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Paper Authors

***K.VINAY KUMAR, DR.DALVINDER KAUR MANGAL.**

* Department of EEE, Sunrise university.

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ADOPTIVE TECHNIC FOR BIDIRECTIONAL POWER FLOW BETWEEN THE ELECTRIC VEHICLE ON SMART GRID

***K.VINAY KUMAR **DR.DALVINDER KAUR MANGAL**

*Research scholar, Department of EEE, Sunrise university, Alwar, Rajasthan.

**Supervisor, Dept of Electrical Engineering, Sunrise university, Alwar, Rajasthan.

ABSTRACT

This is paper present a compensated traction machine and converter topology that has duel mode of power flow capability between an electric vehicle and the dc or ac supply or grid. The weight and size of the converter are challenging issues in the case of on-board chargers which otherwise provides the flexibility of charging the vehicle anywhere. The vehicle is not driven during the period of charging, and hence, the traction motor and inverter of the power train can be used as an integral part of the converter.. During a significant part of the day, most vehicles remain idle in the parking lot when the integrated power converter can use the traction motor and its drive to transfer power to the grid. The windings of the traction motor can serve as the inductors of the power converter along with power devices of the traction inverter to transfer power

INTRODUCTION

1.1VEHICLE-to-GRID (V2G) POWER FLOW

Major automotive manufacturers began launching plug-in electric vehicles (PEVs) in 2010 and the future of transportation is being propelled by a fundamental shift to more efficient electric drive systems, and consumer interest in ownership of PEVs has grown. The first automotive manufacturers are not alone, as every major manufacturer has outlined plans to introduce PEVs in the next few years and most projections of the penetration of PEVs into the automotive market show at least 2.5 million PEVs by 2020.The PEV typically has a higher-capacity onboard energy storage system (ESS) than a hybrid electric vehicle, and the pure battery electric vehicle (BEV) utilizes the highest capacities to provide the longest range. When considering the quantity of PEVs in

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the coming years and the capacities of the ESSs, there are possible additional advantages and uses for this source of stored energy. Most light-duty vehicles spend significant time not being operated and there maybe opportunities to utilize their stored energy. However, there are questions as to what additional hardware and software would be required to deliver the stored energy outside the vehicle, what communications systems would be required, can this be done without affecting the needs of the driver, what would the impact be on battery life and warranties, and what motivations exist to accomplish this and who benefits. The above unknowns are explored in the following sections of this report. First, a common understanding of the existing PEVs and their battery systems is required. Then, the concept and technical details of vehicle to grid (V2G) are introduced and the motivation for this system is investigated. Next, the regulatory and implementation barriers to V2G are listed. Current V2G projects are described, and the codes and standards of specific areas in the United States are discussed. Finally, the commonalities and conflict between the regulatory codes and standards around the United States are explored before recommendations for how these conflicts can be resolved and a national standard is achieved. 2 Plug-in Electric Vehicles:In order to introduce the V2G application, the types of vehicles that are expected to participate in the application also must be introduced.

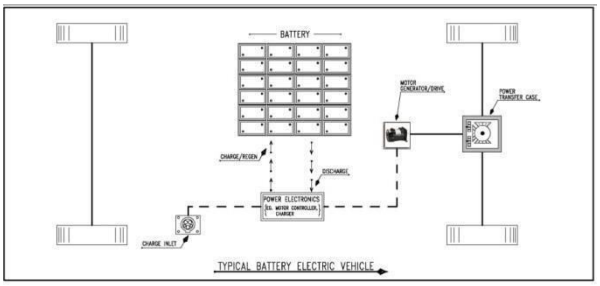

Figure 1.1: Typical Battery of Electric Vehicle.

Fig 1.2: Electrical Vehicle in Plug-in Mode.

1.3 Vehicles-to-Grid Definition:

V2G technology can be defined as a system in which there is capability of controllable, bi-directional electrical energy flow between a vehicle and the electrical grid. The electrical energy flows

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from the grid to the vehicle in order to charge the battery. It flows in the other direction when the grid requires the energy, for example, to provide peaking

po er or spinning reser es. It should be

noted that this is the way V2G would work if a vehicle had such capability, but there are currently no original equipment manufacturer (OEM) vehicles available to the general public with V2G in the United States. Studies indicate that vehicles are not in use for active transportation up to 95% of the time (Letendre and Denholm 2006) and the underlying premise for V2G is that during these times, the battery can be utilized to service electricity markets without compromising its primary transportation function. Subsets of V2G technology include vehicle-to-home (V2H; when the electric vehicle is at a residence) or vehicle to-building (V2B; when the electric vehicle is at a commercial building). In these cases, the battery power is used to supplement the local building electrical load without transfer to the electrical grid. Note that this still effectively displaces building load from the grid, which effectually provides a load-shed function. Alternatively, if there is a power outage from the grid, this permits emergency backup power to continue building processes.

