AN IMPROVED NOVEL PTM FROM VEHICLE TO GRID(V2G)

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ABSTRACT

Batteries from electric vehicles (EVs) have the potential to be used in microgrids as energy storage devices. By storing energy when there is excess (Grid-to-Vehicle, or G2V) and returning it to the grid (Vehicle-to-Grid, or V2G) when needed, they may aid in micro-grid energy management. The development of appropriate control systems and infrastructure is necessary to make this idea a reality. This study presents an architecture for establishing a V2G-G2V system in a micro-grid employing level-3 rapid charging of EVs. A dc rapid charging station is modelled as part of a micro-grid test system for connecting EVs. V2G-G2V power transmission is shown via simulation research. According to test findings, EV batteries actively regulate power in the microgrid using G2V-V2G modes of operation. The controller provides strong dynamic performance, and the charging station design guarantees low harmonic distortion of grid injected current.

INTRODUCTION

Energy storage systems are important components of a micro-grid as they enable the integration of intermittent renewable energy sources. Electric vehicle (EV) batteries can be utilized as effective storage devices in micro-grids when they are plugged-in for charging. Most personal transportation vehicles sit parked for about 22 hours each day, during which time they represent an idle asset. EVs could potentially help in micro-grid energy management by storing energy when there is surplus (Grid-To-Vehicle, G2V) and feeding this energy back to the grid when there is demand for it (Vehicle-To-Grid). V2G applied to the general power grid faces some challenges such as; it is complicated to control, needs large amount of EVs and is hard to realize in short term . In this scenario, it is easy to implement V2G system in a micro-grid. The Society of Automotive Engineers defines three levels of charging for EVs. Level 1 charging uses a plug to connect to the vehicle's on-board charger and a standard household (120 V) outlet. This is the slowest form of charging and works for those who travel less than 60 kilometers a day and have all night to charge. Level 2 charging uses a dedicated Electric Vehicle Supply Equipment (EVSE) at home or at a public station to provide power at 220 V or 240 V and up to 30 A. The level 3 charging is also referred to as dc fast charging. DC fast charging stations provide charging power up to 90 kW at 200/450 V, reducing the charging time to 20-30 mins. DC fast charging is preferred for implementing a V2G architecture in micro-grid due to the quick power transfer that is required when EVs are utilized for energy storage.

LITERATURE SURVEY

A. Negi and M. Mathew - Electric Vehicle (EV) batteries can be utilized as potential energy storage devices in micro-grids. They can help in micro-grid energy management by storing energy when there is surplus (Grid-To-Vehicle, G2V) and supplying energy back to the grid (Vehicle-To-Grid, V2G) when there is demand for it. Proper infrastructure and control systems have to be developed in order to realize this concept. Architecture for implementing a V2G- G2V system in a micro-grid using level-3 fast charging of EVs is presented in this paper. A micro-grid test system is modeled which has a dc fast charging station for interfacing the EVs. Simulation studies are carried out to demonstrate V2G-G2V power transfer. Test results show active power regulation in the micro-grid by EV batteries through G2V-V2G modes of operation. The charging station design ensures minimal harmonic distortion of grid injected current and the controller gives good dynamic performance in terms of dc bus voltage stability. D. Kurczynski, P. Lagowski and M. Warianek - For vehicle-to-grid (V2G) frequency regulation services, we propose an aggregator that makes efficient use of the distributed powerof electric vehicles to produce the desired grid-scale power. The cost arising from the battery charging and the revenue obtained by providing the regulation are investigated and representedmathematically. Some design considerations of the aggregator are also discussed together with practical constraints such as the energy restriction of the batteries. The cost function with constraints enables us to construct an optimization problem. Based on the developed optimization problem, we apply the dynamic programming algorithm to compute the optimal charging control for each vehicle. Finally, simulations are provided to illustrate the optimalityof the proposed charging control strategy with variations.

X. Lu, K. Ota, M. Dong -The proposed model of an electric vehicle charging station issuitablefor the fast DC charging of multiple electric vehicles. The station consists of a single grid- connected inverter with a DC bus where the electric vehicles are connected. The electric power exchange does not rely on communication links between the station and vehicles, and a smoothtransition to vehicle-to-grid mode is also possible. Design guidelines and modeling are explained in an educational way to support implementation in Matlab/Simulink. Simulations are performed in Matlab/Simulink to illustrate the behavior of the station. The results show the feasibility of the model proposed and the capability of the controlsystem for fast DC chargingand also vehicle-to-grid.

