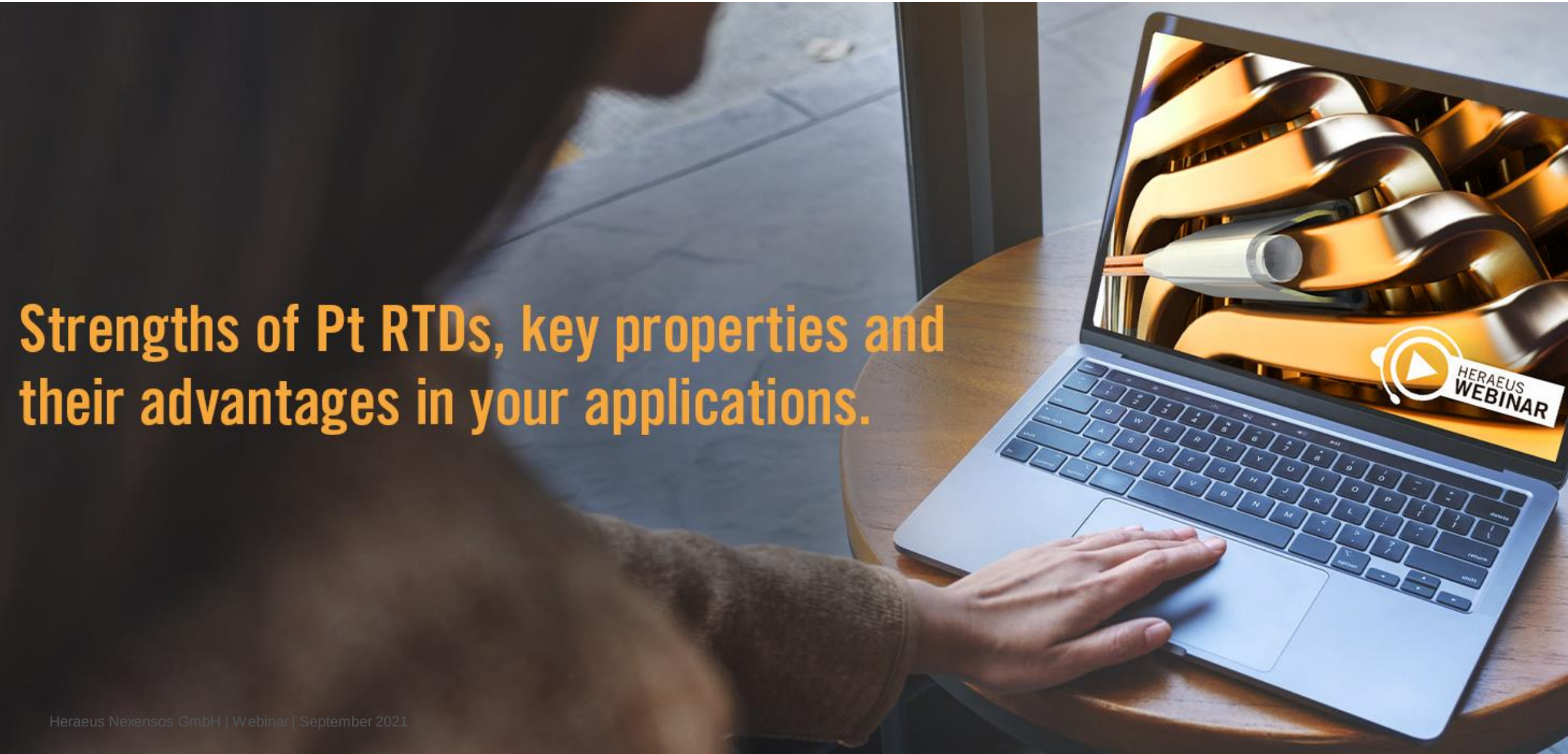
Strengths of Pt RTDs, key properties and their advantages in your applications.



