ATTACHMENT A
Technical Appendix

A.1 SCOPE AND PURPOSE

This Technical Appendix summarizes the technical characteristics of the AprizeSat-8 and AprizeSat-10 satellites (together, the "AprizeSats"), non-geostationary orbit ("NGSO") small satellites ("smallsats") owned and operated by SpaceQuest, Ltd. ("SpaceQuest"), a wholly owned subsidiary of AAC Clyde Space AB. The AprizeSats are currently in orbit and operating pursuant to authority granted under Part 5 of the Commission's Rules, which will expire on July 1, 2021.[1] SpaceQuest is filing this application for a small space station authorization pursuant to Section 25.122 of the Commission's Rules license to provide continuing operating authority for the AprizeSats.

A.2 GENERAL DESCRIPTION

AprizeSat-8 and AprizeSat-10, were launched on November 21, 2013 and June 19, 2014, respectively. The AprizeSats were launched to validate an innovative smallsat-based architecture operating in the UHF, VHF, and S-band frequencies identified herein for tracking and monitoring high-value maritime assets. The AprizeSats continue to conduct such important vessel tracking operations and communicate with earth stations located in Fairbanks, Alaska; Fairfax, Virginia; Naalehu, Hawaii; and Esrange, Sweden.

A.3 SATELLITE OVERVIEW

The AprizeSats are equipped with several automatic identification system ("AIS")[2] payload receivers that continuously collect AIS messages that are being transmitted by ships at sea. These messages are decoded, time-stamped and annotated with the space station ID before being stored for future download to an S-Band Earth Station located in either Alaska or Sweden.

Telemetry, Tracking and Control is accomplished using UHF receivers and UHF transmitters. There is a fixed frequency VHF receiver that is used to perform a satellite power cycle in the event that the on-board computer ceases to operate properly and does not respond to a ground command. The UHF transmitters are operative only in response to a ground command to download its directory and/or telemetry data.

A.4 SATELLITE SYSTEM DESCRIPTION

A.4.1 AprizeSat-8 and AprizeSat-10

The AprizeSats were injected into a near-circular, sun-synchronous orbit using a Russian Dnepr rocket. Each 14.6 kg space station consists of six aluminum trays each housing a specific components and subsystems. The satellite trays contain of the following:

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[1] *See* Aprize Satellite Inc., File No. 0301-EX-CR-2019, Call Sign WD2XFT.

[2] AIS is an advanced marine vessel tracking and navigation technology that can provide vessel information, (*i.e.*, the vessel's identity, type, position, course, speed, navigational status) automatically to appropriately equipped space stations.

TOP Tray

- Two VHF monopole antennas;
- Two UHF monopole antennas;
- One GPS Antenna;
- One S-Band Transmit Antenna;
- A UHF T/R switch, RF subsystem, and Radio Reset Modem;
- One GPS Receiver;
- One VHF Command Receiver;
- One UHF Command Receiver;
- One UHF Transmitter;
- One S-Band Transmitter;
- Two dual-channel AIS Receivers;
- Four single-channel AIS Receivers;
- Four permanent magnets; and
- Two two-channel downconverters.

IFC Tray

- An Integrated Flight Computer;
- An AIS Processor;
- An ARM-7 Processor with memory; and
- A Power PC Processor with memory.

BCR Tray

- A Battery Charge Regulator and Voltage Regulator; and
- A Telemetry system.

BATTERY Tray

- Six 6 Ahr NiCd Cells;
- Power Distribution Board ("PDB");
- Hysteresis Rods; and
- Spacecraft Power Reset Circuit.

Experimental Tray

- One Advanced AIS Payload;
- One AIS Payload Processor;
- One Experimental UHF Transceiver no longer functional; and
- One Experimental AIS Transponder no longer operational.

BOTTOM Tray

- One UHF TT&C monopole antenna;
- One VHF AIS monopole antenna;
- Four S-Band antennas;
- UHF TT&C Command Receiver;
- One Experimental S-Band Receiver no longer used;
- One S-Band Transmitter;
- One UHF Transmitter;
- One UHF T/R Switch;
- Two 4-Port Power Switches; and
- One Multiplexer Switch.

In addition, four solar panels, each consisting of two strings of 7 Triple-Junction GaAs cells, are mounted on the four sides of each satellite. Two solar panels, each consisting of one string of 7 Triple-Junction GaAs cells, are mounted on the top and bottom of each satellite. The four side panels also contain a temperature sensor and thermal control coverings.

There are two communication systems on board the space stations, namely a Command, Control & Telemetry System and an AIS Mission System.

The Command, Control & Telemetry System consists of a linear VHF receive antenna, two linear UHF transmit/receive antennas, two transmit/receive switches, a VHF command receiver, two UHF command receivers (one for the top antenna and one for the bottom antenna), an experimental S-band receiver that is no longer operational, an integrated flight computer, two UHF transmitters (one for the top antenna and one for the bottom antenna), and telemetry electronics.

The AIS Mission System consists of two linear VHF AIS receive antennas, two S-band transmit antennas, a GPS antenna, a GPS receiver, two dual-channel AIS receivers (that can be tuned to either the 162 MHz or the 156 MHz AIS frequencies), four single-channel AIS receivers (tuned to the 162 MHz AIS frequency), and AIS processors. The system also has a Power PC processor running a light version of Linux that collects, processes, stores, formats, encrypts, and transmits decoded AIS data using one of two S-band transmitters. The system also includes an experimental ARM-7 microcontroller that can process, store and transmit AIS messages.

A.4.2 Operating Modes

The primary operating modes are:

- AIS On-Board Processing, Storage & Transmit: Receive AIS data on two channels, filter, decode, store, and transmit on an S-band downlink.
- Command, Control & Telemetry: Receive commands and new flight code on either VHF or UHF; process and execute commands; collect and store spacecraft telemetry; and download telemetry data on request using a UHF downlink.

A.4.3 Orbital Parameters and Operating Frequencies

Table A.4.3-1 shows the orbital paramters and operating frequencies and power for the AprizeSats.

