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Non Isolated Multiport Converter Based on Integration of PWM Converter and Phase Shift Switched Capacitor Converter

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ABSTRACT: Rechargeable batteries present in Photovoltaic (PV) systems are prone to be complex and costly because multiple converters are necessary to individually regulate a load, battery, and PV panel. This paper develops novel non isolated multiport converters (MPCs) integrates bidirectional PWM converter and phase-shift switched capacitor converter (PS-SCC). A PWM converter and PS-SCC are integrated to reduce the entire switch count and realizing the simplified system AND circuit. In the proposed MPCs, two control freedoms of duty cycle and phase shift angle are manipulated for regulating the load, PV panel, and/or battery. The detailed practical analysis was performed to mathematically derive gain characteristics and ZVS operation boundaries. For the battery discharging mode, during which the PV panel isn't available and therefore the MPC behaves as a single-input–single-output converter with two control freedoms available, the optimized control scheme achieving rock bottom RMS current is additionally proposed to maximise power conversion efficiencies. Various sorts of experimental verification tests employing a 200-W prototype were performed to verify the theoretical analysis and to demonstrate the performance of the proposed MPC.

KEYWORDS: Battery Recharging, Multiple Inputs, Power Conversion.

I. INTRODUCTION

Recent power systems are prone to be complex and costly as they have multiple power sources and loads. Photovoltaic (PV) systems, for example, consist of not only PV panels but also have rechargeable batteries to supply power during weather-dependent unstable power generation of panels. Hybrid electric vehicles also contain multiple power sources including a generator and multiple batteries for various loads. In such multi-power-source systems, multiple converters in proportion to the number of power sources are required to regulate power sources individually.

If N no of sources are used, then N number of converters are required. To reduce the converter, count in these type of systems, various kinds of multiport converters (MPCs) that integrate multiple converters into a single unit.This paper proposes non isolated MPCs based on PS-SCCs for standalone PV systems. A traditional bidirectional PWM converter and PS-SCC are integrated with sharing active switches, achieving simplified circuit. The remaining of this paper is organized as follows. Also it presents the derivation and major features of the proposed MPCs. This system introduces three operation scenarios and control schemes in the proposed MPCs. The detailed operation analyses will be performed. A design example for a 200-W experimental prototype will be presented followed by the experimental verification. The proposed and conventional MPCs will be compared from various aspects.

II.SYSTEM MODEL

The combination of a standard bidirectional PWM converter (a) and PS-SCC (b) derives a proposed non isolated MPC. Another key circuit element is a non-isolated DAB converter (c) which can be derived from the PS-SCC. To be specific, by breaking the source pin of Q3 in the PS-SCC and connecting it to the ground, the PS-SCC can be transformed into the non-isolated DAB converter. Fundamental operation principle and major features of the non-isolated DAB converter are just like those of the PS-SCC, though their suitable voltage conversion ratios differ—voltage conversion ratios of M = 2.0 and 1.0 are the simplest conditions for the PS-SCC and DAB

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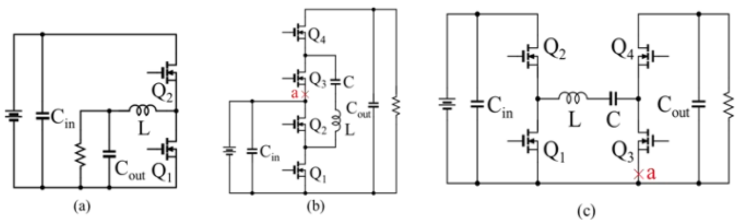
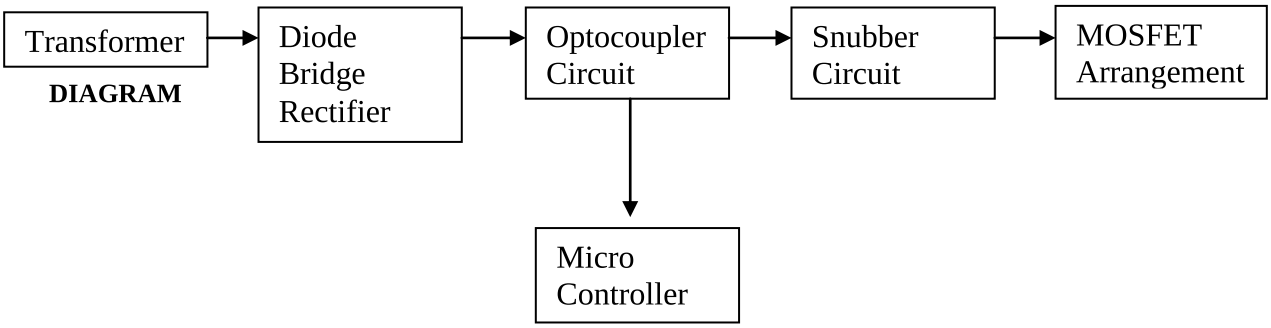
converter, respectively, from the point of view of power conversion efficiency. A resonant SCC topology is extremely almost like the PS-SCC but is taken into account not suitable for the proposed MPC in standalone PV systems. Although the inductor L can be smaller to resonant operations, relatively narrow voltage regulation ranges of resonant topologies are a major drawback. Since voltages of recharge able batteries and PV panels vary significantly, PS-SCCs with wider regulation ranges are a preferable topology—for applications where voltage regulation ranges are not of importance, resonant SCCs would be an appealing candidate from the point of view of circuit miniaturization.

