

Analysis for maximum energy transfer from existing DC-to-DC converter topologies

N. W. H. G. B. Nagahapitiya and N. W. K. Jayatissa*

*Department of Physics, Faculty of Science,
University of Kelaniya, Sri Lanka
Email: jayatissa@kln.ac.lk

A voltage regulator is an electronic device, which maintains a constant output voltage for varying input voltages. There are different types of voltage regulators with various types of control schemes to achieve great accuracy and fast regulation but it requires more complex circuitry and cutting edge technology. The direct current-to-direct current (DC-to-DC) power converters are designed to provide unregulated dc voltage inputs and to regulate constant voltage output.

DC-to-DC converters are applicable to a variety of applications including power supplies of personal computers, office equipment, spacecraft power systems, laptop computers and telecommunication equipment as well as DC motor drives. Thus, high efficiency is invariably required in DC-to-DC converters for maximum energy transfer in these kinds of applications.

In this study, theoretical and practical analysis were done on existing DC-to-DC converter topologies. Moreover, behavior of Buck and Boost converters with variable Inductor, variable Capacitor and different duty cycles were investigated in detail. Also, change of output voltage waveform with the above three factors was analyzed. Three basic DC-to-DC converter topologies were analyzed by using theoretical calculations and transfer functions of the converters were derived. Further, Buck and Boost converter was analyzed significantly in practical method. Then results of both the sections were compared to understand the behavior of converters.

Introducing a input filter to the switching converter significantly reduced the switching harmonics in the input stage. Another important factor of introducing an input filter is that the control of electromagnetic interference (EMI) appeared in the input signal. So in this study, this phenomenon was analyzed with different types of input filter combinations.

The switching converters are the controller unit of the converters. The clarity of the pulse with modulated (PWM) signal is important for stable controller output. This study reveals a technology to provide stable output voltage from distorted PWM signal.

Keywords: DC-to-DC converters, Input filter, PWM generator