ATTACHMENT A

Technical Annex to Supplement Schedule S

1 GENERAL DESCRIPTION

The ECHOSTAR-1 satellite will serve as an in-orbit spare for the EchoStar fleet from the 77.25° W.L. orbital position. The ECHOSTAR-1 technical parameters and payload performance provided in the sections below are shown for information purposes only since operating authority for the communications payload is not being requested. The TT&C information provided below demonstrates the characteristics that will be employed at the 77.25° W.L. location.

2 SATELLITE TRANSMIT PERFORMANCE

The downlink beam coverage of the ECHOSTAR-1 satellite from the 77.25°W.L. location is shown in Figures 2-1 and 2-2. The satellite employs two shaped reflectors, each operating in RHC polarization. The beams generated by each reflector are nominally the same but the pointing directions of the two reflectors are different thereby creating two different sets of beam contours on the surface of the Earth. One reflector generates the southern CONUS beam and the other reflector generates the Mexican beam. The cross-polar isolation of the satellite transmit antennas exceeds 30 dB at all transmit frequencies. The peak antenna gain is 36.1 dBi.

Each transponder uses a single 130 Watt Traveling Wave Tube Amplifier (TWTA). The losses between the TWTA output and the antenna input amount to 2.1 dB. The maximum beam peak saturated EIRP level for the transponders in 55.1 dBW.

Figure 2-1: ECHOSTAR-1 Downlink Southern CONUS Beam Coverage from 77.25°W.L.