Table A.4.3-1: Orbital Parameters and Operating Frequencies

Orbital Parameters	Operating Frequencies & Power	
AprizeSat-10	UHF Uplink	399.925 MHz
Apogee 729 km		399.950 MHz
Perigee 611 km		399.975 MHz
Orbital Period 98.154 min		400.025 MHz
Inclination Angle 97.73 deg		
RAAN 283.65 deg	UHF Downlink	400.525 MHz
Eccentricity 0.0084		400.555 MHz
Semi Major Axis 7048.6km		400.575 MHz
LTAN 13.0 hr		400.595 MHz
Argument of Perigee 183.1 deg		
	VHF Uplink	145.958 MHz
AprizeSat-8	S-Band Downlink	2302.0 MHz
Apogee 662 km		
Perigee 589 km	AIS Uplinks	156.525 MHz
Orbital Period 98.154 min		156.775 MHz
Inclination Angle 97.568 deg		156.825 MHz
RAAN 92.97 deg		161.975 MHz
Eccentricity 0.0052		162.025 MHz
Semi Major Axis 7003.6km		
LTAN 0.4 hr	S-Band TX RF power	0.7 W
Argument of Perigee 7.96 deg		
	UHF TX RF power	4.0 W / 2.0W

Tables A.4.3-2 – 3-4 show example UHF, VHF, and S-band link budgets for the AprizeSats. Figures A.4.3-1 and 4.3-2 illustrate power flux density and link margins.

Table A.4.3-2 Representative UHF Link Budget

UHF	Uplink Budget							4/9/2021
ELEVATION ANGLE TO SATELLITE (Deg)	**5**	**10**	**20**	**30**	**45**	**60**	**75**	**90**
ORBITAL ALTITUDE (km)	620	620	620	620	620	620	620	620
EARTH'S RADIUS (km)	6378	6378	6378	6378	6378	6378	6378	6378
COVERAGE HALF ANGLE TO HORIZON (Deg)	66	66	66	66	66	66	66	66
SLANT RANGE TO SATELLITE (km)	2377	1978	1431	1108	841	706	640	620
SURFACE DISTANCE TO SSP (km)	2202	1799	1234	877	543	322	151	0
Ground Transmitter								
TRANSMITTER FREQUENCY (MHz)	**399.95**	**399.95**	**399.95**	**399.95**	**399.95**	**399.95**	**399.95**	**399.95**
GROUND TRANSMITTER POWER (Watts)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
GROUND TRANSMITTER POWER (dB)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TRANSMISSION LINE LOSS (dB)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
ANTENNA GAIN (dBi)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
GROUND TRANSMITTER EIRP (dBw)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Satellite Receiver								
FREE SPACE LOSS (dB)	152.0	150.4	147.6	145.3	142.9	141.4	140.6	140.3
ISOTROPIC POWER AT SAT ANTENNA (dB)	-130.0	-128.4	-125.6	-123.3	-120.9	-119.4	-118.6	-118.3
SATELLITE RECEIVER ANTENNA GAIN (dBi)	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51
POLARIZATION LOSS (dB)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
IMPLEMENTATION LOSS (dB)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SYSTEM NOISE TEMPERATURE (K)	400	400	400	400	400	400	400	400
FRONT END GAIN (Ant Gain-Losses) (dB)	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
FRONT END G/T (dB/K)	-28.5	-28.5	-28.5	-28.5	-28.5	-28.5	-28.5	-28.5
BOLTZMAN'S CONSTANT (dB)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
UPLINK C/No (dB-Hz)	70.1	71.7	74.5	76.8	79.2	80.7	81.5	81.8
DATA RATE (bps)	9600	9600	9600	9600	9600	9600	9600	9600
Eb/No (dB)	30.3	31.9	34.7	36.9	39.3	40.9	41.7	42.0
Eb/No REQUIRED FOR BER OF 10^{-5} (dB)	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
UPLINK MARGIN (dB)	**18.8**	**20.4**	**23.2**	**25.4**	**27.8**	**29.4**	**30.2**	**30.5**

UHF	Downlink Budget						4/9/2021
ELEVATION ANGLE TO SATELLITE (Deg)	5	10	20	30	45	60	75	90
ORBITAL ALTITUDE (km)	620	620	620	620	620	620	620	620
EARTH'S RADIUS (km)	6378	6378	6378	6378	6378	6378	6378	6378
COVERAGE HALF ANGLE TO HORIZON (Deg)	66	66	66	66	66	66	66	66
SLANT RANGE TO SATELLITE (Km)	2377	1978	1431	1108	841	706	640	620
SURFACE DISTANCE TO SSP (km)	2202	1799	1234	877	543	322	151	0
Satellite Transmitter								
SATELLITE DOWNLINK FREQUENCY (MHz)	400.6	400.6	400.6	400.6	400.6	400.6	400.6	400.6
TRANSMITTER OUTPUT POWER (Watts)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
TRANSMITTER OUTPUT POWER (dBW)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
IMPLEMENTATION LOSS (dB)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SATELLITE TRANSMIT ANTENNA GAIN (dBi)	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24
SATELLITE DOWNLINK EIRP (Watts)	4.23	4.23	4.23	4.23	4.23	4.23	4.23	1.00
SATELLITE DOWNLINK EIRP (dBW)	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26
Ground Receiver								
FREE SPACE LOSS (dB)	152.0	150.4	147.6	145.3	143.0	141.4	140.6	140.3
ISOTROPIC POWER AT ANTENNA (dBw)	-145.7	-144.1	-141.3	-139.1	-136.7	-135.2	-134.3	-134.0
GROUND ANTENNA GAIN (dB)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
POLARIZATION LOSS (dB)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TRANSMISSION LINE LOSS (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SYSTEM NOISE TEMPERATURE (K)	290	290	290	290	290	290	290	290
FRONT END GAIN (Ant Gain-Losses) (dB)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
FRONT END G/T (dB/K)	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
BOLTZMAN'S CONSTANT (dB)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
DOWNLINK C/No (dB-Hz)	67.8	69.4	72.2	74.4	76.8	78.3	79.2	79.4
DATA RATE (bps)	9600	9600	9600	9600	9600	9600	9600	9600
Eb/No (dB)	27.9	29.5	32.3	34.6	37.0	38.5	39.3	39.6
Eb/No REQUIRED FOR GMSK BER of 10^{-5} (dB)	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
DOWNLINK MARGIN (dB)	**16.4**	**18.0**	**20.8**	**23.1**	**25.5**	**27.0**	**27.8**	**28.1**

