

# Infrared measuring technology



## Why Infrared Measurements?

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

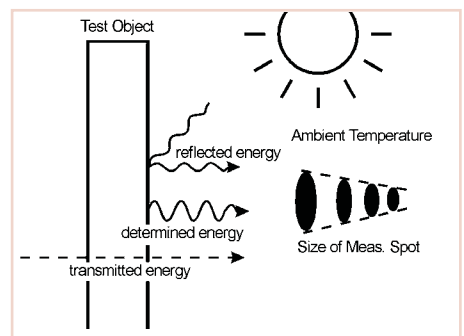
- Measurements of very high temperatures not allowing the use of thermocouples.
- Measurements at surfaces with low thermal conduction and bodies with low thermal capacity.
- Measurements at moving, inaccessible or live parts with a high rate of response ( $<1s$ ).
- Measurements at objects, which must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

## What is Infrared Radiation?

Every substance with a temperature above absolute zero emits an infrared radiation (spectral range of wavelengths from  $0.7$  to  $1000\mu m$ ) 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  $20\mu m$ .

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 elements.

**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 thermometer captures the energy emitted from a circular measuring spot and focuses it onto a detector. A material with a high transmission factor is used for the lenses. The

energy captured by the detector is electronically amplified and converted into an electrical signal. The optical resolution results from the ratio of the measuring distance to the size of the measuring spot.

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 can be measured at further distances.

## What is Intermittent Photometry?

Using intermittent photometry eliminates the thermal drift and immunises devices against thermal shock. The stability resul-

ting from this, combined with noise-optimised signal processing, leads to an excellent 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

(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 furnaces), but can also be moved to pass above

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, amir, 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 on 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  $\epsilon$ . For example, a mirror has an emissivity of 0.1 while a so-called 'black body' has an emissivity of 1.0. Many non-metals 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  $\epsilon = 0.1$ . 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)

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## Application Examples for Infrared Thermometers

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.

## Compact Glossary of Important Terms

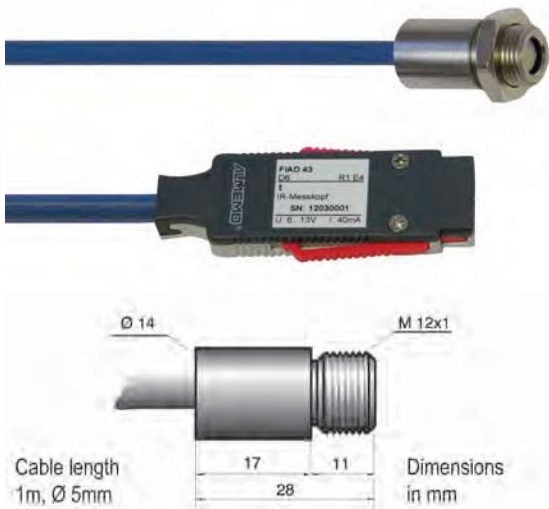
Atmospheric Windows:	The wavelength ranges within the infrared spectrum, in which the atmospheric radiation energy is transmitted and the atmospheric absorption is minimal, approximately 3 ... 5µm and 8 ... 14µm.
Focal Point, Focal Distance:	Measuring distance where the maximum optical resolution is reached.
Far Field:	Measured distance, which is significantly larger than the focal length of a device, in most cases is larger 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 emissivity 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.

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## Emissivities of Various Materials Depending on the Spectral Range

