Design and analysis of Single ended primary inductance Converter (SEPIC) for Battery Operated devices using MATLAB Simulation

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Abstract: - *In present scenario, different portable electronic devices are implemented with dc-dc converters, that are able to gain high efficiency with a wide input and output ranges with smaller sizes. But the conventional converters can't maintain the specified criterion, especially if up and down voltage has to be achieved. This can be obtained by SEPIC Converter. The SEPIC-voltage regulator is a good choice for non-isolated battery-powered systems. The topology is able to both buck and boost the voltage, and unlike a conventional buck/boost regulator, supply a non-inverted- and zero-volt output. Due to this the input current example of the SEPIC is smooth (because of the inductor) and the output current signal is chopped (because of the diode feeding the output) then the energy is passed across the capacitors are widely used because of its very high efficiency in PC power supplies , battery chargers DC motor power systems and different industrial applications.*

Key Words: SEPIC converter, Efficiency, Regulator

1. INTRODUCTION

The single-ended primary-inductance converter (SEPIC) is a DC/DC-converter topology that provides a positive regulated output voltage from an input voltage that varies from above to below the output voltage. This type of conversion is handy when the designer uses voltages (e.g., 12 V) from an unregulated input power supply such as a low-cost wall wart. Unfortunately, the SEPIC topology is difficult to understand and requires two inductors, making the power-supply footprint quite large. Recently, several inductor manufacturers began selling off-the-shelf coupled inductors in a single package at a cost only slightly higher than that of the comparable single inductor. The coupled inductor not only provides a smaller footprint but also, to get the same inductor ripple current, requires only half the inductance required for a SEPIC with two separate inductors. This article explains how to design a SEPIC converter with a coupled inductor.

Circuits run best with a steady and specific input. Controlling the input to specific sub circuits is crucial for fulfilling design requirements. AC-AC conversion can be easily done with a transformer; however dc-dc conversion is not as simple. Diodes and voltage bridges are useful for reducing voltage by a set amount, but can be inefficient. Voltage regulators can be used to provide a reference voltage. Additionally, battery voltage decreases as batteries discharge which can cause many problems if there is no voltage control. The most efficient method of regulating voltage through a circuit is with a dc-dc converter. There are 5 main types of dc-dc converters. Buck converters can only reduce voltage, boost converters can only increase voltage, and buck-boost, Cúk, and SEPIC converters can increase or decrease the voltage. Some applications of converters only need to buck or boost the voltage and can simply use the corresponding converters. However, sometimes the desired output voltage will be in the range of input voltage. When this is the case, it is usually best to use a converter that can decrease or increase the voltage. Buck-boost converters can be cheaper because they only require a single inductor and a capacitor. However, these converters suffer from a high amount of input current ripple. This ripple can create harmonics; in many applications these harmonics necessitate using a large capacitor or an LC filter. This often makes the buck-boost expensive or inefficient. Another issue that can complicate the usage of buck-boost converters is the fact that they invert the voltage. Cúk converters solve both of these problems by using an extra capacitor and inductor. However, both Cúk and buck-boost converter operation cause large amounts of electrical stress on the components, this can result in device failure or overheating. SEPIC converters solve both of these problems [1][3].

1.1 Design of SEPIC Converter

The purpose of this paper is to design and optimize a SEPIC dc/dc converter (Single Ended Primary Inductance Converter). The SEPIC converter allows a range of dc voltage to be adjusted to maintain a constant voltage output. This paper describes about the importance of dc-dc converters and why SEPIC converters are used instead of other dc-dc converters. All dc-dc converters operate by rapidly turning on and off a MOSFET, generally with a high frequency pulse. What the converter does as a result of this is what makes the SEPIC converter superior. For the SEPIC, when the pulse is high/the MOSFET is on, inductor 1 is charged by the input voltage and inductor 2 is charged by capacitor 1. The diode is off and the output is maintained by capacitor 2. When the pulse is low/the MOSFET is off, the inductors output through the diode to the load and the capacitors are charged.

The greater the percentage of time (duty cycle) the pulse is low, the greater the output will be.

This is because the longer the inductors charge, the greater their voltage will be. However, if the pulse lasts too long, the