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# M4Or1B-02: [Invited] Cryogenic Power Conversion and Its Potential in Future All Electric Transportation Systems: From Silicon Age to WBG Era

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The increasing electric power demand for future all-electric transportation platforms poses strong challenges to the power distribution architecture for these mobile power platforms. Compared to ambient temperature power conversion architectures, cryogenic superconducting power conversion (< 123 K) does not require higher power distribution voltage with larger conductors and is expected to have higher power conversion efficiency. Different components, including passive and active power devices and associate components (gate driver, isolation component, controller, etc.,), have different characteristics at cryogenic temperatures and thus bring different design considerations and trade-offs for converter topology selection, design optimization, control strategy, and protection designs. While silicon power devices have been demonstrated in cryo-power converters in literature, the emergence of Wide Bandgap (WBG) power devices provides more variables to this cryogenic power conversion design with potential advantages and new challenges.
This paper provides an overview of the advances in cryogenic power converter design and its application, from its component selection and characterization at low temperatures to the converter topology design, comparison, and optimization [1]. The paper uses a cryo-cooled converter example from the author's lab to explain the WBG power device influences in topology selection, overall architecture design, critical auxiliary circuitry design, and important considerations in low-temperature power conversion experiments and measurements [2,3]. The last part of the paper gives a discussion of envisioned applications, challenges, and potential solutions for future superconducting power conversion systems.

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