**RBC Signals LLC**
**Application for 180-Day Special Temporary Authorization**

**Technical Appendix**

I. Technical Description

II. SW1FT Orbital Debris Assessment Report

III. SW1FT Draft Schedule S

IV. Updated SW1FT ITU Filing Information

V. Draft FCC Form 312 Schedule B

**RBC Signals**
**180-Day STA Request**

## I. Technical Description

RBC Signals seeks to provide receive-only downlink support for the SW1FT cubesat, operated by SatRevolution, in the 2261.5-2269.5 MHz (space-to-Earth) band. This Technical Description provides an operational overview of the SW1FT satellite in support of RBC Signals' request for a 180-day special temporary authorization ("STA") to provide data downlink support for the spacecraft from its existing facility in Deadhorse, Alaska, USA. With the launch of the satellite currently scheduled for mid- to late-December 2020, there should be sufficient time to place this application on public notice in anticipation of the start of the mission (*see* Narrative).

RBC Signals is requesting the STA to support SatRevolution in testing and demonstrating components, software, and operational concepts that are integral to the planned mission, and generally help establish space heritage for the satellite products being evaluated under this STA. SatRevolution seeks to operate the SW1FT mission to demonstrate its Earth observation camera (the "Vision300") and optical module (the "SpaceEdgeZero") technologies, and help make these novel technologies more widely available.

The demonstrations planned for the SW1FT mission will be conducted intermittently over a three-year period commencing shortly after launch of the satellite. The frequencies, ground station location, and operational constraints have been carefully identified to avoid the potential for interference to other spectrum users.

RBC Signals notes that the expected launch window for the spacecraft is December 18, 2020 to December 31, 2020 on the same SpaceX Falcon 9 launch vehicle from Cape Canaveral, Florida. Therefore, RBC Signals respectfully requests that the Commission consider and authorize the proposed operations (as appropriately conditioned) as soon as practicable. RBC Signals will update the Commission with the final launch date once the launch schedule is finalized.

### I. SW1FT

The SW1FT satellite conforms to the form factor of a 3U cubesat (340 mm X 116 mm X 109 mm in the stowed configuration and approximately 431.2 mm X 374.5 mm X 374.5 mm in the deployed configuration), with a total mass of approximately 3.0 kg. The maximum power generated by the solar panels is approximately 22 W (18 W at end-of-life "EOL"), with a maximum transmitter output RF power of approximately 29 dBm in S-band frequencies. The satellite configuration is illustrated in Figure 1.

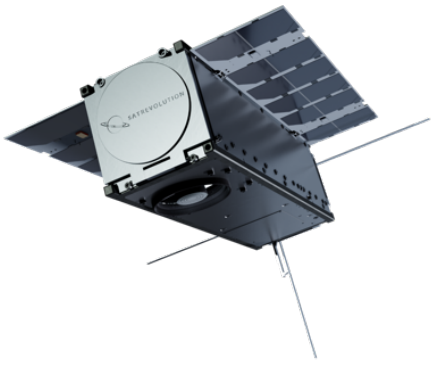

*Figure 1. SW1FT Deployed Configuration*

**A. Orbit.** The SW1FT satellite will be launched aboard a SpaceX Falcon 9 launch vehicle from the Cape Canaveral launch center in Florida in December 2020. The satellites will be launched into a nominal circular, sun-synchronous orbit at 525 km apogee and 525 km perigee with an inclination from the equator of 97.6°. An orbital lifetime calculation for this orbit estimates that the satellite will remain in orbit for approximately 2.97 years (under worst case conditions), well within the limits set by internationally accepted guidelines.[1]

**B. S-Band Earth Station.** RBC Signals will utilize a 2.4m Orbit Gaia-100 earth station to receive earth observation downlink data from the SW1FT payload**.** The Orbit Gaia-100 antenna provides a maximum gain of 30 dBi and a maximum G/T of 9 dB/K for payload downlink reception in the 2200-2290 MHz band. This antenna will be employed for data reception only with this satellite and will not transmit to the satellite.

**C. Operational Parameters.** In addition to the draft FCC Form 312 Schedule B provided with this application, RBC Signals provides a summary of key technical parameters of the receive-only earth station operations below:

S-band Downlink

- Rx (satellite uplink) from 2261.5-2269.5 MHz (8 MHz bandwidth)
- DVB-S2 modulation
- LHCP

**D. Satellite Antenna Patterns.** The satellite antenna patterns for the S-band antenna are illustrated in Figure 4.

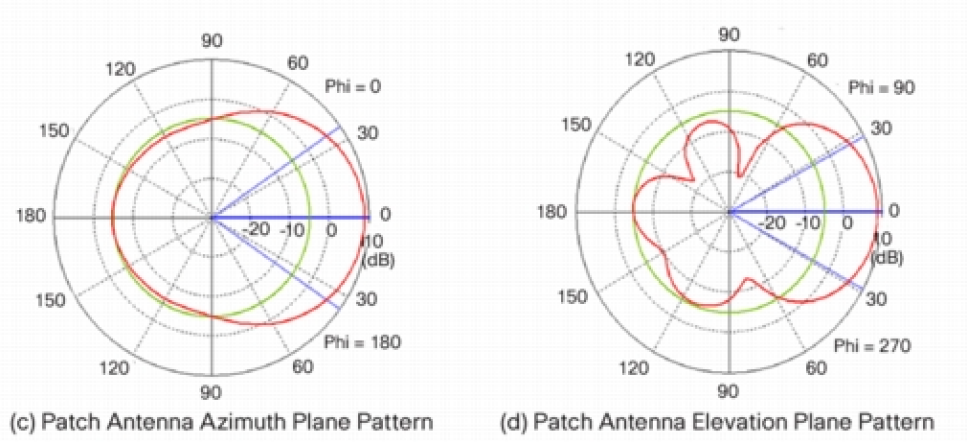


*Figure 2. SW1FT S-band Satellite Antenna Pattern*

[1] *See* SW1FT Orbital Debris Assessment Report (attached).

# SW1FT Orbital Debris Assessment Report (ODAR)

# SW1FT-ODAR-1.0

This report is presented as compliance with NASA-STD-8719.14B, APPENDIX A, 4/25/2019

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DAS Software Version Used In Analysis: v3.1.0

| **Revision Record** | | | | |
|---|---|---|---|---|
| Revision: | Date: | Affected Pages: | Changes: | Author(s): |
| 1.0 | 8/14/2020 | All –Initial | DAS Software Results Orbit Lifetime Analysis | D. Morse |
| | | | | |

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## Self-assessment of the ODAR using the format in Appendix A.2 of NASA-STD-8719.14B:

A self-assessment is provided below in accordance with the assessment format provided in Appendix A.2 of NASA-STD-8719.14B.

| Section | Status | Comments |
|---|---|---|
| 4.3-1, Mission-Related Debris Passing Through LEO | COMPLIANT | |
| 4.3-2, Mission-Related Debris Passing Near GEO | COMPLIANT | |
| 4.4-1, Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon | COMPLIANT | |
| 4.4-2, Design for passivation after completion of mission operations while in orbit about Earth or the Moon | N/A | |
| 4.4-3, Limiting the long-term risk to other space systems from planned breakups | COMPLIANT | |
| 4.4-4, Limiting the short-term risk to other space systems from planned breakups | COMPLIANT | |
| 4.5-1, Probability of Collision with Large Objects | COMPLIANT | |
| 4.5-2, Probability of Damage from Small Objects | COMPLIANT | System will passively deorbit; therefore, no components are critical to deorbit. |
| 4.6-1, Disposal for space structures passing through LEO | COMPLIANT | |
| 4.6-2, Disposal for space structures passing through GEO | N/A | |
| 4.6-3, Disposal for space structures between LEO and GEO | N/A | |
| 4.6-4, Reliability of post-mission disposal operations | COMPLIANT | |
| 4.8-1, Collision Hazards of Space Tethers | COMPLIANT | |

Assessment Report Format:

ODAR Technical Sections Format Requirements:

SatRevolution is a Polish company with a US presence. This ODAR follows the format in NASA-STD-8719.14B, Appendix A.1 and includes the content indicated as a minimum, in each of sections 2 through 8 below for the SW1FT mission. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

## ODAR Section 1: Program Management and Mission Overview

Program/project manager: Mateusz Kellar

Senior Management: Grzegorz Zwolinski (Chief Executive Officer, SatRevolution)

**Launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination:** The SW1FT mission will consist of a single satellite launched into sub-synchronous circular orbit with nominal orbit altitude of 525 km (based upon a range of SSO orbit altitudes from 500km to 550km).

**Schedule of upcoming mission milestones:**

- Scheduled Launch Date: December 16, 2020. SatRevolution has contracted SpaceX Rideshare to broker the SW1FT launch. SpaceX's most recent manifest indicates a launch window of December 1, 2020 – December 31, 2020.

**Mission Overview:** The SW1FT satellite will be launched into a sun-synchronous, Low Earth Orbit (LEO). The satellite bus will use magnetic torque coils, reaction wheel, star tracker cameras, sun sensor, GPS, and an IMU to enable 3-axis pointing control. The SW1FT mission will demonstrate an Earth Observation payload.

**Launch Vehicle and Launch Site:** Falcon 9 Launch Vehicle, Dedicated SSO Rideshare Mission #1. The launch site is Cape Canaveral, Florida. The Falcon-9 launch vehicle will transport multiple mission payloads to orbit.

