ATTACHMENT A

Technical Annex to Supplement Schedule S

1 GENERAL DESCRIPTION

The ECHOSTAR-8 satellite will serve as an in-orbit spare for the EchoStar fleet from the 76.75° W.L. orbital position. The ECHOSTAR-8 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 76.75° W.L. location.

2 SATELLITE TRANSMIT PERFORMANCE

The downlink beam coverage of the ECHOSTAR-8 satellite from the 76.75°W.L. location is shown in Figures 2-1, 2-2, and 2-3. The satellite employs two shaped reflectors, each operating in both right hand circular (RHC) and left hand circular (LHC) polarization. The performance in both polarizations is nominally the same. 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 will use either a single 126 Watt Traveling Wave Tube Amplifier (TWTA) (“medium power” mode) or two parallel 126 Watt TWTAs (“high power” mode) giving approximately a 2.5 dB increase in transmit EIRP. The losses between the TWTA output and the antenna input amount to 2.5 dB in medium power mode and 3 dB in high power mode. The maximum beam peak saturated EIRP level for the transponders in medium power mode is 54.6 dBW and 57.1 dBW in high power mode.

Figure 2-1: ECHOSTAR-8 Medium Power Downlink CONUS Beam Coverage from 76.75° W.L.

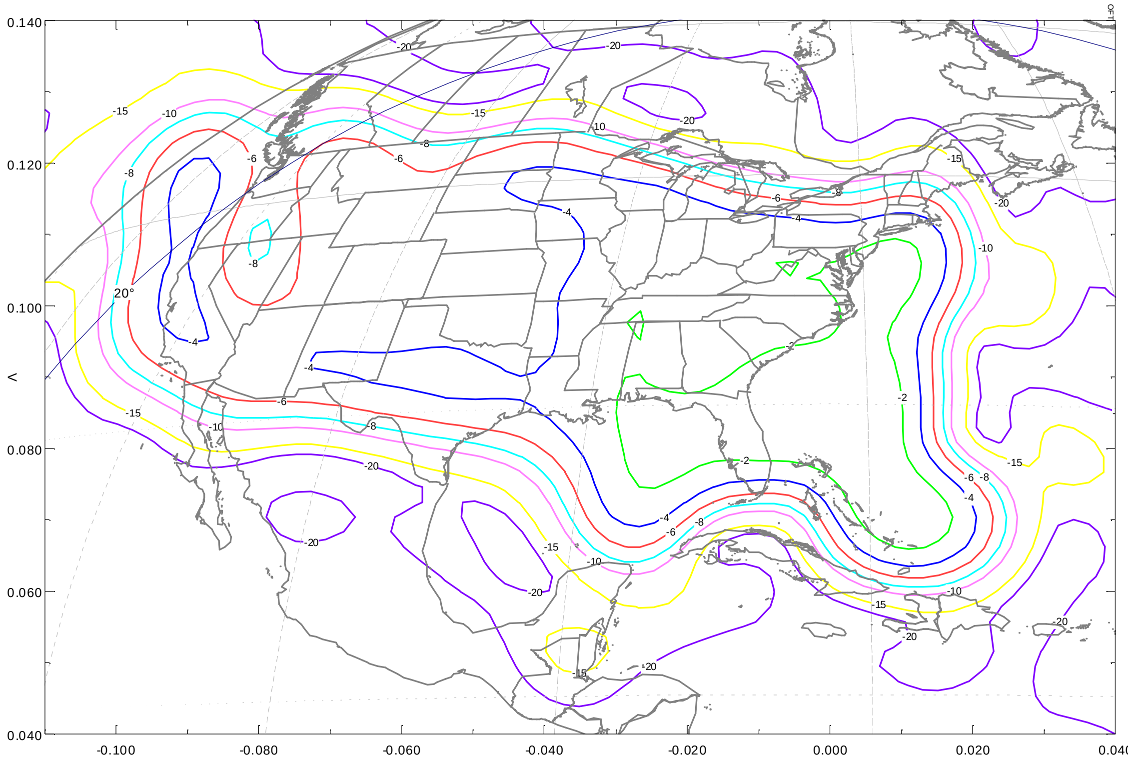


Figure 2-2: ECHOSTAR-8 High Power Downlink CONUS Beam Coverage from 76.75°W.L.

