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BIRDS BUS: A Standard CubeSat BUS for an Annual Educational Satellite Project

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Abstract

The BIRDS program, carried out by the Kyushu Institute of Technology since 2015, consists of educational projects that use 1U CubeSats for capacity building of non-space-faring nations. The first and second generations of the program, BIRDS-1 and BIRDS-2, were launched and deployed to orbit in 2017 and 2018, respectively. BIRDS project members begin as students with no experience in space engineering, but they must design, build, and operate the satellite within two years, to meet a master's degree timeline. A new BIRDS project begins every year, each one requiring satellite design changes to accommodate the new year's mission objectives. To meet the rapid project pace, this study introduces a standard CubeSat bus focused on the electrical architecture: the BIRDS BUS. The BIRDS BUS puts an emphasis on two key ideas for easy training: simplification and unification. The standard bus was applied to the third generation (BIRDS-3) project. The BIRDS BUS has been tested extensively on the ground and has passed all environmental tests. Three BIRDS-3 satellites were launched to the International Space Station (ISS) in April 2019; after the satellites were deployed to orbit (June 17, 2019), the final validation of the BIRDS BUS was successfully conducted in orbit.

1. Introduction

A 1U CubeSat is a small cube-shaped satellite measuring 10 x 10 x 11.35 cm in size, with a mass less than 1.33 kg (Japan Aerospace Exploration Agency, 2015). Originally, it was developed as an educational tool for space engineering technology, given its small size, light mass, and low budget requirements. The first CubeSats were launched in June 2003, successfully demonstrating their potential in orbit and making huge impacts on the space community. From 2012 through 2017, over 700 CubeSats were launched, and that number is still rapidly increasing. Currently, many

CubeSat programs are employed for the purposes of remote sensing, communication and scientific research (Sandau, 2010), although NASA has begun using CubeSats even for deep space exploration.

The chief benefits of using CubeSats are their low cost, short development time, limited number of team members needed, and aggressive use of more economical commercial-off-the-shelf (COTS) parts. (While the use of COTS parts provides no guarantees against harsh space environments, such as strong radiation on orbit, they do provide a short delivery time and low cost, which generally benefit CubeSat projects.) The

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