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RF FRONT END DESIGN FOR NANO-SATELLITES USING LOW COST COMMERCIAL COMPONENTS

Abstract

Over the recent years the development market for low cost nano-satellites has grown considerably. It has been made possible due to availability of low cost launch vectors and the use of (commercial off the shelf) COTS components. The satellite design standardization has also helped great deal to encourage subsystems reuse over number of space missions. This has created numerous opportunities for small companies and universities to develop their own nano-satellite or satellite subsystems. Most COTS components are usually not space qualified. Inorder to make them work and withstand in the harsh space environment needs an extra effort in the circuit redesign and implementation. Also, by adopting the modularity concept and design reuse method, the overall testing and non recurring development cost can be significantly reduced. This can also help minimizing the subsystem testing times. The RF front end design presented in this paper is also based on the above approach. It consists of an s-band transceiver that is fully implemented using COTS Components. In transmit chain it is comprised of the transmitting CC2510 RF matching network and a power amplifier (PA) with RF output power of upto 33dBm which connects to an antenna using two RF switches. The receive chain starts from antenna that is connected through two RF switches to the low noise amplifier (LNA) that further connects to the receiving CC2510 via RF matching network. The Receiver sensitivity is -100dBm. This is a half-duplex system using same antenna for transmit and receive. The receiver and transmitter chains are isolated together using two RF switches which together provide an isolation of upto 90dB at 2.4GHz. The concept behind using two RF switches is to provide a better isolation from transmit chain to the LNA. The matching network of CC2510 has been designed in a symmetric fashion to avoid any delays. All the used RF COTS have been selected according to linkbudget requirements. The LNA, PA and RF switches were tested individually for compliance. The passive components used in overall design of matching network are selected on the bases of minimum dimension, least parasitic behaviors and to ensure optimum RF matching. The used RF COTS are non-CMOS which makes then more robust against space radiations to provide a radio communication datarate of upto 500kbps in both uplink and downlink. The vacant spaces on the implemented PCB are shielded with a partial ground plane to avoid RF interference.