

A High Switching Frequency Flyback Converter in Quasi Resonant Mode

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Abstract - The demand for micro-scaling of power systems has boosted the research on high-switching-frequency power converters. A flyback converter operating in resonant mode featuring low switching losses, low transformer losses, and reduced switching noise at higher switching frequencies are investigated in this article as an alternative to the conventional quasi-state resonance based flyback topology to improve power density. In order to get a compromise between the magnet size, electromagnetic interference (EMI), and efficiency the proposed methodology implements a resonant system between transformer and leakage inductance with a snubber capacitor in order to obtain a zero-voltage switching at turn-on and turn-off of the primary switch with reduced core loss due to a continuous magnetizing current to the transformer and also a lower EMI due to low di/dt and dv/dt ranges. Meanwhile, the concept uses the regenerative snubber to recycle the transformer leakage power consisting of two snubber diodes and a snubber capacitor. The proposed methodology has been verified on a 340 kHz 65W prototype design. Compared with the conventional quasi-resonant flyback converter that is operating at the same switching frequency, the proposed concept has 2% efficiency improvement and better EMI performance.

Keywords: Flyback Converter, High Switching Frequency, Quasi Resonant Mode, Electromagnetic Interference.

I. INTRODUCTION

The flyback converter topology is widely used for low-power DC-DC converters. Nowadays, power density is becoming a more important factor to evaluate such DC-DC converters. Increasing the switching frequency is a potential solution for high power density,

since higher switching frequency allows using lower inductance, i.e. less turns in the transformer and a smaller core [1]. Nevertheless, some problems appear at high switching frequency: (a) the switching loss at turn-off and turn-on of the primary switch will increase linearly with increasing switching frequency, (b) more leakage energy of the transformer will be dissipated in the RCD snubber network, (c) both AC copper losses due to skin effect and proximity effect in windings and core loss will increase significantly [2], and (d) large di/dt and dv/dt values deteriorate the high-frequency noise, where the fundamental harmonic in the frequency band (150kHz – 30MHz) requires more attenuation.

II. EXISTING SYSTEM

The fly back converter topology is widely used for low power dc-dc converters. Power density is becoming a more important factor to evaluate the dc-dc converters [3]-[5]. Increasing the switching frequency is a potential solution for high power density, since higher switching frequency allows using lower inductance. High switching frequency is produced some problems:

- The switching loss at turn-off and turn-on of the primary switch will increase linearly with increasing switching frequency.
- More leakage energy of the transformer will be dissipated in the RCD snubber network.

III. PROPOSED SYSTEM

A fly back converter in resonant mode that features low switching losses, less transformer losses with reduced switching noise operating under high switching frequencies [6]. Alternative to a conventional quasi-resonant fly back topology to increase power density. To utilize the resonant behavior between transformer

leakage inductance and snubber capacitor in order to obtain an absolute zero voltage switching during both turn-on and turn-off stated of the main primary switch [7]. Here the results obtained show a low core loss due to the continuous magnetizing current to the transformer that tends to produce reduced EMI due to low di/dt and dv/dt ranges.

a) Block Diagram

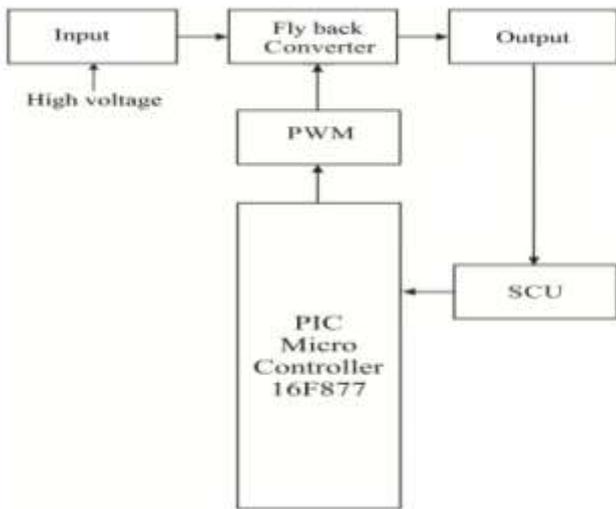


Figure-1: Block Diagram of Proposed System

It uses the regenerative snubber to recycle the transformer leakage energy with two snubber diodes and one snubber capacitor compared with a conventional quasi-resonant flyback converters operating at the same switching frequency. Fundamental harmonic frequency band range (340 kHz / 65W). It has 2% efficiency improvement and better EMI performance.

b) Circuit Diagram

The circuit diagram of the proposed Quasi Resonant mode Fly-Back converter is as shown in figure-2, which shows the primary switch S_i and output switch S_o that are N-Channel MOSFETs with the snubber capacitor C_r and snubber Diodes D_1 and D_2 . C_o is the output filter capacitor which stabilizes the output DC voltage. The load resistor R_o acts as resistive load. The primary and secondary windings are mentioned as L_{pri} and L_{sec} which is the transformer core. The L_1 and L_{s2} are the current limiting inductors reducing the surge currents.

