

Infrared sensor OI98



CE Declaration of Conformity

The device complies with the following requirements:

EMC: EN 61326-1:2013
(Basic test requirements)
EN 61326-2-3:2013

Safety: EN 61010-1:2011

Laser safety: EN 60825-1:2015



The product complies with the requirements of the EMC Directive 2014/30/EU and the Low Voltage Directive 2014/35/EU.

This product complies with the provisions of Directive 2011/65/EU of the European Parliament and of the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Warranty

Should device defects occur despite careful quality assurance, please contact our customer service immediately. The warranty period is 24 months from the date of delivery. After this period, the manufacturer provides a 6-month warranty on all repaired or replaced device components in case of repair. The warranty does not cover damage caused by improper handling, opening of the device or the use of force. The manufacturer is not liable for any consequential damage or in case of improper use of the product. In the event of a device fault during the warranty period, the device will be repaired or calibrated free of charge. The freight costs will be borne by the respective sender. The manufacturer reserves the right to exchange the device or parts of the device instead of repair. If the fault is due to misuse or force, the costs will be charged by the manufacturer. In this case, a cost estimate will be provided upon request before the repair is started.

Read these operating instructions carefully before starting up the device for the first time.

In the interest of technical development, the manufacturer reserves the right to alterations of the specifications given in this manual.

[▶ References to other chapters]

Important notes are highlighted in gray

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Description

The sensors of the OI98 series are non-contact infrared temperature sensors.

They measure the infrared radiation emitted by objects and calculate the surface temperature on this basis [► **principle of infrared temperature measurement**]. The sensor housing of the measuring head is made of stainless steel (degree of protection IP65/ NEMA-4) - the evaluation electronics are housed in a separate zinc die-cast housing.

**The OI98 sensors are sensitive optical systems. Therefore, the mounting should be carried out exclusively via the existing thread.
Please avoid rough mechanical force on the measuring head, as this can lead to destruction and in this case any warranty claims are void.**

Scope of delivery

- Measuring head with connection cable and evaluation electronics
- Mounting nut
- Instruction manual

Maintenance

Lens cleaning: Loose particles can be blown away with clean compressed air. The lens surface can be cleaned with a soft, damp cloth (moistened with water or a water-based glass cleaner).

CAUTION: Please do not use any cleaning agents containing solvents (neither for the optics nor for the housing).

Notes

Avoid abrupt changes in ambient temperature. Should problems or questions arise when working with your Oi98, please contact the staff of our service department.

Model overview

The sensors of the Oi98 series are available in the following basic variants:

Model	Series designation	Measuring range	spectral Sensitivity	typical applications
CT LT	LT02/ LT15/ LT22	-50 ... 975°C	8 ... 14µm	non-metallic surfaces
CT fast	LT15F/ LT25F	-50 ... 975°C	8 ... 14µm	fast processes
CT hot	LT02H/ LT10H	-40 ... 975°C	8 ... 14µm	high ambient temperatures (up to 250 °C)
CT 1M	1ML/ 1MH/ 1MH1	485 ... 2,200°C	1µm	Metals and ceramics
CT 2M	2ML/ 2MH/ 2MH1	250 ... 2,000°C	1.6µm	Metals and ceramics
CT 3M	3ML/ 3MH-H3	50 ... 1,800°C	2.3µm	Metals at low object temperatures (from 50 °C)
CT G5	G5L/ G5H	100 ... 1,650°C	5.2µm	Glass temperatures
CT P7	P7	0 ... 710°C	7.9µm	Temperature of thin plastic films

In this operating manual, only the abbreviated designations are used in the following. For models 1M, 2M, 3M and G5, the total measuring range is subdivided into several bases (L, H, H1, etc.). An assignment of the part numbers can be found on page 73.

Factory default

The devices have the following default settings at delivery:

Signal output object temperature	0 ... 5 V
Emissivity	0.970 [LT/ G5/P7] 1.000 [1M/ 2M/ 3M]
Transmission	1.000
Averaging (AVG)	0.2 s LT15F / LT25F: 0.1 s 1M / 2M / 3M: 0.001 s
Smart Averaging	inactive LT15F, LT25F, 1M, 2M, 3M: active
Maximum value posture (MAX)	inactive
Minimum value holding (MIN)	inactive

Smart Averaging or Adaptive Averaging is a dynamic adaptation of the averaging to steep signal edges [activation only possible via software].
[▶ Appendix C]

	LT	1ML	1MH	1MH1	2ML	2MH	2MH1	3ML	3MH
lower limit temperature range [°C]	0	485	650	800	250	385	490	50	100
upper limit temperature range [°C]	500	1,050	1,800	2,200	800	1,600	2,000	400	600
lower alarm limit [°C] (Normal closed)	30	600	800	1,200	350	500	800	100	250
Upper alarm limit [°C] (Normal open)	100	900	1,400	1,600	600	1,200	1,400	300	500
lower limit output	0 V								
Upper limit output	5 V								
Temperature unit	°C								
Ambient temperature compensation	internal measuring head temperature sensor (output at OUT-AMB as 0-5 V signal at LT, G5 and P7)								
Baud rate [kBaud]	115								

	3MH1	3MH2	3MH3	G5L	G5H	P7
lower limit temperature range [°C]	150	200	250	100	250	0
upper limit temperature range [°C]	1,000	1,500	1,800	1,200	1,650	710
lower alarm limit [°C] (Normal closed)	350	550	750	200	350	30
Upper alarm limit [°C] (Normal open)	600	1000	1200	500	900	100
lower limit output	0 V					
Upper limit output	5 V					
Temperature unit	°C					
Ambient temperature compensation	internal measuring head temperature sensor (output at OUT-AMB as 0-5 V signal at LT, G5 and P7)					
Baud rate [kBaud]	115					

Technical data

General specification

	Measuring head	Electronic box
Degree of protection	IP65 (NEMA-4)	IP65 (NEMA-4)
Operating temperature	see: Measurement specification	0 ... 85 °C
Storage temperature	see: Metrological specification	-40 ... 85 °C
Relative humidity	10 ... 95%, non-condensing	10 ... 95%, non-condensing
Material	Stainless steel	Zinc, cast
Dimensions	28mm x 14mm, M12x1	89mm x 70mm x 30mm
Dimensions CThot/ CT P7	55mm x 29.5mm, M18x1 (with solid housing)	
Weight	40g	420g
Weight CThot/ CT P7	205g (with solid housing)	
Cable length	1m (LT02, LT15, LT22, CTfast only) 3m (standard for CThot, 1M, 2M, 3M, G5 and P7) ¹⁾ 8m 15m	
Cable diameter	2.8mm	
Ambient temperature cable	max. 180°C [High temperature cable for CThot: 250 °C].	
Vibration	IEC 68-2-6: 3G, 11 ... 200Hz, each axis	
Shock	IEC 68-2-27: 50G, 11ms, each axis	
Software	optional	

¹⁾ The 3M models are only available with 3m cable tail.

Electrical specification

Power supply	8 ... 36V DC
Current consumption	max. 100mA
Outputs/ analog	
Channel 1	optional: 0/4 ... 20mA, 0 ... 5/10V, thermocouple (J or K) or alarm output (signal source: object temperature)
Channel 2 [LT/ G5/ P7 only]	Measuring head temperature [-20 ... +180°C / -20 ... +250°C for LT02H and LT10H] as 0 ... 5V or 0 ... 10V resp. alarm output (signal source switchable to object temperature or electronic box temperature for use as alarm output)
Alarm output	Open-collector output at pin AL2 [24V/ 50mA].
Output impedances	
mA	max. loop resistance 500Ω (at 8 ... 36V DC),
mV	min. 100kΩ load resistance
Thermocouple	20Ω
Digital interfaces	USB, RS232, RS485, CAN, Profibus DP, Ethernet (via optional plug-in modules)
Relay output	2 x 60V diagnostic coverage/ 42V AC _{eff} , 0.4A; potential-free (optional plug-in module)
Function inputs	F1 to F3; programmable via software for the following functions: - external emissivity setting, - Background radiation compensation, - Trigger (resetting the hold functions) Input impedance F2 and F3: 43kΩ

Metrological specification [LT models]

	LT02	LT15	LT22
Temperature range (scalable)	-50... 600°C	-50... 600°C	-50...975°C
Ambient temperature (head)	-20... 130°C	-20...180°C	-20...180°C
Storage temperature (head)	-40...130°C	-40...180°C	-40...180°C
Spectral range	8...14µm	8...14µm	8...14µm
Optical resolution	2:1	15:1	22:1
System accuracy ¹⁾²⁾	±1°C or ±1% ³⁾	±1°C or ±1% ³⁾	±1°C or ±1% ³⁾
Repeatability ¹⁾	±0.5°C or ±0.5% ³⁾	±0.5°C or ±0.5% ³⁾	±0.5°C or ±0.5% ³⁾
Temperature coefficient ⁵⁾	±0.05K/K or ±0.05 %/K (whichever is greater)		
Temperature resolution (NETD) ³⁾⁴⁾	0.1K	0.05K	0.05K
Setting time (95 % signal)	150ms	150ms	150ms
Warm up time10min	10min	10min	
Emissivity/ Gain	0.100... 1.100 (adjustable via programming keys or software)		
Transmittance	0.100... 1.000 (adjustable via programming keys or software)		
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)		

1) at ambient temperature 23± 5°C; the larger value applies in each case

2) Accuracy when using thermocouple output: ±2.5°C or ±1%.

3) at object temperatures >0°C, ε = 1

4) at a time constant of 200ms and an object temperature of 25°C

5) for ambient temperatures (measuring head) <18°C and >28°C

For LT02 models, do not move the measuring head cable during measurement.

Metrological specification [CTfast/ CThot].

	LT15F	LT25F	LT02H	LT10H
Temperature range (scalable)	-50... 975°C	-50...975°C	-40...	975°C-40...975°C
Ambient temperature (head)	-20... 120°C	-20...120°C	-20...	250°C-20...250°C
Storage temperature (head)	-40... 120°C	-40...120°C	-40...	250°C-40...250°C
Spectral range	8... 14µm	8...14µm	8...14µm	8...14µm
Optical resolution	15:1	25:1	2:1	10:1
System accuracy ¹⁾²⁾	±2°C or ±1% ³⁾		±1.5°C or ±1% ³⁾	
Repeatability ¹⁾	±0.75°C or ±0.75% ³⁾		±0.5°C or ±0.5% ³⁾	
Temperature coefficient ⁵⁾	±0.05K/K or ±0.05%/K (whichever is greater)			
Temperature resolution (NETD) ^{3) 4)}	0.2K	0.4K	0.25K	0.25K
Setting time (90 % signal)	9ms	6ms	100ms	100ms
Acquisition time (50 % signal)	4ms	3ms		--
Warm up time ^{10min}	10min	10min	10min	
Emissivity/ Gain	0.100... 1.100 (adjustable via programming keys or software)			
Transmittance	0.100... 1.000 (adjustable via programming keys or software)			
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)			

¹⁾ at ambient temperature 23± 5°C; the larger value applies in each case

²⁾ Accuracy when using thermocouple output: ±2.5°C or ±1%.

³⁾ at object temperatures ≥ 20°C

⁴⁾ with a time constant of 100ms, adaptive averaging and an object temperature of 25°C

⁵⁾ for ambient temperatures (measuring head) <18°C and >28°C

For CThot models [LT02H/ LT10H], do not move the measuring head cable during measurement.

Metrological specification [1M/ 2M/ 3M models]

	1ML	1MH	1MH1	2ML
Temperature range (scalable)	485...1,050°C	650....1,800°C	800...2,200°C	250...800°C
Ambient temperature (head)	-20... 100°C	-20...100°C	-20...100°C	-20...125°C
Storage temperature (head)	-40... 100°C	-40...100°C	-40...100°C	-40...125°C
Spectral range	1µm	1µm	1µm	1.6µm
Optical resolution	40:1	75:1	75:1	40:1
System accuracy ¹⁾²⁾	$\pm(0.3\% T_{\text{Mess}} + 2^{\circ}\text{C})^3$			
Repeatability ¹⁾	$\pm(0.1\% T_{\text{Mess}} + 1^{\circ}\text{C})^3$			
Temperature coefficient ⁵⁾	$\pm 0.05\text{K/K}$ or $\pm 0.05\%/K$ (whichever is greater)			
Temperature resolution	0.1°C^3			
Setting time (90 % signal)	1ms ⁴⁾			
Emissivity/ Gain	0.100... 1.100 (adjustable via programming keys or software)			
Transmittance	0.100... 1.000 (adjustable via programming keys or software)			
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)			

¹⁾ at ambient temperature $23 \pm 5^{\circ}\text{C}$

²⁾ Accuracy when using thermocouple output: $\pm 2.5^{\circ}\text{C}$ or $\pm 1\%$.

