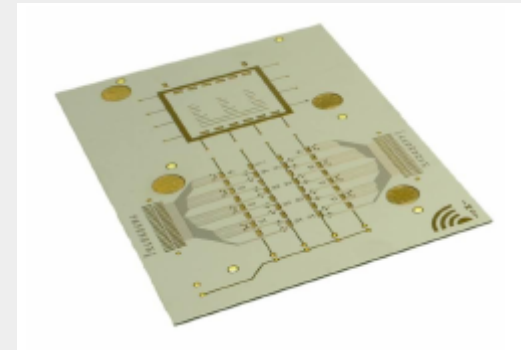


## »In-Board cooler«

### 3D printed ultra thin micro cooler for board integration

The continued increase in the packaging density of printed circuit boards calls for new ways regarding the heat management of electronic assemblies. One solution is a liquid cooler made using a metall 3D printer process and which is integrating directly into a multilayer board to effectively cool its components.



Please contact us for more information or a quotation via

E-Mail: [info@eureca.de](mailto:info@eureca.de)

Phone: +49 (0) 221 952629-0

*Eureca Messtechnik GmbH* as specialized in technical consulting, development and supply for OEM projects with the focus on cameras, optical measurement and thermoelectric cooling systems.

Our partner company *IQ Evolution* is an expert on the development and production of microcoolers for power electronics. Their 3D printing manufacturing technique provides highest efficiency in the micrometer range for the smallest cooling structures.

# **„In-Board cooler“**

## **3D printed ultra thin micro cooler for board integration**

IQ evolution GmbH

Dr.-Ing. Thomas Ebert

The cooling plates are produced by **SLM** procedure, the **Selective Laser Melting**.

The procedure is also known as LPBF (Laser Powder Bed Fusion).

IQ evolution refined this 3D-metal-printing process over more than 10 years, specially to the requirements of building micro structures.

Rapid Prototyping and complex mass production are both efficiently producible with this technology.

For more informations about the 3D-printing process please use our download-center:

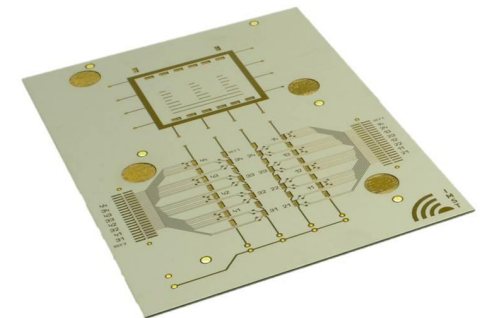
[http://iq-evolution.com/downloads\\_de/](http://iq-evolution.com/downloads_de/)

All our products are covered by registered patents.

Registered patents: US 9083138; US 12438336; EP 1672690; EP 2061078  
Patent pending : EP 18156325



„In-Board“ cooling plate (0,8 mm)



Intergrated  
„In-Board“ cooling plate

# Standard cooling solution with copper core

Inside the board is a copper layer for heat spreading and heat transportation.

Disadvantages are weight, slow heat removal and the need of insulated Vias all over the board.

