-propellant subsystems. The major features of the propulsion system are : 1) a single cylindrical fuel tank, 2) two cylindrical oxidizer tanks, 3) a cylindrical Helium gas tank, 4) a 454N Liquid Apogee Engine ("LAE") that is utilized during transfer orbit, 5) two 22N, dual-mode thrusters ("DMTs"), 6) four mono-propellant, 22N Rocket Engine Assembly ("REA") thrusters, 7) twelve 0.9N REA catalytic thrusters, 8) four 0.48N Improved Electrothermal Hydrazine Thrusters ("IMPEHTs"), and 9) propellant management through pressure blow-down control system using Helium as the pressurant.

Prior to the start of the transfer orbit, the normally closed (pyrotechnic) valves that isolate the propellant tank and the oxidizer tanks from the thrusters are opened. The propellant and oxidizer tanks are then pressurized by the activation of the pressure blow-down system, whereby pressurized Helium is injected into the fuel and oxidizer tanks. The system is then operated in bi-propellant mode using the 454N main thruster and the 22N REA thrusters. In case of an anomaly with the main (LAE) thruster, the two 22N dual-mode thrusters are utilized as back-up to complete the transfer orbit maneuvers.

Upon completion of transfer orbit operations, the bipropellant components of the subsystem are isolated from the on-orbit operation system. This leaves the propulsion system in a monopropellant blow-down configuration. On-orbit operation is performed through the use of 0.9N and 0.48N and 22N thrusters.

The architecture of the propulsion systems is based on a low risk approach and is patterned after successful designs used throughout the industry utilizing space-proven (*e.g.,* Intelsat 15 satellite) or space-qualified components. The system incorporates full redundancy for all critical components. All thrusters have been flight qualified to more than 1.25 times the required throughput to complete the mission life.

2.6) Communication Subsystem

2.6.1) Overview

Intelsat 18 provides 24 active C-band communication channels and 12 active Ku-band communication channels. At C-band, it utilizes 16x72 MHz transponders, 6x36 MHz transponders and 2x41MHz transponders to provide service to East Asia, Australia, New Zealand, the Pacific Ocean region, Hawaii and western North America. At Ku-band, Intelsat 18 utilizes

12x72 MHz transponders to provide service to western North America, Australia, New Zealand and the islands in the southern Pacific Ocean. The Intelsat 18 frequency and polarization plan is shown in Exhibits 5A and 5B.

Intelsat 18 employs full frequency reuse through the use of orthogonal polarization within the same beam and the use of spatially independent beams. The C-band beams utilize circularly (left hand and right hand) polarization, and the Ku-band beams utilize linear (horizontal and vertical) polarization. Accordingly, Intelsat 18 is compliant with the provisions of section 25.210(f) of the Commission's rules.

2.6.2) Antennas and Beam Coverage

Intelsat 18 utilizes a deployable transmit/receive Ku-band reflector antenna deployed off the east side of the spacecraft; a deployable transmit C-band reflector antenna deployed off the west side of the spacecraft. On its nadir side the spacecraft employs a fixed receive C-band reflector antenna, a C-band global horn receive antenna and a C-band global horn transmit antenna. The coverage beams of the Intelsat 18 antennas are shown in Exhibits 6A through 6S, in the format prescribed in section 25.114(d)(3) of the Commission's rules. These exhibits also provide the beam peak antenna gain, the beam peak G/T and SFD ("Saturated Flux Density") for the uplink beams, and the beam peak EIRP for the downlink beams.

With regard to the Intelsat 18 uplink beams, the SFD at any G/T contour may be determined using the following formula:

$$SFD_D = SFD_P + [(G/T)_P - (G/T)_D] + A$$

where

SFD_D: SFD at desired G/T level (dBW/m^2)
SFD_P: Minimum SFD at peak G/T (dBW/m^2)
$(G/T)_D$: Desired G/T level (dB/K)
$(G/T)_P$: Peak G/T (dB/K)
A = Transponder attenuator setting (dB), ranging from 0 to 32 dB for C-band and Ku-band channels (Fixed Gain Mode) in 1 dB steps.

Exhibit 7 provides a detailed calculation of the EIRP, G/T and SFD of the Intelsat 18 uplink and downlink beams.

The Intelsat 18 C-band and Ku-band beams are designed to have a cross-polarization isolation of 30 dB or greater over their primary coverage area.

2.6.3) Transponder description

2.6.3.1 C-band

Signals uplinked to the spacecraft are received by the appropriate receiving antenna. The output of the receive antenna is split into its (opposite) circularly polarized components. The signal is then routed to a test coupler, a band-pass filter and then to a set of redundant wide band receivers.

Intelsat 18 employs three sets of 4-for-2 redundant receivers. The receivers establish the system noise figure and downconvert the received signal to the transmit frequency band. The receivers operate in linear mode and are designed to have high sensitivity (i.e. good noise performance) and low cross-talk coefficients (*i.e.,* good linearity characteristics). Given that the receiver downconverts the received signal to the necessary frequency required for transmission, the frequency stability of the transmitted signal is controlled entirely by the receiver itself. The Intelsat 18 C-band receiver is able to maintain over the life of the spacecraft the frequency of the transmitted (downconverted) signal to within 0.002% of the desired value. Accordingly, Intelsat 18 is compliant with the provisions of section 25.202(e) of the Commission's rules.

The output of each receiver (or receiver-downconverter combination) is then distributed to a bank of Input Muliplexers ("IMUXs"). The IMUXs are filters that provide frequency band separation for each channel.

The output of each IMUX is connected to a dedicated Linearized Channel Traveling Wave Tube Amplifier ("LCTWTA") through a bank of redundancy switches. The redundancy switching permits the output of the IMUX to be routed to a redundant LCTWTA should the primary unit fail or malfunction.

Intelsat 18 utilizes twenty four 45 Watt conduction cooled LCTWTAs. The LCTWTAs are arranged in two 16-for-12 redundancy rings.

Each LCTWTA may operate in the Fixed Gain Mode ("FGM"). In this operating mode, the gain of each channel (and its associated transponder saturation flux density) may be independently adjusted by changing the attenuation of its designated LCTWTA by ground command. Consequently, the output of each LCTWTA may be varied by ground command over a range of 32 dB in 1 dB increments. Accordingly, the C-band channels of Intelsat 18 are compliant with the provisions of section 25.210(c) of the Commission's rules.

The output of each LCTWTA is routed through a bank of switches and to the appropriate Output Multiplexer ("OMUX"). The switching network allows the output of a redundant LCTWTA to be forwarded to the appropriate OMUX should the primary pair of units fail or malfunction. The output of each OMUX is routed to a band-pass filter, a test coupler and then to the transmitting antenna.

2.6.3.2 Ku-band

Signals uplinked to the spacecraft are received by the appropriate receiving antenna. The output of the receive antenna is routed to a diplexer, a test coupler, a band-pass filter and then to a set of redundant wide band receivers.

Intelsat 18 employs four receivers arranged in an 8-for-4 redundancy ring. The receivers establish the system noise figure and down-convert the received signal by 2800 MHz to 11450 – 11700 MHz.

For those Intelsat 18 transmit beams that operate in the 10950 – 11200 MHz or the 12250 – 12750 MHz, the signal from the band-pass filter is sent to a receiver and routed to an output port of the receiver that does not frequency convert the signal. From the receiver, the signal is sent to a series of frequency down-converters that translate the signal to the correct downlink frequency.

Intelsat 18 utilizes four down-converters that down-convert the signal by 1748 MHz. These down-converters are arranged into two 4-for-2 redundancy rings. Intelsat 18 also utilizes three down-converters that down-convert the signal by 3050 MHz. These down-converters are arranged in a 6-for-3 redundancy ring.

Given that either the receiver or the frequency down-converters translate the received signal to the necessary frequency required for transmission, the frequency stability of the transmitted signal is controlled entirely by either the receiver or the down-converters. The Intelsat 18 Ku-band receiver and down-converters are able to maintain over the life of the spacecraft the frequency of the transmitted (downconverted) signal to within 0.002% of the desired value. Accordingly, Intelsat 18 is compliant with the provisions of section 25.202(e) of the Commission's rules.

The output of each receiver or downconverter, as the case may be, is then distributed to a bank of IMUXs. The output of each IMUX is connected to a dedicated LCTWTA through a bank of redundancy switches. The redundancy switching permits the output of the IMUX to be routed to a redundant LCTWTA should the primary unit fail or malfunction.

Intelsat 18 utilizes twelve 150 Watt radiation cooled LCTWTAs. The LCTWTAs are arranged in two 8-for-6 redundancy rings.

Each LCTWTA may operate in the fixed gain mode or in the Automatic Level Control ("ALC") mode. When operating in the fixed gain mode, the gain of each channel (and its associated transponder saturation flux density) may be independently adjusted by changing the attenuation of its designated LCTWTA by ground command. Consequently, the output of each LCTWTA may be varied by ground command over a range of 32 dB in 1 dB increments. Accordingly, the Ku-band channels of Intelsat 18 are compliant with the provisions of section 25.210(c) of the Commission's rules. When operating in the ALC mode, the input power into the TWTA may be maintained at a specific level chosen within a range of 18 dB, in 0.5 dB increments.

The output of each LCTWTA is routed through a bank of switches and to the appropriate Output Multiplexer ("OMUX"). The switching network allows the output of a redundant LCTWTA to be forwarded to the appropriate OMUX should the primary pair of units fail or malfunction. The output of each OMUX is routed to a band-pass filter, a test coupler, a diplexer and then to the transmitting antenna.

2.7) Telemetry, Command and Ranging Subsystem

The telemetry, command and ranging ("TC&R") subsystem provides the following functions:

1) Acquisition, processing and transmission of spacecraft telemetry data.
2) Reception and retransmission of ground station generated ranging signals.
3) Reception, processing and distribution of telecommands.

The TC&R subsystem consists of the following elements: 1) two circularly polarized receive command wide coverage antennas ("WCAs") – one on the nadir side of the spacecraft and one on the aft side; 2) two circularly polarized transmit telemetry wide coverage antennas ("WCAs") – one on the nadir side of the spacecraft and one on the aft side; 3) one circularly polarized receive/transmit toroidal omni-directional antenna ("Omni"); 4) the circularly polarized global coverage receive antenna from the communications subsystem; 5) the circularly polarized global coverage transmit antenna from the communications subsystem; 6) two command receivers; 7) two telemetry transmitters; 8) Command & Data Handling ("C&DH") subsystem; and 9) Microwave components including filters, switches, couplers, isolators, cables and waveguide.

2.7.1) <u>Antennas</u>

When on-station, command and telemetry signals are received and transmitted through Intelsat 18's global horn communication antennas. The coverage patterns of the command and telemetry beams under these circumstances are provided in Exhibits 6T and 6W, respectively.

During emergencies and transfer orbit operations, command and telemetry signals are received and transmitted through the WCAs and the Omni antennas. For command, one WCA is located on the front section of the spacecraft and one is located on the aft section. Similarly, for telemetry, one WCA is located on the front section of the spacecraft and one is located on the aft section. The Omni antenna is mounted on a mast on the Earth deck. Representative gain graphs for the command and telemetry WCAs are provided in Exhibits 6U and 6X, respectively. Representative gain graphs for the command and telemetry Omni antenna are provided in Exhibits 6V and 6Y, respectively.

During extreme on-station emergencies and during transfer orbit operations, it is assumed that the spacecraft is not properly oriented and communication with the spacecraft cannot be established through the global coverage communication antennas. In this circumstance, the Omni antenna and the WCAs would be used for commanding, since the field of view of the Omni-directional antenna and the WCAs is +/- 30º for each antenna and the Earth disk is only +/- 8.4º.

The graphs in Exhibits 6U and 6X show the variation in the gain of the WCA at 0° roll angle, referenced to the (horizontal) plane on the center axis of the antenna aperture, with the azimuth (or pitch angle) varying from -120º and +120º -- generally referred to as the "azimuth cut". Given that the WCAs are horn antennas having symmetrical gain performance about the center axis of the antenna aperture, the gain variations shown in Exhibits 6U and 6X are also representative of the case where the pitch angle of the antenna is 0°, referenced to the (vertical) plane located at the center axis of the antenna aperture, with the elevation (or roll angle) varying from -120° and +120° -- generally referred to as the "elevation cut".

The antenna plots in Exhibits 6V and 6Y show the variation in the gain of the Omni antenna antennas at 0°, 45º, 90º and 135º roll angles referenced to the antenna axis with the azimuth varying from -180º and 180º. As shown in these exhibits, for the Omni antenna, the variation in gain is less than approximately 4 dB for azimuths varying from -30° to +30° relative to the antenna's maximum gain points.

The antenna gain diagrams for the WCA and Omni antennas as depicted in Exhibits 6U, 6V, 6X and 6Y were not prepared in strict accordance with the specifications in Section 25.114(d)(3) of the Commission's rules. This is due to the fact that the satellite manufacturer does not provide the patterns for the WCA and Omni antennas in the required form as the pointing of the antennas with respect to the Earth will vary during an emergency situation. In this respect, however, it is Intelsat's belief that, given the specificity of the antenna beams addressed in Exhibits 6U, 6V, 6X and 6Y, the patterns provided therein together with the descriptive characterization given in the previous paragraphs of this section of the Engineering Statement, sufficiently fulfill the requirements of Section 25.114(d)(3). However, to the extent that the Commission reaches a different conclusion, a waiver of the requirements of section 25.114(d)(3) of the FCC's rules with respect to the presentation of the WCA and Omni antenna patterns is requested.

2.7.2) Command

The Intelsat 18 command subsystem performance summary is provided in Exhibit 9. Detailed calculation of the G/T and command threshold flux density for each command beam is provided in Exhibit 10.

During on-station operations, commands are transmitted to the spacecraft by transmission of two independent, circularly polarized, FM signals on the frequencies of 6176.3 MHz and 6173.7 MHz. The command signals are received by the spacecraft through the Global A (communication) receive beam antenna. The command signals are then routed to two command receivers. The receivers amplify and demodulate the signal, and convert the command signal into a digital stream. The outputs of the command receivers are forwarded to the C&DH, where the commands are decoded and sent to the appropriate unit.

During transfer orbit or emergency operations, the operation of the command subsystem is similar to that for on-station operations, except that the transmitted command signals are received by the two circularly polarized WCAs and the circularly polarized Omni antenna. Exhibits 5A and 5B provide the frequency and polarization plan for the Intelsat 18 command channels.

As indicated above, the command frequencies of Intelsat 18 are not located at the edge of the 5925 – 6425 MHz band but rather in the middle of the allocated band. Hence, Intelsat 18 is not compliant with the provisions of Section 25.202(g) of the rules. The specific command channels for Intelsat 18 are a subset of those on Intelsat 701, the spacecraft that Intelsat 18 will be replacing, and were chosen so as to minimize any corresponding hardware impact on Intelsat's ground control stations.

In addition to Intelsat 701, the nearest co-frequency satellites to Intelsat 18 are Intelsat 602 located at 177.85º E.L. and NSS 9 located at 177º W.L. Intelsat is the operator of the Intelsat 602 satellite. SES World Skies (formerly New Skies Satellites) is the operator of NSS 9.

Operation of the Intelsat 18 command frequencies will be conducted within the conditions established in an existing coordination agreement between Intelsat and SES World Skies. In any case, given that Intelsat 18 command frequencies are a subset of those used on Intelsat 701, no significant impact to NSS 9 or Intelsat 602 operations is foreseen. Intelsat shall internally coordinate the command transmissions to Intelsat 18 and Intelsat 701 (as well as Intelsat 602). Additionally, Intelsat shall coordinate, as necessary, its command transmissions with any other affected satellite operator that may be operating in the vicinity of Intelsat 18. In view of the foregoing, Intelsat believes that its request for a waiver of section 25.202(g) of the Commission's rules is justified.

2.7.3) Telemetry

The Intelsat 18 telemetry subsystem performance summary is provided in Exhibit 9. Detailed calculation of the EIRP for each telemetry beam is provided in Exhibit 10.

During on-station operations, telemetry is transmitted by the spacecraft on two independent, circularly polarized, PM signals on the frequencies 3947.5 MHz and 3952.5 MHz. The telemetry baseband functions are implemented in the C&DH, where data from the various spacecraft units are collected, processed, multiplexed, formatted and encoded onto subcarriers. The output of the C&DH is then routed to two telemetry transmitters where the signal is modulated onto the main carrier frequencies of 3947.5 MHz and 3952.5 MHz. The output of the telemetry transmitters is then routed to the Global A (communication) beam antenna for transmission to Earth.

During transfer orbit or emergency operations, the operation of the telemetry subsystem is similar to that for on-station operations, except that the telemetry transmitter is placed in a high power mode, generating up to 10 Watts of power, and transmitted to Earth through the WCAs and the Omni antenna which are circularly polarized. Exhibit 5B provides the frequency and polarization plan for the Intelsat 18 telemetry channels.

As indicated above, the telemetry frequencies of Intelsat 18 are not located at the edge of the 3700 – 4200 MHz band but rather in the middle of the allocated band. Hence, Intelsat 18 is not compliant with the provisions of Section 25.202(g) of the rules. The specific telemetry channels for Intelsat 18 are a subset of those used on Intelsat 701, the spacecraft that Intelsat 18 will be replacing, and were chosen so as to minimize any corresponding hardware impact on Intelsat's ground control stations.

In addition to Intelsat 701, the nearest co-frequency satellites to Intelsat 18 are Intelsat 602 located at 177.85º E.L. and NSS 9 located at 177º W.L. Intelsat is the operator of the Intelsat 602 satellite. SES World Skies (formerly New Skies Satellites) is the operator of NSS 9.

Operation of the Intelsat 18 telemetry frequencies will be conducted within the conditions established in an existing coordination agreement between Intelsat and SES World Skies. In any case, given that Intelsat 18 telemetry frequencies are a subset of those used on Intelsat 701, no significant impact to NSS 9 or Intelsat 602 operations is foreseen. Intelsat shall internally coordinate the telemetry transmissions of Intelsat 18 and Intelsat 701 (as well as Intelsat 602). Additionally, Intelsat shall coordinate, as necessary, its telemetry transmissions with any other affected satellite operator that may be operating in the vicinity of Intelsat 18. In view of the foregoing, Intelsat believes that its request for a waiver of section 25.202(g) of the Commission's rules is justified.

2.7.4) Ranging

During all phases of the mission, the slant range of the spacecraft can be determined to a relatively high level of accuracy through the use of a multiple tone ranging system. The ranging tones selected are combined with the normal command data and modulated onto the command carrier and transmitted to the spacecraft. Once received by the spacecraft through the appropriate receiving antenna, the signal is routed to the command receiver where it is separated from the normal command data and routed directly to the spacecraft's telemetry transmitter. At the telemetry transmitter, the ranging signal is combined with other telemetry data and modulated onto the main telemetry carrier and transmitted to Earth through the appropriate spacecraft transmitting antenna. On the ground, the ranging tones are separated from the telemetry data, demodulated and their phase compared with that of the transmitted signal to determine the range of the satellite.

Because the ranging subsystem uses the command and telemetry subsystems, the descriptions of the operation of these two latter systems during on-station, transfer orbit and emergency conditions are applicable to the ranging subsystem as well. The performance summary of the Intelsat 18 command, telemetry and ranging subsystems are provided in Exhibit 9.

2.8) Uplink Power Control Subsystem

2.8.1 Antennas

Intelsat 18 utilizes a dedicated (global) horn antenna to generate the C-band global ULPC beam. Similarly, at Ku-band, a dedicated Ku-band (global) horn antenna is utilized to generate the Ku-band global ULPC beam. The coverage patterns of the ULPC beams are provided in Exhibits 6Z-1 and 6Z-2.

With regard to the C-band and Ku-band ULPC antennas, the graphs in Exhibits 6Z-1 and 6Z-2 show the variation in the gain of the antenna at 0° elevation angle, with the azimuth varying from -45° and +45° for Ku-band and from -120° and +120°, for C-band. Given that the antennas are horn antennas having symmetrical gain performance about the center axis of the antenna aperture, the gain variations shown in Exhibits 6Z-1 and 6Z-2 are also representative of the case where the azimuth angle of the antenna is 0°, referenced to the (vertical) plane located at the center axis of the antenna aperture, with the elevation varying from -45° and +45° for Ku-band and from -120° and +120°, for C-band.

The antenna gain diagrams associated with the C-band and Ku-band ULPC antennas shown in Exhibits 6Z-1 and 6Z-2 were not prepared in accordance with the specifications in Section 25.114(d)(3) of the Commission's rules due to the fact that typically satellite manufacturers do not provide the patterns in the required form. Given the specificity of the situation, it is our understanding that Exhibits 6Z-1 and 6Z-2 together with the descriptive characterization given in the previous paragraph, fulfill the requirements of section 25.114(d)(3). However, in case the Commission has a different understanding in this respect, a waiver of the requirements of section 25.114(d)(3) of the FCC's rules with respect to the presentation of these antenna patterns is requested.

2.8.2 ULPC System Description

Intelsat 18 provides one C-band and three Ku-band beacons which can be used for uplink power control ("ULPC") by customers transmitting at C or Ku-band frequencies to the spacecraft. The ULPC beacons operate on the frequencies of 3950 MHz, 11198 MHz, 11452 MHz and 12502 MHz.

The characteristics of the ULPC beacon are provided in Exhibit 2. Detailed calculation of the EIRP for the ULPC beams is provided in Exhibit 7.

The Intelsat 18 C-band and Ku-band Uplink Power Control (ULPC) Beacon/Telemetry transmitters are able to maintain the downlink transmit frequency to within +/- 0/002% of the desired frequency over the life of the spacecraft. Accordingly, Intelsat 18 is compliant with the provisions of section 25.202(e) of the Commission's rules.

The C-band ULPC subsystem utilizes a dedicated 2-for-1 redundant transmitter to generate the beacon. The output of the transmitter is directed to a dedicated C-band ULPC global horn transmit antenna and transmitted to Earth.

The Ku-band ULPC subsystem utilizes three dedicated 2-for-1 redundant transmitters to generate each beacon. The output of the transmitters are multiplexed and directed to a dedicated Ku-band ULPC global horn transmit antenna and transmitted to Earth.

2.9) Satellite Station-Keeping

The spacecraft will be maintained within 0.05° of its nominal longitudinal position in the east-west direction as well as in the north-south direction. Accordingly, it is in compliance with the provisions of section 25.210(j) of the Commission's rules.

The attitude of the spacecraft will be maintained with an accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (i.e., attitude perturbations, thermal distortions, misalignments, orbital tolerances and thruster perturbations).

2.10) Satellite Useful Lifetime

The design lifetime of the satellite in orbit is 15 years. This has been determined by a conservative evaluation of the effect of the synchronous orbit environment on the solar array, the amount of fuel aboard the spacecraft, the effect of the charge-discharge cycling on the life of the battery, and the wear out of the amplifiers and other active units. The mass allocation of propellant for spacecraft station-keeping is at least 15 years. To enhance the probability of survival, equipment/unit redundancy is incorporated into the spacecraft design where possible. Materials and processes have been selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life.

2.11) Spacecraft Reliability

Intelsat 18 is designed for an operational and mission life of at least 15 years. Life and reliability are maximized by incorporating flight proven or flight qualified units and designs to the greatest extent possible. All subsystems and units have a minimum design life of 15 years. Redundancy concepts are applied to all critical components. All avoidable single-point failure modes have been eliminated.

The projected reliability of the payload is 79.6%. The projected reliability of the bus system, which includes the TT&C, is 83.9%. The overall reliability of the Intelsat 18 spacecraft is projected to be 66.8%. The subsystem reliability assessments were based upon the use of failure rates, modeling assumptions from previous spacecraft programs and those specific to Intelsat 18.

3.0) Emission Limitations

The receiver and transmitter channel filter response characteristics of Intelsat 18 are provided in Exhibit 8, as required under section 25.114(c)(4)(vii) of the Commission's rules. The total amplitude response characteristics of the Intelsat 18 Ku-band channels are also provided in Exhibit 8.

Intelsat shall comply with the provisions of 25.202(f) of the Commission's rules with regard to Intelsat 18 emissions.

4.0) Services and Emission Designators

Intelsat 18 is to be a general purpose communications satellite and has been designed to support a wide variety of services. Depending upon the needs of the users, the transponders on Intelsat 18 can accommodate television, radio, voice or data communications. Typical types of communication services to be offered include:

a) Frequency modulated television (TV/FM);
b) Compressed digital video;

c) High speed digital data;
d) Digital single channel per carrier ("SCPC") data channels; and
e) Digital SCPC with 64 kbps data rates.

Emission designators and allocated bandwidths for representative communication carriers, telemetry and command signals are provided in Exhibit 11.

5.0) Power Flux Density ("PFD")

The power flux density ("PFD") limits for space stations operating in the 3700 – 4200 MHz, 10950 – 11200 MHz and 11450 – 11700 MHz bands are contained in section 25.208 of the Commission's rules. With respect to the 12250 – 12750 MHz band, there are PFD limits specified in No. 21.16 of the ITU Radio Regulations.

The maximum PFD levels for the Intelsat 18 transmissions were calculated for a number of TV/FM and digital carriers listed in Exhibit 11 operating in the 10950 – 11200 MHz, 11450 – 11700 MHz and 12250 – 12750 MHz bands. These carriers were chosen because they generally produce high PFD levels on the Earth's surface. The PFD levels were also calculated for the Intelsat 18 telemetry and ULPC carriers. The results are provided in Exhibit 12 and show that the downlink power flux density levels of the Intelsat 18 carriers do not exceed limits specified in section 25.208 of the Commission's rules or No. 21.16 of the ITU Radio Regulations.

