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INTEGRATED APPROACH TO PCB DESIGN AND MANUFACTURING FOR 3U SATELLITE
IN-HOUSE PAYLOAD

Abstract

This paper presents the design and the manufacturing process of a Printed Circuit Board (PCB) that has been developed to be on board the Almunther Mission. The Almunther Mission is the first fully designed and built by the Bahraini Space Team. This PCB serves as a critical component for the Payload system, as it facilitates the integration of the two Raspberry Pi Zero Units. There will be 4 payloads on board Almunther. The payloads will be using a Raspberry Pi High-Quality camera, data compression, cyber-security and transmitting Bahrain's National Anthem in Space! All the payloads missioned will have innovative testing processes and algorithms to secure satellite data. The PCB design is specifically tailored to the interface with the iOBC payload controller from ISISpace through the UART communication protocol. This is used to ensure that there is efficient data and power management onboard the payload controller. Several key design considerations were included by abiding the CubeSat's size, weight, and power constraints, as well as the payload requiring a certain amount of power and mechanical standards. The spatial arrangement layout has been designed in the PCB in a way that allows it to host the computing units and camera. Moreover, it has taken into consideration the power lines and data communication channels while complying with thermal stability and radiation resilience within the harsh space environment. Not to mention that the electrical design incorporates advanced encryption standard (AES), for data security purposes and supports the AI-based image processing algorithms directly on the 3U CubeSat. As for the manufacturing process, the PCB has followed strict quality standards and controls. The PCB utilizes FR4 TG170 material with an ENIG finishing to ensure the PCB's durability and performance under the space mission's harsh operational conditions. In this paper, we will also dig deeper into the technical challenges in designing the PCB's development, as well as how we overcame these obstacles. The paper will include the process of initial design conceptualization to the final assembly, integration, and testing. By focusing on the PCB's role in the satellite, the team has undergone a great amount of capacity building in its role for designing PCBs. The AlMunther mission showcases the successful integration of compact, efficient designs on board a 3U CubeSat, which offers insights into future advancements in satellite technology and onboard data processing methods.

Keywords: CubeSat Payload Design, Raspberry Pi in Space Missions, Space Engineering Innovations.