Abstract

Entwicklung eines bidirektionalen 3,7 kW onboard SiC/GaN-Ladegerätes für 48 V Batteriesysteme

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Electromobility is a significant environmental, economic and socio-political issue, as it can be the key to achieving climate protection targets for the transport sector [GN21].

A total of 394,940 new cars with electric drive were registered in Germany in 2020, of which 48.8% were new registrations by private households [IM21]. However, this increasing acceptance of electromobility among the population also presupposes that it will be possible to create the necessary supply infrastructure for the further spread of electromobility. A transformation is currently taking place in the supply infrastructure. As a result of the promotion of renewable energies, there is a shift from centralized energy feed-in points to a decentralized energy supply. This change requires an adaptation of regional and municipal distribution grids towards smart grids, in which generators, consumers, storage and grid resources are interconnected [MI20]. In this context, the battery capacities of electric vehicles can make a contribution to grid stabilization by being used as distributed energy storage devices.

A compact, bidirectional charger with up to 3.7 kW for 48 V battery systems combines the requirements of the described need for charging facilities for domestic use and the possible use of car batteries as distributed energy storage. Due to the 48 V, which is considered to be a low voltage, costs can be saved during development, so that 48 V drive concepts become attractive for an increasing number of companies.

In this paper, the development of such a bidirectional charger for 48 V battery systems is presented. The topology used is composed of a four-quadrant converter on the grid side and a series resonant converter galvanically isolated on the battery side. For the power bridges, modern wide bandgap switches are used in the form of SiC and GaN fets, which are well suited for the application due to their high switching speeds, high dielectric strength and simultaneously compact design. Even though the full functional range of the developed charger is not evaluated within the scope of this work, essential functionalities can already be tested successfully. Thus, with the completion of this work and the realized hardware and software, a good basis for further development is available.

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[IM21] Immen, S., Pressemitteilung Nr. 01/2021 – Elektromobilität in Deutschland auf der Überholspur, https://www.kba.de/DE/Presse/Pressemitteilungen/2021/Allgemein/pm01._2021_E_Antrieb.html, abgerufen am 22.08.21.

[MI20] Mika B., Goudz A., Dezentrale Energieversorgung. In: Blockchain-Technologie in der Energiewirtschaft. Springer Vieweg, Berlin, Heidelberg, 2020.

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