SuperGen ORE Hub ECR Fund Report

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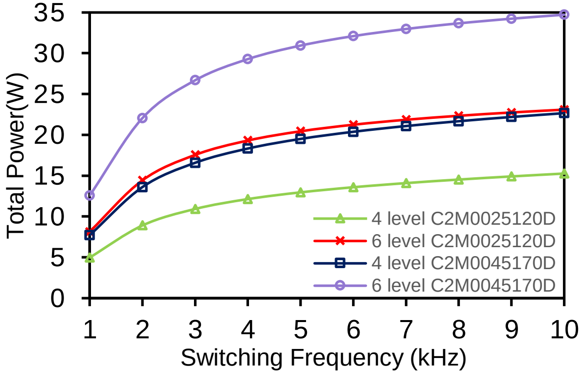
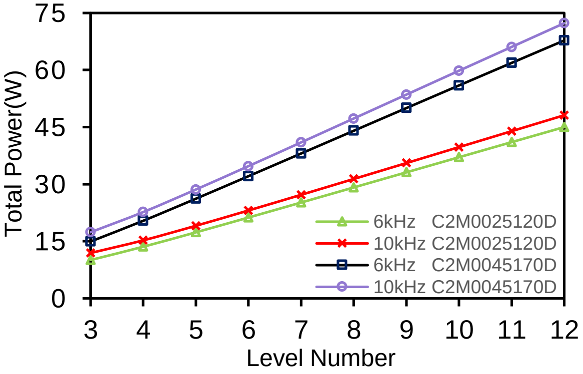
Optimisation of Compact Wide-Bandgap-Enabled Power Electronics Converters for Offshore Wind Farms

- Offshore wind farms are needed to tackle the global climate emergency but require high performance and reliability
- Their substations are typically modular multi-level converters (MMCs) that use a high number of silicon devices, that limit its switching frequency and increases its overall area footprint
- Wide-bandgap devices, like silicon carbide (SiC), overcome the limitations of silicon and reduce the overall converter volume but only through holistic design
- An optimisation tool was developed that models an MMCs power losses for a range of key operational parameters, forming the foundation for holistic design optimisation





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- SiC MOSFETs are able to switch faster than the silicon counterparts, hence reducing the space and weight in offshore platforms by switching at higher frequencies, reducing size & weight of passives.
- Reverse recovery charge and time of SiC devices are much lower compared to the Silicon superjunction MOSFET and almost negligible.
- This can be explained by the low minority carrier lifetime of the SiC along with the smaller drift region for blocking the same voltage.
- The body diode of the SiC MOSFETs performs almost invariable with temperature which is attributed to the very low carrier lifetime in SiC and the smaller dimensions of the die in SiC.