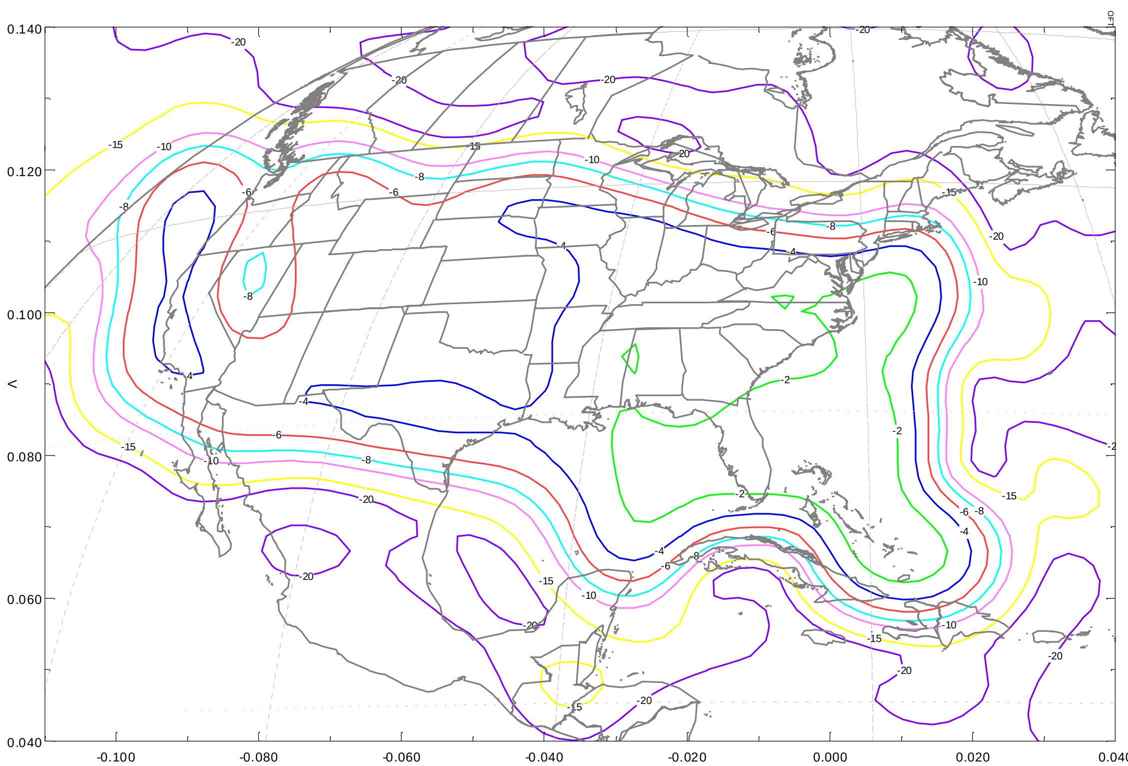
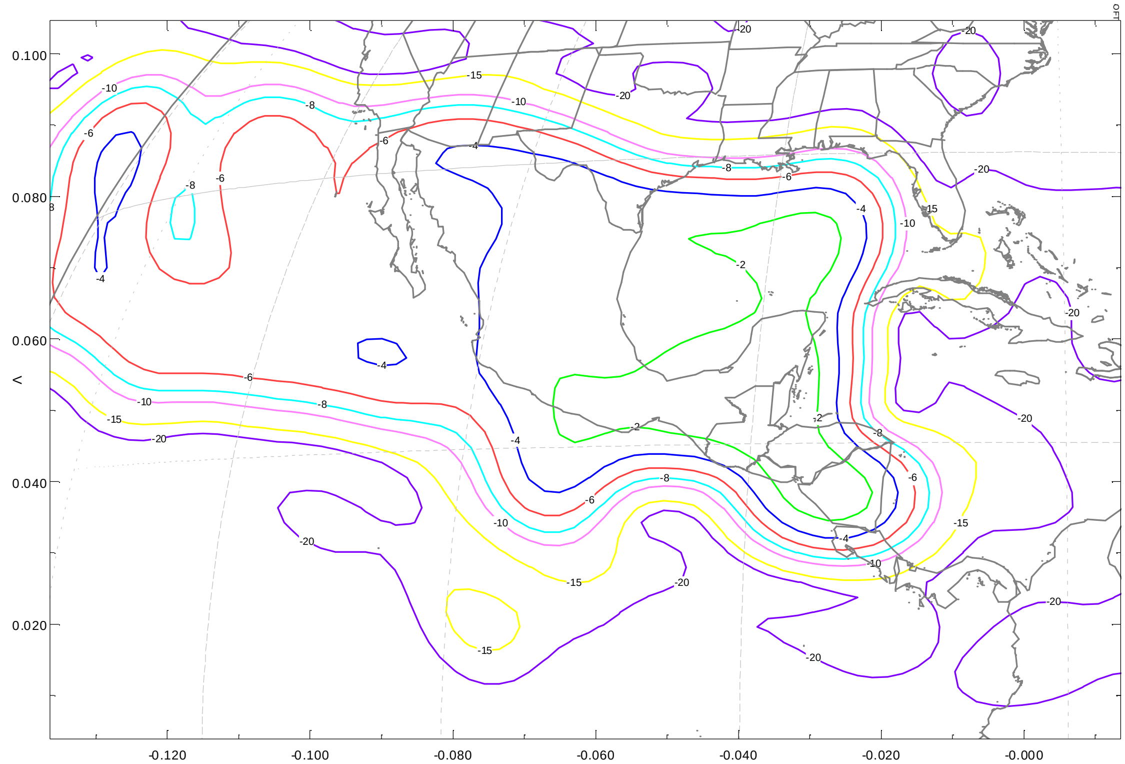


