ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

MUR DM 117/Infineon - Innovative High Power Converters with Advanced Parallel Operation of Power Electronic Devices

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Context of the research activity	Wide bandgap (WBG) power semiconductors, such as SiC MOSFETs, have gained significant popularity in electric power conversion due to their unmatched power density and efficiency, especially at partial load conditions. However, traditional Si-based IGBTs still maintain a competitive edge in terms of cost and availability. With the increasing demand for higher power installations like e-axles and DC superchargers for Battery-Electric-Vehicles, there is a need for a larger number of paralleled chips or discrete devices, particularly for SiC MOSFETs. For instance, the SiC traction inverter in the Tesla Model 3 employs 14 discrete MOSFETs in parallel per switch. However, this parallel configuration poses significant challenges throughout the converter's life cycle, including design considerations, component sorting and matching requirements, and the need to balance performance and reliability. This research aims to develop innovative solutions to optimize the utilization of paralleled chips and devices while meeting the stringent cost and reliability requirements of modern applications, such as electric vehicles, battery chargers, and photovoltaic inverters. Progetto finanziato nell'ambito del PNRR – DM 117/2023 - CUP E14D23002000004
	The research aims to achieve the following objectives: 1. Identify the primary challenges related to the parallel operation of power semiconductor devices and evaluate their impact on power conversion efficiency, peak performance, and reliability.

Objectives	2. Determine the optimal technology for the specific requirements of the application, considering alternatives such as full-SiC, full-IGBT, or hybrid Si-SiC configurations. 3. Develop and implement active and passive matching strategies, including the design and integration of new gate drivers and enhanced layout approaches. 4. Create a proof of concept for the most promising solution derived from the aforementioned strategies. The primary target applications for this research include high-power electrified traction systems, renewable energy generation, energy storage systems (ESS), and off-board charging infrastructures.

Skills and competencies for the development of the activity	Applicants for this research position should have a background in electrical and electronics engineering and power electronics. Experience and willingness to engage in experimental activities will be preferred. Candidates should demonstrate high motivation to join a dynamic laboratory and possess a positive attitude towards teamwork in a multidisciplinary environment.