5.0) Service Area

At C-band, the primary service area of Intelsat 18 is East Asia, Australia, New Zealand, the Pacific Ocean region, Hawaii and western North America. At the Ku-band, the primary service area is western North America, Australia, New Zealand and the islands in the southern Pacific Ocean.

6.0) Orbital Location

Intelsat requests that it be assigned the 180° E.L. orbital location for Intelsat 18. Intelsat 18 will replace the Intelsat 701 spacecraft which is currently operating from 180° E.L., allowing continued use of the C-band and Ku-band channels by the existing customers of Intelsat 701. The 180° E.L. location satisfies Intelsat 18 requirements for optimizing coverage, elevation angles and service availability and ensures that maximum operational, economic and public interest benefits will be derived.

7.0) Orbital Arc Limitations

Intelsat 18 is intended to provide video, audio and data services to satellite users in East Asia, Australia, New Zealand, western North America, Hawaii and the Pacific Ocean region. The 180° E.L. position affords reasonable earth station elevation angles to the region. The attractiveness of Intelsat 18 to this market would be severely diminished if service to this area is not possible.

8.0) Intelsat 18 Carrier Link Analysis

Link analysis for Intelsat 18 was conducted for a number of representative carriers. For the analysis, it was assumed that the nearest satellites to Intelsat 18 were a hypothetical satellite operating from 178° E.L. and a hypothetical satellite operating from 178° W.L. The hypothetical satellites were assumed to have the same operational parameters as Intelsat 18.

At C-band, the uplink power density of the emissions to each of the hypothetical satellites was assumed to be -38.7 dBW/Hz, the maximum level specified in section 25.212(d) of the Commission's rules for digital C-band carriers. The C-band downlink EIRP of each of the hypothetical satellites was assumed to be one of the following values depending on the Intelsat 18 downlink beam and channel bandwidth combination under consideration:
-33.2 dBW/m^2, -39.2 dBW/m^2, -40.4 dBW/m^2, -42.2 dBW/m^2 and -43.4 dBW/m^2.

At Ku-band, the uplink power density of the emissions to each of the hypothetical satellites was assumed to be -50 dBW/Hz, the maximum level specified in sections 25.212(c) of the Commission's rules for digital Ku-band carriers. At Ku-band, the maximum downlink EIRP density of the emissions from each of the hypothetical satellites was assumed to be -26 dBW/Hz, the maximum level specified in section 25.212(c) of the Commission's rules.

Other assumptions made for the link budget analysis were as follows:

a) In the plane of the geostationary satellite orbit, all transmitting and receiving earth station antennas have off-axis co-polar gains that are compliant with the limits specified in Section 25.209(a)(1) of the FCC's rules.

b) All transmitting and receiving earth stations have a cross-polarization isolation value of at least 30 dB within their main beam lobe.
c) At C-band frequencies, degradation due to rain is not considered, given that rain attenuation effects are insignificant at C-band.
d) At Ku-band frequencies rain attenuation predictions are derived using Recommendation ITU-R 618-8.
e) At Ku-band frequencies, increase in noise temperature of the receiving earth station due to rain is taken into account.
f) For the cases where the transponder operates in a multi-carrier mode, the effects due to intermodulation interference are taken into account.

The impact of the TV/FM carriers from the adjacent satellites at 178° E.L. and 178° W.L on the transmissions of Intelsat 18 was not considered due to the fact that TV/FM carriers are known to be high density carriers with most of the energy contained within the near vicinity of the carrier center frequency. Operation of sensitive narrow-band carriers is typically precluded within these high power density areas of the TV/FM carrier. Accordingly, placement and operation of TV/FM carriers are normally achieved through internal coordination and/or coordination discussions with the adjacent satellite operator, whichever may be the case, rather than through C/I calculations – since the results of such calculations would show that narrow-band carriers typically could not operate on a co-frequency basis with TV/FM carriers.

As shown in Exhibit 5, the Intelsat 18 beam connectivity is extensive. In order to keep the number the Intelsat 18 link calculations to a manageable number, worst-case performance values were assumed for each beam type. The worst-case beam parameters were derived from the beam parameters listed in Exhibit 6 and chosen in such a manner that would make carrier links utilizing any specific uplink / downlink beam combination as sensitive to adjacent satellite interference as possible. This would ensure that the link performance objectives would be achieved for all possible Intelsat 18 uplink and downlink beam combinations. The worst-case beam performance for each Intelsat 18 beam type is provided below:

	Aggregate	**Worst-Case Beam**	**Worst-Case Beam SFD Range @ Peak**	**Worst-Case Beam**

Beam Name	Beam Designation	Peak G/T (dB/K)	G/T (dBW/m^2)	EIRP (dBW)
North Hemi A	North Hemi	2.7	-108.1 to -76.1	41.5
North Hemi B				
South Hemi A	South Hemi	0.1	-105.6 to -73.6	40.4
South Hemi B				
Global A	Global	-5.5	-99.3 to -67.3	34.9
Global B				
F1	Ku	8.3	-107.8 to -75.8	52.6
F2 (H)				
F2 (V)				
U.S.				

As shown in Exhibit 5, Intelsat 18 employs, with each beam, channels having varying bandwidths. In an effort to keep the number of link calculations to a manageable level, link calculations were not performed for each channel size, but rather for only one channel size. The channel size chosen for each beam was based upon the level of adjacent satellite downlink interference. As an example, if a channel having a bandwidth of 72 MHz and a channel having a bandwidth of 36 MHz have the same associated adjacent satellite downlink interfering EIRP density, then link budgets were performed only for emissions that were transmitted through the 72 MHz channel, since the carrier level would typically have less (uplink and downlink) power in comparison to those which would be transmitted through the 36 MHz channel; and thus the impact of the adjacent satellite interference would be greater on the former. As a second example, if the level of downlink interfering EIRP density to which the 36 MHz channel was subjected was larger than that for the 72 MHz channel (as may happen for the C-band link budgets), and if this additional level of interference was larger than ten times the logarithmic ratio of the two channel bandwidths (i.e. 10log[72/36]), then link calculations were performed only for the emissions of the 36 MHz channel, since the impact of adjacent satellite interference is greater on emissions of this channel (in comparison to those being transmitted through the 72 MHz channel).

As previously mentioned, at Ku-band, Intelsat 18 can utilize the downlink frequency bands of 10950 – 11200 MHz, 11450 – 11700 MHz, 12250 – 12500 MHz and 12500 – 12750 MHz. In order to keep the number the Intelsat 18 link calculations to a manageable number, all Ku-band link calculations were conducted at the single representative uplink frequency of 14250 MHz and downlink frequency of 11950 MHz (that is approximately midway between 10950 MHz and 12750 MHz). At C-band, all calculations were conducted at the single representative frequency of 6175 MHz for the uplink and 3950 MHz for the downlink.

The results of the C and Ku-band analysis are shown in Exhibit 13 and demonstrate that operation of the Intelsat 18 satellite from 180º E.L. would permit the intended services to achieve their respective performance objectives while maintaining sufficient link margin. Additionally, the EIRP density levels of the carriers listed in Exhibit 13 comply with the limits contained in section 25.212(c) and 25.212(d) of the Commission’s rules.

9.0) <u>Adjacent Satellite Link Analysis</u>

The impact of the Intelsat 18 emissions on the transmissions of adjacent satellites was not analyzed because the power levels of Intelsat 18 transmissions will be limited to those levels contained in section 25.212(c) and (d) of the FCC’s rules. In those cases where Intelsat may require to transmit carriers with power levels in excess of those in section 25.212(c) or (d), it will coordinate with the affected adjacent satellite operators as part of the normal coordination process, so as to limit the level of interference that is caused and received by Intelsat 18 and any future satellite that may operate from 178° E.L. and/or 178° W.L.

10.0) <u>Schedule S Submission</u>

Intelsat is providing with its application a Schedule S for the operations of Intelsat 18 from 180º EL. It is noted that the antenna gain pattern for the Intelsat 18 C-band and Ku-band ULPC antennas as well as the command and telemetry WCA and Omni antennas were included in column “e” (instead of column “f”) of page S8 of the Schedule S, since they are not in GXT format (see sections 2.7.1 and 2.8.1).

11.0) <u>Orbital Debris Mitigation Plan</u>

Intelsat is proactive in ensuring safe operation and disposal of this and all spacecraft under its control. The four elements of debris mitigation are addressed below.

11.1) Spacecraft Hardware Design

The spacecraft is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other small debris (<1 cm diameter) and has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

11.2) Minimizing Accidental Explosions

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in a manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission, and upon disposal of the spacecraft, Intelsat will ensure the removal of all stored energy on the spacecraft by depleting all propellant tanks, venting all pressurized systems and turning off all active units.

11.3) Safe Flight Profiles

Intelsat has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations. With the exception of Intelsat 701, Intelsat 18 will not be located at the same orbital location as another satellite or at an orbital location that has an overlapping station-keeping volume with another satellite.

The proposed orbital location for Intelsat 18 is 180° E.L. Currently Intelsat 701 operates from 180° E.L. Following transfer of traffic to Intelsat 18, Intelsat 701 shall be relocated to another orbital location such that its station-keeping volume shall not overlap with that of Intelsat 18. During the brief period in which communication traffic is being transferred from Intelsat 701 to Intelsat 18, Intelsat will take all the necessary steps, *e.g.,* "pass-in-the-night maneuver" or slight temporary relocation of Intelsat 701 and/or Intelsat 18, to minimize the risk of collision between the two spacecraft.

With the exception of Intelsat 701, Intelsat is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, having an overlapping station-keeping volume with Intelsat 18. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 18 that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

11.4) Post Mission Disposal

At the end of the mission, Intelsat intends to dispose of the spacecraft by moving it to a minimum altitude of 300 kilometers above the geostationary arc. This exceeds the minimum altitude established by the IADC formula. Intelsat has reserved 6.8 kilograms of fuel for this purpose. The reserved fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. To calculate this figure, the "rocket equation" was used, taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order. For reference, the effective area to mass ratios (Cr*A/M) of the Intelsat 18 spacecraft is 0.03 m^2/kg, resulting in a minimum perigee disposal altitude under the IADC formula of at most 238.2 kilometers above the geostationary arc, which is lower than the 300 kilometer above geostationary disposal altitude specified by Intelsat in this filing. Accordingly, the Intelsat 18 planned disposal orbit complies with the FCC's rules.

12) ITU Filing

Intelsat currently has no filing with the ITU for a satellite network that specifies operation on the frequency band of 12250 – 12500 MHz at the nominal orbital location of 180° E.L. Intelsat will submit to the Commission the Advanced Publication Information ("API"), for a new satellite network that utilizes the 12250 – 12500 MHz band at the nominal orbital of 180° E.L.

Certification Statement

I hereby certify that I am a technically qualified person and am familiar with Part 25 of the Commission's Rules and Regulations. The contents of this engineering statement were prepared by me or under my direct supervision and to the best of my knowledge are complete and accurate.

/s/ Jose Albuquerque	October 13, 2010
Jose Albuquerque Intelsat Corporation Senior Director, Spectrum Engineering	Date

EXHIBIT 1: SPACECRAFT CONFIGURATION

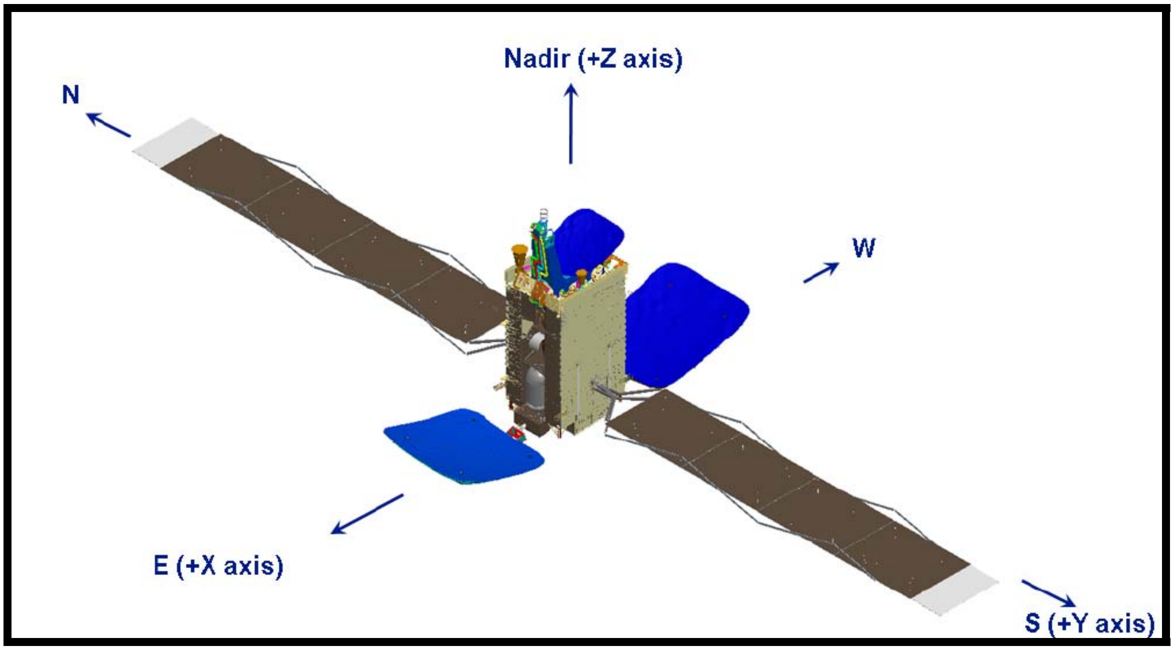


EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS

GENERAL	
Spacecraft Name	Intelsat 18
Orbital Location	180° E.L.
Spacecraft Manufacturer	Orbital
Spacecraft Model	Star 2.4E Bus
Spacecraft Type	3-axis stabilized
Spacecraft Dimensions	
Length	23.6 meters
Width	5.6 meters
Depth	8.6 meters
Spacecraft Mass	
Mass w/o fuel	1464 kg
Mass w/ fuel	3200 kg
Spacecraft Expected Lifetime	≥ 15 years
Eclipse Capability	100%
Station-keeping	
North-South	±0.05°
East-West	±0.05°
Antenna Pointing Accuracy	
North-South	0.1°
East-West	0.1°
Rotational	0.1°
Spacecraft Reliability	66.8 %
Payload Reliability	79.6 %
Bus Reliability	83.9 %
Propulsion Type	Bi-propellant
Maximum Solar Array Power	
Beginning of Life	6949 Watts
End of Life	6746 Watts
Deployed Area of Solar Array	37.5 m^2

EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS (continued)

COMMUNICATION	
Frequency Bands	
Uplink	5925 – 6425 MHz 14000 – 14500 MHz
Downlink	3700 – 4200 MHz 10950 – 11200 MHz 11450 – 11700 MHz 12250 – 12750 MHz
Polarization	
Uplink	C-Band: Right Hand Circular / Left Hand Circular Ku-Band: Horizontal / Vertical
Downlink	C-Band: Right Hand Circular / Left Hand Circular Ku-Band: Horizontal / Vertical
Coverage Area	
Uplink	C-Band: East Asia, Australia, New Zealand, Western North America, Pacific Ocean region Ku-band: Western North America, Australia, New Zealand, southern Pacific Ocean,
Downlink	C-Band: East Asia, Australia, New Zealand, Western North America, Pacific Ocean region Ku-band: Western North America, Australia, New Zealand, southern Pacific Ocean,
Beam Cross-Polarization Isolation	
Uplink	≥ 30 dB
Downlink	≥ 30 dB
Number of Channels	C-Band: 24 Ku-band: 12
Channel Bandwidth	C-Band: 36 MHz, 41 MHz, 72 MHz Ku-Band: 72 MHz
Maximum Downlink EIRP	
North Hemi A Beam (RHCP)	41.5 dBW
North Hemi B Beam (LHCP)	41.6 dBW
South Hemi A Beam (RHCP)	40.4 dBW
South Hemi B Beam (LHCP)	40.4 dBW
Global A Beam (RHCP)	34.9 dBW

EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS
(continued)

COMMUNICATION	
Maximum Downlink EIRP	
Global B Beam (LHCP)	34.9 dBW
F1 Beam (V)	53.3 dBW
F2 Beam (V)	52.8 dBW
F2 Beam (H)	52.6 dBW
Maximum Uplink G/T	
North Hemi A Beam (LHCP)	2.7 dB/K
North Hemi B Beam (RHCP)	2.7 dB/K
South Hemi A Beam (LHCP)	0.1 dB/K
South Hemi B Beam (RHCP)	0.1 dB/K
Global A Beam (LHCP)	-5.5 dB/K
Global B Beam (RHCP)	-5.5 dB/K
F1 Beam (H)	8.2 dB/K
F2 Beam (H)	6.9 dB/K
F2 Beam (V)	6.8 dB/K
U.S. Beam (V)	8.3 dB/K
Uplink SFD Range @ Maximum G/T	
North Hemi A Beam (LHCP)	-108.1 to -76.1 dBW/m^2
North Hemi B Beam (RHCP)	-108.1 to -76.1 dBW/m^2
South Hemi A Beam (LHCP)	-105.6 to -73.6 dBW/m^2
South Hemi B Beam (RHCP)	-105.6 to -73.6 dBW/m^2
Global A Beam (LHCP)	-99.3 to -67.3 dBW/m^2
Global B Beam (RHCP)	-99.3 to -67.3 dBW/m^2
F1 Beam (H)	-107.7 to -75.7 dBW/m^2
F2 Beam (H)	-106.3 to -74.3 dBW/m^2
F2 Beam (V)	-106.4 to -74.4 dBW/m^2
U.S. Beam (V)	-107.8 to -75.8 dBW/m^2
Transponder Range	
Fixed Gain Mode	32 dB in 1 dB increments
Automatic Level Control Mode – LTWTA IBO range	18 dB in 0.5 dB steps (Applicable at Ku-band only)

COMMUNICATION	
Transponder Gain	
North Hemi A Uplink – North Hemi A Downlink	129.9 – 97.9 dB
North Hemi A Uplink – South Hemi A Downlink	129.9 – 97.9 dB
North Hemi B Uplink – North Hemi B Downlink	129.9 – 97.9 dB
North Hemi B Uplink – South Hemi B Downlink	129.9 – 97.9 dB
South Hemi A Uplink – South Hemi A Downlink	129.9 – 97.9 dB
South Hemi A Uplink – North Hemi A Downlink	129.9 – 97.9 dB
South Hemi B Uplink – South Hemi B Downlink	129.9 – 97.9 dB
South Hemi B Uplink – North Hemi B Downlink	129.9 – 97.9 dB
Global A Uplink – Global A Downlink	130.5 – 98.5 dB
Global B Uplink – Global B Downlink	130.5 – 98.5 dB
F1 Uplink – F1 Downlink	134.8 – 102.8 dB
F1 Uplink – F2 (V) Downlink	134.8 – 102.8 dB
F2 (H) Uplink – F2 (V) Downlink	134.8 – 102.8 dB
F2 (H) Uplink – F1 Downlink	134.8 – 102.8 dB
F2 (V) Uplink – F2 (H) Downlink	134.8 – 102.8 dB
US Uplink – F2 (H) Downlink	134.8 – 102.8 dB
Unit Redundancy	
Receiver	C-Band: 3x(4-for-2) Ku-Band: 8-for-4
Frequency Converter	Ku-Band: 2x(4-for-2) & 6-for-3
Amplifier	C-Band: 2x(16-for-12) Ku-Band: 2x(8-for-6)
Maximum Power of Last Amplifier Stage	C-Band: 45 Watts Ku-Band: 150 Watts
Transmit Frequency Stability	< 0.002%

EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS (continued)

TELEMETRY, COMMAND & RANGING	
Command Frequency	
Omni Antenna	6173.7 / 6176.3 MHz
Wide Coverage Antenna	6173.7 / 6176.3 MHz
Global Coverage Antenna	6173.7 / 6176.3 MHz
Command Polarization	
Omni Antenna	Left Hand Circular
Wide Coverage Antenna	Left Hand Circular
Global Coverage Antenna	Left Hand Circular
Command Carrier Modulation	FM
Command Carrier Bandwidth	
Occupied Bandwidth	860 kHz
Allocated Bandwidth	1000 kHz
Command Antennas	
Transfer Orbit / Emergency	2 Wide Coverage Antennas and an Omni Antenna
On-Station	Global Coverage Antenna
Command Threshold at Beam Peak	
Omni Antenna	-97.9 dBW/m^2
Wide Coverage Antenna	-103.9 dBW/m^2
Global Coverage Antenna	-115.3 dBW/m^2
Command G/T at Beam Peak	
Omni Antenna	-36.4 dB/K
Wide Coverage Antenna	-30.4 dB/K
Global Coverage Antenna	-18.9 dB/K
Telemetry Frequency	
Omni Antenna	3947.5 / 3952.5 MHz
Wide Coverage Antenna	3947.5 / 3952.5 MHz
Global Coverage Antenna	3947.5 / 3952.5 MHz
Telemetry Polarization	
Omni Antenna	Right Hand Circular
Wide Coverage Antenna	Right Hand Circular
Global Coverage Antenna	Right Hand Circular
Telemetry Modulation	PM

EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS (continued)

TELEMETRY, COMMAND & RANGING	
Telemetry Carrier Bandwidth	
Occupied Bandwidth	300 kHz
Allocated Bandwidth	500 kHz
Telemetry Antenna	
Transfer Orbit / Emergency	2 Wide Coverage Antennas and an Omni Antenna
On-Station	Global Coverage Antenna
Telemetry EIRP at Beam Peak	
Omni Antenna	6.5 dBW
Wide Coverage Antenna	13.1 dBW
Global Coverage Antenna	12.8 dBW
Ranging Accuracy	≤ 10 meters

EXHIBIT 2: SUMMARY OF SPACECRAFT CHARACTERISTICS (continued)

ULPC	
Frequency	C-Band: 3950 MHz Ku-Band: 11198 / 11452 / 12502 MHz
Polarization	C-Band: Vertical Ku-Band: Right Hand Circular
Coverage Area	Global
Number of channels	C-Band: 1 Ku-Band: 3
Channel Bandwidth	25 kHz
Maximum Downlink EIRP	C-Band: 10 dBW Ku-Band: 13.2 dBW

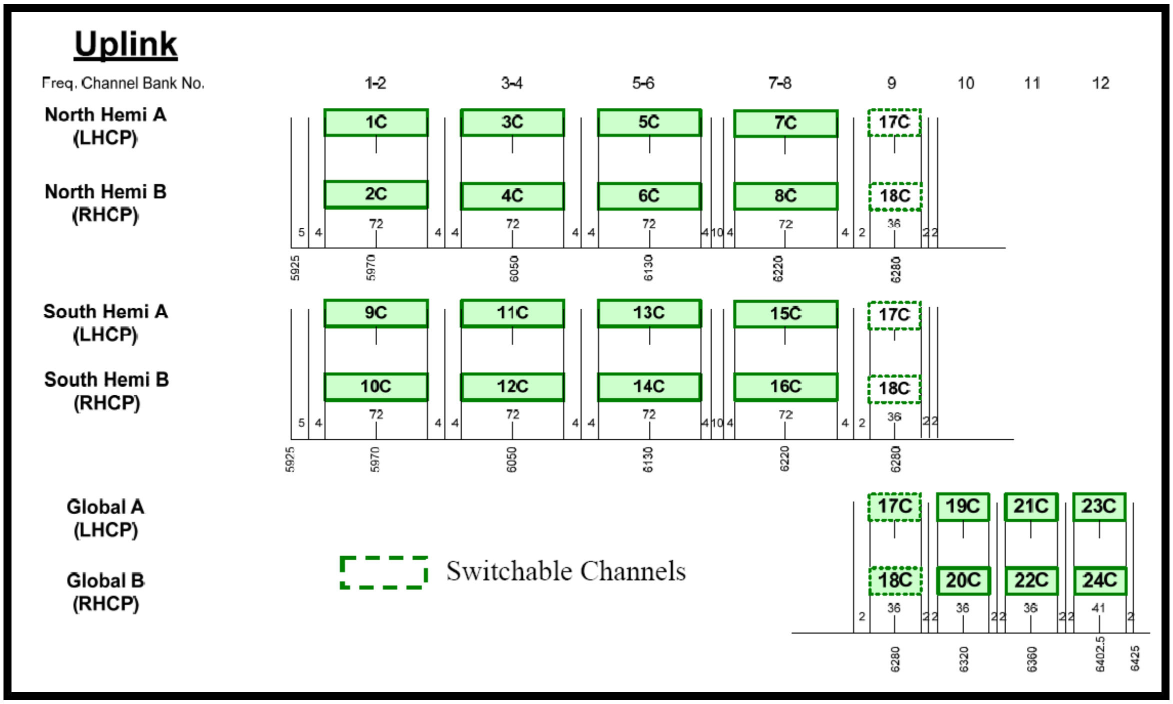
EXHIBIT 3: SPACECRAFT MASS BUDGET

Mass of Spacecraft without Fuel (kg)	1464
Mass of Fuel and Disposables (kg)	1736
Launch Mass (kg)	3200
Mass of Fuel, in orbit, at Beginning of Life (kg)	619

