

Bachelorthesis Frederik Eberhard

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Estimating AC and DC losses in the inductors of a switch mode power supply

Switch mode power supplies are widely used in onboard systems of aircraft. However, accurate prediction of losses in power electronic devices remains a challenge with current models. Inefficiencies are directly converted to operational costs due to the aircraft's extra weight for fuel and the cooling system, as well as regular maintenance costs of fans. Therefore, precise models are required to facilitate the identification of parameters for reducing losses in switch mode power supplies.



For the switching elements, losses are well studied and already implemented in efficient nonlinear models. However, inductor behaviour is only poorly represented by currently used models. Therefore, an improved model of an inductor is to be developed. Moreover, a method how to include parameters like Quality-Factor, Ohmic Resistance, etc. from measurements relevant to the actual operating conditions into the model should be developed. The model is to be implemented in LTspice, and base cases are defined for simulation. The simulation results shall then be compared with measurements to verify the developed model. Finally, the improved inductor model is to be integrated into a Buck-Converter model to derive recommendations for energy-optimized operation of Buck-Converters.

We propose the following structure for the work:

- Literature review on inductor modeling
- Defining measurement cases that allow the extraction of inductor characteristic parameters
- Development of an improved inductor model, considering the measured parameters and implementation of the inductor model in LTspice
- Definition and simulation of base cases for comparison with measurements
- Validation of the simulation and the inductor model with measurements
- Implementation of a Buck-Converter Model in LT-Spice, including the developed inductor model as well as already existing models for the capacitance and switching components. Simulation of the Buck-Converter and evaluation of losses for different operating conditions
- Formulation of recommendations for optimal operation of Buck-Converters to maximize efficiency

Following this work, the results are to be reported in a presentation.

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