

Integrating Internal Model Controller (IMC) into electric vehicle charger of multiple charging mode: DC and AC fast charging

ABSTRACT

Electric vehicles usage and adoption have expanded rapidly over the last decade, as the global energy demand is shifting away from fossil fuels. The recent development of electric vehicle charging technology, which is a fast charging mode, enables an electric vehicle to be fully charged within 10 minutes. However, the generated harmonics, control complexity, and cost of fast charging are the main challenges that need to be addressed to further expand the electric vehicle fast charging technologies. In this manuscript, a new electric vehicle fast charger was designed by introducing the three-stage converters based on the integration between internal model controller with synchronized decoupled controller algorithms. The proposed charger can provide two types of charging approaches, namely alternating current (AC) fast charging and direct current (DC) fast charging. To verify the effectiveness of the proposed charger, the model is developed and simulated in MATLAB/Simulink 2018a platform. Additionally, experimental verification, which utilizes a digital signal processor (TMS320F28335), is conducted to further support the design concept and the simulation findings. These research results have indicated that the proposed charger is applicable for fast AC and DC charging. Moreover, the total harmonic distortion value for the input current is 1.55%, where it has constantly been maintained within the standard limits, thus showing the effectiveness of proposed charger in performing the charging process without causing any significant impact to the grid.

Keyword: EV fast charging; Internal model controller; Decoupled controller; Total harmonic distortion