Fig. A.4.3-1 Power Flux Density as a function of Elevation Angle

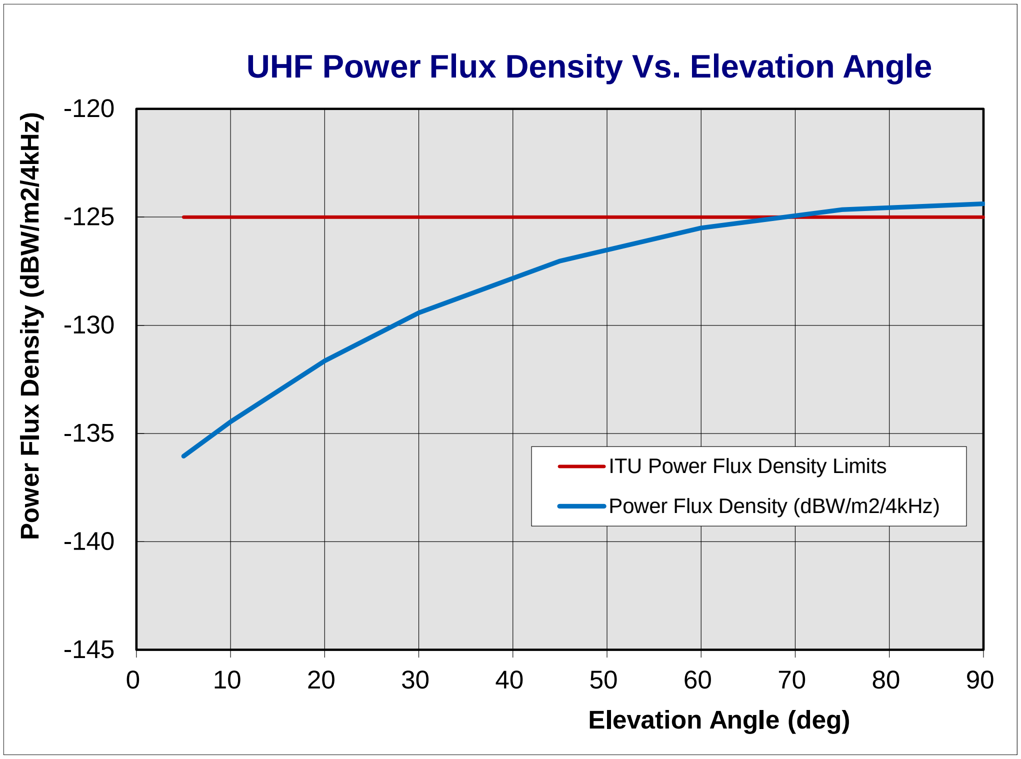


Fig. A.4.3-2 UHF Link Margin as a function of Elevation Angle

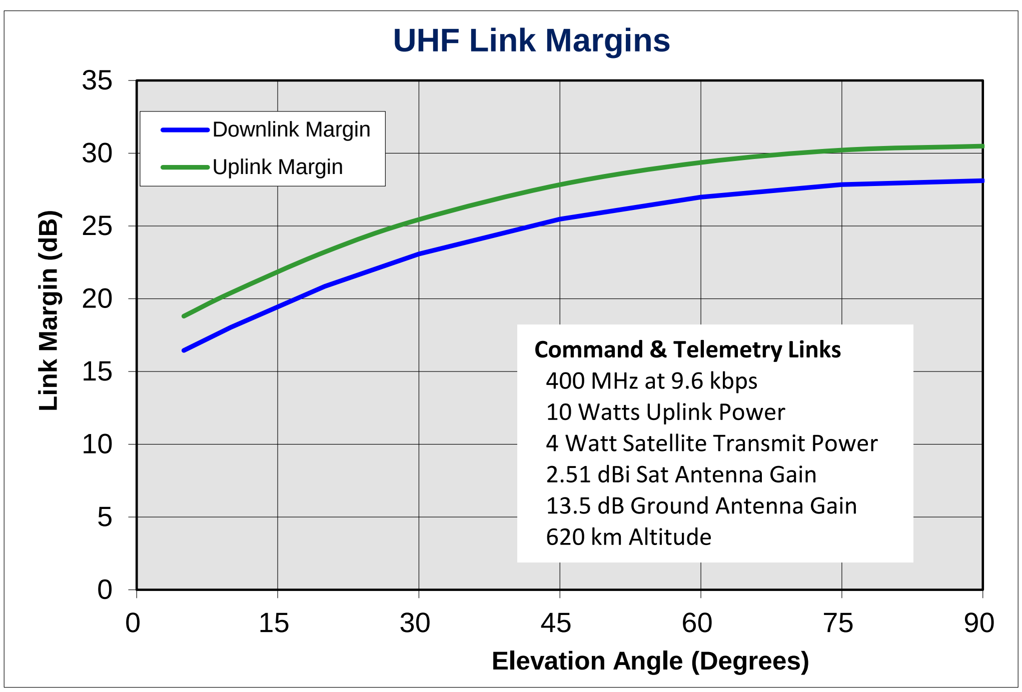


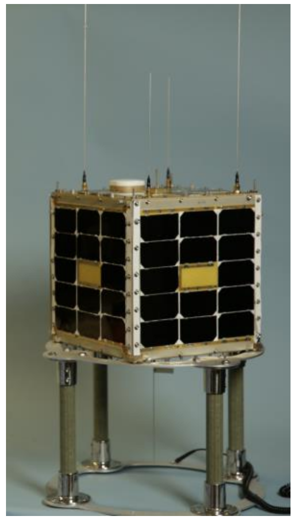
Table A.4.3-3 Representative VHF Uplink Budget

