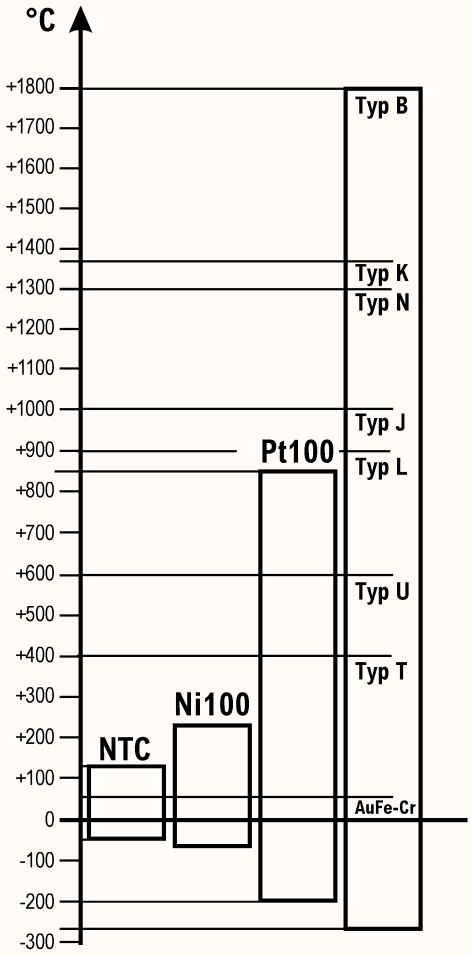
Temperature

The Right Temperature Sensor For Any Measuring Task



Selecting the right type of temperature sensor depends on your measuring task. For example, thermocouples, resistor-based sensors (Pt100 and Ntc) and pyrometers (infrared sensors) are available.

Rule of Thumb:

- Thermocouples are very fast and provide a large measuring range.
- Resistor-based sensors are more accurate but slower.
- Ntc sensors are very fast, accurate, but they have a limited measuring range.
- Infrared sensors do not contact the device under test and they have very small time constants, but they depend on the emission grade.
- The larger the measuring range, the more universal the possible range of applications.

Selection Criteria:

Select the temperature sensor that suits your measuring task according to the criteria below:

- Meas. range
- Accuracy
- Response time
- Stability
- Type of construction

Thermocouples

Thermocouples consist of two spot-welded wires of different metals or alloys. The thermoelectric effect at the contact surface is used to measure temperatures. A relatively small thermoelectric voltage is caused, which depends on the temperature difference between the measuring point and the connecting terminals.

Accuracy, Operating Temperatures:

The basic values for the thermoelectric voltages and for the permissible tolerances of thermocouples are specified in standard DIN/IEC 584. Our thermocouple sensors are available in two tolerance classes as per DIN/IEC 584-2. Following limit values apply (highest value in each case) : type K / N

Class 1:	±1.5 °C	or ±0.004 x l t l	(-40...1000°C)
Class 2:	±2.5 °C	or ±0.0075 x l t l	(-40...1200°C)

Our thermocouple sensors generally comply with Class 2 as per DIN/IEC 584-2. The specified Tmax values refer to the tip of the sensor. The specified T_{90} times refer to measuring operations in a moving liquid. The sensor handles and cables are usually resistant to temperatures up to +80 °C. Heat-resistant cables are also available on request.
Various types of thermocouples are available; these can be distinguished in terms of their temperature range, sensitivity, and in particular their compatibility with the test substance. The most popular thermocouple is the NiCr-Ni (type K).

new Connecting cable with thermal line (stranded wire)
There is no adverse temperature effect at the juncture from measuring element to cable.

With immediate effect, the sensor connecting cables for many sensor types will use a new thermal line (stranded wire, thermal line class 2) instead of the conventional compensation line. The transition from measuring element (sensor tip) to connecting cable (in the cable sleeve or in the handle) thus remains, even over a wide temperature span (up to 200 °C), unaffected by temperature error; the usual measuring errors caused by temperature differences at the juncture when using a conventional compensation line can thus with the new thermal line be avoided.

For just a few sensor types and extension cables a compensation line will continue to be used as previously. The compensation lines generally comply with Class 2 as per DIN 43722. For type K the operating temperature range of the compensation line is 0 to 150 °C.

Resistor-Based Sensors (Pt100 Sensors)

When measuring the temperature the increase in resistance at increasing temperatures is utilised at the Pt100 sensors. The measuring resistor is fed with a constant current and the voltage drop at the resistor is measured as a function of the temperature. Due to the small resistance variation (0.3 to 0.4W/°C) the 4-conductor circuit should always be used to exclude any influences from the lead wires.

Accuracy, Operating Temperatures:

Pt100 sensors are, as standard, used with Class B (DIN/IEC 751) measuring resistors (surcharge for DIN Class A or 1/5 DIN Class B accuracy). The specified Tmax values relate to the tip of the sensor. The specified T_{90} times are related to measurements in a moving liquid. The sensor handles and cables are usually resistant to temperatures up to +80 °C. Heat-resistant cables are available on request.

Measuring ranges, resolution

PT100 probes FP Axxx are by default assigned measuring range PT100-1 (resolution 0.1 K). Measuring range PT100-2 (resolution 0.01K) can be programmed as alternative on the 1st channel or in addition on the 2nd channel.