Figure 2-3: ECHOSTAR-8 Medium Power Downlink Mexico Beam Coverage from 76.75°W.L.



3 SATELLITE RECEIVE PERFORMANCE

The uplink beams use spot beam technology through uplink sites in Gilbert, AZ or Cheyenne, WY (and possibly a site located in Mexico). The receive spot beams can be operated in both RHC and LHC polarizations. The spot beam gain contours are shown in Figures 3-1 and 3-2 for Gilbert and Cheyenne, respectively. The performance in both polarizations is nominally the same. The cross-polar isolation of the satellite spot beam receive exceeds 30 dB at all receive frequencies. The peak gain of the beam is 49.5 dBi, with a noise temperature of 3550K, for a peak G/T of 14 dB/K.

Figure 3-1: ECHOSTAR-8 Gilbert Uplink Beam Coverage from 76.75°W.L.

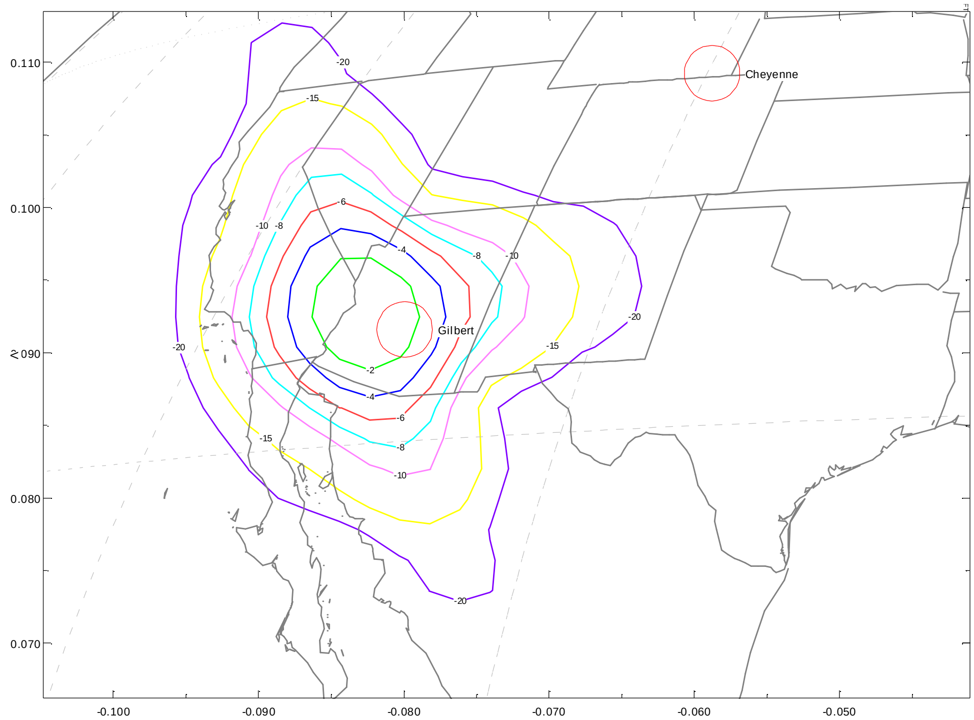
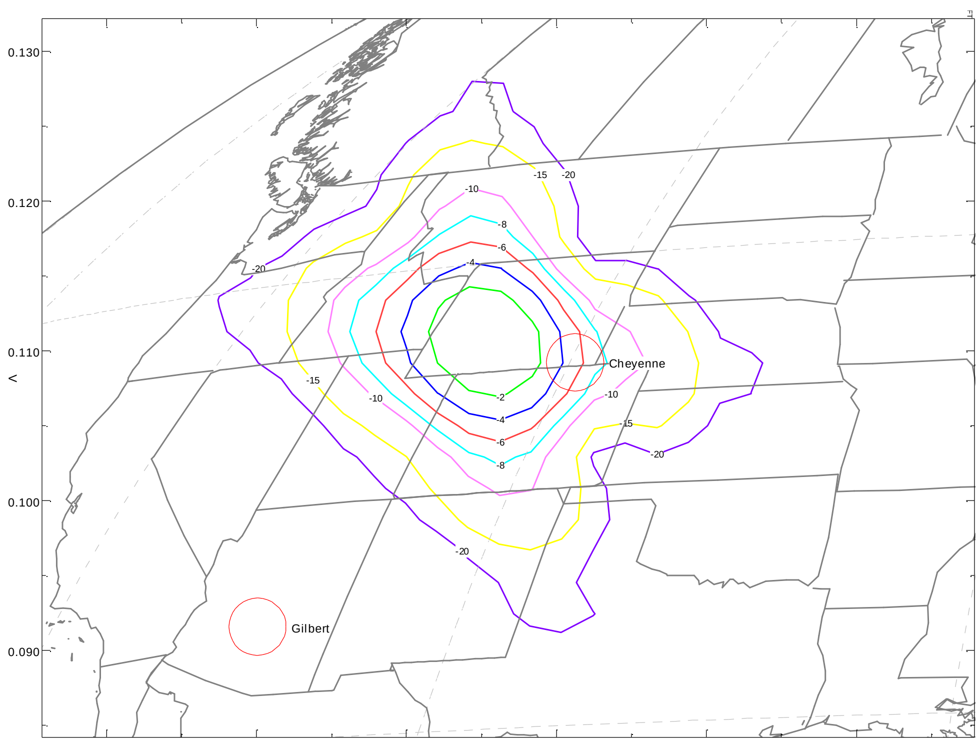


