Fraunhofer ISE

Internship / Bachelor/Master-Thesis offers

The Fraunhofer Institute for Solar Energy Systems ISE offers internships and Master/Bachelor thesis positions in its *Power Electronics* department. The students will be integrated to the group *New Components and Technologies*, which has longtime experiences in highly efficient and integrated power electronics applications based on gallium nitride (GaN) and silicon carbide (SiC) components. We are constantly offering students the possibility to work on innovative projects related to the field of power electronics for solar energy systems. The internship offers the possibility of getting in touch with the Research and Development team of the Power Electronics department while being integrated in the everyday life of a large research institute. The jobs are paid and the work can be supervised in English or in German.

The current topics available are:

ISE-2018-365 **"Thermally improved PCBs for highly compact solar inverters "**
Highly integrated power electronics, PCB design, thermal management in power electronics

ISE-2018-350 **"Electromagnetic compatibility - the devil is in the detail "**
EMI issues in power electronics, simulation, PCB design and hardware development

ISE-2018-354 **"Characterization of HV-SiC transistors for future medium voltage applications"**
Power electronics, construction of a test stand, programming with Scilab, test and measurement

ISE-2018-355 **"Study on system costs of future renewable power plants and inner-city electric storage for grid support "**
Electrical engineering, development and cost-modeling of different scenarios for a specific technical topic

ISE-2018-356 **"Life-cycle assessment of a solar micro inverter"**
Eco-design of power electronic systems, life-cycle assessment

ISE-2018-357 **"Isolated measurement for a secure energy transition"**
Simulation, FPGA programming, VHDL / C programming, digital filters, test and measurement

ISE-2018-358 **"Parallel connection of GaN transistors in battery storage systems for the energy transition"**
Power electronics, simulation, printed circuit board design

ISE-2018-359 **"Development of a controller for oil cooling systems in power electronic converters"**
PCB design and hardware development, Microcontroller programming in C, test and measurement

ISE-2018-360 **"Development of a highly dynamic GaN/SiC semiconductor switch with a blocking capability of 5 kVDC"**
Power electronics, SPICE simulation, semiconductor and circuit development, test and measurement

ISE-2018-361 **"Development of the control concept for the battery storage system of tomorrow"**
Development and simulation of a control system, VHDL / C programming, implementation in SoC-FPGA

ISE-2018-362 **"Study and implementation of different control pattern for the ANPC-Topology"**
PLECS simulation, FPGA programming, test and measurement, power electronics

A detailed description of each topic can also be found in German at https://recruiting.fraunhofer.de/Jobs using the position number (ISE-2018-XXX). ***If you need more information on a topic or on the way to apply, do not hesitate to contact the internship coordinators (in French, English or German).***

If you are interested in one of these topics, please send an email with your cover letter, resume as well as your transcripts of records of the Bachelor / Master or any equivalent diploma to the internship coordinator (in English or German, in one document), and precise which of the topics you are applying for.

https://recruiting.fraunhofer.de/Jobs

Beginning: from February-April 2019 (flexible)

Duration: 4 - 6 months

Contact: Gilles Rouffaud or Corentin Gasser
Fraunhofer-Institut für Solare Energiesysteme ISE
Heidenhofstraße 2 - 79110 Freiburg-im-Breisgau - Germany

Email: gilles.rouffaud@ise.fraunhofer.de / corentin.gasser@ise.fraunhofer.de

About the Fraunhofer Institute for Solar Energy Systems

The *Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung* (in English *Fraunhofer Society for the advancement of applied research*) is a German research organization, international leader of applied research and Europe's largest application-oriented research organization. Its research activities are conducted by many institutes spread throughout Germany, each specialized in a specific field of applied science. In addition to its German institutes, the organization operates subsidiaries, project centers and facilities in other Europeans countries, in North and South America and in Asia. Founded in 1949, the name of the organization refers to Joseph von Fraunhofer (1787 – 1826) mainly known for his discovery of the dark absorption lines ("Fraunhofer lines") in the solar spectrum.

Member of the *Fraunhofer Society*, the *Fraunhofer Institute for Solar Energy Systems ISE* is the largest solar energy research institute in Europe. It also operates subsidiaries in Boston, USA and Santiago, Chile. Established in 1981, the *Fraunhofer ISE* is committed to promoting sustainable, economic and socially just energy supply systems based on renewable energies. Its research provides the technological foundations for supplying energy efficiently and on an environmentally sound basis in industrialized, threshold and developing countries throughout the world. Focusing on energy efficiency, energy conversion, energy distribution and energy storage, the Institute develops materials, components, systems and offers accredited testing facilities and other expert lab services to clients. The specific fields that the *Fraunhofer ISE* focuses on are: Photovoltaics, Solar Thermal Technology, Building Energy Technology, Hydrogen Technology and Energy System Technology.

Incorporated in the *Energy System Technology* department, the *Power Electronics* unit studies and develops electronic components and systems for photovoltaic and storage systems, power plants, on/off grid systems, energy conversion systems. The main focus lies in converters such as inverters or transformers and the required controls systems for their implementation in energy supply and transmission systems. Special emphasis is put on optimizing the complete system and achieving the highest energy efficiency. *The Power Electronics* unit is composed by three groups specialized in specific fields of research and applications: Decentralized Generation and Storage Systems, Sustainable Grids and Power Plants, and *Advanced devices and Technologies*. It is within this latter group that the students will be integrated in order to work on the proposed internship topics.