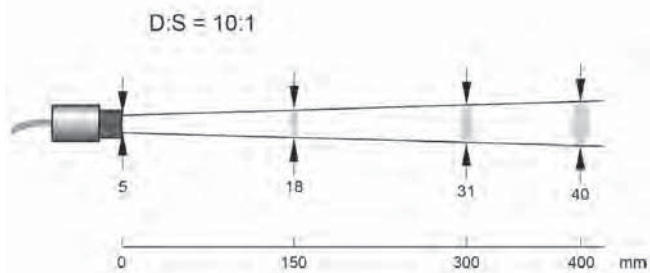
		1 $\mu\text{m}$	2.2 $\mu\text{m}$	5.1 $\mu\text{m}$	8–14 $\mu\text{m}$
<b>Metals</b>					
Aluminium	non-oxidised	0.1–0.2	0.02–0.2	0.02–0.2	0.02–0.1
	oxidised	0.4	0.2–0.4	0.2–0.4	0.2–0.4
Alloy A3003,	oxidised	–	0.4	0.4	0.3
	etched	0.2–0.8	0.2–0.6	0.1–0.4	0.1–0.3
	polished	0.1–0.2	0.02–0.1	0.02–0.1	0.02–0.1
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
	oxidised	–	0.3–0.7	0.2–0.7	0.2–0.6
Chromium		0.4	0.05–0.3	0.03–0.3	0.02–0.2
Iron	oxidised	0.4–0.8	0.7–0.9	0.6–0.9	0.5–0.9
	non-oxidised	0.35	0.1–0.3	0.05–0.25	0.05–0.2
	rusty	–	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		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
Inconel	oxidised	0.4–0.9	0.6–0.9	0.6–0.9	0.7–0.95
	sand-blasted	0.3–0.4	0.3–0.6	0.3–0.6	0.3–0.6
	electropolished	0.2–0.5	0.25	0.15	0.15
Copper	polished	0.05	0.03	0.03	0.03
	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
	electrolytic	0.2–0.4	0.1–0.2	0.1–0.15	0.05–0.15
Platinum	black	–	0.95	0.9	0.9
Mercury		–	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
	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
	oxidised	–	0.6–0.8	0.5–0.7	0.5–0.6
Tungsten	polished	0.35–0.4	0.1–0.3	0.05–0.25	0.03–0.1
Zinc	oxidised	0.6	0.15	0.1	0.1
	polished	0.5	0.05	0.03	0.02
Tin	(non-oxidised)	0.25	0.1–0.3	0.05	0.05
<b>Nonmetals</b>		1 $\mu\text{m}$	2.2 $\mu\text{m}$	5.1 $\mu\text{m}$	8–14 $\mu\text{m}$
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		–	–	0.4–0.97	0.8–0.95
Glass	pane	–	0.2	0.98	0.85
	molten mass	–	0.4–0.9	0.9	–
Rubber		–	–	0.9	0.95
Wood, natural		–	–	0.9–0.95	0.9–0.95
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	(translucent, over 0.5mm)	–	–	0.95	0.95
Fabric	(cloth)	–	–	0.95	0.95
Sand		–	–	0.9	0.9
Snow		–	–	–	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® D6 plug



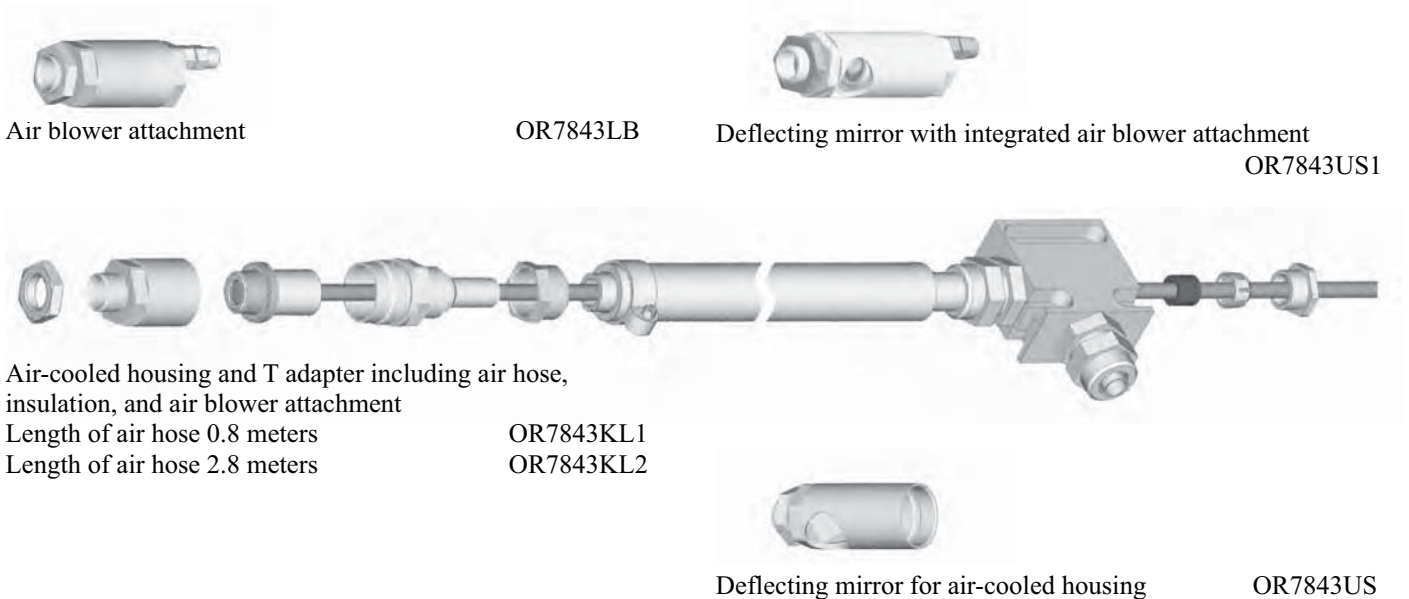
- Digital infra-red probe head with integrated signal processor
- All sensor characteristics and adjustment data are stored in the probe head itself.
- Digital transmission ensures that measured values are not affected by the sensor cable being moved, bent, or twisted.
- Surface temperature is measured 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® D6 plug to any ALMEMO® 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® 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® D6 sensors" page 04.05).

