High G Resistance Nanosatellite: ηSAT-IE

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1. Introduction

The aim of the ηSAT-IE project is to design and build a nanosatellite with mass no greater than 5 kilograms. The proyect is executed by Centro de Investigaciones Aplicadas (CIA) and Universidad Nacional de Cordoba (UNC) together as part of a program managed by the DLR-AS (Deutschen Zentrum Für Luft und Raumfahrt - Institut für Aerodynamik and Strömungstechnik). The Project involves two missions, with two different structural configurations. The first mission consists in a 900 km altitude sun-synchronous orbit whose purpose is data collection from hydro-meteorological autonomous stations or any station that complies with the defined communication protocols[1]. The launch would be done using a electromagnetic rail gun cannon. The second mission is a suborbital flight whose purpose is telemetry data collection and a separation module flight test. The launch would be done using a sounding rocket provided by the Argentinian Air Force.

2. Orbital Mission Configuration

Figure 1 shows the seven modules layout configuration included on the ηSAT-IE for the sun-synchronous orbit mission.

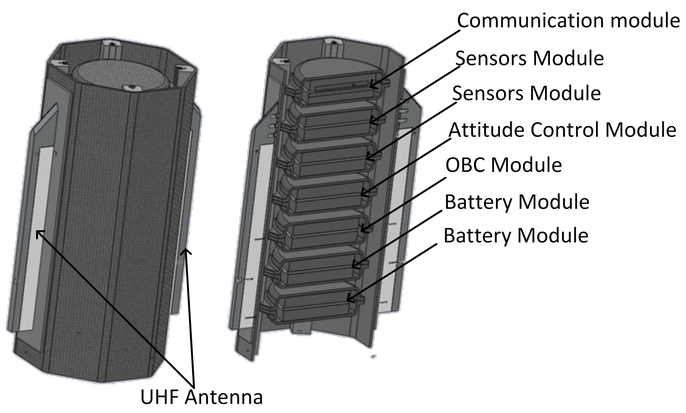

Figure 1: Structural configuration for orbital mission

The attitude control system is composed by magnetic coils to control roll and pitch angles.

3. Sub-orbital Mission Configuration

Figure 2 shows the modules array for the sub-orbital flight mission. A camera will record the trajectory of the flight while the telemetry data is obtained. Polymer ion batteries will be used.

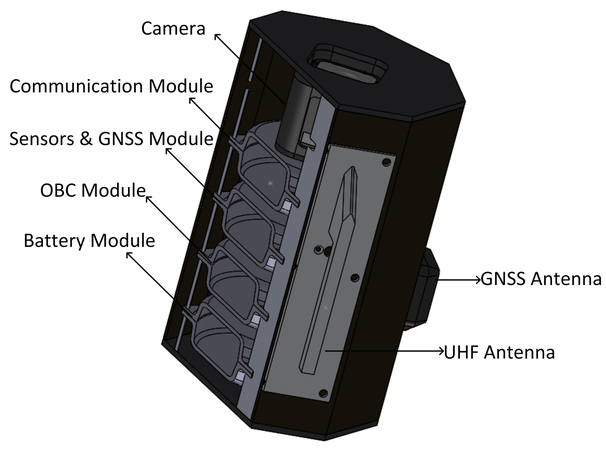

Figure 2: Structural configuration for sub-orbital mission

4. Structure

Low mass requirements demands low density materials for construction, that is why they should be of a high specific stiffness and a high specific resistance. Due to this, the outer structure and the containers are made of carbon fiber and epoxy resin with a high amount of fiber. The containers are formed by two parts glued with epoxy resin, that creates a structural piece where the electronic board is placed within a silicon polymer that buffers the impact during the launch avoiding the failure of the electronic board [2]. Figure 3 shows the different components of ηSat-IE structure.