EXHIBIT 4: SPACECRAFT POWER BUDGET

	BEGINNING OF LIFE		END OF LIFE	
	AUTUMN EQUINOX	SUMMER SOLSTICE	AUTUMN EQUINOX	SUMMER SOLSTICE
PAYLOAD (WATTS)	4898	4898	4898	4898
BUS (WATTS)	1345	753	1345	753
TOTAL POWER (WATTS)	6243	5651	6243	5651
SOLAR ARRAY POWER (WATTS)	6949	6386	6746	6114
DEPTH OF BATTERY DISCHARGE (%)	66.4%	N/A	67.2%	N/A

EXHIBIT 5A: FREQUENCY PLAN



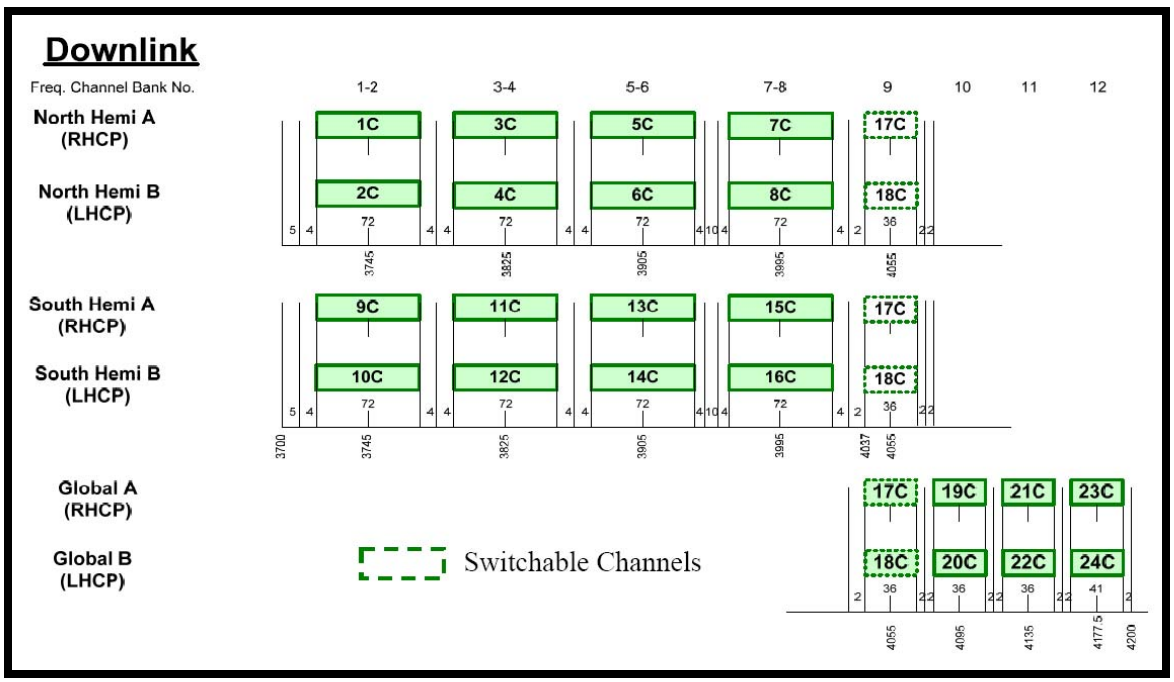


EXHIBIT 5A: FREQUENCY PLAN (continued)

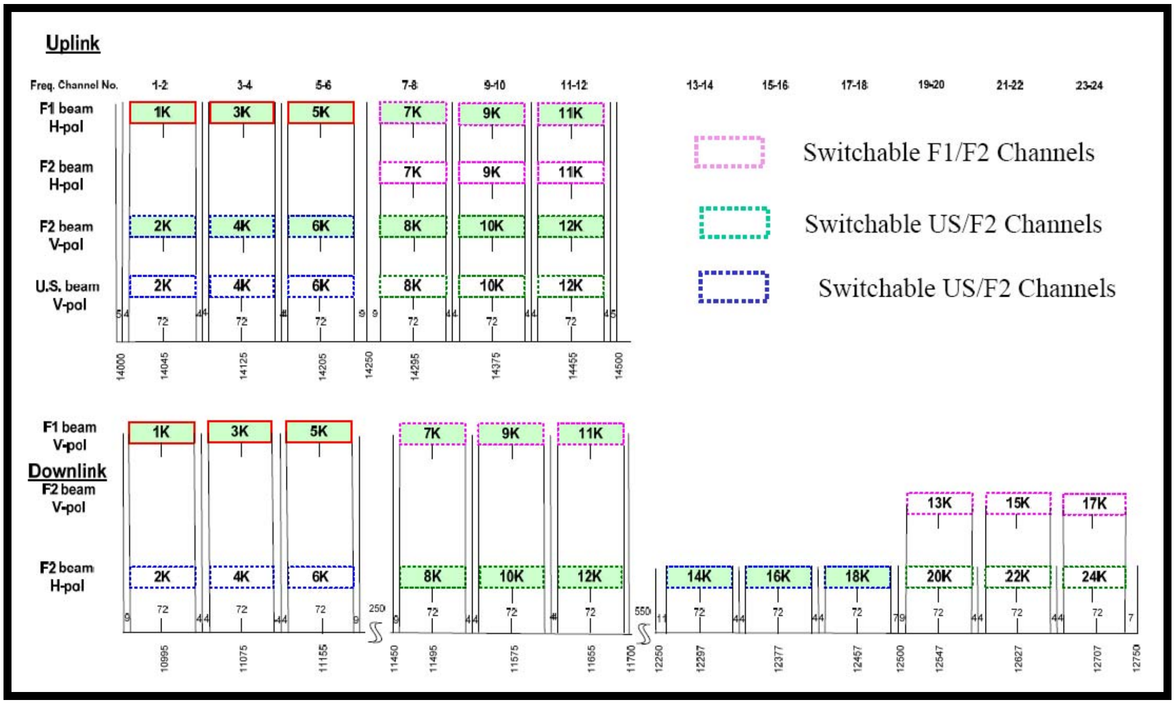


EXHIBIT 5B: FREQUENCY ASSIGNMENTS

Uplink Channel Designation	Uplink Beam Name	Uplink Beam Polarization	Uplink Center Frequency (MHz)	Downlink Channel Designation	Downlink Beam Name	Downlink Beam Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
1C	N. Hemi A	LCHP	5970	1C	N. Hemi A	RHCP	3745	72	129.9
				9C	S. Hemi A	RHCP	3745	72	129.9
3C	N. Hemi A	LCHP	6050	3C	N. Hemi A	RHCP	3825	72	129.9
				11C	S. Hemi A	RHCP	3825	72	129.9
5C	N. Hemi A	LCHP	6130	5C	N. Hemi A	RHCP	3905	72	129.9
				13C	S. Hemi A	RHCP	3905	72	129.9
7C	N. Hemi A	LCHP	6220	7C	N. Hemi A	RHCP	3995	72	129.9
				15C	S. Hemi A	RHCP	3995	72	129.9
17C	N. Hemi A	LCHP	6280	17C	N. Hemi A	RHCP	4055	36	129.9
2C	N. Hemi B	RHCP	5970	2C	N. Hemi B	LHCP	3745	72	129.9
				10C	S. Hemi B	LHCP	3745	72	129.9
4C	N. Hemi B	RHCP	6050	4C	N. Hemi B	LHCP	3825	72	129.9
				12C	S. Hemi B	LHCP	3825	72	129.9
6C	N. Hemi B	RHCP	6130	6C	N. Hemi B	LHCP	3905	72	129.9
				14C	S. Hemi B	LHCP	3905	72	129.9
8C	N. Hemi B	RHCP	6220	8C	N. Hemi B	LHCP	3995	72	129.9
				16C	S. Hemi B	LHCP	3995	72	129.9
18C	N. Hemi B	RHCP	6280	18C	N. Hemi B	LHCP	4055	36	129.9
9C	S. Hemi A	LHCP	5970	9C	S. Hemi A	RHCP	3745	72	129.9
				1C	N. Hemi A	RHCP	3745	72	129.9
11C	S. Hemi A	LHCP	6050	11C	S. Hemi A	RHCP	3825	72	129.9
				3C	N. Hemi A	RHCP	3825	72	129.9
13C	S. Hemi A	LHCP	6130	13C	S. Hemi A	RHCP	3905	72	129.9
				5C	N. Hemi A	RHCP	3905	72	129.9
15C	S. Hemi A	LHCP	6220	15C	S. Hemi A	RHCP	3995	72	129.9
				7C	N. Hemi A	RHCP	3995	72	129.9
17C	S. Hemi A	LHCP	6280	17C	S. Hemi A	RHCP	4055	36	129.9
10C	S. Hemi B	RHCP	5970	10C	S. Hemi B	LHCP	3745	72	129.9
				2C	N. Hemi B	LHCP	3745	72	129.9
12C	S. Hemi B	RHCP	6050	12C	S. Hemi B	LHCP	3825	72	129.9
				4C	N. Hemi B	LHCP	3825	72	129.9
14C	S. Hemi B	RHCP	6130	14C	S. Hemi B	LHCP	3905	72	129.9
				6C	N. Hemi B	LHCP	3905	72	129.9
16C	S. Hemi B	RHCP	6220	16C	S. Hemi B	LHCP	3995	72	129.9
				8C	N. Hemi B	LHCP	3995	72	129.9
18C	S. Hemi B	RHCP	6280	18C	S. Hemi B	LHCP	4055	36	129.9
17C	Global A	LHCP	6280	17C	Global A	RHCP	4055	36	130.5
19C	Global A	LHCP	6320	19C	Global A	RHCP	4095	36	130.5
21C	Global A	LHCP	6360	21C	Global A	RHCP	4135	36	130.5
23C	Global A	LHCP	6402.5	23C	Global A	RHCP	4177.5	41	130.5
18C	Global B	RHCP	6280	18C	Global B	LHCP	4055	36	130.5
20C	Global B	RHCP	6320	20C	Global B	LHCP	4095	36	130.5
22C	Global B	RHCP	6360	22C	Global B	LHCP	4135	36	130.5
24C	Global B	RHCP	6402.5	24C	Global B	LHCP	4177.5	41	130.5
CMD 1	Global A	LHCP	6173.7					1	
CMD 2	Global A	LHCP	6176.3					1	
CMD 3	Global (WCA)	LHCP	6173.7					1	
CMD 4	Global (WCA)	LHCP	6176.3					1	
CMD 5	Global (WCA)	LHCP	6173.7					1	
CMD 6	Global (WCA)	LHCP	6176.3					1	
				TLM1	Global A	RHCP	3947.5	0.5	
				TLM2	Global A	RHCP	3952.5	0.5	
				TLM3	Global (WCA)	RHCP	3947.5	0.5	
				TLM4	Global (WCA)	RHCP	3952.5	0.5	
				TLM5	Global (WCA)	RHCP	3947.5	0.5	
				TLM6	Global (WCA)	RHCP	3952.5	0.5	
				BNC1	Global	V	3950.0	0.025	

EXHIBIT 5B: FREQUENCY ASSIGNMENTS (continued)

Uplink Channel Designation	Uplink Beam Name	Uplink Beam Polarization	Uplink Center Frequency (MHz)	Downlink Channel Designation	Downlink Beam Name	Downlink Beam Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
1K	F1	H	14045	1K	F1	V	10995	72	134.8
3K	F1	H	14125	3K	F1	V	11075	72	134.8
5K	F1	H	14205	5K	F1	V	11155	72	134.8
7K	F1	H	14295	7K	F1	V	11495	72	134.8
				13K	F2	V	12547	72	134.8
9K	F1	H	14375	9K	F1	V	11575	72	134.8
				15K	F2	V	12627	72	134.8
11K	F1	H	14455	11K	F1	V	11655	72	134.8
				17K	F2	V	12707	72	134.8
7K	F2	H	14295	7K	F1	V	11495	72	134.8
				13K	F2	V	12547	72	134.8
9K	F2	H	14375	9K	F1	V	11575	72	134.8
				15K	F2	V	12627	72	134.8
11K	F2	H	14455	11K	F1	V	11655	72	134.8
				17K	F2	V	12707	72	134.8
2K	F2	V	14045	2K	F2	H	10995	72	134.8
				14K	F2	H	12297	72	134.8
4K	F2	V	14125	4K	F2	H	11075	72	134.8
				16K	F2	H	12377	72	134.8
6K	F2	V	14205	6K	F2	H	11155	72	134.8
				18K	F2	H	12457	72	134.8
8K	F2	V	14295	8K	F2	H	11495	72	134.8
				20K	F2	H	12547	72	134.8
10K	F2	V	14375	10K	F2	H	11575	72	134.8
				22K	F2	H	12627	72	134.8
12K	F2	V	14455	12K	F2	H	11655	72	134.8
				24K	F2	H	12707	72	134.8
2K	US	V	14045	2K	F2	H	10955	72	134.8
				14K	F2	H	12297	72	134.8
4K	US	V	14125	4K	F2	H	11075	72	134.8
				16K	F2	H	12377	72	134.8
6K	US	V	14205	6K	F2	H	11155	72	134.8
				18K	F2	H	12457	72	134.8
8K	US	V	14295	8K	F2	H	11495	72	134.8
				20K	F2	H	12547	72	134.8
10K	US	V	14375	10K	F2	H	11575	72	134.8
				22K	F2	H	12627	72	134.8
12K	US	V	14455	12K	F2	H	11655	72	134.8
				24K	F2	H	12707	72	134.8
				BNK1	Global	RHCP	11198	0.025	
				BNK2	Global	RHCP	11452	0.025	
				BNK3	Global	RHCP	12502	0.025	

EXHIBIT 6A: NORTH HEMI A RECEIVE BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 29.3 dBi
Peak G/T: 2.7 dB/K
Saturated Flux Density at Peak G/T: -108.1 to -76.1 dBW/m^2
(Schedule S Beam Designation: NALU)

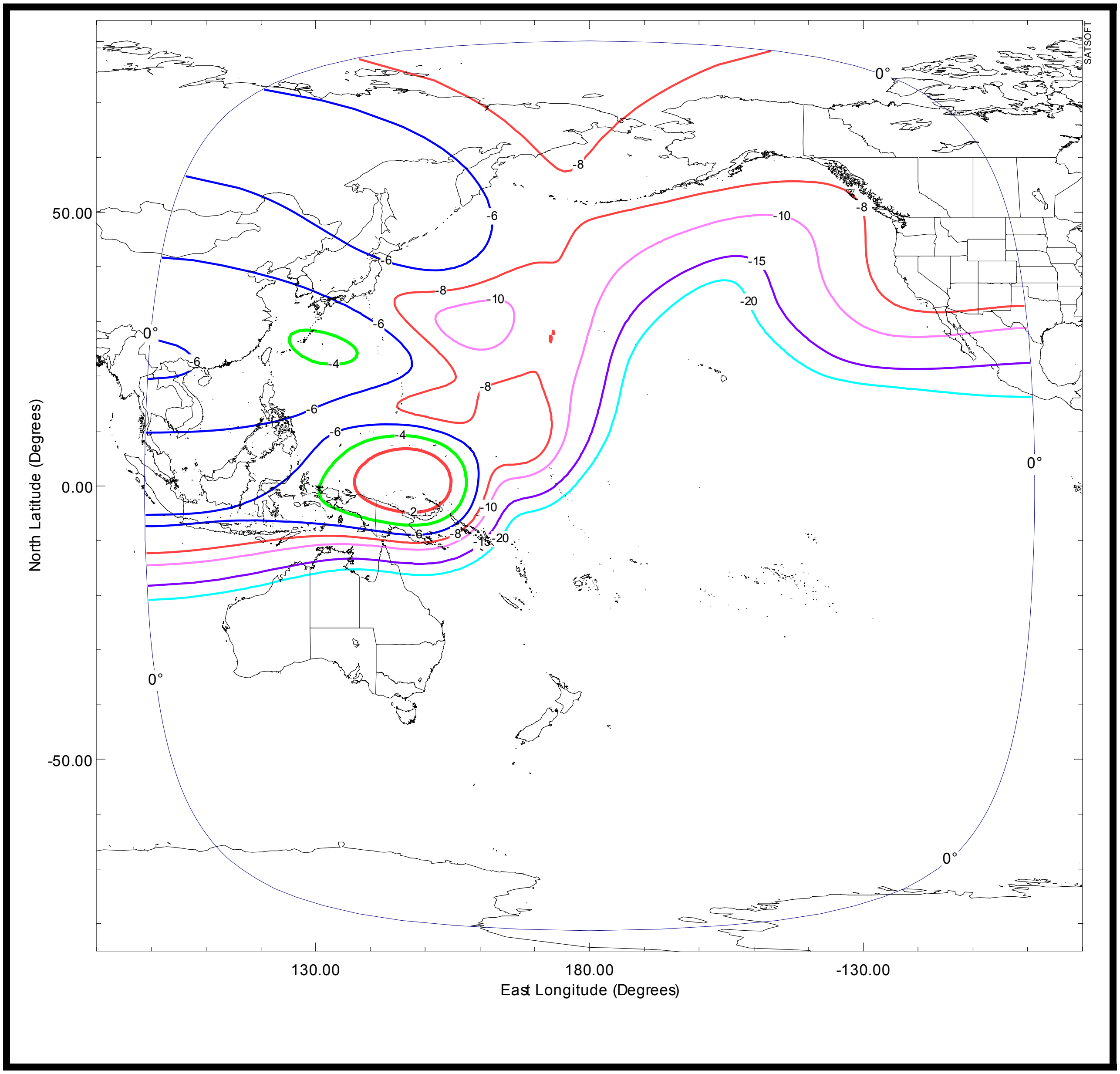


EXHIBIT 6B: NORTH HEMI B RECEIVE BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 29.3 dBi

Peak G/T: 2.7 dB/K

Saturated Flux Density at Peak G/T: -108.1 to -76.1 dBW/m^2

(Schedule S Beam Designation: NBRU)

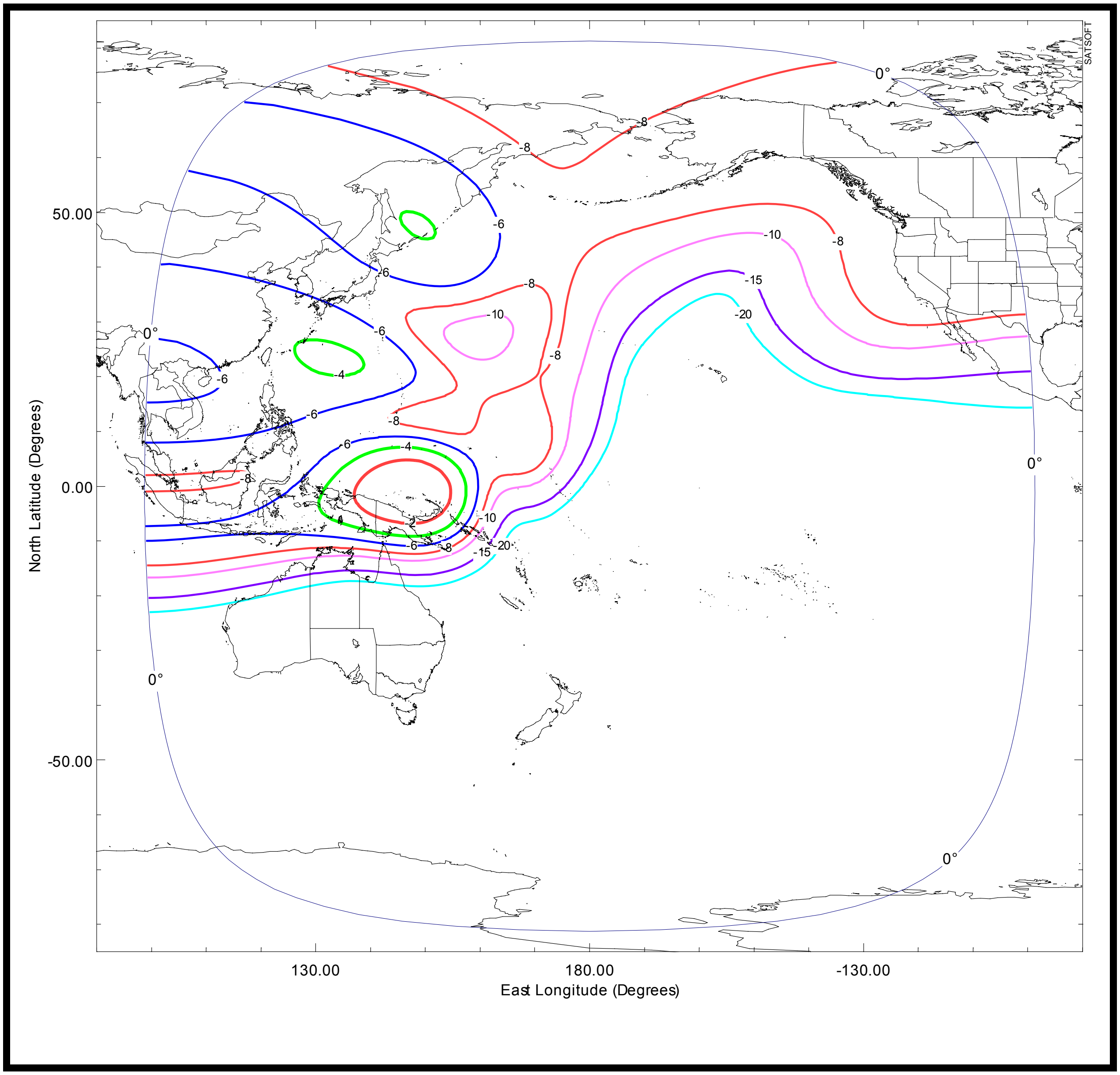


EXHIBIT 6C: SOUTH HEMI A RECEIVE BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 26.8 dBi
Peak G/T: 0.1 dB/K
Saturated Flux Density at Peak G/T: -105.6 to -73.6 dBW/m^2
(Schedule S Beam Designation: SALU)

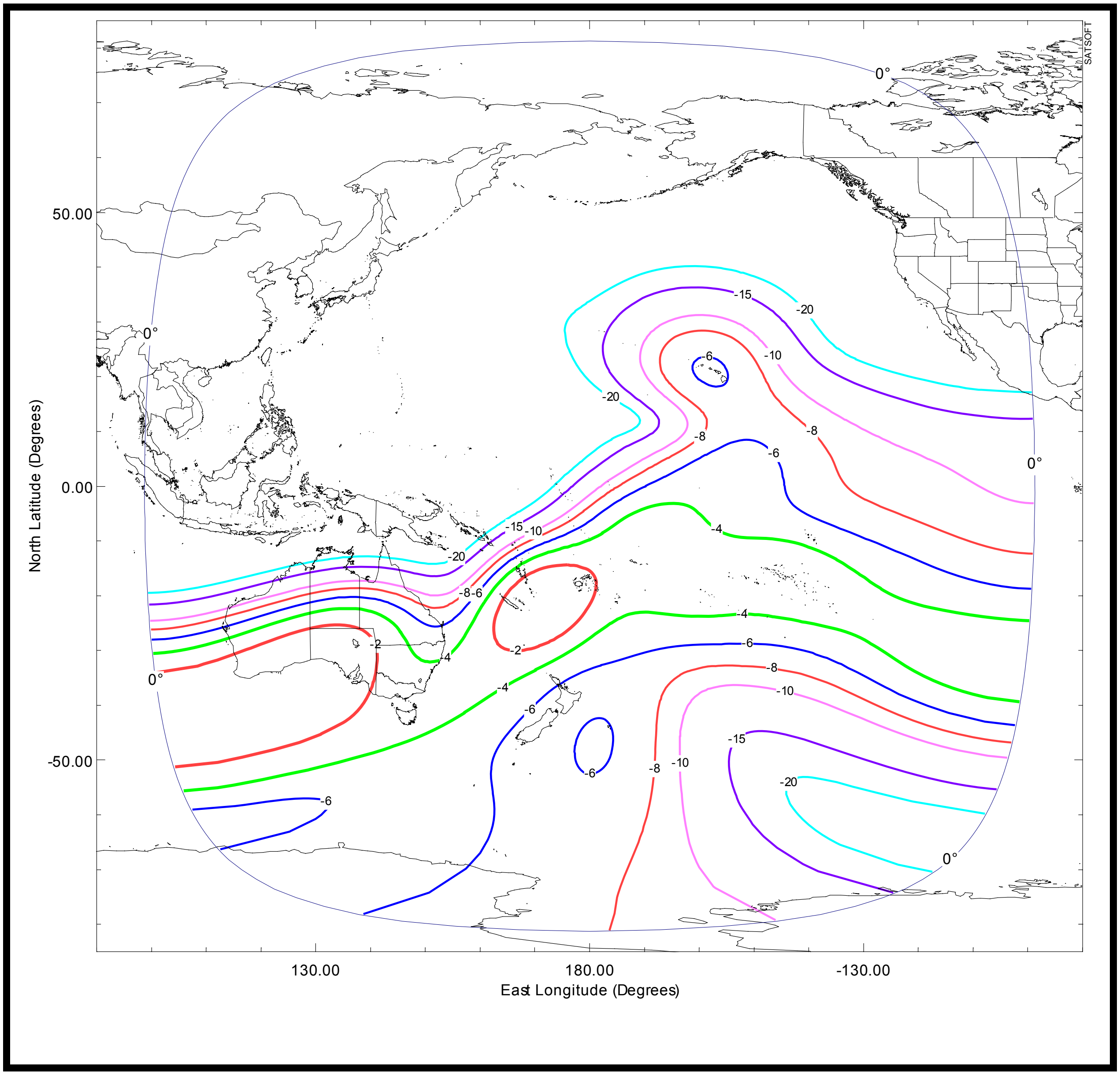


EXHIBIT 6D: SOUTH HEMI B RECEIVE BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 26.8 dBi

