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A Novel bridgeless SEPIC Converter for Power Factor Correction

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Abstract

In this paper, a new Power Factor Correction controlling technique using bridgeless SEPIC (single-ended primary induction) AC-DC converter with fuzzy control is proposed. The converter design has single switching device of MOFET, to reduce switching losses. This design also has Voltage and Current loop controlling technique to improve the Power Factor and output Voltage. Fuzzy logic controllersetup also improves the controller responses in this circuit. The output voltage depends on the switching frequency of the MOSFET. This proposed converter produces low conduction loss, low total harmonic reduction and high power factor reaching near-unity. This converter circuit is simulated with universal input voltage of 190V - 220V DC output Voltage connected to resistive load. All the simulation work is done using MATLAB – Simulink.

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*Keywords:*PFC; PI controller; BLSEPIC;Current controller; THD;Power Factor;Voltage controller

1. Introduction

Recently, power quality of the AC system has become a great challenge due to the heavy increase in Power electronic devices [1], [2]. The current flowing through power semi converter devices from the main, resulting in a

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high Total Harmonic Distortion (THD) and low Power Factor (PF) [3],[4]. The Power factor correction (PFC) plays an essential role in eliminating input power loss. Input power loss may emanate from input current harmonics. A PFC places the input current in phase with input voltage waveforms. When Power Factor is 1.0, the input Current is perfectly in phase with the input Voltage

Single-Ended Primary Inductance Converter (SEPIC) is a AC-DC buck-boost Rectifier that provides an output Voltage that changes from above to below the output Voltage [5], [6]. The output of this converter is positive, hence this is recommended in applications such as battery chargers, fan, Air-conditioners, motor drive and home appliances. The SEPIC has two separate inductors, making the power-supply entirely vast.

Bridgeless PFC topologies are currently gaining increasing interests. Generally, bridgeless PFC converters suffer from the difficulty of implementation of control circuit because of 2 switch, but a bridgeless topology can reduce conduction losses from rectifying bridges; thus, overall system efficiency can increased. In addition, a bridgeless topology has the advantage of total harmonic distortion (THD) decreasing from input diode reduction [7], [8].

More than that, due to strict needed things of improved power quality at input AC mains several standards been developed and are enforced on the consumers such increases cost, size, weight, and losses in the system [9]. These issues can be avoided utilizing newly developed single-stage improved power quality-DC converters; a new bridgeless SEPIC topology is explained in this paper. Unlike the boost, the SEPIC and bridgeless SEPIC converters have many several benefits in PFC applications, such as easier implementation of transformer isolation, input surge current limitation during start up and full-load conditions, lower input current ripple, and less electromagnetic interference.

2. Operation of the SEPIC Converter

2.1. Basic Circuit Diagram of SEPIC

The single ended primary inductance converter (SEPIC) is a DC to DC converter allowing the electrical voltage at it output to be greater than, less than or equal to its input. The SEPIC converter contains inductors L1 and L2, single MOSFET (S1), capacitor C1, diode D and output capacitor C2 and the circuit is shown in Fig 1.

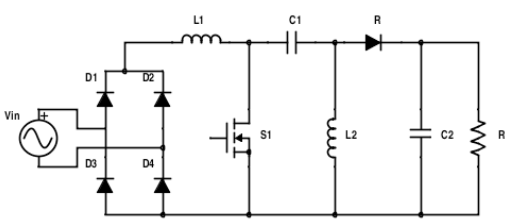

Fig 1:Basic SEPIC circuit

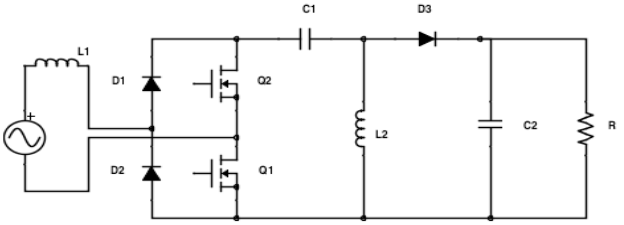

Fig 2:Basic Bridgeless SEPIC Circuit

2.2. Basic Circuit Diagram of Bridgeless SEPIC

The basic single stage Bridgeless SEPIC circuit is shown in Fig 2. In this system, there are two MOSFET switch replacing diode bridge rectifiers, which helps to reduce high conduction losses. But the controller circuit is complex to implement. And the size of the system too high. The circuit diagram of Bridgeless SEPIC is shown in Fig 2**.**

2.3. Design Calculation of Bridgeless SEPIC Converter Circuit

The fundamental operation of the SEPIC converter is, at the point when the switch S1 is turned on, the inductance L1 is charged, in the meantime the inductance L2 reads energy from the capacitance C2.The output