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Control System Design of an Ultra-Small Deep Space Probe

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Abstract

It's a grand opportunity to build new small deep space probe called Shinen2, developed by Kyushu Institute of Technology (KIT), in corporation with the different companies and institutions of engineering in Kagoshima University (Japan), NASA Johnson Space Center, was launched by the rocket H-IIA of Japan Aerospace Exploration Agency (JAXA) with Hayabusa 2, on December 3, 2014 in Tanegashima. This project involves Japanese students and foreigners, permitted a multi-cultural environment and an excellent tools for education. The students are in charge for the design, assembly, integration, tests of the space probe subsystems, and build-up of the existing ground stations facilities for tracking the telemetry data of Shinen2. It will enhance capacity building for the students, and scientific research for upcoming studies. The main approach to carry out the main mission of space probe. In parallel, to develop each subsystem of Shinen2: structure design, system bus architecture including the Communication Control Unit CCU, Power Control Unit PCU specifications, and new Particle Pixel Detector PPD for deep space radiation exploration. The development period for the space probe was only one year; it was extremely a short term. The mass budget and size were strictly limited while requiring a higher reliability. This paper describe a control system design for a small deep space probe which was developed to implement different missions and to satisfy the various requirements listed below.

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Keywords: Shinen2 project; deep space probe; system control unit; sensor radiation.

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1. Introduction

In few previous years, larger number of satellites were launched to the deep space as Hayabusa2, Despatch and Procyon [1], many universities and institutions around the world have now the capability to build small satellites and spacecrafts with different missions for the purpose of the space education and technology demonstration.

Shinen2 is the first ultra-small deep space probe, is described in Fig.1, was developed by Kyushu Institute of Technology in partnership with Kagoshima University (Japan) and Prairie View A&M University (U.S.A). The Space probe was launched by an H-IIA rocket in Tanegashima Space Center, on December 3rd, 2014, together with the asteroid probes listed before. Shinen2 has three main objectives as a space mission: the first mission of Shinen2 is to establish a mutual communication technology between the earth and a space probe near the lunar orbit and establishing a communication above 1 million km distance as full mission by many amateur radio stations, the second is the demonstration in deep space of a structure made of Carbon Fiber Reinforced Thermoplastic CFRTP material. The last mission, as payload for measuring radiation intensity using particle pixel detector to evaluate the distribution of the cosmic radiation [2].

The purpose of this paper is to describe the design of system control unit of Shinen2 space probe missions as well as providing an overview of the space probe might help developers in planning and developing satellites under 50kg.

The current paper describes different sections present the Shinen2 subsystems missions, orbit definition, satellite structure, the system bus architecture, power control specifications and communication control unit. The main approach is the measurement of space radiation environment between the cosmic radiation from the earth via the Van Allen Belt radiation to measure the energy flux and radiation intensity, and finally the conclusion.

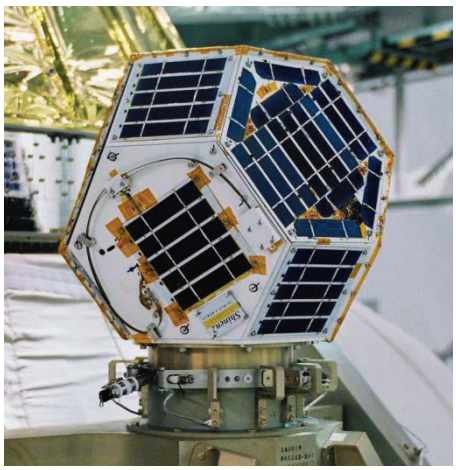

Fig. 1. Flight Model of Shinen2