Peak G/T: 0.1 dB/K

Saturated Flux Density at Peak G/T: -105.6 to -73.6 dBW/m^2

(Schedule S Beam Designations: SBRU)

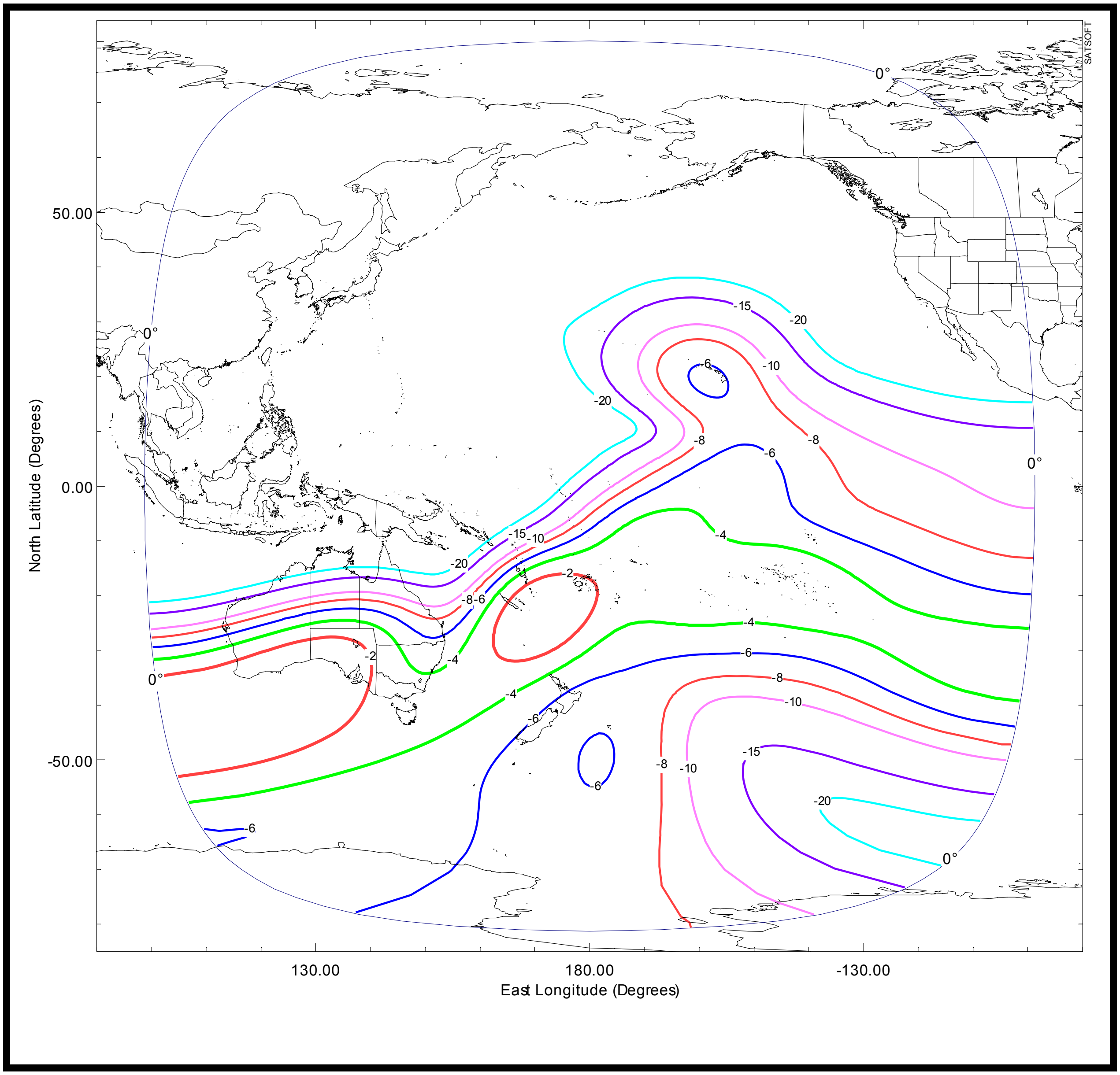


EXHIBIT 6E: GLOBAL A RECEIVE BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 20.8 dBi
Peak G/T: -5.5 dB/K
Saturated Flux Density at Peak G/T: -99.3 to -67.3 dBW/m^2
(Schedule S Beam Designations: GALU)

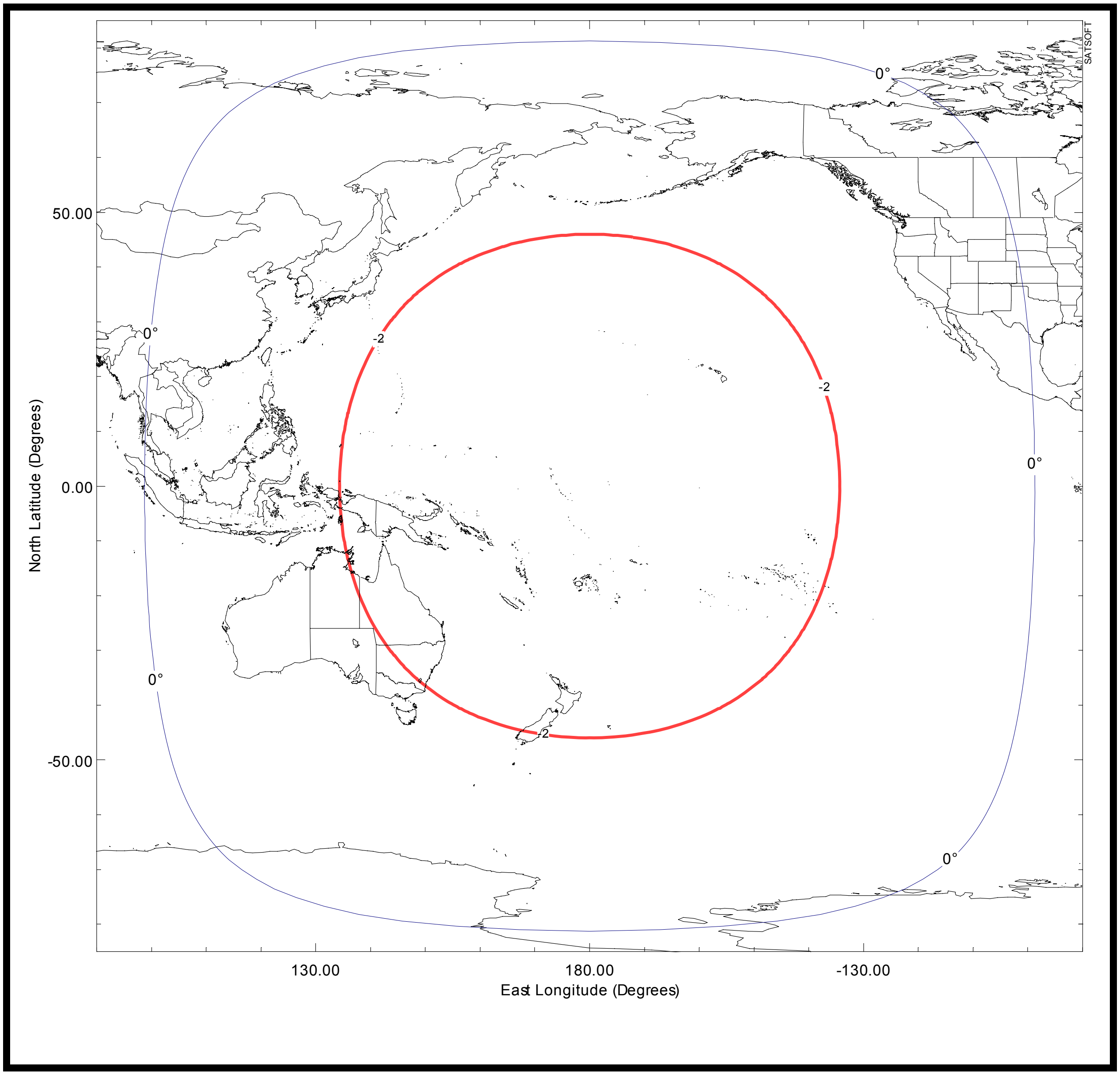


EXHIBIT 6F: GLOBAL B RECEIVE BEAM

Beam Polarization: Right Hand Circular
Peak Antenna Gain: 20.8 dBi
Peak G/T: -5.5 dB/K
Saturated Flux Density at Peak G/T: -99.3 to -67.3 dBW/m^2
(Schedule S Beam Designations: GBRU)

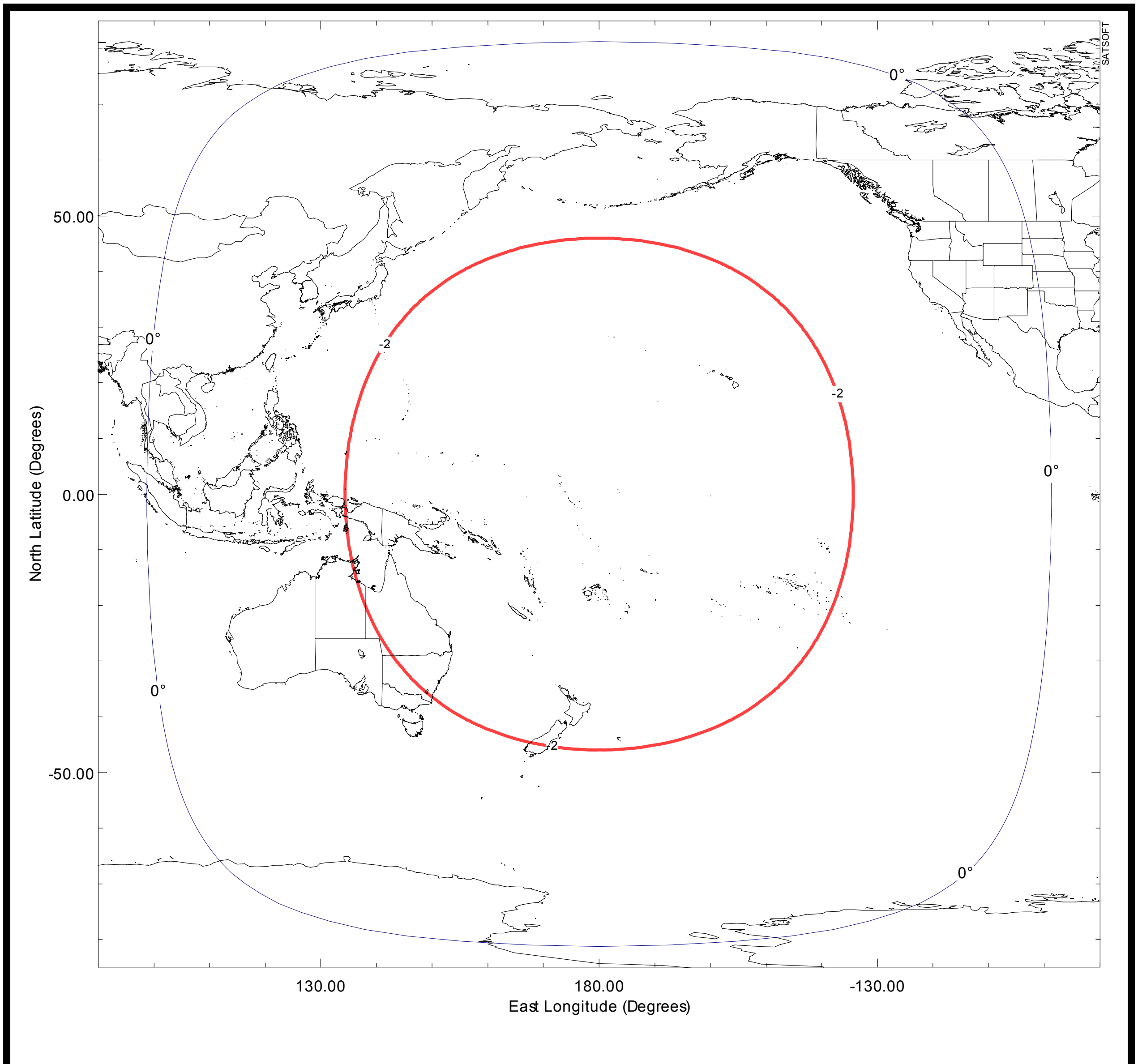


EXHIBIT 6G: F1 RECEIVE BEAM

Beam Polarization: Horizontal

Peak Antenna Gain: 36.2 dBi

Peak G/T: 8.2 dB/K

Saturated Flux Density at Peak G/T: -107.7 to -75.7 dBW/m^2

(Schedule S Beam Designations: F1HU)

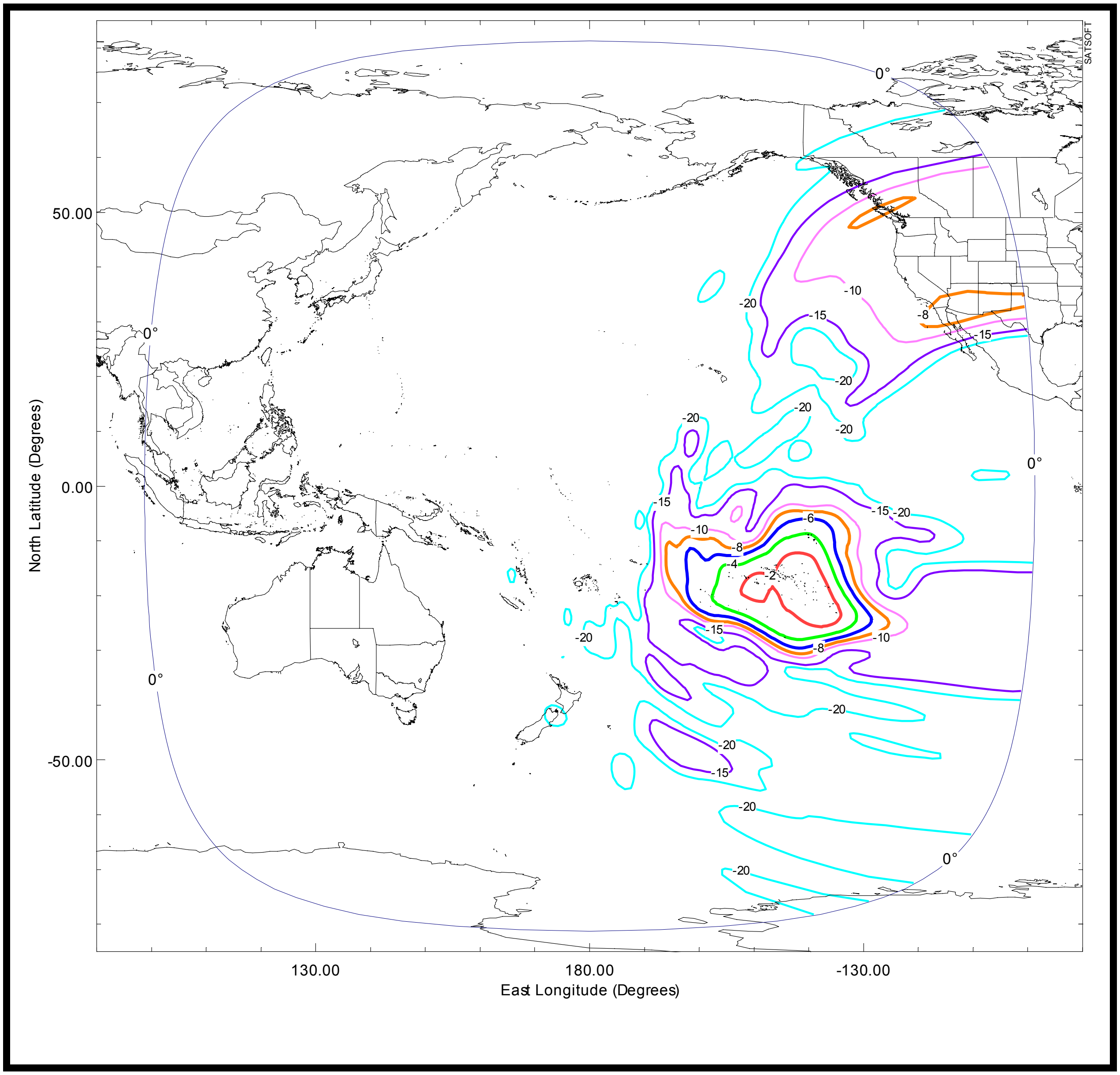


EXHIBIT 6H: F2 RECEIVE BEAM

Beam Polarization: Horizontal

Peak Antenna Gain: 34.9 dBi

Peak G/T: 6.9 dB/K

Saturated Flux Density at Peak G/T: -106.3 to -74.3 dBW/m^2

(Schedule S Beam Designations: F2HU)

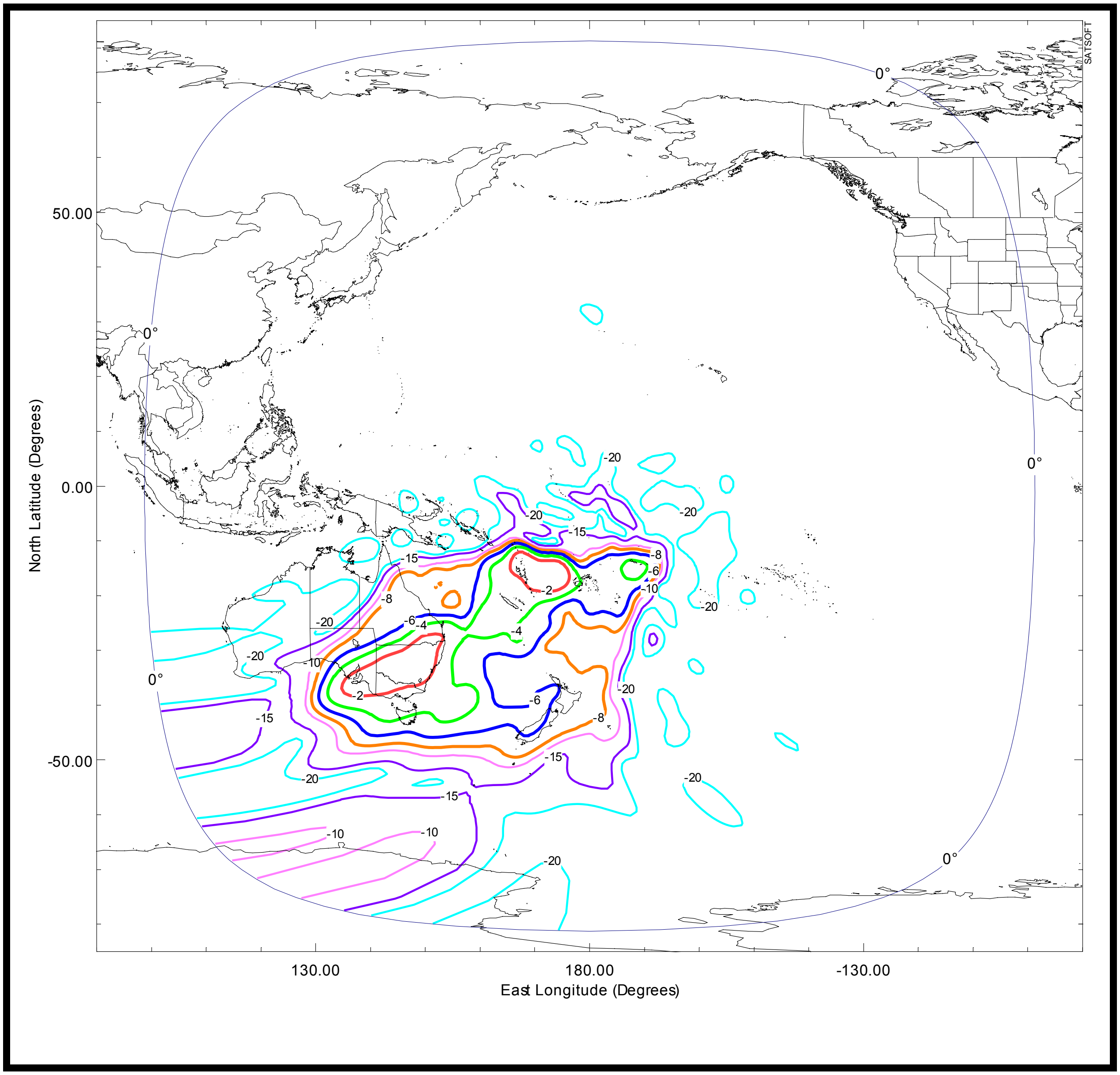


EXHIBIT 6I: F2 RECEIVE BEAM

Beam Polarization: Vertical
Peak Antenna Gain: 34.8 dBi
Peak G/T: 6.8 dB/K
Saturated Flux Density at Peak G/T: -106.4 to -74.4 dBW/m^2
(Schedule S Beam Designations: F2VU)

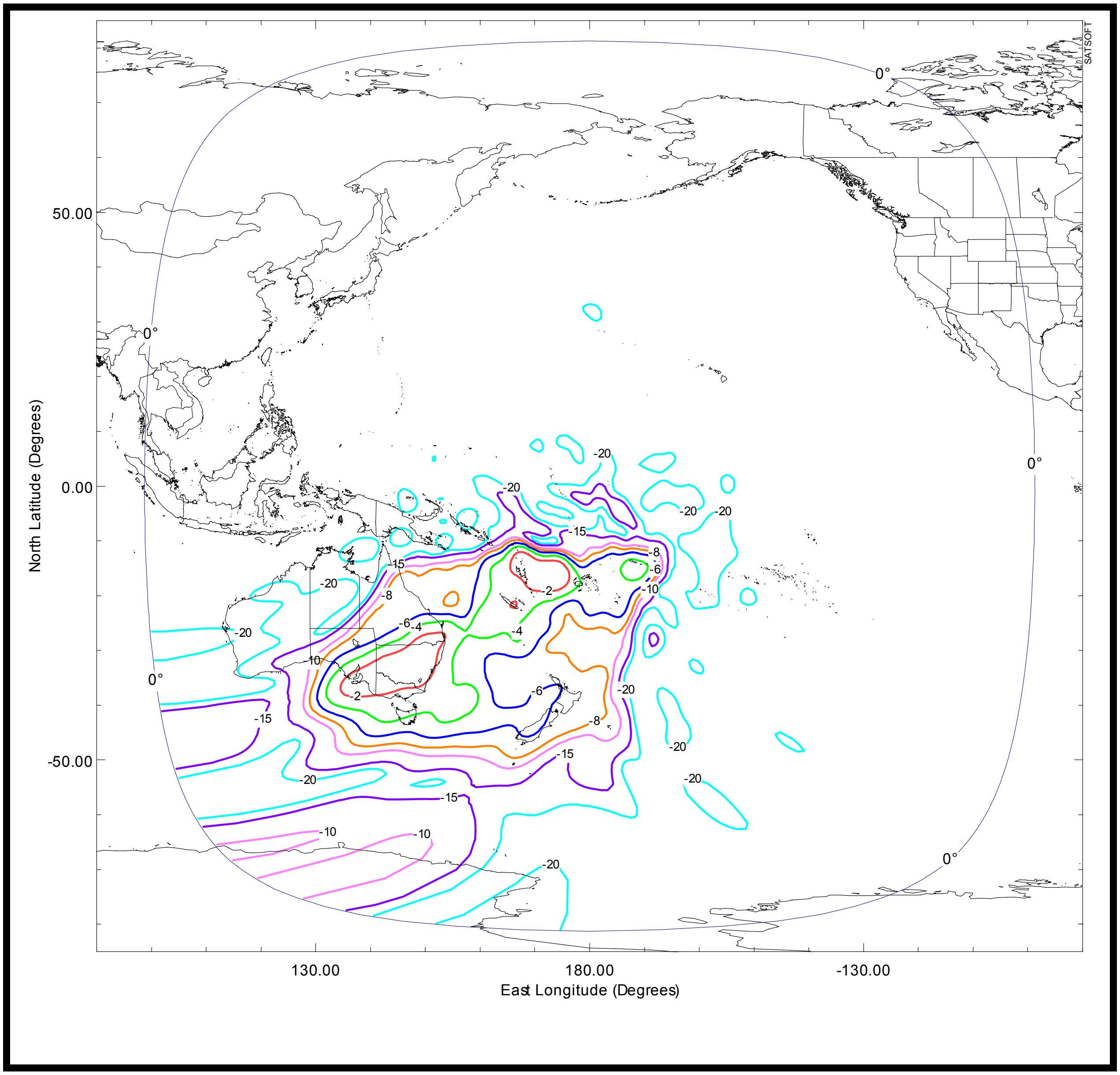


EXHIBIT 6J: U.S. RECEIVE BEAM

Beam Polarization: Vertical
Peak Antenna Gain: 36.3 dBi
Peak G/T: 8.3 dB/K
Saturated Flux Density at Peak G/T: -107.8 to -75.8 dBW/m^2
(Schedule S Beam Designations: USVU)

