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EFFICIENCY AND LOSS OPTIMIZATION IN RAILWAY AUXILIARY POWER CONVERTERS USING WBG DEVICES

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Summary: Wide Bandgap (WBG) devices, such as Silicon Carbide (SiC) MOSFETs and Gallium Nitride (GaN) High Electron Mobility Transistors (HEMTs), are revolutionizing power electronics by enabling higher efficiency, reduced losses, and improved power density. This paper presents a comparative analysis of two isolated Dual Active Bridge (DAB) topologies, the conventional two-level to two-level (2L-2L) DAB and the five-level to two-level (5L-2L) DAB, designed for auxiliary services in railway applications. These auxiliary systems, which power onboard loads such as lighting, HVAC, and communication systems, require high efficiency and reliability under varying operating conditions. The study evaluates key performance metrics, including efficiency, switching losses, and conduction losses, across different power levels and switching frequencies. By leveraging WBG devices, the impact of high-frequency operation on system performance is analyzed. To provide a comprehensive assessment, computational simulations are conducted in PLECS, enabling a detailed evaluation of the electrical and thermal performance of both topologies. The findings offer valuable insights into the trade-offs associated with each configuration, contributing to the advancement of high-efficiency auxiliary power conversion solutions for railway applications.

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