

On electric vehicle battery charger modeling

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Abstract. The increase of electric vehicle (EV) battery chargers connected to electric networks could lead to future harmonic problems in power systems. These loads are non-linear devices that inject harmonic currents and pollute network voltages. Thus, battery charger modeling must be studied in detail to determine their harmonic emissions and prevent future problems. This paper investigates EV battery charger behavior, analyzes its equivalent circuit and reports a model for each conduction mode of the circuit. Experimental measurements and PSpice numerical simulations support the study.

Key words

Battery chargers, harmonics, power quality.

1. Introduction

Effective transportation systems are essential for developed countries' prosperity, having significant impacts on economic growth, social development and the environment. In 2004 the transport sector consumed 30% of the total final energy consumption and it was responsible for 25% of CO₂ emissions (EU-25) [1]. Electrical vehicles (EV) have recently emerged as a promising alternative that uses electricity to displace a significant fraction of fleet petroleum consumption. Nevertheless, this new situation and the expected future growth of EVs can create serious problems of power quality in existing grids, mainly where parking installations are concentrated [2]-[3]. Thus the growing presence of EV battery chargers in residential installations could increase the harmonic levels in power distribution systems. For this reason, several studies in the literature attempt to predict the harmonic impact of these non-linear loads on the network and investigate the harmonic emissions of battery chargers and clusters of these loads in the network [4]-[8]. Others focus on the effects of these devices on the system [9]-[12]. The paper presents the equivalent circuit of EV battery chargers and studies its conduction modes. The analytical models of the battery charger conduction modes are developed in detail. Experimental and numerical examples of these modes are also reported.

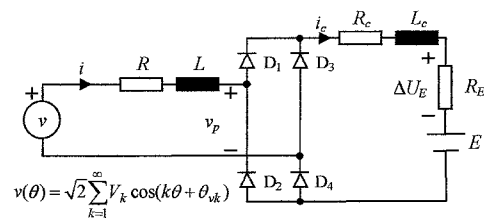


Fig. 1. Equivalent circuit of EV battery chargers.

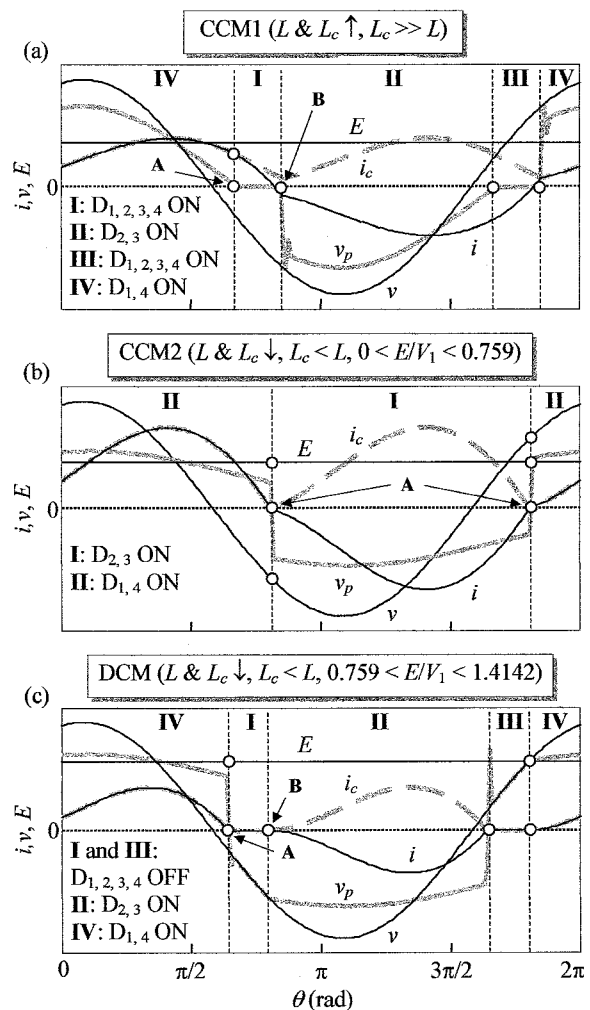


Fig. 2. Conduction modes of EV battery charger equivalent circuit.