ELEVATION ANGLE TO SATELLITE (Deg)	5	15	30	45	60	75	90
ORBITAL ALTITUDE (km)	620	620	620	620	620	620	620
EARTH'S RADIUS (km)	6378	6378	6378	6378	6378	6378	6378
SATELLITE COVERAGE HALF ANGLE TO HORIZON (Deg)	66	66	66	66	66	66	66
SLANT RANGE TO SATELLITE (km)	2377	1669	1108	841	706	640	620
SURFACE DISTANCE BETWEEN RECEIVER AND SSP (km)	2202	1482	877	543	322	151	0
Ground Transmitter							
TRANSMITTER FREQUENCY (MHz)	**146.0**	**146.0**	**146.0**	**146.0**	**146.0**	**146.0**	**146.0**
USER TRANSMITTER POWER (Watts)	10	10	10	10	10	10	10
USER TRANSMITTER POWER (dB)	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TRANSMISSION LINE LOSS (dB)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
ANTENNA GAIN (dBi)	11.5	11.5	11.5	11.5	11.5	11.5	11.5
TRANSMITTER EIRP (dBw)	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Satellite Receiver							
FREE SPACE LOSS (dB)	143.2	140.1	136.6	134.2	132.7	131.8	131.5
ISOTROPIC POWER AT SATELLITE ANTENNA (dB)	-123	-120	-117	-114	-113	-112	-112
SATELLITE RECEIVER ANTENNA GAIN (dBi)	0.48	0.48	0.48	0.48	0.48	0.48	0.48
POLARIZATION LOSS (dB)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
IMPLEMENTATION LOSS (dB)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
SYSTEM NOISE TEMPERATURE (K)	290	290	290	290	290	290	290
FRONT END GAIN (Ant Gain-Losses) (dB)	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0	-4.0
FRONT END G/T (dB/K)	-28.6	-28.6	-28.6	-28.6	-28.6	-28.6	-28.6
BOLTZMAN'S CONSTANT (dB)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
UPLINK C/No (dB-Hz)	76.8	79.8	83.4	85.8	87.3	88.2	88.4
DATA RATE (bps)	9600	9600	9600	9600	9600	9600	9600
Eb/No (dB)	36.9	40.0	43.6	46.0	47.5	48.3	48.6
Eb/No REQUIRED FOR BER OF 10^{-4} (dB)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
UPLINK MARGIN (dB)	**24.9**	**28.0**	**31.6**	**34.0**	**35.5**	**36.3**	**36.6**

Table A.4.3-4 Representative S-Band Downlink Budget

SpaceQuest, Ltd.	S-Band Downlink Budget					4/9/2021	
ELEVATION ANGLE TO SATELLITE (Deg)	**5**	**15**	**30**	**45**	**60**	**75**	**90**
ORBITAL ALTITUDE (km)	620	620	620	620	620	620	620
EARTH'S RADIUS (km)	6378	6378	6378	6378	6378	6378	6378
SATELLITE COVERAGE HALF ANGLE TO HORIZON (Deg)	66	66	66	66	66	66	66
SLANT RANGE TO SATELLITE (Km)	2377	1669	1108	841	706	640	620
SURFACE DISTANCE BETWEEN RECEIVER AND SSP (km)	2202	1482	877	543	322	151	0
Satellite Transmitter	**5**	**15**	**30**	**45**	**60**	**75**	**90**
SATELLITE DOWNLINK FREQUENCY (MHz)	**2302.0**	**2302.0**	**2302.0**	**2302.0**	**2302.0**	**2302.0**	**2302.0**
TRANSMITTER OUTPUT POWER (Watts)	0.7	0.7	0.7	0.7	0.7	0.7	0.7
TRANSMITTER OUTPUT POWER (dBw)	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
IMPLEMENTATION LOSS (dB)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SATELLITE TRANSMIT ANTENNA GAIN (dB)	4.87	4.87	4.87	4.87	4.87	4.87	4.87
SATELLITE DOWNLINK EIRP (Watts)	1.4	1.4	1.4	1.4	1.4	1.4	1.4
SATELLITE DOWNLINK EIRP (dBw)	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground Receiver	**5**	**15**	**30**	**45**	**60**	**75**	**90**
DISH DIAMETER (m)	3.7	3.7	3.7	3.7	3.7	3.7	3.7
ANTENNA FIGURE OF MERIT	0.5	0.5	0.5	0.5	0.5	0.5	0.5
WAVELNEGTH (m)	0.130	0.130	0.130	0.130	0.130	0.130	0.130
ANTENNA GAIN (dBi)	36.0	36.0	36.0	36.0	36.0	36.0	36.0
FREE SPACE LOSS (dB)	167.2	164.1	160.5	158.1	156.6	155.8	155.5
ISOTROPIC POWER AT MOBILE ANTENNA (dBw)	-165.8	-162.8	-159.2	-156.8	-155.3	-154.4	-154.2
GROUND ANTENNA GAIN (dB)	36.0	36.0	36.0	36.0	36.0	36.0	36.0
POLARIZATION LOSS (dB)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TRANSMISSION LINE LOSS (dB)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SYSTEM NOISE TEMPERATURE (K)	575	575	575	575	575	575	575
FRONT END GAIN (Ant Gain-Losses) (dB)	32.5	32.5	32.5	32.5	32.5	32.5	32.5
FRONT END G/T (dB/K)	4.9	4.9	4.9	4.9	4.9	4.9	4.9
BOLTZMAN'S CONSTANT (dB)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
DOWNLINK C/No (dB-Hz)	67.7	70.7	74.3	76.7	78.2	79.1	79.3
DATA RATE (bps)	200000	200000	200000	200000	200000	200000	200000
Eb/No (dB)	14.7	17.7	21.3	23.7	25.2	26.1	26.3
Eb/No REQUIRED FOR GMSK BER of 10^{-4} (dB)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
DOWNLINK MARGIN (dB)	**2.7**	**5.7**	**9.3**	**11.7**	**13.2**	**14.1**	**14.3**

Fig. A.4.3-3 AprizeSat-8 and AprizeSat-10 physical representation



A.5 ORBITAL PARAMETERS

Table A.5.1 gives selected orbital information for the AprizeSats.

Table A.5.1 Select orbital parameters for AprizeSat-8 and AprizeSat-10

Orbit Type	NGSO
Satellite Network Name	AprizeSat
Estimated **Operational** Lifetime of Satellite from Date of Launch	10-12 Yrs
Estimated **Orbital** Lifetime of Satellite from Date of Launch	<25 Yrs
Inclination Angle AprizeSat-8 Inclination Angle AprizeSat-10	97.568 degrees 97.73 degrees
Orbital period	5889 seconds
Apogee AprizeSat-8 Perigee AprizeSat-8 Apogee AprizeSat-10 Perigee AprizeSat-10	662 km 589 km 729 km 611 km

A.6 SPECTRUM

The AprizeSats utilize UHF and S-Band downlink frequencies, and VHF and UHF uplink frequencies as indicated in Tables A.6-1, 2.