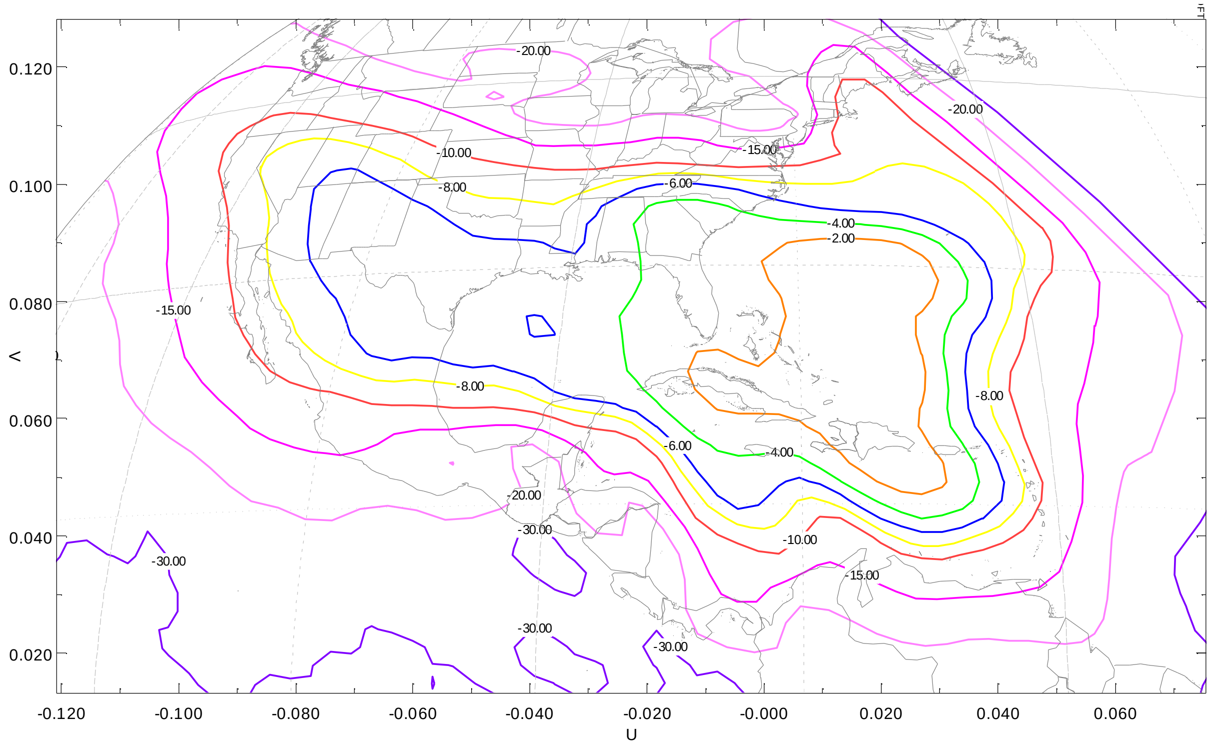
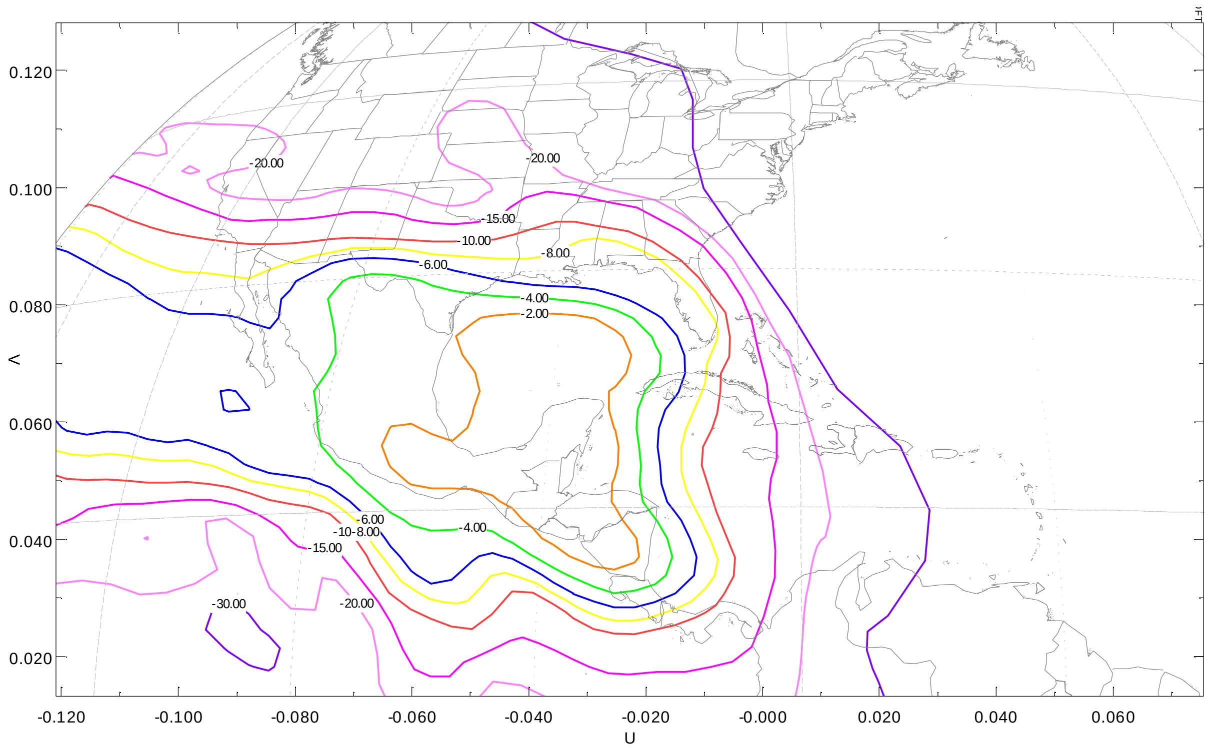


