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QUALIFICATION OF A GPS ANTENNA AND LOW NOISE AMPLIFIER SETUP FOR TEMPERATURES UP TO 120C

Abstract

The small satellite Flying Laptop currently built at the Institute of Space Systems, University of Stuttgart, is equipped with three Phoenix GPS receivers developed by DLR/GSOC, Germany. Each receiver is connected to its own low noise amplifier (LNA) and passive GPS antenna. The LNAs are also developed by DLR/GSOC while the antenna is a COTS part from Sensor Systems, Inc. This setup was already flown on PROBA-2.

The antennas are located on top of a body mounted solar panel; the LNAs are close to the antennas on the backside. Thermal simulations show that the antennas as well as the LNAs can reach temperatures up to 110 °C in orbit. In contrast the maximum specified operating temperatures of both equipments are 85°C. The separation of LNAs and antennas would increase the noise floor. For that reason the LNA and antenna are qualified for the predicted temperature of 110 °C with additional 10K as a margin commonly used in thermal qualification of components.

All tests were performed in the Institute's own thermal-vacuum chamber to simulate the thermal space environment. Both LNA and antenna were mounted on a temperature controlled copper plate and are connected to the test equipment outside the chamber. Three different test scenarios were developed to test the functionality of the LNA and antenna at high temperatures.

The first scenario aimed to test the survival of the LNA and antenna measuring the LNAs amplification and the antennas voltage standing wave ratio (VSWR). Beginning at 80°C the temperature was raised stepwise by 5°C up to 120°C. At every temperature ten amplification and VSWR measurements as a function of the frequency were taken.

The second test scenario aimed for the long time survival of the LNA and antenna. For the first test the temperature was set for 18hrs to 115C. The second test included thermal cycling with a maximum temperature of 115°C and a minimum of -40°C. Nine cycles were completed.

The third test scenario will test the noise performance of the LNA as well as the accurate operation of the whole receiver chain. For this purpose the noise figure is measured and the proper operation is tested with a real Phoenix GPS receiver board connected over the LNA to a GPS signal simulator.

In this paper the successful results of the tests are presented and evaluated.