SW1FT will be deployed into an approximately sun synchronous circular low Earth orbit. SW1FT will deploy solar panels and UHF antenna once deployed from the Momentus Vigoride deployer fitted with an ISIS Quadpack CubeSat deployer. The spacecraft is expected to be deployed with the following orbital parameters:[1]

Highest Apogee: 550 km

[1] The SW1FT satellite will be deployed between 500 km and 550 km at the discretion of the launch service provider. SatRevolution has assumed a 550 km orbital altitude for SW1FT for purposes of this orbital debris analysis report.

Highest Perigee: 550 km

Target Inclination: 97.6° ± 0.3°

SW1FT is demonstrating an Earth Observation payload.

**Mission Duration:** The anticipated lifetime of the spacecraft is 3 years in LEO.

## ODAR Section 2: Spacecraft Description:

*Physical description of the constellation*: The SW1FT satellite is based on the SatRevolution NanoBus bus. Basic physical dimensions are 340.5 mm x 116 mm x 109 mm with a wet mass of approximately 3.0 kg. The satellite is composed of the NanoBus 3U bus, deployable solar panels, deployable UHF antenna and a water-based resisto-jet propulsion module. The solar panel generates up to 22 W of electric power which is stored in a 54.6 Wh COTS Li-Ion unpressurized 3-cell battery assembly. The bus is 3-axis stabilized, employing GPS, 9-DOF IMU, sun sensors, and star trackers for attitude knowledge and magnetic torque rods and reaction wheels for attitude control.

The SW1FT satellite will be separated from the Falcon 9 launch vehicle using the Momentus Vigoride deployer fitted with an ISIS CubeSat deployer which provide debris free actuation.

The SW1FT spacecraft is depicted in Figure 1 for the post-deployment configuration.

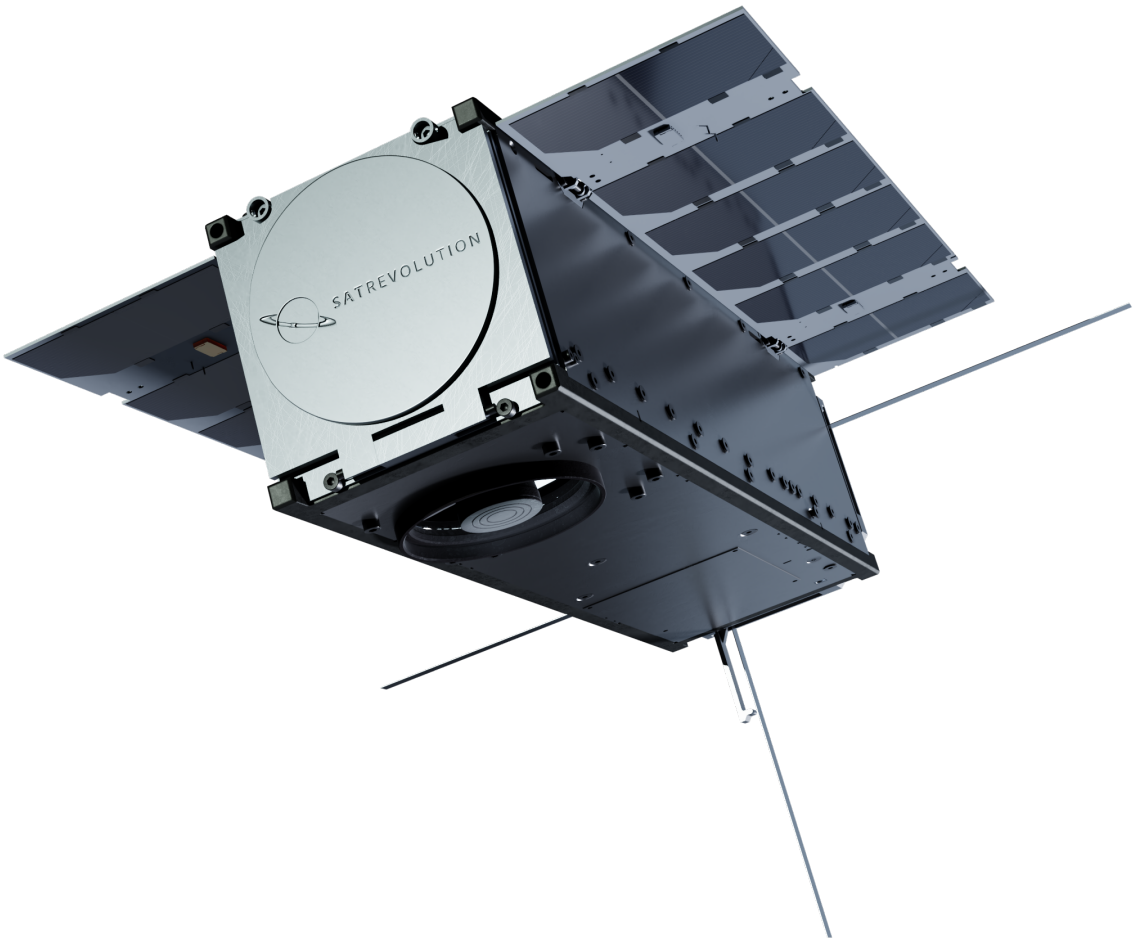


*Figure 1 SW1FT Spacecraft Configuration*

**Total satellite mass at launch, including all propellants and fluids:** 3.0 kg.

**Dry mass of satellites at launch:** 3.0 kg. (no propulsion)

**Description of all propulsion systems (cold gas, mono-propellant, bi-propellant, electric, nuclear):** None

**Identification, including mass and pressure, of all fluids (liquids and gases) planned to be on board and a description of the fluid loading plan or strategies, excluding fluids in sealed heat pipes**: None

**Fluids in Pressurized Batteries**: None

The SW1FT satellite uses a 3-cell unpressurized standard COTS Lithium-Ion battery cells in each spacecraft. The total capacity energy capacity per spacecraft is 54.6 W-h.

**Description of attitude control system and indication of the normal attitude of the spacecraft with respect to the velocity vector**: The SW1FT spacecraft attitude will be controlled initially by torque rods, which will allow the satellite to be aligned relative to the Earth's magnetic field. These will allow the satellite to detumble and align with the magnetic field.

- A *safe mode* that is optimized for solar power generation from the satellite. The spacecraft's deployable panel will be oriented towards the sun.
- A *targeted tracking mode*, which will allow the satellite Nadir panel to be directed at any location on the Earth's surface.
- An *LVLH mode* that keeps the Nadir panel pointed towards the Earth's surface.

**Description of any range safety or other pyrotechnic devices**: None.

The SW1FT satellite will be released from the Falcon 9 launch vehicle using the Momentus Vigoride deployer fitted with an ISIS CubeSat deployer which provides debris-free actuation.

**Description of the electrical generation and storage system**: Standard COTS Lithium-Ion battery cells are charged before payload integration and provide 54.6 W-h of electrical energy during the eclipse portion of the satellite's orbit. The Solar Cells generate a maximum on-orbit power of approximately 22 W degrading down to 18 W at the end-of-life of the mission (3 years for calculation purposes).

**Identification of any other sources of stored energy not noted above**: None

**Identification of any radioactive materials on board**: None

## ODAR Section 3: Assessment of Spacecraft Debris Released during Normal Operations:

**Identification of any object (>1 mm) expected to be released from the spacecraft any time after launch, including object dimensions, mass, and material**: None.

**Rationale/necessity for release of each object**: N/A.

**Time of release of each object, relative to launch time**: N/A.

**Release velocity of each object with respect to spacecraft**: N/A.

**Expected orbital parameters (apogee, perigee, and inclination) of each object after release**: N/A.

**Calculated orbital lifetime of each object, including time spent in Low Earth Orbit (LEO)**: N/A.

**Assessment of spacecraft compliance with Requirements 4.3-1 and 4.3-2 (per DAS v3.1.0)**
**4.3-1, Mission Related Debris Passing Through LEO:** COMPLIANT
**4.3-2, Mission Related Debris Passing Near GEO**: COMPLIANT

## ODAR Section 4: Assessment of Spacecraft Intentional Breakups and Potential for Explosions.

Potential causes of spacecraft breakup during deployment and mission operations: There is no credible scenario that would result in spacecraft breakup during normal deployment and operations.

**Summary of failure modes and effects analyses of all credible failure modes which may lead to an accidental explosion**: The in-orbit failure of a battery cell protection circuit could lead to a short circuit resulting in overheating and a very remote possibility of battery cell explosion.

**Detailed plan for any designed spacecraft breakup, including explosions and intentional collisions**: There are no planned breakups.

**List of components which shall be passivated at End of Mission (EOM) including method of passivation and amount which cannot be passivated**:

- Three (3) Lithium Ion Battery Cells – configure spacecraft to prevent battery charging, let batteries deplete
- Propulsion – all propellant will be vented before passivation

**Rationale for all items which are required to be passivated, but cannot be due to their design**: None

**Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4:**

**Requirement 4.4-1: Limiting the risk to other space systems from accidental explosions during deployment and mission operations while in orbit about Earth or the Moon**: "*For each spacecraft and launch vehicle orbital stage employed for a mission, the program or project shall demonstrate, via failure mode and effects analyses or equivalent analyses, that the integrated probability of explosion for all credible failure*

*modes of each spacecraft and launch vehicle is less than 0.001 (excluding small particle impacts) (Requirement 56449).”*

*Compliance statement*:

Required Probability: 0.001.