PROPOSED SYSTEM

Buck–boost converter is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a flyback converter using a single inductor instead of a transformer. Two different topologies are called buck–boost converter. Both of them can produce a range of output voltages, ranging from much larger (in absolute magnitude) than the input voltage.

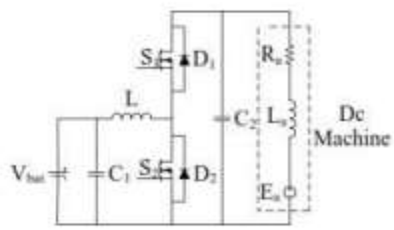


Fig.1: Proposed converter

The output voltage is of the opposite polarity than the input. This is a switched-mode power supply with a similar circuit topology to the boost converter and the buck converter. The output voltage is adjustable based on the duty cycle of the switching transistor. One possible drawback of this converter is that the switch does not have a terminal at ground; this complicates the driving circuitry. However, this drawback is of no consequence if the power supply is isolated from the load circuit (if, for example, the supply is a battery) because the supply and diode polarity can simply be reversed. When they can be reversed, the switch can be on either the ground side or the supply side. A buck (step-down) converter combined with a boost (step-up) converter The output voltage is typically of the same polarity of the input, and can be lower or higher than the input. Such a non-inverting buck-boost converter may use a single inductor which is used for both the buck inductor mode and the boost inductor mode, using switches instead of diodes, sometimes called a "four-switch buck-boost converter".

The main working principle of Buck Boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch is ON the inductor stores energy from the input in the form of magnetic energy and discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high. The large time constant compared to switching period ensures that in steady state a constant output voltage Vo(t) = Vo(constant) exists across load terminals.

