Re-Engineering a Picosatellite for a Langmuir Probe Payload

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Abstract. *Miniaturized satellites are being used for a myriad of missions previously not conceived for such class of devices due to their attractive cost-benefits. This work has a case study focused in a picosatellite, named Tancredo 1, which has been re-engineered from a standard TubeSat platform. It is expected to be launched by early 2016 from the Kibo (きぼう, Japanese for "hope") Japan Aerospace Exploration Agency (JAXA) module of the International Space Station (ISS) from which it will be released. Using the ISS infrastructure has imposed a new set of safety requirements to this project and new system re-engineering tasks. As part of INPE´s Aeronomy research demands, the picosatellite mission has also added a second payload, a Langmuir probe which also imposed extra requirements and changes that this work describes briefly.*

***Keywords*:** Tubesat, Picosatellite, Safety, Space System Engineering.

1. Introduction

Nanotechnology has effectively contributed to the engineering of sophisticated miniaturized systems can be designed for space applications. Miniaturized satellites projects are having a huge interest from many space organizations and companies recently due to their cost reduction, shorter project cycle duration; nanotechnology to mention a few.

In special, this work aims at the space systems re-engineering of a tubesat platform for picosatellite applications face new set of requirements and contributing to the research and new knowledge concerning the ionosphere plasma irregularities over the Brazil which basically affects the Telecommunications and Global Positioning Systems [KELLEY & HEELIS, 1989].

2. Methodology

The re-engineering methodology has various considerations to be taken so this new payload adaptation could occur smoothly. The whole process has the main steps listed hereafter: (1) Layout reconfiguration of PCBs (Printed Circuit Boards) for meeting safety and quality requirements; (2) Assembly, Integration and Testing (AIT) of PCBs with new power, communications, on-board computing and, payload re-designs; (3) Evaluation of issues related to mass, power, RF budgets as well as solar panel cell layouts; (4) Payload and on-board data protocol adaptation for telemetry and telecommand usage; (5) Ground-Space interface issues; (6) Prospective Ionosphere

experiments data collection payload for INPE (the Brazilian Space Research Institute); (7) Interfacing issues to launchers docking at the ISS, e.g SpaceX and Antares.

3. Results and Discussions

The re-engineering methodology has various considerations to be taken so this new payload adaptation could occur smoothly, see Figure 1 for the engineering model of the modified platform, further details can be found in [TIKAMI & DOS-SANTOS, 2014] and [DOS-SANTOS et al., 2014].

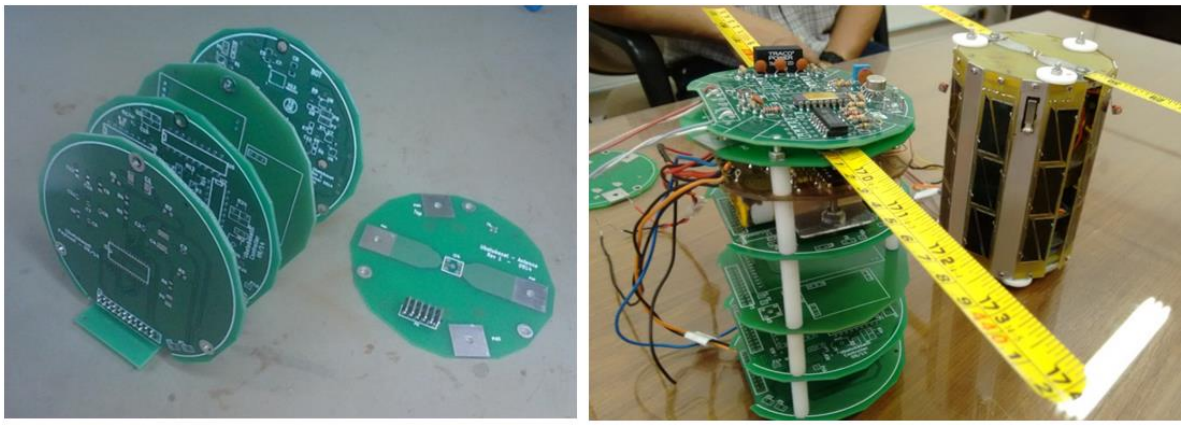

Figure 1. Engineering model of the new tubesat design with Langmuir probe payload.

The proposed Langmuir probe adaptation has the following electronic components which were greatly implemented by DAE/CEA/INPE: (1) A sensitive amplifier that converts the current collected, ranging from few nano-amperes to micro-amperes, to a certain potential; (2) A DC/DC converter that provides +/- 5V power to the amplifiers and generator bias; (3) A 2.5V positive bias generator applied to the sensor; (4) two amplifiers, one for low gain another for high gain amplification to the received signal from the preamplifier and; (5) A multiplexer that alternately sends two payload telemetry channels to satellite downlink.

4. Conclusions

Driven by advances in nanotechnologies, greater attention has been called on minituarized space artifacts. This work briefly presented the re-engineering of a tubesat platform for meeting safety and new mission requirements justified for the ISS delivery and for a new Langmuir probe payload. The expected launch will be by early 2016.

References

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