Single-Stage Bridgeless AC-DC PFC Converter Using a Lossless Passive Snubber and Valley-Switching

Introduction:
With numerous advances in industrial technology, the requirements of a switch mode power supply (SMPS) such as an AC-DC converter are becoming more stringent because they require high power efficiency and low harmonic distortion. In context of these requirements, several strategies have been studied to achieve high power factor, low conduction losses, and low switching losses in AC-DC converters. Generally, the scheme of an AC-DC converter can be classified into two-stage and single-stage. Over the past few decades, a two-stage scheme comprising a power factor correction (PFC) stage and an output regulation stage was usually adopted because it is easy to design regardless of each stage and it provides very good performance such as high power factor and low harmonic distortion.

Existing system:
Two stage and an output regulation stage was usually adopted because it is easy to design regardless of each stage and it provides very good performance such as high power factor and low harmonic distortion. However, the control circuit is complex and the cost, component count, and size of the converter increase because each power stage needs a control system. In addition, the two-stage scheme has a lower power efficiency compared to single-stage scheme. In the single-stage scheme, a PFC stage and an output regulation stage are
merged using shared common switches. As a result, the total component count and size decreases and the power efficiency increase, making the single-stage scheme suitable for cost-effective solutions. However, the single-stage scheme has still some major drawbacks, such as low efficiency and high DC-bus voltage stress.

**Drawbacks:**
- Low efficiency.
- High DC-bus voltage stress.
- Low power factor.
- High harmonic distortion.

**Proposed system:**

The input line filter includes $L_f$ and $C_f$. In the bridgeless boost rectifier, switching devices, such as $D_1$, $D_2$, $S_1$, and $S_2$, are used. $D_{S1}$ and $D_{S2}$ are body diodes of $S_1$ and $S_2$. $L_b$ is the boost inductor circuit. In the DC-DC flyback circuit, there is a coupled inductor $T_1$, shared common switches $S_1$ and $S_2$, DC-bus capacitor $C_{dc}$, output diode $D_o$ and output capacitor $C_o$ with lossless snubber circuit including $L_{sn}$, $C_{sn}$, and $D_{sn}$. The input line filters are not included,
and the input voltage is considered as constant in a switching period. The capacitors CS1 and CS2 are the parasitic output capacitances of S1 and S2, respectively. The coupled inductor T1 includes a magnetizing inductor Lm and a leakage inductor Lk with the turn ratio n:1 (n = Np / Ns). According to the volt-second balance law, since the average inductor voltage should be zero at steady state, the voltages across Csn and Cdc are equal to Vdc. The capacitance of Csn, Cdc, and Co is large enough to regard the voltages across them to be of a constant value.

Advantages:

- Total component count and size decreases.
- Power efficiency increases, making the single-stage scheme suitable for cost-effective solutions.

Applications:

- Electrolytic-less led lighting.
- Switch mode power supply (SMPS).
Block diagram:

1. Input AC Supply
2. Bridgeless boost circuit
3. Flyback lossless snubber circuit
4. Isolation Transformer
5. Rectifier
6. Load
7. Driver Circuit
8. Buffer Circuit
9. Micro Controller Circuit

12V DC
5V DC