에너지 재생 스너버를 갖는 고효율 두 스위치 플라이백 컨버터

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A High-Efficiency Two-Switch Flyback Converter with Energy Recovery Snubbers

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Abstract

A novel soft-switching two-switch flyback converter is proposed in this paper. This converter is composed of two active power switches, a flyback transformer, and two passive regenerative clamping circuits.The proposed converter has the advantages of a low cost circuit configuration, a simple control scheme, a high efficiency, and a wide operating range. The circuit topology and experimental results of the new flyback converter are presented.

I. Introduction

In high frequency power electronics applications, it is necessary to use an energy recovery snubber to reduce switching losses, by regenerating the energy trapped in the snubber circuit to the load or back to the input source.

For the two-transistor flyback converter, which has not been widely reported in the literature in spite of high reliability, [1] has proposed soft switching technique to reduce switching losses as shown in Fig. 1(a). This soft switching technique, however, shows high conduction loss due to a blocking diode Db. To overcome this weak point, Db should be disappeared. In this paper, which will also be extensively published in [2], the blocking diode Db is eliminated to reduce the conduction loss as shown in Fig. 1(b).

II. Experimental Evaluations

To determine the feasibility of the proposed soft-switching two-switch flyback converter, a prototype of the circuit shown in Fig. 2(b) was built. The following are the circuit parameters used in the experiment:

$f_s = 25\,kHz$, $n = 2.4$, $L_1 = 1.25\,mH$, $L_{lk} = 33\,\mu H$, $C_{s1} = C_{s2} = 6.6\,nF$, $L_{s1} = L_{s2} = 200\,\mu\mathrm{H}$. For S_1 and S_2 , IRF 840 is used. For D_3 and D_4 , DSEI 12-06A is used. And DSEI 30-10A is used for D_o and D_p .

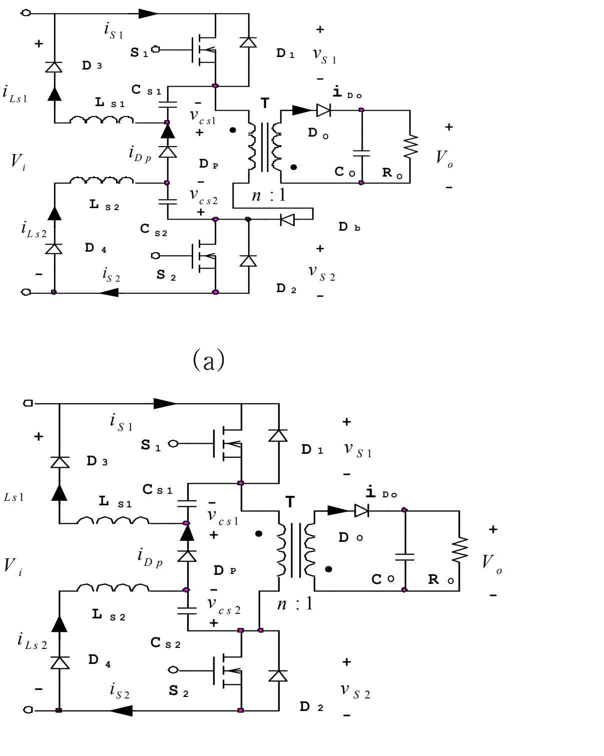

Fig 1. (a) Previous circuit[1] (b) Proposed circuit[2]

Experimental voltage and current waveforms of the active power switch S_2 are illustrated D=0.31 in Fig. 2. From the experimental waveforms, the active switch turns on under a zero current condition and turns off under a zero voltage condition. The experimental waveforms show excellent agreement with theoretical results.

Experimental voltage across C_{s2} and current through D_p are illustrated in Fig. 3. Fig. 4 shows experimental waveforms of V_{cs2} and i_{Ls2}.

In Fig. 5, the measured efficiency of the proposed converter as a function of the output power is represented. The maximum efficiency obtained from this flyback converter is 94.5 %. This efficiency increases approximately 1.5-2.5 % in relation to the previous work[1]. Fig. 6 shows experimental line voltage and current waveforms. The measured input power factor is 0.97.

References

[1] M.G. Kim and Y.S. Jung, " A Novel Soft-Switching Two-Switch Flyback Converter with a Wide Operating Range and Regenerative Clamping " Journal of Power Electronics, Vol. 9, No. 5, pp. 772-780, September 2009.

[2] M.G. Kim and Y.S. Jung, " An Improved Two-Switch Flyback Converter with Regenerative Clamping " To be published in International Journal of Electronics.

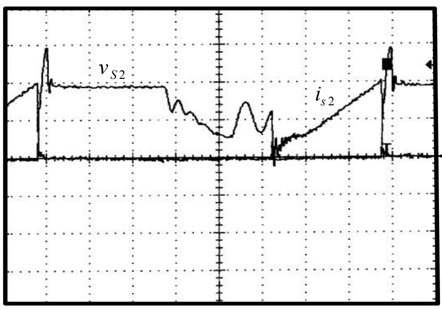

Fig. 2 Experimental waveforms (V_i=200 V) : v_{s2} (100 V/div) and i_{s2} (1 A/div), time: 5 μs /div

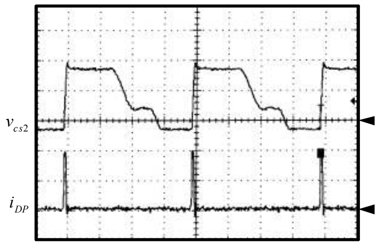

Fig. 3 Experimental waveforms (V_i=200 V) : v_{cs2} (100 V/div) and i_{Dp} (1 A/div), time: 10 μs /div

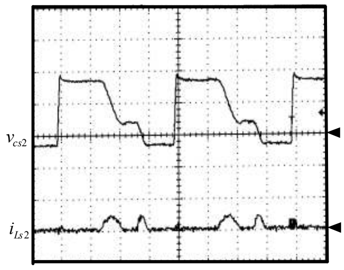

Fig. 4 Experimental waveforms (V_i=200 V) : v_{cs2} (100 V/div) and i_{Ls2} (0.5 A/div), time: 10 μs /div

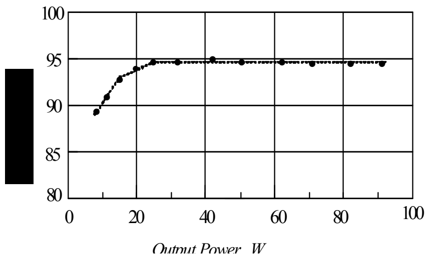

Fig. 5 Measured efficiency as a function of the output power when $V_i = 200\,V$, $V_o = 80\,V$, and f_s = 25 kHz

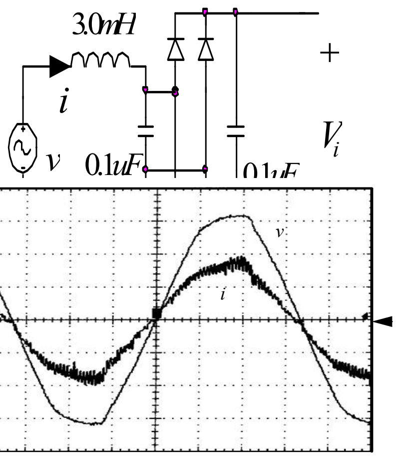

Fig. 6 Line voltage and current waveforms . Outer trace: line voltage at 100 V/div; inner trace: line current at 0.2 A/div. Time base is 2.5 ms /div