# Protostar Orbital Debris Assessment Report (ODAR)

DAS Software v3.2.6

This report is presented as compliance with NASA-STD-8719.14, APPENDIX A.

APPROVAL:

Kayton Lane

Kayton Lane
Star Catcher Inc

Gavin Buck

Gavin Buck
Astro Digital US Inc

## Revision History

| Revision | Date | Author(s) | Description |
|---|---|---|---|
| 1.0 | 2/19/2026 | Gavin Buck | First release |
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| | | | |
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# Self-Assessment per NASA-STD-8719.14

This document contains the orbital debris assessment report (ODAR) for the Star Catcher Industries ("Star Catcher") experimental spacecraft Protostar.

A self-assessment in accordance with the format provided in Appendix A.2 of NASA-STD-8719.14 is shown below in Table 1.

| Section | Status | Comment |
|---|---|---|
| 4.3-1, Mission-Related Debris Passing Through LEO | Compliant | |
| 4.3-2, Mission-Related Debris Passing Near GEO | Compliant | Not passing through GEO |
| 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 | Compliant | |
| 4.4-3, Limiting the long-term risk to other space systems from planned breakups for Earth and lunar missions | Compliant | No planned breakup |
| 4.4-4, Limiting the short-term risk to other space systems from planned breakups for Earth orbital missions | Compliant | No planned breakup |
| 4.5.1, Limiting debris generated by collisions with large objects when in Earth orbit | Compliant | |
| 4.5-2, Limiting debris generated by collisions with small objects when operating in Earth orbit | Compliant | |
| 4.6-1, Natural reentry, direct reentry, or direct retrieval | Compliant | |
| 4.6-2, Storage and Earth escape | Compliant | Not passing through GEO |
| 4.6-3, Long-term reentry for space structures in Medium Earth Orbit (MEO), Tundra orbits, highly inclined GEO | Compliant | No special orbit required |
| 4.6-4, Reliability of post mission disposal maneuver operations in Earth orbit | Compliant | No post mission maneuver is being baselined |
| 4.7-1, Limit the risk of human casualty | Compliant | |
| 4.8-1, Special classes of space missions | Compliant | No special cases |

*Table 1: Assessment Report Format*

## Assessment Report Format

Astro Digital is a US company completing this ODAR for Star Catcher, A US Company. This ODAR follows the format in NASA-STD-8719.14, Appendix A.1 and includes the content indicated as a minimum, in each of sections 2 through 8 below. Sections 9 through 14 apply to the launch vehicle ODAR and are not covered here.

# 1 Program Management and Mission Overview

**Astro Digital**
System Engineer: Gavin Buck
Program Manager: Jack Ackohen

**Payload Provider:** Star Catcher

**Foreign government or space agency participation:** N/A

**Summary of NASA's responsibility under the governing agreement(s):** N/A

## 1.1 Schedule of upcoming mission milestones:

- Shipment of spacecraft: Q3 CY2026
- First launch: Q4 CY2026

## 1.2 Mission Overview:

The Protostar mission is a Low-Earth Orbit (LEO) demonstrator satellite mission in support of Star Catcher's goal of building an in-space power grid through the application of power-beaming satellites. The primary payload is developed and manufactured by Star Catcher and consists of avionics, tracking and laser transmission systems, and a deployable receiver system. The spacecraft bus is based on the Astro Digital Corvus micro platform. This standardized satellite bus uses reaction wheels, magnetic torque coils, star trackers, magnetometers, sun sensors, and gyroscopes to enable precision 3-axis pointing without the use of propellant. Following the payload demonstrations, Protostar will passively deorbit within 5 years with no debris casualty risk. If need be, Protostar has an on-board propulsion system that can be used to accelerate the de-orbit process.

## 1.3 Launch Vehicles and Launch Sites:

The Protostar spacecraft will be launched on a SpaceX Falcon 9 rideshare mission from Vanderberg SFB, California, USA.

## 1.4 Proposed Initial Launch Date:

The proposed initial launch date is in accordance with SpaceX's Transporter-18 mission, scheduled for Q4 CY2026 (1st October 2026 – 1st December 2026).

## 1.5 Mission Duration:

The design lifetime of the spacecraft hardware is a minimum of 3 years. The time to complete the mission is expected to be 3 years.

## 1.6 Launch and deployment profile, including all parking, transfer, and operational orbits with apogee, perigee, and inclination:

The selected launch vehicle will deliver the spacecraft directly to its operational circular polar orbit with an altitude of 510 km provided by the launch vehicle. The spacecraft will operate for approximately 3 years at the following orbital parameters:

- Drop off Altitude: 500km +/- 15km
- Target drop off: 510 km

- Eccentricity: 0.000 to 0.004
- Inclination: Sun-Synchronous Orbit (97.5 +/- 0.5 degrees)

# 2 Spacecraft Description

## 2.1 Physical description of spacecraft

The Protostar spacecraft is based on the standard Corvus-Micro platform. The Current Best Estimate (CBE) mass is 68.95 kg. The satellite envelope has dimensions of 84.12 x 54.39 x 111.7 cm when arrays are fully deployed. The satellite structure is comprised of six aluminum isogrid plates, in which all components are mounted on the inner and outer faces. All structural panels are referred to as against the spacecraft body frame as seen in Figure 1. A base plate on the -X, four side plates (two on the +/-Y and two on the +/-Z axis) and an upper plate on the +X axis.

A total of three Main Solar Panels (MSPs) are used as the primary source of power generation. One MSPs is body mounted in the + Y axis and two are stowed for launch and deploy from the +/- Z faces after separation. The deployment mechanism is a spring-loaded hinge with a burn wire that is activated upon separation. Two additional keep alive panels are mounted on the spacecraft, one on the +Z face and the other one on the -Z face, bother located beneath the stowed solar panels. A single Coarse Attitude Sensor (CAS) board contains embedded electronics such as a coarse sun sensor and magnetometer and is placed on the +Y axis.

The satellite avionics is enclosed inside the Data Power Module (DPM) which is comprised of a flight computer with integrated IMU, GPS module, TT&C transceiver, two battery packs, charging module, power distribution module and a high voltage power board. The DPM is equipped with a TT&C transceiver, Turva S-band/UHF. One X-band transmitter is equipped to provide high speed payload data downlink. Two additional battery packs, Direct Energy Pack (DEP), are used to further supply power to the bus and payload. All the avionics components have previously flown in different Astro Digital missions.

The Attitude Determination and Control System (ADCS) consists of flight proven externally sourced hardware with two star trackers, a gyroscope, reaction wheels and torque rods. In addition to the external hardware a torque rod control module and a reaction wheel control module are used to drive these components.

