Titan by TitanX

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Abstract

During this modern space race, there are countless missions in development to further the human knowledge of Titan. Titan X has dedicated its work to developing interplanetary travel to the most Earth-like body within the Solar System. If humans are to find other living organisms within reach, the celestial body must closely resemble Earth that we can search. The journey to Titan is by no means an easy task, our primary and secondary loads will require, we canretty assists from Earth and Venus in order to reach Titan. Once on the surface of Titan, our amphibious rover known as Turtle Z, will endure freezing cold temperatures and a nitrogen-rich atmosphere that makes solar power a hundred times more difficult than on Earth. To control the challenge of solar power, we are planning to install an MMRTG in our payloads to power them for about 15 years. The cold temperatures will pose challenges for the internal electronics, therefore we have proposed insulating Turtle Z with aerogel. With its robotic arm and sonar capabilities, the rover will be able to collect/examine Titan soil, study liquid bodies on the moon. Meanwhile, our CubeSat known as Hare Y, will orbit the moon to provide us with a more detailed topography of Titan.

Mechanical and Structural Systems

Design Requirements and Specifications:
- **Sizing:** less than or equal to 10 ft long, 9 ft wide, & 7 ft tall
  - This ensures that the Turtle will fit the size requirements that the rocket has.
- **Weight:** less than or equal to 900 kg (1984.16 pounds)
  - This ensures that the Turtle will meet the weight requirement that the rocket has.

Production Process
- **Cleanliness:** During the production process, the environment must be clean to avoid contaminants that might skew the results once on the surface of Titan.
- **Testing:** During the production process, the Turtle must be sanitized to ensure that no living organisms might travel with the Turtle on its voyage to Titan.

Functionality
- **Data Processing:** During the production process, testing of each instrument will be required to ensure the functionality of the components.
- **Components:** Each instrument must meet certain qualifications for duration purposes to ensure that the Turtle will work for an extended period while it is on the surface of Titan.
- **Scheduling:** Ensure that each deadline for the production process is met.
- **Power:** Implement extended amounts of "gap" time to ensure that in the event of a setback to the production process the overall deadline will not extend.
- **Weight:** Ensure that the weight of the Turtle does not exceed the maximum weight requirements of the rockets specified loading, also keeping in mind that the weight of the CubeSat will be included in the overall loading of the rocket.

Communication and Payload

There will be four components of telecommunications between Turtle Z and Hare Y. Both Turtle Z and Hare Y will have a radio modem that will have a radio frequency board as well as antennas to ensure effective transmission of radio waves. The purpose of having a radio modem in Turtle Z and Hare Y is to give them a route of communication by sending and receiving digital symbols or "packets" that can consist of 2000 eight bit bytes. These packets can transfer images as well as information regarding the tests performed on Titan. The purpose of having antennas is to make sure there is effective transmission of radio waves between Turtle Z and Hare Y. The specifications of the radio modems and antennas are seen below in the Tables.

Ground Station

The launch vehicle used for this mission will be the Falcon Heavy. Even though the Falcon Heavy has fewer total flights, it has the ideal payload capacity for this mission in comparison to Falcon 9. Falcon Heavy is inspired from Falcon 9; however, it is a heavier lift version of it by utilizing a stronger Falcon 9 first stage and two added Falcon 9 first stages which act as boosters. The vehicle is also partially reusable, which is an added benefit to its choice. The launch site for the vehicle would be the same as the Falcon Heavy in 2018 – Cape Canaveral Space Force Station LC-39A in Brevard County, Florida.

Radioisotope Power System

Our mission's primary and secondary payloads include a rover and CubeSat. Traditionally, rovers such as Mars’ Perseverance rover and CubeSats such as the FireSat use solar panels to generate power. As mentioned above, solar power at Titan is non-existent. To solve this problem, Turtle Z will use an MMRTG. However, since an MMRTG is rather large, our CubeSat, Hare Y, must be powered by another power source. Hare Y will be powered by a radioisotope heater unit-based radioisotope power system (RHURPS). This system is effectively a miniature MMRTG, also utilizing thermoelectric heat to convert it into electricity. The only difference here is the use of radionuclide (r) and use of lithium-iodine batteries. A standard RHURPS is about 2cm by 13.4cm. With this size, a two-unit (2U) CubeSat frame can house the RHURPS, batteries, chargers, and charging cable.

References


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