Reduced Current Stress Bridgeless Cuk PFC Converter with New Voltage Multiplier Circuit

Introduction:

With the development of computer, communication, consumer electronic production and electric vehicle, the power supplies and/or power chargers with active power correction techniques are becoming necessary to meet harmonic regulation and standards. So far, most power factor correction circuits are implemented by the boost type converters due to its low cost and high performance in terms of simplicity, efficiency and unity power factor ability. However, for universal input voltage, the boost converter suffers from lower efficiency at low input voltage, which led to the development of bridgeless topology. A system review of performance comparison with the conventional PFC boost rectifier was drawn attention. The bridgeless boost rectifier also has the same major practical drawbacks as the conventional one, including that the start-up inrush current is high; the dc output voltage is always higher than the peak input voltage, and input-output isolation cannot easily be implemented.

Existing system:

The topologies all suffer from high current stresses of active switches due to the switch currents flowing together coming from input PFC current and output load current such as bridge Cuk derived AC/DC converters), respectively, which results in to decrease the power rating and lifetime of the power converter. The conventional
one, including that the start-up inrush current is high, the dc output voltage is always higher than the peak input voltage, and input-output isolation cannot easily be implemented.

Drawbacks:

- Decrease the power rating.
- Decrease lifetime of the power converter.
- Inrush current is high.
- The dc output voltage is always higher.

Proposed system:

A new single phase ac-dc Cuk derived PFC bridgeless rectifier with voltage multiplier is introduced. The bridgeless topology with reduced switch current stress can increase the power rating and lifetime of the power converter. Although the four switches are utilized, the active switches all have semi-soft switching function, which implies there only exists one-half switching power losses of the four switches. In addition, the voltage gain also can be extended without extreme duty cycle operation which makes the proposed topology suitable for universal line voltage applications. The proposed bridgeless Cuk derived PFC rectifier with voltage multiplier cell. Where SW1 and SW2 is the PFC switch module and controlled by the PFC-controlled duty Dw, and So1 and So2 is the output voltage switch module and controlled by the output-voltage-controlled duty.
Do. Since the proposed circuit consists of two symmetrical configurations, the circuit is only analyzed in the positive half line cycle. First, assuming that the $L_1$ inductor is operating in CCM and the $L_2$ is operating in DCM, then the key waveforms of proposed bridgeless converter during one switching period $T_s$ in a positive half-line period and the circuit operation can be divided into four distinct operating modes.

Advantages:
- Voltage gain can be extended without extreme duty cycle operation.
- Reduced switch current stress can increase the power rating and lifetime of the power converter.
- Improves system thermal management.

Applications:
- Universal line voltage applications.
- Computer.
- Communication.
- Consumer electronic production.
- Electric vehicle.
- Power supplies and/or power chargers.
Block diagram:

- **Input AC Supply**
- **CUK circuit**
- **filter**
- **Load**

- **12V DC**
- **Driver Circuit**

- **5V DC**
- **Buffer Circuit**
- **Micro Controller Circuit**