

# Measuring laboratory for Peltier modules

## Customized measuring stations

Thermal pumping power, heat flows, long-term stability

*At our measuring stations, which have been specially developed for thermoelectrics, we determine the entire range of essential characteristics of Peltier modules.*

Peltier modules have been widely used as heat pumps for decades. They control temperature in niche products such as wine coolers or temper processes such as the duplication of DNA sections. Accurate characterization of the modules is crucial in order to meet the high reliability requirements even in critical applications such as in biotechnology and medical technology. Fraunhofer IPM uses measuring stations specially developed for thermoelectrics to characterize Peltier modules and determine all their essential characteristics.

### Characterization of modules of different design and size

Our module measuring stations are specially designed for the characterization of Peltier modules. At the measuring station, Peltier modules of different size and design can be characterized in terms of their thermoelectric and thermal performance and their temperature-dependent internal resistance. From these data, the typical data sheet curves for Peltier modules such as temperature- and current-dependent cooling power, COP and "waste heat" are generated.

Depending on the electric current applied and the existing temperature difference, the module's heat flows are measured. To this end, the modules together with two heat

flowmeters are clamped between heat exchangers and pressed on with a given pressure. As an option, the temperature distribution of the outermost pairs of legs in the direction of the Z-axis can be monitored with an infrared camera. Different atmospheres, from vacuum to overpressure with different gases, can be generated in the measuring chamber to simulate different application scenarios.

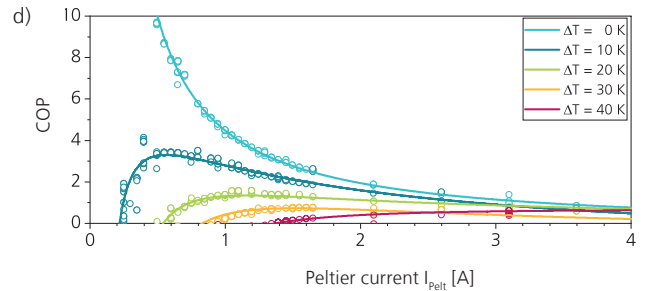
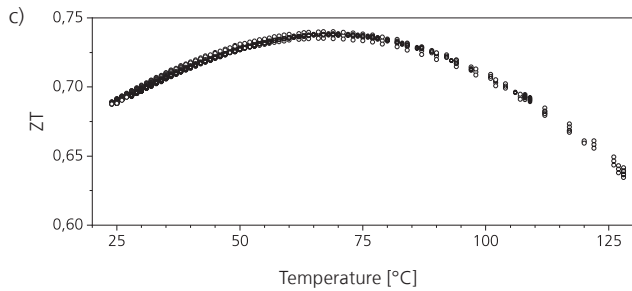
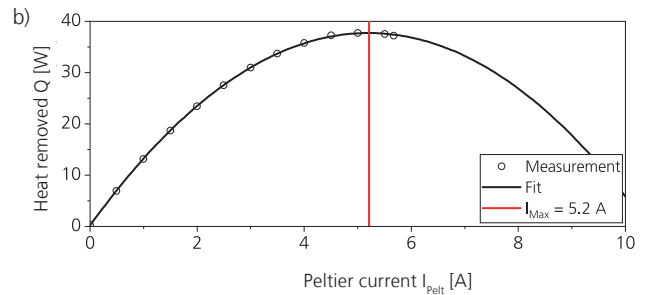
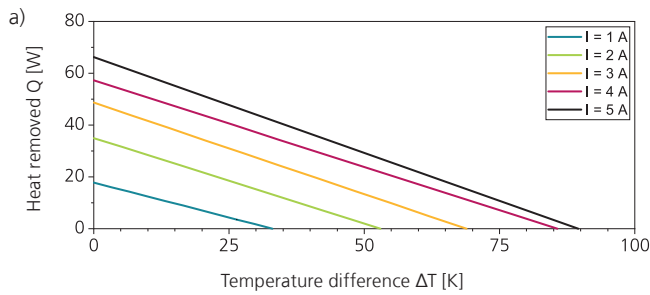
### Possibility of long-term testing

Long-term tests can also be carried out at the module measuring station. For this purpose, temperature, pressure, and power ramps are applied according to a defined test protocol to identify and evaluate any failure mechanisms.

### Our offer

We develop custom-made measuring technology for Peltier modules, and we carry out measurements on behalf of our customers.

- Characterization of Peltier modules and creation of data sheets
- Long-term tests in different experimental environments
- Development of measuring stations upon request
- Simulation of thermal and thermoelectric systems



Data of different Peltier modules, automatically generated at our measuring stations: Besides characteristic curve fields at different hot side temperatures (a), we determine the maximum Peltier current  $I_{max}$  (b), the temperature dependent ZT (c) as well as the coefficient of performance (COP) (d) of the modules.

### Parameter variations

- Heat exchanger -20 to 80 °C
- Maximum electric current: 40 A
- Maximum voltage: 360 V
- Maximum electric power: 5 kW
- Contact pressure according to module size from 0 to 12 MPa
- Module size: 16 × 16 mm<sup>2</sup> to 50 × 50 mm<sup>2</sup>
- Round-shaped modules possible

### On behalf of our customers, we determine

- Electrical resistivity and conductivity
- Charge carrier concentration and mobility
- Thermal conductivity and capacity
- Coefficient of thermal expansion
- Seebeck coefficient
- Thermal decomposition and phase transition temperature
- Density (liquid, solid-state)

We provide cross sections of the legs and modules upon request.

### Harman measuring station

The measuring station developed by Fraunhofer IPM enables precise measurements according to the Harman principle for determining the figure of merit ZT at different temperatures.

### Other measuring procedures

In addition to thermoelectric and thermal characterization, we investigate modules and materials in terms of their basic elemental composition and structure. For this purpose, destructive and non-destructive methods such as SEM/EDX, XRD and a 3D computer tomograph are available at Fraunhofer IPM.

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