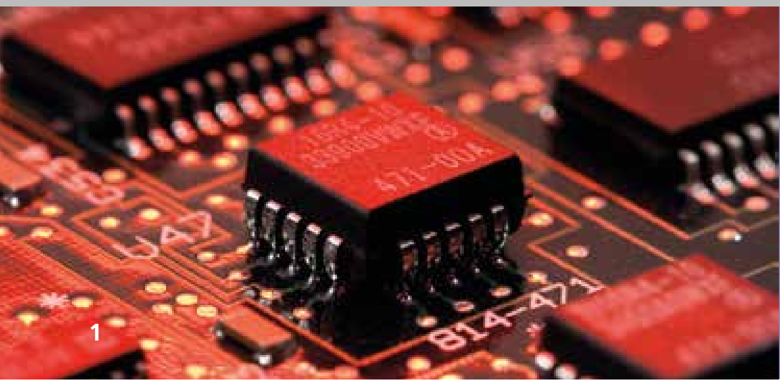
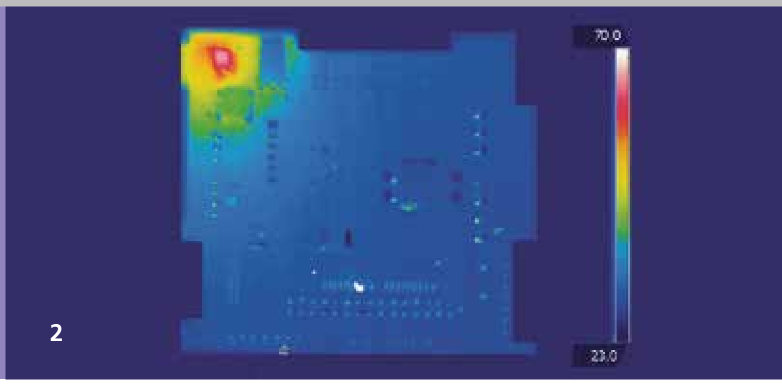
FRAUNHOFER INSTITUTE FOR PHYSICAL MEASUREMENT TECHNIQUES IPM



1



2

1 Thermal management is increasing in importance in view of more and more powerful electronics.
2 Infrared image of a circuit board with overheated component (top left of illustration).

THERMAL MANAGEMENT FOR ELECTRONICS

Fraunhofer Institute for Physical Measurement Techniques IPM
Georges-Köhler-Allee 301
D-79110 Freiburg, Germany

Contact
Dr Markus Winkler
Project Manager
Thermal Energy Converters
Phone +49 761 8857 611
markus.winkler@ipm.fraunhofer.de

www.ipm.fraunhofer.de/en

More power – more waste heat

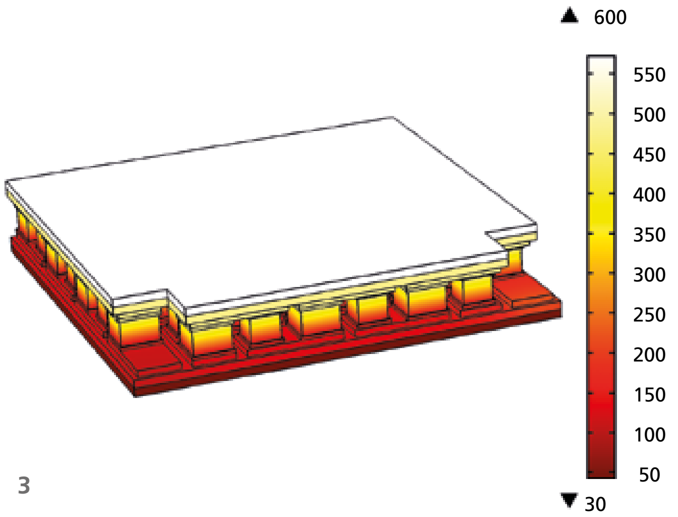
As the power and packing density of electronic components increase, the amount of waste heat generated in a small space also rises greatly. This results in dangerously high temperatures and thus increases the failure risk of electronic devices. Today, 55 percent of electronic component failures are caused by increased temperatures alone. The electronic characteristics of batteries are dependent on operating temperature; battery cells age quickly if operated at excessively high temperatures. These examples clearly demonstrate that tailor-made cooling concepts are becoming more and more important in order to avoid thermal overload. Furthermore, many systems today can be operated in a defined temperature range only.

