



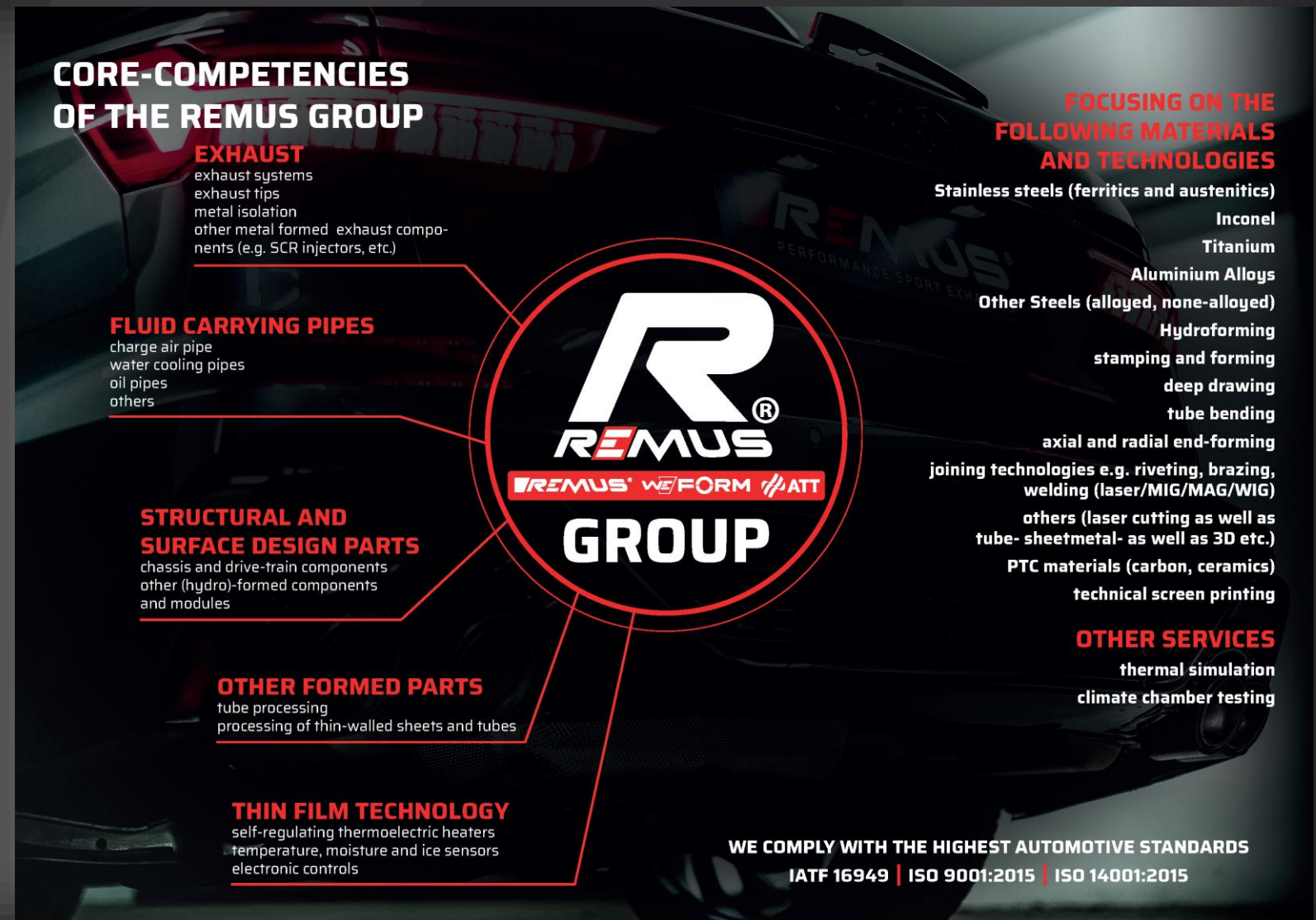
heating science

## ■ Introduction ATT

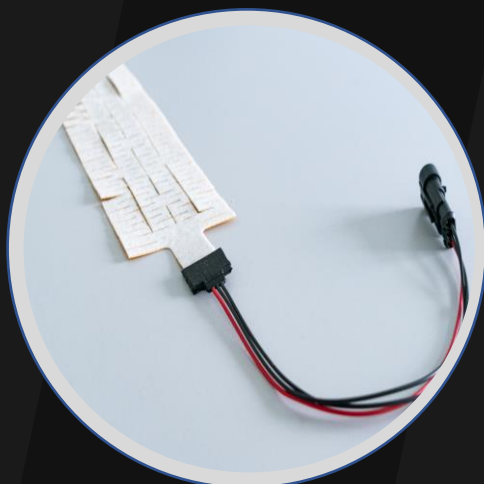


ATT is member of the REMUS-Group

- Employees: ~850
- Turnover: ~170 Mio.
- Production: Austria & Bosnia

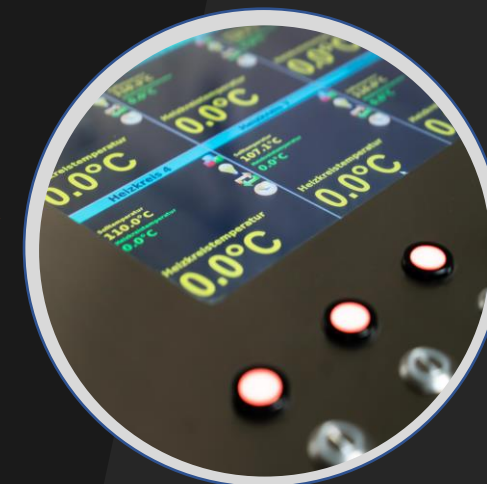


# Introduction ATT



## Printed Electronics Solutions

- Printed Flexible PTC-Heaters
- Printed Flexible Sensors
- Electronics
- Battery Thermal Management
- **Thermal Comfort Optimization**
- ADAS Sensor & Camera Heating Systems
- Heated Floor Panels
- Vehicle Cabin Heating
- Flexible Printed Circuits (FPCs)
- Sensors & Systems