Table A.6-1 Downlink Emissions and Earth Stations: AprizeSat-8 and AprizeSat-10

Frequency Downlink (MHz)	Frequency Center (MHz)	Emission Designator	Station Class	Earth Station(s)	Authorized Power (W)
400.5-400.65	400.525 400.555 400.575 400.595	25K0F1D	FX	Fairbanks, AK Fairfax, VA Naalehu, HI	4.0
2300-2305	2302.0	400KF3D	FX	Fairbanks, AK Esrange, Sweden	0.7

The AprizeSats' downlink transmitters operate only when the satellites can actually communicate with a UHF telemetry or S-Band mission data ground station. Thus, the AprizeSats transmit only within line-of-sight the geographic locations identified above.

Table A.6-2 Uplink Emissions and Earth Stations: AprizeSat-8 and AprizeSat-10

Frequency Uplink (MHz)	Frequency Center (MHz)	Emission Designator	Station Class	Earth Station (s)	Authorized Power (W)
145.9-146.0 399.9-400.05	145.958 399.925 399.950 399.975 400.025	20K0F1D	FX	Fairbanks, AK	10
145.9-146.0 399.9-400.05	145.958 399.925 399.950 399.975 400.025	20K0F1D	FX	Fairfax, VA	10
145.9-146.0 399.9-400.05	145.958 399.925 399.950 399.975 400.025	20K0F1D	FX	Naalehu, HI	10
156.5 -162.5	156.525 156.775 156.825 161.975 162.025	25K0F2D 1K60G1D	MO	AIS Terminals on Vessels	12.5

A.7 PREDICTED SPACE STATION ANTENNA GAIN CONTOURS

The antenna gain contours for the beams of the AprizeSats are embedded in the Schedule S associated with this application and are reproduced below. Figure A.7.1 shows a nominal satellite VHF antenna radiation pattern for AIS reception. Figure A.7.2 shows a nominal satellite UHF receive antenna radiation pattern. Figure A.7.3 shows a nominal satellite UHF transmit antenna radiation pattern. Figure A.7.4 shows a nominal satellite S-band antenna radiation pattern. Figure A.7.5 shows a nominal satellite VHF antenna radiation pattern.

Fig. A.7.1 AprizeSat-8 and AprizeSat-10 Antenna Radiation Pattern, AIS Rx.

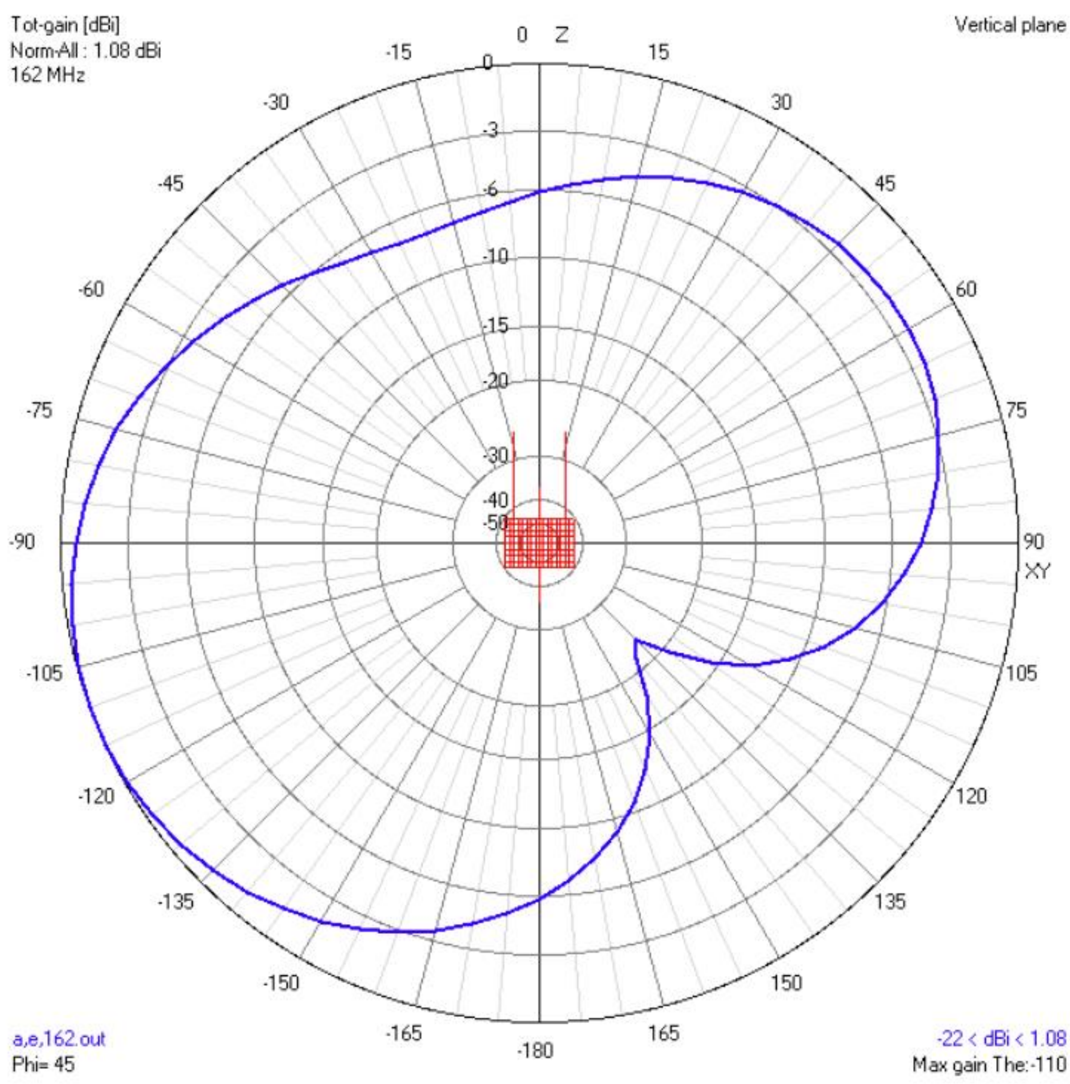


Fig. A.7.2 AprizeSat-8 and AprizeSat-10 Antenna Radiation Pattern, UHF Rx.

