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FLIGHT RESULTS AND LESSONS LEARNT FROM THE DELFI-N3XT ELECTRICAL POWER SUBSYSTEM OPERATIONS

Abstract

Delfi-n3Xt is the second nanosatellite of the Delft University of Technology, developed by students and staff in cooperation with industry and research partners. It was successfully injected into orbit on November 21st, 2013. The Electrical Power Subsystem (EPS) is analysed during its commissioning phase and first months of operations to verify the predicted performance and identify the lessons learnt from operations.

Delfi-n3Xt EPS is composed by 4 double-sided deployable solar panels; 4 Li-ion rechargeable batteries; and 3 PCBs for maximum power point tracking, power control and regulation, and battery management. The electronics where developed by SistematIC and the solar panels where assemble by Dutch Space, in cooperation with TU Delft.

The analysis of flight results is based upon spacecraft telemetry received at Delft Ground Station as well as radio amateurs ground stations distributed worldwide. Using the housekeeping data, several aspects related to the EPS have been studied and are dealt in detail in this paper. Aspects compared and analysed are: predicted subsystems power consumption vs in-orbit measures; predicted incoming solar power and measured one; and EPS functionality and robustness based on design an in-orbit results.

The key findings from the EPS analysis are:

- The power budget predictions are in line with the in-orbit results. Both for incoming power on the solar arrays and consumed power on the bus.
- A critical range of rotation rates of the satellite have been identified in which the EPS cannot effectively retrieve the maximum power available. An operational approach was developed which is able to handle these particular cases.
- The satellite autonomously and reliably detects eclipse and switches to a low power operational mode.
- The overall power efficiency of the entire EPS from solar cells to bus is 63
- The batteries are fully charged during nominal operations and can handle peak loads exceeding 13 Watts required by the micropropulsion system.

Based on the results of the analysis, the lessons learned are that: the EPS is fully functional after a few months operations and will contribute to the missions success of this and future missions. Also that it is required to solve the critical rotation rate problem and to increase the overall efficiency of the EPS.

These will be implemented on the design of the DelFFi mission, successor of Delfi-n3Xt to be launched on 2016 with QB50 constellation, and other relevant projects.