SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Design and Technology for Nano-Sats and Cube-Sats (6B)

Author: Mr. Jasper Bouwmeester
Delft University of Technology (TU Delft), The Netherlands

Mr. Gerard Brouwer
Delft University of Technology (TU Delft), The Netherlands
Dr. Bert Monna
Systematic, The Netherlands
Mr. Jeroen Rotteveel
ISIS - Innovative Solutions In Space B.V., The Netherlands

DESIGN STATUS OF THE DELFI-NEXT NANOSATELLITE PROJECT

Abstract

Delfi-Next is the second project within the Delfi nanosatellite development program of Delft University of Technology. It will provide students hands-on experience, facilitate technology demonstration for innovative miniaturized space technology from the Dutch space sector and allow advancements in satellite bus performance compared to its predecessor Delfi-C3. This paper will describe the mission and provides insight in the design status and trade-offs of each bus subsystem at the end of project phase B.

The electrical power subsystem consists of deployable solar panels, a central power management unit, a battery system and local power regulation units on each printed circuit board. The central power management unit uses redundant maximum power point trackers for each solar panel and distributes and prioritizes the acquired power to a standard system bus on a fixed single supply voltage of 12V, the battery system and a shunt line for excessive power. The single supply voltage is protected and converted locally on each printed circuit board. The communication subsystem consists of two redundant radios transmitting a continuous 1.2-9.6 kbps signal with phase shift keying and non-return-to-zero encoding on a 145 MHz carrier frequency, a receiver and a set of deployable antennae in a turnstile configuration. The downlink is received by a global ground station network consisting of several universities and radio amateurs. Onboard data handling is performed by a hot-redundant onboard computer, which manages and acquires measurement data from local microcontrollers by means of an I2C data bus. The standard implementation of I2C lacks failure tolerance and is therefore supplemented with bus buffers on each local system which can isolate malfunctioning nodes from the main bus. A spacecraft structure optimized for accessibility will provide the basis for all physical subsystems. The structure complies with the outer dimensions of a triple-unit CubeSat. Passive thermal control based on heat sinks and optical properties of surface materials will keep components and subsystems within the required thermal range. Attitude determination and control will be performed by a suite of sensors, actuators and processing algorithms to prove active attitude control functionality as a baseline for future Delfi missions.

The paper will provide insight in the main design details by explaining the mission requirements, design options, interfaces, trade-offs and reliability considerations. It is shown how heritage of the Delfi-C3 missions is implemented by re-using some developed technology and applying lessons learned from the project and in-orbit results.