³⁾ $\epsilon = 1/$ Setting time 1s

⁴⁾ with dynamic adaptation at low signal levels

⁵⁾ for ambient temperatures (measuring head) $< 18^{\circ}\text{C}$ and $> 28^{\circ}\text{C}$

	2MH	2MH1	3ML	3MH
Temperature range (scalable)	385...1,600°C	490...2,000°C	50...400°C ¹⁾	100...600°C ¹⁾
Ambient temperature (head)	-20...125°C	-20...125°C	-20...85°C	-20...85°C
Storage temperature (head)	-40...125°C	-40...125°C	-40...85°C	-40...85°C
Spectral range	1.6µm	1.6µm	2.3µm	2.3µm
Optical resolution	75:1	75:1	22:1	33:1
System accuracy ^{2) 3)}		±(0.3% T _{Mess} +2°C) ⁴⁾		
Repeatability ²⁾		±(0.1% T _{Mess} +1°C) ⁴⁾		
Temperature coefficient ⁶⁾	±0.05 K/K or ±0.05 %/K (whichever is greater)			
Temperature resolution		0.1°C ⁴⁾		
Setting time (90 % signal)		1ms ⁵⁾		
Emissivity/ Amplification	0.100...1.100 (adjustable via programming keys or software)			
Transmittance	0.100...1.000 (adjustable via programming keys or software)			
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)			

¹⁾ T_{Object} > T_{Measuring head} +25°C

²⁾ at ambient temperature 23± 5°C

³⁾ Accuracy when using thermocouple output: ±2.5°C or ±1%.

⁴⁾ $\epsilon = 1 / \text{Setting time } 1s$

⁵⁾ with dynamic adaptation at low signal levels

⁶⁾ for ambient temperatures (measuring head) <18°C and >28°C

	3MH1	3MH2	3MH3
Temperature range (scalable)	150... 1,000°C	200...1,500°C	250...1,800°C
Ambient temperature (head)	-20... 85°C	-20... 85°C	-20... 85°C
Storage temperature (head)	-40... 85°C	-40... 85°C	-40...85°C
Spectral range	2.3µm	2.3µm	2.3µm
Optical resolution	75:1	75:1	75:1
System accuracy ^{1) 2)}		±(0.3% T _{Mess} +2°C) ³⁾	
Repeatability ¹⁾		±(0.1% T _{Mess} +1°C) ³⁾	
Temperature coefficient ⁵⁾	±0.05K/K or ±0.05%/K (whichever is greater)		
Temperature resolution	0.1°C ³⁾	0.1°C ³⁾	0.1°C ³⁾
Setting time (90 % signal)	1ms ⁴⁾	1ms ⁴⁾	1ms ⁴⁾
Emissivity/ Gain	0.100... 1.100 (adjustable via programming keys or software)		
Transmittance	0.100... 1.000 (adjustable via programming keys or software)		
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)		

¹⁾ at ambient temperature 23± 5°C

²⁾ Accuracy when using thermocouple output: ±2.5°C or ±1%.

³⁾ε = 1/ Setting time 1s

⁴⁾ with dynamic adaptation at low signal levels

⁵⁾ for ambient temperatures (measuring head) <18°C and >28°C

Metrological specification [G5 / P7 models]

	G5L	G5H	P7
Temperature range (scalable)	100...1,200°C	250...1,650°C	0... 710°C
Ambient temperature (head)	-20...85°C	-20...85°C	-20...85°C
Storage temperature (head)	-40...85°C	-40...85°C	-40...85°C
Spectral range	5.2µm	5.2µm	7.9µm
Optical resolution	10:1	20:1	10:1
System accuracy ¹⁾²⁾	----- ±2°C or ±1% ³⁾ -----		±1.5°C or ±1% ³⁾⁵⁾
Repeatability ¹⁾	--- ±0.5°C or ±0.5% ³⁾ ---		±0.5°C or ±0.5% ³⁾⁵⁾
Temperature coefficient ⁴⁾	±0.05K/K or ±0.05%/K (whichever is greater)		
Temperature resolution	0.1°C ³⁾	0.2°C ³⁾	0.5°C ³⁾
Setting time (90 % signal)	120ms	80ms	150ms
Emissivity/ Amplification	0.100...1.100 (adjustable via programming keys or software)		
Transmittance	0.100...1.000 (adjustable via programming keys or software)		
Signal processing	Average, MAX, MIN (adjustable via programming keys or software)		

¹⁾ at ambient temperature 23± 5°C; the larger value applies in each case

²⁾ Accuracy when using thermocouple output: ±2.5°C or ±1%.

³⁾ $\epsilon = 1$ / Setting time 1s

⁴⁾ for ambient temperatures (measuring head) <18°C and >28°C

⁵⁾ at object temperatures ≥ 25°C

Optical diagrams

The following optical diagrams show the diameter of the measuring spot as a function of the measuring distance. The measurement spot size refers to **90% of the radiation energy**.

The distance is measured in each case from the front edge of the measuring head.

The size of the object to be measured and the optical resolution of the IR thermometer determine the maximum distance between the measuring head and the object.
To avoid measurement errors, the target should completely fill the field of view of the measuring head optics.
This means that the measuring spot must always be at least as large as or smaller than the target.

D = Distance from the front edge of the device to the measured object

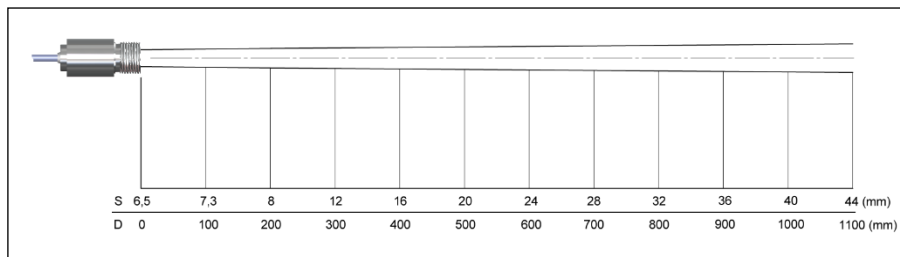
S = spot size

The ratio D:S applies to the focus distance.

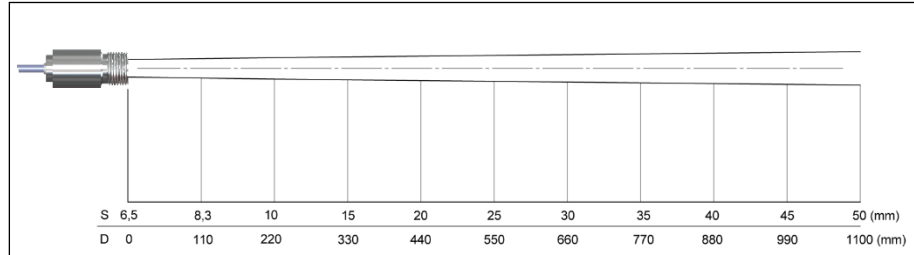
LT25F

Optics: SF

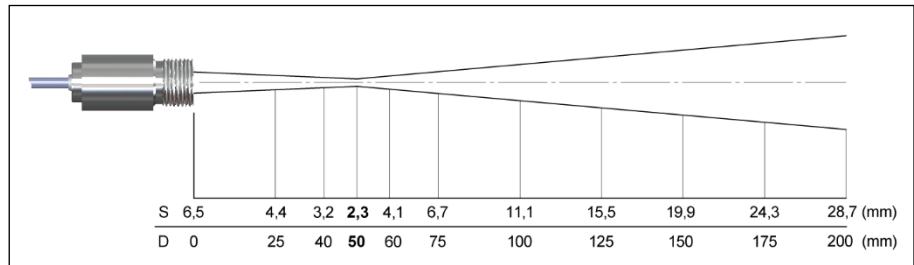
D:S: 25:1



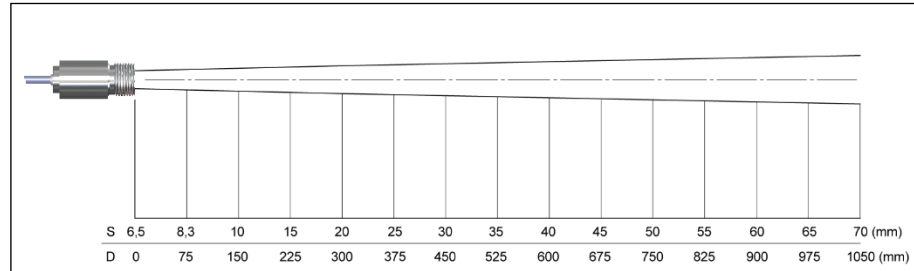
LT22
Optics: SF
D:S: 22:1



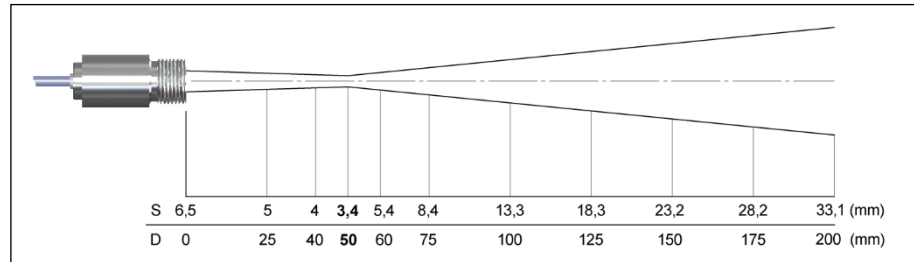
LT22
Optics: CF
D:S: 22:1
2.3mm@ 50mm
D:S (far field) = 6:1



