

LABORATOIRE G2ELAB

The G2ELab is a university Lab, covering a wide spectrum of expertise in the field of Electrical Engineering, from material characterization to system studies. The research ranges from long term research up to collaborative research supported by a strong involvement in partnerships with large companies and SMEs. With more than 100 permanent staff, 110 PhD and 50 Masters, G2ELab appears as a major actor both nationally and internationally in these areas.

Power Electronics Group

While unconventional energy sources and storage solutions have recently emerged, power electronics increasingly rises to an efficient interface between wide-ranging sources and applications. The diffusion of the power converters nowadays affects the majority of industrial and mass consumption domains over a large scale of power levels.

Our team (17 faculty members, roughly 30 PhD students) has chosen for the last ten years to focus on ground breaking researches. Those are aiming to improve the design of the next electrical energy management systems, both on the technological and conceptual level. Therefore, power integration has become a unifying topic in our team. We are working towards conceiving and laying the technological foundations required for our domain's improvement. The team is also pursuing research on modeling tools development to better answer our design needs for pack-

aging and electromagnetic compatibility. To reach those goals, three interdependent topics are investigated:

Research Topics

Integration technologies, both monolithic and hybrid, from the chip to the converter and its cooling system

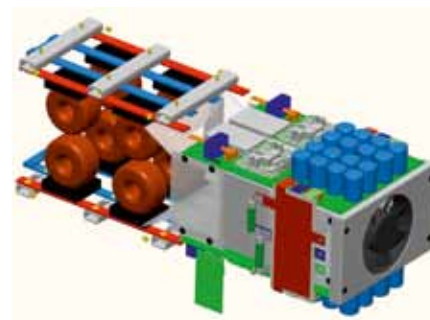
The guiding principle of our investigations is the system integration, while considering the power converter's environment.

Four projects are currently under study:

- Passive components integration: integrated L-C-T structures or multi functional substrates,
- Active components integration: multiple floating potential devices and associated electronic circuitries,
- Heat transfer and spreading techniques and their integration within power converters,
- Assembling and packaging of power components: interconnects optimization and coupled approach between the power component and its electro-thermal-mechanical environment.

Modeling and design tools for passive components and electromagnetic systems

Power devices electromagnetic modeling is mandatory as soon as the structure design is started. This approach guarantees the control over a maximal number of physical parameters. This modeling is done with a fine knowledge of components within the structures and through



200 kVA soft switching rectifier/inverter
(Collaboration G2ELab - Schneider-Electric - L2EP)

the complete system simulation. Two projects are developed:

- Magnetic components modeling (coils and transformers),
- Modeling of any electric wiring (printed circuit boards, thin wires, sheets, busbar).

Power converters design and promotion for unconventional energies and power grids

The general objective is the design of switched-mode power supplies. This research is focusing on the increasing numbers of criteria imposed on the environment, in relation with the applications. Those criteria are divided into two categories: compatibility with the converter's environment, both electrical and/or thermal, and the volume power density rise as a consequence of the integration. These researches are mainly applied to unconventional energies (fuel cells, solar cells, uninterruptible power supply) such as power converters for power grids (embedded power grids for trains and airplanes, electricity distribution networks).