INTRODUCTION – OUR SPEAKERS

Dr. Andreas Schreiber

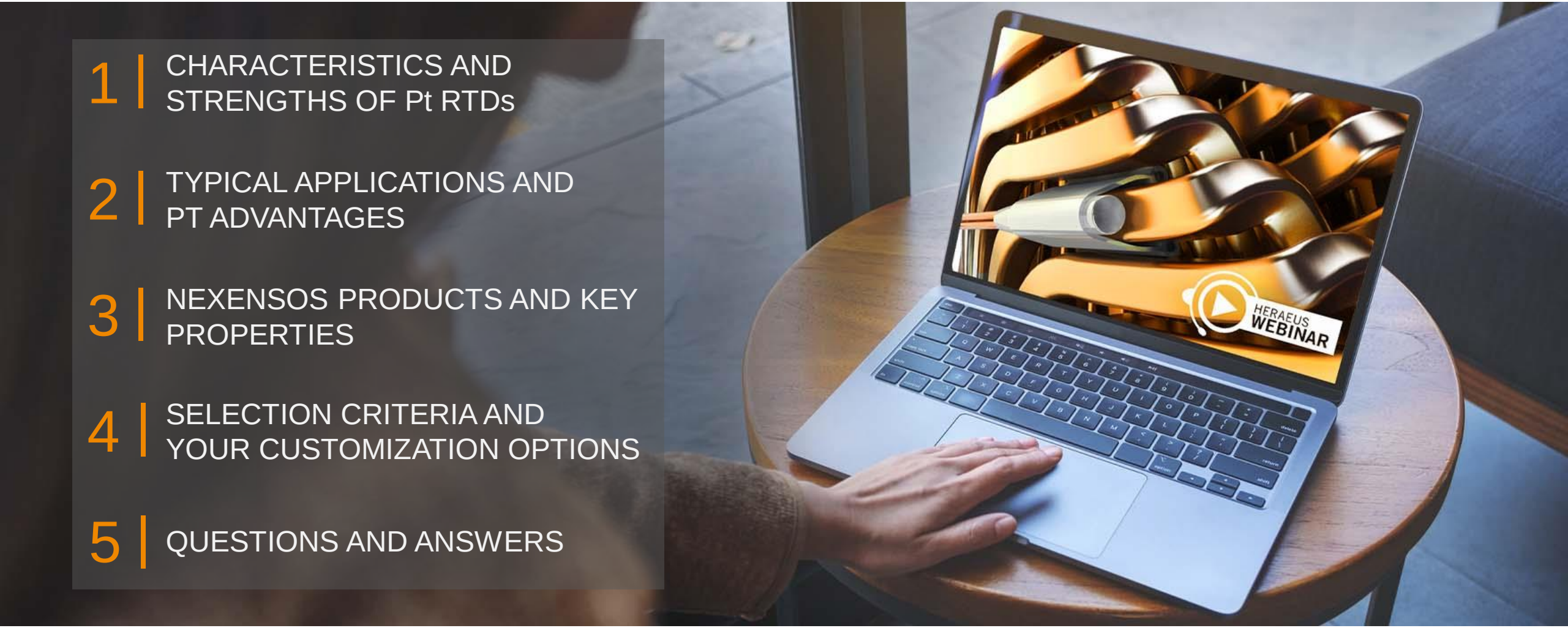
GLOBAL HEAD OF MARKETING

Charlotte Clemen

APPLICATION ENGINEER

Strengths of Pt RTDs, key properties and their advantages in your application

STRENGTH OF PT RTDS, KEY PROPERTIES, AND THEIR ADVANTAGES IN YOUR APPLICATION



1 | CHARACTERISTICS AND STRENGTHS OF Pt RTDs

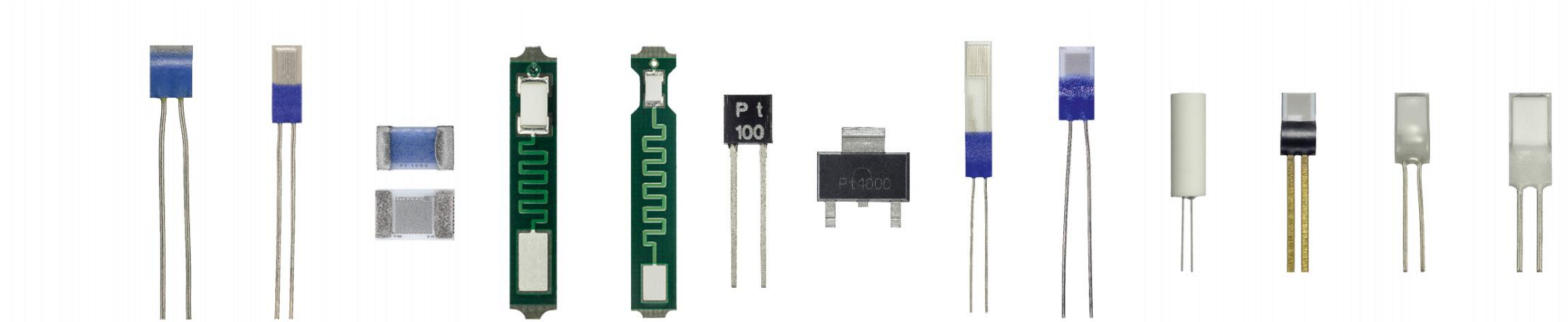
2 | TYPICAL APPLICATIONS AND PT ADVANTAGES

3 | NEXENSOS PRODUCTS AND KEY PROPERTIES

4 | SELECTION CRITERIA AND YOUR CUSTOMIZATION OPTIONS

5 | QUESTIONS AND ANSWERS

WE EXPAND YOUR APPLICATION WINDOW TO OVER 1.000°C

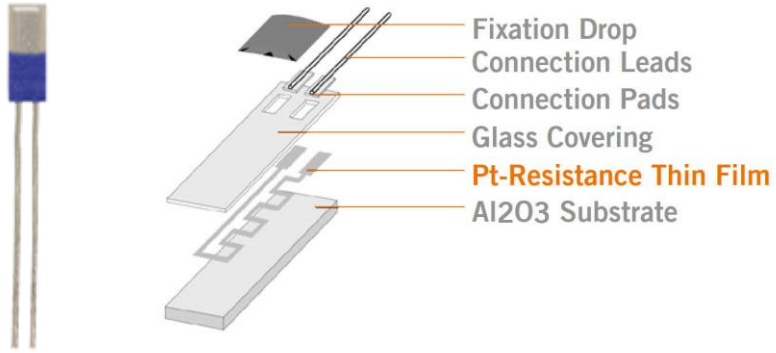


-196 °C ⟷ **1.000 °C**

- high precision
- minimal drift
- standardized output
- broad range of standard products
- large volume availability
- innovation power

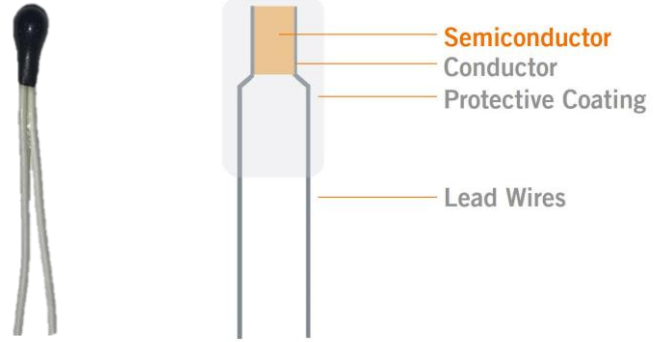
CHARACTERISTICS AND STRENGTHS OF Pt RTDs

PT RTD AND NTC COMPARISON



Pt RTD – Platinum Resistance Temperature Detector

- Our sensors are based on thin film technology
- Typical configurations:
  Elements with lead wires, SMD types, SOT223, TO92



NTC thermistor – Negative Temperature Coefficient

- Bulk resistor based on semi-conductive ceramics
- Typical configurations:
  Elements with lead wires, SMD types, diode package