LT15	LT15F
Optics: SF	
D:S: 15:1	

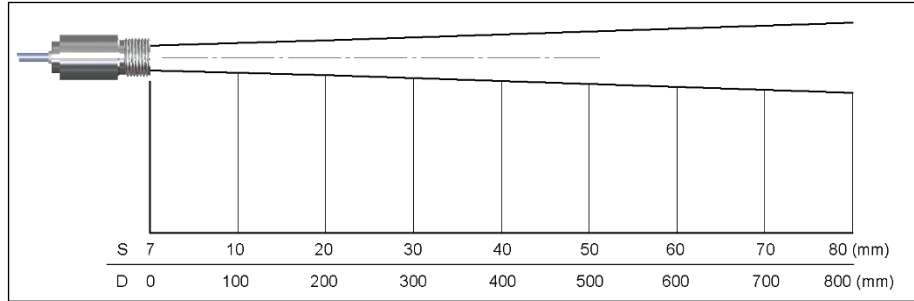


LT15
Optics: CF
D:S: 15:1
3.0mm@ 50mm
D:S (far field) = 5:1



LT10H G5L **P7**

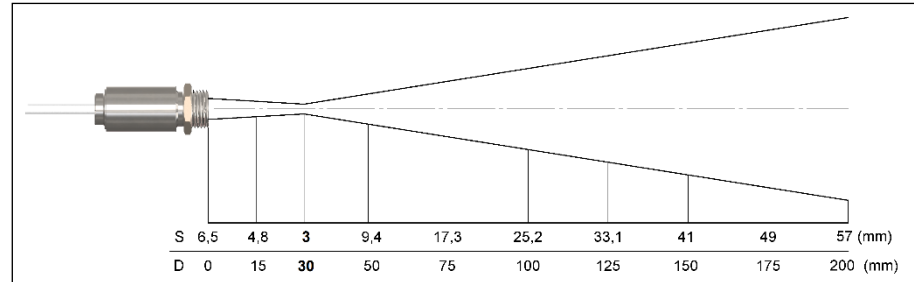
Optics: SF
D:S: 10:1



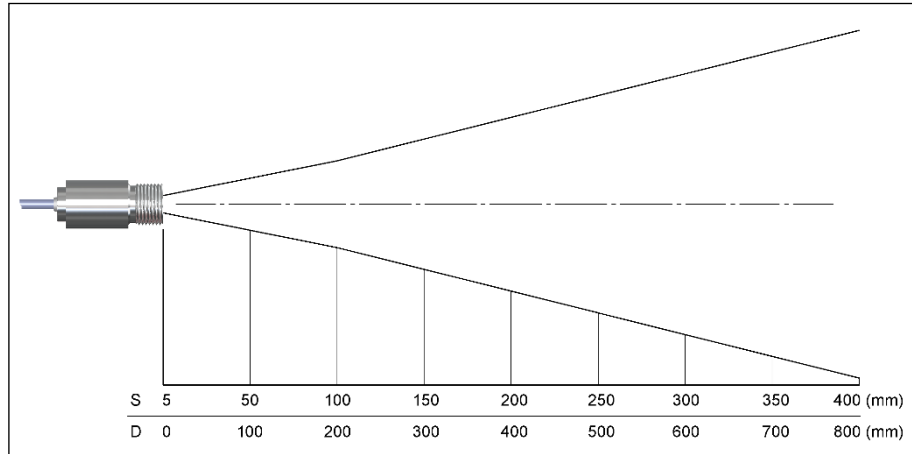
LT10H

Optics: CF1
D:S: 10:1

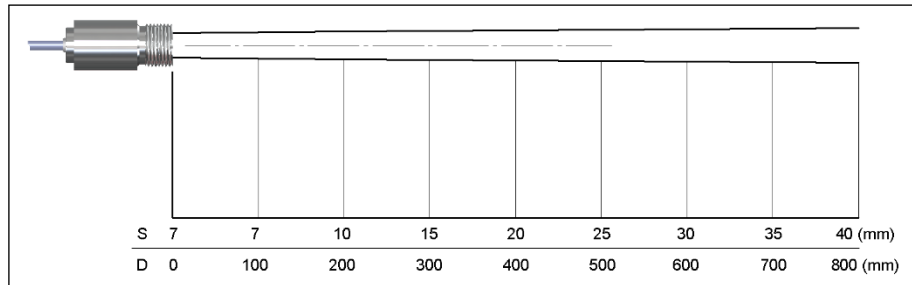
3.0mm@ 30mm
D:S (far field) = 3:1



LT02	LT02H
Optics: SF	
D:S: 2:1	

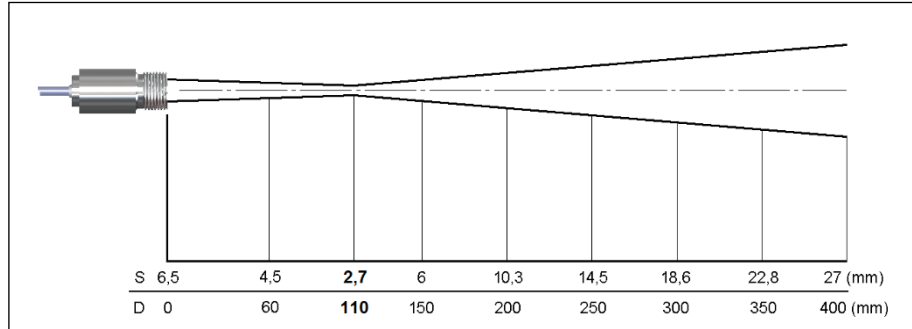


G5H
Optics: SF
D:S: 20:1



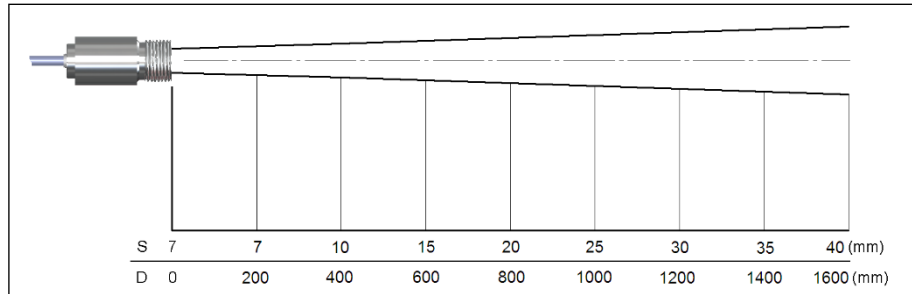
1ML **2ML**

Optics: CF
 D:S: 40:1
 2.7mm@ 110mm
 D:S (far field) = 12:1



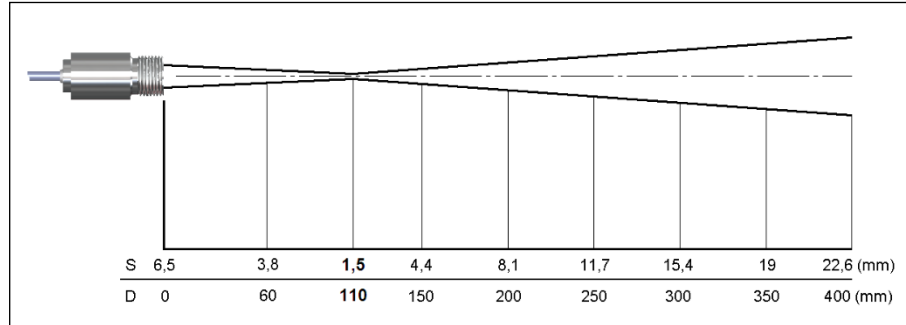
1ML **2ML**

Optics: SF
 D:S: 40:1



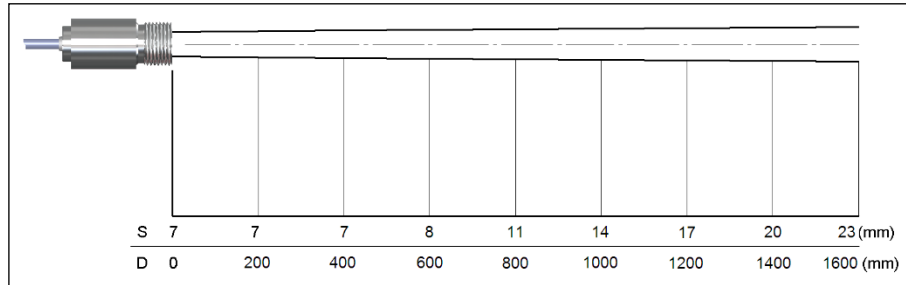
1MH	1MH1	2MH
2MH1	3MH1-H3	

Optics: CF
D:S: 75:1
1.5mm@ 110mm
D:S (far field) = 14:1

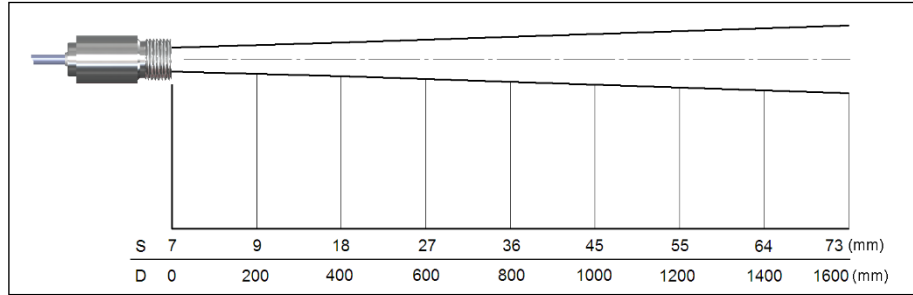


1MH	1MH1	2MH
2MH1	3MH1-H3	

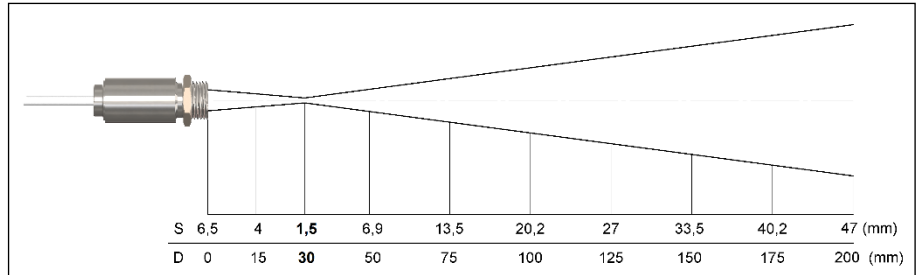
Optics: SF
D:S: 75:1



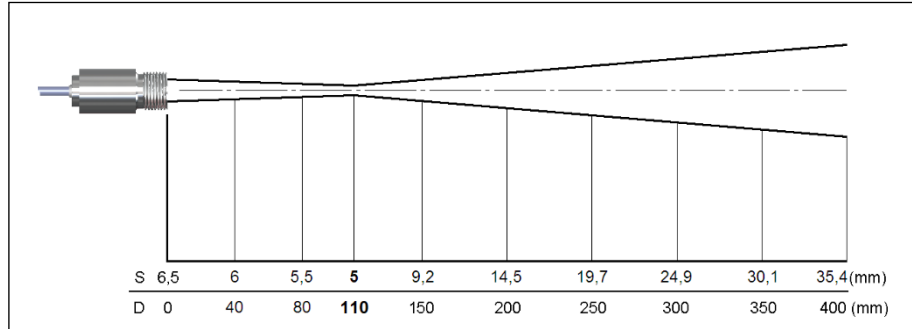
3ML
Optics: SF
D:S: 22:1



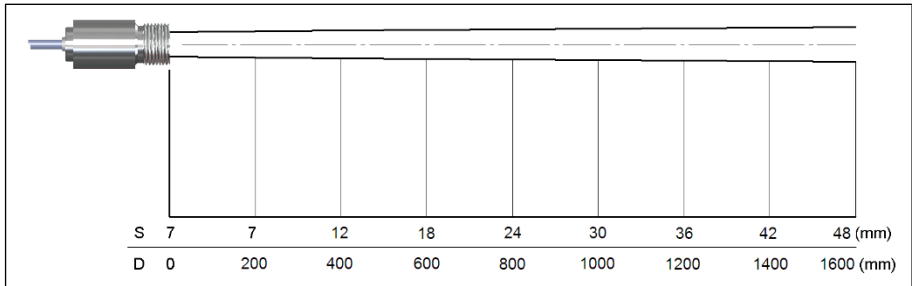
3ML
Optics: CF1
D:S: 22:1
1.5mm@ 30mm
D:S (far field) = 3.5:1



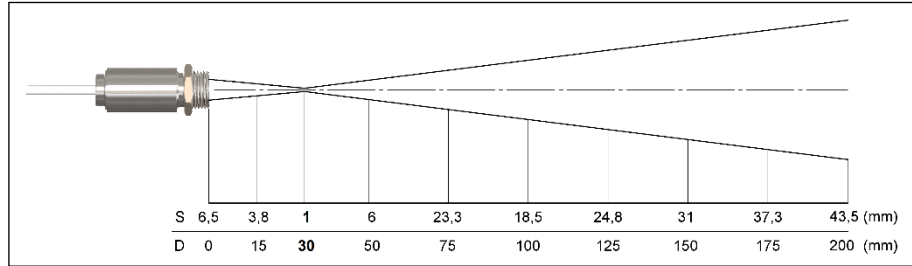
3ML
Optics: CF
D:S: 22:1
5mm@ 110mm
D:S (far field) = 9:1



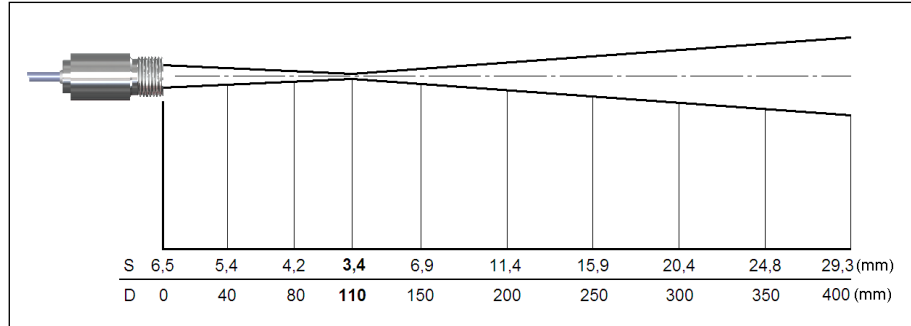
3MH
Optics: SF
D:S: 33:1



3MH
Optics: CF1
D:S: 33:1
1.0mm@ 30mm
D:S (far field) = 4:1



3MH
Optics: CF
D:S: 33:1
3.4mm@ 110mm
D:S (far field) = 11:1



CF attachment optics and protective window

The CF attachment optics (optional) enables the measurement of smallest objects and can be used in combination with the LT, 1M, 2M and 3M models. The minimum measuring spot depends on the measuring head used. The distance is measured in each case from the front edge of the CF lens holder or laminar free-glass attachment. Mounting on the measuring head is done by screwing on the attachment optics up to the limit stop. For the combination with the solid housing, please use the variant with M12x1 outside thread.

