

Mission Profile-Based Online Remaining Useful Life Estimation of Power MOSFETs for Electric Vehicles using CARLA

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This work presents a mission-profile-based method to estimate the remaining useful life of power MOSFETs using a dynamic virtual test bench integrated with the CARLA vehicle simulation platform. Unlike traditional approaches that focus on standardised driving cycles, the proposed method simulates real-world driving conditions. The test bench includes vehicle dynamics, a MATLAB-based EV model, and a comprehensive thermal and power loss model to assess MOSFET performance under varying loads. Additionally, a new online rainflow algorithm is proposed, which computes a time-dependent mean junction temperature for each thermal cycle. The MOSFET's remaining life, based on normalised lifetime consumption, is estimated online from realistic traffic patterns. Results show that traffic conditions significantly impact MOSFET degradation, highlighting the effectiveness of this mission-profile-based approach.

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