CHARACTERISTICS AND STRENGTHS OF Pt RTDs

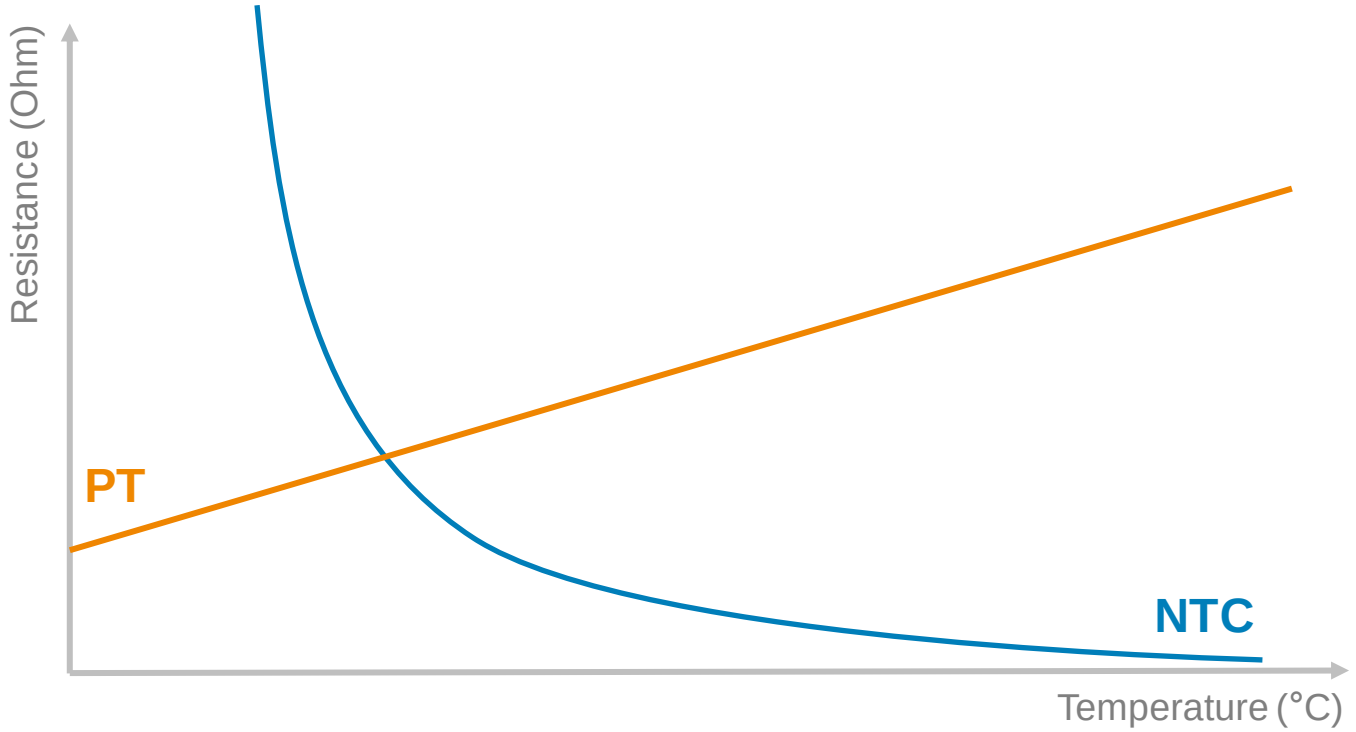
PT RTD AND NTC COMPARISON

PT

- Typical resistance values: 100, 500, 1000 Ohm (@ 0 °C)
- Linear characteristics (TCR 3850 ppm/K)
- Positive Temperature Coefficient
- Characteristics standardized to DIN EN 60751 (IEC 60751)

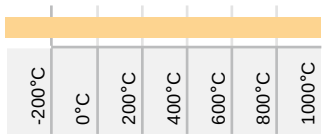
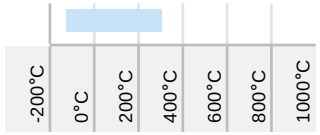
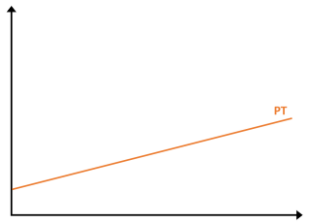
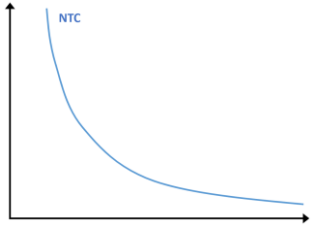
NTC

- Typical resistance values: 10 000 Ohm and higher (@ +25 °C)
- Non-linear characteristics
- Negative Temperature Coefficient



CHARACTERISTICS AND STRENGTHS OF Pt RTDs

PT RTD AND NTC COMPARISON

	Pt		NTC (typical)	
Operating Temperature Range		-196 °C to 1000 °C		-100 °C to 300 °C with special types up to 750 °C
Resolution		Consistent over the entire operating temperature range Differentiates with the sensor type (Pt 10000 also available) Lower resolution		Due to steeper curve higher resolution in a limited range Especially for lower temperatures
Accuracy		High accuracy over a wide temperature range Defined in DIN tolerance class F0.3, F0.15, F0.1		High accuracy over a relatively narrow temp. range No international standard

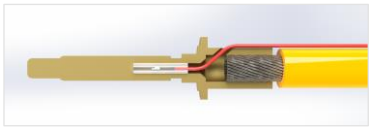
TYPICAL APPLICATIONS AND PT ADVANTAGES

PT RTDs WITH LEAD WIRES

Features

- Ideal for assembly in tubes and probes
- Good thermal contact with planar surfaces

C, L, M, H Types



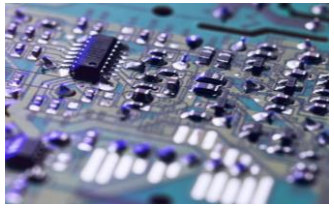
Strengths of Pt RTD

Applications	wide T range	extreme high/low T capability	low signal drift	high accuracy	linear signal
Exhaust gas treatment in Diesel and Gasoline cars	●	●	●	○	○
Petrochemistry, Oil & Gas, Energy & Power	●	●	●	●	○
Process monitoring and automation	●	○	●	●	○
Home appliance	●	○		○	
Pellet grills and pellet furnace	●	●	○	○	
e-mobility charger plug protection	○		●	●	
e-motor protection	●	○	●	●	○
Medical cold chain data logger	●	○	●	●	
Medical devices and equipment			●	●	○
Analytic equipment	●	●	●	●	○
Heater unit control	●	●	●	●	