Transmission values when using the CF attachment optics (average values):	
LT	0.78
1M	0.80
2M	0.87
3M	0.92

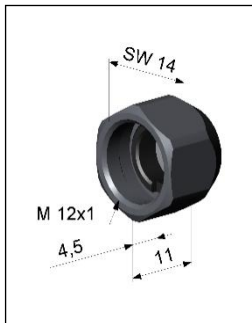
Variant overview:

- AO98C638** CF attachment optics for mounting on measuring head [LT].
- ACCTCFHT** CF attachment optics for mounting on measuring head [1M/ 2M/ 3M].
- ACCTCFE** CF attachment optics with outside thread for mounting in solid housing [LT].
- ACCTCFHTE** CF attachment optics with outside thread for mounting in solid housing [1M/ 2M/ 3M].

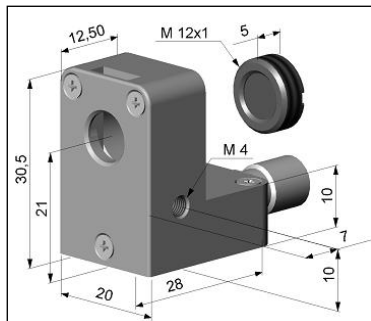
A protective window is available to protect the measuring head optics. This has the same mechanical dimensions as the CF optics and is offered in the following variants:

- AO98C759** Protection window for mounting on measuring head [LT].
- ACCTPWHT** Protective window for mounting on measuring head [1M/ 2M/ 3M].
- AO98C871** Protection window with outside thread for mounting in solid housing [LT]
- ACCTPWHTe** Shield with outside thread for mounting in solid housing [1M/ 2M/ 3M]

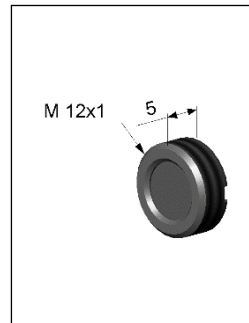
Transmittance values when using the protective window (average values):	
LT	0.83
1M/ 2M/ 3M	0.93



CF attachment optics:
AO98C638/ ACCTCFHT
Protection window:
AO98C759/ ACCTPWHT

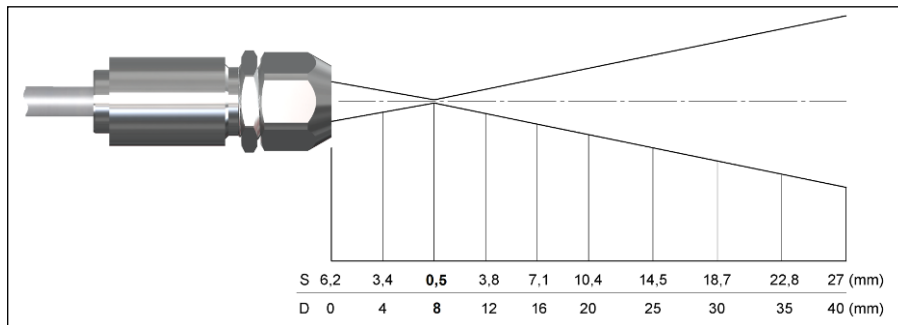


Laminar free-glass attachment with integrated CF optics:
ACCTAPLCF/ ACCTAPLCFHT



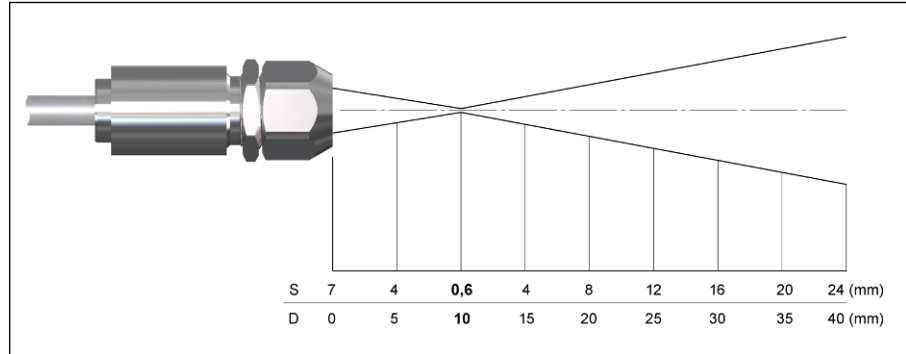
CF attachment optics with outside thread:
ACCTCFE/ ACCTCFHTE
Protection window with outside thread:
AO98C871/ ACCTPWHT

LT25F + CF optics
 0.5 mm@ 8 mm
 0.5 mm@ 6 mm [ACCTAPLCF]
 D:S (far field) = 1.6:1



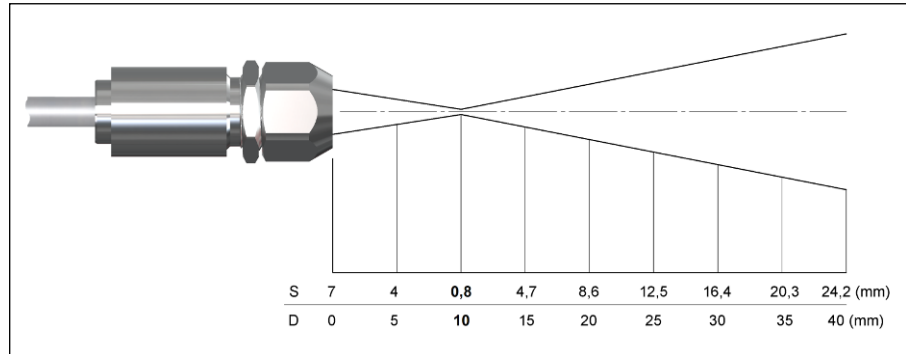
LT22 + CF optics

0.6 mm@ 10 mm
 0.6 mm@ 8 mm [ACCTAPLCF]
 D:S (far field) = 1.5:1



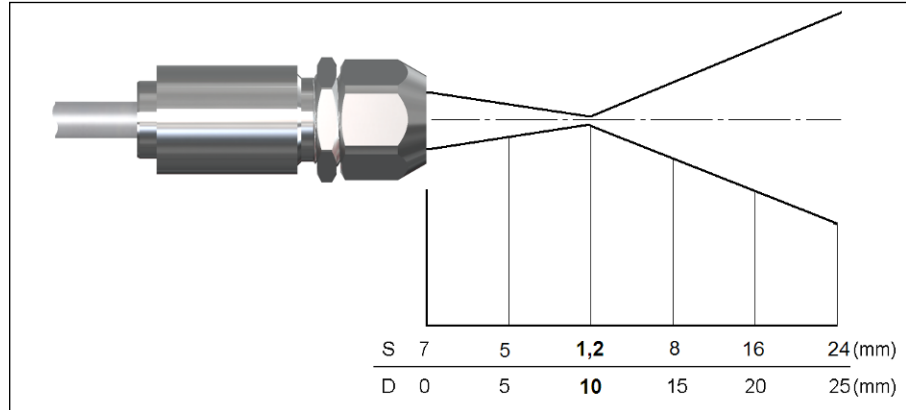
LT15/ LT15F + CF optics

0.8 mm@ 10 mm
 0.8 mm@ 8 mm [ACCTAPLCF]
 D:S (far field) = 1.2:1



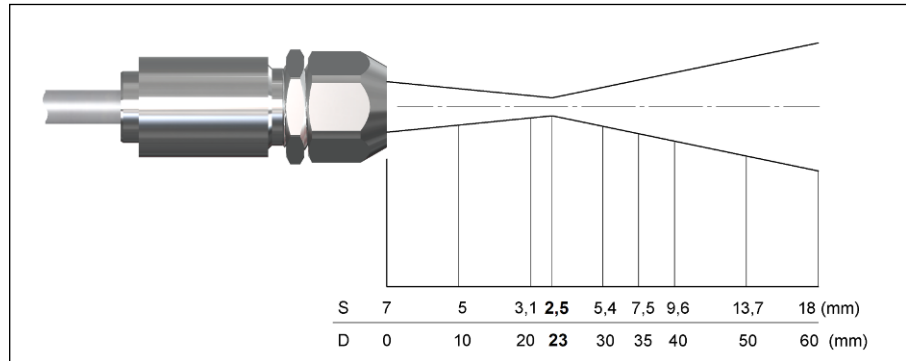
LT10H + CF optics

1.2 mm@ 10 mm
 1.2 mm@ 8 mm [ACCTAPLCF]
 D:S (far field) = 1.2:1



LT02/ LT02H + CF optics

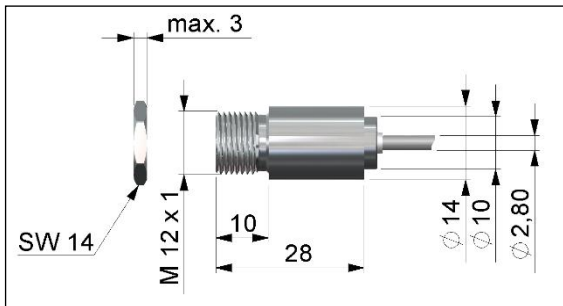
2.5 mm@ 23 mm
 2.5 mm@ 21 mm [ACCTAPLCF]
 D:S (far field) = 5:1



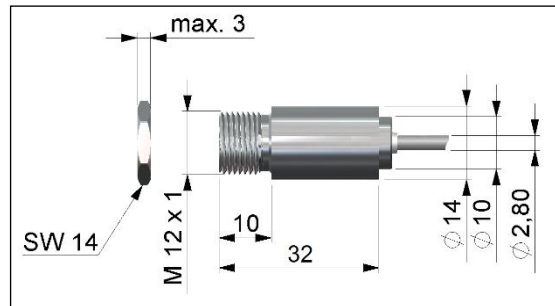
Mechanical installation

The measuring heads have a metric M12x1 thread and can be installed either directly via the sensor thread or to existing mounting fixtures using the hex nut supplied. Various mounting brackets and fixtures are available as accessories to facilitate alignment of the measuring head on the object.

All accessories can be ordered using the item numbers indicated in brackets [].

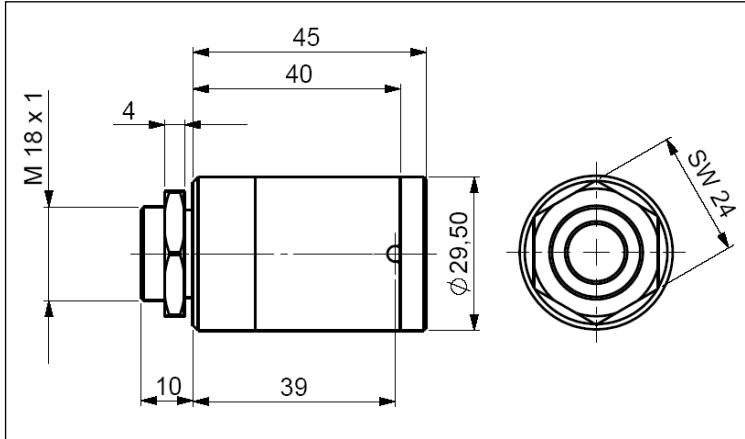


Measuring head



Measuring head LT15CF/ LT22CF

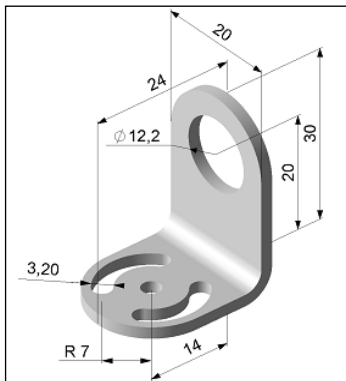
The CThot and CTP7 sensors are supplied with solid housing and can be installed via the M18x1 thread.



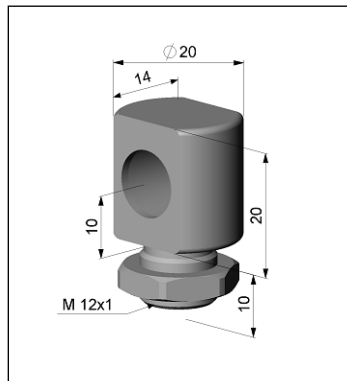
Solid housing (standard for CThot and P7)

The optical path must be free of any obstructions.

