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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

0		/ 51			
Class 1:	±1.5 °C	or $\pm 0.004 \text{ x} l t l$		(-40]	(000°C)
Class 2:	±2.5 °C	or $\pm 0.0075 \text{ x l t}$	1	(-40]	200°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  $^{\circ}$ 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  $^{\circ}$ 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	<b>Maximum Deviation</b>		
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 a	n 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	<b>Maximum Deviation</b>	
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<sup>®</sup> 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/DKD 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:

"Р"	= temperature sensor with Pt100W test resistance
"N"	= temperature sensor with NTC element
"Т"	= 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: FTA1201 (with ALMEMO<sup>®</sup> connector) >> FT91201 (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<sup>®</sup> 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<sup>®</sup> devices.
- The pricing for this results from the efforts and the number of devices required.



ALMEMO<sup>®</sup>sensor connector with 6 terminal screws and EEPROM.

#### Sheathed sensors



#### Thermocouple sheathed sensors FTAxx and FTANxx

Measuring element:	FTAxx; NiCr-Ni thermocouple, type K, DIN class 1 (see 07.03) FTANxx; NiCrSi-NiSi thermocouple, type N, DIN class 1 (see 07.03)
Sensor tip, sheathed line :	diameter, length, operating temperature; see table; material Inconel 2.4816 Here the sensor tip and sheathed line are of the same diameter. These types are therefore also suitable for mounting with clamped screw connections.
Cable sleeve :	Brass, hexagonal, $L = 65$ mm, circumdiameter = 9 mm, operating temp40 to +160 °C
Standard cable :	New 1.5 meter FEP / silicone thermal line (stranded wire)* Operating temp50 to +200°C There is no adverse temperature effect at the juncture from measuring element to cable.
Cable options :	Compensation line, PVC / PVC, insulated, operating temperature –20 to +105 °C The compensation line is also available, on request, with FEP / FEP, insulated.
ALMEMO <sup>®</sup> connector	FTAxx NiCr-Ni ZA9020FS with resolution 0.1 K FTANxx NiCrSi-NiSi ZA9021FSN with resolution 0.1 K

#### Pt100 sheathed sensors FPAxx

Measuring element :	Pt100 4L, DIN class B (see 07.03)
Options :	DIN class A, 1/5 DIN class B (see 07.03)
Sensor tip :	diameter, length, operating temperature; see table; material stainless steel
Sheathed line :	diameter, length; see table; material stainless steel
	On certain types the sensor tip and sheathed line are of different diameter; (i.e. the sensor tip is thicker). These types are therefore not suitable for mounting with clamped screw connections. Types suitable for clamped screw connections are available on request.
Cable sleeve :	Brass, hexagonal, $L = 65$ mm, circumdiameter = 9 mm, operating temp40 to +160 °C
Standard cable :	1.5 meters line, FEP / silicone, insulated, operating temperature $-50$ to $+200$ °C
Cable options :	Line, PVC / PVC, insulated, operating temperature $-20$ to $+105$ °C The line is also available, on request, with FEP / FEP, insulated.
ALMEMO <sup>®</sup> connector	Pt100, ZA9030FS1, with resolution 0.1 K Option: Pt100 ZA9030FS2 with resolution 0.01 K (standard with 1/5 DIN class B)

#### NTC sheathed sensors FNAxx

Measuring element :	NTC type N (see 07.04)
Sensor tip :	diameter, length, operating temperature; see table; material stainless steel
Sheathed line :	diameter, length; see table; material stainless steel
	On certain types the sensor tip and sheathed line are of different diameter; (i.e. the sensor tip
	is thicker). These types are therefore not suitable for mounting with clamped screw
	connections. Types suitable for clamped screw connections are available on request.
Cable sleeve :	Brass, hexagonal, $L = 65$ mm, circumdiameter = 9 mm, operating temp40 to +160 °C
Standard cable :	1.5 meters line, PVC / PVC, insulated, operating temperature $-20$ to $+105$ °C
Cable options :	Line, FEP / silicone, insulated, operating temperature -50 to +200 °C
	The line is also available, on request, with FEP / FEP, insulated.
ALMEMO <sup>®</sup> connector	NTC, ZA9040FS, with resolution 0.01 K.

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.06

#### Sheathed sensors



Sensor with : Sensor tip. dimensior

Sensor tip, dimensions d1, sheathed line, dimensions d2, overall length (including sensor tip) L, Cable sleeve, dimensions length = 65 mm, circumdiameter = 9 mm, Cable

Thermocouple sheathed sensors NiCr-Ni, type K Typical Application: universal, in range -40 ° C to 900 ° C

Diameter d1=d2	Operat	ting temperature Sensor tip	Length L	Order no
0.5 mm	-2	200900°C	50 mm	FTA05L0050
0.5 mm		200900°C	100 mm	FTA05L0100
0.5 mm	-1	200900°C	250 mm	FTA05L0250
0.5 mm	-2	200900°C	500 mm	FTA05L0500
0.5 mm	-1	200900°C	1000 mm	FTA05L1000
1.5 mm	-2	2001100°C	100 mm	FTA15L0100
1.5 mm	-2	2001100°C	250 mm	FTA15L0250
1.5 mm	-2	2001100°C	500 mm	FTA15L0500
1.5 mm	-2	2001100°C	1000 mm	FTA15L1000
3.0 mm	-2	2001100°C	100 mm	FTA30L0100
3.0 mm	-2	2001100°C	250 mm	FTA30L0250
3.0 mm	-2	2001100°C	500 mm	FTA30L0500
3.0 mm	-2	2001100°C	1000 mm	FTA30L1000
Connection cal	ble	<b>Operative range</b>	Length	Order no
FEP/silicone		-50_200°C	15 m	default
Thermal line		50200 C	1.0 11	doluult
(stranded wire)				
( ····································			5 m	OTK01L0050
PVC/PVC		-20_105°C	1.5 m	OTK02L0015
Compensation 1	ine	20105 C	1.0 11	011102220013
			5 m	OTK02L0050

Thermocouple sheathed sensors NiCrSi-NiSi, type N Typical application: in the range -200 ° C to 1150 ° C, long-term stability at high temperatures

Diameter d1=d2	Operating temperature Sensor tip	Length L	Order no
1.5 mm	-2001150°C	500 mm	FTAN15L0500
1.5 mm	-2001150°C	750 mm	FTAN15L0750
1.5 mm	-2001150°C	1000 mm	FTAN15L1000
3.0 mm	-2001150°C	500 mm	FTAN30L0500
3.0 mm	-2001150°C	750 mm	FTAN30L0750
3.0 mm	-2001150°C	1000 mm	FTAN30L1000
6.0 mm	-2001150°C	500 mm	FTAN60L0500
6.0 mm	-2001150°C	750 mm	FTAN60L0750
6.0 mm	-2001150°C	1000 mm	FTAN60L1000

Connection cable	Operative range	Length	Order no
FEP/silicone Thermal line (stranded wire)	-50200°C	1.5 m	default
		5 m	OTNK01L0050

#### Resistor-based sensors Pt100 4L

#### Typical Application: universal, in range -40°C to 500°C

Diameter d1 Sensor tip	Diameter d2, Sheathed line	Operating temp. Sensor tip	Length L	Order no.
1.5 mm	1.5 mm**	-40500°C	100 mm	FPA15L0100
1.5 mm	1.5 mm**	-40500°C	250 mm	FPA15L0250
1.5 mm	1.5 mm**	-40500°C	500 mm	FPA15L0500
2.2 mm*	2.0 mm	-40500°C	100 mm	FPA22L0100
2.2 mm*	2.0 mm	-40500°C	250 mm	FPA22L0250
2.2 mm*	2.0 mm	-40500°C	500 mm	FPA22L0500
3.2 mm*	2.8 mm	-40500°C	100 mm	FPA32L0100
3.2 mm*	2.8 mm	-40500°C	250 mm	FPA32L0250
3.2 mm*	2.8 mm	-40500°C	500 mm	FPA32L0500

\* This sensor type (reinforced tip) is not suitable for clamped screw connections. Suitable types FPA20Lx or FPA30Lx with same end-to-end diameter are available on request.
 \*\* Too strong bending of / kinking of the sheathed line should be avoided.

Options	Order no.
PT100 measuring resistor	
Accuracy	
Class B	default
Class A	OPG2
Class 1/5 DIN Class B	OPG5
Ceramic measuring resistor	
operating range -200 600 ° C	OPM1

Connection cable	<b>Operative range</b>	Length	Order no.
FEP/silicone	-50200°C	1.5 m 5 m	default OPK01L0050
PVC/PVC	-20105°C	1.5 m 5 m	OPK02L0015 OPK02L0050

#### **Resistor-based sensors NTC**

Typical Application: universal, in range 0°C to typ. 70°C

Diameter d1 Sensor tip	Diameter d2, Sheathed line	Operating temp. Sensor tip	Length L	Order no.
2.0 mm	2.0 mm	-20100°C	100 mm	FNA20L0100
2.0 mm	2.0 mm	-20100°C	250 mm	FNA20L0250
2.0 mm	2.0 mm	-20100°C	500 mm	FNA20L0500
3.2 mm*	2.8 mm	-20100°C	100 mm	FNA32L0100
3.2 mm*	2.8 mm	-20100°C	250 mm	FNA32L0250
3.2 mm*	2.8 mm	-20100°C	500 mm	FNA32L0500

This sensor type (reinforced tip) is not suitable for clamped screw connections. Suitable types with same end-to-end diameter are available on request. \*

Connection cable	Operative range	Length	Order no.
PVC/PVC	-20105°C	1.5 m 5 m	default OPK02L0050