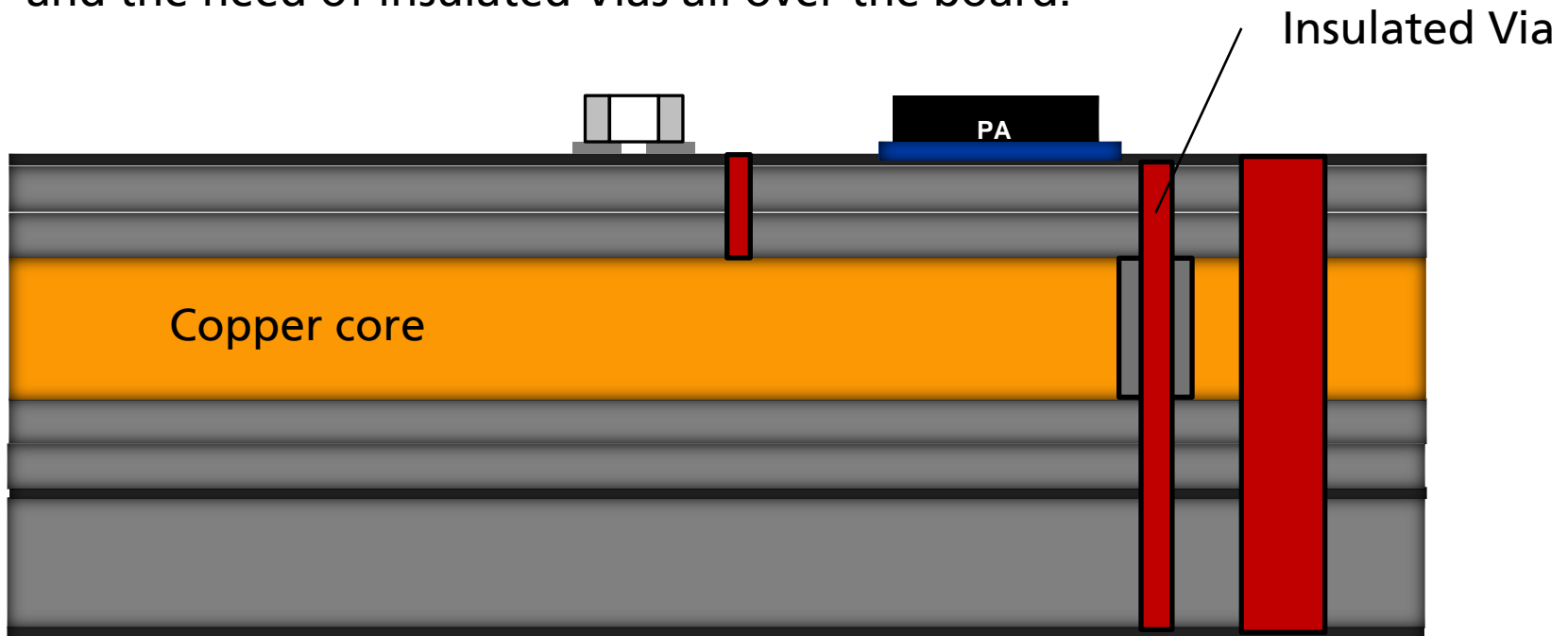


Fig.: PA-PCB with copper core, source IMST\*



\* IMST GmbH, Kamp-Lintfort

# Integrated liquid cooling, „In-Board cooler“

Replacement of the copper core by 3D printed micro cooler (thickness 0,8mm), only at the placement of the heat source (PA).

Advantages: 1/3 of weight as copper core solution, fast heat removal, insulated Vias only necessary at the area of micro cooler, at other places (e.g. FR4-core) no insulation is necessary.