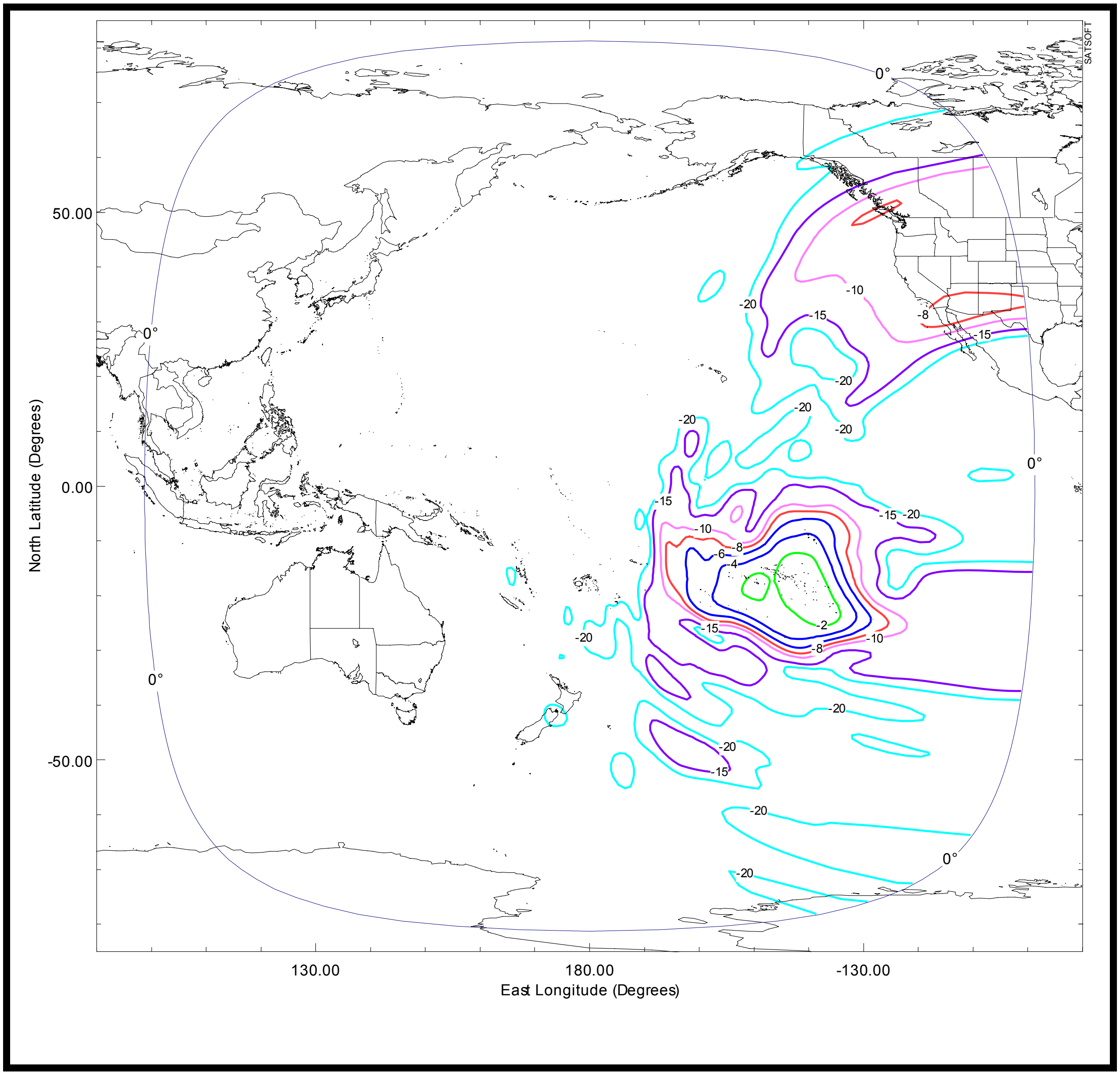


EXHIBIT 6K: NORTH HEMI A TRANSMIT BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 27.6 dBi

Peak EIRP: 41.5 dBW

(Schedule S Beam Designation: NARD)

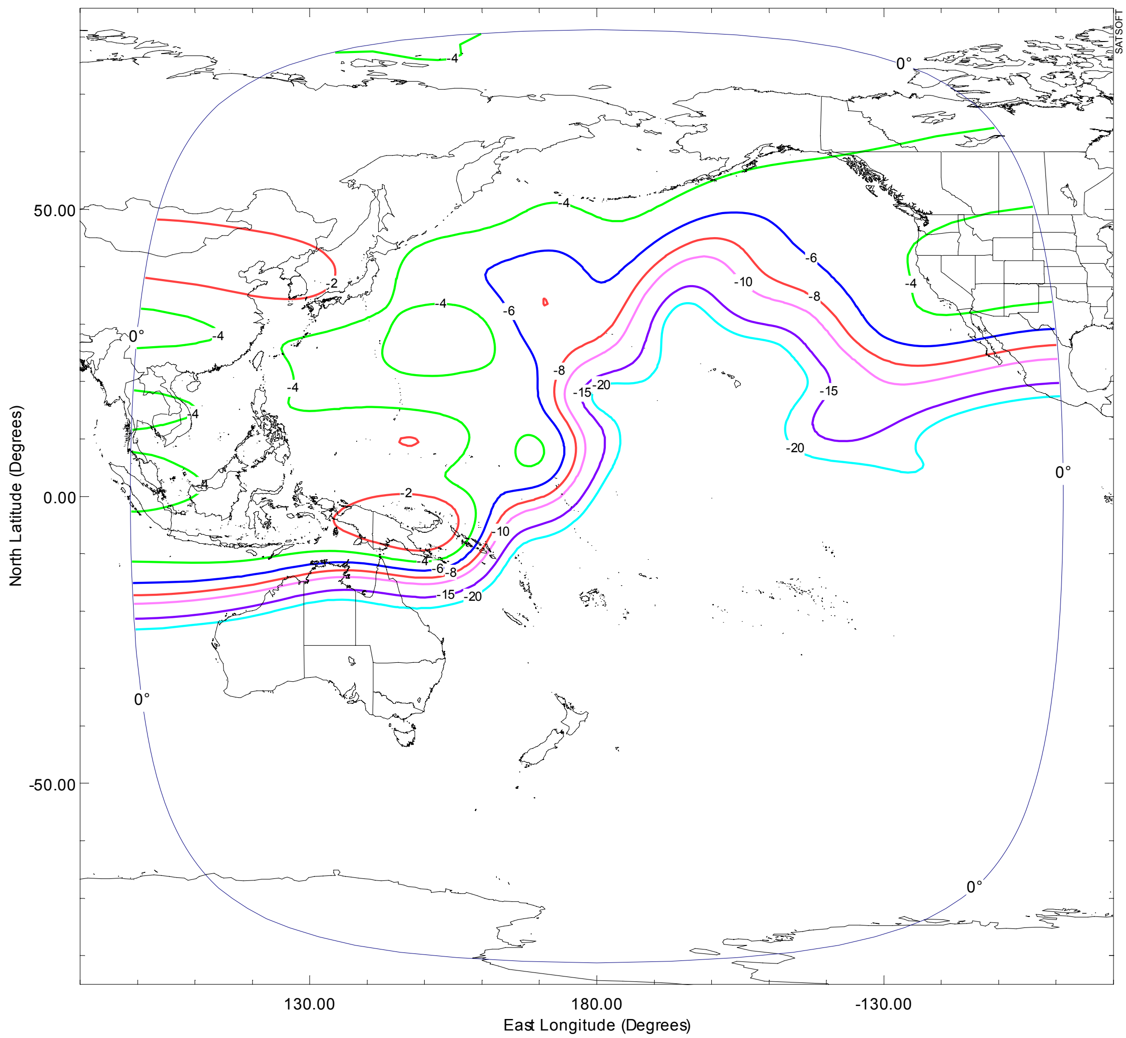


EXHIBIT 6L: NORTH HEMI B TRANSMIT BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 27.7 dBi
Peak EIRP: 41.6 dBW
(Schedule S Beam Designation: NBLD)

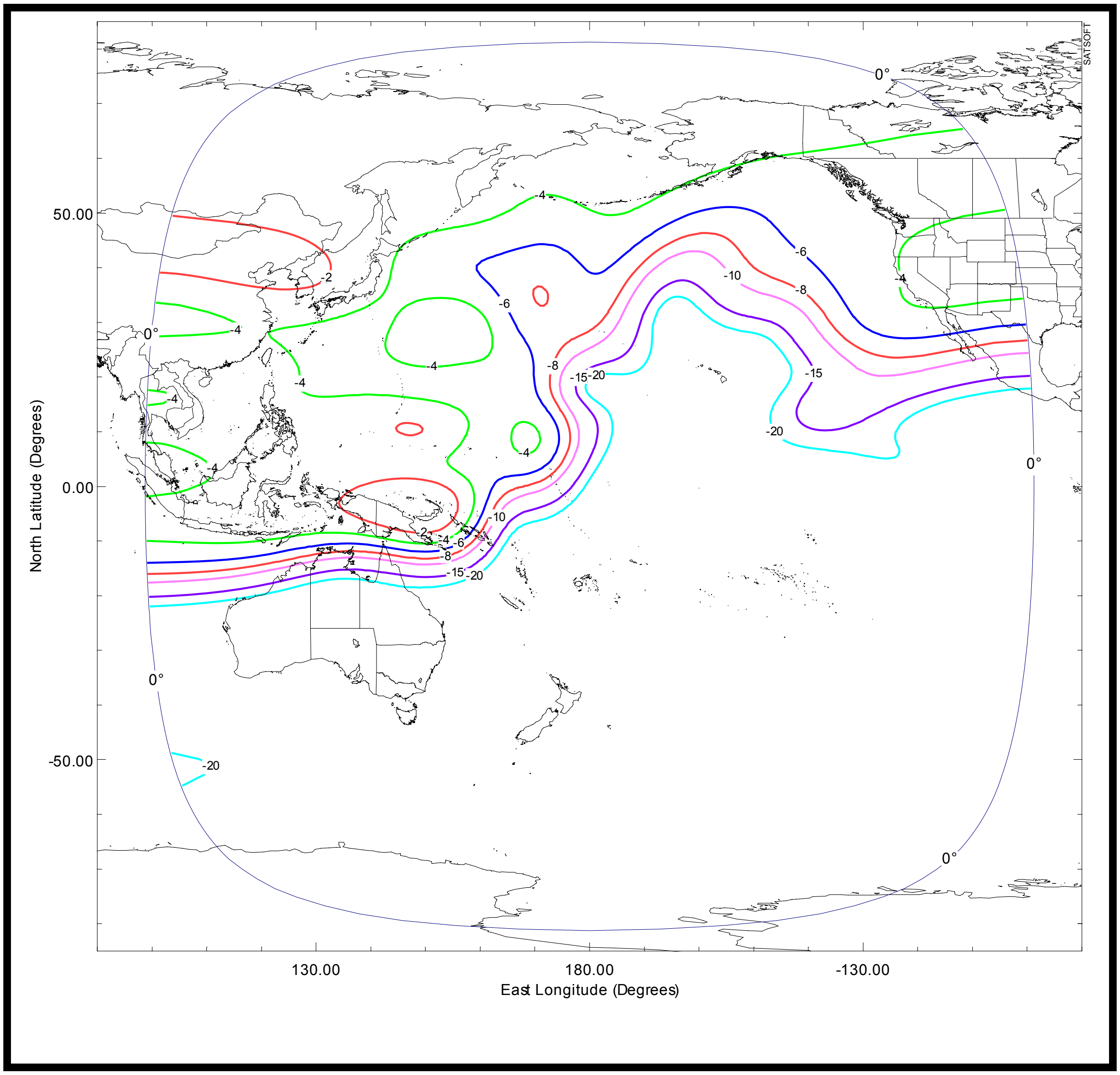


EXHIBIT 6M: SOUTH HEMI A TRANSMIT BEAM

Beam Polarization: Right Hand Circular
Peak Antenna Gain: 26.5 dBi
Peak EIRP: 40.4 dBW
(Schedule S Beam Designation: SARD)

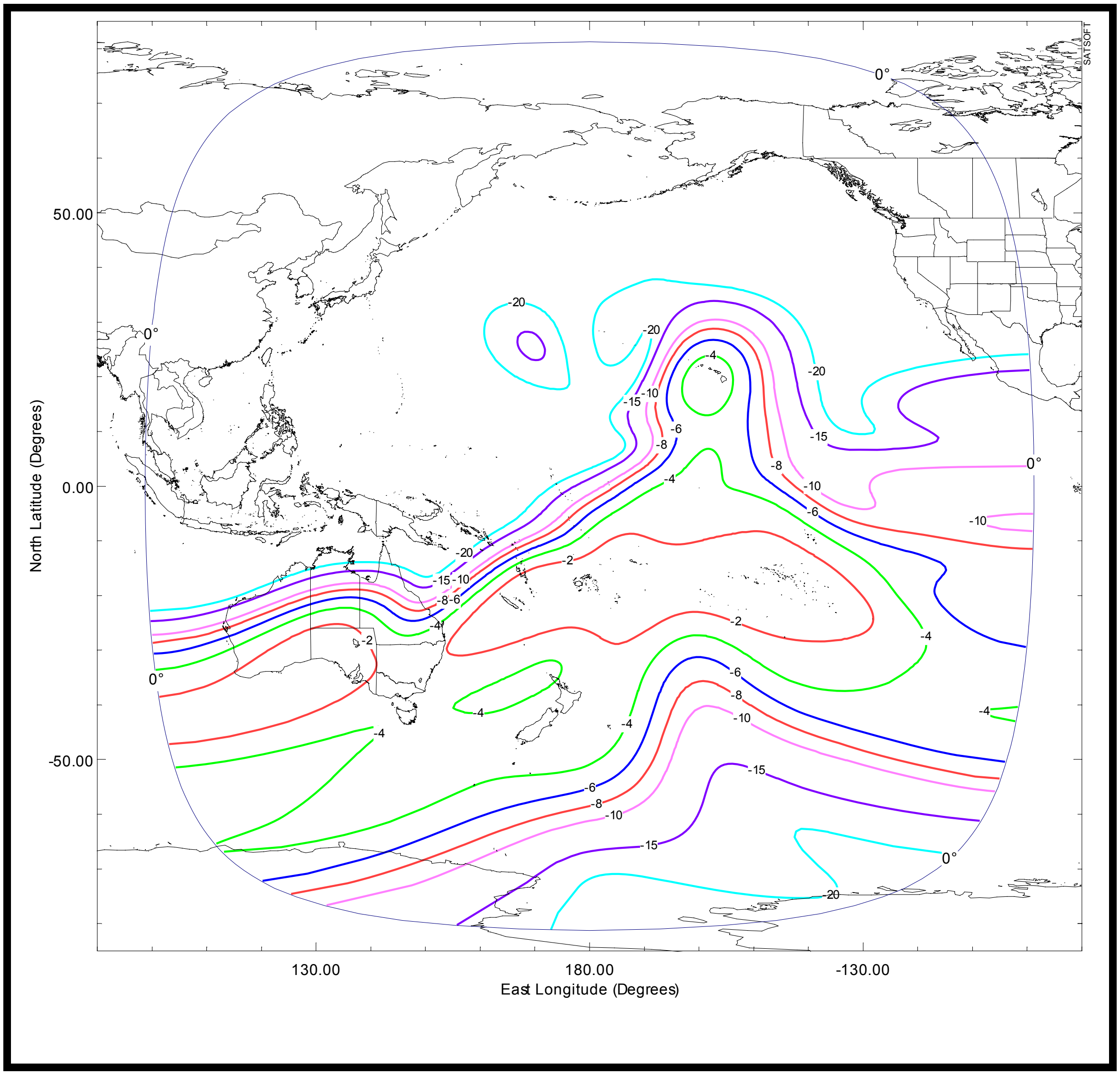


EXHIBIT 6N: SOUTH HEMI B TRANSMIT BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 26.5 dBi
Peak EIRP: 40.4 dBW
(Schedule S Beam Designation: SBLD)

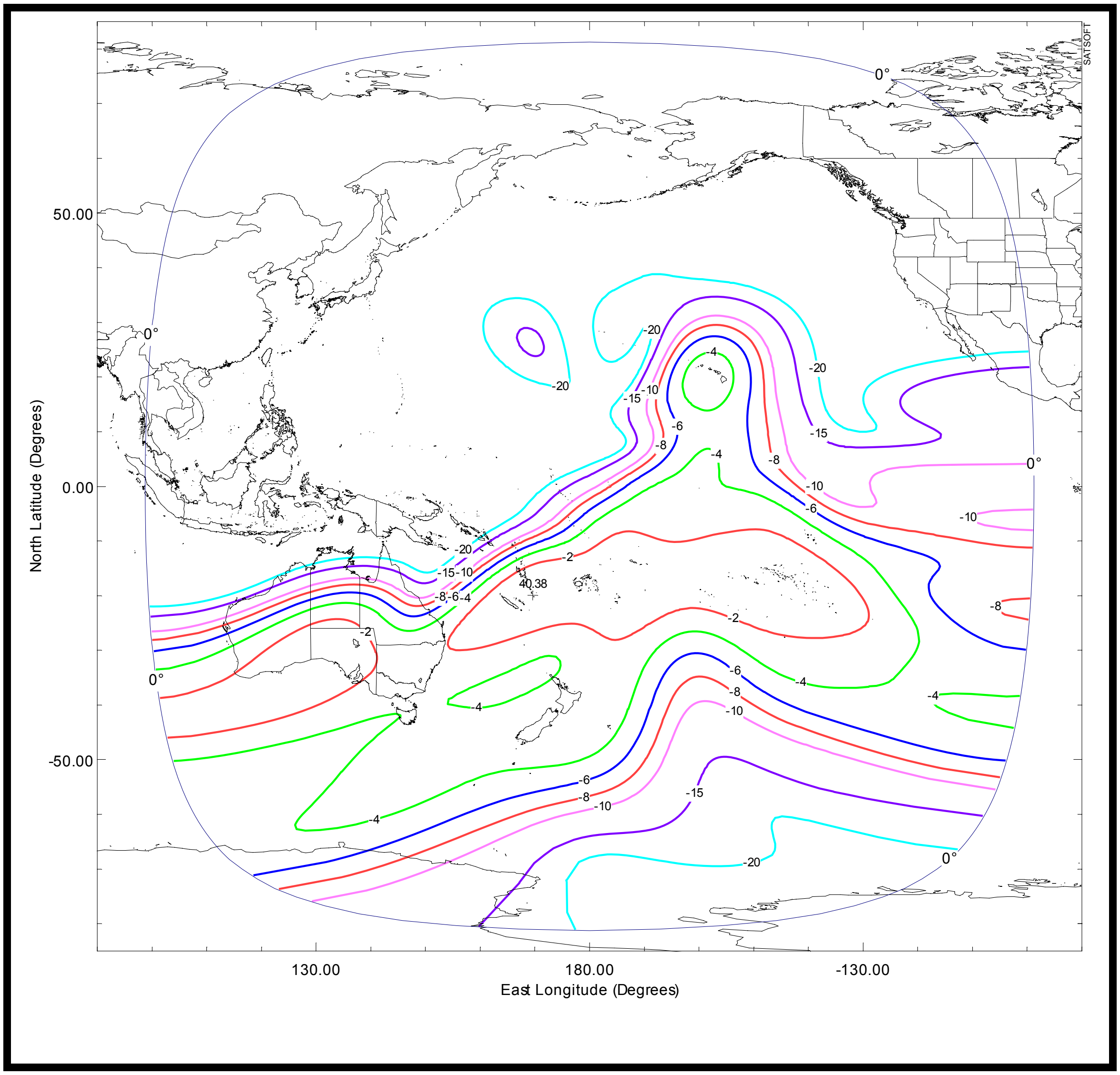


EXHIBIT 6O: GLOBAL A TRANSMIT BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 20.4 dBi

Peak EIRP: 34.9 dBW

(Schedule S Beam Designation: GARD)

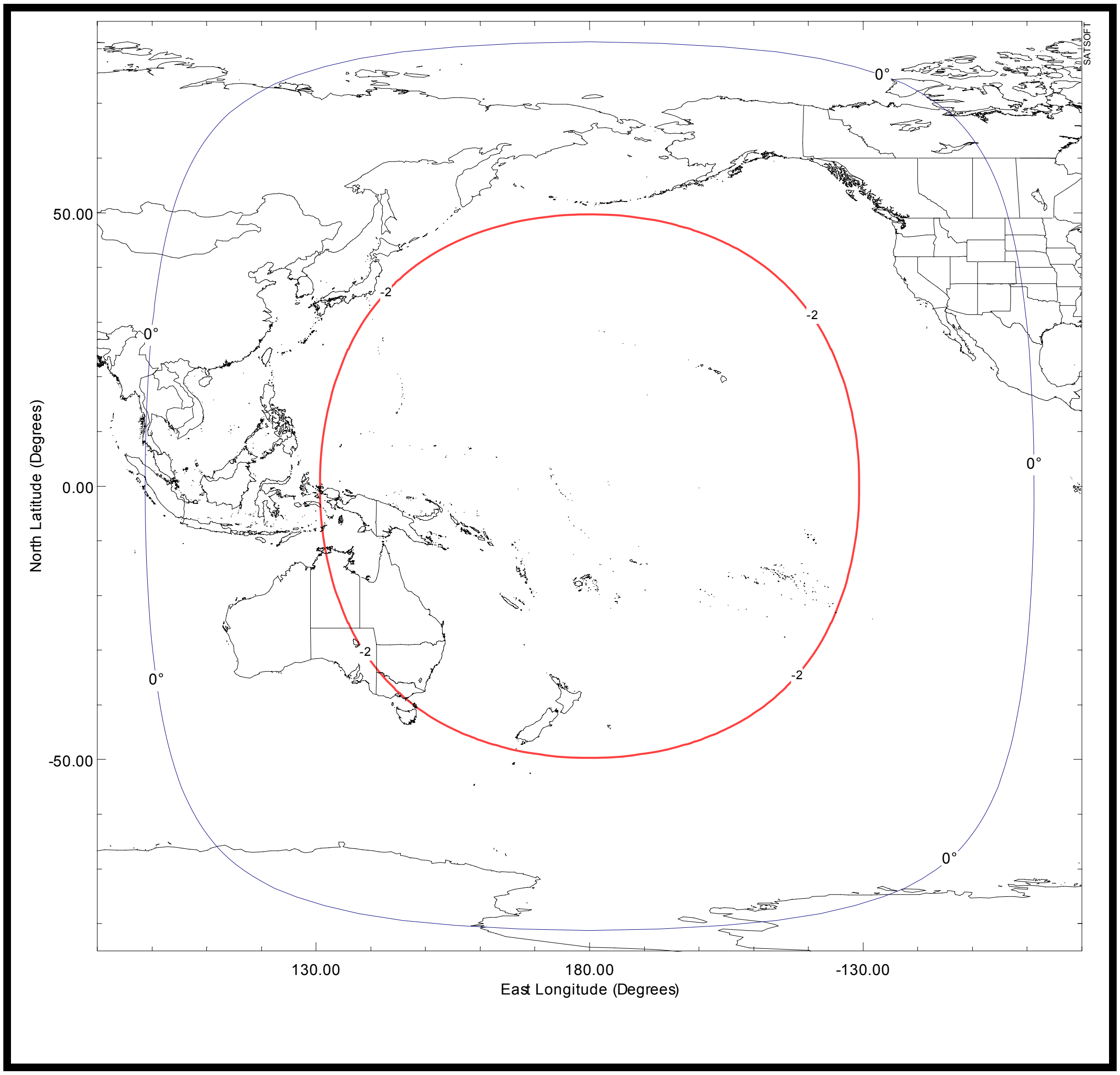


EXHIBIT 6P: GLOBAL B TRANSMIT BEAM

Beam Polarization: Left Hand Circular

Peak Antenna Gain: 20.4 dBi

Peak EIRP: 34.9 dBW

(Schedule S Beam Designation: GBLD)

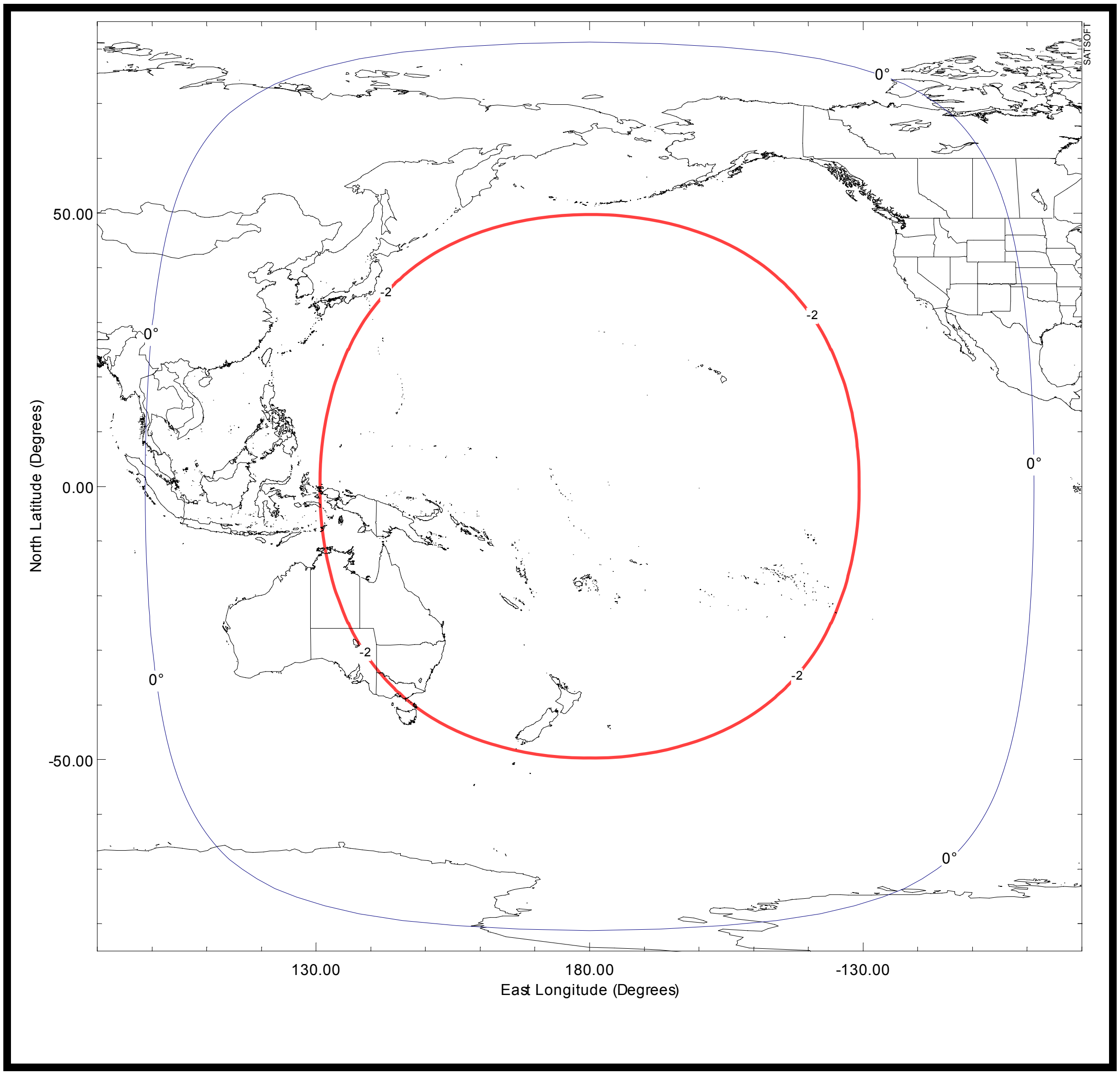


EXHIBIT 6Q: F1 TRANSMIT BEAM

Beam Polarization: Vertical
Peak Antenna Gain: 34.5 dBi
Peak EIRP: 53.3 dBW
(Schedule S Beam Designation: F1VD)