#### Handle for sensors with hexagonal cable sleeve



Option Handle including fitting

Order no. OFH1

#### Clamp srew connection ZT943xKV



**Operative range** For sheath elements

Option: Notched steel ring (once fitted, cannot be removed),  $T_{max} = 800 \text{ °C}$ For ZT9431KV Order no. OT9431ST For ZT9432KV Order no. OT9432ST

Variants (with PTFE clamping ring)	Order no.
for types FTA15Lxxxx, FPA16Lxxxx	ZT9431KV
for types	
FTA30Lxxxx, FPA30Lxxxx and FNA30Lxxxx	ZT9432KV

#### Technical data

Operating temperature	up to maximum 250 °C with option up to 800 °C
Thread	M8x1, 14 AF

#### Heat-conducting paste ZB9000WP

For surface measurement.	operative range	-30 to +200 °C.	heat-conducting paste.	tube, 12 ml

Order no. ZB9000WP

#### NiCr-Ni-sensor FTA 15 P

	Meas. element:	NiCr-Ni Class 1 *
	Measuring tip:	Operative range -200+1100 °C 200x1.5 mm, sheathed line, Inconel
	T <sub>90</sub> : *	1.5 s
	Cable:	approx. 1.4 m FEP/silicone with spray-coated ALMEMO <sup>®</sup> connector
For immersion measurement	L = 200 mm Sensor with hand (No variants avai	Order no. FTA15P lle Order no. FTA15PH lable)
Pt100-sensor FPA 32 P		
	Meas. element:	Pt100, Class B *
	Measuring tip:	Operative range -40+500 °C 200 x 2.8/3.2 mm, sheathed line
	T <sub>90</sub> : *	10 s
	Cable:	approx. 1.4 m PVC with spray-coated ALMEMO <sup>®</sup> connector
For immersion measurement	L = 200 mm Sensor with hand (No variants avai	Order no. FPA32P lle Order no. FPA32PH llable)
NTC-sensor FNA 305		
	Meas. element	NTC*
	Measuring tip	Operative range -10 to +60 °C (non-condensing) Protective tube in stainless steel Diameter = 3.0mm, length = 50 mm mounted directly on ALMEMO <sup>®</sup> connector
For Indoor air measurements	T <sub>90</sub>	8 s
	L = 50 mm (No variants av	<b>Order no. FNA305</b> ailable)
		* For general technical data, see page 07.0

#### NiCr-Ni sensor with handle FTA 120x



Meas. element Measuring tip:	<ul> <li>NiCr-Ni class 1 *</li> <li>Operative range -200+400 °C Silver rivet, level, spring-loaded,</li> </ul>
T <sub>90</sub> : * Handle: * Cable:	not electrically isolated 3 s 138 mm 1.5 m PVC
L = 30  mm	Order no. FTA1201

Order no. FTA1202

L = 150 mm

For surface measurement and immersion measurement

#### NiCr-Ni sensor with handle FTA 122 LxxxxH



For surface measurement and immersion measurement

	Meas. element:	NiCr-Ni class 1 *
	Measuring up.	Silver rivet, level, not electr. isolated
	T <sub>90</sub> : *	3 s
	Handle: *	127 mm
	Cable: <i>new</i>	1.5 m FEP/silicone thermal line**
]	L = 50  mm	Order no. FTA122L0050H
]	L = 100  mm	Order no. FTA122L0100H
]	L = 200  mm	Order no. FTA122L0200H

#### NiCr-Ni sensor with handle FTA 121 LxxxxH



For surface measurement and immersion measurement

Meas. element: Measuring tip:	NiCr-Ni class 1 * Operative range -200+400 °C Silver rivet, level, angled, not electrically isolated
T <sub>90</sub> : * Handle: *	3 s 127 mm
Cable: <i>new</i>	1.5 m FEP/silicone thermal line**
L = approx. 50	mm Order no. FTA121L0050H
L = approx. 200 i	mm Order no. FTA121L0200H

#### NiCr-Ni sensor with handle FTA 150 LxxxxH



#### NiCr-Ni sensor FTA 109 P



L = 100 mmOrder no. FTA1535L0100H

For surface measurement

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.12

#### NiCr-Ni sensor with handle FTA 420 LxxxxH



For surface measurement on level, metallic surfaces

# Meas. element:NiCr-Ni Class 1 \*Measuring tip:Operative range -50...+500 °CSilver disc, spring-loaded,<br/>not electrically isolated $T_{90}$ : \*2 sHandle: \*127 mmCable:1.5 m PVC

L = 150 mm **Order no. FTA420L0150H** 

#### NiCr-Ni sensor with handle FTA 102P



#### NiCr-Ni sensor FTA 025 P



Magnet sensor for surface measurement



Magnet sensor with Velcro fastener e.g. for pipework

Meas. element:NiCr-Ni Class 2 \*Measuring tip:Operative range -50...+300 °C<br/>Thermal ribbon, not electr. isolated<br/>Fastened by magnet $T_{90}$ : \*1.5 sCable:approx. 2 m PVC

Magnet sensor (No variants available) Order no. FTA025P

Klettband: approx. 400 mm, for pipe diameter appr. 10 to 75 mm Operating range: -10 ... +110 °C mounted on sensor tip

Magnet sensor, including Velcro fastener Order no. FTA025PKB

#### NiCr-Ni sensor FTA 131



Magnet sensor For surface measurement

#### NiCr-Ni sensor FTA 026 P



For surface measurement

°C
sulation

N. 01

Ribbon sensor **Order no. FTA026P** (No variants available)

Meas. element: NiCr-Ni Class 2 \*

3 s

T<sub>90</sub>: \*

Cable:

. .

Magnet sensor

Measuring tip: Operative range -50...+100 °C

3 m FEP/silicone

Order no. FTA131

Silver rivet, level, spring-loaded,

not electrically isolated Fastened by magnet

#### NiCr-Ni sensor FTA 8068



For surface measurement on pipes

#### NiCr-Ni sensor FTA 8069



\* For general technical data, see page 07.03.

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.14

#### NiCr-Ni film thermocouple FTA 683



For surface measurement

Meas. element: NiCr-Ni Class 2\* Measuring tip: Operative range -100 to +200°C Folie, Insulation Kresol T<sub>90</sub>: \* 2 s

new With permanently connected FEP / silicone thermal line (stranded wire)\*\* -50 to +200°C, 2 meters, with ALMEMO® connector Order no. FTA683 Measuring element without cable, free ends

not electrically isolated

(for your own sensors) Order no. FT0683

3 s

Operative range -25...+400 °C

Operative range -200...+205 °C

Insulation FEP,

1.5 m

#### NiCr-Ni sensor FTA 390 x



For surface measurement

\* For general technical data, see page 07.03.

\*\* There is no adverse temperature effect at the juncture from measuring element to cable. see page 07.03

#### Digital infra-red sensor for measuring surface temperature FIAD43



Operative range: -40...600 °C, Miniature probe head, with cable and ALMEMO<sup>®</sup> D6 plug and 1 mounting nut

Cable length = 1 mCable length = 3 mFor technical data, see page 07.34 Order no. FIAD4332 Order no. FIAD4332L3

Order no. FTA3900

Order no. FTA39010

DAkkS / DKD or factory calibration KI9xxx temperature for digital sensor (see chapter Calibration certificates)

#### Compact infra-red probe head FIA844



Operative range: -20...500 °C, with cable and ALMEMO<sup>®</sup> plug Probe head, and 2 mounting nuts

Cable length = 1 mCable length = 3 mFor technical data, see page 07.36 Order no. FIA844 Order no. FIA844L3

Factory calibration KI9xxx temperature for sensor (see chapter Calibration certificates)

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates)

#### NiCr-Ni sensor with handle FTA 05 L0050H



For immersion measurement

Meas. element: Measuring tip:	NiCr-Ni Class 1 * Operative range -200+500 °C Sheathed line, Inconel
T <sub>90</sub> : * Handle: * Cable: <b>new</b>	0.8 s 127 mm 1.5 m FEP/silicone thermal line**
L = 50  mm	Order no. FTA05L0050H

#### NiCr-Ni sensor with handle FTA 125 LxxxxH



For immersion measurement

#### NiCr-Ni sensor with handle FTA 126 LxxxxH



For immersion measurement

Meas. element: Measuring tip:	NiCr-Ni Class 1 * Operative range -200+800 °C Sheathed line, Inconel
T <sub>90</sub> : *	1.5 s
Handle: *	127 mm
Cable:	<i>new</i> 1.5 m FEP/silicone thermal line**
L = 300  mm	Order no. FTA125L0300H
L = 500  mm	Order no. FTA125L0500H

Measuring tin:		Operative range $_200 \pm 900$ °C
	Wiedstilling tip.	Sheathed line, Inconel
	T <sub>90</sub> : *	2.5 s
	Handle: *	127 mm
	Cable: <i>new</i>	1.5 m FEP/silicone thermal line**
т	-600 mm	Order no. ETA 1261 0600H

#### NiCr-Ni sensor with handle FTA 1261 LxxxxH



For immersion measurement in plastic and pasty substances, e.g. bitumen

\* For general technical data, see page 07.03.