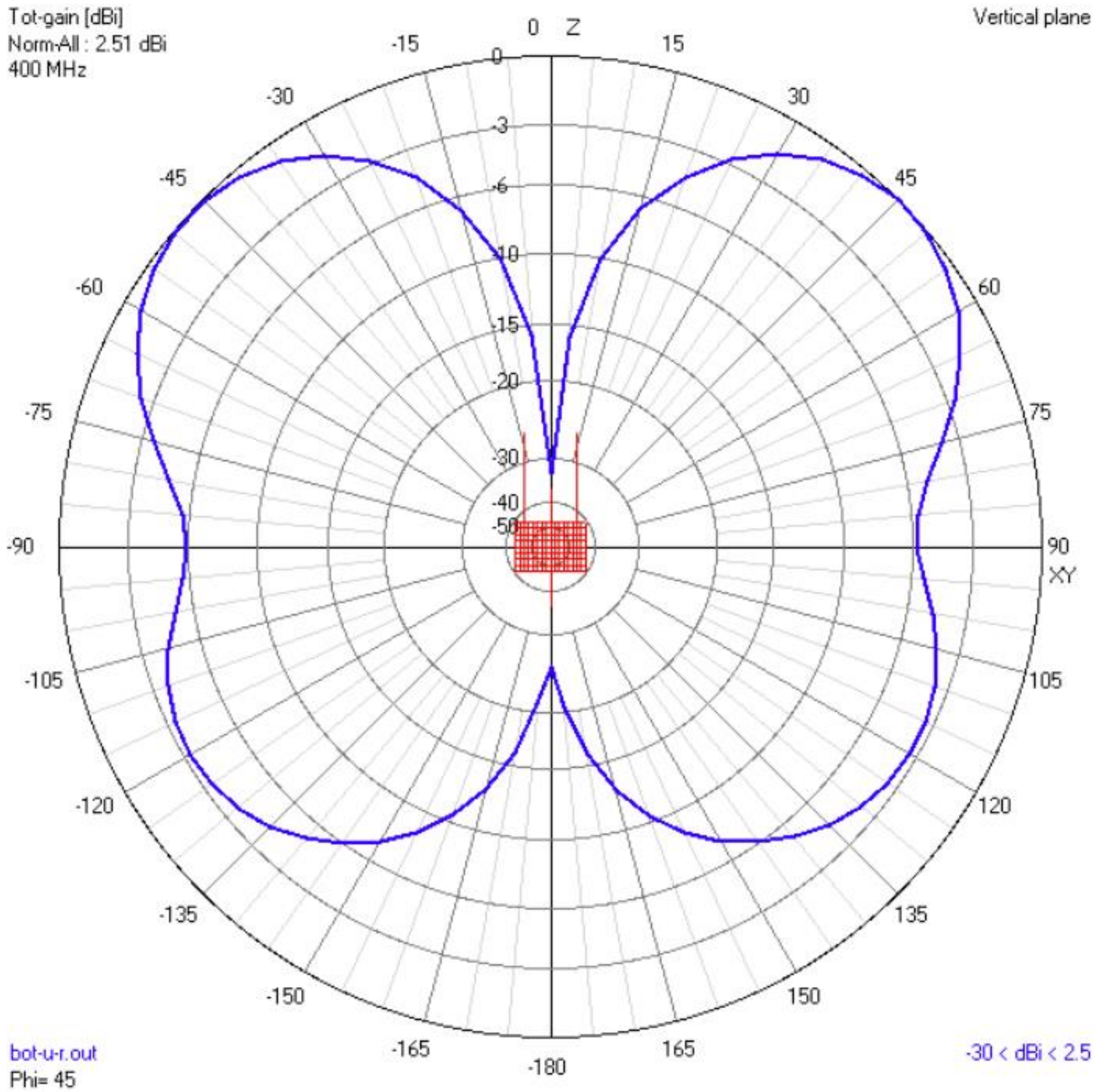


Fig. A.7.3 AprizeSat-8 and AprizeSat-10 Antenna Radiation Pattern, UHF Tx.