The primary payload components are mounted internally to the -Y, +Z and -Z panels and comprise of four major subsystems. The Laser Module System on the -Y panel, the Tracking and Transmission Systems on the +Z panel and Avionics System on the -Z panel. The payload also includes a Retroflector System on the exterior of the +X panel and a Deployable Receiver System mounted to the exterior of the -Y panel, which will deploy a cubesat design to receive power from the payload's power beaming transmission system. A 15 inch Rocket Lab Motorized Lightband (MLB) separation system on the -X panel of the satellite is used to deploy the spacecraft from the launch vehicle.

## 2.2 Detailed illustration of the spacecraft

An illustration of the spacecraft is shown in Figure 1:

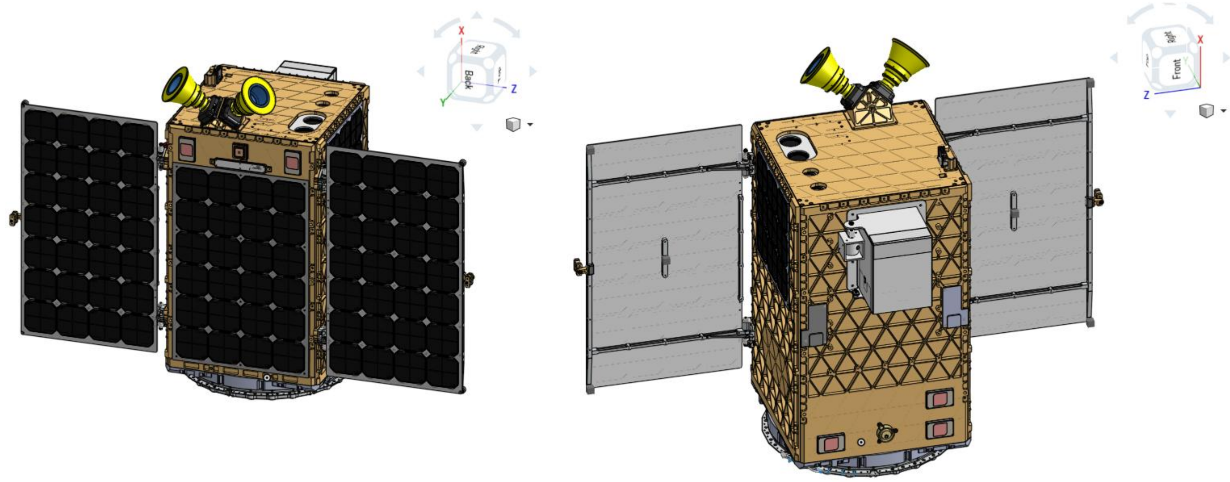

*Figure 1: Protostar Spacecraft*

## 2.3 Total Satellite Mass

Current best estimate (CBE) of 68.95 kg.

## 2.4 Dry Mass of the Satellite

The dry mass CBE of the spacecraft is 68.7 kg.

## 2.5 Identification of All Fluids On-board

No fluids on-board the spacecraft. The propulsion system contains solid iodine as propellant.

## 2.6 Description of Propulsion System

The spacecraft includes a ThrustMe NPT30-I2; a fully integrated propulsion system based on gridded ion thruster technology. The thruster, propulsion power unit (PPU), propellant storage, feed system, and on-board computer (OBC) occupy a total volume of 1U. The propellant is approximately 0.25 kg of solid iodine and is sublimated during operation in space. ThrustMe has launched over 100 of their NPT30 propulsion systems to space, accumulating 12,000+ hours of in-orbit thrusting. This also includes heritage on past Astro Digital missions.

## 2.7 Description of Attitude Control System

Scheduling after separation will consist of autonomous de-tumble followed by a safe mode sun tracking mode. Note that the spacecraft will be launched into a sun-synchronous orbit for which the amount of sunlight it will see throughout an orbit will vary depending on the LTDN. All the following attitude modes use a combination of the following sensors and actuators to perform maneuvers. A magnetometer, sun sensors, gyroscope, reaction wheels, torque rods and star trackers are used to orientate the spacecraft correctly.

| ADCS Mode | Description |
|---|---|
| Nominal | The spacecraft will be tracking the sun vector on its body mounted solar panels to generate sufficient power to charge the batteries. |
| TT&C | The spacecraft will perform a slew to track the ground station but may not be required based on the antenna placement and attitude of the spacecraft |

| | |
|---|---|
| Downlink | The spacecraft will perform a slew to track the corresponding ground station when line of sight is available. |

*Table 2: Spacecraft ADCS Modes*

## 2.8 Fluids in Pressurized Batteries

None, the spacecraft uses unpressurized standard lithium-ion battery cells. The spacecraft will have two battery packs, one inside the DPM avionics and an external pack, DEPs, to accommodate the high-power load that the payload requires. The DPM battery pack contains a set of eight lithium-Ion battery cells in parallel with a total capacity of 160 W-hrs. Each individual DEP contains two sets of eight lithium-Ion battery cells in series, with a capacity of 160 W-hrs. The Protostar spacecraft contains two DEPs with a total capacity of 320 W-hrs.

## 2.9 Description of Pyrotechnic Devices

No pyrotechnic devices on board the spacecraft.

## 2.10 Description of Electrical and Power System

Power is generated by the three Main Solar Panels (MSP) mounted on the spacecraft structural panels. Two keep alive panels are additionally mounted on the structural panel to serve as backup power generators in case of an uncontrolled tumble or clocking maneuvers.

The spacecraft has a total of three battery packs, one internal to the DPM and two external DEPs. The DPM battery pack is contained inside its housing module and mounted inside the DPM. The DEP battery packs are contained within their own housing and function as standalone modules. The battery packs are all equipped with power regulation ICs which regulate the discharge state of the individual battery cells. All the power regulation required for operating the bus is done though DPM. The DEP batteries function as the primary source of energy storage while DPM batteries are used as backup. All battery packs are charged through the solar panels.

The charge/discharge cycle is managed by a power management system overseen by the Flight Computer and Electrical Power Subsystem.

## 2.11 Identification of Other Stored Energy

No additional stored energy devices on board the spacecraft.

## 2.12 Identification of Any Radioactive Materials

No radioactive materials on board the spacecraft.

# 3 Assessment of Spacecraft Debris Released during Normal Operations

## 3.1 Identification of Objects Expected to be Released at Any Time

A single cubesat will be deployed from Starcatch-1 during normal operations.

Note: A full ODAR will be submitted by Star Catcher for the cubesat itself.

## 3.2 Rationale for Release of Objects

The cubesat will be released from Protostar to serve as a power receiver during the payload power-beaming technology demonstration.