● important ○ helpful

TYPICAL APPLICATIONS AND PT ADVANTAGES

PT RTDs IN SMD FORMAT AND ON PCBs



Features

- Support pick & place mounting
- Compact with small footprint
- Cost efficient

1206 0805 0603

Features

- SMD on PCB board (-40°C to +150°C)
- Reduce heat transfer from wires to the chip
- Simplifies assembly process for probes

pads chip

Strengths of Pt RTD

Applications	wide T range	extreme high/low T capability	low signal drift	high accuracy	linear signal
E-charger			●	●	○
Data logger and tracker	○	○	○	●	○
Medical devices and equipment			●	●	○
Electronic and power electronic board protection	○		●	●	○
T drift compensation in gas and other sensors	●		●	●	○
HVAC and smart home thermostats			●	○	○
HVAC probes for duct and immersion sensors	●		●	○	○
HVAC: heat and cold meters	●		●	●	○

● important ○ helpful

HERAEUS NEXENSOS PRODUCTS AND KEY PROPERTIES

M-TYPE DATA SHOWN

Nominal Resistance

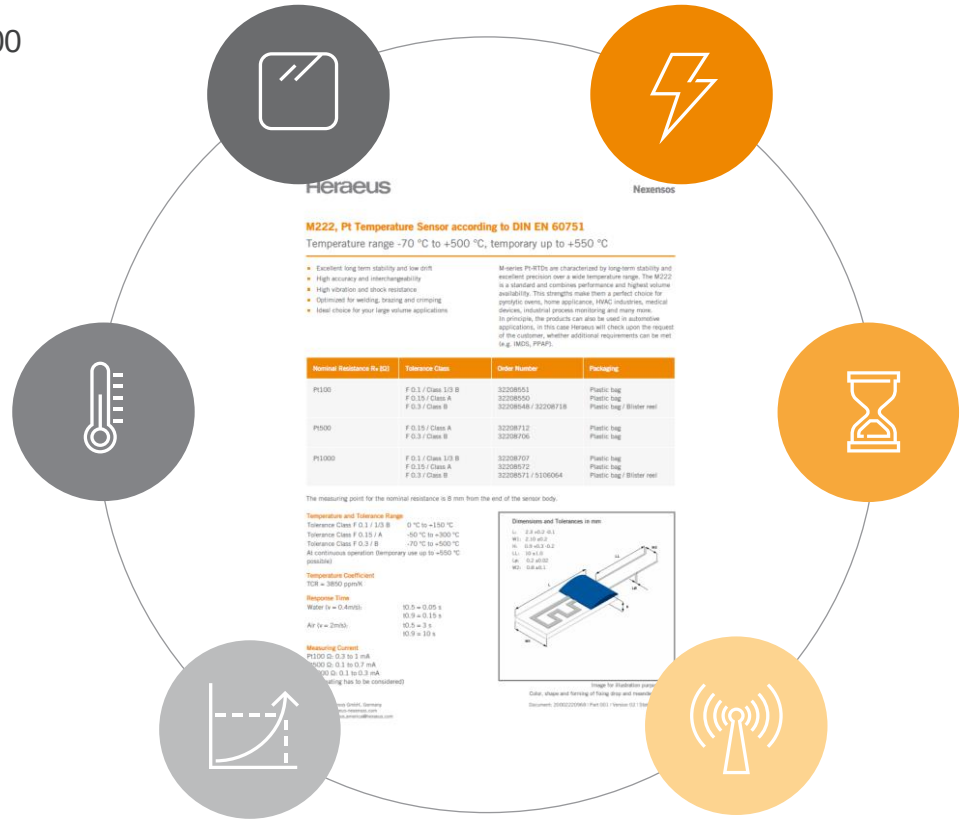
E.g. Pt100, Pt200, Pt500, Pt1000

Temperature and Tolerance Range

E.g. F 0.3 (B) for temperature ranges from -50 °C to +500 °C

Temperature Coefficient (TCR)

Standard TCR = 3850 ppm/K



Measuring Current and Self-Heating

Our recommendations to avoid self-heating effects

Long-Term Stability

Typical R_0-Drift is 0.04 % after 1000 hours at 500 °C

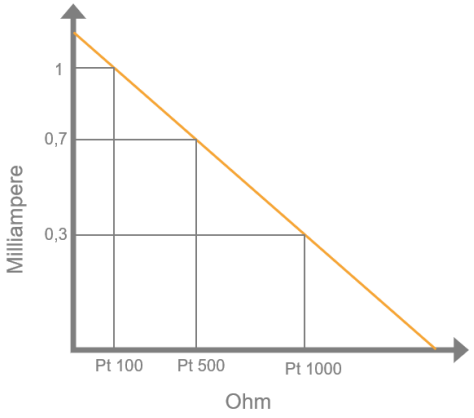
Response Time

Measured in water current and air stream

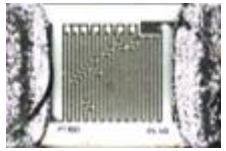
NEXENSOS PRODUCTS AND KEY PROPERTIES

SELF-HEATING: CONTROL MEASURING CURRENT AND INSTALLATION CONDITIONS

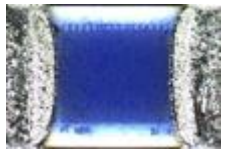
I - Measuring Current



R - Resistance

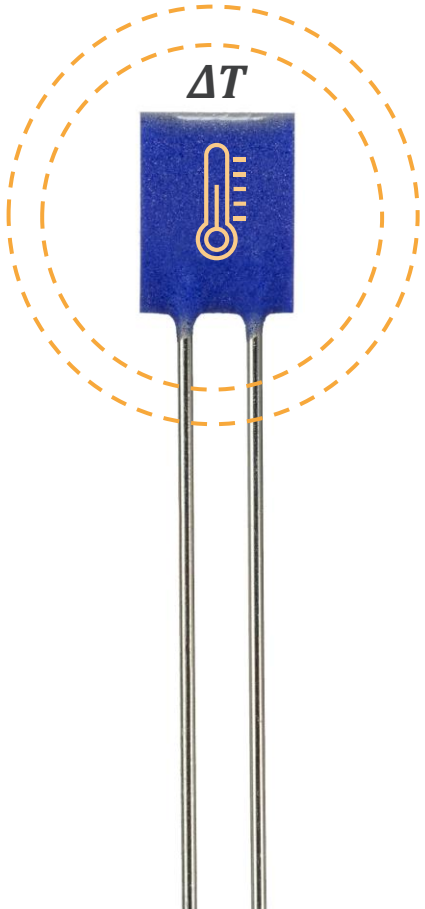


Pt100



Pt1000

$$\Delta T = S \cdot I^2 \cdot R$$



S – Self-heating coefficient

Sensor Element

- Materials, Design
- Dimensions

  The smaller the sensor for a given Ohm value, the higher the self-heating coefficient