Expected probability: 0.000; COMPLIANT.

**Supporting Rationale and FMEA details**:

**Battery explosion**:

On-orbit failure of a battery cell protection circuit could lead to a short circuit resulting in overheating and a very remote possibility of battery cell deflagration. Multiple independent failures must first occur for this effect. In the event of an unlikely explosion, the effect to the far-term LEO environment is considered negligible due to the following:

- SW1FT satellites have a short orbital life due to the low orbital altitude (<6 years under worst-case failure conditions)
- SW1FT satellites have very low mass
- SW1FT satellites have spacecraft structural covers will likely contain debris results from a battery rupturing, except for those that may be vented through small orifices

**Requirement 4.4-2**: **Design for passivation after completion of mission operations while in orbit about Earth or the Moon:**

*‘Design of all spacecraft and launch vehicle orbital stages shall include the ability to deplete all onboard sources of stored energy and disconnect all energy generation sources when they are no longer required for mission operations or post-mission disposal or control to a level which can not cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft (Requirement 56450).”*

*Compliance statement*: At EOM, all propellant will be vented and the cubesat. In the unlikely event that a battery cell does explosively rupture, the small size, mass, and potential energy, of these small batteries is such that while the spacecraft could be expected to vent gases, most debris from the battery rupture should be contained within the spacecraft due to the lack of penetration energy to the multiple enclosures surrounding the batteries.

**Requirement 4.4-3. Limiting the long-term risk to other space systems from planned breakups: Compliance statement:** This requirement is not applicable. There are no planned breakups.

**Requirement 4.4-4: Limiting the short-term risk to other space systems from planned breakups: Compliance statement:** This requirement is not applicable. There are no planned breakups.

## ODAR Section 5: Assessment of Spacecraft Potential for On-Orbit Collisions

**Assessment of spacecraft compliance with Requirements 4.5-1 and 4.5-2 (per DAS v3.1.0, and calculation methods provided in NASA-STD-8719.14B, section 4.5.4):**

**Requirement 4.5-1. Limiting debris generated by collisions with large objects when operating in Earth orbit:**

*"For each spacecraft and launch vehicle orbital stage in or passing through LEO, the program or project shall demonstrate that, during the orbital lifetime of each spacecraft and orbital stage, the probability of accidental collision with space objects larger than 10 cm in diameter is less than 0.001 (Requirement 56506)."*

Large Object Impact and Debris Generation Probability: 0.00000023; COMPLIANT.

**Requirement 4.5-2. Limiting debris generated by collisions with small objects when operating in Earth or lunar orbit:**

***"****For each spacecraft, the program or project shall demonstrate that, during the mission of the spacecraft, the probability of accidental collision with orbital debris and meteoroids sufficient to prevent compliance with the applicable postmission disposal requirements is less than 0.01 (Requirement 56507)."*

Small Object Impact and Debris Generation Probability: Not applicable; the spacecraft is planned orbital disposal by atmospheric entry, and does not require a specific spacecraft orientation and drag state to meet the disposal requirements. Therefore, no element or component of the spacecraft system is required to complete post-mission operations.

**Identification of all systems or components required to accomplish any post-mission disposal operation, including passivation and maneuvering:** None

## ODAR Section 6: Assessment of Spacecraft Post-Mission Disposal Plans and Procedures

**6.1 Description of spacecraft disposal option selected:** The satellite includes a water-based propulsion demonstration that will be used to lower the orbit altitude by up to 70 km. In the case of propulsion demonstrator failure (or other general CubeSat failure), the satellite will still de-orbit naturally by atmospheric re-entry.

**6.2 Plan for any spacecraft maneuvers required to accomplish post-mission disposal:** None

**6.3 Calculation of area-to-mass ratio after post-mission disposal, if the controlled reentry option is not selected:**

Spacecraft Mass (Dry): 3.0 kg

Cross-sectional Area: 0.059607 $m^2$

(Calculated by DAS 3.1.0). Area to mass ratio: 059607/3.0 = 0.019869 $m^2$/kg

**6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v3.1.0 and NASA-STD-8719.14B section): Requirement 4.6-1. Disposal for space structures passing through LEO:**

***"****A spacecraft or orbital stage with a perigee altitude below 2000 km shall be disposed of by one of three methods: (Requirement 56557)*

*a. Atmospheric reentry option: Leave the space structure in an orbit in which natural forces will lead to atmospheric reentry within 25 years after the completion of mission but no more than 30 years after launch; or Maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission.*

*b. Storage orbit option: Maneuver the space structure into an orbit with perigee altitude greater than 2000 km and apogee less than GEO - 500 km.*

*c. Direct retrieval: Retrieve the space structure and remove it from orbit within 10 years after completion of mission."*

Analysis: The SW1FT satellites' method of disposal is COMPLIANT using method "a." In the worst-case orbit altitude of 550 x 550 km near-circular orbit, the passive deorbit time is 4.156 years after launch with orbit history as shown in Figure 2 if the solar arrays do not deploy. It should be noted that this is assuming a launch date of December 2020. If the solar arrays do deploy, the passive deorbit time will be reduced to 2.973 yrs.

Under planned launch conditions, SW1FT will be deployed in a 525 x 525 km nominal near-circular orbit, reentering in approximately 2.973 years after launch. If the solar arrays deploy, the passive deorbit time will reduce to 1.84 years with orbit history as

shown in Figure 3 (analysis assumes a noon-midnight Sun synchronous orbit with solar array tracking).

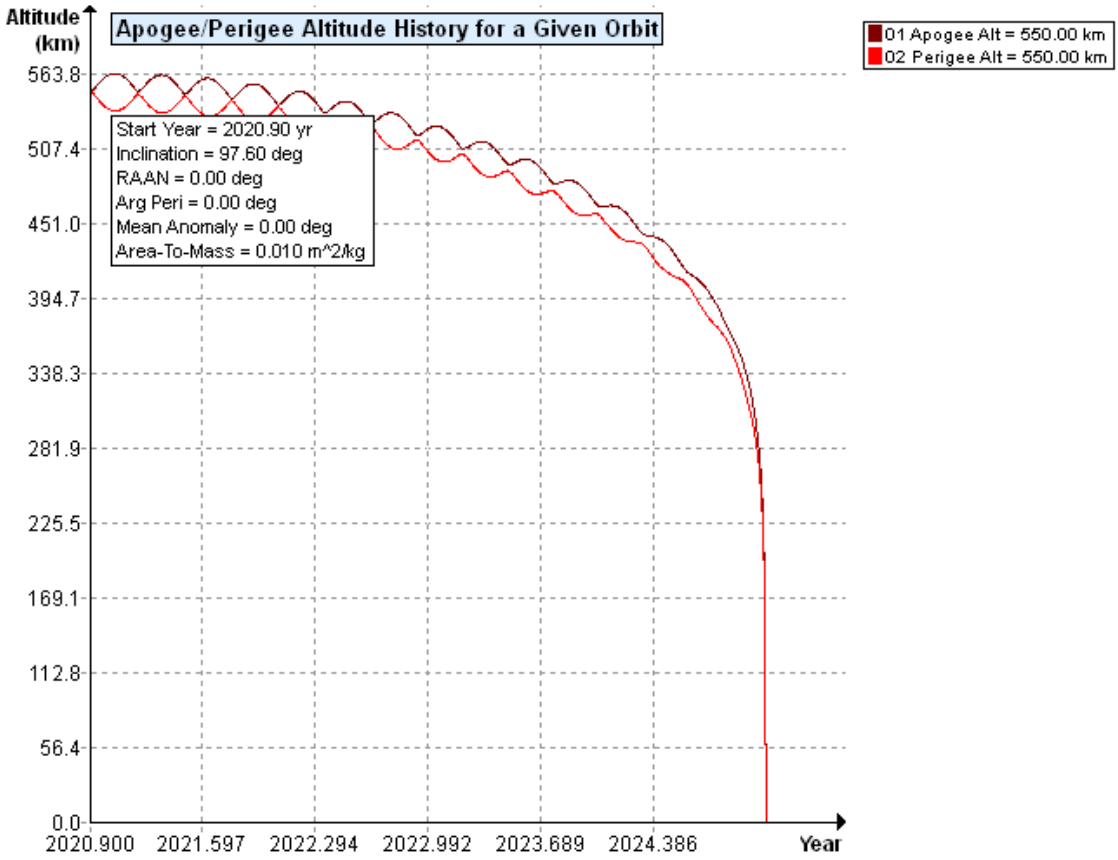


*Figure 2 SW1FT Orbit History – at Maximum Orbit Altitude of 550 km x 550 km SSO in Stowed Configuration*