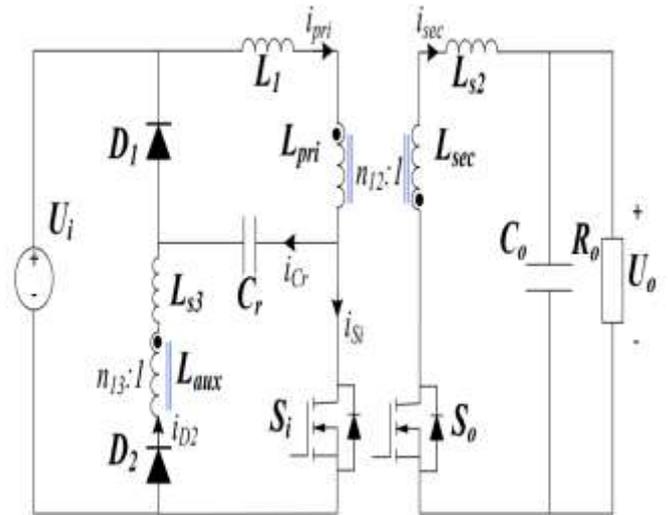


Figure-2: Circuit Diagram of Proposed System

c) Output Result Waveform

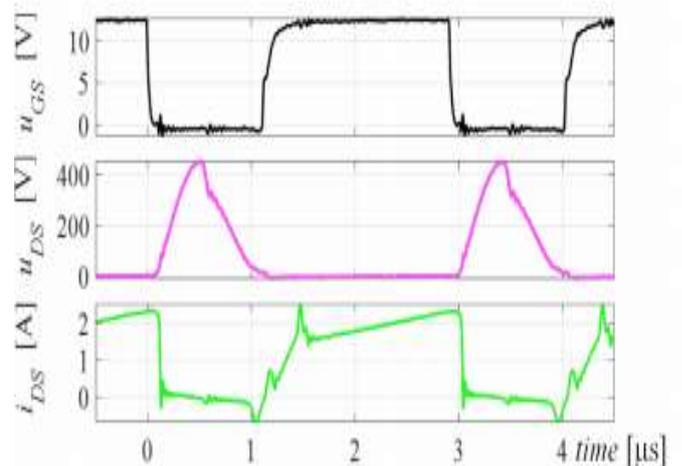


Figure-3: Switch Voltage and Current Wave Form

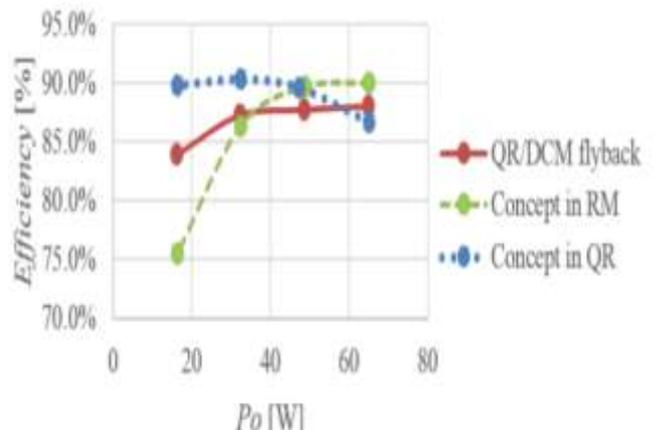


Figure-4: Efficiency Curves of QR/DCM

Advantages

- Low power consumption
- Compatibility
- low switching losses
- less transformer losses
- low switching noise at high switching frequency
- Efficiency improvement and better EMI performance

IV. CONCLUSION

In this work, a flyback converter in resonant mode is proposed to enable soft switching with reduced transformer loss and lower EMI under high switching frequencies. The conventional flyback converter is operating in QR/Discontinuous conduction mode. The resonant-mode operation of the proposed Quasi Sate Resonant flyback converter has enabled a higher power capacity, improved operating efficiency and better EMI interference at high switching frequency. It has 3% efficiency improvement and better EMI performance.

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