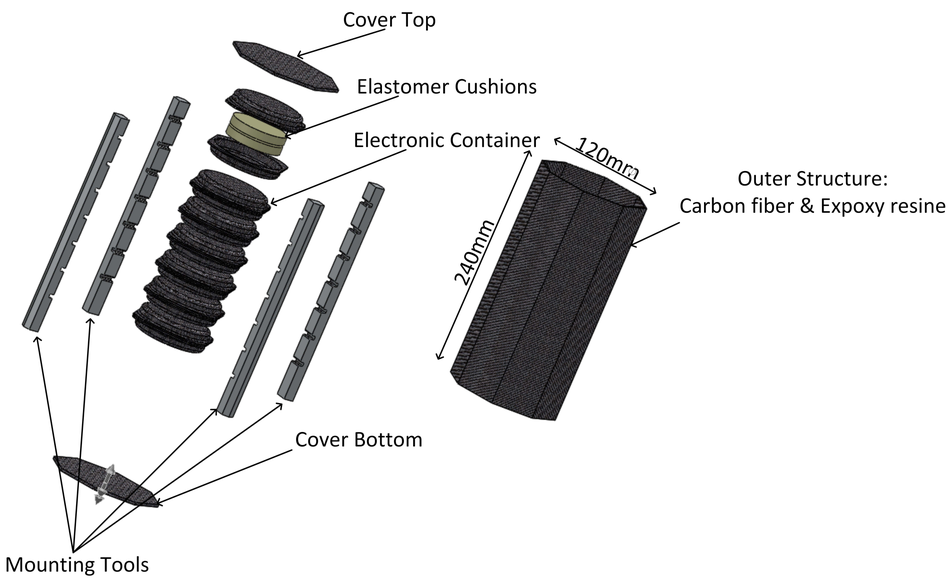

Figure 3: Exploded view of ηSat-IE

5. On Board Computer

In order to select the CPU, energy saving and robustness were prioritized.GNS The main applications of Texas Instruments are the aerospace and automotive industries. It has been chosen the Hercules Cortex-R micro controllers that meets the safety standards: ISO 26262 ASIL-D, IEC 61508 SIL-3 and AECQ100. Figure 4 shows safety architecture of micro controller and the electronic board designed inside the structural container [3].

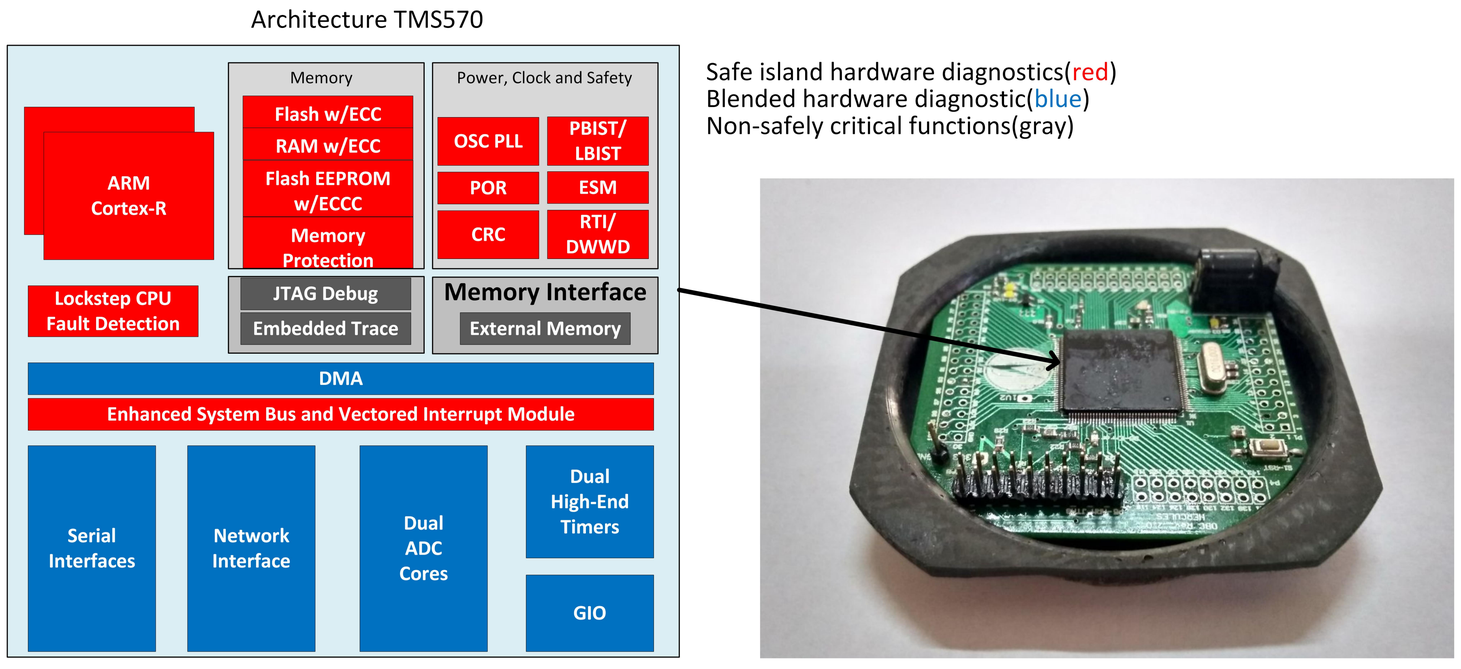

Figure 4: Safety architecture and On Board Computer PCB

6. Conclusions

The results obtained from various simulations (thermal and dynamic analysis with concentrated mass model) shows that the proposed configuration is able to withstand the high accelerations and the high temperatures to which it is subjected. However, care must be taken in the mechanical characterization of the materials as well as of the structure, feeding the theoretical models with these data. We consider that this interaction is a key point that will guarantee the structural integrity of the satellite components, and therefore its mission.

7. References

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