## 3.3 Time of Release of Objects

The CubeSat deployment will occur no sooner than one week post launch.

## 3.4 Release Velocity

The cubesat deployment will have a release velocity of approximately 0.2 m/s.

## 3.5 Expected Orbital Parameters After Object Release

The cubesat will have orbital parameters equal to Protostar's orbital parameters given the minimal deployment velocity (510km altitude SSO, inclination 97.5 +/- 0.5 degrees).

## 3.6 Calculated Orbital Lifetime of Release Objects

The cubesat will have an estimated worst-case orbital lifetime of 10.7 years (assuming minimum drag area in ram direction). The best-case orbital lifetime (assuming maximum drag area in RAM direction) is 1.5 years. Full de-orbit assessment to be included in the cubesat ODAR submitted by Starcatcher.

## 3.7 Assessment of Compliance with Requirement 4.3-1 and 4.3-2

### 3.7.1 Requirements 4.3-1

"All debris released during the deployment, operation, and disposal phases shall be limited to a maximum orbital lifetime of 25 years from date of release. The total object-time product shall be less than 100 object-years per launch vehicle upper stage or per spacecraft."

**Compliance Statement** Compliant, the deployed cubesat is expected to naturally de-orbit from the 510km orbit within a max 10.7 years of the date of release.

### 3.7.2 Requirements 4.3-2

"For missions leaving debris in orbits with the potential of traversing GEO (GEO altitude +/- 200 km and +/- 15 degrees inclination), released debris with diameters of 5 mm or greater shall be left in orbits which will ensure that within 25 years after release the apogee will no longer exceed GEO - 200 km or the perigee will not be lower than GEO + 200 km , and also ensures that the debris is incapable of being perturbed to lie within that GEO +/- 200 km and +/- 15� zone for at least 100 years thereafter."

**Compliance Statement** No planned debris passing near GEO.

# 4 Assessment of Spacecraft Potential for Explosions and Intentional Breakups

## 4.1 Identification of all potential causes of spacecraft breakup during deployment and mission operation

No breakups are baselined during deployment and mission operations.

## 4.2 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. The battery safety systems discussed in the FMEA (see requirement 4.4-1 below) describe the combined faults that must occur for any of seven (7) independent, mutually exclusive failure modes to lead to such an explosion.

## 4.3 Detailed plan for any designed spacecraft breakup, including explosions and intentional collisions

No planned breakups, explosions or intentional collisions are planned for this mission.

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

After the satellite has reached its End of Lifetime (EOL) its lithium-Ion Battery Cells will be discharged completely. The solar array charging circuit will be disabled, which will fully discharge all cells within a few days.

## 4.5 Rationale for all items which are required to be passivated, but cannot be due to their design

All items were designed to be passivated once the mission is over.

## 4.6 Assessment of spacecraft compliance with Requirements 4.4-1 through 4.4-4

### 4.6.1 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 (i.e., every individual free-flying structural object), the program or project shall demonstrate, via failure mode and effects analyses, probabilistic risk assessments, or other appropriate 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.)."

**Compliance Statement**

- Required Probability: 0.001
- Expected Probability:0.000

**Supporting Rationale and FMEA Details**

- Battery Explosion
  - Effect: All failure modes below might result in battery explosion with the possibility of orbital debris generation. However, 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.
  - Probability: Extremely Low. It is believed to be less than 0.01% given that multiple independent faults must occur for each failure to cause an explosion. Each battery cell is UL, UN and IEC certified with individual over-voltage and over-current protection. Identical batteries have been flown on all Astro Digital spacecraft.

- Failure Mode 1: Internal short circuit
  - Mitigation: Protoflight level sine burst, sine and random vibration in three axes, thermal vacuum cycling and extensive functional testing followed by maximum system rate-limited charge and discharge cycles are performed to prove that no internal short circuit sensitivity exists. Additional environmental and functional testing of the batteries at the power subsystem vendor facilities is also conducted on the batteries in accordance with UL1642 standard.
  - Combined faults required for realized failure: Environmental testing AND functional charge/discharge tests must both be ineffective to enable this failure mode.

- Failure Mode 2: Internal thermal rise due to high load discharge rate
  - Mitigation: Battery cells are tested in lab for high load discharge rates in a variety of flight-like configurations to determine the feasibility of an out-of-control thermal rise in the cell. Cells are also tested in a hot, thermal environment to test the upper limit of the cell capability. No failures are observed or identified via satellite telemetry or via external monitoring circuitry. Both overcurrent and temperature protection is implemented in the battery management system.
  - Combined faults required for realized failure: Spacecraft thermal design must be incorrect AND external overcurrent detection AND thermal protection AND disconnect function must fail to enable this failure mode.

- Failure Mode 3: Excessive discharge rate or short-circuit due to external device failure or terminal contact with conductors not at battery voltage levels (due to abrasion or inadequate proximity separation).
    - Mitigation: Qualification tested short circuit protection on each external circuit, design of battery packs and insulators such that no contact with nearby board traces is possible without being caused by some other mechanical failure, observation of such other mechanical failures by protoflight level environmental tests (sine burst, random vibration, thermal cycling, and thermal).
    - Combined faults required for realized failure: An external load must fail/short-circuit AND external over-current detection AND disconnect function must all occur to enable this failure mode.

- Failure Mode 4: Inoperable vents
    - Mitigation: Battery venting is not inhibited by the battery holder design or the spacecraft design. The battery pack is not hermetically sealed and can vent gases to the external environment.
    - Combined faults required for realized failure: The spacecraft design fails to provide proper venting orifices.

- Failure Mode 5: Crushing
    - Mitigation: There are no moving parts in the proximity of the batteries and are mounted internally to each subsystem using bracket fixtures which prevent batteries from moving.
    - Combined faults required for realized failure: A catastrophic failure must occur in an external system AND the failure must cause a collision sufficient to crush the batteries AND the satellite must be in a naturally sustained orbit at the time the crushing occurs.

- Failure Mode 6: Low level current leakage or short-circuit through battery pack case or due to moisture-based degradation of insulators.
    - Mitigation: Battery holder/case design made of non-conductive plastic, tested, and operated in vacuum such that no moisture can affect insulators.
    - Combined faults required for realized failure: Abrasion or piercing of circuit board coating or wire insulators AND dislocation of battery packs AND failure of battery terminal insulators AND failure to detect such failures during environmental test must occur to result in this failure mode.