M310

0.4 K/mW at 0 °C

M1020

0.2 K/mW at 0 °C

Installation Conditions

- Housing and thermal contact to the surrounding medium impact the self-heating coefficient

HERAEUS NEXENSOS PRODUCTS AND KEY PROPERTIES

M-TYPE DATA SHOWN

Nominal Resistance

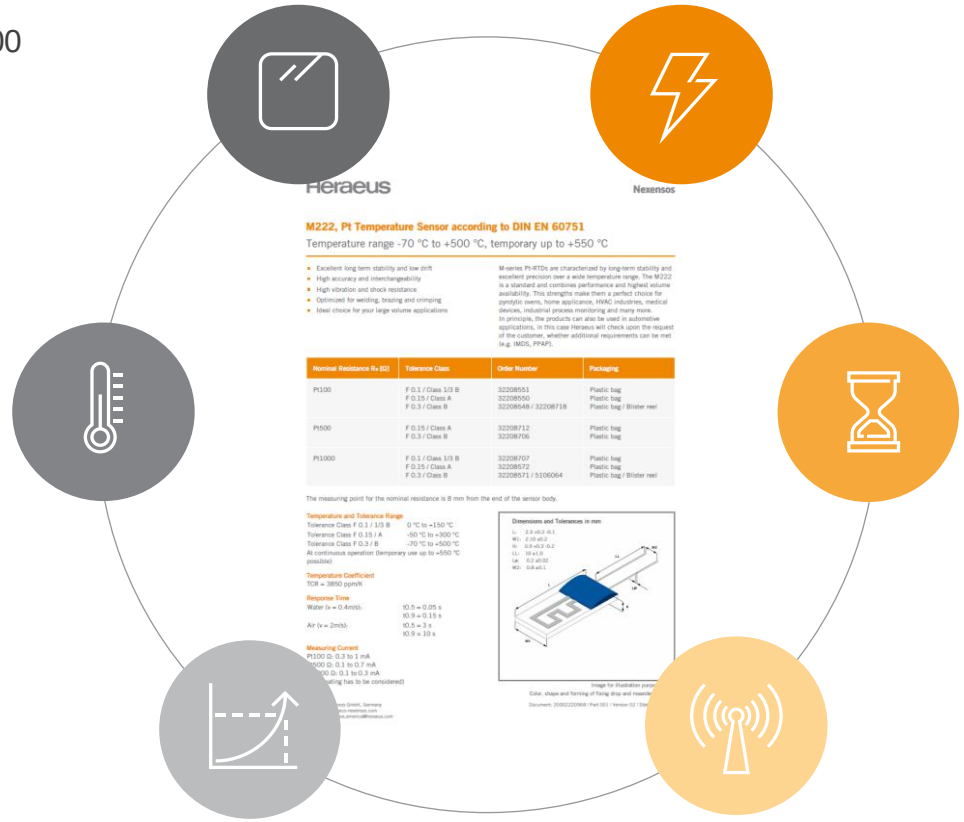
E.g. Pt100, Pt200, Pt500, Pt1000

Temperature and Tolerance Range

E.g. F 0.3 (B) for temperature ranges from -50 °C to +500 °C

Temperature Coefficient (TCR)

