Geophysical Research Abstracts
Vol. 14, EGU2012-2058-1, 2012
EGU General Assembly 2012

Radiation test of AMR sensors for MetNet Mars Precursor Mission

R. Sanz, A. B. Fernandez, J.A. Dominguez, B. Martin, and M. Díaz-Michelena
Space Programs & Space Sciences Dept., INTA, Spain.

The MetNet Mars Precursor Mission (MMPM) to Mars is supposed to be the first penetrator-based on ground meteorological station of a net over the Martian surface. MMPM will have very limited communications, power, and mass and lander and instrumentation will have to stand a huge mechanical shock, extremely low temperatures with huge temperature excursions and a radiation envelope of 15 krad. One of the instruments on board the MMPM is vector magnetometer, which main goal is to register the thermomangetic curves of the crustal magnetic minerals [1]. The instrument is based on Anisotropic MagnetoResistive (AMR) Commercial Off-The-Shelf (COTS) sensors due to the miniaturization objective and the successful previous experience in geomagnetic surveys [2, 3], achieving a whole mass of 65 g with a good trade off of magnetic performance (resolution levels in the order of the nT).
This work reports on the magnetic sensor and the systematic gamma radiation tests performed on the AMR COTS chips.
The objective is to study the damage and degradation of these sensors with the total irradiated dose (TID). The sensors were irradiated with gamma rays up to a total irradiation dose of 200 krad following ESCC Basic Specification No. 22900, with limited number of tested sensors. All tests were performed assuring low disturbances of variable magnetic fields, keeping those variations under the error threshold by means of magnetic shielding and registration of magnetic field variations with pT resolution. Parameters like linear response and saturation field, offset and set/reset strips deviations, and power consumption have been monitored for the four different types of sensors during the irradiation.
The sensors chosen for the test have been of the HMC series by Honeywell: HMC 1021 S, HMC 1043, HMC 6042 and HMC 6052. HMC 1043 has been chosen for the AOCS of OPTOS picosatellite of INTA and as the magnetic sensor payload for MetNet precursor mission.
HMC 1021 S sensors presented low degradation both in sensitivity (<2%) and offset values (<12 nT). HMC 6042 and HMC 6052 tested biaxial magnetic sensors presented a low degradation response up to TID 100 krad both in variation of sensitivity (<3%) and offset absolute value (<2 nT). HMC 1043 presented low degradation up to a TID of 100 krad gamma irradiation. Offset and sensitivity values presented low deviations up to 200 krad (<12 nT and <5%) against gamma irradiation up to 100 krad. The performed test, avoiding full screening results, points out the suitability of sensor HMC 1043 for future Met-Net precursor mission.

[1] R. Sanz, M. F. Cerdán, A. Wise, M. E. McHenry, and M. Díaz-Michelena. Temperature dependent Magnetization and Remanent Magnetization in Pseudo-binary x(Fe2TiO4)-(1-x)(Fe3O4)(0.30<x<1.00) Titanomagnetites. IEEE TRANSACTIONS ON MAGNETICS, 47, 4128-4131, 2011.
[2] M. Funaki, N. Hirasawa and the Ant-Plane Group. Outline of a small unmanned aerial vehicle (Ant-Plane) designed for Antartic research. Polar Science 2, 129-142 (2008).
[3] M. D. Michelena, I. Arruego, J. M. Oter and H. Guerrero, “COTS-Based Wireless Magnetic Sensor for Small Satellites”, IEEE Trans. Aerospace and Electronics 46, 542-557, 2010.