Figure 3-2: ECHOSTAR-8 Cheyenne Uplink Beam Coverage from 76.75°W.L.



4 FREQUNECY AND POLARIZATION PLANS

The ECHOSTAR-8 satellite uses the standard 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.

5 COMMUNICATIONS PAYLOAD CONFIGURATION

The uplink signals are received in both polarizations by the satellite receive antenna beams. Two active receivers are used on the satellite – one for each polarization. After appropriate down-conversion, channel filtering and amplification, the signals are transmitted from the satellite using a single 126 Watt TWTA per channel in the case of medium power mode operation. Each channel can be configured to use two parallel TWTAs for high power mode operation, giving a corresponding increase in the EIRP level of approximately 2.5 dB. In total, the communications payload can support 32 channels in medium power mode, or 16 channels in high power mode, or the corresponding number of a mixture of high power and medium power mode transponders. The reconfiguration of all transponders is switchable by ground telecommand. 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 –87 dBW/m2 (low gain) to –108 dBW/m2 (high gain) at receive beam peak and is adjustable in 1 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 129.1 dB.

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[1] Channel bandwidth is 24 MHz. Spacing between center frequencies of adjacent cross-polar channels is 14.58 MHz. Thus, the center frequencies of co-polar channels are offset by 29.16 MHz.

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 command and range the ECHOSTAR-8 satellite at the 76.75° W.L. orbital position using the 17.799 GHz, 14.001 and 14.003 GHz telecommand and ranging carriers, all receiving in the right hand circular polarization. The ranging carriers do not conflict with any adjacent satellites that might potentially be affected. The 17 GHz telecommand carrier will be used during on-station operations through the communications antenna but can also be received through the wide-angle command antennas. The 14 GHz telecommand carriers will be used during orbit raising and will use a wide-angle command antennas.