## Manufacturing

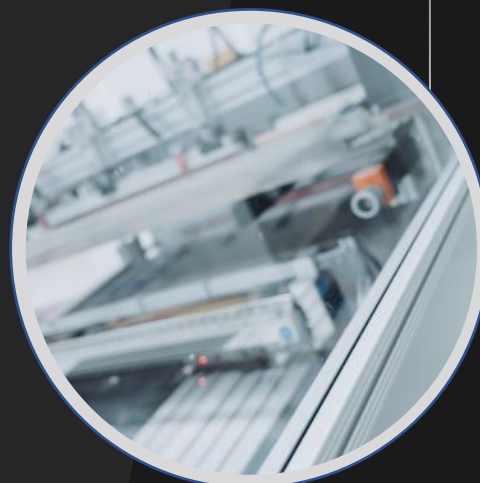
- Prototyping
- Series Manufacturing

## Thermoforming

- High Performance and best-in-class heating systems for thermoforming of plastic foil
- Food and Medical
- Hardware & Software

We are a **solution provider, developer and manufacturer** of **intelligent heating & sensing systems in the field of printed electronics.**

We support our customers in specifying what they need, deliver prototypes in a very short time and beyond that we can also offer series parts.



Home Base  
Graz



## ■ Introduction ATT



As an **innovative company**, we aim to take our **social responsibility** seriously and set the course for a **sustainable future** early on.

- We align ourselves with **international standards**
- We are in the process of implementing **ISO 14001**
- In addition, we are preparing for customer requirements through **CSRD** and planning to calculate the **Product Carbon Footprint** of selected products.
- Regular workshops are held within the company for all employees, covering topics such as **external requirements**, **SDGs** (**Sustainable Development Goals**), opportunities and risks, scopes, and materials.

It is of great importance to us to provide transparent information about our progress in the field of sustainability.

We are aware of the challenges and aim to gradually and continuously address these challenges, **reduce our emissions** along the value chain, and develop and manufacture products tailored to the needs.



We have a strong focus on Automotive industry, because that is where most of us come from. But our technologies and products can be used in many other industries as well. We see ourselves as solution providers and our technologies get integrated into a wide range of different applications.

## AUTOMOTIVE

50%

## AEROSPACE

20%

## RAILWAY

15%

## LIFE SCIENCE

10%

## DEFENCE

5%







# Technology Overview

*ATT is **highly experienced** in developing and manufacturing foil-based flexible heaters and sensors based on printed electronics.*

# Technology Overview

## Heaters

Our heaters are tailor made for each specific application. Material layers are individually selected based on requirements.

- AC/DC (1000V+)
- up to 350 kW/m<sup>2</sup>
- Extremely light
- Very thin & flexible
- Strong PTC effect
- Stress resistant
- Injection Molding
- Individual connectors
- Automotive certified
- Aerospace certified
- Customizable

## Electronic Control



We design specific ECUs for each application with individual interfaces to existing architectures. We offer the full scope of Electronics development

- Concept Development
- Circuit Design & Simulation
- Layout
- Assembly
- Firmware Development
- Graphical User Interface
- Testing
- Certification

The combination of heating, sensing and controlling offers completely new possibilities to bring functionality to components. Make them Intelligent.

## Sensors

Our sensors fully integrate into the heaters or can be used stand alone.

- Temperature Sensors
- Humidity Sensors
- Ice Sensors
- Capacity Sensors
- Pressure Sensors



# Technology Overview :: Comfort Simulation



## Baseline Analysis

A virtual representation of the vehicle cabin is created based on available CAD data or surface scan data. The model gets parameterized based on existing measurement data or characteristic lines. Based on a certain load case, the thermal comfort situation of the baseline vehicle will be analyzed.

## Target Function

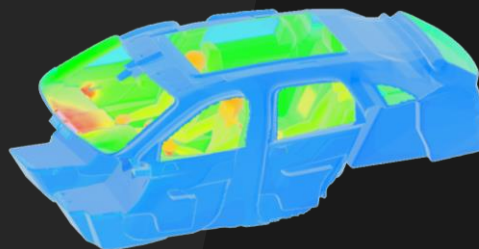
At this point it is very important to decide which goals should be achieved. Basically, there are two different options. Either the current thermal comfort situation should be maintained while consuming less energy, or the thermal comfort situation should be improved while using the same amount of energy.