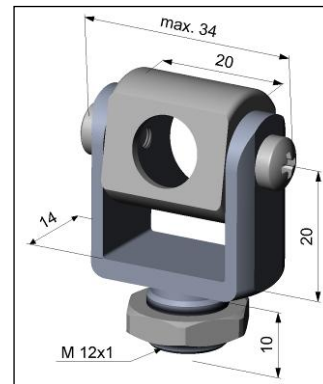
Mounting accessories



Mounting bracket, adjustable in one Axis [AY98C739]



Mounting bolt fork with M12x1 thread adjustable in one axis [ACCTMB]



Mounting fork with M12x1 thread adjustable in 2 axes [AY98C075]

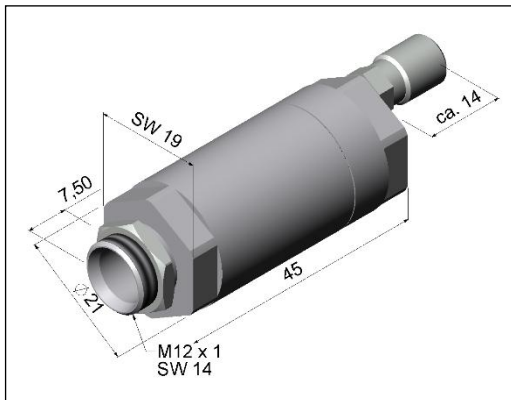
The mounting fork can be combined with the mounting bracket [AY98C739] via the M12x1 foot.



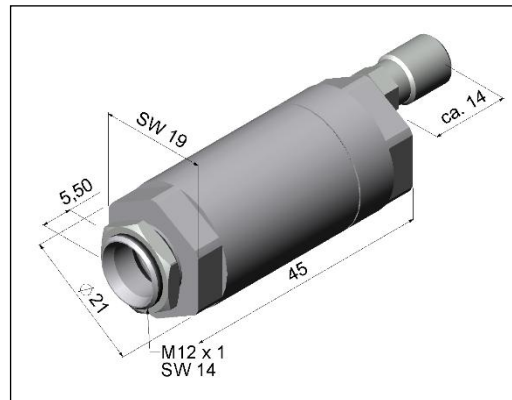
Mounting bracket, adjustable in two axes [AY98C074].

Free blowing attachments

Deposits (dust, particles) on the lens as well as smoke, haze and high humidity (condensation) can lead to incorrect measurements. These effects can be avoided or reduced by using an air purge unit. Make sure to use oil-free, technically clean air.

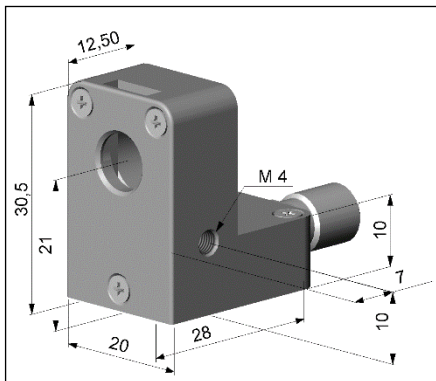


**Standard air purge attachment [AO98C598]
for optics with D:S \geq 10:1
can be combined with mounting bracket
Hose connection: 3x5 mm
Thread (Fitting): M5**



**Standard air purge attachment [ACCTAP2]
for optics with D:S \leq 2:1
can be combined with mounting bracket
Hose connection: 3x5 mm
Thread (Fitting): M5**

The required air volume (approx. 2...10 l/ min.) depends on the application and the conditions at the installation site.



**Combining the laminar air purge attachment with the base of the mounting fork creates a unit that can be adjusted in two axes.
[AO98C499 + AY98C075]**

Lamina Free-Lens Attachment [AO98C499]

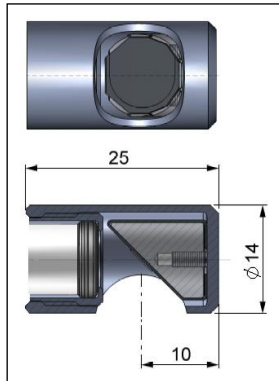
The lateral air outlet prevents a cooling down of the object at small measuring distances.

Hose connection: 3x5 mm

Thread (Fitting): M5

The required air volume (approx. 2...10 l/ min.) depends on the application and the conditions at the installation site.

Other accessories



Right-angle mirror attachment [ACCTRAM]

for optics with D:S \geq 10:1;

enables measurements at a 90° bracket to the sensor axis.

The mirror has a reflection of 96% when used with LT22 and LT15 and 88% with LT15F. When using the mirror, this value must be multiplied by the emissivity of the target.

Example: LT22 and object with emissivity = 0.85
 $0.85 \times 0.96 = 0.816$
Thus, in OI98, 0.816 must be set as the resulting emissivity.



Laser Sighting Aid [D08ACCTLST]

battery operated (2x Alkaline AA), for alignment of OI98 measuring heads. The laser head has the same dimensions as the measuring head.

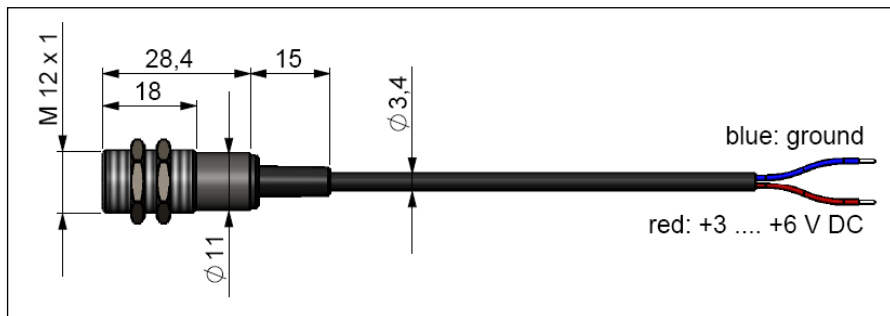
WARNING: Do not aim the laser directly into the eyes of persons or animals! Do not look directly or indirectly into the laser beam via reflective surfaces!



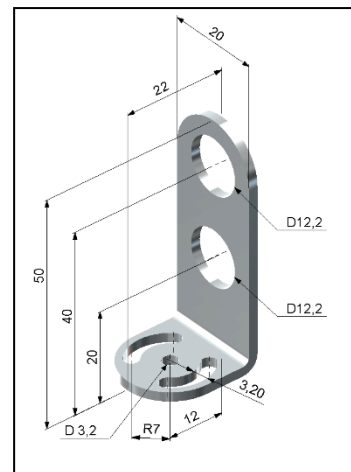
OEM Laser Sighting Aid

The OEM laser sighting aid is available with 3.5m [ACCTOEMLST] and 8m connection cable [ACCTOEMLSTCB8]. The laser can be connected to the **3V SW** and **GND** terminals [► **Electrical installation**] and switched on and off via the operating menu on the device or via the software.

Mounting of CT measuring head and laser head is possible with the special double-hole mounting bracket [ACCTFB2].

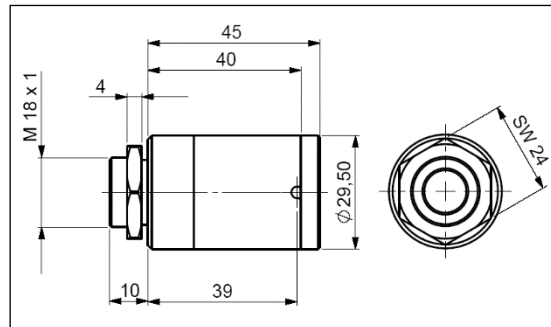


OEM Laser Sighting Aid [ACCTOEMLST or ACCTOEMLSTCB8]



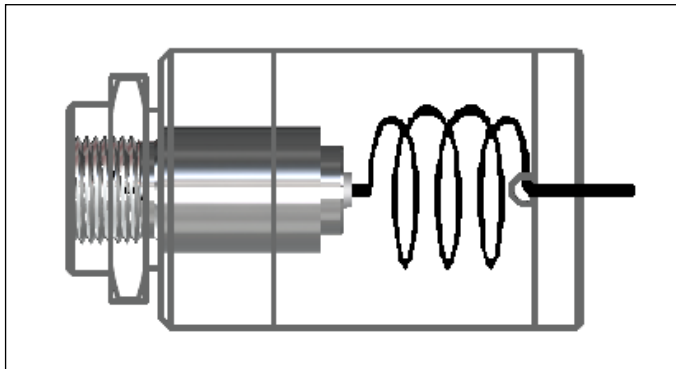
Mounting bracket [ACCTFB2]

Solid housing



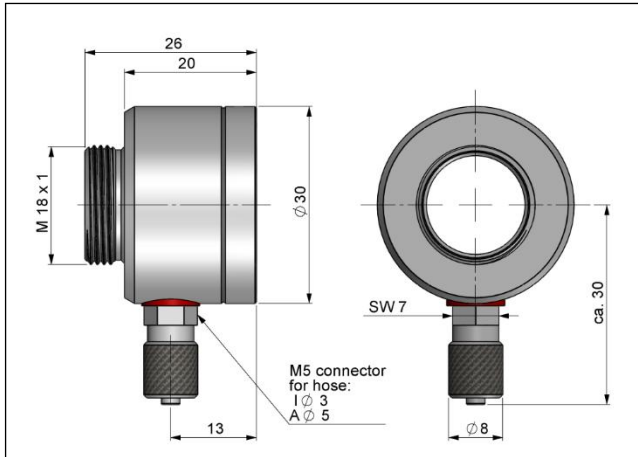
Solid housing, stainless steel [AO98C870] - alternatively also available in aluminum (anodized) or brass [AO98C315].

The solid housing ensures reproducible and stable temperature measurements in applications with dynamically changing ambient temperatures. It can be combined with the CF attachment optics [ACCTCFE] or with the protective window [AO98C871].

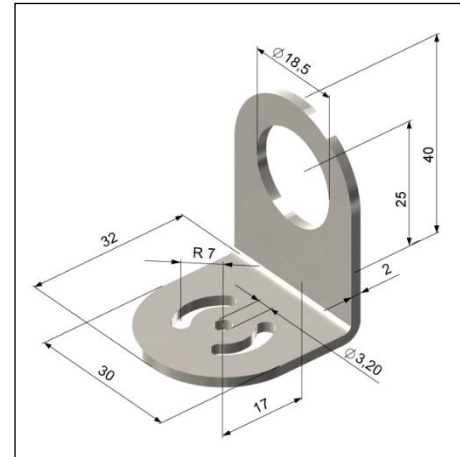


[▶ CF attachment optics and protective window].

Accessories for solid housing



**Air purge unit for solid housing (thread M18x1)
[ACCTAPMH]**



**Mounting bracket for solid housing,
adjustable in one axis [ACCTFBMH]**

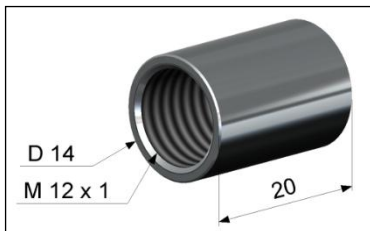
Pipe adapters and reflective tubes

The tube adapter [AO98C913] enables the mounting of reflection protection tubes on the CT measuring head. The reflection protection tubes are available in 3 different lengths:

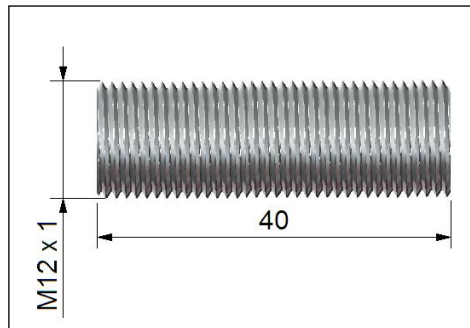
AO98E04220 mm

AO98E04240 mm

AO98C91488 mm



Tube adapter [AO98C913]

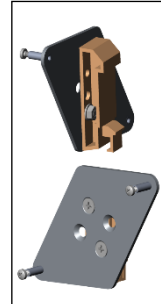
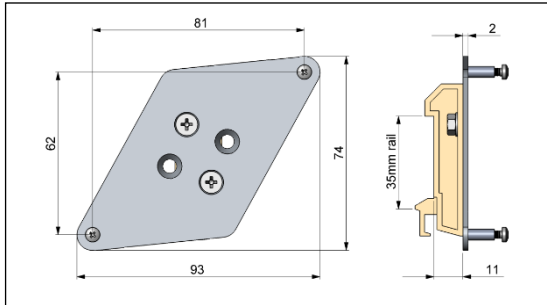


Anti-reflective tube [AO98E041]

The antiglare tubes are only suitable for measuring heads with a distance measuring spot ratio (D:S) of $\geq 15:1$.

Carrier rail mounting plate for electronic box

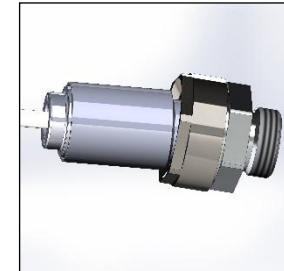
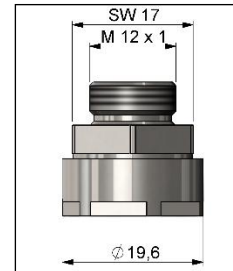
The electronics can be mounted on a top hat rail according to EN50022 (TS35) using the mounting rail mounting plate.