SIMULATION RESULTS

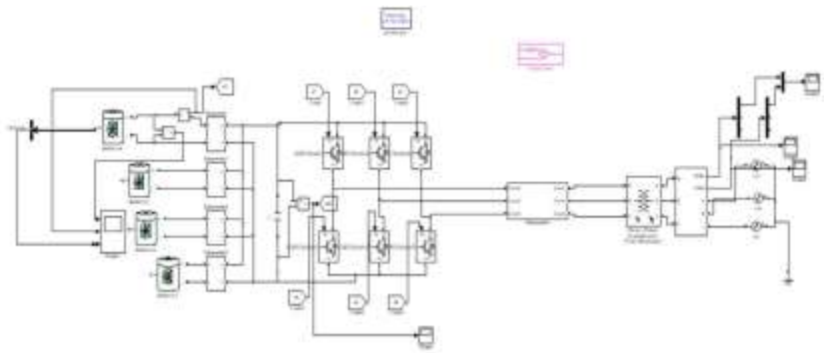


Fig.2: Simulation Circuit

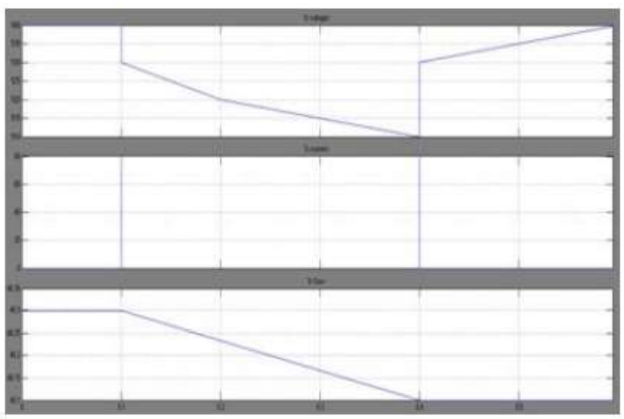
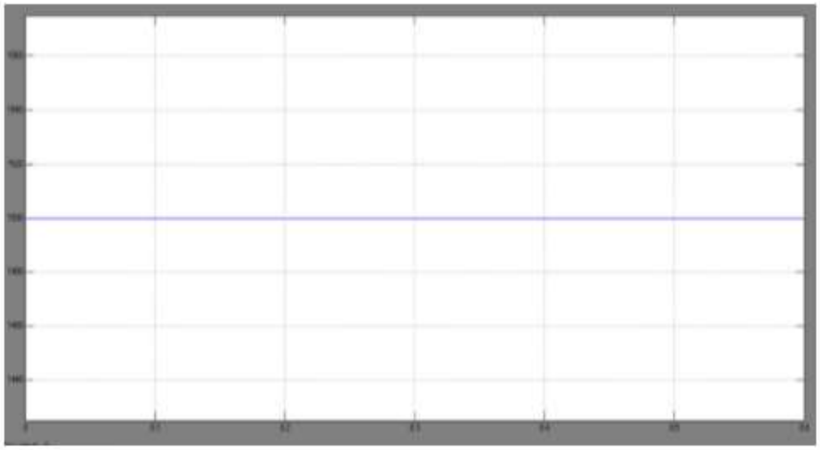
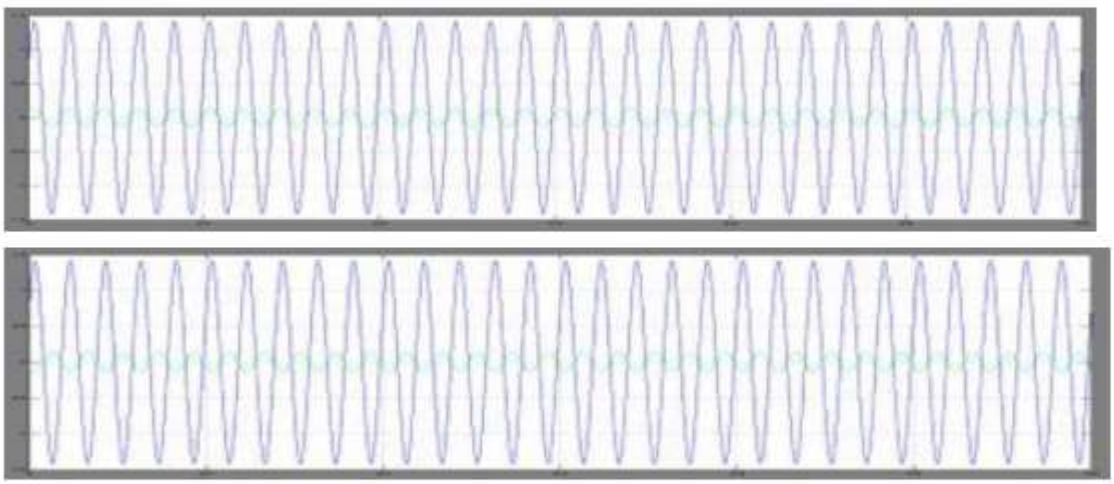


Fig.3: .Voltage, current and SOC or EV1 battery during V2G operation

Voltage, current and SOC or EV2 battery during G2V operation



Variation in dc bus voltage.The grid voltage and current at PCC are shown.



Grid voltage and grid injected current during V2G-G2V operation

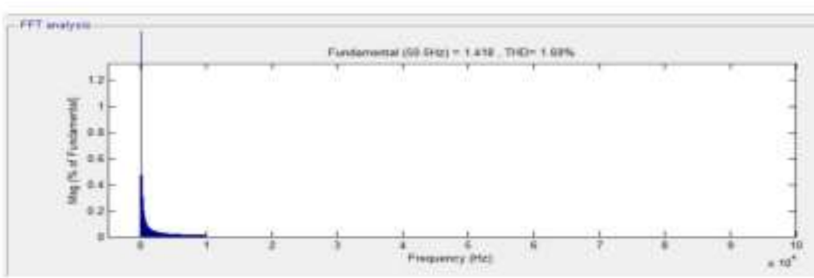


Fig.3: Harmonic spectrum and THD of grid-injected current

CONCLUSION

This work presents the modelling and design of a V2G system on a micro-grid employing dc rapid charging architecture. To link EVs to the micro-grid, a DC fast charging station with off-board chargers and a grid-connected converter is intended. EVs and the grid are able to transmit electricity in both directions because to the control system built for this PES. The simulation findings demonstrate a seamless power transfer between the EVs and the grid, and the EVs' grid-injected current quality complies with applicable regulations. In terms of monitoring the altered active power reference and dc bus voltage stability, the developed controller performs well dynamically. In this study, the micro-grid's active power regulation elements are examined. The suggested V2G system may also be used for reactive power management and frequency.

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