**Master project, 2020-2021**

## — IMPACT OF SURROUNDINGS ON HF TRANSFORMER'S PARAMETERS – APPLICATION TO EV CHARGERS —

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### Context

The development of high-performance SiC power converters require mastery in the design and the development of HF magnetics (transformers, inductors). Indeed, these passive components are essential in power electronic converters but as drawbacks, they:

1. Limit compactness of power converter;

2. Increase losses in HF if designs are not optimal;

3. Can affect the functioning if their parameters' values are not guaranteed and mastered;

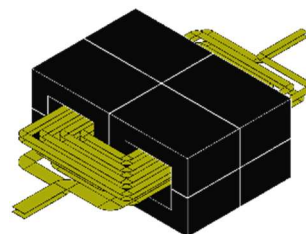4. Are costly because they need specific studies and designs.

Passive components and especially magnetics will always appear as the bottleneck of integration and efficiency of power converters. Extensive work on magnetics must be performed to obtain upgraded components to be suitable for the use inside SiC based power converters.



*Figure 1 :3D Model of HF planar transformer*

In order to reduce developing cost, virtual prototyping of magnetics is mandatory. Models must be developed to predict the functioning and the performances of HF magnetics in their design step, avoiding costly prototypes. However, because of the increase of switching frequencies due to better SiC active devices, the impact of the surroundings of the component cannot be neglected anymore. A component can no longer be designed alone but all its surroundings must be taken into account in its design step.

### Objective

In soft switching isolated DC/DC power converters, one of the transformer main parameter is the leakage inductances that enable the soft switching process. Their values need to be specified and tuned as precisely as possible, with low tolerance, to be correctly set in power converters. However, when the HF transformer is packed into its housing the value of leakage inductance varies and sometimes becomes too low to insure the soft-switching. Moreover, supplementary losses are induced.

The aim of this study is to work on the impact of surrounding on HF transformers. For this master, the focus will be on the housing of the HF transformer.



*Figure 2 : Example of charger-inverter from Valeo*
https://www.valeo.com/fr/onduleur-chargeur/

Characterizations will be performed on different transformer prototypes firstly without housing. Then, components will be characterized again in their housings with different localizations and different orientations in space. In parallel, these configurations will be simulated with FEA (ANSYS) to understand the phenomena and to estimate the leakage inductance variation and the supplementary induced losses.

### Keywords

HF transformers, Leakage inductance, HF losses, SiC DC/DC power converter, characterization, modeling

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**Project information**

The work will take place at the L2EP laboratory in ESPRIT building (Campus for Science – Villeneuve d'Ascq).

This work is part of the French project MOBI-SiC with Valeo Siemens e Automotive, Soitec and CEA-Leti.
This internship may result in a 2-year job from September 2021.

*References*

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