CIRCUIT DIAGRAM

using State 1 and State 2 conditions given in Table I. Fig.3.1 (b) shows the details of the conurbation in the routing

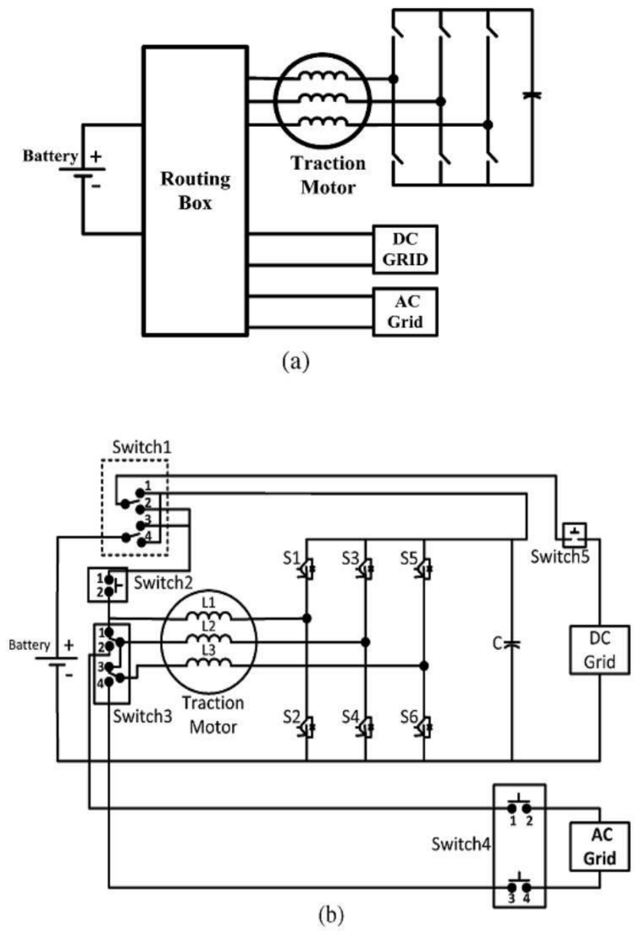

Fig.2.1.Converterwith switches capable of interfacing with both ac and dc grid (a) combined and (b) details.

SWITCHPOSITIONS ANDCONVERTERSTATES:

Switch	State 1	State 2
Switch 1	Pole positions 1 & 3	Pole positions 2&4
Switch 2	1 & 2 disconnected	1 and 2 are connected
Switch 3	Pole positions 1 & 3	Pole positions:2&4
Switch 4	1&2,3&4 disconnected	1 and 2 ,3 and 4 connected
Switch 5	1 and 2 disconnected	1 and 2 connected

The Simulink model of PV Based simulation circuit in Boost mode of operation shown below:

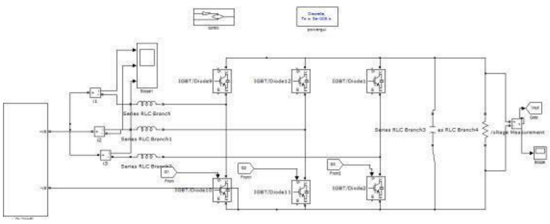

Figure 2.2: Simulink model of PV based bidirectional converter in Boost mode of operation

The Control circuit of Boost mode operation as follows:

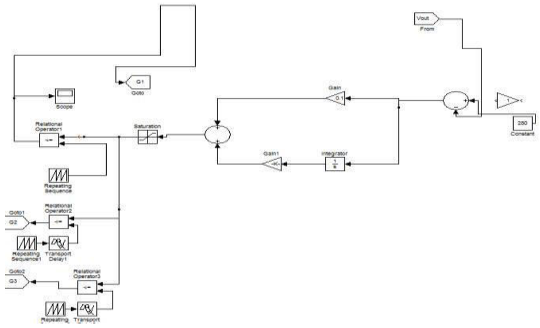

Figure 2.3: Control Circuit in Boost mode of operation

The Boost Output voltage waveform is as follows:

