A Non isolated Three-Port DC–DC Converter and Three-Domain Control Method for PV-Battery Power Systems

Abstract
Exception for direct energy transfer power systems, a pulse-width modulation switching dc/dc converter controlled by the maximum power point tracking (MPPT) algorithm has been used to extract the maximum power of photovoltaic (PV) in PV-battery power systems. Recently, three-port converters, interfacing one PV port, one bidirectional battery port, and one load port of a PV-battery dc power system, are a good candidate for such a renewable power system, particularly for a spacecraft power supply system. Because of the high power density and high efficiency merit of the three-port converters, it has increasingly attracted research interest toward various applications.

Existing system
The dc–dc full-bridge converter uses resonant techniques in which resonant elements such as capacitors and inductors are used to shape the current through a converter switch so that it can fall to zero to allow the switch to turn off with ZCS. The
resonant elements, however, are large and bulky, which makes their use impractical for many applications, and the converter is operated with variable frequency control, which makes the design of the converter more difficult and also increases the size of the converter as it must operate with low switching frequencies at lighter loads.

**Proposed system**

VSA, VBAT, and VBUS denote the voltage of the PV port, the battery port, and the load port, respectively. L1, L2, and L3 refer to the dc inductor. CIN, CBAT, and CBUS are the filter capacitors paralleled with the corresponding port. The duty cycles of Q1 to Q3 are represented by d1 to d3, respectively, where d2 and d3 are complementary. The proposed B3C merits high power density by sharing some common power devices, high efficiency by making one stage power conversion from PV or battery or load, high dynamic performance by employing the two-inductor boost topology, and modular and recurrent property by controlling both battery and load port. In addition, battery voltage can be lower than that of main bus for safety purposes.
Advantages

- Improving the whole topology EMC property and making B3C able to extract maximum power from PV.
- The efficiency of the converter is greatly improved.
- Leading to high power density.
- Reduced costs.
- Based on the three-domain main bus control method, the bus voltage is always regulated with high quality in all power flow conditions.
Block diagram

INPUT
DC supply

DC/DC converter

Battery charge discharge circuit

Battery

Load

OPTO coupler circuit

12 V DC

BUFFFER circuit

5 V DC

PIC controller circuit

DC/DC converter

Battery charge discharge circuit

Load

Opto coupler circuit

12 V DC

BUFFER circuit

5 V DC

PIC controller circuit
Tools and software

- MPLAB – microcontroller programming.
- ORCAD – circuit layout.
- MATLAB/Simulink – Simulation.