Standard TCR = 3850 ppm/K



Measuring Current and Self-Heating

Our recommendations to avoid self-heating effects

Long-Term Stability

Typical R_0-Drift is 0.04 % after 1000 hours at 500 °C

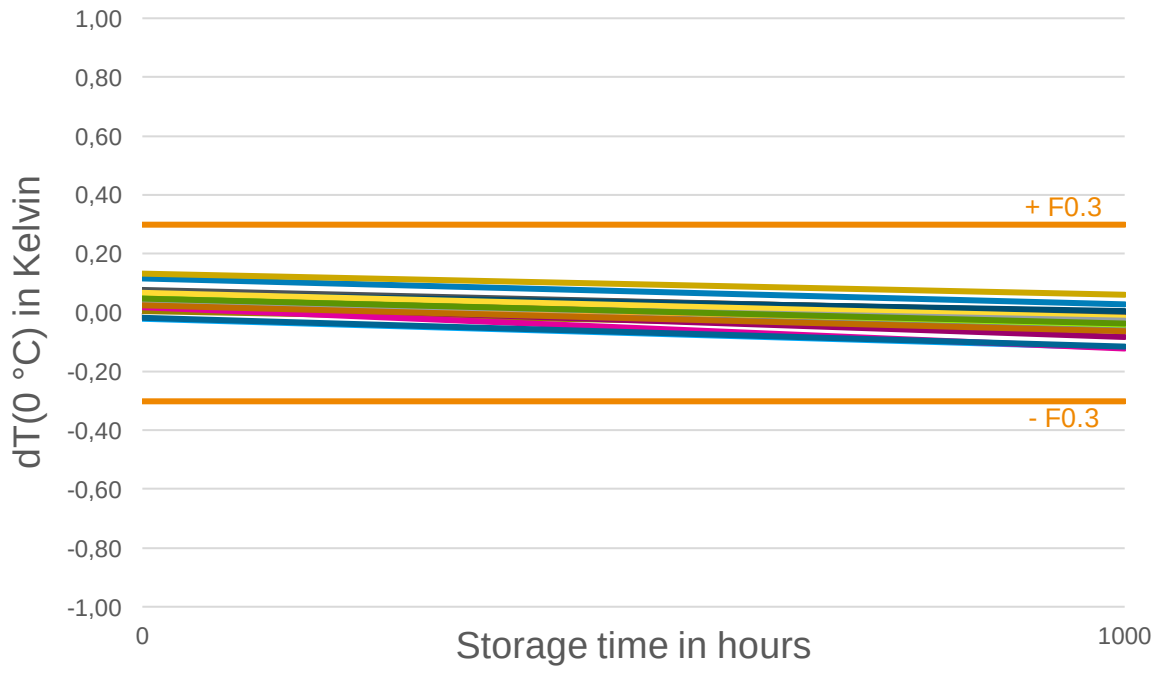
Response Time

Measured in water current and air stream

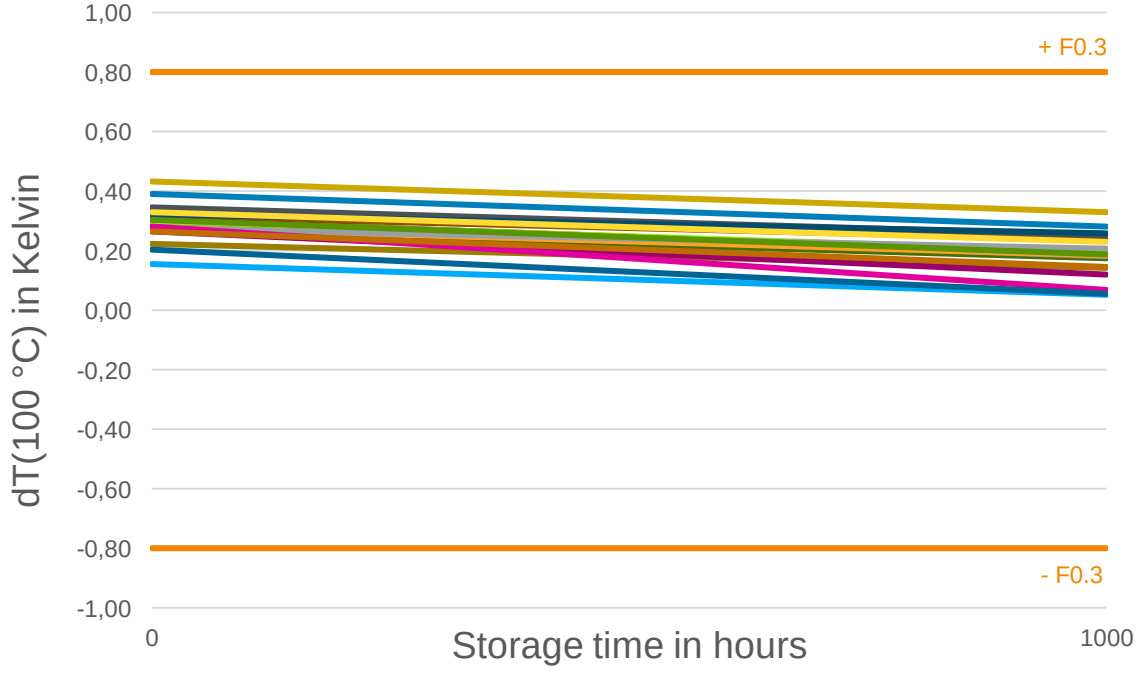
HERAEUS NEXENSOS PRODUCTS AND KEY PROPERTIES

KEY PT-RTD FEATURE: VERY LOW SIGNAL DRIFT, HIGH LONG-TERM STABILITY

M222 Pt1000 B: Deviation dT from ideal value at **T = 0 °C** as a function of the storage time @ **500 °C**



M222 Pt1000 B: Deviation dT from ideal value at **T = 100 °C** as a function of the storage time @ **500 °C**



HERAEUS NEXENSOS PRODUCTS AND KEY PROPERTIES

M-TYPE DATA SHOWN

Nominal Resistance

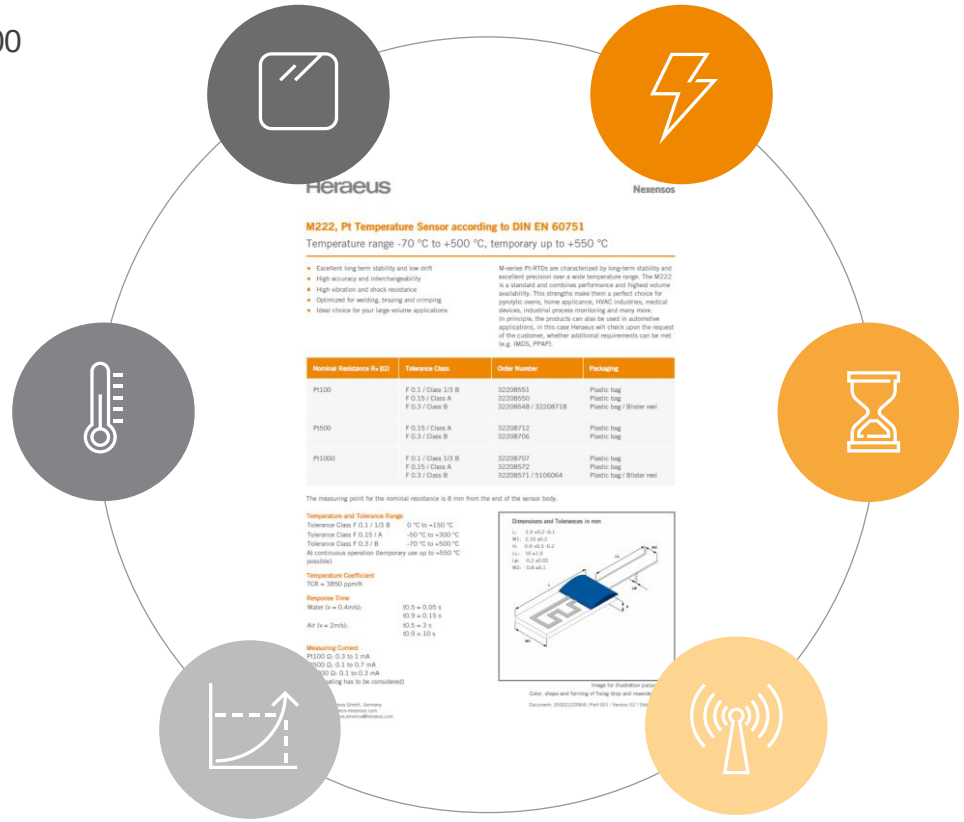
E.g. Pt100, Pt200, Pt500, Pt1000

Temperature and Tolerance Range

E.g. F 0.3 (B) for temperature ranges from -50 °C to +500 °C

Temperature Coefficient (TCR)