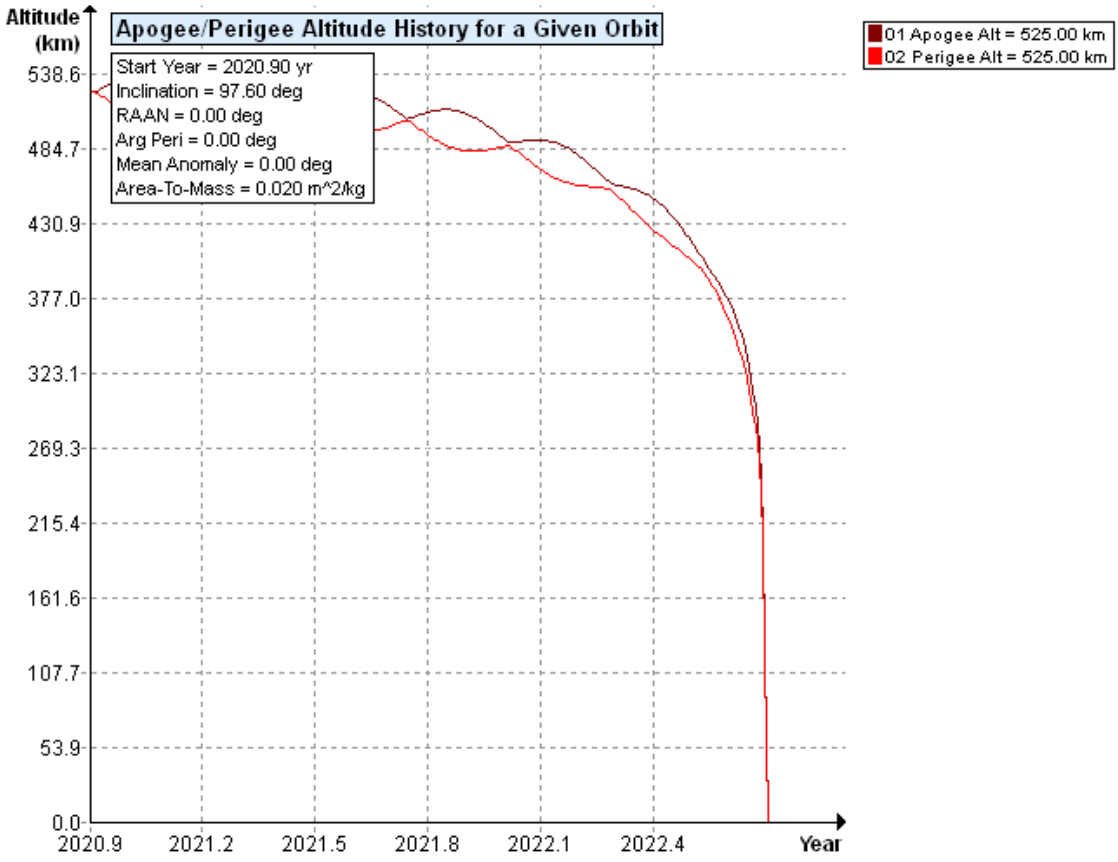


*Figure 3 SW1FT Orbit History – at Nominal Orbit Altitude of 525 km x 525 km SSO in Deployed Configuration*

**Requirement 4.6-2. Disposal for space structures near GEO:**
Analysis is not applicable.

**Requirement 4.6-3. Disposal for space structures between LEO and GEO:** Analysis is not applicable.

**Requirement 4.6-4. Reliability of Post-mission Disposal Operations:**
Analysis is not applicable. The satellite will reenter passively without post mission disposal operations within the allowable timeframe.

## ODAR Section 7: Assessment of Spacecraft Reentry Hazards:

**Assessment of spacecraft compliance with Requirement 4.7-1: Requirement 4.7-1. Limit the risk of human casualty:**

*"The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules:*
*a) For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001 (1:10,000) (Requirement 56626)."*
Summary Analysis Results: DAS v3.1.0 reports that the SW1FT satellite is COMPLIANT with the requirement with a per satellite casualty risk of 1:33000.

This represents an acceptable casualty risk, as calculated with DAS's modeling capability.

The DAS Output Summary Follows:

**08 28 2020; 11:39:07AM Processing Requirement 4.3-2: Return Status : Passed**

**==========**
**No Project Data Available**
**==========**

**========== End of Requirement 4.3-2 ==========**
**08 28 2020; 11:42:37AM Processing Requirement 4.5-1: Return Status : Passed**

**==========**
**Run Data**
**==========**

****INPUT****

**Space Structure Name = SW1FT**
**Space Structure Type = Payload**
**Perigee Altitude = 525.000 (km)**
**Apogee Altitude = 525.000 (km)**
**Inclination = 97.600 (deg)**
**RAAN = 0.000 (deg)**
**Argument of Perigee = 0.000 (deg)**
**Mean Anomaly = 0.000 (deg)**
**Final Area-To-Mass Ratio = 0.0199 (m^2/kg)**
**Start Year = 2020.900 (yr)**
**Initial Mass = 3.000 (kg)**
**Final Mass = 3.000 (kg)**
**Duration = 3.000 (yr)**
**Station-Kept = False**
**Abandoned = True**

****OUTPUT****

**Collision Probability = 2.2934E-07**

**Returned Message: Normal Processing**
**Date Range Message: Normal Date Range**
**Status = Pass**

**==========**

**========== End of Requirement 4.5-1 ==========**

**08 28 2020; 11:42:43AM Processing Requirement 4.6 Return Status : Passed**

**==========**
**Project Data**
**==========**

****INPUT****

**Space Structure Name = SW1FT**
**Space Structure Type = Payload**

**Perigee Altitude = 525.000000 (km)**
**Apogee Altitude = 525.000000 (km)**
**Inclination = 97.600000 (deg)**
**RAAN = 0.000000 (deg)**
**Argument of Perigee = 0.000000 (deg)**
**Mean Anomaly = 0.000000 (deg)**
**Area-To-Mass Ratio = 0.019869 (m^2/kg)**
**Start Year = 2020.900000 (yr)**
**Initial Mass = 3.000000 (kg)**
**Final Mass = 3.000000 (kg)**
**Duration = 3.000000 (yr)**
**Station Kept = False**
**Abandoned = True**
**PMD Perigee Altitude = -1.000000 (km)**
**PMD Apogee Altitude = -1.000000 (km)**
**PMD Inclination = 0.000000 (deg)**
**PMD RAAN = 0.000000 (deg)**
**PMD Argument of Perigee = 0.000000 (deg)**
**PMD Mean Anomaly = 0.000000 (deg)**

****OUTPUT****

**Suggested Perigee Altitude = 525.000000 (km)**
**Suggested Apogee Altitude = 525.000000 (km)**
**Returned Error Message = Reentry during mission (no PMD req.).**

**Released Year = 2022 (yr)**

**Requirement = 61**
**Compliance Status = Pass**

**==========**

**========== End of Requirement 4.6 ==========**
**08 28 2020; 11:42:46AM *********Processing Requirement 4.7-1**
**Return Status : Passed**

************INPUT******
**Item Number = 1**

**name = SW1FT**
**quantity = 1**
**parent = 0**
**materialID = 8**
**type = Box**
**Aero Mass = 3.000000**
**Thermal Mass = 3.000000**
**Diameter/Width = 0.100000**
**Length = 0.200000**
**Height = 0.100000**

**name = Structure-PTFE**
**quantity = 1**
**parent = 1**
**materialID = 64**
**type = Box**
**Aero Mass = 0.127000**
**Thermal Mass = 0.127000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.100000**

**name = Structure-AL**
**quantity = 1**
**parent = 1**
**materialID = 8**
**type = Box**
**Aero Mass = 0.455000**
**Thermal Mass = 0.455000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.100000**

**name = Structure-Steel**

**quantity = 1**
**parent = 1**
**materialID = 58**
**type = Box**
**Aero Mass = 0.003760**
**Thermal Mass = 0.003760**
**Diameter/Width = 0.020000**
**Length = 0.020000**
**Height = 0.020000**

**name = Comm Module - HF**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.130000**
**Thermal Mass = 0.130000**
**Diameter/Width = 0.050000**
**Length = 0.050000**
**Height = 0.050000**

**name = Comm Module - LF**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.080000**
**Thermal Mass = 0.080000**
**Diameter/Width = 0.050000**
**Length = 0.050000**
**Height = 0.030000**

**name = C&DH Module**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.050000**
**Thermal Mass = 0.050000**
**Diameter/Width = 0.050000**
**Length = 0.050000**
**Height = 0.020000**

**name = Battery Management**
**quantity = 1**
**parent = 1**

**materialID = 27**
**type = Box**
**Aero Mass = 0.275000**
**Thermal Mass = 0.275000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.050000**

**name = Energy Harvesting System**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.060000**
**Thermal Mass = 0.060000**
**Diameter/Width = 0.050000**
**Length = 0.050000**
**Height = 0.020000**

**name = Aux Power Supply**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.080000**
**Thermal Mass = 0.080000**
**Diameter/Width = 0.050000**
**Length = 0.050000**
**Height = 0.030000**

**name = ADCS**
**quantity = 1**
**parent = 1**
**materialID = 27**
**type = Box**
**Aero Mass = 0.250000**
**Thermal Mass = 0.250000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.050000**

**name = Reaction Wheels**
**quantity = 3**
**parent = 1**
**materialID = 54**
**type = Cylinder**

**Aero Mass = 0.183000**
**Thermal Mass = 0.183000**
**Diameter/Width = 0.100000**
**Length = 0.050000**

**name = Payload**
**quantity = 1**
**parent = 1**
**materialID = 8**
**type = Box**
**Aero Mass = 0.654000**
**Thermal Mass = 0.654000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.050000**

