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ASSESSING THE IMPACT OF COMPONENT VARIABILITY ON CONVERTERS PERFORMANCE

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AUTHOR'S DECLARATION

I confirm that the work presented in this thesis has been carried out in compliance with the rules of Universiti Teknologi MARA that have been set. It is original and represents my own work, unless otherwise indicated or acknowledged as reference work.

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ABSTRACT

Boost converters are vital components in modern power electronics, especially in renewable energy systems and electric vehicles. This study addresses the robustness of boost converters against parametric uncertainties such as component tolerances, environmental factors, and load variations. Utilizing Sobol's sensitivity analysis and Monte Carlo simulations, the research evaluates the steady-state performance of boost converters under varying conditions. A MATLAB/Simulink model integrated with Python's SALib library facilitates a systematic assessment of parameter uncertainties, focusing on resistors, inductors, and capacitors. The analysis reveals deviations in output voltage, providing insights into the converter's sensitivity and performance stability. Critical parameters affecting robustness are identified, leading to a quantitative robustness index based on statistical metrics like mean, standard deviation, and error rates. The results demonstrate the feasibility of enhancing boost converter designs to withstand real-world uncertainties while maintaining efficient operation. This comprehensive uncertainty analysis framework contributes to advancing reliable power conversion technologies across diverse applications.

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