\*\* There is no adverse temperature effect at the juncture from measuring element to cable. see page 07.03

Meas. element:NiCr-Ni Class 1 \*<br/>Operative range -200...+500 °C<br/>Sheathed line, Inconel $T_{90}$ : \*3 s<br/>Handle: \*Handle: \*127 mm<br/>Cable:Cable:neu:1.5 m FEP/silicone thermal line\*\*L = 150 mmOrder no. FTA1261L0150H

L = 150  mm	Order no. F IA1201L0150H
L = 300 mm	Order no. FTA1261L0300H

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.16

#### NiCr-Ni sensor with handle FTA 123 LxxxxH



For immersion measurement in plastic and pasty substances

Meas. element:	NiCr-Ni Class 1 *
Measuring tip:	Operative range -200+300 °C
	Penetrating tip
T <sub>90</sub> : *	3 s
Handle: *	127 mm
Cable: <i>new</i>	1.5 m FEP/silicone thermal line**
L = 50  mm	Order no. FTA123L0050H
L = 100  mm	Order no. FTA123L0100H

#### NiCr-Ni sensor with handle FTA 1231 LxxxxH



For immersion measurement in plastic and pasty substances

]	L = 250  mm	Order no. FTA1231L0250H
	Cable: <i>new</i>	1.5 m FEP/silicone thermal line**
	Handle: *	127 mm
	T <sub>90</sub> : *	6 s
		stainless steel 1.4541
		Penetrating tip, cone
	Measuring tip:	Operative range -200+400 °C
	Meas. element:	NiCr-Ni Class 1 *

\* For general technical data, see page 07.03. \*\* There is no adverse temperature effect at the juncture from measuring element to cable. see page 07.03

#### NiCr-Ni thermowire T 190-0

Thermowire: NiCr-Ni, class 2* Insulation : Glass fiber (wires and sheath) Operating temp.: -25°C to +400°C Wire diameter: 0.5 mm External diameter: approx. 1.3 x 2.1 mm NiCr-Ni thermowire per meter with glass fiber covering <b>Order no. LT01900</b> NiCr-Ni thermowire sensor, welded tip, with ALMEMO <sup>®</sup> connector 1.5m long <b>Order no. FTA3900</b> ALMEMO <sup>®</sup> connector 5m long <b>Order no. FTA3900L05</b>
Thermowire: NiCr-Ni, Class 2* Insulation : Glass fiber (wires and sheath) Operating temp.: -25°C to +400°C Wire diameter: 0.2 mm External diameter: approx. 0.6 x 1.0 mm NiCr-Ni thermowire per meter with class fiber covering Order no. LT01901
NiCr-Ni thermowire sensor, welded tip, with ALMEMO <sup>®</sup> connector 1.5 m long Order no. FTA3901 ALMEMO <sup>®</sup> connector 5m long Order no. FTA3901L05
Thermowire: NiCr-Ni, Class 2* Insulation : PVC (wires and sheath) Operating temp.: -10°C to +105°C Wire diameter: 0.5 mm External diameter: approx. 2.2 x 3.4 mm
NiCr-Ni thermowire per meter with PVC insulation Order no. LT01902 NiCr-Ni thermowire sensor, welded tip, with ALMEMO <sup>®</sup> connector 1.5 m long Order no. FTA3902 ALMEMO <sup>®</sup> connector 5 m long Order no. FTA3902L05
Thermowire: NiCr-Ni, Class 2* Insulation : Silicone (wires and sheath) Operating temp.: -45°C to +200°C Wire diameter: 0.5 mm External diameter: approx. 4 mm NiCr-Ni thermowire per meter with silicone insulation <b>Order no. LT01903</b>

\* For general technical data, see page 07.03

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.18

	Thermowire: NiCr-Ni, class 2* Insulation : FEP (Wires and sheath) Operating temp.: -200°C to +205°C Wire diameter: 0.5 mm External diameter: approx. 1.5 x 2.5 mm
	NiCr-Ni thermowire per meter with FEP insulationOrder no. LT019010NiCr-Ni thermowire sensor, welded tip, with ALMEMO® connector 1.5m long ALMEMO® connector 5m longOrder no. FTA39010 Order no. FTA39010L05
NiCr-Ni thermowire T 190-11	
	Thermowire: NiCr-Ni, class 2* Insulation : FEP (Wires and sheath) Wire diameter: 0.2 mm External diameter: approx. 1.3 x 2.0 mm
	NiCr-Ni thermowire per meter with FEP insulationOrder no. LT019011NiCr-Ni thermowire sensor, welded tip, with ALMEMO® connector 1.5m long ALMEMO® connector 5m long FTA39011L05Order no. FTA39011 Order no.
NiCr-Ni thermowire T 190-7	
	Thermowire: NiCr-Ni, Class 2* Insulation : Ceramic fiber (Wires and sheath) Operating temp.: -40°C to +1200°C Wire diameter: 0.8 mm External diameter: approx. 3 x 4 mm NiCr-Ni thermowire per meter with ceramic fiber insulation <b>Order no. LT01907</b>
Nur für trockene, nicht agressive Umgebung!	NiCr-Ni thermowire sensor, welded tip, with ALMEMO <sup>®</sup> connector 1.5m long Order no. FTA3907 ALMEMO <sup>®</sup> connector 5m long Order no. FTA3907L05
NiCr-Ni compensation line T 191-1	
	compensation line:NiCr-NiInsulation :PVC (Wires and sheath)Operating temp.:-10°C to +105°CWire diameter:0.5 mmExternal diameter:approx. 3.6 mm
<b>Other types are available on request.</b> LT01912 Insulation Silicone/silicone/glass filament, up to 200°C LT01913 Insulation PVC / screening film / PVC, up to 105°C	NiCr-Ni bunched conductor with PVC insulation, for each meter Order no. LT01911
NiCr-Ni thermal line (Litze) T 191-6	
	Thermal line (stranded wire)**: NiCr-Ni* Insulation: Wires : FEP, sheath : silicone Operating temp.: -50+200°C Wire diameter: 0.7 mm External diameter: approx. 3.8 mm
	NiCr-Ni thermal line (stranded wire) with FEP / silicone insulation, per meter Order no. LT01916
<ul> <li>* For general technical data, see page 07.03.</li> <li>** There is no adverse temperature effect at the juncture from measuring of the second secon</li></ul>	element to cable. see page 07.03

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates)

#### ALMEMO® connector for thermocouples (see Chapter Input connectors)



(no thermo-electric transition / with thermal material)			
Order no. ZA9020FS			
Order no. ZA9021FSN			
Order no. ZA9021FSL			
Order no. ZA9021FSJ			
Order no. ZA9021FST			
For Types U, S, R, B, AuFe-Cr			
Order no. ZA9000FSU			
Order no. ZA9000FSS			
Order no. ZA9000FSR			
Order no. ZA9000FSB			
Order no. ZA9000FSA			

#### ALMEMO® adapter plug with miniature flat socket



For Types K, J, T, S NiCr-Ni (K) Fe-CuNi (J) Cu-CuNi (T) PtRh-Pt (S)

Order no. ZKA029RA Order no. ZJA029RA Order no. ZTA029RA Order no. ZSA029RA

#### Miniature flat connectors for thermocouples types K, J, T, S, E



- Connectors with thermo contacts for avoiding voltage corruption at thermocouple junctions.
- For ambient temperatures -183 to +200 °C.
- Locking plate for complete coupling.

**Ordering:** 

#### Examples for NiCr-Ni (K):

NiCr-Ni flat socket	Order no. ZK9029FB
NiCr-Ni flat connector	Order no. ZK9029FS
Locking plate (10 pieces)	Order no. ZB9026VP
NiCr-Ni single built-in socket	Order no. ZK9029FE
1-row panel with NiCr-Ni socket	Order no. ZK9029FB
6-row panel with NiCr-Ni socket	Order no. ZK9029FB6

Order numbers for the above examples are compiled from the following coding elements : Z①9029F②③.

The coding elements can be taken from the table below.

Туре ①	Color (IEC 584)	Variant 2	Panel ③	Panel dimensions
NiCr-Ni (K)	green	Male connector $=$ S	1-er (1-rhg)	38 x 38 x 2.5 mm
Fe-CuNi (J)	black	Female connector = $B$	6-er (1-rhg)	113 x 38 x 2.5 mm
Cu-CuNi (T)	brown		12-er (1-rhg)	203 x 38 x 2.5 mm
NiCr-CuNi (E)	lilac		24-er (2-rhg)	203 x 76 x 2.5 mm
PtRh-Pt (S)	orange			mounting depth: 25.4 mm

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.20

#### Pt100 cable sensor



Inexpensive resistance-based temperature sensors, for universal use. For immersion measurements in air and gases. Rigid protective tube made from stainless steel A wide variety of cable variants. Operating temperature (depending on variant) -40 to +400°C.

#### Technical features

Measuring element : Pt100 4L, DIN class B, For technical data see page 07.03.

Protective tube: Diameter, length see Variants, stainless steel 1.4301

Junction of protective tube / connecting cable: Direct, hard-crimped for dry uses

**Cables:** Length = 1.5 meters, Other lengths are available as options. Cable diameter is never larger than the diameter of the protective tube.

**Operating temperature:** see variants, Always for whole sensor (i.e. sensor tip and cable)

ALMEMO<sup>®</sup> connector: Pt100 ZA9030FS2 with resolution 0.01 K.

#### Variants

#### With FEP / FEP cable (black),

**Operative range -40...+250°C:** 

Diameter	Length	Order no.
3.0 mm	50 mm	FPA30K03L0050
3.0 mm	100 mm	FPA30K03L0100
4.0 mm	50 mm	FPA40K03L0050
4.0 mm	100 mm	FPA40K03L0100

#### A longer cable is available as an option

6	
Total length 5 m	OPK03L0050
Total length 10 m	OPK03L0100

#### With FEP / silicone cable (red),

<b>Operative range -40+200°C:</b>			
Diameter	Length	Order no.	
5.0 mm	50 mm	FPA50K01L0050	
5.0 mm	100 mm	FPA50K01L0100	
6.0 mm	50 mm	FPA60K01L0050	
6.0 mm	100 mm	FPA60K01L0100	
A longer cable is available as an option			
Total length	5 m	OPK01L0050	
Total length	10 m	OPK01L0100	

## Cable with glass-fiber / glass-fiber / VA wire shielding,

Diameter	Length	Order no.
5.0 mm	50 mm	FPA50K06L0050
5.0 mm	100 mm	FPA50K06L0100
6.0 mm	50 mm	FPA60K06L0050
6.0 mm	100 mm	FPA60K06L0100
A longer ca	ble is available a	s an option
Total length	5 m	OPK 061 0050

Total length 5 mOPK06L0050Total length 10 mOPK06L0100

#### Other designs are available on request:

Pt100 cable sensors FPA30K20L0020 vapor-tight (protective class IP69K), inter alia for temperature measuring in autoclaves, sterilizing units, high-temperature steam applications, vacuum applications, freeze drying units, -30. to +150 °C, protective tube in stainless steel with PFA cable.

