© November 2019 | IJIRT | Volume 6 Issue 6 | ISSN: 2349-6002

Design and Experimental Method of Quasi-Resonant Current-Fed Converter with Minimum Switching

Mrs.V.M.Moulica[1], Mrs. Svenkat[2]
[2]*Guide, BE. M.Tech*

***Abstract*- A quasi-resonant dc–dc converter with high voltage gain and low current stresses on switches is proposed. This converter preserved inherent advantages of current-fed structures, for instance, zero magnetizing dc offset, low input ripple, and low transformer turn ratio. Moreover, by employing the active-clamp circuit, the voltage spikes across the main switch, due to the existence of leakage inductance of the isolating transformer, is absorbed, and switches work in zero voltage switching. Since quasi-resonant switching strategy is employed, turn-off current (TOC) and losses of switches are considerably reduced. Because of zero current switching (ZCS), reverse recovery problem of diodes is alleviated. Experimental results on a 150-W prototype are provide to validate the proposed concept.**

INTRODUCTION

The isolated boost DC-DC converter has been increasingly needed in many applications such as fuel cell systems, photovoltaic systems, hybrid electric vehicles, and UPS where the use of high frequency transformers for high step-up ratio and galvanic isolation are required. Due to the advantages of smaller input current ripple, lower diode voltage rating and lower transformer turns ratio, the current-fed converter is better suited to high step-up applications. The active-clamped current-fed converter has been introduced based on three topologies: push-pull, full-bridge and L-type half bridge. They achieve not only lossless clamping of voltage spikes across the switch caused by leakage inductance of the transformer but ZVS operation of switches. The active clamped push-pull converter has the simplest structure among them, but center-tapping of the transformer at the low voltage, high current side could be a challenge in manufacturing. The active-clamped full-bridge converter requires an additional switch for clamping, and the switching frequency of the clamp switch should be twice that of the main switch. The active clamped L-type half-bridge converter does not need either additional clamp switch as in the active-clamped full-bridge converter or transformer center-tapping as in the active clamped push-pull converter.

FAST CHARGING

As previously mentioned, present EVs are equipped with on-board battery chargers, but in order to be able to compete with the ICE driven vehicles by means of daily driving range, a fast charging infrastructure is needed. There are however problems with the building of a fast charger infrastructure as well. First, the cost of chargers is high and second, designs based on diode or thyristor technology could result in current harmonics and voltage distortion.

CHARGER INFRASTRUCTURE

One way to cope with the problem of the initial high cost of the charging infrastructure, is to make it advantageous both for the power delivering company and for the EV owners. It was previously mentioned that Introduction battery charger using a diode or thyristor based grid interface usually consumes non-sinusoidal current and thus injects harmonics into the grid. If a battery charger infrastructure is built solely on such chargers there would typically be problems like thermal overloading of transformers and shunt capacitors. Furthermore, malfunction of equipment sensitive to disturbances is going to be a problem. If, on the other hand, battery chargers with a power transistor grid interface are used, they can be controlled to inject or consume currents of arbitrary waveform.

OBJECTIVES

The designing of ZCS buck converter for USB power adapter application is the aims of this thesis. To achieve these aims, the objectives of this report are formulated as follow:

1. To propose soft switching buck converter with ZCS for its switch using as simple circuit as possible.
2. To compute the optimal values of resonant converter by applying the characteristic curve and mathematical calculation from the circuit configuration.
3. To simulate the ZCS resonant buck converter using Or CAD Capture CIS software.
4. To analyze the resonant current and voltage waveforms and the switching voltage and current waveforms.
5. To compare the conventional DC-DC buck converter and the proposed soft-switching DC-DC buck converter in terms of switching loss reduction.

LITERATURE SURVEY

Switched mode Pulse Width Modulation technique based DC-DC converters have become an essential element of many commercial, military, communication, automobile, computer and space applications.

Barbie.et.al [4]-[5], Lee.et.al [6]-[7] introduced Quasi-resonant converters to overwhelm the losses due to hard switching. ZVS was better suited over ZCS for many DC–DC converters as reported in literature.

EXISTING SYSTEM

The existing dc–dc converter with voltage isolation, low input current ripple, and high step-up capabilities resulting in high efficiency is required. In addition, high switching frequency is essential for having a high-power density conversion. Even so, high switching frequency causes some problems such as high switching losses, high voltage and/or current spikes, and electromagnetic interference. To eliminate these problems, soft-switching operation is employed in dc–dc converters. In order to provide the soft-switching condition, an auxiliary switch is added to a regular dc–dc converter. The converters which are used for renewable energy resources can be classified into two major categories, which are current-fed and voltage-fed converters. Voltage-fed converters have many advantages like, low switch voltage and simple implementation, but they need high transformer turn ratio. Consequently, the leakage inductance will be large, and it causes high voltage spikes on the switches.

