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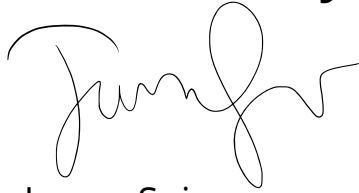
AUDACY LYNQ ORBITAL DEBRIS ASSESSMENT REPORT (ODAR)

Rev. 01

9/27/18

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Submitted By:

A handwritten signature in black ink, appearing to read 'James Spicer', with a stylized, flowing script.

James Spicer
Chief Engineer
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Record of Revisions				
Rev	Date	Affected Pages	Description of Change	Author(s)
1	09/27/18	All	Initial release	James Spicer

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Orbital Debris Assessment Evaluation: Audacy Lynq Mission

Requirement #	Launch Vehicle				Spacecraft			Comments
	Compliant	Not Compliant	Incomplete	Standard Non Compliant	Compliant	Not Compliant	Incomplete	
4.3-1.a	☐	☐	☒	☐	☒	☐	☐	No Debris Released in LEO. See note 1.
4.3-1.b	☐	☐	☒	☐	☒	☐	☐	No Debris Released in LEO. See note 1.
4.3-2	☐	☐	☒	☐	☒	☐	☐	No Debris Released in GEO. See note 1.
4.4-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.4-2	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.4-3	☐	☐	☒	☐	☒	☐	☐	No planned breakups. See note 1.
4.4-4	☐	☐	☒	☐	☒	☐	☐	No planned breakups. See note 1.
4.5-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.5-2	☐	☐	☒	☐	☒	☐	☐	No critical subsystems needed for EOM disposal
4.6-1(a)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-1(b)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-1(c)	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-2	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-3	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-4	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.6-5	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.7-1	☐	☐	☒	☐	☒	☐	☐	See note 1.
4.8-1	☐	☐	☒	☐	☒	☐	☐	No tethers used.

Notes:

1. The Audacy Lynq terminal is being launched on an ISS resupply mission. The associated launch vehicle is not being developed with Audacy.

Assessment Report Format

ODAR Technical Sections Format Requirements:

Audacy Corporation is a US company. Therefore, this ODAR follows the format recommended in NASA-STD-8719.14, Appendix A.1 and includes the content indicated at a minimum in each section 2 through 8 below for the Audacy Lynq terminal. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

I. Program Management and Mission Overview

Project Manager: Ellaine Talle

Foreign Government or space agency participation: None.

Schedule of Upcoming Mission Milestones:

Milestone	Date
Launch	27 Nov 2018

Mission Overview:

Audacy Lynq is a K/K_a-band radio terminal that will be hosted on the International Space Station (ISS) for a period of 15 weeks in 2019. The terminal will be attached to the Earth-facing side of the NanoRacks External Platform (NREP), itself attached to the Japanese Experiment Module - Exposed Facility (JEM-EF) of the ISS. The terminal is a demonstration mission to test Audacy's user communications transceiver and San Francisco Bay Area ground station. The Lynq terminal has a volume of 20 × 10 × 10 cm (L × W × H) with a mass of 3 kg. It will be launched to the ISS on a resupply mission and will be deployed on the NREP. During its mission, the terminal will remain attached to the ISS, and data transmission will focus on telemetry, tracking, and command (TT&C). After a 15-week mission, Lynq will be brought back inside the ISS pressurized volume, where it will remain before being disposed of in another ISS cargo vessel along with other ISS waste.

Launch Vehicle: SpaceX Falcon 9 or Northrop Grumman Antares, as part of an ISS resupply mission.

Launch Site: Cape Canaveral Air Force Station (if Falcon 9) or Mid-Atlantic Regional Spaceport (if Antares).

Mission Duration: 15 weeks in the space environment, otherwise inside pressurized ISS resupply vehicles or ISS modules.

Launch and Deployment Profile: The launch vehicle will match the ISS's orbit and dock with the ISS. Audacy Zero will be deployed on the outside of the ISS for 15 weeks, remaining attached to the ISS at all times.

Apogee: 406 km

Perigee: 403 km

Inclination: 51.64°

Audacy Lynq will remain inside or attached to the ISS at all times, and has no propulsion or orbital maneuvering system.

II. Spacecraft Description

Physical Description:

Audacy Lynq is a 2U-size ($20 \times 10 \times 10$ cm) terminal which will be attached to the ISS for the entirety of its operational mission. It has no solar arrays, power storage, or attitude control. The only moving part is a 2-axis gimbal.

The terminal operates in the K and K_a bands with omnidirectional and patch antennas for receive and transmit of telemetry and command data.