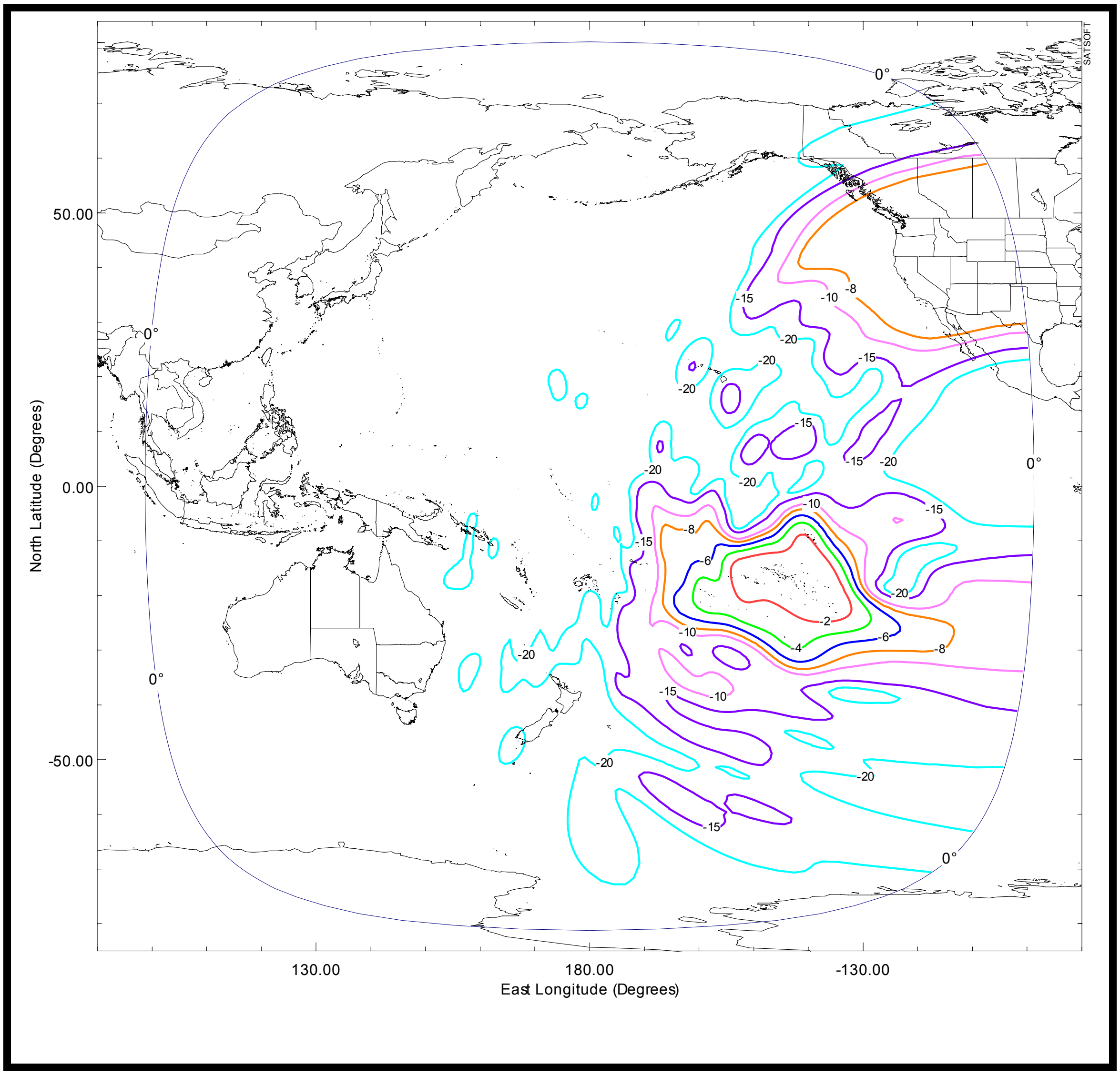


EXHIBIT 6R: F2 TRANSMIT BEAM

Beam Polarization: Vertical

Peak Antenna Gain: 34.0 dBi

Peak EIRP: 52.8 dBW

(Schedule S Beam Designation: F2VD)

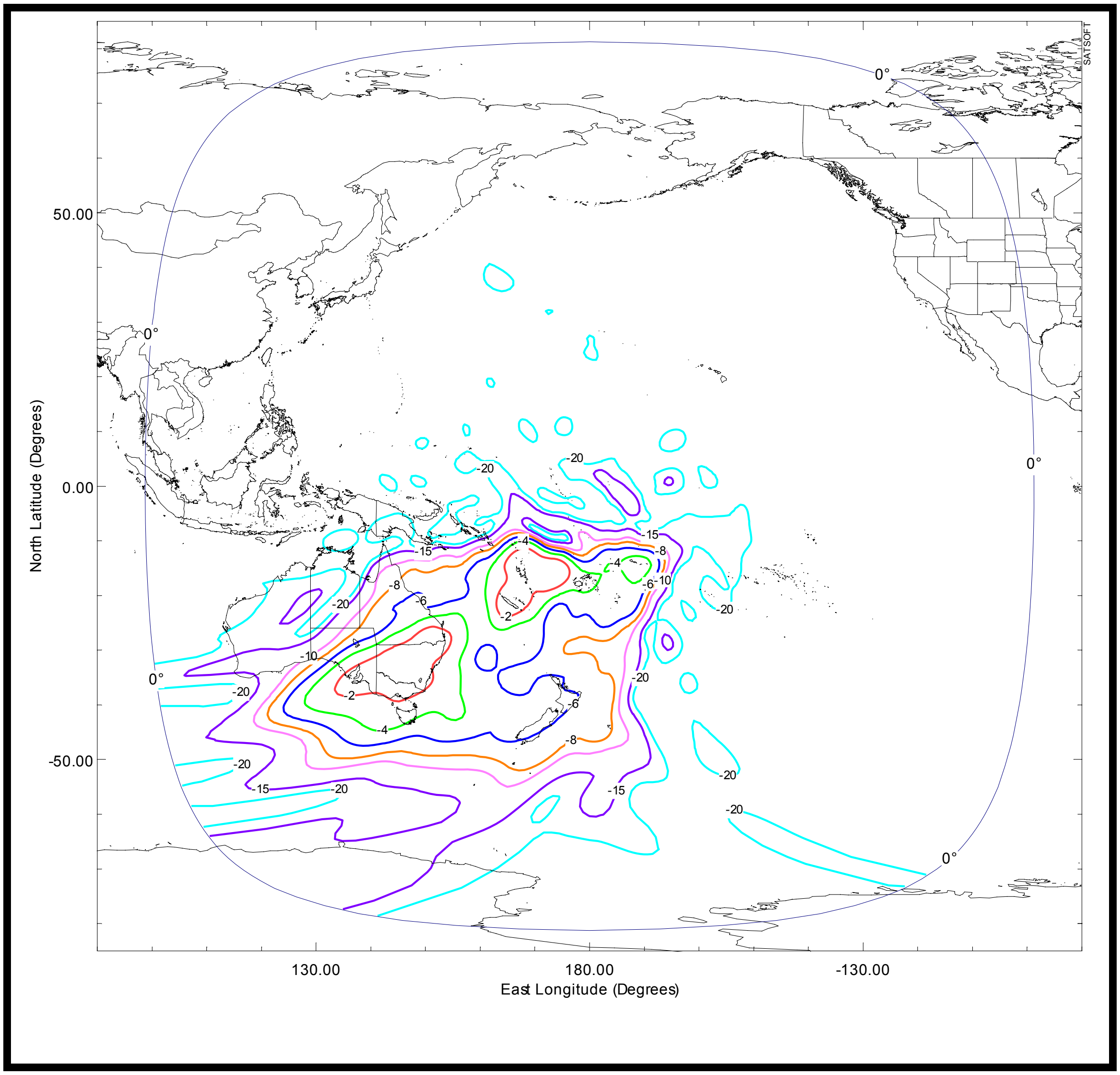


EXHIBIT 6S: F2 TRANSMIT BEAM

Beam Polarization: Horizontal

Peak Antenna Gain: 33.8 dBi

Peak EIRP: 52.6 dBW

(Schedule S Beam Designation: F2HD)

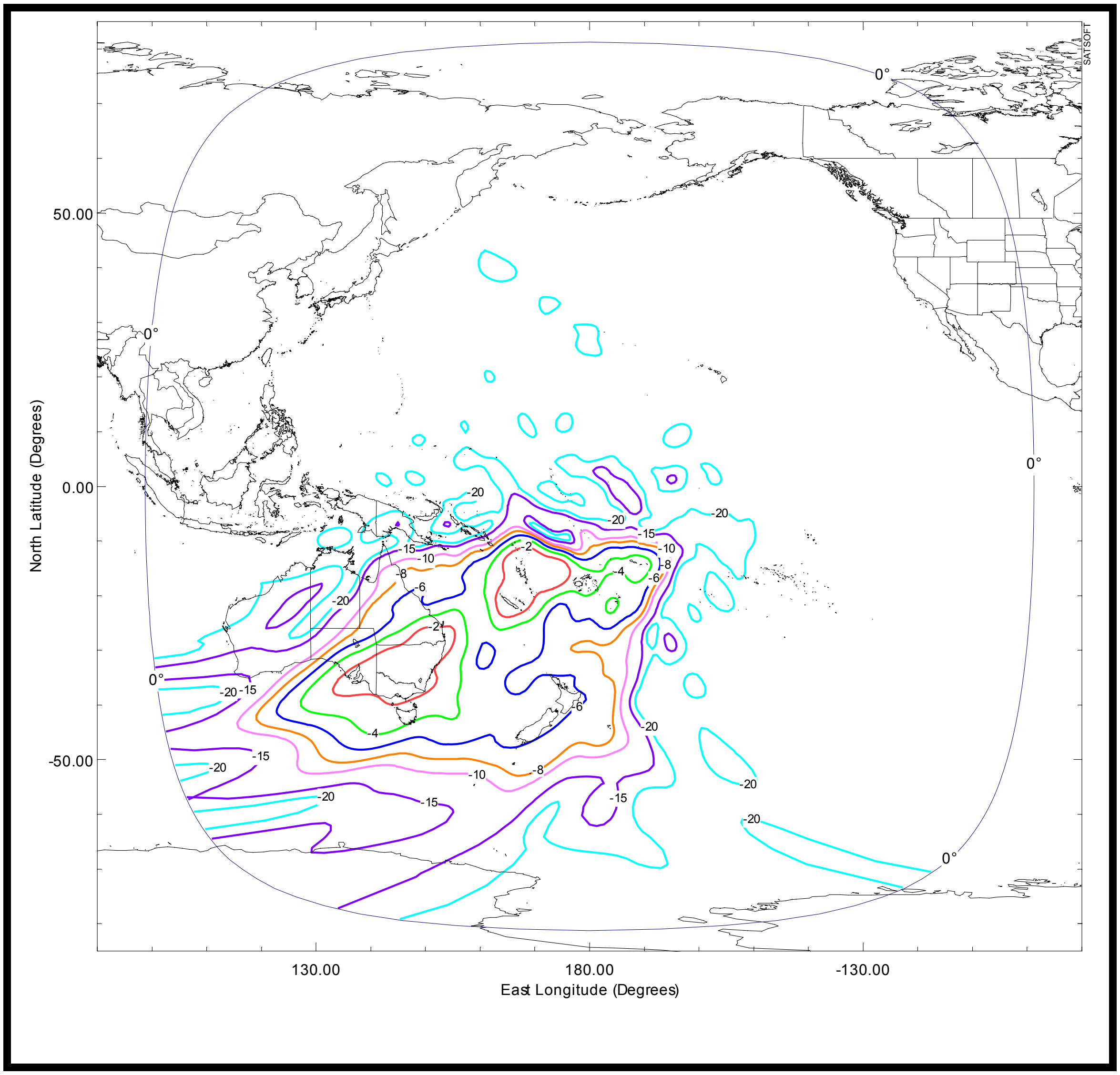


EXHIBIT 6T: ON-STATION COMMAND BEAM

Beam Polarization: Left Hand Circular

Peak Antenna Gain: 20.8 dBi

Peak G/T: -18.9 dB/K

Command Threshold Flux Density at Peak G/T: -115.3 dBW/m^2

(Schedule S Beam Designations: CMDG)

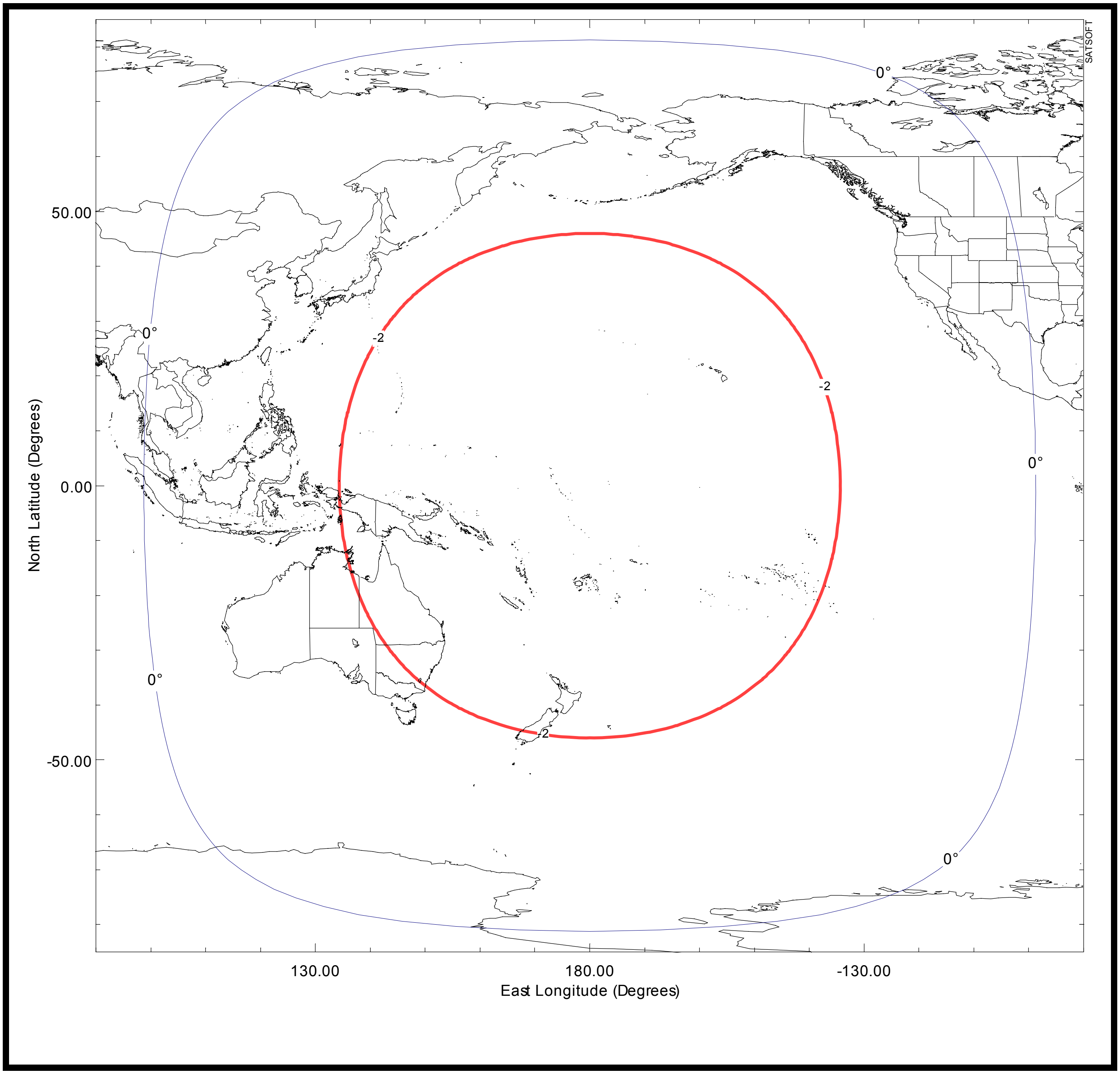


EXHIBIT 6U: WIDE COVERAGE ANTENNA COMMAND BEAM

Beam Polarization: Left Hand Circular
Peak Antenna Gain: 13.1 dBi
Peak G/T: -30.4 dB/K
Command Threshold Flux Density at Peak G/T: -103.9 dBW/m^2
(Schedule S Beam Designations: CMDW)

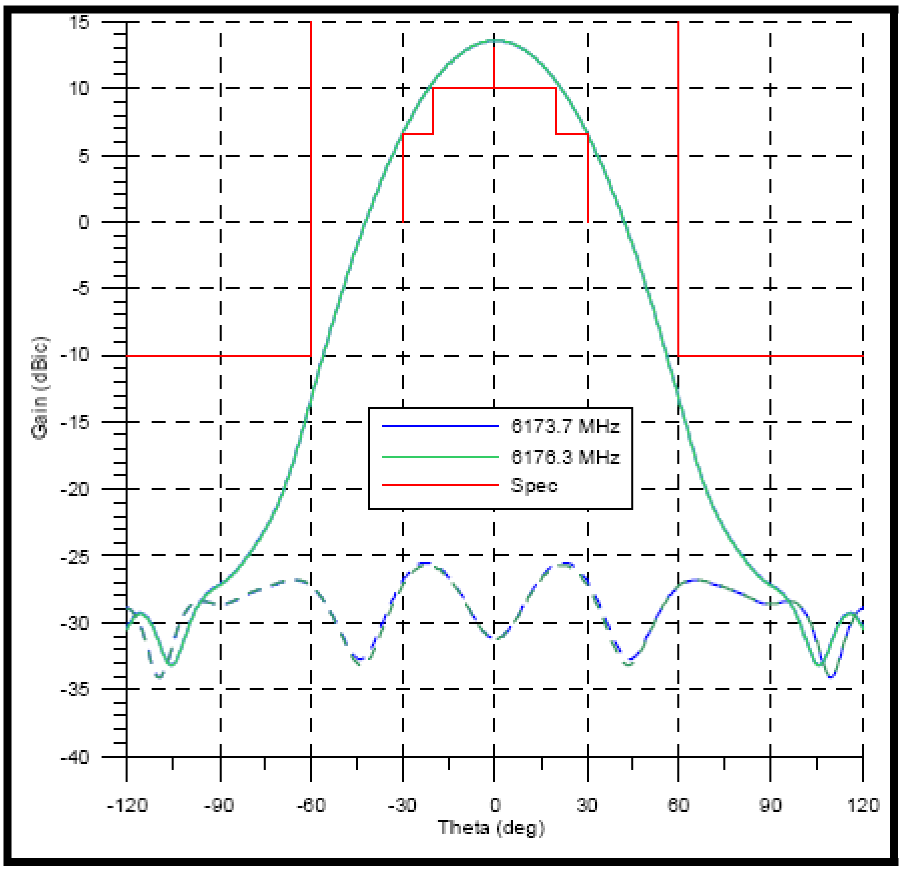


EXHIBIT 6V: OMNI ANTENNA COMMAND BEAM

Beam Polarization: Left Hand Circular

Peak Antenna Gain: 2.4 dBi

Peak G/T: -36.4 dB/K

Command Threshold Flux Density at Peak G/T: -97.8 dBW/m^2

(Schedule S Beam Designations: CMDO)

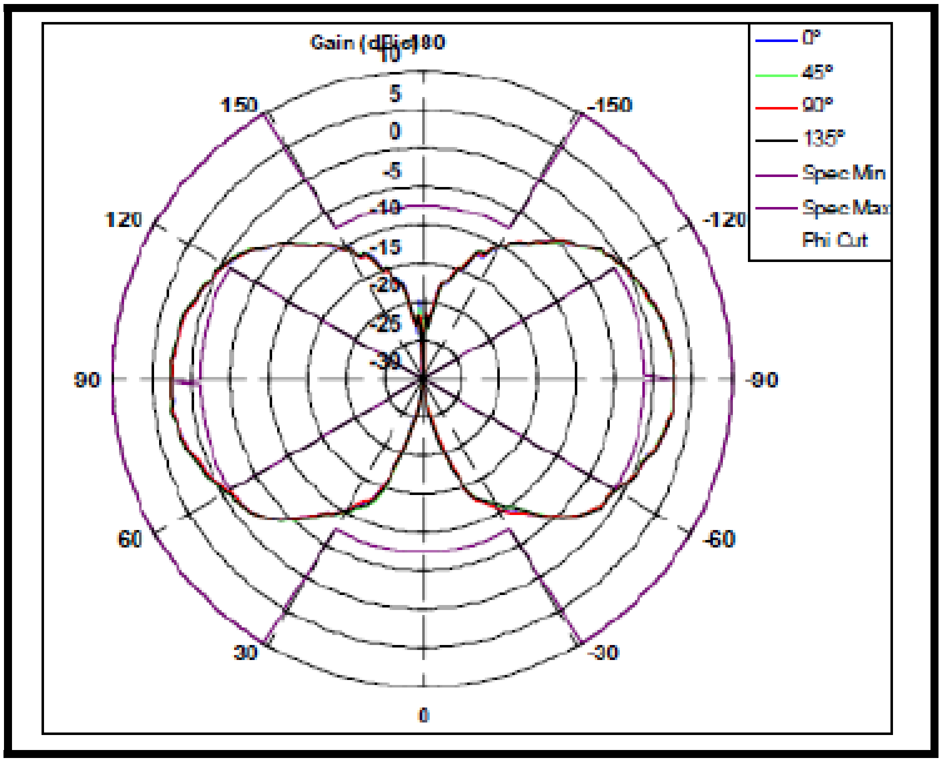


EXHIBIT 6W: ON-STATION TELEMETRY BEAM

Beam Polarization: Right Hand Circular
Peak Antenna Gain: 20.4 dBi
Peak EIRP: 12.8 dBW
(Schedule S Beam Designation: TLMG)