DISADVANTAGES

- High voltage spikes
- Leakage inductance
- High switching losses

PROPOSED SYSTEM

The proposed converter works under ZVS condition for both switches. Also, the main switch operates in below-resonant mode, while the active-clamp switch operates in above-resonant mode in order to retain ZVS condition for the main switch, making switching losses are minimum. The leakage inductance of transformer has been employed

to make the resonant circuit with clamp capacitor. Low input current ripple which is appropriate for FC applications has been made by using a boost circuit at the input of the converter. At the output, to obtain high voltage gain, a voltage doubler circuit has been used. ZCS condition achieved for output diodes working under ZCS alleviates their reverse recovery problem and reduces their switching losses. Finally, the proposed converter power loss has been compared with an L–L-type half-bridge converter, and it was concluded that by employing quasi-resonant performance, total power loss has been reduced.

ADVANTAGES

- Less cost
- Highly reliable in operation
- Reduces loss

CIRCUIT DIAGRAM

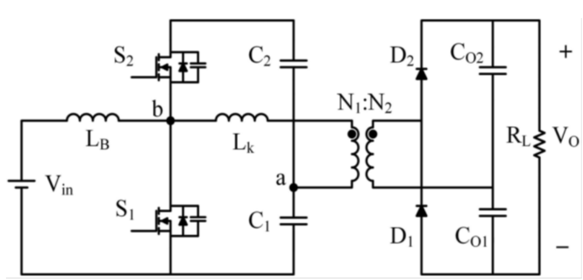
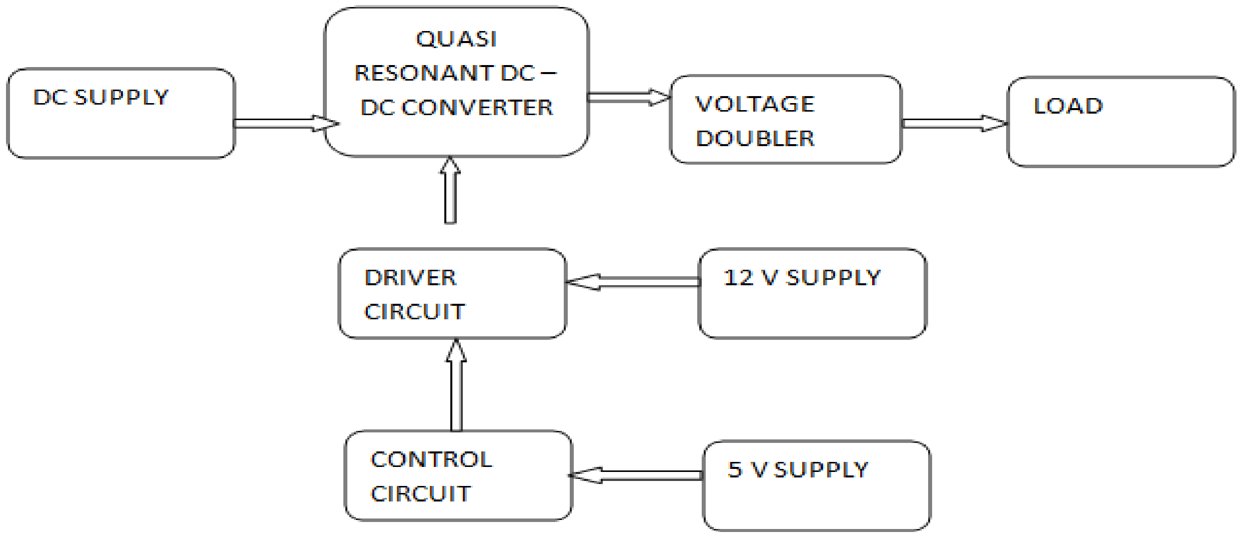


