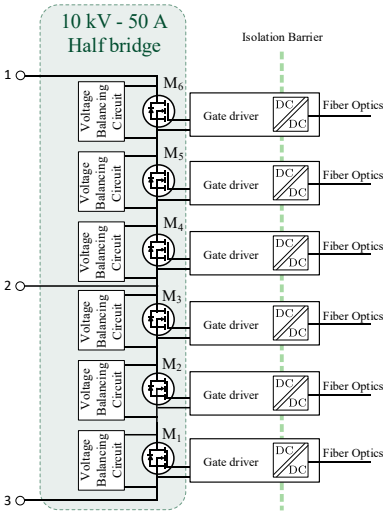
Series Connected SiC MOSFET Switches for Medium Voltage Applications

CONTEXT

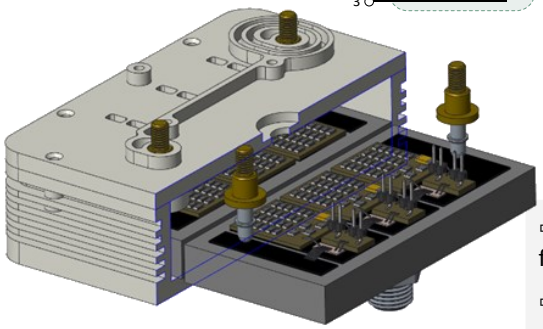
Medium Voltage converters for grid applications require high voltage switching solutions capable of fast and efficient switching. While Wide Band Gap (WBG) transistors have confirmed their advantages compared to Si IGBTs in terms of performance, their voltage ratings are still far from the required ones. In this context, series connected SiC devices are a promising solution in response to medium-voltage constraints while keeping the advantages of WBG transistors in terms of losses and switching speed.



Performances:

10 kV DC / 50 A

Up to 500 kV/µs



⇨ Common-mode-free package

⇨ 20 kV DC isolation

TECHNOLOGY DESCRIPTION

SuperGrid Institute designed, within the project “ARCHIVE” a half-bridge power module prototype by connecting three SiC-MOSFETs in series per switch. Voltage balancing is achieved by either passive or active solutions, both options being explored. Each SiC-MOSFET is driven by an insulated gate-driver supplied by insulated DC/DC converters. To ensure voltage balancing, a common-mode-free package capable of withstanding over 20 kV was developed. This package allies a ceramic substrate which integrates a dielectric liquid to ensure good electrical and thermal performance for high voltage series-connected switches.

APPLICATION DOMAIN

- MVDC distribution grids
- Photovoltaic, wind power
- Marine
- MV drives

ADVANTAGES

- Enables simplified power converter topologies
- Operates at higher voltages than existing SiC components in the market
- Reduces losses and enables higher SiC MOSFETS switching speeds

TRL SCALE

DELIVERABLES

- Design methodology & associated report
- Simulation models
- Testing results on prototypes
- Expertise on active/passive balancing solutions

ARCHIVE PROJECT

ARCHIVE (ARchitectured Ceramic for HIgh Voltage power Electronics) consortium is composed by CeramTec, Electronics Integration Laboratory of the Kempten University of Applied Sciences , Laplace Laboratory of the Université Toulouse III – Paul Sabatier and SuperGrid Institute.

SCIENTIFIC REFERENCE

PCIM 2023 : “Towards a Common Mode Current Free Packaging Solution for High Voltage Series Connected SiC MOSFET Switches ”