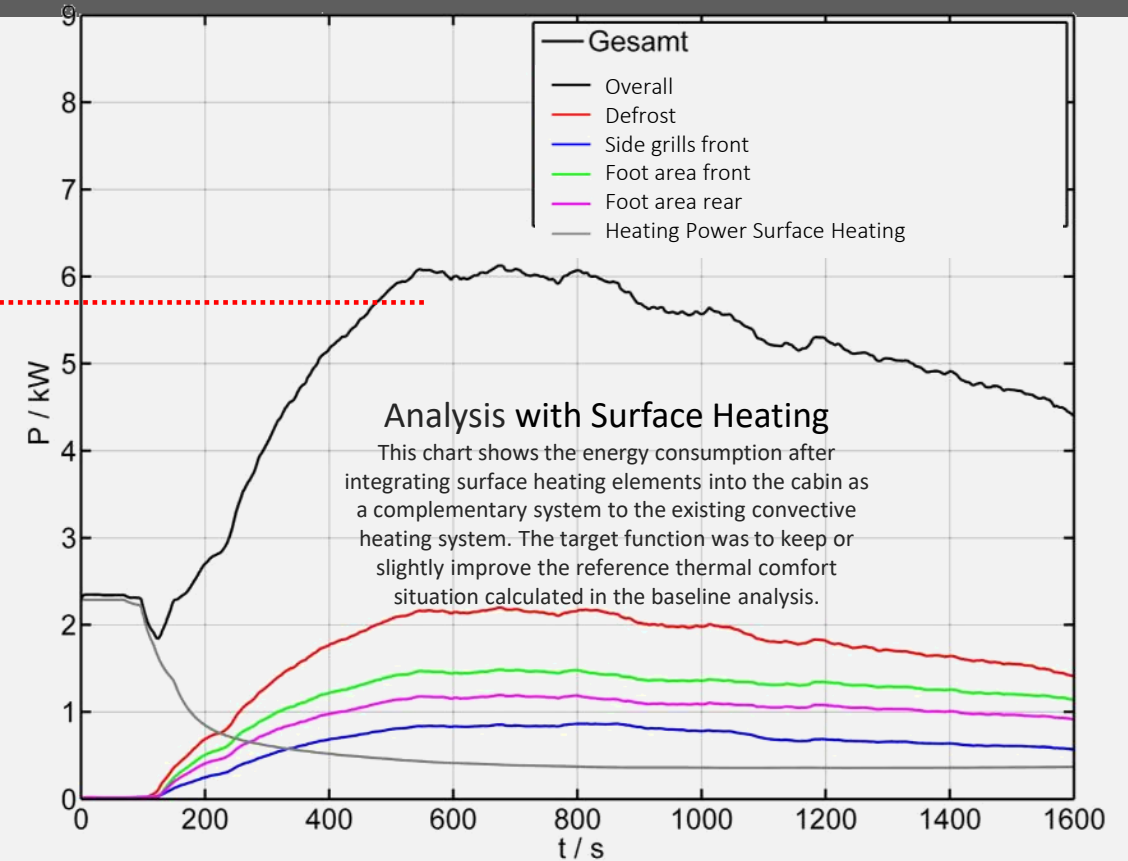
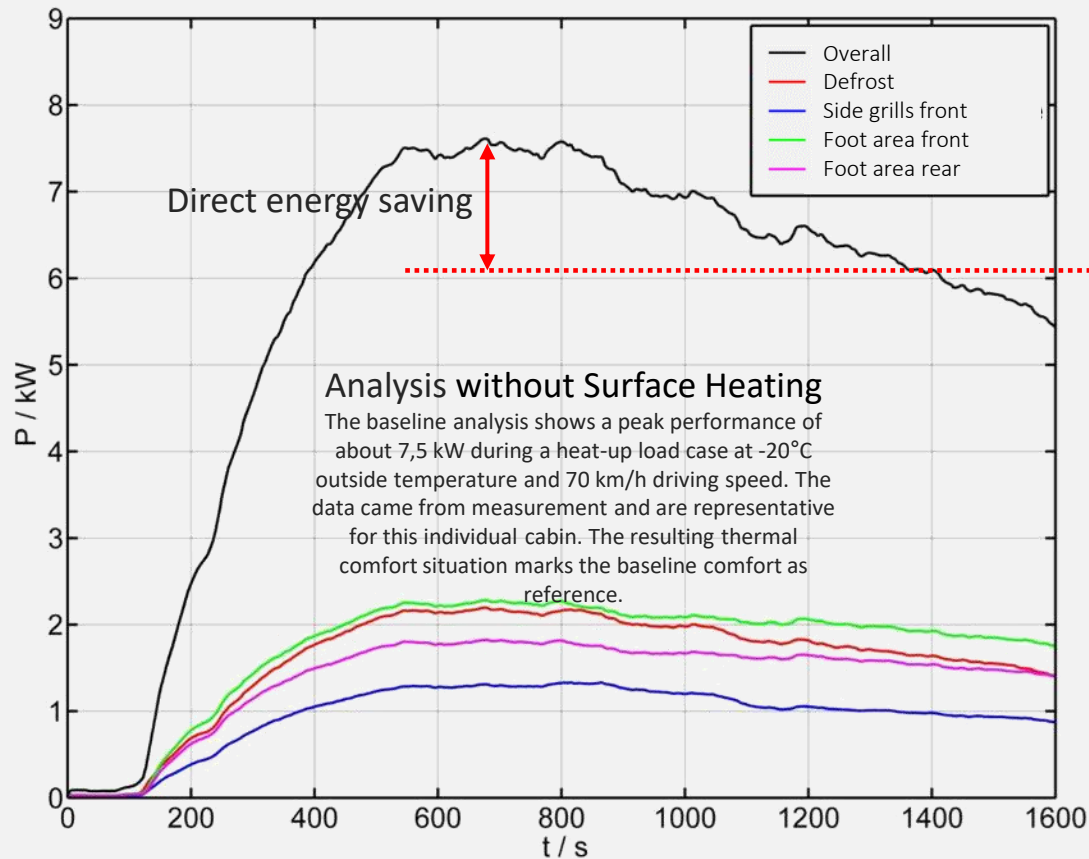
## Design

Next the different locations and desired power consumption of the surface heating system should be determined. Based on these parameters the different heating foils are designed and virtually validated by CAD and simulation tools. The original CAD model of the cabin gets updated.

## Analysis Update

A new comfort analysis while operating the surface heating system will be performed to check the impact on the human organism inside the cabin. The parameters of the present heating elements can be modified to achieve the best possible result.