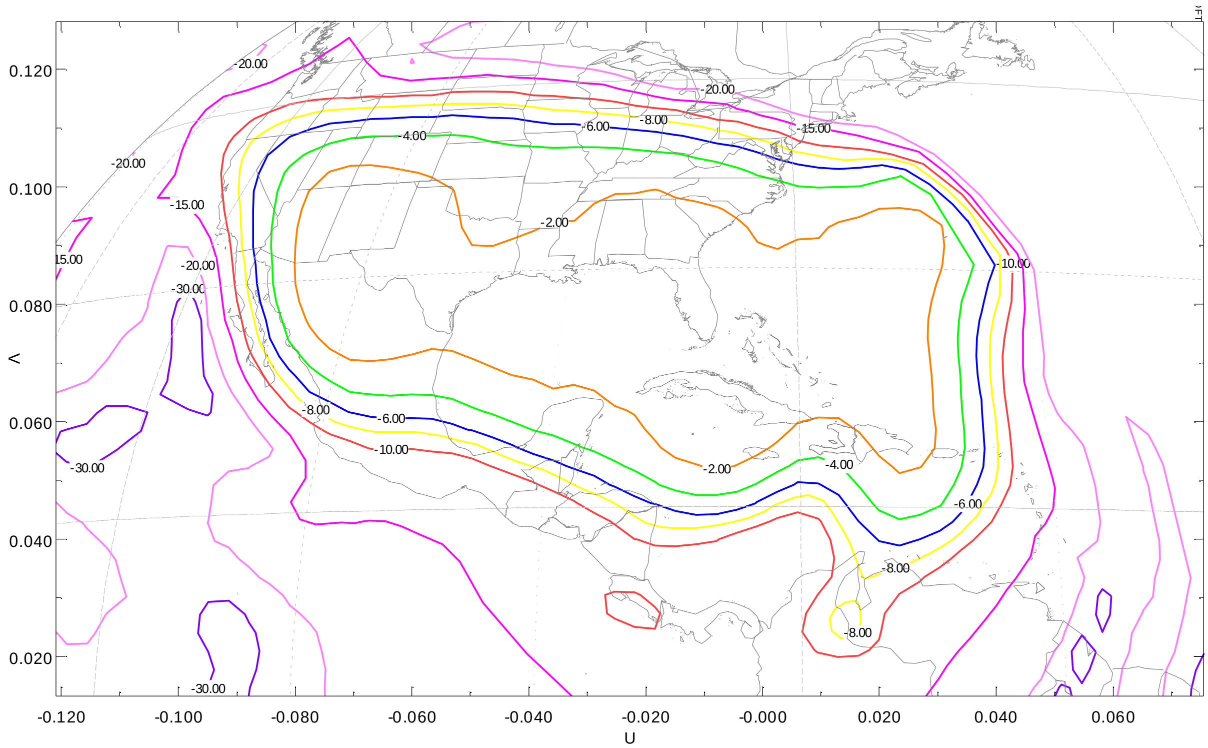
Figure 2-2: ECHOSTAR-1 Downlink Mexico Beam Coverage from 77.25°W.L.



3 SATELLITE RECEIVE PERFORMANCE

The single uplink beam receives feeder link transmissions from EchoStar uplink sites in Gilbert, AZ or Cheyenne, WY, operating in RHC polarization. The relative gain contours are shown in Figure 3-1. The cross-polar isolation of the satellite receive exceeds 30 dB at all receive frequencies. The peak gain of the beam is 31.4 dBi, with a noise temperature of 513K, for a peak G/T of 4.3 dB/K.

Figure 3-1: ECHOSTAR-1 Uplink Beam Coverage from 77.25°W.L.



4 FREQUENCY AND POLARIZATION PLANS

The ECHOSTAR-1 satellite uses the standard RHC polarization channel center frequencies and channel bandwidths prescribed in the ITU's Region 2 BSS Plan.[1] Circular polarization is used on both the uplink and downlink.

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1 Channel bandwidth is 24 MHz. Spacing between adjacent co-polar channels is 29.16 MHz.

5 COMMUNICATIONS PAYLOAD CONFIGURATION

The uplink signals are received in RHC polarization by the satellite receive beam. One active receiver is used on the satellite. After appropriate down-conversion, channel filtering and amplification, the signals are transmitted from the satellite using a single 130 Watt TWTA per channel. In total, the communications payload can support 16 channels. The outputs of the TWTAs are then multiplexed into the appropriate downlink antenna ports.