Carrier rail mounting plate [AO98C526]

Tilting joint for measuring heads

This mounting accessory allows fine adjustment of the Ø198 measuring head with a maximum bracket of +/- 6.5° to the mechanical axis.



Tilt joint [ACCTAS]

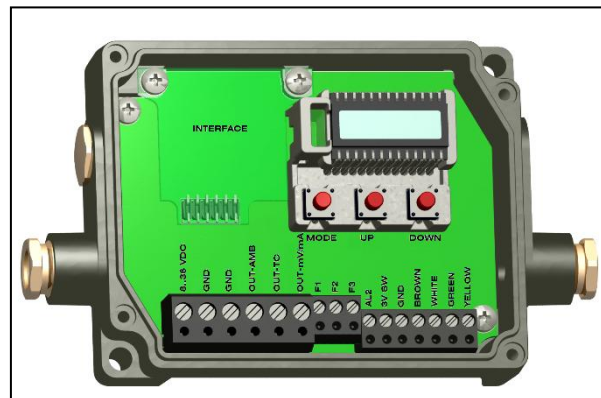
Electrical installation

Cable tail connection

To connect the OI98, first open the cover of the electronics box (4 screws). The screw terminals for connecting the cables are located in the lower area.

Connection marking [models LT/ G5/ P7]

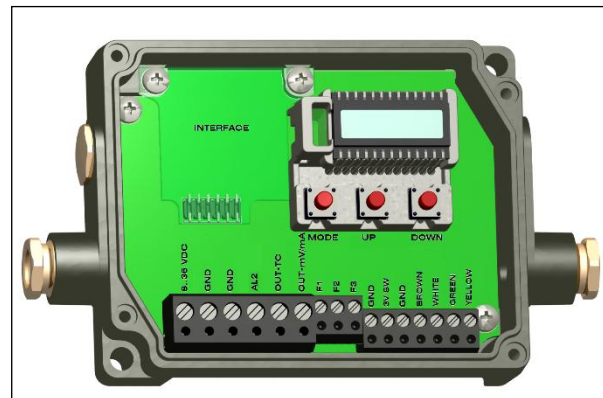
+8...36 VDC	voltage supply	
GND	Ground (0 V) of the power supply	
GND	Ground (0 V) of the internal inputs and outputs	
OUT-AMB	analog output	Measuring head temperature (mV)
OUT-TC	Analog output thermocouple (J or K)	
OUT-mV/m	analog output	Object temperature (mV or mA)
F1-F3	Function inputs	
AL2	Alarm 2 (open-collector output)	
3V SW	3 VDC, switchable, for laser sighting aid	
GND	Ground (0 V) for laser sighting aid	
BROWN	Temperature probe measuring head	
WHITE	Temperature probe measuring head	
GREEN	Detector signal (-)	
YELLOW	Detector signal (+)	



Opened electronic box (LT/ G5/ P7) with connection terminals

Connection marking [Models 1M / 2M / 3M]

+8...36VDC	Voltage supply
GND	Ground (0V) of the power supply
GND	Ground (0V) of internal inputs and outputs
AL2	Alarm 2 (open-collector output)
OUT-TC	Analog output thermocouple (J or K)
OUT-mV/mA	Analog output Object temperature (mV or mA)
F1-F3	Function inputs
GND	Ground (0V)
3V SW	3 VDC, switchable, for laser sighting aid
GND	Ground (0 V) for laser sighting aid
BROWN	Temperature sensor measuring head (NTC)
WHITE	Mass measuring head
GREEN	Power supply measuring head
YELLOW	Detector signal



Opened electronic box (1M/ 2M/ 3M) with connection terminals

Power supply

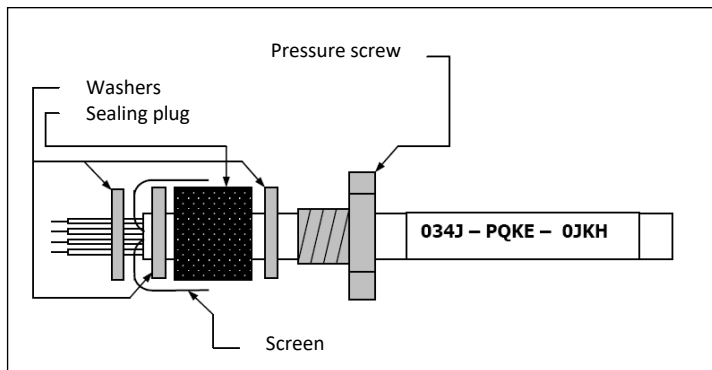
Please use a stabilized power supply with an output voltage in the range of **8 ...36V diagnostic coverage**, which provides a current of **100mA**. The residual ripple should be max. **200mV**.

ATTENTION: Do not apply voltage to the analog outputs under any circumstances, as this will destroy the output!

The OI is not a two-wire sensor!

Cable assembly

The existing M12x1.5 cable gland of the electronics box is suitable for cables with an outer diameter of 3 to 5mm. Remove the cable insulation (40mm power supply, 50mm signal outputs, 60 mm function inputs). Shorten the shield braid to approx. 5 mm and unbraid the shield wires. Remove approx. 4 mm of the individual core insulation and tin the core ends. Slide the pressure screw, washers and rubber seal of the cable gland one after the other via the prepared cable tail as shown in the illustration. Spread the shield braid apart and fix the cable shield between two metal washers. Insert the cable into the cable gland as far as the limit stop. Screw the cap on tightly. The individual cores can now be fixed into the screw terminals provided according to their colors.



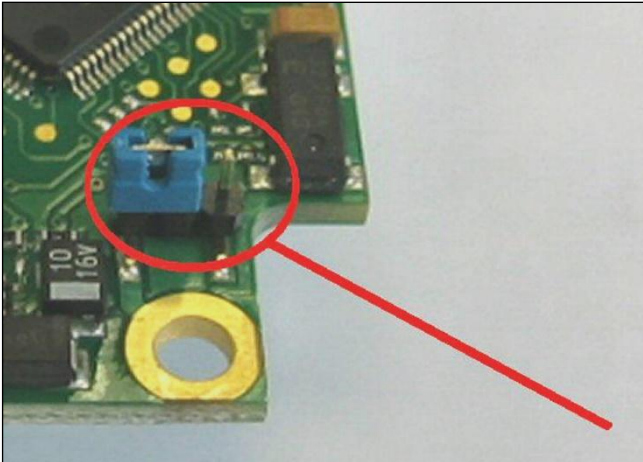
**Only shielded cables may be used.
The shield of the sensor must be grounded.**

Ground connection

On the bottom side of the mainboard board you will find a connector (jumper), which is factory placed as shown in the picture [**left** and **middle** pin connected]. In this position the ground terminals (GND supply voltage/ output) are connected to the housing ground of the electronics box.

To avoid ground loops and associated signal interference, it may be necessary to disconnect this connection in an industrial environment. To do this, please plug the jumper into the other position [**middle** and **right** pin connected].

When using the thermocouple output, it is generally recommended to disconnect the ground connection GND - housing.



Replacing the measuring head

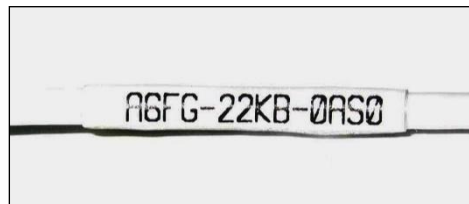
At the factory, the measuring head cable is already connected to the electronics box and the calibration code is entered. Within a given model group, any exchange of measuring heads and electronics is possible. The measuring heads and electronics of the **CTfast models LT15F** and **LT25F** cannot be exchanged.

When mounting a new measuring head, the calibration code of the new head must be entered into the electronics.

Entering the calibration code

Each head has a specific calibration code, which is noted on the measuring head cable. For correct temperature measurement and functioning of the sensor, this measuring head data must be stored in the electronics. The calibration code consists of **3 blocks** (1M, 2M, 3M = 5 blocks) with **4 characters** each.

Example: A6FG - 22KB - 0AS0
 1.block 2.block 3.block



To enter the code, please press the **up** and **down keys** (keep both pressed) and **then** the **mode key**. The display shows **HCODE** and then the 4 characters of the first block. The individual digits can be changed with **Up** and **Down**; **Mode** changes to the next character or the next block. A new calibration code can also be entered via the software (optional).

The calibration code is located on a label on the measuring head cable (near the electronics box). Do not remove this label or make a note of the code, as it will be required if the electronics are replaced or the sensor needs to be calibrated.

After modification of the head calibration code, a reset is necessary to activate the changes.
[▶ Operation]

Measuring head cable

For all OI98 models (**except 3M, P7**), the measuring head cable can be shortened if necessary. For models **1M, 2M** and **CTfast**, the measuring head cable can be shortened by a maximum of **3m**. Shortening the cable tail causes an additional measurement error of approx. **0.1K/m**. The **3M models** are supplied with **3m cable tail only**.

For the LT02, LT02H and LT10H models, do not move the measuring head cable during the measurement.

Outputs and inputs

Analog outputs

The OI98 has two output channels.

ATTENTION: Do not apply voltage to the analog outputs under any circumstances, as this will destroy the output. The OI98 is not a two-wire sensor!

Output channel 1

This output is used for the output of the object temperature. The output signal is selected via the programming keys [► **Operation**]. Via the software, output channel 1 can also be programmed as an alarm output.

Output signal	Area	Connection pin on CT board
Voltage	0 ... 5V	OUT-mV/mA
Voltage	0 ... 10V	OUT-mV/mA
Power	0 ... 20mA	OUT-mV/mA
Power	4 ... 20mA	OUT-mV/mA
Thermocouple	TC J	OUT-TC
Thermocouple	TC K	OUT-TC

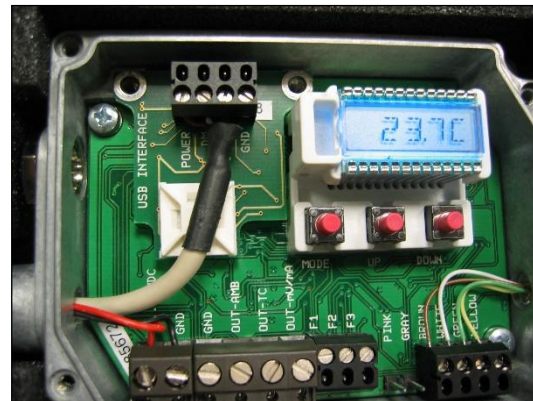
Please note that, depending on the output used, different connection pins (**OUT-mV/mA** or **OUT-TC**) can be used.

Output channel 2 [only LT/ G5/ P7]

The measuring head temperature [-20...+180°C or -20...+250°C (for LT02H and LT10H) as **0...5V** or **0...10V signal**] is output at connection pin OUT-AMB. Via the software the output channel 2 can also be programmed as alarm output. In this case the object temperature **TObject** or electronic box temperature **TBox** can be used as alarm source instead of the measuring head temperature **TKopf**.

Digital interfaces

The OI98 can optionally be equipped with a USB, RS232, RS485, CAN bus, Profibus DP or Ethernet interface. For installation, first take the respective interface board and insert it into the designated receptacle in the electronics box, which is located to the left along with the display. In the correct position, the screw holes of the interface match those of the electronics box. Now push the interface down to reach the contacting and fix it by means of the two supplied screws M3x5. Plug the interface cable with the pre-assembled screw terminals onto the connector strip of the interface board.



The Ethernet interface requires a supply voltage of at least 12 V.
In any case, please observe the instructions of the respective interface manual.

Relay outputs

The OI98 can optionally be equipped with a relay output. The relay board VR98A921 is installed in the same way as the digital interfaces. **Simultaneous installation of a digital interface and the relay outputs is not possible.**

Both relays are designed for complete isolation and can switch with a maximum of 60V DC/ 42V AC_{eff} , 0.4A DC/AC. A red LED indicates a closed relay contact.

The switching points correspond to the values for Alarm 1 and 2 [► Alarms/Visual alarms] and are set according to the ► factory default.
For advanced settings (change low and high alarm) a digital interface (USB, RS232) and the software are required.

Function inputs

The three function inputs F1 to F3 can only be programmed via the software.