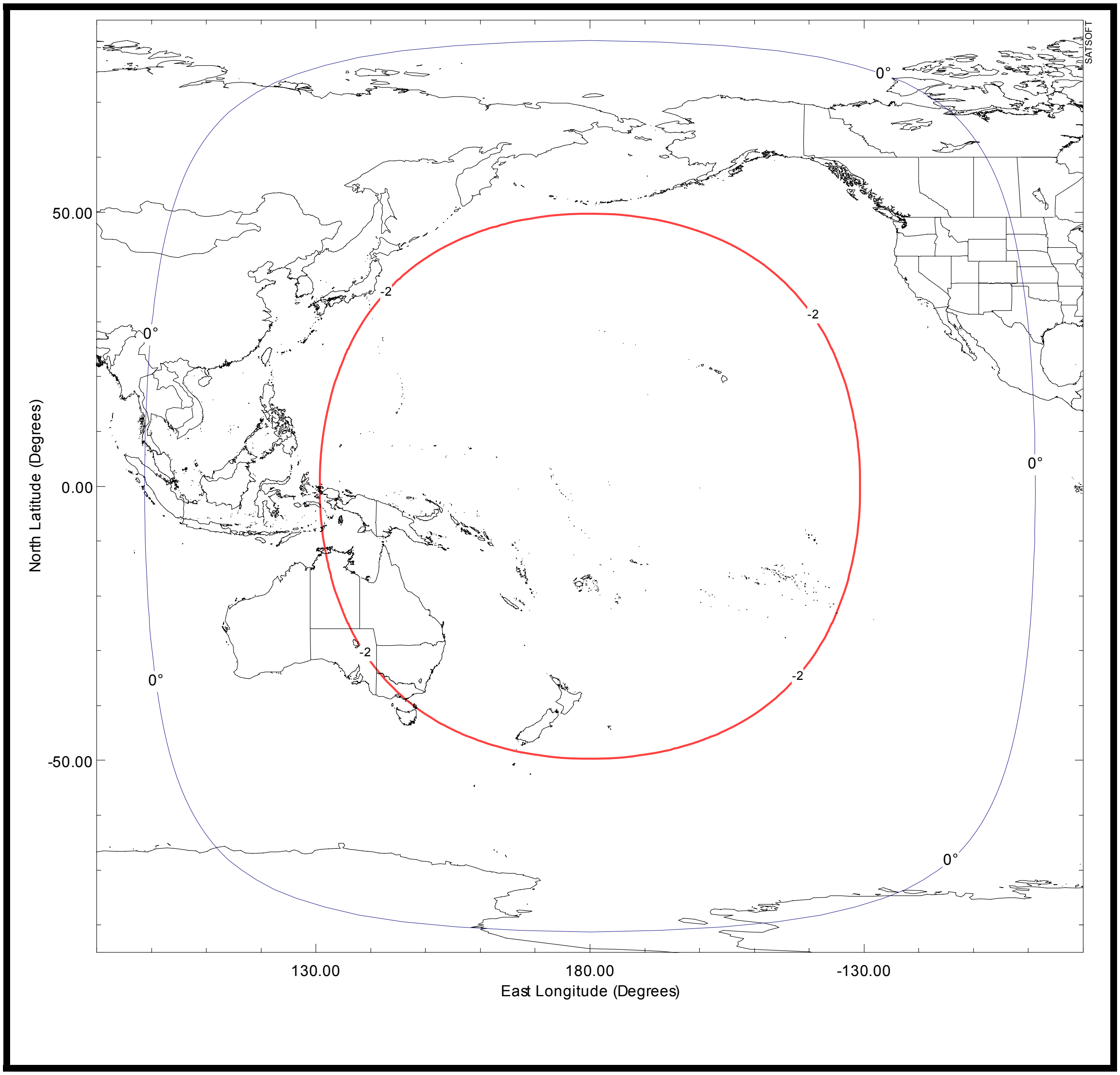


EXHIBIT 6X: WIDE COVERAGE ANTENNA TELEMETRY BEAM

Beam Polarization: Right Hand Circular
Peak Antenna Gain: 13.1 dBi
Peak EIRP: 13.1 dBW
(Schedule S Beam Designation: TLMW)

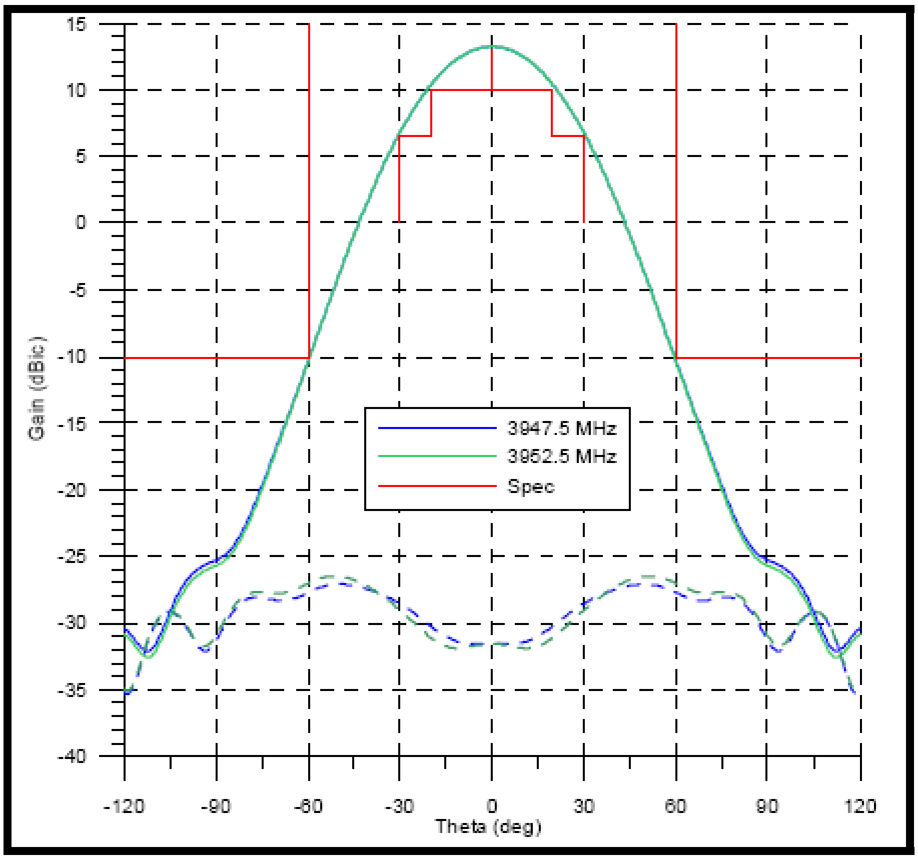


EXHIBIT 6Y: OMNI ANTENNA TELEMETRY BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 1.8 dBi

Peak EIRP: 6.5 dBW

(Schedule S Beam Designation: TLMO)

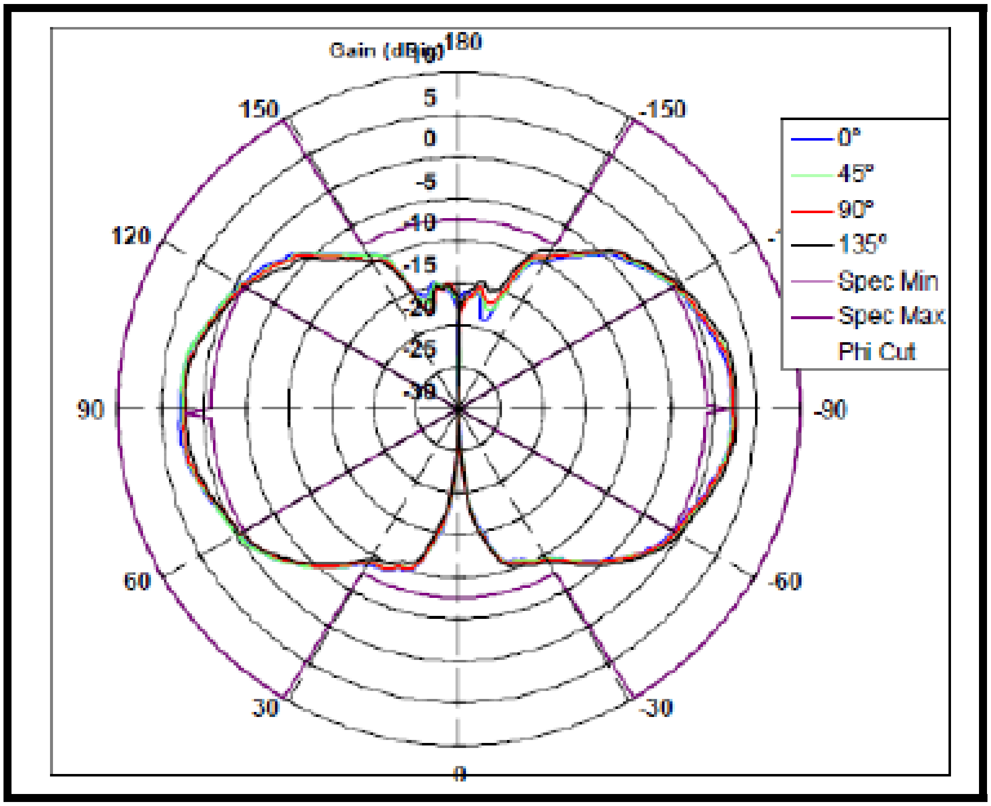


EXHIBIT 6Z-1: C-BAND ULPC BEAM

Beam Polarization: Vertical

Peak Antenna Gain: 13.0 dBi

Peak EIRP: 10 dBW

(Schedule S Beam Designation: UPCC)

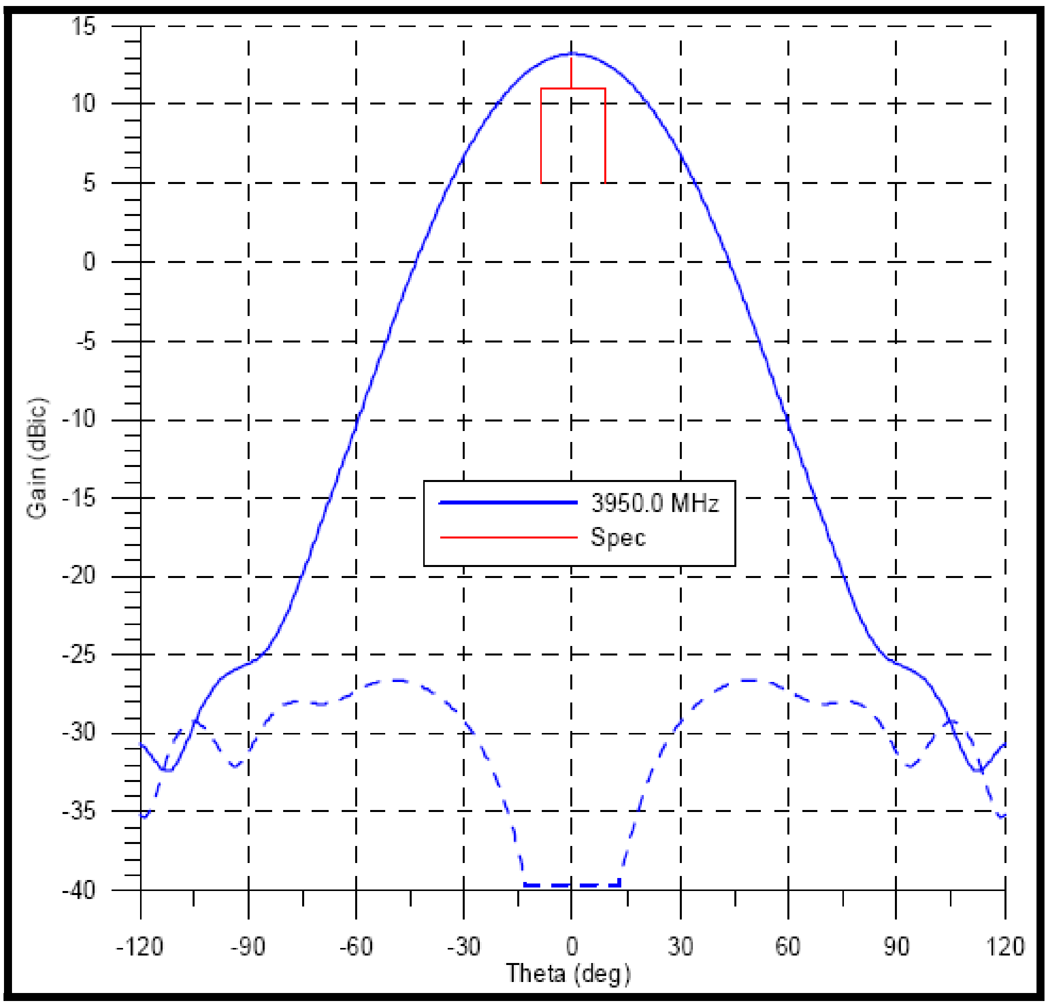


EXHIBIT 6Z-2: Ku-BAND ULPC BEAM

Beam Polarization: Right Hand Circular

Peak Antenna Gain: 20.6 dBi

Peak EIRP: 13.2 dBW

(Schedule S Beam Designation: UPCK)

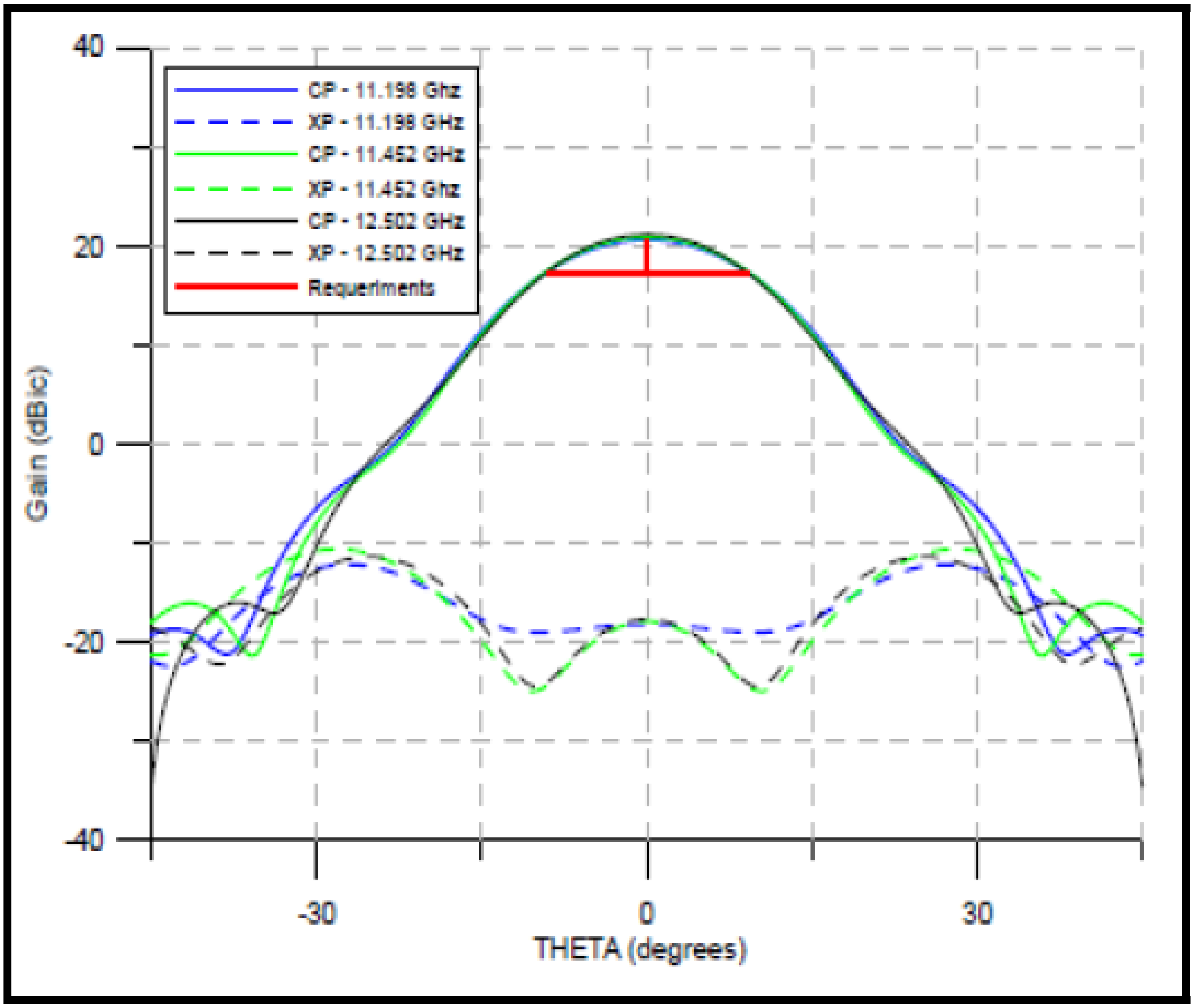


EXHIBIT 7: COMMUNICATION SUBSYSTEM EIRP AND G/T BUDGETS

Frequency Band (MHz)	3700 - 4075	3700 - 4075	3700 - 4075	3700 - 4075	4075 - 4200	4075 - 4200	3950
Downlink Beam Name	North Hemi A	North Hemi B	South Hemi A	South Hemi B	Global A	Global B	C-Band ULPC
Downlink Beam Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP	Vertical
Transmitter Output Power (Watts)	45.0	45.0	45.0	45.0	45.0	45.0	0.95
Transmitter Output Power (dBW)	16.5	16.5	16.5	16.5	16.5	16.5	-0.2
Line Loss (dB)	2.6	2.6	2.6	2.6	2.0	2.0	2.8
Power At Antenna Input (dBW)	13.9	13.9	13.9	13.9	14.5	14.5	-3.0
Power At Antenna Input (Watts)	24.5	24.5	24.5	24.5	28.2	28.2	0.50
Peak Antenna Gain (dBi)	27.6	27.7	26.5	26.5	20.4	20.4	13.0
Beam Peak EIRP (dBW)	41.5	41.6	40.4	40.4	34.9	34.9	10.0
Frequency Band (MHz)	10950 - 11200 11450 - 11700	10950 - 11200 11450 - 11700 12250 - 12750	12500 - 12750	11198 11452 12502			
Downlink Beam Name	F1	F2	F2	Ku-Band ULPC			
Downlink Beam Polarization	V	H	V	RHCP			
Transmitter Output Power (Watts)	150	150	150	0.6			
Transmitter Output Power (dBW)	21.8	21.8	21.8	-2.0			
Line Loss (dB)	3.0	3.0	3.0	5.4			
Power At Antenna Input (dBW)	18.8	18.8	18.8	-7.4			
Power At Antenna Input (Watts)	75.9	75.9	75.9	0.18			
Peak Antenna Gain (dBi)	34.5	33.8	34.0	20.6			
Beam Peak EIRP (dBW)	53.3	52.6	52.8	13.2			
Frequency Band (MHz)	5925 - 6300	5925 - 6300	5925 - 6300	5925 - 6300	6300 - 6425	6300 - 6425	
Uplink Beam Name	North Hemi A	North Hemi B	South Hemi A	South Hemi B	Global A	Global B	
Uplink Beam Polarization	LHCP	RHCP	LHCP	RHCP	LHCP	RHCP	
Antenna Noise Temperature (ºKelvin)	90	90	90	90	80	80	
Receiver Noise Temperature (ºKelvin)	367	367	378	378	347	347	
Total System Noise Temperature (ºKelvin)	457	457	468	468	427	427	
Total System Noise Temperature (ºdB-K)	26.6	26.6	26.7	26.7	26.3	26.3	
Peak Antenna Gain (dBi)	29.3	29.3	26.8	26.8	20.8	20.8	
Beam Peak G/T (dB/K)	2.7	2.7	0.1	0.1	-5.5	-5.5	
Beam Peak Minimum SFD (dBW/m^2)	-108.1	-108.1	-105.6	-105.6	-99.3	-99.3	
Frequency Band (MHz)	14000 - 14500	14000 - 14500	14000 - 14500	14000 - 14500			
Uplink Beam Name	F1	F2	F2	U.S.			
Uplink Beam Polarization	H	H	V	V			
Antenna Noise Temperature (ºKelvin)	150	150	150	150			
Receiver Noise Temperature (ºKelvin)	481	481	481	481			
Total System Noise Temperature (ºKelvin)	631	631	631	631			
Total System Noise Temperature (ºdB-K)	28	28	28	28			
Peak Antenna Gain (dBi)	36.2	34.9	34.8	36.3			
Beam Peak G/T (dB/K)	8.2	6.9	6.8	8.3			
Beam Peak Minimum SFD (dBW/m^2)	-107.7	-106.3	-106.4	-107.8			

EXHIBIT 8: CHANNEL FREQUENCY RESPONSE CHARACTERISTIC

	Attenuation Relative To Peak Level (dB)		
Frequency Offset Relative to Channel Center Frequency (MHz)	Input Section	Output Section	Total
C-Band: 36 MHz Channel			
±8	0.18	0.29	0.41
±12	0.26	0.73	0.91
±14	0.38	0.88	1.15
±16	0.49	0.98	1.35
±18	0.76	1.58	2.20
C-Band: 41 MHz Channel			
±9	0.18	0.29	0.41
±14	0.26	0.69	0.86
±16	0.38	0.92	1.20
±18	0.49	1.02	1.40
±20.5	0.76	1.83	2.45
C-Band: 72 MHz Channel			
±16	0.23	0.29	0.46
±24	0.29	0.48	0.69
±28	0.35	0.78	1.02
±32	0.42	0.93	1.23
±36	0.56	1.68	2.10
Ku-Band: 72 MHz Channel			
±16	0.28	0.32	0.54
±24	0.36	0.53	0.80
±28	0.42	0.89	1.21
±32	0.49	1.05	1.42
±36	0.76	1.88	2.50

EXHIBIT 9: TC&R SUBSYSTEM CHARACTERISTICS

	Spacecraft Antenna		
	Global	**WCA**	**Omni**
Command Frequency (MHz) / Polarization (see note)			
Transfer Orbit / Emergency	n/a	6173.7 (LHCP) 6176.3 (LHCP)	6173.7 (LHCP) 6176.3 (LHCP)
On-Station	6173.7 (LHCP) 6176.3 (LHCP)	n/a	n/a
Command Modulation	FM	FM	FM
Bandwidth of Command Carrier (kHz)			
Occupied Bandwidth	860	860	860
Allocated Bandwidth	1000	1000	1000
Command Threshold (dBW/m^2)			
Beam Peak	-115.3	-103.9	-97.8
Edge of Coverage	-111.3	-99.9	-93.8
Command G/T (dB/K)			
Beam Peak	-18.9	-30.4	-36.4
Edge of Coverage	-22.9	-34.4	-40.4
Telemetry Frequency (MHz) / Polarization (see note)			
Transfer Orbit / Emergency	n/a	3947.5 (RHCP) 3952.5 (RHCP)	3947.5 (RHCP) 3952.5 (RHCP)
On-Station	3947.5 (RHCP) 3952.5 (RHCP)	n/a	n/a
Telemetry Modulation	PM	PM	PM
Bandwidth of Telemetry Carrier (kHz)			
Occupied	250	250	250
Allocated	500	500	500
Telemetry EIRP			
Beam Peak	12.8	13.1	6.5
Edge of Coverage	8.8	9.1	2.5
On-Station Ranging Accuracy (meters)	≤ 10	≤ 10	≤ 10

RHCP: Right Hand Circular Polarization
LHCP: Left Hand Circular Polarization

EXHIBIT 10: TC&R SUBSYSTEM EIRP and G/T BUDGETS

Antenna Type	Global A	WCA	Omni
Frequency Band (MHz)	3947.5 / 3952.5	3947.5 / 3952.5	3947.5 / 3952.5
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular
Maximum Power At The Output of Last Stage Amplifier (dBW)	-2.4	10	10
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	5.2	10	5.3
Power into Transmit Antenna (dBW)	-7.6	0	4.7
Power into Transmit Antenna (Watts)	0.2	1.0	2.9
Peak Gain of Satellite Transmit Antenna (dBi)	20.4	13.1	1.8
Maximum Downlink EIRP (dBW)	12.8	13.1	6.5
Antenna Type	Global A	WCA	Omni
Frequency Band (MHz)	6173.7 / 6176.3	6173.7 / 6176.3	6173.7 / 6176.3
Polarization	Left Hand Circular	Left Hand Circular	Left Hand Circular
Antenna Noise Temperature (°Kelvin)	80	80	80
Peak Gain of Satellite Receive Antenna (dBi)	20.8	13.1	2.4
Receiver Noise Temperature (°Kelvin)	9291	22430	7533
Total System Noise Temperature (°Kelvin)	9371	22510	7613
Total System Noise Temperature (dBK)	39.7	43.5	38.8
Peak G/T (dB/K)	-18.9	-30.4	-36.4
Command Threshold Flux Density at Peak G/T (dBW/m^2)	-115.3	-103.9	-97.8

EXHIBIT 11: EMISSION DESIGNATORS

Signal Type	Emission Designator	Allocated Bandwidth (kHz)
Analog TV/FM Carrier	36M0F3F	36000
49138 kbps Carrier	72M0G7W	72000
27981 kbps Carrier	41M0G7W	41000
24575 kbps Carrier	36M0G7W	36000
6000 kbps carrier	10M3G7W	10300
512 kbps Carrier	1M45G7W	1450
128 kbps Carrier	400KG7W	400
64 kbps Carrier	100KG7W	100

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS

FREQUENCY BAND: 3700 – 4200 MHz							
North Hemi A Beam (RHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	41.4*	41.3*	41.5	41.5	41.5	41.5	41.5
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-152.0	-152.0	-151.7	-151.5	-151.4	-151.3	-150.6
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	0.0	0.0	2.2	4.5	6.9	9.3	8.6
North Hemi A Beam (RHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	41.5	41.5	41.5	41.5	41.5	41.5	41.5
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-160.7	-160.5	-160.4	-160.3	-160.2	-160.1	-159.3
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	8.7	8.5	10.9	13.3	15.7	18.1	17.3
North Hemi B Beam (LHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	41.4*	41.3*	41.6	41.6	41.6	41.6	41.6
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-152.0	-152.0	-151.6	-151.4	-151.3	-151.2	-150.5
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	0.0	0.0	2.1	4.4	6.8	9.2	8.5
North Hemi B Beam (LHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	41.6	41.6	41.6	41.6	41.6	41.6	41.6
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-160.6	-160.4	-160.3	-160.2	-160.1	-160.0	-159.2
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	8.6	8.4	10.8	13.2	15.6	18.0	17.2
South Hemi A Beam (RHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	40.4	40.4	40.4	40.4	40.4	40.4	40.4
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-153.0	-152.9	-152.8	-152.6	-152.5	-152.4	-151.7
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	1.0	0.9	3.3	5.6	8.0	10.4	9.7