6 SATURATION FLUX DENSITY AND TRANSPONDER GAIN

The Saturation Flux Density (SFD) of the uplink receive beam ranges between –78 dBW/m2 (low gain) to –96 dBW/m2 (high gain) at receive beam peak and is adjustable in 1.5 dB steps. The transponder gain is controlled by an Automatic Level Control (ALC) system which automatically adjusts the transponder gain to give a constant satellite transmit power level for each transponder. The maximum transponder gain is 125 dB.

7 RECEIVER AND TRANSMITTER CHANNEL FILTER RESPONSE CHARACTERISTICS

The typical receiver and transmitter frequency responses of each RF channel, as measured between the receive antenna input and transmit antenna, fall within the limits shown in Table 7-1 below.

In addition, the frequency tolerances of § 25.202(e) and the out-of-band emission limits of § 25.202(f) (1), (2) and (3) will be met.

Table 7-1: Typical Receiver and Transmitter Filter Responses

Offset from Channel Center Frequency (MHz)	Receiver Filter Response (dB)	Transmitter Filter Response (dB)
± 5	> -0.5	> -0.4
± 7	> -0.7	> -0.5
±9	> -1.0	> -0.8
± 11	> -1.5	> -1.7
±12	> -2.0	> -3.6
±17.5	< -18	< -8

±20.2	< -38	< -18
±27.2	< -50	< -35

8 EMISSION DESIGNATORS AND ALLOCATED BANDWIDTH OF EMISSION

The emission designators and allocated bandwidth of emissions are provided in S11 and S12 of the associated Schedule S. The payload emissions are shown for information purposes.

9 TT&C

EchoStar will telecommand the ECHOSTAR-1 satellite at the 77.25° W.L. orbital position in normal modes using the 5926.5 MHz telecommand carrier operating in horizontal linear polarization, operating with the higher gain horn antenna on the spacecraft. For emergencies modes when the spacecraft has lost correct orientation, the telecommand will operate through the low-gain omni antenna on the spacecraft using the 6423.5 MHz telecommand frequency. These telecommand carriers have no conflicts with all adjacent satellites that might potentially be affected. Accordingly, EchoStar requests a waiver of § 25.202(g) to permit TT&C operations on frequencies outside of the band edges. Grant of the requested waiver will not undermine the underlying policy objective and will serve the public interest, as the proposed TT&C operations will not adversely affect the operations of neighboring C-band U.S.-licensed satellites.

A summary of the TT&C subsystem performance is given in Table 11-1.

Table 9-1: Summary of the TT&C Subsystem Performance

Parameter	Performance
On-Station Command Frequency	5926.5 MHz (horn antenna) 6423.5 MHz (omni antenna)
Uplink Flux Density	Between -80 and -96 dBW/m^2
Uplink Tx Earth Station Polarization	Horizintal Linear
On-Station Telemetry Frequencies	4198.5 MHz 4199.5 MHz
Maximum Downlink EIRP	10.6 dBW at 5926.5 MHz (horn antenna) 8.9 dBW at 6423.5 MHz (omni antenna)

Downlink Polarization	Horizontal Linear

10 POWER FLUX DENSITY CALCULATIONS

Power flux density (pfd) calculations are required pursuant to section 25.208 for the C-band telemetry carriers used for space operations. Table 12-1 shows the calculations for maximum downlink EIRP of the telemetry carrier transmitted from a horn antenna and the resulting pfd is well below the limits.

Table 10-1: C-band power flux density calculations

		Elevation angle (deg.)				
		5.0	**10.0**	**15.0**	**20.0**	**25.0**
Maximum EIRP	dBW	10.6	10.6	10.6	10.6	10.6
EIRP at elevation angle	deg.	9.8	9.8	9.8	9.9	10.0
Carrier bandwidth	MHz	0.1	0.1	0.1	0.1	0.1
Spreading loss	dB/m^2	163.3	163.2	163.1	162.9	162.8
Calculated pfd	dB/m^2/4kHz	-167.5	-167.3	-167.2	-167.0	-166.8
25.208 limit	dB/m^2/4kHz	-152.0	-149.5	-147.0	-144.5	-142.0
Margin	dB	15.5	17.8	20.2	22.5	24.8

11 LINK BUDGETS

Representative link budgets for the DBS transmissions, which include details of the transmission characteristics, performance objectives and earth station characteristics, are provided in the associated Schedule S submission. These DBS link budgets are shown for information purposes. Link budgets for the TT&C transmissions are also included therein.

