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LASER COMMUNICATIONS FOR CUBESATS: A 50 MBPS LASER/RADIO HYBRID TRANSCEIVER IN A PC-104 FORM FACTOR CARD

Abstract

In early 2018 the Irvine Cubesat STEM Program (ICSP)from California - USA, requested that the Ecuadorian Space Agency (EXA) designed, built, test and deliver a miniaturized LASER emitter for the IRVINE02 cubesat to be launched on board the NASA ELaNa 24 slot in November 2018. The device was requested to meet certain conditions like a minimum output power of 0.7 Watts, operate at a maximum temperature of 50 degrees centigrade, use a maximum electrical power of 3 Watts and be NMOS operated through an UART modulation circuit at a minimum speed of 100 Kilobits per second. The resulting device was shipped one month later to ICSP exceeding all the initial requirements. This device is currently operating in orbit and its denomination is PLM01. To date is the most compact laser ever flown on board a cubesat as small as 1U form factor, this work was funded by the Irvine Public Schools Foundation.

This paper will describe the methodology for stabilizing the LASER in its various electrical and thermal dimensions, tests performed, mechanical, electrical and thermal design and tools used. Also will describe the new generation of laser transceivers PLM02 and PLM03 to be installed in the IRVINE03 and IRVINE06 1U cubesat satellites which will combine radio communications in VHF and UHF frequencies, from 200 MHz to 900 MHz range for uplink and optional downlink and a LASER emitter in the 405nm to 450nm wavelength operating at a minimum of 10 Mbps and a maximum of 50 Mbps in OOK modulation. Different challenges to achieve this performance are to be discussed, like power budget, thermal dissipation techniques, processor speed, data bus speeds, bus technology selection, data processing approaches and techniques that allows this hybrid transceiver to be used by a wide range of cubesat architectures like those based in relative slow speed data transfer buses like I2C and CAN bus and also those based in faster data transfer buses like SPI, USB and USART, also optical link budgets and detector technology and geometry selection matrices have to be applied in order to achieve the objectives of having cost-effective high data rate transfers from orbit to ground using a very compact and efficient device that can be installed in wide range of satellites, from 1U cubesats to full size satellites.