### Measuring Field



**General features and accessories, ALMEMO® D6 sensors**  
see page 01.08

### Options fitted at our factory



### Standard delivery

Infra-red probe head with cable and ALMEMO® D6 plug and 1 mounting nut

Cable length = 1 meter

Cable length = 3 meters

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

### Order no.

FIAD4332

FIAD4332L3



## 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	±1 % of meas. value or ±1 K (whichever value is higher) ±2 K for meas. values <20 °C		
Reproducibility	±0.5 % of measured value or ±0.5 K (whichever value is higher)		
Nominal conditions	23 °C ±5 K, emissivity 1.0		
Temperature coefficient	±0.05 K / K or ±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® 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® 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 with ALMEMO® D6 plug	Polyurethane (PUR)	For available lengths see variants.
ALMEMO® D6 plug	Refresh time	0.25 seconds for all channels	
	Supply voltage	6 to 13 VDC	
	Current consumption	4 mA	

## Accessories



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

Transmittance 0.75

ZR7843CFL



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

Transmittance 0.75

ZR7843PW



Mounting bracket, rigid

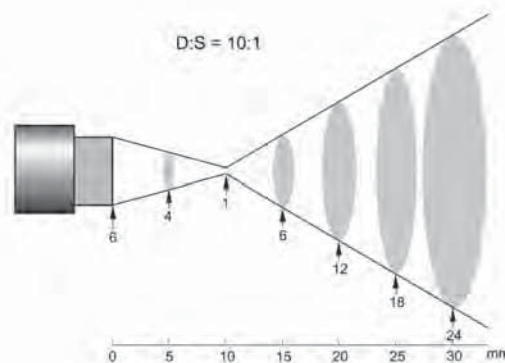
ZR7842H



Mounting bracket, adjustable

ZR7842HJ

Measuring field with focal point lens attachment

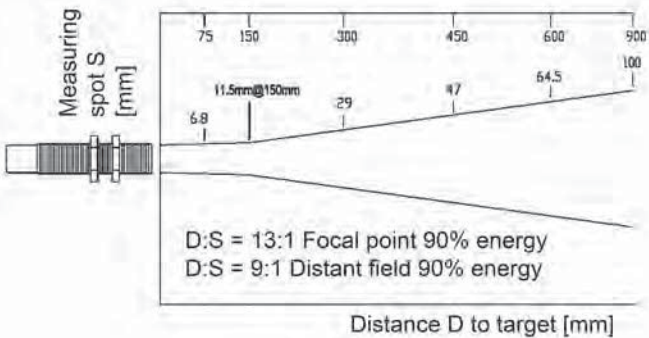
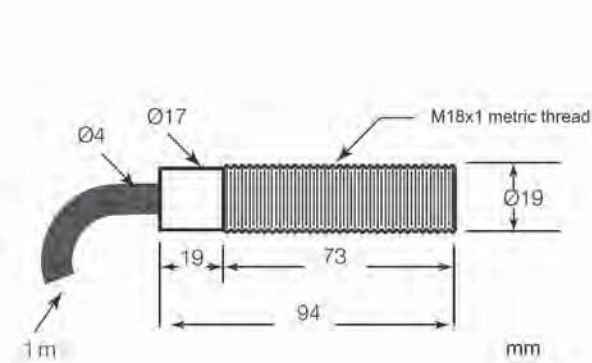


# Infrared measuring technology

## 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® device using an ALMEMO® connector.



### Accessories

	Order no.
Mounting bracket, rigid	ZR7844FB
Mounting bracket, adjustable	ZR7844JB
Air blower attachment Thread M18x1	ZR7844APM
90° deflecting mirror Thread M18x1	ZR7844RAM
Protective window Thread M18x1	ZR7844PWM