**name = Payload processor**
**quantity = 1**
**parent = 1**
**materialID = 8**
**type = Box**
**Aero Mass = 0.252000**
**Thermal Mass = 0.252000**
**Diameter/Width = 0.100000**
**Length = 0.100000**
**Height = 0.050000**

****************OUTPUT******
**Item Number = 1**

**name = SW1FT**
**Demise Altitude = 77.997551**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

****************************************
**name = Structure-PTFE**
**Demise Altitude = 77.726250**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

****************************************
**name = Structure-AL**
**Demise Altitude = 74.142998**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

**********
**name = Structure-Steel**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.384400**
**Impact Kinetic Energy = 0.265090**

**********
**name = Comm Module - HF**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.422500**
**Impact Kinetic Energy = 50.931648**

**********
**name = Comm Module - LF**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.415666**
**Impact Kinetic Energy = 26.284269**

**********
**name = C&DH Module**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.411950**
**Impact Kinetic Energy = 12.537213**

**********
**name = Battery Management**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.471423**
**Impact Kinetic Energy = 85.388275**

**********
**name = Energy Harvesting System**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.411950**
**Impact Kinetic Energy = 18.063890**

**********
**name = Aux Power Supply**
**Demise Altitude = 0.000000**
**Debris Casualty Area = 0.415666**
**Impact Kinetic Energy = 26.284269**

**********
**name = ADCS**
**Demise Altitude = 0.000000**

**Debris Casualty Area = 0.471423**
**Impact Kinetic Energy = 70.546532**

******************************************
**name = Reaction Wheels**
**Demise Altitude = 68.459587**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

******************************************
**name = Payload**
**Demise Altitude = 70.578758**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

******************************************
**name = Payload processor**
**Demise Altitude = 74.943100**
**Debris Casualty Area = 0.000000**
**Impact Kinetic Energy = 0.000000**

******************************************

**========== End of Requirement 4.7-1 ==========Requirements 4.7-1b, and 4.7-1c:**
These requirements are non-applicable requirements because the SW1FT mission does not use controlled reentry.

**4.7-1, b)**: *"For controlled reentry, the selected trajectory shall ensure that no surviving debris impact with a kinetic energy greater than 15 joules is closer than 370 km from foreign landmasses, or is within 50 km from the continental U.S., territories of the U.S., and the permanent ice pack of Antarctica (Requirement 56627)."*

Not applicable to YAM. The spacecraft does not use controlled reentry and no debris is expected to survive.

**4.7-1 c):** *"For controlled reentries, the product of the probability of failure of the reentry burn (from Requirement 4.6-4.b) and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000) (Requirement 56628)."*
Not applicable to SW1FT. It does not use controlled reentry and no debris is expected to survive.

## ODAR Section 8: Assessment for Tether Missions

Not applicable. There are no tethers used in the SW1FT mission.

END of ODAR for SW1FT

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# Appendix A: Acronyms

| | |
|---|---|
| Arg peri | Argument of Perigee |
| CDR | Critical Design Review |
| cm | centimeter |
| COTS | Commercial Off-The-Shelf (items) |
| DAS | Debris Assessment Software |
| EOM | End Of Mission |
| FRR | Flight Readiness Review |
| GEO | Geosynchronous Earth Orbit |
| ITAR | International Traffic In Arms Regulations |
| kg | kilogram |
| km | kilometer |
| LEO | Low Earth Orbit |
| Li-Ion | Lithium Ion |
| $m^2$ | Meters squared |
| ml | milliliter |
| mm | millimeter |
| N/A | Not Applicable. |
| NET | Not Earlier Than |
| ODAR | Orbital Debris Assessment Report |
| OSMA | Office of Safety and Mission Assurance |
| PDR | Preliminary Design Review |
| PL | Payload |
| ISIPOD | ISIS CubeSat Deployer |
| PSIa | Pounds Per Square Inch, absolute |
| RAAN | Right Ascension of the Ascending Node |
| SMA | Safety and Mission Assurance |
| Ti | Titanium |
| Yr | year |

# III. SW1FT Draft Schedule S

Approved by OMB 3060-0678
Estimated Burden: up to 80 hours
April 2016

Federal Communications Commission

# (DRAFT COPY - Not for submission) Schedule S

312 File Number:

## Filing Description

| Question | Response |
| --- | --- |
| Description | SW1FT |

## Satellite Information

| Question | Response |
|---|---|
| Select Orbit Type | NGSO |
| Space Station or Satellite Network Name | SW1FT |
| Estimated Lifetime of Satellite(s) From Date of Launch | 3 Years |
| Will the space station(s) operate on a Common Carrier basis? | No |

## Operating Frequency Bands (3)

| Nature of service | Description | Frequency Band(s) | Mode Type |
|---|---|---|---|
| **Earth Exploration-Satellite Service** | | 401.0 MHz -402.0 MHz | Receive |
| **Space Operation Service** | | 401.0 MHz -402.0 MHz | Transmit |
| **Earth Exploration-Satellite Service** | | 2200.0 MHz -2290.0 MHz | Transmit |

## Orbital Information For Non-Geostationary Satellites

| Question | Response |
| --- | --- |
| Total Number of Satellites in the active constellation | 1 |
| Orbit Epoch Date | 01/01/2021 |
| Celestrial Reference Body | Earth |

## Orbital Plane 1:

| Question | Response |
|---|---|
| Number of Satellites in Plane | 1 |
| Inclination Angle | 97.6 degrees |
| Right Ascension of Ascending Node | 0.0 degrees |
| Argument of Perigee | 0.0 degrees |
| Orbital Period | 5460.0 seconds |
| Apogee | 550.0 km |
| Perigee | 550.0 km |
| Active Service Arc Begin Angle with respect to Ascending Node | 0.0 degrees |
| Active Service Arc End Angle with respect to Ascending Node | 180.0 degrees |

### Mean Anomaly For Each Satellite

| Satellite Number | Mean Anomaly (degrees) at the Orbit Epoch Date |
|---|---|
| **1** | 0.0 |

## Receiving Beams 1:

| Question | Response |
|---|---|
| Beam ID | UU1 |
| Receive Beam Frequency | 401.037 MHz -401.063 MHz |
| Beam Type | Fixed |
| Polarization | H |
| Peak Gain | 3.0 dBi |
| Antenna Pointing Error | 1.0 degrees |
| Antenna Rotational Error | 1.0 degrees |
| Polarization Switchable | |
| Polarization Alignment Relative to the Equatorial Plane | 0.0 degrees |
| G/T at Max. Gain Point | -26.4 dB/K |
| Min. Saturation Flux Density | -128.7 dBW/m2 |
| Max. Saturation Flux Density | -116.6 dBW/m2 |
| Co- or Cross Polar Mode | C |
| Service Area Description | Deadhorse, AK |

## Receiving Channels (1)

| Channel ID | Channel Bandwidth (MHz) | Center Frequency s (MHz) | Feeder Link, Service Link or TT&C |
|---|---|---|---|
| **UU11** | 0.025 | 401.05 | TT&C |

## Transmitting Beams 1:

| Question | Response |
|---|---|
| Beam ID | DU1 |
| Transmit Beam Frequency | 401.012 MHz -401.038 MHz |
| Beam Type | Fixed |
| Polarization | H |
| Peak Gain | 3.0 dBi |
| Antenna Pointing Error | 1.0 degrees |
| Antenna Rotational Error | 1.0 degrees |
| Polarization Switchable | |
| Polarization Alignment Relative to the Equatorial Plane | 0.0 degrees |
| Max. Transmit EIRP Density | -33.0 dBW/Hz |
| Max. Transmit EIRP | 3.0 dBW |
| Co- or Cross Polar Mode | C |
| Service Area Description | Deadhorse, AK |

### Max. Power Flux Density

| * BW: | * 0° - 5° (dbW/$m^2$ /BW): | * 5° - 10° (dbW/$m^2$ /BW): | * 10° - 15° (dbW/$m^2$ /BW): | * 15° - 20° (dbW/$m^2$ /BW): | * 20° - 25° (dbW/$m^2$ /BW): | * 25° - 90° (dbW/$m^2$ /BW): |
|---|---|---|---|---|---|---|
| **4.0 kHz** | -134.8 | -133.2 | -131.6 | -130.2 | -129.0 | -122.8 |

## Transmitting Beams 2:

| Question | Response |
|---|---|
| Beam ID | DS1 |
| Transmit Beam Frequency | 2261.5 MHz -2269.5 MHz |

| | |
|---|---|
| Beam Type | Fixed |
| Polarization | RHCP |
| Peak Gain | 7.0 dBi |
| Antenna Pointing Error | 0.0 degrees |
| Antenna Rotational Error | 0.0 degrees |
| Polarization Switchable | |
| Polarization Alignment Relative to the Equatorial Plane | 45.0 degrees |
| Max. Transmit EIRP Density | -59.0 dBW/Hz |
| Max. Transmit EIRP | 10.0 dBW |
| Co- or Cross Polar Mode | C |
| Service Area Description | Deadhorse, AK |

## Max. Power Flux Density

| * BW: | * 0° - 5° (dbW/$m^2$ /BW): | * 5° - 10° (dbW/$m^2$ /BW): | * 10° - 15° (dbW/$m^2$ /BW): | * 15° - 20° (dbW/$m^2$ /BW): | * 20° - 25° (dbW/$m^2$ /BW): | * 25° - 90° (dbW/$m^2$ /BW): |
|---|---|---|---|---|---|---|
| **4.0 kHz** | -160.9 | -159.2 | -157.6 | -156.2 | -155.0 | -148.8 |

## Transmitting Channels (2)

| Channel ID | Channel Bandwidth (MHz) | Center Frequency s (MHz) | Feeder Link, Service Link or TT&C |
|---|---|---|---|
| **DS11** | 8.0 | 2265.5 | Service Link |
| **DU11** | 0.025 | 401.025 | TT&C |

## Certification Questions

| Question | Response |
| --- | --- |
| Are the applicable service area coverage requirements of 25.143(b)(2)(ii) and (iii), or 25.144(a)(3)(i), or 25.145(c)(1) and (2), or 25.146(i)(1) and (2), or 25.148(c), or 25.225 met? | N/A |
| Are the applicable frequency tolerances of 25.202(e) and out-of-band emission limits of 25.202(f)(1),(2), and (3) met? | Yes |
| Are the cessation of emissions requirements of 25.207 met? | Yes |
| Are the applicable power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application? | |
| For NGSO applications, are the applicable equivalent-power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application? | N/A |
| Are the applicable full-frequency-reuse requirements of 25.210 met? | |
| If the application is for a 17/24 GHz BSS space station, will it be operated at an offset location with full power and interference protection in accordance with 25.262(b)? | |

## Attachments

Information not provided.

