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The NANOSATC-BR1 Scientific Payload: Magnetometer System

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The NANOSATC-BR1 is the first nanosatellite of the Brazilian INPE-UFSM NANOSATC-BR Program. It highly contributes to the cubesat development program supported by the Brazilian government. The purposes of the mission associated with NANOSATC-BR1 are to qualify human resource for the space area; to develop the technological capacity of the partner institutions and to improve the researches on Geospace phenomena and mainly on the Space Weather related to the South American Magnetic Anomaly and the Equatorial Electrojet. The atmosphere above the Brazilian territory is of large scientific interest since several phenomena are still poorly known, which produce local effects and take part in global mechanisms. The NANOSATC-BR1 has two payloads. Concerning science, one magnetometer is available to measure the intensity of the geomagnetic field in its orbit. A second magnetometer is used for attitude determination by the satellite attitude determination and control subsystem. The magnetometers chosen were the XEN-1210 of Xensor Integration because it fits with the technical and scientific aspects of the satellite proposal. Concerning technology, two integrated circuits with radiation protection designed by two different Brazilian universities (SMDH-UFSM and UFRGS) are the payload. The objective here is to detail the characteristics of the science payload magnetometer, as well as the possible analyses to be conducted with this instrumentation.

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1. Introduction

The use of small satellites had a considerable increase in the last few years, due its size relatively reduced, it can be developed and launched with really low costs. This reduced price makes satellites of this sort, a viable option for universities and schools to carry scientific instruments or new technologies for tests on space.

The NANOSATC-BR1 is a 10x10x11.3 cm. cubic satellite weighing less than 1.33 kg. It has its name and its up and down frequencies links determined by The International Amateur Radio Union – IARU, in 2011, and is a 1U class of cubesats. The scientific purpose of the project is to measure the geomagnetic field intensity on space in a polar orbit with inclination of 98º and altitude around 600 km, in order to improve the studies related with the South Atlantic Magnetic Anomaly and the Brazilian sector of the Equatorial Electrojet. The NANOSATC-BR1 has two payloads. Concerning science, one magnetometer is available to measure the intensity of the geomagnetic field in its orbit. A second magnetometer is used for attitude determination by the satellite attitude determination and control subsystem [1].

The accommodation of the payloads in the circuit board: the XEN-1210 Magnetometer, ICs and FPGA, has been solved in cooperation between INPE, Innovative Solutions In Space - ISIS, Federal University of Rio Grande do Sul - UFRGS and Santa Maria Design House - SMDH-UFSM.

2. Scientific Mission

The NANOSATC-BR1 Scientific Mission is to monitor, in real time, the Geospace over the Brazilian Territory. In order to accomplish this aim, the payload instruments will be a fluxgate magnetometer, XEN-1210, from Xensor Integration Company, to measure the intensity of the Earth Magnetic Field over the South Atlantic Magnetic Anomaly (SAMA) [2] and the Ionosphere Equatorial Electrojet over the Brazilian sector [3].

The NANOSATC-BR1 concept was developed to: i) monitor, in real time, the Geospace, the particle precipitation and the disturbances at the Earth's Magnetosphere over the Brazilian Territory, and ii) the determination of their effects on regions such as the South American Magnetic Anomaly (SAMA), and the Brazilian sector of the Ionosphere Equatorial Electrojet.

The requirements for the magnetometer are listed below:

- Collect data in a frequency at least three frames per second;
- Get information about the three components of the geomagnetic field;
- The data must be available at least once daily;
- The acceptable intensity resolution of the magnetic field must be 15nT.

3. Magnetometer System

The three axis magnetometer that will be as the major payload in the NANOSATC-BR1 is a XEN-1210 magnetometer from Xensor Integration from The Netherlands, which is made based on the Hall Effect. It uses Xensor's patented high performance Hall technology, with a resolution of 15nT and a magnetic field range of 63mT [4]. The device is available in the SFN8 package (Fig. 1).

Fig. 1 SFN8 Package of XEN - 1210 - Xensor Integration – XI. The dimensions are 2x2,4x4 mm[4].

It can be freely oriented on a PCB in three directions in order to measure the magnetic field intensity in 3D (Fig. 2), that is the configuration of the payload of the NANOSATC-BR1.

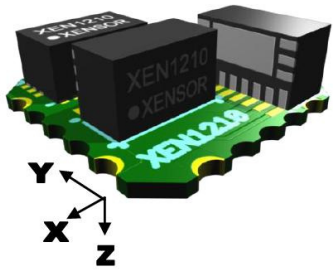

Fig. 2 3D board consists of three XEN-1210 sensors moutedin in three orientations. The size is 8,9x8,9x3,2mm[4].

The choice of XEN-1210 was due the fact it fits with the requirements of the magnetometer for the NANOSAC-BR1 project. The general information about the XEN 1210 magnetometer is on the Table 1, below.

Parameters	XEN-1210
Dimensions	8,9X8,9 X3,2 mm
Resolution	15nT
Wide Magnetic field range	63mT
Volume	253,7mm²
Power supply VDD	2.5 V (Min) – 3.6 V (Max)
Power supply IDD	Sleep mode: 50 nA Idle mode: 10 µA Power-up mode: 4.7mA
Sample speed	5 KHz
Hysteresis	10 nT
Noise	55 nT/Hz
Voltage operation	2.5V to 3.3V
Temperature range	-40ºC to 1125ºC

Table 1. General specification of the XEN-1210[4] .

4. Conclusions

Four magnetometers were considered to be part of the payload of the NANOSATC-BR1. They were HMR2300 e HMC2003 from Honeywell, Mag566 from Bartington and the XEN-1210 from Xensor Integration. The XEN-1210 magnetometer showed to be more qualified for the Brazilian scientific cubesat mission because it had reduced dimensions, low energy consumption, good resolution and has shown less electromagnetic interference from other sources for use in cubesats. The launch of the NANOSATC-BR1 is planned for the second semester of 2013.

5. Acknowledgements

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