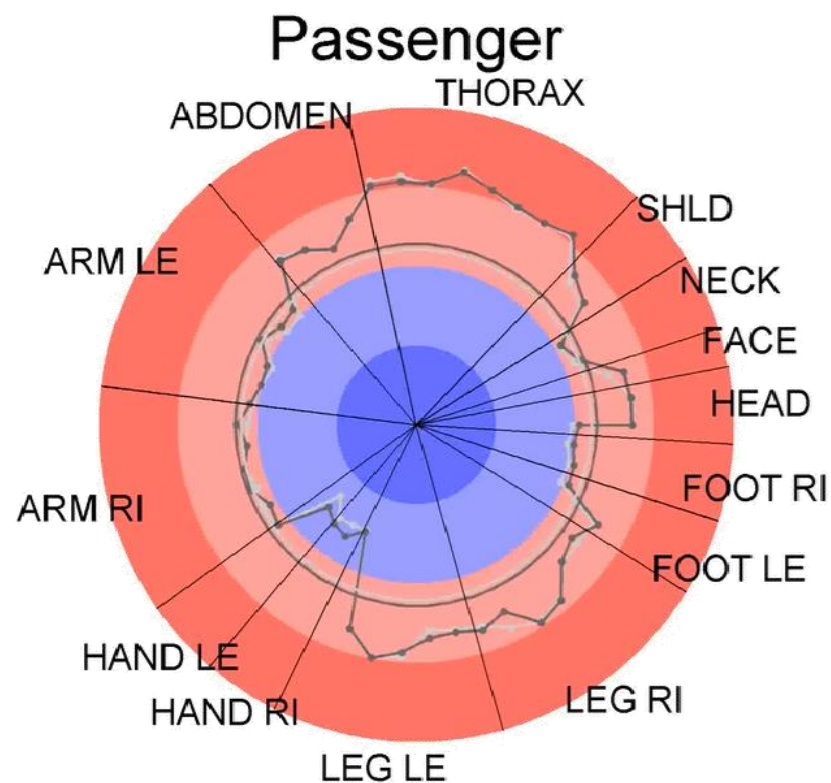
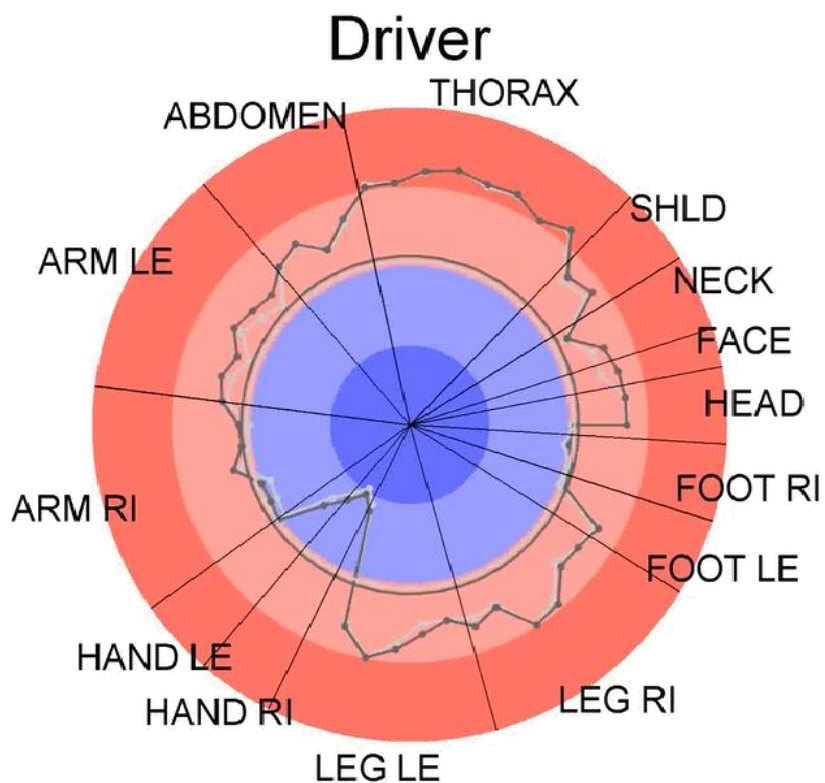




Once a surface heating system is **engineered and integrated into the cabin properly**, **energy savings for establishing and maintaining thermal comfort in the range of 25%** are possible.