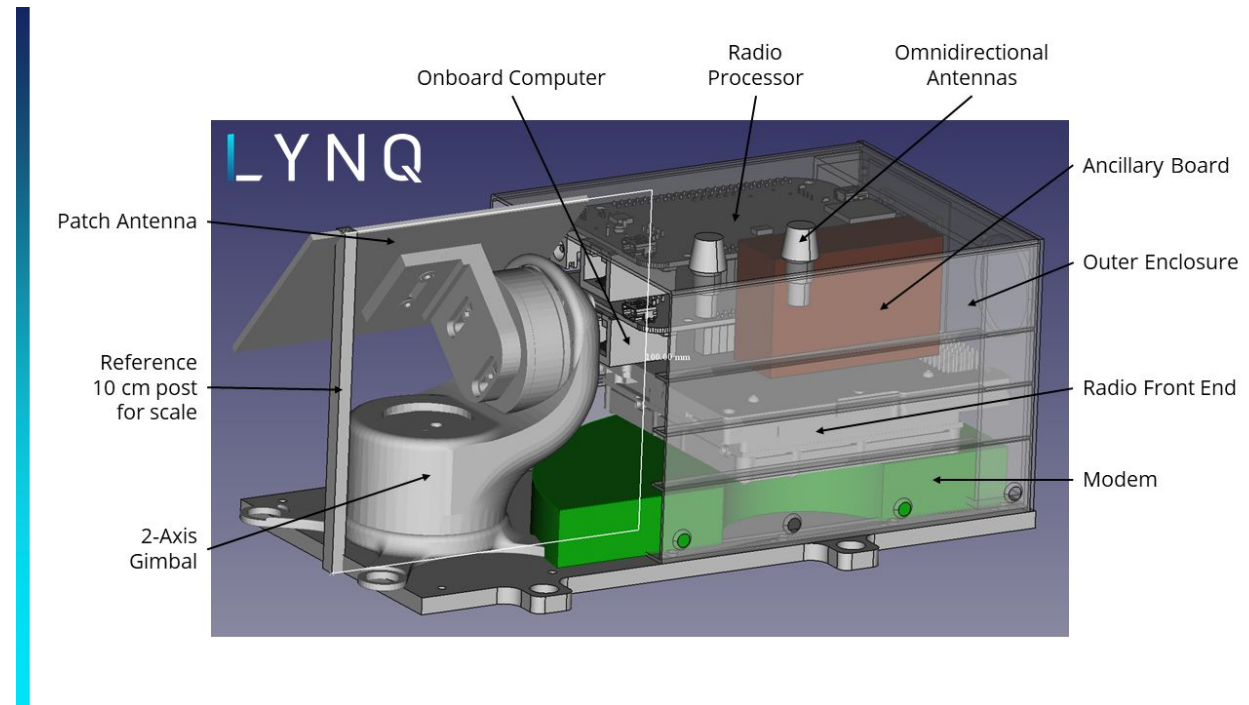


Figure 1: Audacy Lynq CAD model.

Spacecraft Total Mass at Launch: 3.0 kg.

Spacecraft Dry Mass at Launch: 3.0 kg.

Description of Propulsion Systems: None.

Body Dimensions: $20 \times 10 \times 10$ cm.

Deployed Solar Array Dimensions: None.

Identification of all Fluids: None.

Fluids in Pressurized Batteries: None.

Description of Attitude Determination and Control: None.

Description of Range Safety or Pyrotechnic Devices: None.

Description of the Electrical Generation and Storage System: None. The Lynq terminal receives power from the ISS to which it is attached.

Identification of other Stored Energy: None.

Identification of Radioactive Materials: None.

III. 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: No intentional releases.

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 v2.1.1)

4.3-1, Mission-Related Debris Passing Through LEO: COMPLIANT

4.3-2, Mission-Related Debris Passing Near GEO: COMPLIANT

IV. 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 terminal 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:

Audacy Lynq does not have any onboard stores of energy (batteries, propulsion systems, large capacitors, pyrotechnic devices, spring-loaded mechanisms, etc.), so there is no chance of accidental explosion. The probability of a detachment during deployment is negligible.

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:

None.

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: 0.000.

Expected probability: 0.000.

Supporting Rationale and FMEA details:

Audacy Lynq does not have any onboard stores of energy (batteries, propulsion systems, large capacitors, pyrotechnic devices, spring-loaded mechanisms, etc.), so there is no chance of accidental explosion. The probability of a detachment during deployment is negligible.

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:

Audacy Lynq does not have any onboard stores of energy (batteries, propulsion systems, large capacitors, pyrotechnic devices, spring-loaded mechanisms, etc.), so there is no passivation necessary at the end of its mission.

Requirement 4.4-3: Limiting the long-term risk to other space systems from planned breakups:

Compliance statement:

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:

Not applicable. There are no planned breakups.

V. Assessment of Spacecraft Potential for On-Orbit Collisions

Audacy Lynq will spend its entire time in orbit; before, during, and after its operational mission inside ISS cargo vehicles or inside or attached to the ISS itself. Compliance with Requirements 4.5-1 and -2 is contained in the ODARs of the ISS and its cargo vehicles, and not applicable to Audacy Lynq.

VI. Assessment of Spacecraft Post-mission Disposal Plans and Procedures

6.1 Description of spacecraft disposal option selected: After its mission Audacy Lynq will be placed inside an ISS cargo vehicle along with other ISS waste. The vehicle will then un-dock from the ISS and de-orbit via a controlled re-entry. Compliance with Section VI is part of the cargo vehicle ODAR and not applicable to Audacy Lynq.

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: Not applicable.

6.4 Assessment of spacecraft compliance with Requirements 4.6-1 through 4.6-5 (per DAS v 2.0.1 and NASA-STD-8719.14 section): Not applicable.

VII. Assessment of Spacecraft Reentry Hazards

Audacy Lynq will re-enter the atmosphere inside an ISS cargo vessel along with other ISS waste. Assessment of compliance with Section VII is part of the cargo vehicle ODAR and not applicable to Audacy Lynq.

VIII. Assessment of Tether Missions

Not applicable. There are no tethers in the Audacy Lynq mission.