Paper ID: 16040
student

SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

Author: Mr. Anwar Ali
Politecnico di Torino, Italy

Prof. Leonardo M. Reyneri
Politecnico di Torino, Italy
Mr. Juan Carlos de los Rios
Politecnico di Torino, Italy
Mr. M.Rizwan Mughal
Politecnico di Torino, Italy

COMPONENTS SELECTION FOR A SIMPLE BOOST CONVERTER ON THE BASIS OF POWER LOSS ANALYSIS

Abstract

Efficiency and size are main concerns for any converter. Boost converter is a type of switching-mode power supply containing two semiconductor switches (diode and transistor) and at least one energy storage element (an inductor). Now the main objective is to increase the efficiency and reduce the area of the components for the converter. We used Commercial off the shelf (COTS) components for our design. Selection of a particular component for our design requires a power loss analysis in order to achieve minimum power loss and maximum efficiency. This converter is designed for Power Management Tile of NanoSatellites.

In our project we have a MOSFET, two capacitors, an inductor and a diode. It converts 4.4V to 14V. In MOSFET we have three main power losses. The power loss due to the internal resistance of the MOSFET. The power lost due to the gate capacitance. The third one is due to the rise and fall times of the switch. We analyzed so many devices on the bases of these three parameters and selected the best one. Power loss in capacitors is mainly due to the Equivalent Series Resistance (ESR). So in order to have low power losses in capacitors, we have to select the capacitor with minimum ESR value. Low is the ESR of capacitor the higher will be the ripple current capability of the component. Similar to the capacitor, the internal resistance is also responsible for power loss in the inductor. The boost efficiency decrease as the value of internal resistance increases. As a result, the smaller the internal resistance of the inductor, the smaller the power loss will be. The power loss through the diode is related to the current flowing through the diode and forward voltage drop on it. Due to the MOSFET on and off switching, current will never flow through the diode continuously. For this purpose we selected a diode with very low forward voltage drop.

On the basis of the above parameters we used different components for the converter and choose the best one with lower component size and minimum power loss resulting in higher efficiency. Our converter has an efficiency of 93 percent. PSpice OrCAD, MentorGraphics and UML were used for simulation, PCB design and documentation. After having the desired results from simulations we implemented our designed converter on a PCB. After completion the testing results are in correspondence with the simulations.