High-Efficiency Asymmetric Forward-Flyback Converter for Wide Output Power Range

Introduction:
Flyback converter is an isolated step down dc/dc converter that is composed only of one switch, one transformer, and one diode. It has been used widely for an output power $p_0 \leq 100\,\text{w}$ because of the simplicity of circuit. However, the flyback converter has low power conversion efficiency $\eta_e$ at a low $p_0$ because the switching frequency increases as $p_0$ decreases, and its switch is subjected to high-voltage stress because of the leakage inductance $l_{lk1}$ from transformer.

Existing system:
The asymmetric half-bridge (AHB) converter has been used in the power supplies for plasma display panels and liquid crystal displays, which require $100 \leq PO \leq 500\,\text{W}$ and in adapters, battery chargers, and light emitting Diode lamp drivers, which require $PO \leq 100\,\text{W}$. The primary stage of the AHB is similar to that of the flyback converter and the secondary stage is the same as that of the half-bridge converter.

AHB remedies the deficiencies of the flyback converter by using a switch $S2$ at the primary stage to provide a free-wheeling path for the energy stored in the transformer leakage inductance $L_{lk1}$. The off-state voltage of switch $S2$ is clamped to the input voltage $V_{IN}$. AHB converter uses $L_{lk1}$ to achieve a zero-voltage switching (ZVS) turn-on of $S1$ and
$S_2$ at a fixed switching frequency, so it has high $\eta e$. However, $Llk1$ must be high to achieve ZVS for a wide range of $PO$, so the duty loss to provide a freewheeling path for the rectifier diodes $D1$ and $D2$ increases. An additional problem is that $D1$ and $D2$ suffer from a voltage ringing problem that is caused by a resonance between $Llk1$ and the parasitic capacitance of $D1$ and $D2$.

**Dis-advantages:**

- Its switch is subjected to high-voltage stress.
- Low power conversion efficiency

**Proposed system:**

A dc–dc converter that uses a blocking capacitor $CB$ in the primary stage, instead of $CC$, and a voltage doubler structure with a forward inductor $Lf$ is proposed. The proposed asymmetric forward-flyback dc–dc converter is a good candidate for developing a step-down dc–dc converter for applications that require high power-conversion efficiency over wide ranges of input voltage and output power.

The proposed converter increases the range of $VIN$ by using unbalanced secondary turns of transformer, and can reduce the voltage stress of switches and the current stress of diodes.
The primary stage of the proposed converter is the same as that of the AHB converter. The two switches $S_1$ and $S_2$ operate at different duty ratios. The secondary stage is a voltage doubler circuit with a forward inductor $L_f$, which helps achieve ZVS turn-on of $S_1$ and $S_2$, and acts as an output filter. The problem of the duty loss, which is observed in the AHB converter, is minimized because no freewheeling current flows through $D_1$ and $D_2$; a resonance between $L_f$ and $C_1$, and $C_2$ achieves ZCS turn-off of diodes. Also, $C_1$ and $C_2$ remove the voltage ringing in the rectifier diodes by clamping the reverse voltage of $D_1$ and $D_2$.

**Advantages:**
- All inductors and capacitors are loss free;
- $C_b$ is large enough, so that the voltage ripple of $c_b$ is negligible and $c_b$ can be represented by a constant voltage source $v_{cb}$. 
Applications:
- Power conversion applications.

Block diagram:

- DC source
- Asymmetric Forward Flyback Converter
- Load
- Gate driver circuit
- Buffer circuit
- PIC controller circuit
- 12VDC
- 5VDC

Copyright © 2017 LeMeniz Infotech. All rights reserved