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND: 3700 – 4200 MHz							
South Hemi A Beam (RHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	40.4	40.4	40.4	40.4	40.4	40.4	40.4
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-161.8	-161.6	-161.5	-161.4	-161.3	-161.2	-160.4
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	9.8	9.6	12.0	14.4	16.8	19.2	18.4
South Hemi B Beam (LHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	40.4	40.4	40.4	40.4	40.4	40.4	40.4
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-153.0	-152.9	-152.8	-152.6	-152.5	-152.4	-151.7
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	1.0	0.9	3.3	5.6	8.0	10.4	9.7
South Hemi B Beam (LHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	40.4	40.4	40.4	40.4	40.4	40.4	40.4
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-161.8	-161.6	-161.5	-161.4	-161.3	-161.2	-160.4
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	9.8	9.6	12.0	14.4	16.8	19.2	18.4
Global A Beam (RHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-158.5	-158.4	-158.3	-158.1	-158.0	-157.9	-157.2
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	6.5	6.4	8.8	11.1	13.5	15.9	15.2
Global A Beam (RHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-167.3	-167.1	-167.0	-166.9	-166.8	-166.7	-165.9
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	15.3	15.1	17.5	19.9	22.3	24.7	23.9

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND: 3700 – 4200 MHz							
Global B Beam (LHCP): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-158.5	-158.4	-158.3	-158.1	-158.0	-157.9	-157.2
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	6.5	6.4	8.8	11.1	13.5	15.9	15.2
Global B Beam (LHCP): 36M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-167.3	-167.1	-167.0	-166.9	-166.8	-166.7	-165.9
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	15.3	15.1	17.5	19.9	22.3	24.7	23.9
Telemetry - Global Coverage Antenna (RHCP)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	12.8	12.8	12.8	12.8	12.8	12.8	12.8
Occupied Bandwidth (kHz)	250	250	250	250	250	250	250
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-168.5	-168.4	-168.3	-168.2	-168.1	-168.0	-167.2
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	16.5	16.4	18.8	21.2	23.6	26.0	25.2
Telemetry - Wide Coverage Antenna (RHCP)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	13.1	13.1	13.1	13.1	13.1	13.1	13.1
Occupied Bandwidth (kHz)	250	250	250	250	250	250	250
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-168.2	-168.1	-168.0	-167.9	-167.8	-167.7	-166.9
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	16.2	16.1	18.5	20.9	23.3	25.7	24.9
Telemetry - Omni Antenna (RHCP)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Occupied Bandwidth (kHz)	250	250	250	250	250	250	250
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-174.8	-174.7	-174.6	-174.5	-174.4	-174.3	-173.5
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	22.8	22.7	25.1	27.5	29.9	32.3	31.5

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND: 3700 – 4200 MHz							
C-Band ULPC Beam (V)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Occupied Bandwidth (kHz)	25	25	25	25	25	25	25
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-161.3	-161.2	-161.1	-161.0	-160.9	-160.8	-160.0
PFD Limit (dBW/m^2/4kHz)	-152	-152	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	9.3	9.2	11.6	14.0	16.4	18.8	18.0
FREQUENCY BAND: 10950 - 11200 MHz and 11450 – 11700 MHz							
F1 Beam (V): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	43.4*	43.3*	45.7*	48.0*	50.4*	52.8*	52.1*
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
PFD Limit (dBW/m^2/4kHz)	-150	-150	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F1 Beam (V): 72M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	53.3	53.3	53.3	53.3	53.3	53.3	53.3
Occupied Bandwidth (kHz)	60251	60251	60251	60251	60251	60251	60251
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-151.9	-151.8	-151.6	-151.5	-151.4	-151.3	-150.5
PFD Limit (dBW/m^2/4kHz)	-150	-150	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	1.9	1.8	4.1	6.5	8.9	11.3	10.5
F2 Beam (H): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	43.4*	43.3*	45.7*	48.0*	50.4*	52.6	52.6
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.2	-139.5
PFD Limit (dBW/m^2/4kHz)	-150	-150	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	0.2	-0.5
F2 Beam (H): 72M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	52.2*	52.0*	52.6	52.6	52.6	52.6	52.6
Occupied Bandwidth (kHz)	30133	30133	30133	30133	30133	30133	30133
Spreading Loss (dB/m2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m2/4kHz)	-150.0	-150.0	-149.3	-149.2	-149.1	-149.0	-148.2
PFD Limit (dBW/m2/4kHz)	-150	-150	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	1.8	4.2	6.6	9.0	8.2

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND: 10950 - 11200 MHz and 11450 – 11700 MHz							
ULPC Beam (RHCP)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Occupied Bandwidth (kHz)	25	25	25	25	25	25	25
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-158.1	-158.0	-157.9	-157.8	-157.7	-157.6	-156.8
PFD Limit (dBW/m^2/4kHz)	-150	-150	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	8.1	8.0	10.4	12.8	15.2	17.6	16.8
FREQUENCY BAND: 12250 - 12750 MHz							
F2 Beam (H): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	45.4*	45.3*	47.7*	50.0*	52.4*	52.6	52.6
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-148.0	-148.0	-145.5	-143.0	-140.5	-140.2	-139.5
PFD Limit (dBW/m^2/4kHz)	-148	-148	-145.5	-143.0	-140.5	-138.0	-138.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	2.2	1.5
F2 Beam (H): 72M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	52.6	52.6	52.6	52.6	52.6	52.6	52.6
Occupied Bandwidth (kHz)	60251	60251	60251	60251	60251	60251	60251
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-152.6	-152.5	-152.3	-152.2	-152.1	-152.0	-151.2
PFD Limit (dBW/m^2/4kHz)	-148	-148	-145.5	-143.0	-140.5	-138.0	-138.0
Margin (dB)	4.6	4.5	6.8	9.2	11.6	14.0	13.2
F2 Beam (V): 36M0F3F							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	45.4*	45.3*	47.7*	50.0*	52.4*	52.8	52.8
Occupied Bandwidth (kHz)	4000	4000	4000	4000	4000	4000	4000
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-148.0	-148.0	-145.5	-143.0	-140.5	-140.0	-139.3
PFD Limit (dBW/m^2/4kHz)	-148	-148	-145.5	-143.0	-140.5	-138.0	-138.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	2.0	1.3
F2 Beam (V): 72M0G7W							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	52.8	52.8	52.8	52.8	52.8	52.8	52.8
Occupied Bandwidth (kHz)	60251	60251	60251	60251	60251	60251	60251
Spreading Loss (dB/m2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m2/4kHz)	-152.4	-152.3	-152.1	-152.0	-151.9	-151.8	-151.0
PFD Limit (dBW/m2/4kHz)	-148	-148	-145.5	-143.0	-140.5	-138.0	-138.0
Margin (dB)	4.4	4.3	6.6	9.0	11.4	13.8	13.0

EXHIBIT 12: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND: 12250 - 12750 MHz							
ULPC Beam (RHCP)							
Elevation Angle (degrees)	0	5	10	15	20	25	90
Assumed EIRP (dBW)	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Occupied Bandwidth (kHz)	25	25	25	25	25	25	25
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-158.1	-158.0	-157.9	-157.8	-157.7	-157.6	-156.8
PFD Limit (dBW/m^2/4kHz)	-148	-148	-145.5	-143.0	-140.5	-138.0	-138.0
Margin (dB)	10.1	10.0	12.4	14.8	17.2	19.6	18.8

* This is the maximum allowable EIRP level at the specified elevation angle. The actual EIRP level of the carrier at this particular elevation angle will be made to be equal to or lower than the value listed in the table through reduction in the output power of the channel and/or restriction on the movement/placement of the beam.

EXHIBIT 13: INTELSAT 18 LINK BUDGETS

UPLINK BEAM INFORMATION				
Uplink Beam Name	North Hemi	North Hemi	North Hemi	North Hemi
Uplink Frequency (GHz)	6.175	6.175	6.175	6.175
Uplink Beam Polarization	Circular	Circular	Circular	Circular
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	-3.3	-3.3	-3.3	-3.3
Uplink SFD (dBW/m2)	-77.1	-90.1	-84.1	-84.1
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	North Hemi	North Hemi	North Hemi	North Hemi
Downlink Frequency (GHz)	3.950	3.950	3.950	3.950
Downlink Beam Polarization	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	35.5	35.5	35.5	35.5
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.2	-39.2	-39.2	-39.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	182E	182E	182E	182E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.2	-39.2	-39.2	-39.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4
Allocated Bandwidth(kHz)	36000	36000	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	7.0	7.0	7.0
Earth Station Gain (dBi)	58.4	51.0	51.0	51.0
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	4.5	3.0	3.0	3.0
Earth Station Gain (dBi)	43.9	39.7	39.7	39.7
Earth Station G/T (dB/K)	23.6	19.2	19.2	19.2
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	82.5	72.8	66.6	46.2
Uplink Path Loss, Clear Sky (dB)	-200.2	-200.2	-200.2	-200.2
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-3.3	-3.3	-3.3	-3.3
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Uplink C/N(dB)	32.0	23.1	23.4	22.5
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	35.3	35.5	28.0	7.6
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-196.3	-196.3	-196.3	-196.3
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	23.6	19.2	19.2	19.2
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Downlink C / N(dB)	15.2	11.7	10.7	9.8
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	32.0	23.1	23.4	22.5
C/N Downlink (dB)	15.2	11.7	10.7	9.8
C/I Intermodulation (dB)	N/A	N/A	19.9	19.0
C/I Uplink Co-Channel (dB)*	20.0	20.0	21.5	21.2
C/I Downlink Co-Channel (dB)*	20.0	20.0	21.5	21.2
C/I Uplink Adjacent Satellite 1 (dB)	21.6	12.7	13.0	12.1
C/I Downlink Adjacent Satellite 1 (dB)	20.1	11.1	10.1	9.2
C/I Uplink Adjacent Satellite 2 (dB)	21.6	12.7	13.0	12.1
C/I Downlink Adjacent Satellite 2 (dB)	22.6	19.8	18.8	17.9
C/(N+I) Composite (dB)	11.0	5.4	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.0	4.4	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	0.0	1.0	0.0	0.0
Number of Carriers	1	1.0	2.5	276.2
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-41.9	-53.0	-52.7	-53.6
Downlink EIRP Density At Beam Peak (dBW/Hz)	-24.7	-33.3	-34.3	-35.2

EXHIBIT 13: INTELSAT 18 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION				
Uplink Beam Name	North Hemi	North Hemi	North Hemi	North Hemi
Uplink Frequency (GHz)	6.175	6.175	6.175	6.175
Uplink Beam Polarization	Circular	Circular	Circular	Circular
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	-3.3	-3.3	-3.3	-3.3
Uplink SFD (dBW/m2)	-79.1	-85.1	-82.1	-82.1
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	South Hemi	South Hemi	South Hemi	South Hemi
Downlink Frequency (GHz)	3.950	3.950	3.950	3.950
Downlink Beam Polarization	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	34.4	34.4	34.4	34.4
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-43.4	-43.4	-43.4	-43.4
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	182E	182E	182E	182E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-43.4	-43.4	-43.4	-43.4
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	36M0F3F	72M0G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	49318	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	36000	60251	6771.1	75.4
Allocated Bandwidth(kHz)	36000	72000	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	13.0	7.0	7.0	7.0
Earth Station Gain (dBi)	56.4	51.0	51.0	51.0
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	8.1	3.0	3.5	3.5
Earth Station Gain (dBi)	49.3	39.7	41.1	41.1
Earth Station G/T (dB/K)	28.4	19.2	21.0	21.0
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	80.8	77.8	65.8	45.4
Uplink Path Loss, Clear Sky (dB)	-200.2	-200.2	-200.2	-200.2
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-3.3	-3.3	-3.3	-3.3
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8
Uplink C/N(dB)	30.3	25.1	22.6	21.7
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	30.2	34.4	24.1	3.7
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-196.3	-196.3	-196.3	-196.3
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	28.4	19.2	21.0	21.0
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8
Downlink C / N(dB)	14.8	7.6	8.6	7.7
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	30.3	25.1	22.6	21.7
C/N Downlink (dB)	14.8	7.6	8.6	7.7
C/I Intermodulation (dB)	N/A	N/A	20.1	19.2
C/I Uplink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Downlink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Uplink Adjacent Satellite 1 (dB)	19.9	14.7	12.2	11.3
C/I Downlink Adjacent Satellite 1 (dB)	25.1	11.2	15.5	14.6
C/I Uplink Adjacent Satellite 2 (dB)	19.9	14.7	12.2	11.3
C/I Downlink Adjacent Satellite 2 (dB)	26.5	19.9	20.3	19.4
C/(N+I) Composite (dB)	11.0	4.5	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.0	3.5	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	0.0	.2	0.0	0.0
Number of Carriers	2	1.0	4.8	527.0
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-41.6	-51.0	-53.5	-54.4
Downlink EIRP Density At Beam Peak (dBW/Hz)	-29.8	-37.4	-38.2	-39.1

EXHIBIT 13: INTELSAT 18 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION				
Uplink Beam Name	South Hemi	South Hemi	South Hemi	South Hemi
Uplink Frequency (GHz)	6.175	6.175	6.175	6.175
Uplink Beam Polarization	Circular	Circular	Circular	Circular
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	-5.9	-5.9	-5.9	-5.9
Uplink SFD (dBW/m2)	-76.6	-86.6	-76.7	-76.7
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	North Hemi	North Hemi	North Hemi	North Hemi
Downlink Frequency (GHz)	3.950	3.950	3.950	3.950
Downlink Beam Polarization	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	35.5	35.5	35.5	35.5
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-42.2	-42.2	-42.2	-42.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	182E	182E	182E	182E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-42.2	-42.2	-42.2	-42.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	36M0F3F	72M0G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	49138	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	36000	60251	6771.1	75.4
Allocated Bandwidth(kHz)	36000	72000	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	9.0	7.0	7.0
Earth Station Gain (dBi)	58.4	53.4	51.0	51.0
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	7.0	3.0	3.0	3.0
Earth Station Gain (dBi)	47.5	39.7	39.7	39.7
Earth Station G/T (dB/K)	26.6	19.2	19.2	19.2
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	83.3	76.3	71.3	50.9
Uplink Path Loss, Clear Sky (dB)	-200.2	-200.2	-200.2	-200.2
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-5.9	-5.9	-5.9	-5.9
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8
Uplink C/N(dB)	30.2	21.0	25.5	24.6
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	31.3	35.5	25.3	4.8
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-196.3	-196.3	-196.3	-196.3
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	26.6	19.2	19.2	19.2
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8
Downlink C / N(dB)	14.1	8.7	7.9	7.0
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	30.2	21.0	25.5	24.6
C/N Downlink (dB)	14.1	8.7	7.9	7.0
C/I Intermodulation (dB)	N/A	N/A	20.2	19.3
C/I Uplink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Downlink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Uplink Adjacent Satellite 1 (dB)	22.4	13.2	17.7	16.8
C/I Downlink Adjacent Satellite 1 (dB)	23.1	11.1	10.4	9.4
C/I Uplink Adjacent Satellite 2 (dB)	22.4	13.2	17.7	16.8
C/I Downlink Adjacent Satellite 2 (dB)	24.7	19.8	19.1	18.2
C/(N+I) Composite (dB)	11.0	4.6	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.0	3.6	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	0.0	.2	0.0	0.0
Number of Carriers	2	1.0	4.7	518.4
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-41.1	-54.9	-48.0	-48.9
Downlink EIRP Density At Beam Peak (dBW/Hz)	-28.7	-36.3	-37.0	-37.9

EXHIBIT 13: INTELSAT 18 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION				
Uplink Beam Name	South Hemi	South Hemi	South Hemi	South Hemi
Uplink Frequency (GHz)	6.175	6.175	6.175	6.175
Uplink Beam Polarization	Circular	Circular	Circular	Circular
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	-5.9	-5.9	-5.9	-5.9
Uplink SFD (dBW/m2)	-83.6	-89.6	-83.6	-83.6
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	South Hemi	South Hemi	South Hemi	South Hemi
Downlink Frequency (GHz)	3.950	3.950	3.950	3.950
Downlink Beam Polarization	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	34.4	34.4	34.4	34.4
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-40.4	-40.4	-40.4	-40.4
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	182E	182E	182E	182E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-40.4	-40.4	-40.4	-40.4
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4
Allocated Bandwidth(kHz)	36000	36000	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	11.0	7.0	7.0	7.0
Earth Station Gain (dBi)	55.4	51.0	51.0	51.0
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	6.1	3.0	3.0	3.0
Earth Station Gain (dBi)	46.5	39.7	39.7	39.7
Earth Station G/T (dB/K)	26.2	19.2	19.2	19.2
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	79.3	73.3	67.3	46.9
Uplink Path Loss, Clear Sky (dB)	-200.2	-200.2	-200.2	-200.2
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-5.9	-5.9	-5.9	-5.9
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Uplink C/N(dB)	26.2	21.0	21.5	20.6
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	34.4	34.4	27.1	6.7
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-196.3	-196.3	-196.3	-196.3
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	26.2	19.2	19.2	19.2
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Downlink C / N(dB)	16.8	10.6	9.7	8.8
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	26.2	21.0	21.5	20.6
C/N Downlink (dB)	16.8	10.6	9.7	8.8
C/I Intermodulation (dB)	N/A	N/A	20.1	19.2
C/I Uplink Co-Channel (dB)*	20.0	20.0	21.6	21.3
C/I Downlink Co-Channel (dB)*	20.0	20.0	21.6	21.3
C/I Uplink Adjacent Satellite 1 (dB)	18.4	13.2	13.7	12.8
C/I Downlink Adjacent Satellite 1 (dB)	23.3	11.2	10.4	9.5
C/I Uplink Adjacent Satellite 2 (dB)	18.4	13.2	13.7	12.8
C/I Downlink Adjacent Satellite 2 (dB)	25.1	19.9	19.1	18.2
C/(N+I) Composite (dB)	11.0	5.3	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.0	4.3	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	0.0	.9	0.0	0.0
Number of Carriers	1	1.0	2.4	264.5
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-42.1	-52.5	-52.0	-52.9
Downlink EIRP Density At Beam Peak (dBW/Hz)	-25.6	-34.4	-35.2	-36.1

EXHIBIT 13: INTELSAT 18 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION				
Uplink Beam Name	Global	Global	Global	Global
Uplink Frequency (GHz)	6.175	6.175	6.175	6.175
Uplink Beam Polarization	Circular	Circular	Circular	Circular
Uplink Relative Contour Level (dB)	-4.0	-4.0	-4.0	-4.0
Uplink Contour G/T (dB/K)	-9.5	-9.5	-9.5	-9.5
Uplink SFD (dBW/m2)	-81.8	-91.8	-81.8	-81.8
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	Global	Global	Global	Global
Downlink Frequency (GHz)	3.950	3.950	3.950	3.950
Downlink Beam Polarization	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-4.0	-4.0	-4.0	-4.0
Downlink Contour EIRP (dBW)	30.9	30.9	30.9	30.9
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-33.2	-33.2	-33.2	-33.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	182E	182E	182E	182E
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-33.2	-33.2	-33.2	-33.2
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	36M0F3F	36M0G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	24575	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	36000	30133	6771.1	75.4
Allocated Bandwidth(kHz)	36000	36000	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	7.0	7.0	7.0
Earth Station Gain (dBi)	58.4	51.0	51.0	51.0
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	11.0	4.5	4.5	4.5
Earth Station Gain (dBi)	51.9	43.9	43.9	43.9
Earth Station G/T (dB/K)	31.0	23.6	23.6	23.6
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	81.1	71.1	69.1	48.7
Uplink Path Loss, Clear Sky (dB)	-200.2	-200.2	-200.2	-200.2
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-9.5	-9.5	-9.5	-9.5
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Uplink C/N(dB)	24.4	15.2	19.7	18.8
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	30.9	30.9	23.6	3.2
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-196.3	-196.3	-196.3	-196.3
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	31.0	23.6	23.6	23.6
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-74.8	-68.3	-48.8
Downlink C / N(dB)	18.1	11.5	10.7	9.8
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	24.4	15.2	19.7	18.8
C/N Downlink (dB)	18.1	11.5	10.7	9.8
C/I Intermodulation (dB)	N/A	N/A	20.1	19.2
C/I Uplink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Downlink Co-Channel (dB)*	20.0	20.0	21.7	21.4
C/I Uplink Adjacent Satellite 1 (dB)	22.2	13.0	17.5	16.6
C/I Downlink Adjacent Satellite 1 (dB)	18.4	10.4	9.6	8.7
C/I Uplink Adjacent Satellite 2 (dB)	22.2	13.0	17.5	16.6
C/I Downlink Adjacent Satellite 2 (dB)	19.4	12.9	12.1	11.2
C/(N+I) Composite (dB)	11.1	4.4	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.1	3.4	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	.1	0.0	0.0	0.0
Number of Carriers	1	1.0	2.4	262.7
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-43.3	-54.7	-50.2	-51.1
Downlink EIRP Density At Beam Peak (dBW/Hz)	-31.1	-39.9	-40.7	-41.6

EXHIBIT 13: INTELSAT 18 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION						
Uplink Beam Name	Ku	Ku	Ku	Ku	Ku	Ku
Uplink Frequency (GHz)	14.250	14.250	14.250	14.250	14.250	14.250
Uplink Beam Polarization	Linear	Linear	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Uplink Contour G/T (dB/K)	2.3	2.3	2.3	2.3	2.3	2.3
Uplink SFD (dBW/m2)	-79.8	-76.8	-75.8	-75.8	-75.8	-75.8
Rain Rate (mm/hr)	63.0	63.0	63.0	63.0	63.0	63.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name	Ku	Ku	Ku	Ku	Ku	Ku
Downlink Frequency (GHz)	11.950	11.950	11.950	11.950	11.950	11.950
Downlink Beam Polarization	Linear	Linear	Linear	Linear	Linear	Linear
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	46.6	46.6	46.6	46.6	46.6	46.6
Rain Rate (mm/hr)	63.0	63.0	63.0	63.0	63.0	63.0
ADJACENT SATELLITE 1						
Satellite 1 Orbital Location	178.0E	178.0E	178.0E	178.0E	178.0E	178.0E
Uplink Power Density (dBW/Hz)	-50	-50	-50	-50	-50	-50
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-26	-26	-26	-26	-26	-26
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2						
Satellite 1 Orbital Location	182.0E	182.0E	182.0E	182.0E	182.0E	182.0E
Uplink Power Density (dBW/Hz)	-50	-50	-50	-50	-50	-50
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-26	-26	-26	-26	-26	-26
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0	0.0
CARRIER INFORMATION						
Carrier ID	36M0F3F	72M0G7W	10M3G7W	100KG7W	1M45G7W	400KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK	BPSK	BPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	N/A	49138	6000	64	512	128
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256	1/2	1/2
Occupied Bandwidth(kHz)	36000	60251	6771.1	75.4	1229.0	307.0
Allocated Bandwidth(kHz)	36000	72000	10300	100	1450.0	400.0
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99	3.4	3.4
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79	2.7	2.7
UPLINK EARTH STATION						
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1	1.8
Earth Station Gain (dBi)	56.9	56.9	56.9	56.9	56.9	46.4
Earth Station Elevation Angle	20	20	20	20	20	20
DOWNLINK EARTH STATION						
Earth Station Diameter (meters)	3.7	1.8	1.8	1.8	1.8	6.1
Earth Station Gain (dBi)	51.1	44.8	44.8	44.8	44.8	55.5
Earth Station G/T (dB/K)	28.6	22.3	22.3	22.3	22.3	33.1
Earth Station Elevation Angle	20	20	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE						
Uplink Earth Station EIRP (dBW)	80.1	80.6	71.9	51.7	63.7	48.5
Uplink Path Loss, Clear Sky (dB)	-207.5	-207.5	-207.5	-207.5	-207.5	-207.5
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	2.3	2.3	2.3	2.3	2.3	2.3
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Uplink C/N(dB)	28.0	26.2	27.0	26.3	26.2	17.1
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier (dBW)	42.4	45.8	34.5	14.3	26.3	11.1
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-205.9	-205.9	-205.9	-205.9	-205.9	-205.9
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	28.6	22.3	22.3	22.3	22.3	33.1
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-75.6	-77.8	-68.3	-48.8	-60.9	-54.9
Downlink C / N(dB)	17.6	12.4	10.7	10.0	9.8	11.5
COMPOSITE LINK PERFORMANCE						
C/N Uplink (dB)	28.0	26.2	27.0	26.3	26.2	17.1
C/N Downlink (dB)	17.6	12.4	10.7	10.0	9.8	11.5
C/I Intermodulation (dB)	N/A	N/A	26.4	25.7	25.6	16.5
C/I Uplink Co-Channel (dB)*	27.0	27.0	28.5	28.4	28.8	19.2
C/I Downlink Co-Channel (dB)*	27.0	27.0	28.5	28.4	28.8	19.2
C/I Uplink Adjacent Satellite 1 (dB)	30.5	28.8	29.6	28.9	28.8	19.7
C/I Downlink Adjacent Satellite 1 (dB)	21.9	16.2	14.4	13.7	13.6	16.0
C/I Uplink Adjacent Satellite 2 (dB)	30.5	28.8	29.6	28.9	28.8	19.7
C/I Downlink Adjacent Satellite 2 (dB)	22.9	18.3	16.5	15.8	15.7	16.6
C/(N+I) Composite (dB)	14.4	9.8	8.1	7.4	7.3	6.9
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	13.4	8.8	7.1	6.4	6.3	5.9
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0	-3.4	-3.4
Excess Link Margin (dB)	3.4	5.4	3.3	3.5	2.9	2.5
Number of Carriers	2	1.0	5.0	526.0	33.1	180.0
CARRIER DENSITY LEVELS						
Uplink Power Density (dBW/Hz)	-42.8	-54.1	-53.3	-54.0	-54.1	-52.7
Downlink EIRP Density At Beam Peak (dBW/Hz)	-17.6	-26.0	-27.8	-28.5	-28.6	-37.7