## IV. Updated SW1FT ITU Filing Information

| Résumé / Summary / Resumen | | | | |
|---|---|---|---|---|
| Article 9, sous-section IA | / | Article 9, sub-section IA | / | Artículo 9, sub-sección IA |
| 第9条第1A分节 | / | Статья 9, подраздел IA | / | المادة 9، القسم الفرعي IA |

| B1a Beam designation | B2 Emi-Rcp | BR8 Action code | BR7a Group id. | BR9 Action code | BR47 Frequency band (MHz) | | | C4a Class of station |
|---|---|---|---|---|---|---|---|---|
| UPLINK | R | M | 3 /2896 | M | 401.0375 | - | 401.0625 | ED, EW |
| DOWLINKS | E | M | 4 /2896 | M | 2261.5 | - | 2269.5 | EW |
| DOWNLINK | E | M | 1 /2896 | M | 401.0125 | - | 401.0375 | EW |

| *A1f2* Submitted on behalf | POL |
|---|---|

| *A1g* Short Mission Duration Res 32 | N | | |
|---|---|---|---|

| *A4b1* No. of orbital planes | 1 | *A4b2* Ref. body | T | *BR43* Orbital configuration | 0 |
|---|---|---|---|---|---|

| *A4b1a* Constellation | N | *A4b1b* Configuration type | | *A4b1c* Number of sub-sets mutually exclusive | | *A4b1d* Attachment no. | |
|---|---|---|---|---|---|---|---|

| *A4b3a* No. of space stations simult. trans. on Northern Hemisphere | | *A4b3b* No. of space stations simult. trans. on Southern Hemisphere | |
|---|---|---|---|

| *Orbital plane id. no.* | *A4b4a Inclination angle* | *A4b4b No. of satellites in this plane* | *A4b4c Period* | *A4b4d Apogee* | *A4b4e Perigee* | *A4b4f Min. altitude* | *A4b4i Arg. of perigee* | *A4b4j Long. asc. node* | *A4b4m,n,o Sun synchronous* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | *Y/N* | *Node reference time* | *Node local time* |
| 1 | 97.6 | 1 | 0-01:31 | 550e0 | 550e0 | 550e0 | | | Y | | |

| *Orbital plane no.* | *Satellite no.* | *A4b4h Initial phase angle* | *A4b4k Date* | *A4b4l Time* | *B4a Orbit link / List of beams* |
|---|---|---|---|---|---|
| 1 | 1 | | | | ALL |

| M | *B1a/BR17* Beam designation | UPLINK | | *B1b* Steerable | | *B2* Emi-Rcp | R | *B3a1* Max. co-polar gain | 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *B2a1* Transmit only when visible from notified service area | | *B2a2* Min. Elev. Angle | |
|---|---|---|---|

| B3c1 Co-polar antenna pattern | | | | | | |
|---|---|---|---|---|---|---|
| Co-polar ref. pattern | Coef. A | Coef. B | | | | Co-polar rad. diag. |
| | | | | | | 2 |

| List of orbital planes |
|---|
| 1 |

| *B4a3a1* Angle alpha | | *B4a3a2* Angle beta | | | |
|---|---|---|---|---|---|

| *BR92* Attach. for missing angle alpha/beta | |
|---|---|

| M | *BR7a/BR7b* Group id. | 3 | 2896 | *BR1* Date of receipt | 28.08.2018 | *C2c* RR No. 4.4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *BR14* Special Section | | | |
|---|---|---|---|

| *C4a* Class of station | ED | EW | | | *C3a* Assigned freq. band | | *C5a* Noise temperature | 100 | | |
|---|---|---|---|---|---|---|---|---|---|---|

| *C4b* Nature of service | CO | CO | | | *C6a* Polarization type | L | *C6b* Polarization angle | 0 |
|---|---|---|---|---|---|---|---|---|

| *C11a2* Service area | USA | | | | | | | | | *C11a3* Service area diagram | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *A2b* Period of valid. | 10 | *A3a* Op. agency | 404 | *A3b* Adm. resp. | A | *BR16* Value of type C8b | |
|---|---|---|---|---|---|---|---|

| *BR96* Start date for 9.1/9.1A | |
|---|---|

| *BR60* Regulatory deadline(s) | 11.44/11.44.1 | | | |
|---|---|---|---|---|

C1 Frequency Range

| *C1a* Lower limit | | *C1b* Upper limit | |
|---|---|---|---|
| 401.0375 | MHz | 401.0625 | MHz |

| | *C7a* | *C8a1/C8b1* | *C8a2/C8b2* | *C8c1* | *C8c2* | *C8c3* | *C8c4* | *C8e1* | *C8e2* | *C8f2* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Design. of emission | Max. peak pwr | Max. pwr dens. | Min. peak pwr | Attch. | Min. pwr dens. | Attch. | C/N ratio | Attch. | E.i.r.p. on the beam axis |
| 1 | 25K0F1D-- | -7 | -43 | -20 | | -56 | | 10 | | |

*C7b* Carrier frequency of the emissions (25K0F1D--)

| 401.05 | MHz |
|---|---|

| | *C10b1* Assoc. earth station id. | *C10b2* Type | *C10c1* Geographical coord. | | *C10c2* Ctry | *C10d1/C10d2* Cls. / Nat. | | *C10d3* Max. iso. gain | *C10d4* Bmwdth |
|---|---|---|---|---|---|---|---|---|---|
| M | DEADHORSE, AK | S | 148W24 29 | 70N12 45 | USA | 1 | TD CO | 16.2 | 20 |
| | | | | | | 2 | TW CO | | |

C10d5a Co-polar antenna pattern

| *C10b1* Assoc. earth station id. | Co-polar ref. pattern | Coef. A | Coef. B | Coef. C | Coef. D | Phi1 | Co-polar rad. diag. |
|---|---|---|---|---|---|---|---|
| DEADHORSE, AK | | | | | | | 3 |

| *13C* Remarks | |
|---|---|

| M | *B1a/BR17* Beam designation | DOWLINKS | | *B1b* Steerable | | *B2* Emi-Rcp | E | *B3a1* Max. co-polar gain | 7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *B2a1* Transmit only when visible from notified service area | Y | *B2a2* Min. Elev. Angle | |
|---|---|---|---|

B3c1 Co-polar antenna pattern

| Co-polar ref. pattern | Coef. A | Coef. B | | | | Co-polar rad. diag. |
|---|---|---|---|---|---|---|
| | | | | | | 1 |

| List of orbital planes |
|---|
| 1 |

| *B4a3a1* Angle alpha | | *B4a3a2* Angle beta | | | |
|---|---|---|---|---|---|

| *BR92* Attach. for missing angle alpha/beta | |
|---|---|

| M | *BR7a/BR7b* Group id. | 4 | 2896 | *BR1* Date of receipt | 28.08.2018 | *C2c* RR No. 4.4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *BR14* Special Section | | | |
|---|---|---|---|

| *C4a* Class of station | EW | | | | *C3a* Assigned freq. band | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

| *C4b* Nature of service | CO | | | | *C6a* Polarization type | CR | *C6b* Polarization angle | |
|---|---|---|---|---|---|---|---|---|

| *C8d1* Max. tot. peak pwr. | | *C8d2* Contiguous bandwidth | |
|---|---|---|---|

| *C11a2* Service area | USA | | | | | | | | *C11a3* Service area diagram | |
|---|---|---|---|---|---|---|---|---|---|---|

| *A2b* Period of valid. | 10 | *A3a* Op. agency | 404 | *A3b* Adm. resp. | A | *BR16* Value of type C8b | |
|---|---|---|---|---|---|---|---|

| *BR96* Start date for 9.1/9.1A | |
|---|---|

| *BR60* Regulatory deadline(s) | 11.44/11.44.1 | | | |
|---|---|---|---|---|

| C1 Frequency Range | | | |
|---|---|---|---|
| *C1a* Lower limit | | *C1b* Upper limit | |
| 2261.5 | MHz | 2269.5 | MHz |

