High Power Efficiency Design Approach of a LLC Resonant Converter for UPS Battery Charger Application and Battery Charge-Discharge Regression Model

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ABSTRACT

In this study, an optimal design procedure of inductor-inductor-capacitor (LLC) resonant DC-DC converter is developed for uninterruptible power supply (UPS) battery charge applications based on high power efficiency. The LLC resonant converters have many advantages such as high power efficiency and less switching losses when compared with other converters features. It is also capable of operating in narrow switching frequency where zero voltage switching can be provided. The DC-DC converter with 400V input and 48V/3.1A output has been selected as an experimental setup. In order to reach optimal design of LLC resonant converter and required output values, switching frequency might be determined as above of resonance frequency, based on theoretical calculations and Power Electronics Simulation package program. The obtained maximum power efficiency with the proposed method was measured as 95.22%. Besides, charge-discharge models of the battery were obtained from the battery data obtained via deriving regression models with machine learning algorithms where battery electrical energy consumptions, battery status, and temperature data can be analyzed. R^2 score tests are performed for nine different regression models. Random forest regression is determined as the best model among regression models for the obtained data set.

Keywords: Energy; UPS battery charge; LLC resonant converter; regression models

Topic: Electrical and electronics engineering