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INTRODUCING LOW COST THERMAL VACUUM TESTING FACILITY FOR THE EMERGING
SPACE PROGRAM IN AFRICAN UNIVERSITIES

Abstract

Lean satellite is a satellite that utilizes non-traditional, risk taking development and management approaches with the aim to provide value of some kind to the customer at low-cost and without taking much time to realize the satellite mission. Nowadays space activities in Africa has greatly increased due to the use of Lean satellite concept and availability of launch opportunities into Low Earth Orbit. Lean satellite relies on non-space qualified components and therefore to ensure the performance of lean satellite to perform in an appropriate thermal environment, satellite needs to run simulated thermal distribution to check validation of the thermal design, latent defect of workmanship, mission flight functionalities, success and its survivability in outer-space. Using thermal vacuum testing facility in Africa is very rare, because is very expensive to buy the conventional type due to low budget, complex to install, operate and maintain by space program in African universities without an expert. Therefore, most of the satellite developed by Africans needs to be tested in foreign countries with well equipped thermal vacuum testing facility which end up increasing the satellite budget due to travelling expenses. Therefore there is an increasing demand for an affordable thermal vacuum testing facility. This paper proposes an easy access and affordable thermal testing device capable of testing the thermal distribution of COTS components on board 1U satellite in a simulated high vacuum chamber. The proposed thermal testing device (known as PeTT device) utilizes Peltier effect phenomenon to generate cold and high temperature limits in a simulated high vacuum chamber acceptable for testing 1U CubeSat, COTS components and subsystems. This paper gives details of the design requirements and parameters, Assembly and Integration, configuration setup inside vacuum chamber and total cost and performance results of the device. This paper is intended to be a source of motivation for university space research laboratories in Africa which would like to design and construct a similar testing facility, instead of investing expensive commercially available alternatives. The paper proposes a strategy using this idea to support the United Nations Space 2030 Agenda towards achieving the Sustainable Development Goals especially for developing countries in Africa.