12 ORBITAL DEBRIS MITIGATION PLAN

The ECHOSTAR-1 satellite was designed and manufactured by Lockheed Martin Astro Space and was launched in 1995. Since the launch of the satellite, the Commission adopted new orbital debris mitigation requirements under §§ 25.114(d)(14) and 25.283 that were not in effect prior to launch. Therefore, to the extent necessary, EchoStar requests a waiver of these requirements as described in detail below.

12.1 Spacecraft Hardware Design

There is a limited probability of the satellite becoming a source of debris by collisions with small debris or meteoroids of less than one centimeter in diameter that could cause loss of control and prevent post-mission disposal. Such probability has been limited during the design of the spacecraft, specifically through component placement and the use of redundant systems.

The ECHOSTAR-1 satellite has separate TT&C and propulsion subsystems that are necessary for end-of-life disposal. The spacecraft TT&C system, vital for orbit raising, is extremely robust with regard to meteoroids smaller than 1 cm, by virtue of its redundancy, shielding, separation of components and physical characteristics. An omni-directional antenna and wide angle horn system are used during orbit raising and on-station. The command receivers and decoders and telemetry encoder and transmitters are located within a shielded area and physically separated. A single robust thruster provides the energy for orbit raising.

12.2 Minimizing Accidental Explosions

There is a limited probability of accidental explosions during and after completion of mission operations. The probability of accidental explosions has been limited through extensive monitoring of the ECHOSTAR-1 satellite's batteries and fuel tanks for pressure and temperature violations. Furthermore, bipropellant mixing is prevented by the use of valves that prevent backwards flow in propellant lines and pressurization lines. Excessive battery charging or discharging is limited by a monitoring and control system which will automatically limit the possibility of fragmentation. Corrective action, if not automatically undertaken, will be immediately undertaken by the spacecraft operator to avoid destruction and fragmentation. Thruster temperatures, impulse and thrust duration are carefully monitored, and the thrusters may be turned off with a latch valve. At the end of the satellite's life, all energy sources will be depleted to the extent possible. Specifically, the batteries will be left in a permanent state of discharge, chemical propulsion systems will be depleted to the extent possible, all fuel line valves will be left open, and the arcjet propulsion system will be disabled.

12.3 Safe Flight Profiles

In considering current and planned satellites that may have a station-keeping volume that overlaps the ECHOSTAR-1 satellite, EchoStar has reviewed the lists of FCC licensed satellite networks, as well as those that are currently under consideration by the FCC. In addition, networks for which a request for coordination has been published by the ITU in the vicinity of 77.25°W.L. have also been reviewed.

ECHOSTAR-1 currently operates at the nominal 77° W.L. orbital location (specifically, at 77.15° W.L.), along with the QUETZSAT-1 and ECHOSTAR-8 satellites. The ECHOSTAR-1 satellite will be operated at the 77.25°W.L. location, with an east-west station-keeping tolerance of ±0.05°.

The orbital locations for other satellites (*i.e.*, operational satellites, authorized planned satellites, and those for which there are pending applications before the Commission) in the vicinity of 77°W.L. are summarized below:

- The ECHOSTAR-8 satellite will operate at 76.75°W.L. with an east-west station-keeping tolerance of ±0.05° after seeking and receiving Commission authorization; and
- The QUETZSAT-1 satellite operates at 77.0°W.L. with an east-west station-keeping tolerance of ±0.05°.

Given the east-west station-keeping of the current and future adjacent satellites, there is no possibility of any station-keeping volume overlap between the above-listed satellites and the ECHOSTAR-1 satellite.