- F1 (digital):** Trigger (a 0V - level at F1 resets the hold functions)
F2 (analog): Emissivity external [0...10V: 0 V ► $\epsilon=0,1$; 9V ► $\epsilon=1$; 10V ► $\epsilon=1,1$]
F3 (analog): external ambient temperature compensation/ the range is scalable via the software scalable [0...10V ► -40...+900 °C/ preset range: -20...+200 °C].
F1-F3 (digital): Emissivity (digital selection via table)

An input that is not wired is evaluated as follows:

F1= High level | F2, F3= Low level

[High level: $\geq +3V...+36V$ | Low level: $\leq +0.4V...-36V$]

Alarms

The OI98 has the following alarm functions via:

A hysteresis of 2 K (CThot: 1K) is fixed for all alarms (Alarm 1, Alarm 2, output channel 1 and 2 when used as alarm output).

Output channel 1 and 2 [channel 2 only with LT/ G5/ P7]

For activation, the respective output channel must be switched over to digital mode. This can only be done via the software.

Visual alarms

These alarms cause a change of the color of the LCD display and are available via the optional relay interface. Alarm 2 can additionally be used at pin **AL2** (on the mainboard) as an open-collector output [**24V / 50mA**].

By default, the alarms are defined as follows:

Alarm 1	Normally closed/ Low alarm
Alarm 2	Normal open/ High alarm

Both alarms affect the color setting of the LCD display:

BLUE: Alarm 1 active
RED: Alarm 2 active
GREEN: no alarm active

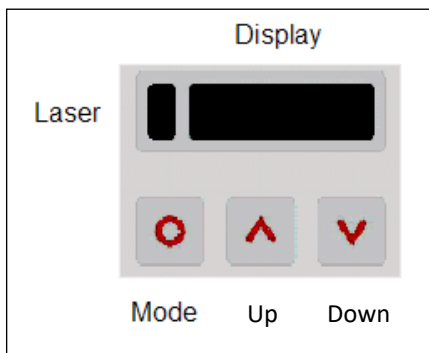
For advanced settings like definition as low or high alarm [**via change normal open/ closed**], selection of signal source [**TObject, TKopf, TBox**] a digital interface (e.g. USB, RS232) including the software is required.

Operation

After switching on the supply voltage, the sensor starts an initialization routine and shows **INIT** in the display for a few seconds. The object temperature is then displayed. The color of the display illumination changes according to the alarm settings [► **Alarms/ Visual alarms**].

Sensor settings

With the three programming keys **Mode**, **Up** and **Down**, sensor configurations can be made on site. The display shows the current measured value or the selected function. The **Mode key is used to access the desired function**, **Up** and **Down are used to change** the function parameters - **a change in settings is adopted instantaneously**. If no key has been pressed for longer than 10 seconds, the display automatically switches to the display of the object temperature calculated (according to the selected signal processing).



Pressing the Mode button automatically takes you to the last function called up.

The signal processing functions **maximum search** and **minimum search** cannot be selected simultaneously.

Factory default

To reset the OI98 to the factory-set parameters, please first press the **Down key and** then the **Mode key** and keep both pressed for approx. 3 seconds.

RESET appears in the display as confirmation.

Display	Mode [Example]	Adjustment range
1 4 2 . 3 C	Obeject temperature (after signal processing) [142.3°C]	immutable
1 2 7 C H	Head temperature [127 °C]	immutable
2 5 C B	Box temperature [25 °C]	immutable
1 4 2 C A	Current object temperature [142 °C]	immutable
□ M V 5	Signal output Output channel 1 [0-5 V]	□ 0-20 = 0-20 mA/ □ 4-20 = 4-20 mA/ □ MV5 = 0-5 V/ □ MV10 = 0-10 V/ □ TCJ = Thermocouple output type J/ □ TCK = Thermocouple output type K
E0.970	Emissivity [0.970]	0.100 ... 1.100
T1.000	Transmission [1.000]	0.100 ... 1.000
A 0.2	Signal output average value [0.2s]	A---- = inactive/ 0.1 ... 999.9 s
P - - - -	Signal output maximum value [inactive]	P---- = inactive/ 0.1 ... 999.9 s/ P 00 00 00 00 = infinite
V - - - -	Signal output minimum value [inactive]	V---- = inactive/ 0.1 ... 999.9 s/ P 00 00 00 00 = infinite
u 0 . 0	lower limit temperature range [0 °C]	model-dependent/ inactive for TCJ and TCK output
n 5 0 0 . 0	upper limit temperature range [500 °C]	model-dependent/ inactive for TCJ and TCK output
[0 . 0 0	lower limit output signal [0 V]	according to the range of the selected output
] 5 . 0 0	upper limit output signal [5 V]	according to the range of the selected output
U °C	Temperature unit [°C]	°C/ °F
l 3 0 . 0	lower alarm limit [30 °C]	model-dependent
l l 1 0 0 . 0	upper alarm limit [100 °C]	model-dependent
X H E A D	Ambient temperature compensation [measuring head temperature]	XHEAD = measuring head temperature/ -40.0 ... 900.0 °C (for LT) as a fixed value for compensation/ actuating up and down simultaneously changes back XHEAD (measuring head temperature)
M 0 1	Multidrop address [1] [only with RS485 interface]	01 ... 32
B 9 . 6	Baud rate in kBaud [9.6] [0.970]	9.6/ 19.2/ 38.4/ 57.6/ 115.2 kBaud
S O N	Laser sight (3 VDC switch to connector pin 3V SW)	ON/ OFF This menu item appears in the first position for the models 1M/ 2M/ 3M.

□ MV5

Selection of the **output signal**. By pressing **Up** or **Down** the different output signals (see table) can be selected. different output signals (see table) can be selected.

E0.970

Setting the **emissivity**. Pressing **Up** increases the value; **Down** decreases the value. **↓** decreases the value (also applies to all other functions). The emissivity (ϵ - Epsilon) is a material constant that describes the ability of a body to emit infrared energy, description **[▶ emissivity]**.

T1.000

Setting the **transmittance**. This function is used if an optical component (e.g. protective window sensor and object (e.g. protective window; additional optics) is mounted. The default setting is 1.000 = 100% (for measurement without protective window etc.).

A 0.2

Setting the time for **averaging**. In this function an arithmetic algorithm is executed algorithm is executed to smooth the signal. The set time is the time constant. This function can also be combined with all other post-processing functions. can be used. For models 1M/ 2M/ 3M the shortest time is 0.001 s (other models: 0.1 s) and can only be increased or decreased with values of the power series of 2 (0.002, 0.004, 0.008, 0.016, 0.032, ...). When setting **0.0**, the display shows --- (function disabled).

P----

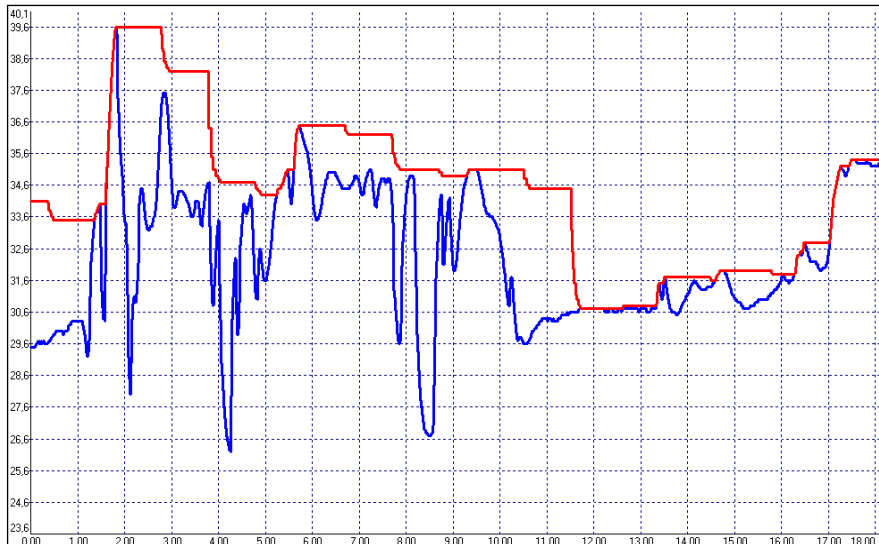
Setting the time for the **maximum search**. This function holds the respective signal signal maximum is held; i.e. when the temperature decreases, the algorithm holds the signal level for the set time. After the holding time has elapsed, the signal drops to the value or decreases by 1/8 of the difference between the previous maximum value and the minimum value during the holding time. This value is again held for the set time held. Afterwards, the signal drops with a slow time constant and follows the course of the object temperature.

When setting **0.0** the display shows --- (function deactivated)



Setting the time for the **minimum search**. This function holds the respective signal signal minimum is held. The algorithm corresponds to that for the maximum search (inverted). When setting **0.0**, the display shows --- (function deactivated).

Signal course at P----



- TProcess with maximum search (holding time = 1s)
- Actually without postprocessing

u 0.0

Setting of the **lower limit of the temperature range**. The minimum difference between lower and upper range limit is **20 K**. If the lower limit is set to a value \geq upper limit, the upper limit is automatically set to **[lower limit + 20 K]**.

n 500.0

Setting of the **upper limit of the temperature range**. The minimum difference between upper and lower range limits is **20 K**. The upper limit can only be set to a value = lower limit + 20 K.

[0.00

Setting of the **lower limit of the output signal**. This setting enables the assignment of a certain output signal level to the lower limit of the temperature range. The adjustment range corresponds to the selected output mode (e.g. 0-5 V).

| 5.00

Setting the **upper limit of the output signal**. This setting enables the assignment of a certain output signal level to the upper limit of the temperature range. The adjustment range corresponds to the selected output mode (e.g. 0-5 V).

U °C

Setting the **temperature unit** [°C or °F].

| 30.0

Setting of the **lower alarm limit**. This value corresponds to Alarm 1 [**► Alarms/ Visual Alarms**] and is thus also used for setting the switching point for relay 1 (when the optional relay interface is using the optional relay interface).

|| 100.0

Setting of the **upper alarm limit**. This value corresponds to Alarm 2 [**► Alarms/ Visual Alarms**] and is thus also used for setting the switching point for relay 2 (when the optional relay interface is using the optional relay interface).

XHEAD

Setting the **ambient temperature compensation**. Depending on the of the measured object, a greater or lesser proportion of the ambient radiation is reflected from the surface. To compensate this influence, this function offers the possibility to set a fixed function offers the possibility to enter a fixed value for the background radiation.

Especially in case of large differences between the ambient temperature at the object and the measuring head temperature, it is recommended to use the **ambient temperature compensation**.

head. A

When **XHEAD is displayed**, compensation takes place via the probe inside the measuring head. Return to **XHEAD is** done by pressing **Up** and **Down** simultaneously.

M 01

Setting the **multidrop address**. In an RS485 network, each sensor requires its own address. This menu item is only displayed if the RS485 interface is installed.

B 9.6

Setting the **baud rate** for digital data transmission.

S ON

pin.

Activation (**ON**) and deactivation (**OFF**) of an optional **sighting laser** [**► Other accessories**]. Pressing **Up** or **Down switches** a 3 VDC voltage to the 3V SW the connection pin **3V SW**.

Error messages

The following error messages may appear in the display of the OI98:

LT/ G5/ P7 models:

OVER	Object temperature too high
UNDER	Object temperature too low
^^^CH	Head temperature too high
vvvCH	Head temperature too low

Models 1M/ 2M/ 3M:

1st digit:

0x	No error
1x	Head temperature sensor has short circuit to ground (bn)
2x	Box temperature too low
4x	Box temperature too high
6x	Box temperature sensor interrupted
8x	Box temperature sensor has short circuit to ground

2nd digit:

x0	no error
x2	Object temperature too high
x4	Head temperature too low
x8	Head temperature too high
xC	Head temperature sensor interrupted (bn)

Software

Installation

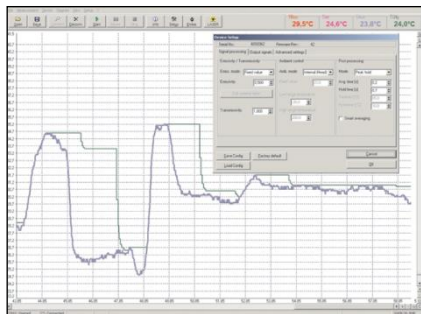
Insert the installation CD into the appropriate drive of your PC. If the autorun option is enabled on your computer, the installation **wizard** will start automatically. Otherwise, please run **CDsetup.exe** from the CD-ROM. Please follow the instructions of the wizard until the installation is completed.

After installation, you will find the software on your desktop (as a program icon) and in the Start menu. If you want to uninstall the software, please use **Uninstall** in the Start menu.

Minimum system requirements:

- Windows XP, Vista, 7, 8
- USB interface
- Hard disk with at least 30 MByte storage space
- At least 128 MByte RAM
- CD-ROM drive

A detailed software description can be found on the software CD.