Fig. 4.1 CIRCUIT DIAGRAM

BLOCK DIAGRAM



Simulation final waveforms

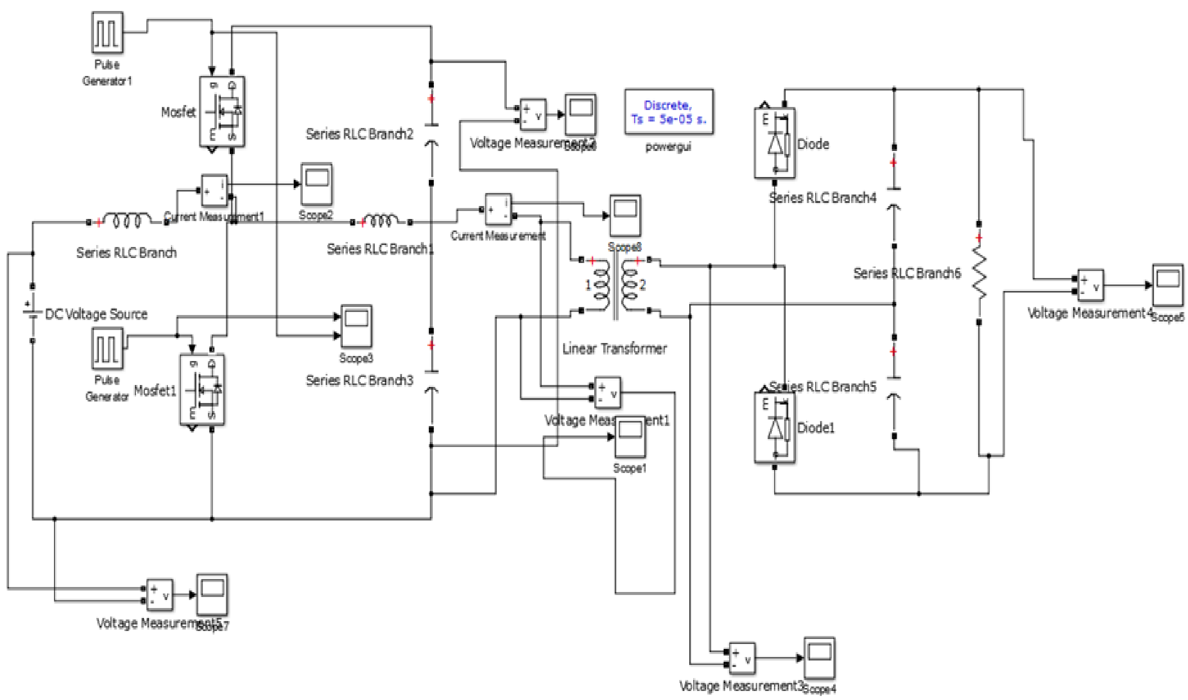


Fig.6.1 MATLAB: SIMULATION FINAL DIAGRAM

CONCLUSIONS

This paper proposes an improved switching method for an active-clamped BHB converter for high step-up application. The clamp capacitors are also used as a resonant capacitor for the QR operation during switch turn-on process so as to reduce the turn-off current of the switches. A small external capacitor across lower switches helps further reduce the turn-off switching losses. Experimental results on a 1.2kW prototype demonstrated 2.8% of full load efficiency improvement of the proposed scheme. In this thesis simulation is implemented as a hardware kit.

REFERENCES

[1] E. Kim, B. Kwon, "High Step-Up Resonant Push-Pull Converter With High Efficiency", IET Power Electron, Vol. 2, pp. 79-89, Jan. 2009.

[2] F. J. Nome, I. Barbi, "A ZVS Clamping Mode-Current-Fed Push-Pull DC-DC Converter", IEEE Trans. Power Electron., Vol. 23, pp.2784-2793, Nov. 2008.

[3] V. Yakushev, V. Meleshin, S. Fraidlin, " Full-Bridge Isolated Current Fed Converter With Active Clamp", in Proc. IEEE APEC 1999, Mar., vol.1, pp.560-566.

[4] R. Watson, F. C. Lee, " A Soft-Switched, Full-Bridge Boost Converter Employing an Active Clamp Circuit", Proc. IEEE PES C"96., pp.1948-1954, Jun. 1996.

[5] S. Jang, C. Won, B. Lee, J. Hur, " Fuel Cell Generation System With a New Active Clamping Current-Fed Half-Bridge Converter", IEEE Trans. Energy Convers., Vol. 22, pp.332-340, June. 2007.

[6] S. Han, H. Yoon, G. Moon, M. Youn, Y. Kim, K. Lee, "A new active clamping zero-voltage switching PWM current-fed half-bridge converter", IEEE Trans. Power Electron., vol. 20, pp. 1271-1279, Nov. 2005.