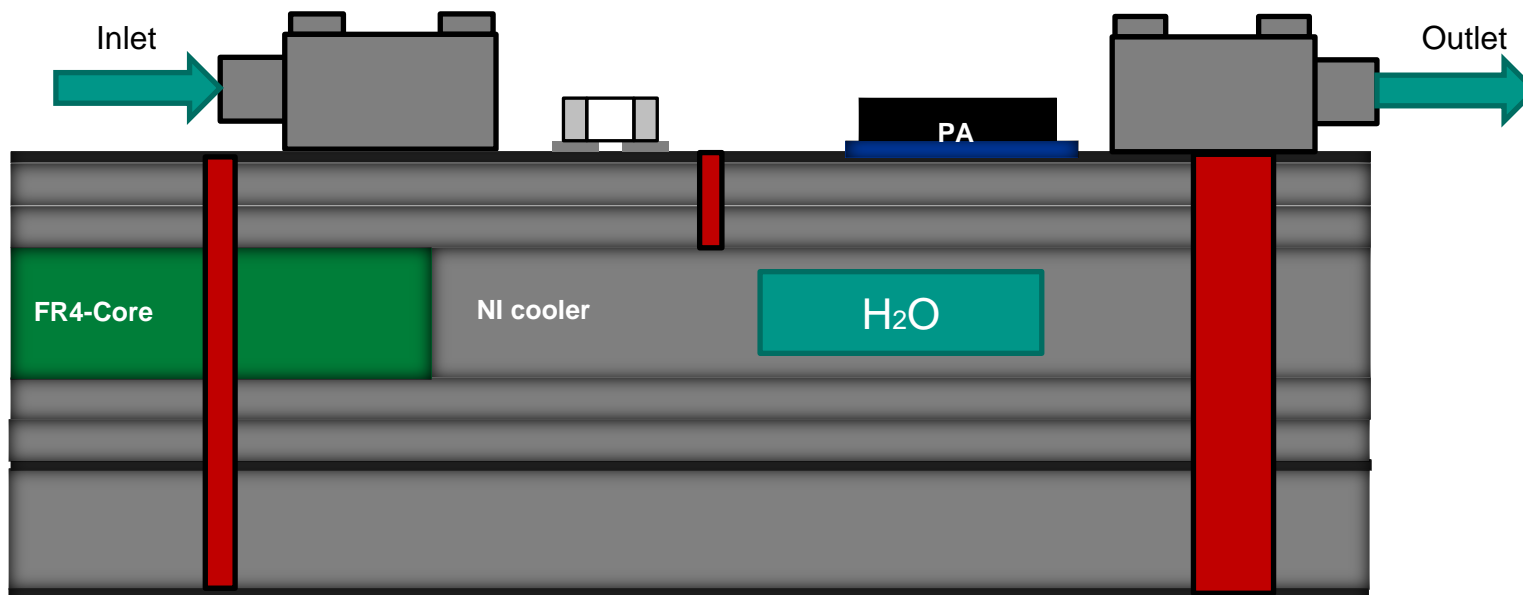


Fig.: PA-PCB with integrated cooler, source IMST\*

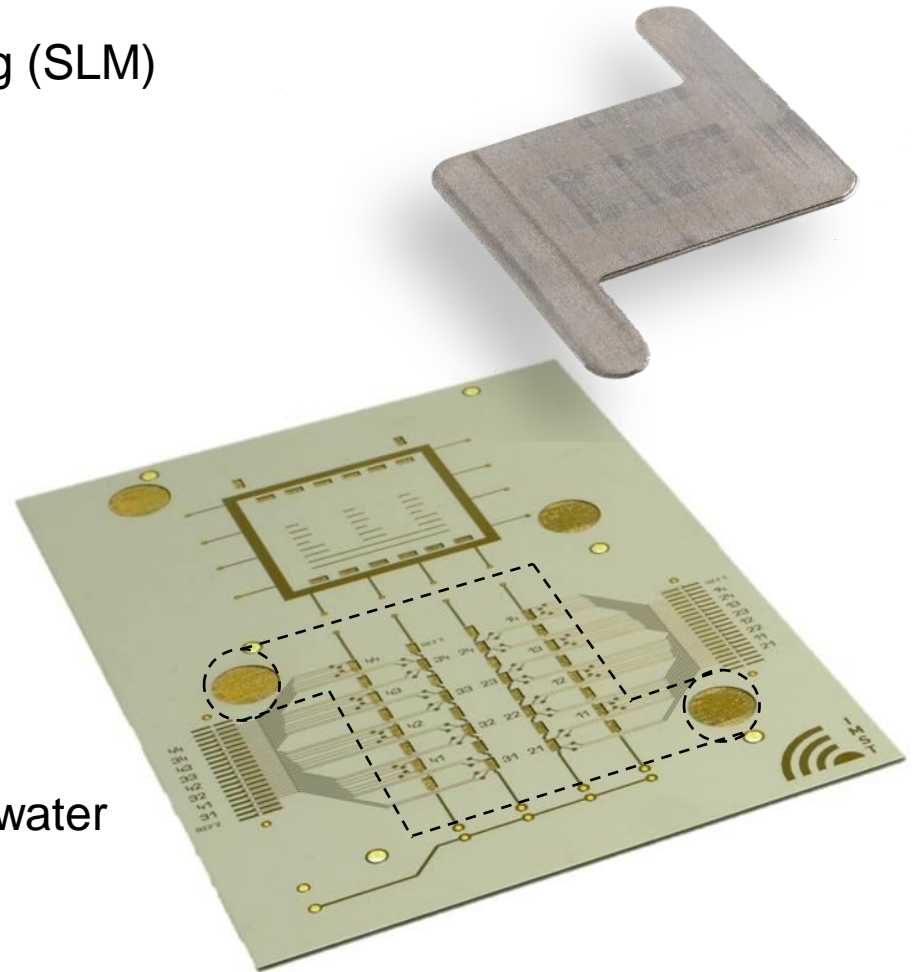


\* IMST GmbH, Kamp-Lintfort

# 3D printed „In-Board“ cooler

- Manufactured: Selective Laser Melting (SLM)
- Material: Nickel\*
- Thickness of the cooler: 0,8 mm
- Cooling performance: 1.000 W
- Adapted for integration in
  - conventional boards
  - Multilayer-HF boards
- Developed after IMST\*\*-Specification
- Only a third of weight in comparison to a similar board with coppercore