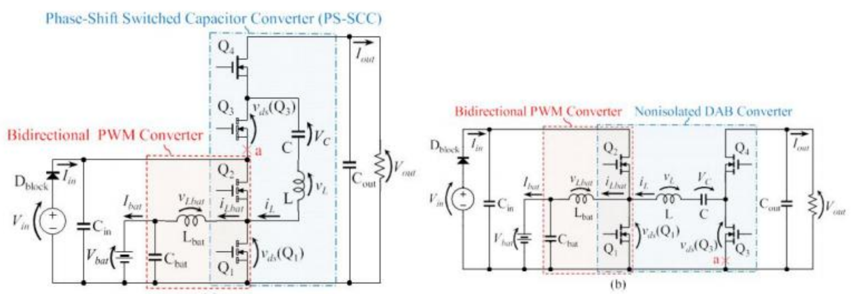


BLOCK DIAGRAM



III.DERIVATION OF PROPOSED MPCs

Q1 and Q2 are switches of the bidirectional PWM converter and PS-SCC or nonisolated DAB converter, Q1 and Q2 has been shared. By these process the proposed SCC-MPC, and DAB-MPC can be derived. Switches Q1 and Q2 are shared by two circuits hence reducing the total switch count and realizing the simplified topology. Although the PS-SCC and nonisolated DAB converter are integrated with the bidirectional PWM converter, their original features and suitable voltage conversion ratios are essentially retained. Hence, a suitable MPC topology should be selected by considering applications and requirements.



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IV.WORKING PRINCIPLE

The step-down transformer is connected to the power supply. The transformer is gives 6V AC output. The output is directly feed to the diode bridge rectifier. The diode bridge rectifier consists of 4 diodes. The input of diode bridge rectifier is ac. The output is dc voltage. The ac voltage is converted into 6V dc. The dc voltage is used to produce PWM signals through a optocoupler circuit. The optocoupler chip has LED and phototransistor, 2 pins for the phototransistor. The rectifier +ve side is connected to the emitter's pin of the phototransistor. IR LED is connected to the microcontroller. The microcontroller gives triggers to LED by giving +ve signals. When the microprocessor gives command voltage to LED, it will blink for a moment. During the blinking moment the photo transistor gets triggered. The gate is closed so the source voltage is passing through the drain pin of photo transistor.The dc voltage is now as PWM signal this is connected to the gate of the MOSFET. The mosfet will conduct only if the gate is closed. The PWM signal is connected through snubber circuit. The snubber circuit for protection of the MOSFET. The Mosfet's source is connected to the input source. Input sources powers the Mosfet the drain is connected to the output with a typical arrangement. When the PWM signal approaches high, the gate of mosfet will closed so the source and drain is connected. Now the MOSFET begin to conduct power.

V. USER INTERFACE

The MPC converter is interfaced controlled by push buttons. By using this voltage will be controlled. 4 push buttons were used to control.by using push buttons the on time of switch is controlled it's reflected as voltage control.

- Start/ON
- Reset
- +ton
- +toff

Start/ON Button	Start button is used as a power on button.
Reset	Reset button is used to turn off the all mosfet.
+ton	This button is used to increase the width of the on time for +5%.
+toff	This button is used to increase the width of the off time for +5%.

VI. RESULT AND DISCUSSION

In the Fig.1 the voltage reading was taken at output. During this time ton is kept maximum so the output voltage at its peak.

Voltage output = 66.6v; Current = 2.83A;

Power = voltage x current (watts)

P =V x I

No we have output of voltage and current of the prototype

P = 66.6 x 2.89

P = 192.474W

Estimated output Pout = 200w

Actual output Pout = 192.474w

So the estimated power output has been obtained by the developed Multiport converter

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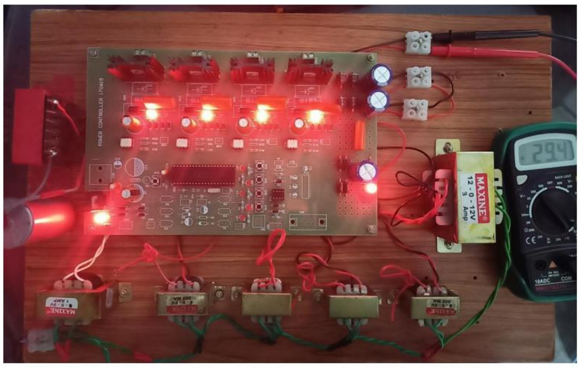

Fig. 1 Overview of Prototype during Working

VI. CONCLUSION

The non-isolated SCC-MPCs integrating PWM converter and PS-SCC are proposed. A bidirectional PWM converter and PS-SCC are integrated into one unit with reducing the entire switch count, achieving the simplified circuit. Previously-reported SCCs, such as a ladder, Dickson, series-parallel, and Fibonacci SCCs, can be used as a PS-SCC, and various types of SCC-MPC topologies can be derived based on the proposed integration procedure. The detailed operation analysis was performed to mathematically derive the gain characteristics and ZVS boundaries within the battery charging and discharging modes. The optimal control scheme for the battery discharging mode, in which two control freedoms of duty cycle d and phase-shift angle φd are available to regulate the output, was also proposed. The optimal d and φd are determined depending on the output power so as to minimize the RMS current of the inductor and to maximize the power conversion efficiency.

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