

# Peltier systems

## Thermoelectric cooling and temperature control

Efficient and with no need for harmful refrigerants

*Peltier modules cool and control temperature without noise or vibration or the need for harmful refrigerants. Fraunhofer IPM manufactures Peltier modules in small batches and assembles ready-to-use Peltier systems for various applications.*

Peltier modules pump heat entirely without harmful refrigerants and without moving parts. This means they operate reliably, without noise or vibration. They feature a compact design, short response times, high temperature resistance and a wide temperature range. This qualifies them for numerous applications in medical technology, in the consumer goods sector, and for special cooling applications in mechanical engineering and the catering business.

### Substantial experience – from material to systems

Fraunhofer IPM draws on over 20 years of experience in material and module development for thermoelectric systems. We manufacture free-form modules in small batches on a partially automated module construction line and we are investigating novel concepts relating to assembly and connection technology. In our in-house measurement laboratories, we use custom-developed measuring devices to characterize the thermoelectric properties of materials and modules. This allows, for example, Peltier modules to be fully characterized under varying operation conditions at a dedicated

Peltier measuring setup and a detailed data sheet to be derived from the data acquired.

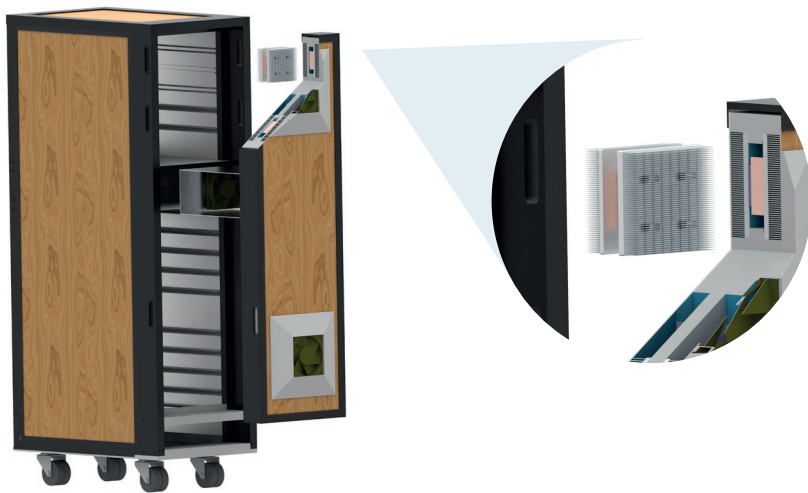
### From prototype to implementation

In order to make optimum use of Peltier modules, thermal coupling and the system design are crucial. We develop, build and characterize specific system solutions for our customers – from prototype to implementation. A thermoelectrically cooled Gastronorm (GN) trolley developed by Fraunhofer IPM together with the companies Siemens Mobility and Zech + Waibel stands as an example for the benefits of Peltier cooling compared to conventional compressor-based cooling systems.

### Our offer

We develop custom-tailored Peltier measuring and systems technology and characterize modules on behalf of our customers.

- Characterization of Peltier modules and creation of data sheets
- Development of measurement setups for modules and systems
- Long-term measurements in different environments
- Simulation and development of thermoelectric systems for Peltier cooling



*Energy-efficient with no need for harmful refrigerants: The thermoelectrically cooled GN trolley developed by Fraunhofer IPM together with Siemens Mobility, ensures a consistent cooling chain. It complies with all the technical requirements in rail vehicles and on transport routes as well as the overall gastro standard.*



Collaborating with Fraunhofer IPM was always hands-on, with a clear focus on the objective.”

Andreas Häußler, Siemens Mobility

### Thermoelectrically cooled GN trolley

Transport and storage of food and beverages are a challenge for railroad operators: Today, the goods are shipped to the trains in GN trolleys with no active refrigeration. If delays occur in the timetable, the trolleys are occasionally parked on the platform. At worst, this will interrupt the cooling chain and the food can no longer be sold. On the train the thermally poorly insulated trolleys are pushed into a cold storage room. The energy required with this concept is many times higher than for standard household refrigerators.

### High energy efficiency – battery runtime up to 12 hours

The newly developed thermoelectrically cooled GN trolley operates with significantly less energy: Compared to the cooling solutions currently used on-board bistros in trains, the trolley requires up to 85 percent less power input. In battery operation, the trolley cools for up to twelve hours with no need for its own power supply – ensuring a consistent cooling chain.

A compact electronics unit in the lower part of the trolley supplies and regulates the components. When opening the doors to take out food or drinks, the electrical output increases, to the effect that the Peltier modules generate up to 200 W of cooling power and thus quickly restore the temperature.

By combining suitable components – which include selected heat sinks, energy-efficient fans and high-performance Peltier modules – with an optimally dimensioned insulation, the cooling system developed by Fraunhofer IPM achieves an excellent ratio of generated cooling power to electrical input power (Coefficient of Performance, COP). At a temperature difference of 10 K between the trolley interior and the environment, an overall COP of 1.6 can be achieved. At the same time, the trolley still meets the tight space requirements in rail vehicles and on transport routes. It also complies with all the requirements of the gastro standard as well as those regarding materials and handling.

#### Technical data: thermoelectric GN trolley

Overall dimensions (H/W/D)	140 cm / 39 cm / 66 cm
Inner dimensions (H/W/D)	113 cm / 33 cm / 53 cm
Battery capacity	40 Ah
Battery runtime	up to 12 hours
Overall COP (@ $\Delta T = 10$ K)	1.6
Max. cooling power (@ $\Delta T = 10$ K)	200 W
Inner temperature	4–7 °C
Materials	inside aluminum, outside HPL

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