### Variants (including 2 mounting nuts):

ALMEMO® infra-red probe head Measuring range -20 to +500 °C  
with permanently fitted cable and ALMEMO® connector, Cable length = 1 meter

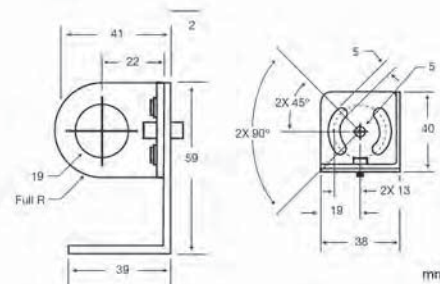
Same as above Cable length = 3 meters

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	±1.5 % of measured value or ±2 K (whichever value is higher) ±3.5 K for measured values <0 °C
Reproducibility	±0.5 % of measured value or ±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)

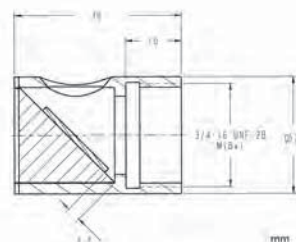
Mounting bracket, adjustable  
Order no. ZR7844JB



Air blower attachment  
Thread M18x1  
Order no. ZR7844APM



90° deflecting mirror  
Thread M18x1  
Order no. ZR7844RAM





# Infrared measuring technology

## 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.



Infra-red sensor suitable for direct connection to ALMEMO® measuring instruments see Digital sensor FIAD43x with ALMEMO® D6 plug (see page 01.08)

10/2013 • We reserve the right to make technical changes.

### Accessories MR7843 series

Order no.

Mounting bracket, rigid	ZR7842H	Focal point lens attachment (cannot be used together with air blower attachment or air-cooled housing)	ZR7843CFL
Mounting bracket, adjustable	ZR7842JH	10:1 optics Measuring spot diameter 1 mm at distance of 10 mm	
Protective window (cannot be used together with air blower attachment or air-cooled housing)	ZR7843PW	22:1 optics Measuring spot diameter 0.5 mm at distance of 10 mm.	

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

Order no.

Air blower attachment	ZR7842LB	90° deflecting mirror	ZR7842US
Air-cooled housing and T branch, including 0.8-meter air hose, insulation, and air blower attachment	ZR7842KL1	(only for air-cooled housing and air blower attachment)	
Same as above but with 2.8-meter air hose	ZR7842KL2	90° deflecting mirror with integrated air blower attachment	ZR7842US1

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

Order no.

Factory test certificate (only with delivery of new devices)	OR7843KZ1	DAkKS / DKD or factory calibration KI9xxx, temperature, for sensors (see chapter „Calibration certificates“)
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### Standard delivery

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

Temperature range	Optical resolution	Ambient temperature, 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

### Options for MR7843-33 / -43

Order no.

Air blower attachment, only fitted at our factory	OR7843LB1	Factory test certificate (only with delivery of new devices)	OR7843KZ1
90° deflecting mirror (only with air blower attachment OR7843LB1)	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 temperature, 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

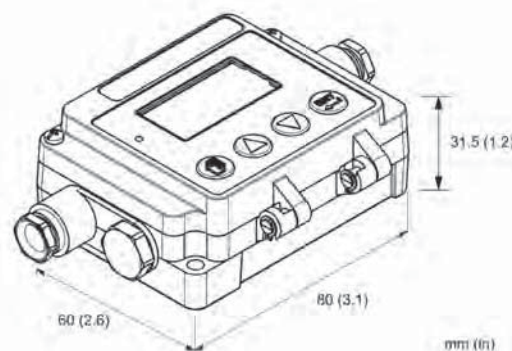
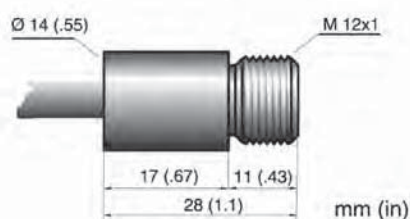
### Probe head

Temperature measuring range	depending on type -40 to +600 °C or 0 to +1000 °C
Spectral sensitivity	8 to 14 µm
Optical resolution (90 % energy)	depending on type 2:1 / 10:1 / 22:1, typical (21:1 guaranteed)
Response time (90%)	130 ms
Accuracy	±1 % of measured value or ±1 K (whichever value is higher) ±2 K for measured values <20 °C
Reproducibility	±0.5 % of measured value or ±0.5 K (whichever value is higher)
Nominal conditions	at ambient temperature +23 °C ±5 K, Emissivity factor 1.0 and calibration geometry
Temperature coefficient	±0.05 K / K or ±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 mm, Ø = 14 mm, Thread M12x1
Probe head cable	depending on type polyurethane (PUR) or fluoropolymer
Weight	50 g (with 1-meter cable)