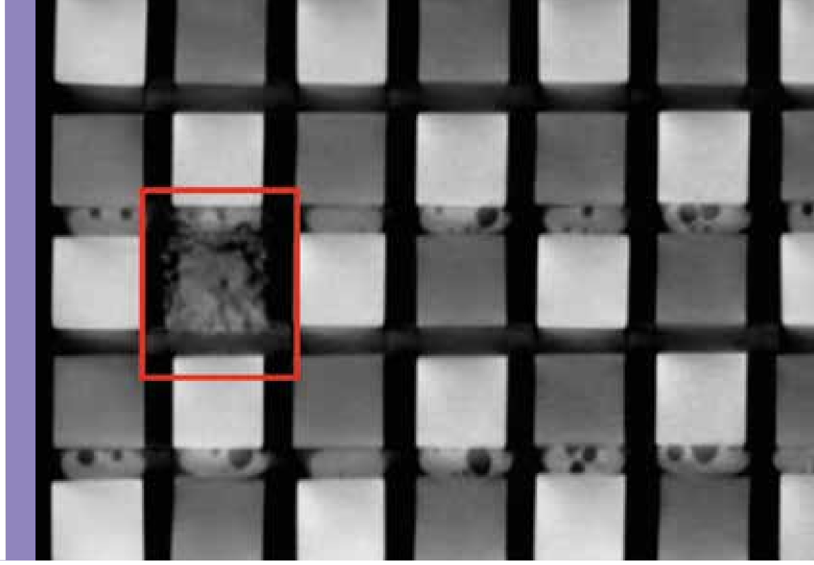
Individual heat dissipation and temperature control concepts

Fraunhofer IPM offers services for thermal management – e.g. for heat dissipation from electronic components on (printed) circuit boards or for battery cooling. The focus is on heat dissipation and temperature control solutions for small to moderate thermal loads. These are based on caloric systems, Peltier coolers and heat pipes which we develop in line with our customers' individual specifications.

Broad range of measurement methods and thermal simulation

- Measurement of temperatures and heat flow etc. – e.g. using thermal imaging



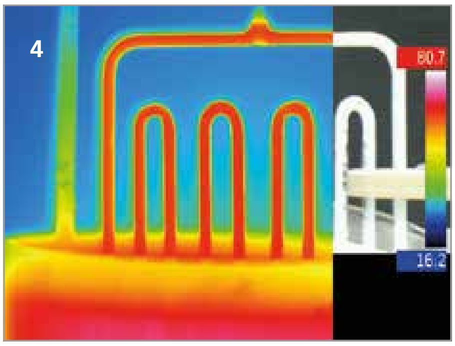


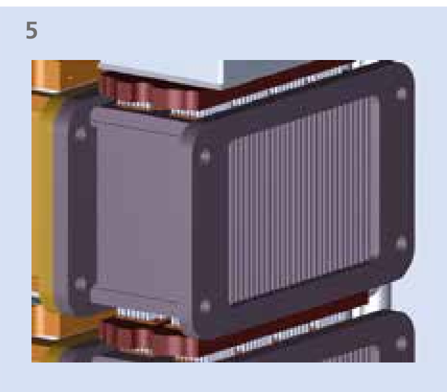
cameras or heat flow meters

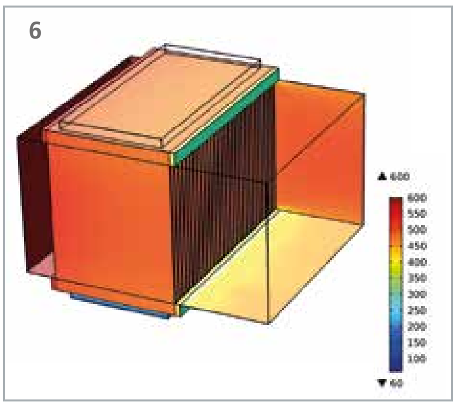
- Thermal simulations of temperatures and heat flow, stationary and dynamic, with various boundary conditions – using COMSOL Multiphysics software packages
- Material characterization of thermal conductivities and heat capacities, coefficients of expansion and specific densities (differential calorimetry, laser flash analysis, time-domain thermoreflectance, dilatometry, etc.)
- Structural characterization and failure analysis (also as a prerequisite for FMEA analyses) of materials – e.g. using scanning electron microscopy, 3D computer tomography and X-ray structural analysis
- Thermal characterization of components and systems – e.g. using IR thermography, heat flow meters, etc.

Our services

- Solutions for thermal management – e.g. of components on circuit boards, batteries, etc.
- Thermal system design
- Assembly, development, characterization and coupling of heat pipes, caloric cooling systems, Peltier coolers, heat exchangers, etc.
- Design, construction, simulation and characterization of heat pipes made of various materials and with various operating fluids – including special types such as pulsating heat pipes
- Processing and shaping of materials
- Prototype construction with state-of-the-art CAD/CAM systems in our in-house workshop







3 *FEM simulation of the temperature distribution in a Peltier module with a fixed hot and cold side temperature of 600 and 30 °C. The underlying simulation also considers the thermoelectric effects.*

4 *Thermographic image of a pulsating heatpipe (PHP) immersed in a hot liquid. A PHP exhibits an enormously high effective thermal conductivity. Compared to a solid copper rod (left in the picture) the temperature compensation with a hot liquid takes place very fast in the whole volume.*

5 *CAD model of a system consisting of heat exchanger (dark gray) and Peltier modules (brown and light gray).*

6 *FEM simulation of the temperature distribution in the heat exchanger (Fig. 5). Gas at a temperature of 600 °C flows through the heat exchanger, which is connected to Peltier modules with a cold side temperature of 70 °C.*