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INTRA-SATELLITE COMMUNICATIONS USING MULTICAST CONTROLLER AREA NETWORK SERIAL BUS STANDARD FOR OPTICAL WIRELESS LINKS

Abstract

Nanosatellites, such as CubeSats, provide a standard platform that allows research institutions and small-medium enterprises to access space research or develop low-cost missions. The miniaturization of equipment and platforms in constrained space systems such as nanosatellites is made possible also by harness reduction. In fact, a satellite's harness account for 7-10To this end, the replacement of data wires and connectors with OWLs represents a valid alternative. However, a standard bus is required for allowing different CubeSats to communicate without a host computer. The multicast Controller Area Network (CAN) bus, although normally used for land in-vehicle communications, is a message-based protocol designed originally for multiplex electrical wiring in the automotive sector with the aim of reducing the quantity of cables, but can also be used in many other contexts, such as industrial automation, robotics and in some avionics systems. In this work, a complete communication system between the CubeSat and the additional modules is implemented through the Controller Area Network (CAN) Bus protocol, using an Optical Wireless Link (OWL) instead of the classic two wire electric bus. The CAN Bus is a digital communication protocol characterized by excellent reliability and high immunity to disturbances. The bit rate used for communication is 1 Mbit/s. For CAN Bus communication, typical values of BER (Bit Error Ratio) are 10-5 10-7. The paper provides the full characterization of the system performances under severe thermal cycling. The characterization has been conducted with the optical transmitter (TX) and optical receiver (RX) 10 mm apart, in the range of optimal operating conditions. Temperatures were varied between -35 C and 130 C. During the test, the evaluation of compliance of the BER has been carried out sending a random byte sequence using the standard CAN protocol, while 10 Mb were transmitted at each temperature. For a temperature variation of about 140 C, a deviation of about 50 mW of dissipated power has been recorded.