Electric vehicle charging technology pdf

This the paper is organized as follow. In Sects. 2 and 3, respectively, on-board and off-board charger most common architectures are presented and their operating principles are explained. In Sect. 4, the concept of fast charging stations is introduced. The available and most suitable charging methods are listed in Sect. 5 with particular attention to the charging methods most suitable for direct-current (DC) fast charging. Finally, a genetic algorithm is used in Sect. 6 to estimate the optimal charging system size and its possible future trends.

Battery chargers can be implemented inside (on-board) or outside (off-board) the vehicle. Onboard battery chargers (OBC) are limited by size, weight and volume [23] for this reason they are usually compatible with level 1 and level 2 chargers. They usually have unidirectional power transfer capability; nevertheless in some case the configuration, a bidirectional power transfer can be achieved. Figure 1 shows the typical architecture of an electric vehicle charging system, in such figure both the on-board charger and the off-board one are represented.

In PFC converter the interleaved boost converter is becoming more and more popular. As shown in Fig. 3, an interleaved boost converter simply consists in two boost converters in parallel, operating 180? out of phase [26]. The main aim of this interleaving is to increase the output current by reducing the input current ripple and hence by reducing the overall volume of the input ElectroMagnetic Interference (EMI) filter and of the boost inductor [23, 27,28,29]. On the other hand, interleaving means increasing the cost and the complexity of the design.

The last type of proposed OBC are the so called multifunctional OBCs. In this type of battery charger some components are shared to accomplish different aims. In this way higher fuel efficiency can be reached by smaller and lighter design. In [41], the proposed multifunctional battery charger can charge the auxiliary battery via the propulsion battery when the vehicle is in a driving state, acting in this way as an OBC and as low-voltage dc-to-dc converter (LDC) jointly. In [42], a similar configuration, shown in Fig. 5, with the same duties is presented.

Level 3 charger, because of their rating powers, are usually installed outside the vehicle (off-board). Also for level 3 off-board charger a large amount of different solutions is studied in literature [43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62]. Since it is mandatory to guarantee galvanic isolation between the AC supply circuit and the DC output circuit according to the IEC EN 61,851-23 standard, in this paragraph only isolated off-board charger have been presented.

The off-board charging system is most commonly composed of two stages: a grid-facing AC/DC converter followed by a DC/DC converter providing an interface to EV battery. Based on the converter topology, both these stages can allow unidirectional or bidirectional power flow.

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