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MITSUBISHI ELECTRIC R&D CENTRE EUROPE

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Internship proposal (6 months)

Design of a temperature sensor for power device using Temperature Sensitive Parameter

(reference JMR022022)

Internship supervisors

Mitsubishi Electric R&D Centre Europe **:** Julien MORAND, Senior Researcher

Overall context

Mitsubishi Electric R&D Centre Europe (MERCE) is the European R&D center from the Corporate R&D organization of Mitsubishi Electric. The aim of our center is to provide advanced R&D support to the Japanese R&D centers and to the business units of Mitsubishi Electric Corporation.

Situated at the heart of Europe's leading R&D community, MERCE includes two entities: MERCE-France and MERCE-UK. MERCE conducts R&D into next generation communication systems and technologies related to Energy and Environment. Design of next generation power converter is a major activity in the Power Electronic System division (PES)

Internship subject

The PES division is divided into two teams: the **D**esign & **I**ntegration **T**echnology (DIT) and the **H**ealth **M**anagement **T**echnology (HMT). DIT team is actively working on advanced packaging for power electronics and one Research topic of HMT team relates to sensing the junction temperature of power device such as Silicon IGBT or Silicon Carbide MOSFET. Among the variety of solutions reported in the scientific literature, MERCE have developed several systems dedicated to IGBT in standard power module capable of measuring indirectly the die temperature using Temperature Sensitive Electric Parameter (TSEP). Following the trend of high-density converters, MERCE has also designed power modules with fast and clean switching capabilities and intelligent functionalities. The high frequency operation of the converter forbids the implementation of temperature sensing technique available at MERCE. In addition, embedded sensors can easily be integrated in the vicinity of the power die with the PCB technology.
The proposed internship has two main objectives. First, the relevance of the current derivative in the die as a TSEP need to be evaluated based on the existing literature and in-house experiment. Then, a circuit able to provide the junction temperature of the die will be proposed.

Detailed objectives / organization

The internship will take place in MERCE premise and will entail the following tasks:

- Review of the state-of-the-art of die temperature measurement using the di/dt as a temperature sensitive parameter. A more detailed study will be carried out on the influence of other parameters in the sensitivity (current, voltage, influence of parasitic)
- Identification of the most suitable detection applicable to integrated packages
- Validation of the sensitivity of the parameter through double pulse tests on several SiC power MOSFET
- Design of a measurement circuit and preliminary validation in simulation
- Experimental validation of the function implemented on a printed circuit board

Prerequisites

- Engineer/Master level student with interest in research;
- Understanding of power electronics mechanisms.
- Strong interest in experimentation, and familiar with basic electrical engineering lab equipment.
- Autonomous, but team player;
- English: spoken / written.

Duration: 6 months

Period: from Feb/March 2023 (possibility of flexibility, depending on schools' internships periods)

Contact: Magali BRANCHEREAU (jobs@fr.merce.mee.com) + Julien MORAND

Thank you to provide us an application letter and your CV mentioning the reference of the internship.

The signature of an Internship Agreement with your school is mandatory.