New Extendable Single-Stage Multi-Input DC-DC/ AC Boost Converter

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Abstract- *This project presents a new extendable single-stage multi-input DC-DC/AC boost converter .The proposed structure comprises two bidirectional ports in the converter central par t to inter face output load and battery storage, and several unidirectional input ports to get power s from different input dc sources. In fact, the proposed topology consists of two sets of parallel dc-dc boost converters, which are actively controlled to produce two independent output voltage components. Choosing two pure dc or two dc-biased sinusoidal values as the converter reference voltages, situations of the converter operating in two DC-DC and DC-AC modes are provided, respectively. The proposed converter utilizes minimum number of power switches and is able to step-up the low level input dc voltages into a high level output DC or AC voltage without needing any output filter. The converter control system includes several current regulator loops for input dc sources and two voltage regulator loops for generating the desired output voltage components, resulting in autonomously charging/ discharging the battery to balance the power flow. Due to the converter inherent multi-input multi-output (MIMO) control system, the small signal model of the converter is extracted and then the pole-placement control strategy via integral state feedback is applied for achieving the converter control laws.*

Keywords- Multi input converter, Single stage converter, Multi-input multi-output, and Hybrid system.

I. INTRODUCTION

Power generation from different renewable energy sources have greater importance in the current global energy scenario. The need of electric power is increasing day by day. combined with each other or fuel cells (FCs) and energy storage systems (ESSs).

Energy sources like wind turbines and photovoltaic (PV) systems are intermittent and unpredictable; therefore, they are not highly reliable. In order to address this issue, renewable resources are either combined with each other or fuel cells (FCs) and energy storage systems (ESSs). Nowadays, the concept of multiple-input converters (MICs) has been proposed to accommodate several renewable energy resources. These converters provide simple circuit topologies, centralized control, high reliability, low manufacturing cost, and size. The systematic approaches of generating and synthesizing MICs have been introduced. In general, all various MICs are responsible to accept dc voltage sources at their input ports, while from the output point of view they can be broken into two categories: dc–dc MICs and dc–ac MICs. For the first category, in three multi-input converters have been proposed based on the structure of the dc boost converter. Most of the dc-dc multi input converters are based on boost converter structure. The converter in uses minimum number of switches and its design is simple. There is a family of multi port converters which uses different structures of magnetic coupling, half bridge boost converter, and hybrid dc-dc control. a new multi input boost converter which uses a single stage power conversion is proposed. Single stage power conversion decreases the power loss in the conversion stages and complexity of the converter is reduced. Also the efficiency and reliability of the converter is increased in a lower cost and less size. The converter has the ability to step up from low level input to require high level output voltage. The load is interfaced in the central part of the converter. The output load voltage is differentially obtained from the both side of the load. In dc-dc mode of operation two pure dc references is given to both side of the converter to get two regulated dc voltages. For dc-ac mode two controlled dc biased sinusoidal voltages which are 180^0 out of phase are produce. The multi-input structure of the converter is the integral state of feedback strategy of multi-input multi output (MIMO) control systems is applied to the converter small signal model to achieve its control laws.

II. SYSTEM OVERVIEW

The proposed structure comprises two bidirectional ports in the converter central part to interface output load and battery storage, and several unidirectional input ports to get powers from different input dc sources.