#### Pt100 sensor with handle FPA 106 LxxxxH



	Meas. element:	Pt100, class B *
	Measuring tip:	Operative range -40+500 °C
	• •	Sheath element, stainless steel
	T <sub>00</sub> : *	8 s
	Handle: *	127 mm
	Cable:	1.5 m FEP/silicone
I	= 100  mm	Order no FPA106L0100H

For immersion measurement

#### Pt100 sensor with handle FPA 123 LxxxxH



For immersion measurement in plastic and pasty substances

Meas. element:	Pt100, Class B *
Measuring tip:	Operative range -40+500 °C
	Penetrating tip
T <sub>90</sub> : *	8 s
Handle: *	127 mm
Cable:	1.5 m FEP/silicone
L = 100  mm	Order no. FPA123L0100H

#### Pt100 sensor with handle FPA 124 LxxxxH



For surface measurement and immersion measurement

Meas. element:	Pt100, Class B *
Measuring tip:	Operative range -40+300 °C Silver rivet, level
T <sub>00</sub> : *	10 s
Handle: *	127 mm
Cable:	1.5 m FEP/silicone



\* For general technical data, see page 07.03

#### NTC sensor with handle FNA 106 LxxxxH



Meas. element: NTC \* Measuring tip: Operative range -20...+100 °C Sheath element, stainless steel T<sub>90</sub>: \* 8 s Handle: \* 127 mm Cable: 1.5 m PVC L = 100 mmOrder no. FNA106L0100H

For immersion measurement

#### NTC sensor with handle FNA 123 LxxxxH



For immersion measurement in plastic and pasty substances

wieds. cicilient.	NIC
Measuring tip:	Operative range -20+100 °C
	Penetrating tip
T <sub>90</sub> : *	8 s
Handle: *	127 mm
Cable:	1.5 m PVC
L = 100  mm	Order no. FNA123L0100H

#### NTC sensor with handle FNA 124 LxxxxH



For surface measurement and immersion measurement

Meas. element:	NTC *
Measuring tip:	Operative range -20+100 °C
	Silver rivet, level
T <sub>90</sub> : *	10 s
Handle: *	127 mm
Cable:	1.5 m PVC

#### L = 100 mmOrder no. FNA124L0100H

#### NTC sensor FNA 305



#### Pt100 sensor FPA 611 x



For surface measurement



Meas. element: Pt100, class B \* Measuring tip: Operative range see below Copper, level *new* Improved thermal transfer thanks to innovative sensor element and new contact technology T<sub>90</sub>: \* 20 s Cable: 2 meters, insulation see below Surface sensor -10...+90°C, Cable PVC Order no. FPA611 -10...+110°C, Cable, PFA for more demanding mechanical stress ALMEMO<sup>®</sup> connector, resolution 0.01 K Order no. FPA611S01

> Accessories Fixture for fastening with cable ties

Best-Nr. ZB9611RM

#### Pt100 film sensor FPA 686



Meas. element:Pt100, class B\*, gewickeltMessfläche:Operative range -50...+200 °C,<br/>temperature-resistant foil,<br/>15 x 40 mm, approx. 0.5 mm thickT\_{90}\*:2 sCable:Stranded wire PFA, 4-wire twistedLength 2 mOrder no. FPA686<br/>Order no. FPA686L10

For surface measurement

#### Pt100 ceramic chip sensor element FP 0802



Meas. element: Pt100, Class B \* Measuring tip: Operative range -40...+400 °C Ceramic chip sensor Connection wires: 10 mm, bare Ceramic chip sensor **Order no. FP0802** 

Unprotected sensor element for constructing your own sensors

\* For general technical data, see page 07.03

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.24

#### NTC sensor FNA 611



For surface measurement



## Meas. element:NTC \*Measuring tip:Operative range -10...+90 °C<br/>Copper, level $T_{90}$ : \*20 sCable:2 m PVC

Surface sensor Order no. FNA611

Accessories Fixture for fastening with cable ties

Meas. element: NTC\*

Measuring tip: Sensor element, unprotected

Best-Nr. ZB9611RM

#### NTC sensor FN 0001 K

	Operative range: Connection wires: appr. 180 mm Connecting cable: 2 meters, PVC wire, Operative r Cable juncture, i	: -20+100°C , fluoropolymer insulation C, thin stranded pick-up range -10 to +90 °C n shrink-fit
Unprotected sensor element with cable	NTC sensor with cable, free ends Option: ALMEMO <sup>®</sup> connector including a	Order no. FN0001K
	Single connectors for 1 sensor Double connector for 2 sensors	Order no. OT9040AS Order no. OT9040AS2

#### NTC sensor element FN 0001



Meas. element: NTC \* Measuring tip: Operative range -20...+100 °C Sensor Connection wires 180 mm, fluoropolymer insulation

Sensor

Order no. FN0001

Unprotected sensor element for constructing your own sensors

\* For general technical data, see page 07.03

#### Pt100 Plug-in laboratory sensor FPA 416



Measuring element PT100, 4-conductor class B, integrated in the socket of a 6 mm laboratory connector made of brass (ni-ckel-plated).

Meas. element:Pt100, class B \*Measuring tip:Operative range -40...+150 °C $T_{90}$ :\*15 sCable:Silicone/FEP 3mALMEMO® connector:resolution 0.01 °C

Plug-in laboratory sensor Order no. FPA416

#### Pt100 Plug-in laboratory sensor FPA 414



Measuring element PT100, 4-conductor class B, integrated in the socket of a 4 mm laboratory connector made of brass (goldplated). Plug-in laboratory sensor Order no. FPA414



Plug-in laboratory sensor, examples of use Measuring object with hole for inserted PT100 plug-in laboratory sensor.

\* For general technical data, see page 07.03

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.26

#### Pt100 glass thermometer with immersion depths as per ASTM



2-meter FEP / silicone cable)

Variants

#### **Operative range:**

Pt100 glass thermometer with immersion depths as per ASTM specifications, with ALMEMO<sup>®</sup> connector (including

For immersion measurement in liquid media at low immersion depths.

Order no.

**FPA910** 

#### **Technical data**

Pt100, class A		
Operative range -50 to +310 °C		
Glass, tapered		
Diameter = 3 mm, length = 15 mm		
Glass, Diameter = 6 mm		
NL=250  mm (total nominal length)		
Labeling codes for immersion depths :		
identification rings on the shaft as per		
ASTM specifications (American Society		
for Testing and Materials)		
2.5 seconds		
Cable junction sleeve Stainless steel, 8 x 40 mm		
Cable exit secured with shrink-fit sleeve		
2 meters, FEP / silicone		
ALMEMO <sup>®</sup> connector Resolution 0.01 K		
Also available on request		
Resolution 0.001 K, in range -8 to +65 °C		
On devices with effect		
from ALMEMO® 2690		

#### Insertable sensor NiCr-Ni with round mounting plug T 820-6



#### **Operative range:**

Measuring tip, spring-loaded, for surface and immersion measurement.

#### **Technical data**

Measuring element	NiCr-Ni class 2*
Measuring tip	Operative range -40 to +400 °C Silver rivet, level, spring-loaded not electrically isolated
T <sub>90</sub> *	3 s
Insert length	60 mm (see layout drawing)
Fixture	Plastic, Ø 20 mm, resistant up to +120 °C
Connection	Round mounting plug

#### Accessories: ALMEMO<sup>®</sup> connecting cable, 2 meters Order no. ZA9020BK2

Гуреѕ	Order no.
Insertable sensor NiCr-Ni	
with round mounting plug	FT98206

#### Screw-fit sensor NiCr-Ni, Pt100, NTC, with fitted cable Fx 0710 L27M10



**Operative range:** For immersion measurement

#### **Technical data**

1

Meas. element:	see under variants
Sensor materials	Stainless steel
Operative range	see under variants
Thread	M10
Insert length	27 mm (see layout drawing)
Cable	3 meters, free ends see under variants

#### Variants

Order no.

Screw-fit sensor, with cable, free ends NiCr-Ni class 2\*, -100 to +400 °C Thermal line Glass filament / glass filament / VA wire shielding

	FT0710L27M10
Option Cable length 5 meters	OTK06L0050
Pt100 class B* -40 to +200 °C Cable FEP	/ silicone
Cable juncture, in shrink-fit	FP0710L27M10
Option Cable length 5 meters	OPK01L0050
NTC*, -20 to +100 °C Cable, PVC,	
Cable juncture, in shrink-fit	FN0710L27M10
Option Cable length 5 meters	OPK02L0050

#### **Options:**

ALMEMO<sup>®</sup> connector, including assembly, for NiCr-Ni sensors Order no. OT9020AS For Pt100 sensors Order no. OT9030AS For NTC sensors Order no. OT9040AS

\* For general technical data, see page 07.03

DAkkS / DKD or factory calibration KT90xx temperature for sensor or measuring chain (sensor + device) (see chapter Calibration certificates) 07.28

#### Einbausensor Pt100 mit Anschlußkopf FP 0463



#### **Operative range:**

For immersion measurements, pressure-sealed up to 15 bar.