There are numerous FSS and BSS networks filed with the ITU in the vicinity of 77°W.L. Several of these were filed on behalf of the operational and planned satellites listed above. For the remaining ones, EchoStar can find no evidence that they are being constructed.

Based on the preceding, EchoStar concludes there is no requirement to physically coordinate the ECHOSTAR-1 satellite with another satellite operator at the present time.

12.4 Post Mission Disposal

Upon mission completion, the ECHOSTAR-1 satellite will be maneuvered to a disposal orbit at least 300 km above its operational geostationary orbit.[2] Based on analyses performed by the satellite manufacturer, we understand that 12 kg of fuel will be reserved to achieve the disposal orbit at the end of the satellite's life. The fuel remaining is calculated using the following three methods: (i) the pressure-volume-temperature method, which uses tank pressure and temperature information to determine remaining propellant; (ii) the bookkeeping method, which evaluates the flow rate at average pressure and total thruster on-time of orbital maneuvers to determine the amount of propellant used; and (iii) thermal gauging, which evaluates the amount of fuel remaining based on the thermal response of the fuel tanks to an applied heater load.

As the ECHOSTAR-1 satellite was not designed with exhaust valves to fully vent the fuel tanks at the end of life, EchoStar requests a waiver of § 25.283(c) to allow the remaining fuel left in the tanks at the end of life. The satellite was launched prior to FCC adoption of § 25.283(c), and it would be technically infeasible and unduly burdensome to require a modification of the spacecraft design to conform to the fuel venting requirement. Additionally, the spacecraft design renders it highly unlikely that the helium tank will leak or burst, and the residual fuel will be at a very low pressure. Thus, the likelihood of accidental explosion has been minimized, consistent with the underlying purpose of the rule.

13 INTERFERENCE ANALYSES

Since no operating authority for the communications payload is being requested, no interference analysis under Appendices 30 and 30A has been performed for the communications payload.

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[2] The ECHOSTAR-1 satellite was launched in 1995. Pursuant to the Commission's Mitigation of Orbital Debris, Second Report and Order, 19 FCC Rcd 11567 (2004), a calculation of the satellite's disposal orbit according to the IADC formula is not required. See Second Report and Order at ¶ 81 ("we will grandfather all on orbit GEO spacecraft that were launched as of the release of the Notice in this proceeding").

For the TT&C operation in C-band, the analysis below demonstrates the compliant operations of the ECHOSTAR-1 satellite under a two-degree spacing environment. There is more than 6 dB of uplink margin with respect to the FCC rules.

Although there are no two-degree rules for the C-band downlink, the analysis below demonstrates that a two-degree neighbor would have a carrier-to-interference ratio of more than 19 dB for link that is similar to ECHOSTAR-1 telemetry carrier resulting in a 4.4% decrease in the total noise temperature when assuming a C/N objective of 6 dB. Also, as demonstrated above, the pfd from the telemetry is well below the FCC requirements with at least a 15 dB margin.

Table 13-1: Uplink interference analysis from ECHOSTAR-1 command carrier

Uplink interference		
Center Frequency	MHz	5926.5
Carrier Bandwidth	MHz	0.8
Tx E/S Antenna Gain	dBi	53.1
Power Density to Tx E/S Antenna	dBW/4kHz	-9.3
Power to Tx E/S Antenna	dBW	13.7
Tx E/S EIRP	dBW	66.8
Power Density to Tx E/S FCC limit	dBW/4kHz	-2.7
Margin below the FCC limit	dB	6.6

Table 13-2: Downlink interference analysis from ECHOSTAR-1 telemetry carrier

Downlink interference		
Frequency	MHz	4199.5
Carrier Bandwidth	MHz	0.8
EIRP	dBW	10.6
EIRP Density interferer	dBW/4kHz	-12.4
Rx E/S on-axis antenna gain	dBi	40.0
Rx E/S off-axis antenna gain at 2°	dBi	20.4
EIRP Density wanted	dBW/4kHz	-12.4
C/I	dB	19.6
C/N objective	dB	6.0
C/(N+I)	dB	5.8

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/ Zachary Rosenbaum
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