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Improving DC-DC Boost Converter Performance by using Feedback Technique

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Abstract- DC-DC power converters are one of the most important tools to change input voltage level to a desired output voltage. In this paper, first of all dc-dc converter are introduced, after that boost converter is described in details and then developed dc-dc boost converter by using feedback technique is presented. In this technique the output is measured and it will be compare with a reference. MATLAB/SIMULINK is applied to show the effect of feedback technique.

Keywords- *Boost converter, DC-DC converter, Feedback control, MATLAB/SIMULINK*

I. INTRODUCTION

With the high speed development of power electronics, switching power supplies are widely used in many fields. DC-DC switching converters are the main components of switching. The dc-dc converters are similar to transformer in AC system. The need of converter is convert dc voltage source to variable output voltage [1]-[3]. In other words, a DC/DC converter is a device that receives a DC input voltage and produces a DC output voltage. The output produced is at a different voltage level than input. Figure 1 shows the basic schematic of a dc-dc converter.

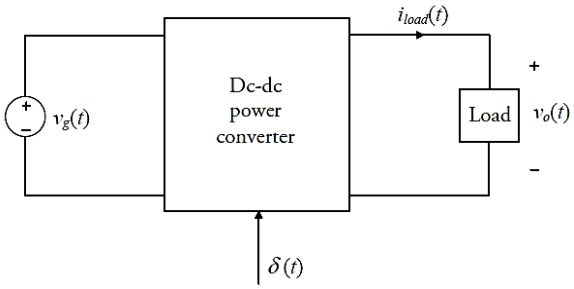

Figure 1. A dc-dc converter

It is desirable that the conversion be made with low losses in the converter. So, the transistor is not operated in its linear interval, so that it is operated as a switch and the control signal is binary. While the transistor is on, the voltage across it is low so the power loss in the transistor is low. While the transistor is off, the current through it is low, therefore the power loss is low [4].

Portable electronic devices, such as PDAs, cell phones and laptops, are usually use batteries. After a period of time, depending on the types of batteries and devices the battery voltage drops, So that this voltage variation may cause some problems in the operation of the device. So, we can say that DC/DC converters are often used to provide a stable and output voltage.

Furthermore they are employed in many applications such as photovoltaic, electrical vehicles, distributed generation and etc. [5]-[9].

II. BOOST CONFIGURATION

Boost converter is a basic topology of DC-DC switching converter. The task of boos converter is produce DC voltages in output with larger amplitude level to compare with input voltage. There are two semiconductors switches in its structure. Figure 2 shows boos converter.

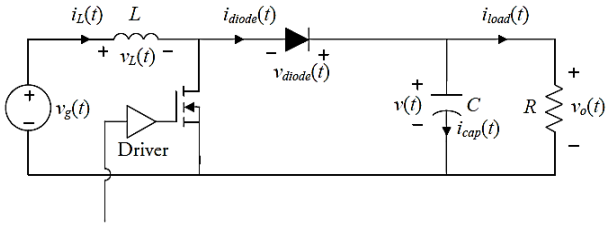

Figure 2. Boost converter

C: Capacitance of the capacitor
D: Duty cycle
D': D'=1− D
R: Resistance of the load resistor
L: Inductance of the inductor
Vg: Input voltage
Vo: Output voltage

By act of switching, a quasi-square waveform voltage appears at the output.

A. Conventional boost converter performance

At the first interval, when the transistor is on, diode is off and the current in inductor, rises linearly and capacitor, supplies the load current, and it is partially discharged. At the second interval when transistor is off, the diode is on and the inductor, supplies the load. Current and voltage waveform is shown in figure 3.

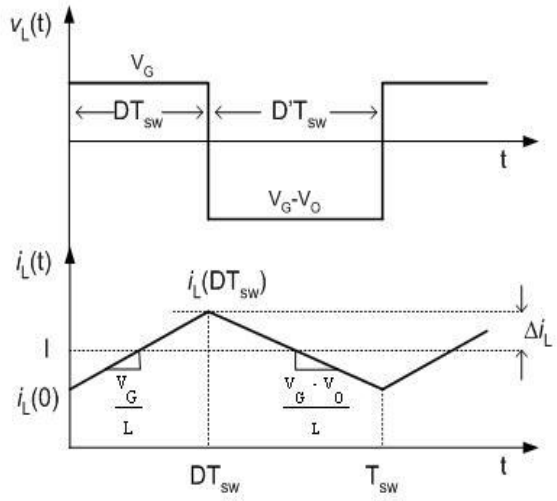

Figure 3. Steady-state inductor voltage and current waveform

$$V_g.T_{on} + (V_g - V_o).T_{off} = 0 \quad (1)$$

$$\frac{V_o}{V_g} = \frac{T_{sw}}{T_{off}} = \frac{1}{1-D} \quad (2)$$

When transistor is switched on, current flows from the input source through L and transistor, and energy is stored in the inductor. There is no current through diode, and the load current is supplied by the output capacitor. When transistor is turned off, the current flowing in L must flow through diode as it has no other path to flow through.

The guidelines to select the inductor and capacitor for boost converter are discussed in reference [10]. The small signal model of boost converter and its control to output transfer function are explained in detail in reference [11].