- Failure Mode 7: Excess temperatures due to orbital environment and high discharge combined.
    - Mitigation: Thermal rise has been analyzed in combination with space environment temperatures showing that batteries do not exceed normal allowable operating temperatures under a variety of modeled cases, including worst case orbital scenarios. Analysis shows these temperatures to be well below temperatures of concern for explosions.
    - Combined faults required for realized failure: Thermal analysis AND thermal design AND thermal chamber testing AND over-current monitoring and control must all fail for this failure mode to occur.

### 4.6.2 Requirement 4.4-2

"Design of all spacecraft and launch vehicle orbital stages shall include the ability and a plan to either 1) 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 2) control to a level which cannot cause an explosion or deflagration large enough to release orbital debris or break up the spacecraft. The design of depletion burn and venting should minimize the probability of accidental collision with tracked objects in space."

**Compliance Statement** The spacecraft includes the ability to fully disconnect the Lithium Ion cells from the charging current of the solar arrays. Once the satellite reaches its End of Life (EOL), this feature will be used to completely passivate the batteries by removing all energy from them. 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, the 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.

### 4.6.3 Requirement 4.4-3

"Limiting the long-term risk to other space systems from planned breakups for Earth and lunar missions. Planned explosions or intentional collisions shall: Be conducted at an altitude such that for orbital debris fragments larger than 10 cm the object-time product is less than 100 object-years. For example, if the debris fragments greater than 10 cm decay in the maximum allowed 1 year, a maximum of 100 such fragments can be generated by the breakup. Not generate debris larger than 1 mm that remains in Earth orbit longer than one year."

**Compliance Statement** No planned breakups, explosions or intentional collisions are planned for this mission.

### 4.6.4 Requirement 4.4-4

"Limiting the short-term risk to other space systems from planned breakups for Earth orbital missions: Immediately before a planned explosion or intentional collision, the probability of debris, orbital or ballistic, larger than 1 mm colliding with any operating spacecraft within 24 hours of the breakup shall be less than 10-6."

**Compliance Statement** No planned breakups, explosions or intentional collisions are planned for this mission.

# 5 Assessment of Spacecraft Potential for On-Orbit Collisions

## 5.1 Assessment of Compliance with Requirement 4.5-1 and 4.5-2

### 5.1.1 Requirement 4.5-1

"Limiting debris generated by collisions with large objects when in Earth orbit: For each spacecraft and launch vehicle orbital stage, 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. For the purpose of this assessment, 100 years is used as the maximum orbital lifetime for the storage disposal option."

**Compliance Statement**

- Status: Compliant
- Probability: 1.1689E-05

### 5.1.2 Requirement 4.5-2

"Limiting debris generated by collisions with small objects when operating in Earth 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 post mission disposal maneuver requirements is less than 0.01."

**Compliance Statement**

- Status: Compliant

# 6 Assessment of Spacecraft Post mission Disposal Plans and Procedures

## 6.1 Description of Spacecraft Disposal Option Selected

The satellite will de-orbit naturally by atmospheric re-entry.

## 6.2 Plan for any spacecraft maneuvers required to accomplish post- mission disposal

No spacecraft maneuvers are baselined for post mission disposal.

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

- Spacecraft Mass: 68.7 Kg (CBE)
  - Current best estimate plus margin is used to assess reentry criteria giving a lower area to mass ratio which in turn increases the orbit dwell time.

- Cross-sectional Area: 0.5948 m2 (Tumbling)
  - The average cross-sectional area for the analysis was calculated using the NASA-STD-871814C guidelines. The scenario was assessed in a random tumble where the spacecraft attitude is variable.

- Area to mass ratio: 0.008658 m2/kg

## 6.4 Assessment of Compliance with Requirement 4.6-1 Through 4.6-4

### 6.4.1 Requirement 4.6-1

"A spacecraft or orbital stage with a perigee altitude below 2,000 km shall be disposed of by one of the following three methods:"

- 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; or maneuver the space structure into a controlled de-orbit trajectory as soon as practical after completion of mission
- Storage orbit option: Maneuver the space structure into an orbit with perigee altitude above 2000km and ensure its apogee altitude will be below 19,700 km, both for a minimum of 100 years

- Direct retrieval: Retrieve the space structure and remove it from orbit within 10 years after completion of mission

**Compliance Statement** The orbit lifetime was assessed using NASA's DAS Orbit Evolution Analysis Tool. The estimated time for orbital reentry, based on the spacecraft parameters outlined in Section 6.3, is approximately 8 years after the spacecraft gets deployed into orbit. Figure 2 illustrates the evolution of the orbit's apogee and perigee over time. The calculated dwell time satisfies the post-mission requirement, remaining within the 5-year limit following the 3-year operational phase. If need be, the on-board propulsions system will also be available to accelerate the de-orbit process.

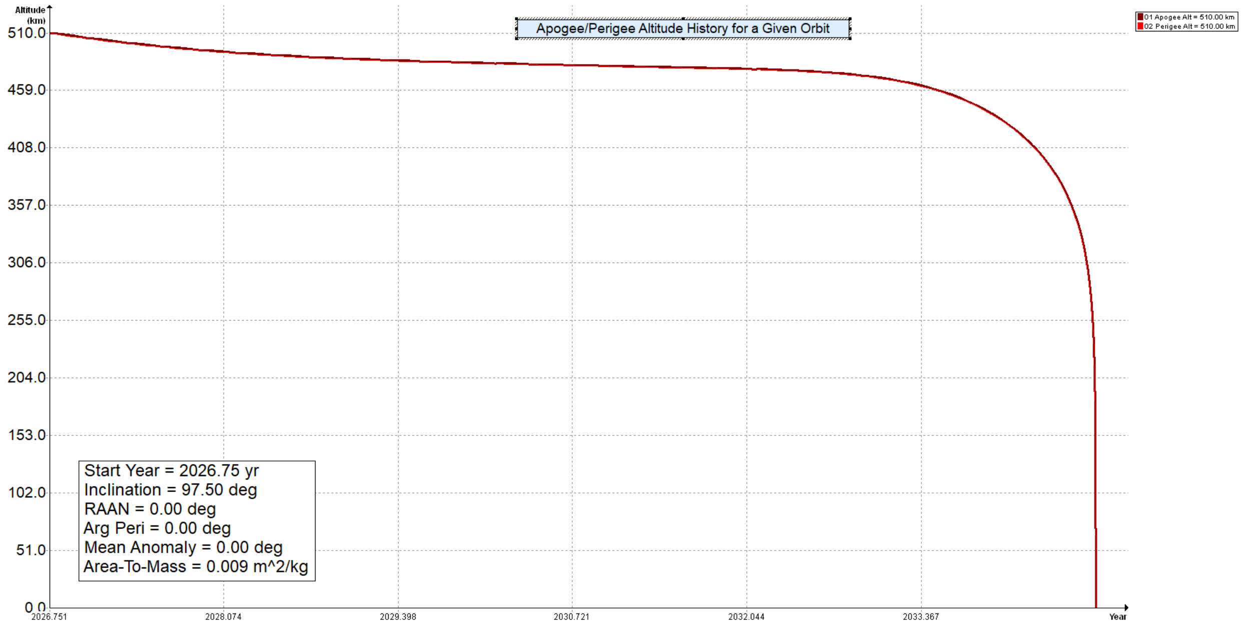


*Figure 2: Apogee/Perigee Altitude History*

Reliability of passive deorbit has been validated through different missions in which the accuracy of the orbit's dwell time has a small variation of a couple of months. It's worth nothing that DAS utilizes a constant solar flux condition of F10.7 which functions as a conservative estimate derived from the Solar Flux sigma level.