# Technology Overview :: Comfort Comparison

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Play Animation



Light grey: no Surface Heating  
Dark grey: with Surface Heating



# Surface Heating Systems

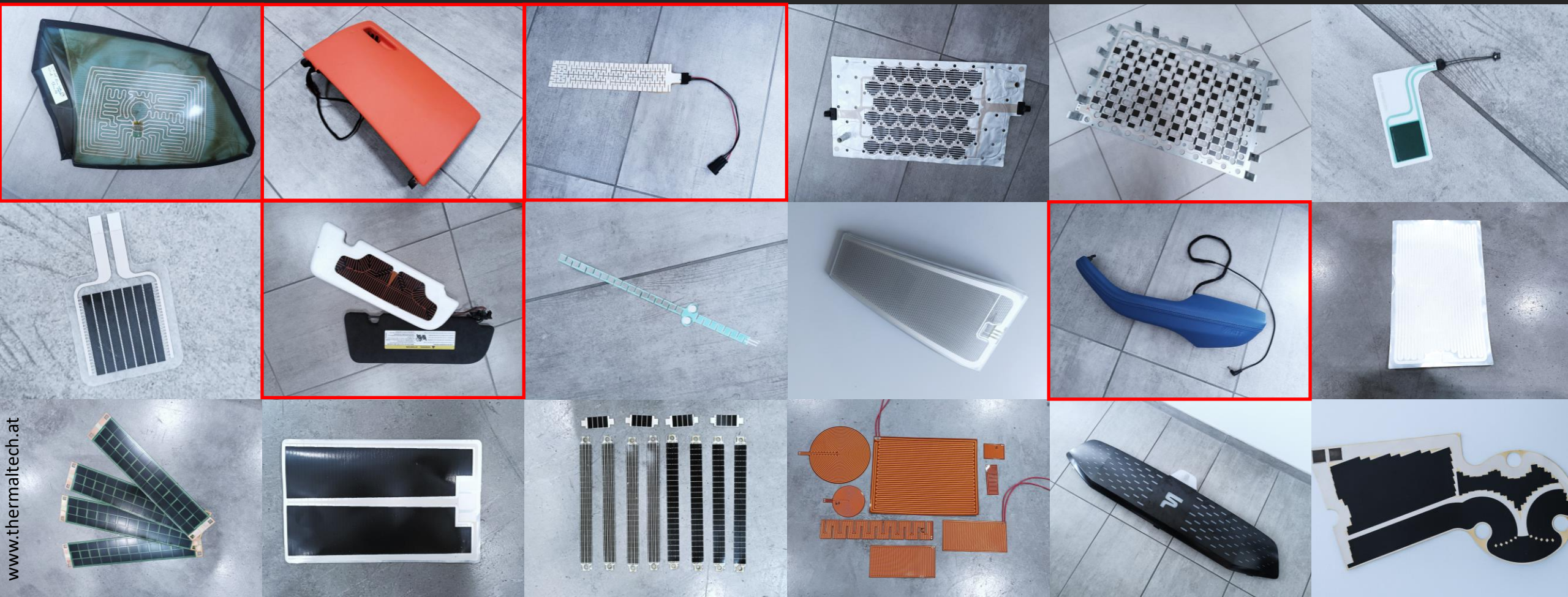
ATT offers a wide spectrum of different products:

- Heaters for *soft-surface* integration
  - flexible Armrest heaters
  - flexible Middle-arm console
  - flexible Seat heaters
- Heaters for *hard-surface* integration
  - *back-molding*
  - Trim panel heaters (Door trim,...)
  - Heaters for cosmetic / functional parts (ADAS,...)
- Functional Heaters for other type of integration
  - *back-foam-able*
  - Various types of *lamination* for a wide range of adhesion partners
  - Heaters for *battery thermal management*
  - ADAS camera sensor heaters (*transparent*)
  - *AdBlue* tank heaters



# Products Automotive

- Door Trim Panel Heater
- Glovebox Heater
- Armrest Heater
- Battery Heater
- Battery Charging Heater
- Battery Temperature Sensor
- NTC Temperature Sensor
- Sun visor Heater
- High Performance Heaters for HX
- AdBlue Tank Heater





# Technology Overview :: Integration Methods

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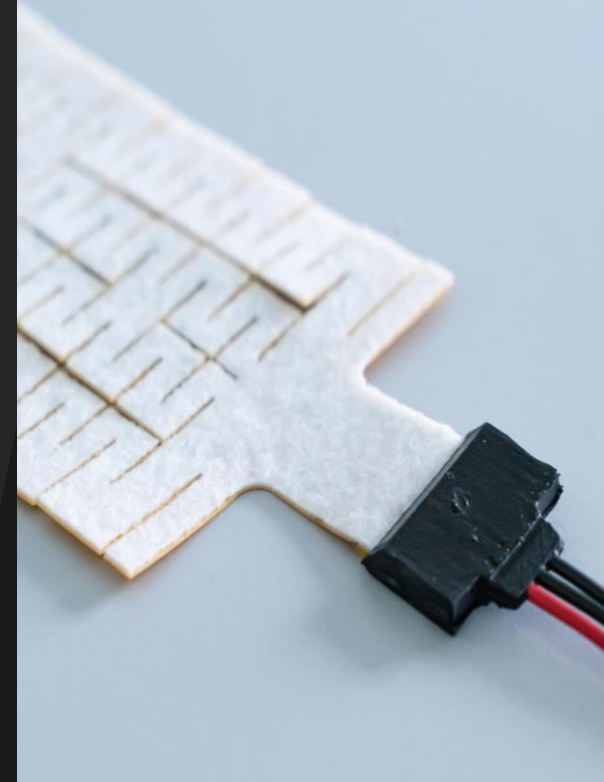
Integration Method 1

Example heatable sun visor. The heating element will be attached on a specially prepared foam carrier.



Integration Method 2

Example door trim panel. The heating elements is placed inside the tooling before being injection molded. With this method, the heating element gets completely integrated into the plastic part.



