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Instantaneous Buck-Boost converter for Battery Powered Devices

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***Abstract*: For a low powered handy electronic applications, a highly efficient control method is necessary for getting better transients at the output. Hence a instantaneous Buck-Boost converter with two transitional combined mode of control is introduced. If the voltage at the output tends to fluctuate, the efficiency automatically decreases. Hence to overcome the drawbacks of the previous converters, an instantaneous buck-boost converter with mode selection is proposed. The proposed converter reduces the fluctuation, producing an immediate non-inverting constant output voltage. A constant output voltage is obtained by applying different sets of voltages at the input. The converter is designed to work in three different modes depending on whether the input voltage increases, decreases or becomes equal to the output voltage, the converter will work as buck, boost or buck boost, in three different modes. Thus as the input varies mode of operation also changes.**

Index Terms—Instantaneous buck-boost converter

I. INTRODUCTION

Obtaining a stable voltage for a variable input voltage is a major power handling criteria, usually for handy applications driven by battery. While the battery supply is either charged or discharged, the supply can increase, decrease or becomes equal to the output voltage. For a small size application, it is necessary to control the converter voltage with great accuracy and operation. As a result, a transaction between the price, efficiency, and output variations must be measured.

To overcome this problem an instantaneous buck-boost converter is proposed which operates on three modes based on the varying input voltages. The converter will either work as Buck, Boost or Buck-Boost converter. The converter is simulated using MATLAB/SIMULINK tool. A variable input voltage between 8V to 14V is applied at the input and a constant voltage of 12V is obtained at the output. The main objective of the converter is to achieve a stable voltage for a wide range of input voltages. It also aims to reduce ripple contents in the output voltage. In an instantaneous Buck-Boost converter, we obtain an immediate steady output voltage at the load without any fluctuation. Hence the name instantaneous.

II. INSTANTANEOUS BUCK-BOOST CONVERTER

At the beginning when the DC input is applied, the instantaneous converter operates in the boost mode. This is because the input applied is lesser than the output voltage. As the initial input voltage supplied at the beginning increase and comes closer to the output voltage, it starts working in the buck boost mode. As the input voltage becomes greater than

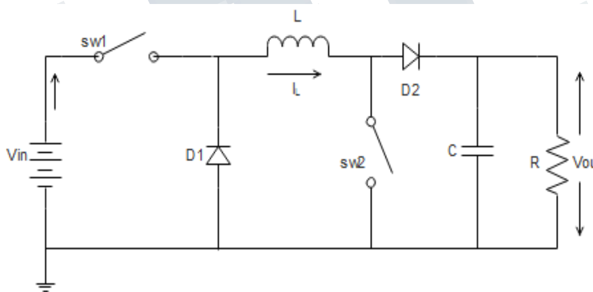

Figure 1. Instantaneous Buck-Boost converter

Output voltage the instantaneous converter starts working in the buck mode.

When the instantaneous converter works in the buck mode, the switch sw1 will be controlled, diode D1 is conducting and switch sw2 is permanently OFF. When the converter works in the buck-boost converter mode, the input voltage becomes equal to the output voltage. During this, the switches sw1 and sw2 will be controlled. The circuit operates in the boost converter mode, when the input voltage falls below the output voltage. During this, the switch sw1 will be ON and switch sw2 will be controlled

III. SIMULATION

The circuit proposed here is simulated using MATLAB/SIMULINK tool. The results obtained are noted down to show the functionality of the circuit. The

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specifications considered for the converter for simulation are as mentioned in table 1.

Table 1. Specifications for the instantaneous converter

PARAMETERS	
Input Voltage	8V-14V DC
L	110µH
C	400µF
R	30Ω
D	0.5
F	100KHz
Required Output	12V DC

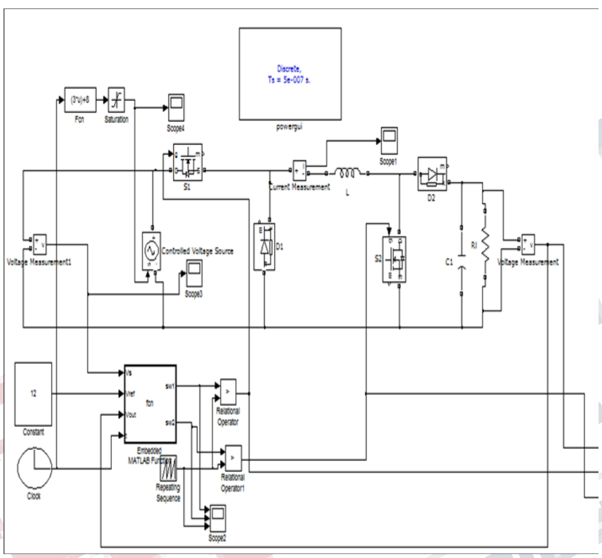

Figure 2. Simulated circuit

Figure 2 shows the circuit simulated in MATLAB/SIMULINK. The circuit is designed so that it produces a stable DC voltage at the output. The constant output voltage to be obtained is set at 12V. Since the converter has to work in three different modes, a set of variable input voltage is applied so that output voltage will be in the midrange of variable input applied. The variable input voltage varies from 8V to 14V DC so that output voltage obtained will be in the midrange of 8V to 14V. Here 12V (Vref) is set as reference voltage.

