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Deadline: 15 December 2023

Section Collection Series: New Horizons and Recent Advances in Power Electronics
Guest Editors: Dr. Luis M. Fernández-Ramírez, Prof. Dr. Ahmed Abu-Siada, Dr. Jean-Christophe Crebier, Dr. Zhiwei Gao, Dr. Kai Fu and Prof. Dr. Eladio Durán Aranda
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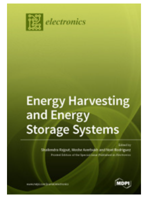

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Section **Power Electronics**

Section Editor-in-Chief

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Section Information

Power electronics has emerged as a key technology in the conversion and control of electrical power in multiple applications: electric drives and generators, renewable energy systems, energy storage systems, smart cities, smart grids, power systems, transport (vehicles, aircraft, ships, and others), industrial, medical, military, telecommunications, consumable and home apparatus.

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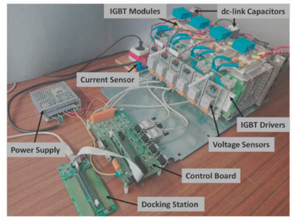
Selected Papers

DOI:10.3390/electronics12040851

Experimental Validation of a Bidirectional Multilevel dc–dc Power Converter for Electric Vehicle Battery Charging Operating under Normal and Fault Conditions

Authors: Vitor Monteiro, Catia F. Oliveira and Joao L. Afonso

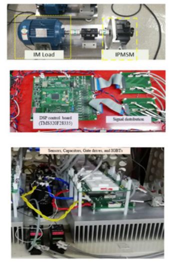


Abstract: This paper presents a bidirectional multilevel dc–dc power converter for electric vehicle (EV) battery charging. The operating principle of the power converter was presented, analyzed, and experimentally validated under normal and fault conditions. The topology under study was integrated into a bipolar dc grid through the split dc-link of the bidirectional multilevel dc–dc power converter. Considering the failures that can occur in the bipolar dc grid, i.e., in each wire of the bipolar dc grid (positive, negative, and neutral), it was experimentally verified that the dc–dc power converter ensures that the EV battery-charging process continues, regardless of the occurrence or absence of open-circuit failures. In light of this fact, the proposed control algorithms and the presented topology were validated through a set of considerable simulation and experimental results, analyzing the distinct states of the power semiconductors, which compose the bidirectional multilevel dc–dc power converter, for distinct conditions of operation. The developed laboratory prototype of the bidirectional multilevel dc–dc power converter for EV battery charging, which was implemented to obtain the experimental results, is described in detail in this paper. The experimental validation was carried out for the main different fault conditions in the bipolar dc grid in terms of open-circuit failures and, moreover, considering the steady-state and transient-state operations of the dc–dc power converter. The experimental analysis demonstrated that even in the presence of failures in the positive, negative, or neutral wires of the bipolar dc grid, the bidirectional multilevel dc–dc power converter guarantees the correct EV battery-charging operation.

DOI:10.3390/electronics12071565

Optimal Placement and Sizing of D-STATCOMs in Electrical Distribution Networks Using a Stochastic Mixed-Integer Convex Model

Author: Walter Gil-González

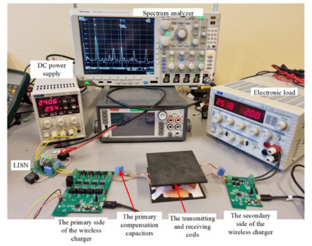


Abstract: This paper addresses the problem regarding the optimal placement and sizing of distri-bution static synchronous compensators (D-STATCOMs) in electrical distribution networks via a stochastic mixed-integer convex (SMIC) model in the complex domain. The proposed model employs a convexification technique based on the relaxation of hyperbolic constraints, transforming the nonlinear mixed-integer programming model into a convex one. The stochastic nature of renewable energy and demand is taken into account in multiple scenarios with three different levels of generation and demand. The proposed SMIC model adds the power transfer losses of the D-STATOMs in order to size them adequately. Two objectives are contemplated in the model with the aim of minimizing the annual installation and operating costs, which makes it multi-objective. Three simulation cases demonstrate the effectiveness of the stochastic convex model compared to three solvers in the General Algebraic Modeling System. The results show that the proposed model achieves a global optimum, reducing the annual operating costs by 29.25, 60.89, and 52.54% for the modified IEEE 33-, 69-, and 85-bus test systems, respectively.

DOI:10.3390/electronics12030687

Thorough Study of Multi-Switching-Frequency-Based Spread-Spectrum Technique for Suppression of Conducted Emissions from Wireless Battery Chargers

Authors: Deniss Stepins, Aleksandrs Sokolovs and Janis Zakis

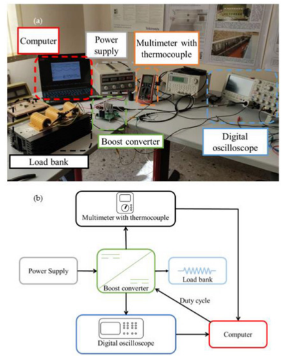


Abstract: The multi-switching-frequency technique is one of the spread-spectrum techniques for suppression of conducted emissions generated by wireless battery chargers. Its advantage is a rela-tively easy implementation with a microcontroller. In this paper, an original thorough experimental study of the effect of the multi-switching-frequency-based spread spectrum technique parameters (e.g., combinations of number of pulses, frequency order, etc.) on the performance characteristics (conducted emissions levels, efficiency, etc.) of an inductive-resonant wireless battery charger with a closed loop control is presented. It is shown that combinations of a number of pulses and frequency order have a noticeable impact on the performance characteristics of the wireless chargers. The sup- pression of the conducted emissions can be improved significantly by using optimized parameters of the technique. Moreover, it is proved experimentally that a relatively inexpensive microcontroller with a transceiver can be used to implement both closed-loop control of the wireless charger and the multi-switching-frequency technique.

DOI:10.3390/electronics12030579

Assessment of the Current for a Non-Linear Power Inductor Including Temperature in DC-DC Converters

Authors: Daniele Scirè, Giuseppe Lullo and Gianpaolo Vitale



Abstract: A method for estimating the current flowing through a non-linear power inductor operating in a DC/DC converter is proposed. The knowledge of such current, that cannot be calculated in closed form as for the linear inductor, is crucial for the design of the converter. The proposed method is based on a third-order polynomial model of the inductor, already developed by the authors; it is exploited to solve the differential equation of the inductor and to implement a flux model in a circuit simulator. The method allows the estimation of the current up to saturation, intended as the point at which the differential inductance is reduced to half of its maximum value. The current profile depends also on the inductor temperature. Based on this, the influence of core temperature on the conduction time of the power switch was determined. This study shows that the exploitation of saturation requires a proper value of the conduction time value that depends on the temperature. The theoretical analysis has been experimentally verified on a boost converter and is valid for the entire class of DC-DC converters in which the power inductor is subjected to a constant voltage for a given time. The simulations agree with the experimental data from a case study concerning conduction time and temperature.