Standard TCR = 3850 ppm/K



Measuring Current and Self-Heating

Our recommendations to avoid self-heating effects

Long-Term Stability

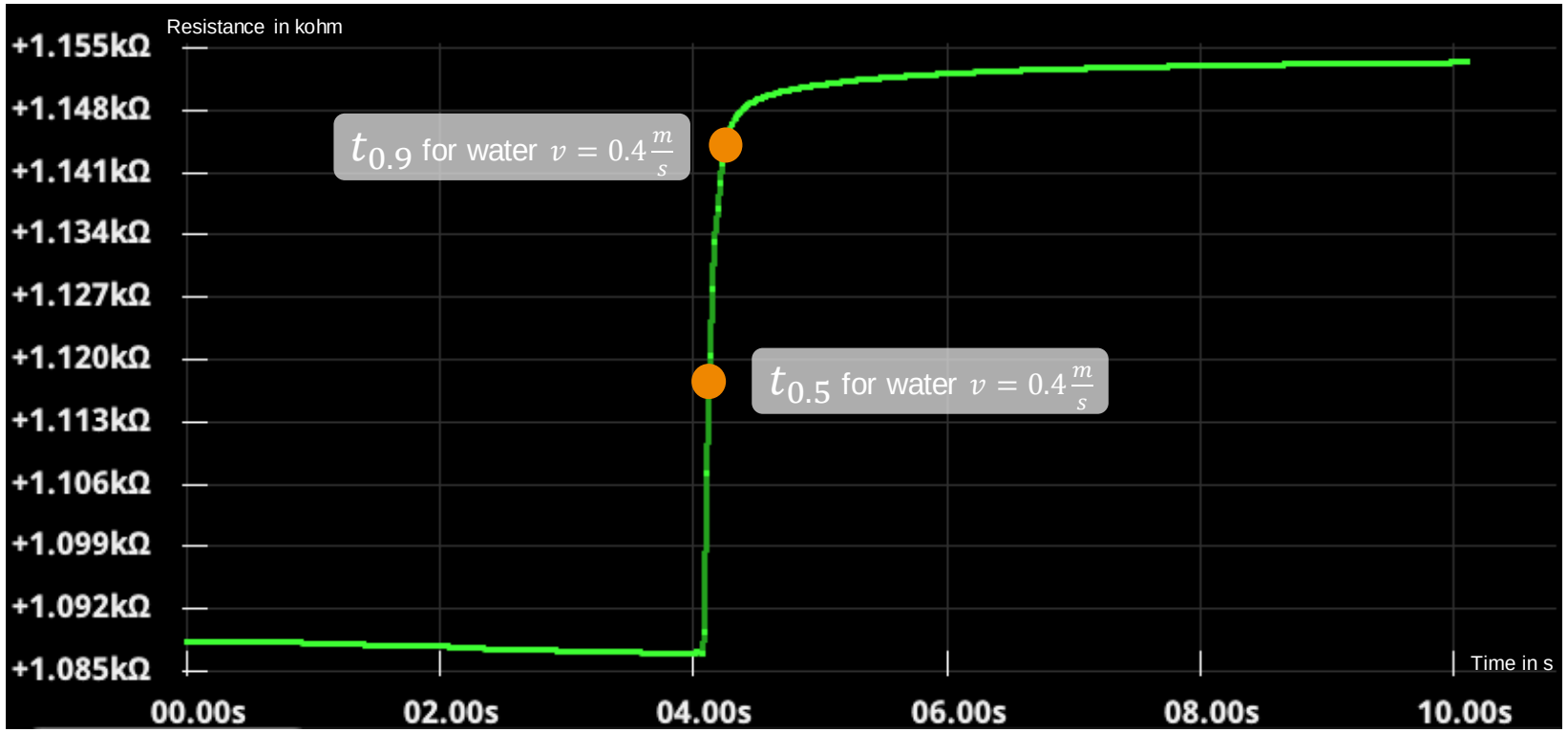
Typical R_0-Drift is 0.04 % after 1000 hours at 500 °C

Response Time

Measured in water current and air stream

HERAEUS NEXENSOS PRODUCTS AND KEY PROPERTIES

PT RTDs HAVE A VERY FAST RESPONSE TIME



Pt RTDs have a fast response time in a range of 0.1 - 0.3 sec.

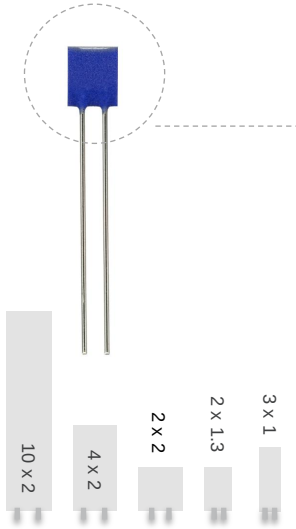
The sensor element is not the limiting factor, but the housing.