### 6.4.2 Requirement 4.6-2

"Storage and Earth escape shall comply with the following:"

- Storage between LEO and GEO:
  - Maneuver to a highly eccentric disposal orbit (e.g., GEO transfer orbit) where (i) perigee altitude remains above 2000 km for at least 100 years, (ii) apogee altitude remains below 35,586 km for at least 100 years, and (iii) the time spent by the space structure between 20,182 +/- 300 km is limited to 25 years or less over 200 years; or,
  - Maneuver to a near-circular disposal orbit to (i) avoid crossing 20,182 +/- 300 km, the GEO zone, and the LEO zone for at least 100 years, and (ii) limit the risk to other operational constellations, for example, by avoiding crossing the altitudes occupied by known missions of 10 or more spacecraft using near-circular orbits, for 100 years.
- Storage above GEO: Maneuver to a disposal orbit above GEO with a predicted minimum perigee altitude of 35,986 km for a period of at least 100 years after disposal.
- Earth escape: Maneuver to a heliocentric, Earth-escape trajectory

**Compliance Statement** The spacecraft is planned for natural reentry and no storage is being baselined.

### 6.4.3 Requirement 4.6-3

Requirement 4.6-3. Long-term reentry for space structures in Medium Earth Orbit (MEO), Tundra orbits, highly inclined GEO, and other orbits shall:

- Maneuver to a disposal orbit where orbital resonances will increase the eccentricity for long-term reentry of the space structure,
- Limit the post mission orbital lifetime to as short as practicable but no more than 200 years,
- Limit the time spent by the space structure in the LEO zone, the GEO zone, and between 20,182 +/- 300 km to 25 years or less per zone, and
- Limit the probability of collisions with debris 10 cm and larger to less than 0.001 (1 in 1,000) during orbital lifetime.

**Compliance Statement** Spacecraft will not operate in any other region that is not LEO.

### 6.4.4 Requirement 4.6-4

"Reliability of post mission disposal maneuver operations in Earth orbit: NASA space programs and projects shall ensure that all post mission disposal operations to meet Requirements 4.6-1, 4.6-2, and 4.6-3 are designed for a probability of success as follows:"

- Be no less than 0.90 at EOM, and
- For controlled reentry, the probability of success at the time of reentry burn must be sufficiently high so as not to cause a violation of Requirement 4.7-1 pertaining to limiting the risk of human casualty.

**Compliance Statement** The spacecraft is planned for natural reentry and no post mission maneuver is being baselined. If need be, Protostar has an on-board propulsion system that can be used to actively de-orbit the vehicle.

# 7 Assessment of Spacecraft Reentry Hazards

Astro Digital's bus is designed for demise in that all material selections are prioritized to have a low melting point and density, such as aluminum, where materials known to survive re-entry, such as tungsten or titanium, are avoided. The spacecraft is based on Astro Digital heritage designs as submitted and approved in prior ODAR filings.

## 7.1 Assessment of Compliance with Requirement 4.7-1

### 7.1.1 Requirement 4.7-1

"The potential for human casualty is assumed for any object with an impacting kinetic energy in excess of 15 joules:"

- For uncontrolled reentry, the risk of human casualty from surviving debris shall not exceed 0.0001(1:10,000)
- 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
- For controlled reentries, the product of the probability of failure to execute the reentry burn and the risk of human casualty assuming uncontrolled reentry shall not exceed 0.0001 (1:10,000)

**Compliance Statement** DAS calculates the risk of human casualty to 0 complying with the limit of the risk of human casualty requirement. All components are listed in detail in the full DAS results, as shown in appendix A.

# 8 Assessment for Special Classes of Space Missions

"Special classes of space missions: Special classes of space missions, including large constellations; rendezvous, proximity operations, and satellite servicing; safety of active debris removal operations; tethers; and small satellites, shall comply with the requirements in Sections 4.3 through 4.7."

**Compliance Statement** Mission does not fall into any of the special classes described in the requirements.

# Appendix A: DAS Output Log

02 19 2026; 16:11:53PM	Activity Log Started
02 19 2026; 16:11:54PM	Opened Project C:\Users\GavinBuck\OneDrive - Astro Digital US\Documents\Programs\Etoniah\De-Orbit\
02 19 2026; 16:12:16PM	Mission Editor Changes Applied
02 19 2026; 16:12:16PM	Project Data Saved To File
02 19 2026; 16:12:16PM	Project Data Saved To File
02 19 2026; 16:12:19PM	Processing Requirement 4.3-1:   Return Status :  Not Run

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

=============== End of Requirement 4.3-1 ===============
02 19 2026; 16:12:21PM	Processing Requirement 4.3-2: Return Status : Passed

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

=============== End of Requirement 4.3-2 ===============
02 19 2026; 16:16:19PM	Processing Requirement 4.5-1:   Return Status :  Passed

==============
Run Data
==============

**INPUT**

Space Structure Name = StarCatcher
Space Structure Type = Payload
Perigee Altitude = 510.000 (km)
Apogee Altitude = 510.000 (km)
Inclination = 97.500 (deg)
RAAN = 0.000 (deg)
Argument of Perigee = 0.000 (deg)
Mean Anomaly = 0.000 (deg)
Final Area-To-Mass Ratio = 0.0087 (m^2/kg)
Start Year = 2026.751 (yr)
Initial Mass = 68.950 (kg)
Final Mass = 68.700 (kg)
Duration = 3.000 (yr)
Station-Kept = False
Abandoned = True
Long-Term Reentry = False

**OUTPUT**

Collision Probability = 1.1689E-05
Returned Message: Normal Processing
Date Range Message: Normal Date Range
Status = Pass

==============

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

02 19 2026; 16:16:21PM Project Data Saved To File
02 19 2026; 16:16:26PM Requirement 4.5-2: Compliant