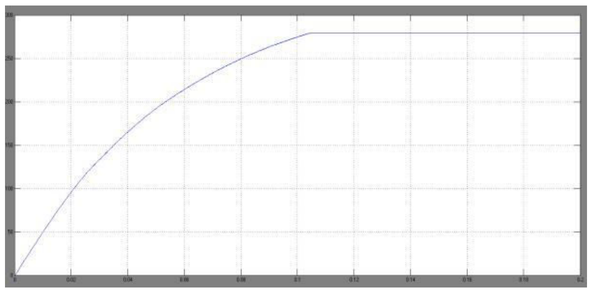

Figure 2.4: The Output wave voltage waveform in boost mode of operation

The Input and output currents of are as follows:

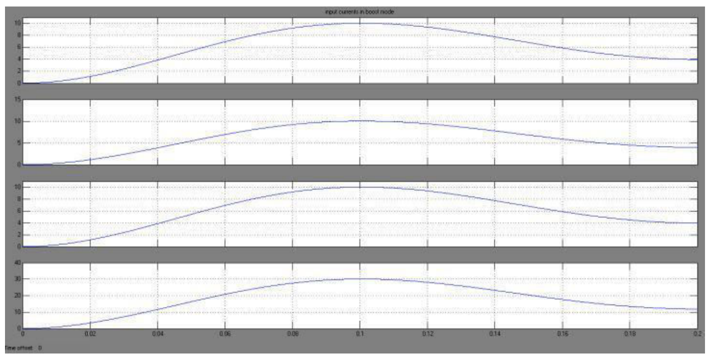

Figure 2.4: Input-output currents in boost mode of operation.

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The Simulink model of power flow from vehicle to gird mode of operation:

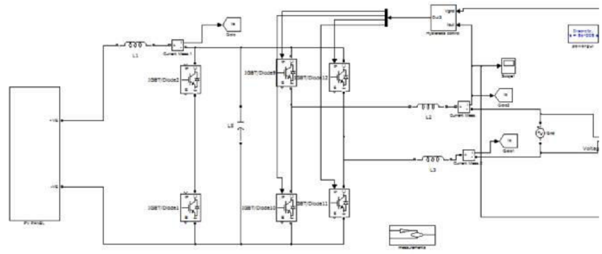

Figure 2.5: The Simulink model of Power flow from Vehicle to AC Grid mode

The Simulink model of Power flow from AC Grid to Vehicle mode of operation:

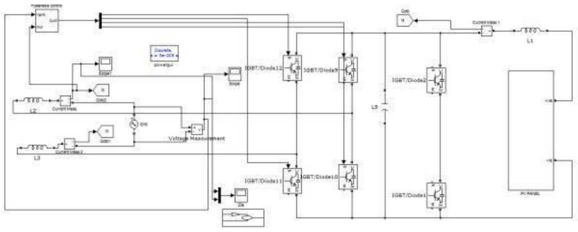

Figure 2.6: Simulink model of power flow from AC grid to Vehicle mode of operation.

The Simulink Circuit of PV Cell:

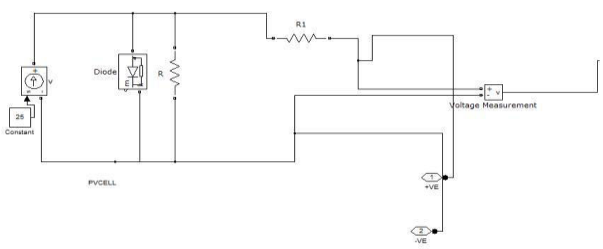

Figure 3: Simulink Circuit of PV Cell

Stator currents in Asynchronous mode operation:

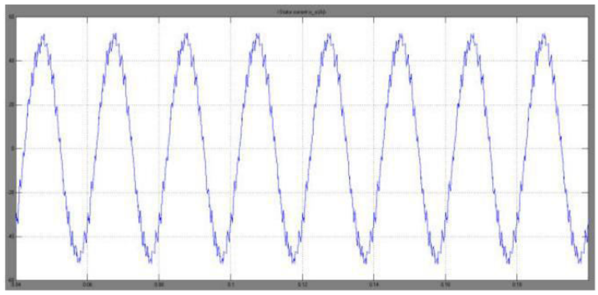

Figure 4: Stator current in Asynchronous mode of operation.

CONCLUSION

An integrated machine-converter topology and reconfiguration method have been proposed in this paper, where traction machine windings can be used as the inductors of the converter to transfer power between a vehicle battery and either a dc or an ac grid. The converter reconfiguration concept is useful in minimizing the size and parts in the power train of an electric vehicle. The machine-converter coupled simulation results showed that the integrated converter can be used for the power transfer with versatility without significantly extra power elements. The converter performance can also be analyzed with the coupled simulation of FEA software and a dynamic simulation tool.