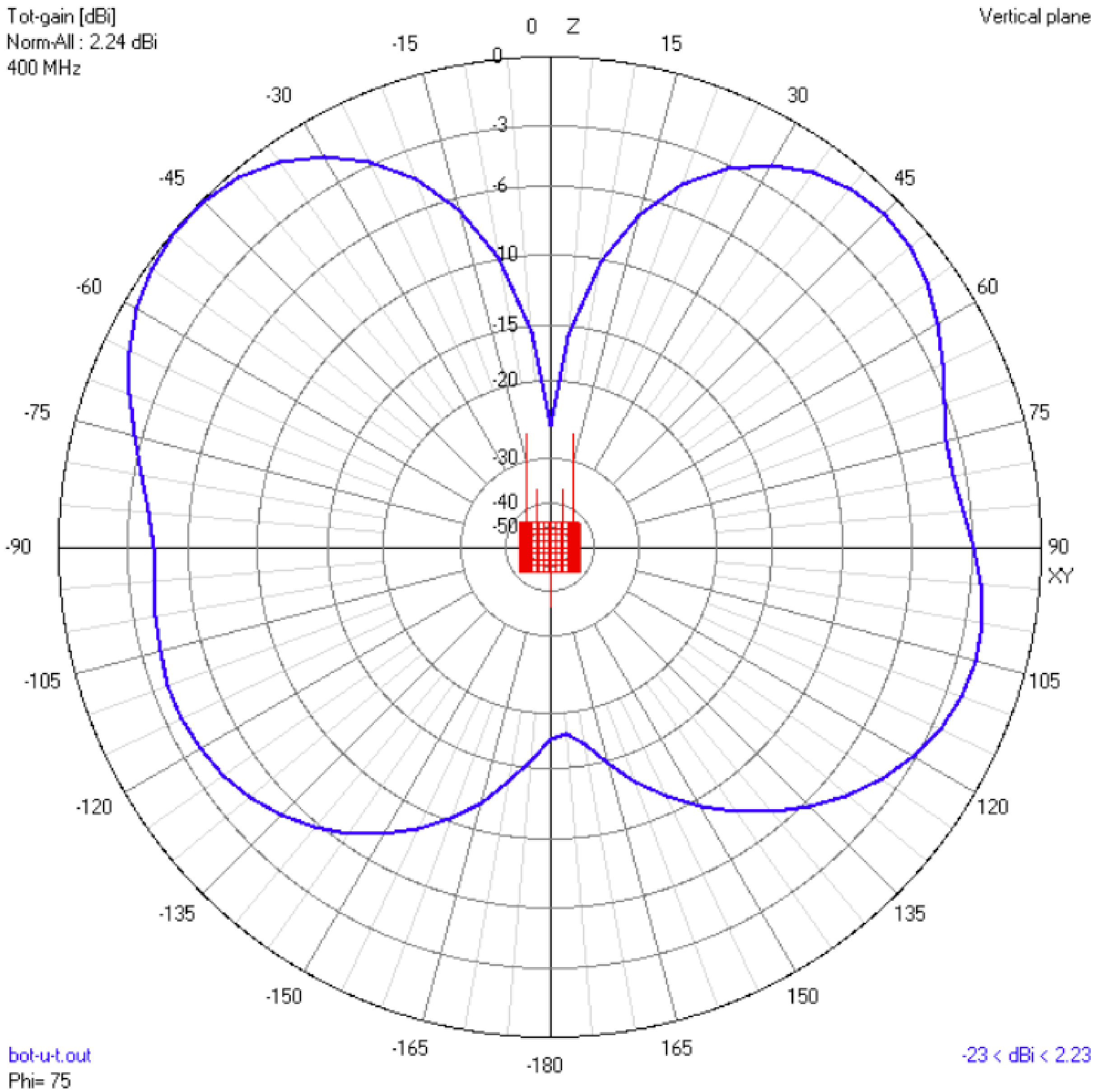


Fig. A.7.4 AprizeSat-8 and AprizeSat-10 Antenna Radiation Pattern, S-Band Tx.

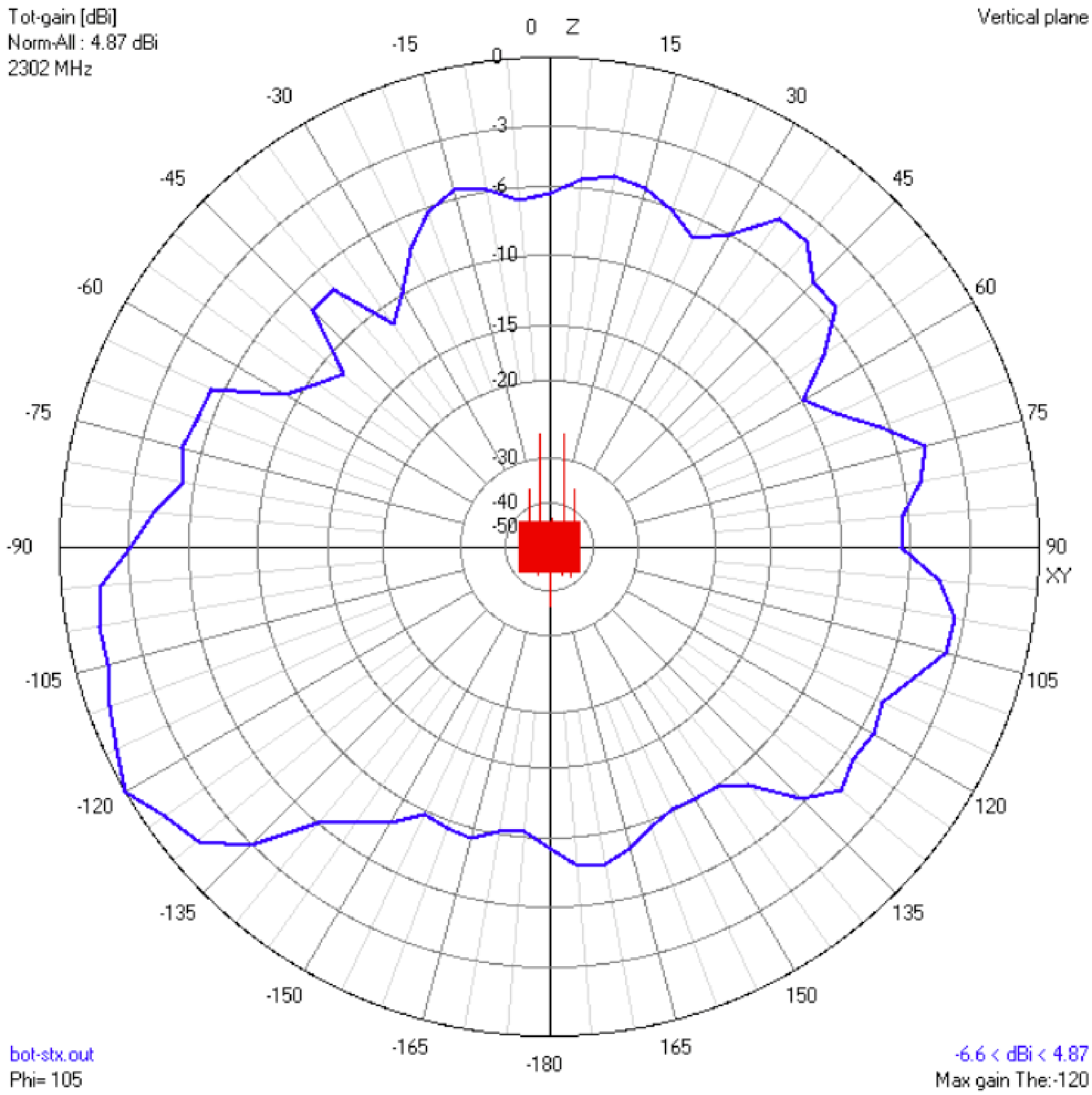
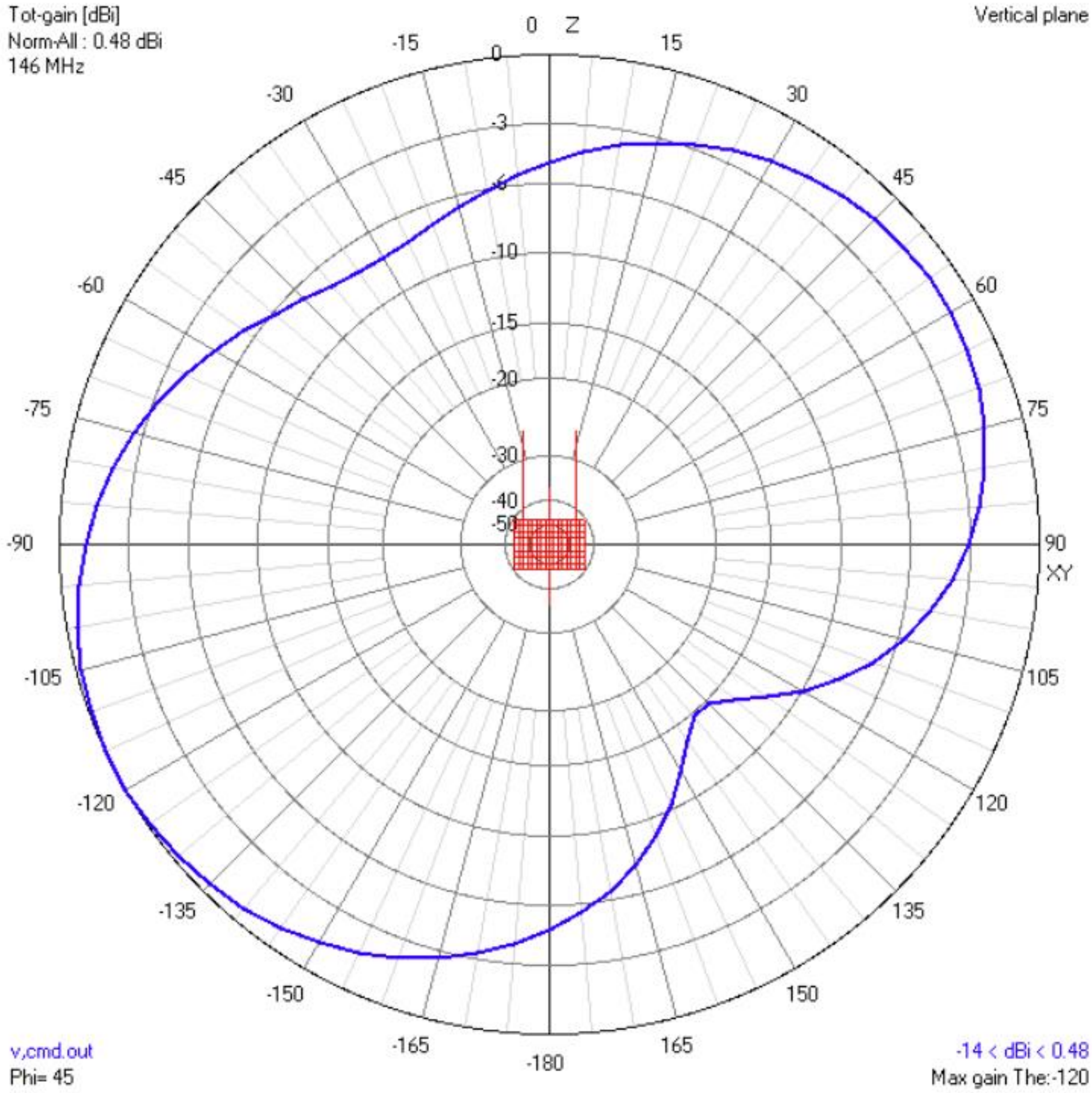