A 3-phase and 3-level multi-string PV inverter with dual-booster developed by the Power Electronics unit

The *Fraunhofer Institute for Solar Energy Systems ISE* is located in Freiburg-im-Breisgau, in southern Germany, only a few kilometers from France and about 40 kilometers from Switzerland. The city houses many research institutes as well as universities and faculties, making it unquestionably a dynamic student city with an international atmosphere.
Surrounded by the mountains of the Black Forest, the city also offers a very pleasant living environment and an ideal location for all nature and outdoor sports lovers (hiking, mountain biking, climbing ...).

Views of Freiburg-im-Breisgau and the Black Forest

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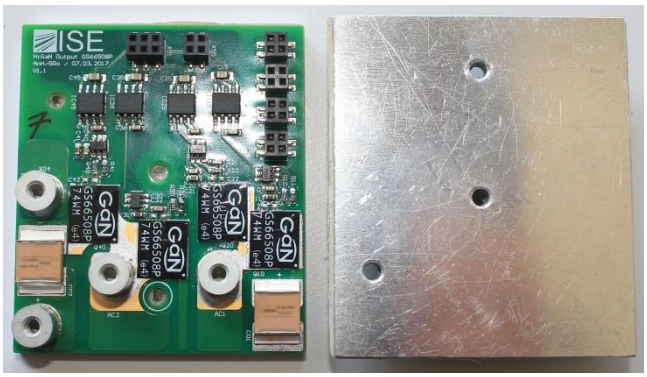
Fraunhofer ISE

Internship / Bachelor-Thesis / Master-Thesis

"Thermally improved PCBs for highly compact solar inverters"

Description of the subject

In many applications in power electronics, the active components releasing a lot of heat (transistors, diodes, integrated circuits ...) are passively cooled by conduction, using heatsinks. These heatsinks are mostly made of aluminum or copper elements and are mounted directly on the component to be cooled. However, these heatsinks are bulky and sometimes heavy, and therefore represent a serious impediment in the development of highly compact and lightweight solar inverters.



Integrated heatsink of a power module for a micro-inverter

To improve the compactness of these converters, it is then interesting to try to reduce the size of the heatsinks, or to use alternative techniques to integrate the cooling function in the printed circuit board (PCB). And, for low power applications (e.g. solar micro-inverters) requiring a high compactness, it is therefore particularly interesting to evacuate the heat through a heatsink integrated in the PCB or even directly through the PCB substrate.

In the context of this internship/thesis, different thermal management and cooling concepts directly integrated in PCB will be first developed, modelled and simulated, then experimentally verified using a dedicated test platform. In addition, different PCB substrates and structures will be analyzed to define optimal design methods of thermal management based on the use of PCBs. The thermal management concepts reaching the best performances will be used later in specific projects to push the limits of miniaturization and integration of solar inverters.

Tasks:

- Review of compact cooling techniques and specific PCB topologies for thermal management
- Modelling and simulation of different thermal management concepts (with FloTHERM)
- Development and realization of a test platform (with Altium Designer)
- Experimental verifications of the different thermal management concepts
- Presentation of the results and writing of a report (or a thesis)

Focus: Highly integrated power electronics, PCB design, thermal management
Beginning: from February-April 2019 (flexible)
Duration: 5 to 6 months

Supervisor: Gilles Rouffaud
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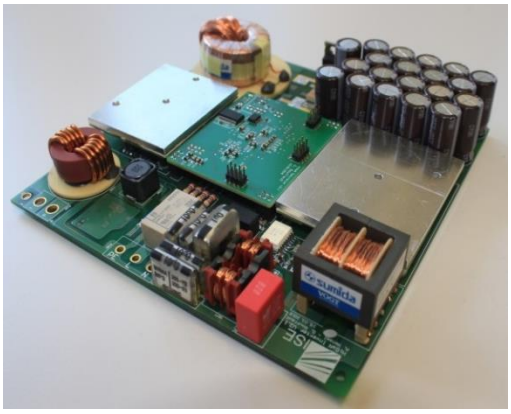
Fraunhofer ISE

Master-Thesis / Bachelor-Thesis / Internship

"Life-cycle assessment of a solar micro inverter"

Definition of topic:



The international community agreed under the Paris Agreement in 2015 to limit the increase in global average temperature to well below 2 °C above pre-industrial levels. A low-carbon power supply by renewable energies is one of the keystones to reach this goal.

However, this energy transition must not be restricted to carbon emissions alone, but other adverse environmental impacts during the life-cycle of the technologies need to be considered as well.

The department "Advanced Devices and Technologies" at Fraunhofer ISE is developing compact and high-efficient solar inverters for many years by deploying novel circuit topologies and devices, which allow an efficient conversion of solar energy to electrical power.

A life-cycle assessment (LCA) of a solar micro inverter shall be performed in this work by using a software system which was especially designed for the electronic industry. This LCA has to consider the carbon footprint over the whole life-cycle as well as the deployed components and materials. The analysis shall be used to develop specific solutions to reduce the environmental impact of the power electronic system.

The results of the work shall finally be used as in guidelines for future projects and therefore continue to be applied in practice.

Tasks:

- Literature review of life-cycle assessment (LCA) methods for power electronic systems
- Implementation of a LCA for a solar micro inverter
- Identification of critical components and materials
- Development of specific solutions to reduce the environmental impact of a solar micro inverter
- Presentation and documentation of results

Focus: Life-cycle assessment, Eco-design of power electronic systems
Begin: from March – April 2019 (flexible)
Duration: 5 – 6 months

Supervisor: Leonhard Probst
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