Paper ID: 16910
oral
student

20th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Nano/Pico Platforms (6B)

Author: Mr. Kehinde Ogunyanda
Cape Peninsula University of Technology (CPUT), South Africa, ogunyanda@gmail.com

Prof. Robert Van Zyl
Cape Peninsula University of Technology (CPUT), South Africa, vanzylr@cput.ac.za
Dr. Wilfred Fritz
Cape Peninsula University of Technology (CPUT), South Africa, FritzW@cput.ac.za

EVALUATION OF A COMMERCIAL-OFF-THE-SHELF SQUID MAGNETOMETER FOR NANOSATELLITE SPACE WEATHER MISSIONS

Abstract

SQUID magnetometers outperform other magnetometer technologies in terms of precision and sensitivity, and are, therefore, very attractive for the implementation of space weather missions. The inability, however, to provide sufficient active cryogenic cooling for high temperature superconducting (HTS) materials, poses a fundamental challenge to their implementation on nanosatellite platforms, where size and power constraints are inhibitive. Preliminary research work has been done to model and simulate a lightweight passive cooling system that can achieve the cryogenic temperature needed for operating such an HTS sensor. The cooler constitutes four stages of radiators, which radiate heat into deep space, and prevent incoming heat from both the Earth and the Sun. The largest radiator is 100 mm in diameter. A deployment boom puts the sensor at some distance from the satellite structure, thereby mitigating magnetic contamination emanating from the satellite. A cooling power of 18 mW, at a cryogenic temperature of 78 K, is attainable from this cooling system in a 600 km Sun synchronous LEO orbit. A commercial-off-the-shelf (COTS) M1000 SQUID magnetometer, fabricated from a layer of YBa2Cu3O7 (YBCO) on a n FR4 button-shaped PCB, can effectively operate under this temperature. Space qualification tests are required for this COTS sensor before it can be recommended for space applications. The effect of radiation on the superconducting material was of primary concern. The sensor was subjected to a total ionising dosage (TID) of 50 Gy, using a teletherapy machine to generate the irradiation of Gamma rays. This proved destructive, as confirmed from the anomalies observed in the its behaviour after the radiation test. Radiation screening of the sensor is, therefore, required.