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DESIGN OF AN EXPERIMENTAL MICROSATELLITE TUUSAT-1B

Abstract

This paper presents the design of an experimental microsatellite TUUSAT-1B to be used as the payload of the Taiwan Small Launch Vehicle (TSLV). It was more than 10 years ago the Taiwan Universities-United Team (TUUT) devoted to the microsatellite development was organized by a small group of professors and students coming from several domestic Universities. At the beginning, TUUT established the basic technologies required for microsatellite development using very limited resources of manpower and budget under the support of the National Science Council (NSC). The Taiwan Universities-United Satellite No. 1 (TUUSAT-1) was manufactured at that time. Then the National Space Organization (NSPO) supported TUUT to develop and manufacture the TUUSAT-1A from 2005 to 2007. Through the cooperation with NSPO, the team has built its very solid and mature technological capabilities in microsatellite development and manufacture. Although for many years, the members of TUUT have been changed due to temporal reasons. However, the core team members keep almost unchanged. Besides, the technological heritage of the whole team is well maintained. Currently there are about 25 professors and students from five universities: China Institute of Technology, Tamkang University, Taiwan Ocean University, Formosa University, and Chiayi University. All team members have very high interest and enthusiasm in the microsatellite development and test. In order to meet NSPO's further requirements in the experimental microsatellite development, TUUT is working on the "TUUSAT-1B research and development (RD), and integration and test (IT) project." According to NSPO's policy, the experimental microsatellite is to be used as the payload of the TSLV. The full name of TUUSAT-1B is Taiwan Universities-United Satellite No. 1B. It consists of the following electrical and mechanical subsystems: solar energy electric power subsystem, satellite ARM-based computer subsystem, VHF/UHF communication subsystem, structure subsystem, thermal control subsystem, attitude determination and passive control subsystem, GPS receiver payload subsystem, cloud observation instrument payload subsystem, MP3 player payload subsystem, etc. TUUSAT-1B is designed to fit in and compatible with the TSLV in all aspects such as electrical interface, mechanical interface, dynamic environmental conditions, and orbital insertion capabilities. It is to be launched at TSLV's early stage test flight as an experimental satellite. According to NSPO's strategy, TUUSAT-1B is to be used to verify and validate the availability and capability of TSLV for the formal mission launches in the future. It is under this policy this project is proposed to NSPO. The micro-satellite is designed to be less than 40 kg in weight. Its shape is near cubical with side width at about 28 cm. Outer surface of the satellite consists of six aluminum plates with solar panels attached to each plate. The main structure of the satellite has four layers. Each layer is an aluminum pan lathed hollow from an aluminum alloy block, on which the components of all electrical and mechanical subsystems are mounted or installed. The layers are securely locked after laminated placement. In other words, we use the above design to cope with the possibility of unpredictable dynamic condition of TSLV. Furthermore, with the use of passive attitude control and surface mounted solar panel, there are no moving parts onboard. Consequently, we believe TUUSAT-1B has very good opportunity to work as it is designed once in orbit. Under the advice of NSPO, TUUT manages and works on the project by

following the general practices of system engineering stringently. TUUT cooperates closely with NSPO for the final mission success of this project.