=============== End of Requirement 4.5-2 ===============

02 19 2026; 16:16:27PM Processing Requirement 4.6 Return Status : Passed

==============
Project Data
==============

**INPUT**

Space Structure Name = StarCatcher
Space Structure Type = Payload

Perigee Altitude = 510.000000 (km)
Apogee Altitude = 510.000000 (km)
Inclination = 97.500000 (deg)
RAAN = 0.000000 (deg)
Argument of Perigee = 0.000000 (deg)
Mean Anomaly = 0.000000 (deg)
Area-To-Mass Ratio = 0.008658 (m^2/kg)
Start Year = 2026.751000 (yr)
Initial Mass = 68.950000 (kg)
Final Mass = 68.700000 (kg)
Duration = 3.000000 (yr)
Station Kept = False
Abandoned = True
PMD Perigee Altitude = 483.665319 (km)
PMD Apogee Altitude = 484.592402 (km)
PMD Inclination = 97.470490 (deg)
PMD RAAN = 10.896774 (deg)
PMD Argument of Perigee = 149.534481 (deg)
PMD Mean Anomaly = 0.000000 (deg)
Long-Term Reentry = False

**OUTPUT**

Suggested Perigee Altitude = 483.665319 (km)
Suggested Apogee Altitude = 484.592402 (km)
Returned Error Message = Passes LEO reentry orbit criteria.

Released Year = 2034 (yr)
Requirement = 61
Compliance Status = Pass

==============

=============== End of Requirement 4.6 ===============
02 19 2026; 16:16:33PM *********Processing Requirement 4.7-1
Return Status : Passed

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

name = StarCatcher
quantity = 1
parent = 0
materialID = 8
type = Box
Aero Mass = 68.699997
Thermal Mass = 68.699997
Diameter/Width = 0.370000
Length = 0.630000
Height = 0.370000

name = Structural Corner Rails
quantity = 4
parent = 1
materialID = 8
type = Box
Aero Mass = 0.230000
Thermal Mass = 0.230000
Diameter/Width = 0.013000
Length = 0.610000
Height = 0.013000

name = pX Structural Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 2.790000
Thermal Mass = 1.690000
Diameter/Width = 0.370000

Length = 0.370000
Height = 0.008000

name = Epson IMU
quantity = 2
parent = 3
materialID = 8
type = Box
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.036000
Length = 0.045000
Height = 0.020000

name = Star Tracker Bracket
quantity = 1
parent = 3
materialID = 8
type = Box
Aero Mass = 0.230000
Thermal Mass = 0.230000
Diameter/Width = 0.072000
Length = 0.084000
Height = 0.057000

name = Star Trackers
quantity = 2
parent = 3
materialID = 8
type = Cylinder
Aero Mass = 0.330000
Thermal Mass = 0.330000
Diameter/Width = 0.060000
Length = 0.096000

name = PL Retroflector System
quantity = 1
parent = 3
materialID = 8
type = Box
Aero Mass = 0.090000
Thermal Mass = 0.090000
Diameter/Width = 0.040000
Length = 0.057800
Height = 0.036700

name = mX Structural Panel
quantity = 1

parent = 1
materialID = 8
type = Box
Aero Mass = 14.330000
Thermal Mass = 3.500000
Diameter/Width = 0.390000
Length = 0.390000
Height = 0.018000

name = DPM
quantity = 1
parent = 8
materialID = 8
type = Box
Aero Mass = 5.350000
Thermal Mass = 2.810000
Diameter/Width = 0.152000
Length = 0.240000
Height = 0.090000

name = DPM Structure
quantity = 1
parent = 9
materialID = 8
type = Box
Aero Mass = 0.620000
Thermal Mass = 0.620000
Diameter/Width = 0.152000
Length = 0.240000
Height = 0.090000

name = DPM Backplane
quantity = 1
parent = 9
materialID = 23
type = Flat Plate
Aero Mass = 0.220000
Thermal Mass = 0.220000
Diameter/Width = 0.150000
Length = 0.220000

name = Battery Module
quantity = 2
parent = 9
materialID = 8
type = Box
Aero Mass = 0.430000
Thermal Mass = 0.430000

Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = Flight Computer
quantity = 1
parent = 9
materialID = 8
type = Box
Aero Mass = 0.130000
Thermal Mass = 0.130000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = Power Board
quantity = 2
parent = 9
materialID = 8
type = Box
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = Charging Board
quantity = 1
parent = 9
materialID = 8
type = Box
Aero Mass = 0.130000
Thermal Mass = 0.130000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = Flexible I/O
quantity = 1
parent = 9
materialID = 8
type = Box
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = TURVA Module
quantity = 2
parent = 9
materialID = 8
type = Box
Aero Mass = 0.110000
Thermal Mass = 0.110000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = GPS Module
quantity = 1
parent = 8
materialID = 8
type = Box
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = ACM
quantity = 1
parent = 8
materialID = 8
type = Box
Aero Mass = 2.830000
Thermal Mass = 1.430000
Diameter/Width = 0.120000
Length = 0.121000
Height = 0.088000

name = ACM Structure
quantity = 1
parent = 19
materialID = 8
type = Box
Aero Mass = 0.490000
Thermal Mass = 0.490000
Diameter/Width = 0.120000
Length = 0.121000
Height = 0.088000

name = Reaction Wheel (60cNms)
quantity = 3
parent = 19
materialID = 54

type = Cylinder
Aero Mass = 0.240000
Thermal Mass = 0.240000
Diameter/Width = 0.063000
Length = 0.025000

name = Reaction Wheel Covers
quantity = 3
parent = 19
materialID = 8
type = Box
Aero Mass = 0.050000
Thermal Mass = 0.050000
Diameter/Width = 0.082000
Length = 0.086000
Height = 0.018000

name = RWPDB
quantity = 1
parent = 19
materialID = 8
type = Flat Plate
Aero Mass = 0.040000
Thermal Mass = 0.040000
Diameter/Width = 0.052000
Length = 0.072000

name = XPU
quantity = 1
parent = 8
materialID = 8
type = Box
Aero Mass = 1.280000
Thermal Mass = 0.680000
Diameter/Width = 0.091000
Length = 0.110000
Height = 0.070000

name = XPU Structure
quantity = 1
parent = 24
materialID = 8
type = Box
Aero Mass = 0.320000
Thermal Mass = 0.320000
Diameter/Width = 0.100000
Length = 0.120000
Height = 0.090000

name = XPU Backplane
quantity = 1
parent = 24
materialID = 23
type = Flat Plate
Aero Mass = 0.020000
Thermal Mass = 0.020000
Diameter/Width = 0.100000
Length = 0.120000