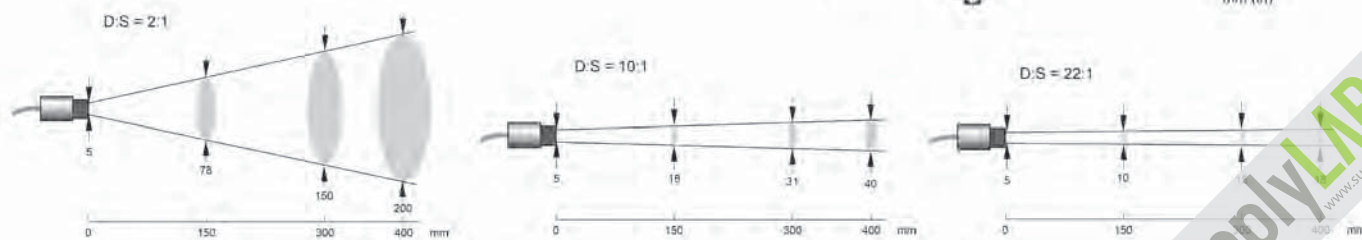
### Transmitter box

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	±0.1 K for temperature range < 500 °C
Accuracy	±1 K for output mA / V ±1.5 K for output, thermocouple
Temperature coefficient	±0.02 K / K for output mA / V, ±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



## Measuring field (90% energy)



# Infrared measuring technology

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

10/2013 • We reserve the right to make technical changes.

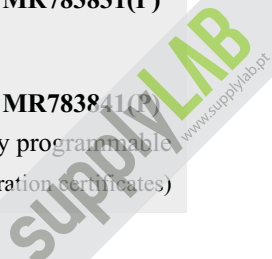


- Compact, robust and precise infrared measuring heads.
- Wide range of versions for applications in intelligent process control and monitoring systems, as well as in production and test lab.
- Low cost standard version with fixed set temperature and output current range and emissivity can be manually 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® connecting cable, 2 meters, ALMEMO® connector, programmed for the probe head's temperature range, Sensor supply via ALMEMO® device (use of the device mains unit is recommended) (cable not suitable for ALMEMO® 4490-2, available here on request)	ZA7838AK
for programmable measuring heads MR7838xP	
Protective window, snap-on, according to above lens detail	ZR7838SF
Remote control set incl. HART adapter and software	OR7838SH
Industrial mains adapter 110/220V – 24VDC	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 remotely programmable	
DAkKS/DKD- oder Factory calibration KI9xxx temperature for sensor (see chapter Calibration certificates)	



## Device Functions

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

Programming:	through PC via HART® 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® 4390-2 panel meters. For other ALMEMO® devices please see Chapter 01. Measuring instruments

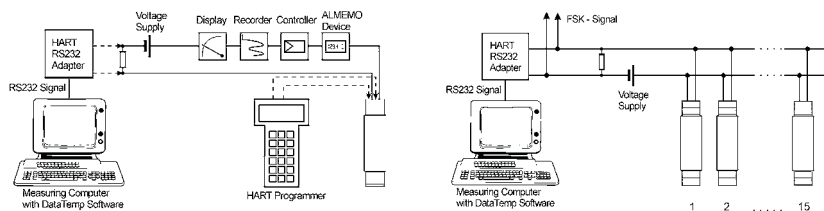
## Technical Data

Accuracy:	±1% of meas. value or ±1.4°C, the higher value of either is always valid
Reproducibility:	±0.5% of meas. value or ±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

