RESEARCH ON A ZERO-CURRENT-SWITCHED (ZCS) ISOLATED FULL-BRIDGE BOOST CONVERTER WITH MULTIPLE INPUTS

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ABSTRACT

This thesis presents a research on the zero-current-switching (ZCS) isolated full-bridge (FB) boost converter with multiple inputs.

By connecting a simple auxiliary circuit, between the full-bridge input and the input choke, in each module, the transformer leakage inductance and output capacitance of the switching devices are used to create a quasi-resonant path for facilitating zero-current-switching of all switching devices.

A new switching strategy for the auxiliary circuit used with the modular-based structure will be discussed. The control only requires a simple control circuit. By monitoring the low-side FB switches gate signals of the corresponding module, the operation of the auxiliary circuit integrates into the FB circuit and each auxiliary circuit operates independently among the modules. Thus, the operation of the multiple-input structure will not be affected by the newly added auxiliary circuits, but, at the same time, all switches become zero-current-switched.

The contents of this thesis are as follows.

In Chapter 1, an introduction on historical development of switching mode power supplies will be given. An energy efficient burn-in process will be discussed. It can save up huge amount of energy. A modular-based converter for the burn-in system will be discussed.

In Chapter 2, a brief investigation on the characteristics of different multiple-inputs DC-DC converter will be given. The advantages and disadvantages of those converters will be studied and discussed. There are many requirements in conducting burn-in process. Some critical characteristics of the multiple-inputs DC-DC converter are needed to be considered.

In Chapter 3, a comparative study would be given on different methods that converts hard-switched isolated full-bridge boost converter into a soft-switched one and eliminating the effect of the unavoidable leakage inductance of the isolation transformer. It will be shown that those discussed methods cannot be applied directly into modular-based isolated full-bridge boost converter structure. Limitations of those topologies will be discussed.

In Chapter 4, the proposed modular-based, zero-current-switching (ZCS), isolated full-bridge boost converter with multiple inputs will be introduced. A new control strategy to the auxiliary circuit will be introduced. Then, detailed steady state analysis on the chosen modular-based structure including the proposed auxiliary circuit will be given. Then, the calculation method of the soft-switching criteria will be given. The value of all passive components can be determined by the maximum loading and minimum loading condition. A 290W prototype including 2 modules with different voltage and current input has been built to show the performance. Moreover, experimental measurement results will be given to compare between the actual performance and the theoretical predictions. The effectiveness of the proposed auxiliary circuit on improving the conversion efficiency will also be studied.

In Chapter 5, an overall conclusion of the research topics and some suggestions for further research will be given.

TABLE OF CONTENTS