Fig. A.7.5 AprizeSat-8 and AprizeSat-10 Antenna Radiation Pattern, VHF Rx.



A.8 POWER FLUX DENSITY ANALYSIS AND SPECTRUM COMPATIBILITY

The AprizeSats are not in any of the services, will not communicate in any of the frequency bands, and will not be located in any of the orbits, as defined in 47 C.F.R. § 25.208(b)-(r). Therefore, the power flux density limit requirements do not apply.

For the UHF downlink, 47 C.F.R. 2.106, footnote 5.264 imposes a power flux density ("PFD") requirement of -125 $dBW/m^2/4kHz$ as defined in Annex 1 of Appendix 5. The PFD analysis shown above demonstrates that this PFD limit could be exceeded under worst-case operating conditions by as much as 0.65 dB.

The worst-case conditions include when the satellite at orbital perigee, transmitting at maximum power, and the satellite is oriented such that the peak antenna gain is directed very close to nadir. The UHF downlink has a reduced RF power transmit mode which reduces the EIRP and EIRP density by 3 dB. SpaceQuest commits to operating at this reduced power level during any configuration where this PFD limit would be exceeded. The link budget calculations above demonstrate PFD results.

A.9 CESSATION OF EMISSIONS

Each active spacecraft transmission chain can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the spacecraft, as required by Section 25.207 of the Commission's rules.

A.10 FREQUENCY TOLERANCE

The frequency tolerance requirements of Section 25.202(e) that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency will be met.

A.11 OUT-OF-BAND EMISSIONS

The out-of-band emission limits of Section 25.202(f)(1), (2), and (3) will be met.

A.12 TELEMETRY MARKER

The satellite does not have telemetry markers.

A.13 ITU FILINGS

SpaceQuest has prepared and submitted an AP4 data file for submission to the ITU.

A.14 ORBITAL DEBRIS MITIGATION

The Commission reviewed the AprizeSats' orbital debris mitigation and satellite end-of-life disposal information in the context of authorizing their initial launch.[3] This information has been incorporated by reference into this small space station application and as is summarized briefly below.

AprizeSat-8 and AprizeSat-10 were placed in orbit on November 21, 2013 and June 19, 2014, respectively, prior to the Commission's rules for mitigation of orbital debris. The total expected operational lifetime of the AprizeSats are 10-12 years based on the history of previous satellites of this class, suggesting an operational lifetime of less than six years from the date of any grant of the requested small space station authorization.

The AprizeSats are in a polar, sun-synchronous orbit. Due to this higher orbital inclination angle and much higher altitude, probability of collision between the AprizeSats and the International Space Station ("ISS") is extremely low.

Disposal will be by uncontrolled atmospheric re-entry. It is estimated that the AprizeSats will completely disintegrate at an altitude of 58.2 km. The probability of collision between the AprizeSats and any other large object (10 centimeters or larger) during the orbital lifetime of the space station has been verified to be below the 0.001 as per the NASA requirement.

The AprizeSats have no onboard fuel or explosives, pressure vessels, deployables, or moving parts. The only stored energy is contained within the six nickel-cadmium batters, which are non-explosive and will be fully discharged at end of life. A full discussion of orbital debris calculations and parameters was included in SpaceQuest's prior filings authorized by the Commission.[4]

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[3] *See* Aprize Satellite Inc., File No. 0023-EX-ML-2012, Call Sign WD2XFT (Response to Correspondence 17195, filed June 28, 2012).

[4] *See id.*

ENGINEERING CERTIFICATION

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/ *David C. Morse*

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