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

Table 11-1: Summary of the TT&C Subsystem Performance

Parameter	Performance
On-Station Command Frequency	17799 MHz
Orbit-raising Command Frequencies	14001 MHz 14003 MHz
Uplink Flux Density	Between -70.5 and -91.5 dBW/m^2
Uplink Tx Earth Station Polarization	RHCP
On-Station Telemetry Frequencies	12,206 MHz 12,207 MHz
Maximum Downlink EIRP	13.5 dBW
Downlink Polarization	LHCP

Note that the wide-angle command antennas used for TT&C are low gain (+2 dBi peak gain), and as such the gain variation over the surface of the Earth is less than 2 dB. Therefore it is not possible to provide a GXT file showing the beam contours for these antennas, and no such GXT files are included in the associated Schedule S.

10 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.

11 ORBITAL DEBRIS MITIGATION PLAN

The ECHOSTAR-8 satellite was designed and manufactured by Space Systems/Loral and was launched in 2002. The ECHOSTAR-8 satellite design may not fully comply with the Commission's orbital debris mitigation requirements under §§ 25.114(d)(14) and 25.283, and so to the extent necessary, EchoStar requests a waiver of these requirements as described in detail below.

11.1 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 through component placement and the use of redundant systems.

The ECHOSTAR-8 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 rugged 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 principally during orbit raising. The redundant command receivers and decoders and telemetry encoders and transmitters are located within a shielded area and physically separated. A single rugged thruster and shielded propellant tank provide the energy for orbit raising.

11.2 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-8 satellite's batteries and fuel tanks for pressure and temperature. 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, all fuel line valves will be left open, and the electrical propulsion system will be disabled.

11.3 Safe Flight Profiles

In considering current and planned satellites that may have a station-keeping volume that overlaps the ECHOSTAR-8 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°W.L. have also been reviewed.

ECHOSTAR-8 currently operates at the nominal 77° W.L. orbital location (specifically, at 76.9° W.L.), along with the QUETZSAT-1 and ECHOSTAR-1 satellites. The ECHOSTAR-8 satellite will be operated at the 76.75°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 satellites for which there are pending applications before the Commission) in the vicinity of 77°W.L. are summarized below:

- The ECHOSTAR-1 satellite will operate at 77.25°W.L. with an east-west station-keeping tolerance of ±0.05° after seeking and receiving Commission authorization; and
- The QUETZSAT-1 satellite will operate 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-8 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-8 satellite with another satellite operator at the present time.

11.4 Post Mission Disposal

At the end of the operational life of the ECHOSTAR-8 satellite, EchoStar will maneuver the satellite to a disposal orbit with a minimum perigee of 360 km above the normal GSO operational orbit. This proposed disposal orbit altitude exceeds the minimum required by § 25.283, which is calculated below.

The input data required for the calculation is as follows:

Total Solar Pressure Area "A" = 112 m^2

(includes area of solar array, satellite body and deployed antennas)

"M" = Dry Mass of Satellite = 1834 kg

"CR" = Solar Pressure Radiation Coefficient (worst case) = 2

Using the formula given in §25.283, the Minimum Disposal Orbit Perigee Altitude is calculated as follows:

= 36,021 km + 1000 x CR x A/m

= 36,021 km + 1000 x 2 x 112/1834

= 36,143 km

= 357 km above GSO (35,786 km)

Thus, the designed disposal orbit of 360 km above GSO exceeds the required minimum by a margin of 3 km. Maneuvering the satellite to the disposal orbit will require 5 kg of bi-propellant, and this quantity of fuel and oxidizer, taking account of all propellant measurement uncertainties, will be reserved to perform the final orbit raising maneuvers. The propellant reserve was calculated using the following two methods: (i) 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 (ii) the propellant depletion gauge operation method, which makes it possible to determine when the oxidizer and fuel tanks are nearing depletion and the approximate amount of useable propellant that remains by monitoring and trending the changes in tank temperatures resulting from operation of the propellant gauge heaters. EchoStar has assessed fuel gauging uncertainty and has provided an adequate margin of fuel to address such uncertainty.

As the ECHOSTAR-8 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.

12 INTERFERENCE ANALSYSIS – ANNEXES 1 TO APPENDICES 30 AND 30A

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.

For the TT&C operation of the FSS Ku-band telemetry carrier, the analysis below demonstrates the compliant operations of the ECHOSTAR-8 satellite under a two-degree spacing environment. There is more than 19 dB of downlink margin with respect to the FCC rules.

Downlink interference		
Frequency	MHz	12206.0
Carrier Bandwidth	MHz	0.8
EIRP	dBW	13.5
EIRP Density	dBW/4kHz	-9.5
EIRP Density FCC limit	dBW/4kHz	10.0
Margin below the FCC limit	dB	19.5

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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