B. Boost converter with feedback control system

Aim of feedback control system is produce constant output voltage. In this technique, output voltage is measure and it will be compare with a reference voltage. The output of comparator is applied to produce pulse width modulation signal. In other words, output of convertor is measured and compared with a reference and the differential value is used to produce a pulse width modulation signal. Figure 4 shows the strategy of this technique:

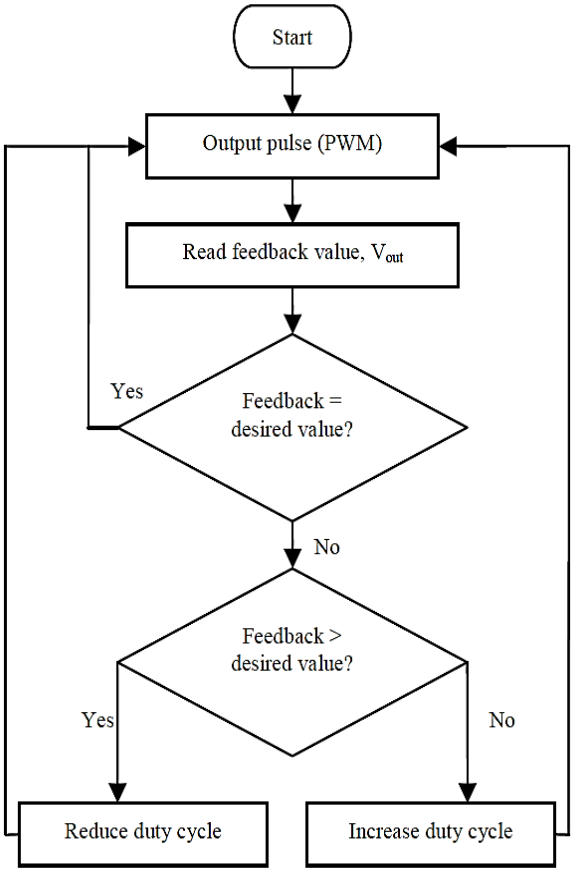

Figure 4. strategy of feedback technique

III. SIMULATION RESULTS

In this part simulation result of boost converter is presented. To shoe the effect of proposed system, output voltage, output current and inductor current are evaluated here. Figure 5, 6 and 7 shows the conventional boot converter performance.

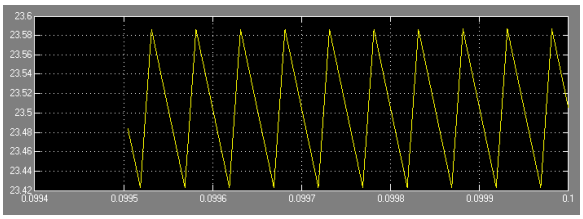

Figure 5. Output voltage

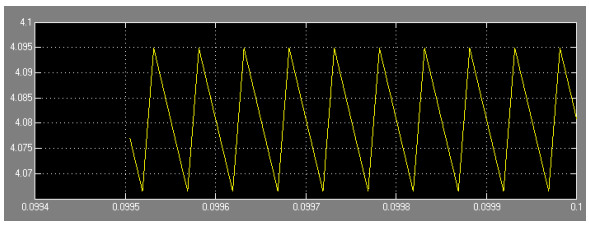

Figure 6. Output current

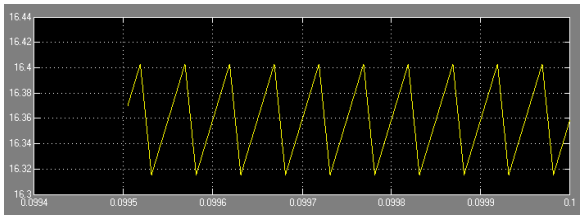

Figure 7. Inductor current

As the figures shows fluctuating in waveforms around their final value. In figure 8, 9 and 10 the result of using proposed system is presented.

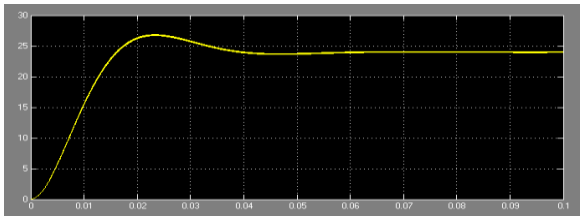

Figure 8. Output voltage

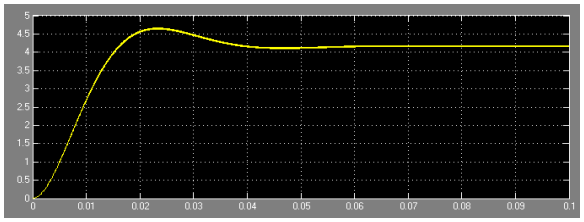

Figure 9. Output current

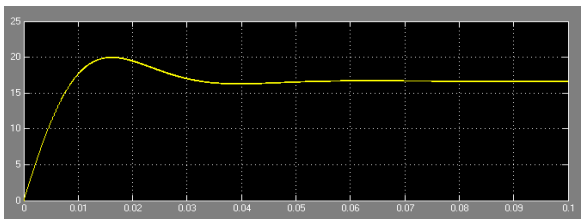

Figure 10. Inductor current

It is clear by using proposed system (feedback control system) fluctuating in waveforms is disappear and constant dc output voltage is produced. Efficiency can be increase by reducing the total losses of the converter.

IV. CONCLUSION

This study has presented electrical field in polluted condition for silicon rubber insulators. Simulation contains two different polluted conditions. As is clear from the simulation results there is difference between the electric field distributions in two different polluted conditions. It is clear the probability of electrical break in polluted condition with cement dust is more than the pollution condition with plywood dust and this related to the permittivity of each area. By using the corona ring this probability is reduced and as future work the design of corona ring is considered

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