name = XPU PCB_1
quantity = 1
parent = 24
materialID = 8
type = Box
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = XPU PCB_2
quantity = 1
parent = 24
materialID = 8
type = Box
Aero Mass = 0.140000
Thermal Mass = 0.140000
Diameter/Width = 0.700000
Length = 0.800000
Height = 0.010000

name = UHF Antenna
quantity = 2
parent = 8
materialID = 8
type = Box
Aero Mass = 0.120000
Thermal Mass = 0.120000
Diameter/Width = 0.033000
Length = 0.060000
Height = 0.030000

name = Prop System (ThrustMe)
quantity = 1
parent = 8
materialID = 8

type = Box
Aero Mass = 1.010000
Thermal Mass = 1.010000
Diameter/Width = 0.090000
Length = 0.096800
Height = 0.090000

name = pY Structural Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 10.660000
Thermal Mass = 2.160000
Diameter/Width = 0.370000
Length = 0.630000
Height = 0.010000

name = Torque Rod
quantity = 2
parent = 31
materialID = 19
type = Cylinder
Aero Mass = 0.500000
Thermal Mass = 0.500000
Diameter/Width = 0.017300
Length = 0.300000

name = TCB
quantity = 1
parent = 31
materialID = 8
type = Box
Aero Mass = 0.050000
Thermal Mass = 0.050000
Diameter/Width = 0.053000
Length = 0.073000
Height = 0.012000

name = DEP
quantity = 2
parent = 31
materialID = 8
type = Box
Aero Mass = 3.370000
Thermal Mass = 0.310000
Diameter/Width = 0.123000
Length = 0.265000

Height = 0.075000

name = DEP Structure
quantity = 2
parent = 34
materialID = 8
type = Box
Aero Mass = 1.480000
Thermal Mass = 1.480000
Diameter/Width = 0.123000
Length = 0.265000
Height = 0.075000

name = Battery Bracket
quantity = 4
parent = 34
materialID = 8
type = Box
Aero Mass = 0.090000
Thermal Mass = 0.090000
Diameter/Width = 0.080000
Length = 0.200000
Height = 0.010000

name = BMS Board
quantity = 2
parent = 34
materialID = 23
type = Flat Plate
Aero Mass = 0.180000
Thermal Mass = 0.180000
Diameter/Width = 0.100000
Length = 0.170000

name = DEP Board
quantity = 2
parent = 34
materialID = 23
type = Flat Plate
Aero Mass = 0.100000
Thermal Mass = 0.100000
Diameter/Width = 0.100000
Length = 0.150000

name = 21700 Cells
quantity = 32
parent = 34
materialID = 8

type = Cylinder
Aero Mass = 0.070000
Thermal Mass = 0.070000
Diameter/Width = 0.020000
Length = 0.100000

name = Body Mounted Solar Array
quantity = 1
parent = 31
materialID = 8
type = Flat Plate
Aero Mass = 0.590000
Thermal Mass = 0.590000
Diameter/Width = 0.345000
Length = 0.515000

name = GPS Antenna
quantity = 1
parent = 31
materialID = 8
type = Box
Aero Mass = 0.040000
Thermal Mass = 0.040000
Diameter/Width = 0.038000
Length = 0.038000
Height = 0.012000

name = S-Rx Patch
quantity = 2
parent = 31
materialID = 8
type = Box
Aero Mass = 0.040000
Thermal Mass = 0.040000
Diameter/Width = 0.040000
Length = 0.060000
Height = 0.007500

name = mY Structural Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 19.180000
Thermal Mass = 2.290000
Diameter/Width = 0.370000
Length = 0.630000
Height = 0.010000

name = PL Laser Module Thermal Sink
quantity = 1
parent = 43
materialID = 19
type = Box
Aero Mass = 15.000000
Thermal Mass = 12.000000
Diameter/Width = 0.260000
Length = 0.402000
Height = 0.013000

name = PL Laser Module
quantity = 2
parent = 44
materialID = 8
type = Box
Aero Mass = 1.500000
Thermal Mass = 1.500000
Diameter/Width = 0.170000
Length = 0.230000
Height = 0.029000

name = S-Rx Patch(1)
quantity = 3
parent = 43
materialID = 8
type = Box
Aero Mass = 0.040000
Thermal Mass = 0.040000
Diameter/Width = 0.040000
Length = 0.060000
Height = 0.007500

name = X-Band Antenna
quantity = 1
parent = 43
materialID = 8
type = Cylinder
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.035000
Length = 0.013000

name = PL CubeSat Deployer
quantity = 1
parent = 43
materialID = 8

type = Box
Aero Mass = 1.740000
Thermal Mass = 1.740000
Diameter/Width = 0.198000
Length = 0.200000
Height = 0.139000

name = pZ Structural Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 7.810000
Thermal Mass = 2.170000
Diameter/Width = 0.370000
Length = 0.630000
Height = 0.010000

name = PL Tracking System
quantity = 1
parent = 49
materialID = 8
type = Box
Aero Mass = 1.750000
Thermal Mass = 1.750000
Diameter/Width = 0.146000
Length = 0.176000
Height = 0.096000

name = PL Transmission System
quantity = 1
parent = 49
materialID = 8
type = Box
Aero Mass = 1.430000
Thermal Mass = 1.340000
Diameter/Width = 0.120000
Length = 0.205000
Height = 0.086000

name = Flexure Mounts
quantity = 3
parent = 51
materialID = 66
type = Box
Aero Mass = 0.030000
Thermal Mass = 0.030000
Diameter/Width = 0.048000

Length = 0.060000
Height = 0.033000

name = Torque Rod(1)
quantity = 1
parent = 49
materialID = 19
type = Cylinder
Aero Mass = 0.500000
Thermal Mass = 0.500000
Diameter/Width = 0.017300
Length = 0.300000

name = Deployable Solar Array
quantity = 1
parent = 49
materialID = 23
type = Flat Plate
Aero Mass = 1.730000
Thermal Mass = 1.730000
Diameter/Width = 0.344000
Length = 0.600000

name = Keep Alive Panel
quantity = 1
parent = 49
materialID = 23
type = Flat Plate
Aero Mass = 0.230000
Thermal Mass = 0.230000
Diameter/Width = 0.266000
Length = 0.270000

name = mZ Structural Panel
quantity = 1
parent = 1
materialID = 8
type = Box
Aero Mass = 10.910000
Thermal Mass = 2.150000
Diameter/Width = 0.370000
Length = 0.630000
Height = 0.010000

name = XCOMM
quantity = 1
parent = 56
materialID = 8

type = Box
Aero Mass = 4.820000
Thermal Mass = 2.410000
Diameter/Width = 0.152000
Length = 0.168000
Height = 0.130000

name = XCOM Structure
quantity = 1
parent = 57
materialID = 8
type = Box
Aero Mass = 1.110000
Thermal Mass = 1.110000
Diameter/Width = 0.123000
Length = 0.143000
Height = 0.118000

name = XCOM Backplane
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.060000
Thermal Mass = 0.060000
Diameter/Width = 0.097000
Length = 0.112000
Height = 0.020000

name = XCOM PCB_1
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.320000
Thermal Mass = 0.320000
Diameter/Width = 0.100000
Length = 0.119000
Height = 0.015000

name = XCOM PCB_2
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.260000
Thermal Mass = 0.260000
Diameter/Width = 0.100000