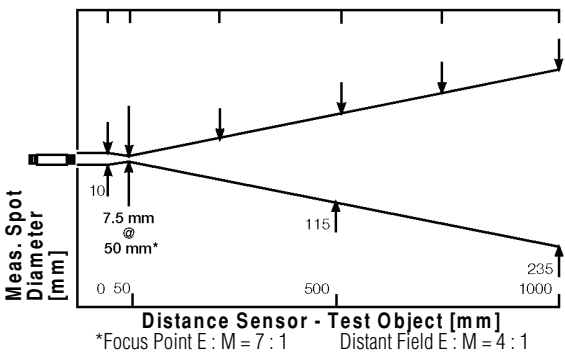
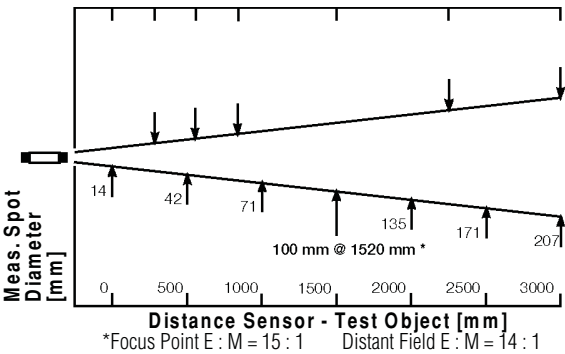
# Infrared measuring technology

## Digital Signal Processing and Configuration

HART® protocol:	The Hart® protocol ('Highway Accessible Remote Transducer Protocol') is one of the most popular intelligent field bus protocols. It is more often used in industry than any other protocol and is supported by a large number of products and software of other manufacturers. The Hart® signal combines the standard output of 4 to 20mA with a simultaneously running digital remote data transmission. As a result, the measuring heads can, additionally, digitally communicate through the 2-conductor current loop (4 to 20mA) with the measuring computer.	
Single installation:	The most frequently used installation method is the single current loop. Analog displays and controls, recorders or measuring equipment within the current loop will not be influenced by digital signals in the current loop.	
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)



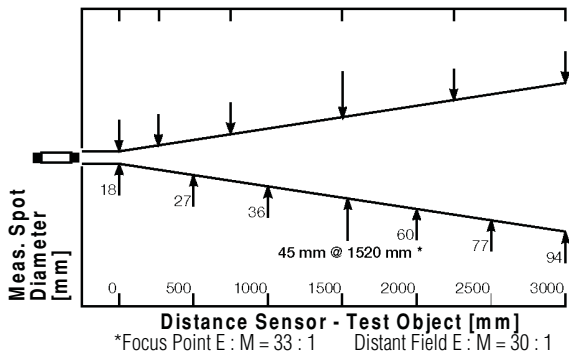
Standard Optics OS1

Focal Point Optics OS2

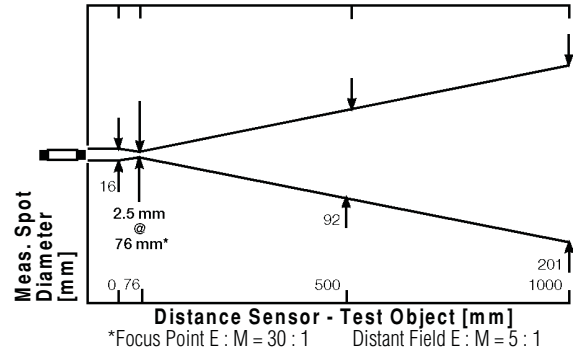
Order no. OR7838OS2



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



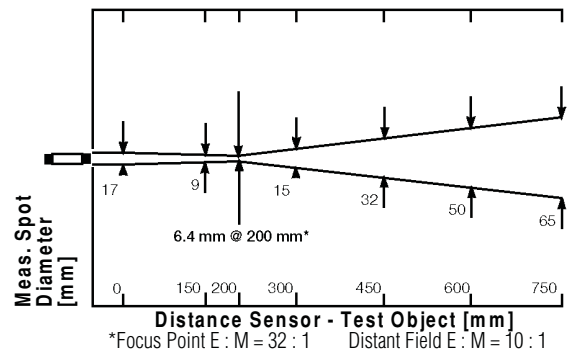
Standard Optics OS3



Focal Point Optics OS4

Order no. OR7838OS4

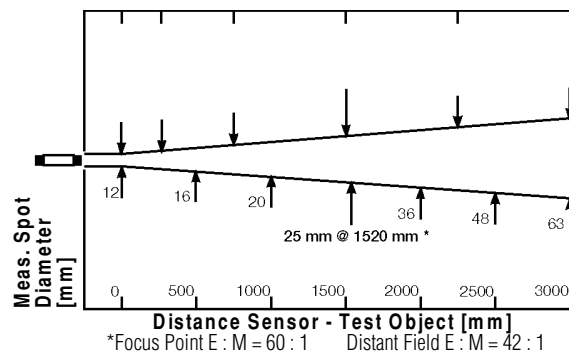
! The devices AMiR 7838-31(P) and AMiR 7838-41(P) are only available with standard optics OS3.



