Description /Abstracts Practical Training

ECPE Tutorial – 'Thermal Engineering of PE Systems: 'Thermal Design and Verification'
Please make your choice between

Training 1: Thermal Network Simulation with LTspice™– Niels Jahn

Equivalent thermal networks are an easy and powerful method to model and simulate the thermal behavior of components in power electronic systems. In this workshop, we will discuss the basics of equivalent thermal networks and demonstrate how they can be derived analytically for simple geometries and how we can determine them from measurements.

In this year, we will model an IGBT power module as a realistically complex example. Suitable equivalent thermal networks will be derived and used to determine self-heating with LTspice. Further, we will show how system simulations including both the thermal and the electrical domain can be carried out easily with LTspice.

Training 2: CFD Thermal System Simulation with Finite Element Method (FEM) with ANSYS Icepak- Martin Pfost

The goal of the workshop is to learn how to perform thermal simulation with power electronics in ANSYS Icepak. We start with a simple model to compare the finite element method with analytical simulation and at the same time to learn how to define power dissipation, materials and boundary conditions. After that we expand the model to heat spreading and discuss the possibility of using a thermal network to model heat spreading.

The next step is the extension of the model to include a heat sink with a fan. This way we learn how to model forced convection to cool a power electronics module. We discuss on how to run parametric simulation to optimize cooling. In the final part of the tutorial we look at the prepared model of the Semicube inverter: how postprocessing looks like and what it takes to simulate this model. We discuss the practical issues: MCAD import, preparation of the model, meshing, etc.

Finally we briefly review features of the software that have not been covered by the tutorial: ECAD import, coupling with other simulation modules (electromagnetics, structural mechanical, electrothermal coupling, system simulation).

Please note! Participation in this working group is subject to the following modalities:

- Passing on your data to CADFEM/ANSYS
- Compliance with the legally prescribed export control regulations
- Registration up to 1 week before the start of the event

Training 3: Developing a Power Board with 3D CFD Thermal Simulation and Thermal Measurement
Andreas Simon-Kajda, Alexander Voth, Samuel Pauls

Practical workshop will start with an introduction of a simulated power board. Followed by a demonstration of a measurement of the same application with the T3Ster measurement system. Topics of the measurement topic will be :

- General introduction to transient thermal measurement method – transient measurement and evaluation of the structure function from the measured temperature response; and physical interpretation of the structure function
- Determining how to measure a component – electrical setup, recommended parameters, calibration of the temperature-sensitive parameter, etc.
- Measurement of the component to determine the component's Rth (i.e. junction to case thermal resistance measurement using the dual interface method (JEDEC JESD51-14 standard)
- Evaluation of the structure function
- Introduction to volume testing – measurement of multiple components, including when mounted on a PCB

After the measurements the results will be compared with the simulation results. As the results will be slightly different there will be done a calibration so that at the end the simulation results will be as good as the measurement results in oder to use them for further simulation runs.

These parts together provide a brief masterclass in thermal design and characterization, using a real product to illustrate the points.