Length = 0.119000
Height = 0.024000

name = XCOM PCB_3
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.160000
Thermal Mass = 0.160000
Diameter/Width = 0.100000
Length = 0.119000
Height = 0.015000

name = XCOM PCB_4
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.180000
Thermal Mass = 0.180000
Diameter/Width = 0.100000
Length = 0.119000
Height = 0.015000

name = XCOM PCB_5
quantity = 1
parent = 57
materialID = 23
type = Box
Aero Mass = 0.170000
Thermal Mass = 0.170000
Diameter/Width = 0.100000
Length = 0.119000
Height = 0.023000

name = XCOM UPCONV
quantity = 1
parent = 57
materialID = 8
type = Box
Aero Mass = 0.150000
Thermal Mass = 0.150000
Diameter/Width = 0.060000
Length = 0.150000
Height = 0.010000

name = X-Band HPA

quantity = 1
parent = 56
materialID = 54
type = Box
Aero Mass = 0.220000
Thermal Mass = 0.220000
Diameter/Width = 0.050000
Length = 0.070000
Height = 0.016000

name = PL Avionics
quantity = 1
parent = 56
materialID = 8
type = Box
Aero Mass = 1.760000
Thermal Mass = 1.760000
Diameter/Width = 0.183000
Length = 0.257000
Height = 0.030000

name = Deployable Solar Array(1)
quantity = 1
parent = 56
materialID = 23
type = Flat Plate
Aero Mass = 1.730000
Thermal Mass = 1.730000
Diameter/Width = 0.344000
Length = 0.600000

name = Keep Alive Panel(1)
quantity = 1
parent = 56
materialID = 23
type = Flat Plate
Aero Mass = 0.230000
Thermal Mass = 0.230000
Diameter/Width = 0.266000
Length = 0.270000

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

name = StarCatcher
Demise Altitude = 77.997614
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Structural Corner Rails
Demise Altitude = 77.670043
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = pX Structural Panel
Demise Altitude = 77.192909
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Epson IMU
Demise Altitude = 76.619341
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Star Tracker Bracket
Demise Altitude = 76.562993
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Star Trackers
Demise Altitude = 75.806831
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Retroflector System
Demise Altitude = 76.698008
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = mX Structural Panel
Demise Altitude = 76.555794
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = DPM
Demise Altitude = 74.709410
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = DPM Structure
Demise Altitude = 74.291885
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = DPM Backplane
Demise Altitude = 73.952702
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Battery Module
Demise Altitude = 74.646675
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Flight Computer
Demise Altitude = 74.691770
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Power Board
Demise Altitude = 74.692141
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Charging Board
Demise Altitude = 74.691770
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Flexible I/O
Demise Altitude = 74.692141
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = TURVA Module
Demise Altitude = 74.697638
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = GPS Module
Demise Altitude = 76.540226
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = ACM
Demise Altitude = 74.734160
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = ACM Structure
Demise Altitude = 74.100617
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Reaction Wheel (60cNms)
Demise Altitude = 68.673610
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = Reaction Wheel Covers
Demise Altitude = 74.561232
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = RWPDB
Demise Altitude = 74.454920
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = XPU
Demise Altitude = 75.430639
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

*************************************
name = XPU Structure
Demise Altitude = 75.004310
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XPU Backplane
Demise Altitude = 75.329880
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XPU PCB_1
Demise Altitude = 75.414320
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XPU PCB_2
Demise Altitude = 75.408569
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = UHF Antenna
Demise Altitude = 75.869834
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Prop System (ThrustMe)
Demise Altitude = 74.903889
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = pY Structural Panel
Demise Altitude = 77.400927
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Torque Rod
Demise Altitude = 74.273655
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = TCB
Demise Altitude = 77.114959
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = DEP
Demise Altitude = 77.178417
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = DEP Structure
Demise Altitude = 76.084490
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Battery Bracket
Demise Altitude = 77.004700
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = BMS Board
Demise Altitude = 76.166834
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = DEP Board
Demise Altitude = 76.553342
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = 21700 Cells
Demise Altitude = 76.571250
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Body Mounted Solar Array
Demise Altitude = 77.182683
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = GPS Antenna
Demise Altitude = 76.906275
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = S-Rx Patch
Demise Altitude = 77.049332
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = mY Structural Panel
Demise Altitude = 77.367673
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Laser Module Thermal Sink
Demise Altitude = 66.128218
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Laser Module
Demise Altitude = 64.572652
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = S-Rx Patch(1)
Demise Altitude = 77.020635
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = X-Band Antenna
Demise Altitude = 76.699996
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL CubeSat Deployer
Demise Altitude = 76.271749
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = pZ Structural Panel
Demise Altitude = 77.396187
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Tracking System
Demise Altitude = 75.817847
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Transmission System
Demise Altitude = 76.233487
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Flexure Mounts
Demise Altitude = 75.414298
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Torque Rod(1)
Demise Altitude = 74.219968
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Deployable Solar Array
Demise Altitude = 75.722111
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Keep Alive Panel
Demise Altitude = 76.880566
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = mZ Structural Panel
Demise Altitude = 77.400886
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOMM
Demise Altitude = 75.537837
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM Structure
Demise Altitude = 74.455458
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM Backplane
Demise Altitude = 75.148825
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM PCB_1
Demise Altitude = 73.467289
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM PCB_2
Demise Altitude = 74.010223
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM PCB_3
Demise Altitude = 74.501896
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM PCB_4
Demise Altitude = 74.374478
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM PCB_5
Demise Altitude = 74.526627
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = XCOM UPCONV
Demise Altitude = 75.110806
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = X-Band HPA
Demise Altitude = 73.358142
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = PL Avionics
Demise Altitude = 75.922007
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Deployable Solar Array(1)
Demise Altitude = 75.754596
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

************************************
name = Keep Alive Panel(1)
Demise Altitude = 76.895633
Debris Casualty Area = 0.000000
Impact Kinetic Energy = 0.000000

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============== End of Requirement 4.7-1 ===============
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