| | *C7a* | *C8a1/C8b1* | *C8a2/C8b2* | *C8c1* | *C8c2* | *C8c3* | *C8c4* | *C8e1* | *C8e2* | *C8f1* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Design. of emission | Max. peak pwr | Max. pwr dens. | Min. peak pwr | Attch. | Min. pwr dens. | Attch. | C/N ratio | Attch. | E.i.r.p. on the beam axis |
| 1 | 8M00D1D-- | 3 | -75 | -15 | | -80 | | 10 | | |

| *C7b* Carrier frequency of the emissions (8M00D1D--) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2265.5 | MHz | | | | | | | | | | | | | | | | | | |

| *C10b1* Assoc. earth station id. | *C10b2* Type | *C10c1* Geographical coord. | | *C10c2* Ctry | *C10d1/C10d2* Cls. / Nat. | | *C10d3* Max. iso. gain | *C10d4* Bmwdth | *C10d6* Noise temp. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M DEADHORSE, AK | S | 148W24 29 | 70N12 45 | USA | 1 | TW | CO | 36.7 | 3 | 100 | | | |

| | C10d5a Co-polar antenna pattern | | | | | | |
|---|---|---|---|---|---|---|---|
| *C10b1* Assoc. earth station id. | Co-polar ref. pattern | Coef. A | Coef. B | Coef. C | Coef. D | Phi1 | Co-polar rad. diag. |
| DEADHORSE, AK | | | | | | | 3 |

| *13C* Remarks | |
|---|---|

| M | *B1a/BR17* Beam designation | DOWNLINK | | *B1b* Steerable | | *B2* Emi-Rcp | E | *B3a1* Max. co-polar gain | 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *B2a1* Transmit only when visible from notified service area | Y | *B2a2* Min. Elev. Angle | |
|---|---|---|---|

| B3c1 Co-polar antenna pattern | | | | | | |
|---|---|---|---|---|---|---|
| Co-polar ref. pattern | Coef. A | Coef. B | | | | Co-polar rad. diag. |
| | | | | | | 2 |

| List of orbital planes |
|---|
| 1 |

| *B4a3a1* Angle alpha | | *B4a3a2* Angle beta | | | |
|---|---|---|---|---|---|

| *BR92* Attach. for missing angle alpha/beta | |
|---|---|

| M | *BR7a/BR7b* Group id. | 1 | 2896 | *BR1* Date of receipt | 28.08.2018 | *C2c* RR No. 4.4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| *BR14* Special Section | | | |
|---|---|---|---|

| *C4a* Class of station | EW | | | | *C3a* Assigned freq. band | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

| *C4b* Nature of service | CO | | | | *C6a* Polarization type | L | *C6b* Polarization angle | 0 |
|---|---|---|---|---|---|---|---|---|

| *C8d1* Max. tot. peak pwr. | | *C8d2* Contiguous bandwidth | |
|---|---|---|---|

| *C11a2* Service area | USA | *C11a3* Service area diagram | |
|---|---|---|---|

| *A2b* Period of valid. | 10 | *A3a* Op. agency | 404 | *A3b* Adm. resp. | A | *BR16* Value of type C8b | |
|---|---|---|---|---|---|---|---|

| *BR96* Start date for 9.1/9.1A | |
|---|---|

| *BR60* Regulatory deadline(s) | 11.44/11.44.1 | | | |
|---|---|---|---|---|

| C1 Frequency Range | | | |
|---|---|---|---|
| *C1a* Lower limit | | *C1b* Upper limit | |
| 401.0125 | MHz | 401.0375 | MHz |

| | *C7a* | *C8a1/C8b1* | *C8a2/C8b2* | *C8c1* | *C8c2* | *C8c3* | *C8c4* | *C8e1* | *C8e2* | *C8f1* |
|---|---|---|---|---|---|---|---|---|---|---|
| | Design. of emission | Max. peak pwr | Max. pwr dens. | Min. peak pwr | Attch. | Min. pwr dens. | Attch. | C/N ratio | Attch. | E.i.r.p. on the beam axis |
| 1 | 25K0F1D-- | 0 | -36 | -10 | | -46 | | | 10 | |

| *C7b* Carrier frequency of the emissions (25K0F1D--) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 401.025 | MHz | | | | | | | | | | | | | | | | |

| *C10b1* | | *C10b2* | *C10c1* | | *C10c2* | *C10d1/C10d2* | | *C10d3* | *C10d4* | *C10d6* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assoc. earth station id. | | Type | Geographical coord. | | Ctry | Cls. / Nat. | | Max. iso. gain | Bmwdth | Noise temp. | | |
| M | DEADHORSE, AK | S | 148W24 29 | 70N12 45 | USA | 1 | TW | CO | 16.2 | 20 | 100 | |

| | C10d5a Co-polar antenna pattern | | | | | | |
|---|---|---|---|---|---|---|---|
| *C10b1* Assoc. earth station id. | Co-polar ref. pattern | Coef. A | Coef. B | Coef. C | Coef. D | Phi1 | Co-polar rad. diag. |
| DEADHORSE, AK | | | | | | | 3 |

| *13C* Remarks | |
|---|---|

| *BR22* Administration remarks | |
|---|---|

| *BR23* Radiocommunication Bureau comments | |
|---|---|

| | SWIATOWID_2 | SW1FT-VISION |
|---|---|---|
| Constellation | Same as ISS orbit | 550km circular SSO |
| SV Uplink UHF Beam | | |
| Gain | 20 dBi | 3 dBi |
| Emission RF Power | 1 to -1 dBW | -7 to -20 dBW |
| Emission RF Density | -10 to -101.2 dBW/Hz | -43 to -56 dBW/Hz |
| Service Type | EESS | EESS, Telecommand |
| Service Area | Poland, Region 1 | USA |
| SV Downlink UHF Beam | | |
| Emission RF Power | 1 to -1 dBW | 0 to -10 dBW |
| Emission RF Density | -10 to -101.2 dBW/Hz | -36 to -46 dBW/Hz |
| Service Type | Space Operations | EESS |
| Service Area | Poland, Region 1 | USA |
| SV Downlink S-band Beam | | |
| Gain | 2 dBi | 7 dBi |
| Frequency | 2270 MHz | 2265.5 MHz |
| Polarization | Linear | RHCP |
| Emission BW | 1 MHz | 8 MHz |
| Emission RF Power | -4 dBW | 3 to -15 dBW |
| Emission RF Density | -10 dBW/Hz | -75 to -80 dBW/Hz |
| Service Type | EESS | EESS |
| Service Area | Poland, Region 1 | USA |
| ES Uplink UHF Beam | | |
| Location | SatRevolution offices, Poland | Deadhorse, AK, USA |
| Gain | 18 | 16.2 |
| ES Downlink UHF Beam | | |
| Location | SatRevolution offices, Poland | Deadhorse, AK, USA |
| Gain | 18 | 16.2 |
| ES Downlink S-band Beam | | |
| Location | SatRevolution offices, Poland | Deadhorse, AK, USA |
| Gain | 18 | 36.7 |

Approved by OMB
3060-0678

Date & Time Filed:
File Number: ---
Callsign/Satellite ID:

| APPLICATION FOR EARTH STATION AUTHORIZATIONS<br><br>FCC 312 MAIN FORM<br>FOR OFFICIAL USE ONLY | FCC Use Only |
|---|---|

## APPLICANT INFORMATION

Enter a description of this application to identify it on the main menu:
Draft Form (180-Day STA for Brewster-SatRevolution)

1-8. Legal Name of Applicant

| | | | |
|---|---|---|---|
| Name: | RBC Signals, LLC | Phone Number: | 404-803-7734 |
| DBA Name: | | Fax Number: | |
| Street: | 2205 152nd Ave NE | E-Mail: | crichins@rbcsignals.com |
| City: | Redmond | State: | WA |
| Country: | USA | Zipcode: | 98052 - |
| Attention: | Mr. Christopher Richins | | |

9-16. Name of Contact Representative

| | | | |
|---|---|---|---|
| Name: | Carlos Nalda | Phone Number: | 6099021670 |
| Company: | LMI Advisors | Fax Number: | |
| Street: | 2550 M Street NW<br>Suite 345 | E-Mail: | cnalda@lmiadvisors.com |
| City: | Washington | State: | DC |
| Country: | USA | Zipcode: | 20037- |
| Attention: | Carlos Nalda | Relationship: | Other |

## CLASSIFICATION OF FILING

17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b.

a.
- (●) a1. Earth Station
- (N/A) a2. Space Station

b.
- (●) b1. Application for License of New Station
- ( ) b2. Application for Registration of New Domestic Receive-Only Station
- (N/A) b3. Amendment to a Pending Application
- (N/A) b4. Modification of License or Registration
- (N/A) b5. Assignment of License or Registration
- (N/A) b6. Transfer of Control of License or Registration
- (N/A) b7. Notification of Minor Modification
- (N/A) b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite
- (N/A) b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States
- ( ) b10. Other (Please specify)
- ( ) b11. Application for Earth Station to Access a Non-U.S.satellite Not Currently Authorized to Provide the Proposed Service in the Proposed Frequencies in the United States.

17c. Is a fee submitted with this application?
- ( ) If Yes, complete and attach FCC Form 159.