#### **Technical data**

Meas. element:	Pt100, class B*
Sensor tube	Stainless steel
Operative range:	-40+350°C
Thread	1/2", with copper ring seal, pressure-sealed up to 15 bar
Insert length	70 mm (see layout drawing)
Terminal head	Clamp connector

Variants	Order no.
(on request with cable and ALMEMO <sup>®</sup> con	nnector)
Insertable sensor with terminal head	
Pt100, Class B*	FP0463

#### Insertable sensor PtRh-Pt (S) with terminal head FT 0425



#### **Operative range:**

For immersion measurements, up to 1400 or 1600 °C.

#### Accessories

Ceramic protective tube for T04251 Order no. ZB9425SR1

Ceramic protective tube for FT04252 Order no. ZB9425SR2

#### Options

ALMEMO<sup>®</sup> connector with assembly Order no. OT9020AS

#### **Technical data**

Measuring element	Thermowire PtRh-Pt (S) see under variants
Measuring tip	Ceramic tube
	see under variants
Operative range	see under variants
Insert length	500 mm
Protective tube	Ceramic, replaceable,
	7 x 1 mm
Cable	2-meter compensation line
	silicone insulation, free ends
Variants	Order no.
Variants (including 2-meter co	Order no. mpensation line)
Variants (including 2-meter co PtRh-Pt(S), T <sub>met</sub> = 14	<b>Order no.</b> mpensation line) $00^{\circ}$ C, element- $\emptyset = 0.35$ mm,
Variants (including 2-meter co PtRh-Pt(S), T <sub>max</sub> = 14 ceramic 610	Order no. mpensation line) $00^{\circ}$ C, element- $\emptyset = 0.35$ mm, FT04251
Variants (including 2-meter co PtRh-Pt(S), $T_{max} = 14$ ceramic 610 PtRh-Pt(S), $T_{max} = 16$	Order no. mpensation line) $00^{\circ}$ C, element- $\emptyset = 0.35$ mm, FT04251 $00^{\circ}$ C, element- $\emptyset = 0.5$ mm,
Variants (including 2-meter co PtRh-Pt(S), $T_{max} = 14$ ceramic 610 PtRh-Pt(S), $T_{max} = 16$ ceramic 710	Order no. mpensation line) 00°C, element- $\emptyset = 0.35$ mm, FT04251 00°C, element- $\emptyset = 0.5$ mm, FT04252

\* For general technical data, see page 07.03



#### Why Infrared Measurements?

Infrared measuring instruments provide large advantages with regard to measuring tasks that cannot be solved with conventional contact thermometers. Examples:

#### What is Infrared Radiation?

Every substance with a temperature above absolute zero emits an infrared radiation (spectral range of wavelengths from 0.7 to 1000µm) that corresponds to its temperature. This range is located below the longer red wavelength range and is not visible to the human eye. For measurements the most interesting range is located between 0.7 and 20µm.

The infrared radiation emitted by the test object follows the known optical rules and, therefore, can be deviated, bundled with lenses or reflected from catoptric ele-

- · Measurements of very high temperatures not allowing the use of thermocouples.
- · Measurements at surfaces with low thermal conduction and bodies with low thermal capacity.
- Measurements at moving, inaccessible or live parts with a high rate of response (<1s).
- · Measurements at objects, which must not be influenced by contact measurements.

ments.

The emissivity of a test object indicates how much infrared energy has been absorbed or released by radiation. The value can be between 0 and 1.0. The fact that the emissivity depends on the wavelength is relevant for measurements. With increasing object temperature the radiation maximum shifts to the short wave range. Therefore, IR thermometers are equipped with filters, which allow only one particular wavelength to pass through for the measurement. The spectral range for spe-



cific materials must be considered for the application.

#### **How Infrared Thermometers Operate**

The optical system of an infrared thermo- energy captured by the detector is electmeter captures the energy emitted from a ronically amplified and converted into an circular measuring spot and focuses it onto electrical signal. The optical resolution a detector. A material with a high trans- results from the ratio of the measuring dimission factor is used for the lenses. The stance to the size of the measuring spot. can be measured at further distances.

The measuring spot must always be smaller than the test object or the measuring point of interest. The higher the optical resolution the smaller the measuring spots

#### What is Intermittent Photometry?

Using intermittent photometry eliminates ting from this, combined with noise-optithe thermal drift and immunes devices mised signal processing, leads to an excelagainst thermal shock. The stability resul- lent temperature resolution and allows the

measurement of smallest test objects and fast response times.

#### Special Infrared Pyrometers

Ratio Pyrometers determine the temperature from the ratio of the energy radiated in each of two wavelength ranges. This method allows for exact measuring results, even in case of a limited view to the test object due to vapour, steam, dust, dirty windows or lenses (up to 95% reduction of meas. signal). Furthermore, test objects, which are smaller than the measuring spot ces), but can also be moved to pass above

(e.g. measurement at wires), or low or varying emissivities at fast moving objects, do not affect the measuring result.

Line Scanners measure the object temperature along a line. Fixed installed line scanners provide coloured heat flow charts from a product passing under the measuring head (e.g. conveyors, rotary furna-

objects (e.g. heat flow chart of a house wall). The infrared scanner measuring head AMiR 7880 scans up to 256 dots over an angle of 90°. 20 lines can be scanned within one second. One measuring tape can be divided into 3 sectors, side by side or overlapping.

#### What You Should Consider For Infrared Measurements

What to do in case of dust, vapour and aerosols at the measuring point?

If the atmosphere at the measuring point is contaminated with dust, vapour and aerosols, the radiation energy impinging on the sensor can be influenced by contaminated lenses. This can be avoided by using an air blow attachment that keeps the lens clean.

#### What to do in case of high ambient temperatures?

If the ambient temperature exceeds the temperature specified for the measuring head of the IR sensor, the measuring head must be protected by mounting an air or water cooling system along with an air blow attachment (to avoid water condensing on the lens). Furthermore, cables and cable routings with high temperature stability must be used.

#### What to do in case of heat sources located next to the measuring object?

If heat sources are located next to the test object, these can transmit or reflect additional energy. Such ambience radiations occur, for example, at measurements in industrial furnaces where the wall temperature is often higher than the temperature of the test object. Many infrared instruments allow for a compensation of the ambient temperature.

#### What to do in case of measurements in a vacuum?

In case of vacuum furnaces and similar applications it is necessary to mount the measuring head outside of the vacuum area and to perform the measurement through a window. When selecting the measuring window the transmission values of the window must match the spectral sensitivity of the sensor. Quartz glass or quartz are typically used for high temperatures. In case of low temperatures within the 8 to 14µm band the use of a special material, which is translucent for IR, is necessary, e.g. germanium, amtir, zinc selenide or sapphire. When selecting the window the temperature requirements, window thickness and pressure difference, as well as the possibility of keeping the window on both sides clean, must be considered. It might be advisable to consider an additional antireflective coating an the window on the window to increase the transmission capacity. Furthermore, it must be considered that not all window materials are translucent in the visible range.

#### Why is the emissivity so important?

In case of ideal radiators the reflected and transmitted energy equals zero and the emitted energy corresponds 100% to the characteristic temperature. However, many bodies emit less radiation at the same temperature (non-selective radiator). The ratio of real radiation value and that of the ideal radiator is defined as the emissivity  $\varepsilon$ . For example, a mirror has an emissivity of 0.1 while a so-called 'black body' has an emissivity of 1.0. Many nonmetals such as wood, rubber, stone, and organic materials have only low reflecting surfaces and, as a result, high emissivities between 0.8 and 0.95. However, metals, especially if they have glossy surfaces, can have  $\varepsilon = 0.1$ . Therefore, IR thermometers provide an option for setting the emissivity. The emissivity should be known as exact as possible. If a too high emissivity has been set, the indicated temperature is lower than the actual temperature, given that the temperature of the test object is higher than the ambient temperature. For example, if 0.95 has been set, while the emissivity is actually only 0.9, a temperature that is lower than the actual temperature will be indicated.

#### How can the emissivity be determined?

Several methods can be used to determine the emissivity. As a first starting point, the following emissivity table can be consulted. The table data only represents average values, as the emissivity of a material is influenced by various factors. These include: temperature, angle of measurement, surface geometry (plane, concave, convex), thickness, surface quality (polished, rough, oxidised, sand-blasted), spectral range of the measurement and transmission capacity (e.g. in case of thin plastic foils)

Temperature Range	Spectral Sensitivity	Application Examples
appr. 0 800°C	8 to 14 μm 3 to 5 μm 7 to 15 μm 7 to 18 μm	All non-metals, wood, paper, textiles, floor coverings, asphalt, lime floor, edibles, pharmaceuticals, as well as use with print, coating, laminating, drying/hardening, wave soldering and reflow soldering, for indoor installations, fire control, dust tips etc.
appr. 10 360°C	nominal 7.9 µm	Fabrication and processing of polyester foil, fluoroplastics, fluoropolymer, acrylate, nylon (polyamide), acetylene cellulose, polyamides, polyurethanes, PVC, polycarbonates.
appr. 260 1650°C	nominal 5.0/5.2 µm	Surface measurement on glass for heating up, forming, sealing, laminating, bending.
appr. 200 1200°C	3.9 µm	Metal finishing, furnaces, melting furnaces, blast furnaces, measurements on thick glass. Measurements slightly influenced by CO <sub>2</sub> atmosphere (combustion gases).
appr. 30 340°C	nominal 3.43 µm	Fabrication and processing of polyethylene, polypropylene, polystyrene and other foils.
appr. 400 3000°C	2 to 2.7 µm	Processing of ferrous and nonferrous metals, induction furnaces, glass production, melting furnaces, lab research.
appr. 200 1800°C	1.6 µm	Heat treatment of steel, bending, hardening, warming up.
appr. 500 3000°C	1 μm	Steel production, molten baths, for highest precision with shaping, casting and processing of metals, as well as the processing of glass, ceramics, semiconductors and chemicals.