Have a closer look at our latest webinar

SELECTION CRITERIA AND YOUR CUSTOMIZATION OPTIONS

PRODUCT NAMING – EASY ORIENTATION

Elements with lead wires



M 220 PT1000 B

Tolerance
Standards

B	F 0.3
A	F 0.15
1/3 DIN	F 0.1

Size indication
220: 2 mm x 2 mm
see details in datasheet

Resistance
Standards:
100, 200, 500, 1000 Ohm

Leadless Elements

SMD 0805 PT1000 B

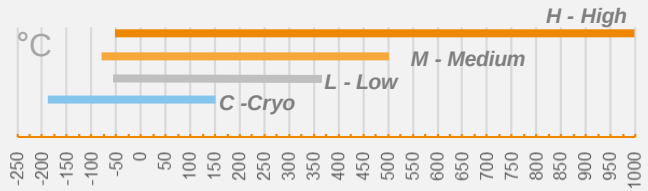
Tolerance
Standards

2B	F 0.6
B	F 0.3

Standard SMD package
1206, 0805, 0603

Resistance
Standards:
100, 500, 1000 Ohm

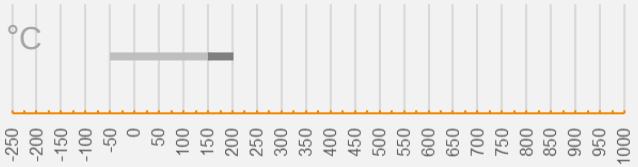
Temperature operation range



Connection methods

- welding
- brazing
- crimping
- soft soldering (L-types)

Temperature operation range



Connection methods

- soft soldering
- bonding/ glueing
- sintering + wire bonding

SELECTION CRITERIA AND YOUR CUSTOMIZATION OPTIONS

HERAEUS WEBINAR

Find the right Pt element for your application

Temperature Range
operation temperature + safety margin

Nominal Resistance
Pt100, Pt1000, …
→ Can influences the wire connection

Tolerance
Standardized in the DIN EN 60751

Sensor Design
Element type and size (lead wire, SMD, …)

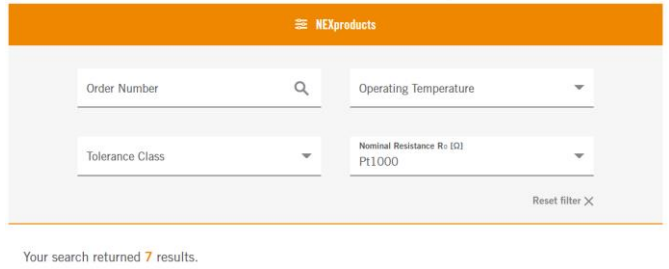
Connection
Lead material, connection technology, wire extension

Availability

Economies of Scale

- Economy of scale
- High volume availability

Product Selector NEXproducts



Website Use our product selector NEXproducts to find the right product

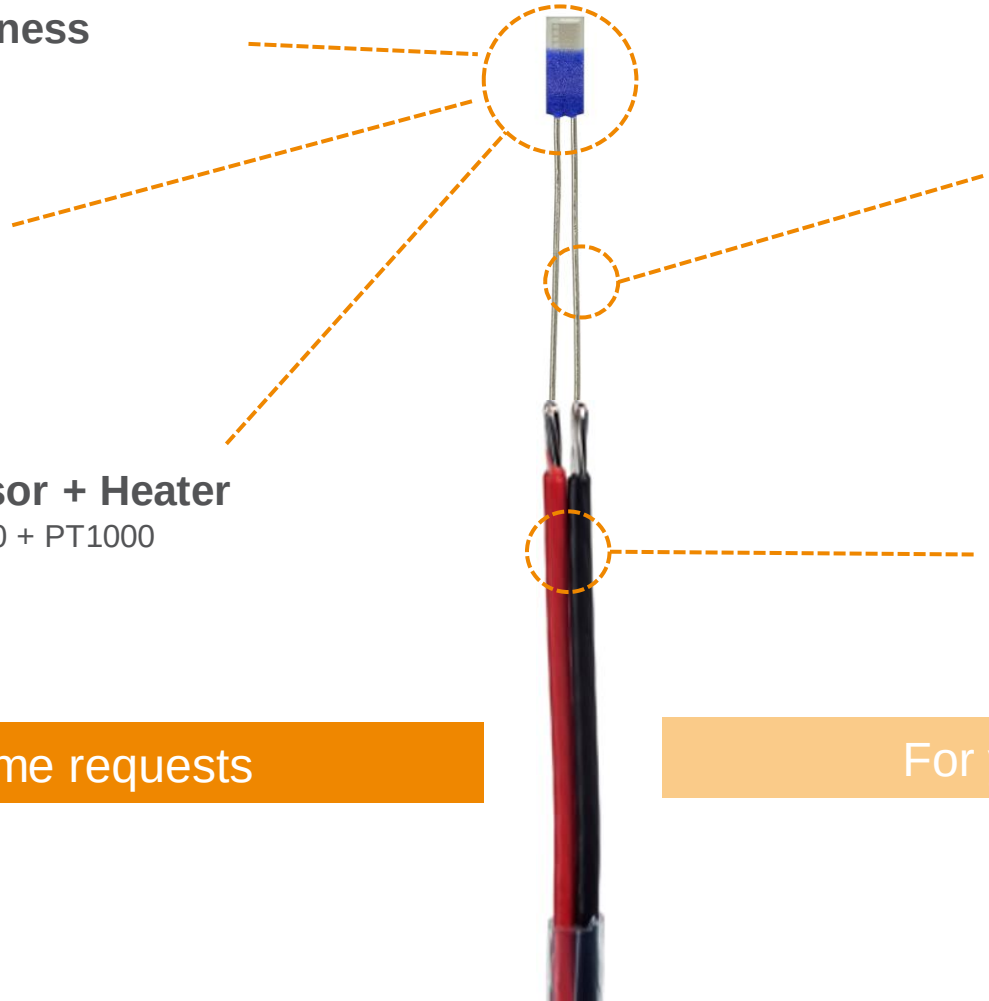
SELECTION CRITERIA AND YOUR CUSTOMIZATION OPTIONS

HERAEUS WEBINAR

Element size & Substrate thickness

Resistance
Individual ohmic values possible

Combination of PT loops: Sensor + Heater
e.g. Pt element with two resistor loops: PT20 + PT1000



Lead length: 5 – 100 mm

Lead material: Ni, Pt plated Ni, AgPd, Pt

Lead extensions
Wires and stranded wires

For your high volume requests

For your mid volume requests

SELECTION CRITERIA AND YOUR CUSTOMIZATION OPTIONS

Semi-rigid encapsulated EC3032

- PT1000 B
- -50 °C to +200 °C (temporary up to 250 °C)
- IP68 protection
- Highly vibration resistant
- Response time $t_{0.9}$ = 8.1 s (0.3 m/s water flow)

Thank you for your attention