\* Long-time resistant against deionized water



Dashed line: contour of the integrated cooler

# 3D printed „In-Board“ cooler

During the manufacturing of a multi layer board an active cooling plate is integrated at the inside of the board.

The active cooler is made out of nickel with a thickness of 0,8 mm, the total height of the board is 1,3 mm

The circular areas are the water in- and outlet.

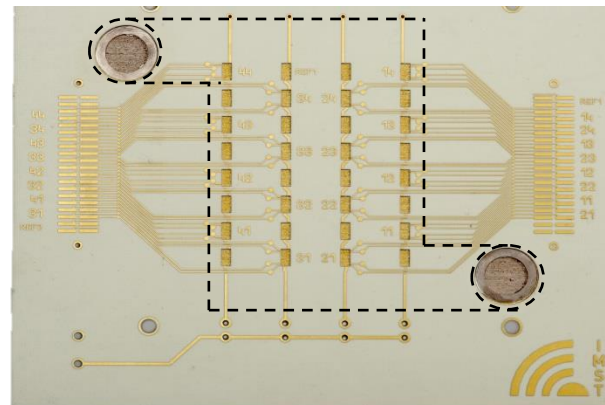
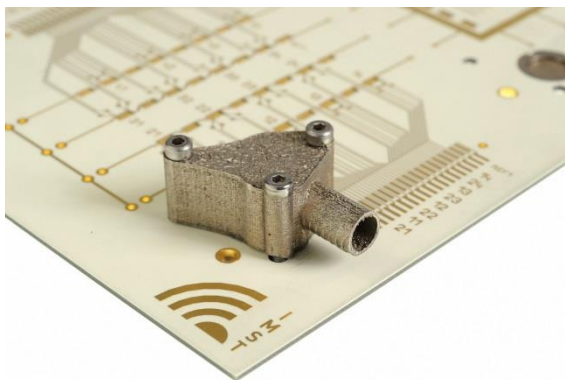
An inlet pressure of 0,5 bar already

leads to a cooling performance of 500 Watt.