#### **Application Examples for Infrared Thermometers**

#### **Compact Glossary of Important Terms**

Atmospheric Windows:	The wavelength ranges within the infrared spectrum, in which the atmospheric radiation energy is transmitted and the atmospheric absorption is minimal, approximately $3 \dots 5\mu m$ and $8 \dots 14\mu m$ .
Focal Point, Focal Distance	e:Measuring distance where the maximum optical resolution is reached.
Far Field:	Measured distance, which is significantly larger than the focal length of a device, in most cases is lar- ger than ten times the focal length.
Field of View:	The test object area, which is measured by the infrared thermometer; the diameter of the measuring spot is proportioned to the distance from the test object; often also specified as an angular variable at the focal point. Also see optical resolution.
Non-Selective Radiator:	Radiating body with an emissivity that, for all wavelengths, bears the same constant ratio to the emis- sivity of a full radiator at the same temperature, which is opaque to radiation of infrared energy.
Background Temperature:	From the view of the measuring instrument the ambient temperature or the temperature behind the test object.
Measuring Spot:	Diameter of the test object area, which is subject to a temperature measurement; the measuring spot is defined by the circular area, which typically allows to capture 90% of the infrared energy radiating from the test object to the optical receiving aperture of the measuring instrument.
Optical Resolution:	Also called the distance ratio: The 'measuring distance/measuring spot size' ratio (distance ratio E:M) of an IR measuring spot. The measuring distance is typically defined as the distance from the focal point and the measuring spot size as the diameter of the IR measuring spot measured at the focal point (typically the 90% energy measuring spot diameter). The optical resolution can be also defined for the far field, by using the values for the measuring distance and measuring spot size within the far field.
Degree of Reflection:	Ratio of the radiation energy reflected from a surface to the incident radiation of the same surface; for a perfect mirror the value is approximately 1, for a full radiator the reflection is zero.
Full Radiator:	Also: black body; ideal radiator. Body, which absorbs the whole impinging radiation energy of all wavelengths and which does not reflect nor transmit any radiation. The surface of a full radiator has a uniform emissivity of 1.
Spectral Sensitivity:	Wavelength range for which an infrared thermometer is sensitive.

#### Emissivities of Various Materials Depending on the Spectral Range

Metals		1 μm	2.2 μm	5.1 μm	8–14 μm
Aluminium	non-oxidised	0.1–0.2	0.02-0.2	0.02-0.2	0.02-0.1
	oxidised	0.4	0.2-0.4	0.2-0.4	0.2-0.4
Alloy A3003,	oxidised	-	0.4	0.4	0.3
	etched	0.2-0.8	0.2-0.6	0.1-0.4	0.1-0.3
<b>T</b> 1	polished	0.1-0.2	0.02-0.1	0.02-0.1	0.02-0.1
Lead	polished	0.35	0.05-0.2	0.05-0.2	0.05-0.1
	etched	0.65	0.5	0.4	0.4
Chromium	oxidised	- 0.4	0.3-0.7	0.2-0.7	0.2 - 0.0
Iron	oxidised	0.4	0.05-0.5	0.05-0.5	0.02-0.2
поп	non-oxidised	0.35	0.1-0.3	0.05-0.25	0.05-0.2
	rustv	_	0.6-0.9	0.5-0.8	0.5-0.7
	molten	0.35	0.4-0.6	_	_
Iron, cast	oxidised	0.7-0.9	0.7-0.95	0.65-0.95	0.6-0.95
	non-oxidised	0.35	0.3	0.25	0.2
	molten	0.35	0.3-0.4	0.2–0.3	0.2-0.3
Iron, wrought	dull	0.9	0.95	0.9	0.9
Gold	11	0.3	0.01-0.1	0.01-0.1	0.01-0.1
Haynes	alloy	0.5-0.9	0.6-0.9	0.3-0.8	0.3 - 0.8
Inconei	oxidised	0.4-0.9	0.0-0.9	0.0-0.9	0.7 - 0.95
	electropolished	0.3-0.4 0.2-0.5	0.3-0.0	0.5-0.0	0.3-0.0
Conner	nolished	0.2=0.5	0.23	0.03	0.13
copper	etched	0.05-0.2	0.05-0.2	0.05-0.15	0.05-0.1
	oxidised	0.2-0.8	0.7-0.9	0.5-0.8	0.4-0.8
Magnesium		0.3-0.8	0.05-0.2	0.03-0.15	0.02-0.1
Brass	polished	0.8-0.95	0.01-0.05	0.01-0.05	0.01-0.05
	high polished	_	0.4	0.3	0.3
	oxidised	0.6	0.6	0.5	0.5
Molybdenum	oxidised	0.5-0.9	0.4-0.9	0.3–0.7	0.2-0.6
	non-oxidised	0.25-0.35	0.1-0.3	0.1-0.15	0.1
Monel (NI–Cu)		0.3	0.2-0.6	0.1-0.5	0.1 - 0.14
Nickel	oxidised	0.8-0.9	0.4-0.7	0.3-0.6	0.2 - 0.5
Platinum	black	0.2-0.4	0.1-0.2	0.1-0.13	0.05-0.15
Mercury	black	_	0.05-0.15	0.05-0.15	0.05-0.15
Silver		0.04	0.02	0.02	0.02
Steel	cold-rolled	0.8-0.9	_	0.8-0.9	0.7–0.9
	heavy plate	_	0.6-0.7	0.5-0.7	0.4-0.6
	polished sheet metal	0.35	0.2	0.1	0.1
	melt steel	0.35	0.25-0.4	0.1-0.2	-
	oxidised	0.8–0.9	0.8-0.9	0.7–0.9	0.7–0.9
TT: ( '	stainless	0.35	0.2-0.9	0.15-0.8	0.1-0.8
Titanium	polished	0.5-0.75	0.2-0.5	0.1 - 0.3	0.05 - 0.2
Tungsten	nolished	- 0.35 0.4	0.0-0.8	0.3-0.7	0.3 - 0.0
Zinc	ovidised	0.55-0.4	0.1-0.3	0.05-0.25	0.05-0.1
Line	polished	0.5	0.05	0.03	0.02
Tin	(non-oxidised)	0.25	0.1-0.3	0.05	0.05
Nonmetals	,	1 um	2.2 µm	5.1 um	8–14 um
Asbestos		0.9	0.8	0.9	0.95
Asphalt		_	_	0.95	0.95
Basalt		_	_	0.7	0.7
Concrete		0.65	0.9	0.9	0.95
Ice		-	-	-	0.98
Soil		-	-	-	0.9–0.98
Paint	(non alkaline)		-	-	0.9–0.95
Gypsum		_	- 0.2	0.4-0.97	0.8-0.95
Glass	pane molton mass	-	0.2	0.98	0.85
Rubber	monen mass	_	0.4-0.9	0.9	- 0.95
Wood natural		_	_	0.9-0.95	0.95
Limestone		_	_	0.4-0.98	0.98
Carborundum		_	0.95	0.9	0.9
Ceramics		0.4	0.8-0.95	0.85-0.95	0.95
Pebble stones		_	-	0.95	0.95
Carbon	non-oxidised	0.8-0.95	0.8-0.9	0.8–0.9	0.8-0.9
	graphite	0.8–0.9	0.8–0.9	0.7–0.9	0.7 - 0.8
Paper	(any colour)	-	-	0.95	0.95
Plastic Fabria	(translucent, over 0.5mm)	-	-	0.95	0.95
raoric Sand	(cioin)	-	-	0.95	0.95
Sanu		_	_	U.7 _	0.9
Argil		_	0 8-0 95	0 85-0 95	0.95
Water		_	_	_	0.93

#### Digital infra-red sensor for measuring surface temperature FIAD43 Miniature probe head, integrated electronics, ALMEMO<sup>®</sup> D6 plug



#### **Measuring Field**



#### Options fitted at our factory



Air blower attachment

OR7843LB





- Digital infra-red probe head with integrated signal processor
- All sensor characteristics and adjustment data are stored in the probe head itself.
- Digital transmission ensures that measured values are not affected by the sensor cable being moved, bent, or twisted.
- Surface temperature is measured over a wide range up to 600°C.
- Robust stainless steel housing, protection class IP65
- The probe head, thanks to its small dimensions, can be installed in cramped and restricted conditions.
- The probe head is threaded for quick and easy installation.
- The sensor cable in polyurethane (PUR) is suitable for industrial use and is resistant to oily, acidic, basic environments.
- The sensor can be connected directly via the cable's ALMEMO<sup>®</sup> D6 plug to any ALMEMO<sup>®</sup> device.
- One measuring channel is preprogrammed on leaving our factory surface temperature (°C).
- Emissivity 0.95 are preprogrammed (on leaving our factory).
- This can be programmed from 0.1 to 1.0 at the current ALMEMO<sup>®</sup> V6 devices via the device or via interface (some only via interface).
- Transmittance 1.0 is preprogrammed (on leaving our factory). Transmittance can be modified directly on the PC using USB adapter cable ZA1919AKUV. (see "General accessories for ALMEMO<sup>®</sup> D6 sensors" page 04.05).