Integration Method 3

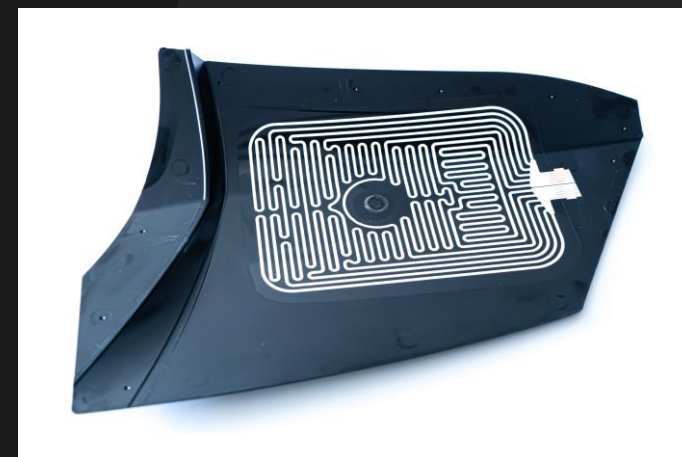
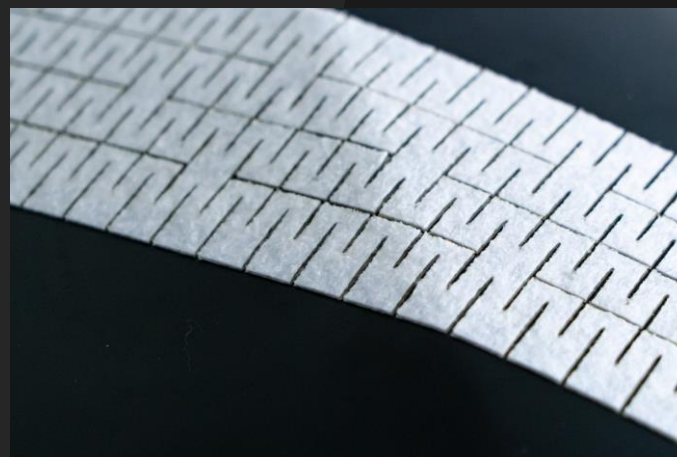
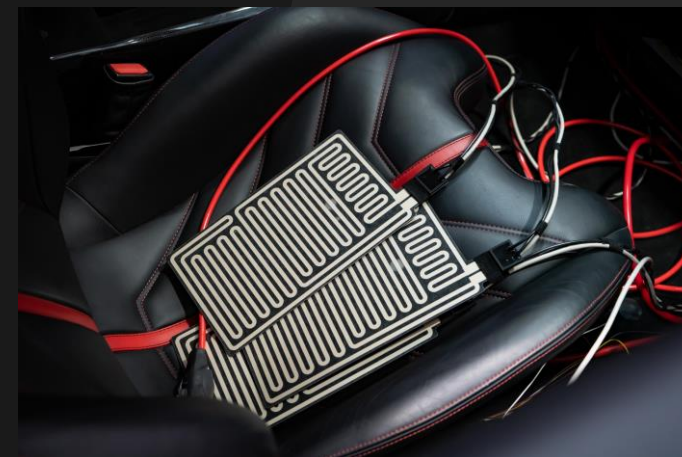
The heating element gets placed between 2 specially designed haptic foams, which are perforated in a certain way. The heating element goes below the leather or fabric and can withstand mechanical and chemical stress. Due to the perforation and the used materials is absolutely noise free.



Integration Method 4

The heating element is placed either on the A or B side of a plastic part. The heater features a dedicated double side adhesive, which is also suitable for HDPE plastic parts.

# Technology Overview :: Integration Examples







## Printed Heaters

*ATT offers different concepts for printed heaters:*

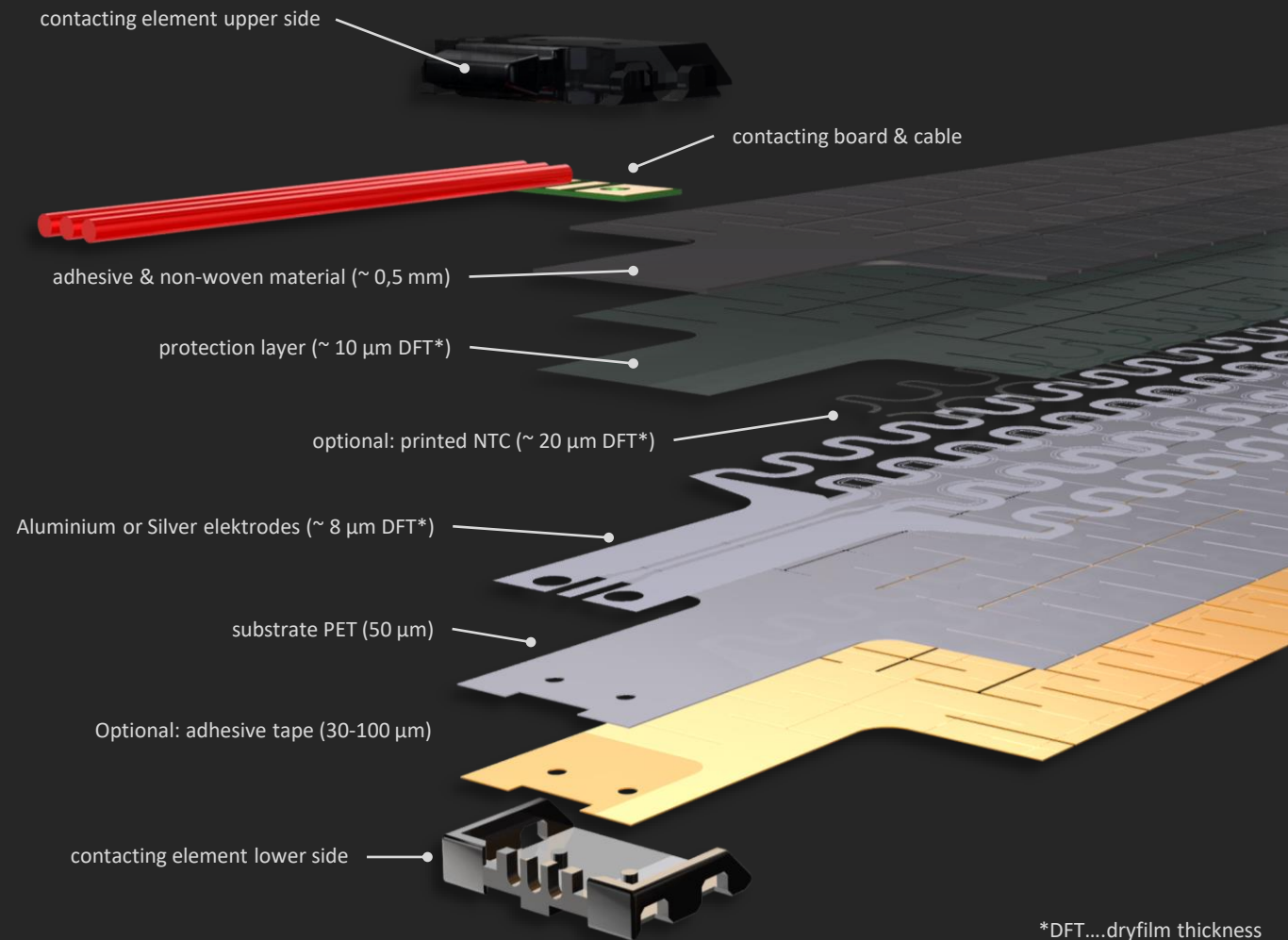
- *Aluminum based heaters*
- *Printed seat heaters (silver based)*
- *Printed heaters with PTC functionality (overheat prevention)*
- *Options for all heaters*
  - Integration of **printed temperature sensors** (NTC)
  - Integration of **occupancy detection** based on capacity sensing
  - Integration of **pressure sensors**

