Hybrid Bridgeless DCM SEPIC Rectifier Integrated with a Modified Switched Capacitor Cell

Introduction:

The single-phase bridgeless rectifiers have been broadly employed at industry due to their reduced losses and number of components. Most of the current single-phase bridgeless rectifiers are based on conventional DC-DC converters, for instance, Boost, Buck-Boost, Cúk, Zeta and SEPIC, where high power factor can be obtained without the use of current control when they operate in DCM (discontinuous conduction mode).

SEPIC rectifiers have continuous input current even in discontinuous conduction mode making them attractive for this operation mode. However, a conventional SEPIC rectifier has high voltage stress on the semiconductors. Therefore, it is not attractive in electronic equipments, which demand high output voltages. On the other hand, converters based on switched capacitors can double the output voltage without increasing the voltage stress across the semiconductors.

Existing system:

The single-ended primary-inductor converter (SEPIC) is a type of DC/DC converter allowing the electrical potential (voltage) at its output to be greater than, less than, or equal to that at its input. The output of the SEPIC is controlled by the duty cycle of the control transistor.
A SEPIC is essentially a boost converter followed by a buck-boost converter, therefore it is similar to a traditional buck-boost converter, but has advantages of having non-inverted output (the output has the same voltage polarity as the input), using a series capacitor to couple energy from the input to the output (and thus can respond more gracefully to a short-circuit output), and being capable of true shutdown: when the switch is turned off, its output drops to 0 V, following a fairly hefty transient dump of charge.

**Drawbacks:**

- A capacitor with high capacitance and current handling capability is required.
- The SEPIC has a pulsating output current
- The SEPIC converter difficult to control, making it only suitable for very slow varying applications.
Proposed system:

A novel single-phase PWM bridgeless rectifier, based on SEPIC converter topology, integrated with a modified switched capacitor cell. The structure has the absence of the diode bridge at the input port reducing the number of components and conduction losses. Besides, it has the presence of a switched capacitor cell, providing double gain at the output voltage. The proposed topology of the single-phase bridgeless SEPIC rectifier integrated with a voltage multiplier stage, which is based on the switched capacitor cell. The bridgeless rectifier structure is composed of the following components: $L_i, D_1, D_3, S_1, S_2, C_{i1}, D_{o1}, L_o$ and $C_{o1}$. The absence of an input diode bridge reduces the number of components and the presence of only one diode and one switch in the flowing current path, during each switching cycle, can result in less conduction losses. The rectifier employs two switches, but both use the same gate signal.
Advantages:
- Lower voltage stress on the semiconductors.
- Double static gain.
- Reduces the number of components.
- Decreasing the conduction losses.

Applications:
- Applications which require higher output voltages and lower voltage stresses.
Block diagram:

- AC Supply
- SEPIC Converter
- Switched Capacitor Cell
- Load

12V DC
- Isolation Circuit

5V DC
- Buffer Circuit
- Micro Controller Circuit