General features and accessories, ALMEMO<sup>®</sup> D6 sensors see page 01.08



#### **Technical data**

Digital infra-red probe head (including A/D converter)

Temperature measuring range	-40 to +600 °C
Spectral sensitivity	8 to 14 µm
Optical resolution (90 % energy)	10:1
	with focal point lens attachment 1 mm at distance of 10 mm Transmittance can be programmed to 0.75. (see below)
Accuracy	$\pm 1$ % of meas. value or $\pm 1$ K (whichever value is higher) $\pm 2$ K for meas. values <20 °C
Reproducibility	$\pm 0.5$ % of measured value or $\pm 0.5$ K (whichever value is higher)
Nominal conditions	23 °C ±5 K, emissivity 1.0
Temperature coefficient	$\pm 0.05$ K / K or $\pm 0.05$ % of measured value / K (whichever value is higher)
Temperature resolution	0.1 K
Response time	130 ms (90 %)
Emissivity	0.95 (preprogrammed on leaving our factory) This can be programmed from 0.1 to 1.0 at the current ALMEMO <sup>®</sup> V6 devices via the device (some only via interface).
Transmittance	1.0 (preprogrammed on leaving our factory) This can be programmed from 0.1 to 1.0 directly on the PC using USB adapter cable ZA1919AKUV. (please place a special order) (see "General accessories for ALMEMO <sup>®</sup> D6 sensors")
Protection class	IP65 (NEMA 4) (National Electric Manufacturers Association)
Ambient temperature	-10 to +120 °C with air-cooled housing -10 to +200 °C
Storage temperature	-20 to +120 °C
Relative atmospheric humidity	10 to 95 % non-condensing
Housing	Stainless steel
Dimensions	Probe head Length 28 mm x Ø 14 mm Thread M12 x 1
Weight	Probe head 50 grams with 1-meter cable
Connecting cable(s)	permanently fitted Polyurethane (PUR) For available lengths see variants. with ALMEMO <sup>®</sup> D6 plug
ALMEMO <sup>®</sup> D6 plug	Refresh time0.25 seconds for all channelsSupply voltage6 to 13 VDCCurrent consumption4 mA

#### **Accessories**



Focal point lens attachment (cannot be used together with air blower attachment or air-cooled housing) Transmittance 0.75 ZR7843CFL

ZR7842H



Protective window (cannot be used together with air blower attachment or air-cooled housing) **ZR7843PW** Transmittance 0.75



Mounting bracket, rigid

Measuring field with focal point lens attachment





Mounting bracket, adjustable

ZR7842JH

#### Compact infra-red probe head AMiR FIA 844 suitable for all ALMEMO® devices



- Compact inexpensive infra-red probe head for measuring surface temperature
- Other measuring ranges -20 to +500 °C
- High optical resolution Measuring spot 11.5 mm at distance 150 mm, in distant field 9:1
- Sturdy stainless steel housing Protection IP65
- Quick and easy to install thanks to screw-fit housing
- Integrated electronics, cable permanently fitted
- Can be connected directly to the ALMEMO<sup>®</sup> device using an ALMEMO<sup>®</sup> connector.





Distance D to target [mm]

Accessories	Order no.
Mounting bracket, rigid Mounting bracket, adjustable Air blower attachment Thread M18x1 90° deflecting mirror Thread M18x1 Protective window Thread M18x1	ZR7844FB ZR7844JB ZR7844APM ZR7844RAM ZR7844PWM
Variants (including 2 mounting nuts):	

ALMEMO <sup>®</sup> infra-red probe head Measuring range -20 to +500 °C	
with permanently fitted cable and ALMEMO <sup>®</sup> connector, Cable length = 1 meter	FIA844
Same as above Cable length = 3 meters	FIA844L
Factory calibration KI9xxx temperature for sensor (see chapter Calibration certificates)	

#### **Technical data**

Temperature range	-20 to +500 °C
Spectral sensitivity	8 to 14 µm
Optical resolution (90 % energy)	13:1 (11.5 mm at 150 mm distance), distant field 9:1
Accuracy	$\pm 1.5$ % of measured value or $\pm 2$ K (whichever value is higher)
	$\pm 3.5$ K for measured values <0 °C
Reproducibility	$\pm 0.5$ % of measured value or $\pm 1$ K (whichever value is higher)
Nominal conditions	23 °C ±5 K, Emissivity 0.95
Temperature resolution	0.1 K
Response time	150 ms (95 %)
Emissivity	0.95, fixed setting
Voltage supply	via ALMEMO® connector (12 VDC)
Protection	IP65
Ambient temperature	0 to +70 °C
Storage temperature	-20 to +85 °C
Relative atmospheric humidity	10 to 95 % non-condensing
Housing	Stainless steel
Dimensions	Length 94 mm Thread M18x1
Connecting cable	permanently fitted, 1 or 3 meters, -30 to +105 °C
	including ALMEMO® connector, programmed
Weight	approx. 160 g (1-meter cable)

Mounting bracket, adjustable Order no. ZR7844JB

Air blower attachment Thread M18x1

Order no. ZR7844APM

90° deflecting mirror Thread M18x1 Order no. ZR7844RAM











#### Infra-red transmitter for measuring surface temperature AMiR 7843 Miniature probe head, transmitter box with display / operating controls, with analog output



- Surface temperature is measured over a wide range up to 600 / 1000 °C.
- The probe head, thanks to its small dimensions, can be installed in cramped and restricted conditions.
- · Robust stainless-steel housing, protective class IP65
- The probe head is threaded for quick and easy installation. • The sensor cable is suitable for industrial use and is resistant
- to oily, acidic, and alkaline environments.
- Transmitter box with display and operating controls • Analog output 10 V / 20 mA, freely selectable and scalable.
- 1 Infra-red sensor suitable for direct connection to ALMEMO<sup>®</sup> measuring instruments see Digital sensor FIAD43x with ALMEMO<sup>®</sup> D6 plug (see page 01.08)

Accessories MR7843 series			Order no.
Mounting bracket, rigid	ZR7842H	Focal point lens attachment (cannot be used together w	ith air blower
Mounting bracket, adjustable	ZR7842JH	attachment or air-cooled housing)	ZR7843CFL
Protective window (cannot be used together		10:1 optics Measuring spot diameter 1 mm at distance	of 10 mm
with air blower attachment or air-cooled housing)	ZR7843PW	22:1 optics Measuring spot diameter 0.5 mm at distance	e of 10 mm.
Accessories for MR7843-12 / -32 / -	42		Order no.
Air blower attachment	ZR7842LB	90° deflecting mirror	
Air-cooled housing and T branch, including 0.8-meter		(only for air-cooled housing and air blower attachment)	ZR7842US
air hose, insulation, and air blower attachment	ZR7842KL1	90° deflecting mirror with integrated air blower attachm	ent
Same as above but with 2.8-meter air hose	ZR7842KL2		ZR7842US1
Options for MR7843-12 / -32 / -42			Order no.

#### Options for MR7843-12 / -32 / -42

Factory test certificate		DAkkS / DKD or factory calibration KI9xxx, temperature, for sensors
(only with delivery of new devices)	OR7843KZ1	(see chapter "Calibration certificates")

#### Standard delivery

Probe head (including mounting nut) with cable, PUR, mounted on transmitter box

Temperature range	Optical resolution	Ambient tempera- ture, probe head	Order no. Probe head cable, 1 m	Order no. Probe head cable, 3 m*
-40 to 600°C	2:1	-10 to 120°C	MR784312	MR784312L03
-40 to 600°C	10:1	-10 to 120°C	MR784332	MR784332L03
0 to 1000°C	22:1	-10 to 120°C	MR784342	MR784342L03

\* Available on request longer probe head cable, 8 / 15 / 30 meters

Ontions for MR7843-33 / -43 Order			
	Options for MR7843-33 / -43		Order no.
Air blower attachment, only fitted at our factory 90° deflecting mirrorOR7843LB1Factory test certificate (only with delivery of new devices)OR7843H DAkkS / DKD or factory calibration KI9xxx, temperature, for senso (only with air blower attachment OR7843LB1)OR7843KZ1(see chapter "Calibration certificates")	Air blower attachment, only fitted at our factory 90° deflecting mirror (only with air blower attachment OR7843LB1)	OR7843LB1 OR7843KZ1	Factory test certificate (only with delivery of new devices)OR7843KZ1 DAkkS / DKD or factory calibration KI9xxx, temperature, for sensors (see chapter "Calibration certificates")

#### Standard delivery

Probe head (including mounting nut) with cable, fluoropolymer, mounted on transmitter box

Temperature range	Optical resolution	Ambient tempera- ture, probe head	Order no. Probe head cable, 1 m	Order no. Probe head cable, 3 m*
-40 to 600°C	10:1	-10 to 180°C	MR784333	MR784333L03
0 to 1000°C	22:1	-10 to 180°C	MR784343	MR784343L03