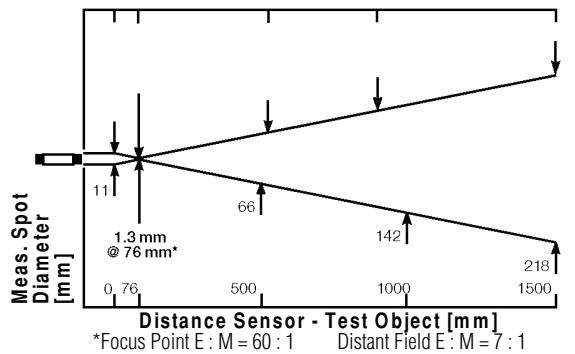
Focal Point Optics OS5

Order no. OR7838OS5

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

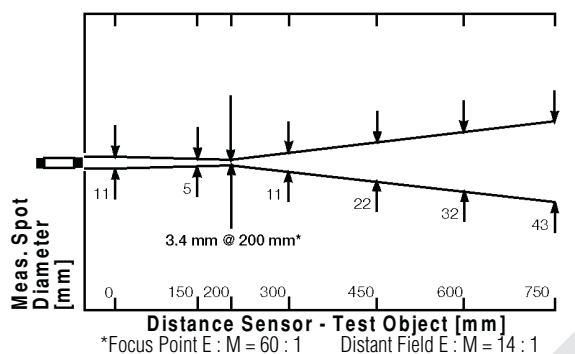


Standard Optics OS6



Focal Point Optics OS7

Order no. OR7838OS7

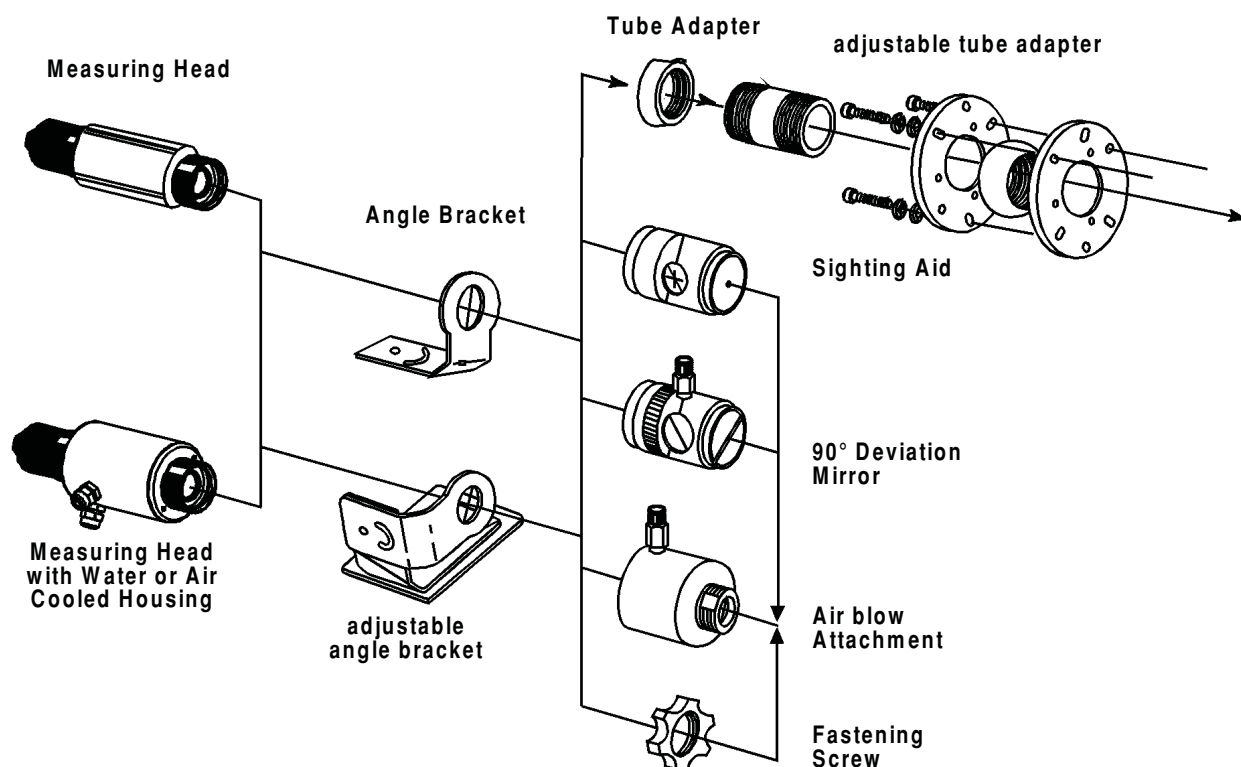


Focal Point Optics OS8

Order no. OR7838OS8

# Infrared measuring technology

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



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### Accessories

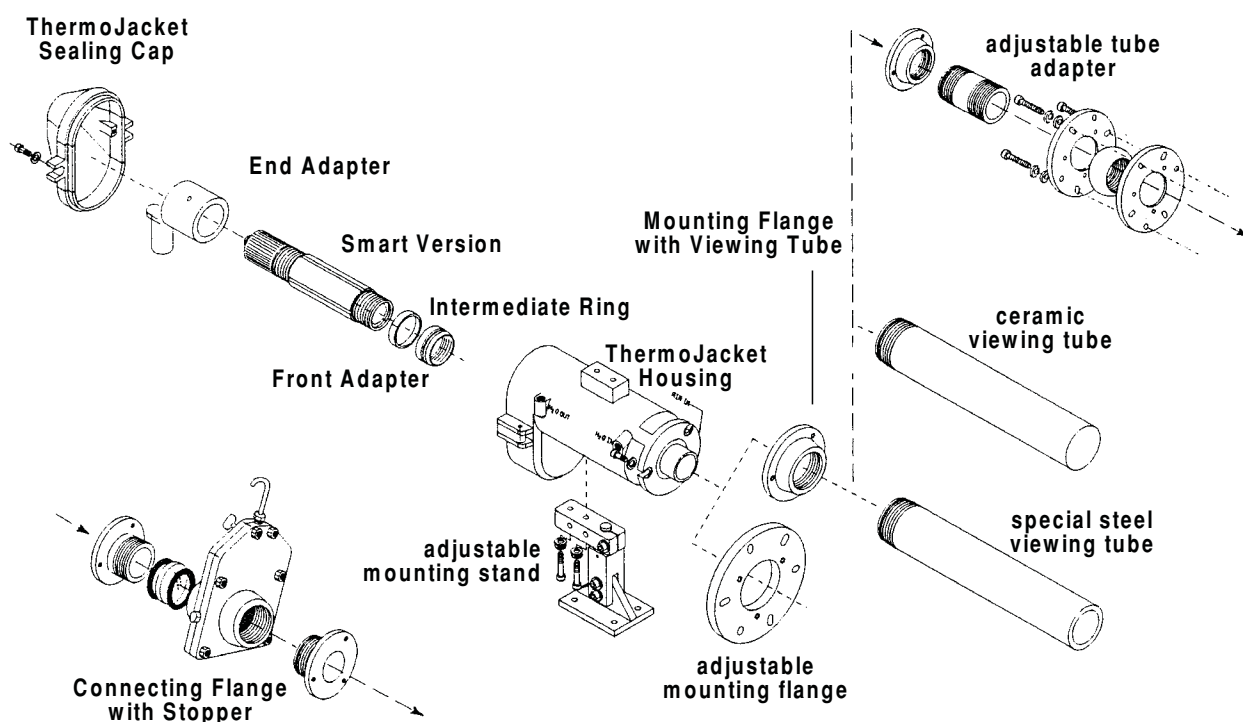
### Order no.

Rigid mounting angle (spare)  
Adjustable mounting angle  
Fastening screw (spare)  
Sighting aid, screw-on  
90° deviation mirror  
Air blow attachment  
Tube adapter onto 1 1/2" NPT

ZR7838H  
ZR7838JH  
ZR7838BM  
ZR7838VS  
ZR7838JS  
ZR7838LB  
ZR7838RA

# Infrared measuring technology

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



### Accessories

Thermojacket protective housing (3.26kg)
Adjustable mounting stand
Adjustable mounting flange
Mounting flange for anti-reflective tube
30cm anti-reflective tube, special steel
30cm anti-reflective tube, ceramics
Adjustable tube adapter
Connecting flange with stopper and Amtir window (from 3.9 to 14 mm)
Connecting flange with stopper and quartz window (from 1 to 2.2 mm)
Water quantity regulator
Air quantity/pressure regulator

### Order no.

ZR7838SH
ZR7838MF
ZR7838JM
ZR7838FR
ZR7838RE
ZR7838RK
ZR7838JR
ZR7838SA
ZR7838SQ
ZR7838WR
ZR7838LR

