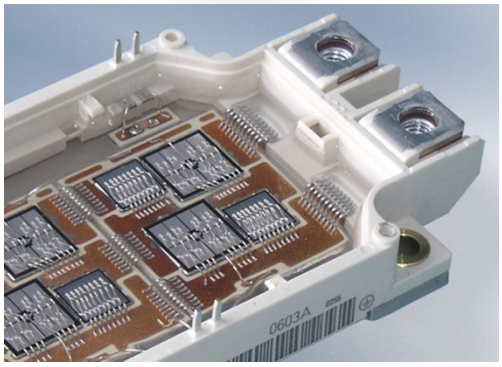
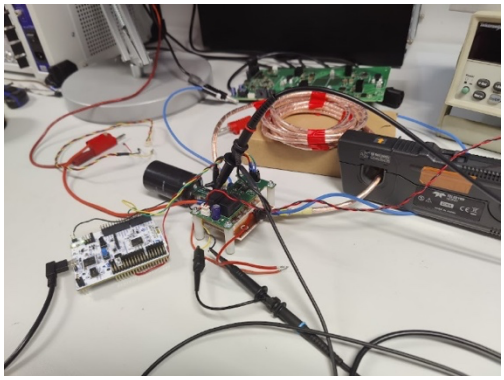
Design and testing of Power Modules for eMobility Applications

Introduction and Application Description

In recent years, power electronics has become the key enabling technology for vehicle electrification. The performance of power electronic converters (traction inverters, on-board chargers, DC-DC converters) are strongly influenced by the power modules that are used for the converter design.
The analysis, design, manufacturing and testing of power modules lead to multiple challenges, such as parasitic effects, cooling techniques, thermal modeling, proper conduction and switching loss evaluation.



Thesis Goal

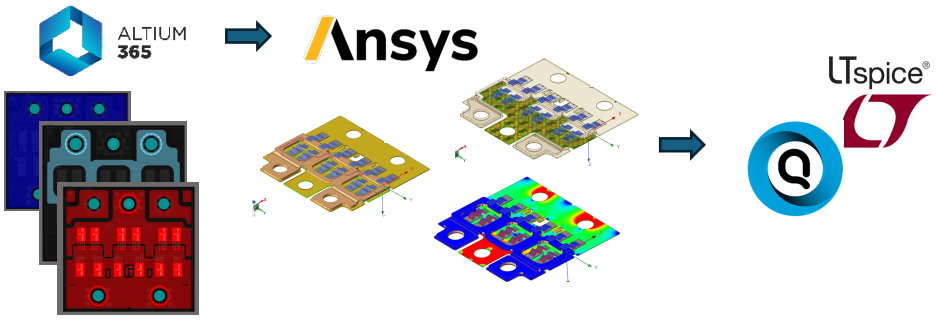


The target of the thesis is to simulate, model and optimize the geometry of an existing power module for light traction by conducting detailed analysis of electrical parasitics and thermal model.

Planned activities:

- Evaluation of an existing power module design to identify parasitic elements, such as stray inductance and resistance, which can significantly affect performance.
- Electromagnetic and thermal simulations performed with **Ansys Electronics Suite**.
- Simulation using **LT Spice** and **Plecs** with different types of semiconductor dies connected in parallel, assessing how various die configurations interact with the previously identified parasitic parameters.

- Evaluate the effects on system efficiency, power loss, and thermal management, guiding the design of more efficient power modules for e-mobility applications.
- Experimental tests on the existing power module (DPT tests). These experimental steps are crucial for confirming the accuracy of the simulation models and the overall success of the optimization process.



The thesis activity is part of a multi-disciplinary research project between Politecnico di Torino and company DANA, involving researchers from Power Electronics Innovation Center from two PoliTO departments (DISAT and DENERG) working in semiconductor technologies (DISAT) and design of power electronic converters (DENERG).

Duration: minimum 6 months.

Required background

- Basic knowledge of power electronics converters and power modules
- Good knowledge of MATLAB and FEM concept
- Basic knowledge of circuit design
- Analytical and problem-solving skills

What will you learn?

- Technical understating of most critical parameters and constraints in power module design.
- Advanced knowledge of FEA simulation tools (**Q3D-Ansys electronics suite)** , CAD tools (**Altium designer**) and electronics simulation tools **(Plecs, LTSpice).**
- Ability to post-processing data acquired from simulation.
- Experimental testing experience.

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Interested students must send a detailed CV including the exam situation, personal skills and motivation.