Abstract

This work covers the creation of two performance modeling tools that aid the design and optimization of power management integrated circuits with magnetic thin-film inductors. The first modelling tool calculates power management integrated circuit performance metrics, such as efficiency and current density, and creates two-dimensional and three-dimensional plots of the results versus a range of input operating points, such as input voltage, output voltage, output current, and switching frequency. These calculations were compared to SPICE simulations of the circuit and bench measurement of a prototype, demonstrating agreement within 1% and 5%, respectively, for efficiency estimates across multiple operating points. The second modelling tool incorporates a regression model and a decision tree model to predict magnetic thin-film inductor parameters, such as inductance, resistance, and saturation current, based upon device layout features, such as turn count, magnetic core dimensions, and winding width. This module was trained and tested on a simulation data set, demonstrating agreement within ±2% for inductance at 100 MHz, ±2% for saturation current, ±4% for direct current resistance, and ±7% for resistance at 100 MHz. The combination of these tools accelerates the power management integrated circuit design process by optimizing the trade-off between prediction speed and prediction accuracy.