## Resistive Heater Layer Setup (non PTC version)

- Heater circuit - *Aluminum based* or printed *silver-filled conductive ink*
- Substrate material: PET foil
- Highly *perforated* heating mat contour provides *high stretchability* and *flexibility* (*elbow test 35.000 cycles / 500 N passed*)
- Contacting area over molded with PA low pressure mold (*fully encapsulated, 300 N cable pull-off force*)
- Overall heating mat thickness: 0.1 mm ... 1 mm possible

## Integration

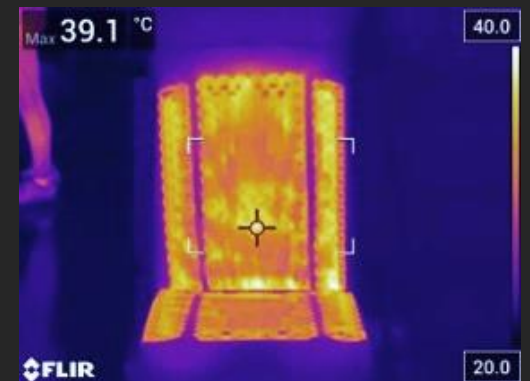
- Various types of lamination (e.g. wet glue or heating mat already equipped with adhesive tape layer)
- *Back-foam-able*
- *Back-injection-moldable*



\*DFT....dryfilm thickness

## Benefits

- *High fraction of active heated area* (compared to conventional, wire-based solution) *up to 60 %* allows for
- *High heating power* and *fast heat-up times* at reduced maximum heating track temperature
- *Thin layer setup* – overall heating mat thickness *starting from 0.1 mm*
- Different heating- and heating power zones possible
- Heating mat (including contacting area) *fully encapsulated against fluids, dust and chemicals* (IP 68)
- Applicable for *any shape or surface contour* – *without restrictions* on *curvature* and *complexity*
- Various integration methods possible (*lamination, back foaming, back injection molding*)
- Several *additional functionalities can be seamlessly integrated* through additional printed layers – *without influence* on the mat's (local) thickness or haptic appearance





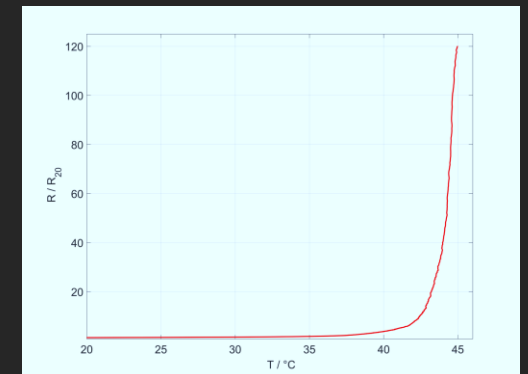
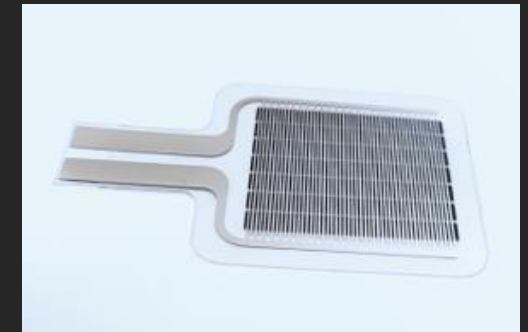
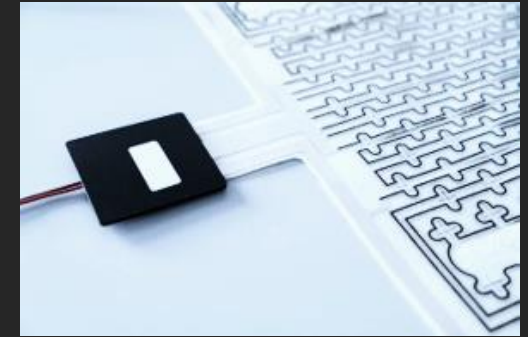
## Optional Functionalities

Optional functionalities can be integrated through *additional printed layers* – no influence on (local) device thickness, flexibility or haptic impression

- Thermal *self regulation* (active heating layer from carbon ink layer with *strong PTC effect* at defined onset temperature) – *providing intrinsic overheat protection without ECU*
- Different PTC temperature levels for self-regulation available, e.g. 42°C and 62°C