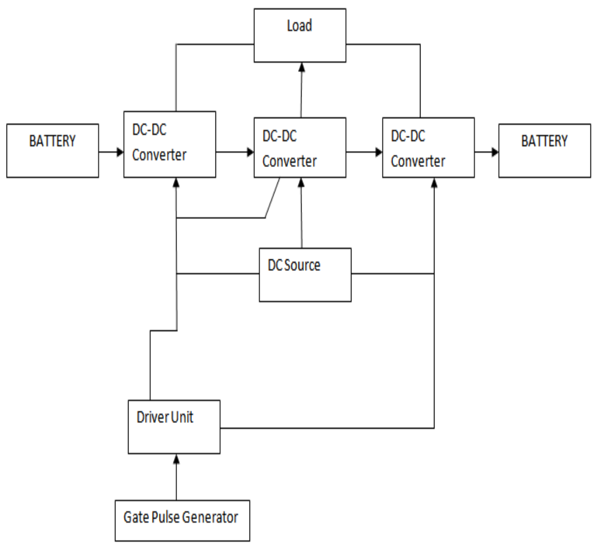

Fig 1. System Block Diagram

As in the figure the load is interfaced on the central part of the structure. Several unidirectional boost converters are incorporated on both sides of the converter in order to include different low level dc inputs. The middle boost converters are current bidirectional and connected to the dc-link of the common battery, while the other ones are current unidirectional and fed from separate input dc sources. Topology consists of two sets of parallel dc-dc boost converters, to produce two independent output voltage components. Two pure dc or two dc-biased sinusoidal values as the converter reference voltages, situations of the converter operating in two DC-DC and DC-AC modes are provided, respectively. The first aim of using the battery storage is to supply or absorb the power difference between the total generated dc power by the input dc sources and the load power For the proposed system, the single power switch of each unidirectional boost converter is controlled to regulate the dc power of its corresponding input source, while in the converter central part both upper and lower power switches of the bidirectional boost converters are complementary switched to produce their corresponding output reference voltages.

III. PROPOSED SYSTEM

Two modes of operation can be obtained from the proposed converter. The operation of proposed converter in different modes is demonstrated in the following section.

A. DC–DC MODE

The two different dc values are chosen as the converter output reference voltages, and then a pure dc voltage appears across the output load as follows:

$$V_{o1} = V_1, V_{o2} = V_2, V_o = V_1 - V_2 \qquad (1)$$

For an output resistive load the consumed power can be expressed by the following equations:

$$I_o = (V_1 - V_2)/(R) \qquad (2)$$

$$P_o = V_o I_o = (V_1^2 - 2V_1V_2 - V_2^2)/(R) \qquad (3)$$

Now, we obtain the converter first- and second-side powers Po1 and Po2 delivered to the load as follows:

$$P_{o1} = V_{o1} I_o = (V_1^2 - 2V_1V_2)/(R) \qquad (4)$$

$$P_{o2} = -V_{o1} I_o = (V_1^2 - 2V_1V_2)/(R) \qquad (5)$$

Equation (4) represents the first side of the converter deliver positive power P_{o1}, while the negative power P_{o2} of is absorbed by the converter second side. These powers are constant values that only depend on the converter both side voltages.

B. DC–AC MODE

If the converter reference voltages are chosen as (6), then the proposed converter will operate in the dc–ac mode as

$$V_{o1}(t) = V_{dc} + (V_m \sin(wt))/2 \qquad (6)$$

$$V_{o2}(t) = V_{dc} - (V_m \sin(wt))/2 \qquad (7)$$

Where their dc parts are the same V_{dc} as and the modulation of each sinusoidal part is 180 out of phase with the other one. This concept results in generating a pure sinusoidal voltage across the load as follows:

$$V_o = V_{o1}(t) - V_{o2}(t) = V_m \sin(wt) \qquad (8)$$

Instantaneous current and power of an output resistive load can be expressed by the following equations

$$I_o = I_m \sin(wt), I_m = \frac{V_m}{R} \qquad (9)$$

$$P_o(t) = \frac{-V_m I_m}{R} \cos(wt) + \left|\frac{V_m I_m}{R}\right| \qquad (10)$$

In (10), the average quantity $\frac{V_m I_m}{R}$ corresponds to the load average power, while the alternative term at the angular frequency of 2ω denotes the pulsation component of the load power.

IV. CONCLUSION

The single stage multi-input boost converter which can work in both dc-dc and dc-ac modes has been proposed in this paper it is extendable to accept more number of input dc sources and the proposed converter does not need any output filter. The proposed converter utilizes minimum number of power switches. This is possible by the battery autonomously charging/discharging placed at the converter central part.

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