Maximum cooling performance is approx. 1.000 Watt



Patent pending

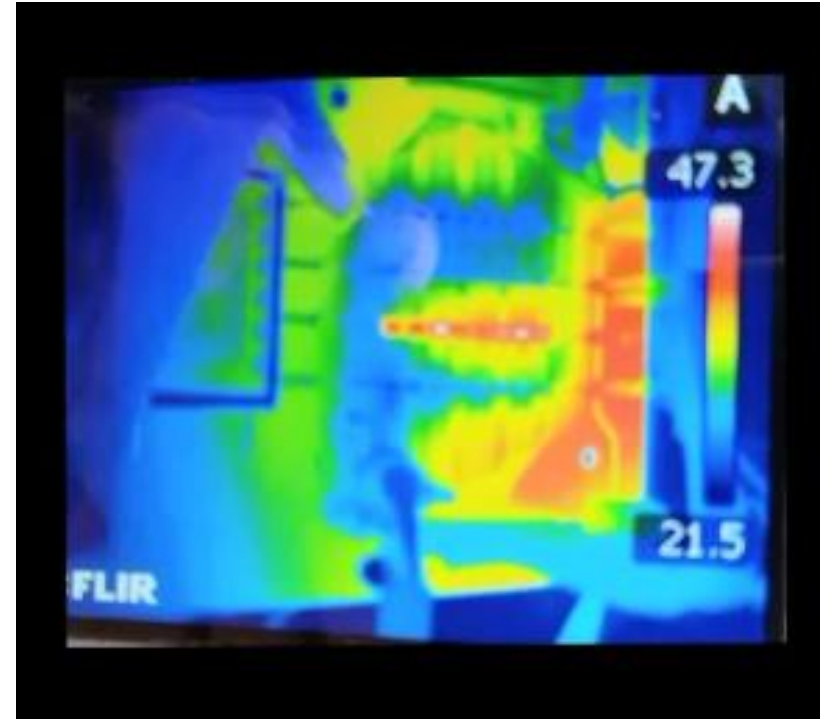
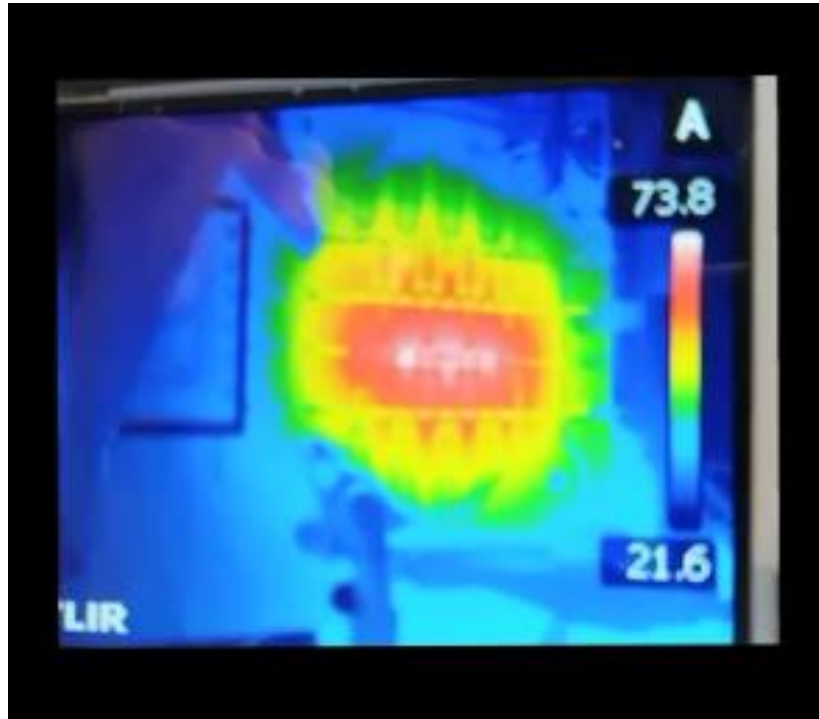