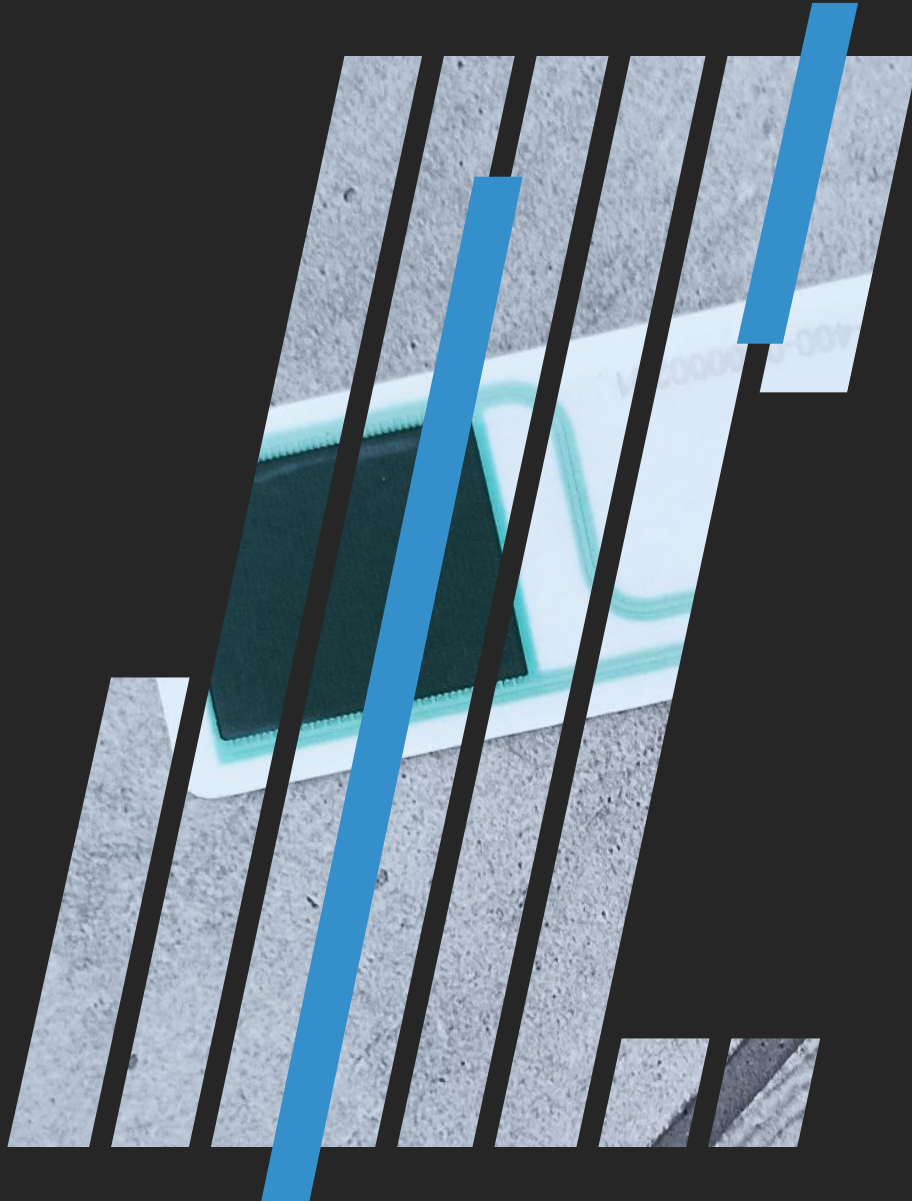
### Sensing capabilities

- Integration of *printed temperature sensors (NTC)*
- Integration of *occupancy detection based on capacity sensing*
- Integration of *pressure sensors*



# ■ Focus printable NTC Temperature Sensor

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for more  
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## priNTC

Printed NTC temperature sensor

- *Thin film - 25 microns*
- *Fully customizable in shape and resistance*
- *Point, line or area sensor possible*

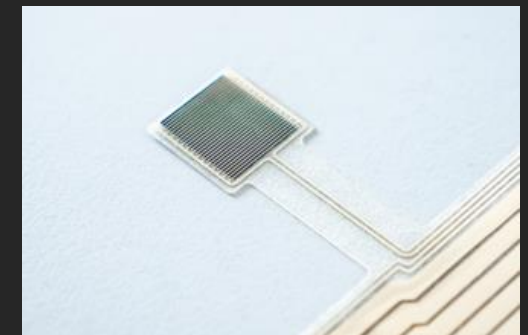
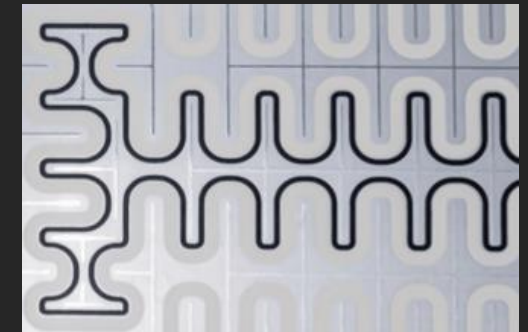
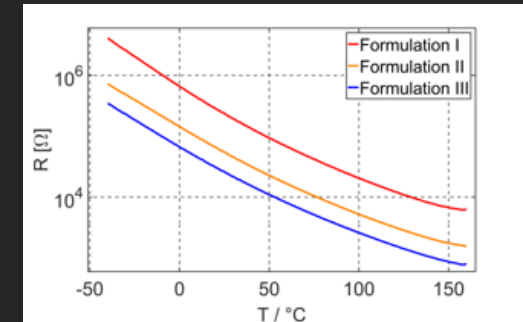
# Focus Seat Heating

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## ATT's proprietary printable NTC ink formulation

- *Seamless integration of temperature sensing* (additional print layer,  $\sim 25 \mu\text{m}$  thickness)
- *Direct integration into seat heating foil/mat* – *no separate device / assembly needed*
- Also available as *stand-alone temperature sensor foil* ( $< 0.1 \text{ mm}$  thickness)
- *Individual adaption of shape/size* (point detection / mean detection over defined area) and resistance
- *Temperature range:  $-55^\circ\text{C}$  ...  $130^\circ\text{C}$  with standard setup ( $> 200^\circ\text{C}$  possible)*
- *Accuracy:  $\pm 1 \text{ K}$  (without any further calibration required)*
- *B25/100: 3.000 K*





# ■ Lab & Production Facility

## Inside Manufacturing & Testing





# contact us



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