If No, indicate reason for fee exemption (see 47 C.F.R.Section 1.1114).
- ( ) Governmental Entity
- ( ) Noncommercial educational licensee

◉ Other(please explain): DRAFT FORM

17d.
Fee Classification

| 18. If this filing is in reference to an existing station, enter: (a) Call sign of station: | 19. If this filing is an amendment to a pending application enter: (a) Date pending application was filed: | (b) File number of pending application: |
|---|---|---|
| Not Applicable | Not Applicable | Not Applicable |

## TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:

- ☐ a. Fixed Satellite
- ☐ b. Mobile Satellite
- ☐ c. Radiodetermination Satellite
- ☐ d. Earth Exploration Satellite
- ☐ e. Direct to Home Fixed Satellite
- ☐ f. Digital Audio Radio Service
- ☑ g. Other (please specify)

NGSO

21. STATUS: Choose the button next to the applicable status. Choose only one.
○ Common Carrier ◉ Non-Common Carrier

22. If earth station applicant, check all that apply.
☐ Using U.S. licensed satellites
☑ Using Non-U.S. licensed satellites

23. If applicant is providng INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:
○ Connected to a Public Switched Network ○ Not connected to a Public Switched Network ◉ N/A

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).
☐ a. C-Band (4/6 GHz) ☐ b. Ku-Band (12/14 GHz)
☑ c.Other (Please specify upper and lower frequencies in MHz.)
Frequency Lower: 2261.5 Frequency Upper: 2269.5

## TYPE OF STATION

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.

- ◉ a. Fixed Earth Station
- ○ b. Temporary-Fixed Earth Station
- ○ c. 12/14 GHz VSAT Network
- ○ d. Mobile Earth Station

(N/A) e. Geostationary Space Station
(N/A) f. Non-Geostationary Space Station

- ○ g. Other (please specify)

26. TYPE OF EARTH STATION FACILITY: Choose only one.
◉ Transmit/Receive ○ Transmit-Only ○ Receive-Only ○ N/A

## PURPOSE OF MODIFICATION

27. The purpose of this proposed modification is to: (Place an 'X' in the box(es) next to all that apply.)

Not Applicable

## ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as an exhibit to this application.A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments. ○ **Yes** ◉ **No**

## ALIEN OWNERSHIP Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30-34.

| | |
|---|---|
| 29. Is the applicant a foreign government or the representative of any foreign government? | ○ Yes ◉ No |
| 30. Is the applicant an alien or the representative of an alien? | ○ Yes ○ No ◉ N/A |
| 31. Is the applicant a corporation organized under the laws of any foreign government? | ○ Yes ○ No ◉ N/A |
| 32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country? | ○ Yes ○ No ◉ N/A |
| 33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country? | ○ Yes ○ No ◉ N/A |
| 34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote. | |

## BASIC QUALIFICATIONS

| | |
|---|---|
| 35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules? If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents. | ◉ Yes ○ No |
| 36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explination of circumstances. | ○ Yes ◉ No |
| 37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explination of circumstances. | ○ Yes ◉ No |
| 38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attemptiing unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition?If Yes, attach as an exhibit, an explanation of circumstances | ○ Yes ◉ No |
| 39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhinit, an explanation of the circumstances. | ○ Yes ◉ No |
| 40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer. | |
| 41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. *See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes*. | ◉ Yes ○ No |
| 42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in *47 C.F.R. 25.137, as appropriate*. If No, proceed to question 43. | ◉ Yes ○ No |
| 42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station?Poland | |
| 43. Description. (Summarize the nature of the application and the services to be provided). See Narrative. | |
| 43a. Geographic Service Rule Certification<br>By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.<br><br>By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic | ◉ A<br>○ B |

coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.

By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached. ○ **C**

## CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- ○ Individual
- ○ Unincorporated Association
- ○ Partnership
- ○ Corporation
- ○ Governmental Entity
- ◉ Other (please specify)

LLC

| 45. Name of Person Signing | 46. Title of Person Signing |
|---|---|
| Christopher Richins | CEO |

47. Please supply any need attachments.

| Attachment 1: | Attachment 2: | Attachment 3: |
|---|---|---|
| | | |

**WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).**

# SATELLITE EARTH STATION AUTHORIZATIONS
# FCC Form 312 - Schedule B:(Technical and Operational Description)

**FOR OFFICIAL USE ONLY**

Location of Earth Station Site

| | | | |
|---|---|---|---|
| E1: Site Identifier: | Deadhorse | E5. Call Sign: | |
| E2: Contact Name | Zachary Reich | E6. Phone Number: | 415-622-5548 |
| E3. Street: | DS12 Access Road | E7. City: | Deadhorse |
| | AK | E8. County: | |
| E4. State | | E9. Zip Code | 99734 |
| E10. Area of Operation: | 70 ° 12 ' 45.0 " N | Brewster, WA | |
| E11. Latitude: | 148 ° 24 ' 29.0 " W | | |
| E12. Longitude: | | | |
| E13. Lat/Lon Coordinates are: | | ○ NAD-27 | ◉ NAD-83 ○ N/A |
| E14. Site Elevation (AMSL): | | 10.0 meters | |

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites,

| | |
|---|---|
| do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurement? If NO, provide asa technical analysis showing compliance with two-degree spacing policy. | ○ Yes ○ No ◉ N/A |
| E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements? | ◉ Yes ○ No ○ N/A |
| E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point. | ○ Yes ◉ No |
| E18. Is frequency coordination required? If YES, attach a frequency coordination report as | ○ Yes ◉ No |
| E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as | ○ Yes ◉ No |
| **E20. FAA Notification - (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and or the FAA's study regarding the potential hazard of the structure to aviation?**<br>**FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.** | ○ Yes ◉ No |

**POINTS OF COMMUNICATION**

| Satellite Name:OTHER \| OTHER \| If you selected OTHER, please enter the following: | |
|---|---|
| E21. Common Name: SW1FT | E22. ITU Name: |
| E23. Orbit Location: NGSO | E24. Country: Poland |

| Satellite Name:OTHER \| OTHER \| If you selected OTHER, please enter the following: | |
|---|---|
| E21. Common Name: | E22. ITU Name: |
| E23. Orbit Location: NGSO | E24. Country: |

| Satellite Name:OTHER \| OTHER \| If you selected OTHER, please enter the following: | |
|---|---|
| | E22. ITU Name: |
| E23. Orbit Location: NGSO | E24. Country: Poland |

**POINTS OF COMMUNICATION (Destination Points)**

| E25. Site Identifier: Deadhorse | |
|---|---|
| E26. Common Name: | E27. Country:USA |

**ANTENNA**

| Site ID | E28. Antenna Id | E29. Quantity | E30. Manufacturer | E31. Model | E32. Antenna Size | E41/42. Antenna GainTransmint and/or Recieve(____dBi at _____GHz) |
|---|---|---|---|---|---|---|
| | | | | | | |
| Deadhorse | Orbit | 1 | Orbit | Orbit Gaia-100 | 2.4 | 30.0 dBi at 22.650 |

| E28. Antenna Id | E33/34. Diameter Minor/Major(meters) | E35. Above Ground Level (meters) | E36. Above Sea Level (meters) | E37. Building Height Above Ground Level (meters) | E38. Total Input Power at antenna flange (Watts) | E39. Maximum Antenna Height Above Rooftop (meters) | E40. Total EIRP for al carriers (dBW) |
|---|---|---|---|---|---|---|---|
| | | | 0.0 | 0.0 | | 0.0 | |
| Orbit | 0.0/0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

**FREQUENCY**

| E28. Antenna Id | E43/44. Frequency Bands(MHz) | E45. T/R Mode | E46. Antenna Polarization(H,V,L,R) | E47. Emission Designator | E48. Maximum EIRP per Carrier(dBW) | E49. Maximum ERIP Density per Carrier(dBW/4kHz) |
|---|---|---|---|---|---|---|
| Orbit | 2261.5 2269.5 | R | Left and Right Circular | 8M00G1D | 0.0 | 0.0 |
| E50. Modulation and Services DVB-S2 | | | | | | |
| | | | | | | |
| E50. Modulation and Services | | | | | | |
| | | | | | | |
| E50. Modulation and Services | | | | | | |
| | | | | | | |
| E50. Modulation and Services | | | | | | |
| | | | | | | |
| E50. Modulation and Services | | | | | | |

**FREQUENCY COORDINATION**

| E28. Antenna Id | E51. Satellite Orbit Type | E52/53. Frequency Limits(MHz) | E54/55. Range of Satellite Arc E/W Limit | E56. Earth Station Azimuth Angle Eastern Limit | E57. Antenna Elevation Angle Eastern Limit | E58. Earth Station Azimuth Angle Western Limit | E59. Antenna Elevation Angle Western Limit | E60. Maximum EIRP Density toward the Horizon(dBW/4kHz) |
|---|---|---|---|---|---|---|---|---|
| Orbit | Non-Geostationary | 2261.5-2269.5 | 0.0/ 0.0 | 0.0 | 5.0 | 360.0 | 5.0 | 0.0 |
| | | | | | | | | |
| | | | | | | | | |

**REMOTE CONTROL POINT LOCATION**

**REMOTE CONTROL POINT LOCATION**

| E61. Call Sign<br><br>NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed. | | | E65. Phone Number |
|---|---|---|---|
| E62. Street Address | | | |
| E63. City | E67. County | E64/68. State/Country / | E66. Zip Code |

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