Bi-Directional Electrical Vehicle (EVs) Charger

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Abstract

This project presents the development of a two-way battery charger for electric vehicles (EVs) targeting GridtoVehicle (G2V), VehicletoGrid (V2G) and VehicletoHome (V2H) technologies. In G2V operating mode, the battery is charged from the grid with a sinusoidal current and a unit power factor. In the V2G operating mode, the energy stored in the battery can be returned to the grid, thus contributing to the stability of the power system. In the V2H operating mode, the energy stored in the battery can be used to power loads in the home during a power outage or to supply loads in places where there is no connection to the electricity network. . Along with the documentation, the hardware topology of the bidirectional battery charger is presented and the control algorithms are explained. Certain considerations regarding the size of the AC-side passive filter are taken into account to improve performance in all three modes of operation. The adopted topology and control algorithms are accessible through computer simulation and validated by experimental results obtained with a developed laboratory prototype operating in different situations.

Key Words: Active Rectifier Buck Converter, Boost Converter, AC-DC Bi-Directional Converter.

1.INTRODUCTION

Electric vehicles (EVs) represent a new concept in the global transportation sector. As a result, in recent years, people's interest in electric vehicle technology has increased significantly, which has led to a number of scientific publications on the subject. By 2030, the electric vehicle market share is expected to grow exponentially, accounting for 24% of light vehicle fleets in the United States and 64% of light vehicle sales this year. In this case, the charging process of the electric vehicle (Car Gridto, G2V) must be monitored to maintain the quality of power in the network. However, with the ubiquity of electric vehicles, large amounts of energy will be stored in their batteries, giving the opportunity for energy to flow in the opposite direction (VehicletoGrid, V2G). In the smart grid of the future, interaction with electric vehicles will be one of the key technologies to help the grid operate autonomously. Currently, many smart grid projects are under development around the world. For this new mode, particularly in homes equipped with charging stations for electric vehicles, in addition to the G2V and V2G operating modes, the electric vehicle can also serve as a voltage source capable of supplying energy for domestic chargers. The technology was originally called VehicletoHome (V2H) in the literature. As an example of this new approach, Nissan has introduced the "LEAFtoHome" system.

2. Literature Survey

1. Several topologies and system architectures for EV PV charging are considered. He has three main conclusions about PV charging systems for electric vehicles: Grid-connected systems are more common than off-grid systems; a TPC with a DClink is the best system architecture; and that the insulation of the EV converter has been neglected by most jobs even though it is required by the standard. Four types of EVPV system architectures are offered depending on whether an integrated power converter or two separate power converters is used for PV and EV; and whether PV and EV are connected together on AC or DC.

2. The authors suggest exchanging power on AC through the use of separate PV inverters and AC EV chargers (possibly with energy storage). The downside of this approach is that PV and EV are essentially DC. As a result, power swapping on AC causes additional losses and requires two inverters instead of one.

3. Hence, For EV charging, a ten-kilowatt bidirectional DC/DC converter with zero voltage switching (ZVS) quasi square-wave at 98 percent efficiency is used (no isolation). PV and EV converters are connected via a 575 V central DC-link. On a 380 V DC link, a 3.3 kW TPC with boost converter for PV, H-bridge inverter for grid, and interleaved buck converter for EV (without isolation) is given.

4. It has been observed that as compared to AC power exchange, there is a 7–15 percent increase in efficiency. In this paper, a 5 kW TPC is presented, consisting of a boost converter for PV, a 1-phase H-bridge inverter for grid, and a buck converter for EV (with no isolation) interconnected on a 400 V DC link.

The contributions of this work, as opposed to earlier publications, are based on the aforesaid literature review.

(i) There is no existing research that quantitatively analyses bidirectional EV-PV converter topologies in terms of efficiency, power density, component count, controllability, and efficiency improvement, based on the aforementioned literature review. This work fills a research gap by comparing nine topologies on the indices mentioned above.

(ii) Each topology is designed based on two switching frequencies (50, 100 kHz), 8 silicon carbide (SiC) MOSFETs, 13 SiC diodes, 17 different sized inductor core materials different modulation techniques and heat sink sizes. This ensures that each topology itself is optimally designed, so that there is a fair comparison between the topologies. Such detailed EVPV topology design and comparison has never been done before.

(iii) Interleaving of converters (1-5 stages) is performed for suitable topologies to reduce ripple at the EV and PV ports and increase power density. This is important because the high ripple prevents MPPT operation at the PV gate. Previous work did not take into account spillover effects.

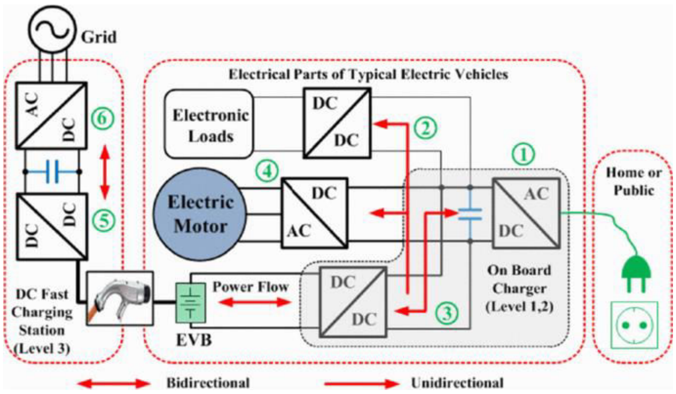

Fig -1: Figure

3. CONCLUSIONS

We must give a MATLAB based model, Constantly supplying (Ib) 24.72A, (Vb) 247.2V, and (Soc) 59.99 in G2V operation, according to the operating of this model in this project.
Inverter voltage and Grid voltage should be in phase for V2G operation, according to the scope.
In V2G operation, (Soc) 59.9 is consistently supplied, with small changes in Ib and Vb.
We also noticed that the grid and inverter voltages are in sync. to order the pdf, and are given instructions as to how to do so.

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