\* IMST GmbH, Kamp-Lintfort

# 3D printed „In-Board“ cooler, measured data\*

Location: Row 2 of 4

Thermal load: 24 W/row



Cooling: Off ← 5 seconds → Cooling: On

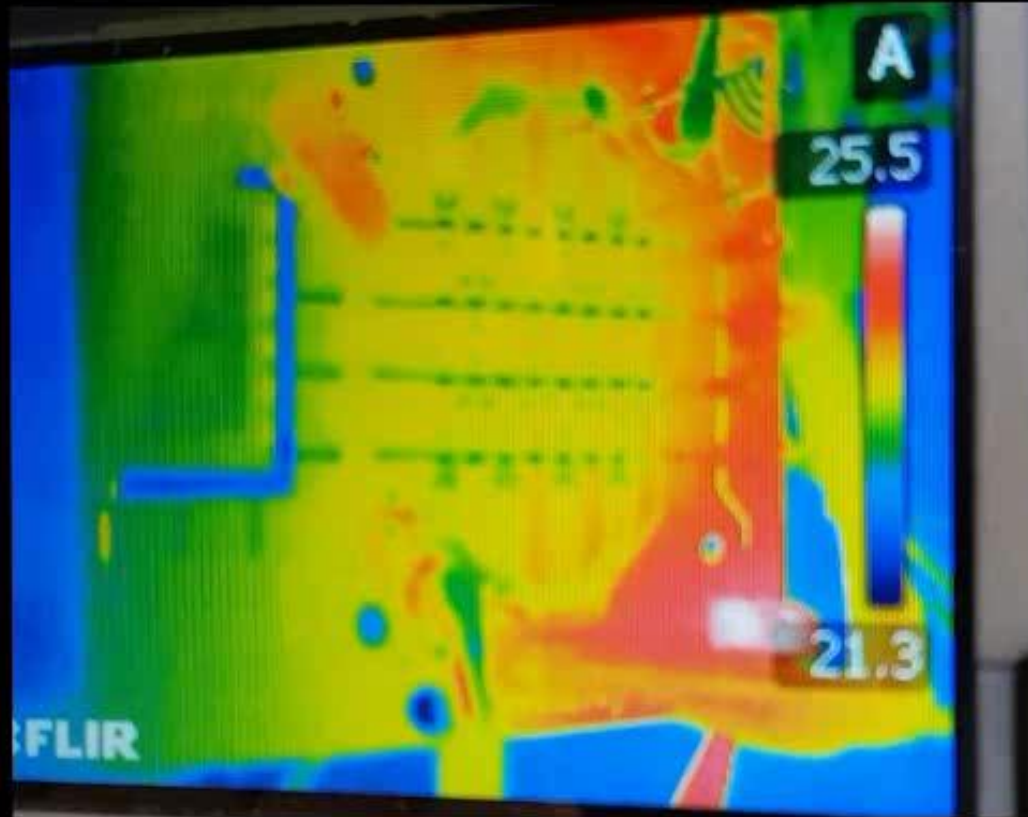


# 3D printed „In-Board“ cooler, measured data\*

Location: Row 2 of 4

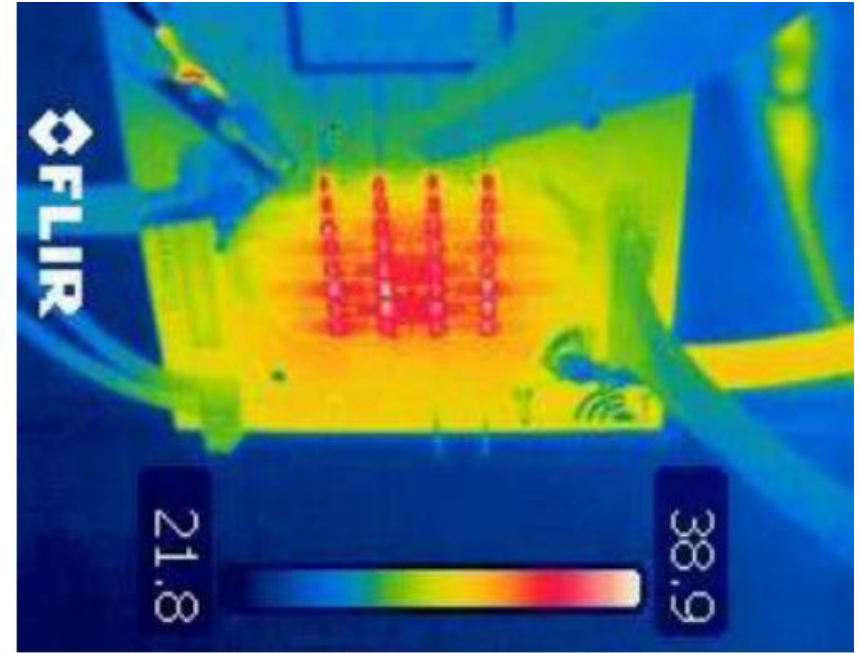
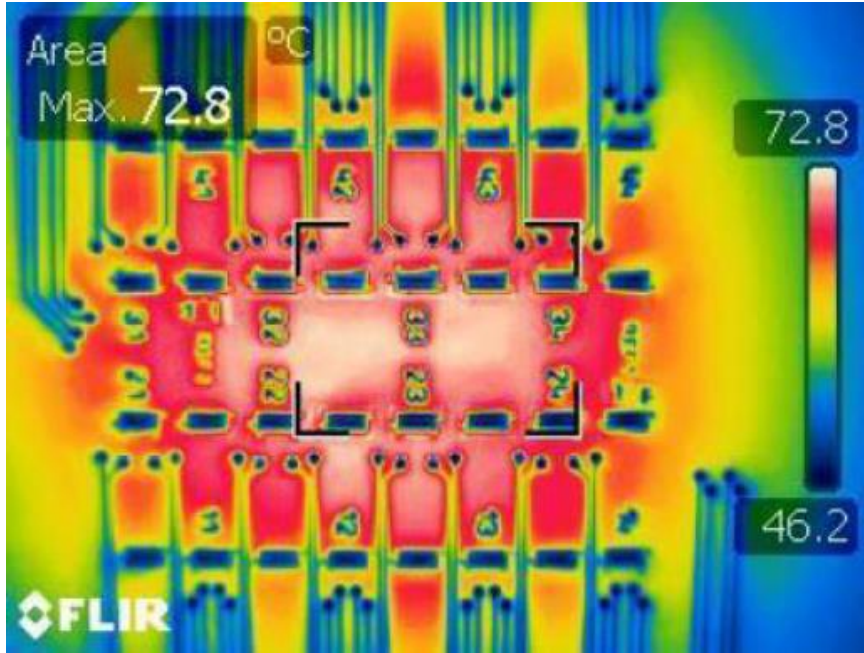
Thermal load: 24 W/row

Click for  
Video clip



# 3D printed „In-Board“ cooler“ vs. Copper core with fan\*

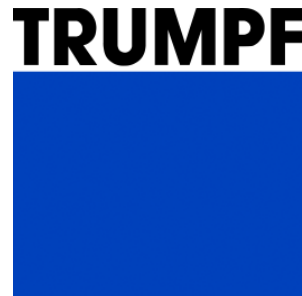
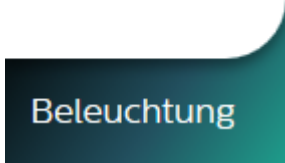
Comparison between copper core PCB with rib-cooler & fan (left) and InBoard-cooler (right).  
4 active rows, 48 W dissipated power, 1 bar pressure drop (InBoard-cooler)



„The copper core, in this case, has reached the limit of its possibilities, even with an external airflow. The liquid cooling is operated with a pressure of 1 bar, far from its limit: The embedded nickel cooler is tested up to 4 bar pressure, so the device has much cooling reserve left“

( Jens Leiß, IMST GmbH @ European Conference on Multifunctional Structures, EMuS 2019)

# References



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