\* Available on request longer probe head cable 8 / 15 / 30 meters

#### **Technical data**

Temperature measuring ran	depending on type -40 to +600 °C or 0 to +1000 °C
Spectral sensitivity	8 to 14 μm
Optical resolution (90 % er	hergy) depending on type 2:1 / 10:1 / 22:1, typical (21:1 guaranteed)
Response time (90%)	130 ms
Accuracy	$\pm 1$ % of measured value or $\pm 1$ K (whichever value is higher) $\pm 2$ K for measured values <20 °C
Reproducibility	$\pm 0.5$ % of measured value or $\pm 0.5$ K (whichever value is higher)
Nominal conditions	at ambient temperature $\pm 23 \text{ °C} \pm 5 \text{ K}$ , Emissivity factor 1.0 and calibration geometry
Temperature coefficient	$\pm 0.05$ K / K or $\pm 0.05$ % of measured value / K (whichever value is higher)
Ambient temperature	depending on type -10 to +120 °C (with air cooling up to +200 °C) or -10 to +180 °C
Protective class	IP65 (NEMA-4) / IEC 60529
Relative humidity	10 to 95 % non-condensing
Housing	Stainless steel
Dimensions	$L = 28 \text{ mm}, \emptyset = 14 \text{ mm}, \text{ Thread } M12x1$
Probe head cable	depending on type polyurethane (PUR) or fluoropolymer
Weight	50 g (with 1-meter cable)
Transmitter box	
Output (selectable)	0 to 5 V / 0 to 10 V; 0 to 20 mA / 4 to 20 mA (Temperature range can be programmed in each case.) Thermocouple, type J, K, R, S Not electrically isolated from supply voltage
Temperature resolution	$\pm 0.1$ K for temperature range $< 500$ °C
Accuracy	$\pm 1$ K for output mA / V $\pm 1.5$ K for output, thermocouple
Temperature coefficient	$\pm 0.02$ K / K for output mA / V, $\pm 0.05$ K / K for output, thermocouple
Emissivity	0.100 to 1.100
Transmittance	0.100 to 1.000
Signal processing	Saving of maximum / minimum / average value retention period up to 998 seconds
Alarm output	zero-potential contact (semiconductor relays) 48 V / 300 mA
Power supply	8 to 32 VDC, maximum 6 W
Ambient temperature	-10 to +65 °C
Protective class	IP65 (NEMA-4) / IEC 60529
Relative humidity	10 to 95 % non-condensing
Housing	Zinc die casting
Dimensions	80 x 60 x 31.5 mm (LxWxH)
Weight	370 g

#### Dimensions



#### Infrared Measuring Heads in Two-Wire Design AMiR 7838



- Compact, robust and precise infrared measuring heads.
- Wide range of versions for applications in intelligent process control and monitoring systems, as well as in production and test lab.
- Low cost standard version with fixed set temperature and output current range and emissivity can be manually set at the measuring head.
- The standard version without programming functions is ideally suitable for connecting to ALMEMO® devices.
- Measuring heads also available as addressable and remotely programmable versions.

Accessories	Order no.
ALMEMO <sup>®</sup> connecting cable, 2 meters, ALMEMO <sup>®</sup> connector, programmed for the probe head's temperature range, Sensor supply via ALMEMO <sup>®</sup> device (use of the device mains unit is recommended)	
(cable not suitable for ALMEMO <sup>®</sup> 4490-2, available here on request) for programmable measuring heads MR7838xP	ZA7838AK
Protective window, snap-on, according to above lens detail Remote control set incl. HART adapter and software Industrial mains adapter 110/220V – 24VDC	ZR7838SF OR7838SH ZR7838NT

Options	
Other focus point optics (also see page 07.44 / 07.45)	
Water/air cooling housing including air blow attachment, factory mounted	OR7838KL
Inherent safety (Ex in IIC T4), only available with programmable meas. heads without cooling jacket	OR7838IS4
Factory test certificate, based on DKD/NIST certified sensors (only with delivery of new devices)	OR7800KZ1

Types (incl. rigid mounting angle and fastening screw)	Order no.
For universal applications, standard optics OR7838OS1 (Fresnel Lens)	
Meas. range –18 to 500°C, spectral range 8 to 14 µm, response time 165ms, optical resolution 15:1	MR783810(P)
For universal applications, standard optics OR7838OS3 (Amtir Lens)	
Meas. range –18 to 500°C, spectral range 8 to 14 µm, response time 165ms, optical resolution 33:1	MR783811(P)
For high temperature measurements in metal finishing and in rotary tubular kilns,	
standard optics OR7838OS3 (Sapphire Lens)	
Meas. range 200 to 1000°C, spectral range 3.9 µm, response time 165ms, optical resolution 33:1	MR783821(P)
For maximum temperature measurements in metal finishing, standard optics OR7838OS6 (Float Glass Lens)	
Meas. range 500 to 2000°C, spectral range 2.2 µm, response time 100ms, optical resolution 60:1	MR783851(P)
For high temperature measurements in glass production and at heating up and hardening,	
standard optics OR7838OS3 (Calcium Fluoride Lens)	
Meas. range 250 to 1650°C, spectral range 5.0 µm, response time 165ms, optical resolution 33:1	MR783831(P)
For low temperature measurements in the production of plastic foils and normal foils,	
standard optics OR7838OS3 (Calcium Fluoride Lens)	
Meas. range 10 to 360°C, spectral range 7.9 µm, response time 165ms, optical resolution 33:1	MR783841(P)
(P) Measuring heads remote	ly programmable
DAkkS/DKD- oder Factory calibration K19xxx temperature for sensor (see chapter Calib	oration certificates)

#### **Device Functions**

#### only AMiR 7838-xxP (programmable AMiR Heads)

Programming:	through PC via HART <sup>®</sup> adapter (OR7838SH)
Emissivity:	0.10 to 1.00 programmable
Data functions:	max, min, average value hold, compensation of ambience radiation
Limit value programming:	1 limit value incl. hysteresis, also usable for monitoring the temperature of the measuring head
ALMEMO® application:	To acquire and save measured values using those measuring head variants which cannot be addressed and remotely programmed we recommend our ALMEMO <sup>®</sup> 4390-2 panel meters. For other ALMEMO <sup>®</sup> devices please see Chapter 01.Mesuring instruments

#### **Technical Data**

Accuracy:	$\pm 1\%$ of meas. value or $\pm 1.4$ °C, the higher value of either is always valid
Reproducibility:	$\pm 0.5\%$ of meas. value or $\pm 0.7$ °C, the higher value of either is always valid
Response time:	165ms, at 7838 - 51(P) 100ms
Nominal temperature:	+23°C, ±5°C
Temperature resolution:	AMiR 7838 -10, -11: 0.125°C, AMiR 7838 -21, -31, -41, -51: 1°C
Relative humidity:	10 to 95%, non-condensing, at 30°C max.
Power supply:	12–24VDC, for AMiR 7838xxP: 24VDC
Output signal:	4 20mA linear, two-wire technology
Emissivity:	0.10 to 1.00 manually adjustable at measuring head (only noprogrammable heads)
Operating temperature:	without cooling: 0 to 70°C, with air cooling: 0 to 120°C
	with water cooling: 0 to 175°C, with protective housing: 0 to 315°C
Protection system:	IP 65, (IEC 529)
Shock:	IEC 68-2-27 (MIL STD 810D), 50G, each axis, 11ms
Vibration:	IEC 68-2-6 (MIL STD 810D), 3G, each axis, 11 to 200Hz
Dimensions:	without water cooling housing: 187mm long, Ø 42mm
	with water cooling housing: 187mm long, Ø 60mm
Weight:	without water cooling housing: 330 g
	with water cooling housing: 595 g

#### **Digital Signal Processing and Configuration**

HART <sup>®</sup> protocol:	The Hart <sup>®</sup> protocol ('Highway intelligent field bus protocols, ported by a large number of p the standard output of 4 to 200 result, the measuring heads ca loop (4 to 20mA) with the me	Accessible Remote Transducer Protocol') is one of the most popular It is more often used in industry than any other protocol and is sup- roducts and software of other manufacturers. The Hart <sup>®</sup> signal combines mA with a simultaneously running digital remote data transmission. As a n, additionally, digitally communicate through the 2-conductor current asuring computer.
Single installation:	The most frequently used inst recorders or measuring equipt the current loop.	allation method is the single current loop. Analog displays and controls, nent within the current loop will not be influenced by digital signals in
Parallel working:	Up to 15 measuring heads can be switched in parallel and the measured values can be digitally further processed. For evaluation a powerful software with a menu-driven and user-friendly interface is available. It allows a graphical display of the ONLINE data including storing the measured values as an ASCII file for data export to other applications.	
Configuration examples:	Single installation	Parallel working.



#### Measuring Field Diagrams: AMiR 7838-10(P)



Standard Optics OS1



Focal Point Optics OS2

Order no. OR7838OS2

#### Measuring Field Diagrams: AMiR 7838-11(P)/-21(P)/-31(P)/-41(P)



Standard Optics OS3



Focal Point Optics OS4

Order no. OR7838OS4



Focal Point Optics OS5

Order no. OR7838OS5

The devices AMiR 7838-31(P) and AMiR 7838-41(P) are only available with standard optics OS3.

#### Measuring Field Diagrams: AMiR 7838-51(P)



Standard Optics OS6



Focal Point Optics OS7





Focal Point Optics OS8

Order no. OR7838OS8

#### Accessories for All Measuring Heads AMiR 7838, 7845, 7850 Without Use of the Thermojacket Protective Housing



Accessories	Order no.
Rigid mounting angle (spare)	ZR7838H
Adjustable mounting angle	ZR7838JH
Fastening screw (spare)	ZR7838BM
Sighting aid, screw-on	ZR7838VS
90° deviation mirror	ZR7838US
Air blow attachment	ZR7838LB
Tube adapter onto 11/2" NPT	ZR7838RA

#### Accessories for All Measuring Heads AMiR 7838, 7845, 7850 With Use of the Thermojacket Protective Housing



Accessories	Order no.
Thermojacket protective housing (3.26kg)	ZR7838SH
Adjustable mounting stand	ZR7838MF
Adjustable mounting flange	ZR7838JM
Mounting flange for anti-reflective tube	ZR7838FR
30cm anti-reflective tube, special steel	ZR7838RE
30cm anti-reflective tube, ceramics	ZR7838RK
Adjustable tube adapter	ZR7838JR
Connecting flange with stopper and Amtir window (from 3.9 to 14 mm)	ZR7838SA
Connecting flange with stopper and quartz window (from 1 to 2.2 mm)	ZR7838SQ
Water quantity regulator	ZR7838WR
Air quantity/pressure regulator	ZR7838LR