Here in this converter the switches are turned ON and OFF depending on the switching pulses. This circuit is designed such that it will have a transition from boost to buck mode. Similarly from boost to buck-boost followed by buck mode.

IV. SIMULATION RESULTS

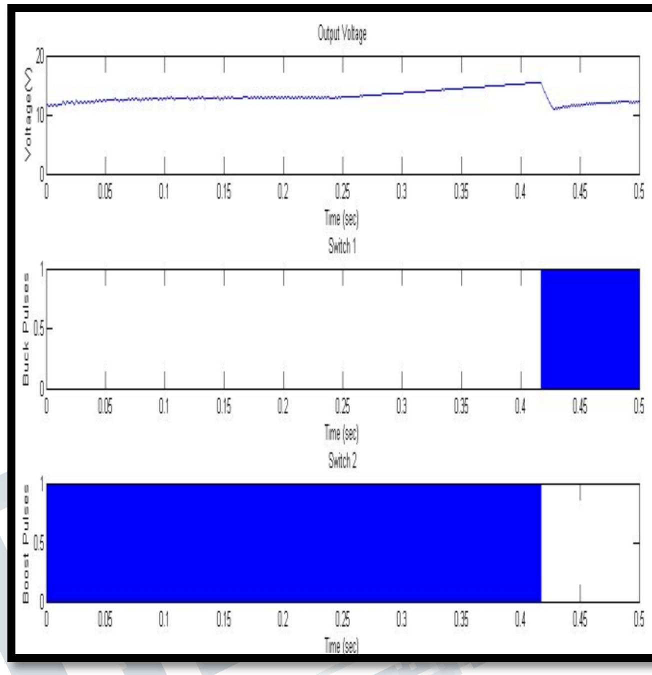

Figure 3. Transition from boost to buck mode

The Figure 3 shows an output voltage, pulses applied to sw1 and the pulses applied to sw2. A constant voltage of 12V DC is obtained at the output. Initially a voltage of 8V dc is applied at the input, the sw2 is controlled and there will be a boost pulses at the sw2 whereas switch sw1 remains ON which is acting as a boost converter mode because the input applied of 8V is lesser than the 12V output voltage. As the input voltage increases more than the voltage of 12V applied at the output, sw2 goes permanently OFF and there will be no boost pulses. During this time the switch sw1 will be controlled and there will be a buck pulses which acts as a pure buck mode till the end.

The Figure 4 shows an output voltage, buck pulses in sw1 and boost pulses in sw2.In this mode of transition a constant output voltage of 12V DC is obtained. Initially when the input voltage of 8V is applied, which is lesser than the output voltage of 12V the switch sw2 is controlled and having a boost pulses whereas the switch sw1 remains ON which is acting as a boost mode.

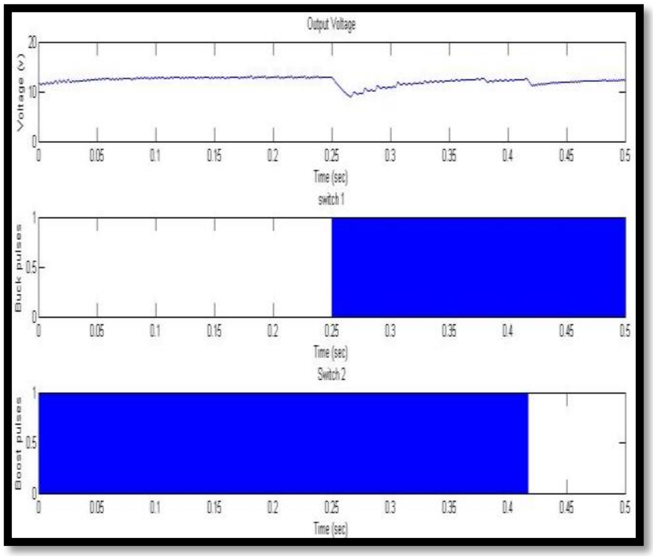

Figure.4 : Simulation Waveforms of transition from boost to buck–boost and then to buck mode

As the input voltage increases near to the 12V output voltage, both the switches sw1 and sw2 are controlled and it will have the pulses, the converter now acts as buck-boost. When the input voltage goes more than output voltage of 12V, the switch sw2 goes permanently OFF. The sw1 will be controlled and will be having a buck pulses till the end which is acting as a pure buck mode.

CONCLUSION

An instantaneous converter with a transition feature between different modes is shown here. This converter gives an immediate response as the input varies. An innovative model is being utilized to get the output voltage variations better during the change over from one mode to the other. This has an efficient method to get better voltage variation in the several use that needs variation among the different converter.

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