New Measuring range PT100-3 (resolution 0.001K) in range 0 to 65 °C (for V6 devices, with effect from 2690-8, 2890-9, 85/8690-9, 5690-1/2)

Measurement Accuracies of Resistor-Based Temperature Sensors

Designation	Range	Maximum Deviation		
Test resistances		DIN Class B	DIN Class A	1/5 DIN Class B
Pt 100 Ω	at –200°C	±1.3 K		
	at –100°C	±0.8 K		
	at –50°C		±0.25 K*	
	at 0°C	±0.3 K	±0.15 K	±0.06 K
	at +100°C	±0.8 K	±0.35 K	±0.16 K
	at +200°C	±1.3 K	±0.55 K	±0.26 K
	at + 300°C	±1.8 K	±0.75 K	±0.36 K
	at + 400°C	±2.3 K		
higher accuracies for an additional charges			Order no. OPG2	Order no. OPG5**

* Range -50 °C only for sheathed sensors with 2mm diameter and bigger

** On request, depending on the sensor design

Thermistors (NTC Sensors)

NTC sensors (thermistors) have a significantly higher resistance than Pt100 sensors. When measuring temperatures their negative temperature coefficient is utilised, i.e. the resistance is decreasing with increasing temperatures.

Accuracy, Operating Temperatures:
The accuracy data of the normalised NTC sensors are based on manufacturer specifications. The specified T_{max} values relate to the tip of the sensor. The specified T_{90} times are related to measurements in a moving liquid. The sensor handles and cables are resistant to temperatures up to 90°C.

Accuracies

Designation	Range	Maximum Deviation
NTC element	–20 to 0°C	±0.4 K
(10K at 25°C)	0 to 70°C	±0.1 K
	70 to 125°C	±0.6 K

Types and Fields of Application

The construction variants of temperature sensors are as many and diverse as the measuring tasks.

T_{max} is the maximum operating temperature of the sensor tip.

T_{90} is the time required by the sensor to reach 90% of the step response after a jump in temperature . The specified T_{90} times refer to measuring operations in a moving liquid.

The temperature sensors listed are also available, on request, with other lengths and diameters

Surface sensors with flat measuring tip
For measurements on good heat conductors, on even and plain surfaces.

Surface sensor with spring-type thermocouple band
For quick measurements, also on non-plain surfaces.

Immersion probes
For measurements in liquids, as well as powdery substances, air and gases.

Sensors with heat-resistant measuring tip
For measurements at extremely high temperatures.

Sensor with penetrating tip
For measurements in plastic and pasty substances.

Sword probe
For measurements in paper, cardboard and textile stacks.

Transducer with free sensor
For measurements in air and gases

! If you do not find a suitable sensor in this catalogue, we can manufacture it according to your specifications (technical drawing or detailed specification) and supply you with a customised sensor!

Temperature Measurement à la ALMEMO®

All ALMEMO® sensors can be adjusted, i.e. the correction values of the sensor can be stored in the connector. This considerably increases the accuracy of measurement.

As a result of the DAkkS and factory-set calibrations performed by us, the corrective factors are automatically determined, stored in the connector plug and locked. Maximum accuracy can then be achieved.

Ordering Information

ALMEMO® sensors are available in different designs. The type designation can be identified by:

„P“ = temperature sensor with Pt100W test resistance
„N“ = temperature sensor with NTC element
„T“ = temperature sensor with NiCr-Ni element

All temperature sensors with an ALMEMO® flat connector can be identified by the „A“ in the order no.

Naturally, they are also available for the measuring instruments of our THERM series. In this case they will have a circular connector.

When ordering please replace the letter „**A**“ by the number „**9**“.

Example: FT**A**1201 (with ALMEMO® connector) >> FT**9**1201 (with circular connector for THERM devices)

Describe your measuring task to us!

We can provide you with comprehensive advice and find the most cost-effective solution for you.

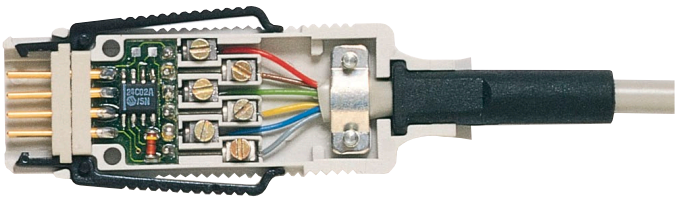
Please do not hesitate to ask !

Use Your Existing Sensor Technology!

The patented idea of the intelligent connector makes the ALMEMO® system an extraordinarily flexible measuring system.

Instead of our pre-configured ALMEMO® sensors you can also use your own, existing sensors.

- We can supply you with pre-programmed ALMEMO® connectors that contain the corresponding sensor parameters and matching measuring ranges. They have six screw terminals and can be easily connected.
- You can correct the errors of the sensors, which means that even simple sensors become precision transducers
- Listing all the combinations and application options would be beyond the scope of this catalogue. Special programming, range extensions and linearisations for other sensor technology are always available for ALMEMO® devices.
- The pricing for this results from the efforts and the number of devices required.



ALMEMO®sensor connector with 6 terminal screws and EEPROM.