Main functions:

- Graphical display and recording of temperature readings for later analysis and documentation
- Complete parameterization and remote monitoring of the sensor
- Programming the signal processing functions
- Scaling of the outputs and parameterization of the function inputs

Communication settings

Serial interface

Baud rate: 9.6...115.2 kBaud (adjustable on the device or via software)
Data bits: 8
Parity: none
Stop bits: 1
Flow control: off

Protocol

All OI98 sensors use a binary protocol. Alternatively the devices can be switched over to an ASCII protocol. To achieve a fast communication, an additional overhead with CR, LR or ACK bytes is omitted.

ASCII protocol

The models **LT02**, **LT15**, **LT22**, **LT02H** and **LT10H** can be changed to ASCII protocol by changing the first character in the 3rd block of the head calibration code. This character must be changed from **0 to 4** (always **+4**; i.e. for the CTeX a change from 1 to 5 must be made).

▶ Replacing the measuring head

Example: Binary: A6FG - 22KB - **0**AS0
1.block 2.block 3.block

ASCII: A6FG - 22KB - **4**AS0
1.block 2.block 3.block

After modification of the head calibration code, a reset is necessary to activate the changes.

[▶ Operation]

You can also use the following command for switchover to the ASCII protocol:

Decimal: 131
HEX: 0x83
Data, response: byte 1
Result: 0 - Binary protocol
1 - ASCII protocol

Saving parameter settings

After switching on the sensor, the flash mode is active, i.e. changed parameter settings are stored in the OI98 internal flash EEPROM and are retained even after switching off the power supply.

If values are to be changed very often or continuously, the flashing of the parameters can be switched off by the following command:

Decimal: 112
HEX: 0x70
Data, response: byte 1
Result: 1 - data is not written to flash
2 - Data is written to the flash

When the flash mode is switched off, parameter changes remain active only as long as the OI98 is switched on. I.e. after switching off the supply voltage and switching on again, the set values are lost. The command 0x71 can be used to inquire the current status.

A detailed description of the protocol and commands can be found on the CD in the directory: **\Commands**.

Principle of infrared temperature measurement

Depending on the temperature, each body emits a certain amount of infrared radiation. A change in temperature of the object is accompanied by a changing intensity of the radiation. The wavelength range of this so-called "thermal radiation" used for infrared measurement technology is between about $1\mu\text{m}$ and $20\mu\text{m}$. The intensity of the emitted radiation depends on the material. The material-dependent constant is called emissivity (ε - Epsilon) and is known for most substances (see section Emissivity).

Infrared thermometers are optoelectronics sensors. They determine the infrared radiation emitted by a body and calculate the surface temperature on this basis. Probably the most important property of infrared thermometers is their non-contact measurement. This makes it possible to determine the temperature of objects that are difficult to access or are moving without difficulty. Infrared thermometers essentially consist of the following components:

- Lens
- Spectral filter
- Detector
- Electronics (amplification/ linearization/ signal processing)

The properties of the lens significantly determine the beam path of the infrared thermometer, which is characterized by the ratio of distance to spot size. The spectral filter is used to select the wavelength range which is relevant for the temperature measurement. The detector, together with the downstream processing electronics, has the task of converting the intensity of the emitted infrared radiation into electrical signals.

Emissivity

Definition

The intensity of infrared thermal radiation emitted by anybody depends on both the temperature and the radiation properties of the material under investigation. The emissivity (ε - Epsilon) is the corresponding material constant that describes the ability of a body to emit infrared energy. It can be between 0 and 100 %. An ideally radiating body, a so-called "black body", has an emissivity of 1.0, while the emissivity of a mirror, for example, is 0.1.

If the emissivity is set too high, the infrared thermometer will determine a lower temperature than the real temperature, provided that the measuring object is warmer than the surroundings. If the emissivity is low (reflecting surfaces), there is a risk that interfering infrared radiation from background objects (flames, heating systems, fireclay, etc.) will falsify the measurement result. To minimize the measurement error in this case, handling should be done very carefully and the device should be shielded against reflecting radiation sources.

Determination of an unknown emissivity

- ▶ A thermocouple, contact sensor or similar can be used to determine the current temperature of the measured object. The temperature can then be measured with the infrared thermometer and the emissivity changed until the measured value displayed matches the actual temperature.
- ▶ For temperature measurements up to 380 °C, it is possible to attach a special plastic sticker (emissivity sticker - order no.: ACLSED). to the measuring spot.

completely covered. Now set the emissivity to 0.95 and measure the temperature of the sticker. Then determine the temperature of a directly adjacent surface on the measurement object and set the emissivity so that the value matches the previously measured temperature of the plastic sticker.

- ▶ Apply matte black paint with an emissivity of more than 0.98 to a part of the surface of the object to be examined, as far as this is possible. Set the emissivity of your infrared thermometer to 0.98 and measure the temperature of the colored surface. Then determine the temperature of a directly adjacent surface and change the emissivity setting until the measured temperature matches that at the colored area.

IMPORTANT: For all three methods, the object must be at a temperature different from the ambient temperature.

Characteristic emissivities

If none of the methods described above are applicable for determining your emissivity, you can refer to the emissivity tables ▶ **Appendix A and B**. Note that the tables are only average values. The actual emissivity of a material is influenced by the following factors, among others:

- Temperature
- Measuring angle
- Geometry of the surface (flat, convex, concave)
- Material thickness
- Surface finish (polished, oxidized, rough, sandblasted)
- Spectral range of the measurement
- Transmission properties (e.g. with thin films)

Appendix A - Emissivity Table Metals

Material		typical emissivity			
		1,0 μm	1,6 μm	5,1 μm	8-14 μm
Spectral sensitivity					
Aluminum	not oxidized	0.1-0.2	0.02-0.2	0.02-0.2	0.02-0.1
	polished	0.1-0.2	0.02-0.1	0.02-0.1	0.02-0.1
	roughened	0.2-0.8	0.2-0.6	0.1-0.4	0.1-0.3
	oxidized	0.4	0.4	0.2-0.4	0.2-0.4
Lead	polished	0.35	0.05-0.2	0.05-0.2	0.05-0.1
	defrosted	0.65	0.6	0.4	0.4
	oxidized		0.3-0.7	0.2-0.7	0.2-0.6
Chrome		0.4	0.4	0.03-0.3	0.02-0.2
Iron	not oxidized	0.35	0.1-0.3	0.05-0.25	0.05-0.2
	rusted		0.6-0.9	0.5-0.8	0.5-0.7
	oxidized	0.7-0.9	0.5-0.9	0.6-0.9	0.5-0.9
	forged, blunt	0.9	0.9	0.9	0.9
	melted	0.35	0.4-0.6		
Iron, cast	not oxidized	0.35	0.3	0.25	0.2
	oxidized	0.9	0.7-0.9	0.65-0.95	0.6-0.95
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	electropolished	0.2-0.5	0.25	0.15	0.15
	sandblasted	0.3-0.4	0.3-0.6	0.3-0.6	0.3-0.6
	oxidized	0.4-0.9	0.6-0.9	0.6-0.9	0.7-0.95
Copper	polished	0.05	0.03	0.03	0.03
	defrosted	0.05-0.2	0.05-0.2	0.05-0.15	0.05-0.1
	oxidized	0.2-0.8	0.2-0.9	0.5-0.8	0.4-0.8
Magnesium		0.3-0.8	0.05-0.3	0.03-0.15	0.02-0.1

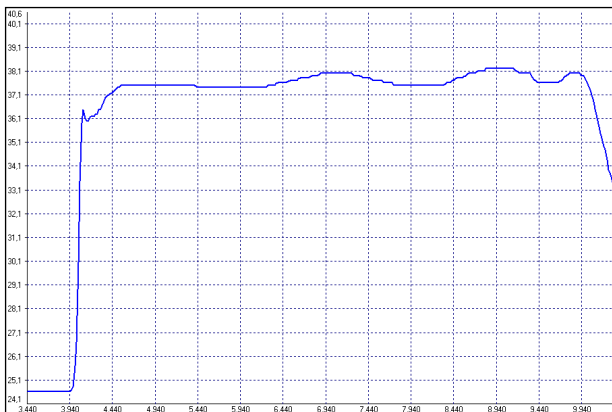
Material		typical emissivity			
		1.0 μm	1.6 μm	5.1 μm	8-14 μm
Brass	polished	0.35	0.01-0.5	0.01-0.05	0.01-0.05
	rough	0.65	0.4	0.3	0.3
	oxidized	0.6	0.6	0.5	0.5
Molybdenum	not oxidized	0.25-0.35	0.1-0.3	0.1-0.15	0.1
	oxidized	0.5-0.9	0.4-0.9	0.3-0.7	0.2-0.6
Monel (Ni-Cu)		0.3	0.2-0.6	0.1-0.5	0.1-0.14
Nickel	electrolytic	0.2-0.4	0.1-0.3	0.1-0.15	0.05-0.15
	oxidized	0.8-0.9	0.4-0.7	0.3-0.6	0.2-0.5
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	polished sheet	0.35	0.25	0.1	0.1
	stainless	0.35	0.2-0.9	0.15-0.8	0.1-0.8
	heavy plate			0.5-0.7	0.4-0.6
	cold rolled	0.8-0.9	0.8-0.9	0.8-0.9	0.7-0.9
	oxidized	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.9
Titanium	polished	0.5-0.75	0.3-0.5	0.05-0.25	0.03-0.1
	oxidized		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	polished	0.5	0.05	0.03	0.02
	oxidized	0.6	0.15	0.1	0.1
Tin	not oxidized	0.25	0.1-0.3	0.05	0.05

Appendix B - Emissivity table non-metals

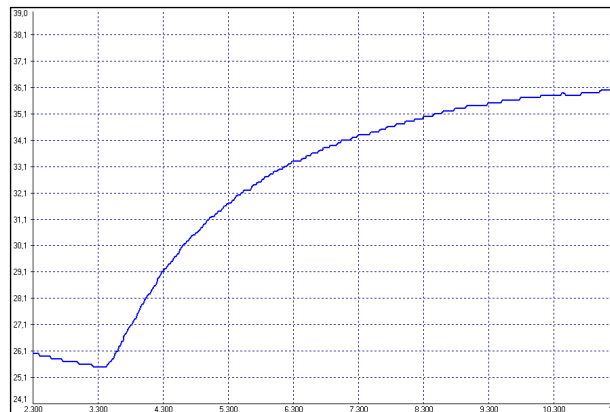
Material Spectral sensitivity		typical emissivity			
		1.0 μm	2.2 μm	5.1 μm	8-14 μm
Asbestos		0.9	0.8	0.9	0.95
Asphalt				0.95	0.95
Basalt				0.7	0.7
Concrete		0.65	0.9	0.9	0.95
Ice					0.98
Earth					0.9-0.98
Color	non alkaline				0.9-0.95
Gypsum				0.4-0.97	0.8-0.95
Glass	Screen		0.2	0.98	0.85
	Melt		0.4-0.9	0.9	
Rubber				0.9	0.95
Woods	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	0.8-0.95	0.95
Gravel				0.95	0.95
Carbon	not oxidized		0.8-0.9	0.8-0.9	0.8-0.9
	graphite		0.8-0.9	0.7-0.9	0.7-0.8
Plastic >50 μm	opaque			0.95	0.95
Paper	any color			0.95	0.95
Sand				0.9	0.9
Snow					0.9
Textiles				0.95	0.95
Water					0.93

Appendix C - Adaptive averaging

The averaging function is usually used to smooth signal curves. Via the adjustable parameter time this function can be optimally adapted to the respective application. A disadvantage of averaging is that fast temperature increases caused by dynamic events are subject to the same averaging time and are therefore only available at the signal output with a time delay. The function Adaptive **averaging (Smart Averaging)** eliminates this disadvantage by passing fast temperature rises directly to the signal output without averaging.



Signal course with Smart Averaging function



Signal waveform without Smart Averaging function

Appendix D - Part number assignment

Series	RatioD:S	Related devices
LT02	2:1	OI98C156, OI98C482, OI98C958
LT15	15:1	OI98C121, OI98C123, OI98C925
LT15F	15:1	OI98C708, OI98C938
LT22	22:1	OI98A920, OI98C271, OI98C525, OI98C558
1MH	75:1	OI98C477
2MH	75:1	OI98C314, OI98C351
3MH/SF	33:1	OI98C772
3ML/CF	22:1	OI98E040
3ML/SF	22:1	OI98C854

Accessories:

Relay card:	VR98C921
USB interface + software:	AO98A998
RS232 interface + software:	AO98C698
RS485 interface + software:	AO98C699
Ethernet interface + software:	AO98C700